CONGRESS AND THE DIESEL-ENGINED SHIP

NEW YORK SEATTLE

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Vol. VI New York, U. S. A., January, 1921 No. 1

First American-Werkspoor Diesel-Engined Ship

Excellent Results on Maiden Voyage of Standard Oil Co.'s Tanker, "Charlie Watson," propelled by Twin Skandia-built Werkspoor-Diesel Engines of 550 Shaft H.P. Each

By CHAS. W. GEIGER

EARLY last year the Standard Oil Company of Calif. placed an order with two Pacific Coast shipbuilders for two motor-tankers, one of 2,300 tons d.w.c. and 1,100 shaft h.p. to be built by the Union Construction Co. of Oakland, and the other of 5,010 tons d.w.c. and 1,700 shaft h.p. to be built by the Moore Shipbuilding Co. of Oakland, Cal. A complete description and drawings of these vessels appeared in our issue of April, 1920. Both are engined by the Skandia Pacific Oil Engine Co. of Oakland, and are of special interest in view of the fact that they are the first Werkspoor-type four-cycle Diesel engines ever built in the United States under license. The smaller of these tankers, namely the "Charlie Watson," was recently placed in service, having started on her maiden-voyage on the morning of Nov. 22 from San Francisco to Seattle, carrying a cargo of petroleum-products from the owners' plant at Point Richmond to their regional plant at Point Wells.

With reference to the trial trips which were previously run, due to the fact that the hull had laid at the dock for two months while being outfitted and did not go into dry-dock prior to the trials, her bottom was covered with growths which retarded her speed, and also because propellers of insufficient size were installed. Therefore this preliminary test cannot be regarded as official, but rather were given to test the reliability of the main motors. As the vessel got away from the dock in the trial it immediately became apparent that the propellers installed were too small, nevertheless the desired speed for the vessel was obtained and maintained throughout the trial, although only 430 b.h.p. was used. In obtaining the desired speed of the vessel at this horsepower 12% overspeed of the Diesel engines was required.

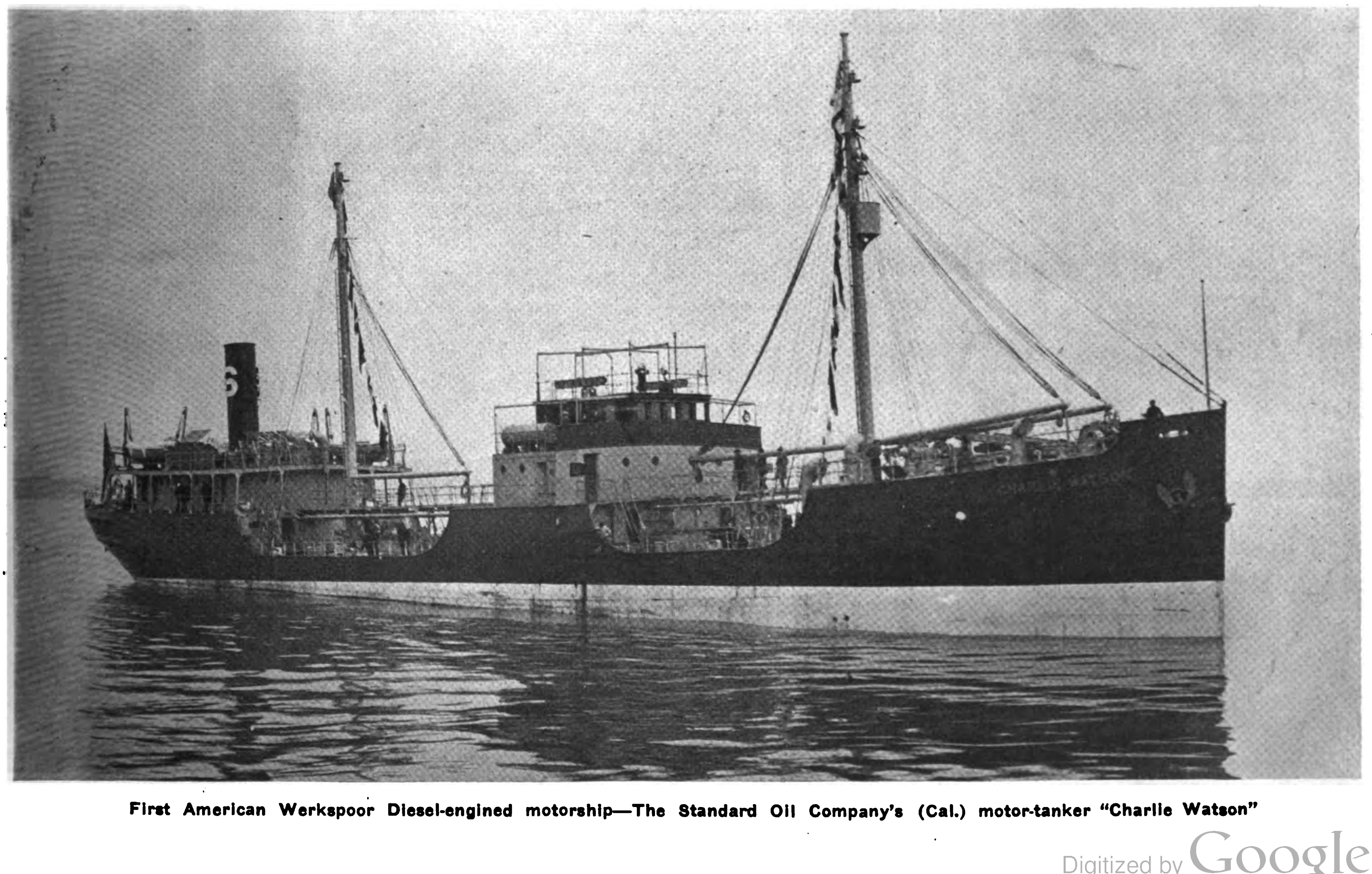
Regarding the maiden-voyage, on account of the swells breaking on the bar, the captain considered it unadvisable to make the trip and put back to San Francisco Bay. While returning from the Light-ship the circuit-breaker threw-off the current throughout the ship with the helm hardover, bringing the vessel close in shore. The captain signalled for full-speed astern on the main Diesel engines and in 11 seconds the engines were reversed, thereby saving the ship from running ashore. Before again starting, the steering-engine connections were made ahead of the circuit-breaker so as to eliminate this dangerous feature, and no more trouble was experienced during the trip.

On Nov. 23rd at 7 a. m. the voyage was again started and the "Charlie Watson" arrived at Point Wells, Nov. 26 at 3 p. m., making an 80-hours non-stop run, averaging ten knots with very small variation of speed throughout the entire trip. This was remarkable considering the heavy head winds bucked for many hours. A 60-mile gale was encountered while going up the Sound, but the tanker still maintained the 10-knot speed, due to the excellent governing feature of the engines.

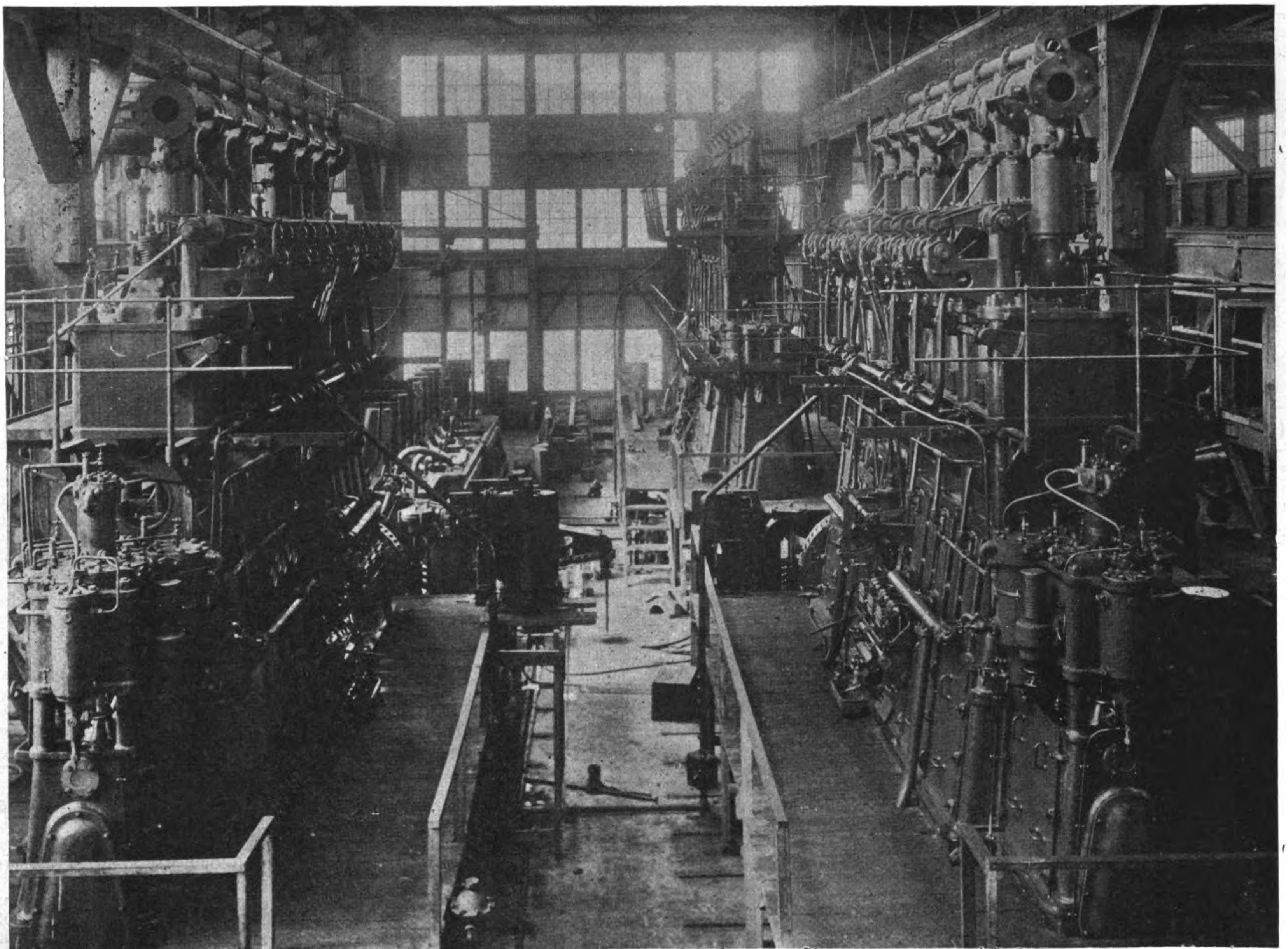
During the trip the British steamer "Statesman"—a vessel designed for higher speed—ran alongside the "Charlie Watson" for an entire day on the first day out. The steamer with safety-valves blowing would pull ahead of the motor-tanker a slight distance, but at the end of each watch, when the fires were cleaned the "Statesman" would fall astern, and could not catch up again until the fires were going good and the safety-valves were blowing. This incident shows the advantage of Diesel propulsion in that there was no fluctuation in the speed. It is the steady plugging that counts over the year's operation.

While the "Charlie Watson's" engines are 550 shaft h.p. they were only called upon to develop 400 shaft h.p. each at the rated-speed of 165 r.p.m. Calculations showed about 16% slip in the propellers.

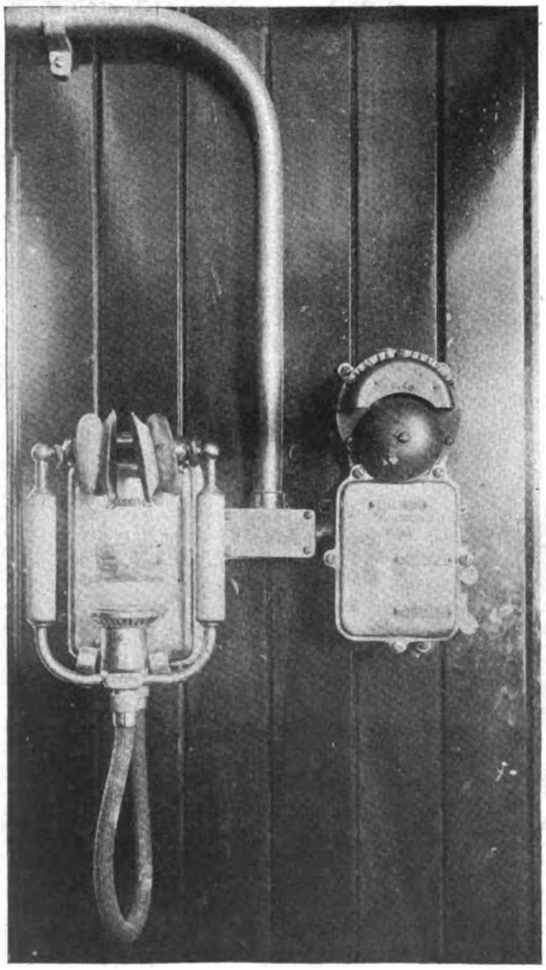
On the return trip she left Point Wells Sunday, Nov. 28, at 8 a. m. There was some little trouble with the exhaust-valves sticking. Then she put back to Seattle to make slight repairs to the anchor windlass. After making the repairs the tanker left Seattle Monday, Nov. 29, at 4:30 p. m.,



First American Werkspoor Diesel-engined motorship—The Standard Oil Company's (Cal.) motor-tanker "Charlie Watson"



Twin-screw Werkspoor-type Diesel engines of the "Charlie Watson" in the erecting-shop of the Skandia Pacific Oil Engine Co., Oakland, Cal. In the back-ground can be seen one of the 850 shaft h.p. Skandia Werkspoor engines of the Standard Oil Co.'s tanker "F. H. Hillman," originally built for the U. S. Shipping Board



Magnavox loud-speaking telephone on the "Charlie Watson"

and arrived at Point Richmond Friday, Dec. 3, at 10 a. m., a total of 89½ hours, but traveling about 30 miles further than on the trip to Point Wells. Due to the weather conditions and the light condition of the boat, she was run at slow-speed part of the time. During favorable weather she made 11 knots.

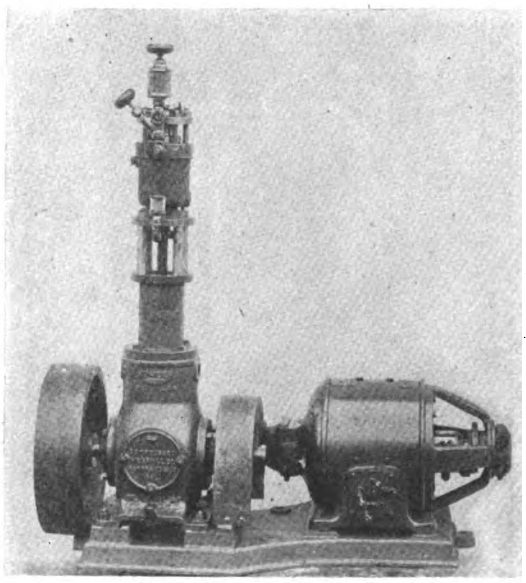
There was practically no vibration from the engines, either the main or auxiliary. In the engine-room there are two 100 k.w. General Electric generators, each driven by a 150 b.h.p. Dow four-cycle type three-cylinder Diesel engine. The following is a description of her electric-driven auxiliaries:

One 9 in. x 4 in. x 6 in. Rix Duplex Tandem 2-stage air-compressor mounted on cast-iron bed-plate with a 50-h.p. 230 volt General Electric, direct-current compound-wound motor operating at 1075 r.p.m., and starting rheostat. The intercooler is removable and is vertical type, fitted with copper tubes secured in a bronze head. The compressor is of the duplex tandem type, with 150 cu. ft. displacement. This compressor is capable of drawing from the atmosphere and discharging at 350 pounds to the square-inch.

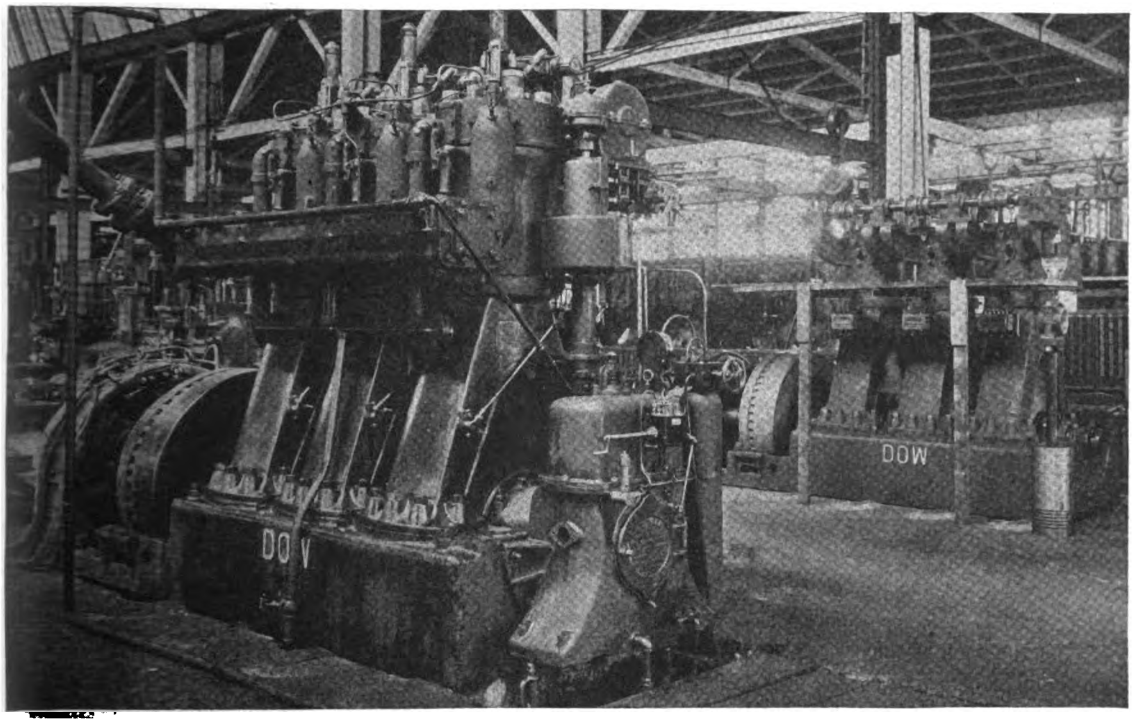
There is one Rix 1⅛ in. x 4½ in. Rix booster-compressor mounted on a cast-iron bed-plate, driven by a 5-h.p. 230 volt, direct current, compound-wound General Electric motor, operating at 1700 r.p.m., the motor being equipped with rawhide pinions and cast-iron gear-guards. Splash oiling in the crank-case and plunger is fitted with both oil and soapy-water lubricator. This compressor is capable of taking air at 350 lbs. and boosting it to 1,000 lbs. This unit is equipped with a starting rheostat.

Crane valves and Wallworth pipes are used for the cargo lines from the tanks to shore. These pipes have an eight-inch discharge. The cargo-oil system of piping is so arranged that three grades of oil may be carried and handled simultaneously without mixing, either in loading or discharging. Her carrying capacity is approximately 16,000 barrels of refined-oil, together with thirty days' supply of fuel, fresh water and stores. This capacity is well-worth comparing with a steam-tanker of similar overall dimensions.

All motors in the pump-room are gas-proof and of the ventilated type, to exclude accumlation of gases in the motors where sparking may occur. For the purpose of steaming-out the cargo tanks a donkey-boiler is installed in the engine-room. This donkey is equipped with the Ray mechanical fuel-oil burning apparatus, manufactured by the Ray Oil Burner Company, San Francisco. An



Rix booster used in conjunction with one of the auxiliary air-compressors in the "Charlie Watson"



The two Dow Diesel engines used as auxiliaries on board the "Charlie Watson"

electric heater is attached to the donkey-boiler for heating boiler-water for getting up steam quickly. This keeps the water in the boiler heated at all times and operates on a plan similar to water-heaters in fire houses. The fuel-oil is atomized in the Ray oil-burner by a small centrifugal pump. A Worthington feed-pump for the donkey-boiler is installed.

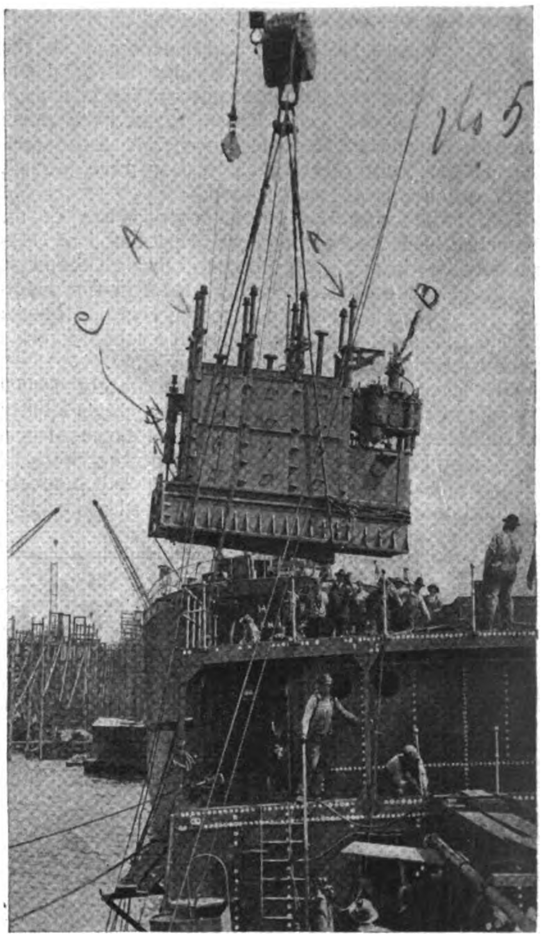
There is one ice machine of the Johns Manville type; one machine-shop lathe operated by a 2-h.p. electric motor, furnished by Manning, Maxwell and Moore of San Francisco.

There is one centrifugal two-stage Alsburger fire-pump driven by a 30-h.p. G. E. motor operating at 1700 r.p.m. A rheostat control gives variable speed to this motor. This is placed on the port side of the engine-room, and pumps into the fire-line that extends throughout the vessel. The pump is gear-driven. Another fire prevention installation is the Foam fire-extinguisher plant, similar to those the Standard Oil Co. has installed on land wherever it has large quantities of oil in storage.

There is a centrifugal bilge-pump operated by a 2-h.p. G. E. motor, and adjacent to this is a sanitary pump of the centrifugal-type driven by a 7½-h.p. motor which pumps salt water, and a fresh-water pump operated by a 3-h.p. motor.

There are three pumps two of which are circulating pumps for the water coolers on the main engines. These pumps are gear driven, each being operated by a 10-h.p. motor.

The cargo-oil pumps are placed under the forward deck, there being a special control-room on the main deck forward. These consist of four rotary pumps direct connected by gear to 30-h.p motors operating at 800 r.p.m. These motors are ventilated by a blower system, the blower being placed in the electric control-room. There is an emergency pump in the pump-room for use in case there should be a shortage of fuel-oil for



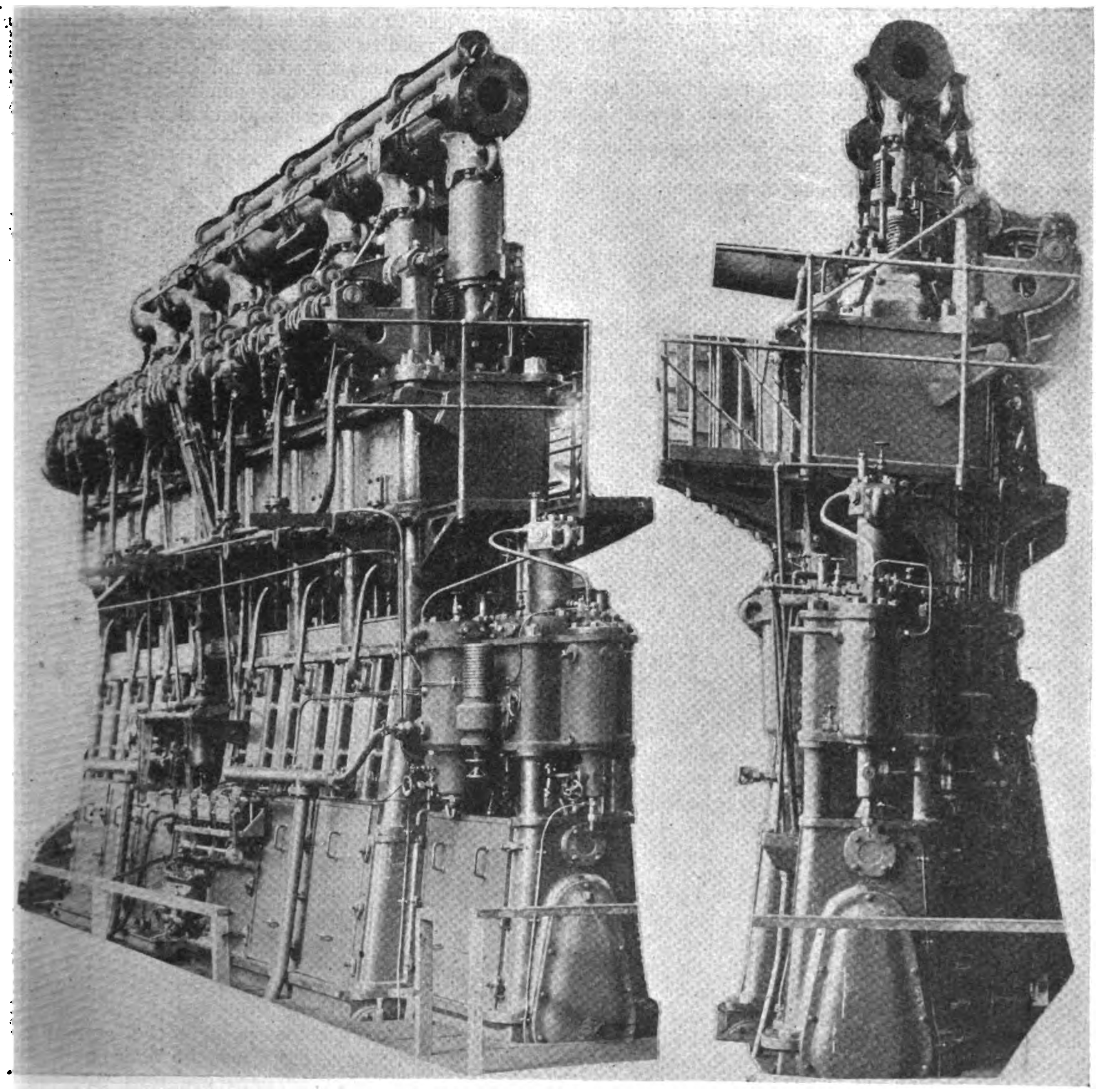
Lifting the forward three-cylinder section of one of the main engines of the motor-tanker "Charlie Watson"

the main engines. By means of this pump it is possible to pump from any cargo tank to the fuel tanks placed aft. This pump is driven by a 10-h.p. motor connected by a gear.

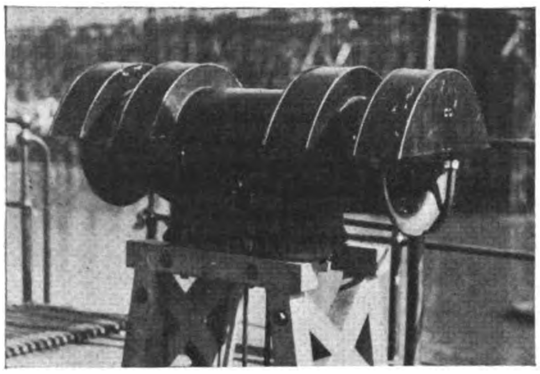
There are two centrifugal lubricating-oil pumps each driven by a G. E. 3-h.p. motor. These are placed aft on the main-engine deck. There is one fuel-oil pump for the engines located on the forward bulkhead of the engine-room and driven by a 3-h.p. electric motor.

For emergency cases there is a 10-k.w. G. E. 250-volt generator, which can take care of the lighting system if necessary. There is a 3-k.w. balancer set located forward of the engines on a level with the Dow Diesel engines, for the lighting system. The 250-volt 2-wire balancer set gives 3-wire 125 volts for the lighting system.

There are two turning motors, each operated by a 5-h.p. motor placed aft of the main engines, which are used in turning the main engines a trifle. A worm-gear is designed to engage the fly-wheel. There is a siren placed over the pilot house and driven by a 2-h.p. motor at 3,500 r.p.m., which was furnished by the Federal Electric Co. of Chicago, Ill. The switches for the various running lights are provided with pilot-lights to indicate that the running lights are in working order. Electric heaters are installed throughout the vessel. Other electric equipment includes a Donkin hydro-electric telemotor and electric indicator. The Magnavox loud-speaking telephones came in to good advantage during the maiden-voyage. One phone is installed in the pilot-house,



The twin-screw 500 shaft h.p. Skandia-Werkspoor Diesel engines of the motor-tanker "Charlie Watson." They are of the cross-head type. Few marine-oil engines of this power are built with cross-heads



Federal electric siren installed on the motor-tanker "Charlie Watson"

which connects with the engine-room and the steering-engine room. By means of this the steering-engine can be operated by hand in case of emergency, the orders being given over these phones. It should be understood that the electrical cooking equipment in the galley gave perfect satisfaction on the maiden-trip.

Her two propelling Diesel-engines are of an Americanized Werkspoor type constructed at Oakland by the Skandia Pacific Oil Engine Company.

The "Charlie Watson" will be used in the coastwise trade, transporting oils to the regional plants of the Standard Oil Co. She will probably make trips to Alaska during the summer time.

Her carrying-capacity is approximately 16,000 barrels of refined-oil, in addition to 30-day's supply of fuel, fresh-water and stores. The cargo-oil system of piping is so arranged that three grades of oil may be carried and handled simultaneously without mixing, either in loading or discharging.

The "Charlie Watson" has the following dimensions:

Deadweight-capacity....................2,800 tons
Carrying-capacity........16,000 bbls. (2,285 tons)
Fuel-capacity............2,700 bbls. (385½ tons)
Fresh-water capacity...................44½ tons
Cargo-space of forward hold.......15,000 cubic ft.
Power............1,100 shaft h.p. (1,300 ind. h.p.)
Engine-speed..........................165 r.p.m.
Cruising radius..........................30 days
Length (O.A.)............................262 ft.
Length (B.P.)............................250 ft.
Breadth (Md.)............................ 37 ft.
Depth (Md.).............................. 21 ft.
Draught (Loaded)......................... 17 ft.
Draught (Mean)......................18 ft. 3 in.
Daily fuel-consumption (at sea).4½ tons (31 bbls.)
Daily fuel-consumption (in port)*.........1½ tons (12½ bbls.)
Speed (Loaded)...................10½-11 knots

*With all cargo-pumps, etc., working

Those who were on the trial-trip (which lasted about eight hours over the prescribed course) were the following:

A. J. Hanna, director, Standard Oil Co. of Cal.

J. C. Rolfs, general manager, Standard Oil Co. (Marine Dept.).

James Cronin, engineer, Marine Department Standard Oil Co.

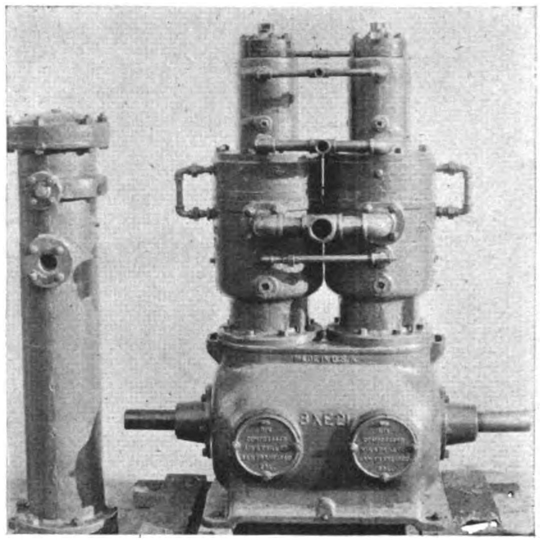
Mr. Gardner and Mr. Knapp of the Union Construction Co.

E. N. Persey, U. S. Shipping Board

Mr. Ryan, San Francisco office of General Electric Co.

Mr. Van der Woert, engineer of Skandia-Werkspoor Co.

The "Charlie Watson" was named in honor of Charlie Watson, superintendent of construction, Sales Department, of the Standard Oil Co. of Calif., until last December, when he retired after having served 38 years with the Standard Oil reorganization. Every city and town on the Pacific Coast where the company has established stations has at one time or another in years gone by been a port of call for the original "Charlie Watson." He knows the coast from Nome to San Diego, and it knows him, too! There will be many a smile of satisfaction and a stirring of pleasant recollections when his namesake pulls into coast ports for the first time.



Rix air-compressor as installed in the engine-room of the motor-tanker "Charlie Watson"

Admiral Benson and Diesel-Electric Drive

Some Existing Steamships to Be Converted to Motorships

(Extracts from Address Before the American Petroleum Institute, November, 1920.)

To compete in the world markets with our ships it is necessary to continue the development of oil for the application of fuel-oil to our motive power, and in order to reduce the operating expenses and make shipping a profitable enterprise there is no one element that is so important as that of reducing the quantity to be used to the smallest possible amount. It would be useless for us to try to compete with our foreign competitors by returning to coal.

What we are doing in the Shipping Board is to try to develop a motive power that will reduce the amount of fuel-oil required. My own opinion is that the answer to the problem will be the development of an internal-combustion engine as a generator of electricity, and then using the current so generated for driving the motors that drive the ship. We have one large vessel, the "Eclipse," which is now on a voyage to the East Indies with careful engineers. They are collecting the data and tabulating them. This data will be fully analyzed on the vessel's return. In this case the electric current is generated by the steam turbo-generators similar to the type that is used in our battleships; and as you know, that has been shown to be very economical.

The engineers with whom I have discussed the question of the Diesel-engine principle as applied to a generator seemed to think that there are some difficulties that are insurmountable. While I am not an engineer, it seems that there is some practical point between the Liberty motor and the ordinary Diesel engine that can be applied for generating electricity, and, of course, we know that having gotten the electric current, the rest of it is a simple and practical proposition.

Another reason that I am strongly in favor of the electric-drive, particularly in merchant-ships, is shown by the fact that it was due to my persistent efforts that the electric drive was retained in our battleships.

In the merchant-ship one of the most expensive elements is the auxiliary, and it is a very self-evident proposition that if we can produce an electric current by an internal-combustion engine and then carry the current to any part of the ship through the wires and cables we will have two forces that are simple and well-understood and their application thoroughly practical, and you use neither fuel nor energy except when you absolutely need it. The loss from the generator to the point of application is very small.

So that from a purely common-sense, practical view-point it seems to me that that is the solution of the problem in our merchant ships.

We have another vessel, the "William Penn," being completed now at the Cramp's Yard, where we have a Diesel engine with certain modications and improvements, the details of which I am not familiar with, but I am informed that they expect to get very excellent results. She will very soon be completed and put on a long voyage, probably going to the East Indies and I know that the engineers who are working with the "William Penn" believe that in that type they will get better results than from the electric drive. That may be compared with the steam-turbine electric-drive, but the point that I feel that we should work for is the internal-combustion engine principle applied to the electric-generator, and then the current used for driving the ship and driving the auxiliaries of the ship.

If we find that the Diesel engine—directly coupled or the electric-drive—whichever one proves the more economical, it will be installed. As the steam engines now installed in existing vessels become worn-out, or if the economy is sufficient to warrant it, the engines will be removed and new motive power will be put in.

We have one case now of a company that is very much interested in taking one of our vessels and removing the engines and boilers. This company has estimated very carefully as to the saving in cargo space, in the number of men that will be necessary to attend to the machinery, and all of the various elements that would enter into the problem; and the offer is so inviting that the board feels very much inclined to turn over a vessel at a very reduced price that will warrant the company in taking the engines and boilers out and putting in this new arrangement of the Diesel engine and the electric drive. Of course, in all of this we require that very careful data shall be taken and tabulated with the intention of giving to the shipping interests generally any information that we may secure along that line.

ANOTHER LARGE STEAMSHIP CHANGED TO DIESEL POWER

A steamship of 9,000 tons d.w.c., which recently commenced construction at the yard of the Copenhagen Floating Dock, will be changed to Diesel-engine power by order of the owners—the Atlanterhavet Shipping Company—and twin-screw Burmeister & Wain Diesel engines will be installed. The Copenhagen Floating Dock is the next largest shipyard in Denmark to Burmeister & Wain. When completed the new vessel will be very similar to the well-known motorship "Oregon" owned by the United Steamship Company of Copenhagen, and which some time ago was chartered by the American Hawaiian Steamship Company of New York.

SMALL GERMAN-BUILT MOTORSHIP FOR SWEDISH OWNERS

"Yara," a 450 tons motorship, has been launched at the Vereinigte Elbe und Norderwerft (Shipyard), Boitzenburg, Germany, to the account of Swedish owners.

"CLAUDIA M" A BRAZILIAN MOTOR-SCHOONER

For Brazilian owner, the shipyard of J. J. Pattje & Zonen, Waterhuizen, Groningen, Holland, recently launched the motor auxiliary schooner "Claudia M" of 650 tons d.w.c. She is propelled by sails and by a four-cylinder, two-cycle, surface-ignition type Kromhout engine.

LAUNCH OF CONCRETE MOTORSHIP "POSEIDON"

A Diesel-engined motorship of concrete construction and of 1,350 tons d.w.c. was recently launched at the Codan Shipyard, Koge. She has been named "Poseidon" and is the second concrete motor-vessel built for the Torben Nielsen Shipping Company. There are now two motorships afloat named the "Poseidon"—the other being the Anglo-Saxon Petroleum Company's Werkspoor Diesel-engined steel tanker.

Convert a Million Tons of Steamers to Diesel Power or Build Big Fleet of Motorships—Says Denman

Extracts from the testimony of Mr. William Denman, former chairman United States Shipping Board and president of the Emergency Fleet Corporation, Before the Select Committee on United States Shipping Board Operations, House of Representatives.

Washington, D. C., Monday, December 13, 1920.

HON. JOSEPH WALSH (Chairman), presiding. Also present—Representatives Kelley, Hadley, Foster and Connelly.

The Chairman. Mr. Denman, when were you appointed to the Shipping Board?

Mr. Denman. My appointment was made in the month of November, 1916. It was confirmed in January, 1917, and the board was organized on the 30th day of January, 1917. I had previously been one of the active participants in the framing of the legislation, beginning back in the latter portion of 1915.

When I proposed to the President the method of division of the powers conferred on him by the Congress in the Act of June 15, 1917, the executive orders that I outlined and suggested made a complete division between the operation of ships as commercial agents, and the construction of ships; and the executive order that was sent to us by the president, following the outline that I had submitted to him, divided the functions of the Shipping Board into two, (1) the construction of ships, and (2) the operation of ships. The manufacture or construction of ships was to be in the Emergency Fleet Corporation——

The Chairman (interposing). Pardon me, but was that possibly in contemplation when the title "Emergency Fleet Corporation" was adopted?

Mr. Denman. I put the word "emergency" into that title to indicate the emergency character of oil-fuel steam engines and wooden hulls. One of them was obsolete, that is, wooden hulls were obsolete as a commercial type when we adopted them. The oil-burning steam-engine had its obsolescence already forecast by the leading shipping men of the world, including Lord Admiral Fisher.

I came in contact with the oil situation, as assistant attorney-general of the United States in control of oil litigation at its beginning, and there made a study of oil conditions. I was attorney for Fred. Olsen's fleet of Diesel motorships, and for a long time before I went on the Shipping Board had been largely operating those ships between Scandinavia and the United States. I have operated ships myself. In fact, I have sailed two wooden Hough ships during the last two years over 120,000 miles on the Pacific, and have carried over 200,000,000 feet of lumber. I know something about the wooden ship, and its obsolescence, and its small remaining usefulness.

The Chairman. Did you, while you were chairman of the Board, make any contracts for Diesel engines?

Mr. Denman. The Diesel project I brought to the Board as my contribution to the commercial feature of the American Merchant Marine. The Diesel motorship has been used on the seas from 1904, very largely in the Baltic and Black Sea trades, and——

The Chairman (interposing). Perhaps you can answer this question: Did you make any contracts for the Diesel engine while you were chairman of the Board.

Mr. Denman. I procured a plant, the license for the Burmeister and Wain Diesel, the standard Diesel of the world then, and which has been adopted by Lord Pirrie and others for use in Diesel manufacturing plants in Great Britain—

The Chairman (interposing). Can't you tell us whether you made any contracts for Diesel-engined ships?

Mr. Denman. Oh, yes. We did not get further than the presentation of the contract for our signature; it was not signed by the Board.

The Chairman. Will you give us the reason why the contract was not signed?

Mr. Denman. Because they were debating as to whether or not we would accept the contract, or would commandeer the plant and run it as a national project. That was to be settled on July 24, the date that we both resigned.

The Chairman. Before I ask you with reference to this Diesel proposition, when first did you know that you were to resign?

Mr. Denman. On the 24th of July, 1917.

The Chairman. Were there any plants in the United States manufacturing Diesel engines?

Mr. Denman. The following plants were manufacturing Diesel engines:

1. Nordberg Manufacturing Company, Milwaukee, Wis.
2. McIntosh & Seymour, Auburn, New York.
3. Skandia-Pacific Oil Engine Co., San Francisco, Calif.
4. Dow Pump & Diesel Works, Alameda, Calif.
5. Worthington Holly Works, Buffalo, New York.
6. Fulton Iron Works, St. Louis, Mo.
7. James Craig Diesel Works, Jersey City, N. J.
8. Midwest Engine Works, Indianapolis, Ind.
9. Winton Engine Works, Cleveland, Ohio.
10. New London Ship & Engine Company, Groton, Conn.
11. Busch Sulzer Diesel Works, St. Louis, Mo.

The last two were manufacturing for the Navy. You will recall that the Navy made very large use of Diesels before anybody else did in this country.

Now, these companies were manufacturing land Diesels, and some small marine Diesels, but the standard Diesel license at that time was not being utilized in the United States. All of these factories could have manufactured standard Diesels of the type used in the Danish East Asiatic fleet for many years before I went on the Shipping Board.

The Chairman. Had the manufacture of Diesel engines at the time you were chairman of the Shipping Board progressed beyond the experimental stage?

Mr. Denman. I hand you, sir, a photograph (group-picture) of 21 ocean-going Diesel-ships, then sailing the seas, and of tonnage running from 6,500 tons deadweight to 10,000 tons deadweight. This is a single fleet, the output of a single yard. Nearly all these ships were operated by the Danish East Asiastic Company, which sailed from Copenhagen through the Mediterranean to the East Indies, up the China coast, across to San Francisco, and around through Magellan, and then to Europe. Many of these vessels were for over a year at sea and no engine troubles developed that at any time interfered with their operation. They consumed about one-third the amount of fuel that our oil-burning turbine engines consume; and because they have no boilers and no condensers, and because they only have to carry one-third of the amount of fuel, which is carried in their ballast tank, they have an increase of 12 per cent in cargo-capacity over the ordinary commercial types of tramp steam-vessels. It was the administration, these years of use of these vessels, that had satisfied every man who knew the world game of shipping that these were the only things to be used by a nation having a fuel-oil supply, long voyage commerce, and bulk cargoes to be carried.

The Chairman. How many contracts you had signed for Diesel engines; or, how many ships had you negotiated contracts for that were to be equipped with Diesel engines?

Mr. Denman. The project which we had was primarily for the manufacture of engines; to get established in this country—

The Chairman (interposing). For how many?

Mr. Denman. They were to turn out in the Cramps organization 24 Diesel motorships of 9600 tons deadweight capacity, with a gain of 12 per cent over the other types. That is to say, they would have been 12 per cent over the 9600 deadweight capacity of steamers, and of 11.6 knot speed on trial trip.

Now, this limitation of 24 ships was a limitation of the yard's capacity, of the Cramps yard, and contemplated two years' construction. The engines and the engine plant could be tremendously expanded, from the license used in other Diesel-engine plants, which I have described here, and a vast fleet of them could have been prepared for. The Diesel engine consists of some 4 to 6 units arranged along a shaft in very much the same way as the cylinders are arranged in an automobile. The consumption of oil, however, or rather the burning of oil, is entirely different from that in the case of the automobile, as it is not by explosion in the cylinders of gas as in the case of the automobile but combustion or burning of oil in the cylinders of the Diesel engine. These 6 units would be smaller in size and have smaller parts, but of smilar power to steam reciprocating engines, and the multiplication of parts by the process we Americans are familiar with would have enabled us to turn out very large numbers of Diesels, probably as rapidly as we did our steam-engines.

The Chairman. If I understand your testimony correctly it is that while these various firms you

"The purpose of my appearance before this committee is to urge the revival of my project as Chairman of the Shipping Board to build a large fleet of Diesel motorships. Its rejection was the climax in the tragedy of misfortunes of the Hurley administration.

"The United States can only balance its fleet by adding or converting from steam at least one million tons of motorships. We should stimulate the building of Diesel factories and produce more than our British and Scandinavian competitors.

"If we do not, we have lost the battle for maritime supremacy, and will not have even a fair minor share in the world's sea carriage."

—Extract from Wm. Denman's testimony before the Congressional Committee.

have enumerated were making Diesel land engines and small Diesel marine engines, none of them had manufactured Diesel engines of sufficient size and power to be installed in these ocean-going steamers, not until the time that you had laid out this program.

Mr. Denman. They had built many engines of size and power, but they were not marine engines. In other words, they were equipped to build marine engines provided licenses and drawings were furnished to them.

The Chairman. Was there a single steamship company operating, a United States corporation, an American steamship company, that had any ship constructed in which had been placed the Diesel engine, at the time you were chairman of the Board?

Mr. Denman. You will remember that our American Merchant Marine was not particularly prosperous during the war, and that during the earlier years of the European War there was very little stimulation of it.

The Chairman. But were there lines operating ships in which were Diesel engines that visited American ports?

Mr. Denman. Yes; the Danish East Asiatic Company, the Swedish East Asiatic Company, Fred. Olsen's line, and others. The first Diesel to come into the port of San Francisco was the "Siam," a 10,000-tonner, which arrived there in the year 1913. I remember that the entire water front group, the shipping group, went down and visited her. There had been a number built before her. She made a voyage around the world, and I think one or two voyages, with this consumption of oil I have described. Among the ships coming in, of the fleet that I represented, Olsen Fleet, there was a 9,600 ton Diesel-engined ship, the "George Washington," which I, as his broker or agent, chartered to the Navy in the fall of 1916. She carried coals from the Delaware Capes to the San Francisco Bay, and made the voyage with her usual economy and efficiency. The "George Washington" was one of the later built vessels, before I went on the Board, but the designs were very little different from the "Selanda," which was of the first group built in 1912, and started on her first trip in February, 1912. The "George Washington" was afterwards chartered by the Shipping Board, in the fall of 1917, and the Shipping Board experts made a voyage on her. I have seen their report. In every respect it confirms the statements I have made here concerning the efficiency of these vessels. And, that was a Shipping Board voyage and one of the most profitable voyages made by any Shipping Board ship.

The Chairman. Were there any plants in this country that were sufficiently well equipped to have undertaken the construction of marine Diesel-engines for these other ships which were contracted for as the result of the war emergency, on a large scale?

Mr. Denman. Yes; this list I have given you, all of them have been completed in plants manufacturing these large size Diesel engines. It was a question of design of engine and of license to use them, we built and expanded a very large number of steam-engine plants, built new ones and expanded them, and the parts to be made in a steam-engine plant are very much larger than the parts to be made in these plants. The metallurgical defects in the Diesel which bothered the Diesel manufacturers in 1904, 1905 and 1906, had all been solved. Our mechanics, men who turned out automobiles and the Diesel engines for submarines, our mechanics in this country are as skilled in construction and even more so than mechanics in Europe. It is all hocus pocus and a defeatist policy to talk about the superior ability of Danish and Swedish and other European mechanics. They have not come up to us in the matter of motor vehicles of any kind.

The Chairman. Had any policy been adopted in the Board prior to your resignation for the construction of any large number of Diesel ships, outside of these 24 that had been arranged for?

Mr. Denman. Yes; the policy of developing a plant for the construction of engines beyond the hull capacity of the Cramps yard.

The Chairman. But, Mr. Denman, you had already signed contracts for some 400 ships, and there were some 70 or 80 other contracts on your desk awaiting signature. Those contemplated putting in the steam marine-engines, did they not?

Mr. Denman. Oh yes. We had the plants. We had to get the tonnage. The sinkings by submarines in the months of February, March, April and May, in which we developed our program, were at the rate of 13,000,000 deadweight tons per annum. Sinkings in the months of May and June would have equalled all the wooden ships at our highest estimate of production, in two years; just two months of sinking would have equalled that production, and a shade over. We had these large steam engine plants in the country, and of course the only thing to do was to build every steamship we could. The idea I had was that when we came to expanding any then existing steam plants and building new steam plants, that some of this billion dollars we were spending should go in for these matured types of Diesel engine—not that the whole thing should be steam production, but that we should carefully insert in the American fleets this type of engine.

The Chairman. Do you know of your own knowledge whether or not those contracts were signed by your successors?

Mr. Denman. They were not.

The Chairman. Do you know of your own knowledge whether any Diesel-propelled ships were contracted for by the Shipping Board after you resigned?

Mr. Denman. Not one. In all the eight million tons that we had contracted for there was but one motorship, which has not yet reached her trial trip. The engines in that ship were procured from Burmeister and Wain, in Copenhagen, and sent over here, and they waited here for nearly a year before they installed them. And the vessel has not yet been tried out.

The disputes that the fleet of ships—and three times as many are on the sea, with Burmeister and Wain engines—the dispute that they are talking about, that this ship is of an experimental type, and that they are experimenting with the Diesel engine, which for 8 years has been sailing the seas everywhere, and for whose efficiency reports are available, the Danish East Asiatic Company puts out its statements—and they will give any information that we want—I say, there seems to be that dispute, and we are talking about experimenting with a Diesel-engined ship sometime within the next eight months, and it is all in the face of this experience that I tell you about.

The Chairman. We have had some testimony to the effect that some Diesel engines were being constructed in a certain plant, and which engines had been tried out and proved to be failures. Do you know of any such engines having been made for the Shipping Board, of your own knowledge?

Mr. Denman. Well, of my own knowledge it only goes to points I have read in the technical journals. No contracts have been let for Diesel engine units of sufficient size to propel a 10,000 ton or 8,000 ton vessel at proper speed for modern commerce. Some small engines were ordered to be constructed in several plants, but none of them would have been commercially available in competition on the sea. Whether or not they were a success I do not know. But I do know that not a dollar of these billions of dollars that have been spent has been spent for the construction of a Diesel engine of sufficient size to drive any 10,000 ton ship at a speed of 10 knots.

The Chairman. Did you procure these licenses in your official capacity as chairman of the Shipping Board?

Mr. Denman. They were procured through the Cramps who operated on an American license, but they did not have the drawings, that they wanted and through Frank Polk correspondence was taken up——

The Chairman (interposing). Through whom?

Mr. Denman. Frank Polk, Assistant Secretary of State. Correspondence was taken up with the Danes, and the equipment that the Cramps people desired, or the information they desired, was secured.

The Chairman. Were they in any position to have undertaken the construction of these Diesel engines had the contract been signed?

Mr. Denman. Beyond any question!

The Chairman. Why didn't you sign the contract?

Mr. Denman. These contracts were presented to us two days before our resignation. We were discussing whether or not we would commandeer the plant and make it a national scheme, like the Hog Island scheme and we were considering whether we would sign the contracts, and, as I say, the request for our resignations came at this time. The first thing I did was to take the matter up with Mr. Hurley. I told him of these other contracts in contract form, ready for signature, that they were in the files of the Shipping Board. I told him of the experience of the Danish East Asiatic Company, and of the Norwegian and Swedish fleets, and urged him to take up the project. I then went to New York, where I met Mr. Fritz Olsen, a son of Mr. Fred. Olsen, and told him what I was trying to do, and he suggested that the "George Washington," a 10,000 tonner, should be put under the American flag, so that the Shipping Board could have a direct and practical trial with it, and study its workings, if they were not satisfied with the innumerable trip reports of all these various owners. I rung up Washington to see if I could get hold of Mr. Hurley, and found he was in Chicago. As I went west I stopped off and spent half-a-day with him at Chicago, and asked him to enter into negotiations with the Olsens' for putting the "George Washington" under the American flag. I wired Mr. Hurley afterwards about it, and he wired back that they were not going ahead on it. I came on again in the following January, and again urged him, and he seemed to be very much interested, but besides writing some magazine articles he has gotten nowhere!

The Chairman. Were you the representative of any firm or ship operator prior to your appointment as chairman?

Mr. Denman. Oh, of a great many. I had had general maritime practice.

The Chairman. Did you represent any Diesel engine manufacturer?

Mr. Denman. No; neither before nor since. As a matter of fact, I have talked with no Diesel engine manufacturer in the last year and a half about Diesels, have not talked with one. I do not have my memorandum here, but I came on to try some cases here in the east, and heard that you were going to call me, and I have availed myself of the library of the "Motorship," a publication in New York. I had some discussion there with some men disconnected from any plant.

The Chairman. Did you represent some steamship line that operated Diesel-engine shipping?

Mr. Denman. Yes, sir; I represented the Olsen line, and it was the Olsen people that offered to put the "George Washington" under the American flag, so that the Shipping Board could have it directly under its inspection.

The Chairman. Was that done?

Mr. Denman. It was not done, but the "George Washington" was chartered by them as I have described, late in 1917.

The Chairman. Did you usually take two days with contracts coming to you, to decide whether they would be signed or not?

Mr. Denman. Oh, it depended on the questions involved. I might take a week. But there was no delay in the signing of contracts. But if you take a pile of contracts that high (indicating about a foot) with the other administrative duties, it cannot be done in the wink of an eye.

The Chairman. You had to sign those contracts, didn't you?

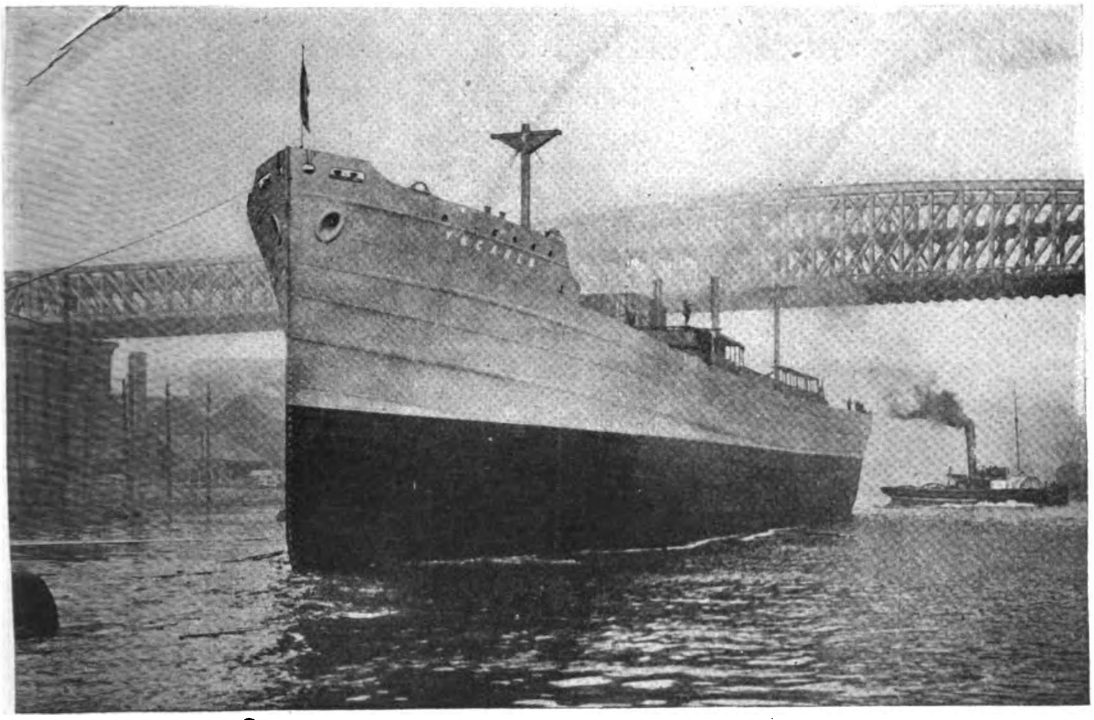
Mr. Denman. Yes, sir; I did.

The Chairman. When you had a pile of contracts such as you indicated a while ago, about a foot high on your desk, didn't you have a brief or a summary of what the contracts contained?

Mr. Denman. No!

Mr. Denman. I was one of the three conferees that sat with the British Commission.

I was also engaged in combating the continued statements that the Diesel-engine was not successful and was in an experimental stage. One of the leading British ship engineers in Washington attempted to tell me that the thing was experimental, but he very quickly changed his tone when I told him I had been attorney for Fred. Olsen's fleet, and knew all about the East Asiatic Fleet, and the 35 odd large size vessels that then were sailing and had for years been sailing on the sea. Josephus Daniels himself said to me "Your English friends do not seem to think much of the Diesel." The same remark was made to me by Mr. Brent, my associate on the Board.



The Wm. Doxford-built 9,400 tons d.w. single-screw motorship "Yngaren" of the Transatlantic S.S. Line. She is propelled by a 3,000 i.h.p. Doxford Diesel-engine at 77 r.p.m., designed to give a loaded speed of 11½ knots. Fuel-consumption 9 tons per day. Radius-of-action at 10½ knots is 32,500 sea-miles.

Everywhere was the urging, not the direct statement, that there was not confidence in the Diesel ships.

Tuesday, December 15, 1920.

Mr. Denman. I desire to offer a statement on the matter of Diesels, which I can be examined upon. The reason I ask to have it placed in the record is because I have drawn together in one place the matters that are scattered throughout my testimony, and so that anybody looking over my policy on Diesels or what I recommend as the future policy of the Shipping Board, may find it in compact form.

The Chairman. Perhaps if you will read it it will be in shape before the committee so that the members of the committee can examine you on it if they so desire.

Mr. Denman. All right. The purpose of my appearance before this committee is to urge the revival of my project as chairman of the Shipping Board, to build a large fleet of Diesel motorships. Its rejection was the climax in the tragedy of misfortunes of the Hurley administration, despite its notable accomplishments.

When I put the word "emergency" into the title of the Fleet Corporation, it was to indicate the war emergency which compelled us to build so many oil-fuel steam-engines, as well as our wooden hulls. The obsolete character of the wooden hull required no explanation. The wasteful use of oil under the steam boilers, consuming nearly three times the fuel of the many existing motorships of the Danish East Asiatic and other fleets, was well known. For years these large motorships had sailed under my window over the Golden Gate. Admiral Lord Fisher had already pointed out the approaching obsolescence of the marine steam engine.

When I became Chairman of the Shipping Board, the East Asiatic Company and other Scandinavian owners, in scores of voyages, some over a year in length and all around the world, had established the paramount commercial value of the Diesel motorship. It was then beyond either practical or scientific question or doubt.

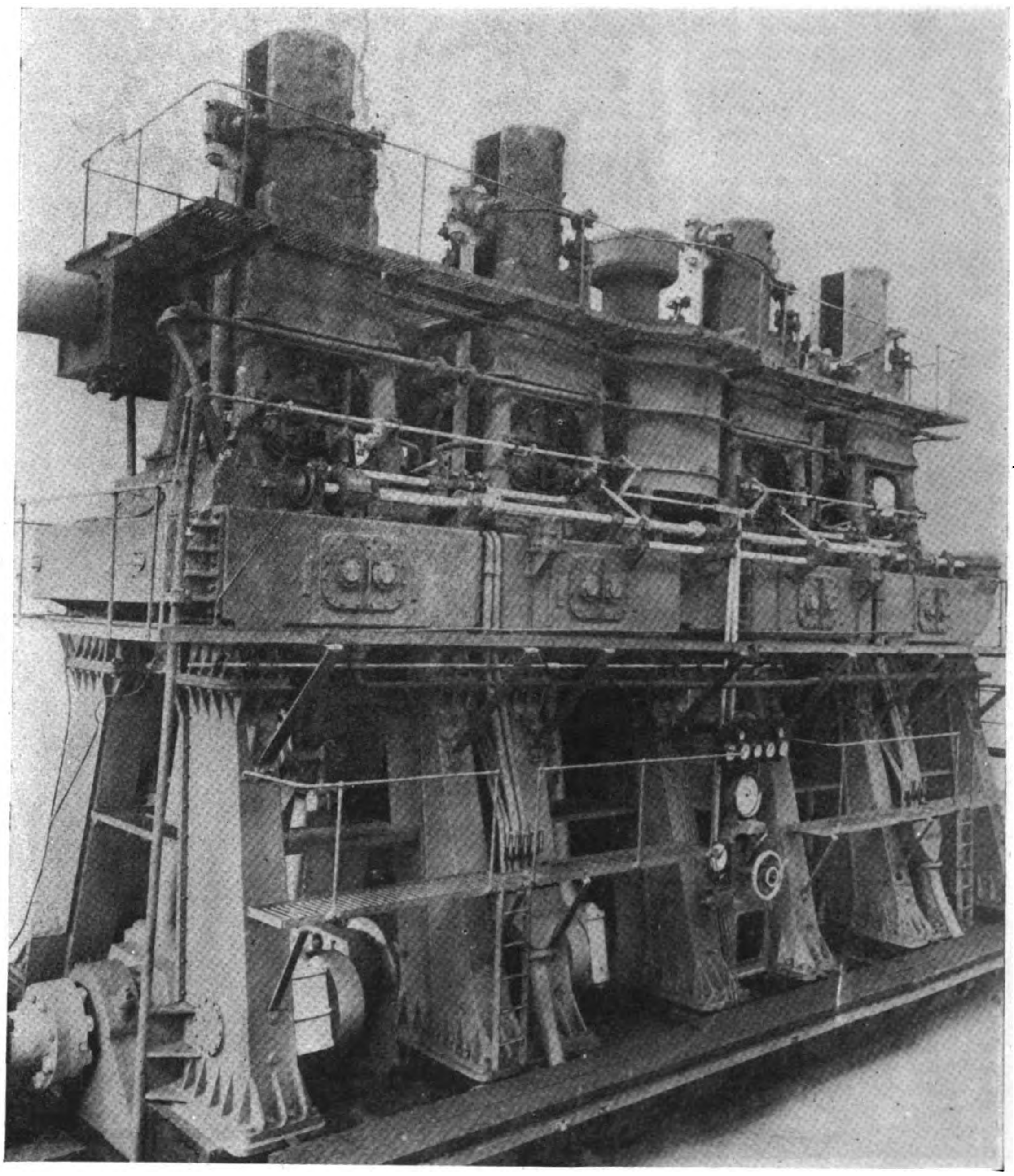
The project for building them, the necessary license, the plant, the Cramps shipyard and the skilled workmen were all procured under my administration. There were many other Diesel plants available for their construction, a list of which I put in the record yesterday. A contract was offered us, and we were debating whether we would commandeer and make it a national project or accept the contract. It was my administration's contribution to the commercial future of the American Mercantile Marine. It would have taken no more time for the Cramps to complete the Diesel plant, than to establish any one of the new plants for steam engines. The contract was for 9,600 deadweight tonners at 11.6 knots speed.

During the war Great Britain, which had many Diesel plants, some making marine and some making other engines, was compelled to turn to building of submarine Diesels. The submarine Diesel is a more complicated and finer mechanism than these commercial marine Diesels, but vast quantities were turned out in the British yards, in those Diesel factories in Great Britain during the activities of the war, and while we were building none with the government money. Lord Pirrie's plant, the Harland and Wolff yard, was using the same license that I procured, and actually constructed the largest commercial marine Diesel-ship at any time built. This was in war time. This ship was the Glenapp, a marine Diesel cargo and passenger ship of upwards of 14,000 tons deadweight capacity and of more than 14 knots speed.

At the present rate of consumption it has been estimated by geologists and practical oil men, that the American oil supply will be consumed inside twenty-five years. This is the occasion of Secretary Colby's note to the British on their mandate over the Mesopotamian oil fields. Can we waste two-thirds of our fuel-oil, thru steam-boiler tubes and up the smoke-stack, in view of this world oil condition?

George Otis Smith, Director, United States Geological Survey, on November 17, 1920, at a meeting of the American Petroleum Institute, said:

"In acknowledging the superior claim of the marine use of fuel-oil, this priority must be qualified by the condition that even on the seas the best use should be made of this invaluable fuel. The marine steam-engine, even of the turbine



Doxford 3,000 shaft h.p. at 77 r.p.m. merchant-marine Diesel-engine. It is of the opposed-piston two-cycle type. Four large single-screw motorships now building by Doxfords are having this engine installed. Complete description of this engine, together with details of the motorship "Yngaren," will be given in an early issue of "Motorship." Great pressure on space forces us to hold over the same.

type, must give place to the heavy-oil engine, under the rule of getting the most out of a limited resource. The very facts that support the argument for the marine use of fuel-oil—greater efficiency and economy of space and labor—can be cited in favor of the internal-combustion engine of the Diesel type as against the steam engine. The increased thermal efficiency of the new engine with its resulting addition to available cargo space or to cruising radius, is more than 2½ times that of the steam engine. The experience of the Bethlehem Steel Company, is that their new oil-engine ore-carrier, the 'Cubore,' in continuous service between Cuba and Sparrows Point, Md., uses only 36.7 per cent of the fuel-oil consumed by a sister-ship differing only in that it has the most modern type of steam plant. The tremendous economy thus possible in the marine consumption of fuel-oil demands the immediate adoption of internal-combustion engines if the world wants to make the largest use of its oil resources for the longest time."

Our wasteful steam-ships built for the war emergency, are hopeless in competition with these Diesel vessels. Motorships carry no boilers or condensers, and but one-third the fuel. As a consequence they have over twelve per cent more cargo-capacity. This in itself means a handsome profit in ship operation.

Over 60 per cent of the new cargo vessels ordered in Great Britian are motorships. Norway, Denmark, Sweden, and Holland, build nothing else when they can get engines. Lloyd's agents are now inspecting the construction of three hundred sets of oil-engines. The largest motorship is a British passenger and cargo-ship of 15,760 tons deadweight, and 14 knots speed. Six are of 14,000 tons deadweight and over.

This is active construction in Great Britain. There are 15 marine Diesel engine factories in Great Britain alone. Lord Pirrie controls four of them, three in Scotland and one in Ireland, using the same license we procured for the Board's program in 1917. There are many more in Holland, Denmark, Sweden and Norway.

In all the billions the government has spent, not a dollar has gone to build a Diesel engine large enough for a 10,000 ton freighter. Our wasteful steam engines are dependent on British bunkers. We cannot carry enough fuel to pay the loss up the smoke stack, and complete our long voyages. We must stop and beg fuel supply at the British and other bunkering stations on the China Coast, in Japan, in the East Indies, at Suez, at Aden, in the Mediterranean and in the South Atlantic. The sailing-radius of a 10,000 ton Diesel ship is 28,000 miles on the oil in her ballast tanks. This is once around the world, past all the British and other bunkering stations, and "then some," as shipping men put it.

The United States can balance its fleet only by adding, or converting from steam, at least a million tons of motorships. We should stimulate the building of Diesel factories and produce more than our British and Scandinavian competitors. If we do not, we have lost the battle for maritime supremacy, and will not have even a fair minor share in the world's sea carriage.

I have here a statement giving a partial list of Diesel-driven merchant-motorships at present building in Great Britain, which I will ask to have copied into the record. Only about one-third I think of the yards, or half of the yards, are shown here. The others have not reported out.

But this list totals 65 ships of 583,600 deadweight tons, and 227,800 indicated horsepower. I have a summary at the foot of this statement showing the fuel saving on this fleet. I won't repeat that. This is only a partial list. It contains nothing concerning the other yards enumerated in a paragraph at the bottom of the list, and nothing about the tremendous activity in Norway, Sweden, France, Italy, Denmark and Holland, where, under various patents, and various designs, large cargo and passenger carrying ships of this type are being built. This list is as follows:

The Chairman. Well, Mr. Denman, I understood from your statement made on yesterday that there are a number of factories which are equipped in this country to build large Diesel engines at the present time.

Mr. Denman. There are now building, just commencing to build, Diesel engines of large marine type.

The Chairman. For whom?

Mr. Denman. Private account.

The Chairman. Are there shipbuilding concerns that are building Diesel motorships of large tonnage in this country at the present time?

Mr. Denman. The Cramps have just began building for the American-Hawaiian Steamship Line, that great fleet of vessels that used to steam from San Francisco to Atlantic ports through the Canal and carried our bulk products by that route—they have just ordered two of the same type that I desired to have the Board adopt.

Mr. Schwab did not have this license; the Cramps had it. Mr. Schwab set about to develop a Diesel of his own, of an entirely different type, what is known as the two-cycle type, and had one vessel running with the new type of Diesel in it, the "Cubore," the vessel to which George Otis Smith, Director of the United States Geological Survey, referred to in the statement I read.

And there are a number of other plants in the United States capable of undertaking the conversion or the building of engines for new Diesel vessels. The trouble about doing the thing on private account is this: Nobody knows to what point the government is going to write down its steam fleet. Nobody knows what the policy of the government is going to be with regard to a merchant marine. Capital is hesitating to invest, fearing that a weak-handed policy may make any ships unprofitable, and also fearing that when the government writes down the values of its present fleet and begins to sell some of them at scrap prices, that the value of steamships will be utterly uncalculable, and therefore that ventures at this time are unwise. The government has got to at once, if we are going to have a balanced fleet of vessels, arrange for something like the same amount of Diesel tonnage that our competitors have.

The Chairman. We have 1,400 ships, a large portion of which at the present are tied up. Would you advocate the government, through the Emergency Fleet Corporation, building more ships with Diesel engines in them?

Mr. Denman. I think so, because you will not have any Diesels tied up. When the last steamship is tied up because it cannot run on the sea your Diesels will be running at a profit; and if it is a question of maintaining our supremacy on the seas and getting our share of the commerce of the world, we should have these ships. It may be the government can't afford it. It may be that it does not want to go ahead but will leave it to private capital.

Partial List of Diesel-Driven Merchant-Motorships at Present Building in Great Britain

December 1, 1920

Number of Sister Motorships On Order	Deadweight Tonnage Per Ship	Horse-power (Indicated)	Name of Shipbuilder	Name of Engine Constructor	Name of Shipowner
4	14,000	6,600	Harland & Wolff, Glasgow	Harland & Wolff, Glasgow	Glen Line, London
6	10,000	3,200	Harland & Wolff, Glasgow	Harland & Wolff, Glasgow	Glen Line, London
1	14,000	6,600	Barclay, Curle & Co., Glasgow	Harland & Wolff, Glasgow	Elder Dempster Line, Liverpool
6	9,000	4,000	McMillan Shipyard, Dumbarton	Harland & Wolff, Glasgow	Lamport & Holt, London
3	9,190	3,200	Harland & Wolff, Glasgow	Harland & Wolff, Glasgow	Pacific Steam Nav. Co., Liverpool & London
3	11,500	4,500	Harland & Wolff, Glasgow	Harland & Wolff, Glasgow	Pacific Steam Nav. Co., Liverpool & London
3	2,000	450	Mercantile Dry Docks Co., England	Vickers-Petters Ltd., Ipswich	Arthur Tate & Co., Newcastle-on-Tyne
1	10,500	4,000	Wm. Doxford & Sons, Sunderland	Wm. Doxford & Sons, Sunderland	B. & J. Sutherland & Co., Newcastle-on-Tyne
3	10,500	4,000	Wm. Doxford & Sons, Sunderland	Wm. Doxford & Sons, Sunderland	Transatlantic Steamship Co. Gothenburg
1	4,000	1,350	Cammell-Laird & Co., Birkenhead	Cammell-Laird & Co., Birkenhead	Anchor-Brocklebank Line, Liverpool
1	5,500	2,750	Wm. Hamilton & Co., Port Glasgow	Cammell-Laird & Co., Birkenhead	Anchor-Brocklebank Line Liverpool
2	10,500	3,250	Vickers Ltd., Barrow-in-Furness	Vickers Ltd., Barrow-in-Furness	Anglo-American-Petroleum Co., London
4	10,500	3,250	Vickers Ltd., Barrow-in-Furness	Vickers Ltd., Barrow-in-Furness	Tankers Ltd., London
2	10,500	3,250	Vickers Ltd., Barrow-in-Furness	Vickers Ltd., Barrow-in-Furness	Un-named owners in England. Probably Tankers Ltd.
2	10,500	3,200	Harland & Wolff, Belfast	Harland & Wolff, Glasgow	Bibby Line, Liverpool
1	10,500	3,200	Harland & Wolff, Glasgow	Burmeister & Wain Copenhagen	Alfred Holt & Co., Liverpool
1	11,000	4,000	Alexander Stephen & Sons, Linthouse, Glasgow	Stephen-Sulzer	British Steam Nav. Co., London
2	10,500	4,600	Barclay, Curle & Co., Glasgow	North British Diesel Engine Co., Glasgow	British Steam Nav. Co., London
1	10,670	4,600	Robert Duncan & Co., Glasgow	North British Diesel Engine Co., Glasgow	British Steam Nav. Co., London
1	15,760	4,600	Wm. Denny & Sons Dumbarton	North British Diesel Engine Co., Glasgow	Union Steamship Co., of N. Z. Liverpool
2	1,200	600	Chas. Hill & Co., Bristol	North British Diesel Engine Co., Glasgow	British Steam Nav. Co., London
1	1,200	600	Wm. Denny & Bros., Dumbarton	North British Diesel Engine Co., Glasgow	British Steam Nav. Co., London
3	3,000	4,500	Workman, Clark & Co., Belfast	Harland & Wolff, Glasgow	Royal Mail Steam Packet Co., London
1	5,000	1,750	Existing Steamer Being Converted	North British Diesel Engine Co., Glasgow	Lane & McAndrew, London
1	10,000	3,000	Swan, Hunter & Wigham Richardson, Walker-on-Tyne	Swan, Hunger & Wigham Richardson, Newcastle-on-Tyne	Owners Unknown (England)
1	6,500	4,250	Sir. Wm. Armstrong Whitworth & Co., Newcastle-on-Tyne	Whitworth-Sulzer, Newcastle-on-Tyne	Spanish Owners
2	7,000	3,000	Ardrossan Shipbldg. & Dry Dock Co., Ardrossan	Hawthorne Leslie-Werkspoor, Newcastle-on-Tyne	Danish Owners
3	9,000	4,500	Ardrossan Shipbldg. & Dry Dock Co., Ardrossan	Burmeister & Wain, Copenhagen	Danish Owners
1	10,000	3,250	Wm. Denny & Bros., Dumbarton	Denny-Sulzer, Dumbarton	British Tankers Ltd., London
2	3,000	1,000	Wm. Beardmore & Sons, Dalmuir	Beardmore-Tosi, Glasgow	McAndrews Ltd., London
65 ships	583,600 tons d.w.c.	227,800 I. H. P.			

No information is available regarding Diesel-engines and motorships building by John Brown & Co., Clydebank; North Eastern Marine Engineering Co., Newcastle-on-Tyne; David Rowan & Co., Glasgow; Dunsmuir & Jackson, Ltd.; Fairfield Shipbuilding & Engineering Co., Govan; Glasgow; Wood & Skinner, Newcastle-on-Tyne; Clyde Shipbldg. & Engineering Co., Glasgow; Palmers Shipbldg. Co., Jarrow, England; and John Samuel White & Co., Cowes; including some motorships for the Cunard Line. In addition to the above the Anglo-Saxon Petroleum Co., of London (Royal Dutch Shell) have taken over about one-dozen motor tankers from the British Admiralty since the Armistice, including a Diesel vessel of 10,200 tons d.w.c. namely the "Marinula," ex. "Santa Margharita."

Attention is drawn to the fact that the above fleet of 65 British Motorships will together only use a total of 735 tons of oil-fuel per 24 hour day, compared with 2,165 tons per 24 hour day by 65 American Oil-Fired Steamers of similar aggregate D. W. tonnage and power—or a daily saving of 1,430 tons of valuable oil.

Furthermore, these British Motorships will be able to carry in aggregate at least 60,000 more tons per one-way voyage than the same number of American Oil-Fired Steamers of the same dimensions and power, and a total of 400 to 500 firemen are entirely dispensed with. This forcibly demonstrates the enormous economies effected by the use of motorships.

Reproduction of list of British motorships on order furnished to Congress by Mr. William Denman and referred to on the adjoining column. Among Diesel-vessels not included are two Werkspoor-engined vessels building by Wood & Skinner, of Newcastle. The three ships building by Workman, Clark & Co., for the R. M. S. P. Co., are 8,000 tonners.

The Chairman. My question is, would you advocate the government, through the Emergency Fleet Corporation, building more ships, when it already has a large fleet of steam vessels, to the number of some 1,400, a large portion of which are tied up.

Mr. Denman. I have my doubts whether I want the government to act through the Shipping Board in any project. I want to see centralized control and not board operation in the matter of building ships. But I would say, in answer to your question, that if they cannot be gotten through any other agency of the government that the government should balance its fleet. If it is its intention to go ahead and manage the fleet that it has, it is foolish to go into competition with our opponents and not have the weapons for the contest.

The Chairman. How do you explain the fact that no American concern has undertaken, with the possible exception of the American-Hawaiian Steamship Company, to have constructed Diesel motorships?

Mr. Denman. In the first place private capital has been loath to enter into the shipping business in competition with the government. It does not know where it is going to land. Very few new ships have been purchased, but the fact is that there is strong inquiry as to where they can be built and a strong demand for Diesel motorships.

The Government of Norway took three 20-year-old hulls and equipped them with Diesels of this type that Lord Pirrie is using in the Harland and Wolff yards. As I have said, the hulls are 20 years old, and the Diesels were Burmeister and Wain Diesels, and those vessels were sold to New York owners six months ago at $240 a deadweight ton—even though the hulls were, as I have said, 20 years old—as against $175 to $180 a ton for new steel turbine steamships. You can therefore see what the demand is for them if they can get them.

The Chairman. But if there is such a great advantage in this type of ship, if they will be carrying freight when the last steam-propelled vessel is tied up, why should private operators or steamship companies hesitate on account of the United States Government's fleet about constructing these ships and going ahead and operating them?

Mr. Denman. Because, first there is general hesitation about expanding in the steamship business with the government's policy unsettled. Second, inability to get the engines if they wanted them for quick delivery, with uncertainty as to future forces on the sea. Now, if we had had built in 1917 a large group of these Diesel factories, then these Americans could have gone to them and gotten their engines, and the government would not now be faced by the problem of a semi-obsolete type of vessel, and bantering the question as to whether private or government ownership should operate them.

As a matter of fact what happened during the war was that these Diesel plants built some engines. If you talk about converting steam plants to Diesel-engine plants, the Diesel plants built steam engines, and of all the topsy turvies I have ever heard of that was the most extraordinary.

The Chairman. Did you ever bring this to the attention of Mr. Schwab when he was acting as Mr. Hurley s assistant?

Mr. Denman. No; I did not. I assumed that the recommendations as to type came from the operating end.

The Chairman. Well now, have you any knowledge, Mr. Denman, as to whether or not the Fleet Corporation or the Shipping Board did actually have constructed some Diesel engines which, upon a try-out proved to be failures?

Mr. Denman. I do not know whether they proved to be failures or not, Mr. Chairman. But they were not of the type of the Danish East Asiatic Fleet and those that these other great fleets were using. They were smaller than were necessary for a 10,000-ton type of ship.

The Chairman. You let contracts for a great many ships of less tonnage than that?

Mr. Denman. Oh, yes.

The Chairman. And could not Diesel engines have been put in smaller types as well as in 10,000-ton ships?

Mr. Denman. Yes, sir; and be very valuable in certain services.

The Chairman. Do you know whether or not they actually did have Diesel engines for smaller ships which, upon try-out were pronounced to be failures?

Mr. Denman. I do not know whether they were pronounced to be failures or not. I understand that those small engines that were ordered by the Shipping Board, of a type that at that time was not developed, and not such as the Burmeister and Wain and the Werkspoor type, were not completed for the Shipping Board, and I am told were completed for other persons and successfully completed and that the vessels had good engines.

The Chairman. They have what?

Mr. Denman. That the engines are good engines.

[Both the Skandia-Werkspoor and McIntosh & Seymour Diesel engines ordered by the Board made a 30 days full-load non-stop run on the test-bed, and can be regarded as eminently successful. —*Editor, "Motorship."*]

The Chairman. If I get your recommendation correctly as read from your statement which you made, it is that the government should either go into the building of motor-propelled ships or assist private concerns in having a fleet of motorships built and developed.

Mr. Denman. That is, if the government is going to adopt a vigorous policy for the purpose of entering into overseas competition. If it is going to have a lax hand, if we are going to drift along as we did, controlled by British and German propaganda, for years in this country, affecting every ship measure that we desired to have put through by the Congress; if the policy is going to be to drift along, then I answer no. But if we are going to get into the game and drive it through, yes.

The Chairman. In event that the government is going to pursue a vigorous policy in behalf of the merchant marine, what is to become of this fleet of steam vessels; that is, if we are going to embark in constructing a motorship fleet or going to assist in the development of a motorship fleet.

Mr. Denman. Exactly what will become of the steam vessels of our opponents. The vast mass of fleets of the world are steam. They are gradually introducing the motorship as the modern type of propulsion. We want to keep pace with them. These vessels will be used, gradually becoming obsolescent and will go on the cheaper runs and the shorter runs, where saving of fuel does not mean so much. We must keep pace at least with our competitors in the type of ship that they are using. We are more in need of it than they are, because, as I have said, we are a high-wage country, and the Diesel engine cuts out a certain number of operators in the engine-room. We are a bulk-carrying country, and we want space and large space on our ships. We are an oil-producing country and have the oil for ships. We are a long-voyage country, across the Pacific and the Atlantic, and the long-voyage savings are the savings in fuel consumption.

The Chairman. Isn't it a fact that practically all of the commerce brought to our ports today in competition with our own fleet arrives in steam-propelled vessels?

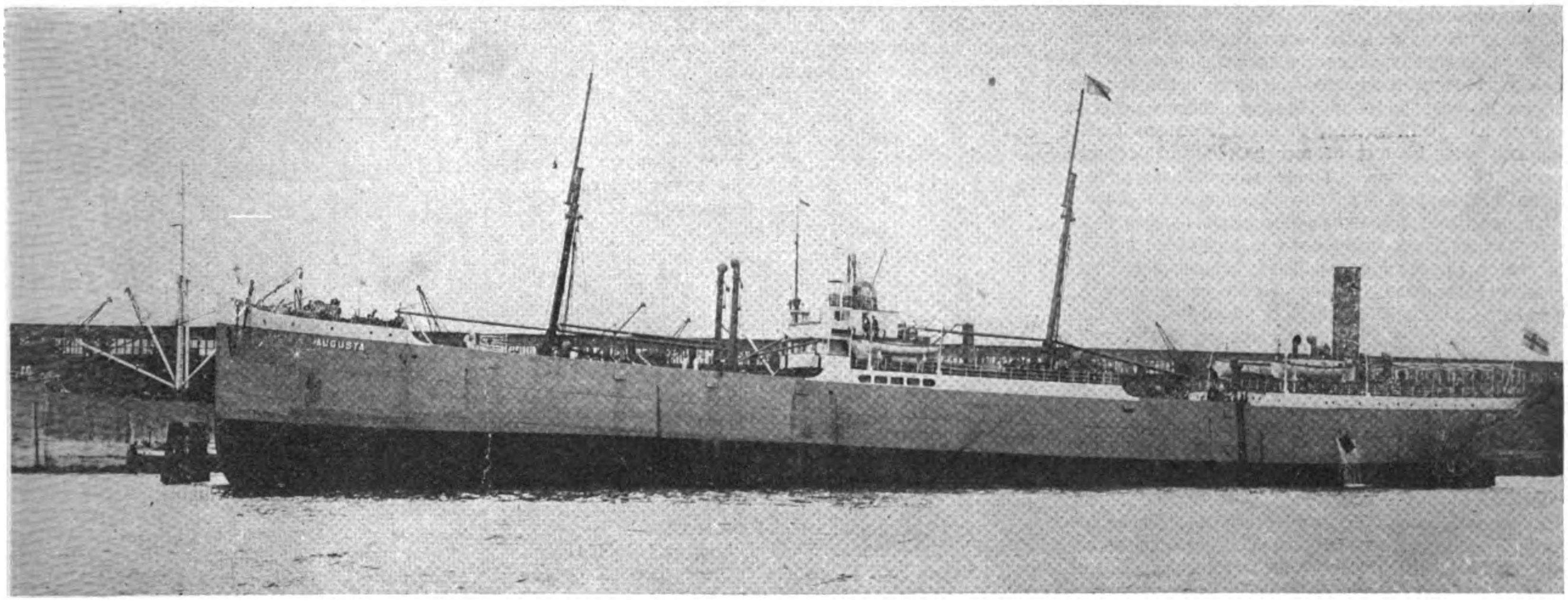
Mr. Denman. That is quite true, because the bulk of the fleets of the world are still of steam, but the fact is——

The Chairman (interposing). There are 21 of these vessels floating around somewhere.

Mr. Denman. Oh, there are over a hundred of them.

The Chairman. How is it that none of them get to the United States?

Mr. Denman. Why, Mr. Chairman, I thought I described on yesterday the voyages those vessels take. They are sailing in and out under my window over the Golden Gate constantly, and unless California is out of the United States they are coming to a port in this country and carrying cargoes to and from that port. The fact is that the Pacific coast is so far from you in the east that the Pacific coast conditions are not known to our Atlantic coast men, just as I wanted somebody on the Atlantic coast to be the chairman of



The 5,000 tons motorship "Augusta," ex-"Zamora," built by Palmers & Jarrow, England, in 1891, and converted to Diesel power in 1919 with a gain of nearly 700 tons net cargo-capacity and a reduction of fuel-consumption from 20 tons of coal down to 4 tons of oil per day. The engine-room staff was reduced from 13 to 8 men. She is now owned by Bror M. Banck, of Stockholm, and is propelled by a four-cylinder 800 shaft h.p. two-cycle type Sulzer-Diesel engine. The same owner has three other Sulzer-Diesel engined ships under construction and conversion, totalling 24,000 tons d.w.c. and 6,600 i.h.p. Mr. Bror M. Banck recently emphasized his belief in motorships in the course of a personal interview with our Scandinavia correspondent.

the Shipping Board for the reason that I did not feel I was acquainted with the Atlantic coast conditions. The United Fruit Company has been using Diesels; the Atlantic Transport Company is using them; the Hamburg-American line has been using them. The Hamburg-American line, at the time the war came on, had orders out for a very large fleet of them.

[Practically every week foreign motorships arrive at Atlantic Coast ports—sometimes several in a day.—*Editor, "Motorship."*]

The Chairman. Do you know whether or not experiments are in process in this country for the development of an American type of this Diesel engine?

Mr. Denman. About a year ago it was announced that we were going into some experiments on what was known as the Diesel electric drive. Now, the electric drive has been very successful on our war ships; and where huge engine powers are involved, 100,000 h.p. for instance, as against 3,000 or 4,000 h.p., used on the freighters, you can see where the value of the electric drive would come in. On the naval ships there is economy and facility of operation gained by taking those enormous powers and transmitting them through electricity to the shaft rather than by trying to put the enormous power directly on the shaft by mere physical action. That is a great gain. Now, it has been suggested that the same thing might be true in transmitting the power from the low-powered Diesels to the shaft. It is an experiment; I hope it succeeds. But, Mr. Chairman, there is no Diesel-electric drive ship running, and I understand no Diesel-electric drive ship under construction.

Now, gentlemen of the committee, by the time you have got your experiments developed, two or three years will have gone by; the commerce of the world will be established on other people's ships to a certain extent, to a large extent I will add, and will be out of our hands and we will be out of the race. These things are proved things. It is just like the Babcock and Wilcox boiler, or the triple-expansion engine, or any of the types that were advanced in the 90's and 80's and which are now going into obsolescence. The Diesel engine in 1917 was a proved commercial success, and those 21 ships, a photograph of which I left here prove it; as the other 100 now in existence demonstrate it every day.

When people come to you and tell you the Diesel is an experimental matter I ask you that you show them these 21 ships and ask them if they have read the reports of trips that are given to the Danish East Asiatic Company, which reports they give out and are glad to give out. Ask if they have seen them, and have noted the tremendous saving and economies in operation annually. The Danish East Asiatic Company is one of the most prosperous shipowning companies in the world and has been since the beginning of the use of these motorships.

The Chairman. Cannot you understand that the new administration coming into the Shipping Board upon your retirement, finding contracts having been awarded for hundreds of ships, with ships under construction already requisitioned, with ships in the fleets on the high seas commandeered, with arrangements having been made for the cessation of bridge building and of building operations generally except where absolutely necessary, with the steel supply practically diverted toward shipbuilding operations, with all the engine builders of the country arranged with for the construction of steam engines, that they would naturally hesitate about departing from that program and entering upon a new line of engine construction using a different fuel.

Mr. Denman. After I came to Washington in the January following and reminded Mr. Hurley of our discussion on the previous July and August, that he had forgotten that there was a contract offered and wondered whether it was in the files and sent down and got it. Now, I have no doubt—and I am not criticizing the good faith of those gentlemen. The last thing in the world I want to do is to criticize Mr. Hurley's good faith. When we had up the fight on the Cunard ships he was with us. Hurley has been right, but he didn't know anything about shipping. All he had done on Diesels is to turn out journalistic articles praising them—I call them journalistic ersatz and not real ships.

The Chairman. He had not signed the contract in January?

Mr. Denman. No. I was told by some members of the Board afterwards that they got the contract and discussed it at that time, and I understood that the thing was dropped in the general mess that arose out of shipping accounting and other difficulties.

Mr. Kelley. Are there any operating depots that might have been avoided by more attention to the operating end.

Mr. Denman. Yes; if they had compared their operation of Diesel ships with their operation of steam vessels I would not be here talking to you about Diesels.

Mr. Kelley. The Diesel ships are very expensive to operate, aren't they?

Mr. Denman. They operate at one-third the fuel cost of steam vessels.

Mr. Kelley. The upkeep is very high, isn't it?

Mr. Denman. No; it is much less, or at least not more than in the case of steam vessels.

Mr. Kelley. What about the initial cost of Diesels?

Mr. Denman. When you take the cargo-carrying capacity of a ship into consideration it is about the same per ton carriage; per ton actually carried it is about the same. That is the real question. If by paying a little more for your engines you do not have to push so much fuel around and you carry more cargo, that is the test. It is volume of cargo carrying capacity or ton mile per annum that determines the value of the results.

Wednesday, Dec. 15, 1920.

Mr. Denman. Coming back to the subject of motorships and the composition of foreign propaganda against them: You will recall that Great Britain was a coal-burning nation prior to the great war and did not possess any great oil fields. British shipping has always been closely coordinated to British raw materials. The Burmeister and Wain Diesel patents were, however, being used in the Harland and Wolff yards prior to the war, and during the war they produced a number of these large Diesel ships.

In my testimony on yesterday it appeared that the British Diesel plants were turned on submarine construction. The Harland and Wolff plant—in which Lord Pirie has the interest I have spoken of—however, continued to build large-size Diesel motor cargo and passenger ships during the war; and since that time, with the Mesopotamian oil fields in sight and now apparently in hand, has come an enormous stimulation of internal-combustion oil-engines in Great Britain, producing the activities shown in the partial list of ships which I gave to you yesterday, and which I trust will appear in the record.

The long voyages of the Danes and Swedes and Norwegians are like ours in America. That, as I say, developed the Diesel long prior to this, and I now will read a short excerpt from "a very voluminous writer" on shipping matters which you will find pertinent.

The Chairman. I know that we might find a whole library full of documents pertinent on the matter, but we cannot continually fill up our record with excerpts, it seems to me, from various documents. We are asking for your views. You have expressed them pretty fully, and submitted documents, which are in the record here; and, besides, the matter to which this is directed is more a legislative proposition, which should properly go to another committee of the House.

Mr. Denman. I quite agree with you that I should not go on and on and on, but this happens to be Mr. Hurley, and it happens to show what Mr. Hurley recommends, and also shows what he knew in August, 1917.

Mr. Steel. Is that an excerpt from his book "The New Merchant Marine"?

Mr. Denman. It is. I want to show that the vessels that are his type are vessels of 1912 and 1913. It is very short—

"Close in the wake of this first bold venture came the 'Selandia,' engine by Burmeister and Wain, in 1911." The "Selandia" is the first vessel in that group of pictures that I handed to you the day before yesterday.

"This vessel is a 7,400 deadweight tons cargo-ship, driven by twin-screws, each shaft being fitted with an 8-cylinder 4-cycle directly reversible marine Diesel motor of 950 brake h.p. The vessel had been engaged in long voyages, between Europe and the Indies, in the service of the East Asiatic Company, and her performance has been so highly satisfactory that several hundred sea-going motorships that have followed her in the service have been designed and engined in substantially the same way. There has been a tendency to larger and more cylinders, but almost every improvement in the marine Diesel has been in mechanical betterment of parts. An excellent and very full idea of the comparative economies of the steam-engine using coal-fuel and the Diesel-motor using any of its wide range of oil-fuels, may be had from the following extracts taken from the engineer's log book and to vessels in the employ of the same company engaged in making the same voyage."

Then follows a description of the vessels and the items of engine performance. Now, this is a typical vessel, which is the basis of Mr. Hurley's conviction that we must go to the building of motorships; it exactly fits the "Siam"—410 feet long, 55 feet wide, 30 feet deep, deadweight carrying capacity 9,500 tons, and speed 11.14 knots. The "Siam' was the vessel that sailed into San Francisco in 1913, and the "Siam" followed the model of the "Selandia" and the hundreds of vessels Mr. Hurley describes. Already had a very large number of them been built when I turned the project over to him.

Now, Mr. Kelley, you asked me on yesterday whether or not the contract from the Cramps group was examined by Mr. Hurley in January, 1918, if that contract at that time would have been of any value to him.

Mr. Connally. I would like to ask you a question with reference to the Hurley quotation which you say was from his book. When was the book published?

Mr. Denman. Recently.

Mr. Connally. Why did you make the statement that the quotation would show what Mr. Hurley thought about the subject in 1917?

Mr. Denman. Because I told him this.

Mr. Connally. But your telling him that does not appear there from the quotation from the book.

Mr. Denman. No; but I am showing the identity of my statements in 1917 with Mr. Hurley's statement in 1920.

Mr. Connally. Do you think it hardly fair to say that you are quoting from a book, which was published in 1920, which would show what Mr. Hurley knew in 1917?

Mr. Denman. If I gave that impression I am sorry.

Mr. Connally. I think you gave it, and I think the stenographer's notes will show that way.

Mr. Denman. If I gave it that way I am glad you called my attention to it. The fact is that this statement is my statement in 1917 in form.

Mr. Connally. But it is not shown in the book or written form?

Mr. Denman. What is here stated in Mr. Hurley's book in 1920 is a reproduction of our discussion in 1917. Mr. Walsh, yesterday you were asking me about the contract proposed with the Cramps group, and our discussion at luncheon, Mr. Hurley and myself, early in 1918, of the Cramps contract. At that time he could not have availed himself of it because when the contract was not taken up by our successors the Navy came in and took up practically all the constructive capacity or activity of the Cramps plant.

The Chairman. For Diesels?

Mr. Denman. It was Navy construction. I cannot tell you about Diesels. I think it was for steam, and that the De la Vergne Diesel plant was not, as I understand it, acquired by the Cramp Shipbuilding people, although I may be mistaken about that. The point is that the licenses of the Cramps were not utilized early in 1918, nor were they utilized after the armistice, nor were any of the hundreds of steel contracts for cargo ships—for hulls I am speaking of now—let for the Diesel form nor for any of these other large Diesel plants that could have manufactured under the Cramp license or the Werkspoor license, or any other license utilized for making commercial Diesel-engines, but instead some of them were converted into the manufacture of steam-engines.

Mr. Kelley on yesterday asked me whether or not the operations of the Diesel engine in commercial-carrying ships was a more or a less expensive operation than a steam-vessel burning oil under the boilers in the form of propulsion, and I gave him my opinion. I have here the opinion of about 25 of the more important shipping men of the world, English and American and Scandinavian on this subject, which answers that question.

The Chairman. How authentic are those?

Mr. Denman. They appear in this technical journal "Motorship," and I imagine will not be questioned. They include Admiral Lord Fisher and the whole group of men who have been for years prognosticating, and many of them manufacturing Diesels. Sir Marcus Samuel, who is engaged very largely today and has been during and since the war in the manufacture of Diesels in England, makes a statement concerning their economies. [We presume Mr. Denman refers to Sir Marcus Samuel's connection with the North British Diesel Engine Work. We omit the list of statements made regarding the Diesel motorships, as the same already have been published in "Motorship," as indicated by Mr. Denman—*Editor.*]

Mr. Denman. You were asking me whether there has been any place in which this project in our time had been laid down as a matter of policy, and I am now quoting from the records of the Shipping Board:

> "Minutes of a special meeting, Wednesday, July 19, 1917. The Chairman. (Mr. Denman). I desire to say, General,* as to the proposals of the Cramp people as to the construction of Diesels, that that is the beginning of a great project, a project which involves the use of the Diesel motor ultimately as a substitute for steam. I happen to be familiar, and have been for some time as attorney for a company operating a fleet of Diesels between Scandinavia and California, with some of the details of their use and their value, and know some of the possibilities of their development." * * *
>
> "In view of the fact that it is not a simple contract but the beginning of a great project, I desired to have the Shipping Board present so that they could sit and consult with the various persons engaged in the project, get information and put questions, so that if they have any suggestions floating out of their experience and minds which is not entirely negligible they could, after consultation with you, work out the project in full.'
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> "The Chairman. (Mr. Denman). We may also want to discuss the question whether or not the contract with these gentlemen for the development of the thing should be along the lines of government ownership of the license, or government ownership of the Diesel plant, itself, just as you are going to make this fabricating ship plant."

Mr. Denman (continuing). After I retired from the Board——

Mr. Foster (interposing). May I ask right there, how soon did you retire after the day on which that meeting was held?

Mr. Denman. On the 24th.

Mr. Foster. This was on what day?

Mr. Denman. The 19th. After I retired from the Board I prepared a statement, which was read into the record of the Senate, as follows:

"The Shipping Board had other constructive policies, both to meet war need and for the upbuilding of our mercantile marine, which it was framing, always acting under the pressure of the consciousness of the submarine menace and always under the necessity of creating a new branch of its organization as its functions were increased. Included in these policies was the following:

"(5) The inauguration of the building of a Diesel motor-driven fleet of merchant-ships of the Norwegian "George Washington" type, which, with the great saving in fuel and cargo space, wide sailing-radius, and reduced labor cost, would free us from bunker control of other nations and give us a dominance in maritime carriage after the war."

Mr. Denman. I was asked yesterday about motorships being constructed in this country. There are today 11 motorships, aggregating 120 odd thousand tons, being built in America; and they, of course, are the beginning of many more to follow. Mr. Schwab is building 4 of about 20,000 tons deadweight capacity.

Mr. Steele. Each one?

Mr. Denman. Yes; each one. That shows how the powers have developed since the 10,000 ships in my time and in Mr. Hurley's time. The 10,000 ton ships was what was regarded in a way as the unit of tramp cargo carriers. Two are being built for the American-Hawaiian Steamship Company by the Cramps. Those I think are 12,000 tonners. One is being built for the Alaska Steamship Company, but I have not got the size of that. Two are being built for the Standard Oil Company of California. One is being built for the Submarine Boat Corporation. In this connection I want to speak of the attitude of certain oil companies towards the Diesel motorships——

Mr. Connally (interposing). Mr. Chairman, I want to object right here, and ask how far is the committee going to pursue the Diesel proposition?

The Chairman. It seems to me that those matters are subsequent to the administration of Mr. Denman and his successors. I do not quite see the pertinency, except the fact, which appears, that they are building Diesel ships now. I do not know that we care anything more about that. This whole Diesel proposition, or a goodly portion of it, Mr. Denman, as you have testified about it before the committee, of course, is not strictly within the jurisdiction of this committee. You have explained very fully, and gone into the matter very fully. You have brought out the fact that this proposition was under consideration at the time you resigned, and that a contract was practically to be signed and was not signed, and that it was feasible, according to your view; and I understand that Diesels ships are being built at this time.

Mr. Denman. That is in pursuance of the question put to me on yesterday.

Mr. Chairman. I do not think we ought to pursue the subject beyond the point that you have I think very fully developed; namely, that this matter was under consideration by you as chairman of the Board; that the most of the details had been arranged; that a contract had been practically prepared and was being taken up with a view to signing it, and was handed down by you to the subsequent administration, but nothing was done by them.

The Chairman. Have you any questions, Mr. Steele?

Mr. Steele. Just a few. After your connection with the Board ended did you remain in Washington?

Mr. Denman. I was here for about three weeks. I wrote a letter to Mr. Hurley advising him that I desired to lay before him these projects.

Mr. Steele. That is, the Diesel projects?

Mr. Steele. Yesterday you placed in the record a list of the ships being constructed in Great Britain of the Diesel type.

Mr. Denman. Yes.

Mr. Steele. Were they constructed under government or private management?

Mr. Denman. I think nearly all of those were under the—those now being constructed are under private management, but during the war all shipping in Great Britain, as it was in the United States, was under government control. Lord Pirrie, who is constructing them, was British Comptroller of Ship building.

Mr. Steele. That list is made up of ships under private management?

Mr. Denman. Yes, sir.

Mr. Steele. You also referred to having obtained a license with reference to the Diesel engine.

Mr. Denman. I obtained it in this sense, that I got the Cramps to make a tender of the license that they already had, in connnection with the contract.

Mr. Steele. The Diesel engine had been patented, had it not?

Mr. Denman. Well, there are a great many patents. The original patent of Dr. Diesel had expired, but the idea had been appropriated to many forms of propulsion, and this particular one, that was chosen by Lord Pirrie, who was the master of English shipping during the war and was had by the Cramps, was the one I chose.

Mr. Steele. Has that been patented in this country?

Mr. Denman. I presume it has but I do not know.

Mr. Steele. It was from the Cramps that you obtained this license that you speak of?

Mr. Denman. I obtained it in the sense that I got the Cramps to offer to build it.

MR. DENMAN AND ENGLAND

In our interview by a reporter of the "New York American" Mr. Wm. Denman, first chairman of the U. S. Shipping Board, following his preliminary statement before the Walsh Committee, said:

"I am not anti-English. I am for an American merchant marine that will not be governed by a British-controlled Atlantic Conference.

"While we were neutrals I vigorously opposed British discrimination, but I am an Englishman by descent, am in sympathy with Liberal England, and reverence English law, which I taught in the University of California for a number of years.

"I believe in 'hands across the sea' between American and English liberals, though I want to grasp the hand of an English Liberal and not a British foreign office representative.

"Commercial competition with Great Britain in sea carriage is now one of the vital economic internationl issues facing the country."

LORD PIRRIE AND MOTORSHIPS

In an interview with a representative of the New York "Journal of Commerce" prior to sailing on the "Olympic" Lord Pirrie stated that he considered speedy passenger-liners, which demand fast dispatch, were the only type of ship which should be equipped with oil-fired boilers. Lord Pirrie stated with emphasis that he did not think that tramp steamers should be fitted with oil-burning installation. Regarding motorships Lord Pirrie expressed the opinion that this class of ship had a great future and that he believed they would be developed into the most economically propelled vessel on the seas.

LORD PIRRIE AND THE OIL SITUATION

Regarding the remarks made by Lord Pirrie in a letter published in the December issue of "Motorship," the following comments culled from "Fairplay" (one of the leading British shipping journals) are of interest:

With oil scarce and dear the "dope" now appears to be that the only economical way in which to burn oil is—not under boilers, but in internal-combustion engines. There is, of course, no doubt about it; Mr. Churchill said so in 1912 when he described oil-burning for steam raising as the half-way house to internal-combustion. Lord Pirrie is not very hopeful of immediate relief from the oil-engine. The progress towards perfection of the Diesel engine will, he thinks, be very slow, and, moreover, if the conversions of cargo steamers to oil-burning continue, owners of motorships may find themselves without fuel for their engines. Considering the success of Lord Pirrie's own Burmeister and Wain Diesel, I think the eminent shipbuilder's pessimism about the progress of the internal combustion engine is excessive. It is not in any degree doubtful that the expensively stimulated demand of cargo steamers for oil fuel is seriously involving the position of steam liners and motorships. Still, if price is the ultimate determining factor—and I have a suspicion that it will be—the motorship and the liner will be able to pay it and the oil-burning cargo steamer will not.

RICHARD AIREY AND LORD PIRRIE'S WARNING

In the correspondence columns of our December issue a letter from Lord Pirrie dealing with the oil situation was published. Commenting on Lord Pirrie's remarks at the recent meeting of the American Petroleum Association, Mr. Richard Airey (Vice-President, Roxana Petroleum Corp. of the Royal Dutch-Shell Group) said:

"A significant statement was given out by Lord Pirrie the other evening before leaving for Mexico. He sounded a note of warning that the supply of oil-fuel was not unlimited and it behooved shipowners to proceed with great care and consideration before definitely adopting an exclusive oil-burning fleet. I do not altogether share in this view of the matter as the use of liquid-fuel is so admirably suited for marine purposes and has so many advantages over coal that if ever a serious shortage should take place, then its use for land installations must be curtailed in order to provide ample supplies for the ships of the world.

*General Geo. Goethals.

Orient S.S. Co.'s First Big Diesel-Ship

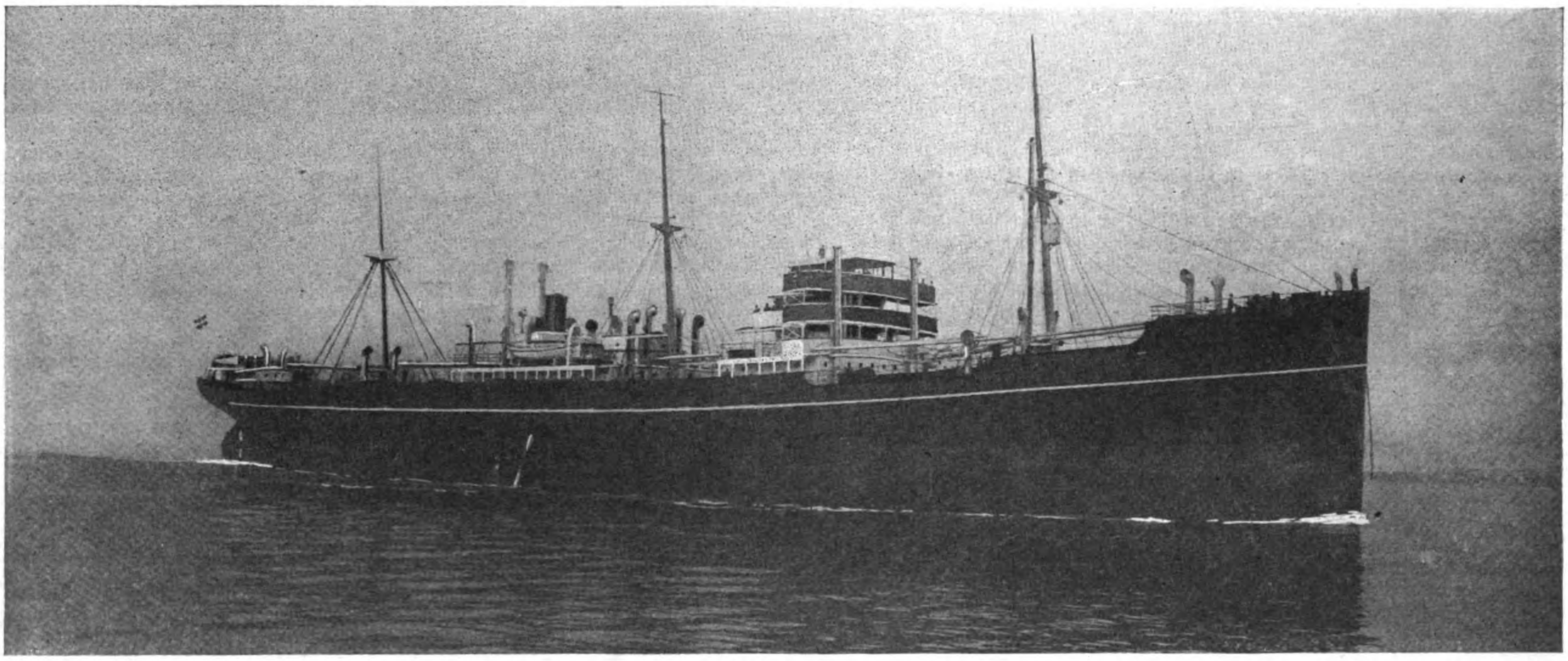
Trials of a Naskov-Built Burmeister & Wain Motorship

AT the end of October last trials took place of the first large Diesel motorship built for the Orient Steamship Company of Copenhagen. It may be remembered that the Orient S.S. Co. was formed for the purpose of purchasing the steamships that were placed on sale by the East Asiatic Company when they decided to abandon that type of vessel in favor of Diesel propulsion exclusively. That the Orient S.S. Co. are now actively taking up motorships is of considerable importance and should be borne in mind by American steamship operators.

The first motorship has been named "Indien" and has been built at the Nakskov Shipyard, while the Diesel-engine construction and installation work were carried out by Burmeister & Wain—the main engines consisting of two 1550 i.h.p. four-cycle type Diesel engines at 125 R.P.M., giving the vessel a fully-loaded speed of 11½ knots. She is of the awning-deck class built to Lloyds 1A+.

Dead-weight capacity	8,750 tons
Power	3,100 i.h.p.
Length between perpendiculars	390 ft.
Breadth Moulded	53 ft.
Depth	36 ft. 6 in.
Mean-draught, loaded	26 ft. 11 in.
Capacity of fuel in the bottom tanks	1,100 tons
Speed (loaded)	11½ knots
Trial speed	12.51 knots

On the trial trip the speed maintained over the measured mile was 12.51 knots, the two engines together developed 3,230 h.p. at 136.75 revolutions per minute. In every respect the trials were satisfactory and the vessel left Copenhagen the following morning for her maiden voyage to the Far East. Owing to there being a dense fog while trials were taking place, the illustration of this ship which we give is not very good, and it has been necessary to slightly retouch the same. Diesel-electric auxiliaries are fitted throughout, including winches, windlass, steering-engine and wireless telegraphy. Her owners, the Orient S.S. Co., are very closely associated with the well-known East Asiatic Co. It is interesting to note that the builders of the "Indien," namely, the Nakskov Yard, also constructed the Diesel-engined tanker "Mexico," which we illustrate in this issue.



The Orient Steamship Co's new 8,700 tons d.w.c. new motorship "Indien." A fog prevailed during trials. She was engined by Burmeister & Wain.

Two American Diesel Engine Papers

Interesting Lectures by Mr. G. C. Davison and Lieutenant-Commander H. Gibson

AT a recent meeting of the Motorboat Section of the Society of Automotive Engineers Lieut. Comm. H. Gibson of the U. S. Navy Department presented some interesting data on German submarine Diesel engines, and Mr. G. C. Davison, Vice-President of the New London Ship & Engine Company, gave a most interesting lecture dealing with commercial motorboats and Diesel engines.

In the course of Lieut. Comm. Gibson's remarks on German submarine Diesel engines he stated that among those which he inspected personally, there were a hundred and eighty-three in all, he found the following makes:

M. A. N.*
Blohm & Voss
Deutz
Koerting Bros.
Krupp.

Only five of these were of the two-cycle type and these were all out of the repair. He stated that at the beginning of the war the enormous influence of the Krupp concern forced the adoption of their two-cycle machines, but their unsatisfactory performance brought it about that towards the end it was no longer manufactured and Krupp's themselves had to build four-cycle engines. The type which was found to predominate was the M. A. N. [Augsburg design—*Editor*] four-cycle machine which was built on a standardized and interchangeable plan by M. A. N., Krupp, Blohm & Voss, and Köerting Bros. Capacities, speeds and some of the weights are given in the following table:

* Maschinenfabrik Augsburg-Nürnberg A. G.

B. H. P.	R. P. M.	Complete with Dependent Auxiliaries Weight in Lbs.
100*	550	......
300	500	......
500†	500	......
1,200†	450	57,000
1,750†	380	97,000
3,000†	380	144,000

*Air starting clutch reverse.
†Oil-cooled pistons double fuel-valve.

All these engines except the three-thousand horse-power model were built of steel castings with cast-iron cylinder-liners and cast-iron pistons. The illustration he gave showed clearly what the method of construction is; we are told that this was adhered to fairly closely in all the sizes from the smallest to the largest. The only important parts of the engines that did not seem to be standardized was the air-compressor, which in some sizes was built four-stage and in others three-stage. The same arrangement as regards position on the engine, however, was maintained throughout; the compressor with fuel-pumps, hand-priming pumps, over-speed governor, and all controlled-gear was placed at the forward end of the engine.

Of the sizes given the 1,200 H.P. seems to have been built in so much greater numbers than the others, that it may be called the standard size used by the Imperial German Navy.

Lieutenant-Commander Gibson brought-out in considerable detail the refinement and excellence of the German constructions. Fundamental in them is the extraordinary use of steel-castings which were cast with sections so thin that they are a marvel to foundry men and engineers of other countries. Sections as thin as one-eighth of an inch were found to have been passed perfectly and it is impossible to escape the conclusion that the Germans were able to cast-steel in the same way that we cast brass. An interesting refinement found on the 3,000 H. P. engine was the use of a separate piston-crown made of steel. It was so perfect and completely free from flaws of any kind that it is a mystery to this day whether the part was cast or forged.

The steel piston-head is flanged to the cast-iron trunk body of the piston and is provided on its under surface with machine labyrinth grooves so disposed as to constrain the cooling-oil to flow in a tortuous path from the periphery to the center and then out. These grooves were closed off by a diaphragm held in place by studs turned out of square bar-stock fitting in square holes in the diaphragm and provided with castellated lock-nuts. Outside of riveting it is impossible to imagine any type of fastening more secure than this against coming loose because of vibration.

The same mystery as regards the nature of the steel used is encountered when the piston-pin boxes are examined. There is no doubt that these boxes are made of steel (lined with a thin layer of babbitt) but no analyses have yet revealed whether they were forged or cast. The lower halves of the boxes considerably over-hang the eye of the connecting-rod and thereby provide so large a bearing-surface that no trouble has ever developed because of the heating of these parts.

An interesting feature of the crank-shaft is that the extreme after journal next to the fly-wheel is considerably larger in diameter than the remaining journal. On the ten-cylinder 3,000 H. P. engine, the enlarged journal is 12⅝" in diameter whereas the regular journals are only 11 7/32" thick. The stroke and bore of this engine is 21" by 21" respectively.

The cylinder-head fastening on all the engines is accomplished in a unique manner by the use of studs in the water-jackets which project so little that they do not begin to reach above the tops of the cylinder-heads. The nuts for them are tubular with a mushroom-head and a square-hole at the upper end. The mushroom or shoulder fits into a counter sink of the cylinder-head surface and thereby becomes practically flushed with it. This feature greatly improves the appearance of the engine and has a great practical use in increasing accessibility on top of the head and permitting greater freedom and neatness in the location of valve-cage flanges, pipes and the remainmaining cylinder-head fittings.

These four-cycle M. A. M. (Augsburg) engines are by no means a war product. One ship that was found in regular service had a 1,200 H. P. engine of this make on board which was dated 1912. The displacement tonnage of the ship was 800 on the surface and the combination of this size of ship with the 1,200 H.P. engine seems to have been the standard submarine used by the Germans. It may be remembered that very complete technical details and illustrations of the 3,000 B.H.P. appeared in "Motorship" of January, 1920, these being the first details ever published.

* * * *

In the paper entitled "Commercial Motorboats and the Diesel Engine," by Mr. G. C. Davison the application of oil-engines to small boats was interestingly discussed. The three types of prime-mover compared were the gasoline engine, the surface-ignition or hot-bulbs engine, and the Diesel engine. Charts based on assumed first costs of the different types and on estimated fuel-consumptions were shown and indicated that in installation where the yearly operating time is less than 250 hours the gasoline-engine still has a considerable field; but as soon as greater numbers of working hours and larger powers are reached the hot-bulb and the Diesel engines show marked economies.

As regards cost of operation in sizes of about 100 H. P. there is no very pronounced difference between the hot-bulb and the Diesel engine; but, Mr. Davison showed that there are other considerations which point to the Diesel engine as the more desirable type of prime-mover. Owing to the fact that practically all the hot-bulb machines operate on the two-stroke cycle with crank-case compression, the consumption of lubricating-oils, he said, is high because of the leakage into the crank-case of oil from the main-bearings. In sizes below 100 H.P. the Diesel engine is at a disadvantage because of its high first-cost, a consideration which, however, is offset to some extent by the ability of the Diesel engine to burn cheaper grades of fuel. Mr. Davison's paper stated that cost of attendance is so nearly the same for all the engines of the sizes considered that it does not enter into the comparison.

The question of direct or mechanical reverse was carefully considered and it was shown that below about 300 H.P. a clutch can be built which is not too cumbersome and which gives a degree of flexibility not easily obtainable in the direct-reversing systems which make use of compressed air.

A rich field for commercial application of oil-engines of smaller power was shown by Mr. Davison to exist in the Northern Fishing Banks. Some excellent fishing banks are not entirely inaccessible to steam-driven trawlers because of their inability to carry sufficient fuel for the round trip and it was stated that in some cases larger steam-boats than were necessary had been built merely to be able to carry enough coal for the moderately distant fishing-banks.

A further promising application for oil-engines can be made in the case of fire-boats, particularly if used in conjunction with electric drive. The unsurpassed flexibility and certainty of control inherent in this system is added to the advantage of being able to drive the fire-pumps electrically with the full power of the ship. The complete absence of standby losses is the governing consideration.

As regards electric-drive in general the interesting point was made that in the applications of this system to vessels used for towing the prime movers can be run at their full-power and normal-speed while the propeller-speed is electrically geared-down to a figure most advantageous for the towing requirements.

Oil-Fired Steam-Engine Obsolete

Burning Oil Under Boilers Is Waste Without Excuse or Justification

By M. L. REQUA*
(Vice-President Sinclair Consolidated Oil Corp.)

We are beginning to realize that we cannot with impunity draw indefinitely and wastefully upon our natural resources; we cannot shut our eyes to the evolution that is continuous from generation to generation, or as individuals burn the candle at both ends, without sooner or later being confronted with a day of reckoning.

Burned under boilers, fuel-oil is at best wastefully consumed, and at worst is losing in every barrel 20% to 30% of lubricating stocks that we shall some day need, and need badly. Over any long period of time its future use in this manner is without excuse or justification. I am not attempting to convert the world from the burning of fuel-oil under boilers to the Diesel-type of engine off hand. It cannot be done; but the oil industry should recognize that there is a forward step that in my judgment is inevitable and must be taken because of economic conditions, if no other. Employed in the Diesel-type of engine that same barrel of oil is used at a saving of 75%. I seriously question whether the marine steam-engine burning fuel-oil is not today as a matter of fact, an obsolete piece of machinery.

There are over 140,000 gross tons of Diesel-type equipped shipping now under construction in the United States, and a large foreign fleet is in operation and building. A recent report of Lloyds indicates that 1.7% of the world's tonnage is already converted to the Diesel-type of marine-engine. I have been very much interested in a discussion with Mr. Grace, of the Bethlehem Steel Co., who has built two identical ships, with the exception that one is equipped for burning fuel-oil and the other is burning Diesel-oil. Those two engines are running in the ore trade between the United States and Cuba in parallel with each other, and as a result of those operations up to date he tells me that in his mind there is no question but that the problem has been solved.

Mr. Robert Moore, of the Moore & Scott Iron Works, of San Francisco, builders of ships, recently passed through New York and I saw him, and I said: "What in the world are you doing here?" He said: "I am on my way to Europe to study the Diesel-type of engine, that is the coming engine, and is going to supersede all types of steam-engines." I made a mental reservation, and it was this: "Provided they get the fuel." It is the part of the oil industry to provide that fuel. You have an obligation resting on you that you cannot get away from.

* Before American Petroleum Institute, Washington, D. C.

FOUR 12,000-TON DIESEL-DRIVEN TANKERS TO BE BUILT ON THE PACIFIC COAST

According to our Scandinavian correspondent, the Norway-Pacific Construction & Dry Dock Co. of Everett, Washington, has received an order for four 12,000 tons tank-ships at a contract price of $210.00 per ton, and these vessels are to be delivered during 1921-1922, and that there are prospects from the same owners for a further order of nine large tankers covering this company's shipbuilding activities from three to four years.

Owing to Diesel engines not being able to be supplied in time, the first two vessels will be given steam-machinery, but remaining vessels will have Diesel engines. The shipyard in question has just been reconstructed—having originally been a yard in which a large amount of Norwegian capital was invested. It is now being amalgamated with a newly formed company known as the International Charters Corporation, with Lord Cecil A. Greenfell as president of the board of directors.

This company has acquired the oil-transport rights from Mexico and the United States to Europe for ten years, and the capital is American, English, Mexican and Norwegian. In return for a cargo of cellulose for use in tube construction in the oil-fields of Mexico, Norway will receive a tanker load of oil.

In addition to these six tankers the Norway-Pacific Construction & Dry Dock Co. will erect five oil-fuel bunker-stations, of 30,000 bbls. capacity each, in Puget Sound, Columbia River, Monterey Bay, San Diego and Panama, costing half-a-million dollars apiece. On each of these the Norway-Pacific Co. has a profit of 20% guaranteed.

GENERAL ELECTRIC CO. OF GERMANY BUILDING 24 LARGE MARINE DIESELS

Now under construction at the works of the Allgemeinen Elektricitats-Gesellschaft (General Electric Company) Berlin, Germany, (generally known as the A. E. G.) are 20 merchant-marine type Burmeister & Wain Diesel engines each of 1,550 indicated h.p. and four engines of the same design but of 2,250 indicated h.p. These are building to the order of the Deutsche Werft A. V. of Hamburg, and the hulls of a fleet of cargo-vessels to take these engines are being constructed by the Deutsche Werft (German Shipyard) at Hamburg. The first pair of these engines recently completed very successful trials and have gone to the shipyard for installation.

It is interesting to note that the A. E. G. are licensees of the Deutsche Werft A. G. who in turn are closely connected with the Deutsche Oelmaschinen-Gesellschaft of Hamburg. The latter concern are the sole concessionaries for the B. & W. license in Germany and Italy, and kindly furnished us with this information.

FROM TURBINE STEAMER TO DIESEL MOTORSHIP CONSTRUCTION

Four More Scandinavian Shipyards Change Plans

The Odense Shipyard, Denmark, is a fairly recently erected plant, and was laid-down for the purpose of constructing Vickers type turbine-driven steamships. This company is diverting their attention from this class of work, and is now engaged in the construction of two large steel motorships for Fred Olsen, of Christiania, in which twin-screw Burmeister & Wain Diesel engines are to be installed.

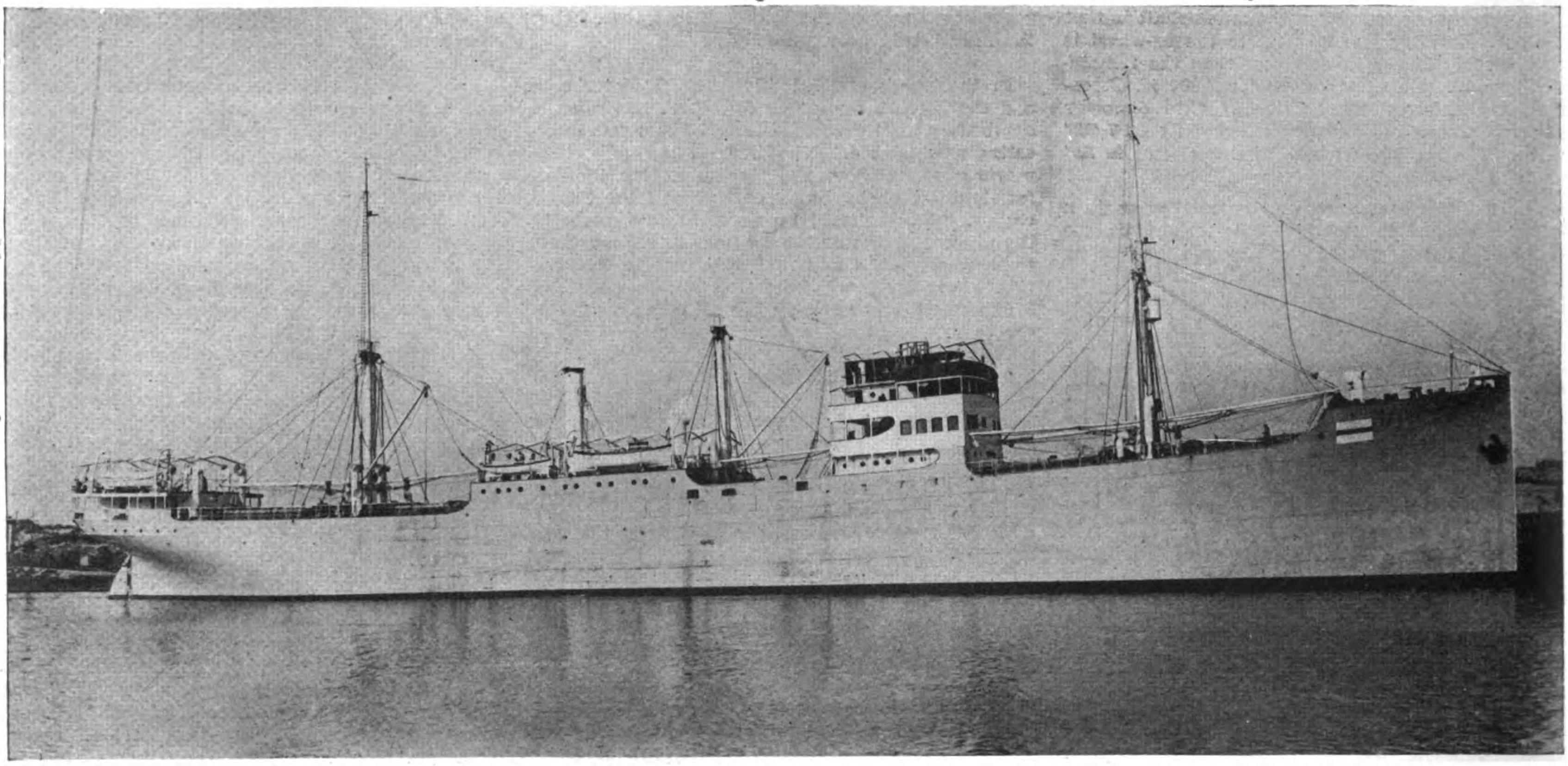
Furthermore, the new Baltica Shipyard at Copenhagen, which was originally laid-out to construct turbine-driven steamships, is now at work building two 6,000 tons motorships for a Copenhagen shipowning company, the Diesel engines of which also will be furnished by Burmeister & Wain.

Thirdly, the Oresundsvarvet, of Landskrona, have turned from the building of De Laval turbine-engined steamers and are constructing two large motorships for Lan Brostrom interests. One of these vessels is of 10,400 tons d.w.c. and 4,000 i.h.p., while the other is of 4,450 tons d.w.c. and of 1,600 i.hip., They are illustrated on page 44 of this issue.

The fourth shipyard which turned from the construction of steamers to Diesel motor vessels is the Nakskov Shipyard, who built the East Asiatic Company's motor-tanker "Mexico" and the Orient Steamship Company's 8,750 tons d.w.c. motor-freighter "Indien." These vessels are also illustrated in this issue.

DODGE HEAVY-OIL ENGINES

We have received an interesting pocket catalogue dealing with the Dodge marine and stationary heavy-oil engine from the Dodge Sales & Engineering Co. of Mishawaka, Ind. A copy of this booklet can be obtained by writing to this firm.



The new Werkspoor Diesel-engined freighter "Tosca," 6,990 tons d.w.c., owned by Winge & Co. of Christiania. Two 1,100 shaft h.p. engines are installed. Loaded speed, 11 knots. Two sister motorships, the "Indra" and "Geisha," are nearly completed.

"Tosca," "Geisha" and "Indra"

Three Large Sister Cargo-Passenger Motorships with Werkspoor Diesel-Engines

By S. SNUYFF

DURING the entire period that this country was in the war and for many months after the Armistice, construction on large motorships on order in Holland for Norwegian owners was practically suspended through lack of materials. Lately, however, work has been actively resumed on such craft, and the past few months has seen the launching and trial trips of quite a little fleet of Werkspoor Diesel-engined merchant vessels, several of which already have been illustrated or described in the pages of "Motorship," and others are pictured in this issue.

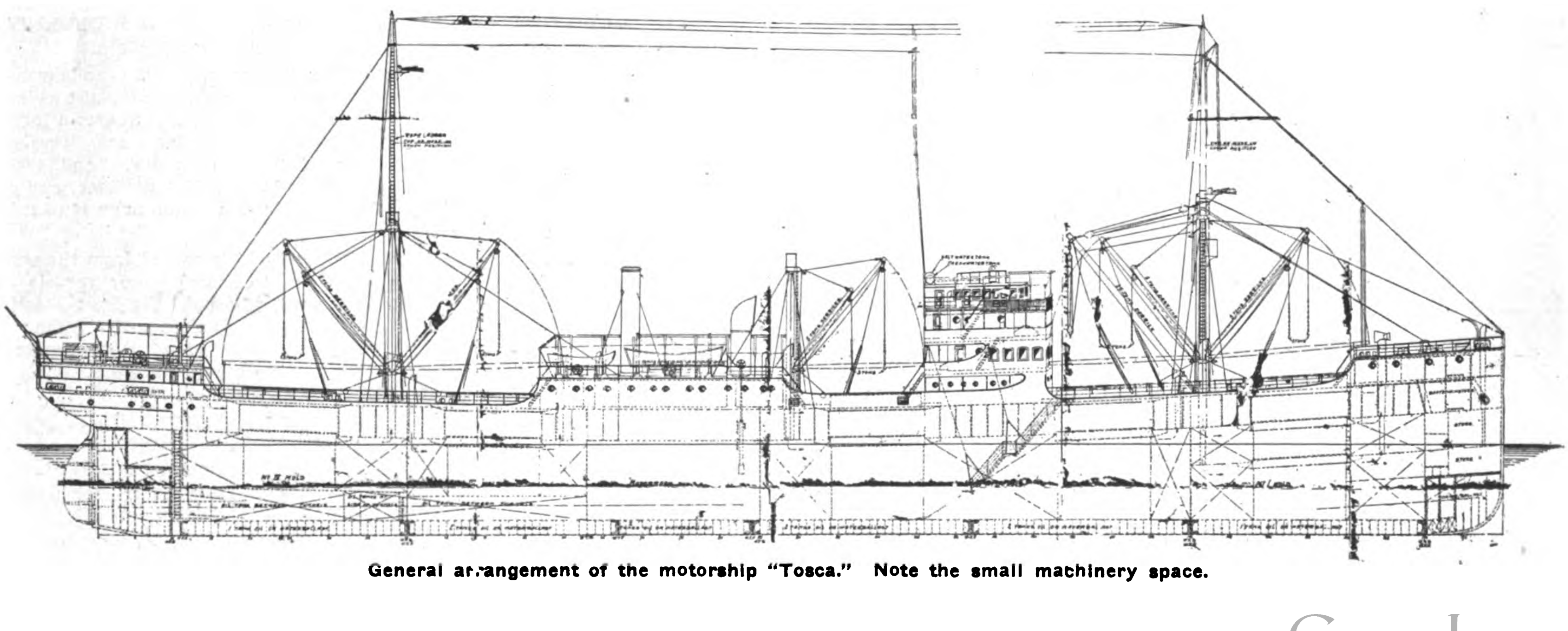
Among trials recently run were that of the new twin-screw motor-freighter "Tosca," one of three sister craft of 6,990 metric-tons d.w.c. each building to the order of Winge & Co. of Christiania, Norway, all of which have Werkspoor Diesel-engines. There also is a single-screw motorship of 6,000 tons displacement and of 2,140 i.h.p. building for the same owners to be Werkspoor powered. We believe she is to be named "Aida." The other two motorships have been named "Geisha" and "Indra." This makes a fleet of four Diesel craft aggregating about 25,000 tons d.w.c., 35,100 tons displacement and 10,540 i.h.p. for this enterprising Norwegian firm, and brings the total of Werkspoor-engined mercantile ships in service and on order up to 44 vessels of about 197,225 tons displacement and 65,615 indicated horsepower excluding ships and engines constructed by Werkspoor licensees in England, France and America. The grand total is 49 merchant-motorships of about 228,000 tons displacement and 73,500 horsepower, according to available lists, making Werkspoor second in the world to Burmeister & Wain, with Sulzers, McIntosh & Seymour and Vickers tying for close third. For naval Diesel engines, Sulzers, Vickers and Augsburg probably lead in number and power.

The "Tosca" was built by the Nederlandsche Scheepsbouw Maatschappiji (Netherlands Shipbuilding Co.) of Amsterdam, and engined by Werkspoor of the same city, the two plants being on adjoining property, and originally were one concern. At one time Peter the Great of Russia worked in this shipyard.

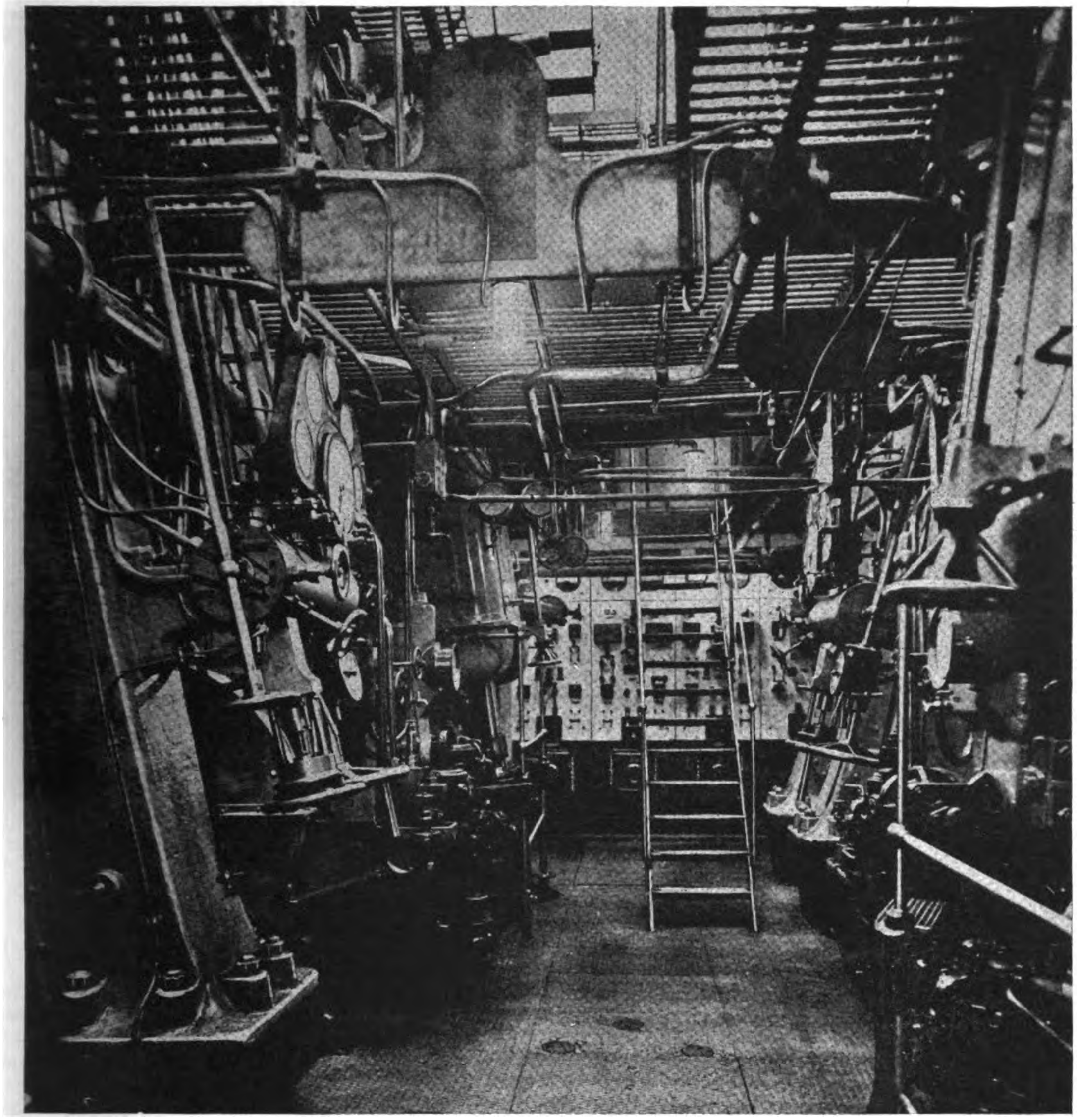
The principal dimensions of the "Tosca" are as follows:

Displacement (loaded) .... 10,260 metric-tons
Deadweight capacity .... 6990 metric-tons
Fuel capacity .... 218 tons
Capacity of ballast tanks .... 1,088 tons
Length (o.a.) .... 391 ft.
Length (b.p.) .... 375 ft.
Breadth .... 51 ft., 3 in.
Depth to main deck .... 25 ft., 6 in.
Depth to upper deck .... 34 ft.
Mean draught .... 23 ft. 1 in.
Gross tonnage .... 5,128.49 tons
Net tonnage .... 3,129.10 tons
Engine-power .... 2,200 shaft h.p. (3,000 i.h.p.)
Diameter of cylinders .... 22.047 in.
Piston-stroke .... 43.307 in.
Engine-speed .... 125 revs. per min.
Propellers .. 11 ft. 9¾ dia. by 10 ft. 2 in. pitch and 3.6m. proj'd area
Ship's speed (loaded to 25 ft., 1 in.) ...... 11 knots
Daily fuel-consumption .... 10 tons
Register .... Norwegian Veritas

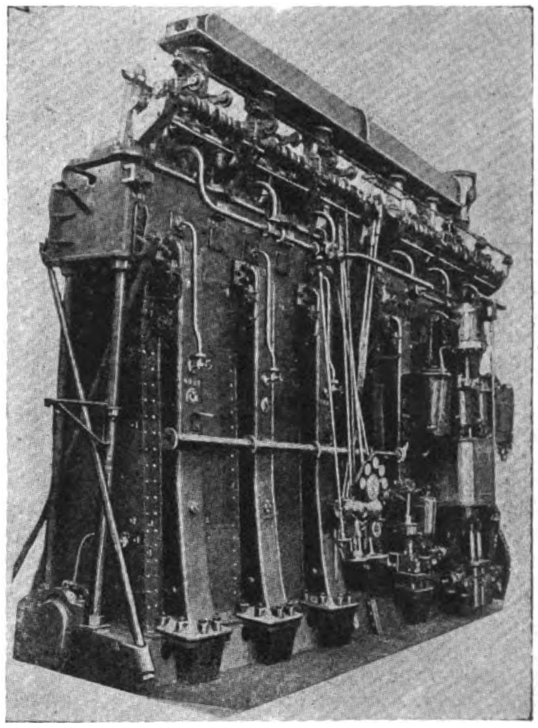
The two Werkspoor 1,500 i.h.p. propelling Diesel-engines are of the four-cycle type and are installed approximately amidships. In addition there are three Werkspoor four-cycle type Diesel two-cylinder engines of moderate power, each coupled to a 50 k.w., 220-volt at 250 r.p.m. generator set, furnishing current for the auxiliary machinery throughout the ship, including deck equipment and



General arrangement of the motorship "Tosca." Note the small machinery space.



M.S. "Tosca." The engine-room looking between the two Werkspoor main Diesel-engines towards the electric control-board.

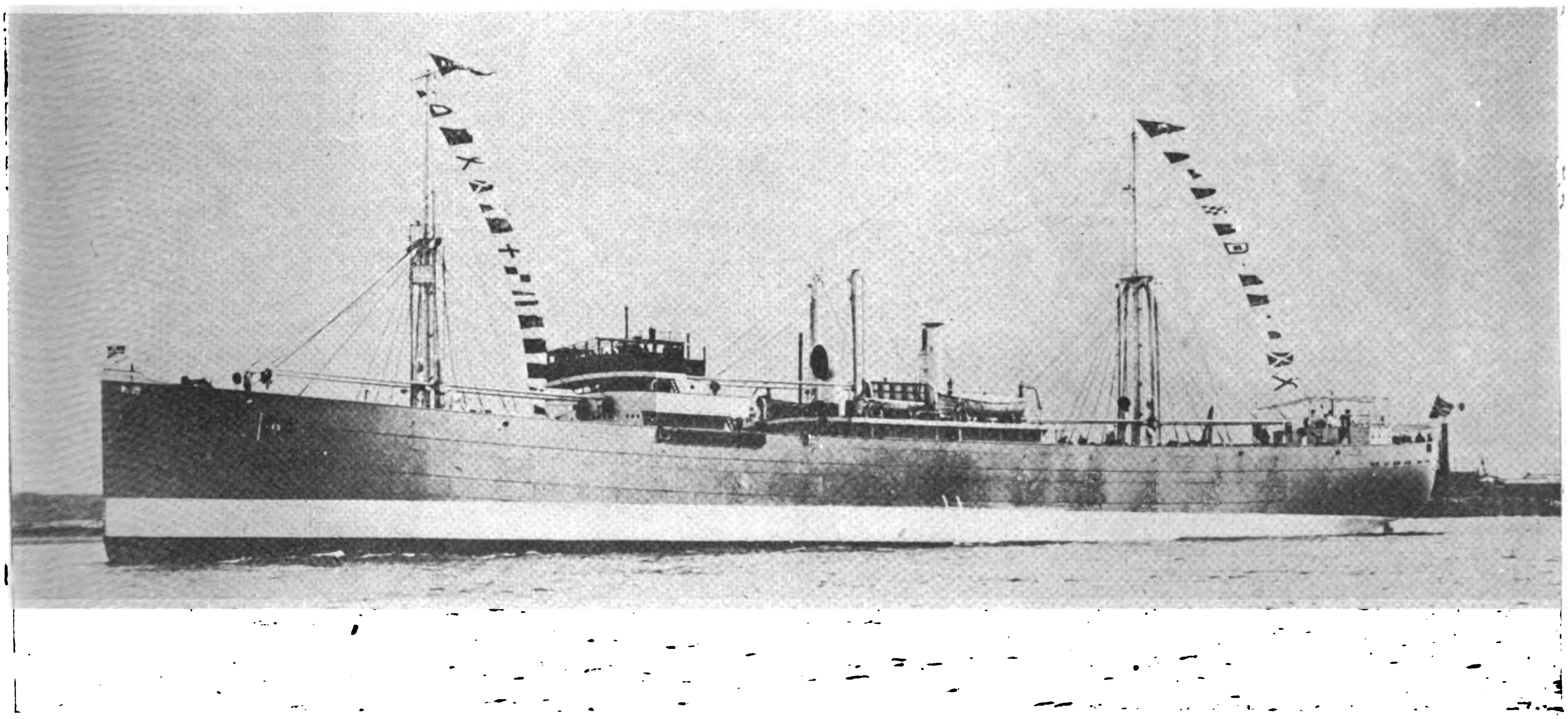


M.S. "Tosca." Back view of one of the Werkspoor Diesel engines, showing both cast-iron and steel columns.

the electric-lighting. There also is a single-cylinder Kromhout surface-ignition oil-engine direct connected to a dynamo for the purpose of emergency electric-lighting. It develops 7½ b.h.p. at 550 r.p.m.

A very interesting innovation is the mounting on the outside of the hull of the ship a water-tight electric-plug contact which is connected with the ship's main circuit. This allows the vessel to receive—if desired—current from the municipal or port electric-system when in harbor, and this saves fuel, labor and engine-wear and tear, whenever the "Tosca" is in port where such electric-current is available. We doubt, however, if any economy will be gained. In harbors where no suitable current is available, the auxiliary Diesel engines and generators will be used. Possibly there is something to be said for this system, because there is no necessity to use it if not required; but, on the other hand, it enables the engineers to go ashore, when a brief stay is being made in port.

Another novel installation which is a combination of engineering skill with culinary ingeniousness, Werkspoor realized that the temperature of the exhaust-gases from the main engines is just correct for cooking, baking, boiling, frying, roasting, stewing, etc., and so developed a cooking-range in part of the exhaust-manifold of the main Diesel engines. It consists of a plate-chest inserted in the manifold which can be closed by doors, but the front side is swept by the exhaust-gases on five sides externally. It is a very simple device, but is so effective that no ships' cook could desire anything better. It has the advantages economizing in coal expense and saving the space where coal or oil would have to be carried. On the other hand, it has a disadvantage, that it could only be used when the vessel is at sea, as

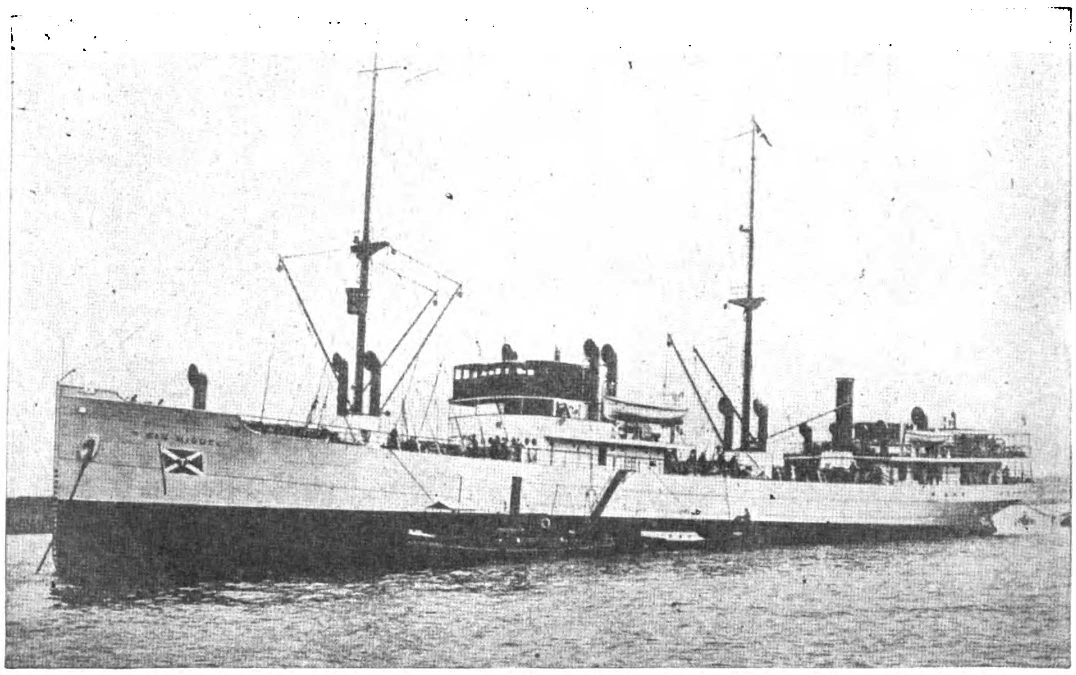


The new 9,700 tons displacement motorship "Athene," built for K. Salvesen (Ada S.S. Co.) of Kragerö, Norway, and just placed in service. She is propelled by twin 1,400 i.h.p. Werkspoor Diesel-engines.

when in port the main engines are stopped. Consequently, when the vessel is in harbor another stove is used for cooking, and this is fired by a small oil-fired burner in conjunction with compressed-air from the storage bottles in the engine-room.

On the trials of the "Tosca," which took place in November last in the North Sea, the ship and all her machinery gave complete satisfaction and a speed of 11 knots was easily attained. Of special attention to those aboard was a change to the reversing mechanism, which has resulted in a decided improvement so far as control of the engine is concerned. It may be remembered that the engines of the motorship "Salerno," described in our issue of November, 1919, and June, 1920, were fitted with the first design of a new reversing mechanism of the diagonal-eccentric system with a single camshaft.

This is retained with the engines of the "Tosca," but instead of control levers operating this mechanism the levers for changing over from starting-air to fuel are substituted by a single hand-wheel. Consequently, the whole manipulation of starting on three cylinders by air and three cylinders on fuel and then the entire six cylinders on fuel is accomplished by a continuous turning movement of this control-wheel, a scale being marked on the wheel showing the exact position of the starting mechanism.

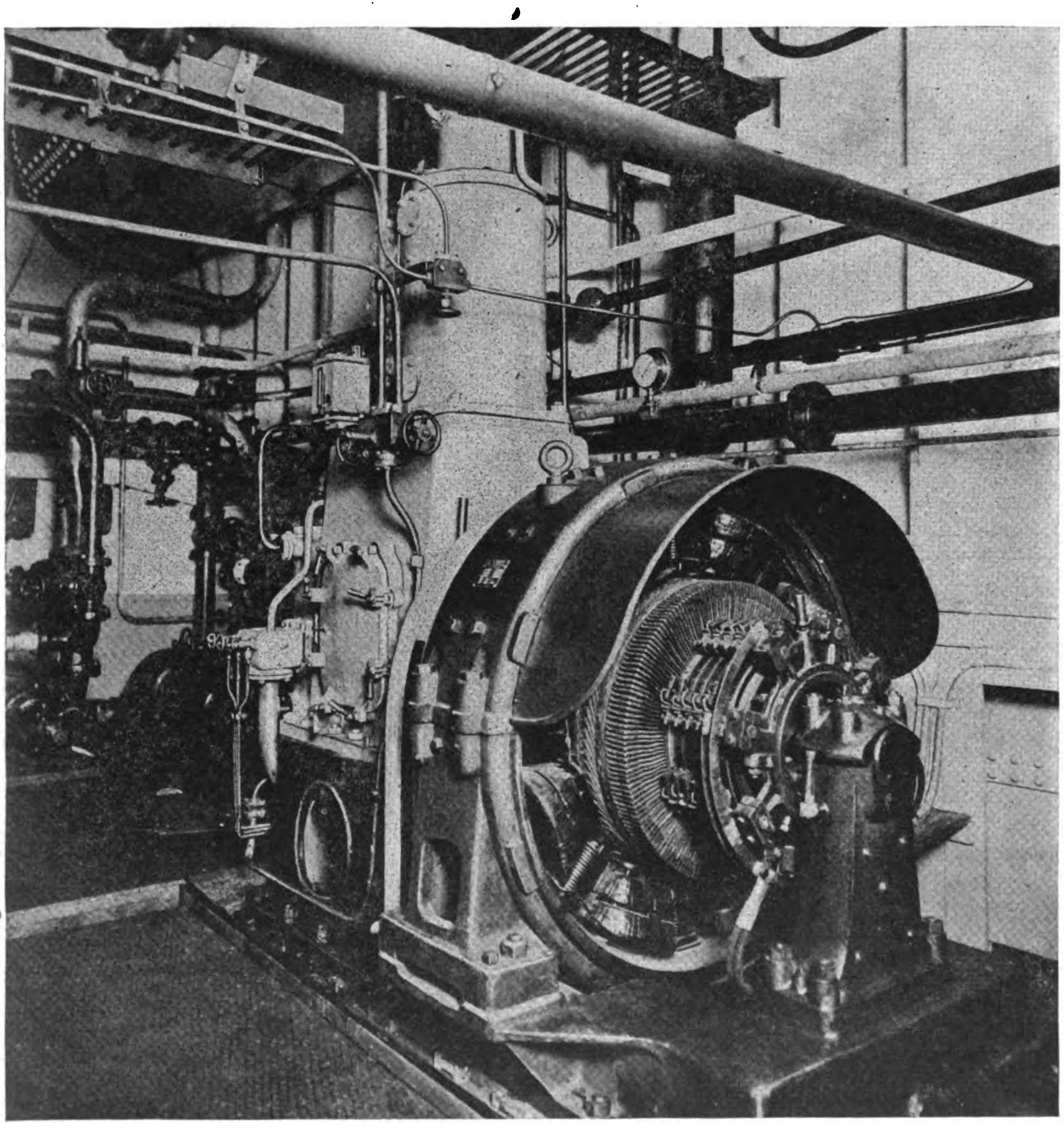


"San Miguel," another new Werkspoor-engined single-screw Diesel motorship of 1,400 i.h.p. and of 4,050 tons displacement, owned by Otto Thoresen, Christiania, Norway.

It should be recorded that the two propelling Diesel engines were never run in the works after construction, but were installed in the vessel, run under light load for some six hours, then run with the vessel tied up for four hours, after which the ship proceeded on her sea trial and was then handed over to the owners ready for any ocean passage.

Regarding the deck machinery, there are four electrical-driven winches forward, two electric winches amidships and four more aft. These motors and winches were built by the Electrotechnische Industrie voorheen Willem Smit of Slikkerveer, Holland, but the winches and all the other electrical machinery on board this ship was constructed by Figge & Co. of Haarlem, with the exception of the small emergency dynamo already referred to.

A new windlass is in a sheltered position on an open forecastle and operates by means of bevel-gears and vertical-shafts connected to two capstans on the forecastle deck. This may be regarded as a decided improvement on the arrangement of the anchor windlass on board the motorship "Athene," where it stands unprotected, the capstans being direct coupled to horizontal shafts. This machinery is equipped with an electric motor of 50 h.p. and has a well-designed slip-coupling in the work-wheel. The Hele Shaw-Martineau steering gear is electric-motor driven, and has a Mactaggart, Scott & Co. telemotor.

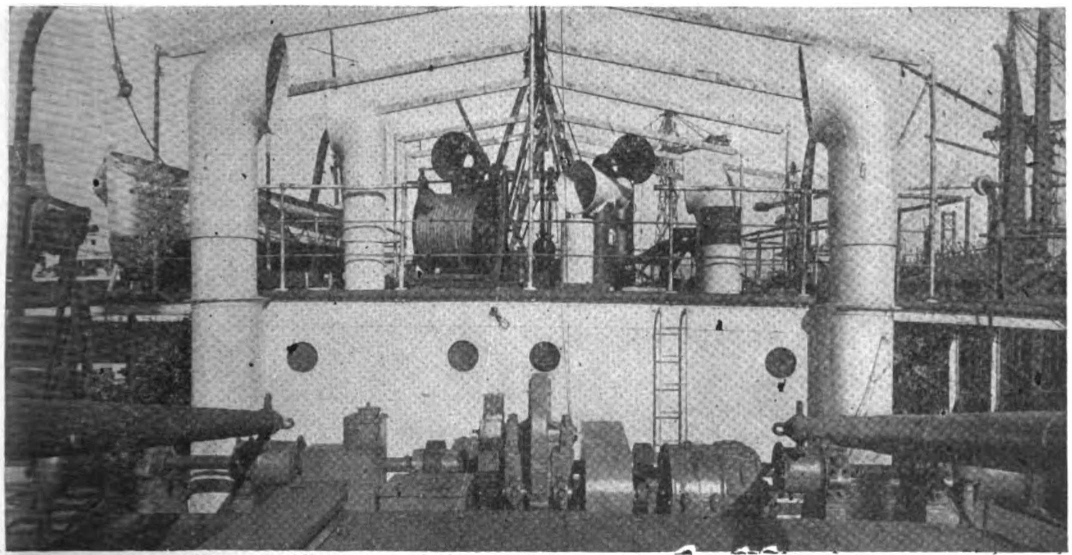


M.S. "Tosca." The electrically-driven air-compressor.

There are eight cargo-derricks each with a lifting power of 3 tons. In addition there are two derricks with 5 tons lifting capacity, and a larger one with a lifting capacity of 25 tons. The four holds have steel bulkheads amidships, which can be lengthened by means of wooden bulkheads, so a continuous bulkhead amidships is formed. The hull and machinery have been built to the rules of the Norwegian Bureau Veritas and the Norwegian Law, and the bow has been made especially strong, with a view to sailing through ice. The four holds are designed for carrying grain cargo, provision being made for the usual trimming boards to prevent bulky cargoes shifting in a sea-way.

On the boat deck there are four sets of Welin davits carrying two lifeboats and two dingies. On the poop deck there are two more sets of Welin davits, one carrying the motor-launch, and the other being in reserve. Passenger accommodation, consisting of six spacious cabins for two persons each, is provided, also a lounge, smoking-room and dining saloon. The lounge is entered from a staircase and is panelled in rich mahogany, and has lofty windows and very comfortable lounging chairs. On the wall of the saloon is an oil-colored portrait of Miss Florence Muysken, daughter of J. Muysken, Managing-director of the Werkspoor Company. It is interesting to note that Miss Muysken's mother is an American, and several months ago this connection was further cemented by Mr. J. Muysken, Jr., marrying an American lady on occasion of a recent visit to the United States, where he was studying at the Diesel engine-works of one of the American Werkspoor licensees.

During the luncheon, Captain Ole Bugge, one of the partners of Winge & Co., in his speech referred to a very interesting point in connection with the shipbuilders. Present at the table was Mr. D. Goedkoop, Sen., until recently managing director of the Nederlandsche Scheepsbouw Maatschappy, with whom the contract was placed. During the construction of the vessel, Mr. Goedkoop retired, and his place was taken by his eldest son, Mr. D. Goedkoop, Dzn., who was also present. Also of the luncheon party was Mr. D. Goedkoop, Jun., the son of D. Goedkoop, Dzn., the lad being the fourth engineer of the "Tosca," in order that he might get some sea experience before taking his place in the Nederlandsche Scheepsbouw Maatschappy. Another rather interesting feature of the proceedings was that as the owners were Norwegian and did not understand Dutch, all the speeches were in English. This particular incident indicates the extreme value of "Motorship" and its work in publishing in English a record of international progress in motorship and Diesel-engine construction. [We had the pleasure of recently meeting Capt. Ole Bugge on the occasion



M.S. "Tosca." View towards boat-deck showing warping-winch in foreground.

of a visit to New York, for the purpose of purchasing supplies and making other arrangements in connection with his company. He emphasized his belief and the belief of his company in the Diesel-engined ship and its remarkable future. Capt. Bugge is a very keen reader of "Motorship."
—*Editor.*]

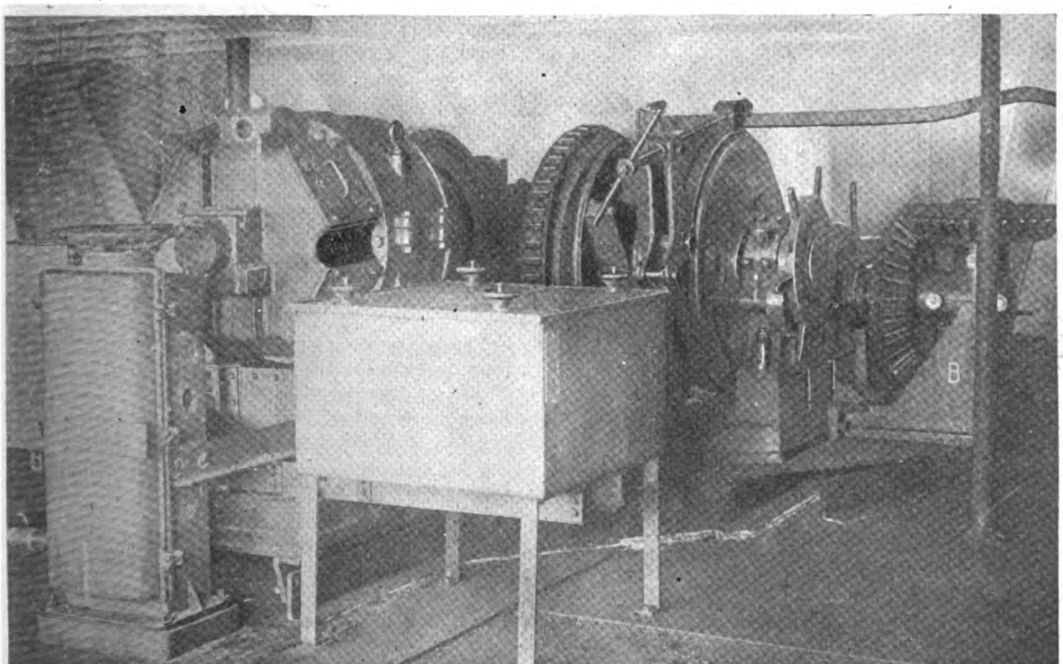
The accommodation is in the bridge deck-house, also contains the captain's cabin, pilot house, chart-house and Marconi wireless station.

Liquid-fuel and water-ballast are carried in the ships' double-bottoms, which extend over nearly entirely the length of the hull. Between the two tail-shaft tunnels the space is used for oil-bunkering, while drinking-water is carried in three big tanks between decks amidships.

The donkey-boiler, which is provided in order to supply steam for heating the oil and cleaning out of the tanks and also for heating the acommodation, is oil-fired, and has a heating surface of 265 sq. ft. and a grate area of 12 sq. ft. The sound signals are given either by an ordinary organ-pipe whistle blown by compressed air, or by an electrically-operated whistle, which is placed high up on the derrick mast amidships.

Returning to the twin propelling engines—generally speaking, the design is similar to those installed in the "Athene" and "Salerno" and in the main resemble the Werkspoor Diesel-engine of the same power installed in the motor-tanker "Juno" ordered by the Anglo-Saxon Petroleum Company in 1911. Since the "Juno" was ordered there have been built or under construction no fewer than 28 Werkspoor Diesel engines of the same cylinder dimensions and power for eighteen motorships, and the "Tosca" is the tenth motorship with engines of this output now completed. The length of this engine is 29½ ft. There are four other types of Werkspoor engines developed, a standardized table being as follows:

TYPE (Name of first ship)	Power B.H.P.	No. of motors ordered	No. of ships ordered	No. of cylinders of each motor	Bore (ins.)	Stroke (ins.)	Speed revolutions per min.	Year in which first ship was ordered
"Juno"..........	1100	28	18	6	22.047	39.370	125	1911
"Ares"...........	850	10	5	6	20.472	35.433	130	1912
"Castor".........	350	8	6	4	15.748	27.559	175	1913
"Boelongan"......	500	4	4	6	15.748	27.559	175	1913
"Sardinia".......	1500	4	3	6	26.378	47.244	110	1917

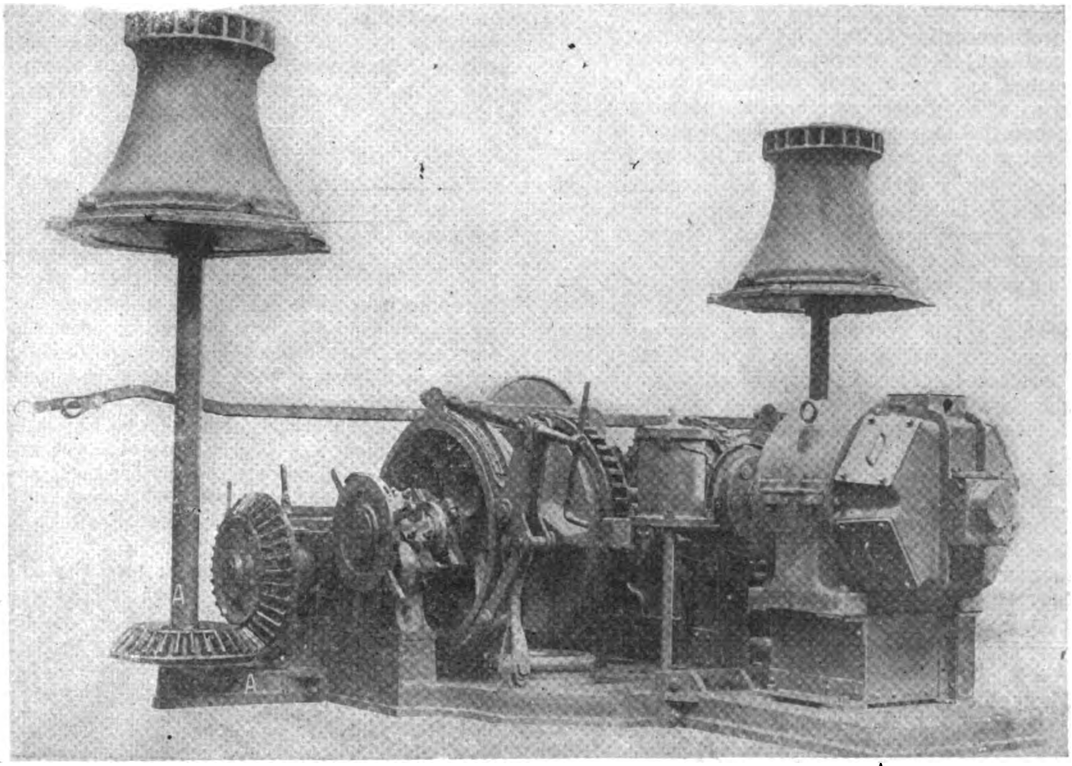


M.S. "Tosca." Electric anchor windlass in forecastle.

On November 6th the motorship "Tosca" left Ijmuiden Harbor for Christiania to take her cargo for her maiden voyage. Unfortunately, the motorship service run by Winge & Co. does not include the United States, although as stated, the Superintending-engineer of the company was recently in New York and expressed strong confidence in the reliability and economy of the motorship, particularly with the type of engines which they had adopted.

Launch of M. S. "Sardinia"

The Werkspoor-engined motorship, the "Sardinia," of 3,000 tons d.w.c. (see above table), was recently launched from the yards of J. & K. Smit of Kinderdyk, Holland, to the order of Otto Thoresen of Kristiania. We have previously referred to this vessel and she is of interest, inasmuch as she is a single-crew vessel propelled by a 6-cylinder, four-cycle Diesel-engine developing 1,950 to 2,140 i.h.p. at 110 to 115 r.p.m.



M.S. "Tosca." Electrically-driven anchor windlass.

OUR FIRST YEAR BOOK

We particularly draw the attention of manufacturers, ship operators and other readers in the industry, to the announcement on another page of this issue of *"The Motorship Yearbook"* which is *the first annual review issued by this publication.* and allied industries, as it partly rests upon them to furnish very complete advertising material for the important catalogue section of this Yearbook.

The success of the book will partly depend upon the co-operation of firms in the motor-shipping and allied industries, as it partly rests upon them to furnish very complete advertising material for the important catalogue section of this Yearbook.

GARDNER-ENGINED COASTER

Two 90 b.h.p. Gardner surface-ignition oil-engines have been installed in the new 270 tons d.w.c. motor coastwise vessel "Corbichill" launched at Noble & Co.'s yards at Fraserburgh, Scotland. She is owned by the Fraserburgh Shipping Syndicate.

ANOTHER LARGE SAILING-SHIP CONVERTED

The ship-owning firm of Empreze Portuense de Transportes Maritmos, Ltd., of Oporto, Portugal, are having their 2,000 tons d.w.c. sailing-bark "Portugal" converted into a motor-auxiliary by Wm. Beardmore & Co. of Scotland. Two Beardmore surface-ignition type oil-engines of 200 b.h.p. each are being installed and a speed of 7 knots is expected under power. It is interesting to note that the vessel will be in the Atlantic service trading between the United States and Portugal.

Allied Powers and German Diesel Engines

The Destruction of German Submarine Diesel-engines and Prohibition of Building High-speed Diesel engines in Germany

(SPECIAL TO MOTORSHIP)

Kiel, Germany, November 16th, 1920

CONCERNING the destruction of the Diesel motors in Germany, the prohibition to build additional Diesel motors was only contained in an inofficial communication of the president of the English commission to the president of the German commission.

In order to clear up the matter I will give a short description of the proceedings.

The decision of the ambassadors' council of the 3-9-20 is as follows:

1. The instructions of the article 189 of the peace treaty are not at variance with those of article 192.

2. Naval war material of all kinds (with the exception of equipment [French: material necessaire a leur armement] which belongs to the 6 light-cruisers and 20 destroyers and which is referred to in a letter of the Ambassadors' council of July 24th, 1920, to the president of the German delegation) as described and specified by the Niaco from case to case, no matter whether it comes from a dismantled vessel or not, is to be dealt with according to the instructions of article 192.

In the letter of the Allied peace commission of the 28-9-20, in which this decision is handed over to the German peace commission there is further mentioned the following:

You will therefore be requested to put the Niaco in a position to carry out the stoppage and destruction of all war material as specified under number 51 to 88 in the blue book; further you are requested to cancel all orders which go against the declaration of material as war material or its classification as such and destruction.

The blue book, to which reference is taken, contains the following under number 73:

> Main-engines, boilers and auxiliary engines, no matter how operated, built in or originally designed for war-ships of all kinds inclusive of submarines.

Germany has protested against the decision of the Ambassadors council because according to Section 189 of the peace treaty which has the following wording:

> Articles, machinery, and material arising from the breaking-up of German warships of all kinds, whether surface-vessels or submarines, may not be used except for purely industrial or commercial purposes. They may not be sold or disposed of to foreign countries, the destruction of submarine-motors cannot be demanded.

According to the decision of the Ambassadors council submarine motors must be dealt with according to Section 192 of the peace treaty, the building of high-speed Diesel-engines, as constructed for submarines in Germany would therefore be forbidden.

Section 192 of the peace treaty says:

> The warships in commission of the German fleet must only have on board or in reserve the allowance of arms, munitions and war material fixed by the Principal Allied and Associated Powers. Within a month from the fixing of the quantities as above, arms, munitions and war material of all kinds, including mines and torpedoes, now in the hands of the German Government and in excess of the said quantities, shall be surrendered to the governments of the said Powers at places to be indicated by them. Such arms, munitions and war material will be destroyed or rendered useless.
>
> All other stocks, deports or reserves of arms, munitions or naval war material of all kinds are forbidden.
>
> The manufacture in German territory and the export of these articles to foreign countries shall be forbidden.

Basing on Section 189 Germany has sold a large number of the submarine motors through the builders, in the first place for stationary purposes and for the driving of merchant vessels. With the help of these engines it is possible for many Plants to carry on thier business in spite of the coal calamity. The destruction of the Diesel engines would therefore not only mean a totally superfluous destruction of valuable work but also increase the difficulties of the German industry in an unnecessary manner. The Diesel engines together represent a capital of at least 1 to 1½ milliards of marks. The capital invested in buildings, foundations and other inventory by the buyers of these motors amounts to about the same sum.

The prohibition of building high-speed Diesel-engines, as contained in the decision of the Ambassadors council with reference to Section 192, would do great damage to the German Diesel industry. Before the war high-speed Diesel-engines of the same type as submarine engines were built for electric power-stations. After the war this type of engine which has been very much perfected, will be very marketable on account of the great saving in material and the resulting low manufacturing and transport costs. It will be made use of in increasing numbers for power-stations of all kinds, especially as peak-load engines and as reserve. But also on merchant vessels these engines will be adopted in connection with electrical or mechanical power transmission in increasing manner instead of the very expensive slow-speed crosshead engines. Also for driving railway-cars and locomotives high-speed Diesel engines are especially suited.

Based on these facts the German foreign-minister Dr. Simons said at the conclusion of his speech in the Reichstag on the 29-10-20. "It was perfectly right, after all matters having been taken into account, if the German government had had a definite no for the unjust and senseless demand of the naval-control commission and was determined to stick to this no." In the meantime the decision of the Ambassadors' council has been made.

FROUDE DYNAMOMETERS

Through an error, not due to ourselves, an illustration of another design of Froude Dynamometer was given in the C. H. Wheeler Mfg. Co.'s advertisement on page 1125 of our December issue, instead of one of the three Froude Dynamometers on the test-floor of the Busch-Sulzer Bros. Diesel Engine Co.'s Works as stated. The correct illustration appears in their advertisement in the current issue.

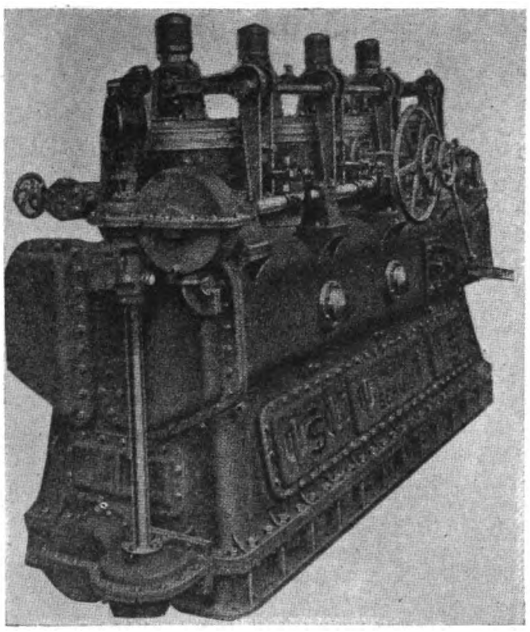
SUBSCRIBERS AND RENEWAL OF THEIR SUBSCRIPTIONS

Except in special circumstances, renewals of subscriptions are not acknowledged, the cancellation on the subscriber's check usually being sufficient indication that payment has been received by "Motorship." Furthermore, a subscriber can refer to the date of expiry of his subscription on every wrapper, to the right of his name. Thus, when this date is changed the subscriber will at once know that the renewal of his subscription has been received.

ITALIAN-ENGINED AUXILIARY MOTORSHIPS FOR GREECE

Several moderate-powered Diesel engines have been installed in Greek auxiliary sailing-ships by Ansaldo San Giorgio Ltd. of Turin, Italy. They are of two types and have been built in the shipyards of the Vocoto-Poulos & Co. One of these vessels is of the "Lover" type, and is of 350 to 400 tons. d.w., 90 ft. length, 23 ft. breadth, 12 ft. depth and 120 brake horse-power. The other vessel is of 600 to 650 tons d.w.c., 110 ft. long, 26 ft. breadth, 15 ft. depth and 200 brake horse-power. On the trials of these vessels a speed of about 8 knots was reached.

Work is now under preparation for the installing of the Ansaldo San Giorgio Diesel engines in a third motor-vessel for Grecian owners. Diesel engines installed by this firm are of the two-cycle type.



The effect of Diesel engine construction upon steam-engine design—a steam-engine built in Germany along the lines of high-speed Diesel engine practice.

BRITISH FIRM PURCHASES THE "FRITZ"

The large two-cycle double-acting Blohm & Voss built motorship "Fritz" has been purchased by the Ellerman Line, Liverpool, England.

MORE GERMAN WARSHIPS CONVERTED TO MOTORSHIPS

Two armoured cruisers of the "Hertha" class are being converted to motorships at the Danzig Shipbuilding yard. These vessels are of 5,660 tons displacement and will carry about 2,000 tons d.w. Each vessel has been installed with two submarine-type Diesel-engines for propulsion purposes.

DECISION OF ALLIED COUNCIL

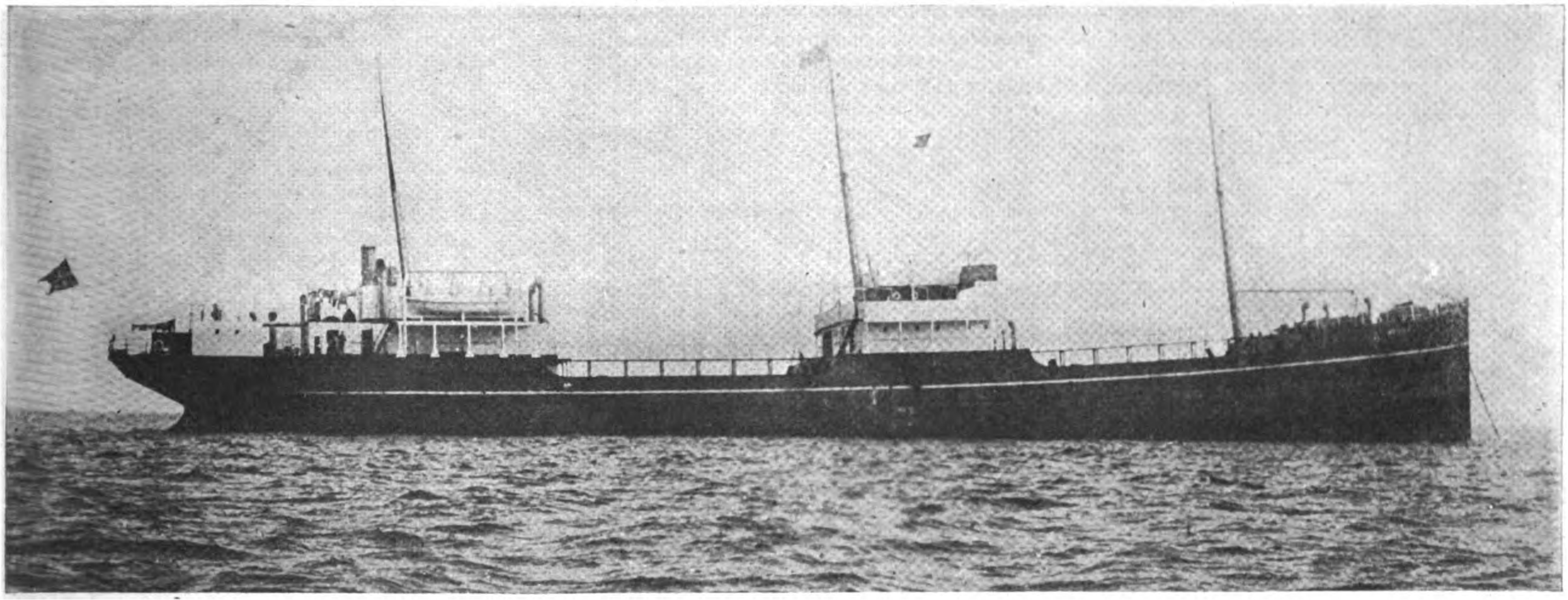
The Allied Economic Council in Paris, in their answer of November 10th to the German Government regarding the 296 submarine type Diesel-engines that the Inter-Allied Navy Association had ordered destroyed under the terms of the Versailles Peace Treaty, gave notice that the sale of this machinery for industrial purposes would be permitted until the 31st of March, 1921, after which date such engines as had not been put into industrial service would be regarded as subject to Article 192 of the Peace Treaty, relating to the destruction of military material. The Allied Economic Council protested that it had no desire to hinder in any way the peaceful operation of German industry, and for this reason it would give Germany every opportunity to utilize the submarine type engines for peaceful purposes. The Association expressed its doubt concerning the suitability of the engines for such work, and stated that the German Government has presented only sixteen examples of such application. A similar statement was made on November 16th by Mr. C. Harmsworth, British Under-Secretary, for foreign affairs.

FORTY-NINE WERKSPOOR-ENGINED MOTORSHIPS

There are now in service and completing forty-four motorships fitted with Dutch-built Werkspoor Diesel-engines, aggregating about 192,225 tons displacement and 65,615 i.h.p. according to a list in the latest Werkspoor catalogue, a copy of which we have before us. In addition, there are five other motorships with Werkspoor engines built by American, British and French licensees, making a total of forty-nine merchant craft aggregating over 228,000 tons displacement and 73,500 i.h.p.

THE MOTORSHIP YEARBOOK

Owing to unexpected delays the publication of the "Motorship Yearbook" has been postponed from the beginning to the end of January.



A bunker-supply ship. The motor-tanker "Mexico" of the East Asiatic Line. She is propelled by two Holeby-Diesel engines

A New Thought for Oil Companies

Operation of the Motor-Tanker "Mexico"—Interesting Details of the New Holeby-Diesel Design

FOR some years the question of oil-fuel supply has been one of grave concern to shipowners, especially to operators in countries that nature did not bless with a natural source of oil. Curiously enough, it is those particular countries which in recent years have been the largest adopters of oil-driven motorships for mercantile service. In these countries may be included Italy, Great Britain, Holland, Norway, Sweden and Denmark, and none of them have yet discovered sufficient mineral-oil to be worthy considering for use in seagoing vessels. This in itself became an obstacle of paramount importance to be met with discriminating foresight only.

In planning their motorships these shipowners have kept before them the fact that the low fuel-consumption of the Diesel engine enables a motorship to cruise around the world on a moderate bunker supply, and so she can easily pick up fuel-oil where it is the most plentiful and where it has the lowest price, provided she is on such a route. Nevertheless, they realize that with a ship on a short and definite route, such as Transatlantic service, the motor-vessel would be dependent upon one particular nation for its fuel supply.

Consequently, three of the leading European motorship owners, namely, the Transatlantic Company of Sweden, the Societa Nazionale di Navigazione of Italy, and the East Asiatic Company of Denmark, have each ordered a Diesel-driven tanker for the purpose of proceeding to any advisable part of the world and securing oil-fuel. As the consumption at sea of these tankers only varies from 5 tons to 12 tons per day, according to the size of the particular ship, they can proceed anywhere to obtain their cargo-oil, because they can return from the remotest parts of the Globe such as the Far East, where a very heavy grade of oil can be secured at low cost, and which oil is particularly suitable for Diesel-engines, and then return to Europe with their cargo-tanks full and upon arrival have sufficient bunker-oil left for the tanker to return to the oil-fields. By this method these three well-known motorship owners are now independent of any particular nation for the bunker-oil for their motorships, regardless of the route on which their cargo and passenger motor-vessels are plying.

As the aggregate consumption of their respective large fleets of cargo and passenger motorships is so extremely small, one Diesel-driven tanker of moderate size not only is sufficient to cover present bunker requirements, allows for further expansion. Meanwhile, the surplus bunker-oil can be sold to other shipowners in Europe less fortunate.

As an alternative the cargo motorships themselves can carry large quantities of surplus oil in their bunkers when they call at a foreign port where the price of oil is moderate. Not only do these shipowners cover their existing bunker requirements in this manner whenever possible, but are enabled to use this medium as an additional source of profit, which in itself is at times very considerable.

The new motor-tanker "Mexico," which has been built for the East Asiatic Company recently, made her second visit to New York. She is a vessel whose economical and technical characteristics will commend her to the careful attention of all those shipowners and others who appreciate an efficient combination of business and engineering.

In order to avoid interrupting the rapid succession of launching of cargo motorships at the Burmeister & Wain yard, the East Asiatic Company ordered her to be built at the Nakskov Yard and to be fitted with twin-screw engines from the Holeby Diesel Motor Works, at Holeby, Denmark. A very interesting little vessel has resulted, and we would recommend that executives of American oil-companies who have not yet gone in seriously for Diesel-driven tankers, should pay her a visit and take their superintending-engineers with them. As the "Mexico" is a supply-ship assigned primarily to the work of fueling the large motorship fleet of the East Asiatic Company, she gives eloquent evidence of the thoroughgoing business-like spirit and keen judgment as regards engineering detail with which this firm has undertaken ocean transportation.

Tables 1, 2 and 3 bear out these observations with actual figures from her first three one-way voyages. From the first of these it will be seen that the cubic-capacity of the oil-tanks bear a very favorable ratio to the gross registered tonnage of the vessel, and demonstrates again how the small machinery-space requirements of the Diesel-ship result in construction economy. The ridiculously small operating expense is attested to by table 2. The voyages on which these figures were recorded were made in bad weather, so severe that on one of them the gale kept blowing the ship's whistle through the sheer force of the wind against the ¼-inch whistle cable. Not a single mishap occurred, the engines kept running like oil, and the ship made excellent headway.

Regarding the engine room of the "Mexico." The arrangement is roomy, accessible, and gives the impression of high efficiency, one which it is impossible to reproduce by means of the drawings except to persons accustomed to this particular kind of presentation. Everything fits into the place assigned to it so sandily that the puzzling and scheming which must have been devoted to the layout to produce such a result is nowhere evident. It is no more than probable that the designer must have had the same thought the first time he saw his plans realized in three dimensions. Plans were published in our issue of April, 1919.

As may be seen from same, the Holeby engines are closely modeled after the well-known Burmeister & Wain machines, the two companies being related. The wide publicity which the latter have received would make it a repetition to give a complete description of the Holeby engines; the most useful thing will therefore be to consider only the most salient departures from the Burmeister & Wain designs. Of these the upper cylinder construction stands out most prominently. An examination of the photograph given in our issue of March, 1920, will remind the reader of the general type of construction with which we are dealing; but the new features can most readily be understood by referring to the sketch in Fig. 3.

Although the cylinder-head is substantially the same as the one visible in the photograph, it is not placed close to the water-jacket (A). A distance-piece of ring (B) makes a joint against the upper face of the water-jacket, and by means of rubber ring (C) is made tight against the flange of cylinder-liner (D). Water enters at H, circulates around the liner and escapes into the core of ring (B) through openings (E). The obvious purpose of the construction is to avoid the accumulations of thick metal which are found in the more usual designs. Considerably better cooling of the cylinder-liner flange in the region of the highest temperatures is thereby secured, a feature whose necessity has been emphasized in the past not only by injured liners, but by cracked water-jackets as well. Thick uncooled liner-flanges have heated and grown to such an extent that they burst the jackets surrounding them. The idea of placing the registering shoulder of the liner far enough down in the jacket to permit of cooling water application between it and the cylinder-head joint is not new, having been proposed, if not actually used by the Franco-Tosi Company years ago. They also go a step farther in constraining the water to flow through narrow grooves cast in the outer surface of the liner, thereby assuring intimate and active contact between the water and the metal.

An interesting "kink" about main-bearings is shown in Fig. 4. Since the cap of a bearing is nothing more than a girder having enough stiffness to hold down the actual bearing-shell without deforming it, and since it has been quite customary to make the cap consist of two such girders between two pairs of studs, the altogether natural course has here been followed of making the cap in two pieces. As a result, each casting by itself is small enough to be conveniently handled. The cap is to all intents as stiff as before, because it differs from the customary cap by the connective metal only, a portion which contributed little or nothing to the rigidity of the part.

Originality has also been shown by the Holeby designers in the treatment of the valve-gear. Although reversal is still accomplished by the use of double-cams and the sidewise shift of the cam-shaft, the method of clearing the cam-rollers during the latter process is different. Referring to Fig. 6, guide-link shaft (A) is straight and con-

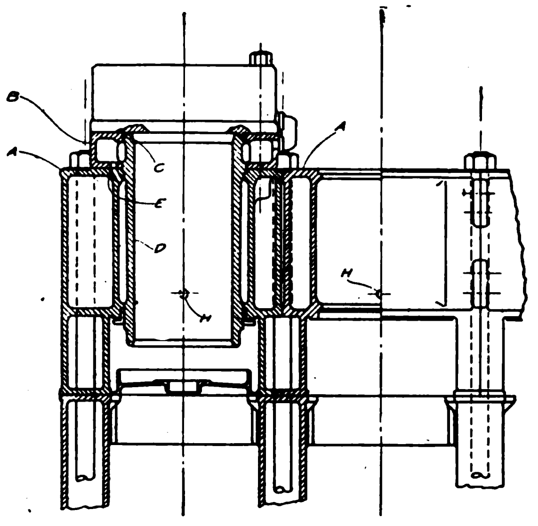


Fig 3.

centric over the length occupied by the guide link bushings, so that its rotation does not shift the big-end centers of the links. The cranks (B), however (one for each cylinder) are keyed to the guide link shaft (A), and a partial turn of the combination will shift the eccentric fulcrum shaft (C) by means of rod (D) and crank (E). Since the ball-end of the tappet (F) cannot leave contact with the valve spindle (see Fig. 5) the upward movement of the center of (C) produces twice the movement of push rod (H), which can now clear the cams. The system represents a bold applica-

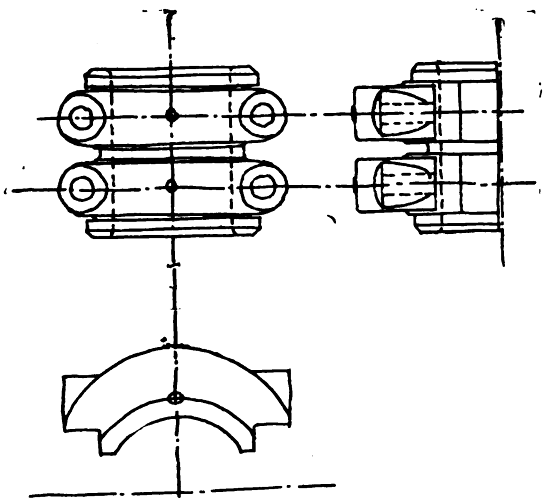


Fig. 4.

tion of the well-known eccentric fulcrum idea, so frequently used on stationary engines for cutting fuel and starting levers in and out.

In fact, the very same thing is also done on the Holeby engines, and the eccentric which governs the registry or non-registry of the fuel and starting levers is moved by means of a starting-air servo-motor. Fig. 5 is a diagrammatic sketch of the arrangement. Tube (B) leads direct to the starting-air manifold, and communicates air to servo-motor cylinder (C) as soon as the operator turns the starting-air wheel. A piston in (C) resisted by a spring in (H) operates a rack in housing (D) which acts on gear (E), and thereby turns cranks (J) and (K). The consequent depression of the center of (L) doubly depresses (M), and brings the cam-roller (N) down on the starting cam.

Compression relief is obtained in a manner illustrated in Fig. 6. When the center of the eccentric fulcrum (C) raises the left-hand end of the exhaust-lever (M), this member pivots under the set-screw (K), and causes a depression of the tappet (F) sufficient to vent any pressure that may have remained in the cylinder. During regular running, when the center of (C) is down in its normal position, there is clearance between (M) and (K), which increases as the valve is lifted. Like the regular Burmeister & Wain compression relief, it is merely "transitory." It insures that no piston will ever have to start moving against a pressure greater than atmospheric, a provision whose adequacy has been amply demonstrated.

Perhaps the most startling break with Burmeister & Wain tradition is embodied in the use of an upward opening fuel-valve. The design here followed is one so well established that further comment is unnecessary. As regards the downward opening valve, it will be remembered that the large area presented by the mushroom head requires that exceedingly minute valve-lifts be used. The order of magnitude of the lifts approaches that of errors due to manufacture and resulting from wear and expansion, with the consequence that the maintenance and control of the lift of downward-opening valves presents problems which possibly are not so pronounced in the case of upward opening valves. Much more might be said on this subject, but space does not permit.

Captain E. H. Jorgensen is enthusiastic about his ship and expressed an emphatic preference for motor propulsion as contrastd with steam. Handling coal is an expensive and time-wasting nuisance and mess. The modern Diesel-engine meets the standards set in steam-engineering practice for dependability in operation insofar as the machinery alone is compared. If, however, the hazard and unreliability of managing a crew of more less savage stokers is taken into account, the oil-engine benefits by the comparison. Captain Jorgensen says that during one voyage in a

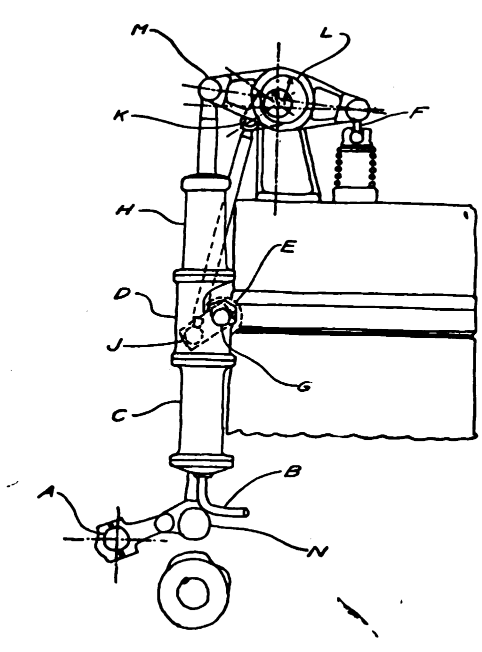


Fig. 5

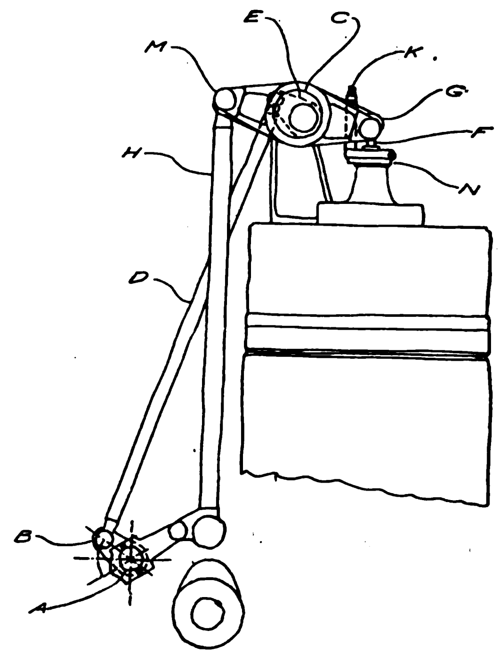


Fig 6

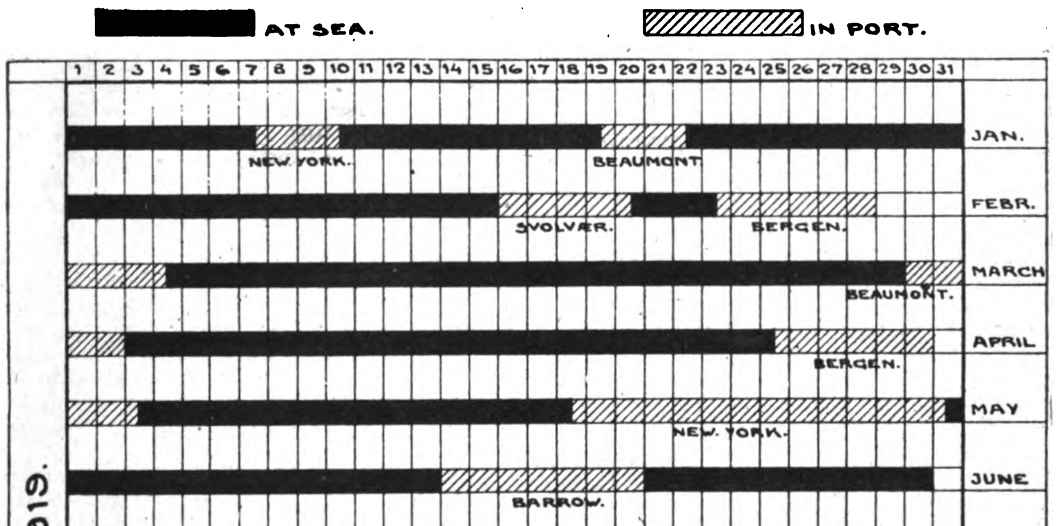


Chart of the voyages of the Polar two-cycle Diesel-engined tanker "Hamlet" during 1919. The black spaces represent the time at sea. Up to the end of 1918 she had covered 102,560 sea-miles in 30 voyages at an average speed of 9.81 knots on a daily fuel-consumption of 9¾ to 10 tons. The "Hamlet" is of 7,100 tons d.w.c., 10,500 tons displacement, and carries 6,300 net-tons of bulk-oil cargo in her holds. She was built by the Gotaverken. Her owners are Bruusgaard Kiosterud & Co., Drammen, Norway, who have a 9,000 tons d.w. Sulzer two-cycle Diesel motorship building at the Rosenberg Shipyard.

ship requiring twenty-four stokers he had to lock up sixteen at one time. Attention is here called to table 2, from which it is seen that the engineering-crew of the "Mexico" comprises eleven men. These are persons selected because of their skill, training, and character. Their substitution for men of the stoker type adds to the overall security of the ship in a manner which commends itself to the attention of ship-owners and operators. It will be noted from the table that the "Mexico" has already covered 24,064 nautical miles in 2,762 hours, or an average speed of 8.71 knots using a total of 1,351 tons of fuel-oil as she is only of 1,100 shaft h.p. these results are excellent.

The Captain is much pleased because it takes just twenty minutes to get the ship under way from the time he signals to the Chief-Engineer, Mr. Einar Gundlach, to get ready. On the steamships he has sailed he had to give twenty-four hours' notice.

Mr. Gundlach is thoroughly pleased with the engines, and pointed out the excellent machine work on them. He showed our representative every courtesy, and assisted him in gathering the data on which this article is based.

VOYAGES OF MS. "MEXICO"

A Few Significant Figures

TABLE 1. SHIP DATA

Length (O. A.)	300′
Breadth (Moulded)	44′
Depth	28′
Mean loaded draught	24′
Dead-weight capacity, tons	4,450
Gross register, tons	2,750
Oil-cargo tanks, total cu. ft	163,340
Sumr. tanks, total cu. ft	22,760
Oil-fuel tanks with double bottom, total cu.ft.	16,490
Lubricating oil tank, total cu. ft	1,100
Total water tanks, total cu. ft	9,340

TABLE 2.* OPERATING DATA

	Copenhagen to New York ½ Cargo. Return Full Cargo	Copenhagen to Beaumont ½ Cargo Return Full Cargo	Copenhagen to New York ½ Cargo.
Distance, nautical miles	7,681	11,930	4,453
Speed, nautical miles per hr	8.56	9.28	7.69
Total hours at sea	896	1287	579
Maximum nautical miles in one day	263	258	243
Average R.P.M. (for 1 week)	127.3	139	132
Mean Ind. Pressure—Stbd. (lbs. per sq. in.)	86.9	86.9	87.6
Mean Ind. Pressure—Port (lbs. per sq. in.)	84.1	86.9	87.6
Total fuel used tons	191.9	298	141
Fuel used per day, tons	5.13	5.56	5.85
Kind of Fuel	Borneo	Texas	Texas
Specific gravity of fuel	0.93	0.85	0.86
Lubricating oil used, lbs	3,030	4,730	1,924
Engine-room crew,			

*Averages do not cover all readings taken on trips.

TABLE 3. ENGINE DATA

Number of engines			2	
Rated I. H. P. each			800	
Bore (inch)			19.69	
Stroke (inch)			28.74	
Rated R. P. M.			140	
Test block I.H.P.	876	(Stbd.)	909	(Port)
Test block R. P. M.	136	"	136.5	"
Test block M.I.P. (lbs.)	93.4	"	97.9	"
Dynamometer Power (B. H. P.)	550	"	582.5	"

Interesting Notes and News from Everywhere

VICKERS HAVE JAPANESE LICENSE

A license to manufacture Vickers solid-injection Diesel-type oil-engines is held by Mitsubishi Zosen Kaisha of Japan. It is incorrect that Vickers Ltd. are engaged in constructing Diesel-engines for large Japanese submarines as has been reported.

MOTORSHIP "CANADA" LAUNCHED

On Nov. 30th the Diesel-driven motorship "Canada" of 9300 tons and of 3100 i.h.p. was launched at the Götaverken shipyard, Göteborg, Sweden, to the order of the Rederiaktiebolaget Nordstjernan (Johnson North Star Line) of Stockholm. She is a sister vessel to the motorships "Balboa" and "Buenos Aires."

KITCHEN REVERSING RUDDER

In our November issue on page 1010 we mentioned that the rights for the Kitchen reversing-rudder had been acquired by the McNab Company of Bridgeport, Conn. This perhaps is misleading, as the McNab Company are not owners of the manufacturing rights, but are representatives in the United States for the Kitchen Reversing Rudder Co. Ltd. of Great Britain.

SULZER-ENGINED CONCRETE MOTORSHIP

An 800-ton d.w.c. concrete cargo-motorship has been built for the Baltisch Rederei of Hamburg, and trials were recently run. Her builders were F. R. Sternemann & Co. of Wewelsfleth, Germany, and she is propelled by a four-cylinder two-cycle type Sulzer-Diesel engine of 400 shaft h.p.

TWO MOTORSHIPS FOR HANSA REEDERI

Two Sulzer Diesel-driven motorships of 9,000 tons and 6,000 tons d.w.c. respectively are under construction for the Hansa Reederi, Bremen, Germany. The 9,000 tons vessel is of 3,200 shaft h.p. and the smaller craft of 1,600 shaft h.p. They also are having built an auxiliary sailing-vessel in which two 420 shaft h.p. Sulzer Diesel engines are being installed.

NEW MOTORSHIP FLEET FOR CAPT. BROR M. BANCK

Reference was made to the converted steamship "Augusta" in our December issue. This is the first of a fleet of similar motorships to the order of Capt. Bror M. Banck of Stockholm, as follows:

Cargo Ship	9,000 tons d.w.c.	2500 shaft h.p.	Twin-screw
Cargo Ship	9,000 tons d.w.c.	2500 shaft h.p.	Twin-screw
Cargo Ship	6,000 tons d.w.c.	1600 shaft h.p.	Twin-screw
"Augusta"	5,000 tons d.w.c.	800 shaft h.p.	Single-screw
	29,000	7,400	

All the above vessels are fitted or are being equipped with Sulzer two-cycle type Diesel engines.

FOUR MOTORSHIPS FOR SVEA SHIPPING COMPANY

Trials of the first three Diesel steel motorships each of 2,500 tons d.w.c. for the Svea Shipping Co. of Stockholm have just been carried out by the Finboda Shipbuilding Co., and these vessels are propelled by Polar two-cycle Diesel engines. The same company owned the motorship "Gestrikland," which was converted from a steamer many years ago. The results of her operation caused them to order three larger Diesel-driven motorships.

MOTORSHIPS EARN 8,400,000 KRONERS NET

The East Asiatic Company, which exclusively operates motorships, made a profit of Kr. 8,400,000 during the last year and have paid a dividend of 40 percent.

THE BOLNES ENGINE

The Bolnes surface-ignition marine oil-engine has been built as an open-type engine since 1912 not 1919, as stated thro' a typographical error in a recent issue.

SWEDISH EAST ASIATIC CO. ACQUIRE ANOTHER MOTORSHIP

The Polar Diesel-engined motorship "Svealand" of 1600 tons, which for the past year has been trading between Swedish and British harbors in the lumber and coal business, has been acquired by the Swedish East Asiatic Co. of Göteborg.

NEARLY 11,000 AMERICAN DOCUMENTED COMMERCIAL MOTOR-VESSELS

To give a comprehensive idea of the big development of the American commercial motor-vessel industry we are advised by the Bureau of Navigation of the Department of Commerce, Washington, D. C., that on June 30, 1920, there were no fewer than 10,711 American documented motor-vessels, aggregating 357,049 gross tons. No pleasure craft are included in this figure. This gross tonnage represents approximately 570,000 tons dead-weight-capacity.

SWEDEN'S MERCHANT MARINE

According to the latest returns Sweden has 1,147,117 gross tons of merchant-ships divided as follows:

	Tons	Gross
Motorships	490	117,844
Steamers	1,230	914,740
Sailers	1,068	114,533
Total	2,788	1,147,117

The motorship tonnage figure represents approximately 188,500 tons d.w.c. and includes a large number of small oil-engined-coast-wise craft, as well as about two dozen big ocean-going Diesel-driven ships. Many of the sailing-ships are fitted with auxiliary oil-engines.

MOTOR VESSEL FOR VANCOUVER ALASKA FISHING SERVICE

A wooden vessel built in 1914 and docked in Seattle, named "Washington" was recently equipped with surface-ignition oil-engines by Capt. Judy, of Seattle. She was purchased by the New England Fish Company who have headquarters in Boston and a branch at Vancouver. They will place this vessel in the fish freight-service between Vancouver and Alaska, but the craft will be operated under United States registry. Going north she will carry general freight, coming south will transport fish.

LINDHOLMEN SHIPYARD MAY BUILD DIESEL ENGINES

Negotiations for a license to build merchant-ship type Diesel engines are now being carried-out with an important Diesel-engine firm by the Aktiebolaget Lindholmen Motala of Gothenburg.

THE WIGELIUS COMPOUND MARINE OIL ENGINE

A consumption of 130 grams per b.h.p. hour was recorded on the test of an experimental single-cylinder 120 b.h.p. compound type marine heavy oil-engine built at the Aktiebolaget Wigelius Motor Works, Gothenburg, Sweden. The fuel used in this test was Texas oil of 0.86 specific gravity and 10,100 British thermal units.

EAST ASIATIC COMPANY ORDERS SIX 15,000-TON MOTORSHIPS

With reference to the new 14-knot motorship of 15,400 tons d.w.c. and 22,000 tons displacement, 6000 i.h.p. ordered by the East Asiatic Company, announced on page 988 of our November issue, our Danish correspondent advises us that six vessels of this size have recently been ordered by the East Asiatic Company from Burmeister & Wain of Copenhagen.

NEW BRITISH MOTOR COASTER "HARPAREES"

The second of a new type of oil-engined coastwise vessel was recently launched at the shipyard of Wells & Packham Ltd. of Sillingbourne, Kent. The vessel has been named "Harparees" and is of 250 tons d.w. She is propelled by a Vickers-Petters marine heavy-oil engine of the surface-ignition type developing 110 b.h.p. at 270 r.p.m. This gives the vessel a speed of 7 knots. Two of three sister motor-vessels now under construction will be propelled by twin 76 b.h.p. Vickers-Petters oil-engines.

ANOTHER MOTORSHIP FOR SWEDISH LLOYD

Several large motorships are under construction in Sweden for the Swedish Lloyd of Gothenburg, as previously stated in "Motorship." A small motorship has just been completed for them at the Limnhamn Shipyard to Bureau Veritas classification. This vessel has the following dimensions:

Displacement (loaded)	1450 tons
D.w.c. (including bunkers)	1000 tons
Length (O. A.)	182 ft. 6 in.
Length (b.p.)	147 ft.
Maximum breadth	28 ft. 9in.
Depth	13 ft. 11¾ in.
Depth of hold	11 ft. 9½ in.
Moulded depth	12 ft. 6¼ in.
Power	500 shaft h.p.

She is propelled by a four-cylinder 500 shaft h.p. two-cycle type Atlas-Diesel engine.

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MOTORSHIP

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THE MOTOR-SHIPPING QUESTION IN CONGRESS

As the result of the intensified efforts of "Motorship," assisted by the most valuable work recently accomplished by Mr. Wm. Denman, Ex-Chairman of the Shipping Board, the leading members of both the Senate and the House of Representatives are now familiar with the enormous value of the internal-combustion oil-engined motorship in America's mercantile-marine. An indication of the current attitude of Congress is perhaps revealed in a letter from Senator Wesley L. Jones (Chairman of the Committee on Commerce and father of the now-famous Merchant Marine Act) dated Dec. 11, 1920, to the Editor of "Motorship." Senator Jones says:

> "I wish the Board would earnestly take up the matter of Diesel-engine construction. I want to see our shipping of the most efficient and economical type. In my judgment that is what we are going to have in order to build up our merchant marine and put it upon a permanent basis."

Recently we spent some little time in Washington and were enabled to form an opinion of the feeling of Congress over the neglect of the Board and Fleet Corporation to provide the country with types of merchant-vessels sufficiently economical in operation to conserve our dwindling oil supply and to be able to properly face foreign competition, also their neglect to adequately develop the marine Diesel engine with this object in view. Unless the utmost is done with the Board's present limitations, we anticipate Congress using a stiff broom and making almost a clean sweep through the construction and operating departments in the coming spring. Unfortunately, Admiral Benson—who has expressed himself as a firm believer in the overseas-competition value of the economical motorship—has found himself confronted with a tremendous amount of work and very low funds left over from the old Board's administration. His views are already outlined in a speech recently made before the American Petroleum Institute, reproduced elsewhere in this issue. However, we have again drawn his attention on this page to what we consider a misuse of funds by one of the departments in changing vessels from one class of steam to another when the vessels could be converted to Diesel power with advantage.

MORE GOVERNMENT GEARED-TURBINE SHIPS TO BE CONVERTED

Once again we feel it necessary to ask why the Shipping Board appears to have plenty of money for converting existing geared-turbine ships to turbine electric-drive when it does not seem to have any money for converting the same vessels or other "semi-obsolete" steam-driven merchant ships to Diesel-electric or direct Diesel drive. The contract for refitting and overhauling the steamship "Invincible" and for the replacement of the so-termed "war emergency type" of geared-turbine with turbine-electric drive has been awarded to the Tebo Yacht Basin Co., Brooklyn, N. Y. The cost of the work is $82,474.00 In the same issue of "The Journal of Commerce" in which this appears; namely, Monday, Dec. 13, 1920, was an announcement that there are about 45 Shipping Board steamers in the New York district alone which have been tied-up with caretakers, and that more steam-ships are to be added to this idle list. We suggest that the officials of the Shipping Board responsible for the non-conversion of ships to Diesel power should read Mr. Denman's comments elsewhere in this issue.

WAR-TIME SHIPS TO PEACE-TIME SHIPS

A clear case for the oil-engined motorship and its economical importance in the American Merchant Marine was vividly portrayed before the Walsh House-Committee of Congress investigating the operations of the Shipping Board, by Mr. Wm. Denman, first chairman of the Board, and many extracts from his testimony are given elsewhere in this issue of "Motorship." How he planned a fleet of motorships, and how this was set aside by the Hurley Administration with the result that the country is now burdened with nearly 1500 oil-wasting, money-burning steamships, dozens of which are already commencing to rust and rot in harbors owing to the impossibility to operate them on the high seas of the world is fully revealed. Mr. Denman made it perfectly clear that his sincere belief in the value of the motorship to the nation was the sole reason for his testimony and for his appeal to Congress to appropriate funds for the conversion of a million tons of these "war-time" steamers to Diesel power, or alternatively build a similar tonnage of new merchant-motorships, to balance the existing fleet. Mr. Denman has no connection whatever with any firm in the industry and is urging the matter purely for *amor patriae.* The nation owes him a vote of thanks for having brought the question into the limelight. It is hoped that reflections of Congress over his recommendation will produce active results.

Adequate steps must be taken without delay in order to avoid almost our entire fleet being left to rust in harbors. Congress is strongly averse to making new financial appropriations because of the great importance of conservation; but where a small appropriation will produce enormous economies, we hope that Congress will approve even in the face of the doubtful results of past Government ship-building.

With one exception, all the vessels laid-down by the United States Shipping Board and Fleet Corporation have been war-time ships built for war-time purposes. No real attempt was made to construct ships specially suitable for peace-time operations, or to insure that such vessels were perfectly suited to meet all foreign competition on the high seas. In addition to Mr. Denman's recommendation to convert a million tons to Diesel power, we have proposed to Congress that, if possible, the Shipping Board or Fleet Corporation, in conjunction with a Committee of experts selected from officials of three old-established and responsible American shipbuilders, be authorized to design and construct three different "model" or "demonstration" merchant-ships of the most modern, the most economical and the most efficient type, based on the very latest European practice, and turn these over to private shipowners (as examples of ideally economical craft) for operation under the supervision of the Board as soon as completed, with the understanding that all technical and operating experiences thus gained shall be made available to all bona-fide American shipbuilders, shipowners, marine-engine builders and naval-architects, and that a sum of $8,500,000 be appropriated, or a fund created, for that purpose.

That the three "model" vessels be of the following specifications:

TYPE	Tonnage (D.W.C.)	Shaft (Horse-P.)	Speed (Loaded) (knots)	Daily Fuel Consumption at Sea (tons)	Approximate Cost
Combination Passenger-Freighter....	20,000	8,000	15	35	$3,300,000
Tanker..............	15,000	5,500	14	24	2,500,000
Express-Freighter....	10,000	4,000	14	17½	1,600,000
Total..............					$8,400,000

Enormous advantages would accrue from having three such economical and up-to-date merchant-ships in "demonstration-operation." Shipowners and shipbuilders then would be enabled to obtain all technical and operating information regarding craft similar to those now being developed in Europe; only these three U. S. Government-built vessels would be a little in advance of most of the ships now building abroad.

If the three foregoing vessels were basically constructed upon the very latest European practice with American improvisation, each would carry from 1,000 to 1,500 tons more cargo per one-way voyage than could existing American war-time built oil-burning or coal-fired steamers of approximately similar hull and speed specifications. Furthermore, these "model" ships would have daily-consumptions of fuel-oil that would amount to only one-third of the fuel-oil at present used by American war-time built steamers of similar hull dimensions and speed. In fact, practical operation of a 14-knot tanker is only feasible because of the low fuel-consumption of the Diesel-engine. Thus, in addition to being able to compete on the Seven Seas with any European vessel afloat, these craft would assist to economize America's dwindling supply of oil. Also, their excellent speed would enable a maximum number of voyages per annum and thereby again increase their earning capacity.

One of the ships could be equipped with internal-combustion engine-electric drive, which Admiral Benson has been advocating. The other two, of course, would have two and four-cycle type direct-connected internal-combustion heavy-oil engines respectively; but, of course, the type of machinery would first be approved by the Board before laying-down the ships.

FIRST MOTORSHIP UNDER TAX EXEMPTION CLAUSE

The U. S. Shipping Board has approved of the construction of the 6,000 tons d.w.c. cargo motorship for the Alaska Steamship Co. under the excess-profits tax exemption clause of Section 23 of the new Merchant Marine Act. This vessel it will be remembered is being built by the Todd Dry Dock and Shipbuilding Co. of Tacoma, Wash., and will be propelled by two 1200 shaft h.p. McIntosh & Seymour Diesel engines.

BOILER BUILDER DEPRECIATES DIESEL ENGINES

Whether it is a deliberate attempt to depreciate and damn the value of the Diesel engine and to mislead prospective users regarding its present advanced development, or whether it is a question of sheer ignorance of the subject, is probably only known to the author of the article entitled

"Common Sense in Engineering," published in the Nov. 25th issue of the "American Machinist." The article in question was contributed by Walter M. McFarland, manager, Marine Department, Babcock, Wilcox Co., the well-known marine-boiler manufacturers of New York. The following are some of his very inaccurate statements:

(1) "marine records of good average practice are ½ lb. of oil per brake-horsepower for the Diesel engine and about 1 lb. of oil per indicated-horsepower for a good reciprocating-engine plant."

(2) "the extent of the use of Diesel engine has been a great disappointment to its advocates, and at the present time relatively few are being installed in new vessels."

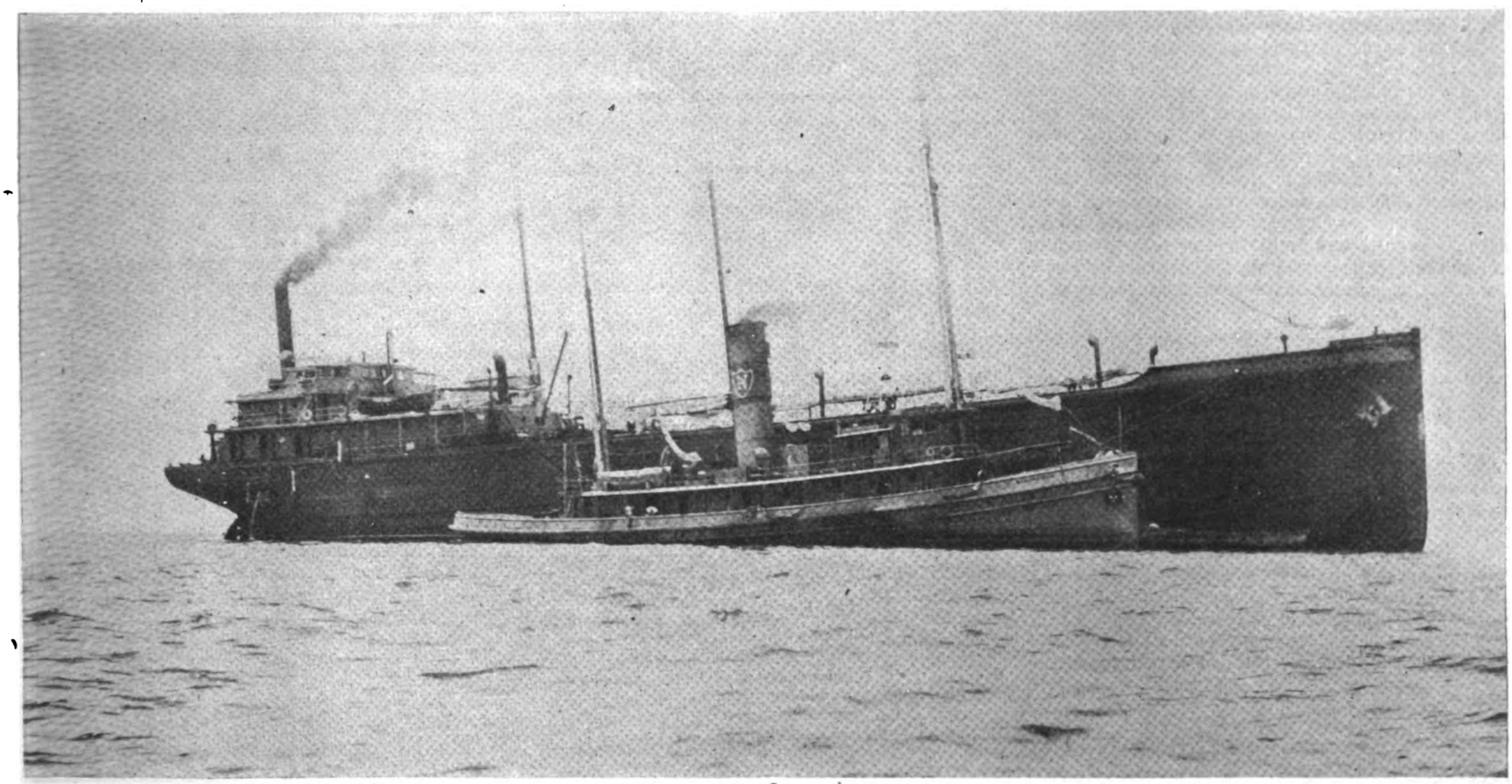
(3) "it became apparent that they were all designed with a horsepower per cylinder which did not exceed 250 to 300. At first there were a great many vague statements that experiments were in progress with cylinders to give from 1,000 to 4,000 h.p. per cylinder. In one such experiment there was an explosion with serious consequences. At all events, for some time there has been no talk of these more powerful cylinders.

(4) "Why is it that the Diesel engine cannot be built in large sizes? And here common sense gives us the answer quite simply. Like all other internal-combustion engines, the Diesel engine requires that the cylinders be water-jacketed so as to keep the barrel sufficiently cool to permit the proper working of the pistons. The pressures carried are quite high, from 700 to 1,000 lbs. per square inch, requiring a thick cylinder even for a power of 250 to 300 h.p. The fact is that this thickness is evidently about the maximum which will permit the interior cylinder wall to be kept of a sufficiently low temperature for satisfactory working."

We emphatically maintain that Mr. McFarland cannot prove any of the above statements, and offer him the privilege of our columns to make his attempt. On the other hand, we will demonstrate the incorrectness of his claims. In the first place, no large motorship placed in service this last five years has shown a fuel-consumption exceeding 0.43 lb. per brake (shaft) horse-power and the majority show a regular consumption of 0.41 lb. per brake horse-power, or from 0.28 to 0.32 lb. per indicated horse-power —including all auxiliaries—at sea. Again, we do not know of any Diesel engines with normal cylinder pressures of 700 to 1,000 lbs.

Regarding his belief that only a few Diesel engines are installed in vessels at the present time, a recently published table shows that eleven motorships aggregating 138,210 tons are now under construction in the United States. In addition, seven 1,000 brake horse-power motorships are building for the U. S. War Department. Furthermore, in Mr. Denman's testimony before the Congressional Committee published elsewhere in this issue, he gives a list of 65 motorships aggregating 583,600 tons d.w. and 227,800 i.h.p. are now on order in Great Britain. This does not include all the British Diesel vessels nor the large fleet of motorships building for German, Danish, Dutch, Italian, Swedish and Norwegian owners, aggregating a total of about 150 Diesel-driven vessels. In addition there are about 500 motorships in service.

In connection with the horse-power of Diesel engines we would like to draw his attention to the cylinder out-put of the Bethlehem-West engine of the motorship "Cubore" and of the same make of Diesel engines for the four motorships of 20,000 tons d.w.c. building for the Ore Steamship Company and of the cylinder out-put of the Doxford engine also illustrated in this issue. Furthermore, if Mr. McFarland will refer to page 1074 he will see confirmation of the fact that the 12,000 shaft h.p. double-acting 6-cylinder Krupp Diesel-engine was completed several years ago and successful trials run. Many other high powered engines are under construction or in service as frequently published in "Motorship."



The wooden-built bulk-oil tanker "J. F. Penrose," owned and built by the National Oil Co. of N. Y., and used for carrying oil from Mexico to New Orleans, La. She is 317 ft. long and is propelled by one 750 shaft h.p. McIntosh & Seymour Diesel-engine originally constructed for the U. S. Shipping Board. This tanker was briefly described in the Jan., 1920, issue of "Motorship," page 20.

HOWALDSWERKE ADOPT SULZER LICENSE

A license to construct Sulzer marine-type Diesel-engines has been secured by the Howaldswerke (Howald Shipyard) of Kiel, Germany.

ATLANTIC TRANSPORT CO.'S SISTER MOTOR-SHIP AND STEAMER

Completed in Great Britain over six years ago, the 6,500 tons d.w.c. 3,600 i.h.p. B. & W. Diesel motorship "Mississippi" has run over 200,000 nautical-miles to date, consuming under 11⅓ tons of oil-fuel per day. She is owned by the Atlantic Transport Co., 9 Broadway, New York, and at the time of her construction was considered an experimental vessel. She operates between London and Baltimore, sometimes calling at New York.

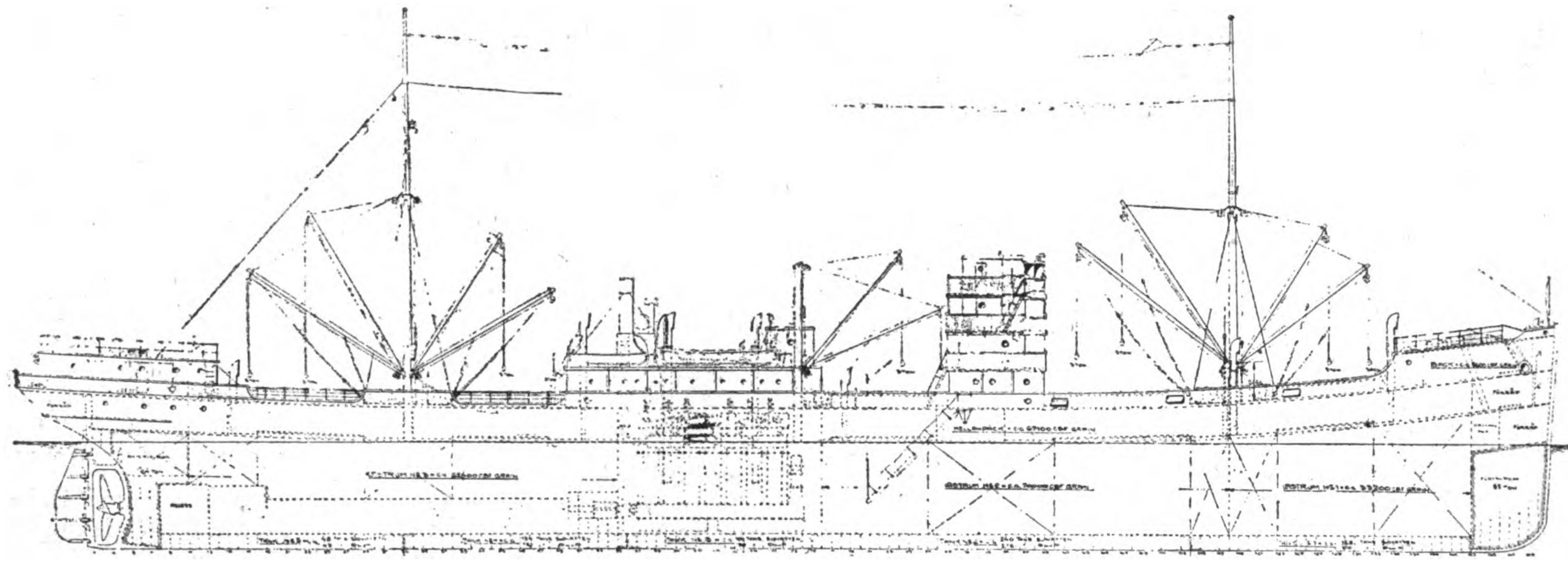
The motorship "Mississippi" is a sister vessel to the steamer "Missouri," and owing to having twice the cruising radius on about half the quantity of fuel, and requiring no boiler-water, she can carry over 500 tons more cargo than the "Missouri." Also she only burns 11⅓ tons of oil per day compared with the "Missouri's" 39½ tons of coal. Furthermore, the S.S. "Missouri" is obliged to bunker at both ends of trip, whereas the M. S. "Mississippi" bunkers in the U. S. A. only.

NEW SHIP DIRECTORY

A very useful international book will be published shortly in Great Britain known as the Ship Compendium and Yearbook. It will consist of over one thousand pages and will contain a complete list of shipbuilders, shipowners, marine engineers, ports, harbors, dockyards, coaling stations, fuel-oil stations, cable and wireless stations, naval architects, naval colleges, nautical academies and institutions, banks and bankers, dock and harbor commissioners, boards of trade, admiralties and their officials, ministries and boards of shipping, ministries of transport, shipbrokers, flags and funnels of the mercantile marine, technical and professional societies, benevolent institutions, salvage associations and shipping registries, throughout the world. Tonnage and constructional statistics, the year's losses, ship and shipping law, insurance and indemnity, the British Admiralty, and many other subjects connected with the shipping world will be exhaustively covered. Even victualling stores in the different ports of the world will be included. Nothing of importance connected with this vast subject will be omitted. It will be a complete referendum of the world's shipping interests, arranged and classified alphabetically and geographically. The publishers are Compendiums Ltd., 18 Old Compton St., Soho Square, London, W. 1, England.

HIGH-POWERED JAPANESE SUBMARINES

Types Q-54 and Q-45 submarines of the Japanese navy are of very high power. The first mentioned is propelled by two eight-cylinder 3,000 shaft h.p. Sulzer two-cycle Diesel engines and the Q-45 is propelled by four six-cylinder 1,300 shaft h.p. Sulzer Diesel engines, or a total of 6,000 and 5,200 shaft h.p. per boat respectively.



Plans of 4,450 tons d.w.c. motorship building at Oresunds to the order of the Swedish Orient Line. A new design of Götaverken-Burmeister & Wain. Diesel engine is being installed

Two Interesting Motorships Building at Landskron

New Design of Gotaverken-Burmeister & Wain Long-stroke Engine with Pistons Removable from Below

NOW under construction for Swedish interests at the Oresunds Varvet (Oresunds Shipyard) at Landskrona, are two motorships of considerable interest. One is of 4,450 tons d.w.c., and the other is a larger vessel somewhat similar to the "Bullaren," "Tisnaren" and "Elmaren," recently constructed at the Götaverken Yard, Göteborg, but is of slightly greater dimensions, being of 10,400 tons d.w.c. Of special interest is the 4,450 tons motorship, as she will have the first of the new long-stroke, slow-speed, Diesel engine designed and built by the Götaverken in conjunction with Burmeister & Wain of Copenhagen, which engine has several features new to the B. & W. design.

One of these is a new form of cylinder-head and cylinder, in which water-cooling is facilitated directly around that portion of the combustion-chamber, where the heat is greatest, and which hitherto was partially prevented by the flanges of the cylinder-head and cylinder-liner. Furthermore, with this new design it is necessary to remove the piston from below instead of detaching the cylinder-head, so facilities have to be made for this purpose. Further details and drawings regarding this interesting feature will probably be given in our next issue.

We take the opportunity to mention that what is practically a duplicate of this motorship is now building for the Swedish Lloyd Line (H. Metcalfe interests), Göteborg, and this vessel will be of the same tonnage and power. The Oresunds boat has been built for the Swedish Orient Line (Dan Brostrom interests), as has the 10,400 tons motorship also building at the Oresunds Yard. Regarding the dimensions of the 4,450 tons boat building at the Oresunds yard, these are as follows:

Net cargo-capacity	3,800 tons
Deadweight-capacity	4,450 tons
Fuel-capacity (maximum)	580 tons
Cruising range	105 days, or 25,200 sea miles
Daily fuel-consumption	5½ tons
Lubricating-oil capacity	6 tons
Fresh-water capacity	20 tons
Grain capacity	238,300 cu. ft.
Power	1,600 i.h.p.
Engine-speed	90 r.p.m.
Ship's-speed (loaded)	10 knots
Co-efficient	0.765
Length (b.p.)	299 ft. 6 in.
Breadth (md)	44 ft.
Depth (to shelter deck)	28 ft. 11 in.
Draught (loaded)	22 ft. 1¾ in.
Winches (electric)	10 of 3 tons
Class	Lloyds+100 A1

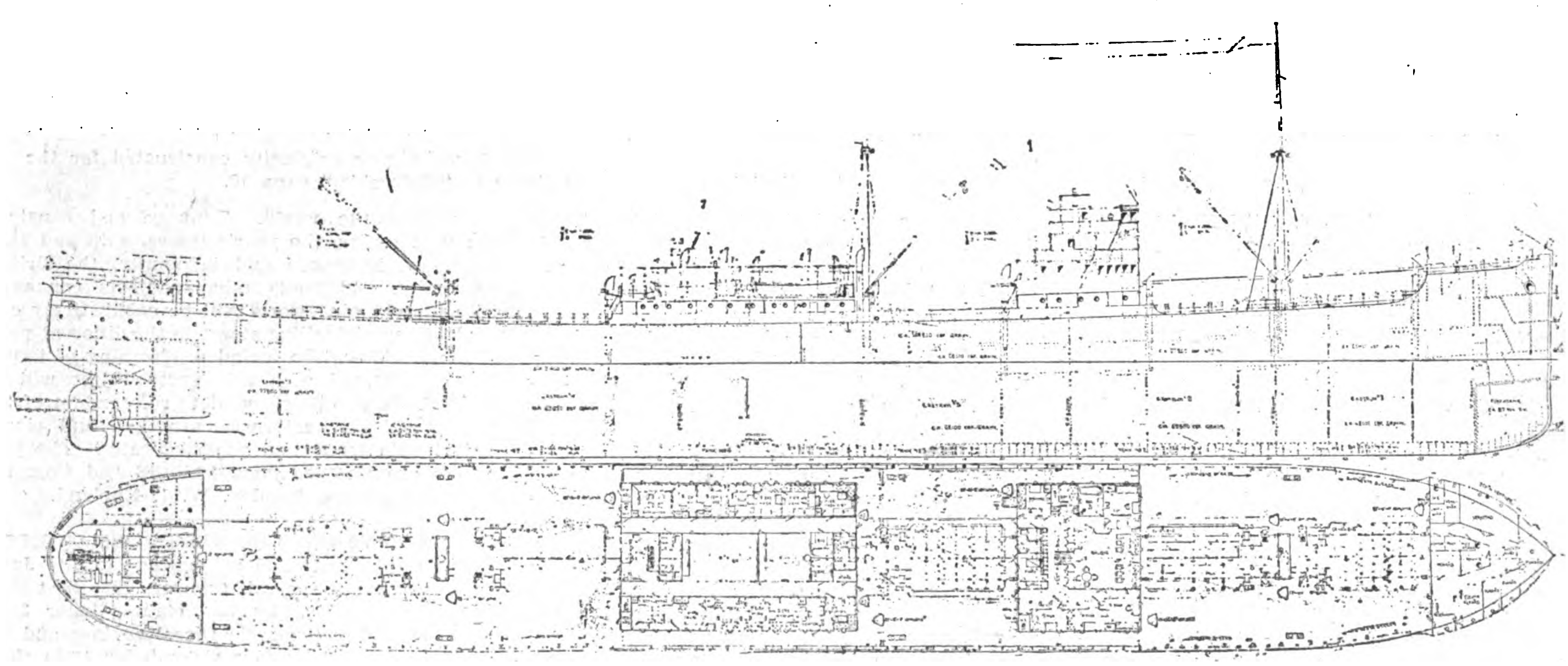
She will have a vertical stem and elliptical stern, with two deck houses amidships on the shelter deck for the accommodation of officers and engineers with lower bridge and boat-deck above, where is situated the captain's cabin, upper bridge and wireless-room. She will be a two-masted vessel with four derricks on each, and two derrick posts per derrick. The hull is of steel construction and will be divided by five water-tight bulkheads and in addition to the fuel-oil space there will be a capacity for 757 tons of water-ballast in the double-bottoms and peak-tanks.

The three holds have steel-grained bulk-heads between hatches. Their capacities are as follows:

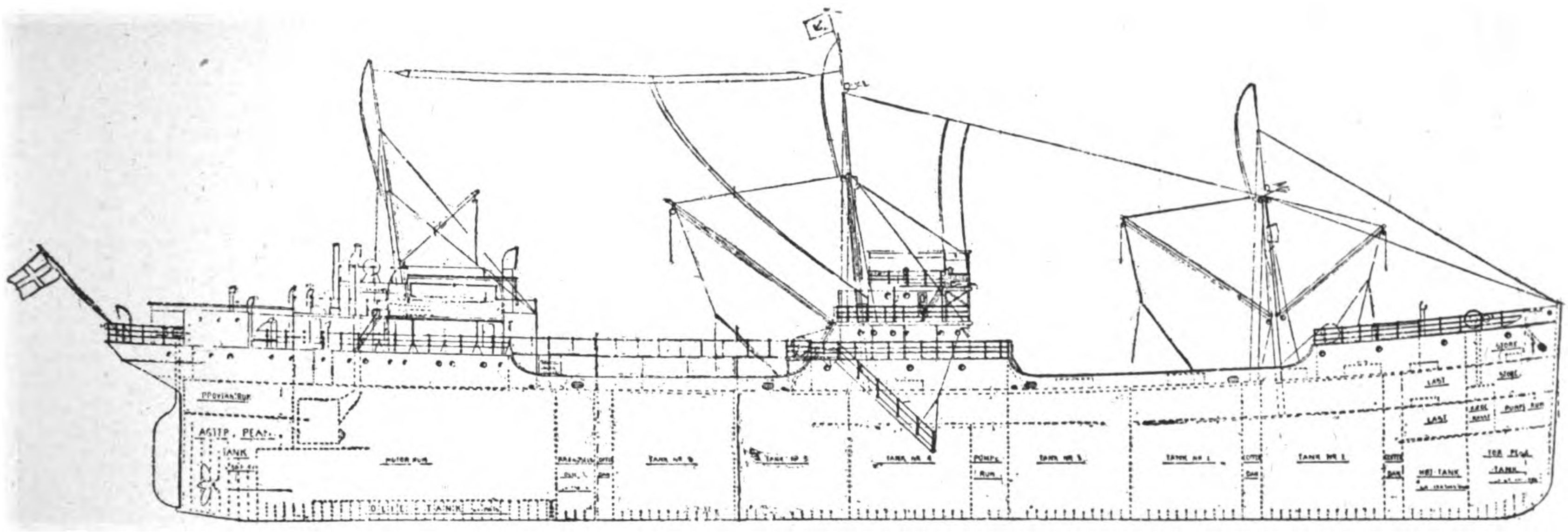
Capacity		Cu. ft Grain
No. 1 fore	Hold about	33,200
No. 2 fore	Hold about	70,000
Aft	Hold about	62,400
'Tween deck	Hold about	67,100
Forecastle		5,600
Total		238,300

As in the case of the winches the windlass will be electric-driven, while steering-gear will be of the hydro-electric type with telemotor. The current for this machinery, also for the electric-lighting and wireless-telegraphy is derived from Diesel-electric generating-sets in the engine-room. Heating is by steam from a small oil-fired donkey-boiler.

(Continued on page 49)



Plans of 10,400 tons d.w.c. Götaverken-Burmeister & Wain Diesel engined motorship building at the Oresunds Varvet, Landskrona for the Swedish Orient Line (Dan Brostrom) of Gothenburg.



Longitudinal section of East Asiatic Co's motor-tanker "Mexico." She is described on another page in this issue.

(Continued from page 44)

Regarding the dimensions of the 10,400 tons boat, these are as follows:

Net cargo-capacity, 8,890 tons dry-cargo and about 900 tons oil-cargo
Dead-weight capacity..................10,400 tons
Total oil-capacity (inc. fuel)...........1,331 tons
Fuel-oil required on round transatlantic voyage, 360 to 400 tons
Daily fuel-consumption ....12¼ tons
Fresh-water capacity ....36 tons
Lubr-oil capacity.......................13.5 tons
Grain capacity of holds.............569,300 cu. ft.
Power of main-engines.................4,000 i.h.p.
Ship's speed (loaded)...................12 knots
Co-efficient...................................0.76
Length (b.p.)............................425 ft.
Breadth (Md.)............................56 ft.
Depth (to shelter deck)..................38 ft.
Draught (loaded)....................27 ft. 6 in.
Winches (electric)..Two of 5 tons, eight of 3 tons
Class..........................Lloyds+100 A1

Generally speaking, she differs in design from the smaller motorship, this vessel having a cruiser stern, also three masts with ten derricks. Her ballast is divided into seven water-tight bulk-heads and she has a water-ballast capacity for about 1,623 tons. There are 5 cargo-holds with two rows of widely-spaced pillars at the side and one center row of ordinary pillars in the fore holds. Also two rows of wider-spaced pillars at the sides in the aft holds. Total capacity of the holds is about 569,200 cu. ft. not counting the 1,331 tons of oil-cargo and bunker-oil in the double-bottom.

She will be propelled by two Götaverken-built Burmeister & Wain Diesel engines, each developing 2,000 i.h.p., which will give her a speed of 12 knots. A complete set of refrigerating machinery is installed, and this will be electrically-driven. All the auxilliary machinery will be electric, power being furnished by three auxiliary Diesel engines in the engine-room, direct-coupled to generators. This also furnishes current for the electric-lighting and wireless telegraphy. Heating the ship will be by steam from a small oil-fired donkey-boiler.

EDITORIAL ARTICLES HELD OVER UNTIL NEXT MONTH

Owing to the illustrations not arriving, they having been delayed during transmission, we have been obliged to hold over a very interesting detailed article on the new Burmeister & Wain Diesel-engined motorship "Fritzoe" of 1,000 tons d.w.c., which recently ran sucessful trials in Norwegian waters.

We have also been obliged to hold over the first installment of a very interesting treatise on the experiment of solid-injection and air-blast in marine Diesel engines by Engineer-Comm. C. J. Hawkes. The first installment of this will now be published in our February issue.

Furthermore, we regret having been obliged to hold over the second installment of Mr. J. L. Chaloner's interesting technical article on "Solid Injection or Mechanical Injection" until our February issue. The amount of new construction has caused this great demand.

VOYAGES OF THE NEW MOTOR TANKER "NARRAGANSETT"

Results of Vickers Solid-Injection Diesel Engines in Service

	New Orleans to Liverpool, July, 1920 (Maiden Trip)	Barrow to New York, Oct., 1920	New York to London Nov. 1920
Total distance (nautical miles)	4,528	3,013	3,204
Running time (hours)........	408	325.5	313
Average speed, actual (knots)	11.1	9.25	10.2
Mean revolutions of engines...	118.	111.	117.3
Engine-fuel used per day (tons)	9.61	9.36	10.51
Auxl. boiler-fuel used per day, (tons)...................	2.13	2.16	1.71
Total fuel-consumption per day, (tons)...................	11.74*	11.52	12.22

*According to information received by Vickers Ltd. from owners regarding similar oil-fired steam-vessels, their average speed is 10.26 knots, and the daily-consumption of oil works out at 35 tons, while the daily-consumption of fuel in a coal-fired steam tanker very slightly larger than the "Narragansett" is 55 tons at 9.8 knots. The reduction in speed of the "Narragansett," compared with the first voyage is due to heavy winter weather.

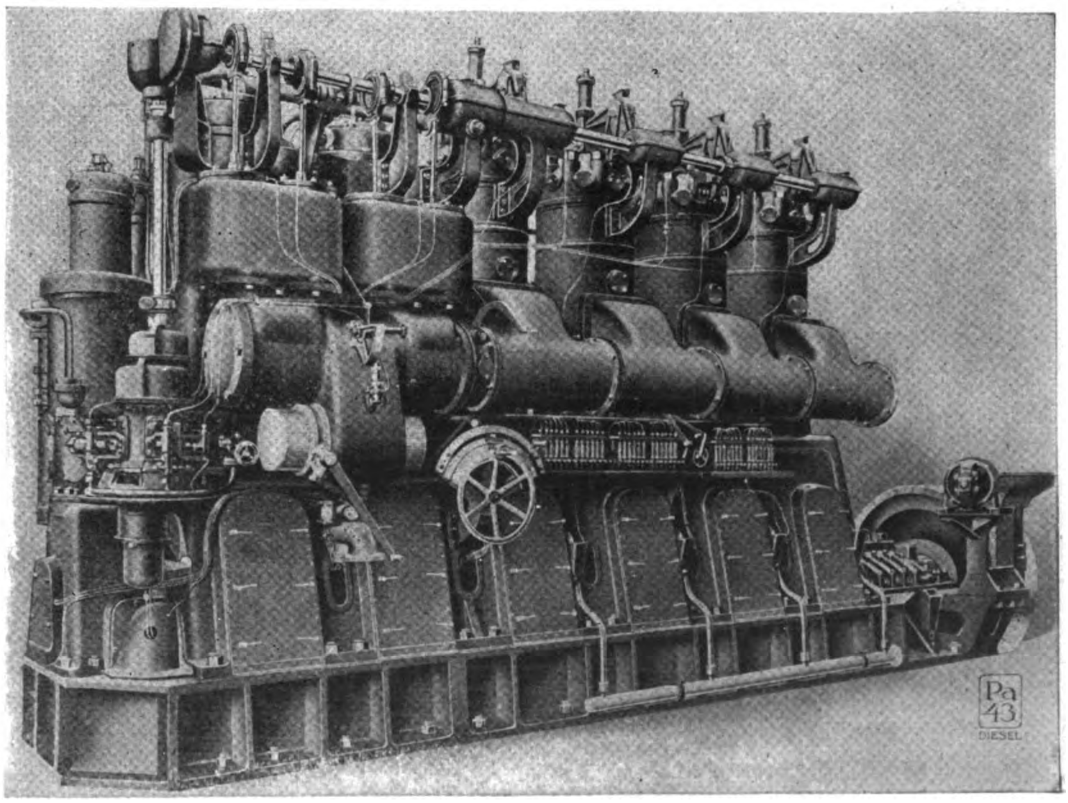
MATSON CO. TAKE RETROGRADE STEP

In these days of obvious economies and reliability of the Diesel-system of propulsion it is somewhat of a surprise to learn that the Matson Navigation Co. of San Fransico, have decided to tear-out the present steam machinery of their steamer "Enterprise" and install a new steam reciprocating-engine. The vessel at the same time is being reconditioned and the total cost will be $180,000.00. The contract has been awarded to the Moore Shipbuilding Co. Incidentally, we will mention that Mr. George Armes, President of the Moore Shipbuilding Co. is a very strong believer in the Diesel-drive and has frequently made public his belief that American steam-driven ships cannot compete with foreign shipping.

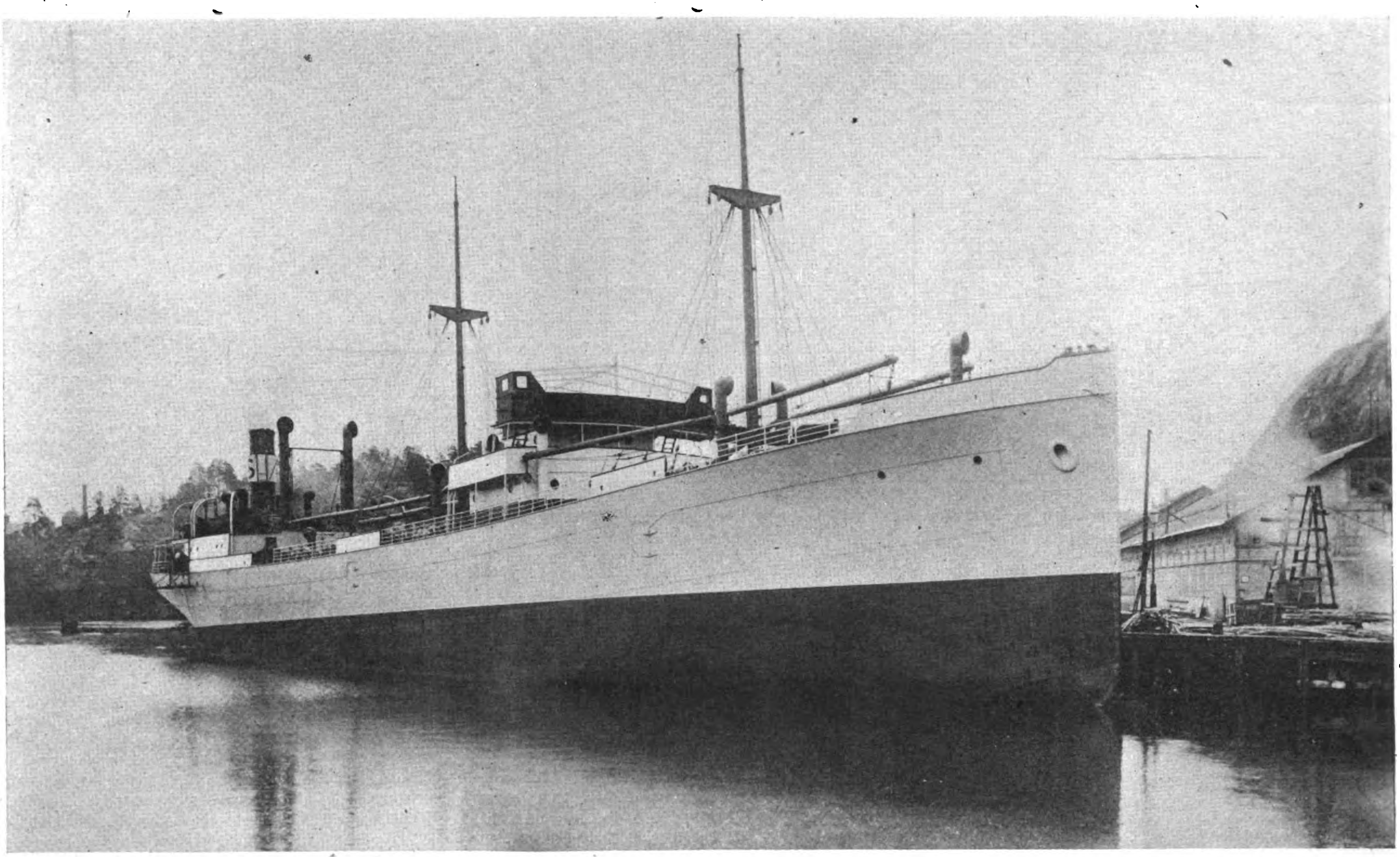
A statement regarding the opinion of Robert Moore, Vice-President of the Moore Shipbuilding Co. appears in the speech of Mr. M. L. Requa of the Sinclair Oil Co. published elsewhere in this issue.

ROYALTY VOYAGE ON MOTORSHIP

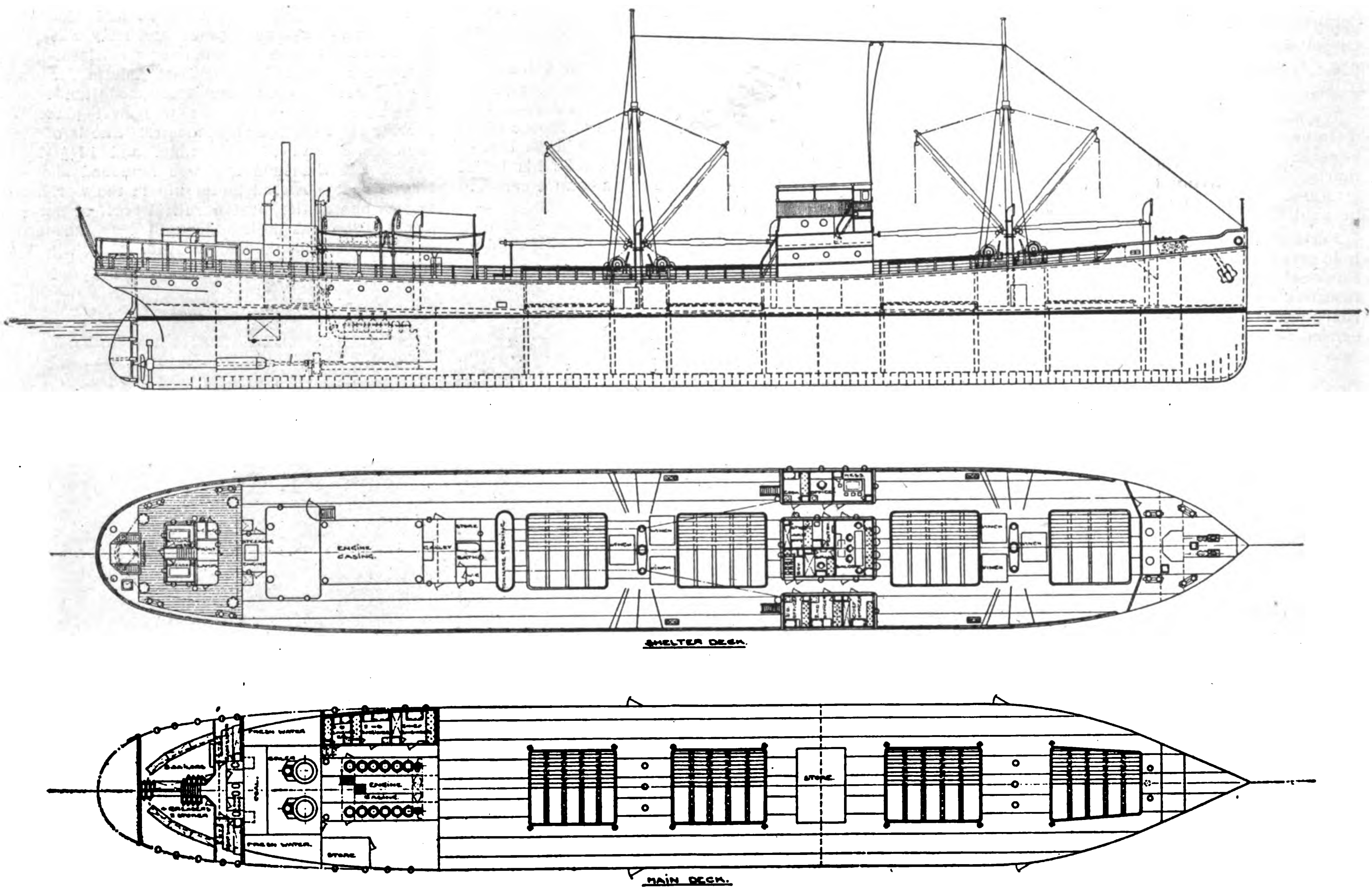
The recent trip of the King and Queen of Denmark to England, France, and Italy was made on board the fine passenger-cargo Diesel-driven motorship "Fionia" of the East Asiatic Company. This vessel has de luxe accommodation for 40 passengers, and when she was first placed in service even carried an orchestra. She is of 7,000 tons d.w.c. and of 4,000 i.h.p. and 13½ knots speed. At the time she was launched she was the highest -powered motorship in the world, and is still one of the most beautiful craft of her size afloat. She was built and engined by Burmeister & Wain of Copenhagen, in 1913.



One of the 500 shaft h.p. Polar Diesel engines of the motorship "Finn," illustrated on page 50



"Finn", a twin-screw cargo motorship just completed at the Finnboda shipyard, Stockholm, Sweden, and propelled by twin 500 h.p. Polar two-cycle Diesel-engines.



Plans of the motor-freighter "Finn." She has recently been placed in service.

From Portland, Maine, to Rimuski, Quebec, by Motor Tug

Maiden Cruise of the Oil-Engined Boat "Lewis L"

By A MEMBER OF THE CREW

THERE are not very many heavy-oil engined tugs in service in this country, so the performance of a boat of this class on her maiden voyage may be of considerable interest. The "Lewis L" now owned by the Brown Company, conducting a lumber and pulp business in the northeastern part of the United States and Canada, is a wooden boat built in Friendship, Maine, equipped with twin-screw 30 h.p. Mianus-Leisner Diesel type oil-engines.

These engines were installed in the "Lewis L" at Portland, Maine, in September, 1920. On September 24th they were started, compass adjusted, and later the officials of the Brown Company, including their President, Mr. Brown, were taken on a trial trip. Mr. Brown, after discovering how little fuel the engines used, said, "Put them in our tow boats."

As soon as the necessary ship's papers were obtained the first lap of our cruise was started on September 29th in the afternoon, when we put out for Boothbay Harbor, Captain Rowell, "Admiral" of the Brown Company's fleet, in charge.

That evening heavy fog was encountered, and the lighthouse near Boothbay Harbor could be heard but not seen, the fog was so dense. We came near running it down, but by good fortune didn't. We anchored and waited for daylight. After we anchored, Captain Rowell asked how much fuel had been used. The measurements and gauge on tank showed that we had used 1.6 gallons per hour per engine.

The next morning, September 30th, leaving the lighthouse at Boothbay Harbor for Rockland, Maine, the storm signals were flying, denoting southeast storm. Weather reports predicted a gale. Before we got to Rockland there was a heavy sea running. Regardless of the sea, the engines kept working steadily, and ran us into Rockland two hours before the gale broke. The next afternoon, October 1st, after the gale had subsided, we started for Jonesport. We had heavy weather all the way, but otherwise the trip to Jonesport was uneventful.

Leaving Jonesport on the morning of October 3rd, we had fine weather and a fair tide making Eastport, Maine, the same day, after a fine run. We lay in Eastport until October 8th, waiting for telegram release of the boat's papers from the U. S. Shipping Board.

During our stay in Eastport, Captain Rowell's numerous duties elsewhere made it necessary for him to return, leaving Captain Smith in charge. We left Eastport October 8th for Yarmouth, Nova Scotia. Crossing the Bay of Fundy, where the rise and fall of the tide is so great that with the contrary winds the sea is usually very boisterous, we were fortunate enough to have a sea that was almost like a mill pond, and arrived at Yarmouth without incident, the evening of the same day. The next morning, October 9th, we left Yarmouth, starting for Liverpool, Nova Scotia. A few hours after sailing we noticed heavy fog banks coming, and we were compelled to make port.

We were up early and left before daylight, and sailed by the compass, as a heavy fog enveloped us. We had to rely on the compass altogether that day. We set our course by chart from one gas buoy to another, which were many miles apart, but luck favored us for about time to locate our buoys, the sun broke through the fog long enough to sight them, shape our course and run by compass to the next buoy. When the sun did break through the fog there were "fog-bows," which resemble rainbows, but are much more brilliant than any rainbow ever seen on land.

We had now completed eleven days of our cruise, and the Mianus twin-screw 30 h.p. engines had certainly given a good account of themselves, and caused us no anxious moments on account of faulty operation; on the contrary, they kept steadily on the job.

Leaving Liverpool, our next port was Halifax, Nova Scotia, where we arrived without incident the evening of October 11th. This was the day of the big race of the Canadian fishing smacks. These, of course, were sailing-vessels used for fishing purposes only, and only Canadian fishermen were participants in the race.

At Halifax, we opened the vessel's hold, got our supply of cylinder and fuel-oil and filled the supply tanks to the engine. We had now covered about 600 miles, or a little less than half the trip. By measurements we found the engine as economical as ever in fuel-consumption.

From Halifax we went to Drum Head, where we arrived at about 9 o'clock in the evening of October 12th. Due to bad weather, we stayed in Drum Head until the morning of the 14th, and our course then lead to Cape Canso. Our barometer gave us fair warning of what we might expect, registering as low as 26.3. About ten miles from the Cape the gale hit us, blowing 50 to 60 miles an hour, and we "land-sailors" on board certainly wished we were on shore. We must say, however, that the engines couldn't have behaved better, never missing an impulse; and despite the rough weather and heavy wind we encountered, as the wind was blowing off shore, had they failed, the chances would have been slim for anyone of us seeing shore again.

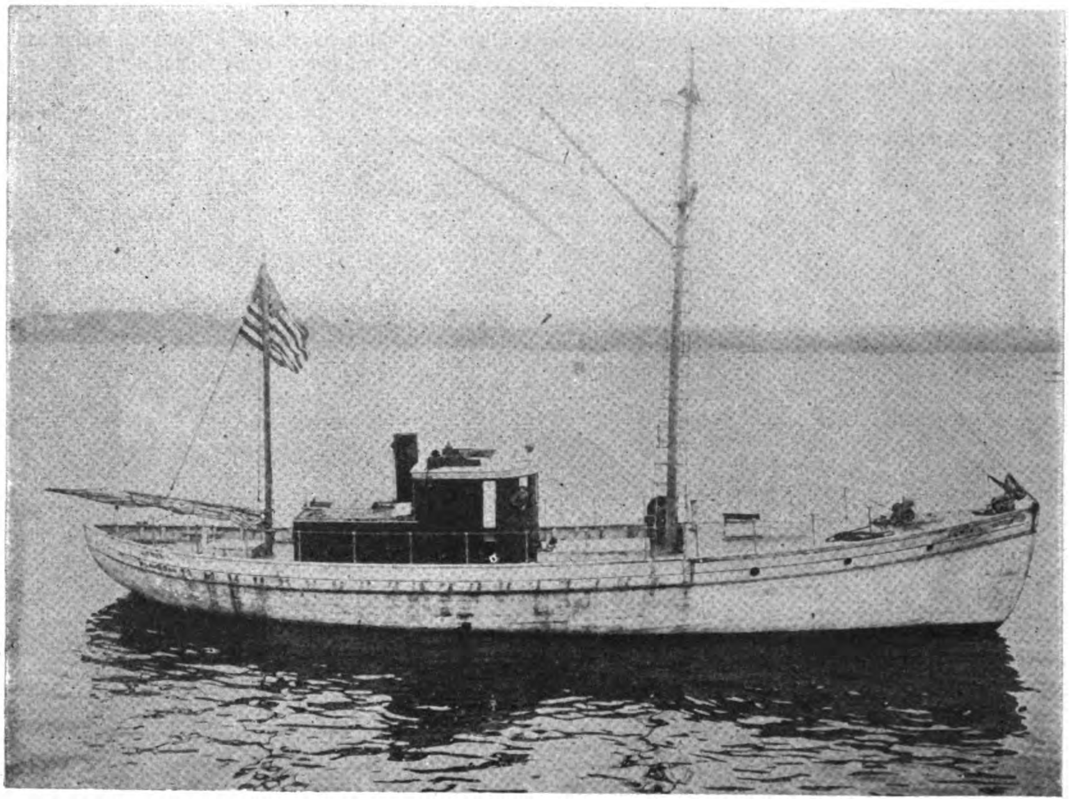
The barometer was still low, but we left Cape Canso for Hawkesbury on Cape Breton Island, the morning of October 15th. Because of bad weather from Cape Canso to Hawkesbury, a distance of about 25 miles, we decided to go no further than Hawkesbury until we got more favorable weather. The wind blew very strong that morning, and it took us about 8 hours to make that short run. Engines working hard all the time in a headwind and heavy sea. The bad weather didn't let up for several days, but by October 19th we started again. It seemed as though the wind blew harder days than nights, so we left Hawkesbury October 19th at 3 o'clock in the morning with fresh wind blowing, and had good going that morning for several hours. Later the wind freshened up, and the sea got very rough. At one time we were apparently standing still with the engines running full-speed ahead, the wind had increased to such an extent and was blowing so hard. The wind was so strong that at times the boat was awash from stem to stern. The pilot we had taken on board at Halifax came back to the engine-room, and wanted to know how things were. He was told that everything was running fine. Notwithstanding this fact, he said if the weather didn't improve, he thought it best to go back to Hawkesbury and wait for more favorable weather. However, because of the performance of the engines, we were able to hold our own for an hour, when the tide turned and ran with the wind, making somewhat smoother water, thus allowing us to proceed to Pictou, which port we finally made at 3 P. M. October 19th.

We started from Pictou the next morning at 3 o'clock. Fog hemmed us in, and we were compelled to anchor. By the time the sun was up the fog had raised, and we headed our course for Summerside, P. E. I. We had rough weather crossing the Bay, but as soon as we were under the lea of P. E. I. we had fine sailing all the way, arriving at Summerside 7 P. M., October 20th, where we lay three days on account of stormy weather.

At 7 P. M., October 23rd, we left Summerside for Gaspee. The engines were not shut down again until 6 P. M., October 24th, making a run of 23 hours. We started from Gaspee at 3 A. M., October 25th, running the motors until 9 P. M. We anchored for three hours to get a little rest, and then started for Rimuski, Quebec, up the St. Lawrence River, and arrived at Rimuski 6 P. M., October 26th. That ended the cruise so far as the boat was to go north.

October 27th, at noontime, there was a telegram from the Brown Company to Captain Dale, telling him that there was a pilot at Rimuski, who would show us across to the Brown Company's lumber camp on the opposite side of the St. Lawrence, and that we were to take over a load of supplies and provisions. The provisions and supplies were put on board, including about a thousand blankets, which were thrown on deck. The wind was with us when we started, but before we reached the other shore we encountered heavy sea, and the blankets were hurled down into the galley, all but smothering the cook. Our pilot, Chappie, the one we had taken on board at Rimuski was seasick, and completely lost his bearings, heading us for the shoal on the other side of the river. Our Halifax pilot and Captain Smith saved the day by running the wheel over and heading for deep water. A few hours later we made port in the lea of a point, remaining at anchor until 3 o'clock the next morning. At that time we left the point and made the entrance to the harbor, where a small launch met us to pilot the "Lewis L" into the Brown Company's dock.

We made the dock and discharged our cargo. The next high tide was about 4 o'clock, and in came a schooner loaded with cattle and pigs in the hold and horses on deck. The sails were furled, and they had started engine to make the dock. The man at the wheel gave orders to stop the engine, but for some reason the engineer didn't



The Mianus oil-engined tug "Lewis L."

obey orders, consequently the boat came up to the dock, passed it and ran on top of a ledge of rocks. As the tide fell, the boat listed, and there was certainly some commotion. The animals in the hold set up such a noise it was almost deafening, especially the pigs. The horses on deck were working as hard as they would on a steep hill to keep on the boat, and there was plenty of excitement for a while. Our crew hurried to the rescue, and assisted in slinging the horses off the vessel.

The next morning at 3 o'clock we got a message that the Brown Company's tow-boat was at the mouth of the harbor with a load of passengers. Due to weather which was too heavy for the tow boat, it was late in coming in. The tide doesn't rise high enough to allow this tow boat to come in over the bar, so we had orders to go out with our boat and get the passengers that had been storm-stayed for several days. The sea was not rough, and we tied alongside the tow boat, taking off her passengers and brought them safely to shore.

The tide now began to drop, and one of the Brown Company officials at the camp came aboard and gave orders to go to the other shore at once. The tide had already dropped to such an extent that the boat, in going over the bar, struck it, but cleared, and the boat's course was headed for Rimuski. The wind freshened, and the sea increased until it was almost too much for a boat to live in. Nearly everyone on board was seasick, and especially the Brown Company's official who gave the order to proceed to the other shore. We thought we had had heavy weather before, but never any weather as severe as this. At one time the bow of the boat was hit by the sea which caused it to drop faster than gravity. The stove left the stove lids in the air, and the boat being struck by another wave sidewise, when the lids dropped instead of dropping on the stove, they dropped on the cabin floor. Such a test as this is seldom given to any marine motor, yet the Mianus oil-engines came through without missing an impulse. During the whole run of about 1,400 miles, they were never held up for engine trouble. Several times on this cruise the seas were running so heavy the propellers were lifted out of the water, but, due to the governor on the engine, the engine didn't race, only increasing its revolutions about 15 per minute.

Standard Oil Motor Barge "Rochester Socony"

Interesting Steel Vessel Propelled by Standard Gasoline Engines

A NUMBER of interesting motor tank-barges are on order with the Moore Plant of the Bethlehem Shipbuilding Corporation at Elizabeth, N. J., and the first of these vessels has recently been placed in service. Such excellent results have been given with gasoline engines built by the Standard Motor Construction Co. of Jersey City, N. J., in craft of this size and smaller which they own, that the Standard Oil Company of New York decided to equip these barges with the same type of power plant.

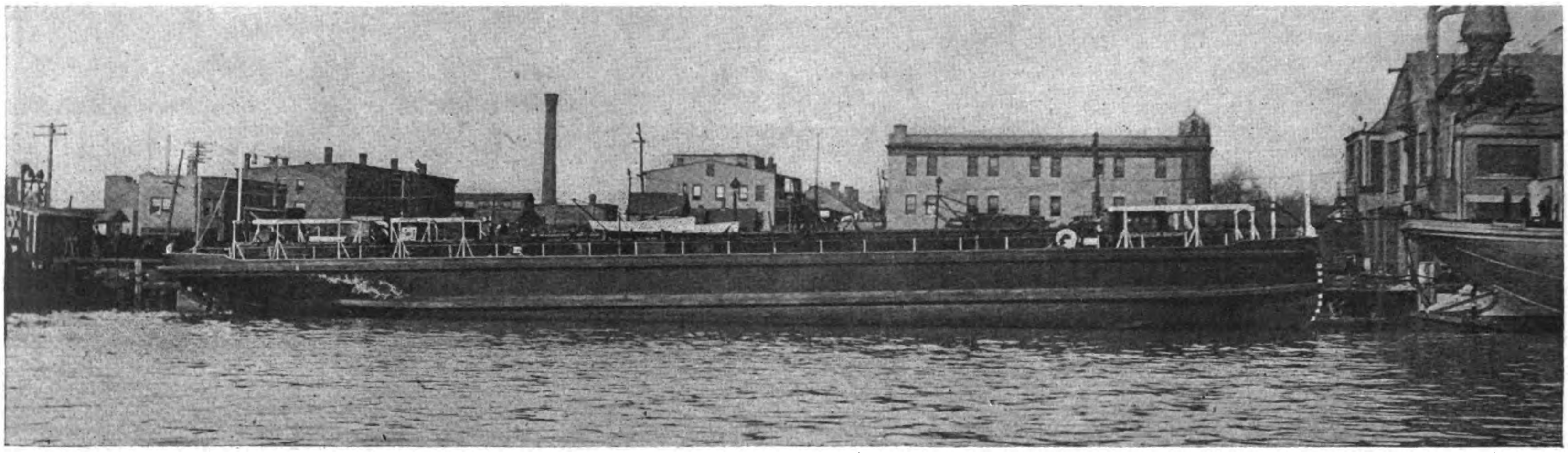
Very interesting vessels have resulted. The hulls are constructed on the Isherwood system in way of eight oil-tanks with transverse framing fore and aft. The leading dimensions are as follows:

Net-cargo-capacity	788 tons
Fuel-oil (gasoline capacity)	4,000 gals.
Length	148.7 ft.
Breadth	28.1 ft.
Depth	11.8 ft.
Gross tonnage	400 tons
Net tonnage	287 tons

The machinery is installed aft, and the main engine is a 6-cylinder, 4-cycle type Standard gasoline engine, 12-inch bore by 14-inch stroke, developing 300 shaft h.p. In addition there is a 24 b.h.p. 4-cylinder Standard gasoline engine direct to a 100 K.W. direct-current generator of 100 volts made by the Electro Dynamic Co. of Bayonne, N. J.

For operating the cargo holds there is one Gould's No. 6 Rotary pump and one auxiliary cargo pump 8x10-inch duplex connected to 50 h.p. 4-cylinder Standard gasoline engine. Furthermore, the engines and pumps can be operated from the deck by means of extension stems and levers. The 100 K.W. electric-generator just referred to furnishes current for an electric steering-gear built by the Moore Plant and fitted with Cutler-Hammer control gear. The gear itself is arranged either to operate by means of electricity or by hand power. The capstan windlass is of vertical type hand-operated.

Quarters for the crew are arranged in the forward part of the vessel just aft of the fore-peak tank. The crew consists of Captain, mate, 2 engineers and 8 seamen. Galley and messroom combined, also toilet with shower baths, are located aft of engine-room.

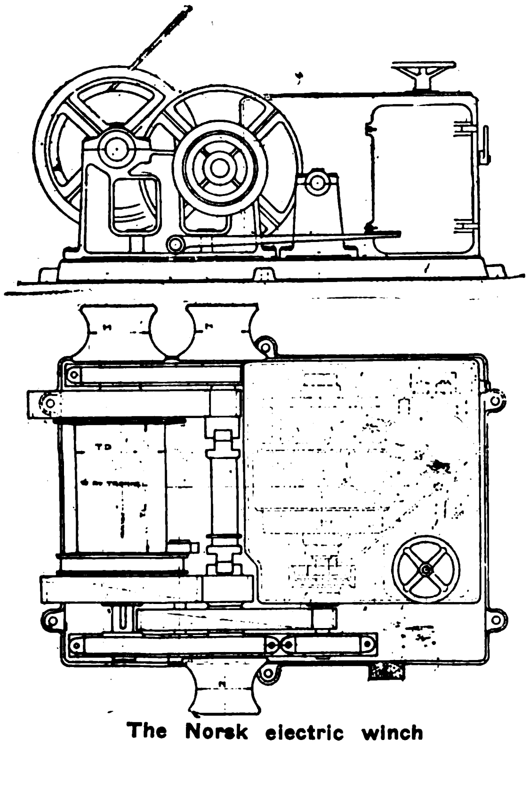


"Buffalo Socony," the first of a fleet of Standard-engined barges for the S. O. Co. of N. Y., built at the Moore plant of the Bethlehem S. B. Co.

NORWEGIAN MOTORSHIP'S ELECTRIC WINCH

Of late a number of descriptive articles have appeared in "Motorship" dealing with different domestic makes and types of electric-winches for merchant-ships, and it is interesting to note that very rapid progress is being made with this class of machinery, as is usual with anything electrical in this country. At the same time it is well not to lose track of what European winch manufacturers are doing, as in most cases their experiences extend over a longer period, particularly in the case of motorships, where the available power for the winches is not very flexible, but which is limited to the power of the auxiliary Diesel engines installed when the ship is built. This power depends upon the amount the owner is willing to invest when planning the ship.

In the past European shipowners do not have appeared to consider that very rapid-operating winches secure sufficient gain to offset the extra cost of the auxiliary plant in general. But with the average American ship-owner, quickly operating deck-gear is of the greatest importance, and that swift handling of cargo and short stays in port affect economies of values. Thus American electric-winches have a lifting speed of 150 to 200 ft. per minute with an average load. This saves quite a little time, both loading and unloading. Most European motorships that have visited this country have electric-winches operating in the neighborhood of 100 ft. per minute. Nevertheless, from a constructional aspect they have many noteworthy features.



The Norsk electric winch

One of the best known electric-winch makers in Scandinavia is the Norsk Elektrisk & Brown Bros. of Kristiania, Norway, whose motorship winch we illustrate. The electrical parts are well-protected from the elements, being placed in a cast-iron case that is fitted with watertight doors and cover, while the housing containing the resistance has a good ventilating arrangement. There are three models as follows:

Direct pull on Drum	Power	Lifting Speed ft. per min.
1½ tons	13	108
3 tons	13	50
5 tons	22	50

The three and five ton models are so fitted that they can run at 132 ft. per minute with 1,000 and 1,800 kg. load. Each which have three capstan-drums and band-brake operated by a foot pedal, and all bearings are metal bushed and the gears have cut teeth.

MOTORSHIP "THEODORE ROOSEVELT" CHARTERED AT LOW RATE

The new Danish motorship "Theodore Roosevelt," 4,500 tons gross and 11 knots loaded speed, has been chartered to load wheat at Portland, Ore., for Great Britain at the rate of 87 shillings 6 pence, or about $14.75 at current exchange rates. This rate is $3.25 under the rate recently set by the U. S. Shipping Board. The "Theodore Roosevelt" has a carrying-capacity of 567,000 cubic ft. of wheat, also 12 passengers, on a loaded displacement of 15,065 tons.

"VOYAGES OF A LARGE CONVERTED STEAMSHIP"

NEW YORK SEATTLE

MOTORSHIP

Devoted to Commercial and Naval Motor Vessels

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Voyages of a Converted Steamer

Interesting Record of the Single-Screw Motorship "Songvaar," One of Three Sister Steam-Vessels Converted to Diesel Power Seven Years Ago

By R. D. KARR

MANY references have appeared in the pages of "Motorship" regarding various steamers that have been converted to motor-power now numbering in excess of twenty, among the more noteworthy of which are the three sister single-screw 5,000 tons d.w.c. cargo-carriers built on the Clyde twelve years ago, and originally known as the "Chumpon," "Bandon" and "Pangan." These craft were the earliest of large conversions, the work having been completed in 1914, since when they have reguarly been plying the Atlantic and other oceans for seven years, making big profits to their owners, especially during the period when there was a scarcity of bottoms.

They were built as steamers by Barclay Curle & Co., Whiteinch, Glasgow, in 1909, and in order that their history may easily be traced by shipowners, we will give their "family tree" as follows:

Present Owners	Original Owner	Second Owner
	East Asiatic Co.	
S. O. Stray & Co.		Norwegian Government

"Songvaar,"	ex	"Landvard,"	ex	"Pangan"
"Songdal"	ex	"Folkvard"	ex	"Bandon"
"Songvand,"	ex	"Lidvard,"	ex	"Chumpon"

Present Dimensions

Deadweight capacity	5,000 tons
Net cargo-capacity	4,300 tons
Gross tonnage	2,462 tons
Net tonnage	2,172 tons
Under-deck tonnage (cubic)	3,145 tons
Classification	Highest Norwegian Veritas 1A1
Power	1,600 i.h.p.
Engine's speed	110 r.p.m.
Ship's speed (loaded)	9 knots
Daily fuel-consumption (loaded)	8 tons
No. cylinders, bore and stroke	Six 26⅜ in.x39⅜ in.
Type	Four-cycle, single-acting
Make	British Burmeister & Wain
Length (b.p.)	330 ft.
Breadth	47 ft.
Depth	28 ft.
Total No. of crew	29 officers, engineers and men

The crew of 29 men is represented by ten engineers, etc., in the machinery-space, fifteen on deck, and four in the galley, the firemen having been eliminated when the vessels were converted to Diesel power, with the exception of the man required for attending to the auxiliary donkey-boiler. Diesel-electric auxiliaries were not installed because the vessels were already equipped with steam deck-machinery and the attendent piping.

Burmeister & Wain Oil Engine Co. of Glasgow (now Harland & Wolff's Diesel Engine Dept.) were the constructors of the marine Diesel-engines of these ships, and the work of conversion was carried out by them under supervision of engineers from the Licensors of that name at Copenhagen, Denmark.

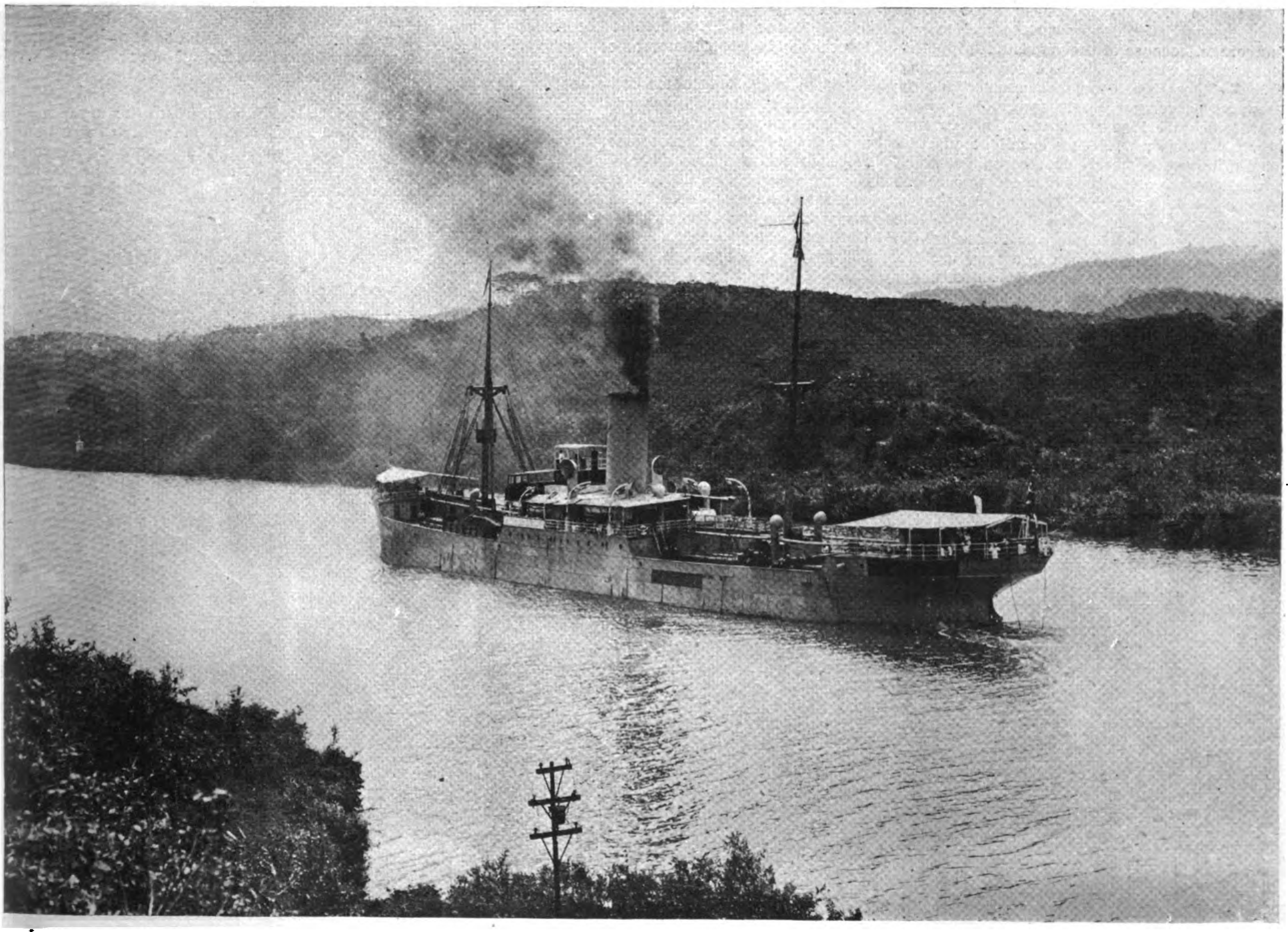


Fig. 1.—S. O. Stray & Co.'s motorship "Songdal," sister to the "Songvaar," in the Panama Canal. The smoke out of the stack is from the oil-fired donkey-boiler and not from her Diesel-engine

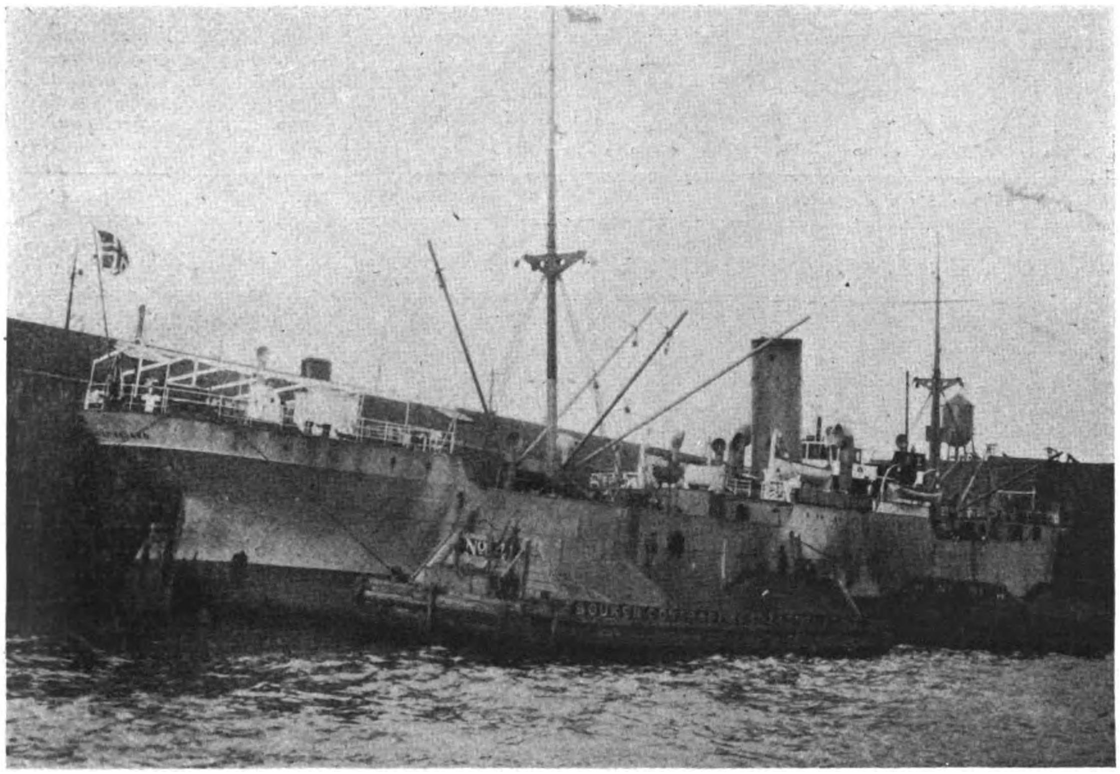


Fig. 2.—The converted steamship "Songvaar" at her pier in New York. She is now propelled by a single 1,600 i.h.p. Burmeister & Wain Diesel-engine

In their capacity as steamers before the conversion these ships may be considered to have been overpowered, being of 2,000 i.h.p. and burning 35 tons of coal per 24 hours, which from the point of commercial economy means too high a fuel-bill for a 5,000-ton ship. This is almost five times the present oil-consumption, and with less than one-knot difference in calm-weather speed, which as motorships, they should now "make up" over a year's average, because of the consistent propeller-efficiency in bad weather, due to absence of racing.

Originally these ships had accommodations for about twelve passengers in six staterooms on the starboard side in bridge structure. These rooms are now used for crew, giving excellent quarters with bath, hospital, messrooms, captain's cabin, etc., far in advance of the average accommodations in a similar-sized steamship. This point, however, is characteristic of the modern motorship—the attitude of all owners seemingly is to attract the higher class of dependable men to a seagoing life. That they have succeeded in most ships under foreign flags is becoming more and more evident. In fact, the way it works out in operation is this—a high standard of living is provided in accommodations, food, etc., and a correspondingly high standard of operating-efficiency is produced. This is now the aim of most American shipowners.

The work of conversion of the M/S "Songvaar," ex "Landvard," ex S/S "Pangan," was completed in 1914, as stated. She with her two sister ships were owned and operated by the East Asiatic Co. until the latter part of 1916, when these three vessels were sold to the Norwegian Government, who made a huge operating profit, and then sold them to S. O. Stray & Co.

Through the courtesy and co-operation of Mr. W. A. J. Kopp, Treasurer of S. O. Stray & Co. and Manager of the New York Office, and Captain Christopherson, the company's marine-superintendent, the writer obtained access to the ship's log-books and records since the beginning of operation by the Norwegian government in December, 1916. He takes the opportunity to acknowledge a debt of thanks to these gentlemen for enabling "Motorship" to place the following valuable operating information before shipowners.

Unfortunately, records of her performance as a steamship are not available, but even if they were, direct comparison would not be advisable, as the vessel was then higher-powered, carried a few passengers, and was in a totally different service from that for which records are at hand. But, undoubtedly, she now carries not less than 500 net-tons of cargo more than before.

At present all three vessels are owned and operated by the S. O. Stray SS. Co. of 11 Broadway, New York, and of Christiania, Norway, who are enthusiastic over their new tonnage. All three ships are in the Trans-Atlantic trade and will undoubtedly continue to "bring home the bacon" in the face of the coming rate-war, which era of economical-operation will serve perhaps more than the past war to bring into prominence the dependability and economics of the marine Diesel-engine. The ms. "Songvaar," of which the accompanying illustrations were obtained specially for "Motorship" and reproduced by permission of the owners, is now under charter to the Ward Line of New York, having left on New Year's Eve for Mexico with oil-well supplies and equipment. She arrived at the port of New York on December 14, 1920, in ballast—discharged, and went into dry-dock at Robins for cleaning and painting—proceeded to Pier 18, Brooklyn, loaded and sailed as stated above.

There are hundreds of steam-driven vessels laid up in the harbor—dozens of which the "Songvaar" passed and re-passed in two weeks on her busy way in and out through the Narrows. Were not the idle steamers seaworthy and ready for cargoes? Certainly! Could not the Ward Line use any of these vessels? We are reasonably sure that S. O. Stray & Co. chartered the vessel at a profit to themselves after paying crew, fuel and port charges. But, evidently, they are making a profit at a price for which American steam-vessels can not be operated. Perhaps it could be said the charter is not profitable! But we have to remember that the m.s. "Songvaar" crossed the Atlantic in a terrific mid-winter storm in ballast, to get this business. She probably would have stayed in Norway if her owners had not found profitable business for her here.

The "Songvaar" isn't the least bit different from a steamer in outward appearance, either from over the side or on deck. The steam cargo-gear, steering-gear, whistle, smoke-stock and rigging are all just as they were before conversion. Even when working the cargo smoke from her donkey-boilers pretty well smudges the atmosphere. The main machinery would perhaps give an unsuspecting steam-engineer a start when he first poked his head through the door in the upper engine casting "to look 'er over." If his glance should first take in the steering-engine, located in the upper deck level at the after end, he would have no intimation of the transformation elsewhere. This is still steam—and is located aft of the observer when viewing the main-engines as in Fig. 4. This picture shows the now generally familiar Burmeister and Wain cylinder-head arrangement. The first cylinder in the foreground is number five of the six cylinders for the whole engine, the last one being almost out of range of the camera, and is behind the engineers. Between the vertical air-suction pipes to the right may be seen the expansion-bend connecting the two halves of the exhaust-leader at the upper center of the engine. There are two one-piece castings for each group of three cylinders. Beyond the men may be seen the day service tanks, and on starboard side the donkey-boiler uptake.

Fig. 5 is a view looking forward on the port side at the operating-platform level. To the extreme left may be seen the steam generating-set—beyond a lathe and drill press. These tools are driven by belts from the shafting mounted overhead on the ship's frames. In the left foreground may be seen a work-bench and vise containing a fuel-valve—forward of the bench under the ladder is a small emergency air-compressor. This compressor is driven by a belt from the flywheel end of the steam generator in case of emergency. Beyond on the operating platform level may be discerned the auxiliary compressor. This is directly connected to a three-cylinder 200 h.p. 4-cyl. B. & W.

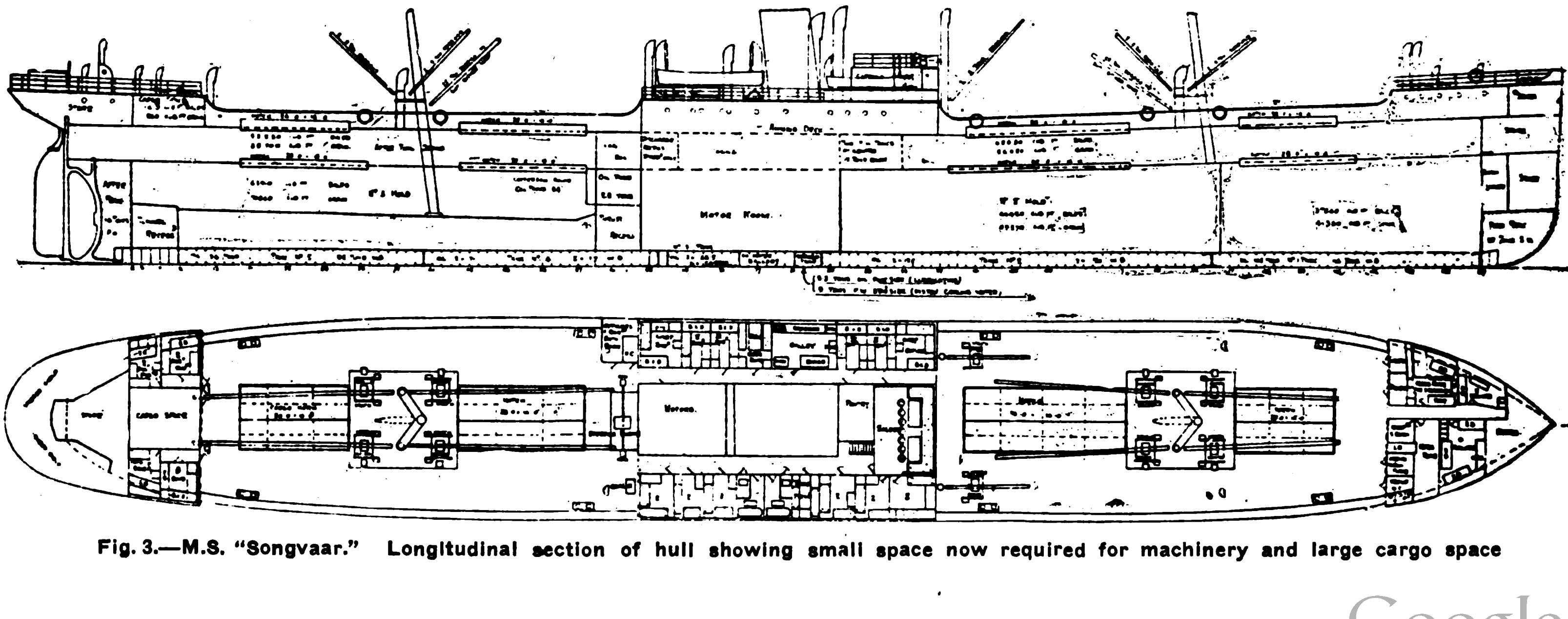


Fig. 3.—M.S. "Songvaar." Longitudinal section of hull showing small space now required for machinery and large cargo space

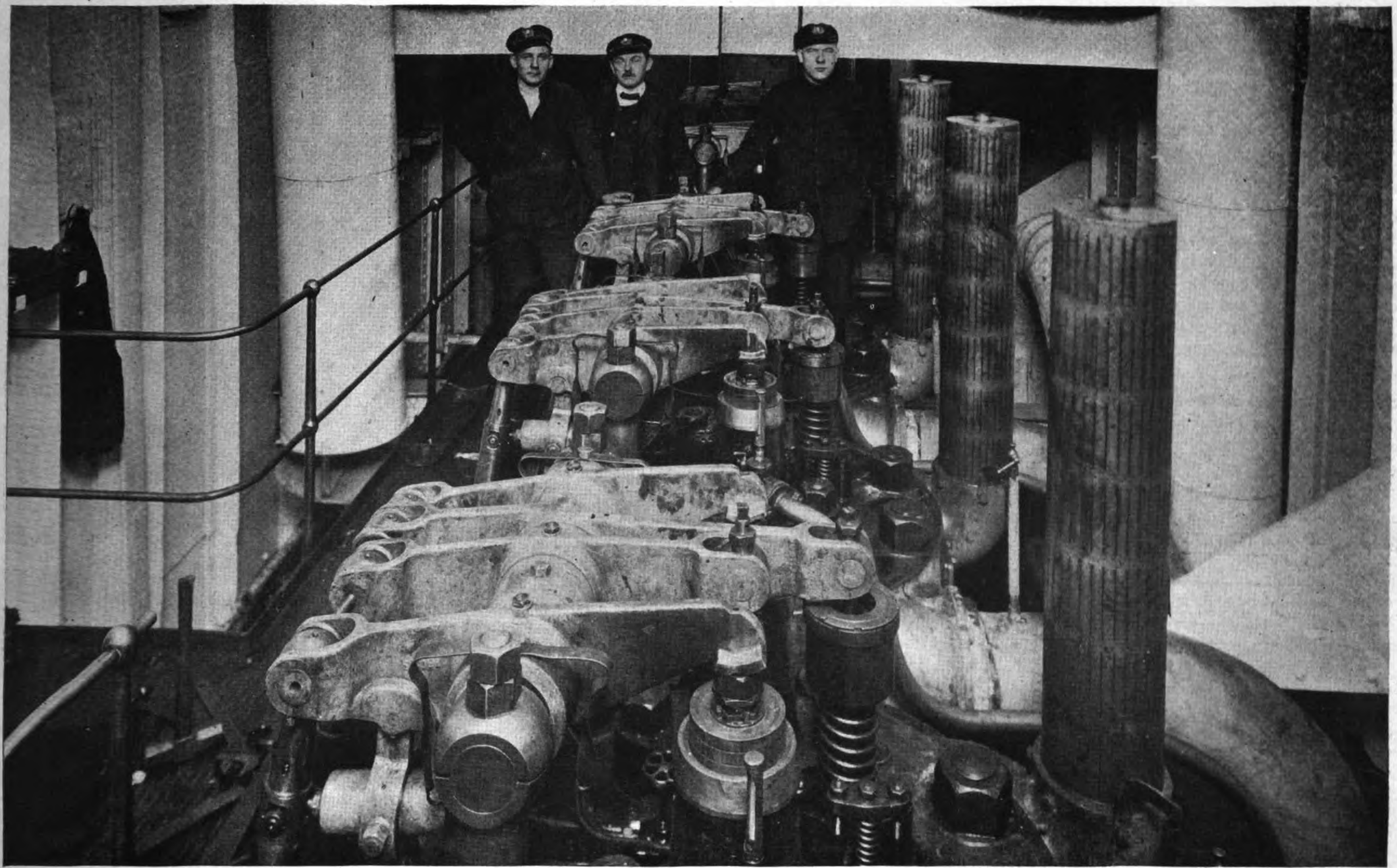


Fig. 4.—M.S. "Songvaar." View of the engine-room looking down on the cylinder-heads. The three after cylinders can be seen behind the engineers

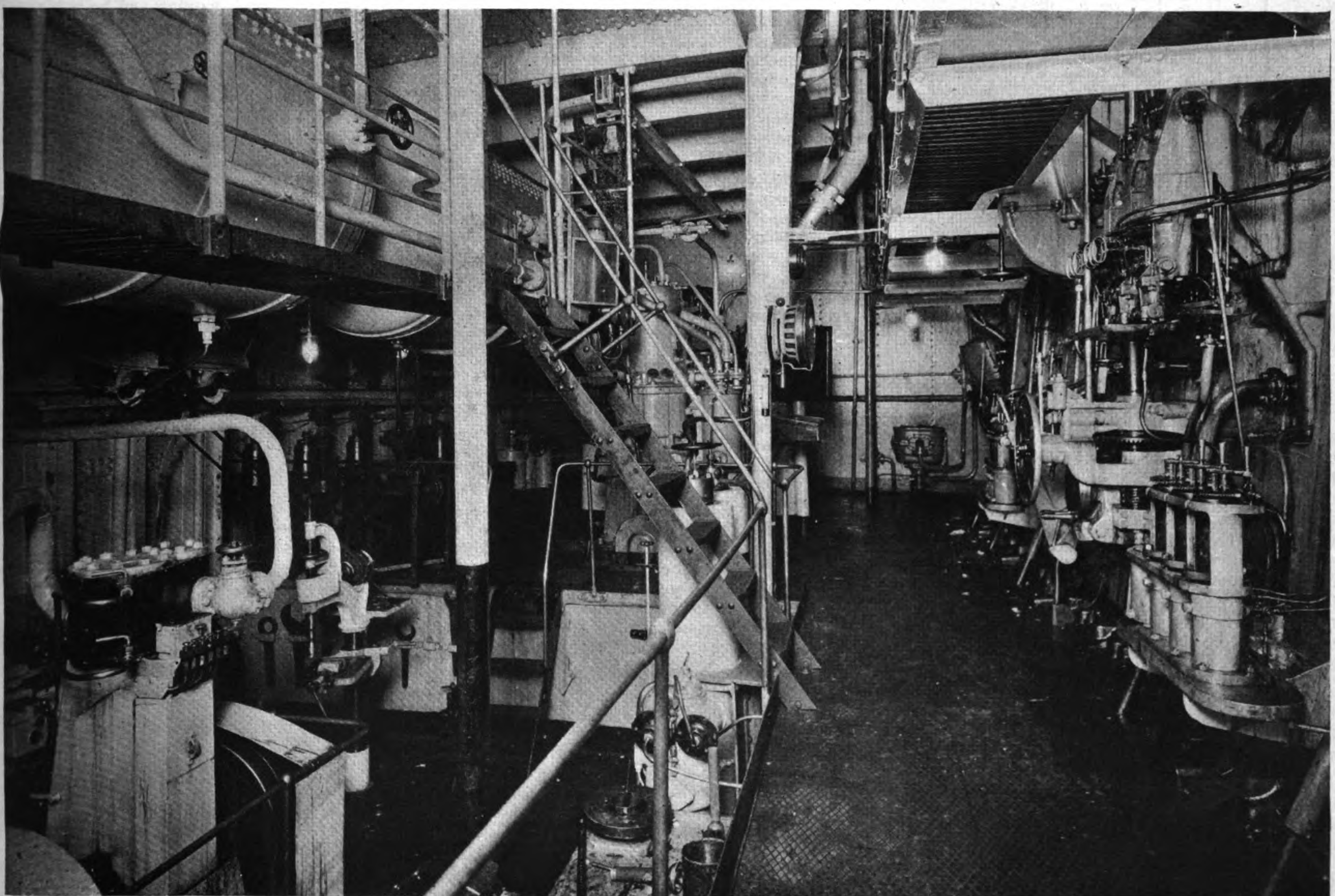


Fig. 5.—M.S. "Songvaar" looking forward on the port side of the operating platform of the engine-room

Diesel-engine, running at 300 r.p.m. Overhead near the shell of the ship are the two manoeuvring air tanks, each about 5 ft. in diameter and 10 ft. long. There can be little said in describing the main engine details as visible to the right in the view shown. This arrangement has often been described, and as this engine has now seen six years of service the only comment that need be made is that one familiar with the later engines of this design will notice the improvement over this arrangement as far as simplicity and neatness of appearance. Essentially all of the characteristic controls and interlocking mechanisms have been retained in the more recent models. Thus we have a hopeful sign regarding the standardization of the marine Diesel-engine.

Proceeding to the starboard side of the engine-room we find the oil-fired donkey-boiler at the forward end, with two banks of auxiliary pumps, piping and manifolds. The boilers are the regular Scotch return-tube type, and are of British manufacture, as are all the pumps, etc. For giving the boiler

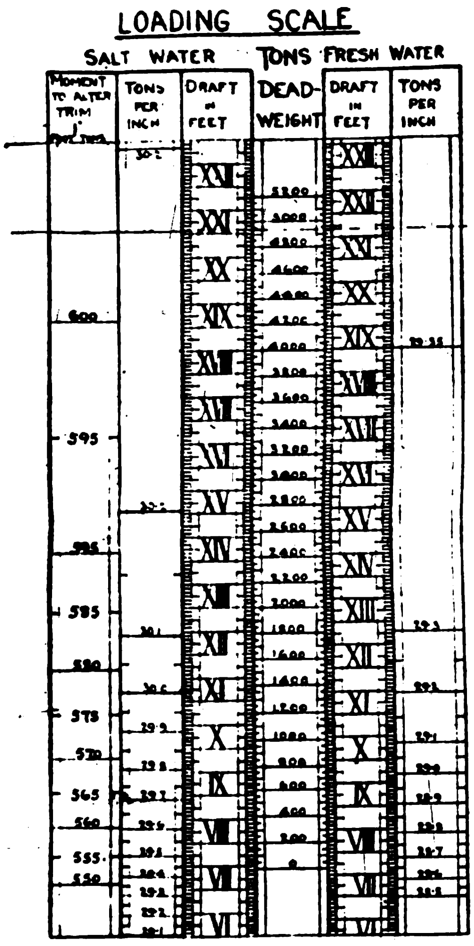


Fig. 6.—M.S. "Songvaar" loading scale

steam is used for atomizing the oil with the usual heaters, strainers, oil-pumps in duplicate. In the left of the picture (inboard side) are arranged the two engine fuel-oil transfer pumps, two lubricating oil-pumps, one distiller, one rotary fresh-water piston, cooling-pump and one centrifugal salt-water cylinder-jacket circulating-pump. On the outboard side are the bilge, ballast, general service, sanitary and wet-and-dry pumps—the latter for a cylindrical-shell single-pass condenser. In the illustration only the piping manifolds are in evidence.

A standard seven-collar thrust-bearing of the horseshoe type is located aft of the flywheel of the main engine with the usual oil and water service for lubrication and cooling.

Returning to a general discussion of the ship, inspection of the deck view will show the usual steam practice. The sizes of hatches may be mentioned as follows:

No. 1—22 ft. long x 13 ft. 11 in. wide
No. 2—36 ft. long x 13 ft. 11 in. wide
No. 3—28 ft. long x 13 ft. 11 in. wide
No. 4—24 ft. long x 13 ft. 11 in. wide

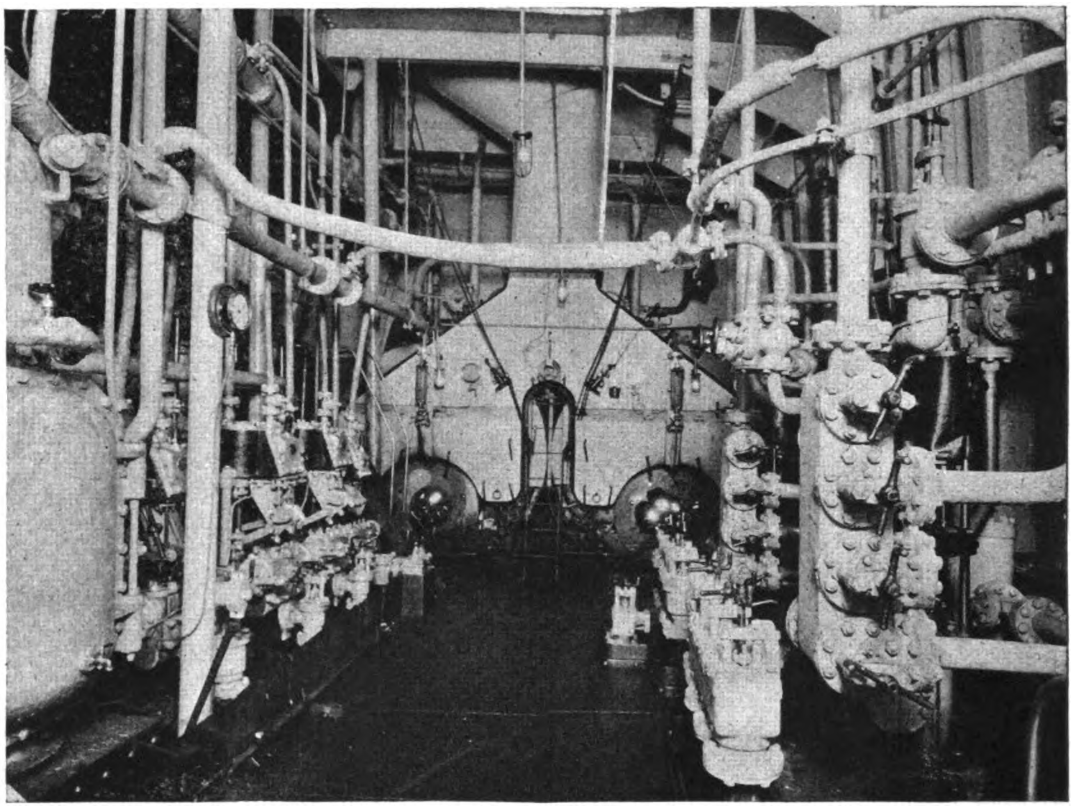


Fig. 7.—M.S. "Songvaar." Port side of engine-room showing oil-fired donkey-boiler at forward end

The ship has a double-bottom throughout which is divided as indicated in the following table of tank capacities:

Tank Location	CAPACITY (Tons) Water Ballast	Fuel Oil
Fore peak—Stem to fr. No. 157	28	—
No. 1—DB.—Fr. 157 to fr. 127—Hold bld at fr. 128	114	105
No. 2—DB.—Fr. 127 to fr. 86 W.4.—Keelson—Hold bld. at fr. 86	260	240
Lub. Oil Tank—Frs. 81-84—Port side		8.5
Fresh-water (piston cooling)—Frs. 81-84—Star side		9.0
Dry well—Frs. 75 to 81		
No. 3—DB.—Fr. 75-67 W.4—Vertical keel	49	45
Eng. Room sump.—Fr. 67-66		
No. 4—DB.—Fr. 66-40	154	142
No. 5—DB.—Frs. 40-13	92	84
Shaft-tunnel sump.—Frs. 13-8		
After peak—Frs. 13-0	14	
Hight tanks—Over-thrust recess	—	28
Day service tanks—Upper engine room	—	3.4
Total capacities	711	647.4

Above the thrust recess are two built-in fuel-tanks, the capacity of them being 3,433 gals. port, and 3,272 gals. starboard. In the upper engine-room the two settling-tanks for the main-engine fuel have a capacity of 7,400 kilos (1½ tons) each, and one tank for the auxiliary-compressor engine with 2,000 kilos (900 lbs.)

An analysis of the record of voyages made since the beginning of operation under the Norwegian Government in December, 1916, will be interesting. The adherence to steam auxiliaries has a marked effect in bringing up the total fuel-consumption as compared with the net main-engine consumption for each voyage.

Remarks on 4 years' service of M. S. "Songvaar":

Voyage No. 1.—Left Copenhagen 12/9/16. Cargo, 600 tons sand ballast. No stops. Weather fair. Arrived Philadelphia 12/30/16. Loaded at Philadelphia. Grain, 4,300 tons; fuel, 309 tons; lubricating oil, 12 tons; stores, etc., 60 tons; fresh water, 90 tons; total, 4,671 tons d.w. (W. N. A.) Stopped at Kirkwall, Great Britain, for inspection of neutrality February 2, 17. Left Kirkwall 2/1/17. Arrived in Bergen 2/9/17.

Voyage No. 2.—Discharged cargo and waited for orders on account of proclamation by Germany of unrestricted U-boat warfare.

Voyage No. 2.—Left Bergen 2/24/17 for Baltimore with 600 tons sand ballast, via Halifax, N. S., for inspection. Arrived at Halifax 3/16/17. Very bad weather. Left Hal 3/18/17. Arrived in Baltimore 3/23/17. No stops. Loaded 4,400 tons of grain and 360 tons fuel. No repairs. Left 3/31/17. Arrived Christiania 4/23/17. No stops. All rough weather. Discharged and went to shipyard of Akers Mek. Vaerksted, in Christiania for miscellaneous machinery over hauling and boilers repaired.

Voyage No. 3.—Left Christiania 5/27/17 in ballast, arrived Halifax for inspection 6/10/17. No stops. Left Halifax 6/11/17. Arrived in New York 6/15/17. Waited for cargo; took on 329 tons fuel, 9.7 tons lubricating oil. Sailed 7/4/17. Arrived in Halifax for inspection 7/7/17. Went aground en route to Halifax. Proceeded under own power. Received temporary repairs without drydocking, and left 8/6/17. Arrived in Sandfjord 8/20/17. Discharged cargo and went to drydock at Sandfjord. Extensive repairs to shell bottom plating, which was all crumpled; all fuel in double-bottoms was lost, but had 200 tons elsewhere, which was sufficient to cross the Atlantic. Shafting was re-aligned.

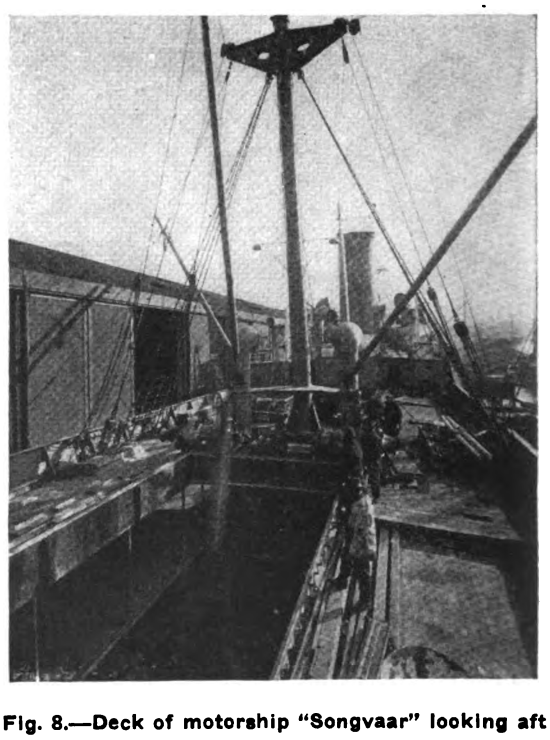


Fig. 8.—Deck of motorship "Songvaar" looking aft

Voyage No. 4.—Left Sandfjord 12/22/17. Arrived in New York 1/17/18. No stops. 600 tons sand ballast. Waited for cargo. Sailed 3/21/18 for Newport News.' Arrived 3/23/18. Loaded 4,637 tons coal; 343 tons in bunkers, stores and f. w.; total, 4,980 tons. Sailed for Habana 3/28/18. Arrived 4/2/18. Discharged cargo and sailed for Cardenas 4/5/18. Arrived Cardenas 4/6/18. Loaded sugar, 4,800 tons. Sailed 4/12/18. Arrived New York 4/17/18 and discharged. No stops. No repairs. Waited for general cargo. Loaded same and 447 tons fuel, 4 tons lubricating oil. Sailed 5/31/18. Arrived Moss, Norway, 6/18/18. No stops.

Voyage No. 5.—Left Moss for New York 6/26/18, in ballast, 600 tons sand. Stopped at Halifax for inspection 7/15/18, to 7/16/18. Arrived New York 7/19/18. Loaded general cargo. Left 7/31/18. Arrived Bergen 8/18/18. No stops. No repairs.

Voyage No. 6.—Sailed from Bergen 9/1/18, via Halifax for inspection. Arrived New York 9/22/18. Loaded general cargo. Sailed 10/6/18. Arrived Christiania, via Bergen, 11/3/18. Bad weather. Proceeded only by day in convoy along coast of Norway, anchoring in ports at night on account of mines in North Sea.

Voyage No. 7.—Sailed from Christiania 11/11/18 to Bergen, light. Loaded 700 tons sand ballast, and left for New York 11/22/18. Arrived New York 12/15/18. Bad weather. Had to go north of Scotland and close to Iceland to avoid war zone. Loaded general cargo, 4,000 tons (all cubic utilized), for Buenos Aires. Sailed 12/30/18. Arrived 1/28/19. No stops. Strike in Buenos Aires; idle 3½ months. Discharged. Loaded general cargo for Norway. Sailed 4/19/19. Arrived Christiania 5/27/19. Consumed two days running into Hull, England, for 300 tons fuel. Discharged cargo. Small repairs to engine.

Voyage No. 8.—Waited for cargo. Finally left Christiania 6/23/19 in ballast. Arrived New York 7/16/19. Took on 470 tons fuel in New York. Sailed for Gulfport, Miss., 7/18/19. Arrived 7/28/19. Loaded lumber, 1,100 standard, and sailed 8/21/19. Called at Port-au-Prince for 156 tons fuel-oil. Arrived Buenos Aires 9/20/19. Discharged and proceeded to Rosario 10/20/19. Arrived 10/22/19. Loaded 4,430 tons flour. Sailed 10/27/19. Arrived Christiansand, via Hull, 12/6/19. No unnecessary stops. Left Christiansand 12/9/19. Arrived Christiania 12/10/19, and discharged.

Voyage No. 9.—Sailed from Christiania 1/6/20 light, to Stavanger. Loaded 3,000 tons fertilizer. Arrived Bergen 1/9/20. Sailed 1/10/20. Arrived Charleston, N. C., 2/7/20. Very rough weather. Bunkered 350 tons fuel at Halifax, N. S. No stops. Waited for berth. Discharged and sailed, light, on 3/5/20. Arrived Louisberg, Canada, via New York, for stores 3/15/20. Lay off Louisberg 2 days for smooth weather. Loaded coal and sailed 3/23/20 for Christiania. Arrived Christiania 4/7/20. Discharged and went to Stavanger for drydocking and refitting. The ship had been sold to S. O. Stray & Co., in February, 1920, and she was now thoroughly overhauled and reconditioned by the Government before delivery. She was in the shipyard from April 28, 1920, to Nov. 9, 1920. All interior joiner work in living quarters is new, all machinery and equipment reconditioned, and she is to-day a pretty ship, sound, well found and well manned. Her first voyage under the present ownership brought her to New York—leaving Stavangar November 11, 1920, in ballast. The machinery is reported as behaving with absolute reliability, and the writer saw no evidence of any repair-work under way as a result of the severe trip.

Operating Data—M. S. "Songvaar"

Voyage	Distance Nautical Miles	Main Engine hrs : min	Auxiliary Engine hrs : min	Hrs. Donkey Boiler Port	Star	Electric Generator hrs : min	Fuel Consump. (Tons) Mn, Eng	Total	Lubr. Oil Consump. (Kg)
1 Copenhagen								+294	+12,800
to Philadelphia..	...	524 : 53	16 : 00	524	358	528 : 00	—94.6	—175	—520
Philadelphia to Kirkwall.....	...	405 : 00	4 : 00	329	193½	376 : 00	....	—141	—350
Kirkwall to Bergen.......	...	39 : 00	5 : 30	110	61	73 : 00	....	—19½	—39
2 Bergen via Halifax to Baltimore....	...	600 : 55	24 : 30	187½	984½	523 : 30	—91	—223	—559½
Baltimore								+360	
to Moss.........	...	480 : 28	10 : 20	1	510	303 : 30	—111.4	—179	—459
3 Moss via Halifax to New York....	...	421 : 05	16 : 30	314	441	216 : 00	—71.6	—145	—422
New York								+329	+9.914
to Sandfjord....	...	423 : 40	11 : 00	606	573	632 : 00	—98.7	—188	—441
4 Sandfjord									+4.810
to New York....	...	560 : 26	27 : 00	859	437	728 : 00	—95.9	—185.2	—565
New York via Newport News									+7.115
to Havana......	...	157 : 39	15 : 00	139	159	730 : 00	—31.7	—151.7	—298
Havana								+447	+4.216
to New York....	...	152 : 33	8 : 00	177	152	141 : 00	—30.8	—57.3	—139
New York		Figures include standing by in New York 4/17/18 to 5/31/18							
to Moss........	...	433 : 12	17 : 15	583	656	551 : 00	—93.7	—176.8	—471
5 Moss to New York....	...	484 : 41	1 : 30	661	101	219 : 00	—83.6	—148	—364
New York									+1650
to Bergen......	3,407	426 : 30	2 : 30	121	675½	264 : 30	—87.3	—141.5	—300
6 Bergen to Christiania and N. Y..	4,240	521 : 15	8 : 00	636	185½	380: 00	—93	—167	—370
New York								+271.1	+1686
to Christiania...	3,460	481 : 30	12 : 00	190¼	713½	497 : 00	—105.7	—185.7	—333
7 Christiania to Bergen......	3,430	583 : 15	6 : 00	709½	316¼	618 : 00	—89.7	—180.4	—389
and New York..								+453	+4,267
New York to Buenos Aires.	5,872	675 : 15	3 : 00	698¼	425¼	620 : 00	—158.1	—257.7	—470
Standing by in Harbor of B. A. 1/29/19 to 4/6/19....	...	4 : 30	4 : 30	9	605	462	....	—47	—81
Buenos Aires to Christiania...	7,183	863 : 30	12 : 00	676	140½	983	—199.3	—340	—659
Christiania to New York...	3,990	571 : 00	6 : 00	591	24	337	—102	—163	—376
New York to Gulfport.....	1,708	231 : 00	4 : 00	11	288	161	—44.6	—73.5	—163
At Gulfport 7/29/19 to 8/20/19...	...	0 : 35	1 : 00	50	716	185 : 00	....	—33	—55
Gulfport to Trinidad								+156.5	
and Buenos Aires	6,683	864 : 00	0 : 00	136	360	608 : 00	—194.5	—291	—613
Buenos Aires to Rosario......	240	38 : 00	5 : 00	115	95	104 : 00	—105	—22.0	—110
Rosario to Hull	7,286	884 : 00	5 : 00	284	761	564 : 00	—198.7	—299.7	—627
and Christiansend								+329.2	
9 Christiansend to Stavanger and									+3,200
Bergen.........	...	64 : 00	8 : 00	834	287	545 : 00	—17.0	—94.0	—223
Bergen								—250	—463
to Charleston...	4,106	658 : 30	16 : 00	291	833	576 : 00	—143.5	+350	
At Charleston 2/8/20 to 3/4/20	...	6 : 30	5 : 00	428	491	316 : 00	—1.8	—58	—149
Charleston to Louisburg....	1,664	210 : 00	4 : 00	566	717	146 : 00	—42.5	—71.5	—149
Louisburg to Christiania...	3,162	584 : 00	11 : 00	909	1068	334 : 00	—86.5	—153.5	—291
		Went to Stavanger, drydocked for reconditioning—delivered to S. O. Stray & Co.							
10 Stavanger to New York...	4,246	731 : 00	92 : 00	402	748	655 : 00	—94.2	—231	—509

It has been interesting and in a sense remarkable to see the growth of the sea-going motorship fleet on the Seven Seas. Like a bit of leaven the achievements of the earlier successses—often garbled into "failures" by opposing forces—have attracted, then convinced, and finally led others to adopt them. More and more shipowners are "seeing the light," just as the present owners of these able little ships learned of those advantages first through observation and then during the war as agents and charterers of the three converted steamers owned by their Government. Now as a result of sane reasoning and the courage of their convictions they purchased and now own these three motorships—"Songvaar," "Songdal" and "Songvand." May their type increase! This company, by the way, owns and operates nine steamships totalling 26,350 d.w. tons, sixteen sailing-vessels totalling 45,635 tons d.w., and one auxiliary motor-vessel of 3,600 tons.

Perhaps we shall see the New York and Cuba Mail SS. Co. (Ward Line) evincing some little interest in the type of vessel which they have just chartered. We await with not a little interest.

FRANK C. MUNSON'S ADVICE

At the recent meeting of the Merchant Marine Association in Washington, Mr. Fields J. Pendleton asked Mr. Frank C. Munson, well-known New York shipowner, what remedies could be adopted to overcome higher operating costs in wages on American ships, because the laws stipulated that our vessels must carry 50 per cent more men and pay 50 per cent more wages than foreign ships. Mr. Munson replied that the U. S. should adopt a Diesel-engine program which should result in the saving of fuel and employment of fewer men.

OPERATION OF 2,250 TONS CONVERTED SAILING-SHIP

The old sailing-ship "Sophus Magdalon," 2,250 tons displacement, and 1,500 tons d.w.c. was converted to Diesel power a year ago by the Haugesunds Mek Verksted of Haugesunds, Norway, and a 500 shaft h.p. Polar two-cycle Diesel-engine installed. After about twelve months' operation, the machinery is in excellent condition, no trouble or stoppage having occurred. The fuel-consumption has worked out at 2.3 tons per 24-hour day, and the speed is 10½ knots light and 8½ knots loaded. The propeller is 2,760 mm. dia. by 2,000 mm. pitch and 245 mm. diameter, and is driven at 150 r.p.m.

SUBMARINE ENGINES IN MERCHANT SHIPS

One merchant-ship propelled by twin 800 b.h.p. submarine Diesel engines reduced in speed so as to develop 600 b.h.p. has covered over 17,000 nautical-miles without any stop or delay. We refer to the m.s. "Oweenee" which is Vickers-engined. Another and similar vessel—the "Circe Shell," has covered över 14,000 miles without mishap of any kind. Both are tankers converted from iron sailing ships.

Nordberg 2000 B.H.P. Two Cycle Diesel Engine

New Carels-Type Four-Cylinder Engine With 500 b.h.p. Cylinder-Output Runs Tests.

IT has frequently been suggested that America has no factories truly capable of constructing high-powered merchant-ship Diesel engines, and that no large sets had been turned out. This is a fallacy that has existed partly because most of our biggest Diesel engineering works are a long way from the seaboard and consequently, shipping-men are unfamiliar with their output and capacities. We have just returned from the Middle West where we visited factories of various kinds, including three plants of considerable size, two of which have been engaged in Diesel engine construction for many years and the third is just starting on their first engine, and which for reasons shall be nameless for the time being.

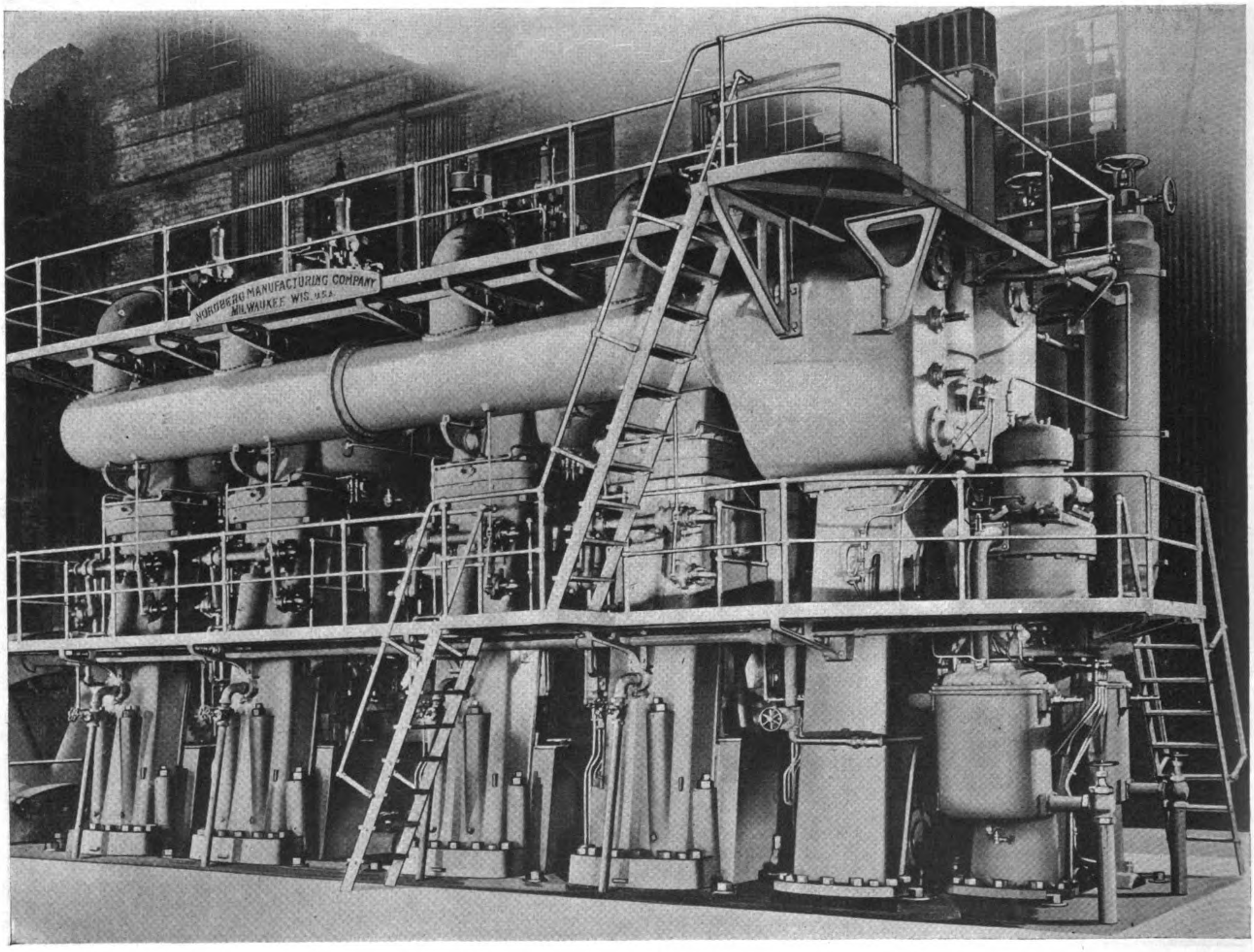
At one of the other two Diesel works, we saw the first of four crosshead-type Diesel-engines of 2,000 brake horse-power each running on the test-bed, and the same company's eighteenth 1,250 brake horse-power crosshead Diesel-engine start-up on her first run on the trial block, apart from five more and a number of smaller engines under various stages of construction. During our visit to Europe we saw most of the leading Diesel factories, and to be perfectly frank, we did not see one plant that could compare in capacity and equipment with this American one in the Middle West,—and, we saw some most excellently laid-out shops in Great Britain and in Continental Europe. The machine-shop alone of the American plant is eleven-hundred feet long, and the foundry is in proportion. Sometime during this year it is our intention to very fully illustrate and describe this and other Diesel factories in the United States in order that shipowners may become properly acquainted with their production facilities without making personal visits.

The particular Diesel plant in question that has completed so many big motors is the Nordberg Manufacturing Company of Milwaukee, Wis., who are constructing the well-known Carels Diesel-engine under license from Carels Frérès, Ghent, Belgium, who have engined a number of merchant ships, and who in conjunction with Schneider et Cie, of Creusot, in the past carried-out exhaustive experiments and developments including the building and testing of a single Diesel cylinder developing 1,250 b.h.p. This latter was quite a feat at the time as it was prior to 1912.

Unfortunately, for America's merchant-marine the 2,000 b.h.p. Nordberg-Carels Diesel-engine just completed and the three sister engines now building, are for land purposes and will be coupled to Westinghouse A. C. generators for providing power at the Phelps Dodge copper mines at Nacozari, Sonari. They will run on 14 Degrees Baumé Mexican crude-oil. Although they will not be installed in ships, we are giving illustrations and a few details, because the design is the same—with a few modifications—as the 2,000 shaft h.p. merchant-marine Diesel-engine that they have designed and which they hope shortly to commence building. Here it may be well to point-out that we were advised by the Nordberg Company that the construction of these large engines has now reached the stage in their plant that there is no necessity to carry-out prolonged tests on the brake at full-load and that the engines are run for comparatively short periods on light load without brake, then disembled and shipped to their destination, thousands of miles away, where they are re-erected and straightaway put in regular service.

In addition to large numbers of Diesel engines, hundreds of steam-reciprocating marine-engines have been turned-out by them. So, with these ideal experiences, associated experiences and facilities, the Nordberg directors and engineers are quite confident that they can build high-powered slow-speed Diesel marine-engines which in operation in merchant-ships will give as near absolute reliability as can be expected from any class of machinery that is called upon to work under severe and consistent conditions year in and year out. In fact, they are to-day prepared to go ahead with ship's Diesel-engines of 3,000, 4,000 and 5,000 shaft h.p. each, and not only stand at the back of results; but, to give shipowners more than adequate guarantees of the necessary reliability and economy in advance. This with the full engineering realization that the task of constructing such big engines is not one to be handled lightly, nevertheless, with the confident knowledge that they and their facilities are fully equal to it. As regards workmanship, we would say that from what we saw at the Plant it would be a difficult task to find better, while the castings are excellent. The latter is one of the most important factors in Diesel-engine construction.

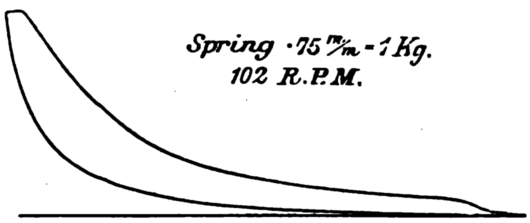
The 2,000 b.h.p. engine which we inspected is of the valve-in-head scavenging two-cycle type,



The four-cylinder, two-cycle type 2,000 b.h.p. Nordberg-Carels slow-speed Diesel-engine built at Milwaukee, Wis.

with vertical scavenging-pump and air-compressor driven off the forward end of the crankshaft, which by the way is built-up from Camden forged-steel sections and pressed together cold, the webs and the 17½ in. diameter crank-pin being in one piece forgings, with separate 17 in. diameter bearing-shaft forgings. The shaft-pins and the webs are turned and bored slightly taper respectively, and are keyed. They are pressed into position at a pressure of 150 tons, and afterwards the small square key is drilled-out and a large round key driven-in. This makes an enormously strong crank-shaft not liable to cracks or fractures. However, this is wandering into details of construction, instead of briefly describing the general features of the design of the engine as a whole.

This high-powered engine is only 40 ft. long, including a marine-type thrust-bearing, but without flywheel and is 22 ft. high above crank-shaft center to top of valve-rockers, with 12 ft. width over bed-plate. It has four-cylinders 28-inch bore by 44-inch piston-stroke, but the marine engine will have the stroke altered to 48-inch and so give the same power at 110 revs. per minute instead of 120 r.p.m. at which the stationary engine operates. It takes its place among the highest-powered four-cylinder Diesel engine yet completed



anywhere, if we except double-acting and opposed-piston motors. As far as a single-acting engine is concerned it is a noteworthy-accomplishment, and the accompanying illustrations and descriptions are the first to be published. This gives a cylinder out-put of 500 brake h.p. at 61.5 lbs. means effective-pressure and is higher powered than any other American Diesel engine yet built, even greater than the new Bethlehem-West engine which develops 2,500 b.h.p in six-cylinders—or 312 b.h.p. per cylinder. At it happens, it is understood that this latter engine is also of the valve-in-head scavenging two-cycle type, but no details are available.

Their respective weights, however, should make most interesting comparison, the Bethlehem-West being 700,000 lbs. without equipment. The marine type of Nordberg-Carels 2,000 shaft h.p. engine weighs 630,000 lbs. or 315 lbs. per shaft h.p. This includes flywheel, thrust-bearing, air-bottles, piping, oil-filters and tanks—etc. or say under 300 lbs. per s.h.p. without equipment.

In appearance the Nordberg engine is very clean-cut and attractive, as will be noted from the illustration. The cylinders are cast separately, and are directly mounted on cast-iron columns without any steel through-bolts—all stresses being borne by the columns. However, in the marine engine there is a cast-iron entablature between the cylinders and the columns to give the additional longitudinal stiffness required in a ship's installation. It will be seen that the design affords a walking space between the columns so that the engineers can easily pass from one side of the engine to the other, and can feel the cross-head and pistons, the latter extending below the cylinder liner on the down-stroke.

Cooling is by fresh-water for the land engines and by sea-water for the marine unit, the water passing to the pistons through the crossheads by means of swinging arms. These arms have very large bearings and are of heavy construction generally. We were advised that the water used for cooling these engines in service at the copper mines contains a high percentage of acid, more deadly in effect than sea-water, but that they have not yet experienced any trouble with leaks at the glands of the swinging-arms. Certainly we could see no sign of the slightest leakage on the engines in the Nordberg shops. Mr. B. F. Nordberg, Jr. said that troubles from leaks at the piston-cooling-water connections was the last thing they expected with a marine engine in service using salt water.

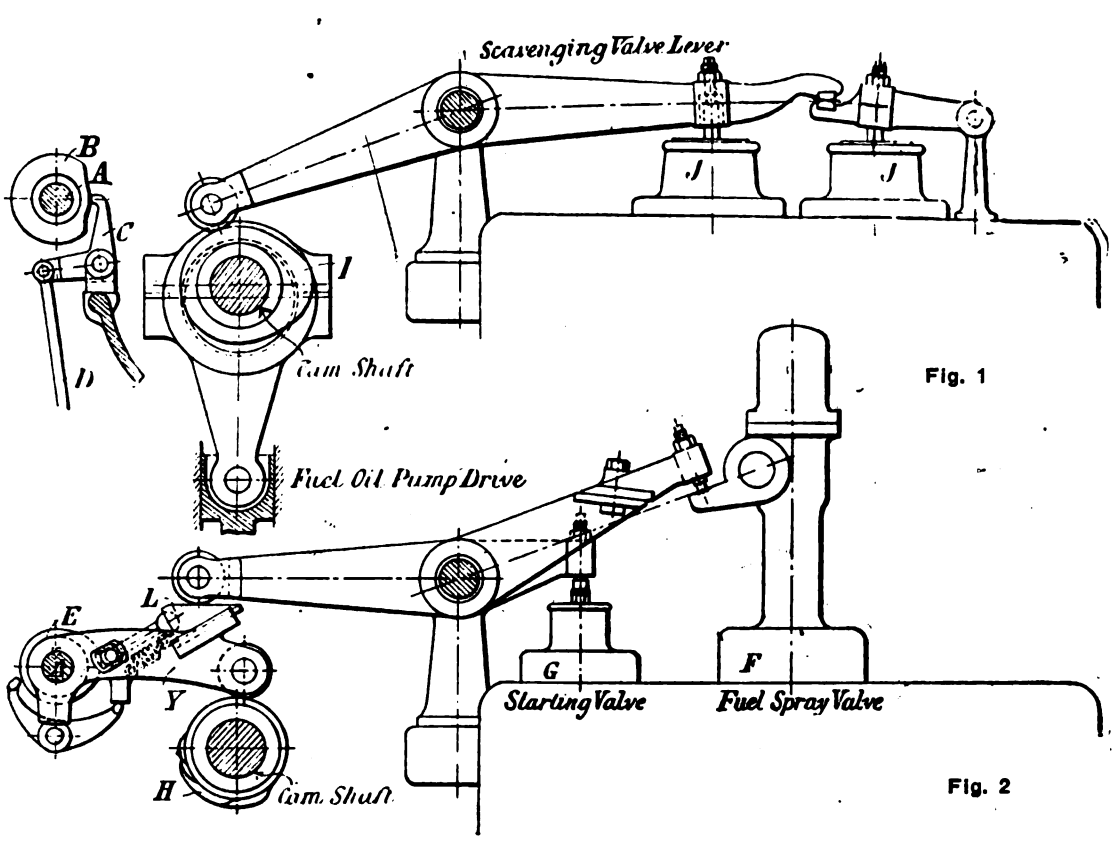


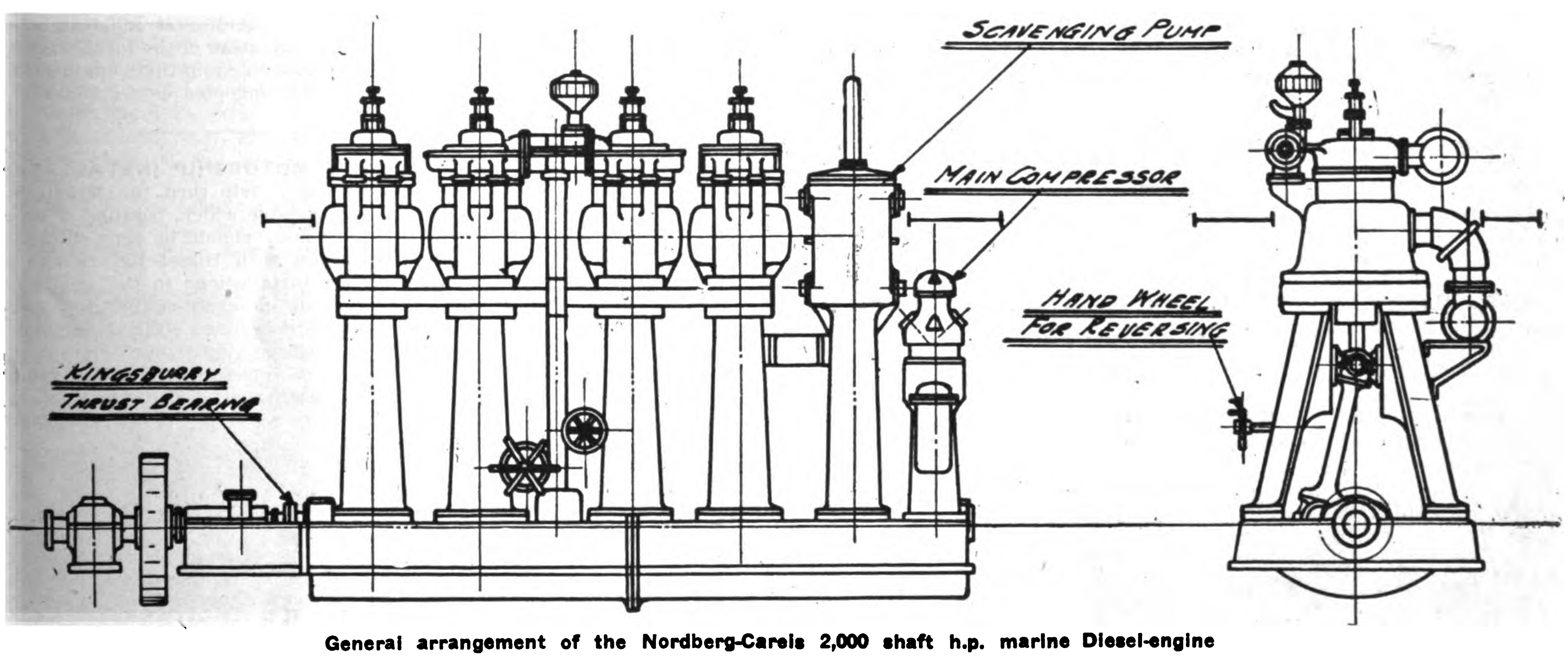
Fig. 1

Fig. 2

Reversing mechanism of Nordberg-Carels engine

Another modification of the stationary design will be found in the bed-plate, which at present is in three sections and will be changed to two sections. The crank-shaft is in two sections, one for each pair of cylinders with the cranks at 180 degrees, one section being at 90 degrees to the other.

As regards the reversing mechanism for the 2,000 shaft h.p. marine engine, that will conform to the design already used on the machinery of Carels-engined motorships, with, of course, minor modifications to suit American-operating and manufacturing conditions, and with such improvements suggested by Nordberg marine-engine experiences. Control of the engine, by the way, can be handled from either deck of the gratings,



General arrangement of the Nordberg-Carels 2,000 shaft h.p. marine Diesel-engine a long vertical shaft having control-wheels on the level of each deck, so that the engineer-in-charge can stop the engine if he is on either grating, or on the floor of the engine-room.

Reference to figures 1 and 2, on the diagrammatical sketches of the valve-gear, will make the valve-gear and reversing and manoeuvring mechanism quite clear. There are two shafts running fore and aft and the cylinder heads, and supported by brackets to the cylinder-body in the usual way. The outer shaft (A) is the manoeuvring shaft, and to it are keyed, firstly, cams (B) for operating the fuel-pump's suction—valves by means of the bell-crank lever (C) rod (D), as seen in Fig. 1; and, secondly, the cams (E) in Fig. 2 which serve to regulate the lift of the fuel and starting air-valves (F) and (G) respectively, and also to lift and replace the inter-starting and inter-fuel levers from off the main cams (H). Loose upon this shaft there are one inter-starting and one inter-fuel levers (Y) for each cylinder.

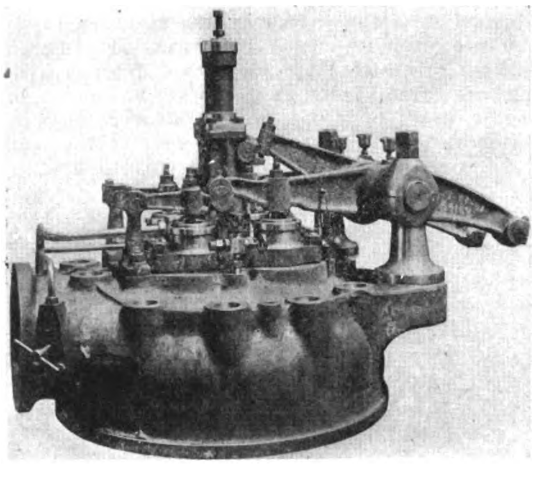
Turning now to a consideration of the reversing mechanism and its operation, there are two scavenging-cams, (I) operating the four scavenging-valves (J), and these are reversed by turning the cam-shaft through approximately 30 deg. by raising or lowering, as the case may be, the driving vertical-shaft by means of a compressed air servo-motor. In order to raise or lower this vertical shaft, the spiral-gears on the vertical-shaft are extra wide so that whether in the ahead or astern position, the proper tooth contact exists. By raising or lowering this vertical-shaft that it is compelled to rotate, due to the fact that the gears are spiral gears, therefore, the relative position of the main engine-shaft and the cam-shaft must be changed.

It must clearly be understood that the scavenging-cams do not move fore and aft. There are two fuel-cams and two starting air-cams to each cylinder, and the cams (E), by means of the roller-raising lever, lift the inter-starting and inter-fuel lever Y from off the cam upon which it has been working. Then the manoeuvring-shaft is moved longitudinally, and the inter-starting and inter-fuel lever is brought into line with the fuel or starting air-cam for the required direction of rotation. Further rotation of the manoeuvring-shaft rotating cams (E)—the inter-starting and inter-fuel-valve levers are loose upon this shaft—causes the inter-fuel and inter-starting air-levers, of bronze to descend upon the requisite cam.

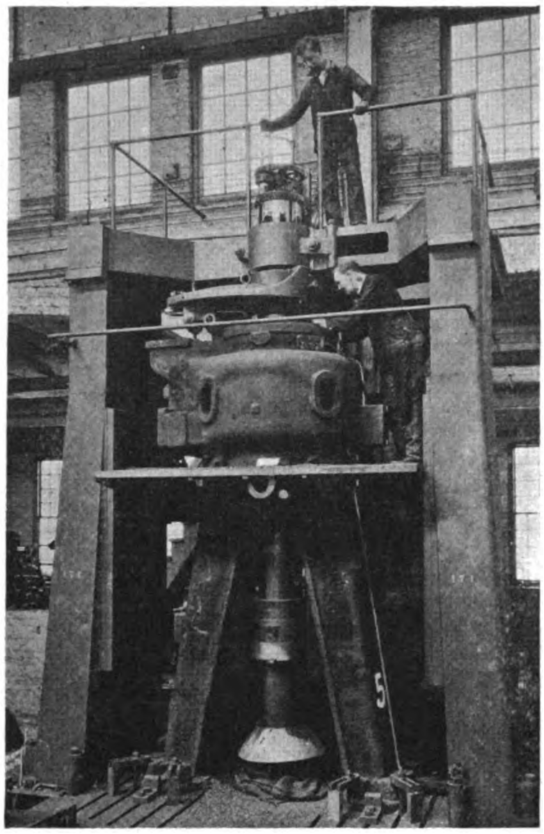
Still further rotation of the manoeuvring-shaft and its cams E actuates the wedge-piece (L) through a roller and spindle, and so first causes the opening of the starting air-valve. Starting-air is thus admitted to all four cylinders, and then for two cylinders by a rotation of the manoeuvring shaft-cams, actuating now the wedge-piece (L), causes the starting-air to be gradually cut-out and the fuel to be gradually cut-in.

The fuel-pumps, one for each cylinder-are operated by eccentrics from the camshaft, and are arranged in pairs each pair operating in one forged-steel body, mounted between each set of two cylinders on the upper gallery of the engine. At the same time as the fuel-oil is being cut-into the first two cylinders the cams shown at (B) operate through bell-crank levers, and so control the suction-valves of the fuel-pumps and fuel-oil is thus delivered to the cylinder. After the two cylinders are firing the further rotation of the manoeuvring-shaft causes exactly the same cycle for the other cylinders, and all cylinders will then be running on fuel.

The working of the valve-gear, the exact relationship between the cam-shaft, manoeuvring-shaft, and cam-levers, can well be understood from reference to the cuts attached. The action of the wedge-piece is obvious, and the spring which controls it is shown. It will be noticed that the fuel and starting-air cam-levers are in two pieces, to facilitate the inspection of the valves. The scavenging air-valve gear is also clearly shown, and the manner in which the four scavenging-valves are operated will be readily understood.



Head of a 500 b.h.p. Nordberg Carels cylinder showing scavenging-valves



Boring a Diesel cylinder at the Nordberg Plant with one of the many special machine-tools

A feature about this valve-gear is the wedging action whereby the starting-air is gradually cut out and the fuel-oil gradually cut-in. This gives an even turning moment all the time. At the commencement the air-pressure, viz., 400 lbs. to 450 lbs. per sq. in., ensures that there is a large starting torque; further, the design of the starting-valve mechanism necessarily gives that large starting torque at all positions of the cranks, and the wedge action makes for an even turning moment throughout the period of engine acceleration. There is no shock due to the air being suddenly cut-off and the fuel suddenly injected in. It is a gradual process the one merging into the other. The air for starting purposes, is reduced in pressure from the blast-air pressure to 400 or 450 lbs. by means of a reducing-valve. By reducing the blast pressure to 400 or 450 lbs. only one auxiliary air-compressor is necessary to perform all functions required in operation or manoeuvring.

The control of the engine is by means of one wheel and two levers on the starting platform; controls the servo-motor, which gives the camshaft its angular misplacement by raising or lowering the vertical driving shaft, and also gives the manoeuvring shaft its fore-and-aft movement. Another lever controls the fuel and also hand control is provided by a handle on the column, which actuates a shaft running fore-and-aft on the engine, and so sets all the fuel-pump suction-valves. A wheel operated by hand, gives the manoeuvring-shaft its rotary motion. As seen in Figs. 1 and 2, the cams upon the manoeuvring-shaft act upon the suction valves of the fuel-oil pump. The small dial above the hand wheel indicates the position of the valve-gear. Although compressed-air is used, as stated, for actuating the vertical shaft, causing the angular rotation of the camshaft and the longitudinal movement of the manoeuvring-shaft, the hand gear in emergency may be used. All of the manoeuvring levers are so interlocked that no false moves can be made.

By reading the foregoing description, at first thought, the valve gear may appear complicated, but this is not the case. It is true that it is composed of many parts but the function of each part is simple and definite. Stopping from full-speed ahead has on trial been accomplished in 2 to 3 revolutions of the main engines, and the reversals from full-speed ahead to full-speed astern has been accomplished in 6 seconds. In one case of a trial with a Carels-engined ship reversals were carried-out from orders given from the bridge of the vessel to correspond with the actual condition in service, and 63 reversals were accomplished in 42 minutes with more than half of the high-pressure compressed-air still unused. The auxiliary compressor was, of course, in use for this trial.

Finally, we will mention that when the first large Nordberg marine-engine is completed, we will give a very complete and detailed description in the pages of "Motorship"; meanwhile limiting ourselves to the foregoing brief description. We noted, by the way, that Manzel lubricators were fitted on this engine instead of the local make with which Nordberg used to equip their engines—Manzels now having been adopted as a standard.

A VALVE FOR MOTORSHIP INSTALLATIONS

When on a recent trip thru the Middle West we came across a valve which, because of its construction, to our mind should be very suitable for use in conjunction with Diesel-engines and auxiliaries, and for installations in the engine-room and other parts of merchant-motorships. Owing to shortage of time we are obliged to leave an illustrated description until our March issue. Meanwhile any firm interested can secure information by communicating with Mr. G. A. MacLean of the O'Malley Beare Valve Co. of 80 East Jackson Boulevard, Chicago, Ill.

Some Large American Diesel Engines Built or Under Construction

Engine Type	Bethlehem-West Two-Cycle	Worthington Four-Cycle	Nordberg-Carvels Two-Cycle	Mc Intosh & Seymour Four-Cycle	Busch-Sulzer Two-Cycle	Craig Four-Cycle	Ingersoll-Rand Four-Cycle	Skandia-Werkspoor Four-Cycle	Newport-News-Werkspoor Four-Cycle	New York-Werkspoor Four-Cycle
Brake horsepower	2,500	1,750	2,000	1,525	1,250	1,555	1,700	850	1,500	1,500
Indicated horsepower	3,500	2,400	2,800	2,000	1,800	2,000	2,200	1,150	1,950	1.950
No. of Cylinders	6	6	4	6	4	6	6	6	6	6
Cylinder Diameter	25½"	29"	28"	28"	24"	28"	....	20.472"	26.378"	26.378"
Piston Stroke	48"	46"	48'	48"	38"	48½"	....	35.433"	47.244"	47.244"
Revs. per minute	105	120	110	105	110	100	....	130	110	110
Piston Speed (per minute)	840'	920'	880	840'	696'	808'	....	767'	866'	866'
Brake H. P. per Cyl	416	291	500	254	312	258	....	141	250	250
Ind H P per Cyl	584	400	700	335	450	333	....	175	325	325
Weight (Short tons)	350 tons	339 tons	281 tons	361 tons	175	tons....	...	117 tons	201 tons	201 tons
Weight per B. H. P.	250	386	315	475	....	....	....	276	268	268
Mean Effec. Pressure	64.1 lbs.	73.27 lbs.	61.14 lbs.	65 lbs.	....	66 lbs.	....	....	....	....
Length Overall	....	45'	44'	47'-4¼"	35'	....	....	26'3"	34'	34"

Motorship "Fritzoe" Runs Trials

Interesting 1,000 Tons D.W. Burmeister & Wain Diesel-engined Vessel for Baltic and North Sea Trades

PROBABLY shipowners on the Pacific Coast will be considerably interested in a new steel motorship of small tonnage which has just run successful trials in the firth of Christiania, Norway. She is a very complete and well-equipped vessel, especially built for transporting lumber to England, carrying coal as return cargo. Furthermore, her operation on this short route will be of considerable interest as some shipowners have been given an erroneous idea that motor-vessels can only be used advantageously on long overseas routes. They make excellent coastwise lumber carriers.

The vessel in question is the motorship "Fritzoe," which has already been referred to in the pages of "Motorship" and which must not be confused with the Götaverken-built Burmeister & Wain vessel "Fritiof" illustrated in the December issue of "Motorship." The latter vessel is a salvage ship.

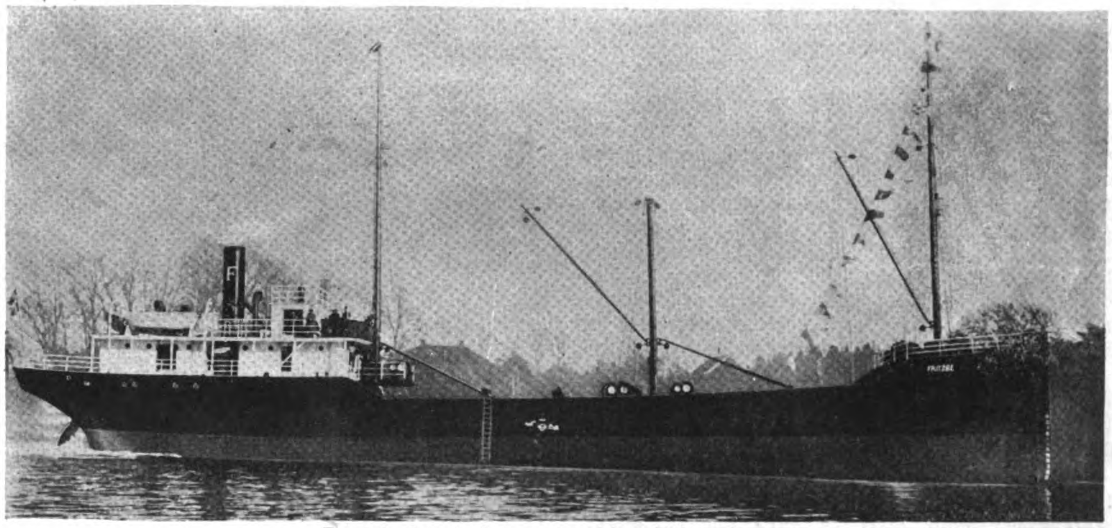
The motor-freighter "Fritzoe" is a single deck ship with machinery installed aft. She has one large cargo hold with two big hatchways, the forward hatch being 33 ft. long by about 15 ft. breadth, while the aft one is slightly longer. Tanks numbers 1, 2, 3 and 4 are arranged to handle fuel-oil while tank 5 and the fore and aft big tanks carry 167 and 47 tons of water, respectively.

She is built to the Norwegian Veritas and has the following dimensions:

Dead-weight capacity	1,000 tons
Length (O.A.)	58 ft. 2 in.
Length (B. P.)	54 ft. 7 in.
Breadth (md.)	9 in.
Cubic-capacity (grain)	51,290
Cubic-capacity (bales)	46,424
No. officers and crew	16 men
Daily fuel consumption	1.9 tons
Loaded speed	10.0 knots
Trial speed	10.8 knots

The "Fritzoe" is propelled by a six-cylinder direct-reversible Burmeister & Wain four-cycle type Diesel engine of the trunk-piston class, and is of a new design especially built for service in small vessels. This reminds us that before the days of the "Selandia"—in 1910, if we remember rightly—Burmeister & Wain ran trials of a 400-h.p. trunk-piston type merchant-marine engine, which they built for experimental purposes prior to constructing the larger cross-head type engine of the "Selandia." The engine in the "Fritzoe" has a bore of 15.748 in. and a piston-stroke of 29.527 in.—the high stroke-to-bore ratio being with a view to securing as low a revolution speed as possible, thus enabling an efficient propeller to be adopted as the vessel has a single screw. At present the propeller is of cast iron with a diameter of 2.6 meters, but later on will be replaced by bronze propellers.

Burmeister & Wain have endeavored to secure a light engine without reducing the strength beyond that necessary for merchant-ship work with a machine of this power. Therefore, parts that have to stand heavy pressures are very strongly built, while the parts through which stresses do not pass are made as light as feasible. The cylinder-heads are bolted together, thus forming one rigid upper connection from which long tie-bolts are laid through the frame down to the main-bearings in the bed-plate, transmitting the pressure from the heads through these bolts into the main-bearings, with counter-balancing by the back-pressure from the crankshaft. Consequently, the cast-iron frame is released of all stresses and is only sufficiently rigid to withstand the tightening of the bolts and the side-thrust from the pistons.



Danish Coastwise motorship "Fritzoe"

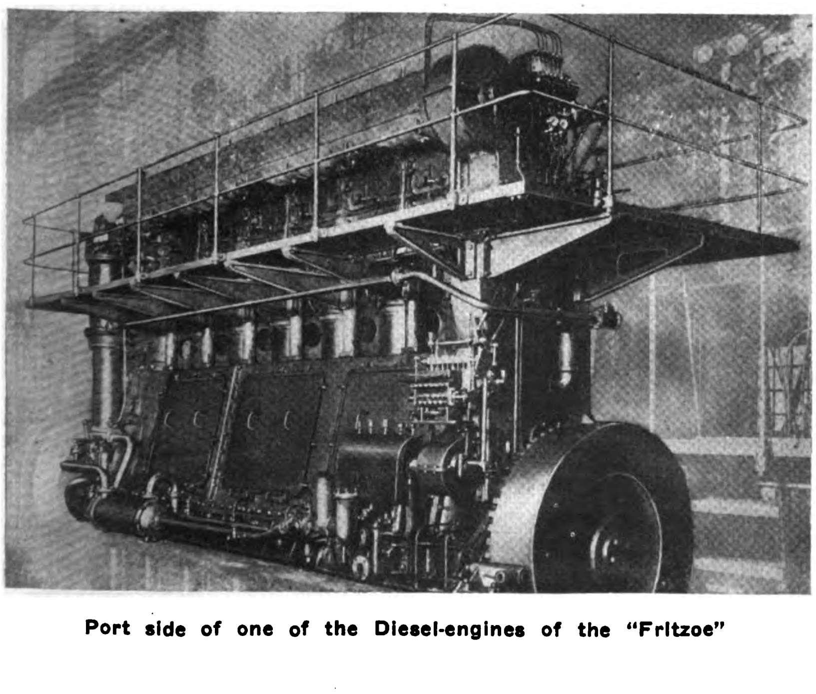
Regarding the cylinders, these have lightly pressed-on water jackets, and the liners are bolted to the lower side of the cylinder-heads. Both the liner and water-jackets are long because of the length of the piston stroke, and are made in decreasing thickness downways corresponding with the dropping pressure in the cylinder. This is possible because the liner does not have to transmit any power to the frame.

As is the general practice with Burmeister & Wain Diesel engine, force-feed lubrication is adopted, the engine being of the enclosed type with large inspection-doors, provided to the frames, through which the connecting-rods and the pistons can be removed. Attention has been paid to the design to having the center of gravity of the engine as far forward as possible, which is of importance in cases where the propelling-machinery is installed in the afterpart of the ship. For this reason the air-compressor—which is lighter than any of the working cylinders—is arranged at the aft part of the engine, while the fly-wheel is at the forward end contrary to usual practice. Also, at the forward end is the cam-shaft-drive mechanism, as well as the pumps which comprise a twin-cylinder cooling-water pump, a single-cylinder bilge-pump and a single-cylinder daily-consumption pump. All these pumps are driven from a common auxiliary crank-shaft driven in turn by gears from the crank-shaft, the gearing being enclosed and has forced lubrication.

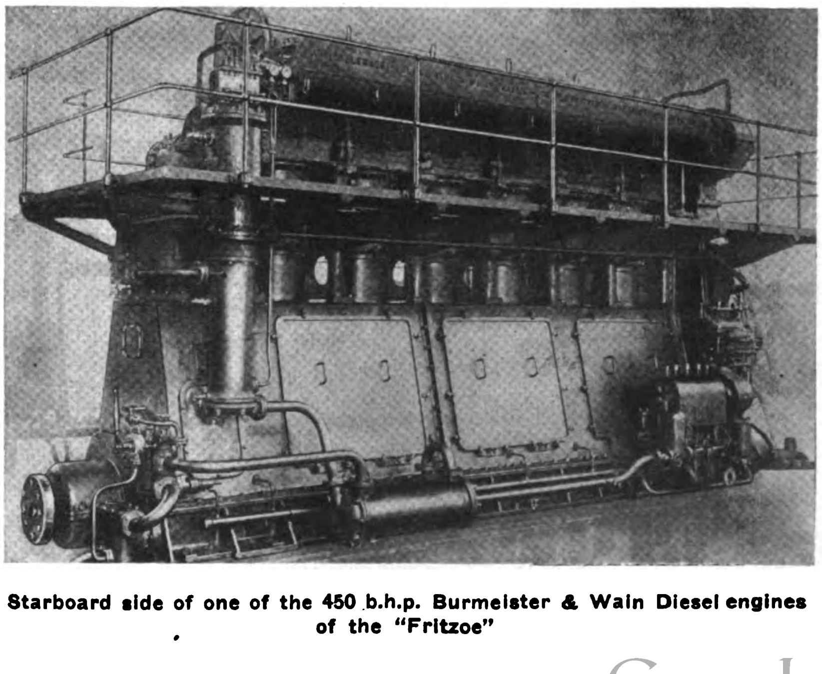
This propelling engine has a rating of 450 shaft h.p. at 145 revolutions per minute. On the test-bed the fuel-consumption worked-out at 177 k.g. per b.h.p. hour when using fuel of 10,000 cals. per k.g. At full power the engine consumes 1.9 tons in 24 hours. During the trial run of the ship this power was sufficient to give the vessel an average speed of 10.8 knots; so that 10 knots may be anticipated in service with the vessel fully loaded.

Shipowners should note that the fuel-capacity of 160 tons is sufficient for 80 days at full-speed, or a distance of 20,000 nautical-miles, which, while being a far greater radius than is required from a vessel in the service in the Baltic and North Sea, clearly shows that because of the economical consumption a small motorship can be employed with advantage on long routes as well as on short trips; whereas a steamship of the same size cannot be profitably employed in this capacity. This should increase the value of the ship.

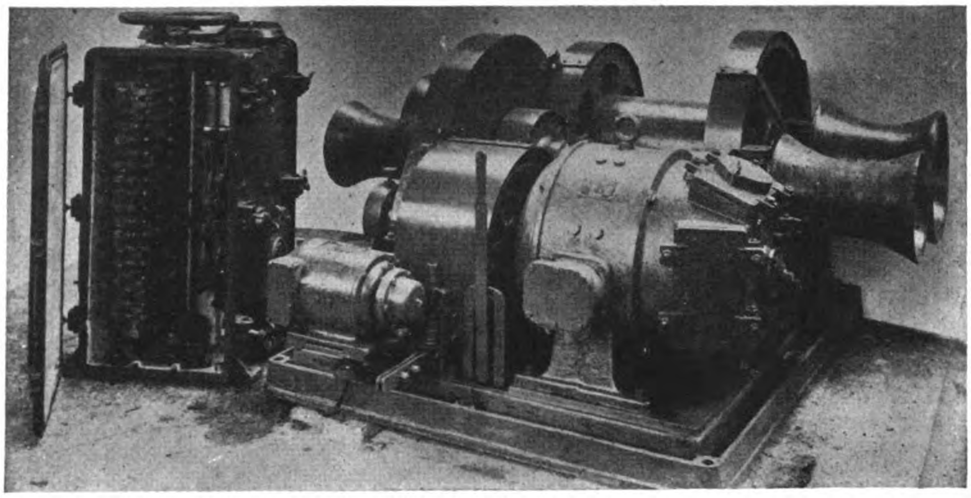
At the aft end of the engine there is a thrust-bearing of special twin-guided force-lubricated type, designed by Burmeister & Wain, while the stern-tube is provided with the well-known Cedervall stuffing-box. The maneuvering-levers are ar-



Port side of one of the Diesel-engines of the "Fritzoe"



Starboard side of one of the 450 b.h.p. Burmeister & Wain Diesel engines of the "Fritzoe"



One of the electric cargo-winches of the motorship "Fritzoe"

ranged at a special "gallery" at the forward end of the engine.

For operating the auxiliary machinery there is a single-cylinder Burmeister & Wain Diesel engine specially built for small motorships. This engine is connected to an air-compressor by means of a clutch and is used for furnishing compressed-air for maneuvering the main-engines, and to act as a reserve compressor for the blast injection of the engine. Also connected to this Diesel engine by a clutch is a 33 k.w. 220-volt dynamo, and the current derived from this is used for operating the electric winches and deck. This auxiliary Diesel engine under normal conditions is only used when entering or leaving harbors and when loading and unloading in port. At sea a 6 b.h.p. surface-ignition oil-engine coupled to a small electric-generator is used for providing electric-light.

For service as ballast, bilge and deck-pump there is an electric-driven plunger pump of 20 cubic-meters per hour capacity built by the Eureka works of Christiania, Norway. Furthermore, there is an oil-fired boiler for steam-heating the cabins.

The m.s. "Fritzoe" is a two-masted vessel. A single Sampson post is provided amidships and there are four derricks, all three of which have a lifting capacity of 2½ tons each, while the fourth has a lift of 4 tons. These derricks are operated by four electric winches built by Titan of Copenhagen and are of the geared type with two speeds, the ratio of which can be changed by reclutching, so that fairly heavy lifts and fast speeds can be obtained with loads of 1¼ tons maximum weight.

The 4-ton winch is driven by a 220-volt 16 h.p. electric motor at 350 r.p.m. and gives the following speeds:

BY LIFT

4	tons	maximum	ratio	13,5	m. p. m.
0	"	"	"	26	"
1, 2	"	minimum	"	43, 5	"
0	"	"	"	86	"

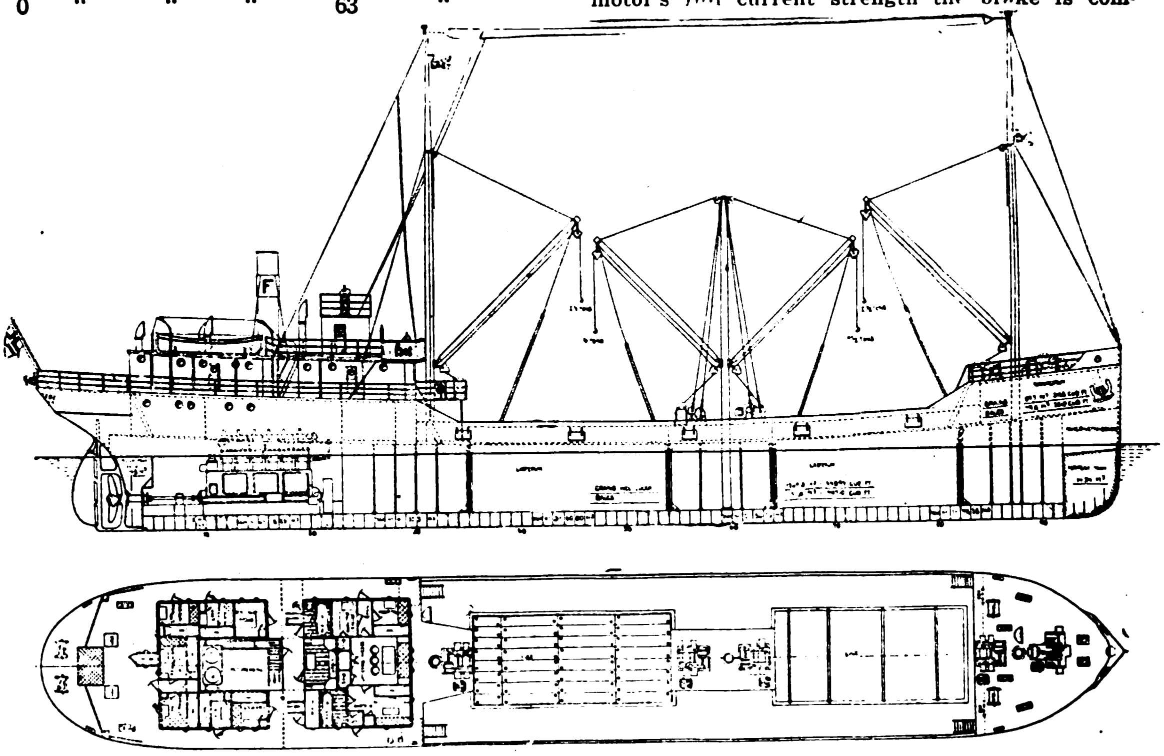
BY VEERING

4	tons	maximum	ratio	35	m. p. m.
0	"	"	"	26	"
1, 2	"	minimum	"	115	"
0	"	"	"	86	"

The 2½ tons winches are operated by 9,5 h.p. electric motors at 400 r.p.m. at the following speeds:

LIFT

2½	tons	maximum	ratio	13,5	m. p. m.
0	"	"	"	30	"
1, 2	"	minimum	"	28	"
0	"	"	"	63	"



General arrangement drawing of the motorship "Fritzoe"

VEER

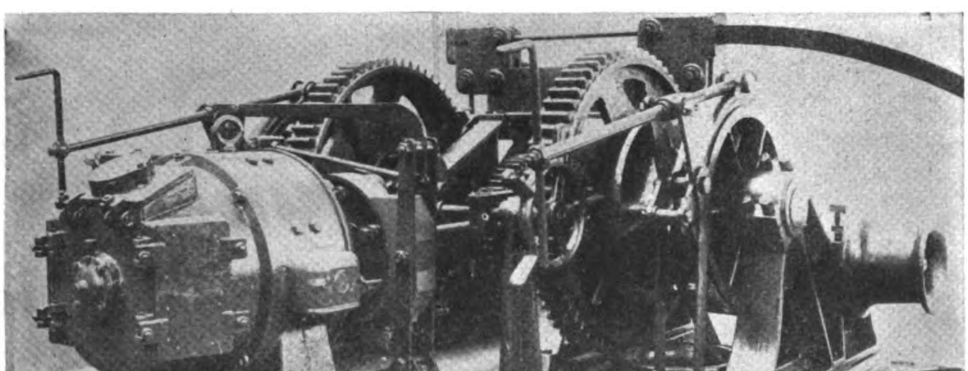
2½	tons	maximum	ratio	44	m. p. m.
0	"	"	"	30	"
1, 2	"	minimum	"	91	"
0	"	"	"	63	"

The given speeds are attained in the last control position. The speeds can be regulated down with very wide range limits by means of the controller and an automatic electro-mechanic brake arrangement, patented by the maker. The electric-motors are together with the controllers and the resistances enclosed in common cast-iron boxes with watertight covers, so that the electric parts are amply protected against the heavy seas in the North Sea. Furthermore, the winches are raised somewhat above the deck by being mounted on a platform formed by the coaming that is lead through between the two hatchways. Through the cover there is easy access to the separate resistance and the controller of the symmetric-roller type with automatically closing maximum and minimum contact breaker. Both are arranged for mounting below deck, and the controller spindle is prolonged through the deck and through a manoevering pillar beside the winch to the control-wheel, the position of which is marked by an indicator on the pillar. The characteristic spring-loaded winch band-brake acts both as lock and for veering and is disengaged by means of a small seriesmotor, the anchor of which can only turn a fraction, and that is series connected with the main motor. When the latter is without current the brake-band presses against the disc. At all current strengths above one-third of the main motor's full current strength the brake is completely disengaged. If the current's strength drops by veering to below one-third of the full consumption of the main motor, the turning moment grows ultimately less than the moment from the brake-spring. Thus the band gradually tightens on the brake disc. In this way the strength of the current can sink to a certain minimum, corresponding to a certain maximum speed.

The electric windlass is arranged for a maximum load of 5 tons and a chain speed of 5.5 m.p.m. and is mounted on a cast-iron base-plate. The watertight motor is of 16 h.p. capacity at 220 volts at 800 r.p.m., and drives the two messenger-wheels through worm and twin-gear drive.

Regarding the crew of this vessel, there is a total of 16 officers, engineers and men, as follows: Captain, first and second officers, chief engineer, first engineer, one electrician, two oilers, one steward, one cook, five men and a boy. The quarters for both the officers and crew are arranged aft. In the two deck houses are,—saloon, captain's cabin, hospital, pantry, bath-room, galley, officers' mess cabins of the first and second mates, first and second engineers, steward and cook.

The builders of this interesting ship are the Nes Mechanical Works, Tonsberg, and she is owned by a shipowning company of similar name, but the management of the vessel is in the hands of Bugge & Olsen, Larvik.



Electric windlass of motorship "Fritzoe"

Marine Diesel Engine of 5,400 Shaft Horse-Power

New Design of Sulzer Two-Cycle Motor for Ocean-Liner Propulsion

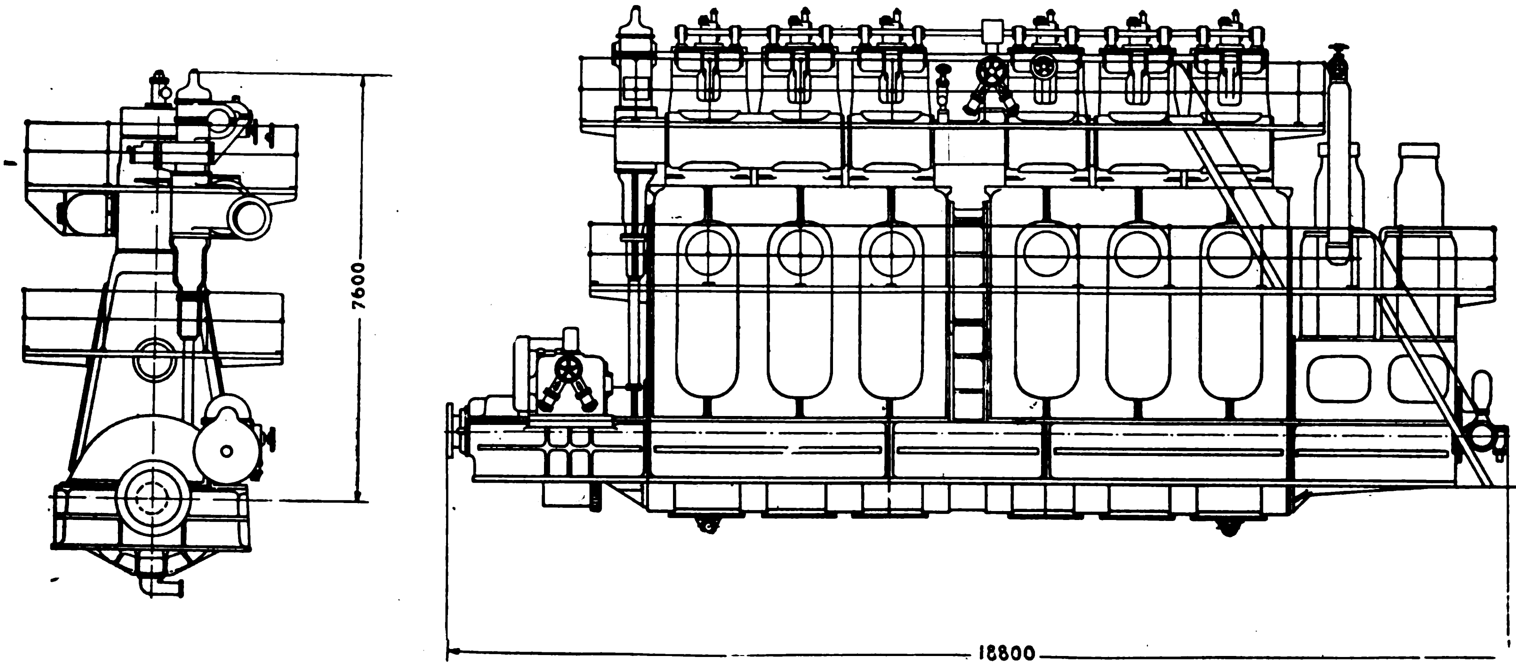
WITH a view to meeting the coming demand for moderate-sized, moderate-speed ocean passenger motor-liners that is being produced by the necessity of post war economies, Sulzer Freres, the well-known Swiss engineers have completed designs for a high-powered marine Diesel-engine of the slow-speed merchant type. In planning this big internal-combustion motor, they have the benefit of several years' operation of two six-cylinder two-cycle Diesel-engines of 4,000 effective horse-power each, one at Harland & Wolff's Belfast dry-dock, and one in France. Also to an extent, they have been aided by the design and construction of submarine-type Diesel-engines of 2,000 to 2,800 shaft h.p. (3,730 i.h.p.), and of 3,000 to 4,000 shaft h.p., the latter being for the Japanese navy.

Their new merchant-type Diesel-engine develops 5,400 shaft horse-power at 72 revs. per minute, or approximately equivalent to marine steam-engines of 6,250 ind. h.p. The dimensions of the engine should appeal to shipowners, as it allows of an engine-room of about 70 ft., the overall length of the engine, including thrust-bearing, being only 61 ft. 8½ in., with a total height of 37½ inches from crankshaft center. A twin-screw set will have an output of 10,800 shaft h.p. (or, say, 12,500 steam i.h.p.), on a total daily-consumption of 48 tons of oil-fuel at full speed. With this set a moderate-sized liner, such as the S.S. "New York" or the S.S. "St. Paul," would be given a speed of 16 to 17 knots, and would require only about 800 tons of fuel for a round-voyage from New York to Liverpool and return, including port-consumption. The small engine and bunker spaces, absence of boiler-room and elimination of firemen's accommodation and of boiler-water tankage, would greatly increase the passenger accommodations. Also, part of the latter would not be subject to undue heat, noise, smell and vibration, as are the passenger quarters near the machinery compartments of most steam-driven ships. Furthermore, there would be no smoke and cinders to annoy passengers on deck, so that there are advantages of comfort as well as of economics to be gained by the use of oil-engines for a propulsive medium.

A single-screw set would furnish adequate power for a modern combination passenger-cargo motorship of 14,000 tons d.w.c. and of 14 knots speed, or for a 14-knot 15,000 tons d.w.c. tanker, and with half the fuel-consumption of the motor passenger-liner. These types of vessels, with slight variations in tonnage and speeds, undoubtedly have great futures in overseas transportation.

This big Sulzer engine has six single-acting cylinders, each 35.433 in. (900 mm.) by 61.023 in. (1,550 mm.), and is of the direct-reversible type, following in general design, the Sulzer cargo-ship type Diesel-engines recently built. Scavenging is affected through ports in the cylinder-walls, and admission of the scavenge-air is controlled by a rotary-valve situated in the air-receiver. Instead of the scavenge-pumps usually fitted to two-cycle motors, the new system of turbo-blowers has been adopted, which arrangement was first described in "Motorship" of November, 1919, in the article on the Sulzer 1,250 shaft h.p. merchant-ship type engine. These turbo-blowers are driven by electric-motors that derive their current from dynamos driven by auxiliary Diesel-engines, so that at sea the full-power of the main-engines is available for driving the propeller-shafts. The current not required for the turbo-blowers when the ship is in port, is used for the electric cargo-winches and other auxiliary machinery on deck and in the engine-room.

Excepting for the turbo-blowers for the scavenging-air, the engine is self-contained and directly drives the pumps for cylinder and piston-cooling water, bilge-water, and lubricating-oil, as well as the two 3-stage compressors for supplying the injection and starting-air. The wheels for manoeuvring can be seen on the upper platform in the sketches. Starting and reversing are carried out as usual by hand and by servo-motors. It may be recorded that the engine can be started with air at a pressure of 25 to 15 atmospheres, or less. The constructional licensees in America are the Busch-Sulzer Diesel Engine Co. of St. Louis, Mo., who have completed many marine Diesel-engines for the U. S. Navy Dept., as well as many stationary-type four and two-cycle Diesel-engines.



Profile drawings of the Sulzer 5,400 shaft h.p. two-cycle type marine Diesel-engine designed for large passenger motor-liners and single-screw express-freighters

Oil-Engines for New York State Canal

Five 2,150 Ton Motor Barges

AFTER months of deliberation the Erie Canal Transportation Company, 42 Broadway, New York City, have decided upon installing oil-engines in the fleet of five grain-carrying barges which are to be built at the McDougall Duluth Shipbuilding Company, Duluth, Minn. Contracts have been let to the Skandia Pacific Oil-Engine Company of Oakland, Calif., through the medium of H. S. Johannsen, Eastern Agent, 25 W. 43rd St., New York, to supply the main and auxiliary motors for these vessels.

The Erie Canal Transportation Company is controlled by Julius Barnes, formerly chief of the U. S. Grain Administration who also controls the activities of the yards where the vessels are being built. Being confronted for years with the ever increasing railroad rates between Buffalo and the Atlantic seaboard and also with the diffculty of obtaining cars this company decided early in 1920 to inaugurate a line of barges to be operated on the Erie Canal to eliminte the rail haul from that point to Atlantic Coast points.

Questions of types of vessels and power were thoroughly discussed with the result that an altogether new class of canal barge —designed after sea-going practice—and propelled with its own power was decided upon. Because of the economy and the unusual demands upon the power plants of the vessels contemplated, a decision was made to use surface-ignition oil-engines of the Skandia-Pacific design. The barges will be 250 ft. in length, 36 ft. in breadth, with a draft of 10 ft. The displacement in fresh water will be 2,150 tons with a block co-efficient of 0.86 giving them a net tonnage of approximately 1,850 tons. The power plants are to consist of twin 140 b.h.p. four-cycle, direct reversible Skandia motors. The auxiliary equipment will consist of three single-cylinder, 16 b.h.p. Skandia stationary motors. Thus the oil engine power for the five barges totals ten 140 b.h.p. and fifteen 16 b.h.p. motors. A speed of 7 knots in open water is anticipated.

OUR REGISTRY OF SHIP'S ENGINEERS

Norman C. Rayner, unlimited license, has had extensive experiences in the installation of Diesel engines, also constructing and testing Diesel engines, and shop practice. Is a member of the M. E. B. A. 15 Whitehall St., New York City.

Carl Jensen, holds American license as Chief-Engineer for both steam and motorships, also Danish license as Chief-engineer for same. From 1908 to 1918 was with East Asiatic Company, five years of which were entirely with motorships. From 1918 to 1920 was employed by the Grace Steamship Lines of New York. Address 1032 Garden St., Hoboken, N. J.

Standard Oil Co. of California's Second Motor Tanker

Diesel-Driven Vessel of 5,010 Tons D.W.C.

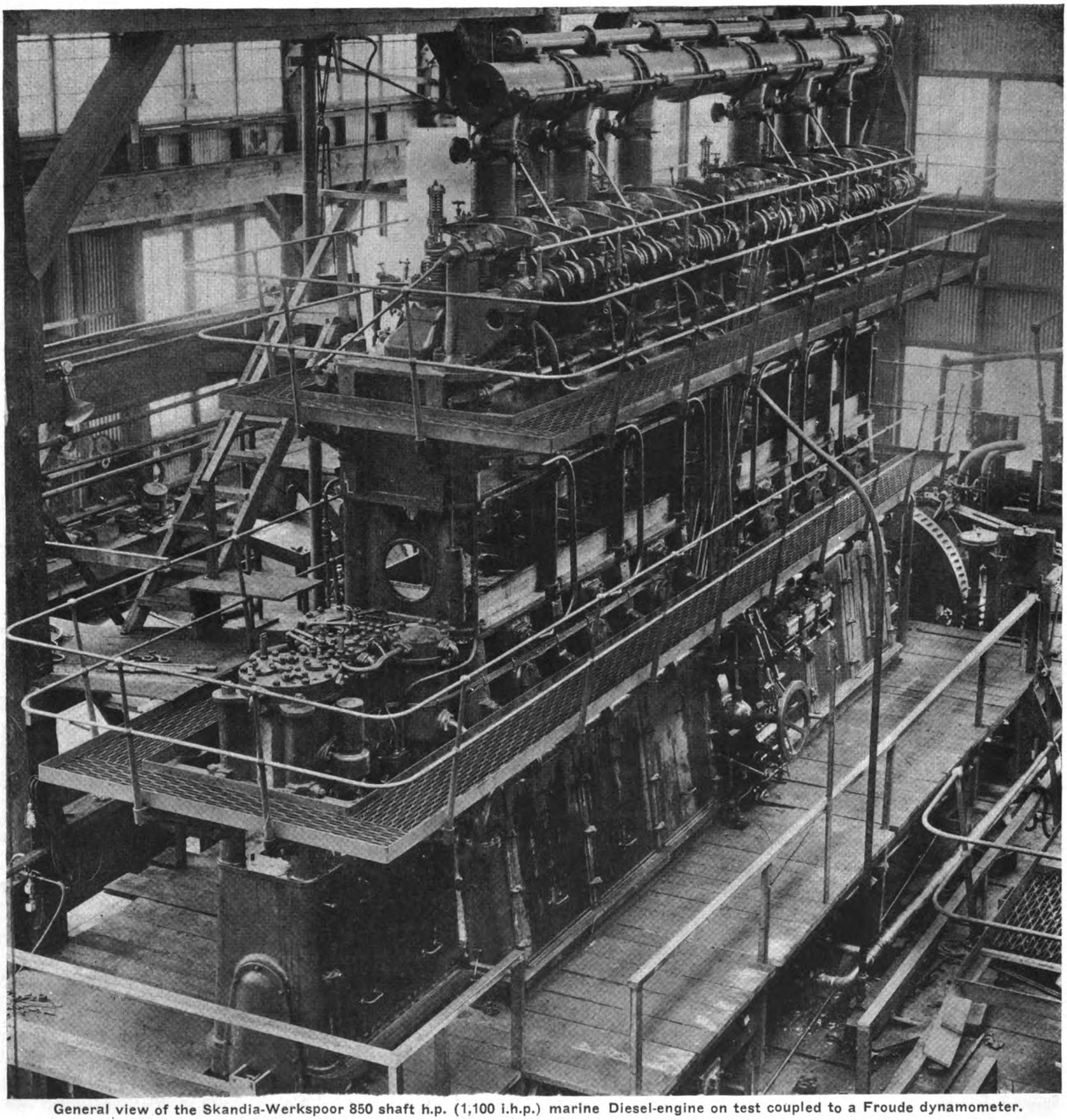
WHILE shipbuilding yards in general throughout the country are not working to capacity, the various steel shipbuilding companies located on San Francisco Bay are more favorably situated, each of the larger plants having on order several large contracts which will keep them busy for two years to come. An interesting feature of the shipbuilding in this region is the extent of the motorship construction. The latest one of these for which the keel has been laid down, is the tanker "F. H. Hillman," being built at the yards of the Moore Shipbuilding Company, Oakland, Calif., for the Standard Oil Company of the same State. This is the second motor-tanker ordered by this company from this region, and equipped with Skandia-Werkspoor 4-cycle Diesel motors built by the Skandia Pacific Oil Engine Company at Oakland, the first of the two having been illustrated and described in our January issue.

We have been able to obtain, from the owners, revised drawings and data of this latest vessel, which should prove of interest to our readers, many changes having been made since this vessel was originally described and illustrated in "Motorship" about a year ago.

The "F. H. Hillman" is a steel vessel, 342 ft. o.a., 330 ft. b.p., 46 ft. beam, and 27 ft. moulded depth to the spar deck, with a deadweight carrying-capacity of 5,010 tons on 21 ft. 6 in. draught. She is being powered with two 850 b.h.p. four-cycle Diesel-engines designed to give her a loaded speed of 11 knots, and is a steel twin-screw tanker of the spar-deck type, built on the transverse system of framing, with straight stem, elliptical stern. She will have three steel pole-masts, cargo-booms, Diesel-electric cargo handling gear and winches, and also electric steering-gear. A double bottom will be fitted under the machinery space; the deep-tank, piped for fuel-oil. The forward and after peak tanks will be fitted and piped for fresh-water.

The deck officers' quarters will be provided for in the bridge-house amidships, along with the wireless-room, the engineer's quarters, mess-room; while galley will be located in the deckhouse aft. The balance of the crew will be located in the quarters under the poop-deck aft. The main propelling-machinery, as well as all the necessary engine-room auxiliary, cargo pumps, deck winches and capstans, anchor-windlass and electric steering-gear will be supplied by the owners, and installed by the builders.

Owners of steam-driven tankers of similar dimensions to the "F. H. Hillman' should note that this vessel is designed to carry 4,350 tons of oil in the cargo tanks, together with 300 tons of fuel-oil in the double-bottom and deep tank; 50 tons of fresh-water in the after peak and fresh-water tanks and 25 tons lubricating-oil, on a mean draught 21 ft. 6 in. She is to trim 12 ft. by the stem, with all the main cargo-tanks full. Cargo space between the engine-room and the pump-room will be divided into seven main cargo-tanks and four wing-tanks, with a cofferdam at each end. A deep-tank and a



General view of the Skandia-Werkspoor 850 shaft h.p. (1,100 i.h.p.) marine Diesel-engine on test coupled to a Froude dynamometer.

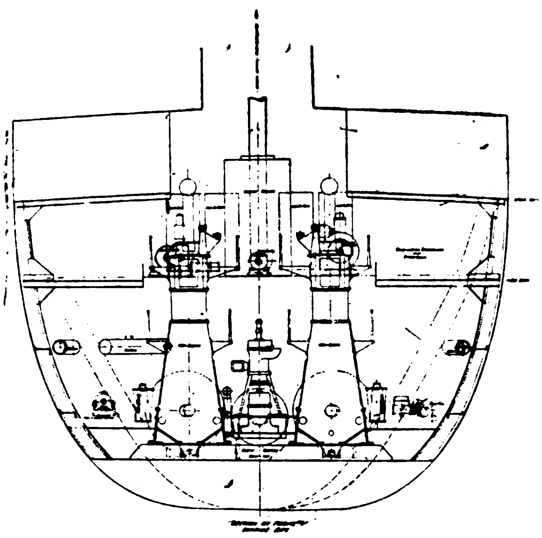
cargo-hold will be fitted forward between the pump-room and the collision bulk-head. Cofferdams are fitted between the engine-room and cargo-tanks, and between the cargo-tanks and pump-room, each of these being two frame spaces in length. A screen bulkhead will be installed in the pump-room to separate the motor-room from the pump-room.

A donkey-boiler will be located on a level with the main deck aft of the main engines. The electric steering-gear is located on the spar deck aft, directly over the rudder. For driving the electric-generator one 150 b.h.p. Dow four-cycle Diesel-engine and two 200 b.h.p. Diesel-engines of the same make will be installed in the engine-room, direct connected to one 100 k.w. 250 volt d.c. General Electric generators, respectively. The wireless motor will be located in a vapor-proof casing in the upper engine-room, with control to the wireless-room. The wireless is being constructed by the Radio Corporation of America. Propellers of the three blade, built-up type, designed by Rear Admiral Dyson, U.S.N., will be installed, and the propeller shafts will be 10 inches in diameter.

There will be three cargo-pumps of the Kinney type, each driven by a 90-h.p. General Electric enclosed motor. The cargo pumps will be controlled from controller room on the spar-deck, and will have its piping arranged as follows:

No. 1 suction-line to connect to tanks No. 1-2 and and 3; No. 2 suction line to connect to tanks 3-4 and 5; No. 3 suction-line to connect to tanks 5-6 and 7. Separate 6-inch suction branches will be fitted with 6-inch valves run to port and starboard tanks. Branches will be taken from the bottom of the 8-inch suction-lines and terminating in 8-inch bell-mouths located in the after end of each tank.

Discharge-lines will run up above deck to three fore and aft discharge-lines on after deck, fitted



Section at engine-room of motor-tanker "F. H. Hillman" looking aft

with gate-valves and discharge-nozzles. The three main suction and discharge lines are to be connected one to each of the three pumps, and cross connection provided in both suction and discharge side. Pumping will be arranged so that any or all pumps can draw from and discharge to any or all lines.

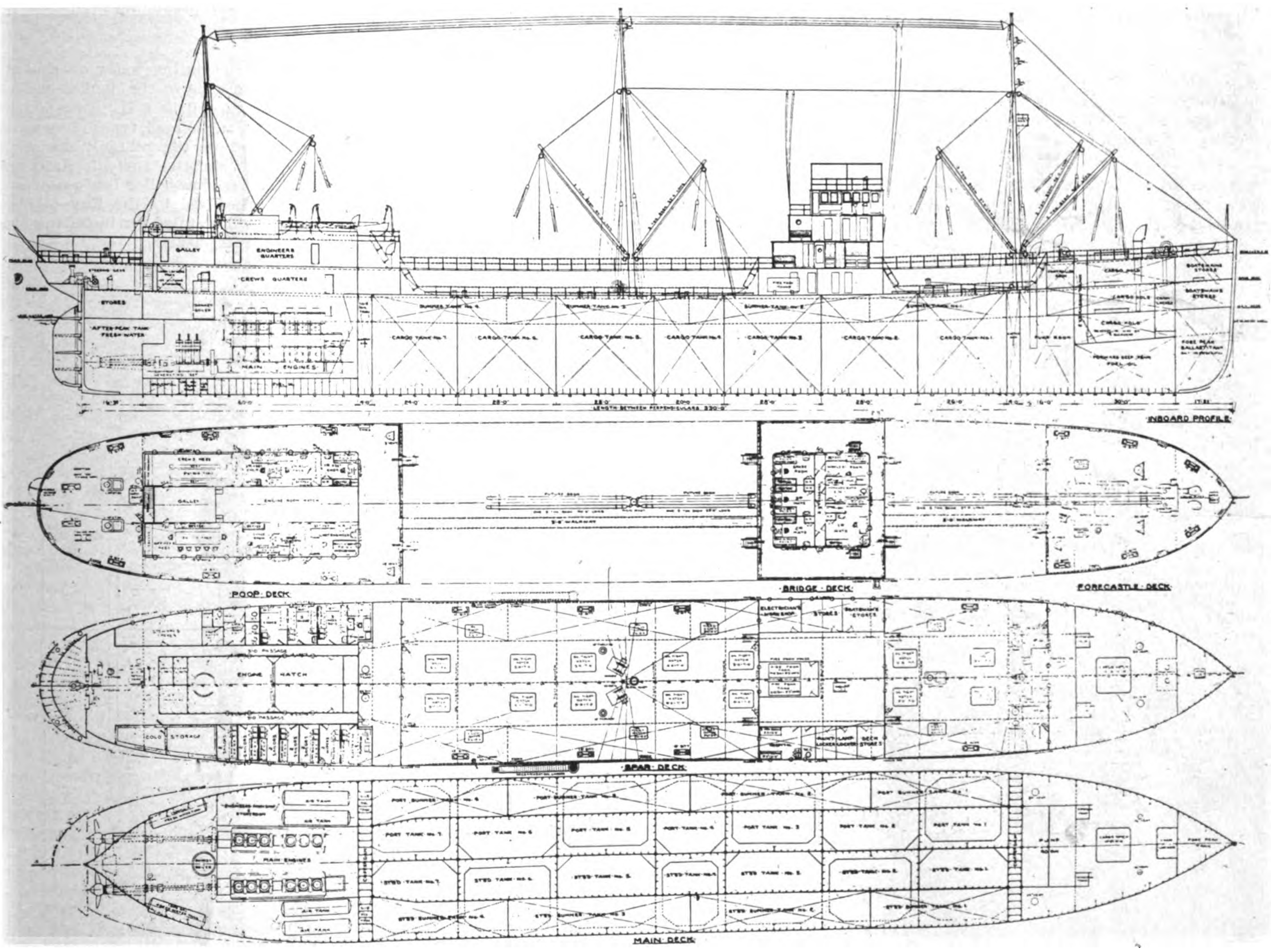
Eight-inch sea-suction will be fitted in each side of the ship, connected by athwartship line with branches to each cargo-pump, and with a 6-inch emergency bilge-suction, fitted with non-return valves. By-pass is to be fitted around the pumps to permit filling of cargo-tanks directly through the discharge and suction lines, without flooding pumps. A three-inch extra heavy galvanized-iron steaming-out line will run from the donkey-boiler forward, with 1½-inch branches to all main cargo-tanks and summer-tanks, also fore deep-tanks and cofferdams. Immediately under the main deck, piping is to be perforated to give the same area as the diameter of the pipe, for the purpose of using the same as a fire extinguisher in case of necessity. Provision will be made at the forward end of the poop, port and starboard, for shore steam-connection, to connect directly with the steaming-out line.

The arrangement of various pumps throughout the ship will be as follows:

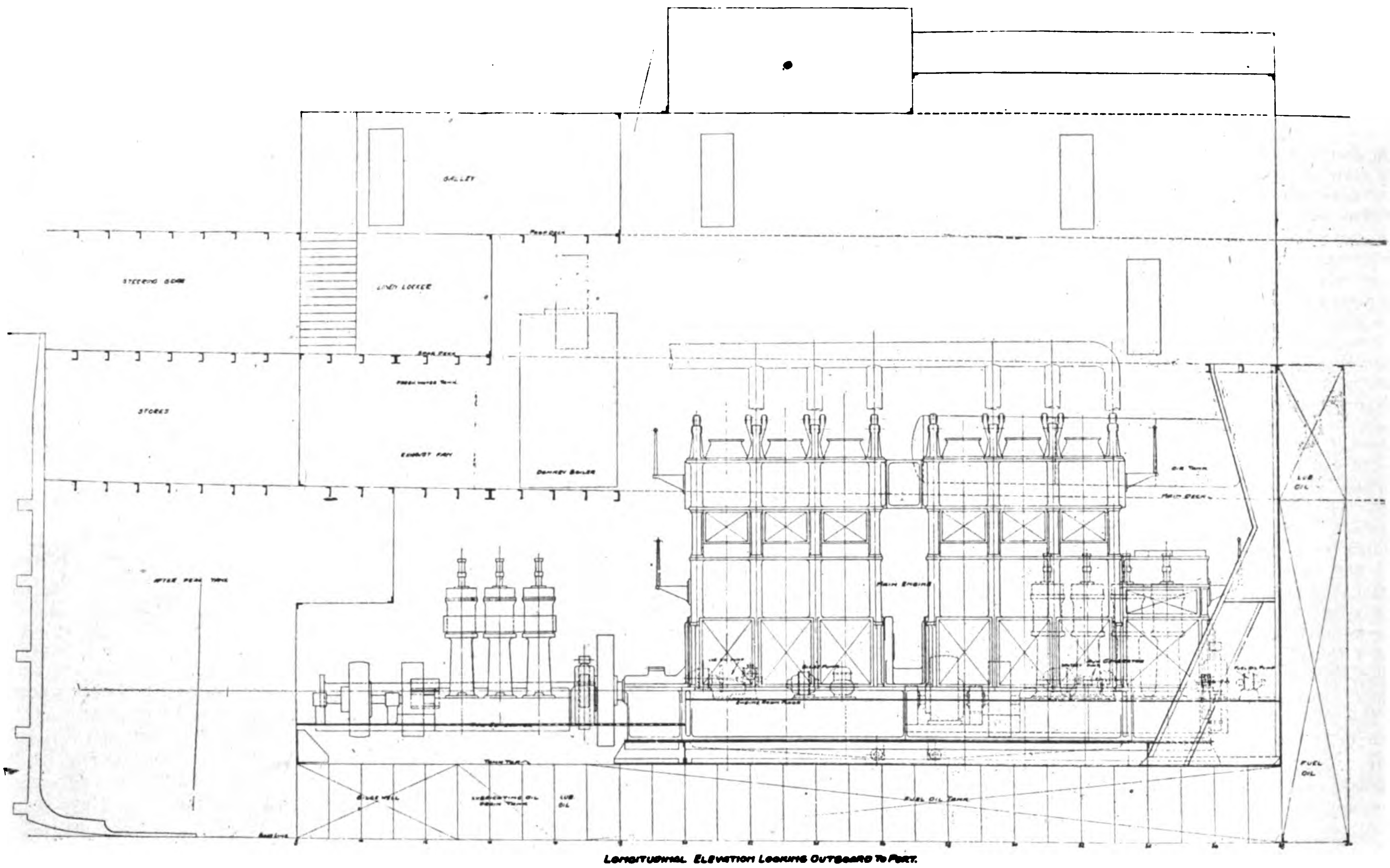
There will be two motor-driven circulating-pumps arranged to draw from the sea through low suction on each side of the ship, and to discharge to the main engines and auxiliary circulating lines. Two motor-driven auxiliary circulating-pumps will be arranged to draw from sea and discharge directly to the auxiliary engines, lubricating-oil coolers, and filters, distiller, ice machine, auxiliary and booster compressor.

One Alsberger fire and bilge pump 3-stage type N., with a capacity of 300 gallons per minute direct-connected to a 40-h.p. General Electric motor will be arranged to draw from sea and bilges, with non-return valves to be fitted on the bilge suction, and will discharge to the firemain, sanitary system and overboard.

A 15-h.p. General Electric motor drives a two-stage Alsberger sanitary-pump, which is arranged to draw from sea and from circulating water overboard discharge from main engines, and to discharge to sanitary system, auxiliary circulating lines and donkey-boiler. Furthermore, there are two motor-driven bilge-pumps to draw from engine-room bilges and to discharge overboard.



Latest drawings of the Skandia-Werkspoor Diesel motor-tanker "F. H. Hillman." These show the changes since the original drawings in our April, 1920, issue were made



Longitudinal section of engine-room of motorship "F. H. Hillman," showing arrangement of Skandia-Werkspoor Diesel propelling-engines with the Dow Diesel auxiliary engines to port, starboard and aft

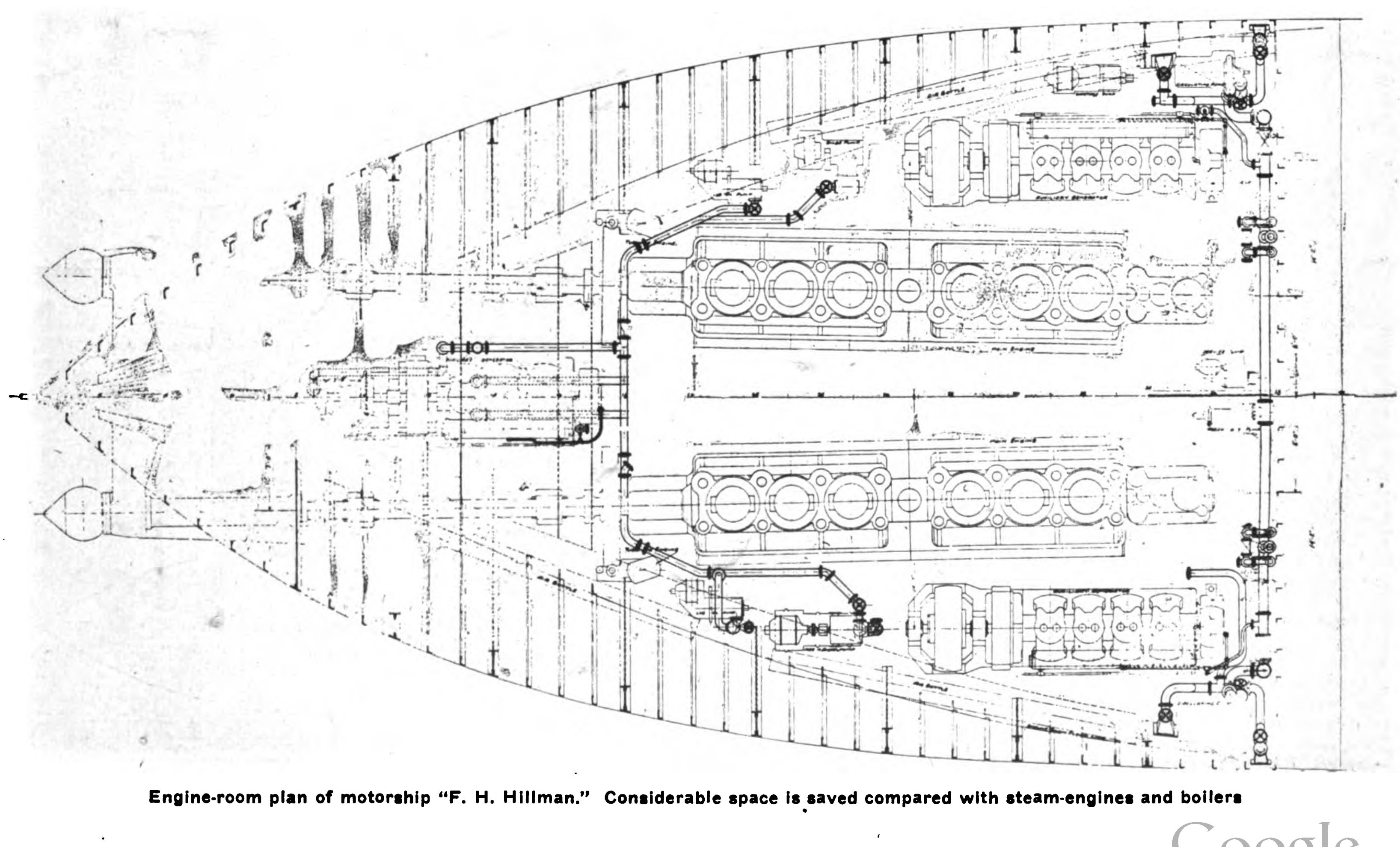
One 2-h.p. General Electric motor drives a Kinney fuel-oil service pump, which is arranged to draw from the engine-room double-bottom and after cofferdam and discharge to the daily fuel service tank.

One motor-driven fresh-water pump is arranged to draw from the after peak tank, fresh-water storage tank on deck, and to discharge to after peak tank fresh-water storage tanks, service tanks on after deck house; also to service tank on upper and navigating bridge.

There is one lubricating-pump, motor-driven, arranged to draw from the lubricating-oil drain-tank, and discharge through the lubricating-oil cooler to the main engines; also through filter to the lubricating oil storage tanks.

One donkey-boiler feed-water pump horizontal duplex, steam driven, is arranged to draw from sea and from the circulating water overboard discharge, and to discharge to the donkey-boiler.

The donkey-boiler will be 6 ft. in diameter and 10 ft. high of the submerged type. Steam outlet is to be connected to the oil-tank steaming-out lines, heating-coils in the fuel-oil, daily-service tank, distiller and donkey-boiler feed-water pumps. The boiler is to be fired by the Ray oil-burning system. Piping will be fitted for installing electric circulating type water-heater.



Engine-room plan of motorship "F. H. Hillman." Considerable space is saved compared with steam-engines and boilers

The auxiliary compressors are of the Rix type furnished by the Rix Company of San Francisco. The low-pressure compressor will be of the duplex tandem type, two stage, 9 in. x 4 in. x 6 in., with a capacity of 125 cubic-feet of free-air per minute, and provided with intercooler. This compressor is arranged to draw from atmosphere and discharge into the manoeuvring tanks at 350 lbs. pressure, and the booster-compressor is arranged to draw from the manoeuvring tanks at 350 lbs. pressure, and to discharge to the injection-air bottles of the engines at 1,000 lbs. per square inch. The booster compressor is also arranged to draw from atmosphere and to deliver full pressure to injection bottles.

There is one oil-engine direct-connected to a 10 k.w. 250-volt generator, and one balancer set connected between the main bus on the switchboard and the lighting load to obtain a 3-wire 125-volt system for the same, the balancer set being of the General Electric type, 38 amperes and direct connected.

Two Sturtevant blowers will be provided for circulating air, one blower to be located on the main-deck aft for ventilating all living quarters under the poop-deck, the second to be located in the controller-room forward to take suction through 18-inch ventilators and to discharge into common ventilating pipe leading into the pump-room and branching off to the motors on cargo-oil pumps and bilge pumps.

An engineers' workshop and storeroom will be located on the main deck aft and fitted with the following machinery, tools, etc.

One Lodge and Shipley direct motor-driven 16-in. x 10-in. lathe, with taper attachment, and all accessories, including 6-in. Universal chuck, and one large and one small face-plate; one direct motor-driven 22½-in. Barnes drill-press; one direct motor-driven double emery-wheel 12-in. diameter with a 2-in. face; one combination vise and ordinary vise fitted on work-bench with drawers under same.

Two McNab direction-indicators, one for each engine, are to be located on the navigating-bridge. There will be one electric sounding machine of the latest approved type, and a wireless and submarine signal outfit, also two Wagner Cherub patent logs. In place of the usual searchlight installation there will be two flood lights, one at each end of the navigating bridge.

Telephones of the Magnavox design will be installed between the pilot-house and the engine-room, also between the pilot-house and the docking-bridge, and between the docking-bridge and the engine-room, and between the engine-room and the captain's room and from the captain's room to the wireless-room.

The galley is to be fitted with range, broiler, bake-oven, steam-table and water-heater—all electrically operated. All wiring for electrical machinery is to be direct-current with a maximum voltage drop not to exceed 3 per cent. All wiring for motors, heaters, galley equipment is to be 250-volt 2-wire and 125-volt 3-wire for lighting, these two systems to be kept entirely separate. The electrician will have a work-room under the bridge-house. For the cold storage department there will be one 2-ton Audiffen-Singrun ice-machine, water supply for same being taken from the auxiliary circulating line. The insulation and construction of the cold storage system follows the plan of the American Balsa Corporation, utilizing "Encysted Balsa Wood."

On the starboard side of the upper bridge will be located one 18-foot motorboat with 5-h.p. Union gasoline-engine, and on the port side there will be located a 16-foot workboat. Four 20-ft. metallic lifeboats will be located on each side of the after deck house. All lifeboats, the motorboat and workboat will be suspended from davits made by the Steward Davit and Equipment Corporation.

There will be two lubricating-oil coolers and two filters, the filters to be arranged to drain to the lubricating-oil drain tanks and overboard. Lubricating-oil will be carried in a 1,500 gallon storage tank located on the main deck and arranged to drain to the drain-tank built into the engine-room double-bottom, that also takes the drain from the engine crank-pits.

The fuel-oil service-tank has a capacity of 70 barrels and is divided into three compartments. Fifteen barrels of kerosene is carried in a special tank provided for this purpose. The manoeuvring-air tanks, of which there are four, are arranged in the wing space in the engine-room. The main and auxiliary engine silencers are on the housing on top of the after deckhouse, and the exhaust-pipes from the silencers will be carried up along the mizzen mast.

All steam and main and auxiliary exhaust-piping in the engine-room are to be insulated with Magnesia non-conductor material and covered over with canvas.

Fresh water tanks will be located as follows: Two 1,500-gallon storage tanks on the main deck aft; one 1,500-gallon service tank on top of the after deck house and draining into fresh water service in galley and all quarters aft; one 400-gallon service tank on the upper bridge supplying the officer's quarters and hospital amidships; one 200-gallon service tank in navigating bridge supplying captain's quarters.

MAIDEN VOYAGE OF MOTORSHIP "AFRIKA"

Readers of "Motorship" will remember the fine cargo-passenger Diesel-driven motorship "Afrika" recently described and illustrated in these pages—she being the largest Diesel-driven vessel yet completed at the Burmeister & Wain Shipyard, Copenhagen, and having the same power installation as is being installed in the United States Shipping Board's motorship "William Penn," which will shortly run her trials.

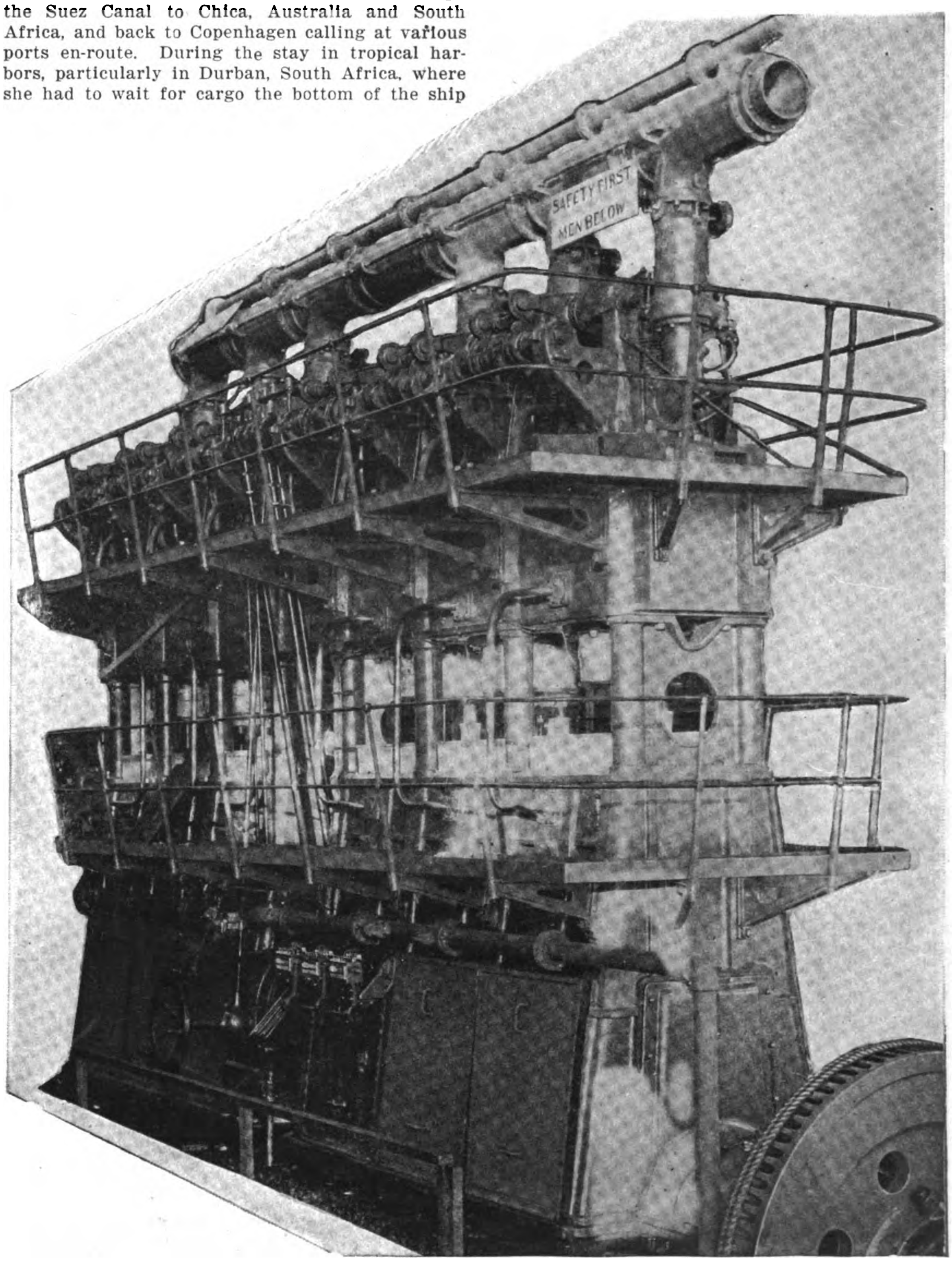
The "Afrika" is of 13.250 tons d.w.c. and has now completed her maiden round-voyage. This voyage was from Copenhagen, Denmark, through the Suez Canal to Chica, Australia and South Africa, and back to Copenhagen calling at various ports en-route. During the stay in tropical harbors, particularly in Durban, South Africa, where she had to wait for cargo the bottom of the ship became covered with barnacles which resulted in slower speed on the return voyage.

The following are some condensed details of the most excellent voyage made—

Distance run..................29,523 naut. miles
Time at Sea...................2,676 hrs., 15 min.
Average Net-Cargo Carried...........11,750 tons
Average speed for entire voyage.......11.03 knots
Average Daily fuel-consumption.......14.16 tons
Fuel used (Borneo crude-oil)........0.943 gravity
Total consumption of lubricating-oil
(all purposes),46 bbls.
Bunker Capacity......................1,470 tons

We will point-out that the thermal value of the fuel used was 990 calories per Kg. or 17,800 B.T.U. per pound. On the outward trip with a full-load on a 25 ft., 6 in. draught a mean speed of 12.05 knots was made between Port Said and Singapore, a distance of 5,062 miles. On one day 313 nautical-miles were logged in 24 hours during fair weather, or an average speed of 13 knots for the day. Generally speaking, very rought weather was experienced, as is shown by the two illustrations which were photographed in the Indian Ocean on August 13th and 15th, 1920. (See page 141.)

On the voyage back to Denmark a fire broke-out in the after hold, spontaneous combustion having occurred in the 4,500 tons of coal she was transporting. Discharging was quickly commenced, and the center of the fire reached before much damage was done to the ship.



End view of one of the Skandia-Werkspoor Diesel-engines of the "F. H. Hillman"

MOTORSHIP

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CRITICISING AN UNKNOWN QUANTITY

Discussing the four 20,000 tons d. w. motorships ordered by the Bethlehem Steel Company from its own plants the London "Times" (Engineering Supplement) says that—"it is questionable if the Bethlehem-West two-cycle Diesel-engines of these ships will prove as successful as Mr. Schwab anticipates, because there are points in the design that are not regarded favorably by European designers."

Seeing that no official details of the design have yet been published and that apparently no "outsider" has seen the first engine, criticism at this time is perhaps a little premature and even unwarranted. Eventually we shall see, and then there will be plenty of time for comment if called for. Nevertheless, as long as the Bethlehem Co. confine themselves to generalities and remain reticent regarding actual design and definite results, both foreign and domestic criticism unfortunately will surely continue; particularly in the form of an undercurrent—a situation that is regrettable.

We have plenty of confidence in Mr. Arthur West's ability as an engineer, but believe the policy of silence regarding the technical details to be a mistake, and Mr. Chas. Schwab would have greatly strengthened his recent broad claims had they been supported by some actual operating figures that he must possess. Whereas, he has merely laid himself and the engine open to attacks such as those of Sir Trevor Dawson, the "Times" and many others that have been made abroad without proper foundation and which he has left unanswered. A few official facts without any claims would have avoided all this; meanwhile we can only hope that these attacks will not leave an unwarranted stigma on the engine, because the same would be difficult to drive away no matter how successful it is. Unfortunately, past criticisms of the two-cycle system itself made such a deep impression in the minds of shipowners that two-cycle engine-builders have lately had to make tremendous efforts to change opinions. Interests opposed to the progress of the marine oil-engine in America's merchant-marine are already distributing derogatory rumors regarding the "Cubore" and her engines, and base reports have reached us from various sources, including that she ran ashore on Cape Hatteras, and that geared-turbines will be installed in placed the Bethlehem-West Diesel engines ordered for the four 20,000 d.w.c. ore-carriers. We believe that these rumors are spread purposely to block motorship progress, and have no real foundation. In the interests of the industry we hope that the Bethlehem Company will soon release the information.

CUNARD LINE AND MOTORSHIPS

Several recent developments in Great Britain indicate that the Cunard Line is taking active interest in the Diesel-engined motorship—not only for freight carriers, but for moderate-sized passenger liners, especially for one-class and immigrant vessels where speed is limited to the maximum amount of fuel that dare be burned within the limits of economy of operation, and where the low oil-consumption of the Diesel-engine enables a speed of 17 to 18 knots to be maintained with a commercial practicability for this class of ship. From this it is but a comparatively short step to the 20-knot first-class Cunard motor-liner. Incidentally, the radical economic advantages of the Diesel-engine may ultimately mean the segregation of all third-class passengers to special ships.

Readers of the financial pages of the "daily press" probably noticed that the Cunard Line is to issue £4,000,000.00 of debentures for constructing new tonnage during 1921-1922, of which stock one-third will be received by holders of outstanding Cunard debentures and first-mortgage debentures of the Anchor-Brocklebank Line, the latter being an associated concern. Here is the connection that would infer that this new fund of nearly twenty-million dollars will be used for building Diesel-driven ships.

Shortly after the Anchor-Brocklebank Line had ordered several motorships from Cammell-Laird's, the big shipyard of John Brown & Co., Clydebank, acquired a Cammellaird-Fullagar Diesel-engine license with a view to constructing high-powered units, and it will be remembered that many of the largest Cunard liners have been built at Brown's yard. Obviously, then, the Anchor-Brocklebank's entry into the cargo motorship field is largely a conservative try-out of a new system of propulsion that offers promise of success in big units, prior to a heavier investment by the Cunard Line in high-powered motor-liners. As the first vessel—the "Fullagar"—has already proved a success, we presume further delay for the bigger programme has become unnecessary, and that both John Brown and Cammell Laird will receive orders for motorships of noteworthy size, power and speed, as well as orders for some regular cargo motorships. This new construction, it will be noted and digested, comes during a period when orders for uneconomical steamers are being cancelled in large numbers in British yards. Altogether the Cunard Company will build twenty-three craft, aggregating 300,000 tons, of which six will be of 15,000 tons each.

There are shipowners in our country—many new to the business—who have not yet listened to our numerous warnings and who still fondly hope to be able to compete on the High Seas against competition from old established British companies, such as the Cunard Line with its world-wide offices and agencies, and which companies now are balancing their fleets with a total of over one-hundred of the very latest class of economical freight and passenger carriers—namely the oil-engined motorship. It simply can't be done unless American shipowners at least adopt similar types of vessels and similar sound business methods, including whole-hearted co-operation with domestic Diesel-engine builders. It is ten years too late to build an "odd motorship or two to give the system a try-out," and the only salvation is to make conversions of existing steamers to Diesel-power on a wholesale scale, and to construct new motorships in batches of not less than six per shipowner, thus securing the lowest possible first-cost. Until Diesel-engines are ordered in reasonably large quantities the constructional costs cannot be much reduced. This must be apparent to any practical shipping-man.

THE DRY-LAW AND MOTOR-LINERS

Possibilities of trans-ocean motor-liners causes one to ponder over the question of the dry-law being enforced on American ships and the probability of its preventing such craft being built in this country in competition with motor-liners now being built abroad. While State laws do not affect foreign-going ships outside of the three-mile limit we do not believe other than that the Constitution of the United States applies to all vessels under the American flag regardless of their whereabouts—the flag itself being symbolic of belief of and adherence to the laws of the land. Nevertheless, in the past there has been a little stretching of the strict legal law in its application on ship-board in international waters, and among other things no ship pays duty on liquor consumed outside the three-mile limit, nor (in actual practice) on the moderate amount used by the officers and crew in port.

Solicitor-General, W. L. Frierson, recently ruled that no alcoholic liquor may be carried or consumed on an American vessel no matter where she may be. In the first place this ruling will be virtually impossible to enforce particularly as far as officers and crews are concerned, except in cases where the captain happens to be a total abstainer of the fanatic type. Secondly, if a strenuous endeavor is made by the authorities to prevent liquor being carried and served to passengers it will simply put American passenger-liners out of the transatlantic service, whether steam or Diesel propelled. Of this we may rest assured! Officers of the vessels will not take upon themselves the work of revenue-agents as few are in sympathy; so, to enforce the law revenue-men will have to be permanently installed on every ship to search passengers' and crew's baggage and to peep into cabins and watch the dining-saloon and smoke-room to see that liquor was not being openly served. In other words act along the lines of spies. Such a procedure would even be obnoxious even to passengers who were the staunchest teetotalers. In a very short time all the passenger traffic would revert to British, Dutch, French and other lines, and our own vessels would be passengerless.

We are not out to advocate liquor consumption or to suggest that the 18th Amendment be not upheld, but are merely coldly indicating what will happen should the Solicitor-General's ruling be enforced aboard passenger vessels. The question is, Does America desire a successful all-round merchant-marine, or would it prefer to see the above amendment legally interpreted in a manner that will drive our passenger-ships off the High Seas? As we are firmly convinced of the great importance of a large mercantile-marine, we consequently feel the necessity of support to the Edmonds Bill, which, if passed, will legally allow of consumption of liquor outside the three-mile limit on American ships.

RUNNING SHORT OF BUNKER-OIL AT SEA

Owing to the comparative low fuel-consumption no Diesel-driven vessel is likely to run short of fuel under conditions recently met with by the Red Star liner "Kroonland," which usually takes about eleven days from Antwerp to New York. On a recent voyage to Belgium she took aboard 3,000 tons of oil, which should have been more than sufficient for a round trip; but owing to high winds and heavy seas her bunker-oil ran out on her return voyage and she was obliged to signal for tugs. When she arrived at Quarantine only 25 tons of oil remained. Normally she burns about 125 tons per day. Were she Diesel-driven she would use between 40 to 43 tons per day, according to the weather conditions. Even in the heaviest weather she would only burn several more tons per day over fine weather consumptions, so climatic conditions should never cause her to run short of fuel-oil. This is another condition which demands economical use of America's dwindling oil supply.

Air-Injection or Mechanical-Injection

A Technical Treatise of a Subject of Great Importance to Diesel-Engine Builders

By J. L. CHALONER

Part II

(*Continued from page* 1085, *Dec.*, 1920, *issue*)

Considering now the other cycle (Fig. 14) and retaining as far as possible the same lettering:—

(a) Adiabatic ($p\,v^n$) compression (1-2) giving:

$$\text{Compression ratio } (r) = \frac{VT}{VC}$$

(b) Combustion at constant volume (2-3) giving:

$$\text{Pressure ratio } (P) = \frac{PE}{PC}$$

(c) Combustion at constant pressure (3-4) giving:

$$\text{Cut-off ratio } (R) = \frac{VE}{VC}$$

(d) Adiabatic ($p\,v^n$) expansion (4-5) giving:

$$\text{Expansion ratio} = \frac{VT}{VE}$$

(e) Exhaust to atmosphere (5-1) giving:

Pressure drop at constant volume = VT

For the thermal changes we get the following relations:

Heat supplied during cycle = HS

$$HS = QS_1 C_p (T_4 - T_3) + QS_2 C_v (T_3 - T_2)$$

$$= QS_1 C_p (R-1) T_3 + QS_2 C_v \left(1 - \frac{P_4}{P_2}\right) T_3$$

Heat abstracted during cycle = HA

$$HA = QA\, C_v (T_5 - T_1) = QA\, C_v T_1 \left(\frac{P_4}{P_2} R^n - 1\right)$$

$$\text{But efficiency } (n) = \frac{HS-HA}{HS} = 1 - \frac{HA}{HS}$$

$$= 1 - \frac{QA\, C_v T_1 \left(\frac{P_4}{P_2} R^n - 1\right)}{QS_1\, C_p\, (R-1) T_3 + QS_2 C_v \left(1 - \frac{P_4}{P_2}\right) T_3}$$

But

$$QA = k(QS_1 + QS_2) = KQS;\ C_p \div C_v = n,\ P_4 = P_3$$

$$V_3 = V_2;\ \frac{T_3}{T_1} = \frac{P_4}{P_2} \frac{V_2 V_1^{\,n}}{V_1 V_2^{\,n}} = P\, r^{n-1}$$

$$\therefore n = 1 - \frac{K P (R^n - 1)}{n r^{n-1} (R - P)} \text{ equals Thermal Efficiency}$$

K is again a constant, depending on the type of engine.

R and P should both have a minimum value in order to give a maximum thermal efficiency.

Examining the two equations for a moment, it will become apparent, that with a combustion at constant pressure, or nearly so, the thermal efficiency is very much higher.

Let us take a Diesel engine and a high-compression engine of the following dimensions:

Air Injection
Diesel Engine
(Constant Pressure)
Mechanical Injection
High Pressure Engine
(Partly Constant Volume)

Compression ratio (r).....	15.5	13.5
Exponential factor (n).....	1.34	1.34
Cut-off Ratio (R)..........	2.5	1.8
Compression Pressure Ratio (P)........	—	1.1

Using the two formulae, given for the Diesel engine (combustion at constant pressure only) and the high-pressure engine (combustion partly at constant volume, partly at constant pressure), it will be found that the thermal efficiencies are as follows:—

Thermal Efficiency:—52.7% 42.5%

This result will explain to a certain extent the discrepancy in the fuel consumption per B.H.P. hour for the two types of engines. Although the mechanical efficiency for the high-pressure engine is some 7% to 10% higher, yet practical results have not shown any corresponding reduction in the fuel consumption.

The principal lesson to be drawn, therefore, from the above results is the necessity of having combustion taking place at constant pressure, and to avoid as far as possible any rise of pressure at the end of compression.

There is no doubt that in those cases of the high-pressure engine, where combustion takes places at constant pressure only, the total combustion period (apart from any after burning which might take place during expansion) is shorter than with the Diesel engine. The reasons for his fact will be discussed later, and in fact is borne out in practice by the cut-off ratio on a high pressure engine indicator diagram being a lower value than for the Diesel engine.

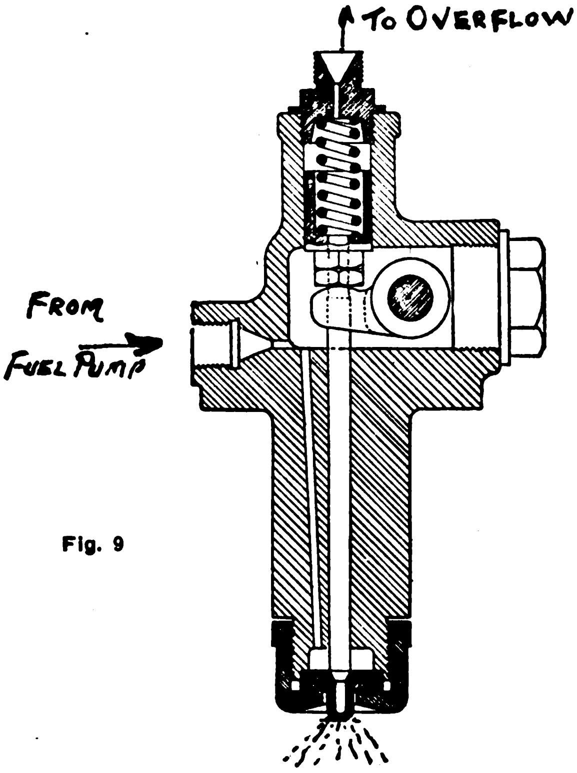


Fig. 9

Comparing the corresponding data in such a case we get the following results:—

Air Injunction
(Diesel engine with constant-pressure combustion).
Mechanical Injection
(High pressure engine with negligible constant-volume, practically constant pressure combustion).

Compression ratio (r).....	15.5	13.5
Exponential factor (n).....	1.34	1.34
Cut-off ratio (R)...........	2.5	1.8
Thermal efficiency	52.7%	54.1%

From these data it will be noted that the cut off ratio has more influence on the thermal efficiency than the compression ratio. Hence the rate of combustion is of primary importance, and the compression is purely governed by the temperature at which spontaneous combustion will take place.

In this connection, the temperature of spontaneous combustion is not the ignition point of the fuel, but is governed by the rate of oil-gas formation, and the ignition temperature of the oil-gas so formed. I am convinced that the ignition temperature of an oil is in no relation to that compression pressure, which will give the best combustion; on the other hand, the War has interfered very greatly with the proposed experiments on the oil-gas formation of fuels, so that even to-day we are not in the position to draw up any definite relations.

The final compression temperature is therefore of no material interest until such times as we are more familiar with the phenomena underlying the oil-gas formation. At the same time the following table should be of general interest, and incidentally points out the decreasing rate of temperature rise with corresponding increase of pressures.

Final Compression pressure lbs. p. sq. in.	Final compression pressure temperatures ° F. Initial temperature 80° F.	Initial temperature 122° F.
140	590	645
215	695	770
285	800	875
360	875	960
435	950	1040
505	1005	1100
580	1055	1155
650	1100	1210
720	1145	1255

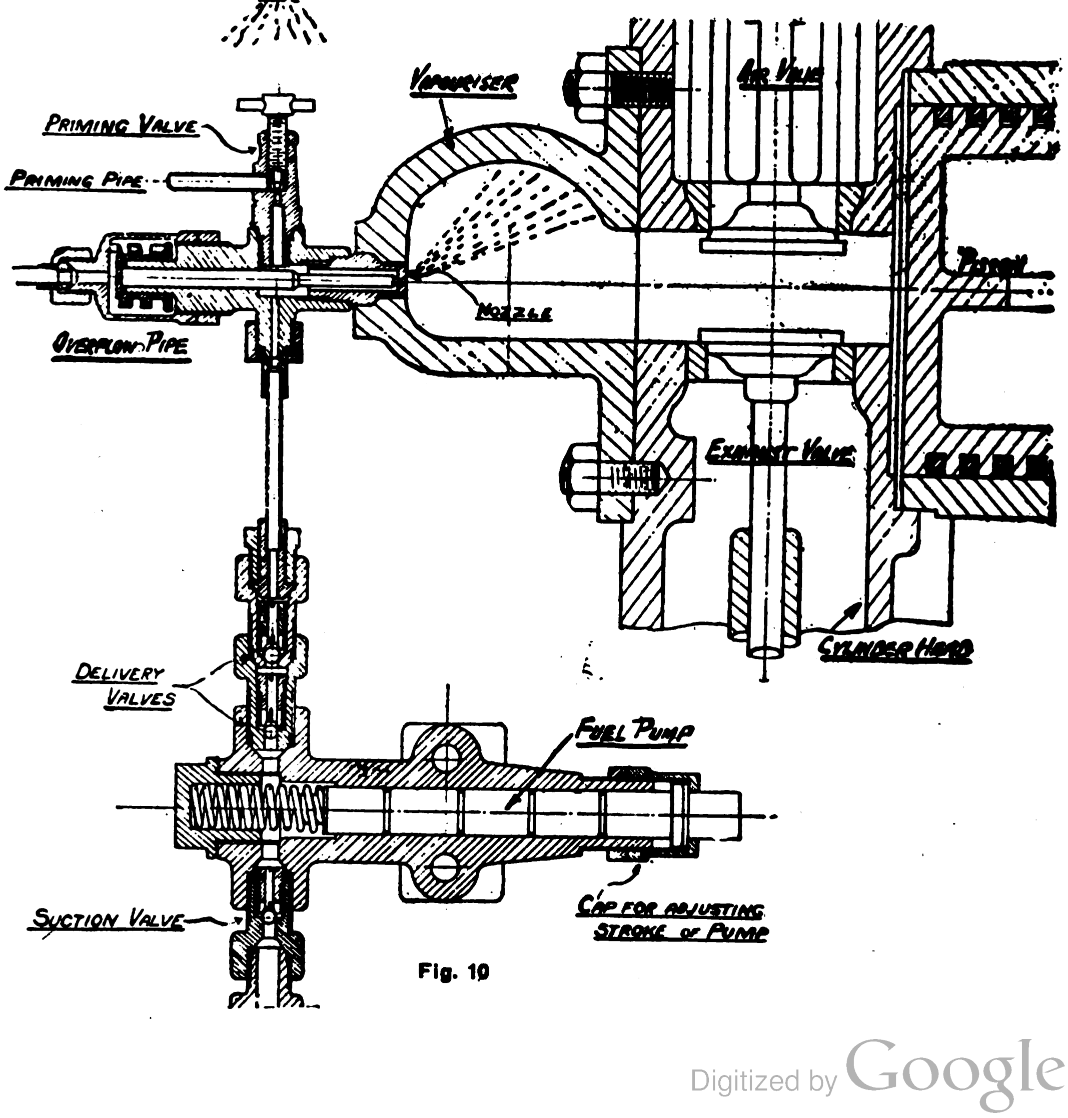


Fig. 10

If we examine the above table with due regard to the fuels which should be burnt in an engine to justify the term heavy-oil engine, it will be apparent that 285 lbs. compression pressure is about the lowest possible pressure, at which a residual-oil will ignite spontaneously without risking an occasional mis-fire.

If, therefore, the engine were designed to burn at more or less constant volume, the maximum pressure for an engine using a residual oil would be higher than with the Diesel engine. Such policy is not recommended, and it may therefore be stated, that a compression pressure of 350 lbs. p. sq. in. or thereabouts should be employed, and combustion should take places at constant pressure or nearly so.

Such a pressure has never been employed with the Diesel engine, yet it has given every satisfaction with the high pressure engine, using mechanical injection. As has been shown above, the final compression pressure has within limits very little effect on the thermal efficiency, and the relatively low fuel consumption of the engine with mechanical injection despite the lower compression ratio, is entirely due to the more favourable conditions under which the combustion of the fuel is initiated and carried out. This point will be discussed more fully, when dealing with the combustion process proper.

It will be agreed that the thermal relation of the total available heat energy and that portion which is converted into mechanical energy depends primarily on the degree of combustion. In order that the highest degree of combustion should be attained, it is essential that the different stages, through which the fuel is to pass, in order to be physically and chemically suitable for complete combustion, should be arranged for in the correct sequence: It is admitted, of course, that there is no hard and fast rule to be laid down for all of the many fuels which are suitable for heavy oil engines. It is not within the scope of this discussion to refer to the question of suitable fuels for internal-combustion engines in great detail, but from a point of view of general information, the three broad divisions of fuels may be briefly enumerated:

1. Liquid fuels which form chiefly highly inflammable vapours, i. e., vapours passing off on the fuel being heated to temperatures ranging from 65° to 300° F. These fuels are only suitable for engines fitted with carburettors or vapourisers.

2. Liquid fuels, which chiefly change to oil gas, i. e., vapours which are produced on heating hydrocarbons of the aliphatic base, which exist as an open-chain series, between 212° and 750°F.

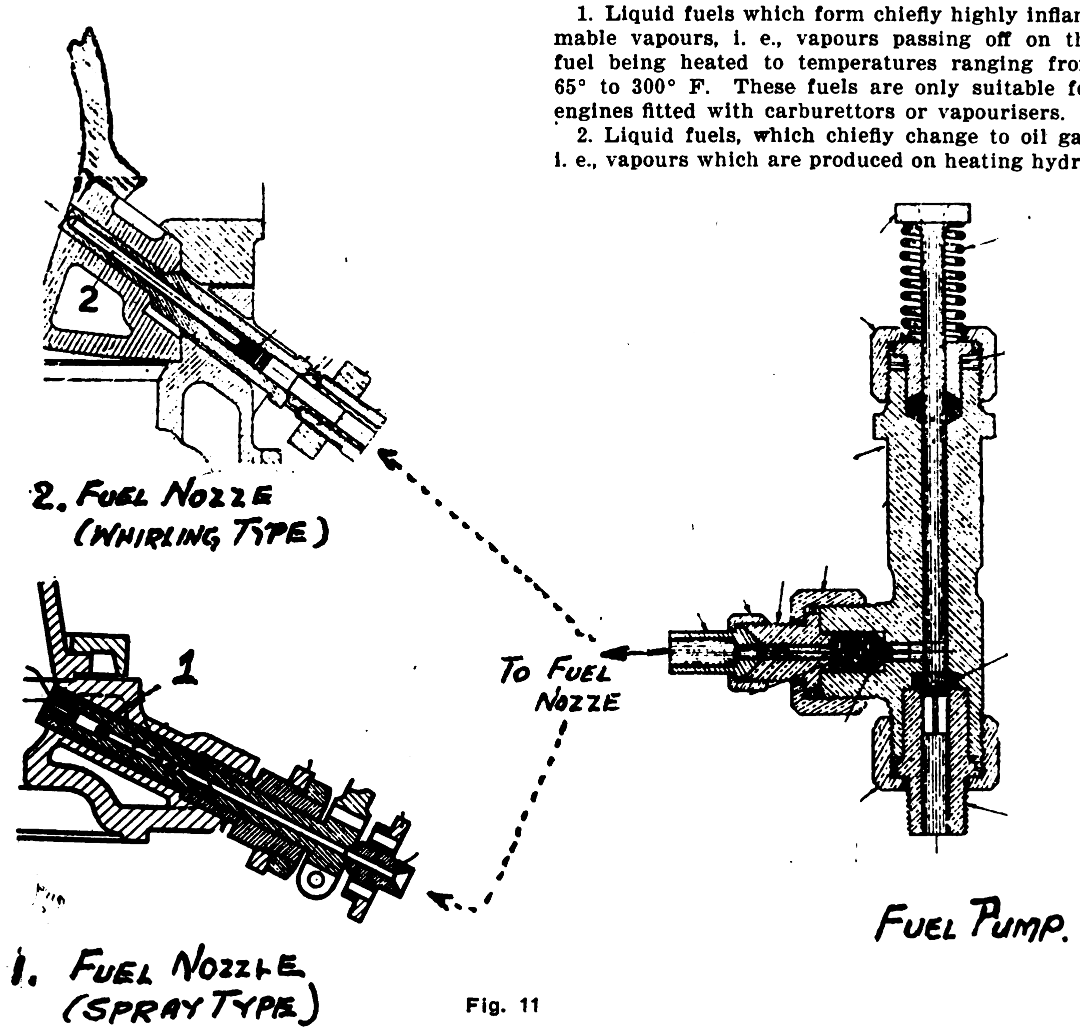


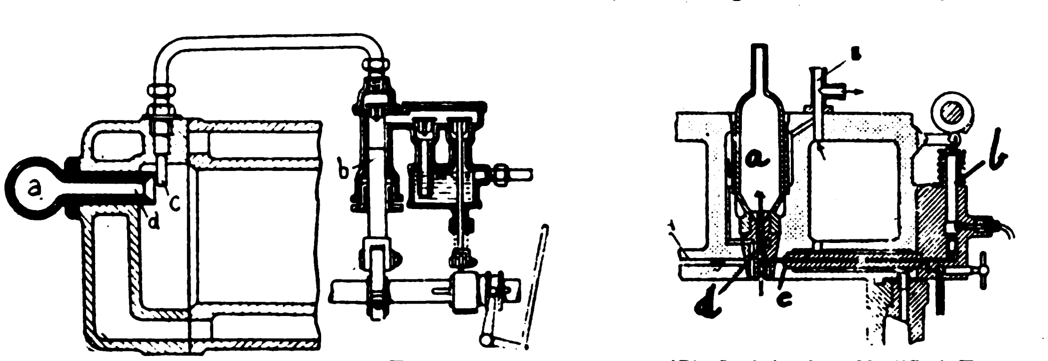
Fig. 11

These fuels are easily dissociated, burn rapidly on account of their high hydrogen contents, are suitable for such engines as are dealt with in this discussion, the suitability depending to a very great extent on the degree of oil-gas formation.

3. Liquid fuels, which on boiling form exclusively oil vapour, i. e., vapour found with aromatic hydro-carbons, which exist as a closed chain or ring structure between 300° and 840°F.

These fuels are only dissociated with additional heat, and owing to their relatively low hydrogen content produce rather sluggish combustion, unless artificially accelerated.

As will be observed, the fuels falling under the second category are found most suitable for Diesel and high-pressure oil-engines, although certain economic conditions of various countries, such as Great Britain and particularly Germany, have compelled the extensive use of such fuels as are enumerated under the third group. These fuels can be obtained from coal, and it is in connection with the attempt to economize as much as ever possible the world's natural fuel supplies, that the suitability of such fuels have been investigated. The results of such investigations will be dealt with in an article which the author has under preparation, and which will appear shortly in the "Motorship."



(A) Deutz Original Type. (B) Steinbecker Modified Type.

Fig. 12

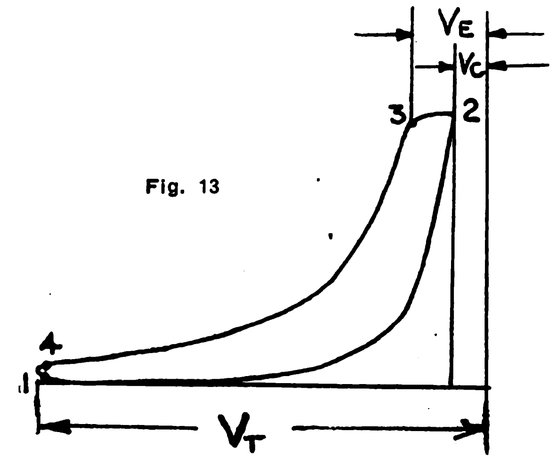


Fig. 13

Reverting now to the main subject, it has been accepted that for the purpose of attaining the highest degree of combustion, it is essential that the following sequence of breaking up the fuel should be adhered to:

1. Atomization of the fuel to the highest possible degree.

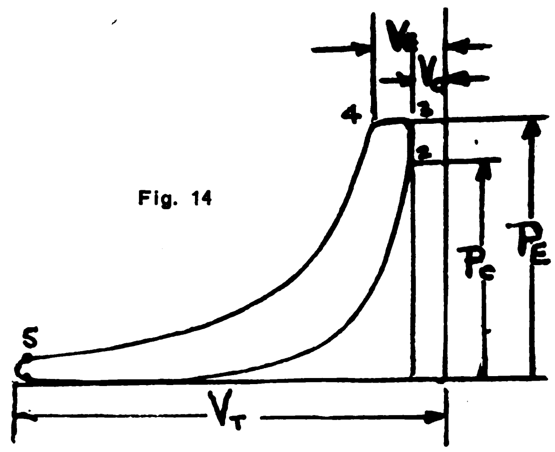
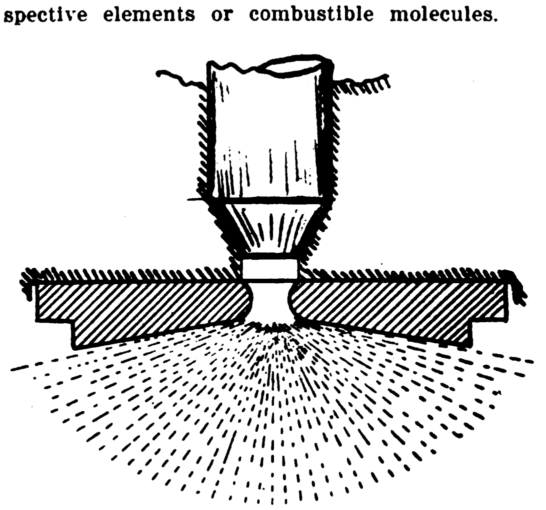


Fig. 14

2. Complete vapourization of the innumerable oil globules, resulting from such a complete atomization.

3. Thorough mixing of the oil vapour with the whole of the available air, provided for combustion.

4. Dissociation of this mixture into their respective elements or combustible molecules.



5. Combustion of the elements in the available oxygen of the total combustion air.

1. *Atomization.* It is quite conceivable that the temperature conditions will have a considerable influence of the above sequence to be attained and maintained, and that with unfavorable thermal conditions dissociation may commence at the end or even during the process of vapourization, resulting in the mixing of the oil vapour and the combustion air being only partially completed. Turbulence will, of course, assist in remedying

such a defect, and as a result plays a very important part in the maximum degree of combustion it is possible to obtain under any set of conditions.

It is therefore imperative that in addition to a properly designed fuel atomizing device there is ample provision for an automatic temperature adjustment.

The trend of design is generally indicative of the defects of the general principles underlying that particular design. This argument applies remarkably closely to the fuel atomizing devices suggested with heavy-oil engine construction.

With the original ring pulveriser design, it was anticipated that the flame plate orifice would assist in the formation of a wide-angled conical spray (Fig. 15), whereas the actual result was more like a very narrow jet (Fig. 16). The main flame plate orifice was in consequence split up into a series of narrow channels (Fig. 17), to distribute the oil spray in an appropriate manner over the combustion space. Experiments were carried out to study the effect of small alterations in the size, direction and number of such channels and the following table gives rather interesting results. Although the experiments were carried out with an engine, working on the air-injection principle, the general deductions apply both to the air and mechanical injection methods.

Angle of spray	23°	23°	23°	23°	23°	23°
Number of spray holes	5	6	8	5	6	8
Bore of spray holes	0.0273"	0.0234"	0.0195"	0.0273"	0.0234"	0.0195"
Revolutions per minute	274.8	274.5	276.3	271.3	267.9	267.9
M. E. P. lbs., per square inch	91.8	94.4	94.1	91.7	91.1	94.2
BHP	12.0	12.1	12.1	11.9	11.7	11.7
IHP	17.0	17.4	17.5	16.7	16.4	17.0
Mechanical Efficiency	70.9%	69.4%	69.2%	71.0%	71.5%	69.1%
Fuel per BHP hour lbs.	0.53	0.56	0.56	0.56	0.60	0.66
Net Thermal efficiency	25.2%	24.4%	24.3%	24.3%	22.6%	20.5%
Injection air pressure lbs. per square inch	740	740	740	740	740	865
Air excess co-efficient	1.78	1.71	1.72	1.71	1.54	1.37
Water circulating inlet Temp. °F	58	58	57	58	58	58
Circulating water outlet Temp. °F	184	184	177	182	181	165
Suction air Temp. °F	70	70	70	72	75	77
Exhaust Temp. °F	653	662	670	655	728	788

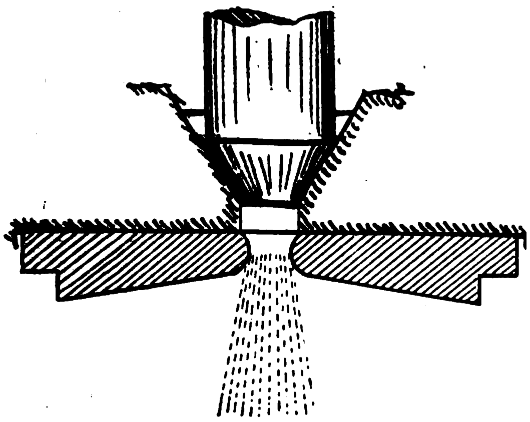


Fig. 16

It should be noted that with the last set of readings, when using an eight-holed flame-plate, having a spray angle of 43°, it was necessary to raise the air-injection pressure from 740 lbs. to 865 lbs. p. sq. in., in order to keep the engine running, although even with this pressure the exhaust was by no means clear. (See Zwerger: The heat diagram as a base for testing an oil-engine.)

By designing a flame-plate with a number of small holes instead of one orifice of reasonable proportions, there is undoubtedly a great tendency of chocking up the narrow channels, especially when employing a residual fuel. Yet on the other hand, in order to produce a definite nozzle velocity, which will stand in favorable relation to the velocity of flame propagation, once the oil-air mixture is ignited, the total cross-sectional area of the flame-plate opening must not exceed a certain value. By using air-injection, a large volume of compressed-air in addition to the fuel charge passes the narrow channels, and the total volume is sufficient to produce a definite orifice velocity without reducing the holes to impractical proportions. Taking, however, the mechanical-injection method, where a charge of oil without any additional air, compressed or otherwise, is forced through the series of pin holes, their bore must be very much smaller in order to retain the required nozzle velocity.

Considering for a moment a practical illustration, we note that in the Vickers 100 B.H.P. per cylinder unit the sprayer nozzle has five holes, each of 0.018 in. bore, which represents a total cross-sectional area of 0.0013 sq. in., or 0.000013 sq. in p. B.H.P.

In the last set of tests, which deals with air-injection method, the best results were obtained with a flame-plate having five holes each of 0.0273 in. bore. The corresponding total cross-sectional area is 0.0029 sq. in., or 0.00024 sq. in. p. B.H.P. The cross-sectional ratio for air and pressure systems is therefore 18.5 to 1. This figure is somewhat low and experimental results have shown, that a ratio of 20:1 is an average value.

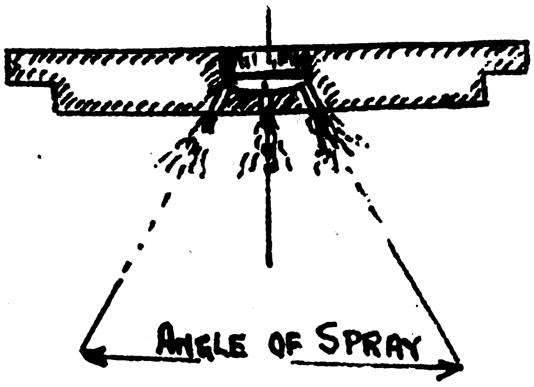


Fig. 17

Considering now for comparative purposes the relative increase in volume of compressed air—the compressed air expands during the injection period from, say, 1000 lbs. p. sq. in. to 485 lbs. p. sq. in.—and oil—the oil on being heated vapourizes and as a vapour or gas occupies a very much larger volume—it will be found that with similar final conditions with regard to temperature and pressure the volumetric ratio is about 1:25. As with the mechanical injection the nozzle temperature will be relatively higher owing to the absence of the cooling effect of the compressed air on expanding, the volumetric increase of the fuel charge on its way through the flame-plate channels will be proportionately higher with mechanical injection than with air injection. As a sequence the nozzle velocity of the oil vapour will in practice not be as unfavorable as might appear on the face of it, and it can be readily seen that by providing correct thermal conditions around the flame-plate orifice, it will be possible to increase the size of the holes accordingly.

In this connection the mechanical injection has a decided advantage, inasmuch as any formation of oil gas or vapours will not endanger the safe running of the plant. With the air-injection method the formation of a gas may, and in fact has, resulted in the formation of an explosive mixture in the fuel-valve casing with rather disastrous effects.

Reverting to the somewhat delicate proportions of the flame-plate holes, we find an analogous case in the case of oil-burners. In comparing the steam-jet and pressure principles, it is recognized, that the pressure system is the better of the two. Yet in practice it has been found that from an all-round point of view the steam jet system is preferred for such size of installations, where the rate of oil passed through each burner does not exceed approximately 150 lbs. per hour. It is again a question of dimensions of the spray-holes, which are larger when employing steam as the medium.

2. *Vapourisation.*

The fundamental condition underlying complete combustion is the vapourisation of the fuel charge prior to mixing the air, which is required for combustion with the fuel.

The distillation curve for a fuel suitable for a marine oil engine shows that evaporation proper—we are here not concerned with possible evaporation due to exposure to atmosphere—begins about 350° F., and is completed about 750° F. To show a comparison between the various grades of fuel, the following table is quoted, and in Fig. 20 the temperature range is shown graphically. The vapourisation curves are in some relation to the I.B.P., although their exact characteristics are not yet fully known.

It should be noted that all the above fuels are used in internal combustion engines of one kind and another, and the initial vapourisation temperatures are to a certain extent a measure of the atomizing agent, thus enabling large sized hole to be used and reducing the risk of choking the holes with carbonized fuel.

It should be remembered, however, that even with the smallest of surface-ignition engines the mechanical-injection principle is retained, and proves quite satisfactory both from a point of running and fuel economy. The grade of fuel used for this class of engine, is very much better than the heavy residuum fuels employed for oil-firing and heavy-oil engine purposes, so that the question of choked nozzles is not purely a question of nozzle dimensions, but also dependent on the grade of fuel.

It is desirable here to compare for a moment the difference between a spray jet and an atomized jet. It is a more or less general impression, that with mechanical injection the oil must be sprayed into the cylinder in a kind of solid stream. However, with certain favourable thermal conditions, it is quite possible to produce a mixture of solid and gaseous particles, and by providing adequate mechanical contrivances, a similar effect can be obtained with an oil/oil vapour mixture than with an oil/compressed air mixture.

Again it has been shown that the degree of atomization possible with compressed air is limited to a minimum size of globule of 0.015 in. to 0.020 in. diameter, and it appears, therefore, evident that for a finer atomization mechanical means must be employed to assist the compressed aid in breaking up the fuel. Such degree of atomization appears rather coarse especially when dealing with heavy residual fuels, and in recent pulverizer designs, the oil channels have been arranged in such a fashion, as to produce a maximum number of changes in the direction of flow, and furthermore "sharp edges" have been introduced, on which the fuel so to speak may tear itself to atoms. Or again the flow of the fuel through the pulverizer has been arranged to create certain differences of pressure, so as to throw the globules of oil with greater force against any intercepting obstacle. Fig. 18 indicates an illustration of the former, Fig. 19 gives the constructional details of the latter suggestion. The designer has obviously realized the limitations of compressed air as an atomizing agent, and has resorted to a mechanical appliance as an additional means of pulverisation.

Grade of Fuel	Boiling Point Temperatures Initial	Final
Gasoline (Motor Spirit)	70° F.	375° F.
Kerosene	250° F.	575° F.
Gas oil	325° F.	700° F.
Light Fuel Oil (26 Baume)	350° F.	750° F.
Heavy Fuel Oil (17 Baume)	375° F.	800° F.

A further point of considerable importance is the variable load condition. It is known that with the ordinary type of pulverizer the injection air pressure must be adjusted in relation to the load. Too high an injection pressure will produce bumping and give a whitish colour of exhaust, whilst too low an injection pressure will be accompanied by a falling-off of the power and a smoky exhaust.

If the injection pressure is to remain constant irrespective of the load, then refinements have to be introduced in the design, which have been considered as delicate and impracticable when evolved in conjunction with mechanical injection.—[Figs. 18 and 19 will be given in our next issue.]

(To be continued)

New American Solid-Injection Engine

Small Marine Diesel-Motor with Mechanical-Injection of Fuel, Built on the Pacific Coast

(Contributed)

FOR many years the only Diesel-engine builder using the solid-injection of fuel system with high cylinder-pressure in a commercial way was Vickers, Ltd. of England, who have developed it and adopted it for all their submarine engines. much outside interest was evinced and many experiments were carried-out by other engineering concerns here and in Europe; but none equipped their engines with it as a standard for marine work. Even the results then being obtained abroad were kept strictly secret by Vickers and the British Navy. After the war, as is now known, the veil lifted and the results were made public,

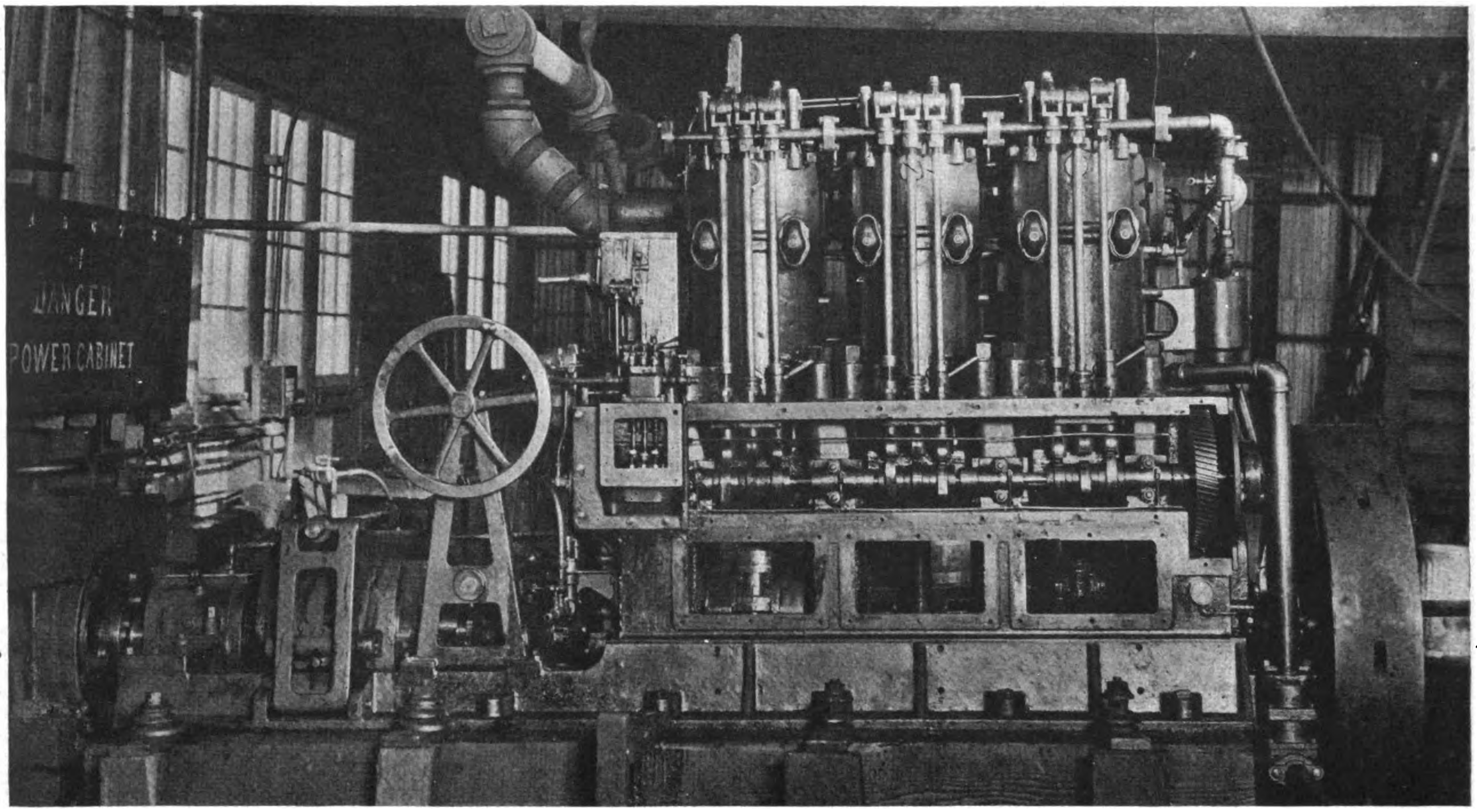


Fig. 1.—General view of the three-cylinder Enterprise solid-injection Diesel marine-engine

and much interesting information was given in the issue of "Motorship" of November, 1919, when it was revealed that on Admiralty tests consumptions as low as 0.37 lb. per brake horse-power were secured with a number of engines on different occasions when running on good grades of fuel. Also that all the British submarines, some monitors and tankers were equipped with solid- injection Diesel-engines with excellent results. Then the Anglo-American Oil Co.'s 10,500 tons d.w.c. tanker "Narrangansett" arrived here and added further impetus to the movement already in progress among some American concerns.

Mechanical-injection is perhaps a better term than is "solid-injection" and probably will be the ultimate name to be employed in this country, as it more clearly denotes the system, or rather the working of the same.

A marine oil-engine of the mechanical-injection type has recently been completed by the Enterprise Engine Company of San Francisco and we understand has been constructed under license and patent rights; altho under what license information is not available. It is a three-cylinder marine-engine of the four-cycle trunk-piston type rated at 75 b.h.p. but actually developes 90 b.h.p. at 325 r.p.m. It is not intended to produce this engine in large sizes at present, but they will be built up to 200 b.h.p.

The first engine is not reversible; but is equipped with a mechanical reversing-mechanism and clutch, which is controlled by a large hand-wheel. Figure 1 depicts the engine on the test-bed coupled to a brake, the splash-plates and cam-shaft-cover being removed to show the arrangement of cams and valve-timing; also the helical-gear for the camshaft drive. It will be noted that the valve-rockers are actuated by long push-rods.

Reference to Figure 5 will show the fuel-pump and governor control. To the right of the fuel-pump is a set of three cams for one cylinder—the cam at the extreme right being the exhaust-cam. The relief-handle (A) is used to relieve the compression while the center cam actuates the air-starting valves and is arranged to automatically cease to operate when the starting air is shut-off and fuel admitted. The cam on the left side is the air-inlet cam operating the inlet valve. Alongside the governor is the main control-lever for operating the engine. Reference to the upper part of this illustration will show a special feature of the cylinder-cooling. There is an outside connection (BB) through which water is passed from the cylinder to the cylinder-head with a view to eliminating gasket trouble at the joint. These water connections are arranged on the forward and after sections of the cylinder enabling good circulation around the valves.

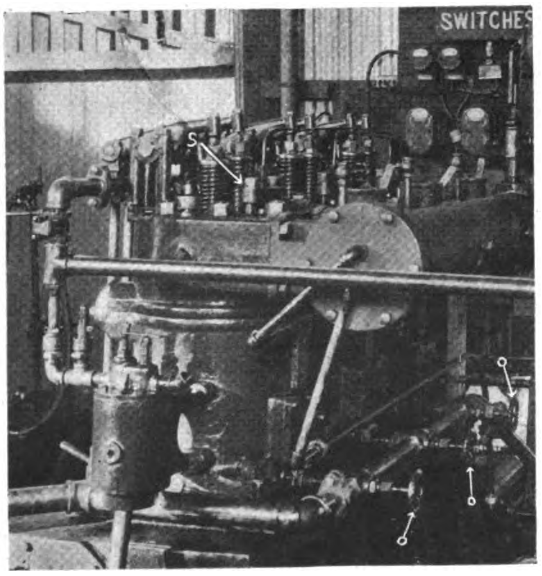


Fig. 2.—Forward view of Enterprise Diesel-engine showing valve operating-mechanism and air-pump

A view of the forward part of the engine is shown in Figure 4 and it will be noted that the cam-shaft and gear is enclosed, while over the casing is a single-cylinder air-compressor (C) driven direct from the crank-shafts. Between the crank-case and the fly-wheel is a plunger-type water-cooling pump.

As air is only used for maneouvring and for the vessels siren, no air being required for the injection of fuel—only a small single-stage air-pump is necessary instead of the usual three-stage compressor. Lubrication is under pressure and the method of lubricating cam-shaft bearings can be seen at "D.D." and lubricating-oil is furnished by an oil-pump located at the after part of the engine, while the gauge (E) indicates the oil pressure, which is designed to be maintained at approximately ten pounds per square inch.

By referring to Figure 5 a fuel-pump can be seen. It is driven off an eccentric at the after end of the cam-shaft. A Manzel force-feed lubricator is also operated from the same eccentric and carries oil-feeds to different working parts of the engine, including to two points on each cylinder. The fuel-pump referred to draws the fuel from the main-tank to the auxiliary-tank at "H" near the rear cylinder. This tank has two compartments, one for fuel-oil of 14 degrees gravity and the other compartment for 20 degrees gravity fuel-oil used for the purpose of starting—the 14 degree oil being so heavy that the pumps cannot handle it until the engine is warmed-up.

The forward end of the engine is shown in Figure 2, and this gives a comprehensive idea of its general design to construction, also the valve arrangement in the cylinder-heads. It will be noted that the cylinders are cast separately and are mounted on a cast-iron box frame which in turn is bolted to the bed-plate. At "S" special brackets are arranged under the exhaust-pipe to carry it when the cylinder-heads are removed for inspection, which enables the heads to be lifted-off without dissembling the exhaust-header.

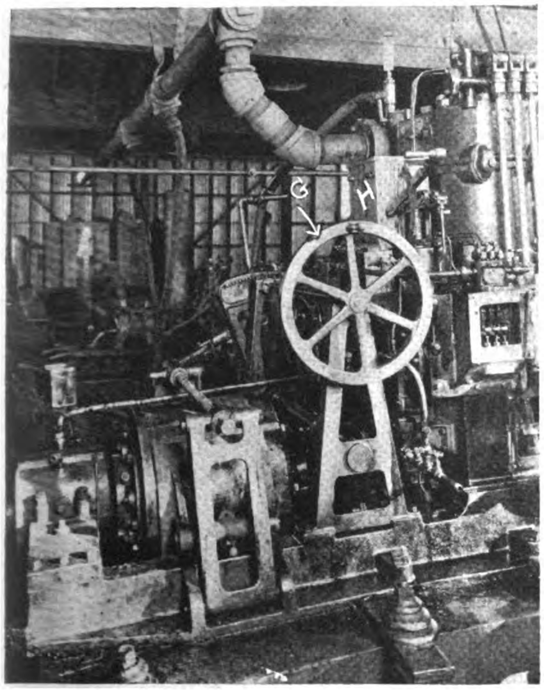


Fig. 3.—Reversing Mechanism of Enterprise engine

In the fore-ground there are two half-inch pipes leading to the flange of the exhaust-header. These are used for the purpose of heating the 14 degree gravity fuel-oil in order that it may flow readily through the pumps and pipes. The single-stage air-compressor can also be seen between the fly-wheel and the forward cylinder. A special gate-valve is connected to the air-line from the air-pump to the starting-air manifold on the cylinder-heads and only comes into operation when starting the engine.

With further regard to lubrication, oil is run through the lower part of the engine bed-plate through a ¾ inch pipe that has two separate leads to each main-bearing for the purpose of lubricating the crank-shaft, and a continuous flow of oil is maintained under pressure on the engine-shaft. It will be understood that when the holes in the main journal of the shaft come in line with the bearing oil-holds, the oil is forced through pressure into the holes in the crank-shaft, lubricating the crank-pin bearings in addition to the main journals. In a similar manner the connecting-rod is drilled with an oil-hole to the wrist-pin so that when the crank is at the top center the oil flows up from the crank-shaft and is forced through the connecting-rod into the wrist pin bearings.

Inside the box-type engine-frame there is a detachable cast-iron skirt to each of the cylinders which can be disconnected from the latter by removing nuts on four studs. With the crank at bottom center the piston can then be removed through the crank-case doors. It will be remembered that the detachable skirt for cylinders was first produced by the Werkspoor Company under patents, and later on was adopted by the Busch-Sulzer Company and by the Midwest Engine Company on small high-speed Diesel-engines. Regarding the fuel-pump, this is actuated by cams keyed to the cam-shaft and automatic changing of the stroke of the fuel-pump with a view to regulating the amount of fuel injected at different loads which is carried-out by a centrifugal-governor driven off the cam-shaft.

As we have previously mentioned, a mechanical reverse-gear is fitted and this is of the plain spur-gear type with forged steel pinions and gears, the pinions being bushed with plaxtic bronze and are housed in an oil-tight case, so run in a bath of lubricating compound. The clutch is of the multiple-disc type and inspection of the same is easily accomplished by removing bolts holding the reverse-gear extension-piece. The main engine crank-shaft is a one-piece forging, machined to 5½ inch diameter. Unfortunately, no details are available regarding the technical datae of the injection-nozzle used, or of the mechanical-injection pump; but we understand that the pressure of the fuel-pump is compartively low. We also understand that particular care was also made in connection with the casting work of the cylinder and cylinder-heads, etc. and that the castings were made in the Enterprise Company's own foundry, following careful experiments with mixtures and chemical analysis. The Enterprise Company has been constructing parts for the majority of distillate engine-builders in the San Francisco district for about thirty years, so have had considerable experience in the small marine-engine field.

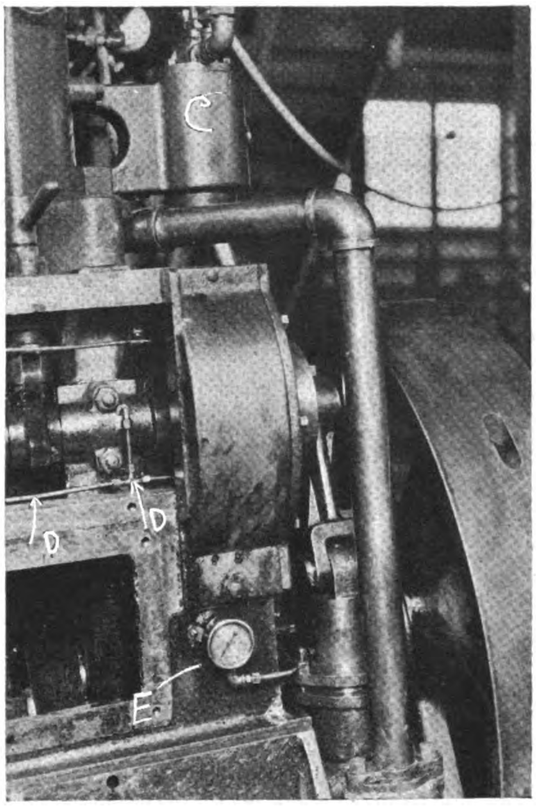


Fig. 4.—View showing lubricating arrangement of camshaft bearings

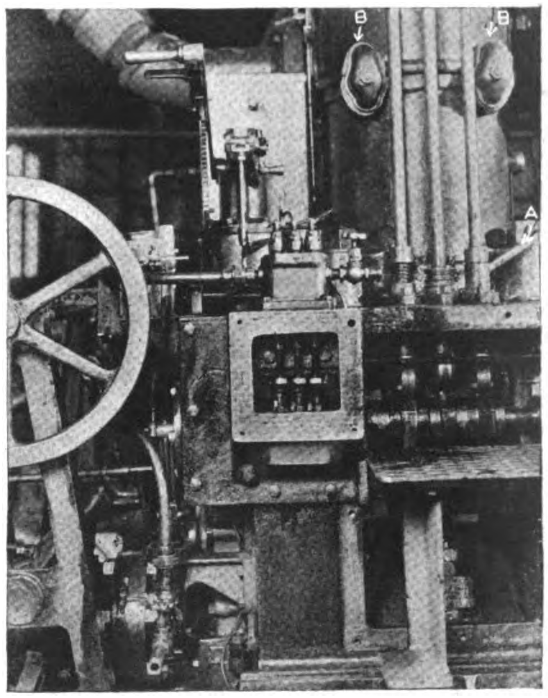


Fig. 5.—View showing fuel-pump and governor arrangement of the Enterprise engine

Ships Built on Isherwood System

The annual report on the progress of the Isherwood system of ship construction for 1920, reflects in a very interesting way the position of the world's shipbuilding generally, for the year just come to a close. From the date of its commencement, which period includes the twelve months ending December, 1908, to the close of 1920, less cancellations during the latter period, the appended list shows the gradual and remarkable progress of the Isherwood system in the number of ships constructed on the Isherwood plan, with a corresponding total of deadweight tonnages.

While the table presented is confined solely to Isherwood ships, it is nevertheless, something in the nature of an authentic record of the fluctuating phases in shipbuilding generally throughout the world.

	Number of ships	D. W. Tonnages
Sept. 1907 to Dec. 1908	6	31,608
1909	36	212,992
1910	76	484,752
1911	140	958,795
1912	240	1,777,348
1913	270	1,993,034
1914	311	2,351,322
1915	468	3,548,221
1916	620	4,666,000
1917	800	6,332,150
1918	1,050	8,707,700
1919	1,260	10,594,700
1920	1,395	11,962,400

It will be seen from the above table, that the Isherwood System progressed steadily from 1907 to 1911 and that for the year 1912, when oil tankers were in great demand, the number of ships constructed on the Isherwood plan during that year numbered 100.

During the first two years of the war the returns show a large increase, the number of ships on the ways during that year being 157 and 152 respectively. During the years 1917-1918, when the boom in shipbuilding began, the United States having joined with the Allies in an endeavor to expedite the output of tonnage, the number of ships again largely increased, 180 and 250 vessels being constructed—on the Isherwood system—during those two respective years.

With the conclusion of the World War and the consequent process of stocktaking resulting in a number of cancellations of emergency orders, the returns naturally show a falling off and, consequently, for 1920, the figures show a considerable drop in the number of new ships built, from those during the immediately preceding war years.

The figures for 1920 include oil-tankers aggregating more than 1,000,000 tons deadweight carrying capacity, which is an interesting commentary on the prophecy made by our shipbuilding authorities and experts that, during 1920, there would be a world's deficit of about a million tons of oil carrying tonnage as against the demands for oil fuel supplies. As a matter of general interest it may be mentioned that most of the tankers included in the 1920 figures range from 8,000 tons to 20,000 tons deadweight and that two vessels are of 20,000 tons deadweight designed foı the carrying of ore and oil and will be Diesel driven.

BRITISH AND DUTCH REDUCE BUNKER-OIL PRICES

Partly Due to Transportation Economies Effected by Use of Diesel-Motor Tankers

EARLY last month important price reductions of bunker-oil were made by the Asiatic Petroleum Co. of London, which is one of the subsidiaries of the Royal Dutch-Shell combine. The prices per ton are as follows:

Adelaide	$47.00	Melbourne	$47.00
Alexandria	46.00	Mombassa	46.00
Amsterdam	30.75	Nagasaki	43.25
Avonmouth	220s	Palambang	43.25
Balik Papan	$27.00	Panama Canal	24.50
Bangkok	43.25	Pangkalan Brandan	43.25
Batavia	43.25	Penang	43.25
Bombay	43.25	Port Said	46.00
Calcutta	43.25	Pulo Samboe	43.25
Cape Town	46.00	Rotterdam	39.75
Colombo	45.25	Saitozaki	43.25
Glasgow	220s	Santos	48.25
Hong Kong	$43.25	Shanghai	43.25
Hull	220s	Singapore	43.25
Hurghada	$46.00	Soerbaya	43.25
Karachi	43.25	Suez	46.00
Las Palmas	39.75	Sydney	46.00
Lisbon	39.75	Tarakan	27.00
Liverpool	220s	Trinidad	20.00
Madras	$43.25	Yokohoma	43.25
Malta	46.00		

About 25 of the Asiatic Petroleum Company's tankers are Diesel-driven, and a few are propelled by surface-ignition oil-engines, which types of machinery allows of the lowest transportation-costs of oil supplied to the bunker-stations.

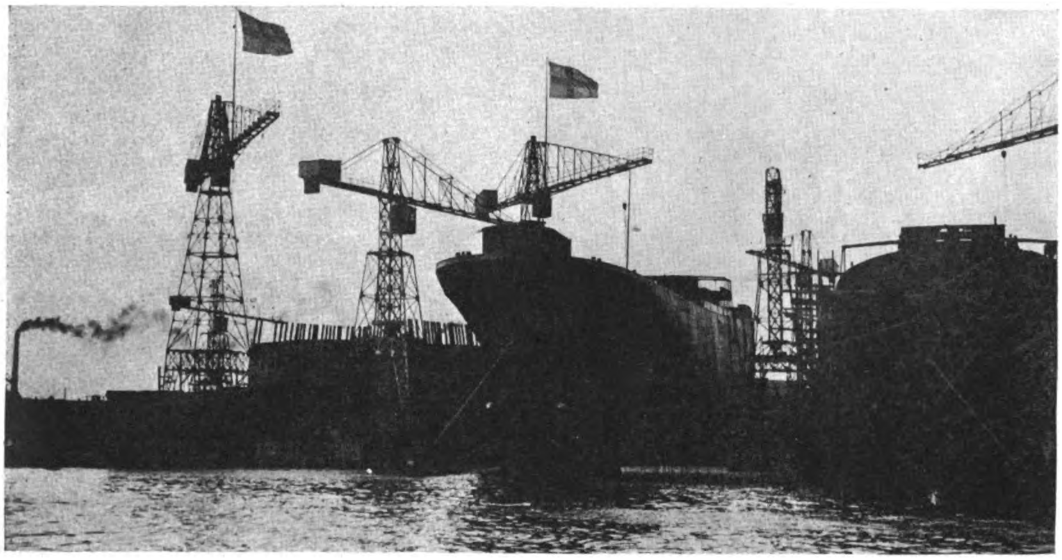
Interesting Notes and News from Everywhere

FAIRFIELD TO BUILD DOXFORD ENGINE

The Doxford opposed-piston type marine Diesel-engine is to be constructed under license for merchant-ships by the Fairfield Shipbuilding & Engineering Co., Govan, Glasgow.

STEAMERS AND MOTORSHIPS IN GREAT BRITAIN

More steamship orders have just been cancelled in Great Britain, including four cargo-passenger vessels of 10,000 tons each belonging to the Lloyd Royal Belge. But the numerous orders for Diesel-motorships still hold good.



The motorship "Canada" ready for launching at the Götaverken yard. Three more Diesel motorships are on the berths

MOTORSHIP "GLENIEG" LAUNCHED

The large Diesel motorship "Glenieg" of the Glen Line was launched by Harland & Wolff towards the end of December.

LAUNCH OF BIG MOTORSHIP "GLENBEG" ON XMAS DAY

To the order of the Glen Line of London, the new 14,000 tons d.w.c. 9,500 tons gross Diesel motorship "Glenbeg" was launched on Xmas Day at Harland & Wolff's Govan shipyard. Twin 3,300 i.h.p. Burmeister & Wain type Diesel engines are installed.

COPY OF "MOTORSHIP" AUGUST, 1919 REQUIRED

We have been advised by the Augsburg Works of the Maschinenfabrik Augsburg-Nurnberg, A. G., Augsburg, Germany, that they particularly desire copy of "Motorship" for August, 1919. Unfortunately we are entirely sold-out of copies of this issue, and we will be glad if any reader who has a spare copy will send same to the above concern.

SMALL MAIL AND PASSENGER MOTORSHIP

To the order of the Saltens Steamship Co., Bodø, Norway, a small passenger motorship has been launched by the E. Nofdbjaerg's Shipbuilding Co., Faaborg. She is 80 ft. long b.p. and is propelled by a 124 b.h.p. heavy-oil engine at 9 knots. She will be used for mail and passenger service along the north Norwegian coast. She is classed to the Norwegian Veritas.

ATLANTERHAVET COMPANY CHANGE STEAMSHIP ORDER TO DIESEL POWER

Some time ago there were ordered at the new Southern yard of the Copenhagen Floating Dry Dock, three 7,000 tons geared-turbine freighters to the order of the Atlanterhavet Shipping Company of Copenhagen. Two of these steamers have been delivered; but the owners have decided to instal Diesel-engines in the third vessel, and the propelling machinery will be supplied by Burmeister & Wain of Copenhagen.

TWO MOTORSHIPS BUILDING AT KOCKUM SHIPYARD

Government subsidies have been granted to the owners in connection with the two 6,550 tons d.w.c. motorships now building at the Kockum Shipyard, Malmo, Sweden, which vessels are similar in size to the motorships "Lima" and "Valparaiso" of the Johnson Line, but will have slightly lower power. These two motorships are being built to the order of the Swedish America-Mexico Line, and the Swedish Farmers Shipping Company, Ltd., and have been previously referred to in the columns of "Motorship." Only the hulls will be constructed at the Kockum Yard and after launching they will be towed to Burmeister & Wain's yard at Denmark where twin-screw Diesel-engines aggregating 2,100 i.h.p. at 150 r.p.m. will be installed.

ERIKSBERG CO. BUILDING MOTORSHIP FOR SWEDISH LLOYD

A single-screw motorship of 1,800 i.h.p. and 4,000 tons d.w. is now under construction for the Swedish Lloyd at the yard of the Eriksberg M.E.V., Göteborg, Sweden. The engine for this vessel is being built by Götaverken, and is of the Burmeister & Wain type.

WALLSEND SLIPWAY TO BUILD DIESEL ENGINES

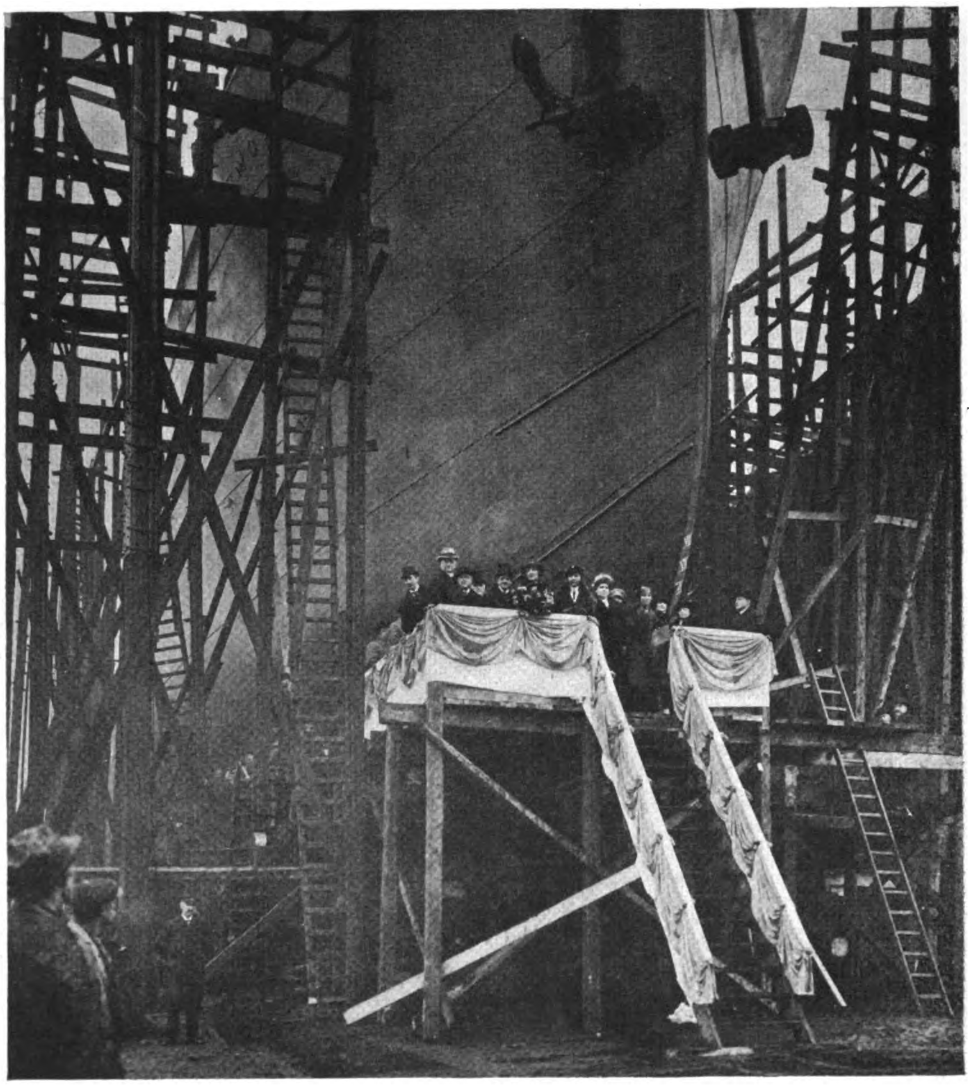
Rapidly growing in number are the list of British shipbuilders who have actively taken-up the construction of marine Diesel engines and motorships. The latest on the list is the Wallsend Slipway & Engineering Co. of Wallsend-on-Tyne, England, who have recently acquired a Sulzer two-cycle Diesel license.

NEW MOTOR FERRY-VESSEL

According to a report received from Cleveland, the Anchor Shipbuilding Co., Washburn, Wisconsin, has under construction a motor-driven steel ferry-boat building to the order of the Hudson and Athens Ferry Co., Hudson, N. Y. The hull dimensions are 115 feet overall, 33 feet molded beam, 44 feet over guards, depth 12 feet, and draft 7 feet. This vessel will have two propellers—one at each end.

MOTALA VERKSTED TO BUILD DOXFORD-ENGINED MOTORSHIPS

Information has reached us that the Motala Verksted of Motala, Sweden, has secured a license from Wm. Doxford & Sons, Sunderland, England, to build their opposed-piston type marine oil-engine, and that they have received an order from the Transatlantic Steamship Co. of Gothenburg for two single-screw 4,000 i.h.p. motorships of about 8,000 tons d.w.c. The shipyard connected to this company is known as the A/B Lindholmen-Motala, Göteborg.



Launch of motorship "Canada" at the Götaverken. The gentleman in the soft gray hat is Mr. Dan Bröstrom, the Swedish shipping magnate, who has decided to build a 600-ft. 16,000 i.h.p. transatlantic motor-liner to be operated by the Swedish-American Line

MARINE PROPELLERS

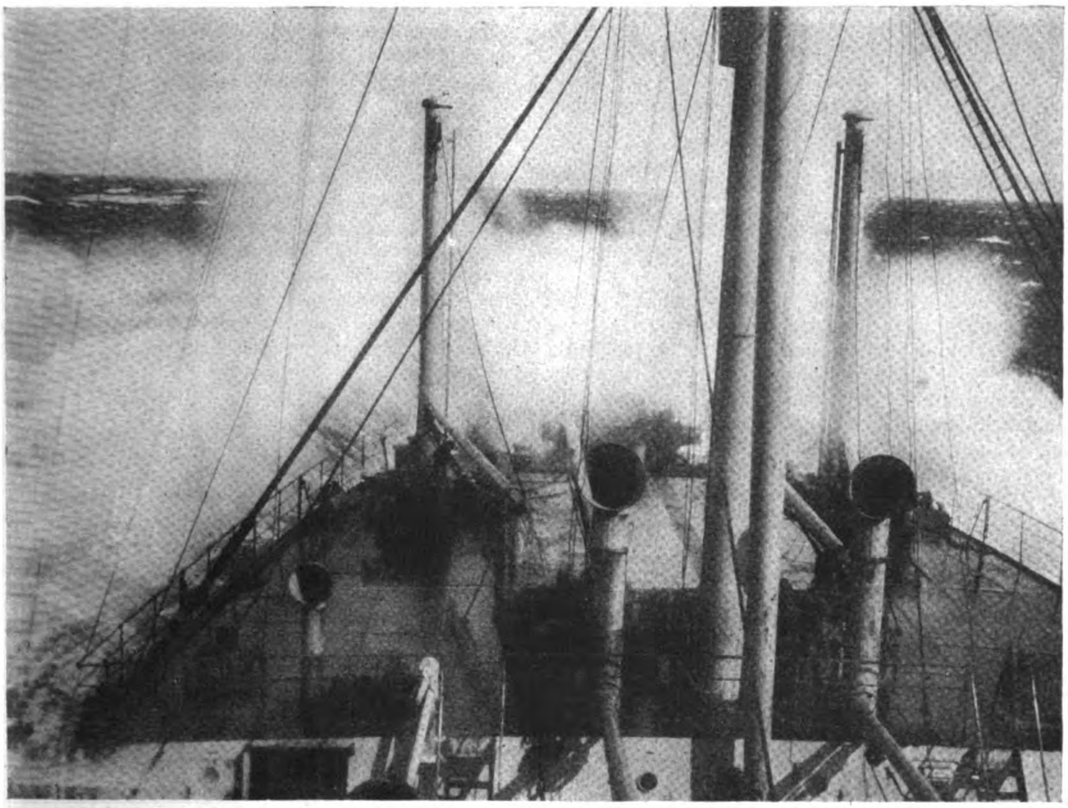
The 6th edition of the well-known book by S. W. Barnaby on marine propellers has recently been published by E. & F. N. Spon, Ltd., of New York and London.

SMALL STEAMER CHANGED TO DIESEL POWER

Some time ago a Danish Shipowning firm ordered a steamer of 1,400 tons d.w.c. from the Flensborg Shipyard. The type of machinery has just been changed by her owners, and a 350 shaft h.p. Holeby Diesel-engine is being installed.

"MADAL" A CONVERTED LIGHTER

A sea-going lighter has been converted to Diesel power under the supervision of the British Corporation by the N. V. Scheepsw. "Deklup" for Norwegian owners. The name of this vessel is "Madal" and she is 180 ft. long by 35 ft. in breadth, and is now propelled by a Polar two-cycle type Diesel engine. She will be used on the East African Coast and river service. Trial trips were recently run in Holland.



Maiden voyage of motorship "Afrika." Smashing into a heavy sea. The voyage is described on page 127

MOTOR TANKERS "WOTAN" AND "LOKI"

An agreement now having been reached between the U. S. Shipping Board and the Reparation Committee, the Diesel-driven tankers "Wotan" and "Loki" have been transferred to the Standard Oil Co. of N. J., who is the rightful owner of these ships.

SWEDISH GOVERNMENT SUBSIDIES FOR MOTOR-VESSELS

A loan of 400,000 kroners has been requested from the Swedish Government by the Rederi A/B Gloria of Helsingberg, Sweden, towards payment of a 2,650 tons motor-driven auxiliary sailing-ship recently purchased from America.

The Blankaholms Sagverks A/B (a sawmill and lumber concern) has applied for a loan of 300,000 kroner towards purchasing a motorship of 1,100 tons d.w.c. ordered from a Vasterik shipyard.

WARSHIP TO MERCHANT MOTORSHIP

Acceptance trials of the "Adolf Sommerfeld," recently converted in Germany from a warship to a cargo-carrying motorship, were made on October 11th with the result that a speed of 13 knots was made light, instead of 12 knots anticipated, the fuel-oil consumption working out at 0.44 lb. per shaft h.p. In view of the fact that the Diesel engines are of the high-speed submarine type, the results may be considered very good indeed. Each engine has six cylinders and develops 800 shaft h.p. She was illustrated last month.

We understand that the cost of reconstructing the vessel was only 3,000 marks per d.w. ton ($42.00 at current exchange). Each of the engines was illustrated on page 25 of our January issue has six cylinders, 17.75 inch diameter by 16.53 stroke, so that the bore is greater than the stroke, which is very unusual with Diesel engines installed in merchant vessels. Of course, in this case there is a special reason, inasmuch as the engines were originally intended for submarines. The vessel has been registered in Danzig.

MOTOR LINERS FOR HAMBURG-AMERICAN CO.

It has been reported that the Hamburg-American Line are shortly placing two 525-ft. emigrant motor-liners on the Hamburg-New York service, and that these ships will be propelled by submarine-type Diesel engines at 14 knots.

WERKSPOOR 3,300 i.h.p. DIESEL ENGINE

Some months ago we stated that designs have been prepared for an eight-cylinder Werkspoor merchant-marine Diesel-engine developing 3,300 i.h.p. at 100 R. P. M. We hear that its length is 48½ ft.

WORLD'S MOTORSHIP TONNAGE UNDER CONSTRUCTION

According to a report recently issued by Lloyds, there are 450,000 tons of motorships under construction in the world, excluding a considerable number building in Germany. This does not inclue motorships on order, that are not yet laid down. We believe that the world's total exceeds a million tons.

CONSUMPTION TEST AFTER NINE YEARS SERVICE

Recently a useful consumption test was made of the veteran single-screw Werkspoor Diesel-engined tanker "Juno" and a fuel-consumption of 0.350 lb. per i.h.p. hour was recorded. The "Juno" was placed in service in 1912 and has one engine of 1400 i.h.p.

SEVEN MORE MOTORSHIPS ORDERED FROM THE NAKSKOV YARD

Four additional motorship are now under construction at the Nakskov Shipyard to the order of Danish shipowners. It may be remembered that this yard built the 9.000 tons motorship "Orient" and the 4,800 tons motor-tanker "Mexico". The first of the additional four vessels is of 13,250 tons d.w.c., a sister-vessel of the East Asiatic Company's motorship "Afrika," and is to the order of the same concern.

The East Asiatic Company, in addition, have ordered from this yard a coastwise motor-passenger liner of 3,800 tons d.w.c., as well as a motorship of 1,000 tons d.w.c. known in the yard as "Number 5."

Furthermore, the United Shipping Company of Copenhagen, owners of the two large motorships "Oregon" and "California" have a motorship of 7,000 tons d.w.c. under construction at the Nakskov Yard. All these vessels will be engined by Burmeister & Wain, with the exception of the 1,000 tons boat which will have a Holeby Diesel-engine.

PERFORMANCE OF THE "KATHERINE"

The Bolinder-engined auxiliary motorship "Katherine" has now run 45,396 nautical-miles, and her engines have only stopped at sea for a total of 7 hrs. 30 min.

Maiden voyage of motorship "Afrika." The tail-end of a "big one" washes the decks

"FRITZ" RE-NAMED "ASSYRIAN"

The Blohm & Voss-built double-acting Diesel motorship "Fritz" has been re-named "Assyrian" by the Ellerman Line, who recently purchased her from the British authorities. She is one of the vessels delivered by Germany under the Armistice terms, and her engines were recently described in "Motorship."

NEW COASTWISE MOTORSHIP

A small cargo coastwise motor-vessel named "Ben Truman," of 125 tons d.w., has been launched by James Pollock & Sons, to the order of Messrs. Truman, Hanbury & Buston Co. of Burton-on-Trent, England. Two 80 b.h.p. Bolinder oil-engines are installed.

COASTWISE MOTORSHIP "ADMIRAL VERNON"

A 340 tons d.w.c. Bolinders oil-engined steel coastwise motorship named "Admiral Vernon" was recently launched by Jas. Pollock & Sons Co. at the Faversham Yard, England, to the order of Wm. Vernon & Son, the well-known millers of Liverpool.

THE COMING OF THE DIESEL ENGINE

The greatest development in marine-engineering is the almost universal extension of engineering shops for the construction of Diesel-engines. This extends right up the European seaboard. The wide adoption in the near future of the oil engine on a very comprehensive scale is regarded almost as a certainty, and one wonders sometimes whether owners, who almost as a matter of routine are ordering reciprocating steam-sets, quite realize the nature of the revolution that is going on around them.—*Shipbuilding & Shipping Record (London).*

Our Readers' Opinions

(The publication of letters does not necessarily imply Editorial endorsement of opinions expressed)

FOUR-CYCLE VERSUS TWO-CYCLE DIESEL ENGINES

To the Editor of "Motorship,"
Sir:

We should be much obliged if you would publish in the next number of your valued paper, under "Our Readers' Opinions," the following short reply to the letters of Mr. Shaw and Mr. J. Muysken.

We note with pleasure that Mr. Shaw and Mr. Muysken, in their letters in the October and December numbers of "Motorship," examine our statements in an objective manner, and we are glad that Mr. Muysken acknowledges that our opinions are correct, if the four-cycle and two-cycle engines are constructed on similar lines.

Concerning the possibility of higher speeds for the four-cycle engines, a four-cycle engine running at the same speed as a two-cycle engine of the same power, has in consequence of its longer stroke (about 30 per cent more) a greater piston speed, and therefore, in our opinion, should not be run at a higher speed than a two-cycle engine.

If the four-cycle engine has any advantages over the two-cycle engine because of the maximum pressures occurring only every second revolution, these advantages are to a large extent counterbalanced by the higher speed of its piston and driving gear, even when the four-cycle engine is running at the same number of revolutions as the two-cycle engine.

When we support the adoption of low speeds for marine engines, we are thereby only meeting the wishes of ship-owners, who prefer to rely on the good experience they have had of slow-speed steam-engines and of propellers turning at a low rate. The general tendency at present is for new motorships to be fitted with propellers of a slower speed than formerly was the case.

We think it only right to support these efforts when designing Diesel engines for the propulsion of ships, and for marine engines we recommend much lower speeds than we have used with success in the many large stationary two-cycle installations we have constructed.

Mr. Shaw's remarks concerning the two-cycle motorship "Hamlet" are not suitable for Sulzer engines, and the conclusions he draws are therefore quite erroneous. Our two-cycle engines work continuously, not with a mean indicated pressure of 4.4 Atm., as he assumes, but with approximately 6.5 to 7.0 Atm., and we, of course, undertake to fully guarantee these figures. By inserting this mean indicated pressure, it is at once seen that the comparison Mr. Shaw makes with a four-cycle engine does not hold for a Sulzer two-cycle engine.

Yours faithfully,
SULZER FRÈRES,
Société Anonyme.

Winterthur,
Dec. 23, 1920.

TWO-CYCLE VERSUS FOUR-CYCLE

To the Editor of "Motorship,"
Sir:

Having had considerable experience with various types of marine Diesel engines for the past eight years, I have followed with interest the correspondence in "Motorship" between Messrs. Sulzer and Messrs. Werkspoor, regarding size and weight of 2 and 4-cycle engines, and I think it would be of greater utility to the public generally if the arguments for and against the two types, by the most prominent representatives of the proposed parties be brought more before the public.

Although not being a party to it myself, I am interested enough to think that the question should be fought out honestly. I have made a careful comparison of the hypothetical Sulzer engine and with the engines of the "Salerno," on page 1094 of your December issue.

The scale of this drawing can easily be computed, the size of the "Salerno" engines being given. Taking the ratio of the distances between centres and the cylinder-bore to be about the same for both engines, we find that the bore of the Sulzer engines is roughly 18 inches, and their ratios of stroke to bore being 1.6, as stated in their letter, a stroke of 29 inches.

A two-cycle engine of this size, with four cylinders, will, at 125 r.p.m., taking a mean-pressure of 75 pounds and a mechanical efficiency of 70 per cent, develop 625 shaft h.p., whereas the "Salerno" engines develop 1,040 shaft h.p. at the same speed and with the same mean-pressure. The diagram illustrating the Sulzer letter is therefore absolutely misleading, and I think it a pity that a diagram of this species be published without criticism.

My opinion is that the Sulzer firm are fighting a losing case, when they have to resort to measures as these, and I doubt very much whether their English licensees will be responsible for such.

Yours very truly,
J. W. WODARD.

Dec. 17, 1920.
3, Osborne Road,
Newcastle-on-Tyne, England.

THE MOTORSHIP "PENDRECHT"

To the Editor of "Motorship,"
Sir:

In the October issue of your paper you have given a description of the Italian M.S. "Ansaldo San Giorgio I," and we can only admire the interest and thoroughness with which you have personally gone into this matter.

There is, however, one little error, which has nothing to do with the article itself, but which we would rectify. While going down to Philadelphia on the "Ansaldo San Giorgio I," you say that you passed the Kromhout-engined motor-tanker "Pendrecht" of Holland. That vessel, however, is equipped with two 320 b.h.p. Bolinder engines, which we have only wanted to point out to you.

Yours very truly,
J. & C. G. BOLINDERS CO.

Stockholm, Sweden.
December 17, 1920.

DIESEL-ENGINE FLEXIBILITY

To the Editor of "Motorship,"
Sir:

On reading the December issue of a London publication, we noted the reports on the results of trials at Sunderland, of Doxford's first 3,000 h.p. oil-engine, 77 r.p.m. being the normal speed of this engine when developing 3,000 b.h.p., the same can run continuously at a low speed of 16 r.p.m.

We beg to send you herewith diagram referring to one of the several trials of our normal type of 1,100 b.h.p. powered engines, fitted on board the motorships of the "Societa Nazionale di Navigazione," which shows how this engine has run from a maximum of 150 r.p.m. down to a minimum of 40 r.p.m., the variation being quite of the same order as the one achieved by the Doxford engine. Very noteworthy is the fact that these figures relate to trials in our Works with dynametric-brakes, and, of course, with practically no resistance on the shaft, owing to the low speed.

In fact, in the other diagram, referring to sea-trials of another engine of the same type and power, can be noted how revolutions down to 35 p.m. were obtained.

On page 250 of the November issue of the same journal, in a report on the operation of the M.V. "Narragansett," there is informed that the Vicker's internal-combustion engines are very flexible, owing to the fact that the revolutions from normal speed of 117 r.p.m. are reduced to 48 per minute. As it can be easily seen, the variation, in this case, is less extensive than for above-mentioned "Ansaldo San Giorgio" type.

The flexibility of these engines is officially stated, with their regularity and reliability, in many reports of the Technical Bureau of R. Corps of Naval Constructors of the Navy, in Genoa.

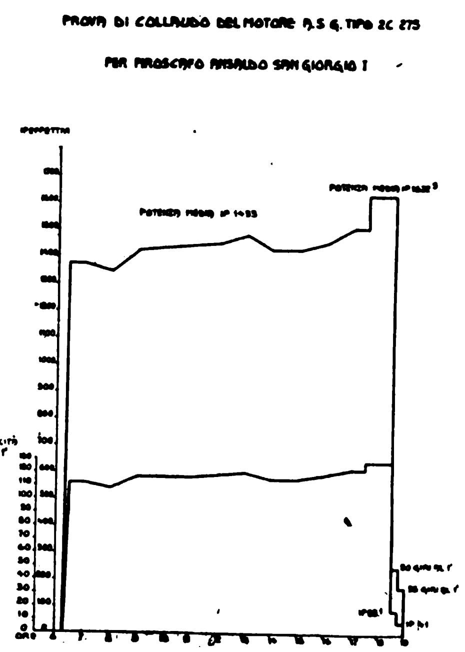
We shall be much obliged if the above remarks, as well as the diagrams, should be published also in a next number of your so appreciated periodical.

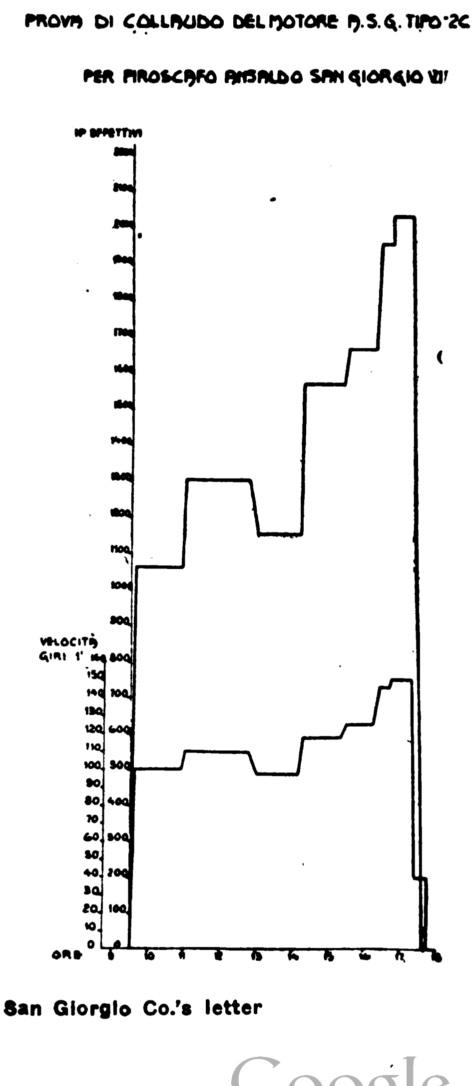
Yours very truly,
Z. M. TORRELO, Director.

Ansaldo San Giorgio, Ltd.
Torino, Italy.

TWO MORE MOTORSHIPS CONSTRUCTED UNDER SECTION TWENTY-THREE OF THE MERCHANT MARINE ACT

Approval has been given by the U. S. Shipping Board for the construction of the motor-tankers "F. H. Hillman" and "Charlie Watson," of 5,140 tons d.w. and 2,300 tons d.w., respectively, under the provisions of Excess-Profits Tax Exemption of Section Twenty-three of the Merchant Marine Act. Both vessels are owned by the Standard Oil Company of Calif.





Diagrams illustrating Ansaldo San Giorgio Co.'s letter

Injection and Combustion of Fuel-Oil

Experiments with Solid-Injection and Air-Blast in Marine Diesel-Engines

By Engr. Commander C. J. HAWKES, R.N.(Ret.)*
Professor of Engineering, Armstrong College, Newcastle-upon-Tyne

[Owing to great pressure on space, we have been obliged to hold over this interesting article until this issue, as stated in our January number.—*Editor.*]

INJECTION of fuel-oil in Diesel engines is of the utmost importance, especially in the case of engines of comparatively high speed. In dealing with this subject references are made to experiments which have been carried out at the British Admiralty Engineering Laboratory in connection with development for naval purposes. The more general method of injecting fuel-oil into a Diesel engine is by the use of compressed-air, but considerable advance has been made with the, so-called, solid-injection system. It is now generally known that nearly all British submarine engines are fitted with the solid-injection system—and the credit for this development is due to Vickers, Ltd.

With the air-injection system a definite quantity of fuel-oil is pumped into the fuel-valve casing, and when the fuel-valve is lifted off its seat compressed-air, provided by a high-pressure air-compressor, blows the fuel-oil into the cylinder in a very finely divided state. In the case of the solid-injection system no air-compressor is required. The fuel-pump raises the oil in the fuel-valve casing, and in the system generally, to a comparatively high pressure, and when the fuel-valve is lifted off its seat the requisite quantity of oil is forced, by its own pressure, through a number of small holes in the sprayer—which causes the oil to be split up into a mist. It is proposed to refer in the first instance to experiments carried out with the solid-injection system and then to certain experiments with the air-injection system.

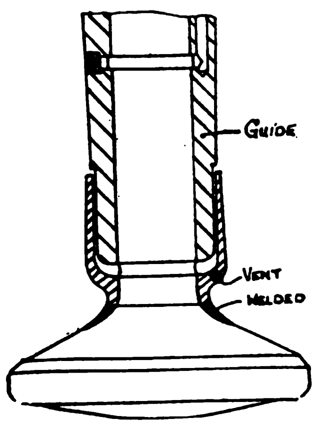


Fig. 1

The single-cylinder four-stroke engine used for the solid-injection tests was the first engine installed in the Admiralty Engineering Laboratory. This engine, which is fitted with a piston of aluminium alloy, has a cylinder diameter of 14½ inches, stroke 15 inches, and develops 100 b.h.p. (nominal) at 380 r.p.m.

The solid-injection fuel-valve used during most of the experiments detailed was of the direct-lift type, i. e., the fuel-valve spindle, which passed through a gland, was operated directly by the fuel-valve lever. The instant of injection of the fuel was adjusted by means of the timing-gear which altered the position of the fuel cam-shaft in relation to the crankshaft. The fuel-pump used during the tests was of bronze and the suction and delivery valves were of hardened steel. The fuel-pump glands were packed with Palmetto packing.

Owing to the use of very small holes in the sprayer it is imperative that the oil should be thoroughly strained, and strainers are consequently fitted on the suction side and also on the discharge side of the fuel-pump between the pressure-gauge and the fuel-valve. The fuel used during all the solid-injection tests referred to was shale fuel-oil having a specific gravity of about 0.86 at 60° F., flash point 220° F. (close test) and a viscosity of 43 sec. at 70° F.

The fuel-tank, 18 in. in diameter and 5 cu. ft. capacity, was arranged with a narrow neck 3½ in. in diameter in which a point gauge was fitted. At the commencement and at the end of each fuel-consumption test the level of fuel-oil in the tank was arranged so that the gauge point in the neck was just visible; consequently the weight of fuel-oil poured into the tank was the fuel-consumption during the test. The fuel-oil was conveyed to the tank by means of a can. This can was carefully weighed within half an ounce, by means of a standard balance, when it was full of oil and again when a quantity of oil had been poured into the tank.

The power developed by the engine was absorbed by a Heenan and Froude dynamometer. The counter readings and other records were taken every 15 minutes. In some cases only half-hour tests were made but, even with such short

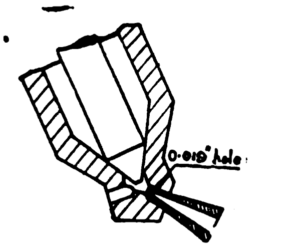


Fig. 2

runs, with the apparatus used and with the engine at working temperatures the records were for all practical purposes accurate. The results given are the means of not less than two tests carried out under the same conditions. In all cases, with the exception of a few runs at low powers, the initial, or maximum, pressure was adjusted by means of the timing gear to about 630 lbs. per sq. in. before commencing a test. The compression-pressures used during the tests are shown in the tables of results. Throughout the principal tests the jacket, etc., cooling water was kept at a mean temperature of about 80° F.

On account of the situation of the laboratory it was necessary to fit an exhaust pipe about 180 ft. in length. The engine exhausted into two silencers fitted with water-sprays and consequently steam was produced in the exhaust-pipe which made it difficult to ascertain the condition of the exhaust with any degree of accuracy. The drainage water from the first silencer was, however,

TABLE 1.—RESULTS OF TESTS WITH VARIOUS SPRAYERS, &c.

Ref. letter of Tests.	R.P.M.	B.H.P.	Opening of Fuel Valve before t.d.c. Degs.	Fuel Oil.		Fuel Valve.			Compression Pres. Lbs. per sq. inch.	Remarks
				Lbs. B.H.P.-hr.	Press. lbs. per sq. in.	Sprayer. No. of holes.	Sprayer. Diam. of holes.	Roller Clearance. Inches.		
A	380	100·1	20	0·45	4,000	5	0·019	0·030	460	
B	381·5	101	10·5	0·42	4,200	5	0·016	0·072	460	
C	377·5	99·4	11·5	0·42	4,600	5	0·016	0·095	460	
D	380	100	19	0·47	4,300	5	0·016	0·003	485	Steel plates used.
E	382·9	101	23	0·43	3,400	5	0·016	0·003	380	Compression reduced to 380 lbs per sq. in.
F	380·3	100·3	12	0·42	5,600	5	0·016	0·090	380	
G	380·8	100·4	15	0·49	3,700	5	0·016	0·003	490	Piston top cov…d with plates. Compression increased to 490 lbs. due to addition of plates.
H	380·3	100·2	8	0·46	5,600	5	0·016	0·100	490	Do. do.
J	378·4	99·8	8½	0·47	5,700	5	0·016	0·100	490	Steel plates. Fuel oil heated to 400 deg. Fahr. on pressure side.

Table 1

allowed to pass over a glass plate painted white on the under side, and it was found that by this means the condition of the exhaust could be readily ascertained and the presence of even a smaller quantity of carbon in the exhaust-gases was immediately detected. In the results given, therefore, the condition of the silencer drainage water is recorded. The aluminium-alloy piston, which was fitted with six narrow cast-iron rings, was lubricated with the same oil as was used for bearing lubrication. The exhaust valve of the experimental engine is water cooled.

During tests which were previously made with this engine it was found that the exhaust-valve had a tendency to stick even after a comparatively short period of working. When examined it was found that the clearance between the valve spindle and its guide was always filled with a hard carbon deposit and it was decided to grind the spindle parallel and fit a deflector, as shown in Fig. 1, arranged so that when the exhaust-valve opened the spindle was protected from the rush of exhaust-gases. This deflector was found to be effective in the experimental engine, and since it has been fitted there has been no sign of sticking of the exhaust-valve and the spindle has always been free and clean when removed for examination. The valve spindle is lubricated by means of a mechanical lubricator.

Experiments were carried out with the object of ascertaining the effect of varying the number and size of the holes in the solid-injection sprayer.

Before commencing these experiments tests were carried out with the single-cylinder engine at 100 b.h.p. and 380 r.p.m. with a sprayer provided with five holes 0.019 in. in diameter. This sprayer was similar to the sprayers fitted in submarine engines in 1914. It had previously been found that better results could be obtained by increasing the pressure in the system, and Test A, Table I., was therefore carried out with a fuel pressure of 4,000 * lbs. per sq. in. (gauge). The fuel-consumption was 0.45 lbs. per b.h.p.-hour, but

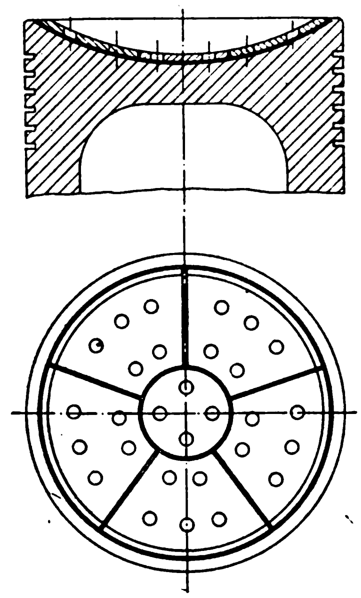


Fig. 3

it must be remembered that the experimental engine has only a single cylinder and it is fitted with a camshaft driving mechanism which was originally made for a multicylinder engine of the same design.

It was thought that slightly better results might be obtained if the fuel sprays were passed over a heated surface and a sprayer was therefore made so that each of the five 0.019 in. holes was surrounded by a steel trumpet expanding from 1/16 in. to 3/16 in. in 3/4 in. Each trumpet was driven into the sprayer and caulked, and the 0.019 in. holes were drilled in their ends as shown in Fig. 2. The fuel-valve in the experimental engine was inclined to the axis of the cylinder, and owing to this inclination a large portion of some of the trumpets had to be cut away to allow the fuel-valve to enter the cover. The modified sprayer was tested in the engine, but the maximum b.h.p. obtained was only 65. When the valve was removed and examined it was found that the interior of each trumpet was quite clean and bright, but there was a considerable carbon deposit on the external surface. There was no doubt that the jets of oil had been striking the inner surfaces of the trumpets, and it was decided to ascertain the effect of increasing the size of each

* North East Coast Institute of Engineers and Shipbuilders. Nov. 26, 1920.

* The pressure in the system during all the experiments referred to in this Paper was increased as necessary by increasing the clearance between the roller carried by one arm of the fuel valve actuating lever and the fuel cam.

trumpet so that it expanded from 1/8 in. to 5/16 in. in 3/4 in. This alteration resulted in increasing the power to 95 b.h.p. at 380 r.p.m., but after 40 minutes running the power dropped to 90 b.h.p. On examining the trumpets it was evident that the jets had again been striking the sides and dribbling had occurred. The color of the trumpets also indicated that they had been comparatively cool and had not reached a red heat. It was decided, therefore, to proceed no further in this direction.

Several tests were then made with sprayers provided with holes smaller than the standard 0.019 inch. As there were, at that time, no suitable drills available, the small holes were made by drilling holes about 0.019 inch diameter, caulking them over, and then opening them out again to the size required with a fine tapered reamer. The holes were, therefore, 0.019 inch in diameter with a knife-edged orifice of slightly smaller diameter. Fairly good results were obtained with a sprayer having five 0.015 inch holes, but a sprayer provided with five 0.015 inch holes, was not promising. The best all-round results were obtained with a sprayer having five 0.016 inch holes, equally spaced. Tests B and C, Table I., give the results obtained with the 0.016 inch-hole sprayer. It will be seen that in each case the fuel-consumption is appreciably less than with the 0.019 inch-hole sprayer.

At this stage it was decided to ascertain the effect of fitting steel plates to the top of the aluminum-alloy piston. Five insulated steel plates were therefore fitted, each 2½ inches by 2½ inches by ⅜ inch thick, in positions such that the fuel-sprays would strike them. The fitting of these plates increased the compression-pressure by 25 lbs. per square-inch. The results obtained are shown in Test D, Table I. It will be seen that the effect of the plates was to increase the fuel-consumption. When the plates were examined it was found that they had been running at an appreciable temperature and some were blistered. As it was thought that the sprays had not been striking the plates fairly it was arranged to fit larger plates.

Before fitting the large plates the compression was reduced to 380 lbs. per square-inch and tests were carried out with the sprayer provided with five 0.016 inch holes. Test E, Table I., gives the results with a fuel pressure of 3,400 lbs. per square inch and Test F, Table I., gives the results with a fuel pressure of 5,600 lbs. per square inch.

Six insulated steel plates were then fitted to cover the piston, as shown in Fig. 3, and tests carried out. The results are given in Table I, Tests G and H, and it is clearly shown that the plates did not assist the combustion. The fuel-consumption per b.h.p. in Test H was 0.46 as compared with 0.42 obtained in Test F under similar conditions as regards fuel-valve roller clearance and fuel-injection pressure, but without the plates.

It was then decided to increase the temperature of the fuel-oil on the delivery side of the pump, and this was done by passing the fuel-oil through a steel-coil placed in the exhaust-pipe. The temperature obtained, recorded by a thermocouple in the circuit, was 400° F. No improvement resulted. (See Table I., Test J.)

When the plates were removed it was found that they had been very hot in places, they were generally free from carbon deposit, and although they were not blistered there were distinct signs of erosion where the fuel-jets impinged. The unsatisfactory results were certainly due to delayed combustion—which was clearly shown by the indicator cards and the exhaust temperature. The Author was of opinion that possibly the results obtained were to a certain extent due to some of the particles of fuel-oil assuming the spheroidal state on striking the hot piston, thus delaying vaporization and combustion. Some simple experiments, which it was hoped would throw some light on the matter, were made by allowing heavy petroleum oil to fall in drops through a distance of about 6 inches, at the rate of one drop per second, on to a heated steel-plate. No temperature measurements were taken but at a barely visible red heat in daylight (say 930°F.) there was no sign of the spheroidal state. The drops did not break up, but carbon deposit was left by each drop and accumulated—and this was difficult to burn off at a bright-red heat. At a full cherry-red heat (say, 1,470° to 1,560° F.), each drop broke into six or eight smaller round drops, which did not "run" as water in the spheroidal state does, but they scattered over a circle about 1 inch in diameter and remained momentarily where they fell Hardly a trace of carbon was formed and the oil appeared to crack almost at once into heavy vapours and gases. Texas oil gave very similar results.

(To be continued in our March issue)

More Thought on the Diesel Oil-Engine

Possibilities of Improving Methods of Fuel-Injection

BY Z. WIRT

MUCH has been published regarding the attitude of American shipowners and shipbuilders toward the Diesel oil-engine and it is fair to assume that they are at least awake to the needs of the situation. Altho, it would seem that constant republication of such articles with variations and additions in the light of progress made until their full object has been attained and results secured, might serve a useful purpose.

The possibilities for an American designed Diesel-engine conforming to proven established practice in all essentials of standard construction, are great. The elimination of complicated mechanical movements for valve operation, accessibility of moving parts requiring lubrication, examination, adjustment and repair affords a promising field for improvement as does the design of parts so that they are interchangeable for either right or left hand engines; thus saving production and erection cost.

On the important question of efficiency much of the loss may be charged to the initial direct thrust at the start of combustion, the crankpin and shaft being in direct line, while the point in the revolution when the leverage is greatest, is near that when injection of fuel ceases, but there seems no practical way to overcome this condition until the internal-combustion oil-turbine becomes a practical reality, which seems a long way in the future.

The effect of design and type upon installation cost and efficiency can not be expected to produce much result above the present percentage of efficiency until such means are employed as will give quicker and more complete combustion of the injected fuel, at the same time not increasing complication and loss of efficiency thro friction or in other ways. Perfect combustion can not take place without sufficient oxygen within the combustion-chamber to balance the fuel injected as it enters from the valve nozzle. Even where the amount of oxygen is sufficient, a question arises as to how perfectly combustion takes place owing to the rapid expansion or explosion of the first sprayed oil-fuel entering the compression-chamber forcing back the oxygen from coming in contact and mixing with the atomized fuel-oil entering later. Also, what effect the rapidly increasing space in which the combustion takes place, has upon combustion, for as the piston recedes on the power stroke there is a rapid increase of space behind the piston which naturally permits the unused oxygen content to move away from the point of fuel injection rather than toward it, and it would seem that combustion would be slowed up accordingly resulting in its continuing to the end of the power stroke which is practically what does take place, resulting in lower mean pressure.

This might seem an unwarranted speculation when dealing with time as related to an explosion or combustion such as takes place in the compression space of a Diesel engine; but, obviously there is a time of beginning, whether "sprayed" or mechanically injected, and as the beginning of the combustion is coincident with the commencement of fuel-oil entry, and the absorption of oxygen also being simultaneous, the setting-up of a rapidly expanding barrier of flame around the injection-nozzle retards the access of oxygen further away from the spraying-nozzle, and the increasing pressure of the expanding gases has a tendency to retard the spraying and distribution of the finely divided atoms of oil which would otherwise give the proper balanced mixture.

More than one fuel-valve would have a tendency to better mixing of sprayed fuel with oxygen, but multiplies mechanical difficulties in valve operating-mechanism, so it is doubtful whether the improved results obtained outweigh the disadvantages. Much might be looked for, to improve Diesel engine efficiency, from a better designed valve-nozzle whereby the oxygen is either permitted more continuously complete access to the sprayed oil, or air injected into the atomized oil.

It is difficult to determine accurately conditions, causes and effects that obtain within the cylinder walls of a Diesel engine during the several strokes, but it is reasonable to assume that during the compression stroke of a four-cycle engine, aside from the raise in temperature and pressure there is very little turbulence and that the increased pressure would have a tendency to decrease such agitation within the compression space. During the combustion period and explosion stroke the initial density of highly-compressed air would seem to have a tendency to retard atomization or the reduction of the fuel into a fine mist. Agitation by means of admission of compressed-air from a high-pressure supply would certainly cause better combustion and it is conceivable that the closer such inlet of air is to the fuel-oil inlet the better mixing and better combustion.

Frictional and mechanical losses are not likely to be reduced to an appreciable degree, while very little can be hoped for in greater thermal efficiency of heat units as now generated, therefore it is to more perfect combustion resulting in more thermal units being created that anything approaching increased efficiency may be looked for. The utilization of heat from exhaust-gases may be made for purposes of heating living quarters of ships advantageously.

However interesting and vital the possibility of improved efficiency in the Diesel engine may be, the question that transcends all others in importance is how to move American engineers, ship-builders and shipowners to a full realization of the needs of the situation and get them to abandon the un-American position of holding back.

S.S. "MOUNTJOY" CONVERTED TO MOTOR POWER

Before the days of Diesel motorships—in 1898, to be exact—Burmeister & Wain, of Copenhagen, built the steel steam-vessel "Mountjoy," ex "Rudolph," 214 tons gross. This little ship was recently fitted with twin-screw Vickers-Petters surface-ignition oil-engines, and is now owned by Salterns, Ltd. (G. Castle, Manager), Parkstone, Dorset, England.

LEROUX & HEUZEY OPEN BRANCH OFFICE

We have been advised that Leroux & Heuzey (ex-Prenthout, Leblond & Leroux) have opened a branch office at 48 Rue des Petits Champs, Paris, which will be under direction of Mons. J. Decoudier, Chevalier de la Legion d'Honneur, Croix de Guerre. It may be remembered that Prenthout Leblond & Leroux is the enterprising shipowning firm who had the courage to build the 10,500 tons displacement Diesel-driven steel auxiliary sailing-ship "France." Their new branch office will deal with the charter, sale and purchase of all merchant ships.

NEW AMERICAN MARINE OIL ENGINE

With a view to entering the marine market a 100 b.h.p. vertical oil-engine has recently been designed and constructed by the Standard Fuel Oil Engine Company at Bucyrus. The first engine will be used for stationary purposes, but from the same it is expected that a marine engine will be developed. It is a two-cylinder, two-cycle type machine and the present tests are showing mechanical efficiency of 80% and better—the work being distributed as follows:—

To Scavenging Pump	3.2%
To Compression	6.4%
To Mechanical Losses	10.4%
To Useful Work	80.0%

MOTORSHIP "GLENAPP" LEAVES WITH FULL CARGO

The 14,500 tons d.w. British motorship "Glenapp" of the Glen Line recently left London on a voyage to the Far East with full cargo and with full passenger booking of one dozen first-class passengers. The "Glenapp" is the second motorship of this name—the first now being known as the "Aba" and is owned by the Elder Dempster Line.

It will be noted that the majority of motorships are obtaining full cargoes, while many steamships are laid-up. Incidentally we will mention that the passenger accommodation of the "Glenapp" is booked beyond next September. Her average loaded speed is 12½ knots and she only burns about 18 tons of oil per day.

NEW SPANISH MOTORSHIP

Trials will shortly be run of the motorship "Alca" recently completed at Gijon, Spain. She is of 450 tons d.w.c. and is propelled by a 150 b.h.p. Diesel engine.

CONVERT OUR STEAMERS TO DIESEL POWER —SAYS FRANK MUNSON

"The uneconomical steam-engines and boilers must be removed from the Shipping Board's steel ships, and replaced with Diesel-engines or Diesel-electric drive, or we will be unable to compete with foreign shipping"—said Mr. Frank C. Munson, President of the Munson Steamship Line at the banquet of the National Marine League, held in connection with the Merchant Marine Exposition on January 25th. Further details of Mr. Munson's important advice will be given in our March issue.

CHAS. PIEZ'S ANSWER TO WM. DENMAN

In his testimony to the U. S. Senate Committee investigating the Shipping Board operation, Mr. Chas. Piez, formerly Director General of the U.S.S.B. Emergency Fleet Corp., said:

"Mr. Denman in some recent utterances has dwelt on the advantages of the Diesel engine. I need only say that Mr. Hurley, Mr. Schwab, Mr. Rosseter and all of the men in our technical department were as conscious of that as Mr. Denman. Mr. Schwab's plants were completing a very large two-cycle engine about the time of the armistice, and expected to try it out in one of the Bethlehem ore ships.

"It is well to bear in mind that only a very few engines of a size large enough for even a 5,000-ton cargo-ship, had up to that time been built; that no shops in the United States were prepared to deliver anything over 750 h.p. at that time, and that we could neither wait nor take the chances involved. Mr. Hurley bought two Burmeister and Wain engines immediately after the armistice, for installation in a Fleet Corporation ship."

[We may have some comments to make on Mr. Piez's remarks in our next issue.—*Editor.*]

MOTORSHIPS OF 1920

Eighteen of the largest Diesel motorships completed and placed in actual service during 1920 aggregated 170,990 tons d.w.c. and 62,850 indicated horsepower. This is an average of 9,499 deadweight tons per ship, and an average horse-power of 3,492, according to recent launches and vessels on the ways, the tonnage for 1921 will be five times the amount by December 30 next.

NEW MOTORSHIP COMPANY FORMED

For the purpose of taking advantage of the present remarkable development in the motorship field, and on account of the heavy demand for oil and for mediums of oil transportation, a new company has been incorporated under the name of the Emerald Motorship Company, 25 Broad Street, New York City. According to advices received, the directors have decided upon a Diesel-driven tanker as their first vessel.

The policy of this company, as outlined to us, is an obvious indication that the men behind it are progressive and far-sighted, and the adoption of economical motorships, particularly during the time of steamship depression, is greatly in favor of its success in the undertaking, and their enterprising action should be noticed by prominent American oil-companies, who so far have been slow in adopting the Diesel-driven tanker for the transportation of oil in bulk.

No doubt other shipping men will, before long, adopt motor-tankers for the purpose of transporting their own bunker-oil unless oil-companies endeavor to reduce the transportation charges by propelling their tankers with the most economical power available. Meanwhile, the Emerald Motorship Company will have a considerable advantage in competition in the transportation of oil if they are able to complete several tankers at an early date. So, we cannot but wish them success in their new venture.

INSURANCE ON DANISH DIESEL MOTORSHIPS

Reference is made to the insurance of motorships in Denmark in the first issue of the Bulletin of the American Bureau of Shipping. Their Copenhagen representative states that no difference in insurance rate is made between coal-burners and oil-burners and Diesel-driven ships. But, he gathers the impression that a Diesel-ship is considered the best risk.

The Royal Chartered Marine Insurance Co. quoted a rate of 5 to 5½ per cent, while the De Private Assurandrer quoted a rate of 5½ to 6 per cent; but is considered a very conservative concern. One broker declared he could obtain a lower rate for Diesel motorships than for oil-fired steamers or other vessels of the same age and character, and that the rate on motorships fitted with B. & W. Diesel engines. The rate on Danish Diesel-driven wooden-ships is 1 per cent higher than the steel ship rate, unless the vessel is not first-class.

Wooden auxiliary oil-engined sailing vessels are quoted at 5 per cent higher than full-powered ships.

LAUNCH OF MOTORSHIP "FORMOSA"

An 11,000 tons d.w.c. motorship for the Swedish East Asiatic Company of Gothenburg was recently launched by Burmeister & Wain of Denmark and is the 29th motorship that has taken the water at this well-known Danish yard.

RECORD MOTORSHIP CONSTRUCTION

Considering only an 8-hour shift has been working each day, a remarkable speed has been made with the construction of the 6,000 tons d.w. motorship "Kennecott" building for the Alaska Steamship Co. of Seattle, by the Todd Dry Dock & Construction Company of Tacoma. Exactly 45 days from the date of keel-laying were taken for the launching and no second shift or over-time was used to accomplish this splendid feat. It is expected that the motorship "Kennecott" will be ready for delivery at the end of February, or the early days of March.

DUTCH EAST INDIAN GOVERNMENT TO ORDER MOTORSHIPS IN THE U. S. A.

For the purpose of ordering fast motorships, and to investigate shipbuilding on the Pacific Coast of the U. S. A. on behalf of the Dutch East Indian Government, Mr. R. G. Leegraste recently arrived at San Francisco. The vessels, states Mr. Leegraste, must be powered with Diesel-engines and will be triple-screw boats of 900 tons up, and will have a speed of at least 18-knots—as they will be used for coast-guard and patrol work in connection with opium smuggling traffic into Java. The total amount of money to be spent in the United States will not exceed $4,500,000.

PASSENGER MOTOR-LINER "MAGVANA" LAUNCHED

In our issue of November, 1919, appeared the first details of the motorship for the British India Steam Navigation Co. One of the vessels the "Magvana" was launched on Dec. 24th at Barclay Curle's shipyard in Glasgow. She is of 10,500 tons d.w.c. and has accommodation for 100 first-class and 50 second-class passengers and will trade between London & Calcutta. Twin North British Diesel-engines are being installed, giving the ship a speed of 13½ knots. Complete details will be given in our March issue.

LLOYD'S MOTORSHIP RETURNS

According to Lloyd's recent report there are actually under construction under their supervision in the principal British shipyards a total of 52 motorships aggregating 224,231 gross tons. The total including other districts is 57 motorships aggregating 227,010 gross tons. This is approximately 359,880 d.w. tons. Of these vessels 15 are small coasting craft under 1,000 gross tons each. This refers to Dec. 31, 1920.

Referring to this report "Syren & Shipping" of London states that these figures certainly come as a surprise to all except those most closely in touch with the work which is going on in the shipyards, few people having imagined that the construction of motor-propelled vessels had become such an important part of the British shipbuilding industry, and that these figures emphasize the rapidity with which the new form of propulsion is making a recognized place for itself.

COMPETITION WE WILL HAVE TO FACE

A bill now before the Netherland Parliament will provide a subsidy of one-million guilders per annum for five years to the Holland-South Africa Line.

AMERICAN ENGINES FOR SPANISH SUBMARINES

Twelve 700 b.h.p. Nelseco Diesel engines are being installed in six submarines now under construction at the shipyard of the Sociedad Espanola de Construccion Naval, Cartagena, Spain.

DIESEL ENGINES AT HELIGOLAND

According to a report emanating from a British engineer operating in Germany on behalf of the Allied Governments, some Diesel engines of 1600 b.h.p. generating electric-current for power and lighting in connection with the fortifications of Heligoland run so quietly that if one stands with one's back to the engine it is impossible to say whether or not the engine is running.

OPERATION OF OIL-ENGINED LAUNCHES

Two motor launches named "Louise" and "Asiento" respectively are now in service of the Curacaosche Petroleum Maatschappij of Curacaosche, D. W. I. These boats are both propelled by Bolinder surface-ignition oil-engines and an interesting feature in connection with the operation is that colored men are used for operating the machinery. We recently had the opportunity of seeing a communication from the Curacaosche Company to their associates in New York; namely, the Asiatic Petroleum Co., Woolworth Bldg. The statement says that notwithstanding the colored operators being picked from the ordinary coolie-class of blacks, the oil-engines have never given any trouble. Each boat is 42 ft. long by 11 ft. breadth and carry about 60 passengers each at a speed of 6 knots on a consumption of 1¾ liters of kerosene per mile.

The service consists of short trips of about one mile and the natives generally leave the engines running when moored.

THE ANSALDO-SAN GIORGIO DIESEL-ENGINE

To the Editor of "Motorship,"

Sir:—

To Mr. E. Chiesa's letter re "Ansaldo San Giorgio's Internal Combustion Engines" in your December number, a note is appended that might be rather misleading. We should like to make clear that we have never endorsed any of the remarks made by Mr. Chiesa regarding the Ansaldo-San Giorgio, or Fiat-San Giorgio, Diesel-Engines. On the contrary, our opinion of this two-cycle design is quite the opposite of his, and we have in fact already instituted proceedings against Ansaldo-San Giorgio Ltd. on account of infringement of several of our patents, not only referring to the method of scavenging, but also to constructional details and other working principles.

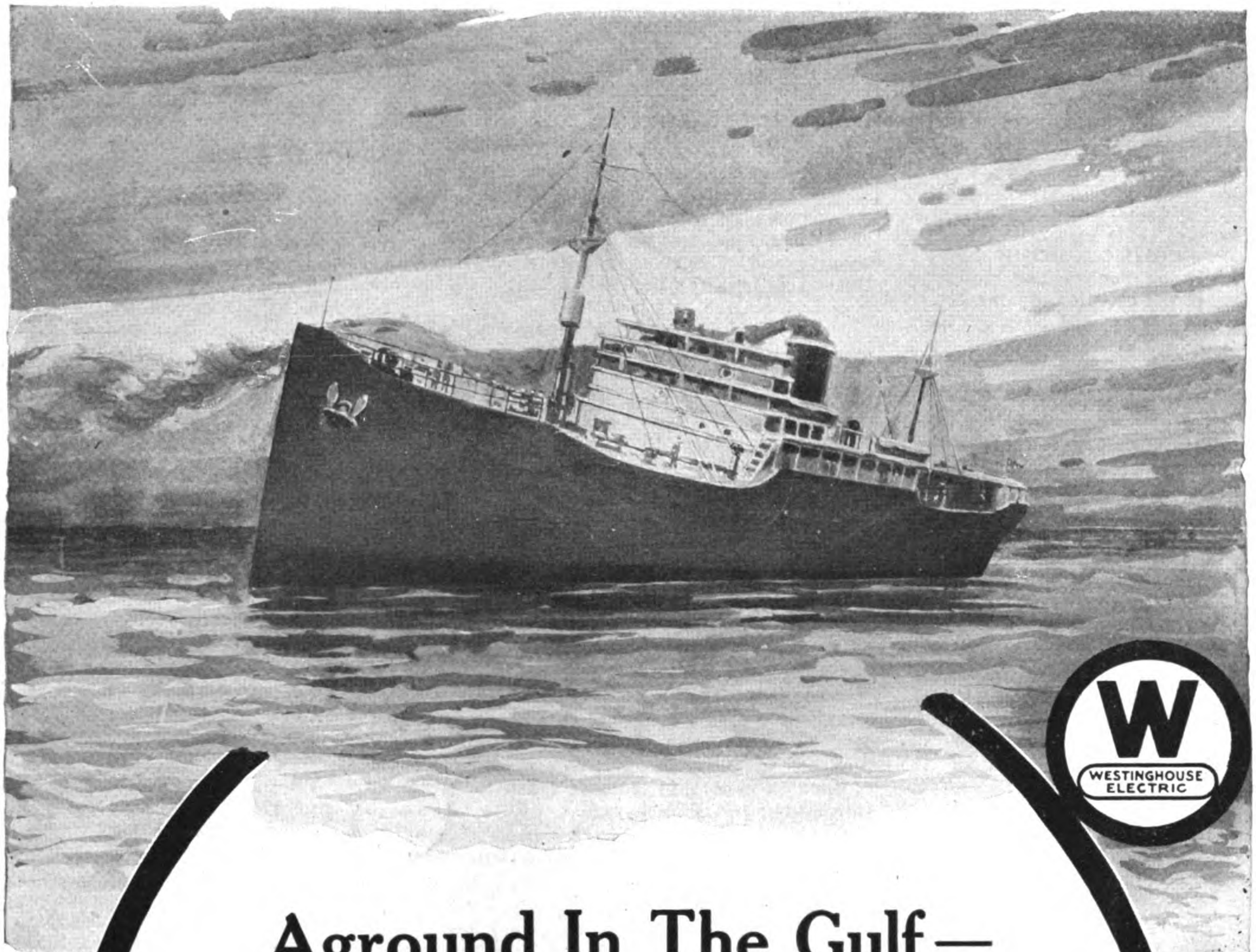
Yours faithfully,
SULZER FRERES.

Winterthur, Switzerland,
22nd December, 1920.

[The above letter arrived too late for inclusion in our regular "Readers' Opinion" page.—*Editor.*]

CONCRETE AUXILIARY SAILING-SHIP

A German firm, the Kieler Eisenbeton Werft A/G of Budelsdorf-Rendsburg, has launched a 230 tons d.w.c. concrete auxiliary sailing-ship fitted with a 70 b.h.p. surface-ignition oil-engine, to the order of Wentzel & Co. of Lubeck.



FIRST DIESEL-ELECTRIC CARGO-SHIP IN AMERICA

NEW YORK SEATTLE

MOTORSHIP

Devoted to Commercial and Naval Motor Vessels

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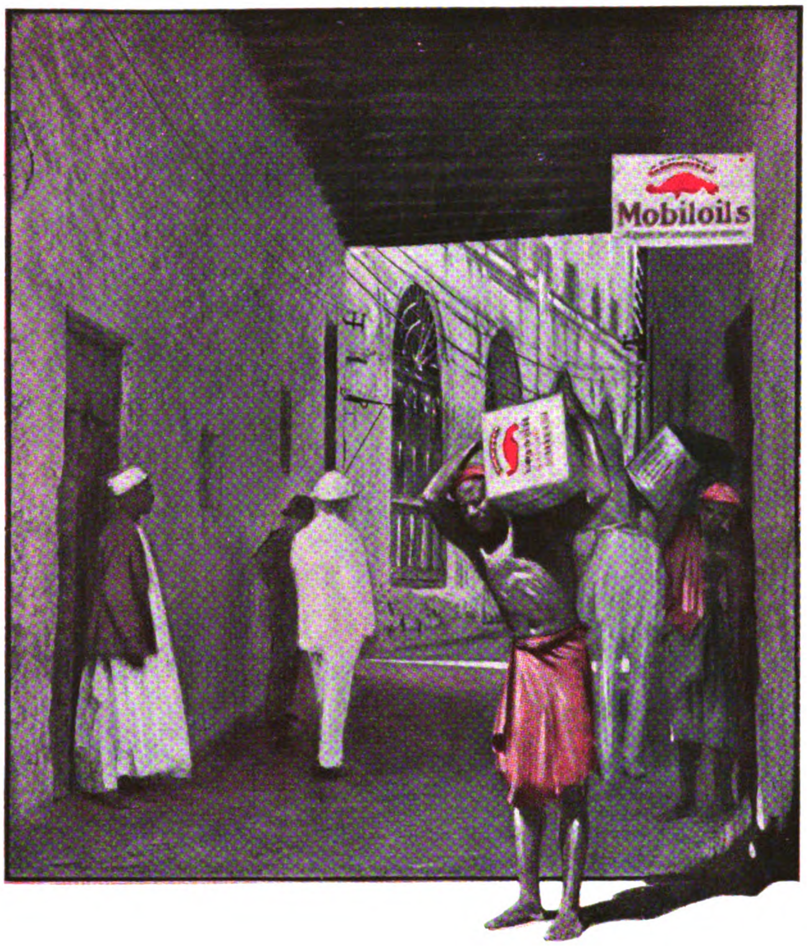

– and in Zanzibar

ZANZIBAR has not been favored by the constant shifting of world trade routes. Yet the occasional motorship which calls there finds that Vacuum Oil Company service *serves*—in this corner of the world as in so many others.

The quality of D. T. E. Oils is so outstanding that Gargoyle Marine Oil distributors all over the world—over 250 in number—have an ever-active call for them. Ships' officers appreciate a service which enables them to buy oil when needed in any part of the globe.

Gargoyle D. T. E. Oils give unusual results on Diesel type engines. They minimize abrasion and corrosion. They resist emulsification. They separate readily from water and other impurities.

Cases are not rare of motorships which after several years still use the original charge of Gargoyle D.T.E. Oils with little "make-up" added.

Diesel type engine manufacturers recommend Gargoyle D. T. E. Oils. Companies operating principal motorship fleets use them.

Send for the booklet on Gargoyle D. T. E. Oils. It contains valuable information on the various uses of these oils as related to the lubrication of Diesel Type Engines.

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Marine Oils

A grade for each type of service

VACUUM OIL COMPANY *Specialists in the manufacture of high-grade lubricants for every class of machinery. Obtainable everywhere in the World.* NEW YORK, U.S.A.

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Vol. VI New York, U. S. A., March, 1921 No. 3

Economical Transportation on the New York State Canal

A Series of Exhaustive Articles On Barge-Commerce Along the World's Greatest Inland Waterway

BY OUR SPECIAL COMMISSIONER

PART 1—Historical Analysis as a Key to the Present Problems of Floating Equipment.

A WATERWAY that traverses the most densely populated general area of the richest and most populous state in the Union and which links together the focus of a great nation's industry with the world's foremost seaport, is one which cannot long remain neglected in the attention of men of finance, commerce and industry, shippers, shipowners, shipbuilders, engine-makers and others connected with transportation. The New York State Barge Canal has extraordinary commercial possibilities and ranks among the greatest engineering works with which Nature has ever been harnessed by humanity.

Man has been improving on the waterways furnished him by Mother Nature ever since the Babylonians floated Barges of State from the Tigris and Euphrates to the Babylonian court and since Defoe's Robinson Crusoe attempted to launch his overweight "dug-out" by means of a trench which he led to it from the vast Ocean. George Washington was dissatisfied with the limping portages and uncertain streams over which commerce had to be carried through the only natural land-break existing between the Delaware Water Gap and the St. Lawrence valley.

Dissatisfaction is the real secret of progress, and it was not long before De Witt Clinton, additionally stirred by the signs of an exuberant commercial development, caught the infection and initiated the construction of the Erie Canal in 1817. After its completion in 1825, only a few years were needed to demonstrate its huge success. Although it was a cut of only modest dimensions, confining a water prism of 40 and 28 feet by four feet deep, it gave New York State such a boost as it has never known before or since. The villages that dotted the line of the canal blossomed out into flourishing municipalities and the population of the State went soaring.

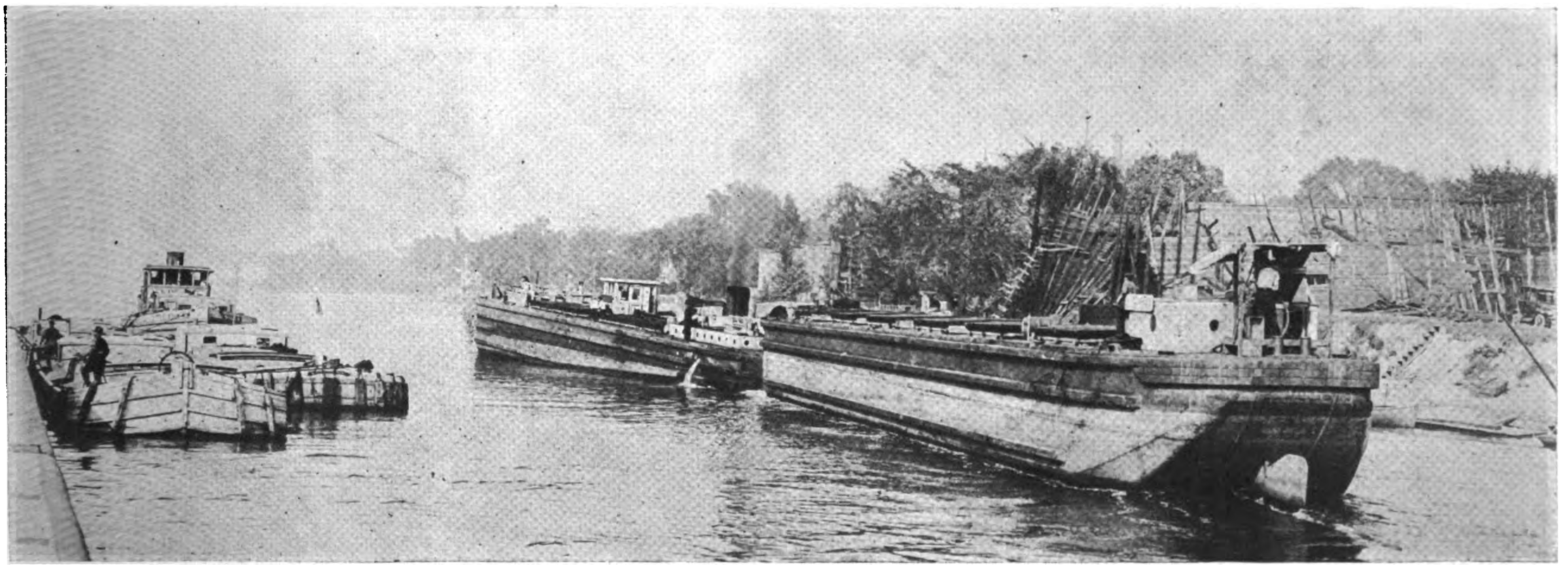
Contrary to the original conceptions of an uninterrupted waterway that was to link Buffalo and New York City, and in contrast with the most modern development in canal engineering, the original Erie Canal was build in such a way as to avoid very systematically any utilization of the natural watercourses which offered themselves between Troy and Buffalo. Even the Hudson River was utilized only as far as Albany, from which point on the canal ran parallel to the river bed instead of through it as far as Watervliet and Cohoes. At the last-named place it bent westward closely paralleling the Mohawk River as far as Rome. Turning now quite sharply southward, past New London and Oneida, it tapped Oneida Lake through a branch and passed through Syracuse at the southern tip of Lake Onondaga. After leaving the banks of the Clyde River at Lyons, the canal continued cross-country past Rochester to Tonowanda, whence it ran parallel to the Niagara River into Buffalo. The total length of this waterway was 363 miles and was served by 84 locks 15 feet wide and 90 feet long. Before any improvements or enlargements were made it had cost $7,144,000.00 and was capable of accomodating boats of 30 tons' carrying-capacity.

Practically simultaneous with the construction of the main Erie Canal, was the building of the six most important branches. The first of these was the Lake Champlain Canal, paralleling the upper reaches of the Hudson River between Troy and Whitehall, a town situated at the southern extremity of Lake Champlain and forming the key to a rich traffic in lumber from the North, marble and quarry products from Vermont, and excellent iron ore from the western shores of the lake. Two other branches, or laterals, the Chemung and the Chenango, connected up the coal and manufacturing regions which focussed at Binghamton and Elmira. A branch located in the valley of the Genesee started at Olean, joined the Erie Canal at Rochester and gave one access to Lake Ontario.

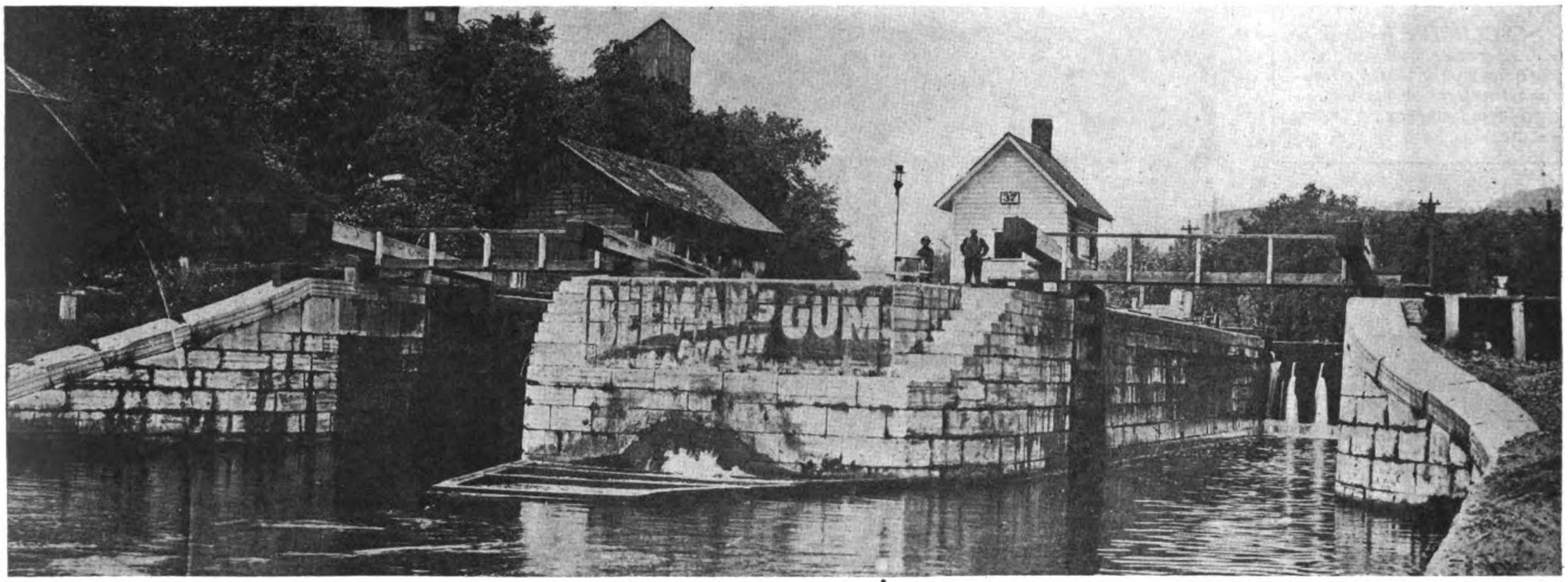
Another lateral was the Black River Canal, which led from Rome through Lyons Falls and Carthage into Lake Ontario via the river after which it is named. The remaining outlet to Ontario was the Oswego branch and joined the main canal at Syracuse. These and a number of minor cuts formed a system totaling something like 1,000 miles and carried more than 4,000,000 tons of freight in the year 1856.

EDITORIAL NOTE

With a view to developing transportation on that magnificent inland water artery of commerce—the New York State Barge Canal, "Motorship" recently appointed Julius Kuttner as its Special Commissioner to tour Canal district and make the most exhaustive study of its facilities and methods of propulsion yet undertaken by any publication. Also with a view to ascertaining the possibilities for an extensive use of crude-oil engine propelling-power to secure the greatest economy in operation of freight carriers. The first of this absorbingly interesting series of articles is herewith given and another will follow each subsequent month until all phases and problems are adequately dealt with. Mr. Kuttner is a young engineer whom we have been watching for some little time, he having occasionally contributed technical articles to our pages. His live canal articles indicate promise of a brilliant future in the marine engineering world.



Old "Western" type of Erie Canal boat at left. "Semi-Modern" steam-driv en war-time government-built craft on right. Much greater progress will attend their substitution by crude-oil engined motor-barges such as the fleet Julius Barnes recently ordered



Typical view of old part of "the canal that put New York City and State on the map"—Note that even the advertisement fiend finds a use for the lock structure

to appear. It was vaguely felt that something had to be done, but the half-hearted way in which these impulses were obeyed had just the wrong effect. An increase in the size of the Champlain cut from five to seven feet depth and its widening to surface and bottom widths to 58 and 44 feet was begun but never completed, and a second and unsuccessful attempt to reach these dimensions was made in 1896. An effort to deepen the Oswego branch between Oswego and Syracuse met with a similar fate. Shippers and barge owners became reluctant to engage in enterprises as long as the State kept puttering around.

Although railroad rates never come down to the level where they could compete with the canal rates, there were other factors besides ton-mile cost which had a bearing on the movement of traffic. Even these would not have been serious had it not been for the fact that an unfounded expectation of competing rail service would make extensive canal enterprises hazardous. The inability of the fixed and rigid canal routes to gather up as a single strand the complex weave of traffic became a factor. Closure of the canals during four months of the year diverted traffic into other channels and as railroad rates continued to decline, it became increasingly difficult to force a reversion of freight movements to the canals.

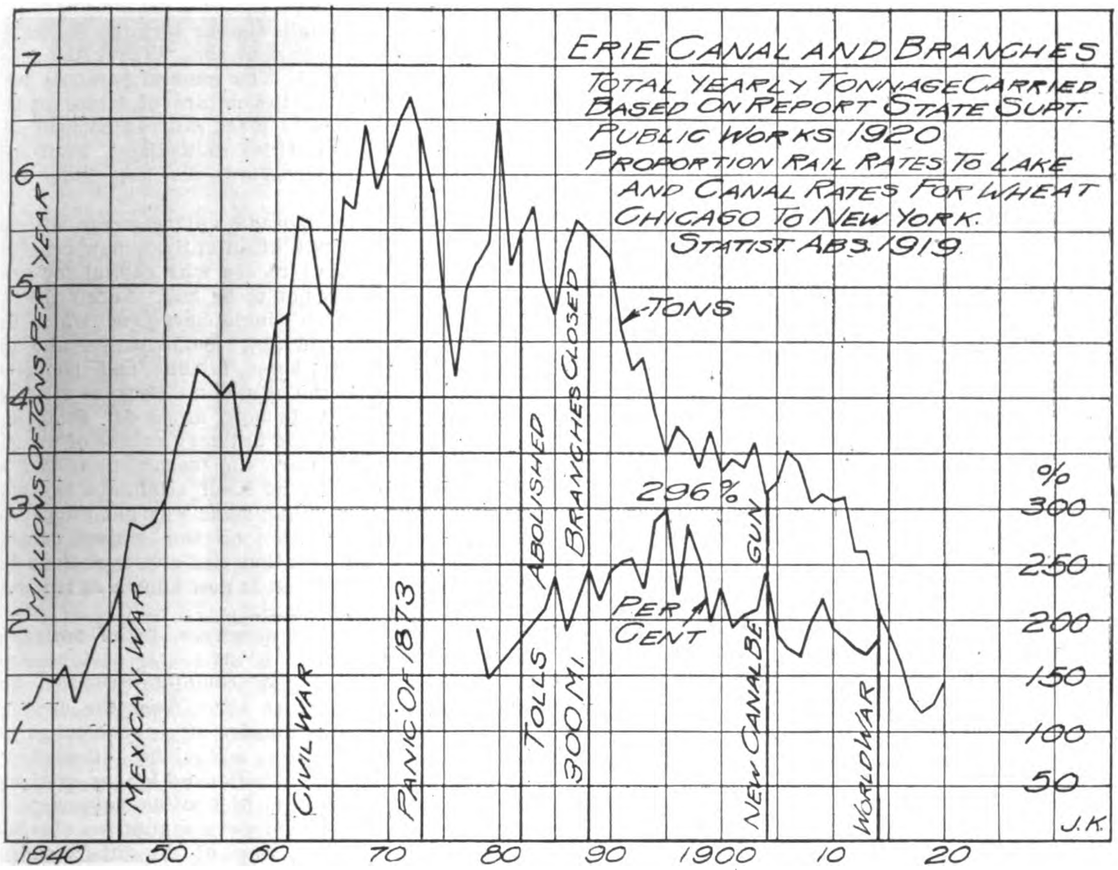
The very fecundity of the growth of the communities along the canal route precluded the choice of factory and warehouse sites with reference to Canal frontage; whereas the undeniable convenience afforded by railroad spurs which were located right at the shipping platforms of factories, nay, the switching of cars into the actual factory buildings, afforded a type of service which no canal systems could give. While the suburbs of cities began to bristle with smoke-stacks and railroad spurs, the shiny surface of the canal continued to wind its way ever more placidly under railroad bridges and over the countryside.

Although the failure of craft and motive power which has been indicated may be considered as the effect of the conditions just described, they were also a cause of them and as such they require consideration. Until the end of the prosperous period of the original canal, new barges for replacement of old were generally increased in size to take advantage of larger canal sections and bigger locks whenever the State made such improvements.

From about 1880 on, however, when traffic began to decline, no progress whatever was made in the design of canal boats, no matter what the canal did. The type crystallized at about that time into the long familiar "Erie Canal Boat," a craft which today constitutes the biggest part of the floating equipment of the canals. These barges were 98 feet long, had a beam of 17½ feet and depths varying between 9 and 11 feet. Their carrying-capacity was 240 tons, based on wheat. Their section was, of course rectangular, and the question of its most economical proportioning in relation of the then existing canal sections had been scientifically considered from the point of view of towing resistance and most economical speed. In the stern of this type of boat were accommodations for a crew of one man and family and ample hatches gave commodious access to the cargo space.

Some of them, known as the "Western" type, were built with a pronounced upward flare of the upper bow structure, the purpose of which was to prevent spare mules that were sometimes carried from walking overboard. Needless to say, they were obsolete already in 1890, but they were better than nothing. A former State Superin-

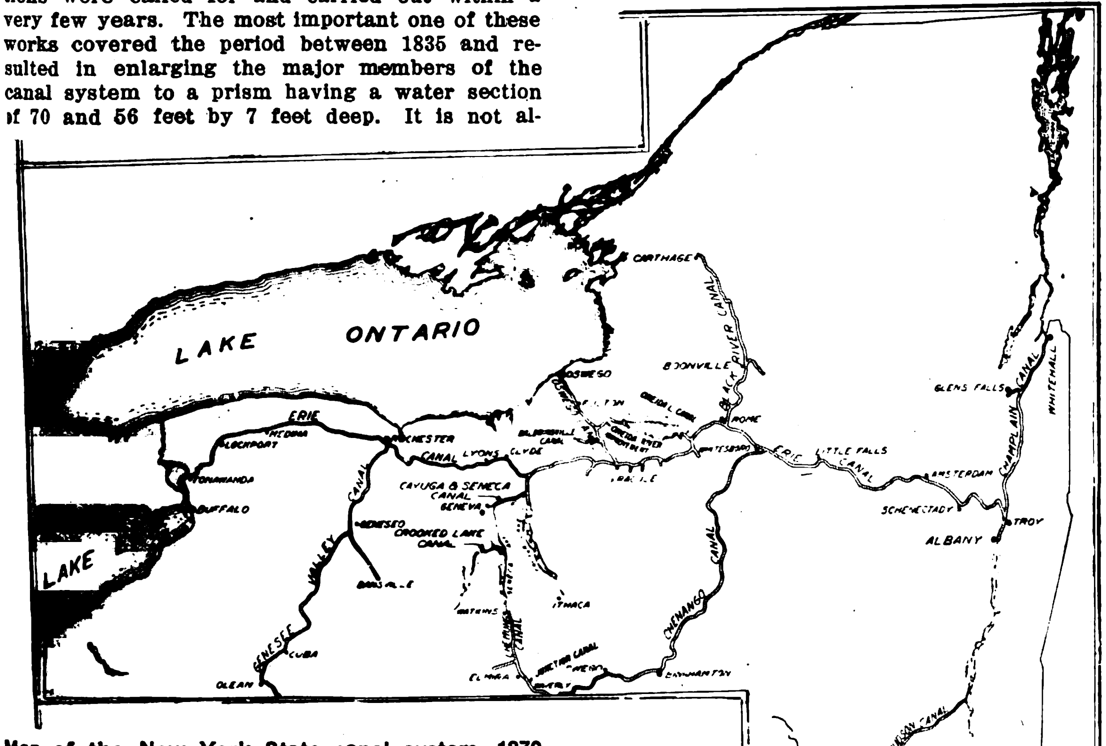
Tandem locks at Lockport, N. Y., illustrating the great advance in civil engineering phases of Canal Transportation



Illustrating rise and fall of canal traffic and indicating that the decline was due to causes other than railroad rate competition

The very aspect of the cities which owe their growth to the canals has been determined by their courses and the general nature of their commerce even to-day shows how deep "Clinton's Ditch" was really dug. The lines of the streets and the location of the business and industrial centers are in many instances related to the artificial waterways. Some idea of the influence which the canal had on the minds of the cities' inhabitants may be had by considering that many of the city seals and insignia bear representations of the canal, of the craft used on it, and of the old freight terminals.

In view of the powerful influence thus exerted even by the original and diminutive canal, it is not at all surprising that enlargements and additions were called for and carried out within a very few years. The most important one of these works covered the period between 1835 and resulted in enlarging the major members of the canal system to a prism having a water section of 70 and 56 feet by 7 feet deep. It is not al-



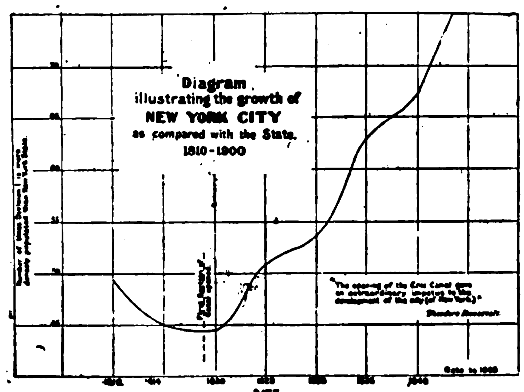
Map of the New York State canal system, 1870

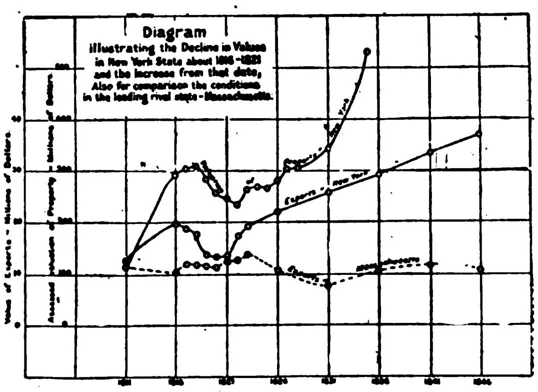
together clear why the first enlargement of so important a branch as the Champlain involved a deepening of only one foot, that is, from four feet to five feet. On the main system, at any rate, boats of 240 tons' capacity, eight times that of the earliest ones, could now be operated and a further great impetus was thereby given to the development.

Strange as it may seem, the steam boat, whether tug or freighter, did not make its appearance until 1875, fifty years after the first opening of the canals. The original boats had runways on them for poling by man-power and it is astonishing that the excellent showing should have been made in the face of handicaps like that. For many succeeding decades towing by mules who walked on tow-paths specially provided along the banks of the canals was the only motive power in spite of Fulton's invention at the beginning of the century.

In our own day, this lack of progressiveness is curiously matched by the stubborn retention of the non-condensing steam tug and power barge, notwithstanding enormous rewards that are held out by even the most modest application of the modern economical oil-engine. It is a safe estimate that the internal-combustion engine of today with its astonishingly low consumption of cheap heavy mineral-oils and common town gas-works tar-oils fuels will do for the canals what the substitution of steam for mules has done in years gone by. Then as now, floating equipment was a step-child in the minds of the canal builders and of the millions that were freely spent for excavation and lock construction, hardly a tithe went for boat or engine building.

Nevertheless, the Canal has continued on its extraordinary career of prosperity. Neither the Mexican War nor the Civil War halted the Canal more than temporarily and even after the Panic of 1873, it proved up to the hilt its ability to come back strong. Up to and including the year 1882, at which time tolls were abolished, the Erie Canal had cost the State $79,000,000.00 for construction, maintenance, repair and all other charges; it had yielded to the State a revenue exceeding $121,000,000.00 and had earned a total net-return of $42,000,000.00. Manufacturing in New York State increased three-fold, personal property value four-fold, and manufacturers five-fold. Philadelphia yielded its first place as a sea-port, and Boston, New York's only other rival, dropped hopelessly



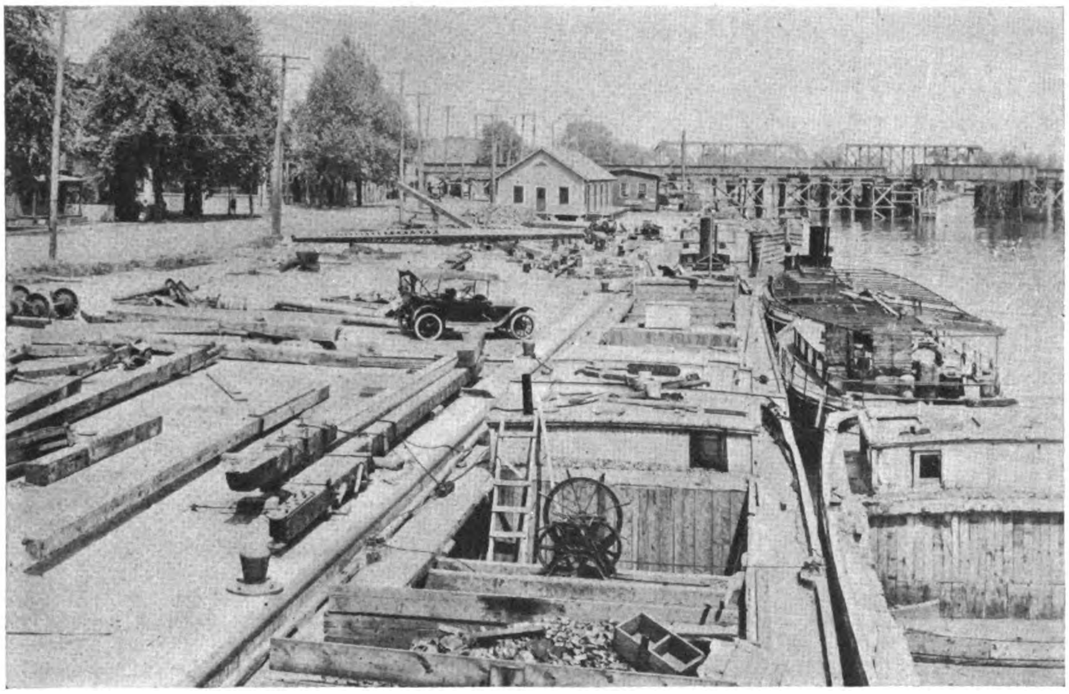


out of the running. In very truth, the canal system had put New York State and City "on the map."

Almost at the high-water mark of the Canal's success, there began to manifest itself a tendency of abandoning the less important branches, a phenomenon of significance not only because it showed the beginning of the railroads' effect on the canal system, but also because it presaged the present low peak of the canals' local and interurban transportation. During the years 1877 and 1878 the Chemung, Chenango, Genesee Valley and minor branches totaling about 300 miles were closed to navigation and instead of floating the rich traffic which had been prophesied for them, continued exclusively as the "abode of frog and water-fowl." They had at no time been successful; during their last years the best yearly tonnage of the Chemung branch did not exceed 215,000 tons, the Chenango carried less than 34,000 tons, and the Genesee Valley less than 80,000.

These southern branches, like a good many wild-cat railroad lines, owed their existence to the general canal-building mania which attended the spectacular success of the original Erie. Far from being the fulfilled dreams of a Washington or a Clinton, they came into being because they gave some lesser statesmen the only opportunity they might ever have of sharing in the glory of the Canal System.

Although the main artery was at this time (1875 to 1880) still in its strongest pulse, additional signs of its weakening and decline began



Miscellaneous Assortment of "tubs" that were out of date in 1890. Seven hundred of these still remain on the canal. If not a menace to navigation, they are at least an obstacle to progress

tendent of Public Works, Mr. C. S. Boyd, in his report for 1902 laments their growing extinction as follows:

"It is hardly necessary to again refer to the direct bearing on canal tonnage of the abandonment of old boats and the failure to replace them with new. A very large number of boats at present in commission on the canals have been in use continuously for many years. Many of these boats go out of commission only when they are so dilapidated that insurance companies no longer accept them as risks. I believe it cannot be expected that any large number of boats intended for canal traffic will be constructed until the State policy with respect to future treatment of her waterways has been defined. It is a fair estimate to say that for every new boat constructed during the last six years ten boats have been abandoned. With this condition existing and bound to continue, even the most enthusiastic canal men, it would seem to me, have little ground for hoping to see any great revival in canal interests as reflected in tonnage shipments."

The excessive pessimism of this statement conceals within itself a bright promise for the future of canal traffic, because it strengthens the evidence already considered, to the effect that the decline of canal traffic was due to a variety of circumstances, among which competing rates per ton-mile were only a secondary and contributory factor. As a matter of fact, railroad rates have to this day failed to come even within competing range of canal rates, as an examination of the appended curves will show. For reasons of a different nature, the railroads have cooked the old canals' goose as far as way-traffic is concerned, but they never were and never will be able to destroy the availability for canal traffic of immense bulk through shipments. Such might have consisted of flour, grain lumber, pig-iron, and foundry and building materials. Their very nature makes them a far more suitable subject for canal transportation than for rail shipments.

With a little aggressiveness and determination and the use of up-to-date equipment, canal carriers might have re-organized their service for the through bulk traffic and snapped their fingers at the railroads. Such a course would have been too much to have been expected of a host of small barge owners who had glorious memories to live on, but who had never had a chance for acquiring a broad business outlook. As will become apparent later, the lessons of this bit of history have a pointed bearing on the situation of to-day and there is a good prospect of their being heeded.

Railroad competition on the basis of rates, then, was not a very real factor in the decline of the canals, and freight handling seems to have been the decisive element. A third method of competition, namely, undercutting in specific cases with the intent to ruin small canal carriers, was also probably resorted to. It has a little or no bearing on the canal business of to-day.

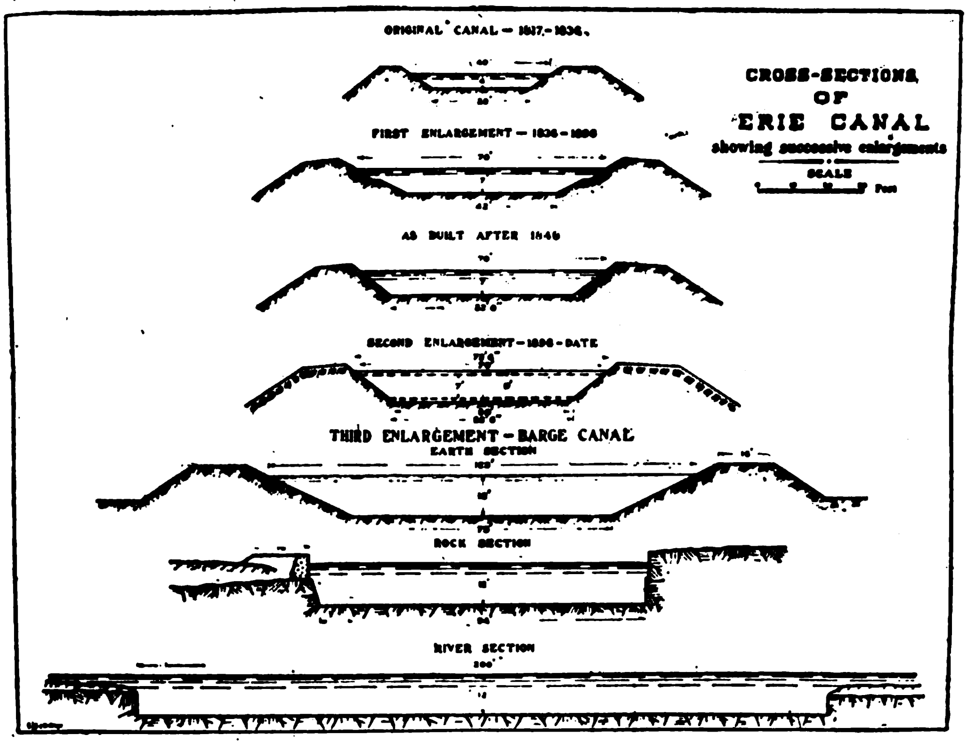
Confronted with a chaotic situation and having an insufficiency of even third-rate equipment to meet it, there is small wonder why the people of New York State began to ask "What's the matter with the Canal?" The general paralysis due to uncertainty as to the nature of future traffic and to the inability to meet railroad competition with the inferior facilities immediately available, hit hardest at undertakings for new boats and tugs.

As the result of sporadic enlargements left unfinished and with talk of an entirely new canal in the air, it isn't hard to see why capital for new types of boats was not to be had. Surely the individual owner of a single barge, on which he reared his family and which embodied for him the sum total of hearth, home, fortune, and livelihood was no match for the situation. Because of these many dilemmas, a demand arose for State improvements, and, in the ordinary course of events, barring a world war, the assumption that a modern canal would of itself stimulate the production of suitable equipment was not altogether unreasonable. Agitation on the subject culminated in 1903 in legislation and appropriations for the construction of what is now known as the New York State Barge Canal.

This newly erected structure, to be portrayed in a continuation of this article, is a stupendous engineering work, fully complete, refined, and settled, a very different affair from the doubtful ditch of 1880. Uncertainties of a technical or engineering nature that might be affected by changes in canal construction no longer exist and it is up to the builders of floating equipment to take the initiative. Shippers cannot be expected to take the lead in view of the miscellaneous tubs and junk that form the greater part of the transportation facilities now offered to them. At the risk of getting a little ahead of the story, attention is here called to the extraordinary suitability of internal combustion-engine propulsion for barge canal work. With a power cost of only a few per cent of that of the present wasteful propulsion means, reduction in labor costs, elimination of heavy stand-by losses, residual-oil engine-builders have a proposition to offer for which no competition is even in sight.

JULIUS KUTTNER

(To be continued in April issue of "Motorship")



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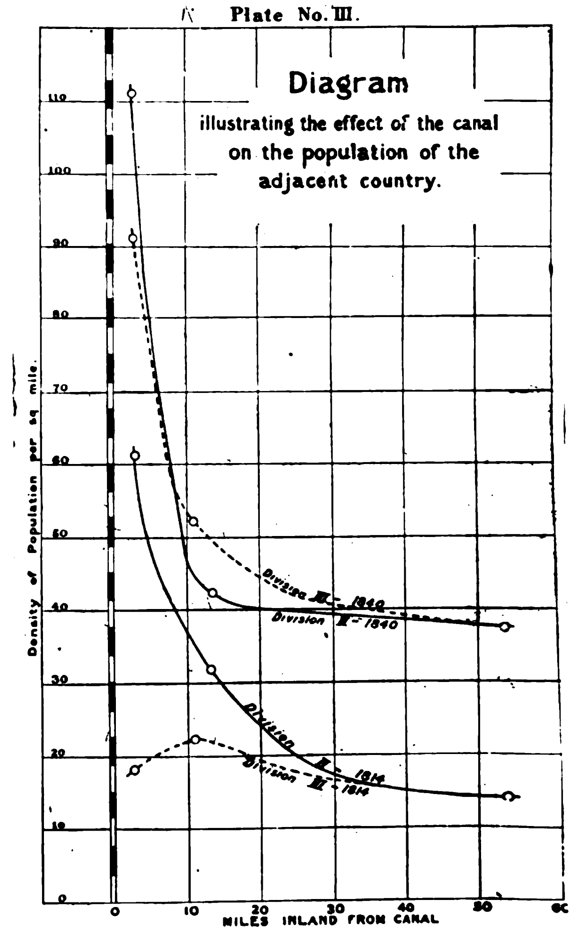


ANOTHER GERMAN WARSHIP WILL SOON BE MOTORSHIP

"Odin," a German coast-defense battleship of 4,100 tons displacement built in 1894, is being reconstructed and converted into a Diesel motorship.

First Diesel-Electric Cargo-Ship Installation in America

Conversion of the "Fordonian" by the Todd Shipyards Corporation — First Ansaldo-San Giorgio Diesel-Engine Installation in America

SINCE penning the Editorial in this issue entitled "Solution of America's Serious Shipping Problems" in which we urge conversion of existing uneconomical steamers to oil-engine power and propose Federal subsidies for such work, news has reached us that the Todd Shipyards Corporation of New York has received an order from the American Mediterranean Steamship Co. (McDonnell & Truda, New York representatives) to convert the single-screw ship "Fordonian" to Diesel-electric propelling power, and indications show that many more vessels soon will be converted to Diesel or Diesel-electric power.

This vessel was originally built in England for Canadian owners in 1912 for service on the Great Lakes and was afterwards sold to the United States. Her dimensions are as follows:

Deadweight-capacity	2,200 tons
Power	750 shaft h.p.
Length	257 ft.
Breadth	42 ft., 6 in.
Depth	26 ft., 6 in.

The new machinery is to consist of twin Ansaldo-San Giorgio two-cycle type four-cylinder Diesel engines, each of 425 b.h.p. coupled to two 340 K.W. 250 volt compound-wound General Electric generators turning at 200 R. P. M. which will furnish current to an 850 brake h.p. electric-motor coupled direct to the propeller-shaft. All the machinery will be installed aft in the present engine-room. The Diesel-engines have been built in Italy, and are now en route to this country. Contract for the conversional work has been placed with the Todds Shipyards Corporation.

Simultaneously, the same company—or rather its subsidiary the Tebo Yacht Basin—received an order from the U. S. Shipping Board to convert the 11,800 tons steamship "Archer" into a turbine-electric ship. It would be interesting to know why, and who is responsible in the Shipping Board for the ignoring of Diesel-electric power in the conversion of the "Archer," as the latter system is far more economical than turbine-electric drive. If consumption economies of the two systems are compared the turbine-electric drive hasn't a look in. No wonder how much longer the officials of the Board, will be allowed to continue wasting the Country's money in this manner, when hundreds of other American steamers are already tied-up. We suggest that Admiral Benson investigate the matter.

To return to the "Fordonian," the following new auxiliary equipment will be installed—

Auxiliaries

One 5 K. W. motor generator-set, 125-volts for lighting.

One complete control-equipment, arranged for engine-room operation only.

One Motor-driven blower for ventilating main-motor.

The following auxiliaries will be furnished and installed by contractor:

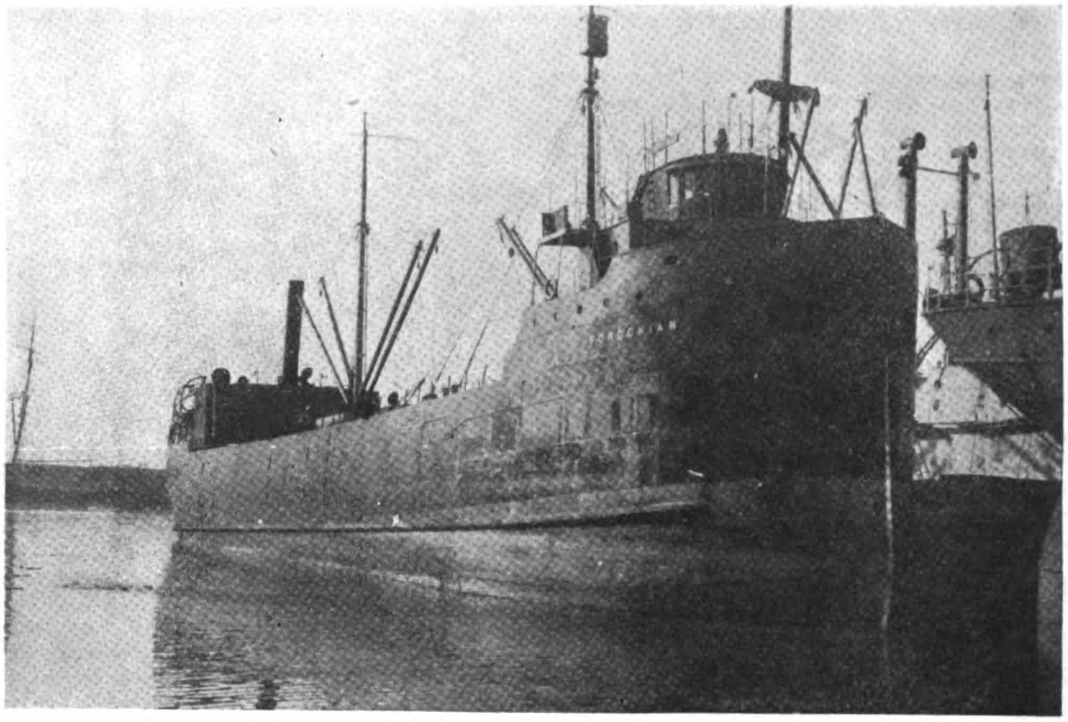
One circulating-pump, 400 gallons per minute, driven by 10 H.P. electric motor—Rumsey figure 1120.

One 5 in. x 8 in. vertical triplex single active fuel-oil pump, driven by 5 H.P. motor—Rumsey figure 692.

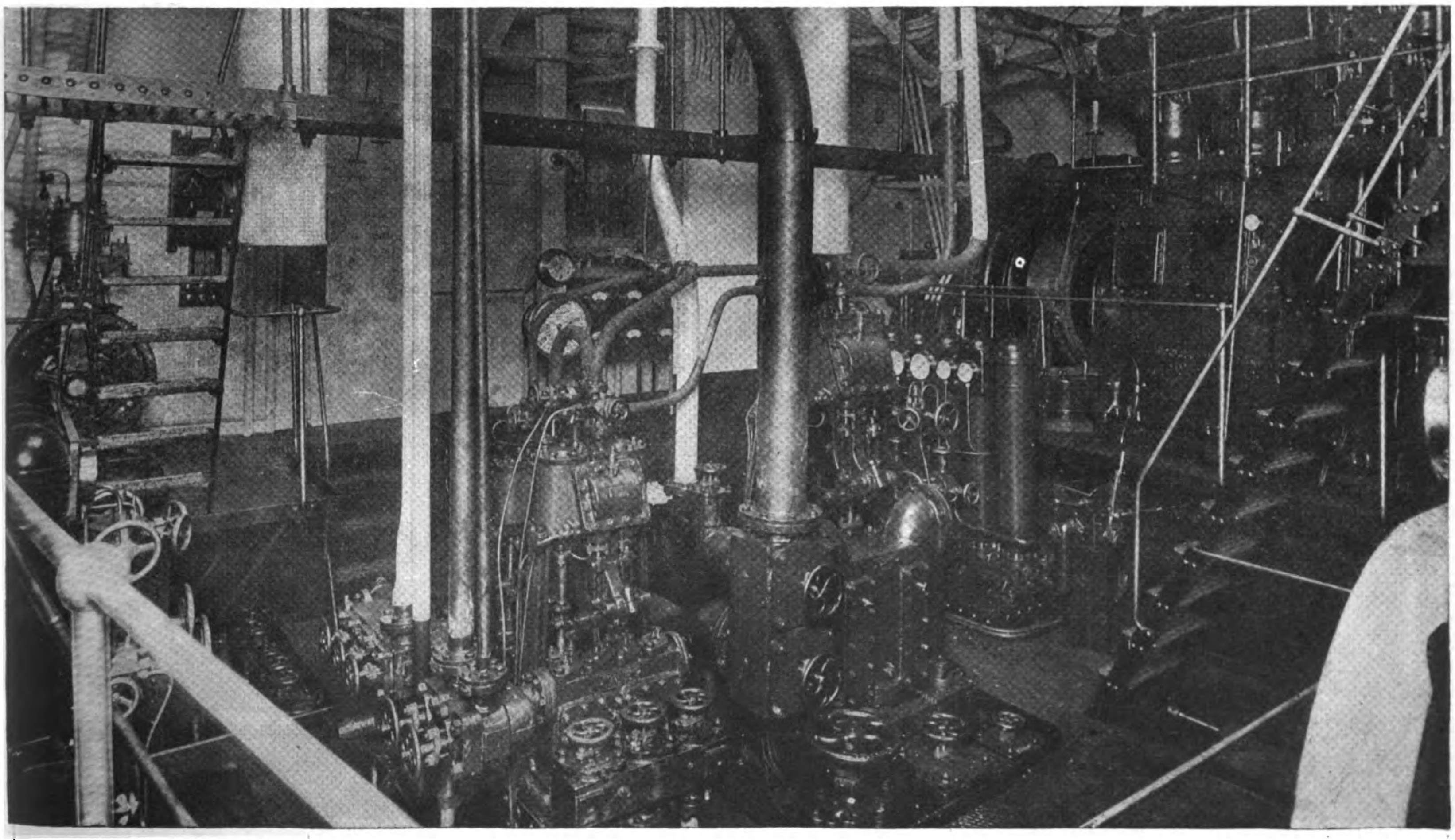
One 6 in. x 8 in. vertical Rumsey triplex single-active fire-pump, driven by 10 H.P. motor.

One 25 H.P. Meitz vertical single-cylinder hot-bulb oil-engine direct-connected to 15 K.W. generator, 250 volts, direct-current.

One 9 H.P. Meitz vertical single-cylinder hot-bulb oil-engine direct-connected to 6 K. W. generator, 125 volts, direct-current.



The freighter "Fordonian" being converted to Diesel-electric drive by the Todd Shipyards Corp.



Engine-room of a British freighter with Diesel-electric drive. On the right is one of the two main 300 b.h.p. Diesel-engines coupled to a generator

Service of a Wooden Motorship—Extraordinary Figures for Shipowners' Digestion

IT certainly seems extraordinary that, although all the steam-driven wooden motorships America built during the war have proved commercial failures, and most of them hopeless as ocean-going craft, yet every full-powered Diesel-driven wooden motorship constructed at the same time has proved most seaworthy and commercially successfully in every respect. At the time the big wooden fleet was projected, one of our leading naval-architects told the Senate Investigating Committee that if Diesel-engines were installed in these craft we would not be able to operate them after they were built, and that he would not recommend internal-combustion engines for wooden hulls to the Emergency Fleet Corporation, because they had never been demonstrated for overseas work. (See "Motorship" March, 1918, page 3.)

Since this naval-architect made these statements over a dozen full-powered Diesel-driven wooden motorships have been placed in service by private owners on the Pacific coast and without a single exception have put up surprising performances as to seaworthiness, reliability and economy in operation, forming a strange contrast to the pitiful fiasco made by the Government's wooden coal-burning steamers built and powered in accordance with the plans of the naval-architect in question. Among these successful wooden Diesel-ships we will mention the "Libby Maine," "Cullbura," "Babinda," "Donna Lee," "Cethana," "Balcatta," "Trolltind," "Benowa," "Semiltind," "Borrika," "James Timpson," "Isle de Java," "Coolcha," "Boobyalla," etc., which are vessels of 2,000 to 4,000 tons d.w.c. We do not refer to many of the large ridiculously under-powered wooden motor auxiliaries, some of which were equipped with experimental oil-engines of other types, as most of these installations were practically condemned by "Motorship" before they were launched.

One of the earliest of these wooden motorships was the "full-powered" freighter "Libby Maine," whose only "defect" is that to our mind she has insufficient power and speed for her size, but in the face of this little deterrent has done splendidly. She is a twin-screw ship of 2,000 tons dead-

Sixty-Three Thousand Miles in the Pacific Run by Seven-Knot 2,000 Tons D.W. Vessel in 2½ Years—An Average of 65 Miles per Ton of Fuel-Oil Burned

weight capacity, powered by twin Dow Diesel-engines of 320 shaft h.p. each (428 i.h.p.), whereas she should have had at least 1,000 shaft h.p. total or 500 h.p. per shaft. Her trial speed averaged 7 knots. Since that trip she has covered a total of 63,185 nautical-miles at an average speed of 6.72 knots. Under the circumstances this is a most remarkable performance, probably never equalled by any wooden steamer of her size and power.

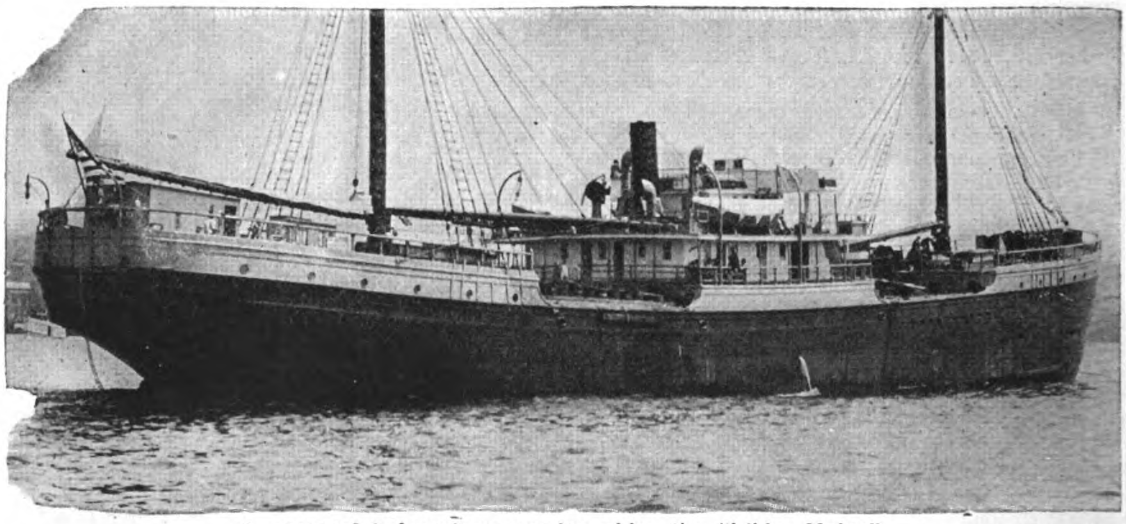
She was placed in service in June, 1918, by her owners, Libby, McNeil & Libby of Chicago, and is 240 ft. long with 43 ft. breadth and 24 ft. moulded depth, her twin engines turning at 240 r.p.m. but driving the propellers at 100 r.p.m. through Falk reduction-gears.

We are enabled to give a complete record of her voyages, and a chart showing the various routes. An analysis of these voyages reveal some most extraordinary figures, that will bear the closest comparison with the very best of steel steamers of the same size and power.

Altogether she has successfully made 14 voyages aggregating 63,185 nautical miles at an average speed of 6.72 knots, using but a total of 966 tons of fuel-oil, or an average distance of 65 nautical-miles run per ton of fuel-consumption.

The following is a summary of the results of the 14 voyages:

Period of operation	2 years, 7 months
Total mileage run	63,185 naut. miles
Time at sea	9,339.9 hours
Average speed maintained	6.72 knots
Total fuel-oil consumed	6,764 bbls. (966 tons)
Distance per bbl. of fuel	9.36 naut. miles
Distance per ton of fuel	65 naut. miles
Daily fuel-consumption	17.37 bbls. (2.48 tons)
Average engine-speed	238.21 r.p.m.
Average propeller speed	About 92 r.p.m.



A successful American wooden ship—the "Libby Maine"

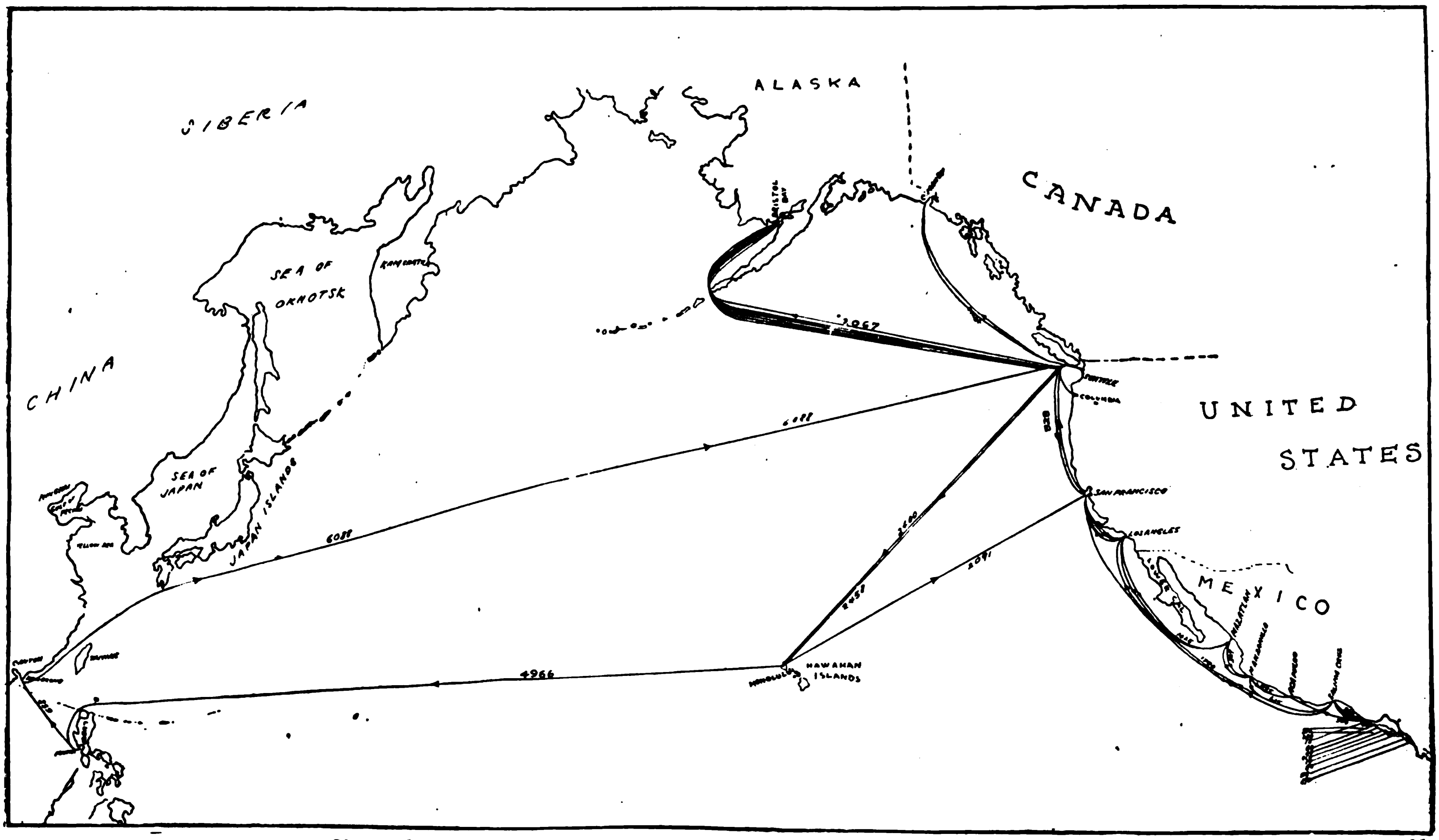


Chart of voyages made by the Diesel-driven wooden motorship "Libby Maine"

VOYAGES OF DIESEL-DRIVEN WOODEN MOTORSHIP "LIBBY MAINE"
ABSTRACTS OF LOGS

(See Page 206)

Voyages	Voy. No.	Naut. Miles	Time Hrs.	Aver. Knots	Fuel Total No. Bbls.	Naut. Miles Per Bbl.	Bbls. Per Day	R.P.M.
Portland-Seattle	1	389	60	6 48	....	....	....	220
June 23, 1918								
Seattle-Alaska		2067	309.5	6.90	209.6	10.4	16.25	....
Alaska-Seattle		2067	291.5	7.3	244.4	8.75	20.5	....
Seattle-Honolulu	2	2400	354.25	6.88	259.5	9.25	17.6	237.75
Honolulu-San Francisco		2091	357.3	5.77	305.	6.85	20.4	237.33
San Francisco-Seattle		828	141.4	6.0	103.4	8.01	17.5	....
Seattle-Honolulu	3	2458	362.3	6.0	255.	9.63	16.9	236.3
Honolulu-Manila		4966	688.7	7.21	468.	10.60	16.36	239.09
Manila-Hongkong		658	87.7	7.72	63.	10.61	17.26	236.0
Hongkong-Seattle		6088	860.	7.08	663.4	9.17	18.51	238.6
Seattle-Koggiong	4	2090	348.5	5.99	268.5	7.79	18.46	236.5
Koggiong-Seattle		2051	257.6	7.97	192.	10.67	17.92	239.4
Seattle-Koggiong	5	2058	331.2	6.22	237.	8.67	17.17	....
Keggiong-Seattle		2035	286.8	7.10	236.5	8.60	19.75	....
Seattle-Yakutat	6	1064	150.6	7.07	100.	10.64	15 95	....
Yakutat-Seattle		1038	135.5	7.65	95.5	10.85	16.92	....
Seattle-San Francisco	7	....	....	....	....	....	....	....
San Francisco-San Pedro		....	....	....	....	....	....	....
San Pedro-Mazatlan		....	....	....	....	....	....	....
Mazatlan-Manzanillo		....	....	....	....	....	....	....
Manzanillo-Salina Cruz		....	....	....	....	....	....	....
Salina Cruz-Champerico		....	....	....	....	....	....	....
Champerico-San Jose		....	....	....	....	....	....	....
San Jose-Acajutla		....	....	....	....	....	....	....
Acajutla-La Libertad		....	....	....	....	....	....	....
La Libertad-Amapala		....	....	....	....	....	....	....
Amapala-La Union		....	....	....	....	....	....	....
La Union-Corinto		3826	532.8	7.22	387.3	9.88	17.43	239.2
Corinto-San Jose		....	....	....	....	....	....	....
San Jose-Champerico		....	....	....	....	....	....	....
Champerico-Salina Cruz		....	....	....	....	....	....	....
Salina Cruz-San Francisco		2695	388.25	6.94	284.5	9.47	17.59	240.8
San Francisco-San Pedro	8	....	....	....	....	....	....	....
San Pedro-Mazatlan		....	....	....	....	....	....	....
MazatlanManzanillo		....	....	....	....	....	....	....
Manzanillo-Acapulco		....	....	....	....	....	....	....
Acapulco-Champerico		....	....	....	....	....	....	....
Champerico-San Jose		....	....	....	....	....	....	....
San Jose-Acajutla		....	....	....	....	....	....	....
Acajutla-La Libertad		....	....	....	....	....	....	....
La Libertad-Amapala		....	....	....	....	....	....	....
Amapala-Corinto		....	....	....	....	....	....	....
Corinto-San Juan del Sur		3046	412.1	7.39	278.15	10.94	16.21	240.85
San Juan del Sur-La Union		....	....	....	....	....	....	....
La Union-San Jose		....	....	....	....	....	....	....
San Jose-La Union		....	....	....	....	....	....	....
La Union-Champerico		....	....	....	....	....	....	....
Champerico-Salina Cruz		....	....	....	....	....	....	....
Salina Cruz-San Pedro		....	....	....	....	....	....	....
San Pedro-San Francisco		3275	493.2	6.64	340.	9.63	16.54	239.87
March 8th, 1920								
San Francisco-Seattle		818	181.6	4.82	141.4	5.8	18.7	232.5
Seattle-Yakutat	9	1011	155.7	6.48	115.4	8.77	17.7	240.
Yakutat-Seattle		999	132.3	7.55	89.2	11.2	16.12	241.
Seattle-Koggiung	10	2063	338.	6.1	242.7	8.5	17.22	238.3
Koggiung-Seattle		2078	303.	6.85	210.7	9.9	16.68	239.7
Seattle-Kanai	11	1357	221.6	6.12	161.8	8.3	17.5	239.5
Kanai-Seattle		1417	207.5	6.82	144.1	9.7	16.74	241.3
Seattle-aYkutat	12	1035	141.5	7.31	98.9	10.5	16 7	240.8
Yakutat-Seattle		1045	168.2	6.19	117.1	8.9	16.6	239.5
Seattle-Taku	13	885	126.5	6.99	84.	10.5	15.18	240.7
Taku-Seattle		903	129.3	6.98	94.2	9.6	17.4	241.1
Seattle-San Pedro	14	1202	206.	5.83	148.	8.1	17.2	238.4
San Pedro-San Francisco		1182	179.5	6.5	126.3	9.35	16.8	239.2
TOTAL AVERAGE		63,185	9,339.9	6.72	6,764.6	9.36	17.37	238.21

TWO MOTORSHIPS FOR REDERI STJARNAN

Two motorships of 1,150 tons d.w.c. and 1,200 tons d.w.c. are being built for the Rederiaktiebolaget Stjärnan of Karlsted by the Bergsunds Motorfabrik of Stockholm, Sweden. Bergsunds surface-ignition oil-engines are being installed.

SOCIETA TRANSATLANTICA ITALIANA'S MOTOR-LINERS

The three passenger motorships building for the Societa Transatlantica Italiana, of Genoa, at Ansaldo San Giorgio, Ltd.'s, yard will carry 350 first and second class passengers and 5,800 tons of cargo. Twin 2,000 shaft h.p. Ansaldo San Giorgio two-cycle type Diesel-engines are to be fitted, and a speed of 13 knots attained. The crew will consist of 149 men of whom 16 will form the engine-room staff.

GROWTH OF SWEDISH MOTORSHIP FLEET

It is of particular interest to note the gradual change in Sweden from steam to motor-driven vessels says "Fairplay," and this feature seems to have received considerably stronger accentuation during the last year. At the end of 1914 the number of motor-vessels in the Swedish mercantile fleet amounted to 4.7 per cent. of the whole fleet, with a gross register capacity of 2.2 per cent. The corresponding figures at the end of last year were 18.4 and 10.7 per cent.

SUBMARINE ENGINES ON SAILING-SHIPS

Ansaldo-San Giorgio submarine-type Diesel-engines have been installed on a number of Italian sailing-ships, including the "Aosta" owned by the Societa Il Mare of Genoa, and some vessels owned by the Societa Andora of Genoa, and in ships owned by Quaglia & Galdini of Genoa. Also in some of the French ex-patrol boats, details of which were given in our December, 1919, issue, which are now operating very successfully along the Liguria Coast in commercial work.

TRIALS OF MOTORSHIP "TRITON"

Regarding the Frichs Diesel-engined motorship "Triton," she made a trial trip on Oct. 13th since when has completed some very successful voyages between Denmark, Norway & Great Britain with a fuel-consumption at full-speed (400 shaft h.p.) of 1¾ tons or 0.45 lb. per shaft h.p. A second engine of the same size and type is being installed in the concrete cargo ship "Poseidon." Both ships are owned by the Triton Shipping Co.

MOTORSHIP FOR COPENHAGEN S. S. COMPANY

Materials have arrived and the keel will shortly be laid for a 6,000 tons d.w.c. Diesel motorship at the Baltica Shipbuilding Company, South Harbor, Copenhagen, to the order of the Kobenhavnske Dampskibselskab (Copenhagen Steamship Co.). She will be built, says the "Scandinavian Shipping Gazette" on the ways where the steamer for the Storbelt Co., is now under construction.

THE HOWALDSWERKE MOTORSHIP

"Vistula" is the name of the 8,800 tons d.w.c. Sulzer Diesel-engined motorship building at the Howaldswerke, Kiel, Germany.

INSURANCE OF MOTORSHIPS

We understand that the Pierce Navigation Co. of New York has insured their steel Bolinder-engined motor-tanker "Pennant" for $860,000 at 5½%, this representing half the vessel's value.

TRIALS OF MOTORSHIP "SCANIA"

On her trials the Swedish Lloyds new small motorship "Scania" (already described and illustrated in "Motorship") attained a speed of 10 knots. She is propelled by twin 500 shaft h.p. Polar Diesel engines.

MOTORSHIP "KIRKTIND" CHANGES HANDS

The Donovan Lumber Company of San Francisco has purchased the wooden motorship "Kirktind," 2,205 tons gross, for $153,000.00. This vessel is propelled by twin 460 b.h.p. Winton Diesel engines and will be used on the coastwise service between Aberdeen, Washington and San Pedro, Calif.

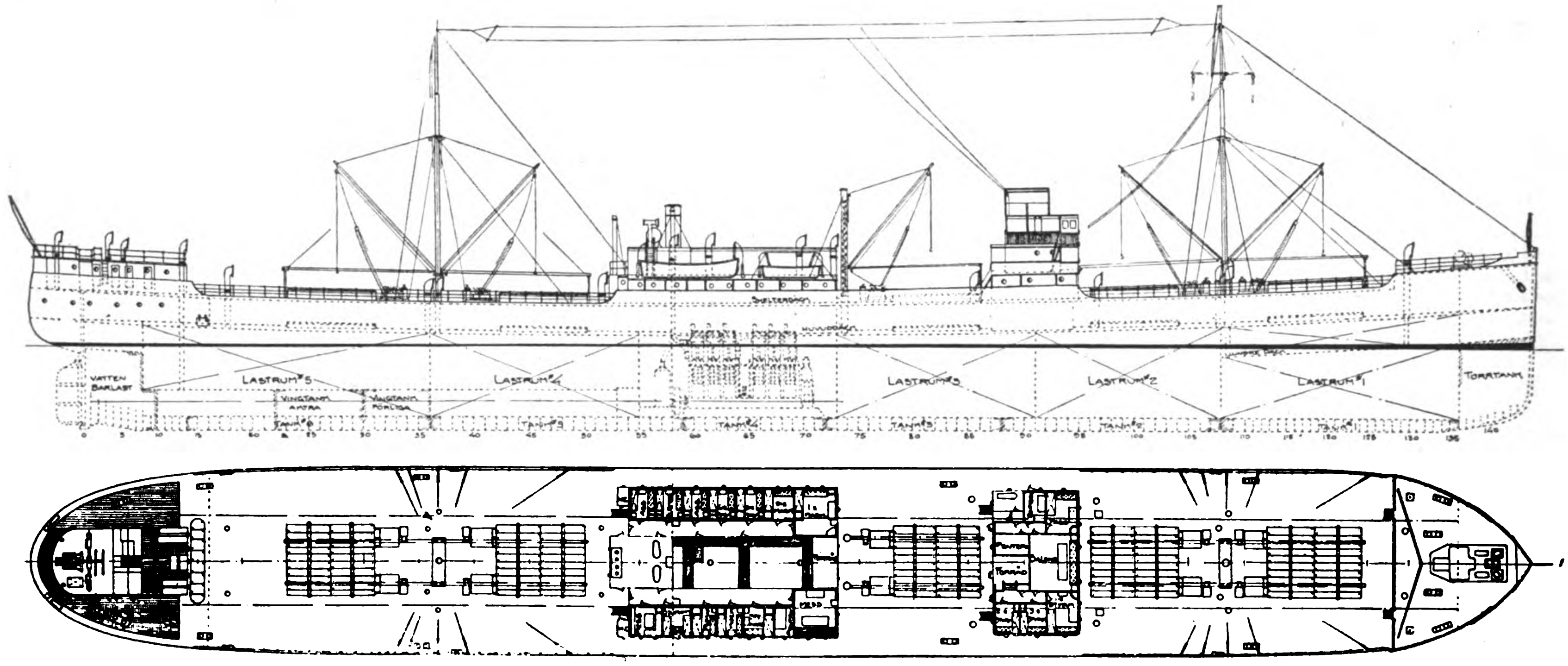
SEVEN VOYAGES OF MOTORSHIP "STUREHOLM"

(See Page 620)

	Nom. Dist. nau.m.	Dist. By Log. nau.m.	Hrs. at Sea by Log	Average Running Speed Knots	Fuel Used On Trip Tons	Lubr. Oil Used Lbs-* Kg-†	Cargo Includ-ing Fuel Tons	Mean Draught
Goteborg—Baltimore Oct. 11—Oct. 27, 1919	3,800	3,737	354	10.5	144	717†	5782	19'- 1"
New York—Goteborg Nov. 30—Dec. 15, 1919	3,580	3,561	352	10.1	146½	722†	7049	22'- 6"
Goteborg—Baltimore Feb. 7—Feb. 27, (a)	4,000	3,876	462	8.4	194	859†	4000	17'- 9"
New York—Gothenburg Apr. 2—Apr. 19, 1920	3,615	3,775	356	10.6	160	1543*	7162	23'- 9"
Gothenburg—Havana June 14—July 3, 1920	4,650	4,887	440	11.1	165	1650*	6700	22'- 3"
Philadelphia—Gothenburg Sept. 18—Oct. 6, 1920	3,736	3,800	366	10.4	163	1654*	7521	23'-10"
Gothenburg—Baltimore Nov. 10—Nov. 30, 1920 (b)	3,960	3,889	450	8.6	170	1875*	5500	19'- 8"
	27,341	27,525	2,780	9.9	1,142½		43,714	

(a). Very bad weather, and detoured to avoid ice off Cape Race.
(b). Very heavy weather. Structure of ship damaged.

Deadweight cargo carried in 13 months		43,714 tons
Less Fuel and Water "	" " "	1,600 "
Net-Cargo Carried	" " "	42,114 "



Plans of the motorship "Stureholm," built by the Götaverken. The propelling-machinery only occupies 18 frame-spaces, including donkey-boiler and auxiliary Diesel-electric plants

First Thirteen Months' Operation of a Motorship

Record of the Seven Voyages of the Swedish Diesel-Ship "Stureholm." Total of 42,114 tons Net-Cargo Carried 27,525 miles at 9.9 knots on 1,142 tons of Oil-Fuel Costing $5,712.50

AS far as possible we make a special point of "keeping tabs" on the operation of the more important of motorships now in service—both domestic and foreign, partly in order that we ourselves may be assured of their success and partly to be in the position of placing such information before shipowners who are not yet fully satisfied in their own mind that the Diesel-system of propulsion today is as reliable as steam reciprocating-engines and even more reliable than the average geared-turbine drive. There can be no doubt but that despite the mass of information published by "Motorship," the attitude of ship owners in building steamers now is (as stated by the Anglo-American Oil Company elsewhere in this issue)—only based on ignorance of the facts. Our work in securing and distributing authentic operating datae has been greatly aided by a number of motorship-owners who have been broadminded enough to see the universal benefits for the distribution of such confidential matter, even tho it may result in gain to rival ship-operating concerns.

Possibly our comments may often be considered biased, but in our efforts to furnish our readers with reliable data and unbiased information, we extract our figures from ships' log-books whenever possible, and then analyze and comment upon the same in order to possibly bring-out the points of comparison with average steam-drive. A typical example was to be found in the case of the converted steamers now owned by S. O. Stray and Company and fully dealt with in our last issue.

Recently we made another visit to the Swedish motorship "Stureholm," which we originally described in an issue of April, 1920 on pages 298-299, following a visit abroad with Mr. Kermit Roosevelt and other well-known American shipowners and bankers. This Diesel-vessel has unusual interest for us as we happened to be in Sweden when she started on her maiden voyage just a few minutes too soon for us to get aboard. A few weeks ago she was once again in New York harbor, and our representative was enabled to secure further details concerning the last three voyages through the courtesy of Chief-Engineer Axel Carman. This data we give in an accompanying table and we also repeat the previous four voyages, making seven trips all told.

As all our readers may not have their copy of last April, we will repeat the leading dimensions of the motorship "Stureholm," which vessel was built by the Götaverken and engined by Burmeister and Wain.

Dead-weight capacity .... 7,800 tons
Actual cargo-capacity of holds with fuel for
10,000 miles in bunkers and stores, etc. 7,200 tons
Cubic capacity (bales) .... 419,611 ft.
Cubic-capacity (grain) .... 457,000 ft.
Length (O. A.) .... 409 ft.
Breadth (moulded) .... 53 ft. 9. in.
Draught .... 26 ft.
Indicated horse-power .... 2,960 H.P.
Shaft horse-power .... 2,250 H.P.
Engine-speed at sea .... 140 R.P.M.
Rated power per engine..1,300 I.H.P. at 130 R.P.M.
Daily fuel-consumption (incl. auxiliaries at
sea) .... 10¼ tons
Fuel-consumption per Ind. H.P. hour...... 0.317 lb.

Swedish-American-Mexico Line Motorship "Stureholm." Details of seven voyages are given on page 203 of this issue.

Fuel-consumption per shaft H.P. hour....0.418 lb.
Auxiliary power required at sea..........85 b.h.p.
Auxiliary power required in port...85 to 170 b.h.p.
Reserve auxiliary power.................85 b.h.p.
Port fuel-consumption..............½ to ¾ tons
Total crew (officers and men)................32

There is a small oil-fired donkey-boiler for heating the ship, and this unit burns more fuel than all the other Diesel-electric auxiliaries together when used.

The complement of this motorship consists of captain, chief-officer (who also operates wireless) second-officer, third officer, chief-engineer, three assistant-engineers, six oilers, three motormen, one motorman also is electrician, carpenter, bo's'n. Six deck-hands, two apprentices, steward, cook, waiter, and two mess-room boys, a total of thirty-two men and boys.

In connection with the number of crew and their wages and sustenance we desire to point-out to ship-owners of our country that they could with advantage spend the time now consumed in agitating against the La Follette act in studying the enormous economies and savings to be affected by means of Diesel propulsion of ships; because if they are ultimately successful in getting this hampering law repealed the gain will be comparatively small—in fact, far too small to enable our steamers to compete against foreign motorships. After the major economies have been effected then attention can be vigorously centered upon unwise laws.

For instance, the wages and food-bill of an American steamship of the same size as the Swedish motorship "Stureholm" will be from $3,000 to $4,000 more per annum. Whereas, it was clearly indicated in our last article on the "Stureholm" that her additional cargo-capacity and fuel-economy together alone represents approximately $333,720.00 per year, based upon six round trans-atlantic voyages, provided she was fully loaded each voyage. And—the earning power of a ship should be based upon her maximum capacity because she is built for that object.

Unfortunately, we haven't the current Swedish wage-scale before us, but the following table is the wage-scale now current in the Norwegian mercantile-marine. We presume that the Swedish wages are approximately the same.

	Maximum per Month, Kroners
Captains	767
(1) Mates	500
(2) Mates	400
(3) Mates	350
Engineer (chief)	580
(2) Engineers	485
(3) Engineers	415
Stewards	400
Cooks	300
Cooks' mates and cabin boys	80
Carpenters	345
Boatswain	345
Able seamen	316
Ordinary seamen	200
Young men	127
Boys	105
Motor- and donkeymen	345
Firemen	322
Trimmers	215
Engine boys	105

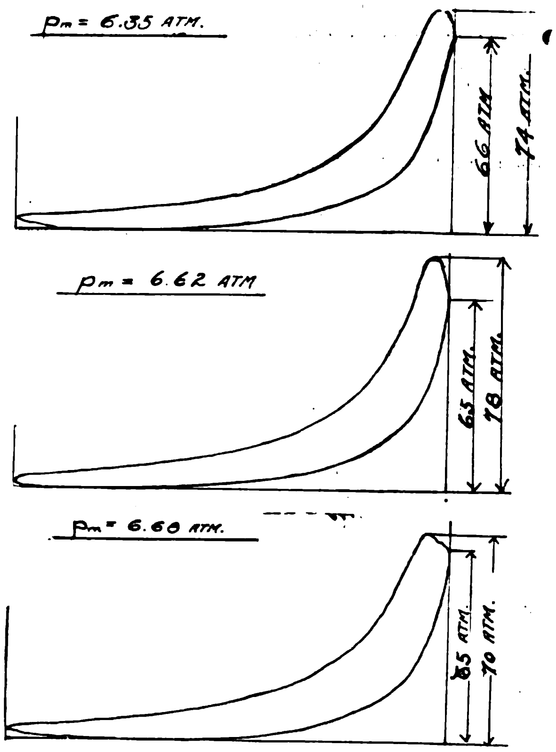
The normal exchange-rate between the United States and both Sweden and Norway is 26.80 cents to the kroner, but the current-rates are about 19c and 22c. respectively. However, in making a comparison only the normal rates should be taken into consideration.

Early this year nearly all the marine steam-engineers in Sweden went on strike after negotiations for a higher wage-scale had failed. They asked 1,655 kroners per month for a 4,000 tons ocean-going cargo-ship, and 2,340 kroners for a passenger-ship.

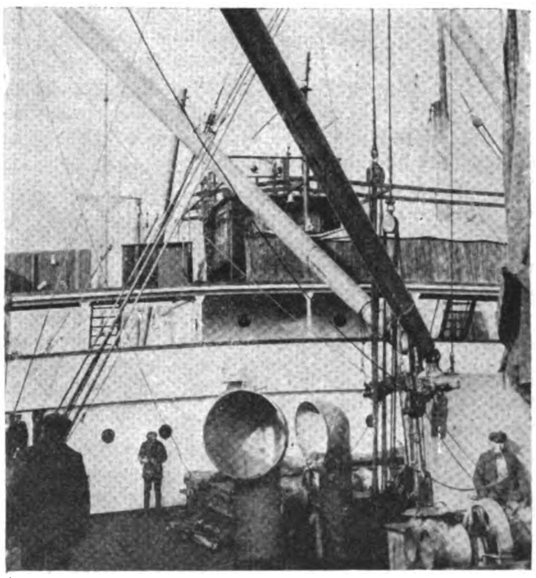
Quite recently we received a letter from a civil engineer of Rasunda, Sweden, who for a long while has been a subscriber to "Motorship." He writes to say that because of the Swedish motorship engineers strike he has taken a position as third engineer on the 9,400 tons 13-knot motorship "Elmaren" of the Transatlantic S.S. Company. His letter was written on board en route to Sydney, Australia.

At the normal-exchange rate Norwegian Captains get a minimum of $204.55 per month and Chief-Engineers $154.44 minimum. As is known, in America there are five grade of Captains and Chief-Engineers ranging from $330.00 to $412.00 and $305.00 to $387.50 respectively.

On this particular subject Mr. Frank C. Munson, President of the Munson S.S. Line of New York made a terse reply to another shipowner; namely, Mr. Fields J. Pendleton, who asked what remedies could be adopted to overcome higher wages on American ships and what must be done to overcome the additional men that had to be carried. Mr. Munson quietly replied that the United States should adopt a Diesel-engine program which would result in the employment of fewer men and a great saving of fuel.



Indicator cards from the "Stureholm's" engines



Captain's bridge on motorship "Stureholm" damaged by heavy sea

When America has converted her steamers to economical Diesel or Diesel-elctric power then can shipowners well spend their time getting the La Follette act repealed, in order to put American motorshipping on an equal basis with foreign Diesel-vessels. Our natural oil-supply will then afford us a big advantage over most foreign shipping, regardless of type.

Regarding the actual results of "Stureholm," as a matter of fact, she only made seven one-way voyages in thirteen months, so the saving has not been $333,720.00. But this has been during a period of bad shipping depression when month after month uneconomical American steamers have been laid-up by the dozen as the conditions got worse until the total now reaches hundreds. All this time the "Stureholm" has been in steady service, and only once half loaded.

What she actually carried in these seven one-way voyages can be seen in the appended table. Although she is of but 7,800 tons deadweight capacity, she carried a total of 43,714 tons of cargo or on an average of 6,245 tons per one-way trip. Of this total amount only about 1,600 tons was represented by fuel, fresh-water and stores consumed by her engines and crew, leaving a total of 42,114 net tons of money-earning cargo actually transported.

Then again, to carry this cargo a total distance of 27,525 nautical miles at an average speed of 9.9 knots she only burned 1,142½ tons of fuel-oil.

We will be glad if some American firm of shipowners will kindly furnish "Motorship" with similar figures concerning the operation during the same period of one of their steamers of approximately the same overall dimensions and power as the "Stureholm." They will form most interesting and valuable comparisons.

M. S. "STUREHOLM"

Distance covered in 13 months,	27,525 nautical-miles
Total dead-weight cargo carried (seven trips),	43,714 tons
Total Net-Cargo carried in holds	42,114 tons
Total fuel, water and stores consumed	1,600 tons
Total fuel-bill (seven voyages)	$5,712.50
Average speed maintained	9.9 knots

Assuming that the average rate obtained for the net-cargo carried was $12.00 per ton (U. S. A. to Sweden) her earnings for the period must have been $505,332.00 while her total fuel-bill probably has been about $5,712.50, the prices of fuel paid by the "Stureholm" in America having varied from $2.50 to $6.50 per barrel. To get the above fuel-bill figures we have quoted an average price of $5.00 per ton in order to be on the safe side.

Let us here again point-out that motorships engaged in the trans-atlantic route, such as the "Stureholm," have an additional earning power not possessed by steamers, which accounts for the high figures of $333,720.00 being quoted by us earlier in our previous article as an estimated earning-capacity over steam. We refer to the fact that while she only burns about 300 tons on a round trip, she has a bunker-capacity of 1,000 tons. This means she can fully load her oil-compartments in the U. S. A., sell 600 tons in Sweden and still have ample left for the return voyage. When a motorship does this it means that she has absolutely no fuel-bill whatever, but is actually making a profit out of her fuel space.

Doubtless, these figures will seem so extraordinary to some steamship owners that they will doubt them. We will be glad to personally conduct such shipowners to motorships in harbor at the first opportunity, and let them secure their own figures and information direct.

We have endeavored to outline the foregoing facts as they are to-day, in order that American shipowners and shipbuilders may realize that our useful propaganda work is based as a very solid foundation.

Finally, we should state that on the latest voyage to New York, the excellent showing includes a period of terrific weather. During one day a heavy sea carried away a part of the railing on the captain's bridge. Water which came down the ventilator-pipe of the fuel-supply tank caused a stoppage of only ten minutes. Another sea came through the engine-room, skylight, flooding the engine-room momentarily with two feet of water and short-circuiting the starting-box for the daily fuel-supply pump. A spare starting-box was fitted and the pump made ready for running before the time came for refilling the service-tank and no interruption of the running of the main-engines resulted from the flood.

As to the question—is the Diesel ship genuinely reliable? the records of the voyage prove this beyond doubt. Chief-Engineer Carman's endorsement of her machinery is absolutely and unqualified. Yet this vessel has an old pair of Diesel-engines that had been laying on the dock for several years before installation. All such theories as "America hasn't any good Diesel engines," or "America hasn't any skilled operators," etc., are purely evasive to "stall off" the salesmen of Diesel concerns who desire shipowners to take definite action and to induce them to take the trouble of seeing for themselves. Enough of this evasion, let our shipowners show their business commonsense and do something tangible and worth while, before their present vessels are driven off the seas by economical foreign motorships such as the "Stureholm" and dozens of others that regularly call at American ports.

MOTORSHIP

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SOLUTION OF AMERICA'S SERIOUS SHIPPING PROBLEMS

What has only recently become apparent to some American shipowners, has for a long time been obvious to those who possessed a little discrimination and far-sighted judgment. Under normal conditions steamships cannot be profitably operated under the U. S. flag in competition with foreign motorships, and for years we have been using a sledge-hammer in our endeavors to drive this fact home. Many of our readers will remember that in November, 1918, we asked, "What will the nation say if after the war it discovers itself saddled with hundreds of merchant-ships of an uneconomical type that cannot be operated against foreign motorships without imposing a heavy burden upon the people?" A few weeks after those words were penned the Armistice was signed. That was two and a half years ago! Results, however, speak louder than words, and the shipping slump that recently came with rapidity has had the effect of waking-up shipping-men to the substantiality of our warnings. But it seems almost too extraordinary that nothing should have been done since 1918 to meet this situation, either by the Shipping Board or by private shipowners.

Since our February issue was published, Mr. Wm. Averell Harriman in a speech declared that our merchant-marine is in a dying condition and that prompt measures must be taken to save it. In the same room Admiral Benson again maintained that the necessity of reducing the cost of operation of ships was the chief problem now confronting the country and that vessels must be given greater motive power, using the Diesel engine or Diesel-electric drive, thus reiterating his statements made at the recent Marine League dinner, when Mr. Frank Munson, of the Munson Steamship Line, also declared that the uneconomical steam-engines and boilers must be removed from the Shipping Board's steel ships and replaced with this new economical class of power, or else be unable to compete with foreign shipping.

Hundreds of fine steel ships are laid up at the present time, so now is the psychological moment to scrap their "useless" steam machinery in a wholesale manner and replace them with an economical type of power that will enable them to be sent to sea and hold their position regardless of all-comers in the way of fair competition. Absolutely without doubt these vessels will have to be converted, so let it be done now. Further delay is maritime suicide! Next year foreign shipping competition will be more strenuous than ever, and well over one-hundred additional European motorships of 4,000 to 18,000 tons d.w.c. will be in service, and many more up to 25,000 tons d.w.c. will be under construction.

Mr. Harriman urges Government subsidies to assist American shipping! If a subsidy be given, we believe that the wisest course will be to let it take the form of a straight grant of somewhere between $50 and $75 per shaft horse-power on every existing steamer when converted to Diesel or Diesel-electric power, and a certain subsidy on every new motorship ordered. Subsidizing existing, or new, uneconomical and oil-wasting steamships would purely be a sheer waste of the nation's funds. In the case of conversions the subsidy should be based—not on the existing power, but on the new plant in order to encourage higher speeds and quicker turn-rounds up to the limits of commercial practicability and economical operation.

Thus a steamer of 10,000 tons net-cargo capacity, 3,000 shaft h.p., 11½ knots speed, burning 32 tons of oil-fuel per day, should receive a subsidy of $200,000 to $300,000 for conversion into a motorship of 11,000 tons net-cargo capacity, 4,000 shaft horse-power, 13 knots speed, burning but 18 tons of oil-fuel daily, the shipowners, of course, to stand the balance of the cost. The enormous advantages thus accrued must be obvious to everybody. An addition of 2½ knots in speed and about one thousand tons of cargo-capacity is gained, while the fuel-consumption is reduced by 40 per cent. Also firemen are eliminated. Some ships are suited for the Diesel-electric drive, others are better adapted for direct Diesel propulsion. This the owners will have to decide in accordance with individual ship designs and trade routes.

In view of these vast economies is it surprising that Mr. Wm. Denman recently urged Congress to appropriate sufficient funds to convert one million tons of existing steamers to motor power?

AN ALTERNATIVE CONVERSION PLAN

In an interesting article to be given next month a chief-engineer of an American steamship proposes an interesting alternative for giving existing steamers a means of operating profitably. In cases where the owners believe it would not pay to tear out the present machinery, he suggests that oil-engines and electric generators be installed as an additional power for the purpose of operating the cargo-winches, electric light, etc., when the vessel is in port, thus allowing the main boilers to be shutdown, as some standardized steamers of 9,600 tons d.w.c. operated by a well-known firm burn from 15 to 25 tons of fuel-oil per day when in harbor loading and unloading. This is unusually high, the general consumption being from 5 to 8 tons per day. With oil-engine-electric auxiliaries the fuel-consumption for a vessel of this size would be reduced to one-half to one ton per day with similar cargo handling speeds and powers. For operating the donkey-boiler this engineer proposes to utilize the exhaust-gases of the oil-engines, a practice adopted with success in the past with some foreign tankers.

STOP THE CRIMINAL WASTE!

In the first nine months of last year, bunker-oil supplied to steamers in American ports was more than double that of the same period of 1919, and totaled 4,614,956 tons. This amount could have been reduced to about 1,500,000 tons had all these ships been Diesel-driven, and much valuable oil thus saved.

AMERICAN SHIPBUILDER RETURNS FROM EUROPE

Shortly after his return from Europe, we had the pleasure of interviewing Mr. H. M. Robinson, president of the Merchants Shipbuilding Corp., who had been investigating shipbuilding abroad, including in Great Britain. Mr. Robinson has returned enthusiastically in favor of the Diesel-motorship and is convinced that its extensive adoption is absolutely essential if America is to successfully maintain a large merchant-marine. Two large motorships are now being built at his own shipyard!

OUR SPECIAL CANAL INVESTIGATIONS

For the purpose of making the most thorough investigation of the transportation facilities on the New York State Canal yet attempted, and with a view to ascertaining the most economical methods of carrying all classes of products, and for making comparisons with charges for railroad hauling, etc., "Motorship" at no small expense has sent a Special-Commissioner through the Canal zone interviewing barge-operating companies, builders, state officials and many others interested—or opposed to, as the case may be—in the welfare of this magnificent and valuable waterway. These investigations will be continued for many months, and we believe the result will demonstrate that the oil-engine will play a great part in bringing about an economical system of propulsion for canal craft. The reports of our Special-Commissioner will be given in a series of articles, the first of which appears in the current issue. We believe that there is a great field for the small and moderately powered heavy-oil engine as a propulsive and auxiliary machinery driving medium in canal craft. Co-operation of everybody concerned is especially requested.

PROPOSED MOTORSHIP ENGINEERS' REGISTRY BUREAU

Some excellent suggestions are made in our correspondence columns this month by an American motorship-engineer, and we believe his proposals could be acted upon by shipowners to their advantage. This is the formation of a central Bureau of Registration for experienced oil-engineers where the records of numbers would be kept on file, also the performance of motorships operated by them. In this manner skilled engineers would be available at all times. We believe that engineers would willingly co-operate with shipowners and utilize the facilities to the greatest extent. It is entirely up to shipowners to make a move in their own interests. Several years ago we urged shipowners to co-operate in the formation of a fund for building, placing a small motorship engineer training-ship in service, but nothing was done.

THE HIGH-POWERED GERMAN DIESEL-ENGINES

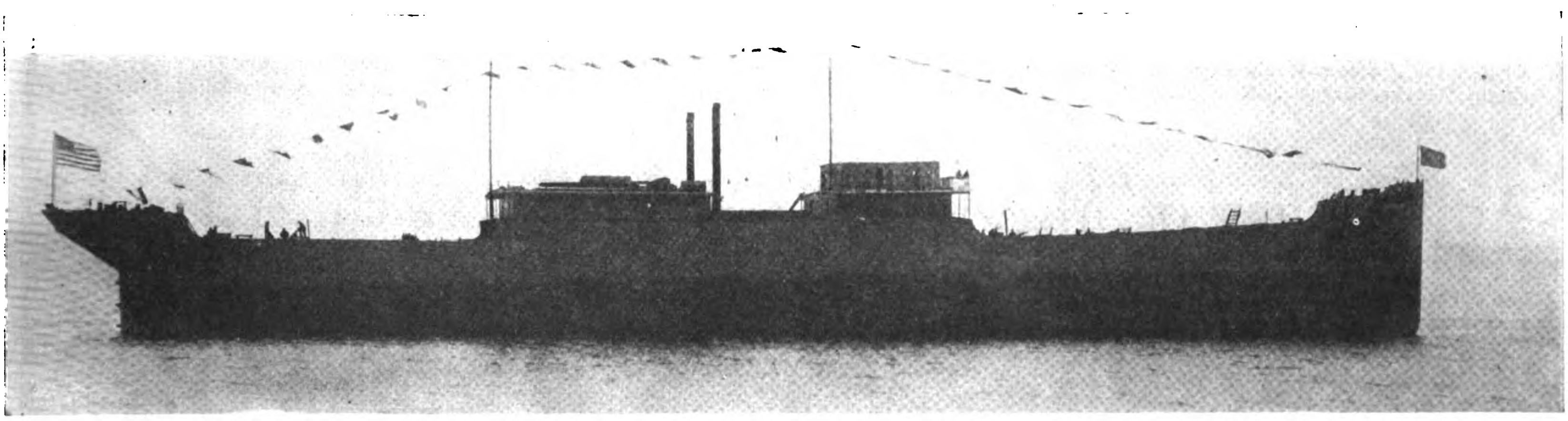
Our readers are now familiar with the fact that completed, tested and now laying idle dismantled in the builders' works in Germany are two marine Diesel-engines of 12,000 shaft horse-power each, both of the two-cycle type in six double-acting cylinders. One of them is at the Krupp shipyard in Kiel, and the other at the Nürnburg plant of the M. A. N. We are now enabled to add some remarkable information concerning the engine built at Nürnburg. One of the tests of this great marine Diesel-motor was of 6 days non-stop duration, and for two days during this period an average output of sixteen thousand (16,000) shaft horse-power was developed, making it the highest powered Diesel-engine in the world.

It only remains for this engine, and the Krupp duplicate engine, to be tried out in a ship. Some far-sighted and courageous American ship-owning firm should purchase these great engines and install them in some large passenger liner in which the present steam-machinery is nearly worn out. That these engines safely developed 4,000 horse-power over their rated load for 48 hours is a fair indication that they would run almost indefinitely at their normal load of 12,000 shaft horse-power. Because of the vastness of the "experiment" we would not be at all surprised if the builders would accept the major part of the payment upon completion of first voyage if permission to sell was granted by the German authorities.

What a splendid opportunity for one of our large ship operating concerns. It would give them a wonderfully economical 20-knot passenger motor-liner of about 600 ft. length burning but 130 tons of oil per day, and have a total machinery-space of only about 85 ft. length and have no firemen. With such a ship, the passenger-rates could be lowered to a figure way beyond those possible today and her cabins would always be full even when other vessels were running half filled. If too large a sum of money is involved for a private firm to undertake the purchase of these engines, we offer the suggestion that the Shipping Board co-operates and shares half the expense. These engines in operation in an American ship would be of vast technical value to shipbuilders and engine-builders in this country, as they are away ahead in power of anything yet constructed.

When the first three cylinders of this big engine was being tested in 1913 at the factory, an explosion of oil-vapor in the exhaust-pipe smashed the measuring fuel-tank and blazing oil poured over the engine, inflicting serious damage. Repairs were afterwards made and the three remaining double-acting cylinders constructed, making the 12,000 b.h.p. total, and final tests were then run with very successful results. At first difficulty was experienced, not with the lower cylinder-heads and stuffing-boxes, but with the upper heads, because of the intense heat. This, however, was safely overcome to the satisfaction of the designers. After the first series of heavy tests of the complete engine many of the cylinders, pistons, bearings and cylinder-heads were interchanged and further tests made with satisfactory results.

Blohm & Voss, the well-known shipbuilders of Hamburg, are now completing two most interesting motorships for the Hamburg-American Line's transatlantic freight service. They are cargo-carrying motorships of about 14,000 tons d.w.c., in each of which twin ten-cylinder 3,000 shaft h.p. Augsburg Diesel-engines are being installed. These engines are not direct-connected to the propeller-shaft, but will drive through reduction-gearing. The engines, we understand, will not be operated at their full load but at slightly reduced revolutions, and together will produce about 5,500 shaft h.p., or sufficient to give the vessel a loaded speed of about 13 knots. If these lightly-built, high-speed submarine engines will stand up to the work of propelling such big ships, it will mean a big "boost" for the Diesel-electric drive, as the ideal Diesel-engine for electric drive will be a cross between a land power plant Diesel-engine and a submarine engine. That is to say, lighter than the one and heavier than the other, and with a speed of between 250 and 350 revs. per minute according to power. In this manner a reliable generator-driving engine will result. We are not yet convinced that mechanical reduction-gears with such big engines will be as satisfactory as the electric system, so await the arrival of the first of these ships from Germany with much interest. This should be about the end of June next.



Alaska Steamship Co.'s new motorship "Kennecott" constructed from laying of keel to the launching in 50 working days without one hour of overtime, by the Todd Shipbuilding & Dry Dock Co.'s Tacoma Plant. Two 1200 i.h.p. McIntosh & Seymour Diesel engines are being installed. Her dead-weight-capacity is 6,500 tons. In addition to the regular cargo she will carry 1,500 bbls. of fuel-oil and 4,500 bbls. of oil-cargo in her double-bottoms. Complete details appeared in "Motorship" of October, 1920.

LARGE MARINE DIESEL-ENGINE REQUIRED

We have been given to understand that Mr. Alexander McDougall, President of the McDougall Duluth Shipbuilding Co., of Duluth, Minnesota, will shortly be in the market for a Marine Diesel-type engine of about 1,100 H.P.. We suggest that oil-engine builders get into communication with the above gentleman.

ROYAL MAIL CO. TO ENTER U. S. FRUIT TRADE

According to reports the Royal Mail Steam Packet Co., who have three 8,000 tons Diesel motorships under construction in Great Britain, is to open a monthly series in the fresh-fruit transportation trade from the Pacific Coast to Europe.

ANOTHER FRUIT-CARRYING MOTORSHIP LAUNCHED

"Sevilla," a new British-Werkspoor Diesel-engined motorship was launched during January last to the order of Otto & Thor Thoresen Line, Christiania, for the fruit-carrying trade. The builders of this vessel are Wood, Skinner & Co., Bill-Quay-on-Tyne, Newcastle, and twin Werkspoor-type Diesel-engines are being installed by the North Eastern Marine Engineering Co., licensees of Werkspoor. Both the ship and engines have been built to the Norwegian Veritas, all modern cargo-handling devices have been fitted including steel derricks and electric-winches. In addition to cargo, a certain number of passengers will be carried in cabins on the bridge-deck.

THE ARDROSSAN AND BALTICA MOTORSHIPS

Hitherto the names of the owners of the three 9,000 tons d.w.c. Burmeister & Wain engined motorships building by the Ardrossan Shipbuilding & Dry Dock Co., Ardrossan, Scotland, have been kept secret. Two of them are for the Gylfe Steamship Co. of Copenhagen (Th. Just, Mgr.) which concern also owns the two 6,000 tons d.w.c. B. & W. Diesel motorships building at the Baltica shipyard, Copenhagen, the constructional materials for which were purchased in the U. S. A.

The third Ardrossan 9,000 tons motorship is for the United Steamship Company, of Copenhagen, owners of the m.s. "Oregon" and "Californian," who also have a new 7,000 tons d.w.c. B. & W. Diesel motorship building at the Nakskov yard.

MOTORSHIP-FUEL AVAILABLE, BUT NO STEAMER-OIL

According to a report no fuel-oil for steamers was recently available at Piraeus, Greece, but Diesel-oil was obtainable at $9.00 per barrel.

SHIPPING BOARD CONTRACTS FOR COAL AT $7.39 PER TON

A contract for 300,000 tons of coal has been placed by the U. S. Shipping Board at $3.73 at the mine, or $7.39 per ton alongside ships, the coal to be delivered during the coming twelve months.

The U. S. Shipping Board pays about $15.50 per ton for fuel-oil, and as coal-fired steamers use from four to five times the weight of oil-fuel burned by motorships it will be realized that a Diesel fleet would receive enormous economies. Let the Government convert these fuel-wasting vessels to Diesel power.

LATEST NORWEGIAN MOTORSHIP STATISTICS

At the beginning of 1921 there were no fewer than 1,497 Diesel motorships and other oil-engined commercial-vessels aggregating 222,871 tons gross, representing an increase over the previous year of 120 motor-craft of 36,517 gross-tons total. Only 97 steam-driven ships were constructed during the same period. These are official returns.

NEW AMERICAN SUBMARINES

A number of large submarines are already launched, or on the slips, at the Fore River Plant of the Bethlehem Shipbuilding Corp. Ltd. These consist of two AA-type submarines of 1,500 tons surface-displacement and 269' length, and are the largest Diesel-driven craft of this type ever built in the U. S. A. They have been illustrated in "Motorship." There are also twelve S-type submarines of 900 tons surface-displacement and 220' length. Keels are soon to be laid for six submarines of 225 ft. length. In some new U. S. Navy yard-built submarines now building, twin 2,400 b.h.p. Busch-Sulzer two-cycle Diesel engines will be installed. These engines are the highest-powered submarine units ever constructed in the United States.

HUDSON AND ATHENS FERRY BOAT

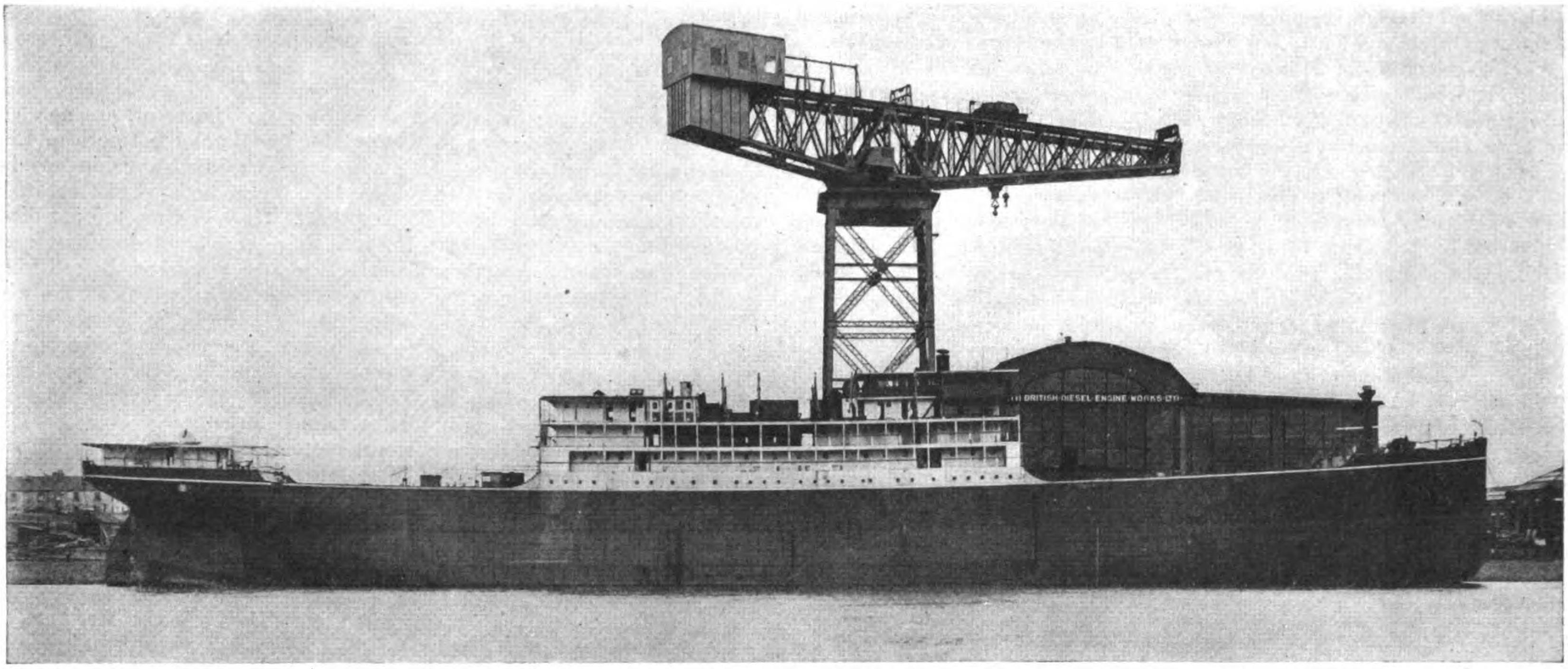
Referring to the motor-ferry boat for the Hudson & Athens Ferry Company now building at the Anchor Shipbuilding Company's yard from designs by Eads Johnson of New York, a 200 b.h.p. Ingersoll-Rand mechanical-injection oil-engine is to be installed.

ROYAL DUTCH-SHELL HEAD KNIGHTED

That business and financial genius at the head of the great Royal Dutch-Shell oil combination—H. W. A. Deterding, has been knighted by King George of England. The French Government has also honored him by conferring upon him the Cross of the Legion of Honor.

NEW AGENCY FOR "MOTORSHIP" IN GERMANY

Readers of "Motorship" in Germany who may have had difficulty in securing copies of this publication in that country will be pleased to know that we have concluded arrangements with Mr. Julius Springer, the well-known technical publisher, Linkstrasse 23-24, Berlin W. 9, to act as our sales-representative in Germany. Subscriptions to "Motorship" may be sent to Mr. Springer direct, the subscription price being 300 marks per year.



British India Steam Navigation Co.'s passenger-cargo motorship "Magnavana" having her Diesel engines installed at the North British Diesel Engine Works, Glasgow. Two 3,300 i.h.p. North British Diesel-engines and complete Diesel-electric auxiliaries are being installed. She will carry 150 first and second-class passengers and 10,500 tons of cargo.

Advantages of Motorships Compared With Steamships

Suspicious Attitude of Some Shipowners Can Only Be Based on Ignorance of Facts

BY THE ANGLO-AMERICAN OIL CO., LTD.

[The following opinion regarding the reliability, economy and advantages of Diesel-driven ships by this well-known American-British oil company, doubtless will be read with interest as the Anglo-American Oil Co. is the British branch of the Standard Oil Co. They have backed their faith in the new economical power by building two 10,500 tons d.w. motor-tankers, the "Narragansett" and the "Seminole," the first of which already has made several voyages to New York, while the second will soon be here on her maiden trip. We are indebted to "Oil Power" of England for the reproduction of the following.—Editor.]

TO those familiar with the progress of the motorship during the last decade, and its overwhelming advantages over the steamship, it is a source of surprise that any owner should be foolish enough to purchase the latter if they they can obtain the former. Yet vessels to be propelled by steam machinery are being built in large numbers at the present time by shipowners who still regard the oil-engine with grave suspicion. This attitude can only be based on ignorance of the facts.

It is proposed to show in the following how reliable the motorship has become, how great are its advantages over the steamship, and how favourably it is regarded abroad and by a few progressive shipowners in this country.

Even the warmest advocate of the motorship will not deny that tronble at sea has been experienced with large marine oil-engines in the past; but some failures, owing to lack of experience, have always accompanied the advent of new prime-movers: even the steam-engine has been no exception to this rule. With any new machinery the faults are only eliminated after many years of extensive practical use. In the case of the large marine oil-engine it is surprising that so little trouble has been experienced at sea, even with some of the older examples. In support of this reference may be made to the good services still being obtained from the machinery in the motor-tanker "Juno," which was put into commission in 1912. This vessel is fitted with single-screw oil-engines of 1,330 indicated horse-power, and she is still running regularly. Tests gave a consumption of 0.35 lb. of fuel-oil per indicated horse-power per hour and an average speed of 9.64 knots.

More recently the motorship "Glengyle" did the round voyage from England to Vladivostock and back without any stoppage of the engines due to defects, while from Singapore to Suez—about 5,000 miles—a non-stop run was made. During the voyage the consumption of fuel oil was about 0.325 to 0.36 lb. per indicated horse-power per hour, and her average speed 10.5 knots.

We now come to another point in connection with stoppages at sea, this being the type of trouble experienced. With oil-engines any stoppages that occur are usually caused by failure of the smaller gear, accessories, etc., such as oil-fuel pumps, air-compressors or piston-cooling devices, which can quickly be put right. Cracked cylinder covers, at first a fruitful source of trouble, have now become very rare, as are troubles with main moving parts, the only common moving part being the crank-shaft. Hence, when a failure occurs, it is a simple matter to cut-out one-cylinder and its parts altogether until repairs can be effected, the reduction in power being almost negligible in 6 and 8 cylinder engines. This feature contrasts favourably with reciprocating steam-engines or even turbines, in which the parts are dependent on each other throughout. The above consideration brings us to the position that troubles at sea are not now more frequent with oil-engines than with steam-machinery when the latter is taken to include boilers and auxiliaries.

That breakdowns to steam-engines leading to serious results are not unknown, is shown from time to time in the records of losses of ships at sea. Another feature worthy of consideration is the possibility in a steamship of the boilers being put out of action by water entering the stokeholds and extinguishing the fires. Flooding of the engine-room could, of course, take place in a motorship, but the water would not stop the engines so quickly. In fact oil-engines could be so constructed as to run until the water reached the cylinders, and, although steam engines could be similarly modified, this course would be futile if the supply of steam could not be maintained. Finally, if the oil-engine is not quite so reliable as steam machinery at sea, the difference is too small to effect the progress of the former for ships' propulsion.

When making comparison between steam and oil engines in favour of the latter, it is only fair to select the best designs of either type. During the last two years so many ships have been fitted to burn oil-fuel in place of coal that we may safely assume the former to be the more economical fuel. Then again, geared-turbines are being largely installed, and it is evident that this is deemed to be the most economical form of steam-machinery. Among oil-engines the four-stroke type is the more economical. Comparisons will, therefore, be made between oil-fired geared-turbine steamships and the motorships having four-cycle oil-engines.

First and foremost there is the saving in space, which amounts to 30% for the machinery alone in favor of the Diesel plant, when due allowance is made for the elimination of boilers and bunkers. The saving of fuel depends on the respective consumptions per indicated horse-power per-hour for the rival types of machinery. Figures for motorships have been already stated as about 0.33 lb. per indicated horse-power per hour. The consumption of oil fuel in a geared turbine steamship is seldom below 0.990 lb. per indicated horse-power per hour and may be even higher, or exactly three times that of the motorship. The amount of reduction that can be made in the bunker capacity depends on where a vessel is sailing to the duration of the voyage and the cost of oil-fuel at either end. A motorship would only consume one-third of the oil-fuel required by a steamship and a proportionate reduction could be made in her bunker space, and additional cargo carried.

With motorships no standby losses occur as with steamships, as the oil-fuel allowed for the steamship is based only on the consumption when under way and with the machinery in perfect order. Then again, with steamers, when entering and leaving port, delays are not infrequent, during which period either the steam-pressure is maintained or has to be raised when the engines are wanted. In other words, loss of fuel is incurred owing to radiation and leakages from boilers and piping. Then, as a voyage proceeds, both internal and external surfaces of boilers become foul, and more fuel is burned to transmit heat through the plates to the water. Moreover, leakages arise, and there is a general falling-off in efficiency which demands an increasing consumption of fuel to maintain the supply of steam.

The efficiency of oil-engines is not affected by any of the above-mentioned features and is maintained throughout the longest voyage, while no standby losses occur, fuel only being used when the engines are running.

The stokehold staff who attend to the boilers in a steamship are not required in a motorship, hence a saving in wages can be effected in this direction, and for the class of vessels of 8,000-10,000 tons capacity this is equal to about 12 per cent of the total wages bill in favor of the motorship.

Cleaning and repairs cost less in a motorship owing to the absence of boilers and auxiliaries, while the numerous stuffing-boxes that need so much attention and frequent repacking in a steamship are almost entirely absent. There is a reduction in the machinery space, equal to an increase of about 10 per cent in the vessel's capacity for carrying additional cargo by measurement which can be taken advantage of when comparatively light-weight cargoes are carried.

All the maritime nations have greatly increased their shipbuilding capacity during the war, and in a few years we shall be faced with a glut of ships, when freights will come down, and only the most efficient types of cargo-carriers will be able to make a living. That the motorship is more economical than the steamship, few will deny after making themselves *au fait* with the facts; hence the former is certain to oust the latter when competition for freights becomes keen. This position is more fully appreciated abroad than in this country, although some progressive British shipowners are building motorships as fast as they can be obtained.

Summing up briefly the many advantages of motorships as compared with steamships may be stated as follows:

A saving of 66 per cent of the oil fuel used in steamships, a reduction of 12 per cent in wages and a 10 per cent increase in cargo capacity on the same dimensions as steamships.

Motor-Tankers "Seminole" and "Narragansett"

Performance of the "Narragansett"—Saving of $43,419.00 Per Voyage Compared with Oil-Fired Steam-Tanker—Frank Opinions of Her Owners.

IT is most regrettable that the leading American oil-companies have not taken a similar attitude towards the economical oil-burning Diesel-motorship as that of the Anglo-American Oil Co. (British subsidiary of the Standard Oil Co.) who have boldly expressed their belief in this power as given elsewhere in this issue of "Motorship." They have backed their beliefs by building the two sister 14,000 tons loaded displacement motor-tankers "Narragansett" and "Seminole," and the performances of the first of these ships to date have fully corroborated their faith in Diesel-propulsion both in economy and reliability as the figures presently given will conclusively prove.

The "Seminole" was launched during December last, while the sister motorship "Narragansett" has already made several visits to the States, having been placed in service on July 4, 1920. Compared with another ship owned by the Anglo-American Oil Companies but propelled by oil-fired steam engines, the m.s. "Narragansett" has shown a saving of £8,934 ($43,319.00 at normal exchange rates) per round-voyage in the fuel-bill alone, without taking into consideration her greater cargo-carrying capacity.

Based on available fuel-costs of the steam and Diesel ships in a round voyage from Liverpool to New Orleans and return, the figures are as follows and include consumptions of auxiliaries, heating, steering, etc., the motorship having a large donkey-boiler for working the auxiliaries:

Oil-fired steamship, 1,289 tons of fuel-oil at £10-7-6 per ton £13,373
M. S. "Narragansett" 386 tons of oil-fuel at £11-10-0 per ton £4,439

Actual saving effected in oil-fuel alone in one return voyage £8,934
or $43,419

The "Narragansett" burns 9¼ tons per day for the main Diesel-engines, and 2¾ tons for the boiler, compared with 36 tons of oil per day for the steamer, or 55 tons per day for a coal-burning tanker. The actual shaft horse-power hour consumption of the twin 1,250 b.h.p. Vickers engines of the m.s. "Narragansett" has worked out at 0.423 lb. although comparison figures often given by "opposition-interests" are quoted as being 0.55 lb. or 0.60 lb. per shaft h.p. hour.

In the case of the above motorship the total daily-consumption would be reduced by two tons were she equipped with Diesel-electric auxiliaries, and the exhaust-gases used towards generating steam for keeping heavy oil-cargoes in a liquid state.

Another point of interest is the question of speed. The oil-fired steamer is of slightly higher power. Over the same number of voyages the oil-fired steamer averaged 10.25 knots on 35 to 36 tons of oil per day, and the coal-burner averaged only 9.8 knots on 55 tons per day. The m.s. "Narragansett" average has been 10.08 knots on 12.09 tons of oil (including all auxiliaries) over a distance of 16,758 nautical-miles. Extracts from her log up to the middle of December last are herewith given. She will be back in the U. S. A. again before this article is in print, so will have another record to be added. The average shaft h.p. maintained at sea is 2,120 compared with her designed out-put of 2,500 b.h.p.

On one of her voyages the "Narragansett" had to make a trip from London to Manchester via Liverpool. She arrived at Liverpool early in the morning and entered the Ship Canal at Eastham Lock at 8.10 a. m., the passage from London being:

Distance .... 564 nautical-miles
Time .... 2 days, 1 hour, 32 minutes
Average speed .... 11.39 knots
Diesel-Engines .... 23.3 tons
Donkey-Boiler .... 6.5 tons
Fuel Consumed—

The ship was delayed at Eastham all day Friday as there were no tugs available, and she left for Manchester at 6.45 a. m. on the Saturday, arriving at the Oil Wharf at 4.39 p. m. The engines worked very well, and gave no trouble whatever. The following maneuvering orders were given from the bridge:

Port	*Starboard*
412	415
195 Starts	195 Starts
45 Reversals	58 Reversals

In view of the foregoing economies and reliable performances, we are not surprised that at the launch of their second sister motorship—the "Seminole" at Vickers shipyard, Mr. F. E. Powell, chairman of the Anglo-American Oil Company, in his speech made some startling remarks which should interest other American oil companies and shipowners. He said:

"I think we might call these motor-ships milestones in the progress of merchant shipbuilding and that there may be many more of these milestones to the credit of this great firm is the earnest hope of myself and my colleagues. We cannot speak too highly of the efficient and most satisfactory manner in which the work on these ships has been carried out. I may tell you that not only is the m.s. "Narragansett" being watched with the greatest interest by large shipowners on this side, but many of the important companies in America are following her movements with the keenest interest. We know that this means more than mere curiosity on their part.

"At a recent launching at which I was a guest at one of the large yards in Philadelphia it seemed to me a pity that the ship going off the ways was a coal-burning vessel. It seemed as if I was witnessing an anachronism. If there is any vessel that ought to be equipped with Vickers Diesel-type of propulsion, it ought to be a tank-vessel, so that where she takes cargo she takes fuel, and as the refineries cannot make the cargo without making the fuel, the thing links up and makes this type of vessel logically the proper type for tank-vessels given all the other conditions.

"As regards the remarks which your chairman made in quoting Lord Pirrie, I had the good fortune to cross with him recently from the other side and had several interviews on this very delicate subject of oil-fuel supply. If I understand his ideas correctly he takes the position that the use of oil-fuel under boilers in anything less than an ocean-liner or a tanker is something in the nature of sacrilege, because oil-fuel is more badly needed in other lines of men's endeavour."

"When you hear talk of the quantity of fuel and petrol available in the world, your minds revert to motor-car fuel because that is the fuel that all of us use in every-day life. Second to that comes Diesel-fuel for Diesel-engines. Fortunately the quantity of Diesel-fuel consumed on ships using that power is only about one-third of what they would require for burning fuel under boilers. I recently made an extensive trip through the oil-fields of America, and I feel confident in stating that so far as the supply of Diesel-fuel coming from the United States is concerned, it is the country which stands foremost, and we are prepared to do what is necessary to guarantee that the supply will be forthcoming."

Following Mr. Powell's speech Mr. James Hamilton (vice-chairman of the Anglo-American Oil Co.) remarked that "his fellow-directors and himself had watched with considerable interest the very successful achievement of the sister motorship to the vessel whose launch they had witnessed. The splendid results achieved by the "Narragansett" were in themselves a surety of the success of her sister, the "Seminole."

"On her last voyage from the States the 'Narragansett' was scheduled to discharge a portion of her cargo at Thames Haven and he took the opportunity of paying a visit to the ship with the object of making personal inquiry as to her behaviour on what had been a very stormy voyage. The ship, he was pleased to say, was in splendid condition, and he was greatly impressed by the cleanliness and good order of the engine-room. He took the opportunity of asking members of the they had experienced, and the replies he received were that no trouble had been experienced and he gathered they were rather sorry on this account, as they would have welcomed a diversion just to relieve the monotony of the voyage."

In every way the "Narragansett" has come up to the highest expectations of her builders and owners alike, and has justified the confidence in heavy-oil engines for marine propulsion. The following advantages are possessed by her over similar vessels fitted with steam-driven machinery, viz—

1. Increased cargo-capacity.
2. Much lower fuel-consumption and fuel cost.
3. No standby losses due to main-boilers having to be alight.
4. Reduced staff, no firemen or trimmers being required.
5. Less cost of upkeep; no main boilers to clean or repair.
6. Less danger to life.
7. Full power can be developed almost immediately either ahead or astern.
8. Less liability of total breakdown. A single-cylinder of the oil-engine may be put out of action without stopping the engine.

LOG OF MOTOR TANKER "NARRAGANSETT"

From / To	New Orleans / Liverpool	Barrow / New York	New York / London	Liverpool / *New York	New York / Liverpool
Date From	4–7–20	25–9–20	16–10–20	16–11–20	4–12–20
To	22–7–20	9–10–20	30–10–20	30–11–20	17–12–20
Distance—Nautical Miles	4,528	3,013	3,204	2,985	3,028
Running Time, (hours)	402	325½	313	317	289
Average Actual Speed (knots)	11.1	9.25	10.2	9.41	10.48
Mean Revolutions of Engines	118	111.	117.3	114.4	117.9
Engine-Fuel Used per day, (tons)	9.61	9.36	10.51	9.23	10.76
Boiler-Fuel used per day, (tons)	2.13	2.16	1.71	2.95	2.03
Total Fuel-Consumption per day, (tons)	11.74	11.52	12.22	12.18	12.79

9. No falling off in economy. The results obtained on trial can be relied upon, or even better. Whereas with steam-machinery, boilers may become fouled inside and out, glands, joints and piston-rings become leaky which decreases the efficiency of the steam plant.

10. The first cost may be higher, but the oil-engines are of much higher grade than the ordinary steam-plant, resulting in more satisfactory running and decreased depreciation.

11. Fuel is easily carried in an oil-engined ship and the bunkering process is simplicity itself, occupyng a very short time and with no "dust."

Vickers Ltd. have had twenty years' experience in building marine internal-combustion engines, and the following is a short resume of the performances of merchant and naval ships equipped with the Vickers Diesel-engines, viz—

(1) "Circeshell." After 14,000 miles the engines were opened-out and found to be in excellent condition.

(2) "Medway." On maiden voyage from Hong Kong to Balik Papan average speed was 9.5 knots.

(3) "Oweenee." From Clyde to Port Said averaged 9.88 knots for 14 days with a daily consumption of 4½ tons of oil-fuel. This ship has now covered about 17,000 miles without any stop at sea or delay in port.

(4) "Marinula." An oil-tanker of 9,916 tons d.w. with s.h.p. of 2,500. In Admiralty service in Persian Gulf during the war. She was bought by the Anglo-Saxon Petroleum Co. in 1919, and refitted last July for a single trip pending alterations to suit her new owners, but has been running for the last four months in the Gulf of Mexico without any main-engine trouble.

(5) "Trefoil." Oil-tanker of 2,390 tons d.w., 1,500 s.h.p. In service for 18 months without opening any cylinder, and refit only eventually required owing to breakdown of steam-plant. This ship was constantly in attendance on the British fleet during the war.

(6) "Marshall Soult." This ship did strenuous work off the Belgian coast during the war and every call on the engines was answered. Her performances were considered remarkable and she is now a training ship for oil-engineers for the British fleet. She is of 1,600 shaft h.p.

Up-to-date, Messrs. Vickers Limited and their licensees have manufactured internal-combustion engines, fitted with their patent system of mechanical spraying, to a total of 500,000 b.h.p., the diameters of cylinders ranging from 10¾ in. to 30 in. As almost the whole of these engines have been supplied to the orders of the British Government, by whom the makers until recently were required to observe the strictest secrecy.

Before concluding this article we will give a few of the remarks made by Sir James McKechnie at the launching of the m.s. "Seminole," because he condemns the burning of oil-fuel under ships' boilers. Sir James said:

"It is almost unnecessary to point out that the maximum efficiency of liquid-fuel is only obtainable by utilizing it in internal-combustion engines, and in view of the opinion on the world's oil position recently expressed by Lord Pirrie it has momentary importance, which consumers generally, and shipowners in particular, will be unwise altogether to ignore. Lord Pirrie advises shipowners to go slowly in the fitting of their steamships with oil-burning apparatus, because he fears that, as matters stand, there is grave danger of an oil shortage. I agree with him that in these circumstances shipowners, who are of a mind to convert their *steam*ships to oil-burning, or fit new *steam*ships for oil-burning, will be better in their own interests to go slowly."

"But to my mind, a far more important consideration is that to burn oil under steam-boilers is not only wasteful but wrong in principle. We claim that from the remarkably successful sea performances of the m.s. "Narragansett" she has in every way in service come up to the highest expectations of her owners and builders, and has fully justified Barrow's confidence in heavy-oil-engines for marine propulsion.

"There is no misinterpreting the significance. The heavy-oil engine is bound, sooner or later, to play a large part in the expansion of the ocean-borne trade of the world. The Anglo-American Oil Company are therefore to be congratulated upon their public policy in adopting this most economical type of engine. They will doubtless reap a good reward in the decreased running cost of their ships."

In conclusion we will point out that the opinions of the Anglo-American Oil Company are also evidently borne by the British oil-company Tankers Ltd. as Vickers Ltd. are building four sister Diesel motor-tankers for this concern, and all will be duplicates of the "Narragansett" and "Seminole." Their yard numbers are 580, 581, 582 and 583. All six vessels are built on the Isherwood constructional system to Lloyds 100 A1 and their Diesel-engines are of the solid-injectiou type.

It is to be hoped that some of the principle oil-companies in the United States will follow the excellent lead set by these British-American oil companies—not overlooking the brilliant motorship development work of the Anglo-Saxon Petroleum Co.—and that they will co-operate more generously with "Motorship" in its work than they have done in the past.

Semi-Submerged Diesel-Driven Battle-Monitors

Noted Italian Engineer Advocates New Type of Vessel as Warship of the Future

DOUBTLESS inspired by the success of the British Diesel-driven M-class submarines with 12 in. guns, Nabor Soliani, a well-known Italian engineer, recently outlined a new class of motor-warship before the Italian Society of Naval Architects at Genoa. Unfortunately pressure on space has prevented our dealing with his paper prior to this. He outlined four classes of large high-powered Diesel-driven semi-submerged battle-monitors and one with turbines varying from 21,600 tons displacement, 24,000 H.P., 16.5 knots speed, to 22,600 tons displacement, 18,500 H.P., and 20 knots speed.

We give an illustration of what Signor Soliani's terms Type 3A, a vessel of 21,600 ton displacement, by 95 ft. breadth, 33 ft. depth and 29 ft., 9 in. normal draught. In this vessel it is intended to fit twelve-cylinder Diesel engines driving quadruple screws, and apparently on each shaft there is a four-cylinder Diesel-engine driving high and low stage air-compressors, although why these should be on the same shafting as the main engines is not clear. The total power is 24,000 B.H.P. or 500 B.H.P. per cylinder, which to many may seem like a wild dream; but, now being constructed in Europe for the Japanese Navy are a number of submarine Diesel-engines of 4,000 B.H.P. in eight cylinders. Six of them would produce the desired horse-power with 48 cylinders, or the same cylinder out-put as the engines in Signor Soliani's battle monitors.

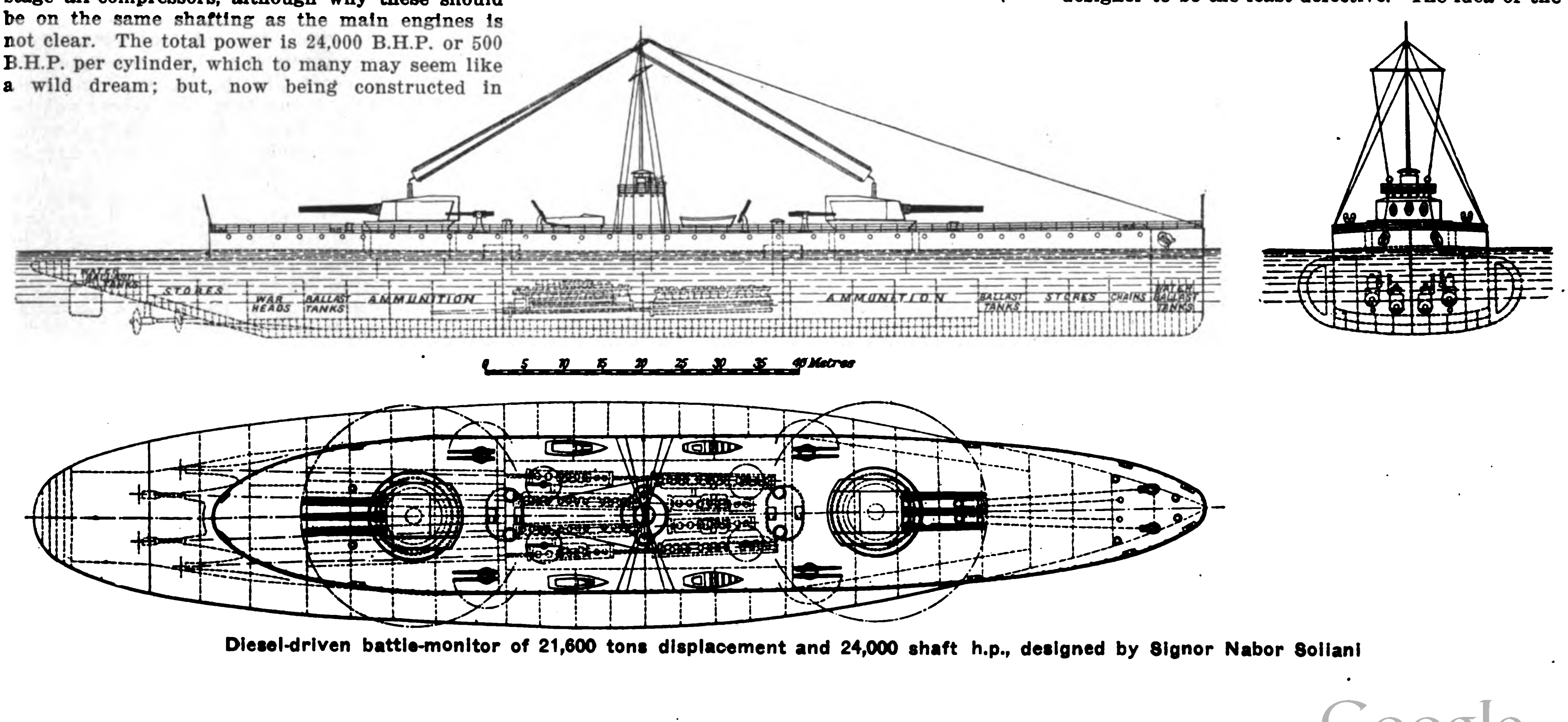
The main armament consists of six 381 mm. guns and eight 120 mm. guns in two triple-turrets. Two 102 mm. anti-aircraft guns are also carried. He has excluded torpedo-tubes as being inefficacious with larger ships. The main protection consists of a 15 in. belt.

The designer has endeavored to get over this in the type 3A by means of upper-works above the water, provided with cork filling, by which the reserve is sensibly increased. This superstructure, which he terms "a raft," even if it were completely destroyed, would not materially effect the stability of the vessel, as there would still remain a positive stability of weights. It has besides the following advantages:

1. It sensibly increases the reserve-buoyancy.
2. It renders the ship more habitable.
3. It increases protection against aerial attack.
4. It allows using the guns even in a rough sea.

The reserve of buoyancy, which in the type 3B having no upper works is hardly 900 tons, increases in the type 3A with 120 tons of cork to 1,500 tons, and this could be further increased by increasing the cork filling, which in the type 3A has only a volume of 600 cub. m. and occupies only the eighth part of the upper works. The latter, of course, are divided into watertight compartments to increase the buoyancy of the ship independently of the cork.

All points considered the type 3A appears to the designer to be the least defective. The idea of the



Diesel-driven battle-monitor of 21,600 tons displacement and 24,000 shaft h.p., designed by Signor Nabor Soliani

New German Motorship "Lisa"

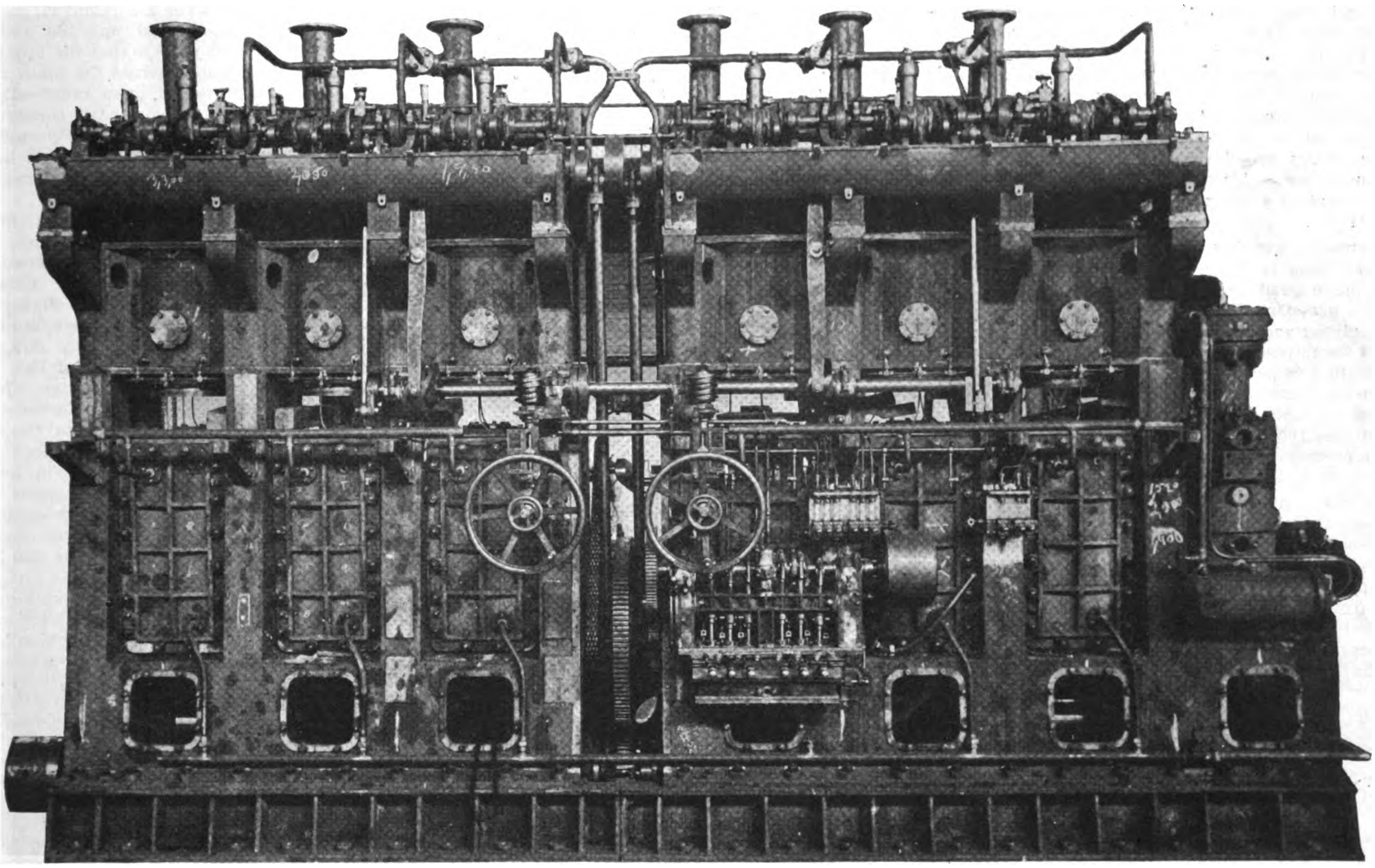
A Fourteen-Hundred Tons D.W.C. Vessel Propelled by Holeby-Diesel Engines Runs Trials

WHEN our Motorship Year-Book is published we believe our readers will be surprised at the large number of motorships now under construction in Europe and in the U. S. A., especially in Germany where rapid strides are now being made. This Year-Book's biggest feature will be a complete list of every motorship of note in service and under construction, with dimensions, etc., will be included.

Speaking of new German craft, a small motorship—the "Lisa" has recently carried-out sea-trials, the same being run in the firth of Flensburg, on Jan. 11th last. She was originally laid-down as a steamship, but during construction her owners wisely decided to install a Diesel-engine instead of steam-engines and boilers. This vessel has the following dimenions:

Deadweight Capacity	1,400 tons
Power	500 Ind. H.P. (350 shaft h.p.)
Engine-Speed	230 R.P.M.
Propeller	2,080 mm. dia.
Pr. Shaft diameter	175 mm.
Crankshaft Diameter	195 mm.
Length B.P.	72 m. 6 mm.
Breadth O. F.	8 m. 49 mm.
Depth	5 m.
Fuel-capacity	90 tons

The main Diesel-engine was built by the Holeby Engine Works, Aarhus, Denmark, and is of 500 i.h.p. and is similar in design to the larger Holeby engines of the tanker "Mexico" described in our issue of January last and illustrated in our issue of March, 1920. For auxiliary purposes there is a twin-cylinder 30 b.h.p. Diesel-engine driving a spare air-compressor, through a friction-clutch, also a bilge-pump by means of a belt drive. On tests in the factory the main engine showed a fuel-consumption of 72 kg. per hour.



Holeby 500 i.h.p. (350 shaft h.p.) reversible, four-cycle Diesel engine of the motorship "Lisa." It is the lowest-powered crosshead-type merchant marine Diesel-engine built. The method of actuating the cam-shaft is similar to the well-known Werkspoor system of long pull-rods and cranks

Shipping Board's Duty to Convert Steamers to Diesel Power

Extract from Frank C. Munson's Speech at National Marine League Banquet—President, Munson Steamship Line, New York

"AMERICAN shipowners have among their first considerations the necessity for placing themselves always in competition with the other steamship operators throughout the world. They must follow the market; their tonnage cost must be low; they must take whatever rates are necessary, both as to freight and passengers in order to maintain their position and prevent the competitor taking their business.

"The U. S. Shipping Board has been and is faced with the same problem, but during the first eighteen months after the Armistice there was a high-freight market as an aftermath of the war, and so the Government was able to make a profit, even with inefficient operators and ships running in the majority of cases with part cargoes. This entire situation has changed in the last six months, due to the law of supply and demand, and the fact that Europe in its distressed condition cannot buy our products as she did before the war. The rates of freight are down today to a very low basis, barely covering the operating cost in a great number of trades.

"All of us agree that the Government-owned property should pass into the hands of private interests as speedily as possible. Immediate action is necessary on this matter, because the only government operating ships today is the U. S. Government, and so long as the Government continues to be an owner it is interfering with the operations of privately-owned lines and with the shipbuilding industry. Owners are afraid to place orders for new ships because they do not know what the sales-policy of the Shipping Board will be. The delay therefore is causing a serious prejudice to two of the great industries of the United States and its influence is felt among the basic industries, such as the production of steel.

"During the war all of the ships of 7,000 tons and under were constructed with larger engines and boilers to drive them through the water than would ordinarily have been considered practical, but this was done in order to drive them through the water and get them away from the submarines. These ships are high consumers of fuel and, in my judgment, they must be modernized before they will be readily marketable.

"It is the duty of the Shipping Board to change the reciprocating type of engines and the water-tube boilers and put in Diesel motor, or Diesel-electric drive, or other modern and economical type of propulsion. The American operator cannot hope to compete with the foreign operators with the fuel-consumption and the loss of cargo space taken by the engines in these ships if they are handicapped in this way.

"We are a great producing country. We have proven beyond peradventure our ability to manufacture, for example, motor-cars in competition with all the manufacturers of the world. If we could arrive at such a wonderful stage in the motor development, it is certainly possible that American initiative, brains and inventive genius may, with proper encouragement and stimulation, arrive at a more remarkable stage in ship and Diesel-engine production."

First Details of New Burmeister and Wain Engine for Single-Screw Motorships

Long Stroke Diesel Motor with Piston Removable From Below.

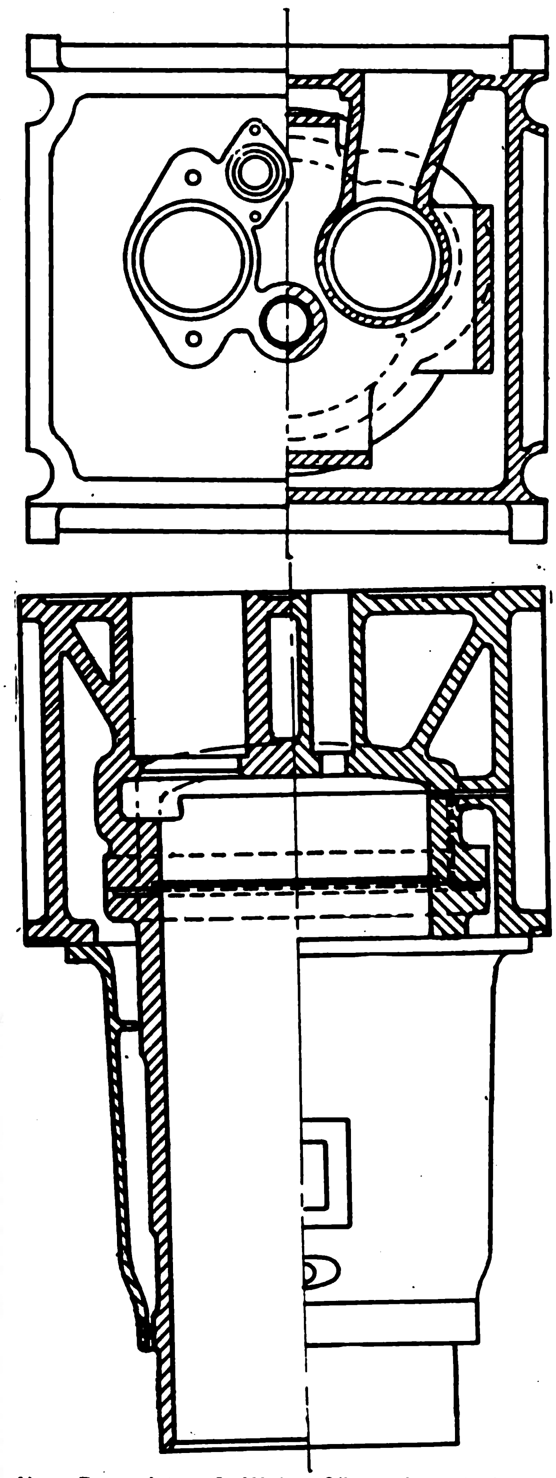
(Contributed)

SINCE the advent of the marine Diesel oil-engine, engineers and designers have endeavored to produce a motorship with a single propeller, particularly in the case of vessels of about 4,000 tons d.w.c. In a vessel of this size the height between the tank top and the deck does not permit the installation of twin slow-speed engines and for the power of the engines to be sufficient they must be of the high-speed type, in which case the propeller-efficiency is considerably lowered. Twin motors also leave insufficient room at the sides for auxiliary motors, compressors, etc.

Several years ago shipbuilding companies installed single four-cycle motors in ships, but the type was not suited to the purpose, being rather high in speed for driving a single propeller. Recently another English company brought forth an opposed-piston solid-injection motor for single installations in motorships. Busch-Sulzer and Sulzer Freres are developing a two-cycle motor for single propeller installations, and stand a good chance of putting out a machine adapted for this service.

A company working on this problem along very sensible lines is Burmeister and Wain, who already have produced a four-cycle Diesel engine for this purpose. The R.P.M. have been lowered to 90, giving good propeller-efficiency. This motor differs considerably from the standard Burmeister and Wain design for about the same power. The dimensions are I.H.P. 1750; cylinder diameter 630 mm.; (24.803 in.) stroke 1300 mm.; (51.181 in.) revolutions 100; length from aft coupling to front of compressor 10,500 mm.; height from center of crankshaft to top of valves 6600 mm.

The most interesting features of this new engine are the cylinder head and liner. The heads are nearly square and are supported by distance pieces which stand on the "A" frames. The heads are bolted together, three and three. Long bolts pass from the main frame, thro the "A" frames and distance pieces, and between the heads, each nut pressing down on two heads. The long bolts also have nuts at the top of the "A" frames. The



New Burmeister & Wain—Götaverken design of cylinder and cylinder head of their long-stroke Diesel-engine for single-screw motorships

liners are bolted directly to the head, without any packing, iron to iron. Outside the liner, bolted to the head with a gasket is the water-jacket, which packs off against the liner near the lower end with a rubber ring. This allows the liner perfect freedom to expand. The inner shell of the cylinder-head is well braced by four stays. The cooling-water enters at the lower end of the jacket and most of it is made to pass into the cylinder-head at the opposite side by a baffle-ring inside the jacket. The water space in the head is very large, insuring effective cooling around all valves.

The construction may be criticized by some engineers because the piston must be removed downward for inspection. In the ship it requires too much work to take it out through the top. In order that the removal of the piston downward may not be too complicated, it has been made oil-cooled instead of water-cooled. The construction of the piston as well as its oil-cooled feature seems to be the controversial feature of the design of the engine.

To remove the piston, it is brought almost to top center, the crosshead shoe is blocked-up, the crosshead bearings taken apart, and the connecting-rod lowered by turning the crank almost to bottom center while lowering the upper end of the connecting-rod with a chain hoist, so that it rests on the outboard side of the main frame. The outlet and inlet valves are removed, eyebolts screwed into the piston head, and the piston is lowered through the top plate so that the cross-head pin rests on beams placed across the main frame. It can then be inspected or even removed. The top plate differs from the ordinary construction in that it has a hole large enough to permit passage of the piston, this hole being closed by two semi-circular plates, which contain a scrape-ring for the piston rod.

The frame for the gear-train stands in the center but is separate from the "A" frames. The three fore and the three aft cylinder heads are bolted together with horizontal bolts. This construction allows the engine to weave slightly, too great rigidity having been found detrimental.

The main frame and "A" frame are largely of "I" section. The air-compressor is of the latest Burmeister and Wain three-stage design, directly connected to the crank-shaft at its forward end, having its own base frame bolted to the main frame, though its "A" frame and cylinders stand free. Other parts of the motor are in general Burmeister and Wain standard, with such small refinements as experience has made desirable.

A motorship with this engine has three auxiliary Diesel motors. Two are of Burmeister and Wain standard type of 75 b.h.p. at 325 r.p.m. The third is a single-cylinder four-cycle engine, cylinder diameter 310 mm., stroke 350 mm., r.p.m. 400 and of 50 b.h.p. This has its head and liner of the same general design as the large motor, though the head and liner are cast integral which feature, while not new, has for the first time been adopted with B. & W. engines. The maneuvering air-compressor has three stages, and in case the main engine compressor fails, can supply sufficient spray air to operate the main engine.

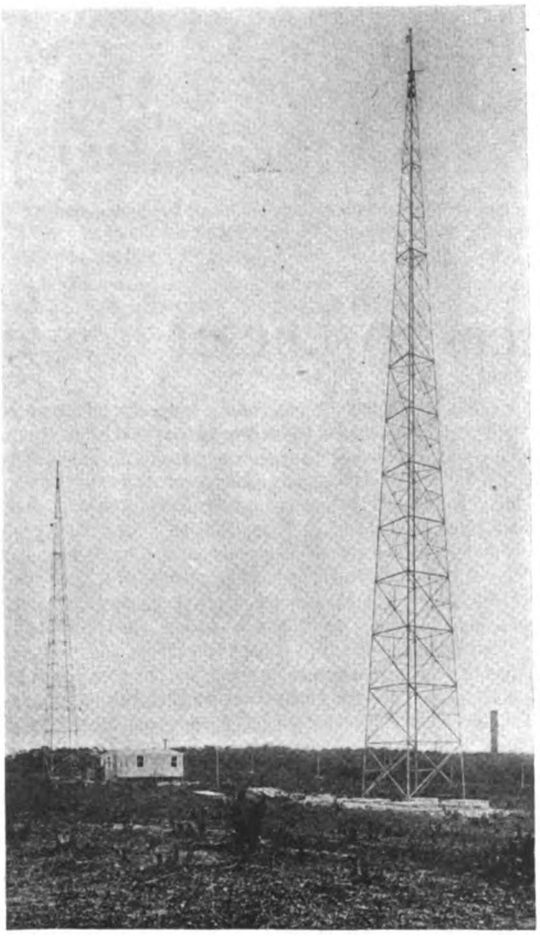
In this engine and auxiliaries the Burmeister and Wain Company has brought forth a four-cycle single-screw motorship installation which is well in keeping with its former standard of excellence. This new design is being followed by the Götaverken for several single-screw freighters for which they are building engines.

EASTHAMPTON MARINE RADIO STATION

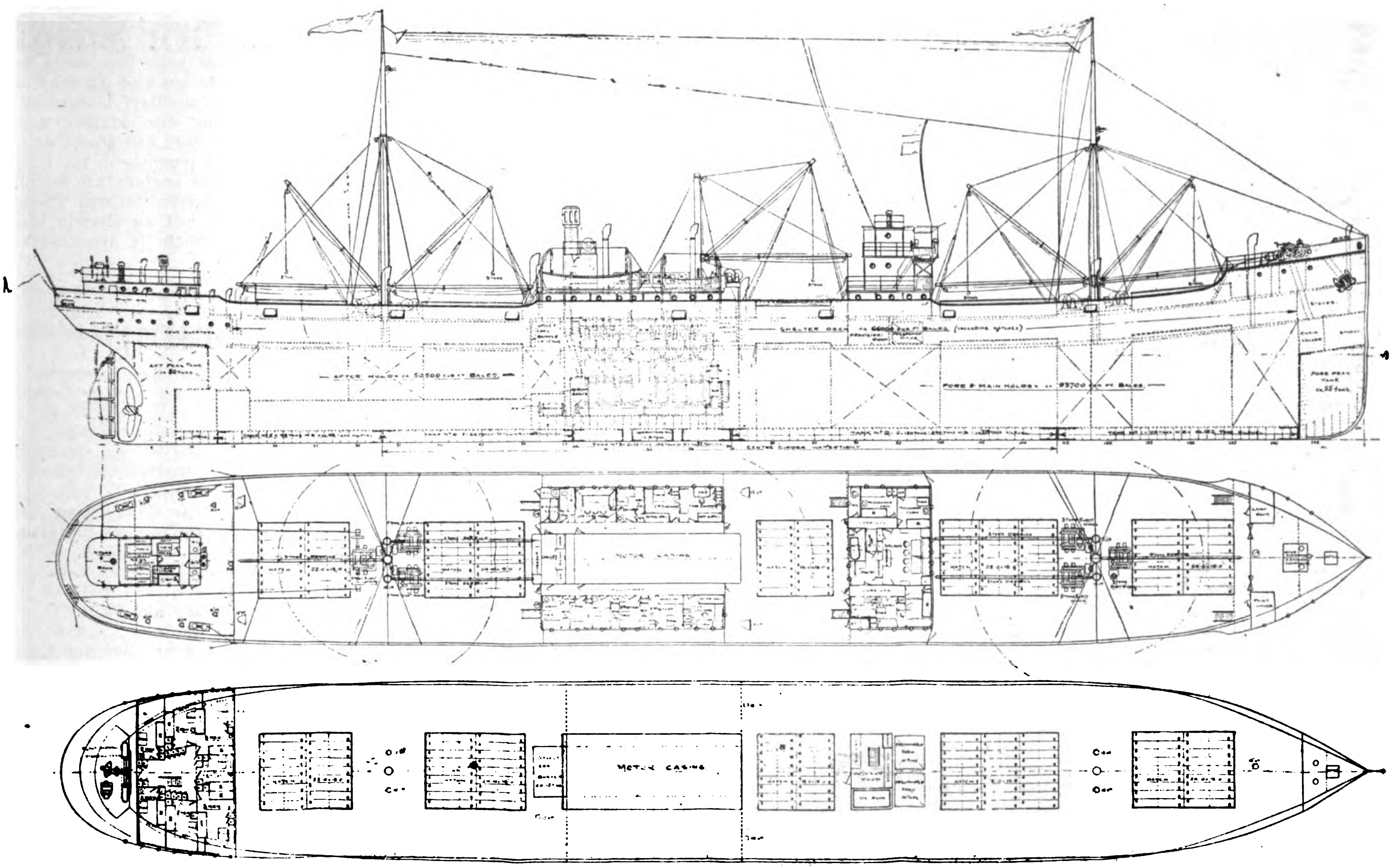
Telephone conversations half-way around the world, the navigation of ships, the direction of the movement of airplanes from a central station, the communication with submerged submarines—all by means of Radio, presages wonderful achievements yet to come.

Alive to the practical needs the Cutting and Washington Radio Corporation recently opened up a new commercial Radio Coastal Station at Easthampton, Long Island. The location of this station was the first important consideration for the Company's engineers and Easthampton was decided upon only after most careful study of the necessities of ships entering and leaving New York. The location of the Radio Station is on one of the highest knolls in the town about one mile from the shore. It occupies a plot of ground some six acres in extent. The two galvanized steel towers are three-hundred feet apart and are one-hundred and sixty-five feet high surmounted with wooden masts which bring the total height of the antenna to one-hundred and seventy-five feet above the heavy concrete foundations.

The station is the most complete and thoroughly equipped station of its kind in the country and will no doubt for some time to come occupy a leading position among commercial coastal radio stations.



Cutting & Washington Wireless station at East Hampton, L. I.



Single-screw motorship of 3,015 tons gross for Svenborg Steamship Co., now building at the Odense Shipyard. She is equipped with the new long-stroke Burmeister & Wain Diesel-engine described elsewhere in this issue

Motorships for Svenborg Steamship Co. and for Fred Olsen

Single-Screw Diesel-Ship of 3,015 Tons Gross With New Burmeister & Wain Slow-Speed Long-Stroke Engine—Also Two Small Motorships Building at Odense Shipyard with Trunk-Piston Engines

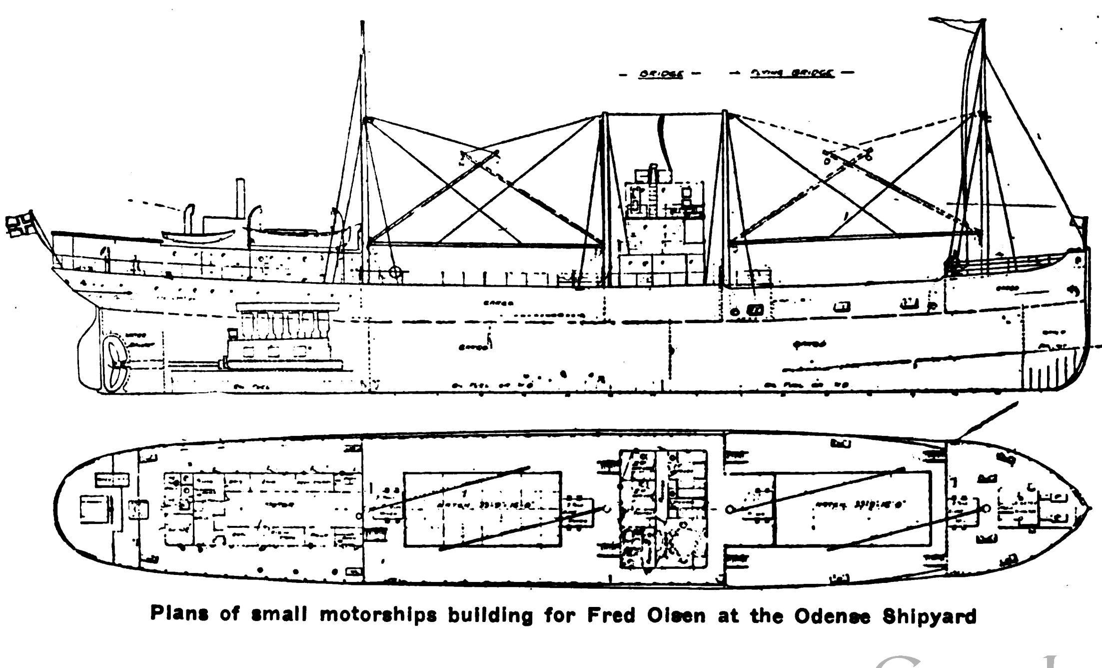
In addition to numerous new large motorships building at other shipyards Fred Olsen the well-known Norwegian shipowner has two small twin-screw motorships under construction at the Odense shipyard, as stated in our January issue (page 31) in which the new trunk-piston type Burmeister & Wain Diesel-engine similar to that in the "Fritzoe" is being installed. At the same shipyard another interesting Diesel ship is being built, but to the order of the Svenborg Steamship Company. A new type of Burmeister & Wain engine is being installed in this vessel too—namely the long-stroke slow-speed motor specially designed for single-screw vessels, particularly for converting existing steamers to internal-combustion power. It was built at Copenhagen. Reference has previously been made to this design in our columns and drawings and details of the engine are given elsewhere in this issue. The vessel has the following dimensions:

Dead-weight capacity	about 4,500 tons
Gross Tonnage	3,015 tons
Net Tonnage	1,800 tons
Length O. A.	315 ft., 3 in.
Length B. P.	301 ft.
Breadth Md.	44 ft.
Depth to S. D.	28 ft., 11 in.
Depth to U. D.	21 ft., 11 in.
Draught	22 ft.
Cubic-Capacity (Bales)	210,000 ft.
Cubic-Capacity (Grain)	230,000 ft.
Fuel-Capacity	580 tons
Water Ballast (d. b. & P. t.)	771 tons
Power	1,500 i.h.p.
Engine & Propeller Speed	85 R.P.M.
Bore & Stroke	24.803 in., 51.181 in.
Ship's Speed (Loaded)	10 knots
Propeller	Four Blades, Solid Manganese-Bronze
Registry	British Lloyds 100 A1

For auxiliary machinery power there are three four-cycle twin-cylinder B. & W. Diesel engines, 11.60 in. bore by 13.77 in. stroke, each direct-connected to an electric-generator. Two sets are used in port, one being a stand-by. There is an oil-fired donkey-boiler for steam heating the ship. In the engine-room the day fuel-tanks contain sufficient oil for 12 hrs. running.

Midships on the shelter-deck there is a deckhouse, with saloon, two passenger-cabins, hospital, cabins for steward and pilot, and a pantry, bath, etc. Above on the bridge-deck is a deckhouse with cabins for the captain and the wireless-operator, and above again the charthouse with navigation-room and the wireless-room, is on the flying-bridge. On the side of the engine-casing the accommodation of the deck and engine officers are to be found, as well as their mess and the cabins for the cook and the boys and pantry and bath. Below the shelter-deck aft the accommodation for the crew is arranged with cabins for two and three men. Above the shelterdeck is a deckhouse with a mess for the men and a mess for the engineers, bath and entry to the cabins.

The vessel is fitted with two masts with out-



Plans of small motorships building for Fred Olsen at the Odense Shipyard

riggers and samsonpost, there being in all 7 derricks and 5 hatchways. Her deck machinery is electric, and comprises a windlass and seven 3-ton Thomas B. Thriges winches. The steering-gear is of the electric-hydraulic type. Electric-light is fitted throughout.

The Two Small Motorships

Regarding the two small single-screw motorships just referred to as being building at the same yard to the order of Fred Olsen of Christiania, Norway, these will both have a dead-weight capacity of 1,350 tons and are being built to the Norwegian Veritas 1A1. Their dimensions are as follows:

Dead-weight-capacity	1,350 tons
Cubic-capacity (grain)	89,200 ft.
Cubic-capacity (bales)	75,500 ft.
Fuel-capacity	311½ tons
Power	900 i.h.p.
Engine Speed	130 R.P.M.
Ship's Speed	10 knots
Length O. A.	227 ft.
Length B. P.	215 ft.
Breadth Md.	34 ft., 6 in.
Depth to U. D.	15 ft.
Height of forecastle	7 ft., 6 in.
Draught	14 ft.
Gross Tonnage	950 tons

These vessels are rigged with two masts and two samson-posts and there are four derricks and two large hatches. All the auxiliary machinery is Diesel-electric, there being two single-cylinder Diesel-engines of the same bore and stroke as the three twin-cylinder B. & W. engines in the larger ship just described. These engines are coupled to generators and furnish current for four Thomas B. Thrige electric-winches and an electric steering-gear. One of the lifeboats is fitted with a motor.

Comparison of Steamship With Sister Motorship Now Building

Drawings Show Large Gain in Cargo Space in Favor of Diesel Propulsion—Both Single-Screw Vessels

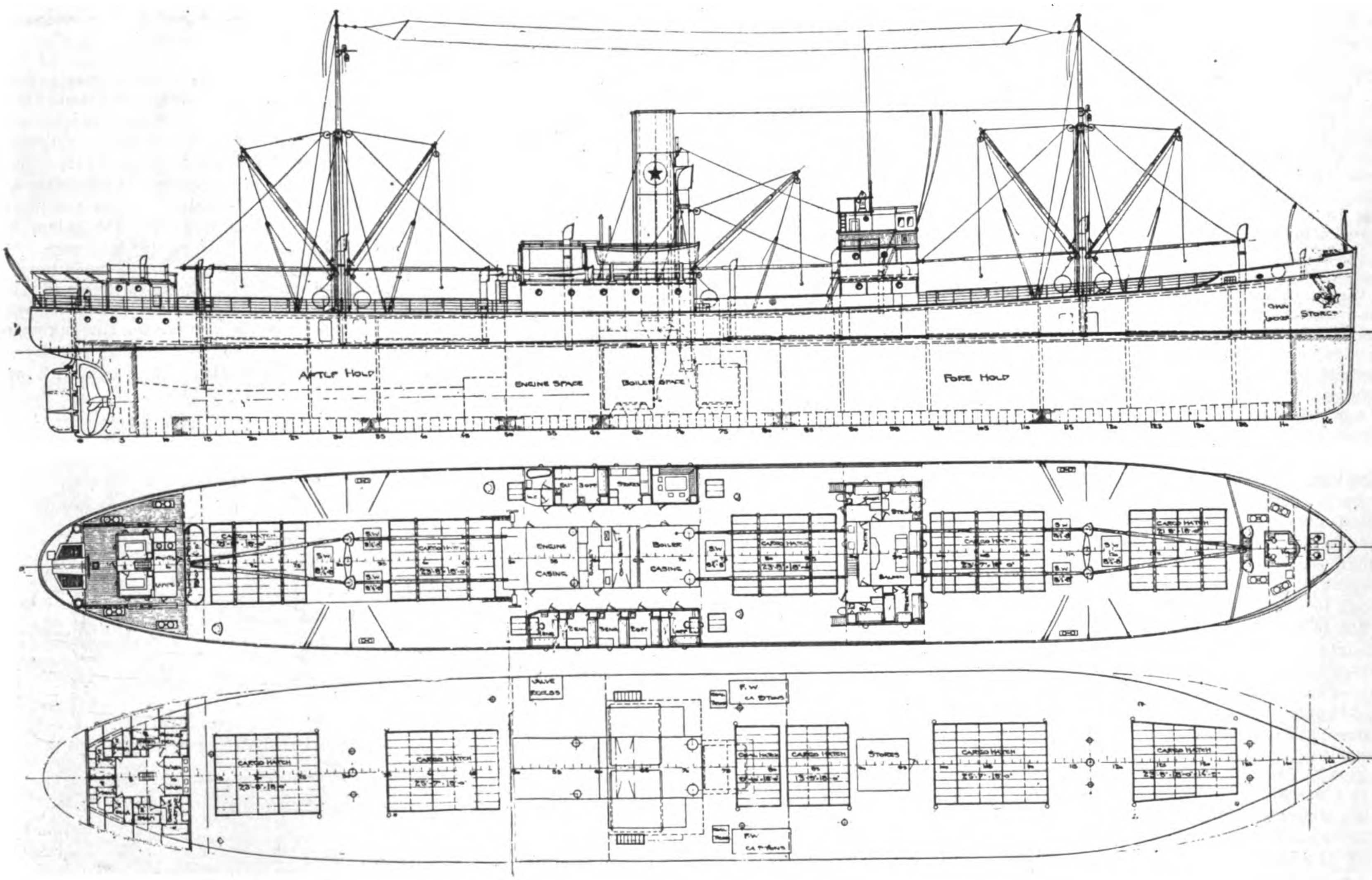
HITHERTO Swedish merchant-ship Diesel-engine builders have been limited to the Götaverken and the Atlas-Polar Works, but lately other shipyards have taken an active interest in motorships, this having been stimulated by their having had the hulls only to build, the motors having previously been supplied by other firms which, of course, has left their own boiler and steam-engine shops more or less slack, but has had the advantage of enabling them to personally see the savings in space and weight to be gained by utilizing internal-combustion power. Thus the motorships themselves have been good educational factors.

The Eriksbergs Mek Verkstads Aktiebolaget, of Göteborg, is one of the most recent comers into this new field, and now under construction at their shipyard is a new Diesel-engine machine-shop for building and repairs. Their new 15,000 tons d.w. floating-dock will be ready by the time this appears in print.

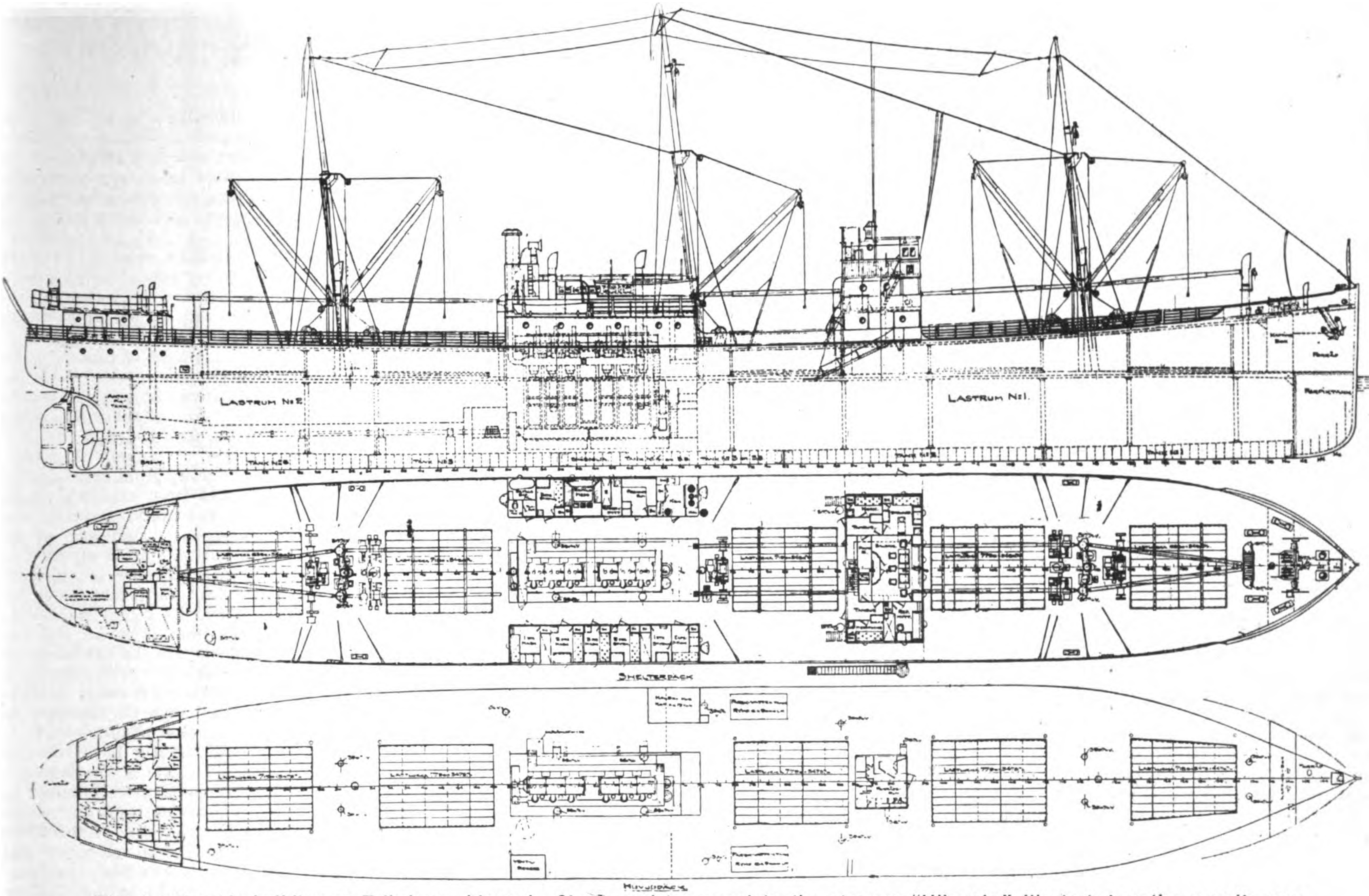
This firm is now building a single-screw motorship of their standard closed shelter-deck type, which design of hulls have previously been fitted with steam reciprocating-engines and boilers, whereas the new hull—which is for the Swedish Lloyd—will have a four-cycle Götaverken-built Burmeister & Wain Diesel engine of the slow-speed, long-stroke type. Later motorships will be Diesel-engined by themselves.

Through the courtesy of the Eriksberg Shipyard we are enabled to produce the drawings of this motorship and drawings of the steamship "Hibernia," also owned by the Swedish Lloyd and built by them, and it will be seen that the installation is heavily in favor of the Diesel power even though many of the motorships' detailed figures are not yet available. The following are some interesting comparisons between the two vessels:

	Swedish Lloyds S.S. "Hibernia"	Swedish Lloyds Motorship
Deadweight capacity	3,750 tons	3,750 tons
Net cargo-capacity on round trans-atlantic voyage	3,000 tons	3,425 tons
Length O. A.	302 ft. 10 in.	302 ft. 10 in.
Length B. P.	292 ft.	292 ft.
Breadth M. D.	43 ft.	43 ft.
Depth M. D.	19 ft.	19 ft.
Depth to S. D.	26 ft.	26 ft.
Draught	19 ft. 9¼ in.	....
Power (indicated)	1,300 h.p.	1,600 h.p.
Power (effective)	1,150 h.p.	1,200 h.p.
Engine's speed	———	95 r.p.m.
Ship's speed (loaded),	10½ knots	10½ knots
Cyl. bore and stroke,	22-7/16x35-7/16x58½x36 in.	6-25x51 in.
Daily fuel-consumption,	22 tons (coal)	5½ tons(oil)
Bunker capacity	605 tons	....
Fuel required on round transatlantic voyage (incl. port)	555 tons	185 tons
Cruising radius,	6,700 nau. miles	7,200 to 25,000 nau. miles



Steamship "Hibernia" built at the Eriksberg Yard for the Swedish Lloyd. She has the same overall dimensions as the motorship this yard (illustrated on next page) is now completing for the same shipowners. The great difference in the cargo capacity is worthy of special note



Diesel motorship building at Eriksburg shipyard. She is a sister vessel to the steamer "Hibernia," illustrated on the opposite page

Cubic cargo-capacity (grain)	186,430 ft.	200,000 ft. (about)
Cubic cargo-capacity (bales)	173,200 ft.	190,000 ft. (about)
Machinery space,	28 frame-spaces	22 frame-spaces
Length of machinery space	54 ft. 6 in.	42 ft. 6 in.

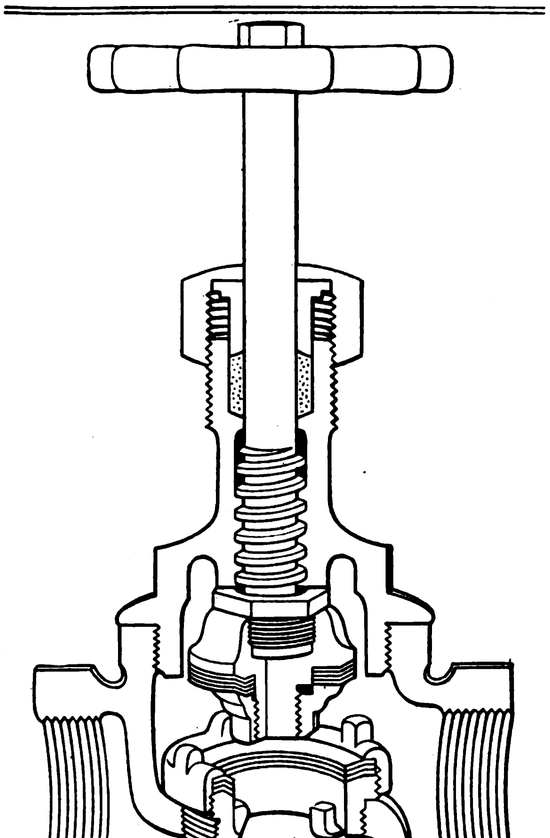
In the first place the engine-room of the new motorship is 42 ft. 6 in. long compared to the 54 ft. 6 in. length occupied by the steam-engines and boilers of the steamer "Hibernia," or 62 ft. 9 in. length if the latter's bunkers are taken into consideration, which they should be as the fuel of the motorship is carried in the double-bottoms. Here is a gain of a total of 20 ft. 3 in. of cargo space in the best part of the ship. Furthermore, this particular make of Diesel-engine is somewhat longer and heavier than many other equally well-known Diesel-engines, so the big saving in space here made is not an exception.

The motorship will only fuel at the United States end of the voyage, whereas the S.S. "Hibernia" has to coal at both ends, but the latter burns about 355 tons on the 3,600-mile run from Sweden to New York, assuming an average of about 16 days, and also will burn about 100 tons in port at each end.

On the other hand, the motorship will only require about 175 tons on the 7,200 naut. miles round-voyage, and will use less than ten tons of the fuel-oil during each two-week stay in port, so a total of 200 to 250 tons of oil in her double-bottom bunkers will be ample, unless she is desired to carry a larger amount from New York to Göteborg and sell the balance as cargo in Sweden.

If the S.S. "Hibernia" was oil-fired instead of coal-burning she would need a total of 725 to 800 tons of fuel in her bunkers for the round-voyage and two weeks' port-consumption at each end. So it will be seen that regardless of the class of fuel a steamship burns, the motorship has the benefit of a large gain in cargo-space and weight, without even counting the gain of at least 100 tons of fresh-water that a steamer of this size must carry for use in her boilers. Then, of course, there is the absence of firemen to be considered. Also, as no fires have to be drawn, etc., there is no drop in speed when one watch gets tired, or fluctuations with the change of watch, dirty tribes, and propeller racing in rough weather.

This new motorship for the Swedish Lloyd (Moore & McCormack, New York Agents) has accommodation for her officers in the housing amidships, except that the chief-engineer's cabin is placed in a separate house between the second and third hatches. The crew's space is aft. There are two holds and five large hatches. In the engine-room the auxiliary machinery consists of three Diesel-driven electric-generators furnishing current for the steering-gear, winches, windlass and one spare air-compressor. For heating purposes there is a small oil-fired donkey-boiler and this also provides steam for a small auxiliary air-compressor.



Section of the O'Malley Beare multi-plate valve

A MULTI-SEAT VALVE

Reference was made in our February issue to a valve of a special type which we consider very suitable for Diesel-engine and merchant-motorship installation work, and which we recently saw at the head-offices of the O'Malley Beare Valve Co., 80 East Jackson Boulevard, Chicago, Ill., U.S.A. As will be seen by the accompanying sketch, the valve has two series of multiplates of thin metal, one series on the valve-head and the other on the seat. These plates are detachable, so that as each becomes worn and pitted, it can quickly be detached, but a true seating remains. After all the plates are gone, and if no further supplies are available, there still remains the main head and seat both ground to a tight fit. These plates are made in different kinds of metal and of varying hardnesses in order to suit various classes of duties.

Removal of the plates is a simple process. This operation consists of unscrewing the bonnet from the valve-body, whereupon the disc-plates are made accessible by removing the disc-nut on the end of the valve-stem. The master seat in this valve being removable, is then unscrewed from the valve-body by inserting a special box-wrench between the lugs provided on the inner surface of the nut, unscrewing the retaining-ring from the master seat as one would a nut, after which the metal plates on the seat are made accessible by unscrewing the retaining-ring on the master seat. To provide for contingencies when the plates are gone, the master seat is properly shaped as just mentioned.

While we are without authority to make a definite statement, we believe that a specimen valve would be sent to any responsible engineering or shipbuilding firm communicating with Mr. G. A. McLean of the above company and referring to "Motorship."

Electricity Applied to Ship Auxiliaries

Extract from Paper Presented at the Joint Meeting of the N. Y. Section of the American Institute of Electrical Engineers and the Metropolitan Section of the American Society of Mechanical Engineers, New York

BY H. L. HIBBARD

THE advent of the fuel-oil engine-driven ship has marked a great stepping stone in the adoption of electric power, particularly for auxiliary purposes.

At the present time there are quite a number of oil-engine driven cargo-vessels with electrical auxiliaries and others with electric drive and electrical auxiliaries being constructed and projected in this country, and in the opinion of certain editorial writers, the outlook was never more favorable in this country, particularly for construction of oil-engine driven vessels, than at the present time. Motorships are now under construction for the American-Hawaiian S. S. Co., the U. S. Shipping Board, the Standard Oil Co., the Alaskan S. S. Co. and the Submarine Boat Corporation, and quite a number more are under contemplation for this year.

In the selection of the generating plant for the electrically-operated vessel, considerable thought is necessary as to the number and size of the units to be installed. A number for instance, of the Burmeister and Wain vessels have three 60-kw. machines, 230-volt; the English vessel *La Paz* has three 100-kw., 230-volt, the American tanker *Solitaire* has three 45 kw. and one 10-kw., 230-volt; the *Cubore* is provided with three 100 kw., 250-volt sets. The aim is in general to provide an equipment which is sufficiently flexible to permit of the operating of all auxiliaries and lights with one machine when cruising and to operate the vessels while handling cargo in port with two machines, or under possible extreme emergency conditions three machines, one machine being however in practically all cases considered as a spare. Much division of opinion exists, however, as to the wisdom of going to as many as three units, some claiming a preference for two units of larger size.

These installations have in general provided two wire d-c. system and such vessels as the *La Paz* and *Solitaire* have furnished lights at 230 volts. Generally satisfactory results are reported from the *Solitaire* for lamps of this high voltage with the exception of the small instrument lamps which are frequently broken. The officers of the *La Paz* reported frequent breakage and rather unsatisfactory results. A practise which has been followed by the Burmeister and Wain Co. and has found general favor amongst engineers in this country also, is the use of a small motor generator set for reducing the 230 volts of the generators to 110 or 115 volts for the lamps and providing this small machine with sufficient flywheel effect also to smooth out any pulsations from the auxiliary oil engines and fluctuation of voltage due to sudden changes of loads on the generators. 110 volt lamps are furthermore in addition to being mechanically stronger, more universally obtainable.

Direct Current versus Alternating. A few years ago a considerable controversy existed between engineers as to the advisability of the use of alternating and direct current on shipboard, and as previously outlined in 1916 to 1917 a number of vessels were constructed in this country, including vessels of the cargo and tanker type, which had a-c. equipment. It was contended by some at that time that direct current was impracticable particularly for tanker vessels, owing to the danger of igniting inflammable gasses by sparks moving from contacts, etc. We believe, however, that later developments have quite clearly disposed of these contentions and shown the wisdom of providing in general, for auxiliary equipments on shipboard, the d-c. system; and we understand that some of the vessels which were constructed in 1916 and 1917 with the a-c. outfits have not proved themselves nearly as satisfactory as d-c. installations. The direct current has a distinct and decided advantage in the flexibility and extent of speed control obtainable, and in the obtaining of speed and torque characteristics for hoisting apparatus such as deck winches, windlass and capstan, which can not be furnished by the a-c. motor. There is no advantage furthermore, on a vessel from the distribution stand-point, in the use of alternating transmission, and a 3 or 4-wire system is more expensive and complicated than the straight 2-wire d-c. distribution. We note that English authorities have recently appeared definitely in print to the above effect, recommending strongly also against the use of a voltage higher than 220 generally throughout the vessel.

With regard to tank vessels, it is possible to furnish motors entirely enclosed, gas and watertight, and where location renders the same desirable, to furnish forced ventilation through the enclosed motor cases. The experience of the Diesel tanker *Solitaire*, which was thus equipped, has been to date very satisfactory and two tankers, the *Watson* and *Hillman*, are being constructed with d-c. equipments on the Pacific Coast for the Standard Oil Co.

Various types of electrical apparatus, generators, motors and controllers are required for the electrical auxiliaries on board ship, according to their location, duty and general requirements, which are discussed in some detail.

For motorships oil-engine sets are naturally employed with generator mounted on a common bedplate and the fly wheel of suitable proportions to assist the regulation and smooth out the voltage fluctuations.

These sets are now in all cases furnished with open-type generators, but in many instances are protected by hoods or metal shields from drippings due to moisture condensation and throwing of oil.

Motors. For driving the various auxiliaries, motors of the open, ventilated or enclosed watertight type are employed, especially the two latter types as but few installations justify the use of entirely open motors.

For deck auxiliaries such as windlass and deck winches, entirely enclosed watertight motors are essential which must be made rugged and sufficiently watertight to withstand such submergence as is occasioned by heavy seas coming over the vessels. This condition therefore, practically necessitates the use of stuffing boxes or similar means around the motor shaft to exclude water and particular attention paid to the design of bearings to insure proper lubrication and operation under roll of the ship.

Some electric motors are provided with ball-bearings, which are coming into considerable favor for shipboard use to meet the particular conditions.

The operation of engine-room auxiliaries, such as pumps, compressors, etc., open or entirely enclosed watertight motors are occasionally employed but the ventilated type of motor finds particular favor for this purpose as it provides protection against drippings and at the same time permits the use of smaller motor frames for the same duty than when absolutely water-tight.

Controllers. As in the case of motors, several types of controllers are utilized, according to the installation conditions and duty to be performed. These consist of the panel, drum or contactor type, either open, enclosed non-watertight, or watertight.

For the operation of certain of the auxiliaries where watertight construction is not considered necessary but where it is desired to prevent unauthorized manipulation and render the controller drip-proof, a manually-operated panel with hinged doors provided with lock and key is employed, which shows a manually-operated starter and speed-regulator, especially suitable for the control of small motors.

Where watertight or gastight protection is desired, a manually-operated watertight panel type controller is frequently utilized. The motor starter and speed regulator is operated by control levers extending through stuffing-boxes in the front cover. Gum rubber gaskets with clamping devices are furnished to insure watertightness.

Particularly where installations are in somewhat inaccessible positions, automatic controllers operated by push-buttons now find great favor, as the buttons can be located in a very convenient location, and furthermore, the operation of starting the motor is automatic and taken out of the hands of the operator.

For deck machinery, such as winches, windlass, capstan, etc., a manually operated watertight drum is frequently employed which, owing to its watertight construction, can be mounted at the auxiliary above decks.

Centralized Control. A method of control of the auxiliaries, particularly on tank vessels, which has found favor in some quarters, mounts the control apparatus, except for the deck winches and windlass, all on a centralized control board in the main engine room. In the case of tankers this takes the controlling apparatus away from cargo-pumps, etc., where there is danger from explosive gases. With this arrangement automatic starting controllers are provided for each auxiliary at the board and with a push button station at the auxiliary, for signaling to the engineer to start the apparatus, and for stopping the apparatus at the auxiliary if desired. When the signal is received the operator at the switchboard closes the line switches or circuit breakers and the equipment is automatically started. Such an arrangement is installed on the motor-tanker *Solitaire*, and reports from officials of the Texas Co. indicate entire satisfaction with the arrangement.

In all shipboard work reliability is of the first importance and electrical apparatus for ship auxiliaries must be ruggedly constructed, yet at the same time need not be clumsy as we are frequently led to feel is the case with many of the European designs. Furthermore, each piece of electrical apparatus should be particularly designed for the service and conditions to be met. These conditions need to be carefully *studied* and too great emphasis cannot be laid on this point, as it is at the root of the successful operation of electrical machinery. Motors on deck will in many cases frequently be awash and hit by heavy seas, also, when the crew is washing down the deck the hose will often play over the motors. Vessels trading in tropical climates will have deck machinery subject to the excessive heat of the tropical sun and all vessels on northern routes have their deck motors at times subjected to very low temperatures. In the engine room leaky steam-pipes are a danger to the motors, and where Diesel engines are employed for the propelling machinery, thought should be given to the protection of motors and controllers from oil fumes and drippings.

(*To be continued in our April issue*)

LAUNCH OF 13,500 TONS D.W. MOTORSHIP "JAVA"

The East Asiatic Co.'s second 13,500 tons d.w.c. motorship was launched on January 24th at the Nakskov Shipyard, Nakskov, Denmark, and was named "Java." At the same shipyard the Diesel-tanker "Mexico" of 4,500 tons. d.w. and the Diesel freighter "Indien" of 8,800 tons d.w. was launched during 1920. At the present time three other Diesel motorships are on the ways, as previously announced in our columns. The dimensions of the "Java" are 440 feet length b.p. by 60 feet breadth by 42 feet depth. She is propelled by two Burmeister & Wain Diesel engines of 2,300 i.h.p. each.

MOTORSHIPS FOR CARRYING BARGES

A new type of Diesel-driven motorships has been designed in England for the purpose of transporting barges of 220 tons and 280 tons gross. The design is being developed by the International Barge Supply & Transport Co., Ltd., to the design of Mr. Robert McGregor, of Dibles, Ltd., Southampton, England. The motorship is of 850 tons d.w.c., with a length of 175 ft. by 28 ft. 9 in. breadth, and is intended to have a speed of 9½ knots on a 12-ft. draft. She is to be propelled by two Sulzer two-cycle type Diesel-engines of 300 shaft h.p. each. As the daily fuel consumption of this vessel will only be 2½ tons of oil per day, there will be sufficient fuel in the double bottom of the hull for a voyage of 18,000 nautical miles.

Interesting Notes and News from Everywhere

RUSSIAN VOLUNTEER FLEET'S MOTORSHIP

The large Krupp Diesel-engined tanker "Baku," sister to the "Loki" and "Glenpool," is now owned by the Russian Volunteer Fleet.

CONCRETE MOTORSHIP "DURHAM" PASSES TESTS

The Bolinder-engined American concrete motorship "Durham" built for carrying oil in bulk for the France & Canada Transport Co. has passed the tests of the U. S. Steamboat inspectors and run her trials.

CONCRETE MOTORSHIP "FJELDBE" RUNS TRIALS

Trials of the concrete motorship "Fjeldbe," 570 tons d.w.c. 34,000 ft. cubic-capacity, have been run. She has been built at Moss, Norway, to the order of I. Sorensen, of Christiania, and is propelled by a 320 b.h.p. Bolinder surface-ignition oil-engine.

219 MOTORSHIPS OF 1,027,202 TONS D.W.C. IN ACTUAL CONSTRUCTION

On December 31 there were no fewer than 189 motorships of 454,502 gross tonnage (about 727,202 tons d.w.c.), upon which constructional work had actually been commenced, according to Lloyds Register recent report. Fifty-seven of these aggregating 227,001 tons gross (about 363,200 tons d.w.c.) are in British yards.

This does not include many motorships on order, upon which construction work had not actually commenced at the above date. Furthermore, these figures exclude Germany, where there are about 40 motorships aggregating over 300,000 tons d.w.c. now under construction or being converted from steam. This makes a total of vessels actually under construction, 219 of 1,027,202 tons d.w.c. approximate.

OUR REGISTRY OF MOTORSHIP'S ENGINEERS

Lieut. (j.g.) D. L. Trautman, graduate of Carnegie Institute of Technology and Electrical Engineering, qualified for submarine command, holds second Asst. marine engineer's license. Has had 8 years at sea in the U. S. Navy, the last two being as engineer and electrical officer in submarine service.

G. H. Pendleton.—Has had 12 years' experience with operation of marine gasoline, surface-ignition and Diesel engines. Has been with Allis-Chalmers in connection with erection work of steam and electrical equipment. Was Chief-Engineer on the Winton Diesel-engined motor-auxiliary "Sherewog." Also guarantee-engineer on Norwegian auxiliary "Ekstrand" of 680 tons net, powered with twin Fairbanks-Morse 60 b.h.p. oil-engines. Is member of M.E.B.A. No. 80, 15 Whitehall Street, New York.

L. Benjamin, 4213 Jerome Avenue, Woodhaven, L. I., N. Y.—Has unlimited license for motorships. Until recently was first assistant on the Diesel motorship "Brammel Point." Prior to that was second assistant on the Diesel motorship "Bayonne." Shop experience includes erection in the Southwark-Harris Diesel Works, Philadelphia, and at the De LaVergne Oil Engine Company's plant, New York. During the war was in the U. S. Navy in the engine-room of a motor patrol boat "Kemah" powered with twin 225 b.h.p. Southwark-Harris Diesel engines.

SIR CHARLES GREENWAY AND THE MOTORSHIP FIELD SITUATION

In a recent speech at the last general meeting of the Anglo-Persian Oil Co., Sir Charles Greenway, Bart., said that he agreed with Lord Pirrie as to the wastefulness of burning liquid-fuel under boilers, but he did not agree that shipowners should be so very cautious in ascertaining whether oil could be obtained for use in the internal-combustion engine in motorships in the near future because there was no ground for pessimism as to the future supplies of liquid-fuel. Sir Chas. Greenway said that the world's production of liquid-fuel is probably not more than 10,000,000 million tons to-day, after deducting the oil used by refineries and railroads. But that in the course of a few years' supplies from already proved fields will amount to fully 50,000,000 tons per annum, or equivalent for burning in Diesel-engines of 175,000,000 tons of coal.

EAGLE OIL OFFICIAL PARTLY CONVERTED

Speaking in the behalf of the Eagle Oil Transport Co. Mr. R. P. Brousson said that—"he thought the future on the seas rested largely with the Diesel ship, but not entirely, as hand-in-hand with the Diesel-ship would be the turbine-ship." Belief in the motorship is a gradual one produced only by results, but it will be noted that Mr. Brousson is half-way converted. In another year or two he will be a full-fledged Diesel enthusiast. Mr. Andrew Laing replying to Mr. Brousson stated that the Eagle Co., had displayed great courage in going-in for geared-turbines. We would say they certainly did!

BALTIC-AMERICAN LINE MAY HAVE MOTORSHIPS

It is possible that two 15,000 tons d.w.c. Diesel motorships may be allotted by the East Asiatic Company to the Baltic-American Line for its new freight and passenger service from Hamburg, Danzig, Libau to New York. The Baltic-American Line is a subsidiary of the East Asiatic Co. of Copenhagen.

MOTOR TANKER FOR ANGLO-PERSIAN OIL CO.

A small motor-tanker to be propelled by one 180 b.h.p. Kromhout surface-ignition oil-engine is now under construction at the West Lynn Shipyard of the Kings Lynn Ship Co., England. The vessel is 147 ft. long. Steam for steam-heating coils in the cargo tanks will be supplied by an oil-fired boiler. She is for the Anglo-Persian Oil Co.

INTERNATIONAL MONEY-ORDER RATES

For the benefit of our readers and advertisers overseas, we will mention that, according to a recent ruling by Postmaster-General Burleson, Washington, D.C., U.S.A., the following new conversion rates on international money orders were made effective on February 15, 1921:

Great Britain, pound, $4.00.
Netherlands, florin, 35 cents.
Sweden, krona, 24 cents.
Denmark, krona, 20 cents.
Norway, krona, 20 cents.
France, 13 francs, $1.00.
Belgium, 13 francs, $1.00.

International postal exchanges with ten countries will be effected only through United States currency. The countries are: Bolivia, Chile, Costa Rica, Honduras, Hong Kong (China), Italy, Japan, Nicaragua, Salvador and Uruguay.

International money-orders are obtainable at any post-office in the countries listed above, as well as any post-office in the U.S.A. and Canada.

BRITISH-BUILT SHIP FOR AMERICA

With the ways of our shipyards gradually getting empty, it may come as a shock to read of the launching of a ship in England to the order of a New York firm. A fruit-carrying steamer was launched during January at Newcastle-on-Tyne to the order of the Atlantic Fruit Co. of New York. Comparison details with the Diesel-driven fruit-carrying motorship "Sevilla" of about similar size launched last month by Wood & Skinner, Newcastle-on-Tyne, to the order of Otto Thoresen of Norway would make most interesting reading. We are endeavoring to secure the same for publication.

AMERICA TO LEAD WORLD IN MOTORSHIP BUILDING

America is destined to assume leadership in the construction of motorships, it is predicted by Dr. Charles E. Lucke, professor of mechanical engineering at Columbia University, in an editorial on the relative merits of motor and steamships in the Journal of the American Society of Mechanical Engineers. Professor Lucke asserts the country is entering upon a program of motorship construction, and will eventually wrest leadership in that industry from the European countries in which it is at present most highly developed.

THE MOTORSHIP "FRITZOE"

In the description of the motorship "Fritzoe" on page 119 of our February issue the dimensions of the ship were given in feet and inches. This, of course, should have read metres and millimetres.

SIX 9,000-TON MOTORSHIPS UNDER CONSTRUCTION AT THE DEUTSCHE WERFT —OTHERS ON ORDER

In our January issue on page 31 we published the first official announcement that 24 Burmeister & Wain merchant-marine Diesel-engines aggregating 31,000 i.h.p. now under construction at the Berlin Works of the A. E. G. (General Electric Co.) for ships building at the Deutsche Werft, Hamburg.

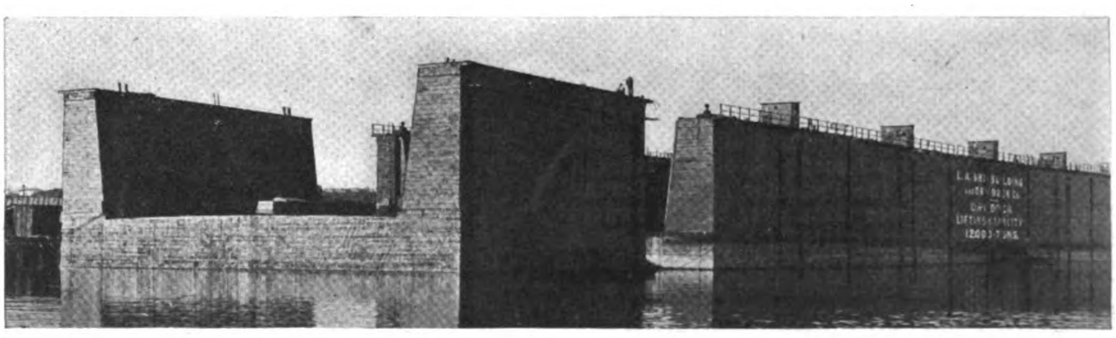
Six of the hulls are now on the stocks at this new yard which is entirely devoted to motorship building, having recently been founded by the Hamburg-American Line, the Güte Hoffnungshutte, the Allgemeinen Elektricitats-Gesellschaft, and the Deutsche Oelmaschinen-Gesellschaft.

These vessels are standardized twin-screw 9,000 tonners, built from fabricated steel supplied by the Güte Hoffnungshutte, while the Diesel-engines are built under B. & W. license by the A. E. G. Their dimensions will shortly be published in "Motorship," details now being en route to the United States. We understand that these motorships are being built to stock to the order of the Deutsche Werft A. V. who will place them on the market.

BIG DRY DOCK AT LOS ANGELES

When the Loss Angeles Shipbuilding and Dry Dock Company of Los Angeles, Cal., secured its site of about 70 acres of tide-flat land in Los Angeles harbor in 1917, it faced the problem of first creating solid-ground upon which to set its shops. To-day, the plant stands a hive of peacetime activity with a war record of thirty great steel freighters launched, four 11,600 ton steel vessels now on its ways, machine shops, copper, brass and wood working shops, one of the largest oxygen, acetylene, and hydrogen-gas generating plants on the entire west coast, and a floating dry-dock of 12,000 deadweight tons lifting capacity equal to the requirements of vessels of all sizes and classes from yachts to freighters, tankers and government craft. We are enabled to give an illustration of this fine dry dock.

Prior to several weeks ago this dock consisted only of five pontoons. The sixth pontoon is now added. The operation and control is electric and such that any number of units up to the entire six can be employed according to the size of the ship to be lifted.



The sixth pontoon being added to the other five of the Los Angeles Shipbuilding & Dry Dock Co., at Los Angeles harbor, making this the largest floating dry dock in Southern Pacific waters and capacity of handling ships up to 12,000 deadweight tons

Our Readers' Opinions

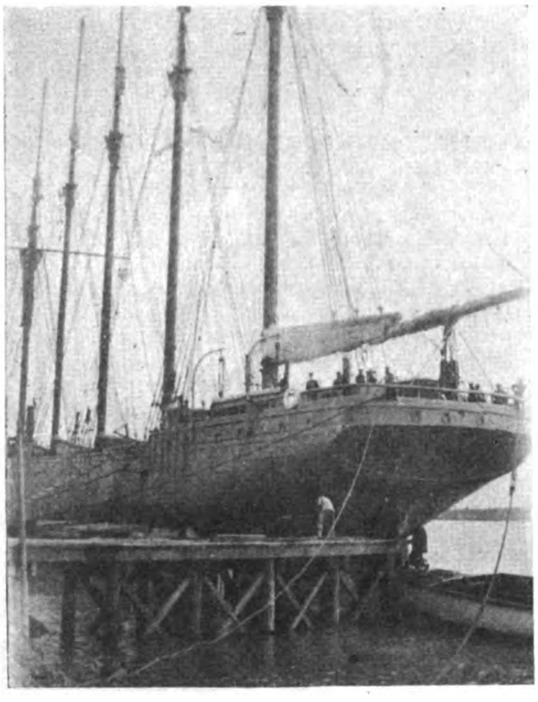
(The publication of letters does not necessarily imply Editorial endorsement of opinions expressed)

OVERHAULING THE M. A. "STASIA" IN CHINA

To the Editor of "Motorship."

Sir:—

Being an American Diesel marine-engineer and gas and oil-engine enthusiast, the arrival of the latest number of your magazine "Motorship" reminded me to send you the incidents surrounding the auxiliary-schooner "Stasia," built at Vancouver, B. C., and equipped with two 160 h.p. Bolinder oil-engines. You will recall that this wooden ship caught afire at Shanghai in Nov., 1918 and was sunk with a six-inch explosive shell by a British gunboat, the actual scene having been illustrated by you. The hole was patched by divers, and the ship raised by means of the ship's



Wooden Motor-schooner "Stasia" after overhauling following the cargo fire.

Worthington steam bilge-pump. The ship was dismantled and all useful material stored in warehouses. The engines were also dismantled and stored away.

In June, 1919, I undertook to rebuild the engines, and upon close examination found that the cylinders, heads, and one muffler were cracked and that most of the copper piping and brass parts had been melted by the fire. Also the port crankshaft was sprung ½ inch out of line.

Not wishing to re-machine the crank and thereby change the standard diameter if I straightened it hot, I accomplished the task by "peening" the web cold. As Chinese fitters are noted for their patience I had a true shaft in two weeks. The cylinders and heads were furnished by Mr. Eckman, Shop Supt. of the Kiangnan Dock of Shanghai, turning out a first-class job of good close-grained grey iron.

I had considerable difficulty making up the list of parts required, as my Bolinder catalogue does not include parts of the larger engines. So I was obliged to compare my requirements with the parts catalogue of the small engine. However, I succeeded and am very pleased to state that, although the cable was wired to Mr. Hy Lund, the Bolinder representative at San Francisco and rewired to Sweden, the parts arrived as ordered without error and adapted themselves to the engine without requiring machining or other fitting.

The engines started with the first "shot" of air, and after a few days I made an official test-run (dock trial) before the inspector of the Bureau Veritas. The ship was taken over by the owners a few days later and started for a trip to Marseilles.

The two French engineers who took the ship had seen service on French submarines and being accustomed to splash lubrication set the bearings too close, developing hot bearings. The ship put in at Shanghai for deck repairs and the engineer tried

developing hot bearings. The ship put in at Shanghai for deck repairs and the engineer tried
to alter the oiling system but failed, so returned to the original system. Not having word to the contrary I presume that the ship proceeded on her trip to France. The engine-crew consists of Chief-engineer Begi and First-Assistant (both Frenchmen); two Chinese engineers, three-oilers and one donkey-man.

Yours very truly,

A. L. LESCHOT.

Tientsin, China.

PROPOSED MOTORSHIP-ENGINEERS' BUREAU

To the Editor of "Motorship":

Sir:

Would it not be a good plan for motorship-owners of the United States to have some kind of a Registry or Bureau devoted to engineers of that class of vessel. There have been complaints that there are not enough skilled oil-engine operators, or if men have been obtained they have not been competent.

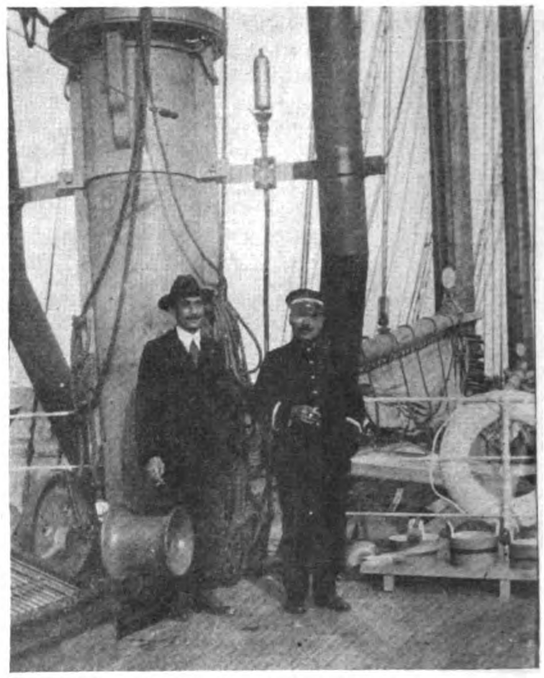
Now, in my duties as Chief-Engineer of motorships, I have been forced to take inexperienced men to make-up my staff, solely because I did not know where to get in touch with the available experienced men, although I knew at that time there were good men who were working in machine-shops because of not being able to find jobs on motorships and had given-up the sea for that reason. Whereas, the engineers of low-grade ability who cannot get work ashore have to scratch around and get another ship somehow.

In order to attract the class of man who is a good mechanic, and who takes a pride in his work and would be ashamed to have an outside shopman come aboard his ship to do any job that did not take machine-tools to do, you have to give a reasonable amount of study to employment systems. This could be accomplished by having a central Bureau of Registry where a motorship-engineer can either call or telegraph his application and receive notice of any positions vacant. It would also serve to clean the ships of "grafters," repair-sharks and "bluffers" who infest the internal-combustion engineers' ranks of to-day.

While working in a repair-shop I have been on jobs that have filled me with disgust and have been called upon to do things that should and would have been done on the ship without outside assistance if the engine-room force had been even in the "handy-man" class, thus saving the shipowners hundreds of dollars.

Now I believe that America in manning its ships should get men from the same place it obtains men for defence in case of war, and also the same kind of "Americans" by having a place of this kind where their records could be kept. Then we would get a class of men that could not be bettered.

I have been to sea twenty-two years and have operated engines burning gasoline, kerosene and producer-gas, also hot-bulb and Diesel oil-engines, and I fail to see any substantial reason why some engines of the same design can make voyages of thousands of miles without repairs, while others of the same make have to go into port every three or four hundred miles for break-downs. I will admit that some installations have been made where economy has been the main feature, resulting in poor layout, and also ignorance has played a great part. But, unreliable results are usually due to the crew. I have been on two ships where I have had to line-up the motors each time we were loaded and discharged; but that is what an engineer is there for.



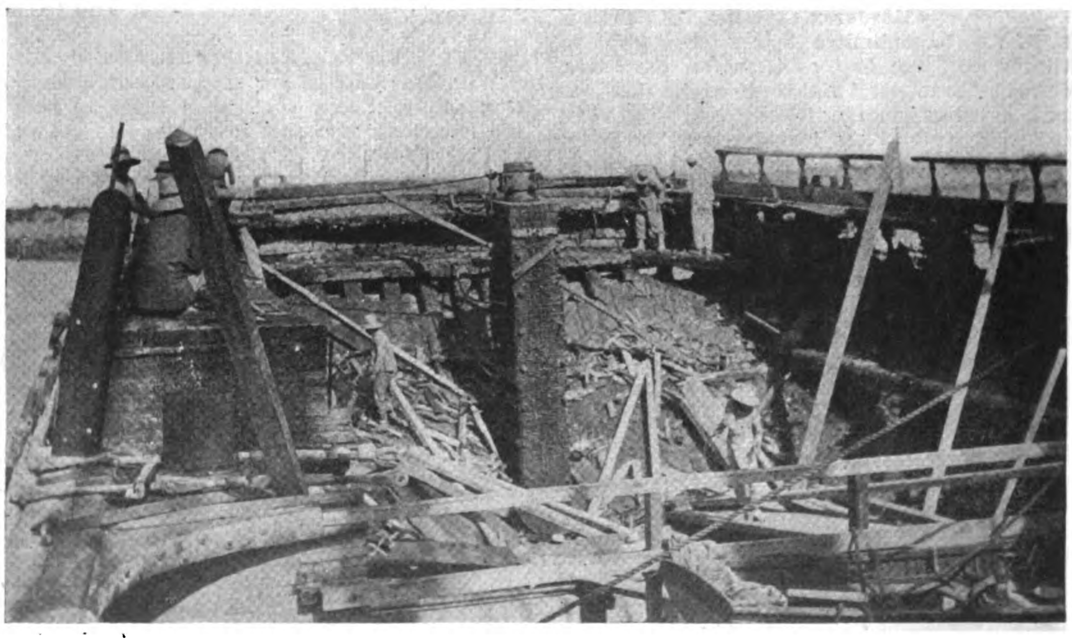
On the left, Mr. A. L. Leschot, who reconstructed the auxiliary "Stasia." On the right, Chief-Engineer Begi.

This proposed Central Bureau could also be used to compare the performances of the different motorships by filing abstracts of runs by both captains and engineers, in order that the development of the motorship could be checked-up as a whole, and advice given in monthly reports as to different types of engines, deck-machinery; fuel-oils, lubricating-oils, etc. Faults that are bound to occur in any new development thus may be reduced to a minimum. Last of all, let us remember that the United States has never started anything that it couldn't finish and come out at the top of the heap. If motorship owners and crews work together I can see nothing but success and prosperity in sight.

SHIP'S ENGINEER.

New York, Feb. 11, 1921.

[We have been obliged to hold over a number of letters.—*Editor.*]



Engine-room of the motor-schooner "Stasia" after the cargo fire.

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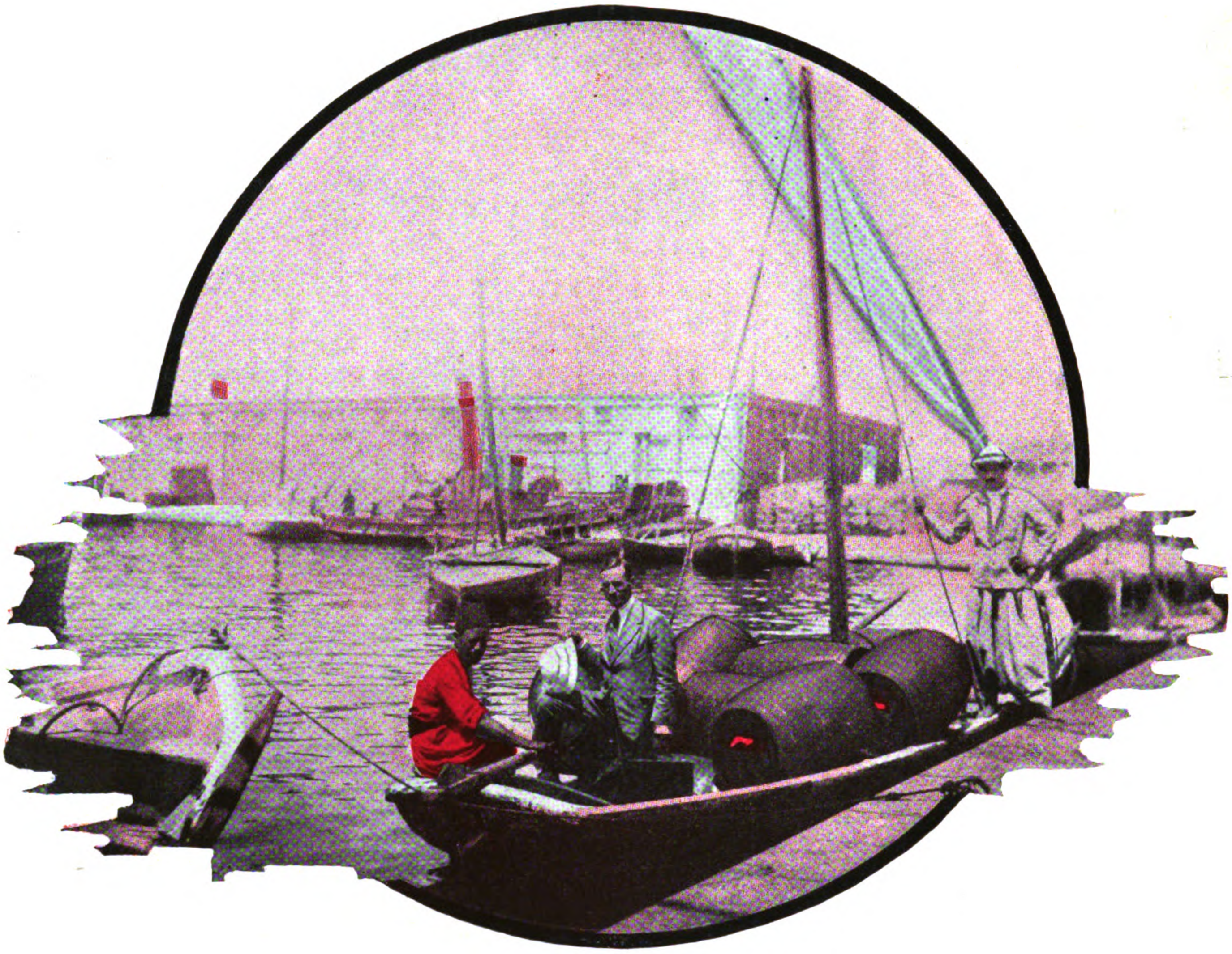

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Vol. VI New York, U. S. A., April, 1921 No. 4

"Buenos Aires" in New York Harbor

Many American Shipping-Men Visit Interesting Swedish Motorship at Personal Invitation of Her Owner—Some Plain Facts Concerning Why She Came Over Fully Loaded, and Returned Fully Loaded with U. S. Products When Hundreds of American Steamers Are Idle

By THE EDITOR

Consul-General Axel Johnson

ONE obstacle to rapid development and adoption of the Diesel-engined motorship in America has been the persistent reluctance of shipowners to inspect visiting motorships. At various times dozens of invitations to visit domestic and foreign motorships in New York Harbor have been sent to shipping-men in New York, but in nearly all cases the absence of executive-officials at these inspections has been conspicuously noticeable, they in the majority of cases having pleaded pressure of other business, and have delegated their superintendent-engineers or other representatives to attend in their place, instead of personally accompanying their engineers and seeing for themselves the benefits of motor-power. Surely the fact that a single motorship can effect annual economies as large as $300,000.00 makes a personal visit more important than the average business a shipowner may have had to transact at that particular moment—often a shipowner will spend hours with fellow directors figuring how a thousand dollars can be saved in some other direction. Pleas of urgent business affairs, or that they would not understand what they saw because of non-technical experiences, are merely evasions which we believe can only be due to shipowners not seriously believing in the reliability of the modern motorship or in the enormous economies to be effected by their adoption. Therefore, this is no time to use soft phrases to indicate the position, as the American shipping situation is getting too serious.

A direct contrast of such attitudes is paramount at the moment in the case of a leading Scandinavian shipowner who, although swamped with his own urgent business affairs, devoted the final few hours of his extremely busy time in New York to making such a visit to his newest motorship possible to American shipowners, thus facilitating their knowing what his company was doing in the shipping-world, what advances they are accomplishing, and with what degree of success. That his ships are in competition with American vessels increased the importance of this inspection, and incidentally demonstrated the fine feelings prompting him.

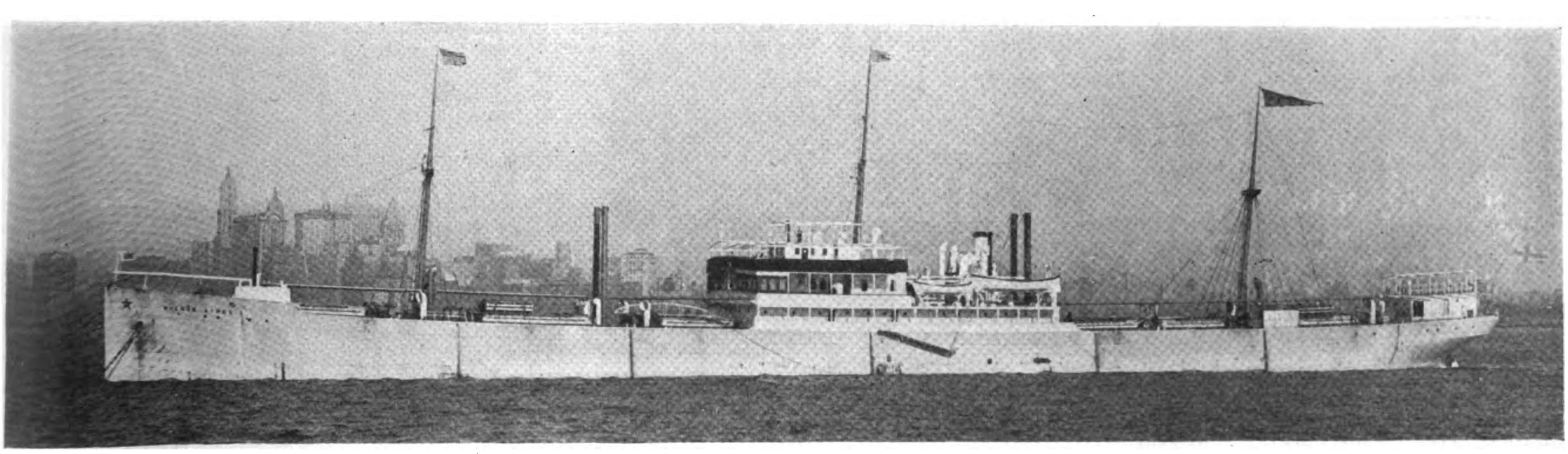
After a few weeks in the United States, studying oil-fuel conditions, and the general shipping business, Consul-General Axel Johnson, managing-owner of the Johnson North Star Line (Nordstjernan) of Stockholm, Sweden, was mystified as to why American shipowners still continue to build oil-fired steamers when it is the ideal country for Diesel-driven motorships because they will help conserve the available oil supply. That such a waste of valuable oil should be continued, he thought, is terrible. He also was astonished to find how little the directors and executives of American ship-operating companies know about motorships and Diesel power, particularly as his own line of motorships show economies and additional earning powers on the Sweden-South America-San Francisco route of over $150,000.00 per round trip per ship, or about $300,000.00 per annum, the saving in fuel being enormous. There can be no questions regarding reliability, he said, as the first of his fleet—the m.s."Suecia" had been operating for eight years and had never had any machinery trouble. Mr. Johnson is a believer in the direct-Diesel drive, and has no faith in electric-transmission in preference because there is at once 12 to 15 per cent less in economy, and knows that the present slow-speed engines are quite reliable, and have ample flexibility of operation. But he thinks the oil turbines now developing in Germany have quite a future.

In order to convince American shipowners of the reliability and economy of the Diesel-motorship as it stands to-day, and as an obtestation against the building of oil-fired steamers, Mr. Johnson courteously sent an invitation—at no little inconvenience to himself—to about one hundred leading shipowners, shipbuilders and bankers to visit his new vessel "Buenos Aires" on Saturday, February 19, on which vessel he started the same evening en route for Sweden. In sending this invitation he showed a most broad-minded spirit, because he realized that unless America adopts similar type of craft and converts large numbers of existing uneconomical steamers, it will be impossible for our merchant-marine in its present condition to compete against his motorship fleet.

As an instance to support this contention, his own Diesel-vessel "Buenos Aires" passed down New York harbor loaded to her Plimsoll mark with American products, passing by hundreds of American coal-burning and oil-fired steamers swinging idly at their moorings—laid-up because of high-cost of operation and absence of cargoes. On her voyage from London to Pernambuco (en route to San Francisco via the Straits of Magellan), her deadweight-capacity was 10,250 tons, or even higher than on this return voyage, so she has been fully loaded every trip since placed in service. Practically all the Johnson line of steamships are now laid-up, they running motorships almost exclusively while the present shipping slump lasts. So far as we are able to ascertain, there isn't an ocean-going, steel Diesel-motorship laid-up to-day anywhere in the world for want of cargo or for high cost of operation, and work on the completion of new motorships is going ahead in the face of cancellations of steamship contracts.

We regret to say that of the shipping-men invited only about 30 attended personally. About thirty sent representatives, and half-a-dozen were unable to attend through absence from town, while the others did not trouble to acknowledge the invitation. We are bringing this delicate matter to the light of day in this manner, because it is necessary to bring home the fact that the present condition of our mercantile marine is partly due to the indifference of shipping executives to the really vital factor of ship operation; namely, economy! Nevertheless, those present came ashore feeling that their time was more than well-spent. Among those present were Frank Munson of the Munson S.S. Line, and Wm. Thompson of the Texas Co. It is to be hoped that those shipowners who missed the opportunity afforded them will visit the next available motorship.

Consul-General Johnson and Captain E. Atterling



Johnson Line Diesel-motorship "Buenos Aires" anchored off New York City. Her owner Consul-General Axel Johnson is so appalled at the terrible waste of oil under the boilers of American ships that he invited about one-hundred American shipowners and shipbuilders aboard in order to convince them of the success of Diesel propulsion, and that it is practically impossible for American steam ships to compete with his motorship fleet. Over fifty of those invited were aboard.

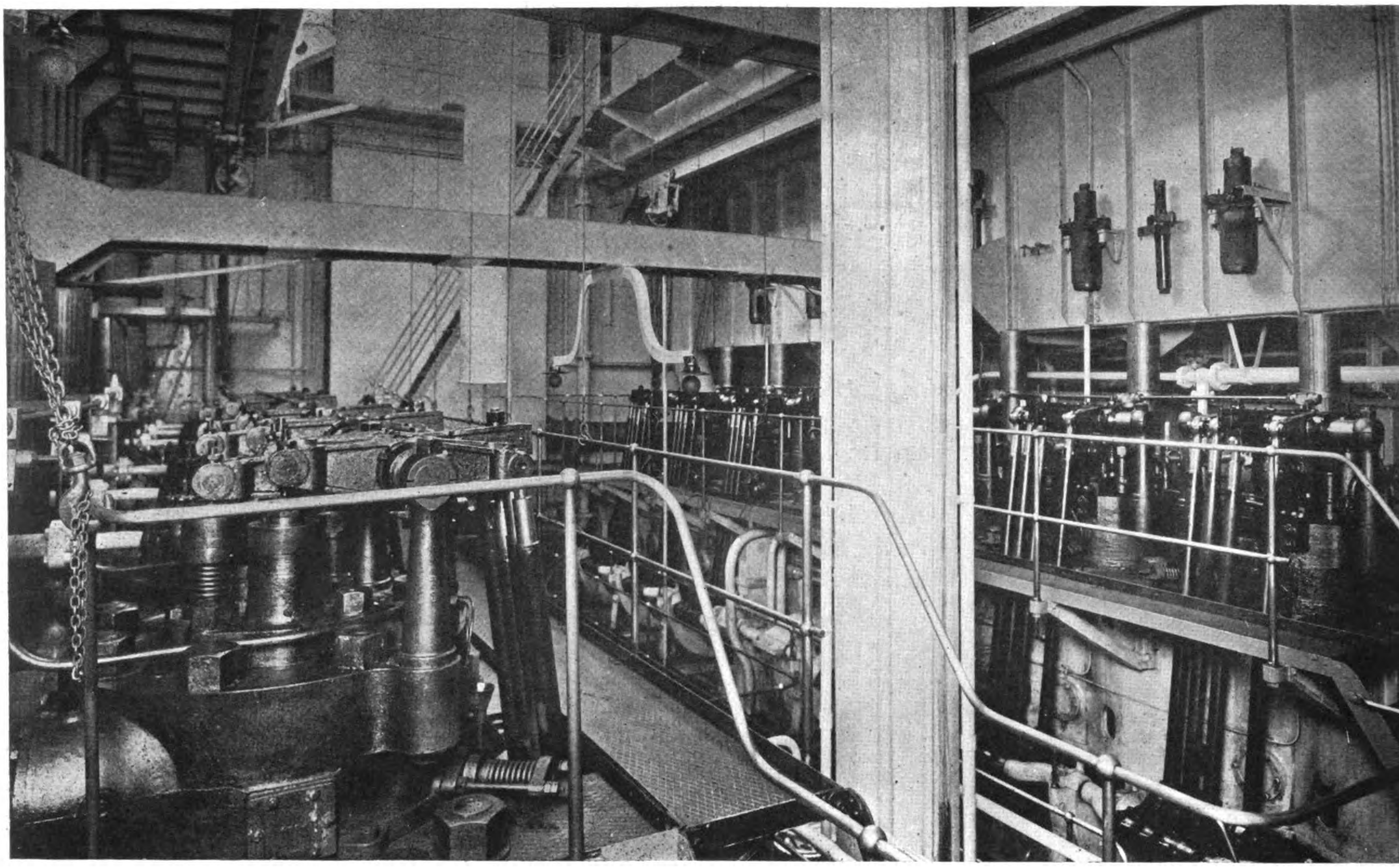


Photo by Morris Rosenfeld

Engine-room of the m. s. "Buenos Aires" the day she arrived at New York from San Francisco. Note the perfect order and cleanliness. Not a single repair was required.

personally received the guests, who after inspecting the ship were entertained to a delightful light luncheon. The Ekstrom brothers, New York agents of the Line, kindly arranged for a tug to transport the visitors to and from the ship, and acted as marshalls. The m.s. "Buenos Aires" was anchored off the Battery where she had arrived the previous evening from San Francisco via the Panama Canal. We are greatly indebted to Mr. Johnson and the others for their kindness and courtesy.

The Johnson Line fleet of motorships consists of the following vessels:

Name	Deadweight Capacity Tons	Power I.H.P.
"Suecia"	6,550	2,000
"Pedro Christophersen"	6,550	2,000
"Pacific"	6,550	2,000
"Kronprinzessan Margareta"	6,550	2,000
"Kronprinz Gustaf Adolpf"	6,550	2,000
"San Francisco"	6,550	2,000
"Valparaiso"	6,550	2,000
"Lima"	6,550	2,000
"Balboa"	9,350	3,100
"Buenos Aires"	9,350	3,100
"Canada" (recently delivered)	9,350	3,100
Building	6,500	2,000
Building	6,500	2,000
Building	6,500	2,000
Total 14	99,950	31,300

In addition to these motorships they own and operate a large number of steamers built before they had tried-out the Diesel system of propulsion. These steam craft they intend to convert to Diesel-machinery as soon as is feasible, with the exception of a few which will be retained in their present form. Meanwhile, as just stated, the steamers are now laid up. An article on their m. s. "Kronprins Gustaf Adolf," which was placed in service in January 1914, appeared in "Motorship" of July, 1919, when complete details of her auxiliary machinery were also given.

Many of the above fleet were built by Burmeister & Wain of Copenhagen, but the "Buenos Aires," "Balboa" and "Canada" were constructed by the Götaverken, of Göteborg. The most excellent construction of the hull, machinery and accommodation was remarked upon by the engineering section of those invited aboard. To ourselves the "Buenos Aires" is of special interest as we were in Göteborg the day she was launched in September, 1919, and this was the first time we had seen her since then.

Photo by Editor of "Motorship"

Consul-General Johnson and Captain Atterling watching the arrival of the visitors on the tug.

Her leading capacities are as follows:

Loaded displacement (this trip).......13,800 tons
Net dry and wet cargo carried this trip
(not including actual fuel)..........8,900 tons
Net cargo-capacity (not including oil-cargo
fuel, water, etc)............8,100 to 8,300 tons.
Dead-weight capacity (summer)........9,350 tons
Dead-weight capacity (winter).........9,050 tons
Cubic-capacity of holds (5)..553,835 cu. ft. (grain)
Cubic-capacity of holds (5)..506,080 cu. ft. (bales)
Fuel-capacity (maximum).............1,622 tons
Fuel carried this voyage...............1,500 tons
Gross tonnage (British)..............5,524 tons
Net tonnage (British)................3,380 tons

Here it should be mentioned that about 800 tons of this fuel-oil practically represents cargo and is disposed of such in Sweden, so her net cargo-capacity exclusive of fuel, water and stores for a round trip from Sweden to San Francisco and return is about 9,000 tons, on a displacement of 13,800 tons. This should be compared by American ship owners with the net cargo-capacities of their own oil-fired steamers of similar dimensions over a similar route. It will be found that the "Buenos Aires" carries from 1,000 to 1,200 tons more money-earning cargo. The draught with this load is 25 ft. 11¾ in. Her dimensions are:

Length (O.A.) ....440 ft.
Length (B.P.) ....425 ft.
Breadth (Md.) ....56 ft.
Depth ....30 ft. 38 in.
Depth of hold........................16 ft. 9 in.
Mean draught (on this voyage)........26 ft. 8 in.
Co-efficient 0.76
Passenger accommodation,
12 first-class and 2 second-class

After the capacities for the dimensions have been compared with those of steamers the powers, speeds and fuel-consumptions should he considered, namely:

Designed power.......................3,100 i.h.p.
Power actually averaged.......3,100 to 3,400 i.h.p.
Designed engine speed.................125 r.p.m.
Engine-speed actually averaged.......124½ r.p.m.
Designed speed ....11½ knots
Speed actually averaged (fully-loaded).11¼ knots

Designed daily fuel-consumption........10¼ tons
Actual daily fuel-consumption..........10¼ tons
Daily fuel-consumption in port............¾ ton

Few steamships follow their designed specifications so closely as this in actual service, so the foregoing results may be considered excellent and speak volumes for the reliability of her Diesel propelling machinery.

Regarding her loaded sea-speed, on this voyage from San Francisco to Stockholm she had aboard 8,000 tons of grain, several hundred tons of case-goods such as dry fruit, and 1,500 tons of fuel-oil, the latter reducing to 1,250 tons by the time she reached New York. She also stopped at Acajutla and took aboard 50 tons of cargo. So it may be said that her average dead-weight capacity (including drinking water and stores) was about 9,600 tons throughout, making allowances for the consumption of fuel. This, of course, is higher than her rated d.w.c., but according to her owner her maximum d.w.c. is 10,250 tons. At this load her net dry and oil cargo capacity must be about 9,600 tons without including fuel, etc.

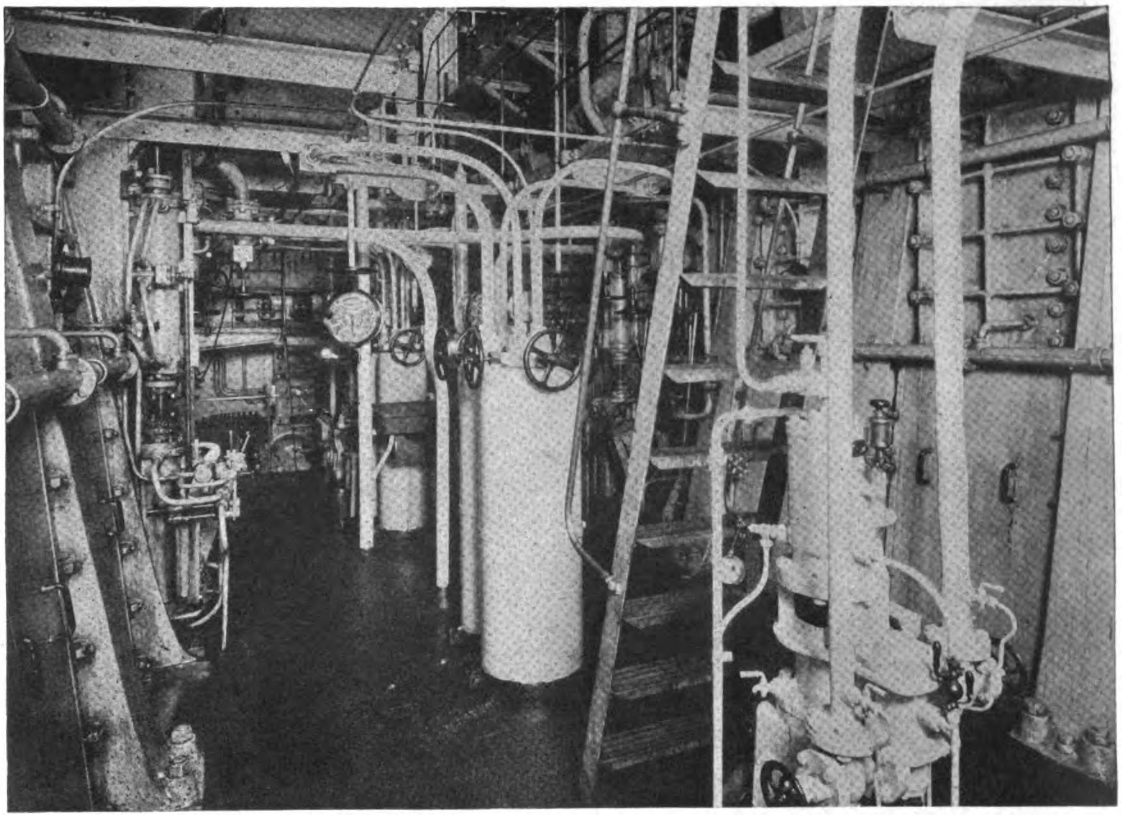
On the chief-engineer's desk was the log of the last ten days of the trip. The average daily speeds were recorded as follows: 10.63 knots; 10.95 knots; 11.04 knots; 11.20 knots; 11.28 knots; 11.24 knots; 11.28 knots; 11.49 knots, and 10.92 knots. The speed of 11.25 knots generally averaged is attained on a daily consumption of 10¼ tons of fuel (0.308 lb. per i.h.p. hour) and with the twin engines together indicating 3,100 i.h.p. at 124½ revs. per minute.

But the speed of 11.49 knots average was secured by running the engines at 126.9 and 126.3 r.p.m., respectively, together developing 3,400 i.h.p. on a daily fuel-consumption of 10.35 tons of fuel-oil, or 0.311 lb. per i.h.p. hour.

This is sufficient answer to those who dispute the fact that the i.h.p. hour consumption of Diesel-engines in service does not exceed 0.35 lb. and who doubt that the consumption is only one-third of that of the average oil-fired geared-turbine drive. For instance, in a recent speech before the National Merchant Marine Association, Mr. Joseph W. Powell, ex-vice-president of the Bethlehem Shipbuilding Corporation, erroneously declared that the saving of oil on a 10,000-ton ship was only 12 tons per day, or $100.00.

Owing to Chief-Engineer Emil Hallengren being swamped with questions by other visitors we were unable to secure a complete log for the entire round trip of the ship, which was her maiden voyage.

Next for comparison with a steamer comes the engine-room crew. The "Buenos Aires" carries a total of 14 men, namely, chief-engineer, second, third and fourth engineers and 10 greasers. No electrician, donkey-man or firemen are carried. The engineers attend to the electric motors, etc., and to the donkey-boiler.



Main-engine control-floor of the engine-room of the m. s. "Buenos-Aires."

Then comes the question of fuels. Already Chief-Engineer Hallengren, has been making some interesting experiments, with a view to eventually running entirely on Mexican crude-oil if necessary, or if the resulting economy is sufficient to warrant the step. Mixtures of heavy crude-oil and Diesel-oil were tried as follows:

Percentage of Mexican crude	Percentage of Diesel-oil	Increased Consumption
⅔	⅓	2%
½	½	1½%
⅓	¾	½%

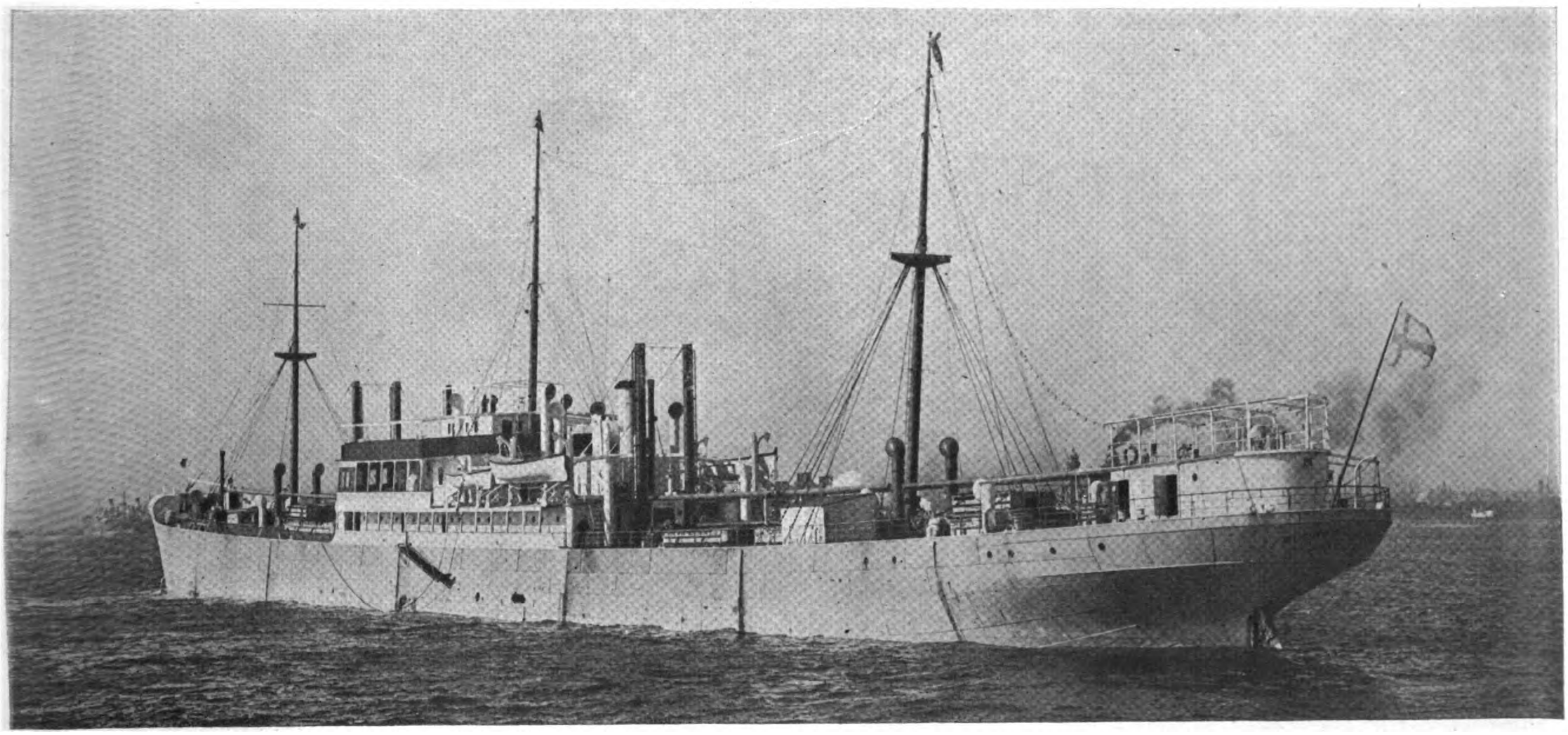
From the above results we estimate that if all Mexican crude-oil were used, without the mixture, the consumption would be 3% higher than when burning Diesel-oil solely.

But, shipowners have to bear in mind that the total daily consumption of fuel with a motor ship of this size is so low that the difference in fuel-bill is very small, and to-day Diesel-oil can be obtained in almost any leading port in the world, also a Diesel-vessel can carry at least four months' supply without interfering with her cargo capacity.

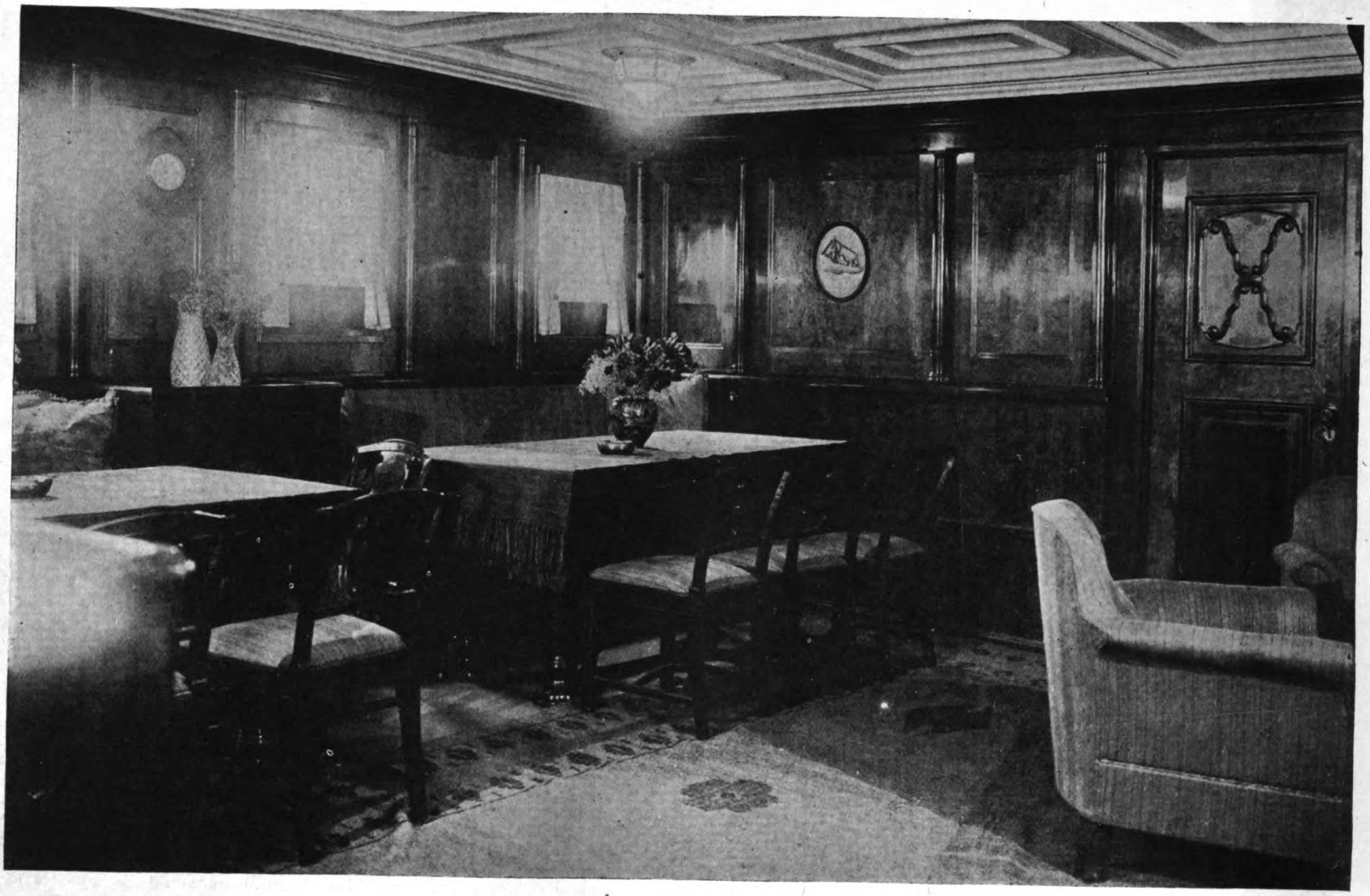
For instance, the "Buenos Aires" uses approximately 10 tons per 24-hour day. To-day this quantity of Mexican crude-oil would cost about $155.00. If she used Diesel-oil her fuel-bill would amount to about $200.00. Thus by using boiler-oil the daily saving is approximately $45.00 less 3%, and the question at once arises, is it really worth while, in view of the economies already effected compared with steamers?

The argument that motorships should be able to use regular steamer-oil is not so important as claimed by opponents because of the following reasons:

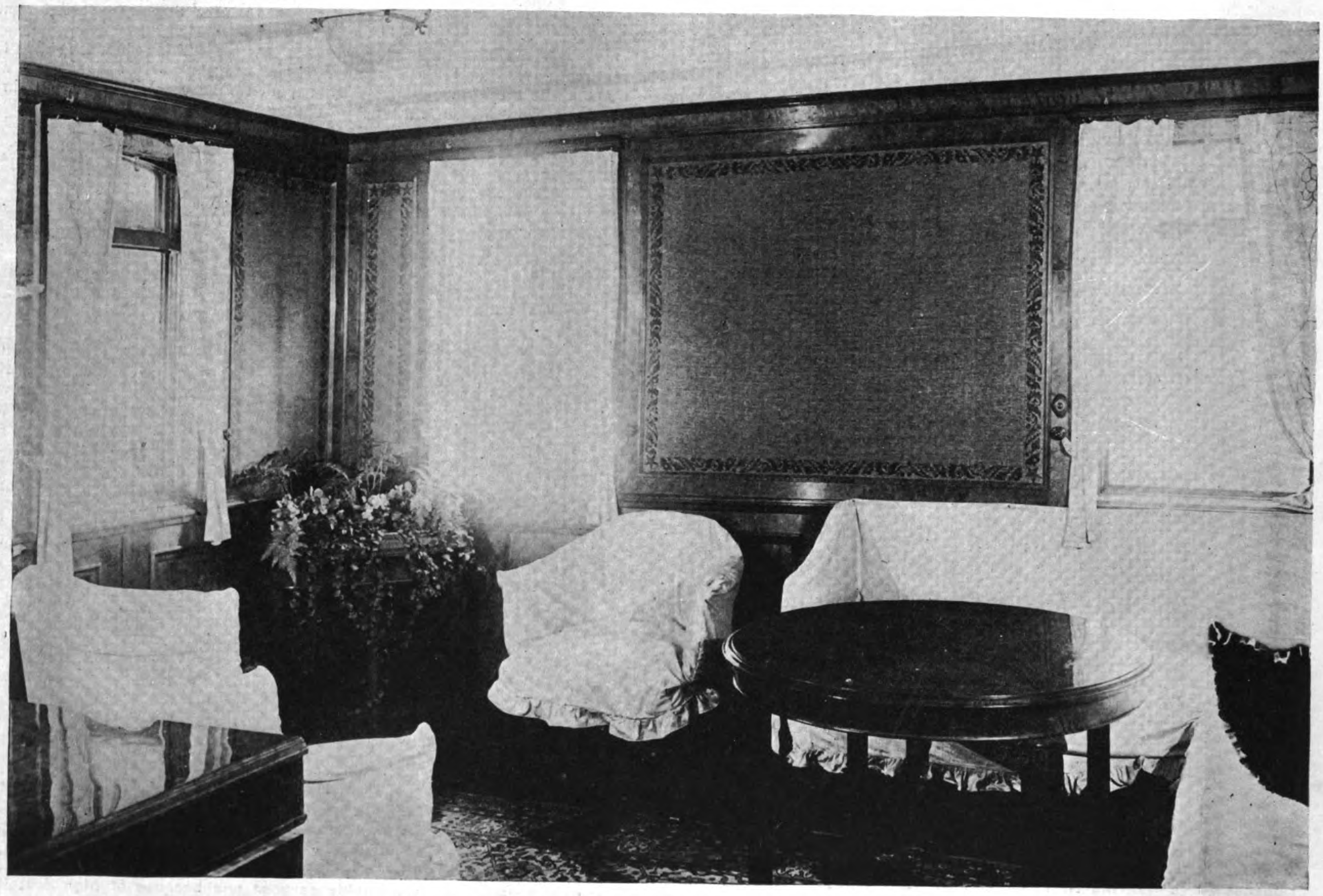
(A) Saving is comparatively slight.
(B) Motorships are not dependent upon overseas bunker-stations, but can pick-up oil where it is cheapest.



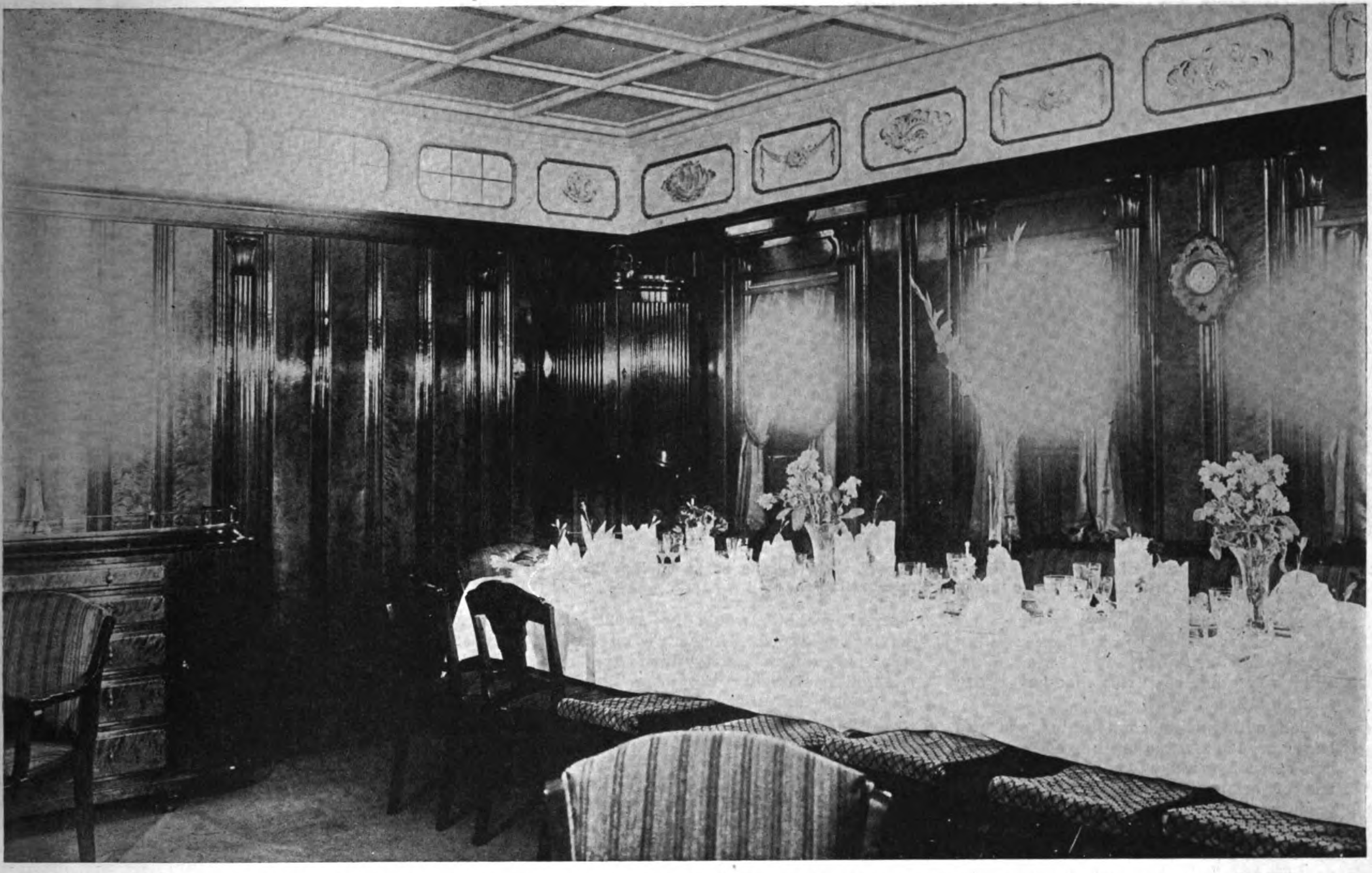
"Buenos Aires" leaving N. Y. for Sweden fully loaded with American products on Feb. 19, 1921. On her way down the harbor she passed numbers of uneconomical American oil-fired and coal-burning steamships laid-up because of no available cargoes and because of high cost of operation. The m. s. "Buenos Aires" will go to Sweden and back without costing a cent in fuel-oil.



A corner of the smoking-lounge of the "Buenos Aires."

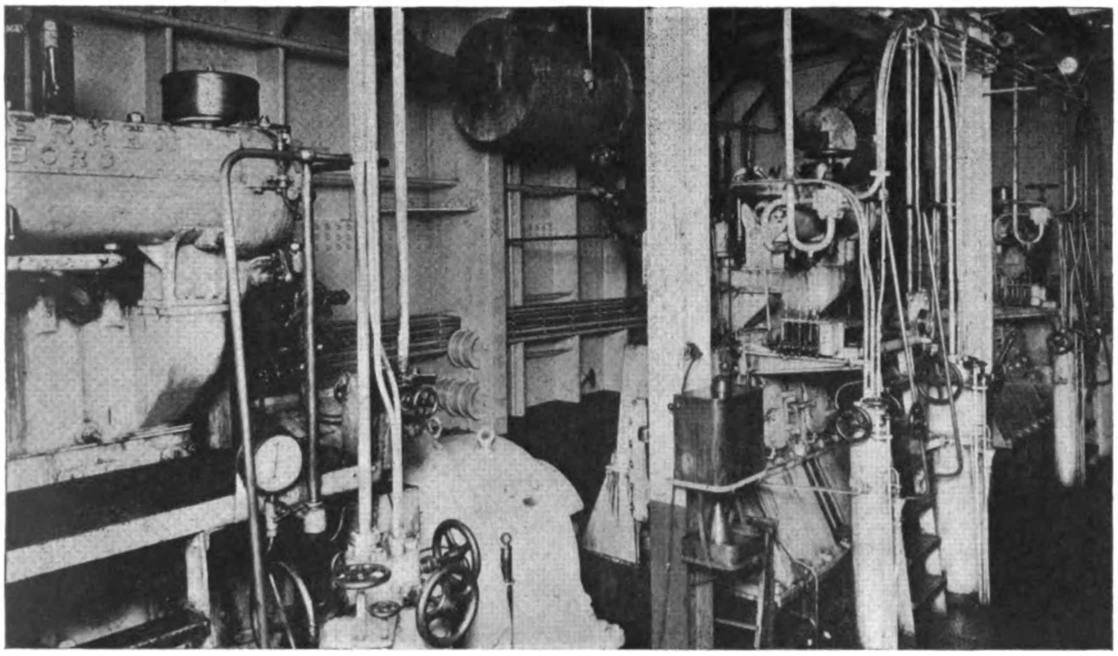


Owner's lounge on the Diesel motorship "Buenos Aires."



Dining-saloon of the Johnson Line's motorship "Buenos Aires" where Consul-General Axel Johnson entertained over fifty American shipping men.

Stairway and cosy-corner of the Diesel motorship "Buenos Aires."



Port side of engine-room of the m. s. "Buenos Aires" showing the three 90 h.p. Diesel-electric generating-sets for operating the auxiliaries of the ship.

(C) Need only bunker two or three times per year, unless selling part bunker-oil as cargo in Great Britain, Scandinavia, France or other countries that have little or no natural fuel-oil.

(D) When called upon, motorships can use heavy crudes if same are heated by steam generated by exhaust-gases, although the use of crude-oil means more work for engine-room crew.

(E) Grade of fuel advisable largely depends upon skill and conscientiousness of engineers-in-charge.

(F) Using Diesel-oil (solar-oil) on motorships engaged in U. S. A.-Europe service has certain benefit of its own, because there is always a steady demand for this class of oil for new motorships leaving Europe on maiden-voyages, also because need of this oil for cleaning gas in large city gas-plants. This enables surplus bunker-oil to be sold at prices much higher than those paid.

Therefore, the question of grade of oil-fuel should be decided by the particular requirement of every individual ship and her route. For instance, let us take the particular case of the "Buenos Aires." At San Francisco she took aboard 1,500 tons of Diesel-oil contracted for at a fairly low rate by her far-sighted owners (every American shipowner should be in the position to do likewise). She arrived New York with 1,250 tons, and needs about 375 tons to go to Stockholm and back to the Panama Canal, leaving a surplus, after making all arrangements for emergencies, of over 800 tons which will be sold as oil-cargo in Sweden. This fuel cost about $20.00 per ton at San Francisco while to-day the market price in Sweden is about $43.00 per ton. This means that her bunker-load of fuel cost $30,000.00. The 800 tons surplus fuel-oil which she will sell in Sweden, either to sister ships or to other concerns, will bring about $35,000.00, so that the vessel has absolutely no fuel-bill whatever.

Here would appear to be a case, where the use of a good grade of residual-oil fuel is a distinct gain to the shipowner, as in addition to giving the owners of the "Buenos Aires" the opportunity of avoiding a fuel-bill, there seems to be a good chance of making about $5,000.00 in addition. These figures, of course, are worked out by ourselves, but are based on the consumption and fuel-cost figures given us by the owners. Nevertheless, it will be seen that the motorship brings many new conditions of operation into being, all of which should be studied by the shipowner in all its phases, and properly weighed and balanced. We do not suggest that crude-oils should not be used, but that there are sides to the question which must be thoroughly probed.

Even if the motorship could not sell her surplus Diesel fuel-oil, her fuel-bill for one year with oil at $20 per ton would not exceed $25,000. If she burned steamer fuel-oil at $15 per ton, her annual fuel-bill would be about $18,500, or a saving of $6,500. Hence we once more suggest that shipowners satisfy themselves as to the advisability of using the lower grade oil unless necessary for other reasons.

There can be no doubt but that when more ship's engineers are trained in the operation of Diesel-engines heavier fuels will be more generally used on motorships. But, without American motorships, American engineers cannot be trained, except in the builders' shops while the engines are being constructed, which is the policy adopted in Europe. Even at the present time, however, there can be no question but that two-cycle type of engine will use many heavy grades of Mexican and Texas oils. To shipowners whose ships operate to the Far East, we suggest that Taraken crude-oil be used whenever it can be obtained. This is a heavy-oil that is cheap in the Dutch East Indies, and which makes excellent Diesel-fuel if warmed to a fluid state.

We must mention that on one motorship Chief-engineer Hallengren was the only experienced marine Diesel-man in the engine-room, as owing to influenza his entire engine-room staff were sick, leaving the chief the sole operator for three days. He prefers men without Diesel experience, as it is a much easier matter to train them to his views on successful methods of operation.

As yet we haven't said much about the machinery of the "Buenos Aires." She is propelled by twin Götaverken-built Burmeister & Wain type four-cycle Diesel-engines, each with six cylinders 630 mm. (24.803 in.) bore by 960 mm. (37.795 in.) piston-stroke, and they are installed about amidships. Each develops 1,550 i.h.p. at 125 r.p.m.

For auxiliary power everything is electrically driven. There are three two-cylinder four-cycle B. & W. type Diesel-engines of 120 i.h.p. (90 b.h.p.) coupled to 60-K.W., 273 ampere, 220-volt electric-generators, built by the Almanna Svenska Elektrisk A/B, of Vesteras, Sweden. They are arranged on the port side of the engine-room. One is in operation all the time, two when in port working cargo, and the third is a stand-by. Each burns half a ton of fuel-oil per 24-hour day at full load. So when in port one engine operates for 12 hours and the other for 24 hours, giving a combined daily consumption in port of ¾ ton.

The small oil-fired donkey boiler at the after end of the engine-room is for steam-heating the ship. It has a diameter of 1,350 mm. by 3,150 mm. length, with a working pressure of about 45 lbs. Generally speaking, the auxiliary machinery in the engine-room follows the arrangement of other B. & W. type motorships completed during the last few years, the plans now being practically standardized. For instance, at the forward end of the engine-room there is a battery of four rotary-type lubricating-oil pumps, driven by two 220-volt electric motors. On the starboard side is a planer, and a lathe, the electrically-driven auxiliary air-compressor, bilge and general service pumps, etc. On each main Diesel-engine there is a 5 b.h.p., 220-volt, 25-amp. electric-motor for turning over the engine. It operates at 375 r.p.m. and is geared to the engine-shaft.

To manufacturers of pressure-gauges who are not yet fully acquainted with Diesel motorship construction, we will mention that we counted no fewer than 42 pressure-gauges in the engine-room of this vessel. So there is an excellent market available for such instruments.

There are 12 derricks on deck and six hatches, worked by twelve 3-ton electric-winches and by one 5-ton electric winch. There is no deep-tank to the ship, the double-bottoms having a capacity of 1,323½ tons of fuel, and 298½ tons of fuel are carried in the wing tanks. Also, in the double-bottoms, wing-tank, fore peak and after peak tanks, ballast-water to the total of 2,028 tons can be carried when the ship is light. As yet she has not needed this feature. The electric-winches were constructed by the Almanna Svenska Elektriska A/B, but the electric steering-gear was made by John Hasties & Co., Greenock, Scotland.

Consul-General Johnson stated that before the war the cost of a similar motorship in Scandinavia was about $50,000 more than that of a steamer, but to-day the cost is about 10% higher than the price of a steamer.

However, we desire to point out that the cost of a motorship is really less than a steamer if we take her net cargo-capacity as a basis, instead of the obsolete and misleading deadweight-capacity tonnage, because the motorship carries about 12% more cargo per ton of steel used in the construction. As already indicated, when the "Buenos Aires" is loaded to a displacement of 13,800 tons, no less than nine-thousand tons represents profit-earning cargo. Whereas, with an oil-fired steamer of similar dimensions loaded to 13,800 tons displacement not more than 7,700 tons would represent dividend-earning cargo especilly if she was carrying fuel for this long voyage from San Francisco to Sweden and return.

Shipowners who believe that motorships are more costly to construct because American Diesel-engines are 30% higher than steam machinery, will do well to bear this in mind. They can make their motorship smaller in size, and consequently cheaper, and still carry as much cargo as the steamer, while the overhead, operating, insurance and depreciation charges will be less.

Designers, as well as owners, hitherto have overlooked the fact that the net cargo-capacity of an oil-fired or coal-burning steamer is very much limited by the distance of the voyage (which is hardly the case with a motorship), so to lift the same net-cargo as the "Buenos Aires" on a voyage of 7,000 to 15,000 miles, the hull of a steamer would have to be from 10% to 14% larger, and the engine-power fuel-consumption, dues, proportionately greater. Shipbuilders bidding on vessels should point this out to shipowners.

THOS. ORCHARD LISLE.

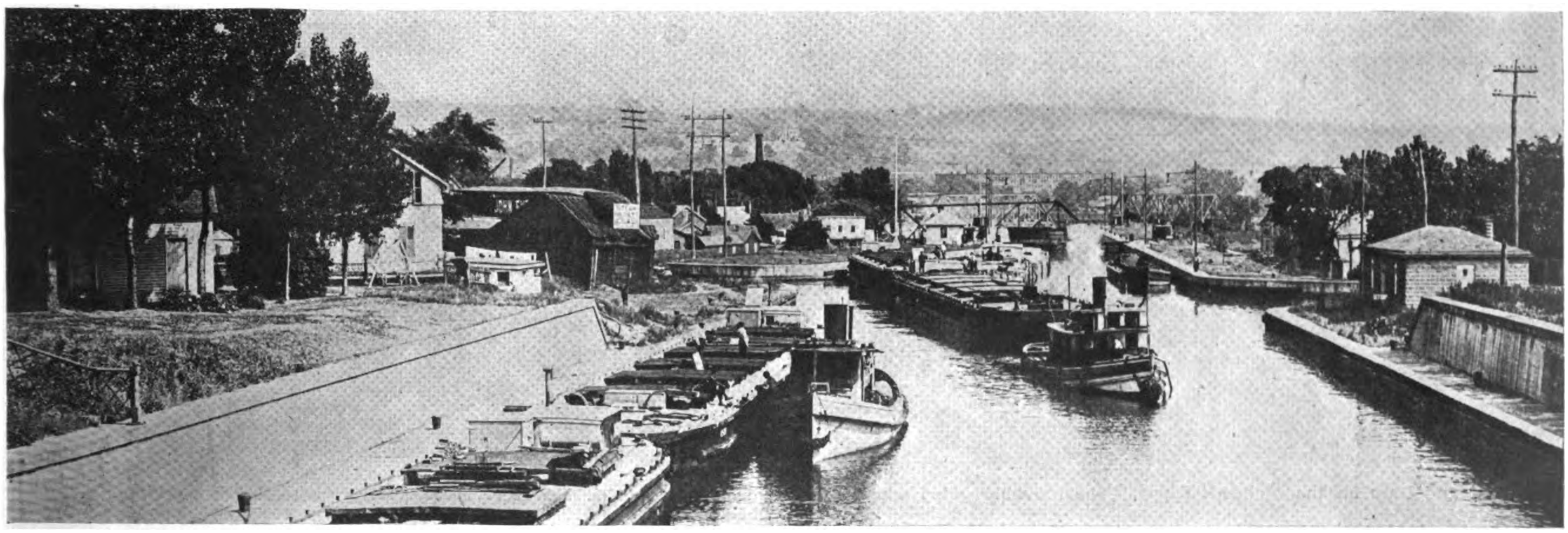
FUEL-BILL OF THE "STUREHOLM."

A clerical error crept into the article on the operation of the motorship "Stureholm" on pages 206-207 of our March issue. The total fuel-consumption was given as being 1,142 tons at an average of $5.00 per barrel, and the total fuel-bill as $5,712.50. The latter figure, however, is obviously incorrect as $5.00 per barrel is $35.00 per ton, so that the cost of 1,142 tons at that average price would be about $39,970. We had inadvertently taken the price per barrel as the cost per ton when multiplying.

Nevertheless, the "Stureholm's" actual fuel-bill probably was lower than this, as of each bunker-load of 1,000 tons taken aboard in the U. S. A. she can, if desired, sell about 600 tons in Sweden and still have enough fuel to return to the U. S. A. And there is a steady demand for this class of fuel-oil in Scandinavia for motor-vessels and for cleaning gas at town gas-works. Furthermore, the prices actually paid by the "Stureholm" for oil varied from $17.50 to $45.50 per ton, and to be on the safe side we took $35.00 per ton as an average, whereas it probably was less than this. So a total fuel-bill of $25,000.00 is probably nearer the mark.

PROPOSED STATE TAX ON FUEL-OIL

A measure has been introduced in State legislature providing for tax of 1c per gal. on all liquid-oils used in internal-combustion engines in the State of Washington.



Lock No. 3 at Waterford, N. Y. The tugs are burning-up fuel while waiting for lockage. Oil-engine power can be instantly shut-down and immediately started, without waste of fuel during the interim.

Economical Transportation on the New York State Canal

A Series of Exhaustive Articles on Barge-Commerce Along the World's Greatest Inland Waterway

BY OUR SPECIAL COMMISSIONER

PART II—The Structures and Boat-Handling Equipment of the New Canal

[Continued from page 202, March issue. Owing to the printer's devil being particularly active last month, pages 200 and 201 were accidentally transposed, so page 201 should be read before 200.—*Editor.*]

FEW people realize that the New York State Barge Canal suffers not at all by a comparison with the Panama Canal. Whereas the latter has cost $400,000,000.00 and required 200,000,000 cubic yards of excavation, the modern New York State waterway will have incurred a bill for $200,000,000.00 and necessitated carving out 115,000,000 cubic yards. 5,000,000 cubic yards of concrete have been poured on the Isthmus and 3,000,000 in New York State. In order to cope with a far more diversified range of technical problems, the Barge Canal engineers had to build 39 dams and 57 locks, while at Panama only 4 dams and 6 locks were necessary. The Panama Canal is 50 miles long, less than one ninth the extent of New York's 454-mile watercourse. More than half of the entire Adirondack watershed had to be impounded and controlled to meet its needs.

Because of a variety of unsettled conditions originating in the later history of the old Erie Canal and because of circumstances arising out of the World War, a direct comparison on a commercial basis is not now possible. Among other things, floating equipment is sadly lacking on the New York State Barge Canal; but inasmuch as an adequate supply of this would only represent something like a quarter of the entire physical basis of canal transportation, it is a certainty that commercial development must take place as the result of present necessities and because three quarters of the physical basis—a stupendous civil engineering accomplishment—is already complete and functioning perfectly.

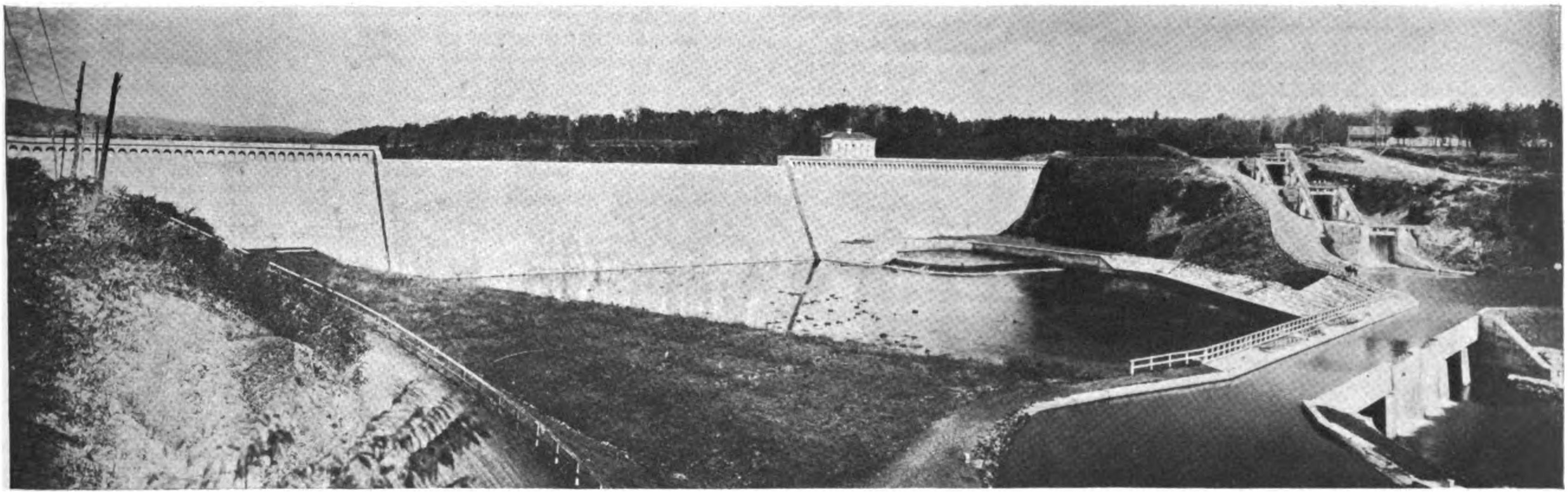
Before the modern New York State Canal was begun in 1904, traffic on the old Erie waterway had dwindled away at a steady rate. Although competition by the railroads had something to do with this, the facts of the matter fall far short of supporting the assumption that railroad rate cutting killed the old canal.

The growing inadequacy of floating equipment, a self-intensifying cause of canal decline, was a much more vital factor. Lack of boats was due originally to uncertain and halting action on the part of the State as regards enlargements and to the consequent unwillingness of entrepreneurs to commit themselves on types that might be rendered unfit because of State action. As old boats rotted away, fewer replacements were made, and the resulting damage to the service made it less and less attractive for any one to be bothered with it all. Owing to the lack of elevator facilities at New York City, canal-boat shipments labored under a severe handicap as compared to the railroads, to whom the use of a few hundred thousand freight-cars more or less for storage purposes every year was of no great consequence.* The old canal was completely out of the running as regards way traffic, which could be handled at all seasons and with infinitely greater convenience by means of railroad spurs and sidings. These temporary and far-from-conclusive discouragements brought the business of canal transportation to such a pass in 1898 that the State of New York made up its mind that something had to be done.

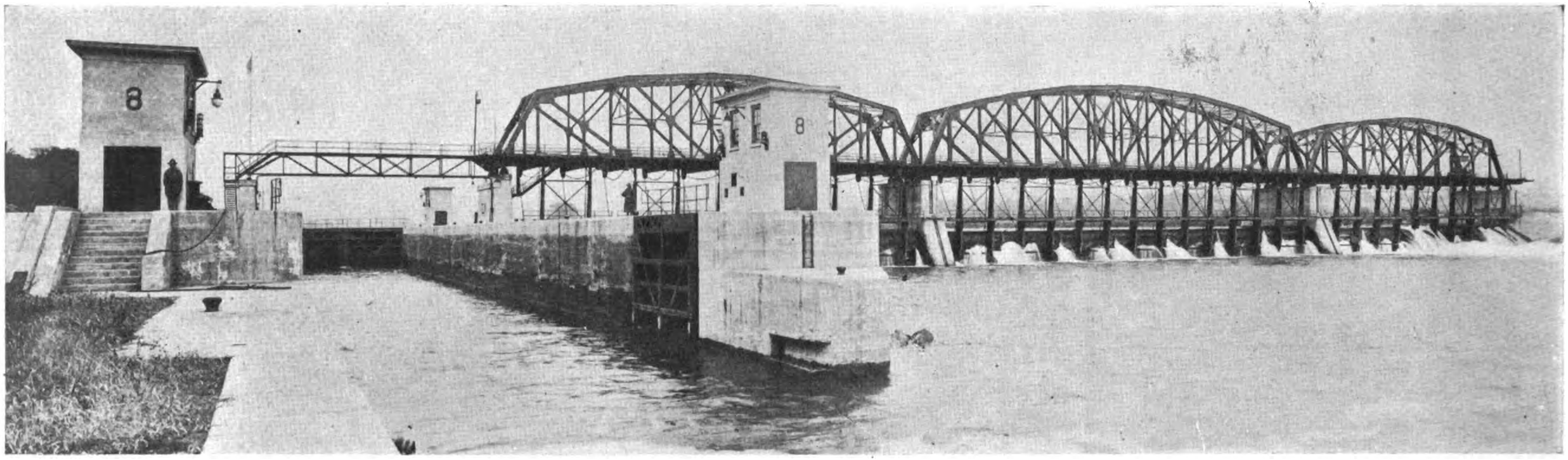
*In recognition of these facts, New York State has appropriated $3,000,000 for elevators at Brooklyn and Oswego.

The Greene Committee was appointed by the late Col. Theodore Roosevelt in 1899 to study the matter and consisted of General Francis E. Greene, Ex-Mayor George E. Greene of Binghamton, N. Y., Representative J. M. Scatcherd of Buffalo, Major Thomas W. Simons, Mr. Frank S. Witherbee of Port Henry, N. Y., State Engineer Edward A. Bond, and Superintendent of Public Works John M. Partridge. As the result of their comparative consideration of a ship canal to replace the old Erie, they found that such an undertaking would not be desirable. Its capacity for handling freight would not greatly have exceeded that of a barge canal. The cost of building ocean-going tonnage was estimated at $71 per dead-weight ton, lake freighters at $36 per ton, and canal barges at $7.50 per ton. A traffic which might require tying up equipment costing $71 per ton over a creeping lengthy voyage did not seem to offer great inducements and the $500,000,000.00 cost was prohibitive. The committee made an emphatic recommendation for what is now known as the New York State Barge Canal. They were silent on the subject of floating equipment, in the assumption, presumably, that the creation of a high-class modern waterway would automatically stimulate the design and construction of suitable boats. They did not forsee the great World War and its results.

At a referendum vote in 1903 the proposition was declared O. K. by a very substantial majority,



Delta Dam, on the upper Mohawk River north of Rome. This superb structure impounds 2,750,000,000 cubic-feet of water to feed the locks of the New York State Barge Canal.

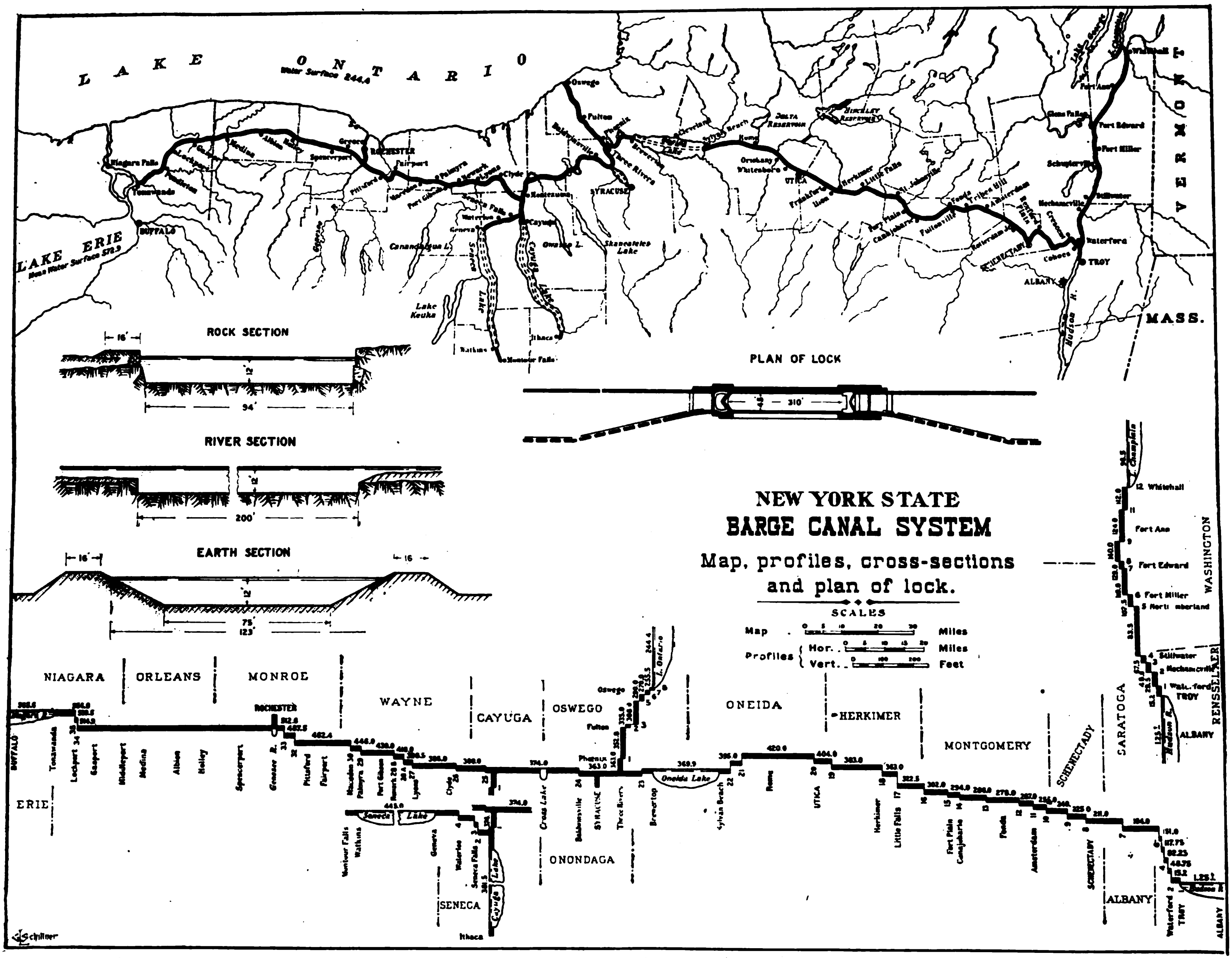


Lock and Dam on the Mohawk River. The movable gates are in operation, regulating the flow of water to suit the needs of the New York State Barge Canal.

and as a result of this $101,000,000.00 were appropriated. Since it took about a year to make the plans and let the contracts, actual construction work was not begun until the spring of 1905. Three years later an additional $8,000,000 began to be devoted to a project for connecting up Cayuga and Seneca Lakes with the modern canal system, an undertaking which seems at first glance to fly in the face of early canal experience. For it had been found that branch canals or "laterals" such as the Chemung, the Chenango, and the Genesee Valley tributaries, which had been opened within a few years of the original Erie's completion, could never be successful and were speedily abandoned. These lessons of history lose their validity, however, in view of the fact that the Cayuga and Seneca branches really tap the coal mining and industrial center of Pennsylvania and that through bulk traffic from there to New York City is highly advantageous in spite of the detour. Other additions to the original canal budget, notably $19,000,000 in 1914 for terminals, increased the original cost to $154,000,000 and before all the proposed grain elevators and miscellaneous improvements have been carried out, the outlay will have amounted to something more than $200,000,000.

The State engineers who started the job in 1905 had anything but plain sailing. Owing to the law which required that the old Erie canal be kept open at all times, roundabout methods had to be used and many delays had to be put up with. Another circumstance that did not contribute to a speedy prosecution of the enterprise was the fact that a large number of railroad lines had to be relocated and gave rise to protracted litigation. The greatest difficulties were those inherent in the project itself and arose from the ambitious plan to utilize the existing turbulent and seasonally erratic water-courses which the original canal engineers had so studiously avoided. Two thirds of the Erie canal were abandoned and the rivers in whose banks it had been cut were "canalized."

Wherever the route of the new canal passed through those parts of the Mohawk, Oswego, Cayuga, Seneca, or Hudson rivers whose cross-section was at any point less than 12 x 200 feet, they were modified to suit these dimensions either



The last word in Inland Waterways, but which has no vessels with the modern system of economical propulsion-machinery.

by dredging or by the construction of dams and locks. Sometimes, as was the case at Troy, a plain fixed dam could be depended upon to maintain the proper level throughout all known variations in the volume of water discharged at that point by the Hudson river and to incur no risks attendant upon ice jams or freshets.

Some dams, as for instance a number of those situated on the Mohawk river, had to be made movable and adjustable, not only to take care of variations in flow, but also to permit the river to return to its natural state during periods when torrential discharges threatened the dam itself with destruction and the surrounding country with inundation. Such would ordinarily occur only during winter months during which inland navigation is stopped anyway. Elaborate bridge-like structures providing anchorage and control for massive gates had to be built and powerful electric hoisting-gear installed. All of these structures caused extensive changes in the aspect of the adjacent country and gave rise to a variety of private claims arising out of property and water-power damage.

The hydraulics of the New York State Barge Canal would fill a book. Even to persons accustomed to thinking in engineering terms, it comes as quite a shock to realize that a canal must have water in it in order to be of any use. More startling yet is the wide application of the simple principle that water won't flow up-hill and a firm adherence to these precepts is essential if we are not to lose our patience as we follow the State engineers through their complicated constructions.

From a glance at the profile of the Canal, it will be seen that as boats progress between Troy and Buffalo, they must be raised and lowered a distance of 564 feet. Every time a boat passes through locks connecting sections of the canal which are at different elevations, an amount of water equivalent to the cubic capacity of one of the locks is taken away from the upper level and must be replenished if the upper level is to be kept from going dry. Nothing would be simpler, in view of the endless supply of water in Lake Erie, if the descent from its level, (573 ft.) to the Hudson River (1.25 ft.) were uniform. But Mother Earth's bosom at Rome, N. Y., is elevated to 420 feet and water from Lake Erie could not flow to this level because of a low region of 363 ft. which intervenes in the neighborhood of Syracuse. Although Seneca Lake has an elevation of 445 ft., its long distance from the Rome summit level would make it unsuitable as a feeder even if it were not for the fact that it is cut off by the same bottom level. Water from Lake Erie would replenish the locks between Tonawanda and Syracuse and would furnish an ample supply as far as Oswego, situated on the 244-ft. level of Lake Ontario, and Lake Oneida would take care of the short stretch between Brewerton and Three Rivers.

But from Lake Oneida to Rome the Canal rises with considerable abruptness, falling again uninterruptedly until it reaches the Hudson river level at Troy. Here is a long stretcvh of 22 high-lift locks, which, if operated to anything like their capacity, require careful provision of an unfailing water supply. It makes no difference even if a large proportion of the waterway in this section consists of "canalized" rivers, which are ordinarily thought of as containing large amounts of flowing water. The draining effect of the big locks would be so great as to make the normal discharge of the various streams seem quite insignificant and it is interesting to note that the ultimate annual carrying capacity of the Canal is fixed by the number of lockages that can be artificially provided.

When a boat passes down through a flight of locks, it takes the water which it needs with it. If the locks are spaced close together, as they are at Waterford, N. Y., the filling of a given lock is taken care of with the water drained from the preceding lock and if allowance is made for leakage and wastage, it may roughly be said that it takes one lock-full of water to lower the boat down. When the individual locks are far apart, however, this approximation is no longer justified, because the water that came down through a given lock with the boat gets to the next lock considerably in advance. If some other boat just happens to be there in readiness to utilize it, well and good, but it is a practical certainty that it will not be needed just at the moment when its gets there and that it will leak through the gates slowly or run over the spillway unused.

An adequate supply of water is fed into the Rome summit level from reservoirs formed by damming up the entire southern watershed of the Adirondack Mountains. 137 square miles of this area are drained into an artificial lake behind the Delta Dam, having a height of 100 ft., inundating 4 1/3 square miles, and impounding 2,750,-000,000 cubic feet of water. An even greater part of the supply comes from the Hinckley Reservoir, which has been produced by a dam 56 ft. in height. The water which runs off an area of 372 square miles is collected behind this dam in a lake that has a superficial area of 4½ square miles and stores 3,500,000,000 cubic feet.

The heavier demand on this water-supply system is made by boats that pass upward through the locks. Water that is fed into a lock with a boat floating in it near the bottom is irrevocably lost, so far as that particular boat is concerned, as soon as it has been floated into the bottom of the lock next higher up. The water goes down the flight and the boat goes up the flight, and "ne'er the twain shall meet." The more traffic there is on the canal, the greater are the chances that the discharged water will be used further along.

If we consider that for upward-moving boats each lock requires, in round numbers, 250,000 cubic feet of water to fill it and that there are 22 of them between Troy and Rome, we don't need much arithmetic to discover that the passage of a single boat or tow of barges might drain the reservoirs to the extent of five-and-a-half million cubic-feet of water. When the State Engineers first told us about the Hinckley and the Delta Reservoirs, it seemed to us as though they might be bandying about billions of cubic-feet of water in a rather irreverent manner, but they really should be pardoned. Careful estimates which they have made on the basis of the foregoing considerations and a great many more besides, indicate that the water supply to the locks can take care of an annual traffic amounting to fifteen million tons.

The construction of the locks represents a thorough job of planning and execution. Although the plan dimensions of the craft that are admitted to the locks are limited to 42 ft. by 300 ft., their actual size is 45 ft. by 310 ft. Gates weighing as much as 200,000 pounds are swung open and closed on steel pivots within thirty seconds and are in some cases locked shut against a total water pressure of more than a thousand tons. Each group of locks is fitted with two independent hydro-electric generating plants which furnish current for operating the heavy steel gates and the comprehensive machinery of the movable dams.

Hand-operation is also provided, against the rare contingency that both turbines might be out of commission simultaneously. There is a single lock near Glens Falls with a lift of 40½ feet, a height considerably in excess of the greatest lift employed at the Panama Canal. The total lift of all the locks on the Isthmus is exceeded more than twice by the world's greatest flight of locks situated at Waterford, N. Y. There are five in the series and their combined lift is 169 ft.

A minimum depth of 12 ft. is maintained not only above the sills of the locks, but also throughout the remainder of the Canal. As may be seen from the sections, a minmum bottom width of 75 ft. is maintained in the "land lines." To allow for currents and other uncertainties incident to navigation on canalized rivers and lakes, 200 ft., almost three times as much, of clear channel are provided.

Where the canal has been cut through solid rock, its walls are practically vertical and enclose a passage 19 ft. wider than that of the land line, or 94 feet., in all. The extra width of the rock section is good insurance against damage that might occur to boats as the result of bottoming. Owing to the varied character of the rock which had to be cut, and particularly to the flinty nature of that which was encountered near the center of the State, a variety of expedients for removing it had to be resorted to. Drilling within dry cofferdams, under-water blasting, and the use of a 16-ton drop-hammer for breaking the rock were some of the methods devised by the State Engineers.

A complete story of the great engineering work that has been carried out would fill volumes and libraries; as we can barely skim over the subject here, and as our special purpose is to show what part should and will be played, in the final fruition of the huge effort, by the modern oil-engine, we refer those of our readers who are interested in further details to the many and excellent works that have already been published. Notable among these is an article by Mr. Wilfred H. Schoff in the Bulletin of the American Geographical Society, Volume XLVII. The comparative diagrams of the various historical cross-sections which we showed in our March issue, page 202, were borrowed from one of Mr. Schoff's articles. The curves relating to growth of population and real estate values were taken from the Historical Supplement of the Report of the State Engineer and Surveyor for 1905. This is a most exhaustive work and deserves high commendation.

A conclusion which even our fragmentary review of the vast engineering structures of the New York State Barge Canal forces home upon us is that this elaborate waterway is no place for steam-driven craft. The length of the new Canal with its branches and tributaries is 454 miles and it has 57 locks. This means that for each average clear sail of 8 miles lasting an hour and twenty minutes, a quarter of an hour must be spent in locking and unlocking. Twenty percent of the time is therefore spent in consuming a very substantial amount of fuel to no purpose whatever. Although the stand-by losses incident to the operation of steam locomotives are highly burdensome, they cannot compare to the inroads on the coal-pile made by firing coal under the boilers of tugs and power-barges that have to wait around for a fifth of the time during which they are in service. Even in the face of this handicap imposed on steam-barge operation, railroad rates have in the past continued to bear a relation of several hundred per cent to Canal freight rates.

There is nothing speculative about what Canal competition would do to the railroads, no matter what facilities they might offer, if fleets of economical motor-driven craft were put on the Canal. Railroads have maintenance, overhead, interest, and depreciation charges to meet on their right-of-way; not a penny of these costs needs to be borne by Canal transportation enterprises. The competitive margin on which the railroads have been able to do business against Canal traffic has been convenience of service and freight-handling facilities, and that has been effective against steam-driven Canal craft. The enormous economies effected by means of the modern oil engine not only in the matter of stand-by losses, but also as regards steady operation, can easily pay for differences in service facilities.

JULIUS KUTTNER

(To be continued in May issue of "Motorship")

CHICKASAW MARINE DIESEL ENGINE

It is reported that the Chickasaw Shipbuilding Co. of Mobile, Ala., is building a large four-cycle type marine oil-engine. This yard is a subsidiary of the U. S. Steel Corporation.

CHALONER'S TREATISE ON AIR INJECTION OR MECHANICAL INJECTION

In the last column of Mr. Chaloner's article on "Air Injection versus Mechanical Injection" on page 133 of our February issue some paragraphs of type were accidentally interposed by the printers in wrong places. Correcting same Mr. Chaloner writes as follows—

"My manuscript finishes on page 9 with the paragraph, which you print in column III on page 133—"again a question of dimensions of the spray-holes, which are larger when employing steam as the"— On the third line of column III page 133 you continue with the word "medium", although my manuscript commences on page 10 with the words—"atomizing agent, thus enabling larger sized holes to be used and reducing the risk of choking . . ."

Your printers interposed from line 3 to line 23 of column III, page 133, several paragraphs, which are in the wrong place, and then with line 24 come back to the correct sequence of the manuscript, which still deals with "Atomization", whereas the way you have printed it, it appears to refer to "Vaporization".

According to my manuscript, the chapter on "Vaporization" follows the last paragraph in column III on page 133; i. e.—the one ending—" . . . and impracticable when evolved in conjunction with mechanical injection."

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MOTORSHIP

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PROMINENT SHIPBUILDER'S MISCONCEPTION OF MOTORSHIPS

We are obliged to take exception to some figures regarding hypothetical motorship operation-costs recently given before the National Merchant Marine Association by Joseph W. Powell, ex-Vice-President of the Bethlehem Shipbuilding Corporation, because they are quite inaccurate and misleading and calculated to hamper the progress of the motorship industry if allowed to be absorbed into the minds of shipowners without challenge. In giving such figures, Mr. Powell is inadvertently "killing the goose that lays the golden eggs for the shipbuilder," as without a wholesale change to economical oil-engine power the American merchant-fleet undoubtedly will dwindle almost back to its pre-war days, as is already indicated on every side, and American shipbuilding then will be in an equally unfortunate position.

Referring to the economies gained by the use of the Diesel engine, Mr. Powell said "the principal saving was in fuel, and that with a 10,000 tons ship the saving would be about $100 per day, or approximately $25,000 for a 250 days' operating period, and that added to this was a small advantage due to increased deadweight of the vessel because of the smaller amount of fuel to be carried . . ." It would be interesting to know how and whence Mr. Powell obtained his fuel-saving figures, because they are far from accurate. As shown by figures issued by the Anglo-American Oil Company (see page 211, March issue of MOTORSHIP), the fuel-consumption of their 10,050 tons deadweight tanker compared with an oil-fired steam-tanker of theirs, the saving in fuel on a single round transatlantic voyage was $43,419. As we believe six to eight voyages are made in a year, the saving (if fuel prices did not fluctuate) would be from $260,514 to $347,343 per annum. This is a vast difference to Mr. Powell's $25,000 per annum.

Supposing we assume this to be an exceptional case, as it deals with tankers, why is it many dry-cargo motorships regularly show similar gains in service? For instance, Consul-General Axel Johnson states in this issue of MOTORSHIP that his Diesel-vessels show savings in their fuel-bills of $300,000 per annum per vessel compared with his own steamers on round-the-world voyages. Figures concerning the actual fuel-consumption of his new 9,600 tones d.w.c. Diesel motorship "Buenos Aires" are given in the same issue, and to the figures in question we respectfully draw Mr. Powell's attention. This vessel hasn't a cent in fuel costs! Then again there is the fuel-consumption record of the m.s. "Stureholm" in our March issue, showing that this 7,800 tons d.w.c. Diesel vessel covered 27,525 nautical-miles on 1,142 tons of fuel, carrying 42,114 tons of net-cargo in addition to bunker-oil. Assuming the average high price of $5.00 per barrel ($35.00 per ton) that has been paid in the past, the total fuel-bill for these seven voyages only amounted to $39,931—part of which she regained by selling surplus bunker-oil at higher prices. At to-day's price of $20.00 per ton, her total fuel-bill would only have been $22,840, without making deductions. We can quote a hundred such cases.

Mr. Powell says that "with the Diesel-engine the cost of fuel can be cut in half compared with a good steam-turbine installation." We won't split hairs, or we would ask why take a "good" steam-turbine job instead of an average ship? Nevertheless, we do request him to produce authentic consumption-figures of any ocean-going four-cycle Diesel-engined motorship of 1,000 i.h.p. per shaft or over in service, with which the average fuel-consumption over six months' or a year's period is in excess of 0.350 lb. per indicated h.p. hour, including all Diesel-electric auxiliaries at sea, or say 0.43 lb. per shaft h.p. hour. We also would like him to show an authentic record of the similar average consumption of say a dozen turbine-driven vessels where the fuel-consumptions at sea over similar periods has averaged under 0.95 lb. per shaft h.p. hour. Figures given us by shipowners demonstrate that the general run is 1.0 lb. or 1.1 lb. under regular conditions. Readings to be by a tortion-meter on shafting, because indicator-cards are not possible as with the Diesel-engine. We in return will produce authentic figures of not less than 25 motorships, with which the consumptions have never averaged over 0.330 lb. per i.h.p. on long voyages, and in most cases under 0.320 lb.—even with some vessels that have been in service over five years. The average fuel-consumption records of a turbine-ship after five years' operation would be interesting, particularly if no new boiler-tubes had been fitted.

Regarding Mr. Powell's reference to " . . . the small advantage due to increased deadweight because of the smaller amount of fuel to be carried," he as a shipbuilder should know that the deadweights of a motorship and of a steamship of the same dimensions are practically the same, the only difference being in the weight of machinery and boiler-water; but that the net cargo-capacity of the motorship is greater by reason of less fuel being necessary.

Mr. Powell also declared that " . . . there are increased capital charges due to the higher cost of the motorship." To compare capital charges in this manner is unfair as well as misleading. True, if you build two hulls the same size, one with Diesels and the other with steam machinery, the motorship will cost about 10 per cent more. But, for every 10,000 tons deadweight she will carry 1,000 to 1,200 tons more cargo, so why not build the motorship 10 per cent to 12 per cent smaller in size? She will still carry the same amount of net-cargo as the larger steamer, and will cost about the same! Her capital charges will then be approximately the same, while her operating charges will be at least 65 per cent less. In Europe insurance rates on modern steel Diesel-ships are lower than on steel steamers with geared turbines. These are important factors apparently overlooked by Mr. Powell.

Finally, Mr. Powell said he was a particular advocate of the oil-engine, but he wished to lay emphasis upon this fact, namely, " . . . that the belief of those who would *seize the commerce of the world* by substituting the Diesel for the steam-engine, is in his judgment a dream, and will always remain a dream." The best answer to this belief is "Lloyds' 1920 Returns of the World's Shipbuilding," which on December 31st showed 189 Diesel motorships aggregating about 727,202 tons deadweight actually under construction, without counting about 40 Diesel-vessels building in Germany. Readers should compare these figures with the returns for 1919 and form their own conclusion.

SHIPPING BOARD TO CONVERT SEVENTY STEAMSHIPS TO DIESEL POWER

Just as we had closed for press information came to hand that the U. S. Shipping Board intend to convert 70 of the A-type vessels built at Hog Island to Diesel and Diesel-Electric propelling power. These steel freighters are of 7,500 tons d.w.c. and were originally equipped with water-tube boilers and geared-turbines. At present most of them are laid-up because of shipping depression and need for repairs. Instead of replacing the gearings which have proved unsatisfactory in many instances, it is now proposed to remove the entire steam-machinery and place the vessels in a position to compete with any in the world by substituting economical Diesel-engines or Diesel-Electric-drive.

HOLLAND-AMERICA LINE'S MOTORSHIP

Considerable furore was recently produced in marine-engineering and shipping circles by an announcement given to the New York "Journal of Commerce" by Director-General Van Doorn of the Holland-America Line that his company had determined to install Burmeister & Wain type Diesel propelling-engines in the new 32,000 tons gross transatlantic-liner "Statendam" building at Harland & Wolff's Belfast shipyard, which Mr. Van Doorn confirmed to us. While such would be the most remarkable advance ever made in marine-engineering, were it correct, we doubt that such a project will be attempted until the Swedish-American Line's 20,000 tons twin-screw 16,000 i.h.p. 18-knot motor passenger-liner has made at least one voyage across the Atlantic, and which will hardly be within two years from now,—unless some enterprising shipowning company or Government purchases the two 12,000 shaft h.p. double-acting Diesel-engines now available in Germany and installs them in some existing ocean-going liner.

However, according to Harland & Wolff, the Holland America Line has just ordered from them a big combination passenger-cargo Diesel-driven motorship which will be a duplicate of the "Glenogle," "Glenbeg," etc., of the Glen Line's fleet. This being the case, she will be of 14,000 tons deadweight 6,600 i.h.p. and of 13 to 14 knots speed. Nevertheless, it is very interesting to see that this conservative Dutch steamship company has at last taken up the construction and operation of motorships.

PRESENT POSITION OF THE DIESEL MOTORSHIP INDUSTRY

Recently we inferred that the American Diesel-engine and motorship industry is in a flourishing condition. We were, of course, referring to the large amount of new development work and the increased general interest. Since then Lloyds report for the year ending December 31, 1920, has been published, and an extract was given in our last issue, which shows that the motorship industry of the entire maritime world is in a position never previously attained.

On that date no fewer than about 219 motorships aggregating over 1,027,000 tons d.w.c. were actually under construction in the shipyards of leading countries, or an average of 4,689 tons d.w.c. per vessel. Of these 189 of 454,502 gross tons (727,202 tons deadweight) had actually commenced construction under the survey of Lloyds inspectors, which does not include about 40 Diesel motorships of over 300,000 tons building in Germany, and which do not come under the jurisdiction of Lloyds, but which are enumerated from reports sent in by our own correspondents. Nor does this total include a number of vessels on order, but upon which work had not begun by the end of last year. Furthermore, since that date several additional motorships have been ordered, including the new 14,000 tons liner for the Holland-America Co. and the order to convert the "Fordonian" to Diesel-electric power. The American vessels "Astmacho III" and "Astmacho IV" both are just being equipped with twin 500 b.h.p. McIntosh & Seymour Diesel engines.

In America progress is being made and greater attention is being focused upon the Diesel-engine by sheer necessity of stringent economy. No longer can shipowners afford to overlook the great savings to be effected by the use of Diesel power. One firm, the Winton Co., report that they have never before had so many orders for Diesel-engines on hand. Others advise us that judging by the apparently serious inquiries coming in, business will shortly be very bright. Several of our leading shipbuilders have just returned from Europe deeply impressed by the turn of affairs in Great Britain and Continental Europe, where steamship construction is in a very bad condition, while more motorships are completing than ever before. In two cases following the return of these shipbuilders, activities in their hitherto semi-dormant and embryo Diesel-engine departments at once began to show signs of vigorous life.

The list on this page shows what is now doing in some of the shipyards, Although not in this list the Merchants Shipbuilding Co. is seriously considering taking up Diesel-engine construction. the Sun Shipbuilding Company is also pondering over the matter, while there is very little doubt but that the Federal Shipbuilding Co.; Todds Shipyards Corpn.; and the Moore Shipbuilding Co. will start something in this direction before long, in accordance with their advices to us. It has been reported to us that the Chickasaw Shipbuilding Co. has already started work on a Diesel-engine, while an engineering firm in the Middle West, whose name we cannot reveal at this time, has commenced their first marine set. Also the Manitowoc Shipbuilding Co. and the United Engineering Works both have acquired a Tosi Diesel license, although so far they have done nothing but complete a small engine and prepare large designs. The big engine building by Craig is for the Submarine Boat Corporation for installation in a hull they have built. Experimental marine oil-engines are being built by the W. & A. Fletcher Ship & Engine Repair Co., by the Seattle Machine Works, and by the Sperry Co. So with these firms in the list we have a total of 24 American companies whose futures are more or less involved with the marine Diesel-engine construction industry. Even then we have not included firms who have built moderately-powered Diesel-engines for merchant motorships, such as the Dow Pump & Diesel Engine Co., not to speak of the several surface-ignition oil-engine manufacturers, one of whom very recently received an order for 25 sets for large 240 b.h.p. barges for the N. Y. State Canal. There are also several domestic solid-injection oil-engine builders, one of which is supplying an engine for the new Hudson & Athens motor-ferry-boat. Also the new Poughkeepsie ferry-vessel is to be Diesel-electric driven.

THAT POWERFUL INFLUENCE!

At the present time a dozen of the Shipping Board's steamers are being converted to turbine-electric drive although the first of these converted vessels, the "Eclipse," is said to be burning about two tons per day more fuel than previously and has about half-a-knot less speed, yet nothing is being done to convert any of the Board's steamers to the more economical Diesel-electric drive or to direct Diesel propulsion. More and more of the Board's vessels are being laid-up, meanwhile foreign motorships regularly leave American ports fully laden with American products. On Feb. 4th the Division of Operation's figures showed that there were 505 vessels of 3,078,000 tons d.w.c. belonging to the Board definitely tied-up and 111 vessels of 660,000 tons awaiting assignment or fixture, and that another 100 vessels may be withdrawn from trade. Also, it is estimated that the Board will lose $25,000,000 on operations in the first six months of this year. What powerful influence is at work blocking the adoption of the Diesel engine in conjection with electric drive? Certainly this system is no less experimental than the turbine-electric propulsion.

Some Large American Diesel Engines Built or Under Construction

(Revised Table of Dimensions)

Engine	Cramp-Burmeister & Wain	Bethlehem West	Worthington	Nordberg-Carels	Mc Intosh & Seymour	Busch-Sulzer	Busch-Sulzer	Craig	Skandia-Werkspoor	Newport-News Werkspoor	New York Werkspoor
Type	Four-Cycle	Two-Cycle	Four-Cycle	Two-Cycle	Four-Cycle	Two-Cycle	Nav. Type	Four-Cycle	Four-Cycle	Four-Cycle	Four-Cycle
Brake horsepower	1,750	2,500	1,760	2,000	1,525	1,250	2,250	1,850	850	1,450	1,500
Indicated horsepower	2,250	3,500	2,400	2,800	2,000	1,850	3,400	2,240	1,150	2,000	2,000
No. of Cylinders	6	6	6	4	6	4	6	6	6	6	6
Cylinder Diameter	29⅛″	25½″	29″	28″	28″	24″	...	30″	20.472″	27″	27″
Piston Stroke	45¼″	48″	46″	48″	48″	38″	...	48″	35.433″	48″	47″
Revs. per minute	115	105	120	110	105	110	...	105	135	110	110
Piston Speed (per minute)	827′	840′	920′	880′	840′	696′	...	840′	800′	880′	862′
Brake H. P. per Cyl	291	416	291	500	254	312	375	310	141	242	250
Ind. H. P. per Cyl.	375	584	400	700	335	450	570	375	191	325	333
Weight (Short tons)	303 tons	350 tons	339 tons	281 tons	361 tons	175 tons	...	275 tons	148 tons	240 tons	270 tons
Weight per B. H. P.	346 lbs.	250 lbs.	386 lbs.	315 lbs.	475 lbs.	280 lbs.	...	300 lbs.	349 lbs.	330 lbs.	360 lbs.
Mean Effec. Pressure	66.3 lbs.	64.1 lbs.	64 lbs.	61.14 lbs.	65 lbs.	...	...	68½ lbs.	72 lbs.	6.33 lbs.	72 lbs.
Length Overall	43′ 6″	...	45′	44′	47′–4¼″	35′	...	41′	38′ 5″	35′ 8″	34′

This table substitutes the table published in our February issue, as some of the figures given were incorrect, also some figures were missing. Furthermore the four Cramp B. & W. engines building for the American-Hawaiian Steamship Co.'s ships were accidentally omitted. In the above table details of the Ingersoll-Rand engine have been omitted by request. It will be noticed that seven firms are building the four-cycle type and three firms are constructing the two-cycle system. Of the latter class is the Busch-Sulzer Naval Engine. Complete details of this motor are not permissible at this time. With one exception; namely, the 1,250 shaft h.p. Busch-Sulzer Merchantship Engine, all engines are building or in service, and this particular engine will soon be started. Six of the Busch-Sulzer 2,250 shaft h.p. naval Diesel-engines are under construction. Altogether the above list represents 30 Diesel engines aggregating 98,890 i.h.p. actually on order or under construction, and include the eight Bethlehem-West engines which order has not been officially cancelled regardless of rumors, but does not include the balance of the Shipping Board's M. & S. and S-W engines.

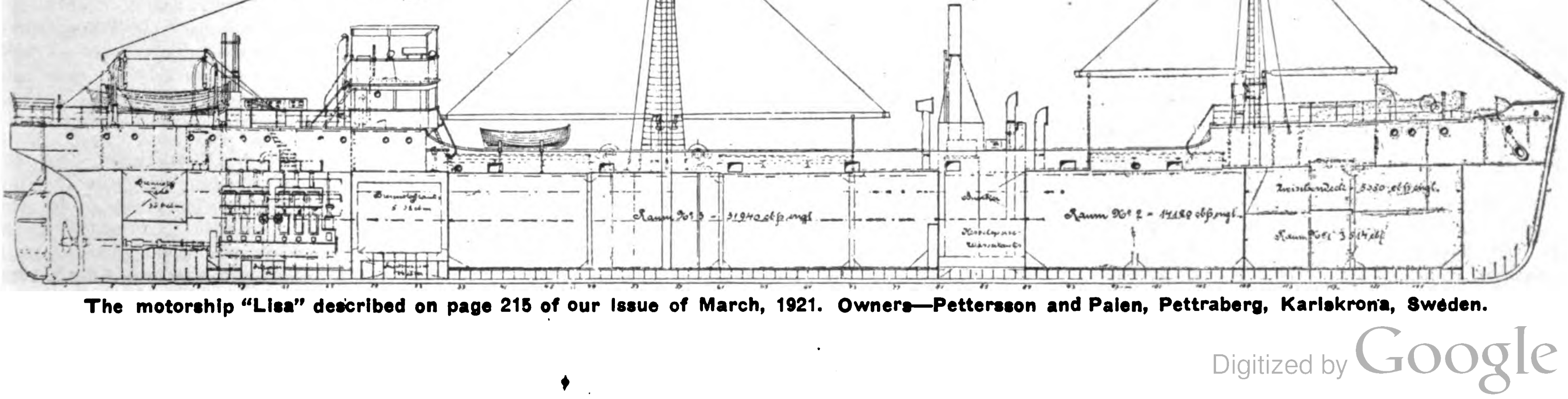
Atlas Mechanical-Injection Marine Oil-Engine

By CHAS. W. GEIGER

After making an exhaustive study as to the requirements in the field in which they now intend to devote their entire efforts, the Atlas Imperial Engine Company of Oakland, California, have decided on a definite plan to which they will adhere.

Having had a great many years' experience in both building and selling of various types of internal-combustion engines including the Atlas-Diesel motor, Mr. A. Warenskjold, President of the company stated to a "Motorship" representative that they will hereafter engage their entire plant along quantity production lines and will direct their energies to the manufacture of a solid-injection type of Diesel engine, which they lately have developed. In Mr. Warenskjold's opinion this system which they have evolved is far superior to the air-blast method of fuel-injection which was installed in the large Diesel-engines which they have built in the past—the superiority resting upon the percentage of efficiency gained.

Quantity production has necessitated standardization of all parts and they have decided that the cylinders will be made in two sizes only, namely—55-h.p. three-cylinder; 80-h.p. four-cylinder; 120-h.p. six-cylinder, all 8 in. bore with 10½ in. stroke. Then in a larger size cylinder they have—100-h.p. three-cylinder; 135-h.p. four-cylinder; 200-h.p. six-cylinder, with a bore of 10½ in. and 14 in. stroke.



The motorship "Lisa" described on page 215 of our issue of March, 1921. Owners—Petterson and Palen, Pettraberg, Karlskrona, Sweden.

Motorships and Diesel Engines—New Construction Reports

DIESEL-ELECTRIC PROPELLED FERRY FOR POUGHKEEPSIE

It seems almost certain that the new ferry-vessel for service on the Hudson river at Poughkeepsie will be Diesel-electric propelled.

MOTORSHIPS AT BALTICA SHIPYARD

The motorships previously referred to as being under construction at the Baltica shipyard, are 350 ft. long by 50 ft. breadth and 26½ ft. depth.

"GROTIUS" A 200 H.P. MOTOR TUG

Trials have been run in Holland of the motor-tug "Grotius" owned by De Roode Ster of Rotterdam. A 200 i.h.p. Skandia surface-ignition oil-engine is installed.

WALLSEND BUILDING SULZER-DIESEL ENGINES

Sulzer-Diesel marine-engines are being built under license by the Wallsend Slipway & Engineering Co. of Wallsend-on-Tyne, England.

MOTORSHIP "SOMERSETSHIRE" LAUNCHED

At the end of February, Harland & Wolff launched the big Diesel motorship "Somersetshire," sister to their motorship "Dorsetshire" already illustrated in "Motorship."

DANISH SHIPBUILDING IN 1920

(Vessels Completed)

Motorships	25	40,000 tons d.w.c.
Steamers	16	36,700 tons d.w.c.
Sailing-Vessels	19	4,060 tons gross

Of the above motorships, three for the East Asiatic Co., totalled 26,500 tons d.w.c.

SVENDBORG S.S.CO.'S MOTORSHIP LAUNCHED

"Laisae Maersk" is the name of the single-screw motorship for the Svendborg Steamship Company, illustrated and described on page 217 of our March issue. She was launched at the Odense Staal Skibsvaerft (Odense Steel Ship Building Co.) on Feb. 12th, and will be completed about the end of May.

ANOTHER NEWCOMER

"Syren & Shipping" of London in a recent issue stated that it had been whispered to them that the present list of British motorship owners is likely to be added to before long by a well-known firm now engaged in the passenger and cargo trade. We presume they refer to the Cunard Line, as indicated in our February issue.

THE CRAIG 2,500 H.P. MARINE DIESEL-ENGINE

We recently saw the new 2,500 b.h.p. open-crank-case four-cycle type Craig Diesel-engine at the Craig plant in Jersey City, N. J. It is about 95% completed and shortly will be installed in a single-screw freighter built by the Submarine Boat Corporation. No technical details will be published until trials have been run. Many novel features of design and construction are incorporated, and the general design may be said to be strictly original and all-American.

NEW MOTORSHIP BUILDING WAYS AND DIESEL FOUNDRY

Burmeister & Wain of Copenhagen are completing their new 600-ft. building ways at their shipyard, and the first keels to be laid down will be the two motorships (Yard Nos. 310 and 317) for the Johnson North Star Line, and the motorship (Yard No. 319) for Wilhelm Wilhelmsen of Tonsberg. According to our Scandinavian correspondent, Otto Thoresen also has some B. & W. motorships on order. Motorship yard No. 318 is for the East Asiatic Company, but will not be laid-down for a short while. The new iron foundry now being created by Burmeister & Wain is making rapid progress.

SWEDISH ELECTRICALLY-WELDED MOTORSHIP

A small electrically-welded steel motorship named "Erab IV" has been completed in Sweden by the Elektriska Svetsnings Aktiebolaget at Göteborg to their own order as an experiment. The hull was welded on the Lindfors system and the total length of the welds is 5,655 feet. A surface-ignition oil-engine is fitted for propulsion purposes. There are now three welded steel motorships in service, the others being the British boat "Fullagar," and the craft built on the Kjellborg system by La Sondure Antogene Francais, of Paris, France, for service in Havre Harbor.

BIG MOTORSHIP FOR HOLLAND-AMERICA LINE

A large combination passenger cargo motorship for transatlantic trade has been ordered by the Holland-America Line from the Belfast plant of Harland & Wolff. We understand that this vessel will be practically a duplicate of the Glen Line's "Glenogle" class Diesel-driven ships; namely about 14,000 tons d.w.c., 6,600 i.h.p. and of 12½ to 13½ knots loaded speed. Recently a statement appeared in the daily-press based on a report issued by the Director-General in New York of the Holland-America Line to the effect that the 32,000 tons gross passenger-ship "Statendam" was to be Diesel-powered, which statement was confirmed to us by Director General Van Doorn himself. Evidently there has been some misunderstanding in the matter.

NEW BIG MOTORSHIP FOR LIVERPOOL, BRAZIL & RIVER PLATE STEAM NAVIGATION CO. LTD.

Among motorships recently completed in Gt. Britain is the "Leighton", a vessel of 7,300 tons gross built to the order of the Liverpool, Brazil & River Plate Steam Navigation Co. Ltd. (Lamport & Holt) by A. McMillan & Son of Dumbarton, Scotland, which is a subsidiary company. She is propelled by twin six-cylinder 26 2/5 in. by 39 2/5 in. Harland & Wolff B. & W. Type Diesel-engines. Her dimensions are as follows—

Deadweight-capacity	11,500 tons
Power	4,000 i.h.p.
Length	430 ft. 1 in.
Breadth	56 ft. 2 in.
Depth	34 ft. 9 in.

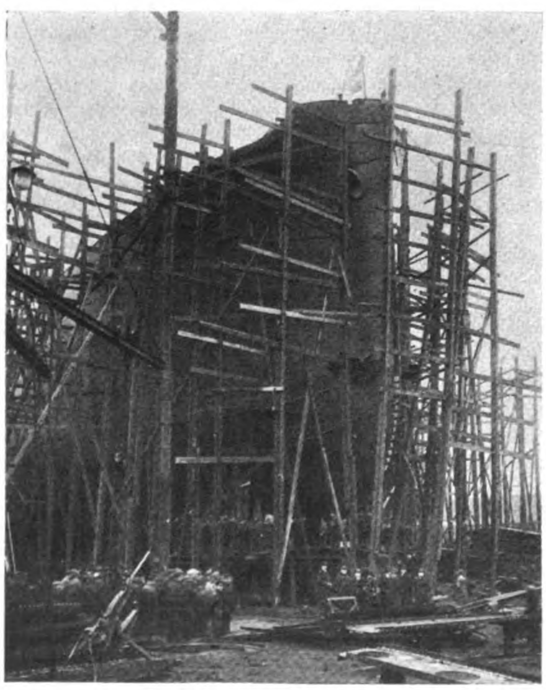
She is the first of six of these Diesel vessels on order and they have previously been referred to as building for Lamport & Holt.

ATLANTERHAVET'S NEW MOTORSHIP

Regarding the 7,000 tons d.w.c. cargo-ship building at the Southern Yard, Copenhagen, for the Dampskibsselskabet Atlanterhavet (Atlantic Shipping Company) of the same city in which a geared-turbine was to be installed, but in which a Burmeister & Wain Diesel-engine will be fitted instead. She was referred to in our February issue and her dimensions are as follows—

Deadweight-Capacity	7,000 tons
Cubic Cargo-Capacity	440,000 ft. grain
Fuel-Capacity	1,021 tons
Length (on W. L.)	375 ft.
Breadth	52 ft.
Depth to Shelter-deck	35 ft. 8 in.

There will be 10 Thrige 3½ ton electric-winches, and a special warping device astern. The steering-gear is of the electric-hydraulic type, the windlass is electrically operated, but heating is by steam from a donkey-boiler. On the boat-deck is a "wireless" cabin. Electric-light is installed throughout the ship. The keel was recently laid. The owners are now one of "Motorship's" numerous subscribers in Europe.



13,500 tons d.w. motorship "Malaya" just prior to launching. She is fitted with Burmeister & Wain's 4,500 i.h.p. Diesel-engines

SALVAGE MOTORSHIP IN SERVICE

The new 1,250 i.h.p. salvage motorship "Fritiof" was used, together with the steam tug "Harald", to tow the Eriksburg Co.'s new 14,000 tons floating-dock from Lubeck to Göteborg.

ANDORA II, A NEW ITALIAN AUXILIARY

Among Italian motor-vessels completed last year was the wooden auxiliary "Andora II," 1,056 tons gross, built and owned by Quaglia & Galdini, of Andora & Genoa. Length 201 ft., 1 in., Breadth 36 ft., 4 in., depth 20 ft., 3 in. A six-cylinder 9 4/5 in. by 10 3/5 in. Ansaldo-San Giorgio two-cycle Diesel engine is installed.

LAUNCH OF BIG MOTORSHIP "MALAYA"

Burmeister & Wain of Copenhagen have launched the new big motorship "Malaya," 13,500 tons deadweight-capacity and 4,500 i.h.p. to the order of the Diesel East Asiatic Cmpany. She is about the same as the same owners' motorship "Afrika," completed last year, and has the following dimensions:

Deadweight capacity	13,500 tons
Length (O.A.)	464 ft.
Length (B.P.)	445 ft.
Breadth	60 ft.
Depth (from A.D.)	42 ft.
Power	4,500 i.h.p.
Speed	12 knots

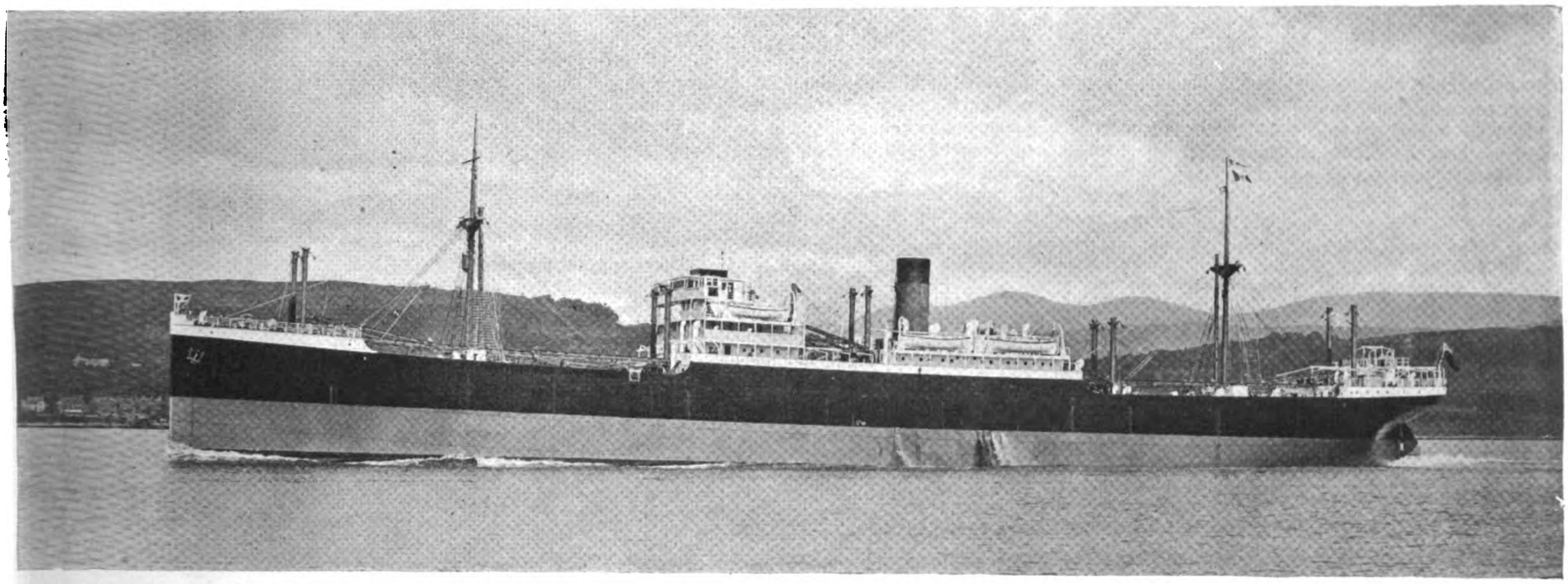
All the deck machinery is electrically-driven. A very powerful wireless is installed.

"MURIEL" A NEW 1,000 h.p. WOODEN MOTORSHIP

Among wooden oil-engined vessels recently built is the "Muriel", completed last year on the Pacific Coast at the Anderson yard, Houghton, Wash., and owned by the Scandinavian-American Bank of Seattle. Trials have just been run. She is classed at Lloyds A1, for 12 years and is of 3,200 tons bale capacity. Her propelling power consists of twin 500 b.h.p. Skandia surface-ignition oil-engines, which are said to give her a speed of 10 knots, although we estimate that an average of 9 knots loaded would be a good speed for her tonnage and power. The "Muriel" has the following dimensions—

Bale Capacity	128,000 cub. ft. (3,200 tons)
Lumber Capacity	1,600,000 ft.
Fuel-Oil Bunkers	323 tons
Daily Fuel-Consumption	4½ tons
Cruising Radius	70 days
Fresh Water Tankage	7,000 gallons and 3,750 gals. reserve
Lubricating-oil Tankage	700 gallons
Winches (steam)	Six 7 in. by 8 in.
Shaft horse-power	1,000 h.p.
Wireless	Kilbourne & Clark 1,600 miles max. range
Gross Tonnage	2,185 tons
Net Tonnage	1,597 tons
No. of Crew	23
Classification A-1-12 years	Lloyds Highest
Length overall	260 ft.
Length water line	247 ft.
Breadth moulded	46 ft.
Breadth overall	47 ft. 1 in.
Depth Moulded	26 ft.

The length of her hold is 153 ft. and she has 154 ft. of clear deck. Electric light and Markey electric steering-gear is fitted. The engines are installed aft. Her engines differ from the usual Skandia surface-ignition oil-engine in that they are of a new design with separate scavenging-pumps, instead of crankcase compression.



Harland & Wolff-built 14,000 tons d.w.c. 6,600 horse-power motorship "Glenogle." She is one of two sister Diesel-vessels in the service of the Glen Line, and two more are nearing completion. She is propelled by twin 3,300 i.h.p. B. & W. Burmeister & Wain type Diesel-engines. On her maiden voyage the "Glenogle" averaged 12½ knots for 25,000 miles, at times making 14.6 knots. Her average daily fuel-consumption is 18 tons.

Remarkable Motorship Progress on the Clyde

Review of Extraordinary Post-War Development Taking Place in Scotland in the Face of Steamship-Building Slump

By W. ROYLANDS COOPER

AMERICAN shipowners should ponder over the fact that the general slump in shipbuilding, which announced itself towards the end of last year, by the cancellation of a number of steamship contracts, and which at the time of writing is a disquieting feature in the industrial outlook, has not materially affected the position as regards the motor-vessels under construction on the Clyde.

Profiting by the experience of the Glen Line, the pioneer company of motorship owners in Britain, other ship-owning concerns have, during the past year, begun to equip their vessels with Diesel oil-engines. Chief among these are The Pacific Steam Navigation Company; The Bibby Line; Royal Mail S. S. Co.; Elder-Dempster & Co.; Lamport & Holt; the British India Steam Navigation Company, and others. A noteworthy feature observable in all cases, is that a standard type of hull has been evolved, and repeated in subsequent vessels for the same owners. This is, of course, in accordance with the practice of the Glen Line, where the "Glenogle" type (14,000 tons d.w.c. and 6,000 i.h.p.) is represented by four new ships in service, the "Glenogle," "Glenapp," "Glengarry" and "Glenbeg," and the earlier "Glenade" type (6,800 tons gross and 3,200 i.h.p.) —mostly launched in 1919—also by four ships, the "Glenade," "Glenariffe," "Glenluce' and "Glentara."

The Holland-America Line has just ordered a 14,000 tons, 13 knot motorship, similar to the "Glenogle" from Harland & Wolff, but she is being built at their Belfast plant.

Standardization of hulls and consequent economy in construction has without doubt received greater consideration following upon the adoption of highly standardized propelling machinery. That shipowners are not only being compelled by economic conditions to experiment with Diesel-propelled vessels, but that they have developed confidence in the reliability at sea of machinery, which has been thoroughly tested under all conditions of working is evidenced by the fact that British owners are now following the lead of their Continental rivals, and orders have been placed for single-screw vessels of about 6,000 tons gross, fitted with Diesel oil-engines.

Whatever may be the opinion elsewhere, there can be little doubt that in the opinion of shipbuilders and engineers on the Clyde, the motorship is the vessel of the immediate future, and shipyard and engine shops' reconstruction is all being organized to cope with this line of development.

This is particularly noticeable in the establishments owned by Harland & Wolff, who hold the British patent-rights for the Burmeister & Wain type of four-cycle engine. The extensive alterations and additions to the firm's original Diesel-engine factory at Lancefield Quay, commenced early in 1918, have now been completed, and this plant is now capable of turning out the complete engine equipment for one 10,000 tons vessel per month. [An American shipbuilder who recently visited this plant considers it the finest in the world.—*Editor.*]

This, however, is apparently inadequate for Harland & Wolff's requirements, and during the past year, the works formerly owned by the Coventry Ordnance Company at Scotstoun—an admirable site lower down the river—were acquired, and there also reconstruction work is in full progress. There is ample space for extension adjacent to the present shops, and it is expected that when completed and fully equipped this plant will rival, if not excel, that at Lancefield Quay. The craftsmanship of the Ordnance workers will doubtless prove a decided asset in manufacturing Diesel-machinery, which requires a higher grade of workmanship than is necessary in the case of merchant-ship steam-engines, whereas, there is probably no industry in which interchangeability has been so highly developed as in the manufacture of gun mountings.

On the shipbuilding side, Harland & Wolff show the same spirit of preparedness. Extensive alterations have been made at their yard in Govan; where slip-ways have been relaid, and the most modern cranes and machinery installed; but this yard is still unable to meet the demands made upon it, and the recently acquired Greenock Shipyard, formerly owned by Caird & Co., is now being vastly extended in order to provide the requisite number of hulls for the Diesel motorships on order.

Although the services of the most important foundries in the Clyde district and several further South have been enlisted, to supply the necessary castings for the large output of specialized machinery, the supply has only been maintained with difficulty. Messrs. Harland & Wolff have now decided to manufacture their own castings, and late in the summer a 40-acre site in the Govan district was secured and an extensive foundry for the production of all kinds of castings is in course of construction. This foundry will be equipped with the most up-to-date appliances for the economical production of sound marine Diesel castings.

Similiar activity has characterized the development of the North British Diesel Engine Company, at Whiteinch, Glasgow. These well-laid-out and extensive works, unique in Britain, in that they are the only works originally founded and designed to build marine Diesel-engines, are after the interruption of the war period, now fulfilling their proper functions, and the shops are fully occupied on main engines and auxiliaries for the large number of merchant-ship sets on order. Here again, the usual local foundry services have proved inadequate to supply the large number of castings required, and during the year controlling interests have been acquired in the steel works and foundries of Wm. Muirhead, of Mount Vernon, the foundry of Rennie's Steel Castings, Ltd., and the Kilmarnock firm of Grant, Ritchie & Co., these allied concerns will greatly assist the development and enhance the output of the Whiteinch plant.

A notable feature of the year has been the completion for the North British Co. of the 150-ton hammer-head crane supplied by Sir William Arrol & Co., Ltd., and the 900-ft. quay-wall which enables a ship to lie alongside the works during the fitting-out period. This crane is undoubtedly a great acquisition to the Clyde basin, and it is understood that the services of the crane will be available for other builders when not required by the North British Diesel Engine Company themselves. The first motorship to be engined by this crane, as shown in the illustration given in the March issue of "Motorship," is the British India Steam Navigation Co.'s passenger motor-liner, "Magvana," which was launched from the Whiteinch yard of Barclay Curle & Co. Ltd., on December the 24th. She has a length of 464 ft. and is designed for a speed of 13½ knots. Her two engines, which are now being fitted, each develop 2,330 i.h.p.; they are eight-cylinder, four-cycle type engines of North British Diesel Engine's own design.

It is of interest to note that several of the engineers who are to sail on the "Magvana" and sister ships, are at present in the shops and are making themselves conversant with the engines, as they are being built and tested. This is a sound and wise policy for both owner and builder, and will have as its outcome the speedy training of a capable and confident staff of engineers. It is a policy that "Motorship" for years has urged upon American shipowners.

Not very distant from Whiteinch on the opposite side of the river are the famous Linthouse yards and shops of Alexander Stephen & Sons, Ltd. Here the first two 1,600 b.h.p. engines of the Stephen-Sulzer two-cycle type are rapidly advancing, and the new work is being enthusiastically taken up. Special instructional classes are being held to familiarize the younger men with Diesel principles and practice.

At William Beardmore's Dalmuir Works considerable progress has been made with the Beardmore-Tosi engine. Chief among other orders are two single-screw cargo vessels for McAndrew & Co. Ltd., of London, for the fruit-carrying trade already described in "Motorship." The principal dimensions of these vessels are 240 ft. between perpendiculars 38 ft. moulded breadth and 18 ft. moulded depth with a displacement of 3,300 tons at 17 ft. 5 in. draught. The machinery will consist of one six-cylinder Beardmore-Tosi four-cycle reversible crosshead type engine, the cylinder dimensions of which are 620 m.m. bore (24.409 in.) by 975 m.m. (38.385) in. stroke, developing about 1,100 shaft h.p. at 110 r.p.m. The speed of the vessels loaded on trial is designed for 10½ knots.

A special feature is that there will be no steam plant in the ship, all auxiliaries including winches and heaters being supplied with current at 220 volts from two Beardmore-Tosi Diesel-driven generators, each of 50 k.w. capacity. With regard to the engines, no pumps will be fitted, all being separately motor-driven. The Tosi-manoeuvring-gear is electrically operated; also Michell thrust-blocks will be fitted.

Although the name of Yarrow & Co., Ltd., has during the year been associated with one or more of the prominent firms of Diesel-engine designers, there has as yet been no definite announcement of their proposals, but they have been considering building the Werkspoor Diesel engine. Prior to the war Yarrow & Co. held an M.A.N. License and built from this design. At the outbreak of hostilities in 1914 they had on order for the Imperial Japanese Navy, two large destroyers, in which Diesel-engines driving through Fottinger hydraulic transformers, were used as cruising units. Unfortunately the international situation prevented the completion of these unique boats and the obtaining of what would have been very interesting results.

During the war several submarine Diesel engines of the Vicker's design were built at Scotstoun. At the present time, Yarrow & Co. are devoting their attention to the development of high-speed motor-craft for the navigation of shallow rivers, and as larger powers are called for they will again interest themselves in Diesel-engine work.

One of the outstanding events of the summer was the visit to the Clyde of the M.S. "Fullagar" and the successful demonstration of the Cammellaird Fullagar principle before a large and influential company of engineers and shipbuilders. As lately announced, it has now been decided that the engine originally fitted for experimental purposes is too large for the ship. This engine is to be taken out and reinstalled along with a duplicate set now under construction at Cammel Laird's Birkenhead works, in a larger vessel.

Another vessel with this design of engine is being built to the order of the Anchor-Brocklebank Line, and is now almost ready for launching at the Glen yard of Messrs. William Hamilton & Co., Port Glasgow. Her name will be the "Malia,' and she has the following approximate dimensions:

Length between perpendiculars.......350 ft. 0 in.
Moulded breadth.................... 49 ft. 9 in.

The two Cammellaird Fullagar engines which will together develop about 1,300 i.h.p.—the cylinders being 14 in. bore by 20 in. stroke—will be fitted into the ship by the well-known firm of engine builders, David Rowan & Co. Ltd., who have acquired a manufacturing license for the Cammellaird-Fullagar engine, and are preparing their shops for an early commencement of Diesel-engine work.

As already announced in "Motorship," the two other Cammellaird-Fullagar licencees on the Clyde are Dunsmuir & Jackson Ltd., of Govan, and the famous Clydebank yard of John Brown & Co., Ltd. Work has already been started at Clydebank, and the castings for the first large sets of engines are now being delivered. We understand that John Brown & Co. will build the hull themselves.

William Denny & Bros., Dumbarton, have on order at present several motor-vessels which will be engined with Sulzer-Diesel engines of their own manufacture in sizes from 2,500 b.h.p. to 3,000 b.h.p., in addition to a large motorship for the Union Steamship Co. of New Zealand, which will be engined by the North British Diesel Engine Co. of Whiteinch.

Developments of considerable significance are taking place with marine engines of the Still type, which, as readers of "Motorship" are aware, embody a new principle consisting of a combination of an oil-engine and a steam-engine. The patent rights are held by the Still Engine Co., and the development of the engine for different purposes is being carried out by that Company and their Licensees. The largest engine of the type so far constructed is of slow-running merchant-service type specially designed and constructed for marine propulsion by Scotts' Shipbuilding & Engineering Co., Ltd., of Greenock.

Scotts were interested at an early stage in the development of the internal-combustion oil-engine and the first Diesel-driven submarine built by Scotts' Co., was delivered shortly before the outbreak of war. Other contracts followed and the experience gained placed the firm in a very favorable position to take part in the development of the Still engine.

An experimental Still engine constructed at Scotts' Works, is illustrated on this page the engine being erected in position for shop trials, giving some idea of the thoroughness in which the work was carried out. The engine has one-cylinder 22 in. diameter with a piston-stroke of 36 in., giving an output of about 350 brake horse-power when running at 120 to 130 revolutions per minute. This cylinder is intended to form a standard unit, so that a range of powers up to 4,200 brake horse-power can be obtained by varying the number of cylinders in line up to six per engine and employing single or twin screws. Great powers will be met by increasing the size of the cylinders.

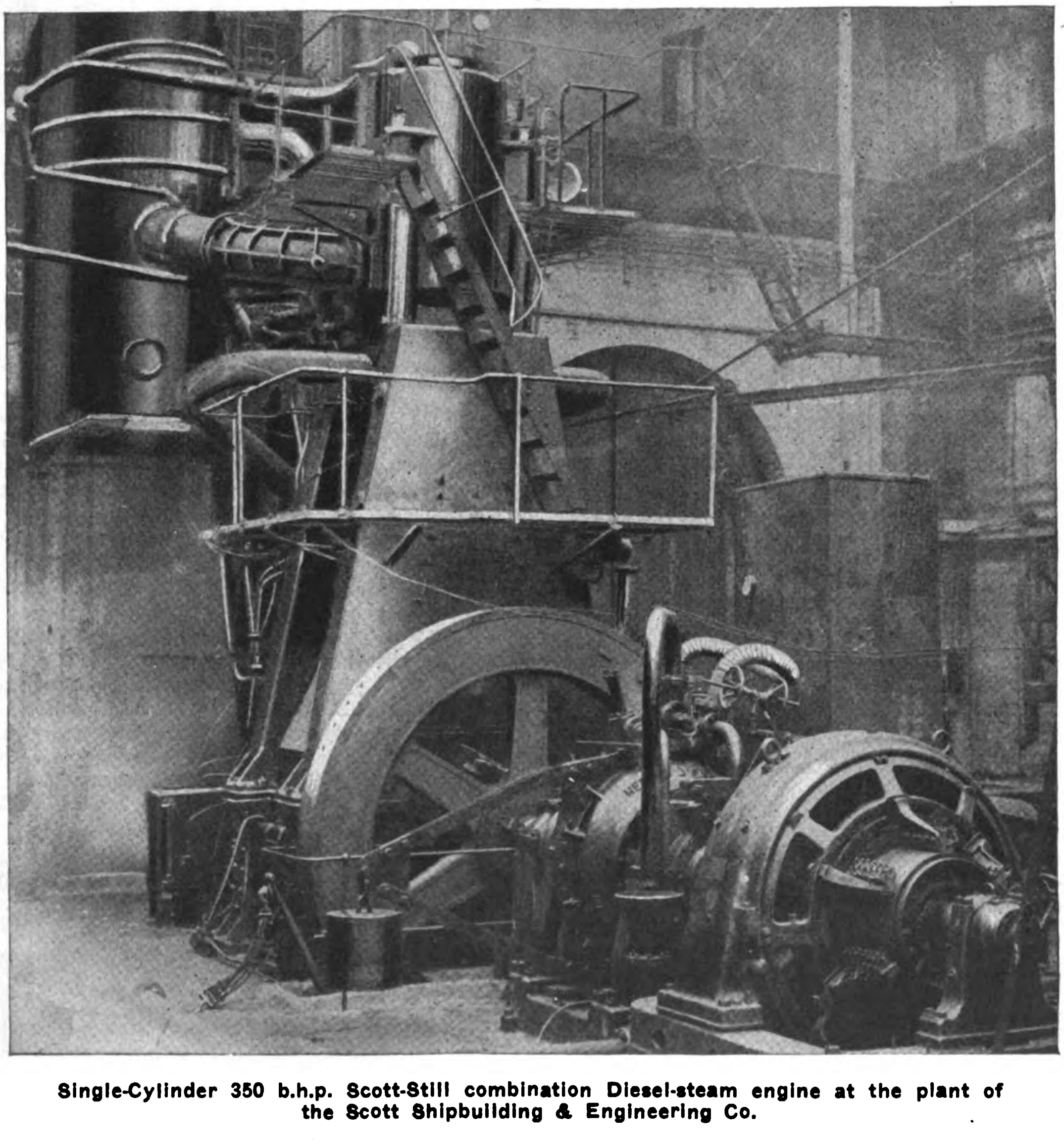
It will be remembered that the main source of power of the Still marine engine is oil consumed within the cylinder for the down-stroke, operating on the two-cycle principle, while steam forms a supplementary source of power, being used for the up-stroke on the lower side of the piston. The engine is designed to reduce heat losses to a practical minimum, the primary consideration being to accomplish this in such a manner as to improve the thermal conditions of the working-cylinders and so insure the maximum efficiency from the fuel burnt therein.

Referring to the illustration, it will be seen that a large fly wheel is fitted, this being necessary to improve the running of the singe-cylinder unit. The power of the engine is absorbed and measured by a Heenan & Froude dynamometer which also can be seen. In addition, a large electric-generator is provided which can be coupled up when necessary to absorb the power when the engine is running astern. The engine is enclosed and is provided with forced-lubrication to all its bearings, the necessary doors being provided for ready access to the crank-case when required. The method of securing the combustion cylinder by means of four through-bolts attached to the columns is indicated.

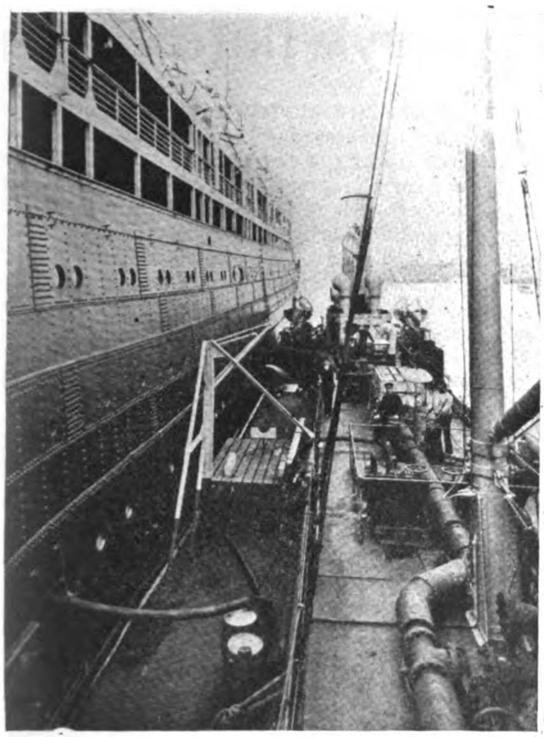
Special provision is made in the design of the structure for expansion and contraction due to heat. The boiler, which forms an integral part of the engine equipment, will be observed in the back-ground at such a height that the water level is above the top of the main cylinder-jacket. A large diameter lagged pipe conveys the exhaust-gases from the engine to the boiler, which in this instance serving the purpose of a re-generator. After passing through the boiler these gases proceed to the feed-water heater, and from this the gases pass up the funnel. Oil measuring-tanks are placed on the wall behind the boiler. There are two control-wheels, the larger wheel being employed to stop and reverse the engine, while the smaller wheel is used for speed regulation of the engine under the control of the governor.

Scavenging-air to the cylinder is supplied by a Reavell turbo-blower, which, in the experimental set, discharged to a large tank in order to minimize the fluctuation of pressure which follows the use of a single cylinder. Air passes from this tank to the bedplate, and is taken up the columns to the cylinder. The condensing plant and feed and water measuring-tanks are placed in the space beneath the boiler.

At first sight it would appear that such an engine must necessarily be relatively of a complicated nature and that it must carry the burden of oil-engine auxiliaries in addition to steam-engine auxiliaries and a boiler. Such, however, is not necessarily the case. Most oil-engined



Single-Cylinder 350 b.h.p. Scott-Still combination Diesel-steam engine at the plant of the Scott Shipbuilding & Engineering Co.



The bunkering-tanker "Scotol" fueling a ship with oil.

vessels to-day carry a boiler for steam heating, while some such vessels employ steam for port use and other auxiliary purposes. The auxiliary steam plant associated with the Still engine for starting purposes is of no larger capacity than is fitted on some oil-engined vessels. It supplies steam for starting the main-engine, oil-fuel being burnt in the furnace for this purpose in the usual manner.

In an installation of machinery on board a vessel, this steam boiler would of course be available for supplying steam to the auxiliaries in port. When the main engine is started, the oil-burner on the boiler is shut-off and the boiler then serves the purpose merely of a steam and water reservoir. The combustion-cylinder jacket and the jacket surrounding the exhaust-pipe are in circuit with this boiler. The cooling-water, therefore, enters and leaves the cylinder-jacket at a constant temperature regulated by the pressure of the steam. During combustion and expansion heat is taken up by the water circulating in the cylinder-jacket, all of which goes to form steam, and steam is also produced by heat recovered from the exhaust-gases through the medium of the re-generator or boiler (which may be designed to serve this purpose), and the feed-water heater. Steam generated from these sources when the engine is under way, performs useful work on the steam side of the main-engine piston, and may be also employed for auxiliary purposes.

During compression, owing to the cylinder-walls being at steam temperature, the air charge picks up heat, instead of losing during the greater portion of the stroke which is claimed to be an advantage of the greatest value to the Still engine. One result of this is that the compression pressure is very considerably less than in the ordinary Diesel-type engine. This enables lighter scantlings to be used, or alternatively provides a larger margin of safety, as the maximum pressure possible in the cylinder is a function of the compression-pressure. It further provides a very desirable margin for any loss of compression-pressure in service, as the pressure used in practice on the Still engine is well above the minimum pressure found necessary to ensure combustion.

In the engine illustrated, the compression- pressure is about 300 lbs. per sq. inch. The design is practically free from the array of rods, valves, and cams associated with the ordinary type of oil-engine. There are no exhaust-valves on the oil side to give trouble, and the fuel-inlet valves are automatic in action. In the experimental engine, the valves on the steam side of the cylinder are operated by oil under pressure, thus dispensing with the usual valve gear, and simplifying and facilitating the control of the engine.

Shop trials of the experimental engine have proved very satisfactory, and we are advised that the results obtained have borne-out the claims put forward. Therefore test figures would be of great interest if issued. In comparison with ordinary oil-engines it is believed that the wear and tear and upkeep expenses will be small. It has been found in practice that the manoeuvring of the Still engine is greatly facilitated by the existence of the steam side with the result that the engine is very easily handled. It is capable of relatively low speeds of revolution, quiet running and absence of vibration.

Obviously a new term will be required for a merchant ship fitted with this combination oil and steam engine, so we offer as a suggestion that hitherto has often been erroneously used, namely—"motor-steamer."

Yet another Greenock firm of engine builders have taken out a Diesel-engine license—namely, J. G. Kincaid & Co., who will build the Burmeister & Wain four-cycle type of engine under the master licence of Harland & Wolff.

Important developments have taken place during the year with regard to Clyde oil-bunkering arrangements, and the river now possesses excellent facilities for storage, distribution and rapid bunkering. Prior to the establishment of oil-tank stations on the Clydeside, oil-fuelling was effected by means of fuel delivered in railway tank wagons, either from one of the Scottish Oil Company's refineries, or from the Anglo-American Oil Company's extensive tank equipment at Grangemouth on the Forth. The Anglo-American Oil Co. Ltd. have now purchased a site near Bowling, which wil be developed later. In spite of increased competition, the excellence of these services remains unimpaired. The Admiralty storage tanks on the Forth are now connected by pipe-line to the Admiralty fuel-oil installation on the Clyde, and adjacent to this station is the Anglo-Mexican Petroleum Co.'s Installation at Old Kilpatrick, where the largest vessels may call on their way up or down the Clyde for the purpose of taking supplies of fuel-oil. The pumping plant is of the latest type, the pumps delivering approximately 300 tons of oil per hour through four 5-in. dia. hoses. The rate at which a vessel takes supplies on board, therefore, depends entirely on its own facilities for rapid bunkering. A ship fitted with one 6-in. dia. intake line is normally supplied at the rate of 100/130 tons per hour. The Anglo-Mexican Co. have at present storage for 16,000 tons of oil at this installation, the stocks being constantly replenished by tank steamer. Should supplies be required alongside vessels loading or discharging in Glasgow harbor or at ports at the mouth of the river, delivery can be arranged by lighter. As will be seen from the photograph of the "Scotol," this lighter is in itself a small installation being equipped exactly in the same manner as the bunkering-station above outlined.

Of special interest is the new installation of the British-Mexican Petroleum Company at Dunglass, below Dumbarton. A bird's-eye view of this unique station is herewith shown. On the extreme left of the picture will be seen Dunglass House and the famous "Bell Monument." This property is self-contained, and, having its own wet dock, is suitable for the accommodation of large steamers. The size of the dock is 600 ft. long by 200 ft. broad, with a depth of 27 ft. at low water. On the eastern side of the dock are three jetties, the centre one being of reinforced concrete, and the other two, timber. On the west are two fender dolphins, and at the entrance to the dock, both on the east and west side, are two fender dolphins specially constructed to allow ships to breast them for turning up stream or down. The capacity of the station at present consists of two 8,000-ton tanks for carrying oil fuel and one 3,500 ton tank for Diesel-oil. The pump room is equipped with two large oil fuel cargo-pumps supplied by G. & J. Weir, Ltd., of Cathcart, and specially designed to deal with heavy Mexican oil. These pumps are guaranteed to deliver 250 tons of fuel-oil per hour. Actual tests have shown the pumps to be capable of dealing with 50 per cent. more output. The pipe lines throughout the stations are 10 in. in diameter, and are fitted with heating devices, as previously described.

It may be mentioned that the station is provided with excellent offices and also a Customs Office to accommodate vessels coming direct to the dock. Attached to the station are three oil barges, one self-propelled of 1,200 tons d.w. capacity, and two dumb barges of 800 tons d.w. capacity. These barges deliver oil from the tail of the bank to the docks in Glasgow, and have proved very successful, having handled over 500 tons of fuel each per hour. The installation was commenced in the beginning of February last year, and will be completed by the beginning of March.

The keen interest which is being taken in Diesel matters was reflected in the very live discussion on Mr. Richardson's paper on "The Present Position of the Marine Diesel Engine" at "The Institution of Shipbuilders and Engineers.' The Scientific Society of the Royal Technical College are fortunate in having a paper by Mr. A. O. Bruce, of the North British Diesel Engine Co. of Whiteinch, on "Some Factors Limiting the Power of Diesel-engines." The Royal Technical College is also the headquarters of the research work which is being carried on by the British Marine Oil Engine Manufacturers' Association under the personal superintendence of Dr. A. L. Mellanby, Professor of Mechanical Engineering. Valuable work has been done, and is in course of progress on piston and cylinder-liner temperatures and the structure and properties of cast-iron.

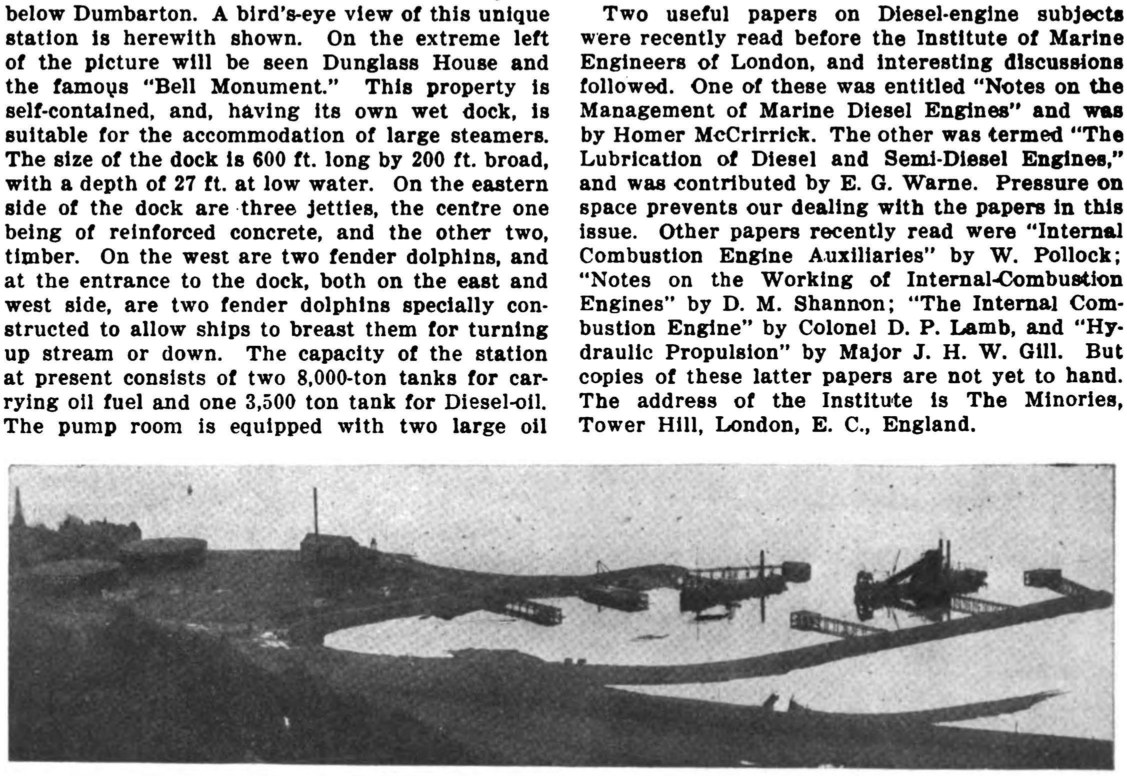
From what has been said, it is clear that the Clyde is in the forefront with regard to motorship developments, whether the problem be one of scientific research, methods of manufacture, or maintenance of efficiency of service when the ship is in commission.

THE "GLENOGLE'S" FIRST VOYAGE

On her maiden voyage to the Far East from England and return, the Diesel motorship "Glenogle," 14,000 tons deadweight, and 6,600 i.h.p. covered 25,000 nautical-miles at about 12½ knots. From Suez to Columbo she averaged over 13 knots (and has made as high as 14.6 knots) the fuel-consumption figuring-out at 0.308 lb. per i.h.p. hour. At 12¾ knots her daily fuel-consumption is 18¾ tons. The Holland-America Line's new motorship is a duplicate of the "Glenogle."

PAPERS ON DIESEL ENGINES

Two useful papers on Diesel-engine subjects were recently read before the Institute of Marine Engineers of London, and interesting discussions followed. One of these was entitled "Notes on the Management of Marine Diesel Engines" and was by Homer McCrirrick. The other was termed "The Lubrication of Diesel and Semi-Diesel Engines," and was contributed by E. G. Warne. Pressure on space prevents our dealing with the papers in this issue. Other papers recently read were "Internal Combustion Engine Auxiliaries" by W. Pollock; "Notes on the Working of Internal-Combustion Engines" by D. M. Shannon; "The Internal Combustion Engine" by Colonel D. P. Lamb, and "Hydraulic Propulsion" by Major J. H. W. Gill. But copies of these latter papers are not yet to hand. The address of the Institute is The Minories, Tower Hill, London, E. C., England.



Aeroplane view of British Mexican Petroleum Co.'s oil bunker-station at Dunglass, River-Clyde.

Interesting Notes and News from Everywhere

"MOTORSHIP'S" CABLE ADDRESS

The new cable address for the editorial and business offices of "Motorship" and other Miller Freeman publications is "Freemote New York." This covers all cable and wireless system.

MOTORSHIP "CETHANA"

We noticed that the American wooden Diesel-driven motorship "Cethana" recently put in at Balboa for repair to her donkey-boiler. Nothing needed doing to the main motors.

BUNKER-OIL PRICES IN BRITISH PORTS

At British ports steamer fuel-oil was recently quoted at £8 per ton (about $32.00), and Diesel motorship fuel-oil at £11 (about $44.00), representing a decline from the previous year of about 50 per cent.

U. S. SUBMARINES

According to a statement recently made before Congress 170 submarines have been authorized during the last four years by Congress. All but six of them are either completed or unuer construction.

AMERICAN-BUILT PATROL BOAT TO BE TUG

One of the motor patrol-boats built in America for the British navy is to be equipped with twin 40 b.h.p. Nat. surface-ignition oil-engines and operated as a tug by her present owners.

DIESEL-ENGINEER TRAINING SHIP AVAILABLE

Recently offered for sale in Great Britain among ex-German vessels was the motor-auxiliary training-ship "Grossherzog Friedrich Augusta", 1,800 gross tons. She was placed on the market by Lord Inchcape.

AFRICAN OIL NUTS CO. HAVE MOTORSHIPS

The "Meredith A. White" an auxiliary sailing-vessel of 490 tons gross has been purchased by the African Oil Nuts Co., Ltd., of London, England. Two 90 b.h.p. British Kromhout oil-engines are installed. She will trade between Liverpool and West Africa.

OIL-ENGINE FUEL RESEARCH ASSOCIATION

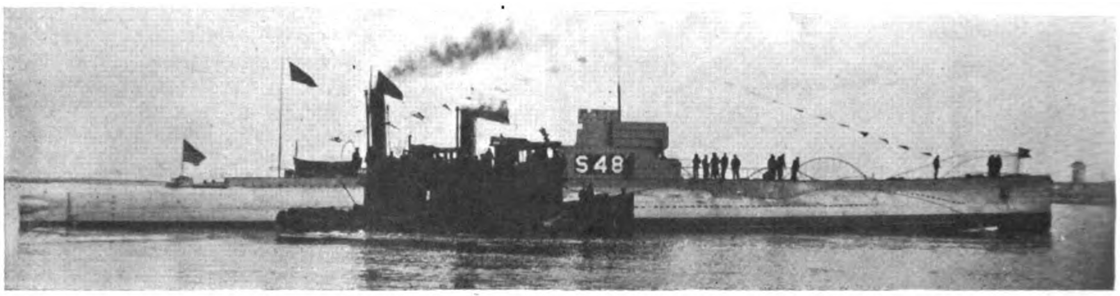
The British Government's Department of Scientific and Industrial Research has approved of the British Research Association for Liquid-Fuels for Oil-Engines, recently formed in conjunction with the Diesel-engine Users Association, 19 Cadogan Gardens, London, S. W.

NEW FINNISH MOTOR SCHOONER

The Reederi Nylund, of Mariahamn, Finland, are operating the new motor schooner "Signal" built by Stocks & Kolbe at Kiel, Germany. She is of 1,400 tons displacement and of 700 tons d.w.c. Her propelling plant consists of a Benz-Polar Diesel-engine of 180 b.h.p. at 250 r.p.m. built by Benz & Co., engineers, Mannheim, Germany.

AMERICAN WOODEN MOTORSHIP MAKES LONG VOYAGE

According to a letter from F. S. Nilsen, ex-Chief-Engineer of the wooden motorship "Semmeltind," and now Chief-Engineer of the sister wooden motorship "Trolltind," he recently completed a voyage almost around the world, from Portland, Oregon, to Norway, covering 19,000 nautical-miles in ninety-six days, at an average speed of 8.24 knots. Both these motorships are American built and are propelled by twin 450 H.P., Winton Diesel-engines.



New U. S. Navy 1,000 tons surface-displacement submarine "S-48" launched by the Lake Torpedo Boat Co., Bridgeport, on Feb. 26th. She is propelled by a pair of 950 b.h.p. Busch-Sulzer Diesel-engines. Her length is 240 ft, and she carries one 4-in. gun and has five 21-in. torpedo tubes.

NEW BIG EUROPEAN OIL UNION

The International Petroleum Union, of Zurich, with a capital of 210,000,000 gold-francs, has been formed by Swiss, French and German capitalists for exploiting oil-wells in Alsace, Hanover, etc. One of the directors is Dr. Hans Sulzer, who also is a director of Sulzer Frérés, the Diesel-engine builders of Zurich. Swiss bankers have furnished part of the capital and will manage the Union. Of the capital F. 150,000,000 is fully paid.

MATERIALS FOR DIESEL-ENGINE CONSTRUCTION

A paper dealing with castings for Diesel engines, and the importance of using high-grade machine tools was recently read by John Holloway, before the British Association of Foreman Engineers and Draughtsmen. A resume of this interesting treatise together with illustrations is before us but we are obliged to defer its publication, owing to the mass of editorial material already on hand.

NEARLY ONE-HUNDRED PACIFIC COAST BUILT MOTORSHIPS

We take the opportunity to remind our readers that altogether over 90 auxiliary and full-powered motorships of from 2,000 to 6,500 tons d.w.c. and of from 320 b.h.p. to 2,000 b.h.p. have been built on the Pacific coast of the United States and Canada. A list of 86 of these was given on page 49 of our issue of August, 1919. Diesel and surface-ignition type of engines are fitted. These represent over a quarter-million tons deadweight, and are mostly wooden vessels.

TRIALS OF THE MOTORSHIP "FORMOSA"

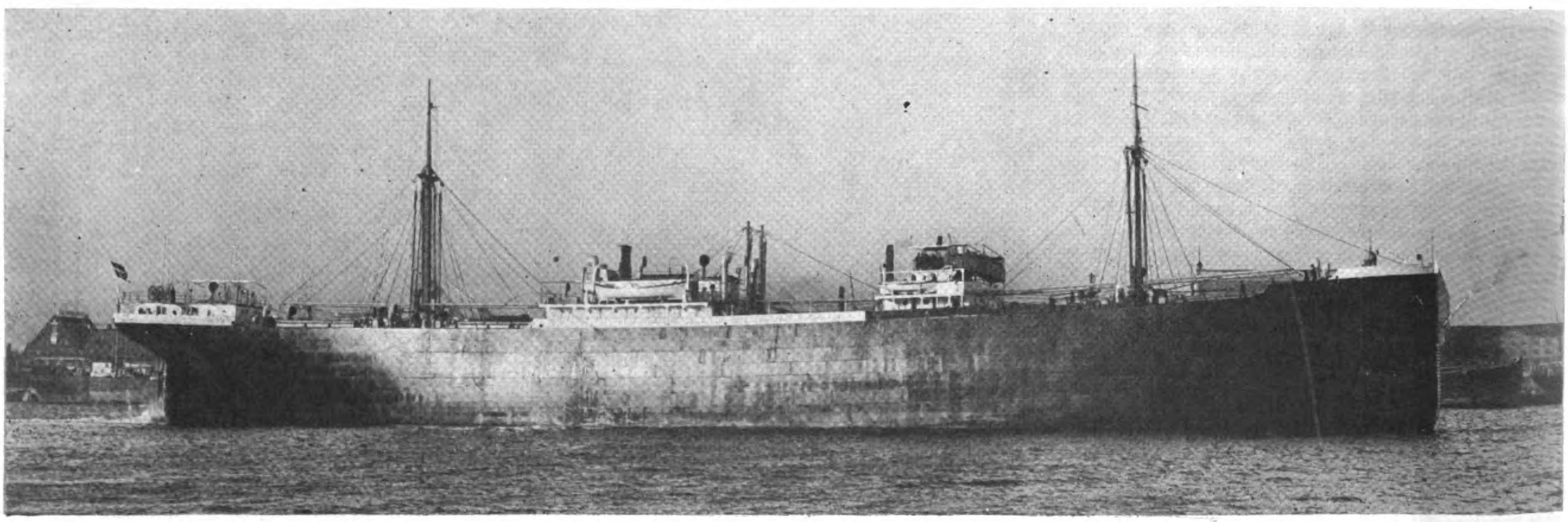
Through the photographs of the motorship "Formosa" arriving at the same time as the report of the launch of the motorship "Canada," pictures of the former were described in our issue of February (page 136) as being the latter. Both vessels, of course, are for Mr. Dan Brostrom's companies, but the "Formosa" was built by Burmeister & Wain where the latter was constructed by their licensees, the Götaverken.

The "Formosa" ran trials on February 8th and a mean-speed of 12 knots was attained over the measured-mile, though a strong breeze was blowing and the ship in light condition. She is owned by the Swedish East Asiatic Company, and has the following dimensions:

Deadweight capacity	9,800 tons
Cubic-capacity	572,700 ft. (grain)
Cubic-capacity	519,600 ft. (bales)
Fuel-capacity	1,152 tons
Cruising-radius	29,000 tons
Speed (loaded)	11½ knots
Trial speed	12 knots
Daily fuel-consumption	10½ tons
Length (O.A.)	442 ft. 7 in.
Length (B.P.)	425 ft. 5½ in.
Breadth	55 ft.
Depth (to A.D.)	38 ft. 6 in.
Draught (loaded)	29 ft. ½ in.
Gross tonnage	7,032 tons

Her propelling machinery consists of twin 1,550 i.h.p. Burmeister & Wain four-cycle Diesel-engines of similar size to the pair in the "Buenos Aires" illustrated elsewhere in this issue, and there are also three auxilary Diesel-engines of 120 i.h.p. driving 220 volt electric generators. The fuel-consumption of the main and auxiliary machinery on the trial was 145 grams per i.h.p. hour.

The "Formosa" has two masts and one 30-ton derrick, one 15-ton derrick and ten 5-ton derricks. These are worked by eleven Asea electric winches. There is a Clark Chapman electric-winch and a Brown Bros. electric-hydraulic steering-gear. Wireless is installed. There are cabins for two passengers.



The East Asiatic Co.'s new Burmeister & Wain Diesel motorship "Formosa" leaving Copenhagen for trial trip.

Alternative Installation for America's Cargo-Ships

Proposed Use of Surface-Ignition Oil-Engines and Electric-Drive for Auxiliary Machinery of Existing Steamers

By W. P. SPOFFORD, Chief Engineer, S. S. "Tripp"

[*The author raises many interesting points and new possibilities which could be well followed by a discussion in our correspondence columns. Many things he outlines are correct, but on the other hand some are not. For instance, we cannot agree that steam propelling machinery weighs less and occupies less space than Diesel machinery. Moreover, no space for boiler-water is required with Diesel machinery. We also suggest that the total fuel-costs given by Mr. Spofford be compared with the fuel-costs of the motorship "Stureholm" on another page.—*Editor.*]

IT is well-known that the Diesel-type of engine is the most economical prime-mover. However, for reasons best known to themselves, American shipowners are still doubting the desirability of this type of construction. Believing some changes necessary to enable American shipping to enter world competition with any chance of success, the author submits the following plan in the sincere hope and belief that it will prove beneficial to shipping and will be a move towards the conservation of fuel.

The plan involves the replacement of the customary steam-auxiliaries by direct-current electric-auxiliaries throughout, these, in turn, to receive their power from a set of three duplicate, surface-ignition, oil-engine driven electric-generators so arranged that they may be operated singly or in parallel, two of these to be capable of handling the entire machinery. These engines to exhaust into a large manifold from which it may be directed through an especially designed feed-heater, under the boilers, or into the atmosphere as desired. The feed-water from the main engines to be used as circulating-water when underway.

Direct-current electrical machinery has proven its reliability for sea purposes in the Navy, in the large passenger-ships, and in driving motorship auxiliaries. There are also some recent installations where it is being used to drive the main propellers as well. All of the late battleships have several hundred horsepower operating satisfactorily. In fact, it was found to be the only satisfactory motive-power for certain hard tasks, such as driving blowers in destroyers where a very strong draft that could be relied upon was essential.

The surface-ignition oil-engine is chosen, as of all the oil-engines it is the simplest, lightest in weight, most compact, and lowest in cost. These engines have been built for over twenty years, undergoing steady improvement. They have been operated successfully under the most trying conditions, often by wholly inexperienced men. Any of the standard companies can produce data from actual practice which will convince the most skeptical as to their reliability. Although not as economical as the Diesel, the difference in running costs at these powers would not be great enough to warrant the change with its added weight, cost and complications, except, possibly, in the very large ships. Then again, by converting the heat from the jackets and exhaust into useful work, the difference in consumption between the two types is lessened considerably.

For purposes of comparison assume a cargo-vessel 370 feet in length, by 51-foot beam and of about 6,500 deadweight tons. This vessel to have 2 single-end, 3-furnace, Scotch boilers equipped with Howdens forced-draft, Diamond soot-blowers, and superheaters capable of 100 deg. superheat at a working-pressure of 210 lbs. To have besides the usual fittings only two steam-pipes; one to the main engine, and one to a heating and fire-extinguishing manifold. The main engine to be an impulse-turbine of 1,500 S. H. P. driving the propeller through a double reduction-gear of the two-plane type† equipped with Kingsbury thrust-bearing. The turbine to be mounted on top of the condensor. The air-pump to be of the Rotrex type. An ash-ejector and a hoist to be installed in fire-room. The steering-gear to be of the electric-hydraulic type.

All auxiliaries to be electrically-driven from the generators as described. Two hot-wells to be installed one above the other, the circulating-pumps of the oil-engines taking suction from the lower and discharging into the upper when underway. The upper hot-well to be at least 10 ft. above turbine feed-pumps. The feed-heater to be of the closed type very similar to a surface-condenser. The feed-water in this case following the path of the circulating-water, and the exhaust-gases that of the exhaust steam. A scraper to be fitted on the straight tubes in such manner that it is only necessary to slide it back and forth to clean the tubes of soot. It is possible that a small induced draft-blower placed above the heater may be necessary to prevent excessive back-pressure on the oil-engines.

It would take up considerable space to set out the specifications in further detail at this time, but the above should be sufficient to give a general idea of the installation.

The turbine is selected for motive-power due to the usual well-known reasons, and because there would be absolutely no oil in the feed-water system, thus eliminating filter-boxes and grease-extractors, and preventing any possibility of oil deposits in the oil-engine cooling-space or in the boilers. The two-plane type of gear enables the turbine to be mounted over the condenser, which gives good drainage, and, when coupled with the two-plane type of gear, renders the entire high-speed element very accessible. Considering the fact that the great majority of repairs necessary in a turbo-reduction gear unit are in the high-speed element, this brings nearly all the main engine work within the scope of the ship's force and also facilitates emergency repairs at sea. The rotrex air-pump is the best adapted for motor-drive when it is not desirable to use steam for an air-ejector, as in the present case. The soot-blower is essential when coal is burned with superheaters if economy is desired.

The author has had actual experience with all the foregoing machinery, and there is no question as to its reliability given a reasonable amount of care. This vessel would burn about 25 tons of coal and 5 tons of fuel-oil a day for a speed of 10 knots. Figuring coal at $6.00 a ton and oil at $3.00 a barrel, the daily fuel-bill would amount to about $160.00. A corresponding motorship would burn for all purposes at sea about 7 tons of fuel-oil per day, or $145.00. This leaves a balance of $15.00 per day in favor of the motorship at sea, which is partly offset by the difference in lubricating-oil, the motorship using more and of better quality.

In port the fuel cost would be practically the same: The steamer would require 4 men more in the engine-crew than the motorship, amounting to $12.00 a day. Other operating expenses would be practically the same under average conditions.

It is estimated that the steam-vessel would cost $1,170,000.00 against $1,270,000.00 for the motorship, a difference of $100,000.00. Charging interest and depreciation at 10% this would impose a charge of $10,000.00 yearly against the motorship. Thus so far as straight operating costs are concerned, the steamer has slightly the better of it, but on the other hand, except for certain special cargoes, its earning capacity is not equal to the motorship. The machinery installation of the steamer would weigh less and take up less space than the motors.† However, the steamer running transatlantic would require about 1,000 tons of bunker-space for the round trip, about 700 of which is occupying space and dead-weight that could be utilized for cargo in the motorship. Then too, there is sometimes delay and trouble in bunkering which weighs heavily against the coal-burner, though lately the reverse has been the case. There is also a certain loss of speed due to cleaning fires, etc. This last, however, would be lessened greatly could our shipping-laws be altered so as to give the ship's officers some semblance of authority aboard ship.

As a motive-power for oil-tankers, vessels making long trips or running between ports where coal is scarce and expensive this installation would not be as satisfactory as the motorship. But for the usual tramp-steamer where considerable lay time may be expected, for vessels making trips up to moderate length, coastwise ships, etc., this installation would compare very favorably with the motorship. In short, it evolves itself into a question of running time, and the relative prices and facilities for coal or oil, which can best be decided in each individual case.

When compared with the ordinary steamer, whether oil-fired or coal-burning, this installation offers considerable advantages. The two types of vessels can be built at practically the same cost, and the difference in weight and space occupied by the machinery is slightly against the straight steamer for small ships, gradually increasing as the power of the auxiliaries is increased. Considerable bunker space can be saved if oil-burning, as no allowance need be made for lay time, one double-bottom full of oil being sufficient to operate the vessel nearly a year in port. The amount of coal necessary for a given trip can be figured accurately and taken at the cheapest port.

Under present conditions, with strikes, freight congestion, etc., lay time is a big factor. On the ordinary steamship one 1,000 H. P. boiler must be kept going all the time to operate often as low as 30 H. P. There is the same amount of loss by radiation as when the boiler is working full capacity, which keeps the engine-room and nearly the whole ship very hot and uncomfortable, especially in the tropics. If the valves leak, as they often do, it is very difficult to work on the dead boilers and piping. On an oil-burning vessel practically all men are on watch and boiler cleaners, etc. must be brought aboard to do the work. If a coal-burner, nearly half the men are on watch and it takes the coal-passers about half the day to get the ashes out of the fireroom, and to get out coal for the firemen. These ashes are a nuisance on the ship and in time lighters must be procured to carry them away.

Fresh water is used constantly, usually more than at sea for the oilers are not too watchful as a rule, and in some ports it is very inconvenient and expensive to get more. Then again, if the water-supply is small it is necessary to fill-up just before leaving port, often causing expense and delay if vessel is in the stream or away from supply. Every Sunday or holiday, 3 firemen, 3 oilers, and 3 water tenders get $4.80 over time, totaling $43.20, and every time ship is working-cargo or ballast at night all three must be paid. These are all small items but they aggregate quite a heavy total.

With the oil-engine and electric installation as described only one man is necessary on watch, and the power generated is in some proportion to the power expended. All boilers are dead and the ashes and coal are cleaned out of the fireroom once only. There is a large crew available to do all the work, from grinding in the main stops to cleaning and red leading the fireroom bilges. In fact, the work can be followed up promptly and deterioration largely prevented instead of having to let things go as long as possible and then bringing aboard a yard crew to renew what is gone. Overhaul bills should be easily cut in half, which under present conditions is a large item. The average engineer would rather keep a yard crew away if possible as they mess things up and often do very poor work after all.

As for steam-piping there are only about a dozen joints, glands, and valves to keep tight; hence the fresh water consumption should be very small. In winter time with the ordinary steamer great care and much coal must be used to keep the deck steam-lines and machinery from freezing, besides the great waste from condensation when in use. This is eliminated with the electric machinery. The exhaust from the oil-engines under the boilers will maintain steam while lying in open roadways or will keep the boilers dry and prevent corrosion when laid up. The fuel-consumption for this installation in port would

†The two-plane double-reduction gear referred to in this article is different from anything so far manufactured. It is designed so that any renewals or repairs may easily and quickly be made with ordinary ship's equipment and by the ship's force. This installation was primarily designed for the Cuban trade.

be from 0.2 to 0.5 ton of oil against 3 tons for the oil-fired steamers, or from 4 to 8 tons for the coal burner. At sea the saving should be about 10% for turbine and 5% or better for reciprocating vessels depending on the number of independent auxiliaries. Steam auxiliaries are notoriously uneconomical, whereas, when utilizing the jacket and exhaust heat, the oil-engines should show a very high efficiency.

A specific vessel was described to give the idea clearly and for purposes of comparison, but there are many other useful applications for this installation. This country has a large fleet of ships which are spending a good deal of their time undergoing repairs. Those that have poor main engines and boilers should unquestionably have them ripped-out and replaced with Diesels.

But, there are many which have excellent boilers and engines and yet are having a great deal of trouble due to poor auxiliaries. Many a vessel which the Shipping Board will never be able to sell as it now stands would bring an excellent price if altered as described. There are ships in which the boiler-power has been cut-down, or in which it never was sufficient for the machinery such as some refrigerating-ships built during the war. These could be improved greatly in this manner and brought up to their designed speed.

War-vessels which spend a good deal of their time in port have a great many auxiliaries, mostly electric, but steam is used as the motive power. Were this system installed on all our capital ships the yearly saving to the Government would mount well into the millions. The problem which has been worrying the designers of our new battle-cruisers, namely, getting all the machinery of the desired power below the protection deck, could be solved in this manner.

If considered desirable, motors could be incorporated on the propeller shafts giving Diesel-electric drive at cruising speeds, which would give the ships an immense cruising radius. When full speed was desired it would be only necessary to disconnect the brushes and the armatures would merely act as flywheels.

For passenger ships the lay time is small, but even so the saving to a line like the Cunard might mean the difference between a good year and a loss.

During the war a large number of turbine vessels were built. In certain circles these vessels have a very poor reputation, and even considered failures by some. In the great majority of cases this is due to no fault of the turbines, but rather to the poor layout of machinery, poor auxiliaries, and negligence or ignorance on the part of the operators. If this installation as described is laid out with equal inattention to detail the results will very likely be the same. But if care is taken to select good reliable machinery and to have it installed properly, its reliability will be equal to the best of steamers.

Without question the present type of steamer is very wasteful. On the other hand, it would be folly to scrap all existing machinery and replace with Diesels. This installation will serve to round out a fleet nicely, giving many years economical service with existing ships, and at the same time offering an opportunity for engineers and shipowners to become acquainted with the merits of the internal-combustion engine.

"Carolyne Frances," A Diesel-Driven Whaler

Wooden Auxiliary Sailing-Vessel with McIntosh and Seymour Oil-Engine

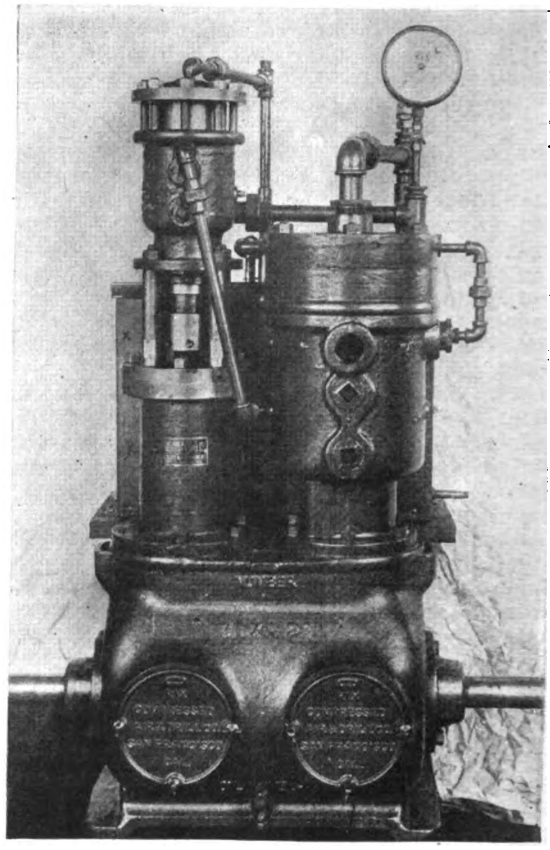
By CHAS. W. GEIGER

DIESEL engines were first used in whalers in 1912, when the "G. D. 1," and the "G. D. 2," together with their mother-ship "Sound of Jura" a large auxiliary, by a British firm. All three were propelled by Polar Diesel engines built by the Atlas Diesels Motorer of Stockholm, Sweden. There is a relation between these motor-whaler and the three-masted auxiliary whaling-schooner "Carolyne Frances" which is now on a four months whaling cruise off the West Coast of Mexico under command of Captain L. L. Lane, this permission having been granted by the Mexican Government. The "Carolyne Frances" is propelled by a McIntosh & Seymour Diesel engine, the makers of which are the American licensees of the Atlas-Polar concern.

She was formerly used by the Northern Fisheries, Inc., in transporting the catch of the fishing-vessels. She was taken over by the Western Whaling & Trading Company and equipped as a whaler. A four-cycle Diesel-engine, developing 300 shaft horse-power, (390 indicated h.p.,) at 265 revolutions a minute, was installed. She carries 400 barrels of fuel, sufficient for sixty days' cruising at a speed of 6½ knots on a consumption of about 6½ barrels a day. Her length is 160 feet overall, 140 feet on the water line; with a breadth of 38 feet; and a draft of 13. Her deadweight capacity is about 1,000 tons.

She carries seven 32-foot whale-boats, built by Kneass of San Francisco. All of these boats have sails and oars, and three are equipped with 24-h.p. Wisconsin motors, with which a speed of 18 knots can be made. These boats are slung outboard from davits and supported underneath by brackets.

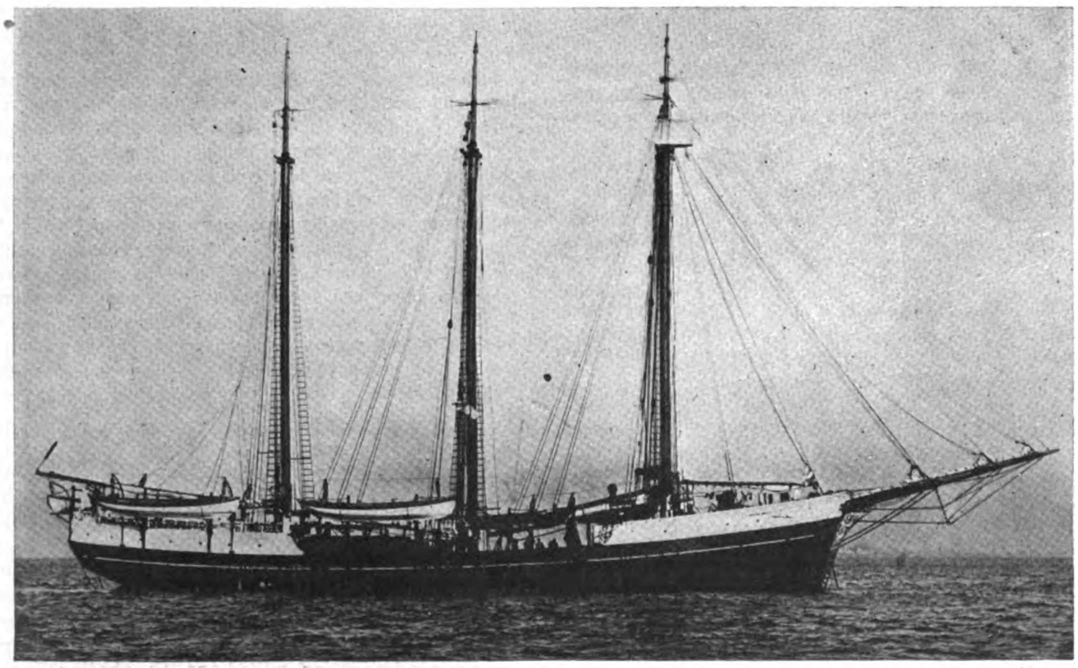
When the lookout on the "Carolyne Frances" discovers a whale, the fact is communicated to these boats by means of flag signals. Experiments are being made in which compressed-air is used in killing the whales. Steel bottles charged with 1,000 pounds of compressed-air are connected with a special designed harpoon by means of armored hose. When the harpoon enters the whale the air-pressure is released, which smothers the whale and at the same time keeps him afloat until he can be towed alongside the mother ship. By the use of compressed-air the struggles of the whale are reduced almost instantly, it killing him in a few minutes. One of the types of harpoon is about four feet in length. At one end there is attached a cable to take up the strain. About a foot from this is attached the air hose. At the other end of the harpoon there is a cutting device, which enables the harpoon to easily pass into the whale. Just back of this is a device which closes against the harpoon when it is pasing into the whales' body, but opens when an attempt is made to pull the harpoon out, thus preventing the harpoon from being withdrawn. The harpoon is hollow, the air passing through and out of the end of harpoon at the sharp point. There are two other types of harpoons used.



Rix air-compressor used in connection with special harpoon on motor whaler "Carolyne Frances"

Air for the steel-bottles is provided by the regular air-compressor which is a part of the Diesel engine equipment, there being a superfluity of high-pressure injection-air for this purpose. For use in emergency a auxiliary Rix air-compressor has been installed which perform a double duty, by providing air at 350 lbs. and also at 1,000 lbs. pressure. By means of special arrangement and by a system of by-passes, one side of this compressor can be used to raise air to the injection-pressure of 1,000 lbs. The compressor is operated by a 10-h.p. General Electric motor direct connected. The compressor cylinders are 4½ in. by 1 in. and ⅝ in. by 4½ in. The air-hose is fed along to the harpoon in loops, there being special floats to keep the hose straight.

At the point of the arrow in photo No. 1 can be seen a specially designed platform on which the whale is placed to be cut up.



The Diesel auxiliary whaler "Carolyne Frances," fitted with a McIntosh & Seymour Diesel engine

MESSRS. BEATTIE, QUINN & ADAMS PLEASE NOTE

We are holding copies of "Motorship" for Mr. Geo. M. Beattie, copies for Mr. G. E. Quinn and copies for Mr. J. J. Adams. These are copies resulting from paid subscriptions, held at this office on their behalf. Will they kindly call for them or send forwarding address?

Vessel With Remarkable Under-Deck Cubic Capacity

Werkspoor-Engined 6,500 Tons d.w.c. Motorship "San Paulo" Runs Trials—Has nearly 400,000 cubic-feet Capacity Underdeck

By S. SNUYFF, Netherlands Correspondent of "Motorship"

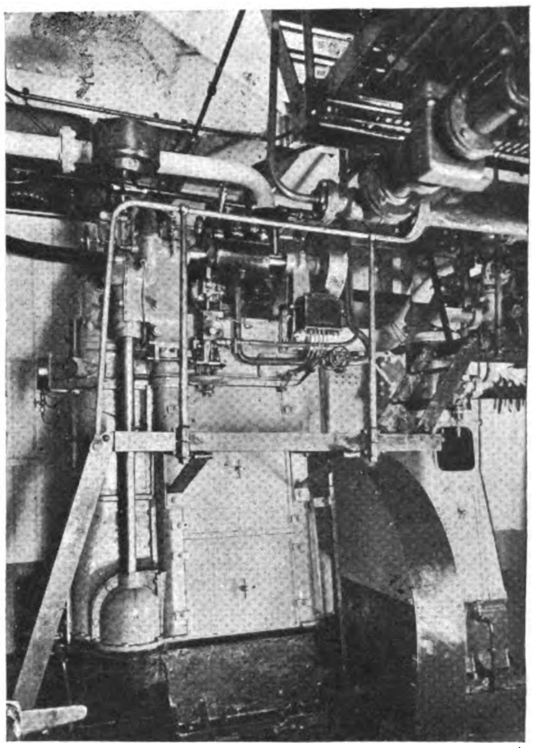
COMPLETION of motorships ordered in Holland during the war is now making rapid progress. In the issue for January of "Motorship" the trials of the "Tosca" were mentioned, and now again we have occasion to record the trials of a Dutch-built sea-going motor-vessel of importance. We refer to the "San Paulo," owned by Dampskibsaktieselskabet Otto Thoresen's Linie (Otto Thoresen Steamship Line) of Christiania and built on the yard of Naamlooze Vennootschap Werf Rijkee & Co. (Rijkee & Co., Ship-Yard Company) of Rotterdam.

This vessel is the sixth ship to be equipped with 2,200 shaft h.p. twin-screw sets developed by the Werkspoor Works of Amsterdam, and the seventeenth Dutch-built Werkspoor-engined motor freighter of more than 1,000 b.h.p. propulsive power to be placed in service. She is the third motor freighter built on the Rijkee Yards, the foregoing having been the "Meijer," owned by the Koninklijke Paketvaartmaatschappij (Royal Packet Mail Company) of Amsterdam for the service in the Dutch East Indies and the "Athene" of Dampskibsaktieselskabet Ada ved. K. Salvesen (Steam Ship Company Ada late K. Salvesen) of Kragerö, Norway. The Otto Thoresen's line has ordered seven Werkspoor-engined motor-vessels, three of which having been now completed, namely, the "Salerno," "San Miguel," "San Paulo." We were able to attend the trials of the "San Paulo" by the courtesy of the builders of the engine-plant.

A remarkable feature of the "San Paulo" is her very large under-deck cubic-capacity, due to the very small machinery space and by reason of the absence of bunkers or deep-tank other than the double-bottoms and peaks, which latter hold a total of 1,029½ tons of fuel-oil, or part oil and part ballast-water. Although of only 6,500 tons d.w.c., this vessel has a total cubic-capacity of 394,326 cubic-feet under-deck, as will be seen by referring to the drawings. This is represented by hold, 'tween-deck, and upper 'tween-deck capacities of 354,326 cubic-feet of grain, and a refrigerating-hold of 40,000 cubic-feet capacity. For the small overall dimensions of the hull, this certainly is an unusually large capacity.

Her dimensions are as follows:

Length (B.P.)	375 ft.
Breadth (M.D.)	51 ft., 3 in.
Depth (M.D. to main deck)	25 ft., 6 in. to 26 ft.
Deadweight Capacity at 23 ft., 1 in. mean draught	6,500 tons
Cubic-Capacity (total)	394,326 cu. ft.
Fuel-Capacity	1,029½ tons
Engine Power	2,560 to 2,800 i.h.p.
Cylinder-bore	560 mm (22.074 ins.)
Piston-Stroke	1000 mm (39.370 ins.)
Engine Speed	125 revs. per minute
Ship's Speed	11.5 knots
Daily Fuel-Consumption	8½ to 9 tons



Werkspoor 50 b.h.p. Diesel engine direct-coupled to a refrigerator compressor in the "San Paulo"

The ship is designed as a cargo carrier, but has accommodation for twelve passengers in six cabins, a saloon, smoking-room and bathroom. She has a straight stem and cruiser stern (as is the case with the "Athene") and the boat equipment consists of two life-boats and two "jolly-boats" with davits on the C. J. J. L. De Vos system. A wireless installation of the Horeth system is provided. The saloon is fitted in polished mahogany with mahogany framing and teak pilasters. The smoking-room is also fitted in mahogany and the rooms are provided with steam, stove and electric heating.

The main-engines are of the same design as those of the "Tosca," described in the issue of January 1921, of "Motorship." This set of engines is the second to be provided with *the new control-box* carrying a single wheel for subsequently admitting starting-air and fuel to three and six cylinders.

The auxiliary equipment, driven by the main engines, consists of:

1st: Air-compressor, driven by rocking levers off the crosshead of one of the cylinders; three-stage type with intermediate ail-cooling. Each cylinder is separately driven and has its own piston-rod and crosshead guide.

2nd: Two high-pressure fuel-pumps driven off the spur-geared shaft from the cam-shaft drive. One pump can serve six cylinders, the other being provided as a spare one.

3rd: Water-cooling and cooling-water pump.

4th: Two bilge-pumps, driven off the same yoke as the air-compressor, one of these pumps may serve as a piston-cooling water pump.

5th: One low-pressure fuel-pump, driven off the extended balance-lever shaft of air-compressor.

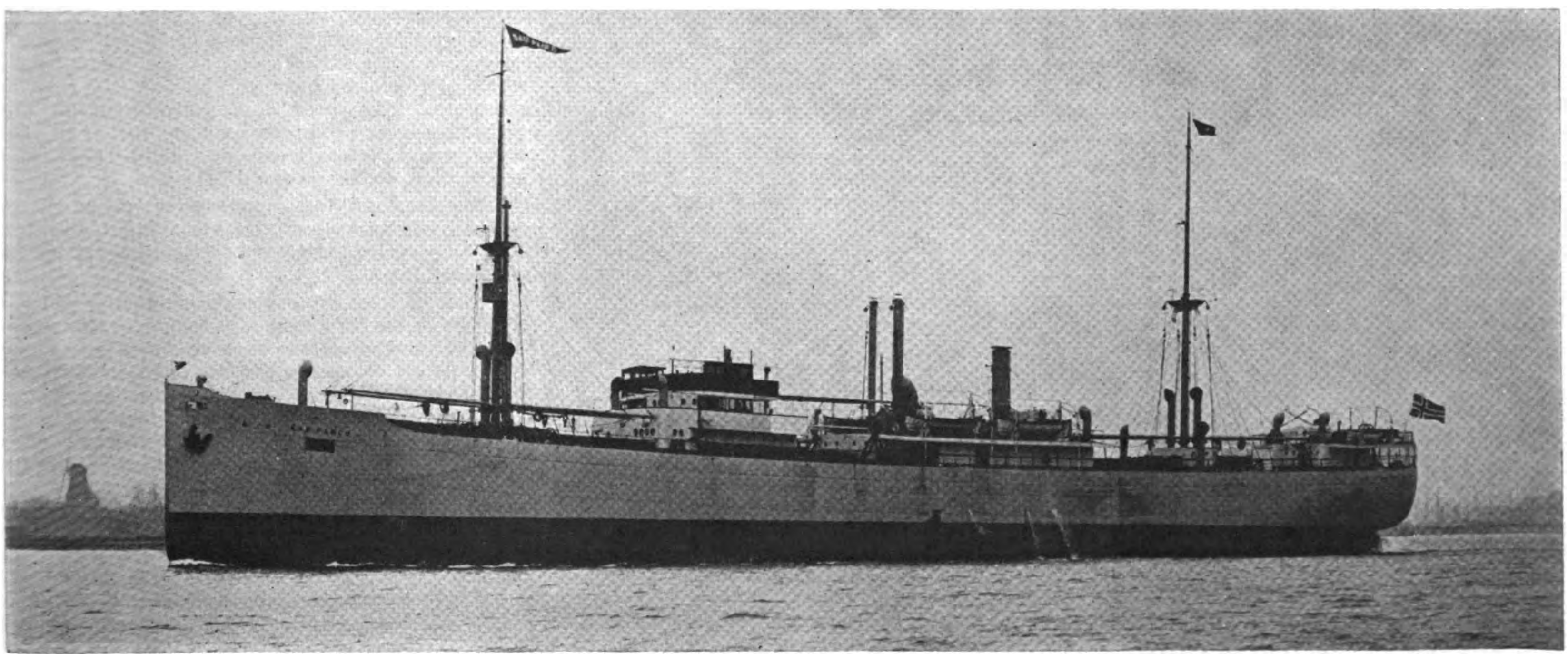
6th: One lubricating-oil pump, driven off the extended balance-lever shaft and pumping the oil out of the bed-plate into a large duplex oil-tank placed on a high level and containing a filtering plant of large capacity. The oil is cooled when passing to the tank and flows by gravity from the tank to the engine, being shut off automatically when the engine is stopped. For piston-lubrication, there are a number of small plunger-pumps driven off the cam-shaft.

Besides these auxiliaries the engines have the well-known floating fuel-oil vessel, air-vessels, fuel-oil tank and fuel-oil filtering system. The outlet of each cylinder is provided with a thermometer, for measuring the temperature of the exhaust-gases.

The thrust-shaft has a diameter of 290 mm (11.41 ins.) and is of the multi-collar system as till now has been the practice with all Holland-built Werkspoor sets. The propellers are cast-steel with a diameter of 3,600 mm (11 ft., 9.75 ins.) with four blades.

Though the independent engine-room auxiliary equipment is rather extensive we had not the impression of a crowded engine-room, regardless of the comparative short length. On the contrary, there was plenty walking-room everywhere. The length of the engine-room is not more than 50 ft., but the arrangement of the auxiliaries and their design seem to have resulted in a gain as regards space proportions.

The electric generating-plant consists of three 2-cylinder four-cycle Werkspoor-Diesel engines with the following main figures:



The new Werkspoor-engined motorship "San Paulo"

Speed ....250 revs. per minute
Power output ....80 to 100 b.h.p.
Electric output ....265 KW
Current ....220 Volt × 295 Amps direct

We may say, that the generating-engines attracted our special attention. When getting on board we were immediately struck by the remarkably steady running of the engine that was then at work with small load. There was not the least oscillation in the revolution speed noticeable, nor when listening to the sound of the exhaust. When we examined the engine in the engine-room we observed that the speed regulator had no "retarding-cylinder." The load was then about 80 to 100 amps, being about 27-34 per cent. We did not notice the least oscillative movement, as often occurs at light loads, on account of the governor movement exceeding the amount just required for close regulating, thus causing the engine to slow down.

Here we may have the proof that a "retarding-cylinder" is not always necessary for preventing the oscillation phenomenon and even may have a detrimental effect, as it has a tendency to prevent the regulator from reacting directly upon the speed variations of the engine. On the other hand we have frequently experienced oscillations with engines that were not provided with a retarding device. We are inclined to think that the peculiar properties of the two-cylinder engine in connection with the type of governor, and the system of fuel regulation, play an important part. In each case we are glad to state that the two-cylinder engine functioned properly, because we believe that the two-cylinder engine is cheaper than a three- or four-cylinder model for a given power and speed, besides having less weight and a better fuel-economy.

It must be kept in view that with the two-cylinder engine both cranks are running in parallel, so that in respect of kinetic forces the engine shows the same properties as a single-cylinder engine. That is to say, with high speeds the masses of the pistons and the reciprocating portions of the connecting-rods may be fairly compensated by the balancing-sector weight-masses on the opposite side of the cranks, but the last named masses will exert an unbalanced kinetic force in a horizontal sense that may have a bad effect when the speed exceeds a certain amount.

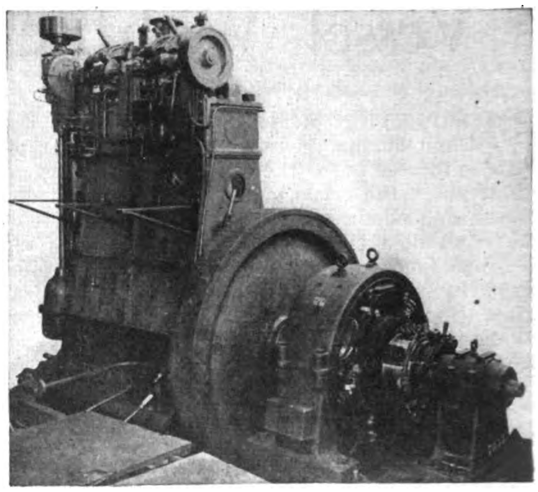
With the speed chosen—250 revs. per min.—this effect was, however, not present to any serious extent and as higher speeds are to be avoided in general with commercial Diesel-engine practice the question of kinetic balancing is not likely to prevent the introduction of the two-cylinder engine for electric-power generating on board ship.

This is of importance not only in connection with auxiliary power generating, but also with a view on the development of Diesel-electric propulsion in small vessels. If a high speed two-cylinder engine does its work well for lighting purposes it will certainly not fail to render good services when employed for propulsion-power generating as then it will have the advantages of simplicity, economy, cheapness, small weight and small space required when compared with multi-cylinder engines of same speed.

No doubt the shipping world will find interest in this engine and we may hope that we will find the Werkspoor Company inclined to provide us with more particulars about these engines, especially as regards running experiments. A detailed record of experiment results of the kind that was liberally furnished to "Motorship' by the North British Diesel Engine Co. of Glasgow and published in the issue of September, 1920 (page 810), would be regarded as a useful contribution to the knowledge and appreciation of the small Diesel-engine for ship's auxiliary drive.

The generators to which the Werkspoor engines are coupled, are made by the Electro-technische Insdustrie vooheen Willem Smit (Electric Engineering Works of the late William Smit) of Slikkerveer, Holland. The electric generating-plant is completed by an emergency generating set, consisting of a Kromhout surface-ignition oil-motor of 7½ b.h.p. direct coupled to a 4½ k.w. dynamo, turning 550 revs. per minute.

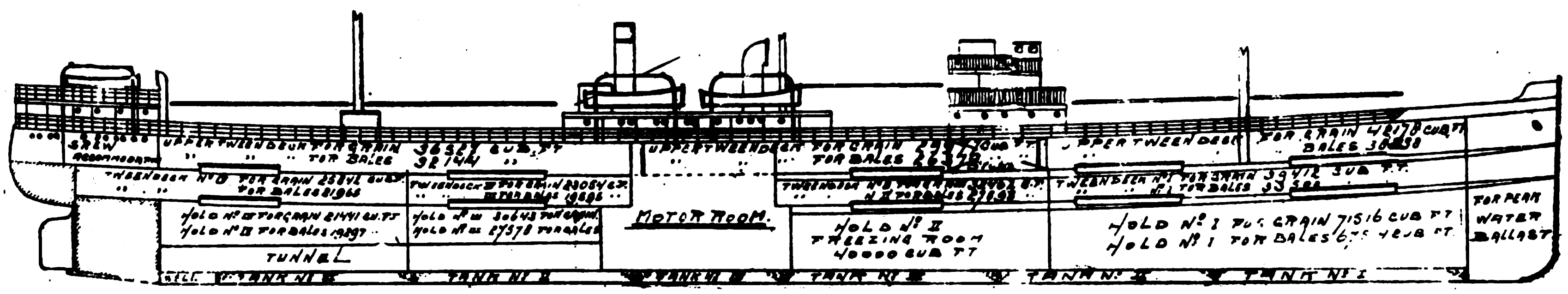
The switch-board has the same position as on the "Tosca" and is perfectly accessible at the back. Current is utilized for the usual ship's purposes, provision is made for taking current from the shore, enabling the generating plant to be



The new Werkspoor ship's Diesel-electric generating set

set at rest when the ship is in port. For this purpose a water-proof electric plug-contact is provided, mounted on the upper part of the engine-room casing. A motor-generator of Swedish make, converting three-phase current of 220-Volts into direct-current of 220-Volts having a motor of 11 h.p. is placed in the engine room in connection with the shore-contact circuit.

The Diesel-driven generators are located on the port side of the engine-room. On the starboard side at the after end there is a workshop, containing a shaping-machine, boring-machine and a lathe, all electrically driven by a common electric-motor by means of belt transmission, from which the power for a De Laval oil-separator, placed on the second floor, is also derived.



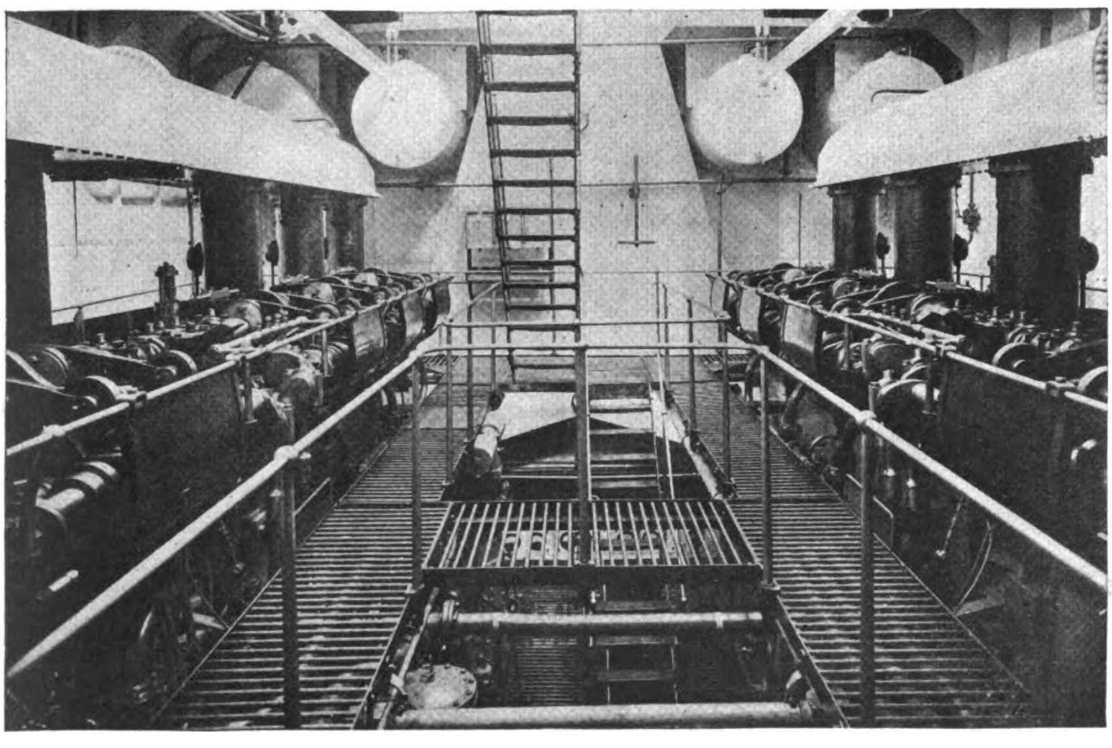
Profile plan of the motorship "San Paulo." Note the very small engine-room space. Her total under-deck cubic capacity is almost 400,000 cubic ft., although but 375 ft. x 51¼ ft. x 25½ ft. over all

The next auxiliary is the spare electric-driven air-compressor with a capacity of 230 cu. ft. of free-air per minute, delivered at a pressure of 65 atm. (925 lbs. per sq. in.). The motor has a capacity of 92 k.w. and turns at 275 revs. per minute.

Next to the air compressor a refrigerating-set is installed, composed of two Linde-ammonia-compressors, one of which is direct-driven by a 40-h.p. electric motor, the other by a single-cylinder four-cycle Werkspoor-Diesel engine of 40 to 50 h.p. The speed of the electric-motor can be regulated between 190 and 270 revs. per minute. The speed of the Diesel-engine, driving the other compressor can be varied in about the same range by means of a hand-wheel on the governor, visible on the illustration.

The refrigerating compressors can be worked separately as well as together. The brine-circulation is provided by an electrically-driven centrifugal pump.

Next to the brine circulation-pump, which is placed in the fore-starboard corner of the engine-room, we find on the fore end wall a combination pump, consisting of: one auxiliary two-stage air-compressor, one double-acting piston-pump and one single-acting plunger-pump. The pumps are driven by a common electric-motor working with spur gearing. On the intermediate gear shaft the crank for the auxiliary air-compressor is mounted. When not at work the crank-end bearing of the connecting-rod of this compressor is taken off and placed on a pedestal, the crank-pin turning loose on the shaft. The double-acting pump may serve as well for bilge- as for cooling-water, sanitary- and deckwash-pumping. The single-acting one is especially for pumping lubricating-oil. The motor, driving this combination engine is of 6 h.p. and runs at 1,000

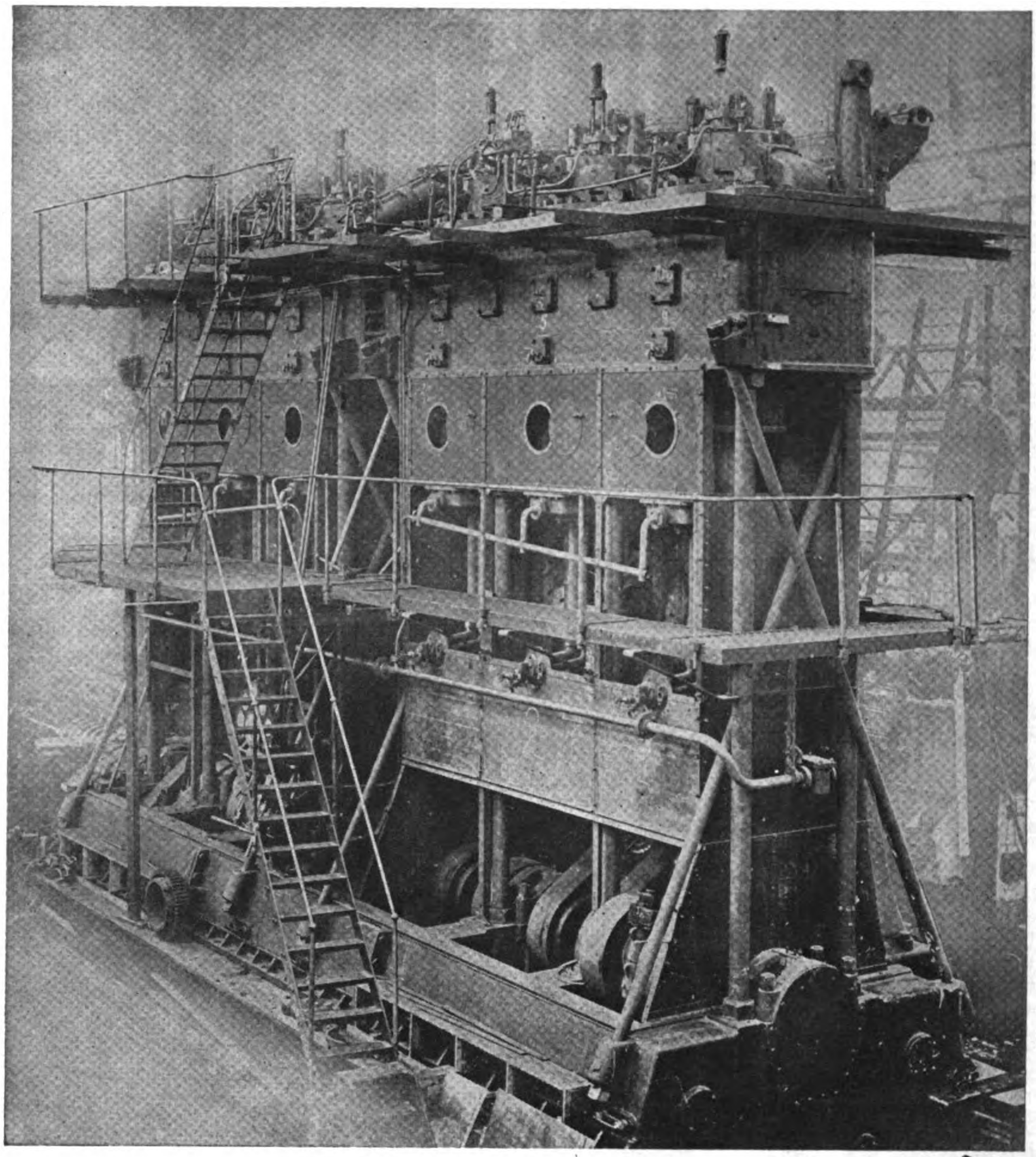


Engine-room of the "San Paulo." It is less than 50 ft. long revs. per minute, and the whole engine may be regarded as an auxiliary one—used only when in port.

On the same front end at starboard two electric-driven centrifugal-pumps are placed. The one is a cooling water-pump with a capacity of 150 tons per hour, driven by an electric-motor of 16 h.p. at 975 revs. per minute. The other is a ballast pump with the same capacity, worked by an electric motor of 30 h.p. at 1,450 revs. per min. This pump can also serve for engine-cooling and deckwash purposes.

Two spare pumps (low and high pressure) are driven from the intermediate shafts of the electric-driven turning-gears for the main-engines. On the aft end of the engine-room opposite to the switch-board a donkey-boiler is installed with a heating surfare of 265 sq. ft. and a working-pressure of 100 lbs./sq. in. (7 atm.). This boiler is oil-fired and serves for heating purposes. No attempt is made to provide heating steam from the exhaust gases though this practice has already been tried by Werkspoor and, as we were informed, in some cases met with success. On this ship, however, exhaust-heat utilization is practised in connection with bath-water heating. We observed that the siren mounted on the exhaust stock was not an ordinary whistle, but a specially constructed air-blast horn.

The steering-gear is of the electro-hydraulic system with two plungers and electrically driven multi-plunger pump, which machinery is Werkspoor-made. The anchor-winch with two horizontal warping drums is equipped with a 60-h.p. electric motor, working on a worm wheel. It is made by Clarke, Chapman & Co., Ltd., Gateshead-on-Tyne, England. Of the ten electric-driven winches four are of 5-tons lift and six of 3-tons. The winches were built on the Rijkee yard and the motors for them by the Electric Engineering Works, Slikkerveer. An interesting feature with these winches is the application of so-called "breast-controllers." These are light and small controllers, hung from the shoulders of the man-in-charge and connected to the motor-resistances by means of strong, flexible cables. So the man on the controller can move from hatch to railing and vice-versa or, rather, the signalling and controller-man can be combined in one person. We think that this system may give a gain both in wage costs and cargo handling speed.



The 2,150 i.h.p. Werkspoor four-cycle Diesel engine of the new single-screw motorship "Sardinia." The "San Paulo's" engines are of similar design, but of less power.

THE TRIAL TRIP

The trial was to be held on February 17 last, at 8 o'clock. When we got on board a dense fog hung over the Rotterdam harbor, preventing us discerning anything beyond a hundred yards. However, about twelve o'clock the fog had begun to clear up and a good weather report came from the coast-guard at Maassluis. This gave an occasion to appreciate the distinct quality of a motorship to start at very short notice, or, practically speaking, with no notice at all, the vessel simply starting when the order is transmitted by the ship's telegraph!

At 12.15 the order: "Stand by" came, and when at 12.20 the telegraph indicated: "Slow ahead" the engines turned within 16 seconds in the direction wanted. Before half-an-hour had past the speed was gradually raised to 100-110 revolutions per minute, the ship proceeding to sea, which was reached at 2 o'clock.

We were much impressed by the quietness with which the engines were handled by the men-in-charge, and the moderate use of lubricating oil, resulting in a clean engine-room where it was quite agreeable to remain on watch. Indeed one would not have thought a trial trip was going on, and still less would one have believed that this was the first time that the engines were making a continuous run, if one did not know that it was the truth! From the start till the return to the starting-point there was not one moment where the engines did not perform what they were asked. Not one involuntary stop occurred during the whole 7-hours run and the exhaust was invariably clear.

We noted too the marked quietness of running of the engines and the absence of escaping-gases (which in some engine-rooms cause a prickly feeling on the eyes.) Standing on the second floor however, there is some noise caused by the suction at the inlets of the air-compressors. Though this noise is not of a character to be harmful it may still be worth while to make provision for preventing it, so attaining an all-silent engine-room. [The Maxim Co., have produced a device for this purpose.—*Editor.*] The suction-inlet noise of the main cylinders has been entirely suppressed as we have already stated in the case of the "Athene" and it would be appraised by the men-in-charge if this cause of noise, though minor, were eliminated too.

Another point of some interest to the operating-men is the protection against loud reports caused by the lifting of the cylinder-relief-valves, which under some circumstances may be uncomfortable to the ear drums of the men engaged in the neighborhood of the valves; for example when taking indicator-diagrams.

In the engine-room we had pleasure to meet Mr. John Tindale, A. M. Inst. C. E. of the North Eastern Marine Engineering Co., Ltd., Wallsend-on-Tyne, who told us some interesting feats about Werkspoor-Diesel engine building in England. His firm are building the propelling engine sets for the vessels "Segovia" and "Sevilla," both being single-screw freighters building to the order of Dampskibsaktieselskabet Otto Thoresen's Linie, of Christiania. The engines will be built on Werkspoor-lines and of the same 1,000 to 1,100 shaft h.p.-type as the "San Paulo"-engines. It is of interest, that these British-built engines will be constructed in the North-Eastern works *exactly in accordance to the plans furnished by the Werkspoor Works* of Amsterdam, which is rather a departure from the practice we encountered with different foreign makers of Werkspoor-engines as the reader of "Motorship" will know from the descriptions about American- and French-built Werkspoor-Diesel engines showing the tendency of licensees to bring more or less important alterations in the general design. Which practice is the better one we may perhaps soon learn in practice by the results attained.

From Mr. Rijkee, the manager of the shipbuilding firm, we learned that the "Athene,"* which made her trials on July 29th, 1920, is operating very reliably and that the firm has received enthusiastic letters from her captain, Mr. I. Danielse about the performances of the ship and her engines. Certainly a great deal of the success of the ship has to be ascribed to the excellent way in which the engines are attended to by the chief-engineer, Mr. Nielsen, who is an experienced motorman.

The building of a sea-going motorship in general requires more skill from the part of the shipbuilder than is the case with a steam-ship. The requirements about strength, exactness, tightness of seams, etc., are of a more severe character. It seems an important matter to every shipbuilding yard to get experiences in this line. Mr. Rijkee assured us that the firm in every respect liked the work of building sea-going motorships and that the good results already gained were a very great satisfaction to him. Beyond the three vessels already mentioned in this article the firm has secured the order for building the "Hallrid" to the order of Kleppe's Rhederi of Bergen, Norway. The "Hallrid" will be a freighter of the same dimensions and power as the "San Paulo" and will be equipped with Werkspoor-Dieseel engines.

S. SNUYFF

Bloemendaal, February, 1921.

*According to a notice in a Dutch paper, the "Athene" has been sold to Bergenske Dampskibsselskabet, of Bergen, Norway.

Injection and Combustion of Fuel-Oil

(*Continued from page 144, Feb. issue*)

Experiments with Solid-Injection and Air-Blast in Marine Diesel-Engines

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Professor of Engineering, Armstrong College, Newcastle-upon-Tyne

PART II

SIMILAR experiments were then carried out with shale fuel-oil—which was the fuel used in the engine. The steel-plate was heated by a gas-burner and the temperature of the plate was measured by a thermocouple. It was found that at temperatures up to 250° F. there was no sign of the spheroidal state and each drop left a carbon deposit which ultimately burnt off, but at a comparatively slow rate. At about 250° F. the drop of oil on reaching the plate broke into a number of smaller drops and assumed the spheroidal state. The spheroidal state occurred until the plate reached a temperature of 600° F. which was the highest temperature recorded with the simple apparatus used. The subsequent evaporation of each small drop was more rapid as the temperature increased, and at the higher temperatures there was no carbon deposit on the plate when drops had vaporized.

Although the globules of shale-oil which reached the piston of the experimental engine under working conditions were much finer than the oil drops used in the experiments just referred to, the time during which the operations took place in the engine was exceedingly short. It is considered possible, therefore, that if that portion of the injected oil which reached the piston, and remained in contact with it, assumed the spheroidal state a slight delay in combustion would result. But what proportion of the fuel-oil which reached the piston remained in contact with it?

When the engine is working under ordinary conditions, *i.e.*, without the hot-plates, a certain portion of each fuel-spray strikes the piston, and it seems fair to assume that at least some of the globules striking the piston rebound—for if they did not rebound then, with the form of the combustion space of the engine, the distribution of fuel-oil would be adversely affected and the fuel consumptions recorded in this Paper would not be realized. If, therefore, in tests G and H the temperatures of the hot-plates were such that the globules of fuel-oil on striking the plates very rapidly vaporized it would follow that the distribution of fuel-oil would be modified. Under these conditions it is probable that pockets rich in fuel-vapour would be formed—in which case the rate of combustion would depend on the rapidity with which the air above the sprays mixed with the fuel-vapour in the pockets. This action would also result in delayed combustion. It is suggested, therefore, that in the engine the increased fuel-consumption and the delayed combustion with the hot-plates may have been due either to the oil-globules which reached the piston assuming the spheroidal state or to very rapid vaporization, or partly to both actions, depending on the temperature of the plates.

Rapid gasification of the oil-globules would appear to be an ideal condition so long as it is accompanied by good distribution, and had time permitted it would have been interesting to ascertain whether the hot-plates had the same effect on the fuel-consumption with air-injection as it did with solid injection.

From these experiments it seems clear that in the case of a solid-injection engine of comparatively high speed using shale fuel-oil the sprays should not strike a very hot piston. In the experimental engine the centre line of each spray strikes the piston at an angle of about 75° to the tangent to the surface at the point of striking.

It has been stated, however, that with a certain engine of comparatively low speed an improvement in consumption has been obtained by causing the fuel-sprays to pass over a heated surface, but in this instance the sprays hit the heated surface at a small angle and the fuel-oil used was a petroleum fuel-oil of heavier grade than shale oil.

Up to this time the best consumption figures had been obtained with the sprayer provided with five holes 0.016 inch in diameter, without any special hoisting devices. Comparing tests E and F, Table I., it will be seen that the fuel-consumption was slightly reduced by increasing the fuel-injection pressure. When carrying our tests at higher injection-pressures, however, it was noticed that increasing the fuel-valve roller clearance beyond a certain point did not give any better results.

It was also noticed that the fuel-valve roller did not follow the contour of the cam, and it was decided to take valve-lift diagrams from the engine when running. For this purpose an extension was fitted to the fuel-valve spindle, and an ordinary indicator was secured to the fuel-valve body so that the spindle extension pressed against the underside of the indicator piston. The drum cord was then connected to an indicator-rig which was approximately 90° out of phase with the piston. By this means the fuel-valve lift diagrams were obtained. A 200 lb. indicator spring was used.

Copies of actual diagrams, the ordinates of which give the lift of the fuel-valve magnified six times, are shown in Figs 4 to 7. The quadrant of the fuel valve cut-out lever was notched. Notch 4 represents the position in which the fuel valve had its full lift, notch 2 the lowest lift position at which tests were made and notch 3 an intermediate position.

Fig. 4 shows one of the first valve-lift diagrams taken with the sprayer provided with five holes 0.016 inch in diameter.*

5 Hole Sprayer. Holes ·016" Dia.
Revs. 380. B.H.P. 100.
Curve 1. Barring round Diagram, Notch 4.
" 4. Running Diagram, Notch 4. Fuel Pressure 3,700 lbs.
" 2. Barring round Diagram, Notch 3.
" 5. Running Diagram, Notch 3. Fuel Pressure 5,200 lbs.
" 3. Barring round Diagram, Notch 2.
" 6. Running Diagram, Notch 2. Fuel Pressure 5,600 lbs.

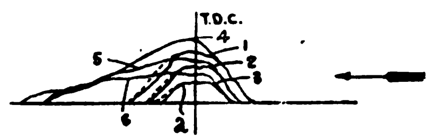


Fig. 4.

4 Hole Sprayer. Holes ·0'6" Dia.
Revs. 380. B.H.P. 10.
Curve 1 Barring round Diagram.
" 2. Running Diagram. Fuel Pressure 4,100 lbs.
" 3. " " " " 5,600 lbs.

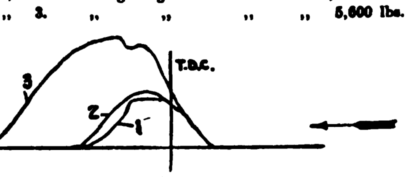


FIG. 5

5 Hole Sprayer. Holes ·019" Dia.
4th Notch of Quadrant. Fuel-Valve Roller Clearance ·003.
Revs. 380.
Curve 1. Barring round Diagram.
" 2. Running Diagram. Fuel Pressure 2,500 lbs.
" 3. " " " " 4,000 lbs.

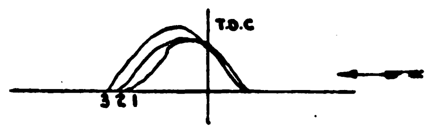


FIG. 6.

5 Hole Sprayer. Holes ·019" Dia.
2nd Notch. Roller Clearance ·090"
R.P.M. 380.
Curve 1. Barring Diagram.
" 2. Running " Spring load of 618 lbs.
" 3. " " " " 750 lbs.

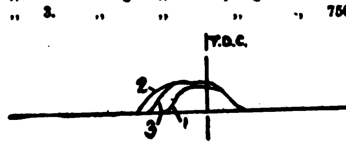


FIG. 7

The effect of "notching out" on the movement of the fuel valve is clearly indicated. Curves 1, 2 and 3 represent the movement of the fuel-valve for each position of the cut-out lever when the engine was barred round, *i.e.*, when the fuel-valve roller followed the contour of the cam. The breaks in these curves, *e.g.*, at "*a*" in curve 3, are due to the back-lash of the camshaft driving mechanism which is taken up by the load on the fuel-valve spring when the top of the cam passes below the roller. Curves 1, 2, and 3 are, therefore, not correct as drawn, but should be somewhat as shown dotted.

Valve-lift diagrams were also taken with a sprayer provided with four 0.016 inch diameter holes and these are shown in Fig. 5. With this sprayer the effect of increasing the fuel pressure is most marked—but it must, of course, be regarded as an extreme case.

Valve-lift diagrams obtained with a sprayer provided with five 0.019 inch diameter holes are shown in Fig. 6. Curve 1 is the "barring" diagram and making the necessary correction for the back-lash in the driving mechanism it will be seen from curve 2 that when the engine was running with the normal fuel pressure of 2,500 lbs. per square-inch the roller practically followed the cam. At a pressure of 4,000 lbs. per square-inch the roller began to leave the cam (curve 3, Fig. 6). In this instance a valve-spring was in use loaded to 618 lbs. when the valve was in the closed position.

The effect of increasing the spring-load was next ascertained. Fig. 7 shows the diagrams obtained with the 0.019 inch-hole sprayer. Curve 1 shows the "barring" diagram. Curve 2 is the running diagram with a spring load of 618 lbs. and a fuel pressure of 4,500 lbs. per square inch, and curve 3 is the running diagram with a spring load of 750 lbs. and a fuel pressure of 5,200 lbs. per square inch. The quantity of fuel-oil passed was the same for curves 2 and 3. The effect of the stronger spring is fairly marked but it is still insufficient to cause the roller to follow the cam.

Better results were obtained by increasing the load on the spring to 850 lbs., but, with the minimum valve-spindle friction, no appreciable advantage was obtained by increasing the spring load beyond this figure.

It was considered desirable at this stage to investigate the fuel-valve cam, spring, etc., and to ascertain under what conditions "jumping" of the fuel valve was likely to occur. The curves shown in Fig. 8 were therefore prepared. Curve "*a*" represents the curve of velocity of opening and closing of the fuel valve; curve "*b*" represents the forces necessary to accelerate and decelerate the valve, etc., curve "*c*" represents the load due to a 618 lb. spring, and curve "*d*" the spring load available after deducting the forces necessary to accelerate or decelerate the valve and its operating gear.

TABLE 2.—VARIATION OF PRESSURE IN INJECTION SYSTEM.

Maximum pressure. lbs. per sq. inch. (*a*)	Minimum pressure. lbs. per sq. inch. (*b*)	Fluctuation of pressure. lbs. per sq. inch.	Mean of (*a*) and (*b*).
4,560	3,440	1,120	4,000
4,320	3,280	1,040	3,800
4,240	3,200	1,040	3,720
4,000	3,040	960	3,520
3,680	2,800	880	3,240
3,480	2,640	840	3,060
3,360	2,560	800	2,960
2,840	2,160	680	2,500
2,360	1,720	640	2,040
2,000	1,400	600	1,700
1,920	1,360	560	1,640

Diagrams had previously been taken from the fuel-system with the object of ascertaining the variation of pressure during the cycle. For this purpose an ordinary hydraulic-indicator was used, but as shale-oil was found to leak past the indicator-piston a U-pipe connection was made to the indicator which was filled with a viscous oil—so that the heavy-oil was in contact with the piston. This overcame the leakage difficulty, and it is considered that reliable records of the variations of pressure were obtained. Table 2 shows the maximum and minimum pressures recorded when pumping varying quantities of fuel-oil, with the engine running at 420 R.P.M.

(*Fig. 8 will be given in the next installment*)

*It was subsequently found that the load on the valve-spring in use was slightly less than 618 lbs.—which was the load on the standard springs fitted in submarine engines in 1914.

Reconditioning the "Bacoi"

Installation of a Pair of 640 I.H.P. McIntosh & Seymour Diesel-Engines and New Auxiliary Equipment

By R. D. KARR

SOME of those familiar with the peculiarities of tank-ships in operation and the special requirements of the service see but little advantage in using the internal-combustion engine as the main power unit where a comparatively large-sized boiler is required for heating cargo and steam smothering for fire control. But the newly equipped motor-tanker "Bacoi" recently delivered to the L. C. Gillespie Co. of New York City will demonstrate that such a dual equipment can be of very great value. This company's business involves the importation from China of quantities of oil extracted from some native woods and used in the manufacture of paints and varnishes. This Chinese wood-oil is thick and hard when cold, but becomes quite watery when heated, so that it is perhaps ideal as a cargo if proper and sufficient means for heating the same are provided. While at sea the oil will resemble the natural wood gams while cold, thus possessing a minimum of fluidity, and the free surfaces of the oil will not cause much diminution of the latent stability of the vessel.

It may be mentioned that this vessel was originally built in Great Britain for service on the Great Lakes in 1912 under the name of "Calgary." Several years ago she was converted to a tanker and owned and operated in the Baltimore district by the Standard Oil Co. of New Jersey as a distributing vessel for refined-oil, such as water-white, gasoline, etc.

Although rather large for her new service, she is at first glance seemingly small for the run between Shanghai, China, and Tacoma, Wash. It may be mentioned right here that a vessel of this size with an equivalent steam plant would require about half the boat's deadweight capacity for the coal or oil for a round trip—thus automatically placing its operation beyond the bounds of an economic possibility. As it is, however, the vessel can be operated at a cost that results in a reasonable cost per bale of cargo transported and in amounts sufficient to keep pace with the facilities in China for assembling the required amount of oil between trips to Tacoma and return.

Thus we see that in the case the Diesel oil-engine lies at the crux of the whole situation, without its enormous cruising radius on a moderate double-bottom storage capacity, the operation would immediately have attached to it elements of uncertainty and expense that would have hampered initiative and probably forbidden the enterprise all together.

The dimensions of the "Bacoi" in her new condition are as follows:

Displacement (loaded)	3,525 tons
Dead-weight capacity	2,200 tons
Net cargo-capacity (10,420 miles voyage)	1,900 tons
Fuel-capacity	500 tons
Fuel, stores, water, etc., required on round voyage (10,420 miles)	525 tons
Ratio of net-cargo to displacement (10,420 mile voyage)	53%
Length	248 ft.
Breadth	42 ft. 5 in.
Depth	19 ft. 1 in.
Draught (mean loaded)	14 ft. 3 in.
Power	1,280 i.h.p.
Speed (loaded)	10 knots
Built	1912
Reconditioned	1920-1921
Builders	Swan, Hunter & Wigham Richardson
Re-conditioners	Vulcan Iron Works
Engine-builders	McIntosh & Seymour
Gross tonnage	1,696½ tons
Net tonnage	1,185 tons

Delivered to the L. C. Gillespie Co. by the former owners in July, 1920, the vessel was towed to the yard of the Vulcan Iron Works in Jersey City, N. J., for the reconditioning and installation of twin six-cylinder, four-cycle, 500 shaft h.p. (640 i.h.p.) McIntosh & Seymour Diesel-engines and a Ward watertube boiler for auxiliaries, cargo-heating, pumping. Considerable structural work was involved in the proposed changes including cutting away the old engine-room bulkhead aft of No. 4 cargo-tank, and building a new one, or rather two bulkheads with a cofferdam between about five frames forward. This required cutting off a segment from the after side of the No. 4 cylinder tank giving a flat surface in the tank about twenty feet wide.

Ordinarily with the Jack tank system no stiffening is required, due to their cylindrical shape; but naturally the flat surface of the new bulkhead required full strength as is demanded for ordinary oil-tight bulkheads. In addition to the extensive underwater charges necessitated by relocation of the propeller-shafts, bossing of frames and shell plates, new shaft brackets, etc., a complete new poop-house was built of steel—to provide quarters for the engineer's force, to house the steam-boiler and incidentally to raise the engine-room skylight.

In profile the vessel has really quite changed, for the pilot-house, captain's and mates' quarters, with upper bridge all intact; was disconnected from its location at the aft end of the hull and moved bodily aft to a new skeleton structure erected amidships. This undoubtedly increases the general appearance of the boat and will tend toward more efficient handling at sea and in crowded waters, while also permitting better protection to the deck-force while on watch.

Below decks the bulkhead at the after end of the forecastle is continued to the tank top to separate the pump-room from the refrigerator space. In this pump-room is located a large duplex horizontal Wilson-Snyder oil-pump 14 in. by 10½ in. by 18 in.—with 12 in. suction and discharge connections. A smaller Worthington horizontal duplex pump is connected by 3-in. suction and 2½ in. discharge lines to the forward fuel-oil tanks including the forepeak. This is used as a transfer-pump to deliver oil aft where it may be fed to the high gravity service-tanks as required.

The refrigerating machinery is of the Brunswick type—the compressor being driven by a 4 in. by 4 in. steam engine. Circulation is taken care of by a small Worthington horizontal duplex—a pump which had previously done service elsewhere on the boat. To install such an outfit was obviously the only logical thing to do, as to carry ice enough to keep food a month would be impracticable as well as prohibitive in cost. Besides the lower maintenance cost, the better living conditions resulting from properly preserved foods will become a large factor in the crew's contentment and efficiency.

There are four main cylindrical Jack tanks for cargo in the "Bacoi" and the four double-bottom tanks for ballast and fuel, besides the after-peak for fresh-water, the fore-peak for fuel and a deck-tank at the forward end of the poop-deck also for fuel.

On the platform level outboard of the starboard engine is located the Egsberg 7 in. by 7 in. steam driven electric generator, 120-amperes, 110-volts at 400 r.p.m. A Westinghouse standard panel is arranged for two power circuits—one from the above generator and one for the Mietz surface-ignition engine-driven dynamo located in the lower engine-room. There are eight feeder-circuits provided for lighting and two for power to various motor-driven auxiliaries. All switches are double pole, two-throw knife-switches. The two-power feeders have overload and no voltage releases. Each generator circuit has its own volt and ampere meter.

At this level near the forward bulkhead is the steam-trap for collecting oil and water from the exhaust-steam from the cargo heating-coils. Aft of the steam-electric unit is a hot well and filter tank, and an Alberger 350 sq. ft. condenser mounted over a combined wet and dry pump. Near the hot-well are duplicate Worthington feed-pumps. Aft of the condenser near the shell is a Row and Davis distiller with a small Worthington pump for salt-water feed.

At the after end on the upper level is situated the Ward water-tube auxiliary boiler. It is equipped to burn oil under forced draft, the fuel being fed by a White fuel-oil unit. The forced draft is provided by a small Simplex turbo-blower furnished by the Power Turbo Blower Co., of New York. The boiler, tested to 300 lbs. per sq. in., is made of Lukins Steel Co's. boiler plates—6,000 lbs. per sq. in. elastic limit.

On the port side at this level there are arranged from forward-aft three lubricating-oil trunks, Excelsior hand bilge-pump—two Richardson-Phoenix lubricating-oil filters for the main engines and the engine-room machine-shop and tool-room. This machine-shop, enclosed in a wire netting is equipped very completely. The lathe is a particularly fine piece of equipment. It is a National Lathe Co.'s machine from Cinncinnati, back-geared to a 3 h.p. Western Electric motor, controlled by Cutler-Hammer starting and overload controls. The whole outfit was supplied by the Wickes Machinery Co., Jersey City, N. J. In addition there is a Hoosier Drilling Machine Co.'s drill-press, made in Goshen, Ind., and furnished by Van Dyk Churchill Co. of New York.

On the lower level of the engine-room the port side is given over principally to duplicate cooling-water circulating-pumps and the main bilge and ballast-pump. The circulating water-pumps are Goulds centrifugal, 10 h.p. electric motor-driven type at 165 r.p.m.; the suction is 6 in. and discharge 4 in. diameter. The main ballast, fire and bilge pump is the original installation, being a Lamont (English made) vertical duplex 7 in. by 9 in. by 8 in. This has not been changed except to be opened up and overhauled. In addition there is a small sanitary-pump and a new Dean duplex auxiliary engine-room and forward bilge-pump.

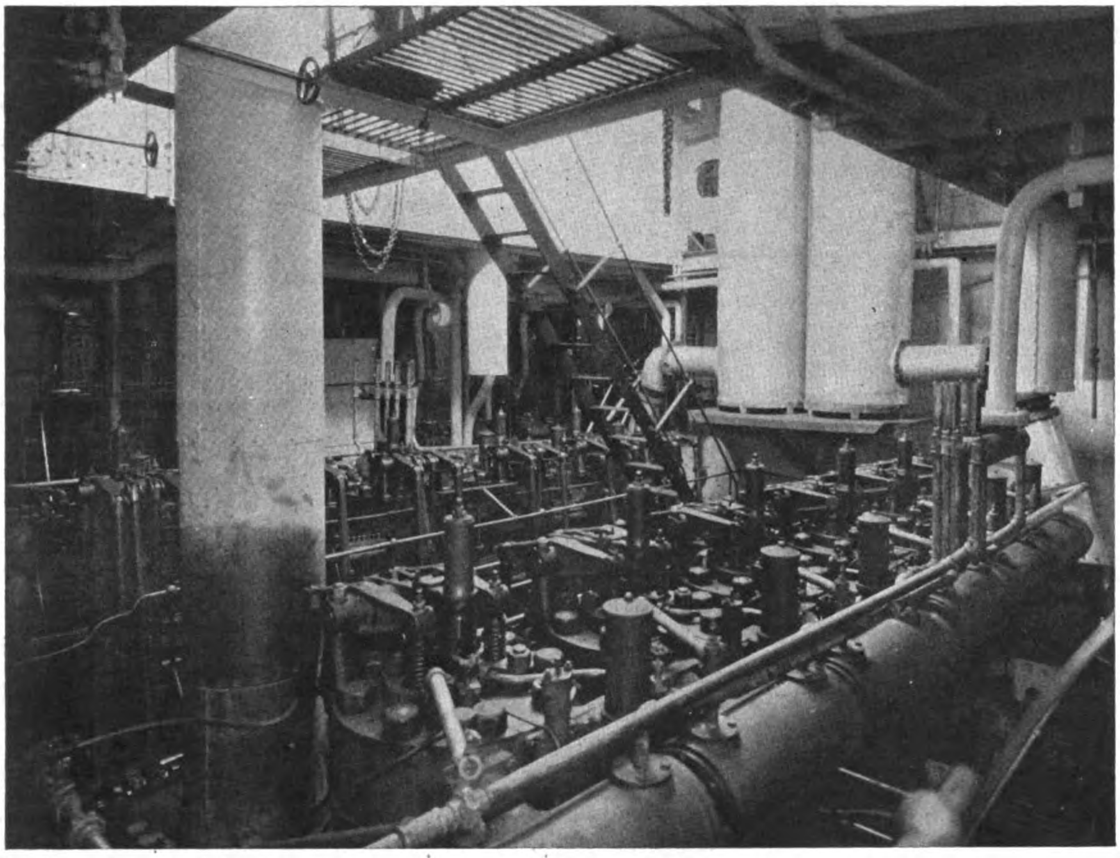
Against the forward bulkhead on this side is a vertical duplex Lamont auxiliary fuel-oil transfer pump. On the starboard side is a motor-driven Kinney gear-pump. The pump is driven through a silent chain by a Crocker Wheeler electric-motor running at 1,300 r.p.m. A Cutler-Hammer two h.p. starting-box is used.

There remains on the starboard side only the Mietz single-cylinder 15 h.p. oil-engine direct-connected to a General Electric 10 k.w. electric-generator, and a Bury air-compressor. A McCord mechanical-lubricator is mounted on this engine. Steam is the power element for the Bury compressor, which is a horizontal single-crank machine—all cylinders being arranged in tandem, first the steam cylinder next to the crank and beyond the first and second stages, respectively, for the compression of air. The cylinder sizes are, steam 8 in., air 5 in. and 1½ in. dia. all with an 8-in. stroke. An intercooler and after-cooler is supplied with all connections, lubricator and governor. In connection with the usual type of centrifugal ball-governor there is an automatic device linked-up with the discharge of the last stage, thus the machine may be controlled by the pressure of air built up in the tank.

On the engine platform level, aft of the boiler are the crew quarters. The deck and engine crew are Chinese and it is reported that they have proved to be very good workers. The steering-engine is steam and turns the rudder through gearing and a quadrant.

Completion of the conversion was delayed beyond the time originally set as much more work was actually performed than was at first contemplated, but the owners now have a splendidly equipped, well powered efficient little carrier for their raw product. All machinery and outfit is A-1 to pass the Bureau's highest class and her chief-engineer, Mr. Barnes, is enthusiastic as to the entire engine-room.

In her trial trip Mr. Parks, general-manager of the Vulcan Iron Works, had full charge and everything went off satisfactorily, excepting some trouble with the steering gear. She made 2 5/8 nautical miles in 15 minutes and 30 seconds against a slight ebb tide. This is equivalent to a speed of 10.1 knots or in slack water 10.25 knots. Her mean draft, however, was only 12 ft. —equivalent to a displacement of 2,924 tons. Fully loaded her mean draft will be 14 ft. 3 in., displacement 3,525 tons. The average r.p.m. was 192.5, three-bladed turbine propellers of 8 ft. diameter and 6 ft. 5 in. pitch being fitted. These propellers are of manganese bronze designed by Mr. Ebsen, consulting turbine and propulsion en-



Engine-room of the "Bacoi," showing new power installation

fuel now due to be burned under the boiler will be saved. This will amount to $10,000 to $12,000 per year alone. Readers of "Motorship" will recall the disproportionately large amount of oil consumed in this manner under the auxiliary boiler on the M.S. "Songvaar" in comparison with the amount required to operate the main Diesel-engine of 1,600 i.h.p. Truly the Diesel-electric generator and motor-driven auxiliaries have an enormous field of application.

It is gratifying to note that the "Bacoi's" first voyage for her new owners has already begun. She left Philadelphia about March 5th with a full cargo of kerosene and fuel-oil for Alexandria, Egypt, whence she will no doubt proceed through the Suez Canal and the Indian Ocean to China. The designs and specifications as well as the superintendence of the conversion work was performed by Kindlund & Drake, marine architects and engineers, who have been studying the requirements and practices in motorship work. They were, in fact, the designers and consulting firm in connection with the Vacuum Oil Co.'s tanker "Bayonne."

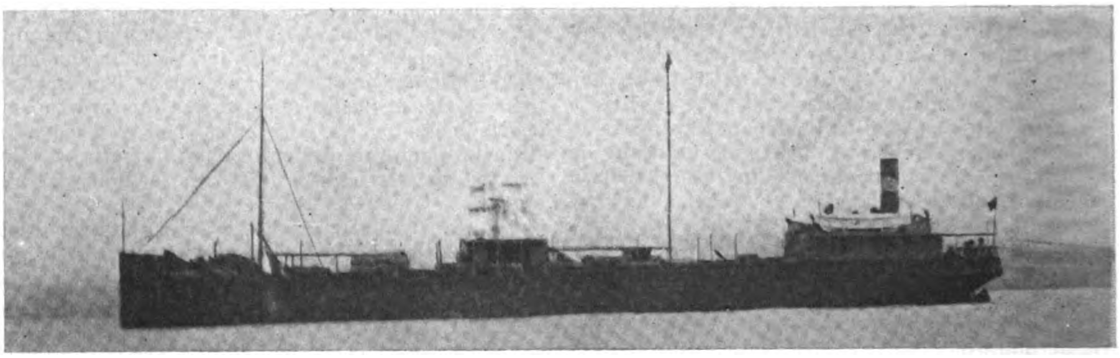
In addition to the "Bacoi" there are two more motorships in the yard of the Vulcan Iron Works, namely the "Astmahco III" and "Astmahco IV"—each having McIntosh & Seymour Diesel engines installed. The latter ship has just run trials.

Incidentally, the Vulcan Ironworks are anxious to witness the development of the Diesel-electric drive. This proposition to the careful student and one who keeps abreast of the march of progress is full of endless possibilities of which it is safe to say our present knowledge is quite limited.

gineer for the Vulcan Works, and made at W. A. Fletcher's plant in Hoboken. Chadburn's telegraphs were mounted at the control station and Elliott twin basket fuel-oil strainers were provided in the delivery-line to the engine fuel-pumps.

Her displacement is figured at 3,525 tons so that her efficiency or ratio of net cargo to displacement loaded is 53%. This is assuming 300 tons for fuel, feed-water and stores. The total capacity of fuel will be over 500 tons, but on the return trip 250 tons would be on board at Shanghai.

Her owners have tentatively considered equipping her engine-room with electric auxiliaries so that the boiler may be entirely shut-down while at sea. This is a most logical step inasmuch as about 300 days a year will be saved in the operation of the boiler and about three-fourths of the



The re-conditioned motorship "Bacoi," now powered with twin 500 shaft h.p. McIntosh & Seymour four-cycle Diesel engines

Electricity Applied to Ship Auxiliaries

Extract from Paper Presented at the Joint Meeting of the N. Y. Section of the American Institute of Electrical Engineers and the Metropolitan Section of the American Society of Mechanical Engineers, New York

BY H. L. HIBBARD

(Continued from page 220, March, 1921, issue)

Engine Room Auxiliaries. As an example of the engine room auxiliaries which are included in a large oil-engine driven vessel, we give below a list of those supplied on one of our latest motorships, the *Cubore*, of 11,500 tons d.w.c.

Deck Machinery. The deck machinery equipments, consisting of windlass, winches, capstan and steering-gear, may be considered separately to advantage.

Windlass. For the windlass equipment a watertight motor is essential and a manually operated drum controller, if installed on and operated from the deck. Frequently, however, control equipments are provided non-watertight and installed below deck with shaft extensions through stuffing box, or a contactor equipment remotely controlled with small watertight master on the deck and non-watertight automatic panel below deck. A compound wound motor can be used to the best advantage usually for the anchor windlass, particularly when of the spur-geared type, and provisions must be made in the control for stalling the motor on any controller point in case of fouling the anchor on the bottom or jamming of the gear.

Deck Winch. The auxiliary upon which probably more thought and study is being given at the present time from an electrical standpoint, than any other on shipboard, is the cargo deck-winch. This is an especially important piece of machinery on a vessel handling miscellaneous cargo, and reliability of operation, and range of speed control in both hoisting and lowering, are of prime consideration.

Much discussion has been had of late with regard to the exact type of control to be furnished for deck winches and the results to be accomplished. One manufacturer is strongly advocating at the present time, the electrically operated winch but provided with mechanical load lowering brake in place of the customary dynamic electric lowering control. While differences of opinion naturally exist on these details, one point is obvious; that the ideal electric winch is one which provides as nearly as practicable, a straight horsepower curve, accommodating its speed automatically to the value of the load and permitting the handling of light and heavy loads without the necessity of changing gears; also that it gives in lowering as near as practicable, corresponding range of speeds for heavy and light loads down to the empty hook. And it must be borne in mind that time gained in the hoisting and lowering of the empty hook is that much clear gain in loading and unloading the vessel.

In the case of deck winch equipments and anchor windlass as well, it is the practise to provide a mechanical brake on the motor shaft, electrically operated, to prevent falling of the load in case of failure of voltage.

An arrangement of control for the deck winches which has been used to some extent and was recently illustrated in the cases of the British motorship *La Paz*, provides a small deck-housing between or adjacent to the hatches and in the center of a group of winches. In this small deck-housing is placed the main controlling- apparatus of the contactor type, as well as the rheostats all of open construction. At the winch itself is provided a small watertight master controller carrying contacts only for the operation of the contactors within the deck housing. This arrangement we believe is worthy of serious consideration as it groups the apparatus together to advantage, makes the apparatus readily accessible, and permits of good ventilation to the rheostats, thus permitting less capacity and smaller resistances.

Capstans. Capstan equipments, where used, are frequently so arranged as to permit installation of the driving motor in a compartment be-

ENGINE-ROOM AUXILIARIES OF BETHLEHEM STEEL CO.'S MOTORSHIP "CUBORE"

Auxiliary	No.	H.P.	Location	Motors Type	Motors Open or en.	Control Type	Control Open or en.
Fresh Water Pump	1	5	Floor	Hor.	Encl. Vent	Mag.	Encl.
Turning Gear	1	20	"	"	"	Mult. Switch	"
Booster Compressor	1	25	Platform	Ver.	Open	Mag.	"
Refrigerator	2	5	"	Hor.	"	Hand Start	"
Oil Transfer Pump	1	3	Floor	"	Encl. Vent.	Mag.	"
Steering Gear	1	25	Steer Room	"	Encl.	Spec.	"
Circulating Pump	2	25	Floor	Hor.	Encl. Vent	Mag.	Encl.
Lubricating Oil Pump	1	7½	"	"	"	"	"
200-Ton Ballast Pump	1	15	"	"	"	"	"
Bilge Pump	1	15	"	Ver.	"	"	"
Air Compressor	2	125	Platform	"	Open	"	Open
500-Ton Ballast Pump	1	50	Floor	Hor.	Encl. Vent.	"	Encl.
Lub. Oil Purifier	2	1	For'd Blk.	"	Encl.	Hand Start	Open
Fuel Oil Pump	2	3½	Floor	Hor.	Encl.	Mag.	Encl.
Sanitary Pump	1	7½	"	Hor.	Encl. Vent.	Mag.	Encl.
Lathe	1	1½	Platform	"	Open	Mag.	Encl.
Grinder	1	3	"	"	"	Hand Star	Open
Drill	1	2	"	"	Open	"	"
Generator	2	100 k. w.	Floor	Oil Engine driven			
Generator (Emergency Set)	1	100 k. w.	"	Geared steam turbine driven			

low decks and thus allowing an open or at least a self-ventilated motor, which is usually furnished heavily compound wound to provide the varying torque characteristics necessary with this equipment. The control, in its simplest form, may be a plain starting hand operated or push button controller, but the best practise provides stalling features and dynamic or armature shunt control on one or more points in either direction for use in paying out cable. The motors should be usually provided with an electrically operated mechanical brake as the drive is often through gearing efficient enough to permit overhauling.

Steering Gear. The early stages of development of the electric drive as applied to steering gears, is quite generally covered by the writer's paper before the A. I. E. E. in May 1914, which describes in detail the direct application of electric-drive where a motor is geared directly to the transmission, frequently of the screw gear type. With this arrangement the motor is operated by a contactor panel remotely controlled from the bridge, usually on the non-follow-up system, although electrical follow-up control has been designed and some times employed.

(*To be continued in our May issue*)

ELECTRIC AUXILIARIES OF MOTORSHIP "TOSCA"

In our article on the motorship "Tosca" published in our January issue, we stated that the electrical winches were supplied by Messrs. Figge & Co. of Haarlem. This is a typographical error, as the correct spelling of the name is "Figee."

Electric Propulsion of Ships

Advantages of the Diesel-Electric System

BY W. E. THAU* General Engineer, Westinghouse Elec. & Mfg. Co.

THE following types and arrangement of power drives have been applied with more or less success to ships:—

1. Direct-connected reciprocating steam-engine.
2. Direct-connected turbine.
3. Geared turbine.
4. Turbine-electric with direct-connected motor.
5. Turbine-electric with geared motor.
6. Internal-combustion engine, direct connected.
7. Internal-combustion engine, geared.
8. Internal-combustion engine, or Diesel-electric, using direct-connected motors.

From an economic standpoint, the direct-connected Diesel drive is far superior to any type of steam drive, and is certain to see an era of prosperity. However, when compared with the Diesel-electric drive, the economy advantages of the direct Diesel drive are small and in the case of long runs, the additional weight has a slight disadvantage.

The ordinary internal-combustion engine using gears will probably see very little more development under present conditions. The internal-combustion engine or Diesel electric drive using direct-connected motors offers possibilities superior to those of any other type of drive.

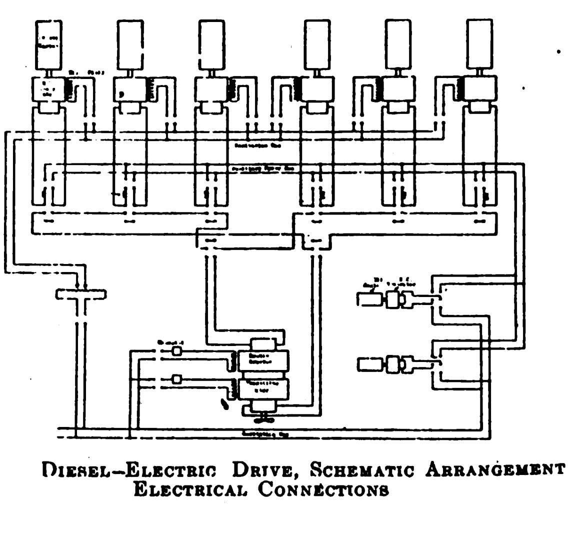
Reliability should not be sacrificed for any other consideration. Reliability necessitates close adherence to rugged and thoroughly proven apparatus which must of necessity stand more or less abuse without danger of failure. The machinery must operate continuously for days and possibly for months without shutting down, and must be simple within reason and thoroughly understood by the operators. Economy, cost, weight space, etc., are important in that they determine the relative earning capacity of the ship.

With the Diesel-electric drive, the electrical equipment is of the d-c. type, because of its flexibility, ease of speed control and simple requirements of the engine governors. If alternating current were used with Diesel-electric drive, the engine governors would have to be highly refined as it would be necessary to operate the generators in parallel; whereas with direct current, the generators may be operated in series, thus permitting relatively simple engine governors. Even with parallel operation of the d-c. generators, the governor problem offers no difficulty, however, there are other decided advantages in favor of the series operation. The propeller speed is varied any amount from zero to a maximum in either direction, without opening a single circuit, by merely adjusting the generator voltage by means of a simple field rheostat, the engines always operating at constant speed.

For ships up to 6,000 h.p., (the larger sizes having twin screws) the Diesel-electric types of propulsion possesses marked advantages over all other types. With this type of drive, any reasonable number of generating units may be used, independent of the arrangement of the propellers. It is, therefore, possible to use a number of relatively small reliable, high-speed Diesel-engines driving direct-connected d-c. generators. By using a number of the small units, the disadvantages of large Diesel-engines are obviated. Aside from the reliability thus obtained, there is the added important advantage of flexibility with regard to reserve power, and as will be shown later, this advantage is possessed in an extreme degree only by the Diesel-electric drive.

The electrical apparatus is well understood, thoroughly tried out, and there is consequently no question as to its reliability. The motors are separately excited at constant potential in one direction while the generators are supplied with excitation through a reversing field rheostat so that any desired voltage may be obtained from zero to the maximum in either direction. With this arrangement, the speed of the motors is directly proportional to the voltage of the generators. Therefore, the control is as simple as could possibly be desired.

Series connection of the generators with the motors interposed to reduce the ground voltage to a minimum has certain advantages over parallel connection of generators. For the purpose of discussion, let us assume a single-screw drive consisting of six generators and a motor consisting of two separate units mounted on the same shaft. Electrically, the machines would be arranged in series as follows: Three generators, one motor unit, three generators, one motor unit. On the basis of 250-volt generators, the maximum ground voltage would be 750 volts, although from the standpoint of current, the system has all the advantages of a 1,500-volt circuit. This arrangement of generators and motors is independent of the number of either, and is particularly advantageous in case the number of generators is uneven, such as five generators and two motors. Furthermore, the motor units may be on different screws as in the case of a twin-screw drive. Even in the latter case, independent control of the port and starboard screws can be obtained. However, with the same or opposite rotation of the screws, the amount of speed difference obtainable is limited, although wholly within requirements.



Diesel—Electric Drive, Schematic Arrangement Electrical Connections

With the series arrangement, more power can be obtained from remaining generator units in case of failure of one or more generator units, without providing excess capacity in the motors. The reason for this is that each of the remaining generators can be operated at normal voltage and the field of the motors weakened to increase the propeller speed to a value which will load the remaining generator units to their capacity.

In the way of a summary, the following table of comparison of the various principal drives will be of interest. In arriving at the figures given, all items of machinery and supplies necessary to the main propelling machinery were considered; foundations, water, fuel, etc., were taken into account. However, it was necessary in some cases to make certain assumptions, but an effort was made to place such assumptions on the conservative side, so as not to show an exaggerated comparison. Further, certain major figures are at great variance in practise, and the table is, therefore, given as indicative of the trend of this comparison rather than actual proportions. The figures for turbine electric drive and geared turbine drive are based on the same steam conditions.

The figures are based on a 3,000 h.p. ship operating over a 4,000 mile course at a speed of 11 knots, and making a total of 14 single trips per year. The geared-turbine ship is taken as unity.

Drive	Fuel Consumption	Machinery Weight
Geared turbine	1	1
Turbine electric	1.06	1.05 to 1.10
Direct-connected Diesel	0.49	1.10 to 1.25
Diesel-electric	0.57	0.75

*Extract from paper presented at the Joint Meeting of the N. Y. Section of the American Institute of Electrical Engineers and the Metropolitan Section of the American Society of Mechanical Engineers, New York, N. Y., January 28, 1921.

Air-Injection or Mechanical-Injection

A Technical Treatise on a Subject of Great Importance to Diesel-Engine Builders

BY J. L. CHALONER

Part III.

[We have been fortunate enough to secure Mr. Chaloner's exclusive services, and his valuable articles on Diesel-engine subjects will only be found in "Motorship."—*Editor.*]

(*Continued from page* 133, *February issue*)

IT will be observed that for a heavy fuel, such as is suitable for a marine oil-engine, the vapourization temperature range is about 400° F., which value will make it quite clear, how difficult it is to evaporate the whole of the fuel charge, before a partial admixture takes place with the more readily evaporated portion of the fuel. Again important it is to have maximum degree of vapourization, to ensure a homogeneous combustible mixture. It is essential therefore, that a maximum amount of heat should be transferred from the highly compressed air in the combustion-space to the fuel in the shortest possible time. This condition becomes absolutely imperative with heavy fuels, such as are now forming the main fuel supplies for oil-engines.

In the previous article on "Notes on Air-Injection for high pressure oil-engines," in the August

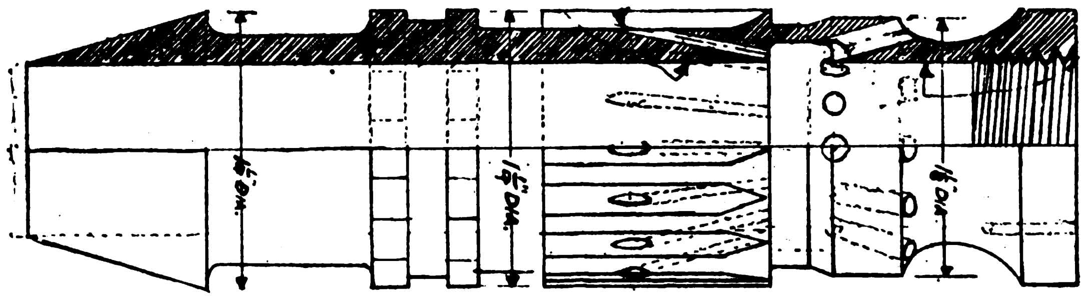


Fig. 18

1920 number of "Motorship," attention was already drawn to the following important observation:—

With the air-injection it can be assumed that each globule is surrounded by a corresponding layer of compressed-air, assuming of course, that the air is acting as an efficacious atomizing agent. As the size of globule, with increasing atomizing pressure, decreases, the depth of the surrounding layer of compressed air will at least remain of the same depth as in the previous instance. The relative volume of air to oil will, therefore, increase, and either more heat per globule of the oil charge will be necessary to penetrate the larger volume of compressed-air in the same time, so that the same amount of heat is given to the oil particle, or otherwise it will take a longer time for the requisite amount of heat to be imparted to the oil charge to complete vapourization. As the time element plays a very important factor in the degree of combustion of the fuel charge, it will be clear, how essential it is to transfer the requisite amount of heat from the highly compressed-air charge to the fuel in the desired space of time.

It is generally accepted that partial dissociation will take place when vaporization of the fuel takes place in the fuel-valve and combustion-chamber However, the effect of pressure on such chemical reaction is not yet known sufficiently well, to draw any definite deductions. This point will be discussed in detail in another article dealing with the suitability of fuel-oils.

There is however, another aspect of the problem. The fuel-valve temperature in a Diesel-engine is on the average about 650° F. It has been determined from practical tests, that the amount of oil in the fuel-valve chamber below the level at which the fuel enters the valve-casing proper, should not exceed 30 to 40% of the total weight of oil required for any particular charge. This surplus and the major portion of the next charge should be distributed in the pulverizer as near to the fuel valve face, as practically possible, in order to get the full benefit of pre-heating.

Such a distribution, however, would lead to an insufficient atomization. On the other hand, a distribution of the fuel in the compressed-air in the fuel-valve proper would diminish the pre-heating effect. Figs. No. 21 and 22 show light-load and full-load cards, when the greater portion of the charge is as near to the fuel-valve opening, whereas in Figs. 23 and 24 care is taken to have the fuel-charge well distributed over the air. The effect of the compressed-air is quite apparent, although it is admitted at the same time that this point is not of such material importance, when using as fuel an oil approaching in quality that of a gas-oil or solar-oil.

To-day the aim of every designer is to construct an engine which will run satisfactorily on a residuum such as is burnt under boilers or in furnaces. It is with particular reference to such fuels that attention is drawn to the importance of favourable thermal conditions, not only in the combustion-chamber proper, but also already in the fuel-valve casing. Only under such conditions will it be possible to vapourize the oil-charge sufficiently to product an effective combustible mixture.

With mechanical-injection the conditions are fundamentally more favourable. The absence of any air will prevent any possible formation of a combustible or even explosive mixture with the more inflammable portion of the fuel charge, which, if in existence, would produce a spray, less homogeneous than desirable, on entering the combustion-chamber.

It is suggested that particularly for heavy fuels the mechanical injection method offers more favorable conditions to give a high degree of combustion, especially in high-powered units.

3. Combustible Mixtures

By a suitable combustible mixture it is understood, that a requisite amount of air is mixed with the charge of fuel to form a mixture which under favorable thermal conditions will readily and completely burn without leaving any appreciable residue in the combustion-chamber. With every class of fuel, an amount larger than the theoretically calculated amount, is required to burn any specific quantity of fuel.

In the recent article on "Air-Injection for high-pressure oil-engines" several tables and data are quoted giving the excess air co-efficient for different conditions with regard to the air injection method, and the reader is referred to the "Motorship" (July, August, and September, 1920) for reference.

From tests taken over a wide range of powers and types of engines it has been observed, that about 4% of the total available combustion or "Cycle" air is provided by the compressed-air, following the fuel charge into the combustion chamber, when considering normal load (full load) conditions. The air excess co-efficient is about 1.4, and varies with the load, and also to a certain extent with the size of cylinder. Such an average curve is shown in Fig. 25.

With mechanical-injection the co-efficient does not vary at the same rate, and a corresponding curve is graphed on Fig. 25, the size of cylinder and load being as far as possible very similar.

In the former case the data were calculated from the exhaust-gas analysis, whereas in the latter the chemical composition of the fuel to-

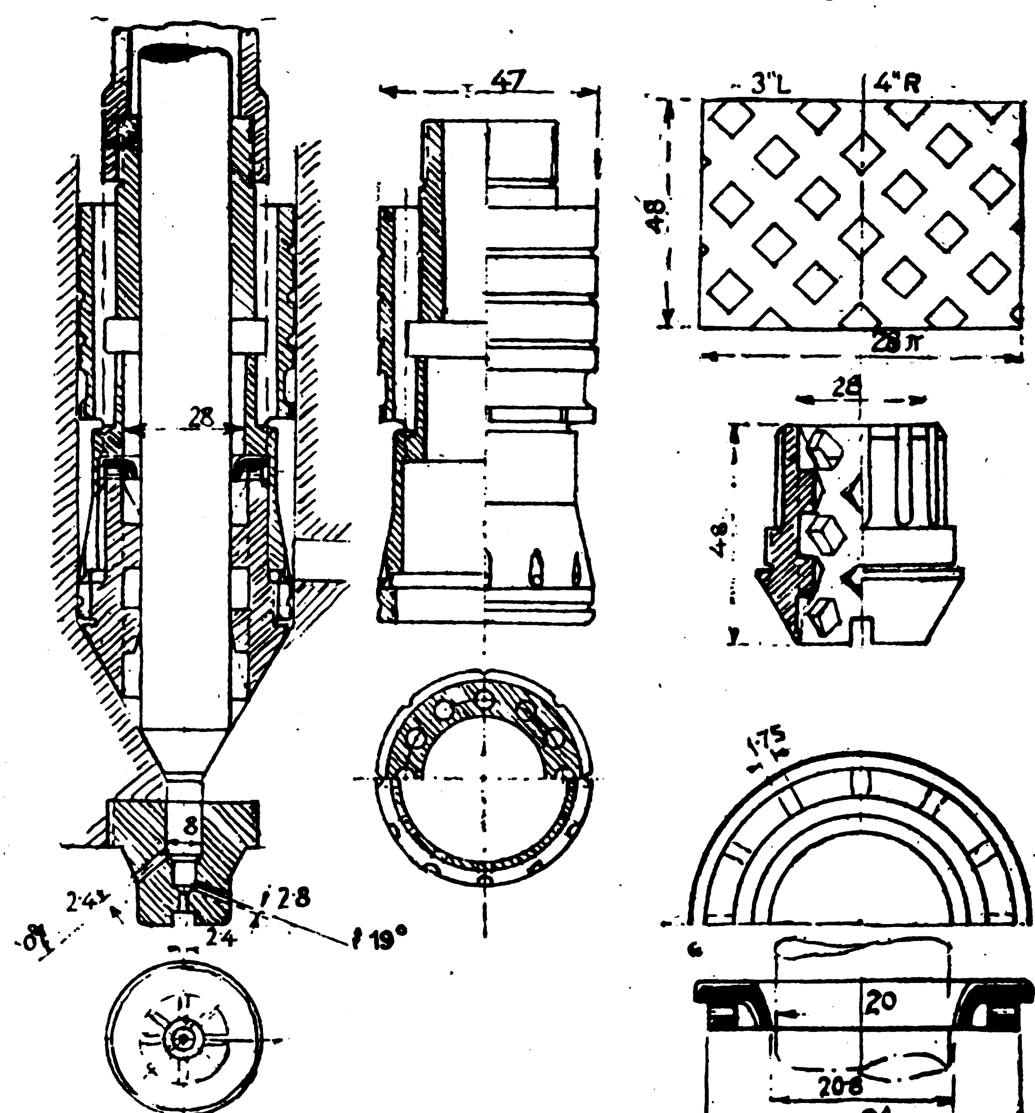


Fig. 19

gether with the measured quantity of the total air were utilized for the purpose.

As has already been stated, turbulence is essential in addition to a high degree of atomization to obtain a homogeneous mixture, and it has been stated that in this respect the mechanical-injection method has great disadvantages relative to the rival system. But it is suggested that a suitable design can be evolved, which together with the natural properties of a fuel changing rapidly from a liquid state into a gaseous state, will produce that degree of turbulence as is required to obtain a high degree of combustion.

4. Dissociation of Mixture

It is too previous to discuss the dissociation of a combustible mixture for the simple reason, that so far very little is known as to what takes place actually inside the cylinder. It would therefore be fruitless to draw any comparison between a mechanically injected and air-injected charge.

In a recent discourse by Prof. Chas. Lucke in "Motorship" attention was drawn to this point, and there is here a very wide field where a cooperation between chemist and technical engineer would result in the recording of invaluable information with regard to the combustion process inside an oil-engine cylinder.

The writer has from time to time impressed the industry with the fact that the oil-gas formation of a fuel is of primary importance to the more accurate understanding both of the preliminary and actual stages of combustion. It is so far quite agreed upon, that partial or even untimely dissociation is the point to guard against.

In the article on the "Progress in Marine Diesel-Engine Building at Krupp During the War" by Otto Alt, the author quotes on pages 694 and 695 of "Motorship" (August issue) several references, and the reader is referred to this particular article for further information on this subject.

The comparatively high temperatures of the fuel-valve and casing, the presence of compressed-air (the pressure of the air does not materially affect the resultant condition) are two factors conducive to partial dissociation before the fuel-valve opens. During such dissociation the more volatile fractions may become liberated and form a mixture which on entering the combustion-chamber would have a tendency to burn more in form of an explosion than combustion.

The injection-air has a cooling effect on the entering charge, and to a certain extent counter balances this "explosive" tendency, although at the same time it disturbs the homogenity of the mixture, to a degree proportional to the pressure difference between the combustion-chamber and the fuel-valve casing. It will be apparent, that the effect increases with conditions approaching full load.

Whilst there is a similar effect on the charge injected under mechanical-pressure, the cooling effect does not exist, and there is under certain thermal conditions of the fuel-valve casing a correspondingly greater tendency to burn in form of an instantaneous combustion. The correct adjustment of the thermal conditions of the fuel-valve casing is therefore of considerable importance with mechanical-injection systems, to minimize this high initial rate of combuston.

5. Combustion

Whilst the temperature of the "cycle-air" charge in the combustion-chamber governs the ignition of the charge, it is not clear what relation exists between the final compression-pressure temperature and the ignition point of the fuel. The fact that with mechanical-injection a lower compression-pressure can be used, does not bear on the subject, but simply illustrates the retarding effect, which the compressed-air has on the rate of combustion during its expansion. The compressed-air is said to give back a certain amount of energy absorbed in the air-compressor on expanding into the combustion-chamber. Experiments, however, have shown that at the most only about 0.75% of the total available energy is usefully employed.

On the other hand, mechanical-injection permits of an accelerated combustion and the thermal-efficiency equation shows that the efficiency increases with lower cut-off ratios, provided that the time element is of sufficient duration to allow for complete combustion. The following table gives a series of data, confirming this point.

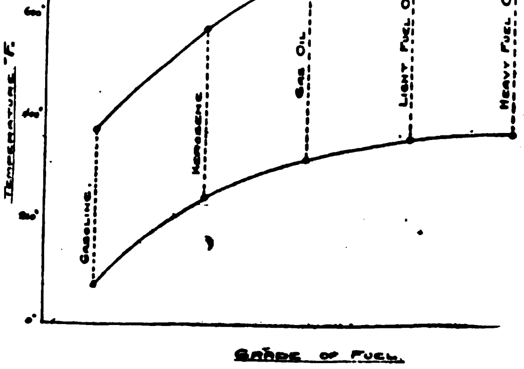


Fig. 20

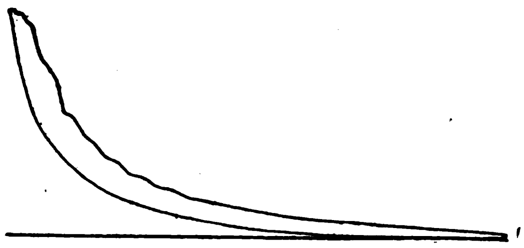


Fig 21

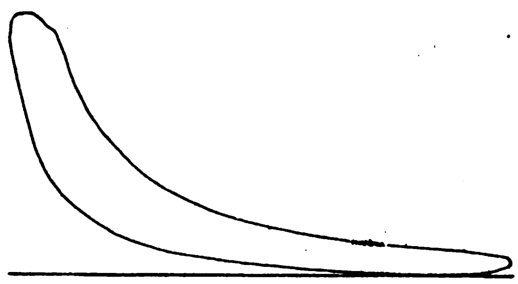


Fig. 22

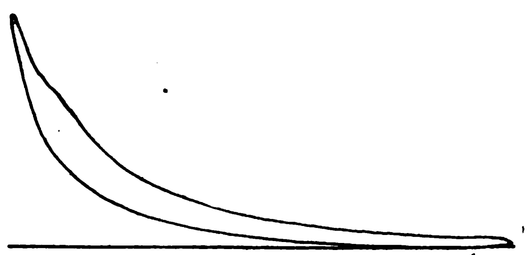


Fig. 23

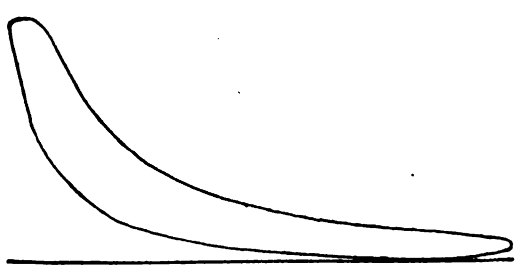


Fig. 24

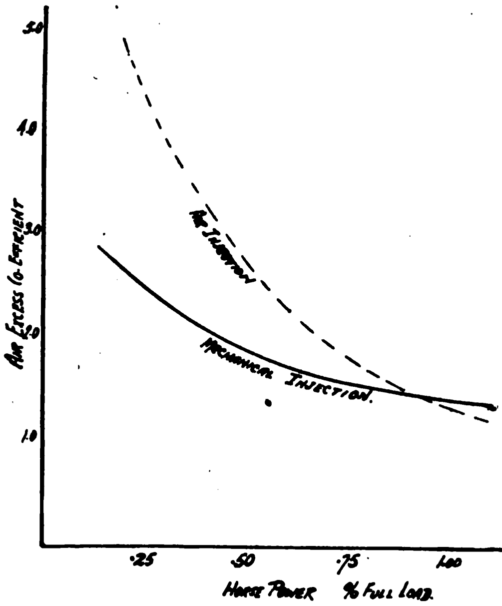


Fig. 25

The degree of combustion and the after-burning effect have occupied the careful attention of designers and there is no doubt that the general running of heavy-oil engines can be improved considerably.

For comparative purposes the following tables have been compiled, representing average results for a large number of tests with both methods. Unfortunately the fuels used were not the same, or even in some cases similar, but the data quoted refer to similar powers developed per cylinder, being 125 h.p. in the case of air-injection, and 120 h.p. for the mechanical type.

The conditions for complete combustion specify that each particle of oil is to be brought in contact with the requisite amount of oxygen, and that combustion should commence at a pre-determined moment. After burning in pockets inside the combustion-chamber, abnormal temperatures owing to irregular castings or insufficient cooling, faulty scavenging are some of the main factors which will assist in creating unfavorable conditions irrespective of it being an air or mechanical system.

Timing of the combustion depends in the air-injection method on the correct distribution of the fuel-charge around the valve-seating, and numerous devices have been suggested and introduced, which although more or less effective, do not tend towards simplicity of the construction of those parts, which are somewhat inaccessible from the point of running adjustments. The valve must be designed to allow the fuel to enter the combustion-chamber in front of the injection-air. This is essential as the resultant conditions govern the temperature and size of the ignition-flame.

The air-excess co-efficient has already been discussed and more or less identical conditions exist for both systems. The additional amount of air which is added to the cycle-air, when using the compressed-air method only represents about 3.5% to 4.0% of the total amount of air. Assuming an air-excess co-efficient of 1.45, then the above percentage would alter its value to about 1.50.

Relation between exhaust temperatures and air-excess values have been compared, but the difficulties in getting representative samples of exhaust-gases in connection with two-stroke engines have made the available data somewhat valueless for the present.

(To be continued)

Load	¼	½	¾	Full
Cut-off Ratio (Calculated)	1.81	2.20	2.84	3.38
Cut-off Ratio (measured from indicator diagram)	1.39	1.56	2.11	2.54
Efficiency (thermal)	56.0%	55.7%	52.4%	51.4%

PERCENTAGE OF COMBUSTION COMPLETED

Position of piston during power-stroke	Air-injection	Mechanical-injection
¼ stroke	87.5%	85.0%
½ stroke	6.0%	8.5%
¾ stroke	4.5%	3.5%
end of stroke	2.0%	...
Fuel Used	Light fuel-oils 0.89 sp. gr.	Light fuel-oils 0.915 sp. gr.

Joseph W. Powell and the Diesel Engine

Discrediting the Importance of Motorships

(Contributed)

IN the leading article of *Marine Journal* of February 26th there are quoted some remarks of Mr. J. W. Powell, former Vice-President of the Bethlehem Shipbuilding Corporation, which were recently made before the National Merchant Marine Association and in which he discredits the economic importance of the Diesel engine as a prime mover for merchant vessels.

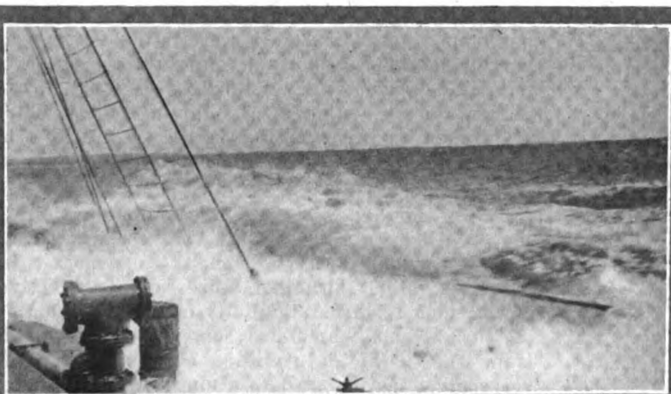
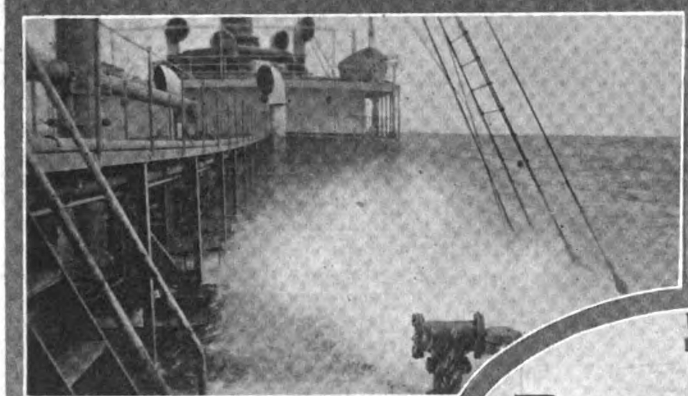
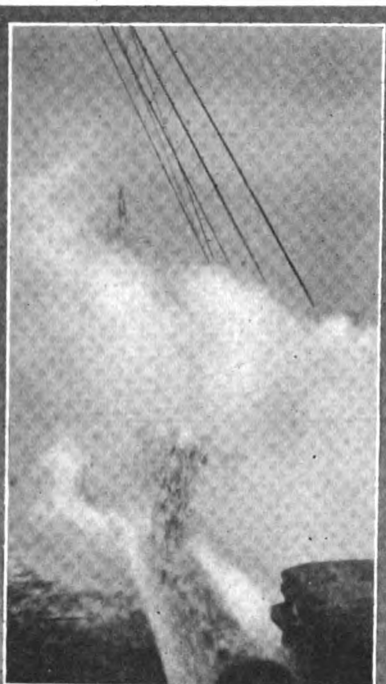
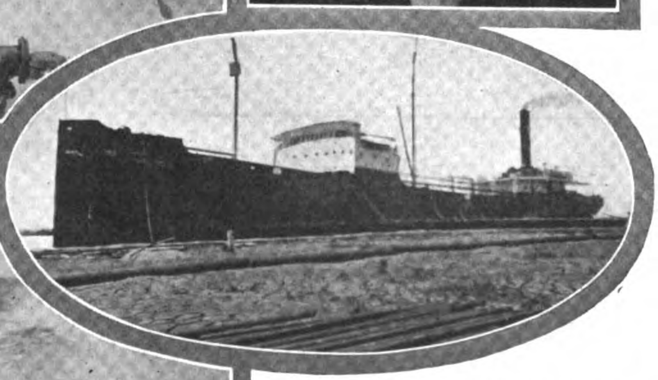
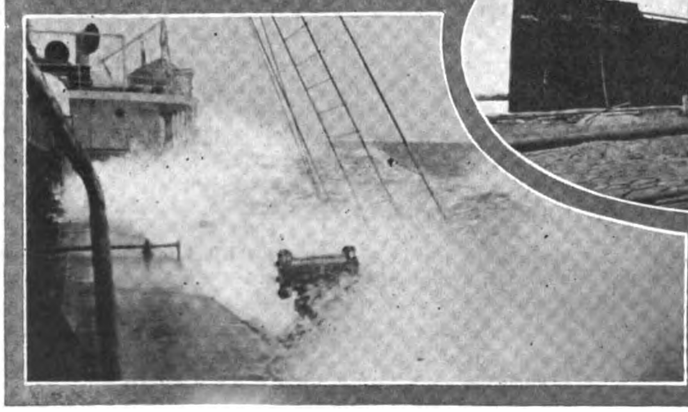
The reasons for Mr. Powell's present attitude may be found by referring to the period when the Bethlehem Corporation was developing a new marine Diesel engine of their own design, from which great things were expected. At that time Mr. Powell frequently and somewhat enthusiastically expressed his belief in the future of the marine Diesel-engine and particularly in the future of their new design. As the active head of the Bethlehem shipbuilding interests it is not unlikely that Mr. Powell was responsible for Mr. Schwab's optimism when the former Director-General of the Emergency Fleet gave to the press certain extravagant claims in reference to the Bethlehem Diesel-engine then being installed in the "Cubore," which claims were freely criticised by technical papers abroad. It will be remembered that remarkable economy was claimed as well as various other points of superiority over anything previously built. The designer of this engine was also reported in the press as having made the following explanation of the superior features involved in his design:

> "Europeans failed in the designing of Diesel-engines for American operation because their creations were not suited to American operating conditions, especially those prevailing in American ships' engine-rooms, where the crew was not used to a multitude of fine adjustments and delicate mechanism. The secret of the success of any design, so far as its operation by Americans is concerned, is that it be made with the fewest possible adjustments. Not only that, but it ought to remove the possibility of an engineer's adjusting it any other way—if he can do so. That is where our European friends failed when it came to making engines for American operation."

The announcement was next made that the Bethlehem Corporation was immediately beginning the construction of four more large motorships to be equipped with their new and exclusive design of Diesel engine.

After the ship in which their first engine was installed had been in service a few months, notable changes in Bethlehem's organization and plans took place. It has been reported from all directions that the three new vessels will be fitted with steam propelling machinery and in the meantime Mr. Powell, no longer vice-president of the Bethlehem Coporation, has become fully qualified as an authority on the disadvantages of the Diesel motor for merchant-vessels; all of which is very unfortunate, but not sufficient to discount the uniformly successful experience of foreign owners of large fleets of big motorships that have seen years of service, nor that of several American owners who operated Scandinavian motorships of the first-class under charter during the War, also smaller vessels with American built engines, and who are convinced that the steamship cannot compete with the vastly more economical and equally reliable motorship. The evidently unfortunate experience of the Bethlehem Corporation, who in their design wandered from accepted marine engineering practices, should not be taken as a criterion in deciding the economic status of the hazard incurred in disregarding the accumulated experience of successful builders of marine motorship but rather as an illustration of the Diesel machinery, which policy caused the downfall of several other engines in the past. It is time that Operators and Owners realized that the only successful marine Diesel installations in large ships are those being produced by firms with years of experience in such work or the licensees of such firms, who pay for and are guided by such experience. Had Mr. Powell acquired the manufacturing rights for some first-class marine Diesel construction there would have undoubtedly been several additional American motorships approaching completion and his opinions of their worth would not be those of an apologist.

[In our issue of February, we indicated that criticism of the Bethlehem design was a little premature because no authentic information was available; but, further information regarding the operation of this experimental ship is now to hand.—*Editor.*]

Striking pictures of the Vacuum Oil Company's motor-tanker "Brammell Point" in a gale. Note the solid water breaking overboard. She is propelled by twin 750 shaft h.p. McIntosh & Seymour Diesel engines

QUESTION OF THE TWO-CYCLE MECHANICAL INJECTION ENGINE

A paper on "Oil Engine Progress," by Mr. J. L. Chaloner was recently read before the Diesel Engine Users Association and was followed by an instructive discussion. The author referred in very favorable terms to the position of the British internal-combustion engine industry and the lines on which it was likely to develop in relation to Continental and American competition. He gave figures in support of a statement that of the high-pressure engines in this country 25 per cent worked on the mechanical-injection principle and that 50 per cent. were two-cycle gines, 96 per cent worked on the mechanical-in- engines. In the case of medium-pressure enjection principle while 58 per cent. were two-cycle engines. This data showed the tendency towards the two-cycle design and the position which the mechanical-injection principle already held with regard to the heavy-oil engine. He urged the imperative necessity of further flexibility on the part of the engines in order that heavy-grade oils might be used to a greater extent for internal-combustion engines. The efforts made in Great Britain to simplify oil-engine construction had met with greater success than either on the continent or in the United States.

Various methods of fuel atomization and of air, mechanical, and gas-pressure injection were described and compared. Mr. Chaloner considered that the gas-pressure system might be discarded as a practical solution of fuel-injection. The principle involved was only suitable for light fuels and the mechanical difficulties were many. The greater portion of the charge was in contact with burnt gases which made it difficult to bring the combustion-air into contact with the fue within the limited time of the combustion period.

The important part which turbulence played in the combustion process had been fully realized and it had been suggested that with mechanical injection a very much lower degree of turbulence was only possible. The general tendency of introducing long-stroke designs for marine and other slow-running engines produced conditions favorable to the application of mechanical injection.

The author did not suggest that the problem of mechanical-injection had been solved, but the results obtained so far showed that satisfactory progress was being made. The prospects were great and the possibility of a two-stroke engine without any mechanically-controlled valves justified the closest attention by engineers who were anxious to further the progress of the oil engine. In the opinion of the author the two-cycle mechanical-injection engine would materially assist in bringing the various types into line.

SWEDISH MOTORSHIPS FOR SPAIN

Alvaro Rodrigney, of Teneriffe, Spain, has take delivery of two small steel motorships recentl built in Sweden by the Aktiebolaget Vaxholm varvet, of Rameo. They are named "Santa Ursula and "Sancho II" and both are of 318 tons gros Each is propelled by a four-cylinder 320 b.h. Bolinder surface-ignition oil-engine.

Our Readers' Opinions

(The publication of letters does not necessarily imply Editorial endorsement of opinions expressed)

SENATOR WESLEY L. JONES AND MOTORSHIPS

To the Editor of "Motorship,"
Sir—

As a layman I feel that Diesel-engined motorship construction is worthy of the most careful consideration. It is impossible to do anything in a legislative way at this session, if at all; but I feel confident that after March 4, we will have a Shipping Board which will give careful consideration and take the proper action on this and all other administrative questions involving the promotion and maintenance of an adequate American merchant-marine. Certainly the wonderful strides in motorship construction in other countries justifies the matter being gone into exhaustively in the interests of our own merchant marine.

Yours very truly,
W. L. JONES,

Chairman, U. S. Senate
Committee on Commerce,
Washington, D. C.
March 1st, 1921.

ADMIRAL BENSON AND MOTORSHIPS

To the Editor of "Motorship",
Sir—

Regarding the construction of motorships you are, of course, aware of my deep interest in this matter and I am doing everything I can towards development by the United States.

Yours very truly,
W. S. BENSON,

Chairman,
U. S. Shipping Board,
Washington, D. C.
March 1st, 1921.

PLEASE ADVISE NEW SHIPPING BOARD ACCORDINGLY!

To the Editor of "Motorship",
Sir—

Admiral Benson has been kind enough to show me your letter of February 23d which demonstrates the most remarkable showing of the savings which can be effected by motorships when properly handled and when the full capacity of their tanks is made use of in order to sell bunkers on the other side. This showing is something which should be brought to the observation of American shipowners, because herein I find one of the greatest savings that the American owner can effect, particularly as the greater part of the world's oil supply is found in our own country. I think it is due to shortsightedness that our country is so sparingly represented by motorships in its fleet.

Yours very truly,
JOHN A. DONALD,

U. S. Shipping Board,
Washington, D. C.
March 8, 1921.

SIFTING CHAFF FROM CORN

To the Editor of "Motorship"
Sir:—

I should like to compliment you upon the mercurial liveliness of your journal and upon the soundness of the articles. I have been on Diesel-engine work for sixteen years and know the business, so I find it very refreshing to come across a journal written by people that understand their subject. It is only too often the case that the people who work such specialized journals merely repeat information they receive whether it be right or wrong and have not the experience to sift the chaff from the corn.

I have pleasure in enclosing herewith Post Office order for 19s/- to renew my subscription for your journal.

Yours very truly,
H. GEO. KIMBER.

13 Grosvenor Drive,
Whitley Bay,
Northumberland, England,
January 17th, 1921.

OUR READERS ACROSS THE SEA

To the Editor of "Motorship."
Sir:

I would like to say that I appreciate "Motorship" more every year and would not like to be without it. You will perhaps be surprised to hear that a great number of men connected with marine Diesels, with whom I come in contact, have not yet made the acquaintance of your worthy paper, to their own disadvantage. Wishing you every success,

Yours very truly,
(Signed) H. F. THURGOOD.

33 West Cumberland St.,
Glasgow, Scotland,
Jan. 23rd, 1921.

[Recently we have been enabled to make satisfactory arrangements regarding the distribution of "Motorship" in Great Britain, and copies are now carried on the Smith bookstalls and Wyman bookstalls at the principal railway stations. Our wholesale and retail agents are the Atlas Publishing & Distributing Co., Ltd., 21 Bride Lane, Fleet Street, London, E. C. 4. We will be glad if you will advise your friends accordingly.—*Editor.*]

ANOTHER COMPLIMENT FROM ENGLAND

To the Editor of "Motorship",
Sir—

I must congratulate you on your Paper; it certainly is first in with the news, which speaks well for your organization.

Yours very truly,
ALFRED J. WILSON,

"Blairalan,"
Woodside Rd., Sutton,
Surrey, England.

FROM AN UNEXPECTED SOURCE

To the Editor of "Motorship,"
Sir:

I have received the January and February numbers of "Motorship," and feel that I am in my glory now. Please enter the following subscriptions to "Motorship" for one year commencing with January issue to—

(Here followed the names and addresses of four new subscribers.—Editor.)

These men are all experts on turbine and steam-engines.

Yours very truly,
JOHN M. RANKIN,
Scout-Master

Boy Scouts of America,
Hampton, Va.

DESCRIPTION OF AMERICAN DIESEL PLANTS

To the Editor of "Motorship",
Sir—

In the recent February issue of your splendid magazine, in the Nordberg article, you speak about "Sometime . . . it is our intention to very fully illustrate . . . this and other Diesel factories in the U. S." I am sure others besides myself await these indirect factory visits with pleasure. It is good to see what some progressive plants are doing. I remain

Yours very truly,
C. H. DENGLER,

Irvington, N. J.

FROM A STUDENT READER

To the Editor of "Motorship",
Sir—

As a student engineer specializing on the design of Marine oil-motors I have been greatly aided by your progressive magazine. The development of the Oil Motor has been so rapid that tests, etc. are antiquated by the time they are published. I am certain that with your up-to-the-minute information that you have forwarded that development in no small measure. You and your magazine richly deserve the high opinion held by all engineers, etc. that I have met.

Yours very truly,
C. ARTHUR JACOBSON,

Schenectady, N. Y.

CRANK-PIN BOX DESIGN

To the Editor of "Motorship":
Sir:

In the last December (1920) issue of "Motorship," a very interesting article was presented by Mr. Hildebrand, on "Marine Crank-Pin Boxes." A serious defect in the ordinary crank-pin box design was explained, with mathematics accounting for bolt fracture, and a patent design described that should remedy this design error. The defect of the old, and the worth of the Hildebrand box, is immediately apparent to any thoughtful engineer; and no doubt many of this new design will be incorporated in 1921 engines.

What was puzzling me with this proposed box and also the older designs, why this same defect does not hold true, as for instance in Fig. 1 at A; and why some means is not taken from preventing the box from parting at this joint? A loose bolt here or misalignment between the two pieces is just as serious a matter, at the top of the box as at its lower face. If in the pistons reciprocating movement it develops a tendency to turn, what prevents it other than these two bolts—should this occur, and it certainly does—the bolts will still be subject to shear.

Having read that this box design is patent protected, it might be interesting to know that with a certain company that I was once connected with, a connecting-rod for a high-speed automobile-engine incorporated a rod with this spigot feature, for alignment of the cap to the rod. Fig. 2 represents the rod mentioned, the similarity in design is at once apparent. This design is at least three or more years old, and I might add the engine, which is still in daily service, on the block shows a piston-speed of 3,844 ft. per min., and develops 0.323 h.p. per cub. in. of piston-displacement, as a proof of the practicability of the design.

C. H. DENGLER.

Irvington, N. J.

P. S.—Fig. 1 is same as Fig. 1 in the original article, with the letter "A" pointing to the joint of the rod to the upper box. This I did not draw. Fig. 2 our rod design is enclosed with the article.

C. H. D.

[We have been obliged to hold-over a number of communications, including an interesting letter from Ernest V. Parker.—*Editor.*]

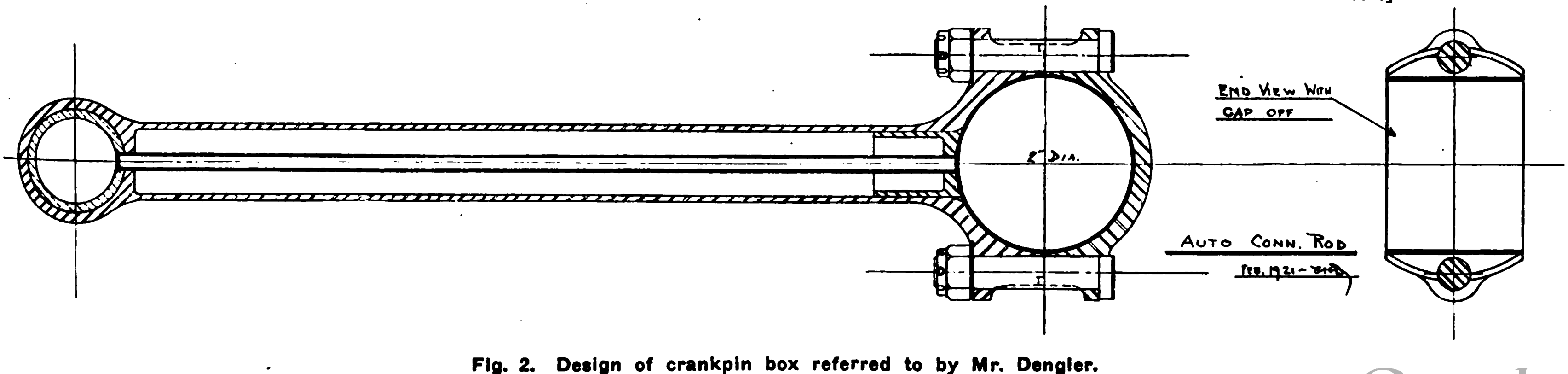


Fig. 2. Design of crankpin box referred to by Mr. Dengler.

NEW HIGH-POWERED MARINE DIESEL-ENGINE

NEW YORK SEATTLE

MOTORSHIP

Devoted to Commercial and Naval Motor Vessels

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MOTORSHIP

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PROFUSELY illustrated with photographic reproductions of the newest designs in international merchant motorship construction.

Vol. VI | New York, U. S. A., May, 1921 | No. 5

New All-American 6,000 Tons d. w. Motorship "Kennecott"

McIntosh & Seymour Diesel-Powered Freighter Averages 11 Knots on Maiden Voyage Burning Regular Heavy Boiler-Oil

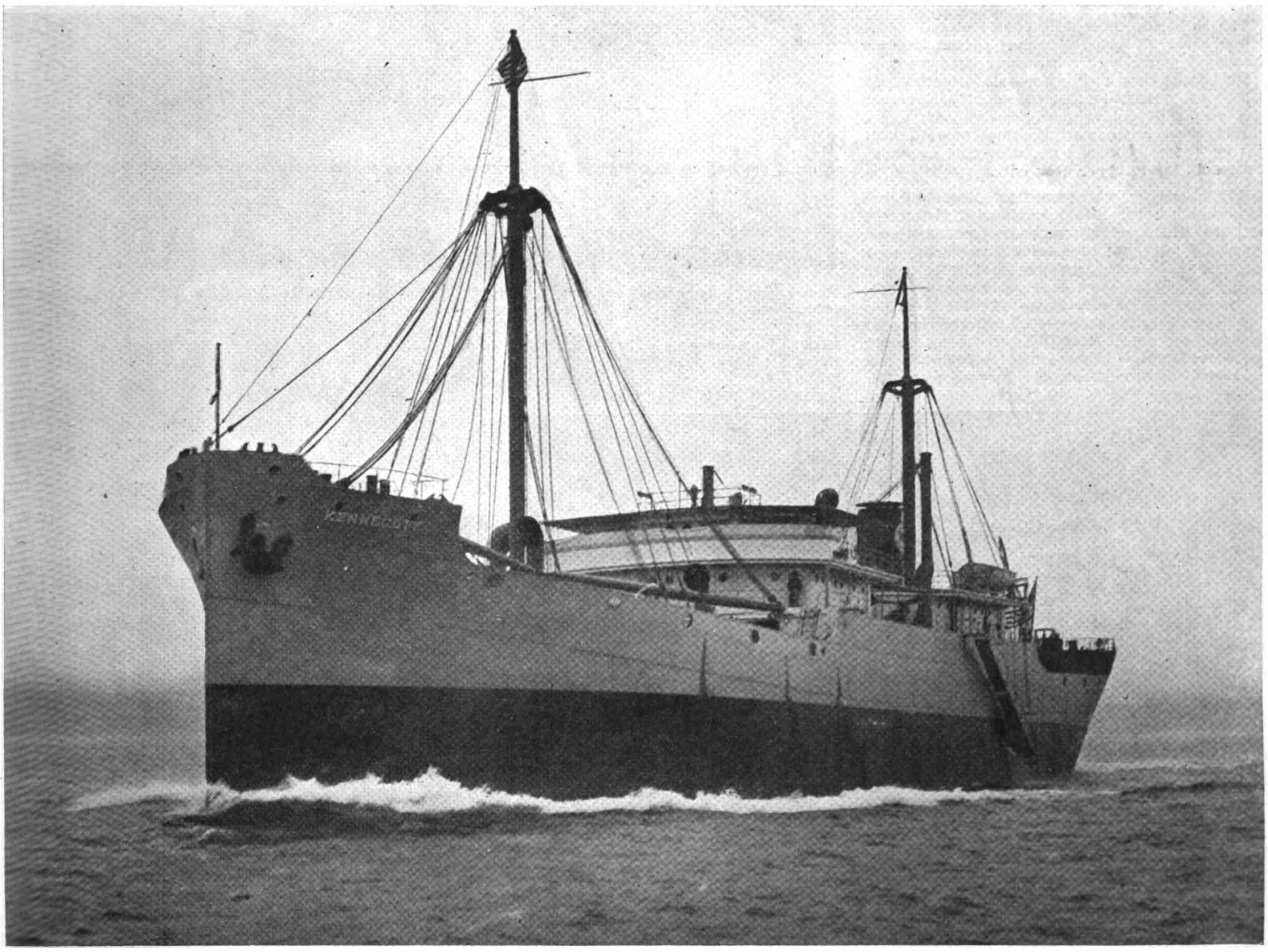
BY DANIEL L. PRATT.*

(*Editor of "Motorship's" Sister Journal, "Pacific Motor Boat.")

IN THE annals of Pacific Coast shipping, March 17th, 1921, was an important and a significant date, for it marked the initiation into service of a vessel which is the first all-steel motorship ever built by a West Coast transportation company for operation on the high seas. Never before has so much interest been taken in the new vessel by local shipowners, architects, engineers, shipbuilders and marine men generally, as was evidenced in the trial trip of the Diesel-driven freighter "Kennecott." Upon the operation of this new ship undoubtedly hinges not only the future policy of her owners, the Alaska Steamship Company of Seattle, but also of a number of other big coast shipping concerns, for it is a known fact that steamship men all along the western seaboard will be watching with vital interest the record made by this boat during the first year of her operation.

The "Kennecott" was built for operation in the coastwise and offshore trade. Her first voyage will be to San Pedro with lumber, after which she will return to the Sound and load cargo for the East Coast. Primarily, however, she was designed to carry ore, for the Alaska Steamship Co. is closely affiliated with the Kennecott Copper Corporation and during certain seasons when these mines are running full blast, the vessel will be used between the mines in Alaska and Chile and the Tacoma smelter. With a fuel-consumption which on her trial trip was approximately 0.42 lb. per shaft horsepower hour, or a total of only 55 barrels (under 8 tons) a day, and burning the same low gravity of oil used under the boilers of steamships, she will prove the most economical type of vessel ever used in this service.

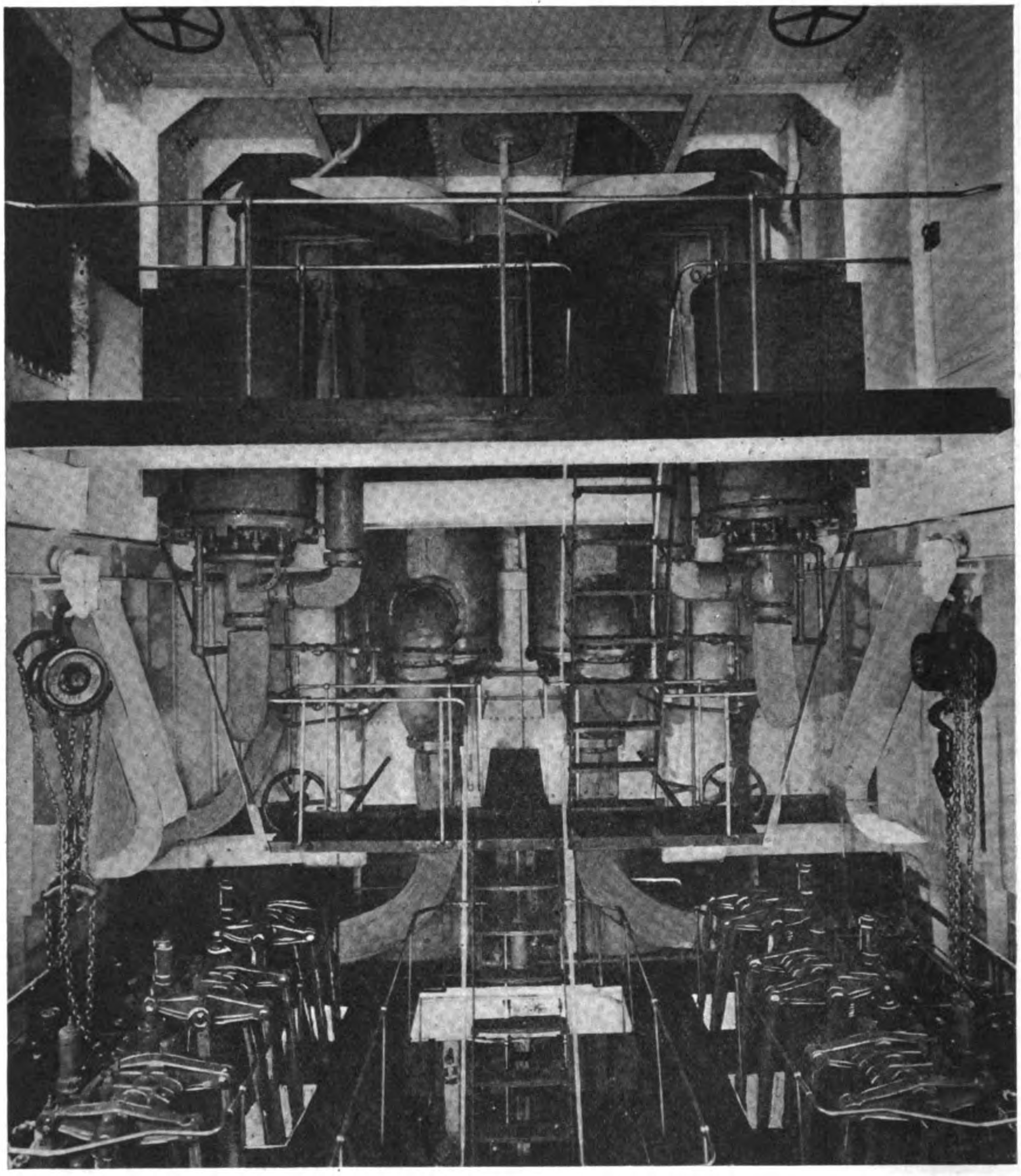
In design, construction and completeness of equipment, the "Kennecott" is undoubtedly one of the finest motorships so far built in any part of the world. She is the product of the plant of the Todd Dry Dock & Construction Corporation, at Tacoma, Washington, and was built by them in fifty working days, following the laying of the keel last November. The new vessel is of the usual "Three Island" type of steel freighter and has the following dimensions.



The first large all-American Pacific Coast built Diesel-driven steel motorship—the "Kennecott"—on her trial run. She is propelled by twin 1,200 i.h.p. McIntosh & Seymour oil-engines and is of 6,000 tons d.w.c. Owners—Alaska Steamship Co., Seattle, Wash. Builders—Todd Shipyards Corp.

Name of Ship	Kennecott
Name of Owner of Ship	Alaska Steamship Co., Seattle
Name of Builder of Ship	Todd D. D. & Constr. Co., Tacoma
Name of Engine Builder	McIntosh & Seymour Corp.
Class and Society	Approved by Lloyds (not classed)
Displacement (Loaded)	8,425 tons
Displacement (Light)	2,415 tons
Dead-weight-capacity of Ship	6,010 tons
Cubic-capacity of Holds	330,610 cu. ft.
Cargo Carried on Maiden Voyage	3,300,000 ft. Lumber
Length (O. A.)	360 ft.
Length (B. P.)	345 ft.
Breadth (Moulded)	49 ft. 6 in.
Depth (Moulded)	26 ft. 9 in.
Loaded Draught (Mean)	22 ft. 3 in.
Capacity of Fuel-bunkers (double bottom)	1,075 tons fuel oil*
Total Fresh-water Carried	49 tons
Cruising Radius	22,000 miles
Shaft Horse-power	1,800
Indicated Horse-power	2,400 (total)
Engine Speed	140 r. p. m.
Ship's Trial Speed (expected)	11½ knots
Ship's Speed (Loaded)	11½ knots
Average Speed on Maiden Voyage	11 knots
Propeller, Dia., Pitch and Area	11 ft. 6 in. dia. x 9 ft. 6 in. pitch; 32.5 sq. ft.
Daily Fuel-Consumption (with ship fully loaded)	55 bbls. a day
No. of Engine-room and Boiler Staff	(8) 3 engrs., 3 oilers, 1 electrician, 1 machinist
Daily Fuel-consumption in Port	¾ ton
Type of Diesel Engines	four-cycle
Cylinder Bore	21 inches
Piston Stroke	32 inches
Type of Deck Machinery	Electric
Length of Machinery Space	44 ft.
Date Put in Service	Mar. 17th, 1921

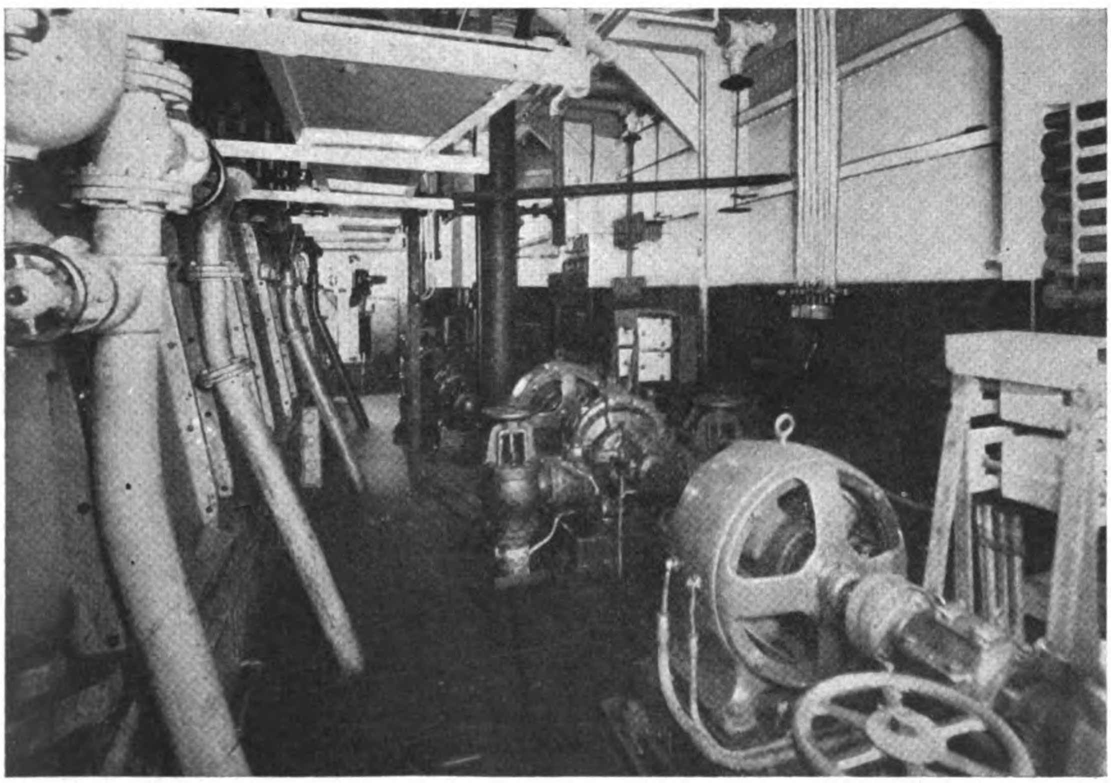
*About half of this oil will be oil-cargo.



Showing arrangement of exhaust-silencers from main and auxiliary Diesel-engines in engine-room of motorship "Kennecott." The silencers are equipped with a water-heating device for ship's service

The height to upper deck is 26 feet and the allowed draft 22 feet 1½ inches to the Summer freeboard mark, with a resulting deadweight of 6,010 tons at that draft. Her hull is built on the Isherwood longitudinal construction system and has four cargo-holds, three forward of the machinery space and one aft, the three forward holds having 'tween decks and the after hold extending from tank top to upper deck only.

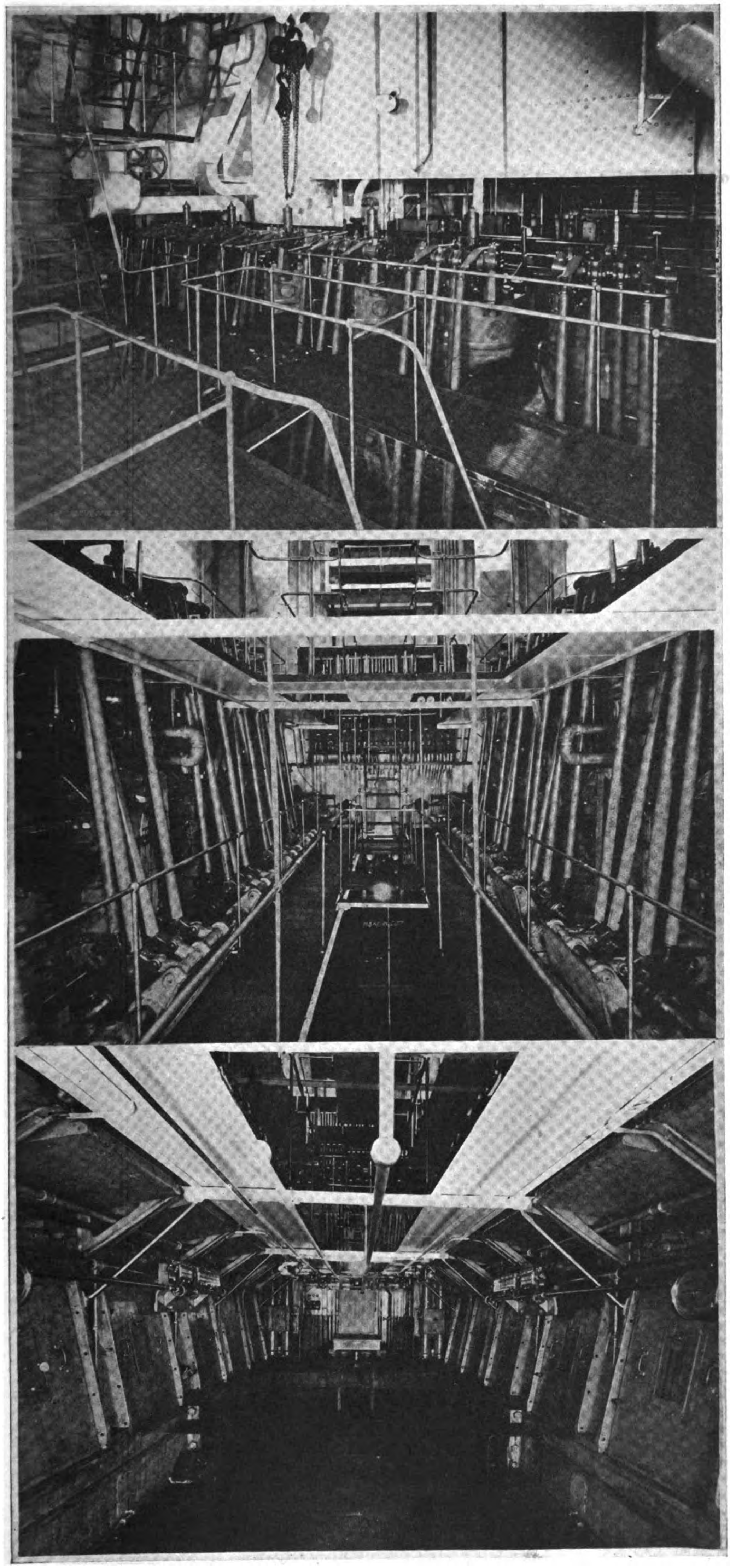
The machinery, which consists of two McIntosh & Seymour 4-cycle Diesel engines of 1200 I.H.P. or 900 B.H.P. and all necessary auxiliaries, as described later, is fitted about one-third length forward of the stern, and the shafting is carried in the Lundberg design of stern having spectacle frames at the after end, totally enclosing the shafts and eliminating the struts. The forward and after peaks of the vessel are fitted for carrying water ballast and fuel-oil is carried in the double-bottom tanks which extend from the forward and after peak bulkheads and also in a tank fitted between the shaft alley extending from the tank top to the top of the shaft alley, making a total fuel-capacity of 1,075 tons, giving the vessel a cruising radius of 22,000 miles. Her tanks were made unusually large so that she can if necessary transport oil for cargo from one port to another or carry it to the company's mines, which by the way are also operated by stationary Diesel engines of McIntosh & Seymour construction.



Electrically-driven pumps in the engine-room of the motorship "Kennecott." The motors are of the G.E.C. type

The cargo holds are so arranged that with the Isherwood transverses and wide-spaced pillars, clear stowage such as is desirable in ore-carrying boats, is allowed throughout. The rigging is also made especially heavy to allow of handling this type of cargo. There are two steel masts and two derrick posts. The foremast is fitted between No. 1 and 2 holds and has four 10-ton booms and one 30-ton boom. No. 3 hold is served by two king posts, each one having one 10-ton boom and No. 4 hold is served by the mainmast having two 10-ton booms. The 30-ton boom is of steel and is stepped in the centerline at No. 2 Hatch and so arranged that when not in use the boom can be stowed on deck alongside the hatch. All the 10-ton booms are of clear Douglas fir, fitted with plowsteel running-rigging proportioned to handle the weights specified.

The officers and crew are berthed in houses on the bridge deck amidship, the deck officers and engineer in the forward house on the bridge deck and the crew in the after-house. Captain's quarters, pilot-house and owner's quarters are in the house, chart-room, stateroom, office and private bath for captain, and pilot's room and owner's room with private bath. These quarters are ceiled with white quartered oak and furnished with the same wood. In the forward deck house are the saloon, staterooms for 1st, 2nd and 3rd officers,



Upper, center gratings and control-floor in the engine-room of the motorship "Kennecott"

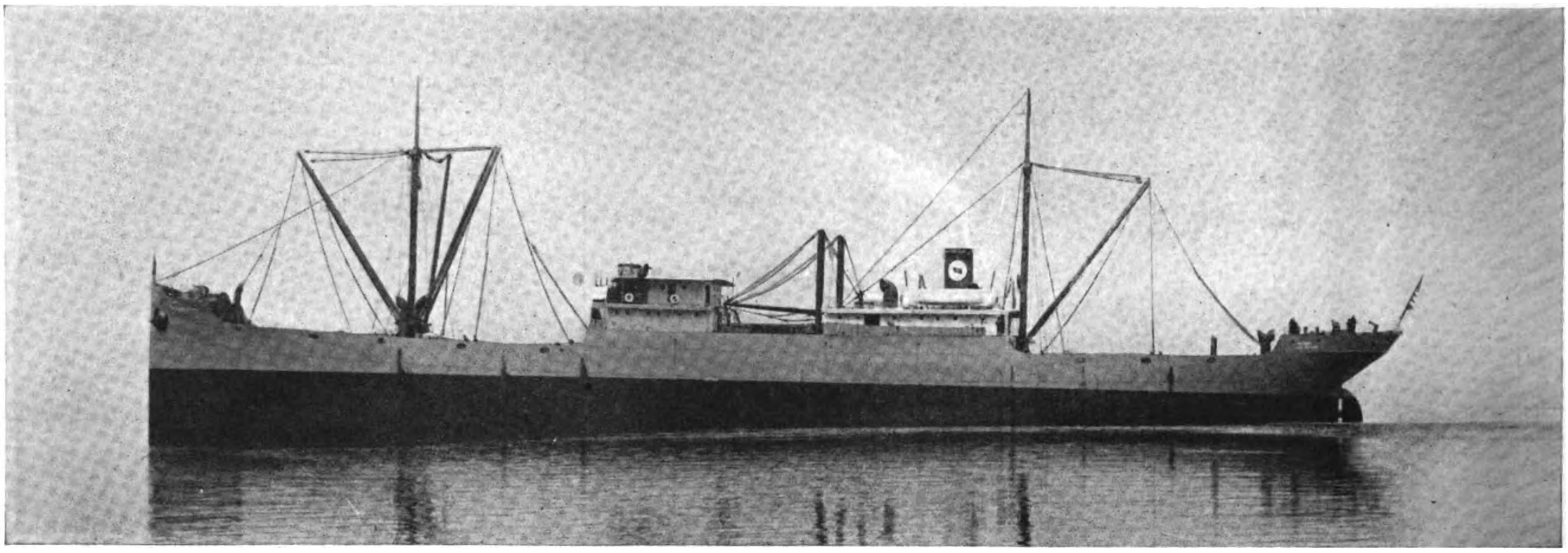
Purser, Steward, Chief-Engineer, 1st Assistant Engineer, pantry, linen stores and officers' toilets and bath. Here, also is a smoking-room fitted with seats and tables for use of officers when not on duty, a novelty on boats of this type. The rooms in this house are also finished in white quartered oak with furniture to match and there is running water in each stateroom.

In the after house are situated staterooms for the 2nd and 3rd assistant engineers with quartered oak furniture the same as in the forward house, also engineers' bath and toilet, rooms for carpenter and boatswain, cook, messboys, oilers, wipers and electrician, with separate baths and toilets for deck and engine room crew. The owners of the boat had their own ideas about her accommodations and laid particular stress upon having comfortable and roomy quarters for the crew and the boat as completed is arranged so that the crew are berthed not more than four in a room, these rooms having metal berths and lockers and running water. In this same house is the galley with oil-burning range, made by T. P. Jarvis of San Francisco, a small but well-equipped hospital and wireless-room and operator's quarters. The decks and passage in officers' and crews' quarters are laid with magnesite flooring with carpets or lineoleum covering same. All of the living quarters are heated with portable electric heaters supplied with current generated by the Diesel driven auxiliary plant. In fact, the vessel as completed, represents the highest type of cargo carrier and is a credit to our Merchant Marine.

The main interest to the engineer and to marine men generally, however, is in the engine-room, which is one of the most interesting and completely equipped that has ever been designed for an American motorship. It is but 44 ft. long. Every detail was carefully worked-out in advance by the engineers of the Alaska Steamship Co. in cooperation with the designers of the Todd Drydock & Construction Corporation's Tacoma plant, and nothing has been overlooked. The main engines were selected by Vice-President and General Manager E. T. Stannard of the Alaska Steamship Co. as a result of his previous experience and observation of the work of a number of McIntosh & Seymour stationary Diesel type of motors in the various mines of the Kennecott Copper Corporation. Mr. Stannard before going with the steamship company was a mining engineer by profession and had charge of the Kennecott interests in Alaska which are still under his supervision. In the north he had an excellent opportunity to observe the service given by the Diesel engines in the mines and found them thoroughly satisfactory in every particular, so that he had very definite ideas regarding this type of motor. In his opinion, the four-cycle, heavy duty type of engine is best suited to the heavy work necessary in a freighter like the "Kennecott" and he therefore settled upon the McIntosh & Seymour engines for the new boat. While these engines are the standard stock models as turned out at present by the McIntosh & Seymour Corporation of Auburn, New York, they are nevertheless unique in that they are the first of the new open crosshead type as now made by this company to be installed, and in fact are the largest marine engines which this company have so far completed although a 2,000 I.H.P. engine is now under construction.

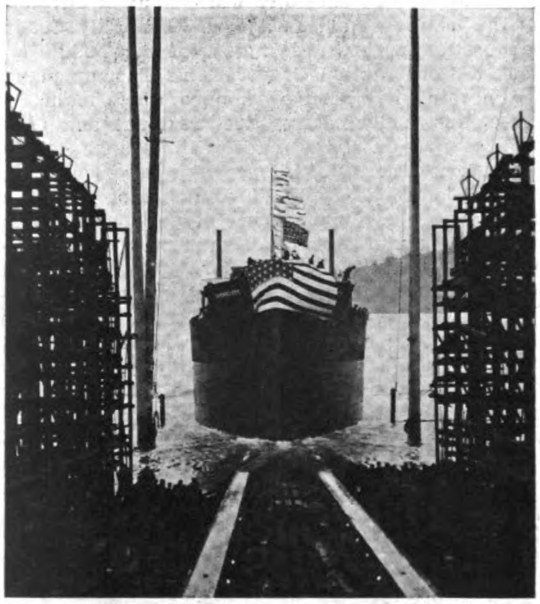
Eighteen of the 1,200 i.h.p. engines were ordered for the Emergency Fleet Corporation toward the end of the war and these motors are the first pair to be completed under this order, although a number of them have been finished since. They are six-cylinder engines of 1,200 i.h.p. (900b.h.p.) each, developing their power at 140 r.p.m. and giving the boat a speed running light of 12½ knots and loaded of from 11 to 11½ knots By the use of a specially designed preheating system for the fuel, the motors are enabled to operate successfully on fuel of 16.7 degrees Baume, the same oil that is burned under the boilers of steamships. This feature, in itself, has effected a great economy for the boat as most of the motorships so far built on the Pacific have been forced to operate on Diesol and Calol which is about 21 degrees to 24 degrees gravity.

The preheating of the fuel is accomplished by means of steamcoils installed in the silencers. In the stack, through which the motors exhaust is a



Broadside view of the "Kennecott" in light condition. She was built by the Todd Shipyards Corporation's Tacoma plant. On her maiden-voyage she loaded 3,300,000 ft. of lumber

head tank filled with water which circulates down through these coils in the silencers and after being heated passes on through the inside of the daily service tanks where the oil for the engines is preheated to a temperature of 130 degrees, the pipes then passing on down through the inner bottoms and heating the oil there, the circulation of the water being forced by means of a centrifugal pump of the Cameron, motor-driven, single stage type. The temperature of the water from the coils is regulated by a by-pass feature at the silencers which permits of absolute regulation.



Launch of the motorship "Kennecott"

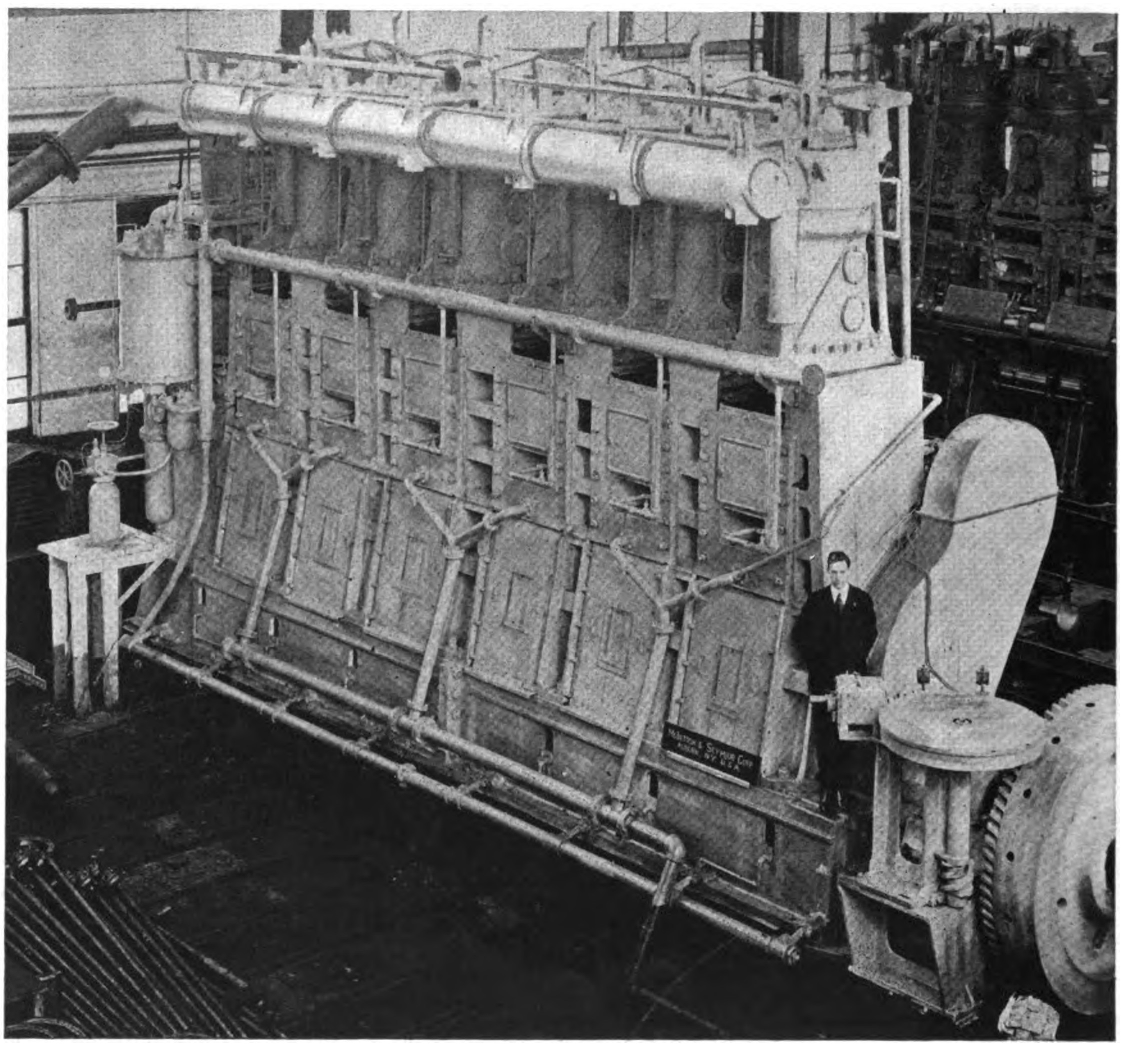
All of the auxiliary machinery on the ship is electrically driven. With the exception of the heating-coils mentioned above there is not a steam pipe on the entire vessel. The current is generated by two 100 i.h.p. McIntosh & Seymour auxiliary Diesel-engines driving 75 kw. General Electric generators which supply the current direct for operating all of the pumps, deck-machinery, lighting plant, etc., and also charge the emergency set of 100 cells of Edison A4 storage batteries. These batteries are used for emergency lighting, for the auxiliary compressor and the galley oilpump which supplies oil to the burner in the range.

The circulating-water for the cylinder jackets and piston cooling is supplied by two single-stage motor-driven pumps made by the A. S. Cameron Steam Pump Works, of New York City, who also made the three-stage centrifugal fire and bilge-pumps. There is also another bilge pump of the double-suction centrifugal type made by the Cameron people and a pump of the rotating plunger type made by the Kinney Manufacturing Co. of Boston, Mass. There are two oil-transfer pumps of the Kinney rotary plunger type and a motor-driven fresh water pump of the single-stage centrifugal type made by the Cameron people. Lubricating-oil is handled by three Kinney pumps of the rotary plunger type, and the hot water circulating pump, previously mentioned is of the Cameron single-stage centrifugal type.

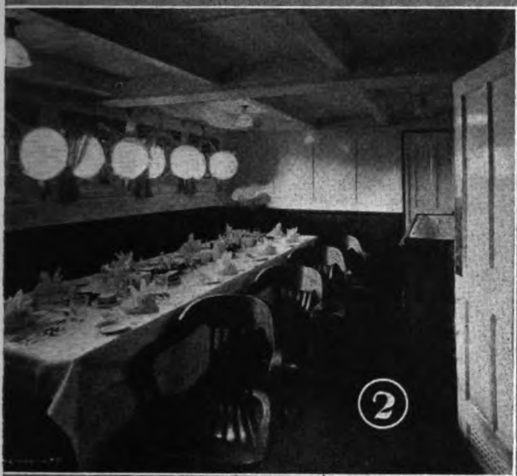
The daily service tanks for fuel are unusually large, there being three of them, each with a capacity of five tons. The main lubricating-oil tanks holds 2,000 gallons and there is also a 1,000 gallon oil settling tank. Another 1,000 gallon tank is provided for kerosene and a number of smaller tanks are installed for miscellaneous lubricating-oils and one for compressor oil. Two large tanks are also installed for the storage of maneuvering air. All the tanks are of steel and were built at the Todd yards which built everything connected with the boat except the machinery. The only wood aboard the boat is in the lockers and bins for the engineers' storeroom, everything else being of steel. The engineers have the advantage of a fully-equipped machine-shop with lathe, drill presses and grinder and can make all of the necessary everyday repairs aboard the boat.

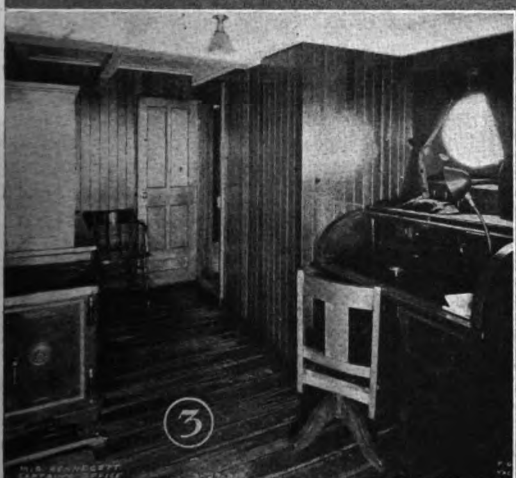
The filtering system for the lubricating-oil is worthy of mention. The oil, after passing through the engine, falls by gravity to the crank-pits and from there to the pump tanks underneath the engine room floor plates. There are three continually operated filters of the Richardson-Phoenix type, two sizes, No. 90 for the main engines and one size No. 80 for the auxiliary engines. The pumps heretofore mentioned pump oil through the system and when it gets dirty through the filters. One pump handles the oil from the sump tank to the filters, the second pump from the filters back to the system and the third pump is a relay.

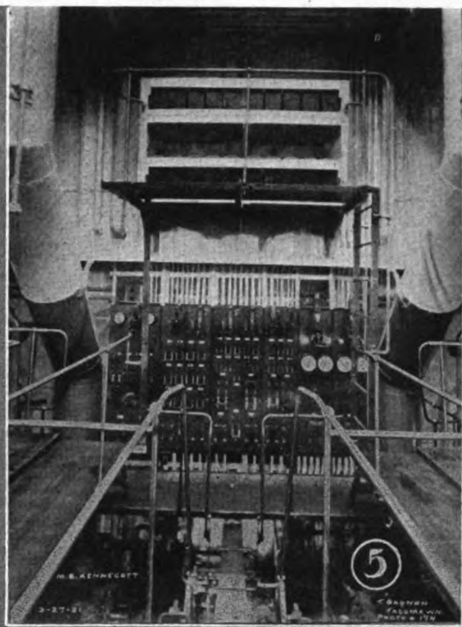
The engine-room also contains a one-ton refrigerating plant of the direct-expansion ammonia type, using the Brunswick Refrigerating Company's machines, electrically driven. The engines exhaust through the boat's stack. This stack is divided into two parts. One section is heated by the hot-water pipes after leaving the silencers thus providing a heated space which is used to provide ventilation for the lower engine-room by

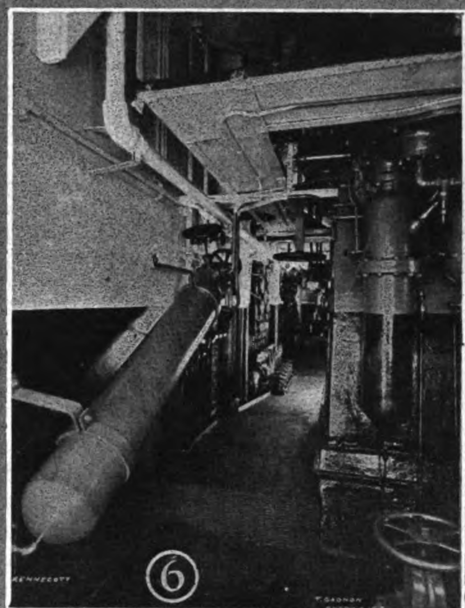


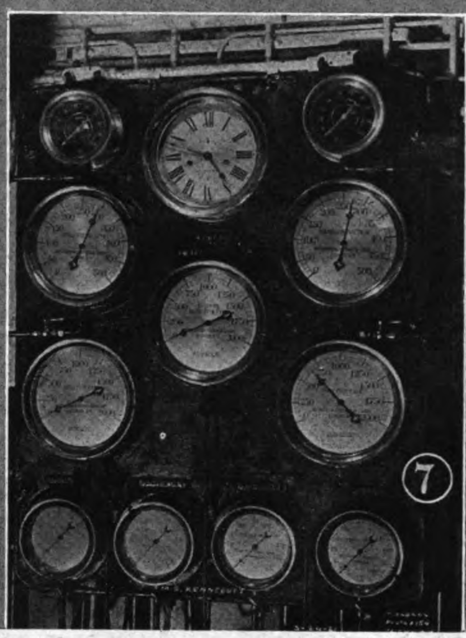
One of the new 1,200 i.h.p. crosshead type McIntosh & Seymour Diesel engines of the "Kennecott"

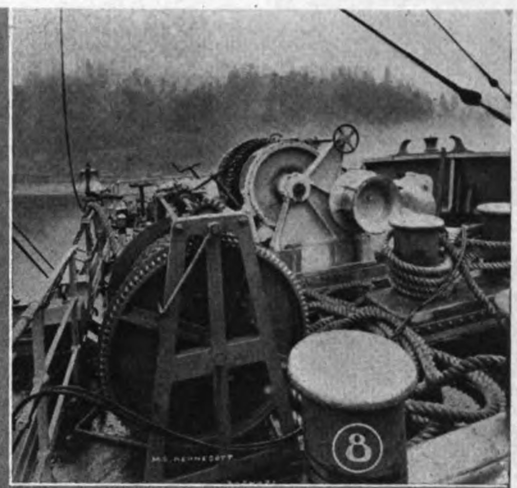


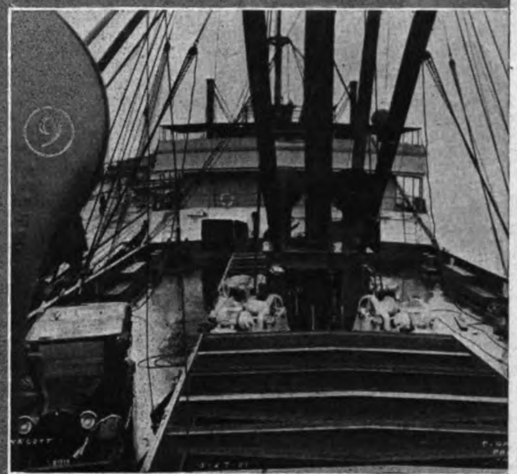


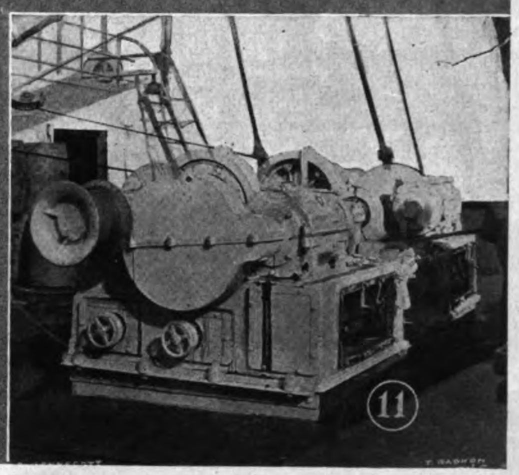




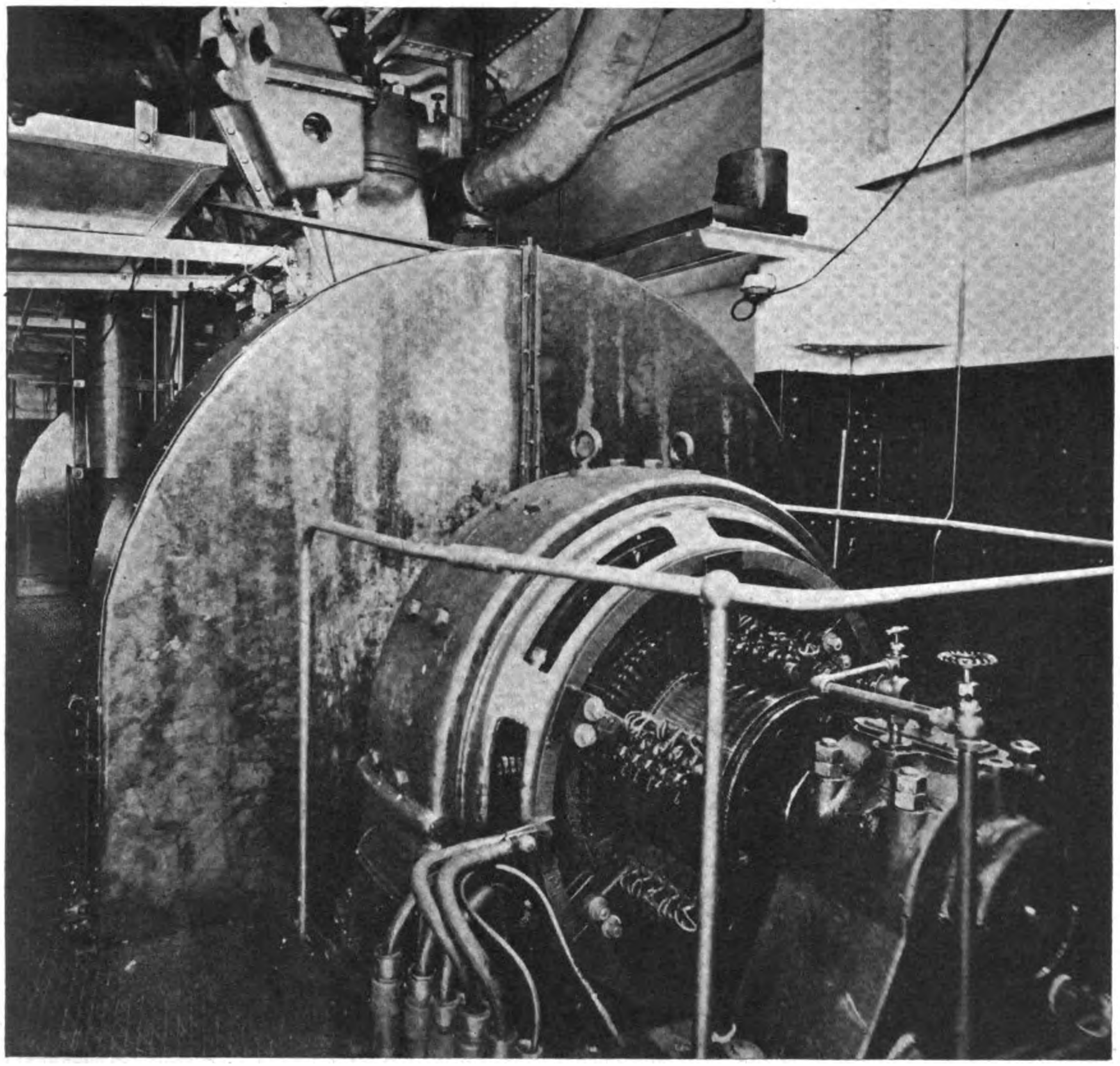








(1) Allan-Cunningham steering-gear and telemotor.
(2) Dining-saloon.
(3) Captain's cabin.
(4) Galley.
(5) Switchboard and storage batteries.
(6) Fuel-oil and ballast manifolds. Also forward ends of main engines showing control-levers and injection-bottles.
(7) Gauge-panel with lubricating-oil and manoeuvring air-gauges.
(8) 75 h.p. electric-winch.
(9) Deck view of "Kennecott" showing two hatches and group of electric-winches.
(10) No. 4 hatch looking forward to entrance of shelter deck.
(11) Electric-winches at forward end of No. 3 hatch.



75 K.W. G.E.C. generator coupled to a 100 b.h.p. McIntosh & Seymour auxiliary Diesel engine in the "Kennecott's" engine-room

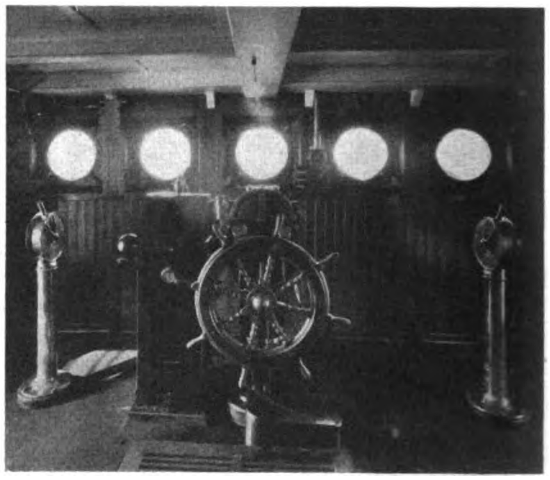
means of a vacuum system which drains off all the bad gases. The other section is used for upper engine room ventilation and also contains the head tank for the hot water system previously described. The stack is therefore virtually a room stood on end and if not very ornamental is very useful.

With this system the engine-room ventilation is exceptionally well provided for. Four 24-inch ventilators are operated continuously and fresh air is diffused uniformly all over the motor compartment. In order to prevent the high-pressure compressors from picking up dangerous gases in the engine-room, suction-pipes have been provided from the ventilators to the compressors, thus assuring a supply of fresh, cold air at all times.

The air-compressor was manufactured by the Rix Compressed Air & Drill Co. of San Francisco and Los Angeles. The signalling apparatus consist of an air-whistle on the for'd side of the smoke-stack and also an electrically-driven siren manufactured by the Hendrie & Boulthoff Mfg. Co. of Denver, operated by a 3 h.p. motor.

Electrically-driven deck machinery is one of the most noteworthy features of the ship and attracted as much attention on the trial trip as any other items of the vessel's equipment. It consists of the anchor-windlass, capstan, eight cargo-winches and the electro-hydraulic steering-gear. It was all designed and manufactured by the Allan Cunningham Company of Seattle who specialize in this sort of machinery, principally using G. E. C. motors.

The anchor windlass is situated on the foc'sle head and is of the Cunningham electric self-contained type with a combination spur and worm-gear. The worm-gear is of phosphor-bronze with forged-steel worm with ball-thrust bearings. The main reduction-gear is steel spur-gearing and the bearings are all adjustable bronze shaft-bearings. There are two cast-steel wildcats for 2 1/16 inch chain and two quick-warping heads on the intermediate shaft. The windlass is sufficiently powered to heave both anchors at once in 70 fathoms of water.

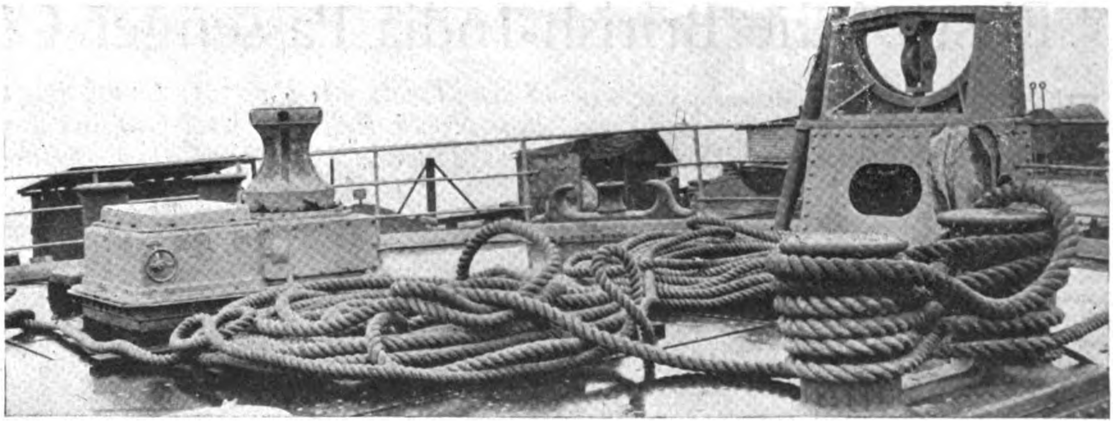


Pilot house of the "Kennecott"

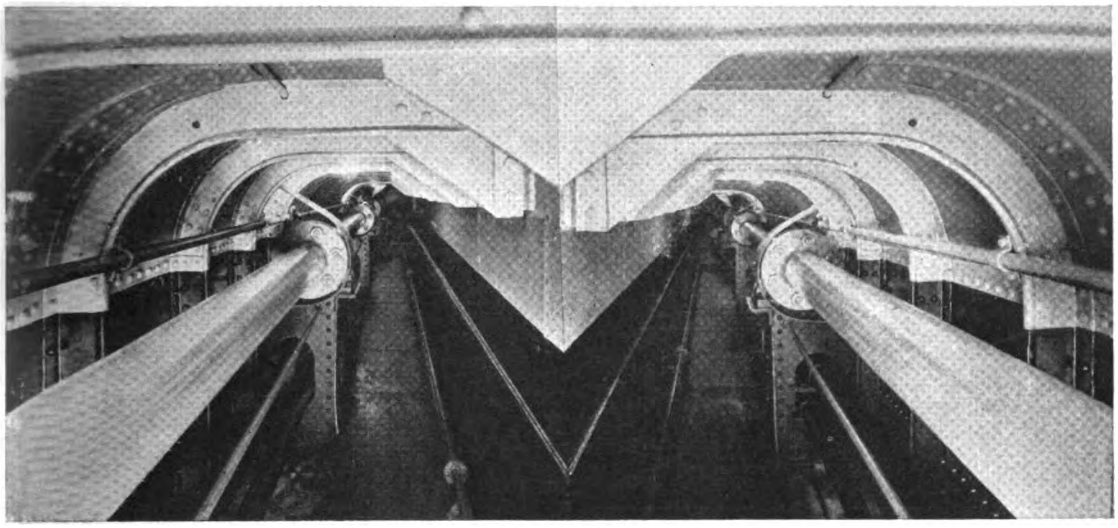
The electric capstan is on the poop deck and has an 11½-inch barrel. It is fitted with handbar head for hand operation in emergencies. The base is divided into two compartments, one of which carries all the gearing which runs in a bath of oil. The other compartment contains the motor and control apparatus, all of which is completely enclosed in the waterproof compartment. The capstan bearings are all adjustable bronze.

Six of the eight electric cargo-winches are of the Cunningham patent self-contained hollow-base

Three of the Allan-Cunningham-General Electric motor-winches on the deck of the "Kennecott" type and carry all the control apparatus in the base of the winch. The controllers are operated by a pump lever which is raised to hoist and pushed down to lower in the same way as a throttle-reversing steam winch. This enables one man to operate two winches in accordance with usual Pacific Coast practise. The winches are driven by 25 h.p. G. E. C. marine type motors and have a lifting capacity of 4,000 lbs. and 250 ft. per minute and heavier loads at corresponding rope speeds up to a maximum lift of 15,000 lbs. The winches are double reduction; the first gear-reduction is cut herringbone gearing running in a bath of oil in an oil-tight gear casing; the second or main reduction is machine-cut spur-gearing fitted with substantial and close-fitting flanged gear-guards. Both main and intermediate shafts run in adjustable bronze bearings. A waterproof magnetic dish holding-brake, fitted with simple external adjustments is fitted to the armature shaft of each motor. This brake is merely a safety holding device, however, and is not used in lowering, the lowering control being accomplished by a system of dynamic braking which gives a range of speed control in lowering from creeping to practically free dropping speed. The winches are provided with safety devices to prevent accident from any possible cause.



Electric capstan of the "Kennecott"



Twin propeller-shaft tunnels of the "Kennecott"

The two winches on the bridge-deck are designed for remote control on account of the fact that it was impossible to arrange winches at this hatch close enough together for operation by pump-levers. The two controllers are mounted in a waterproof control-box which stands right against the hatch combing so that the operator can look down into the hatch while manipulating them.

The powerful deck machinery and cargo-booms are a notable feature of this boat and she has been equipped to handle not only the heaviest kind of ore but also machinery or mine locomotives if necessary. The hatches are also of unusual size. There are four hatches on the main deck and four below on the 'tween decks, the largest ones being 18 x 28 ft. and the smaller ones 18 x 24 ft.

Probably the one feature that has attracted more attention than any other about the boat is the Cunningham electric steering-gear. This is a new type of electro-hydraulic gear controlled from the bridge by a duplex ram type of hydraulic telemotor of the McTaggart-Scott design as built by the Allan Cunningham Co., who are the McTaggart-Scott United States licensees. The steering gear itself is of the geared-spring quadrant type in which a tiller is keyed solidly to the rudder-stock and the tiller in turn is fastened to a floating quadrant by means of compression springs. The permimeter of the quadrant is fitted with gear-teeth which are fastened to it in blocks of five teeth to the block. The gear quadrant meshes with the driving-pinion of the steering-engine which in turn is driven through worm-gearing by a 15 h.p. G. E. C. motor through a Waterbury hydraulic variable-speed gear. The motor is controlled by a contactor type controller with automatic re-starting device and numerous other safety devices which prevent damage to the steering-gear and ensure its immediate return to normal operating conditions in event of temporary interruption of the current or abnormal variations in voltage. The steering-gear is extremely silent in operation as well as being unusually efficient.

The vessel is also provided with a Cunningham towing chock and foundations have been provided for an electric towing machine which will be installed later.

Other interesting features of the "Kennecott's" equipment include the 2 kw. wiring set installed by Kilbourne & Clark, Seattle; a 110 volt 25 amp. searchlight of the Carlisle-Finch type; a system of Magnavox intercommunicating telephones; an electric driven jacking gear made by McIntosh & Seymour Corporation for turning up the main engines; a hand bilge and fire pump made by the Rumsey Pump Co. of Senaca Falls, N. Y., and special davit equipment manufactured by the Steward Davit & Equipment Co., New York City. The plumbing was supplied by the Crane Co., Chicago, and the compasses, binnacle and other navigating instruments by Max Kuner of Seattle.

On her maiden voyage from Bellingham to San Pedro, the "Kennecott" averaged 11 knots with full-load of cargo, burning heavy crude-oil. The trip took four days and five hours. She is now en route for New York, and should be inspected by all shipping interests in that city upon arrival.

ANTI-NOISE TELEPHONE FOR MOTORSHIPS.

Like many inventions that have benefited mankind, the anti-noise transmitter developed by Peter L. Jensen and Edwin S. Pridham, engineers of the Magnavox Company and pioneers in the adaptation to commercial use of the electro-dynamic principle of telephone reception, is exceedingly simple. Most of us have memories of exasperation incidents of trying to carry on telephone conversations against outside noises of any sort—from the tintinnabulation of a riveting hammer on the steel building next door to the roar of the elevated railroad under our own office windows, and consequently endeavor to visualize some scheme for eliminating from the line all foreign sound, but there arise visions of complicated retardation-coils and sound-proof face masks and the like or else a hot, stuffy booth. And with these preconceptions in mind, the first glimpse of the Magnavox device that has made undisturbed telephone communication possible under the most harrowing conditions of outside noises and disturbances is apt to produce a distinct mental jolt. For, with the exception of the light and astonishingly small aluminum protecting case, the small brackets that hold the instrument at the proper distance from the operator's mouth, the whole device would almost [illegible] to the case of an Ingersoll watch.

Instead of going at the problem from the only too natural angle of attempting to exclude outside noise from the diaphragm, the designers boldly stripped from the essential mechanism of the carbon granule transmitter—the diaphragm and the "button"—every encasement whatever likely to exclude a bit of the circumambient racket. In other words, they threw open the doors and let all the noise in. Cannily, however, they opened both the front and back door as it were. That is, they allowed the mixture of extraneous sound-waves equally free access to both sides of the diaphragm. The result was unqualified success, a diaphragm that is immune from all influence save that to which it is desired it shall be susceptible —the voice of the person using it—and a transmitter that will carry that voice and nothing else.

To illustrate the simple principle involved, imagine a huge flat gong of the Chinese tom-tom type, suspended by one edge. Then imagine the gong being struck on both sides simultaneously by hammers of equal weight, the blows being equal in force. The gong will not vibrate. Then imagine either a small supplementary hammer striking one side of the gong along with one of the two hammers—or, what amounts to the same thing, a slight increment in the weight of one of the hammers or in the force of its blow. The gong will then vibrate, in direct measure to the additional impulses on one side.

The effect of the twin hammers on the gong is analogous to the effect of extraneous sound-waves, due to any near-by noises, on the transmitter diaphragm (since the sound waves are freely admitted to both sides of the diaphragm). In practice, as in theory, they set up no vibrations. Therefore they cause no "side-tone," as transmitter-disturbance is designated in telephone parlance. The diaphragm is left free to vibrate solely to the directed voice-waves, from the lips of the operator, impinging against one side only.

The engine-room of a motorship or in the pump-room of a tanker are typical examples of places where the use of an ordinary telephone-transmitter would be entirely out of the question. Also, the instruments are for communication between the bridge of the vessel and the compartment aft in which is located the mechanical steering-gear —just over the rear of the propeller shaft, and one of the noisiest places on a vessel. [Crossing the North Sea on a crowded ship in 1919, our cabin was located under the steering-gear.—Editor.] In case of mishap to the steering apparatus on the bridge, communication is immediately established from the bridge to the steering-engine compartment, and the officer on the bridge then directs the engine-operator who, with the equipment on his head, is free to devote his entire attention to the control of the steering-engine or emergency steering-wheel.

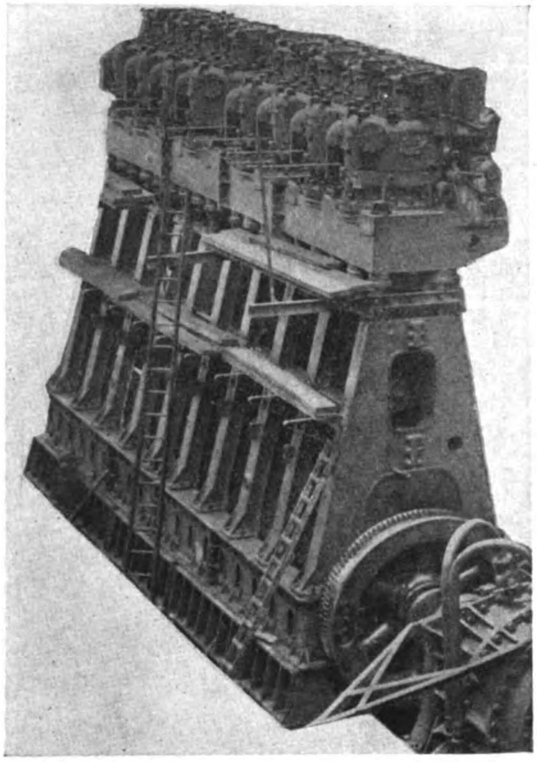
First of the British-India Passenger Cargo Motor-Liners

Shop Trials of Pair of 2,000 Shaft h.p. North British Diesel-Engines for the "Domala," a New Ship of the Combination Type

TRIALS of a pair of Diesel-engines of new design and construction have just been successfully run in Scotland at the works of the North British Diesel Engine Company, Whiteinch, Glasgow, a 7 days' non-stop run at full-load having been completed by the port engine. These oil-engines are being installed in the first of several combination passenger-cargo motor-liners now nearing completion to the order of the British India Steam Navigation Company, two of the hulls having been built by Barclay, Curle & Co.

Unfortunately, none of these fine ships, the first of which was named "Magnavana," but has had her name changed to "Domala," is likely to be seen in American waters, as they will regularly trade between London and Calcutta via the Suez Canal. But, the illustrations and description which we give will afford a comprehensive conception of these vessels and their machinery. They are of a class that "Motorship" has repeatedly urged construction in the United States. "Melma" and "Melita" are the names of two of the craft. Another motorship is building by Denny Bros. of Dumbarton, Scotland, for the Union Steamship Company, New Zealand, which is a subsidiary of the B.I.S.N. Co., but the latter motorship is a 10,500 tons d.w.c. freighter, and will not carry a large number of passengers like the other ships.

Both these prominent shipowning companies for a long while have been subscribers to "Motorship," and news regarding the ordering of this interesting fleet was published in our issue of November, 1919, prior to appearing elsewhere. Altogether eight Diesel-driven motorships are building for the B.I.S.N. Co. and its subsidiaries, and all but one will have four-cycle Diesel-engines—the exception being a vessel of 430-ft. length b.p. and 3,200 shaft h.p. building by Alexander Stephen & Sons of Govan, in which will be installed Stephen-Sulzer two-cycle type Diesel-engines, equipped with electric-driven turbo-blower scavenging. Two of the remaining vessels are small ships of 2,050 tons loaded displacement and of 1,200 i.h.p. now building by Charles Hill & Son, Ltd., of Bristol, England. North British four-cycle Diesel-engines will be installed in these craft.

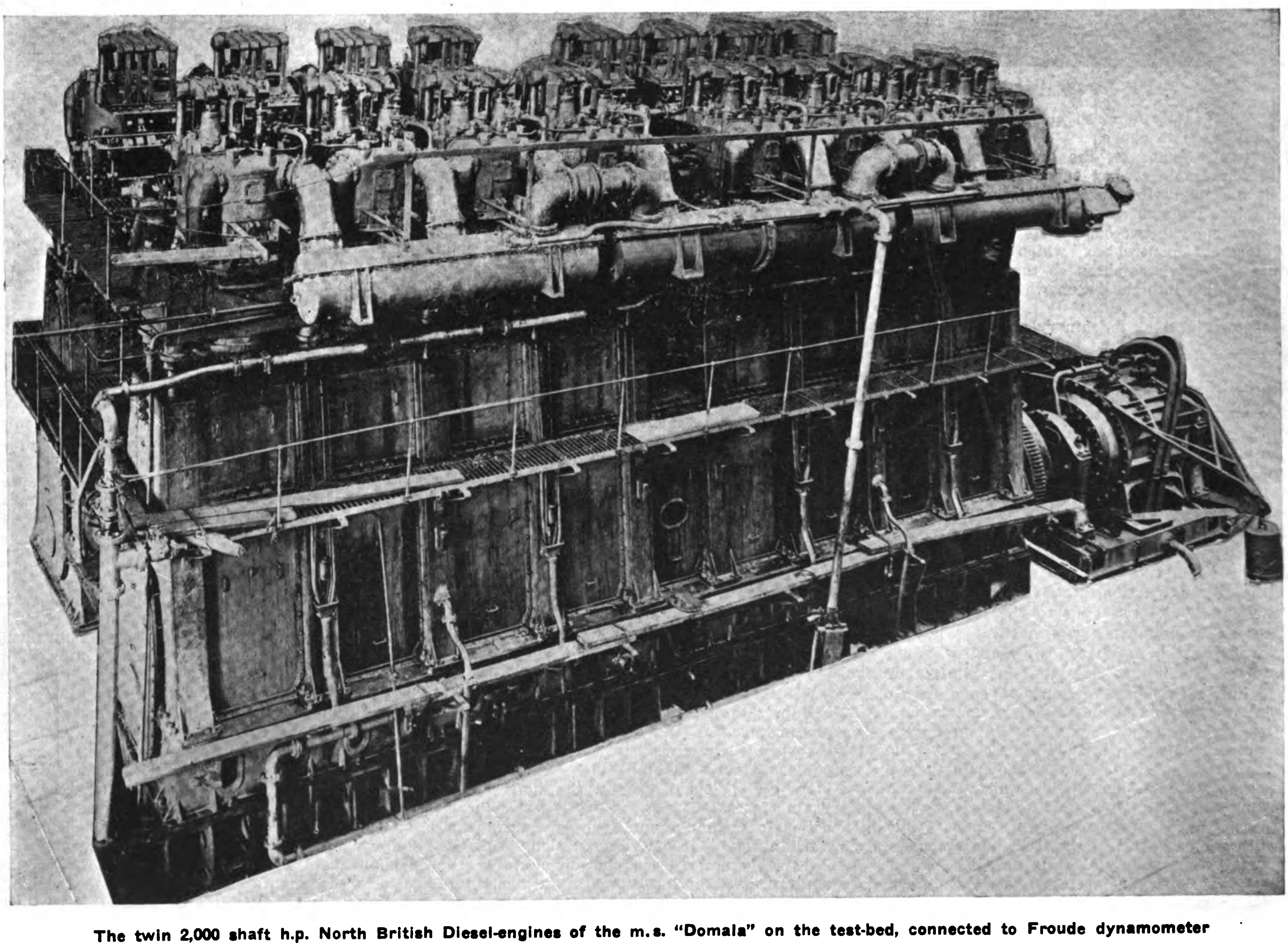


Showing framing and cylinder-box construction of the North British Diesel-engine of the "Domala"

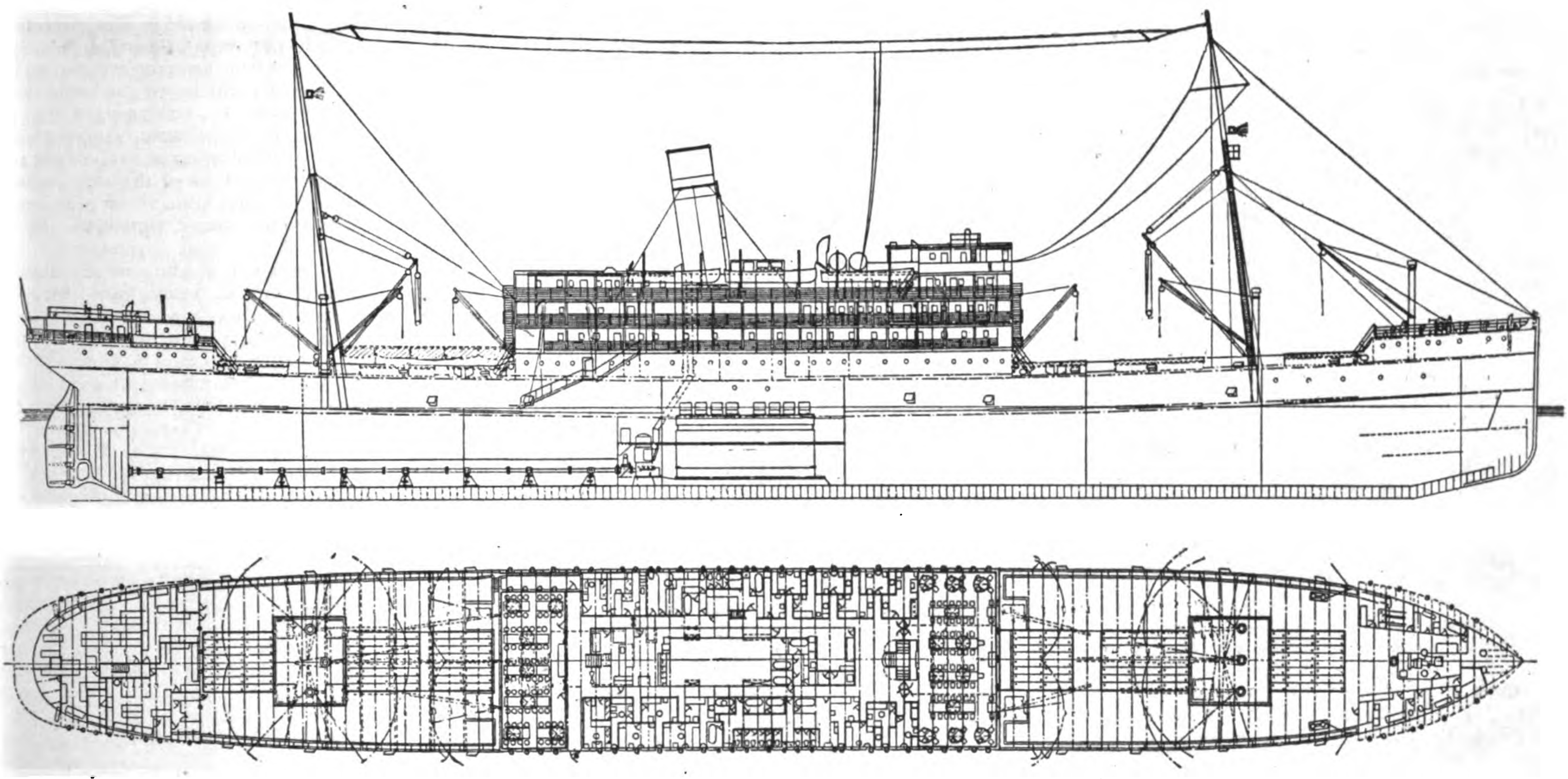
One of the illustrations shows the motorship "Domala," which is the first of their fleet to receive North British Diesel-engines. We also give drawings of her machinery arrangements and engines, and for a vessel of her speed and power her machinery space is small, being only 56 ft. in length. Her general dimensions are as follows:

Deadweight-capacity	10,500 tons
Passenger capacity	100 first-class, 50 second-class
Length O.A	464 ft.
Length B.P	450 ft.
Depth (md.) to U.D	35 ft. 6 in.
Gross tonnage	8,500
Designed sea speed (loaded)	13½ knots
Power main engines	4,600 i.h.p. (4,000 shaft h.p.)
Power, auxiliaries	1,400 b.h.p.
Total power	6,000 i.h.p.
No. of cyl. main engines	8 per engine
Cyl. power and piston stroke	26½ in. x 47 in.
Engine speed	96 r.p.m.
Piston speed	752 ft. per min.
Daily fuel-consumption (main engines)	18 tons
Fuel-oil used on test-bed	Anglo-Persian
Fuel-consumption	0.42 lb. per b.h.p.
Time of reversing	8 seconds

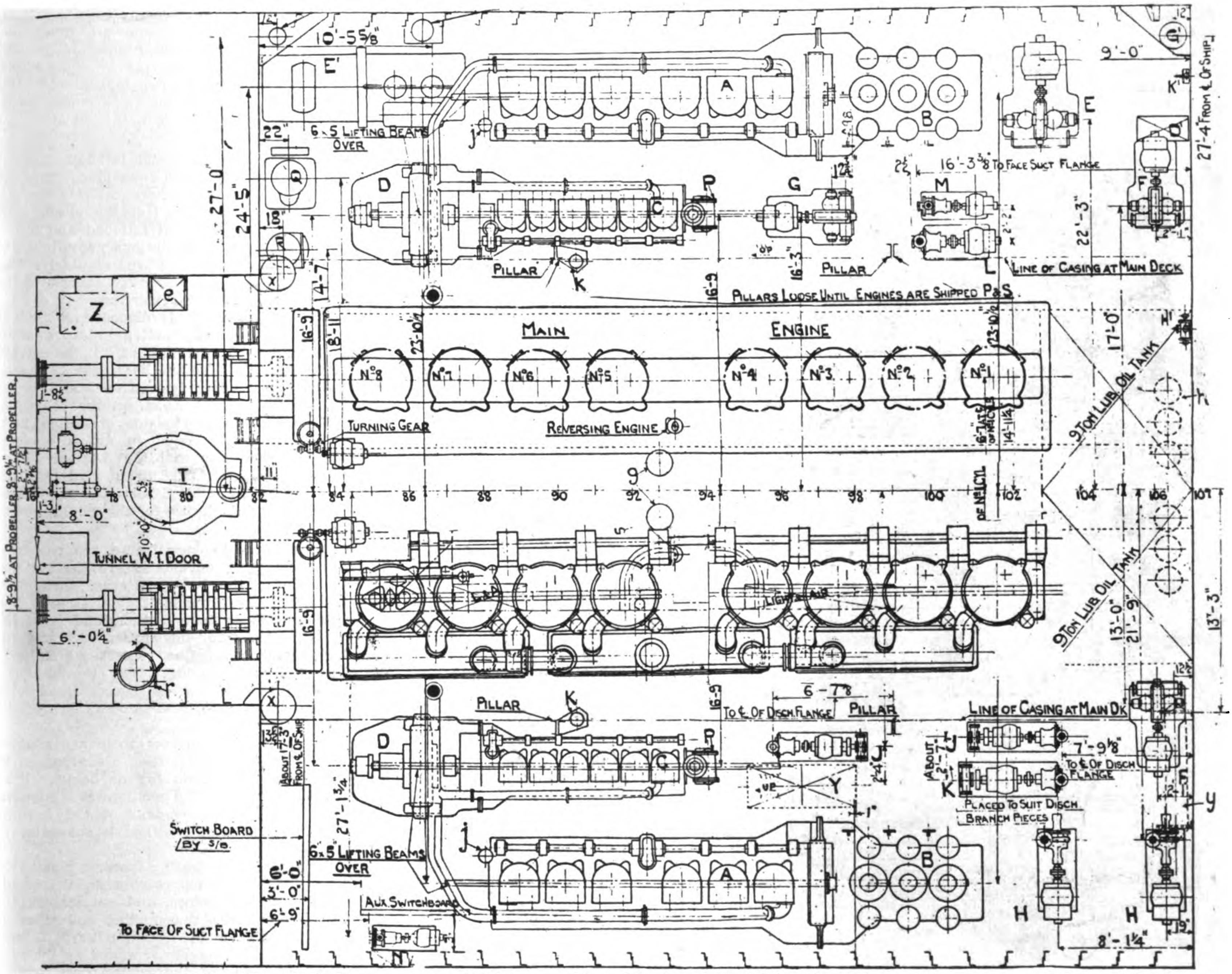
The high power of the auxiliary engines is due to the fact that all the crews and passenger accommodations will be electrically heated and to the air compressors being separately driven. Accommodations provided on the bridge and promenade decks for 100 first-class and 50 second-class passengers, the first in one, two and three berth-rooms and the second in two, three and four



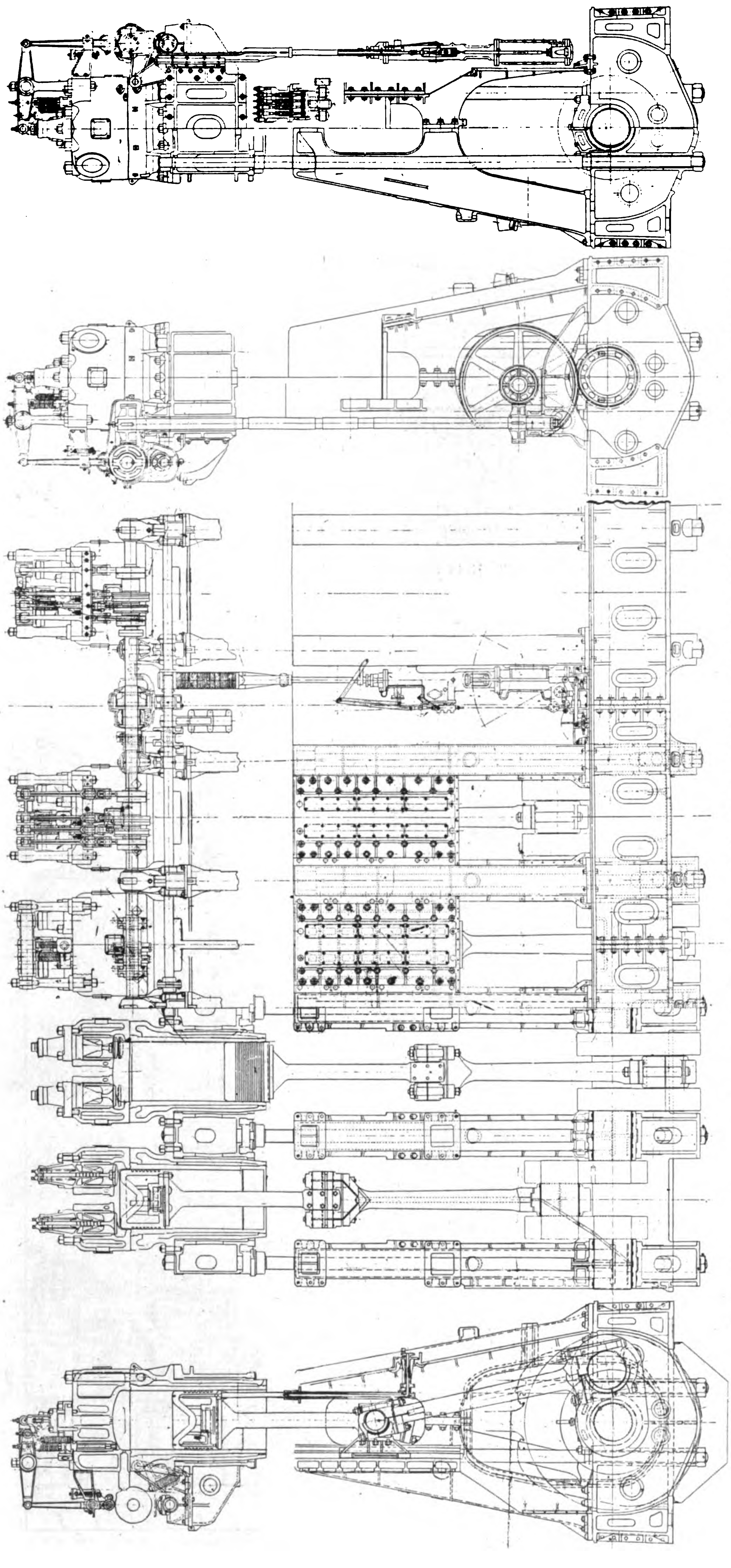
The twin 2,000 shaft h.p. North British Diesel-engines of the m.s. "Domala" on the test-bed, connected to Froude dynamometer



General arrangement plans of the motorship "Domala." Note the small machinery space.



Engine-room plan of the "Domala." There are two 400 b.h.p. auxiliary Diesel-engines driving three-stage air-compressors, and two 200 b.h.p. Diesel-engines connected to electric-generators. There are no air-compressors on the main engines



Sectional, general arrangement, and end view drawings of the 2,000 shaft h.p. North British Diesel-engines of the motorship "Domala"

berth-rooms. At the fore-end is the first-class dining saloon, while the second-class dining saloon is at the after end of the bridge between decks, with the kitchens and pantries on the same level between the two saloons.

In addition there are music-room, smoking-room and entrance-hall for the first-class passengers, and corresponding rooms for those of the second-class. Space in promenade on both boat and promenade decks are covered by permanent sun-decks. Excellent accommodation has been arranged for the captain, officers, engineers and crew. Cabins are also provided for 12 cadets and for two Marconi operators. There is also a ship's hospital, as a doctor will be carried.

There are six cargo-holds, and a very efficient cargo-working apparatus is fitted. At each cargo-hatch there are two derricks, each for four-ton lifts with electric-winches. There is a heavy derrick capable of lifting up the 30 tons fitted on the foremast, and another for lifting up 50 tons on the main mast. By means of deep girders and wide-spaced pillars the holds are left free and unobstructed for the storage of bulk cargo. Large coal storage chambers are provided, and these are kept cool by a Haslam refrigerating plant. The Hele-Shaw Martineau type of electric-steering-gear has been adopted.

A new feature aboard motorships is the installation of an electrically-driven disinfecting apparatus with connection to the passenger and crew spaces for disinfecting, and with connections for all cargo-space for fire extinguishing. For operating the water-tight bulk-head doors from the bridge a hydraulic system is fitted. All fuel is carried in the double-bottom forward, while the double-bottoms aft and the after-peak is used for fresh water. Exhaust-gases from the main auxiliary engines are carried up a large stack amidships, so that in general appearance there will be nothing to distinguish this vessel from the conventional combination-type steamer. One of the reasons for the installation of Diesel-engines in this large fleet of ships is the keenness and interest which Lord Inchcape has displayed in the development of the motorship.

Regarding the 7-days non-stop full-power run of the port main-engine, which took place from the 4th to the 11th of April, every satisfaction was given. At the end of the test the engine was manoeuvred several times at full-load and finally reduced in speed to 28 revolutions per minute, at which speed the cylinders all fired regularly. The table which we give is an average sample of the readings taken on the full-power run.

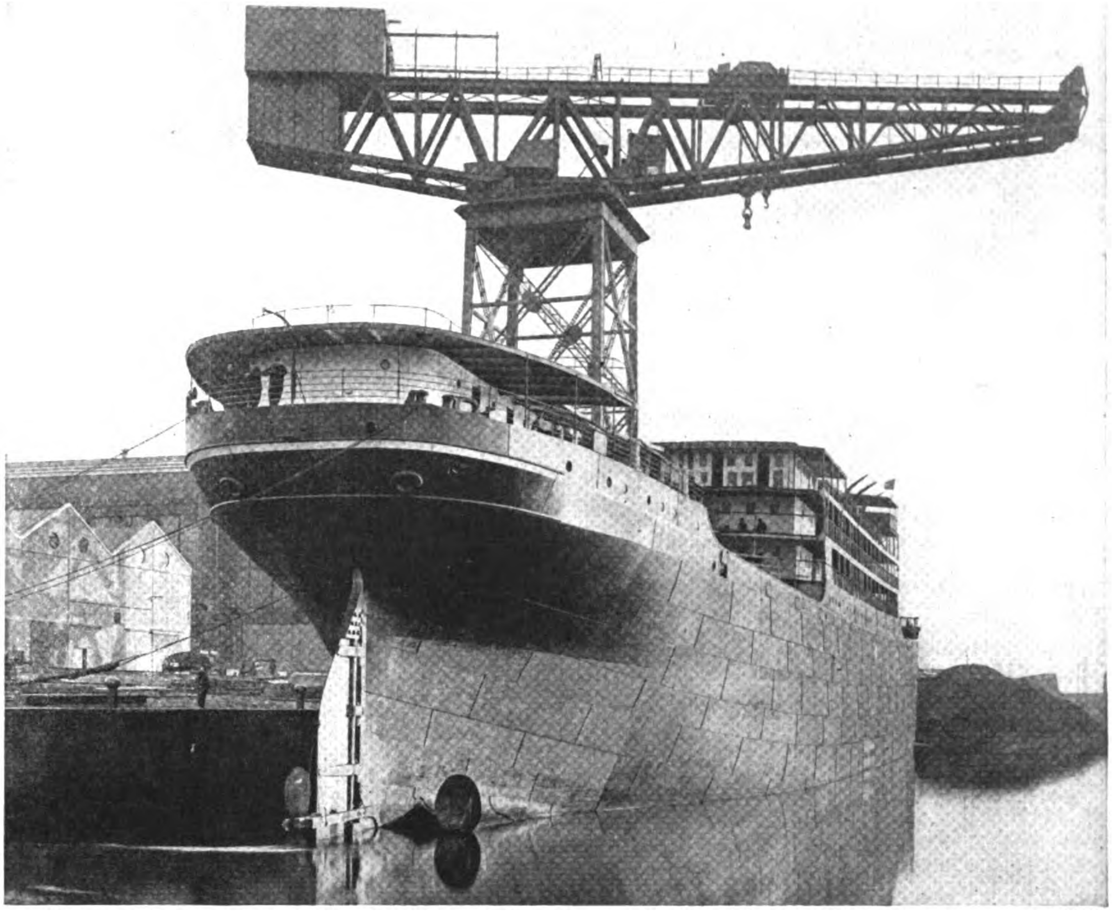
The brake horse-power developed was 2,008 at 98 r.p.m., with a mean-effective pressure of 99 pounds on a fuel-consumption of 0.42 pound per shaft h.p. hour. The engine has eight cylinders, 26½-in. bore by 47-in. piston-stroke, and is designed to operate at 95 r.p.m. on the four-cycle principle. It is of the short-piston, cross-head type, the cylinders being carried in an entablature mounted on box-section cast-iron A-frames. The bases of the frames are fixed to the girders of the bed-plates by studs and fitted bolts, the top flanges forming another entablature for the closing plates below the cylinders.

Long steel bolts, two per frame, are run from the top of the cylinder entablature through the frames down to the bed-plate cross girders to relieve the A-frames from logitudinal stress. The bed-plate is made in four sections and is of the usual form, with strong box-section fore and aft, carrying lateral box-section girders which form seats for the main-bearings. Of circular form, the main-bearings are of cast-steel lined with white-metal. The cross-head slippers are of the single-sided type.

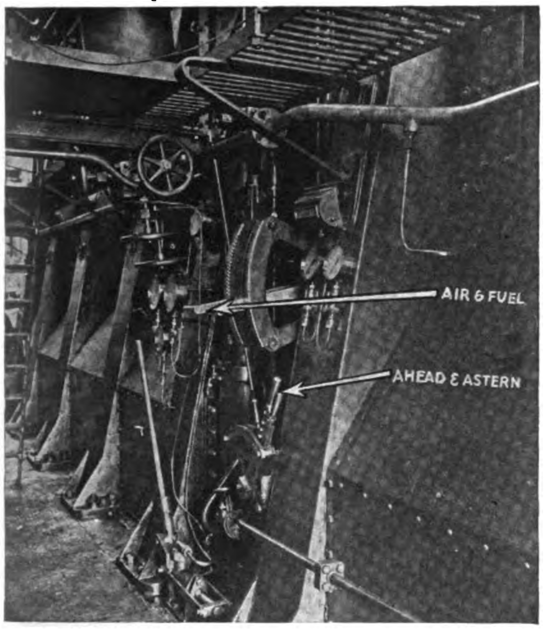
Box-pistons with a concave crown are adopted and are sea-water cooled. They are arranged to be withdrawn either from top or below. It is interesting to note that the cooling-water supplied for the pistons is independent of the cooling-water for the cylinders; although sea-water is used for both purposes.

One of the most interesting features about this engine is that no air-compressors are driven directly by the main motors, and compressed air for fuel-injection—also for starting and manoeuvring—are furnished by two auxiliary Diesel-engines driving compressors arranged on the port and starboard sides of the engine-room respectively. These auxiliary Diesel-engines are six-cylinder four-cycle sets of 400 b.h.p. driving three separate stage vertical air-compressors. Each set has sufficient capacity for serving both main engines at full-power, the other acting as a standby or for use when an unusual amount of manoeuvring has to be done.

In the case of similar engines now being built for a motorship owned by the Union Steamship Co. of New Zealand, the main air-compressors are driven off the crankshaft. The original reason of this was that the motorships for the British India Steam Navigation Company require a little more power. This was secured without increasing the size of the main engines, but by operating the compressors by auxiliary engines. However, it is noteworthy that additional benefit will be gained by taking the compressors away from the main engines, because the Union Steamship Company's vessels will be obliged to carry a full crankshaft as a spare, whereas if the air-compressors were independent they would only have to carry half-a-crankshaft, as in the case of the "Domala." In view of the power of the engines, a complete crankshaft is a costly and heavy fitting to carry.

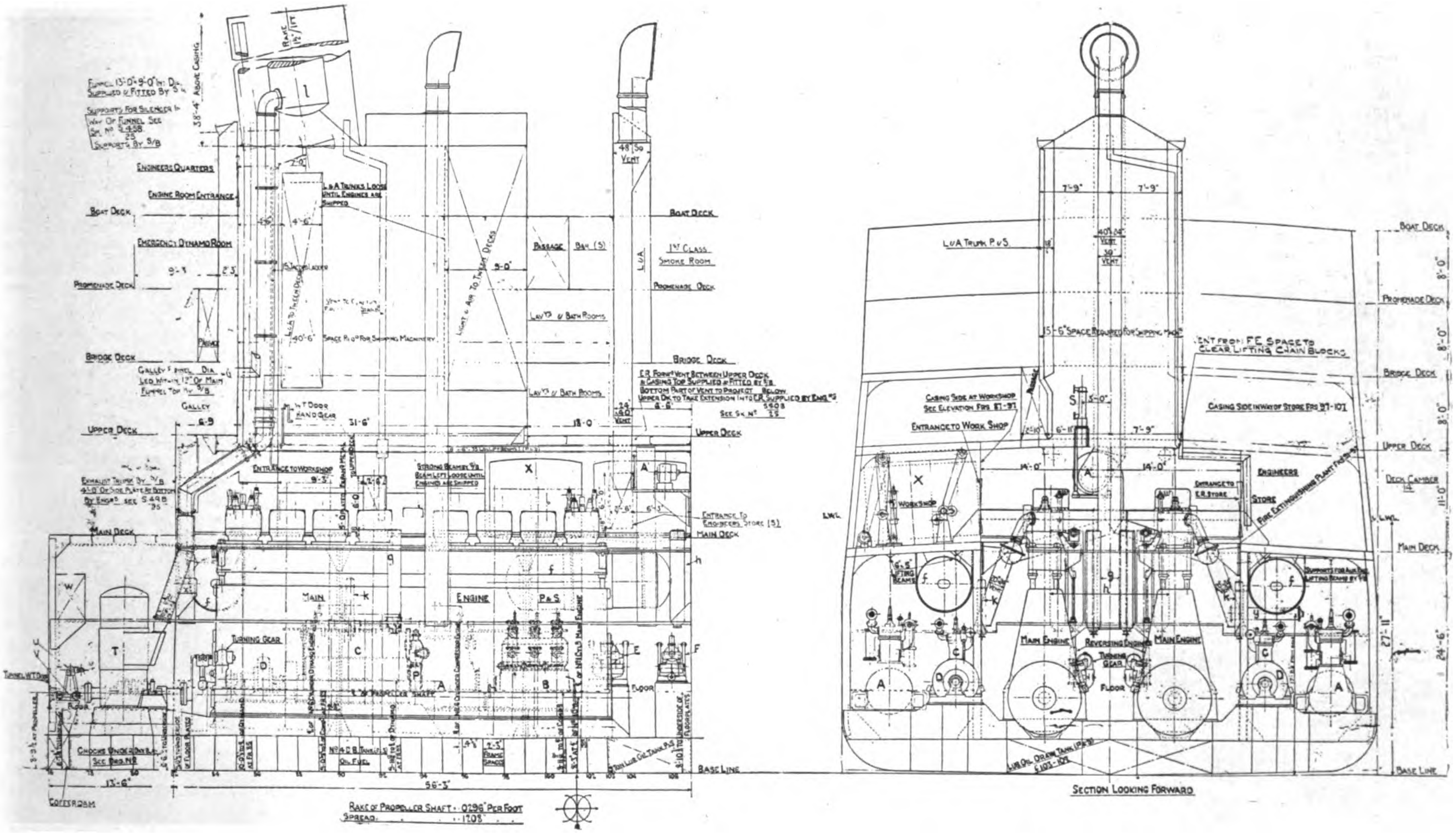


The motorship "Domala" under the North British Co.'s 150 tons crane having her 6,000 i.h.p. Diesel machinery installed



Control levers of North British engine

With regard to the valve-operating and manoeuvring-gear, it will be noticed from the drawings and illustrations that the camshaft is carried on brackets bolted on the cylinder entablature and the motion from the cam is transmitted to the valves by means of short steel push-rods and cast-steel rockers. Separate cast-iron cams are arranged for ahead and astern running, the same being brought into action respectively by lowering the camshaft, moving it endwise and raising it again. Owing to the drawings having only arrived at the time of closing this issue for press, we are unable to have these re-drawn in detail, so that this particular movement is not very clearly shown. Nor in the few hours available have we had the time to study the drawings for the purpose of giving a complete technical description, so it is our intention to publish a more detailed article of these interesting engines at an early date. Readings are given on next page.



Profile plan of engine-room and section looking forward, of the m.s. "Domala"

Main Engine—Typical Set of Readings Taken During Seven Days' Trial

FUEL OIL USED	PARTICULARS OF ENGINE	LUBRICATING OIL USED
Anglo Persian. Sp. Gravity, .895. Flash Point, 167° F. Vicosity, 302 4/5 Secs. at 61° F.	Type: 8 Cyldr., 4-Cycle, S. A. Bore: 26.5". Stroke, 47". Revs. 96 per min. Stroke/Bore Ratio, 1.772.	Main Brgs, Bottom Ends, Etc: Price's S/S 3255, Sp. Gravity .925. Cylinders: Price's Oleogene, Sp. Gravity, .918.

Time of Observation	Revs. Per Min.		M. E. P.										Pressures—Lbs. Per Square Inch				
			Cylinder														
	Tachometer	Counter	I	II	III	IV	V	VI	VII	VIII	Mean M. E. P.	B. H. P.	Blast Air	Starting Air	Lubricat'g Oil	Cylinder Cooling Water	Piston Cooling Water
2 P.M.	98	97.5	102.4	102.1	103.7	104.1	91	108.9	942.	93.4	99.1	2008	1000	250	15	17	42

Temperatures in Degs. Fahr.																				
								Cylinder Cooling Outlet												
Atmosphere	Crankcase	Circ. Water to Cyld. Guides	Piston Cooling Inlet	Brake Discharge	Piston Cooling Discharge	Guide Discharge	Exhaust Manifold Discharge	I	II	III	IV	V	VI	VII	VIII	Lub. Oil Inlet	Lub. Oil Outlet	Mean Ex Gas Temp.	Fue Lbs. /HR	Fuel Lbs. /B.H.P. /HR
72°	88°	52°	52°	126.5°	144°	81°	151°	118°	118°	120°	118°	118°	118°	110°	110°	66°	96°	592°	845	.42

Air Compressor independently driven. Slow Speed Trial, 28 revs/min. Time for reversal from Ahd. to Astern, 11 seconds

MOTORSHIP "KENNECOTT" COMING TO NEW YORK

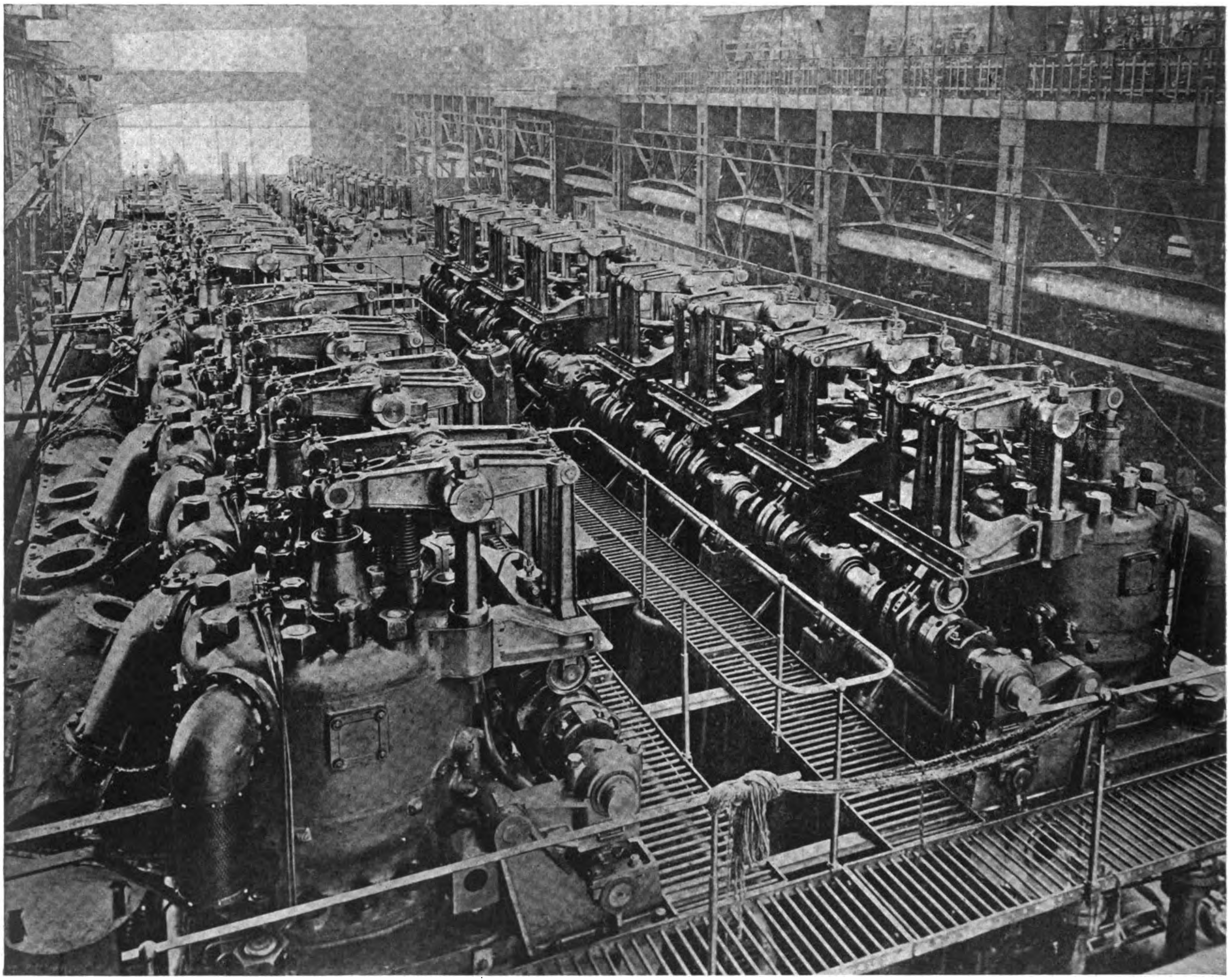
We understand that the new 6,000-ton motorship "Kennecott," owned by the Alaska Steamship Company, is now en route for New York. We suggest that shipowners visit this interesting all-American vessel when she arrives. She is in command of Capt. John Johnson. The "Kennecott" arrived in San Pedro on April 16 from Bellingham, with 3,500,000 ft. lumber, after a record voyage of 4 days, 5 hrs., the new engines running at overload all the time. She brings a full-cargo to New York.

TRIALS OF SINGLE-SCREW MOTORSHIP "SARDINIA"

Owing to very great pressure on our editorial space, we are obliged to hold over a description of the trials of the new single-screw Werkspoor Diesel-engined motorship, "Sardinia," built in Holland to the order of the Otto Thoresen Steamship Line. She is a vessel of 3,000 metric tons d.w.c. propelled by a six-cylinder four-cycle engine of 1,950 i.h.p. (1,500 shaft h.p.), and is the first of the Werkspoor engines of this power to be fitted in a ship.

DETONATION OF INTERNAL-COMBUSTION ENGINES

On April 15th a very interesting paper on the "Detonation of Internal-Combustion Engines" was read by Mr. H. T. Tizard before the North East Coast Institution of Engineers and Shipbuilders, Bolbeck Hall, Newcastle-on-Tyne, England. Owing to the mass of editorial matter on hand, we are unable to publish an extract in this issue. However, copy can be obtained by communicating with the secretary of said address.



View of erecting-shop of the North British Diesel Engine Works showing a number of high-powered marine Diesel-engines under construction

Motor-Tug of Unusual Design

"Percheron" a Winton Diesel-Electric Tow-Boat of the Hullfin Type for New York State Canal Service

THOSE of our readers who are interestedly following "Motorship's" series of articles on the New York State Canal, will also be interested in a new type of motor-tug that has been designed on Captain Golden's "hullfin" principle by C. V. S. Wyckoff of New York to the order of Capt. R. E. Pretty of the Hudson Towboat Co., Hoboken, N. J., for towing service between New York and Buffalo on the Hudson River and New York State Canal. We understand that the contract for building the hull is being placed with the Brooklyn Dry Dock Co. and Repair Corporation, and that the twin Diesel-engines will be supplied by the Winton Engine Works.

An unusual feature of this craft, which had been tentatively named "Percheron," is the arrangement for Diesel-electric drive, and the design shows the main engines coupled to two 90 k.w. Westinghouse generators, these developing direct-current for two 100-125 b.h.p. Westinghouse electric-motors direct-connected on the twin propeller-shafts. Each of the six-cylinder four-cycle Diesel-engines develops 150 b.h.p. at 450 r.p.m.

Reference to the design of this vessel will show that the hull is shoal-draft along easy diagonal lines, but has a section, termed "fin," projecting below the hull in which the electric-propelling-motors are placed—the Diesel-engines and generators, as well as the auxiliary machinery, being in the engine-room above.

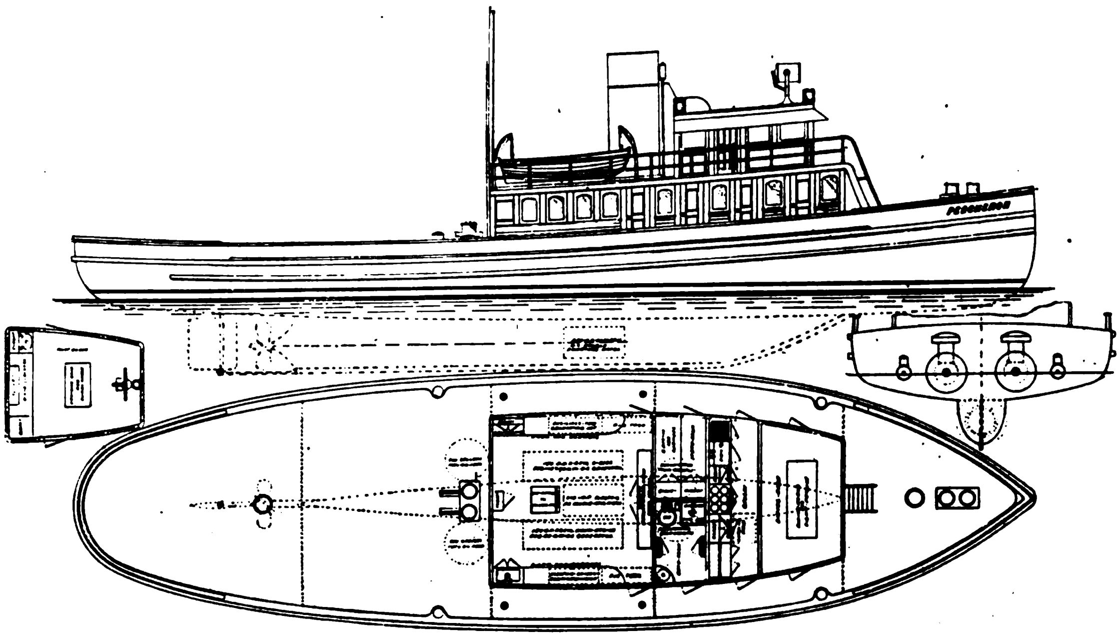
The craft has the following dimensions:

Length (O. A.)	96 ft.
Length (W. L.)	93 ft.
Breadth (M.D.)	26 ft. 6 in.
Extreme draught	7 ft. 9 in.
Diam. of propellers	5 ft.
Displacement	75 tons (short)
Weight of power plant	33 tons (short)
Power of Diesel engines	300 b.h.p.
Shaft h.p. (normal)	200 h.p.
Shaft h.p. (maximum)	240 h.p.
Propeller speed	200 to 500 r.p.m.
Fuel-tank capacity	2,400 gals.

Many broad claims are made by the designers for this special hull design, and it will be interesting to see if all or most of the anticipated benefits result in actual practice. Above the water-line the boat does not depart much from recognized practice, except that she has unusually clean-cut above-water lines, and when afloat should make quite an attractive looking tug.

Claim is made for remarkable propeller efficiency, due to a clear flow of water to the propellers allowed by the fin. In fact, we are advised that 200 shaft h.p. (240 engine b.h.p.) is approximately 80% more efficient than it would be in an orthodox hull, and so is equivalent to 360 b.h.p. (or 450 steam i.h.p.) in ordinary tow-boat practice. Furthermore, the design is said to offer unusual maneuvering ability, with freedom from bottom suction, the latter being very important in canal navigation or other shoal water. Then again the high stabilizing efficiency and lateral resistance said to accompany the hull-fin form of construction, eliminates the pounding incidental to the average wide-bottom shallow-water boat. Easy lines, increased accommodation area, reduced displacement and machinery weights are produced, rendering the design superior for sea-going and general towing service.

A high propeller-speed has been adopted for this vessel on the basis that diameter and revolution rules in common use are not relative, and that a small wheel of proper pitch and blade area with high revolutions will tow or drive as effectively as a larger wheel with fewer revolutions. In this boat the propeller is located well forward of the stern, functioning in almost 100% solid water with the idea of securing maximum efficiency at any speed.

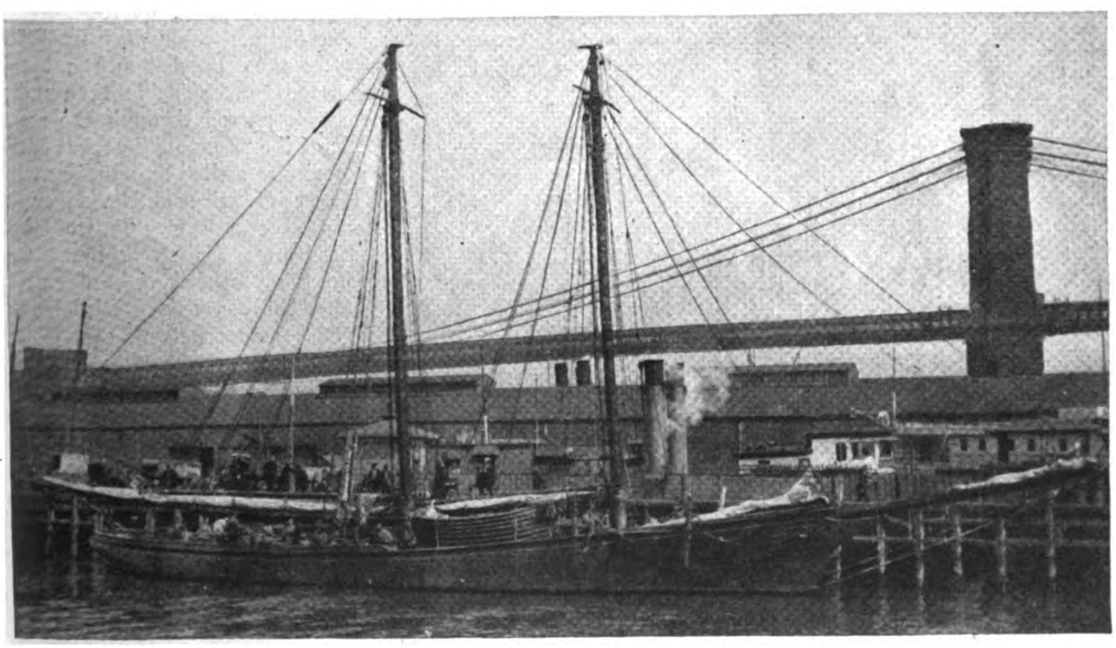


Hullfin-type tug to be built for service on New York State Canal

Modernizing an Old Fishing Vessel

While not of any unusual nature an interesting installation of a Bolinders heavy-oil engine is that recently completed in the case of the old auxiliary gasoline-engine driven fishing-schooner, the "Ruth M. Martin," owned by Chesebro Bros. of No. 1 Fulton Fish Market, New York City, a subsidiary of the Atlantic Coast Fisheries Company with executive offices at 16 Exchange Place.

The "Ruth M. Martin" was built at Essex, Mass., in 1892, and measures 98 gross tons and 43 net tons being of the following principal dimensions: Length 89.2 feet, breadth 23.7 feet, with a depth of 9.8 feet. While originally a two-masted schooner with top sails she has for the last eight or ten years had an auxiliary gasoline engine as a "kicker" and is now stripped of her top sails.



Auxiliary fishing-schooner "Ruth M. Martin," Chesebro Bros., New York, recently equipped with a 100 b.h.p. Bolinders oil-engine. Speed without sails, 8½ knots.

After having been re-engined at the Tebo Yacht Basin, foot of 23rd Street, Brooklyn, N. Y., with the new two-cylinder, direct-reversible engine developing at normal load 100 b.h.p. she set out on Thursday, March 24th, on her first fishing trip for the season having a crew of 17 men commanded by Captain Tobias Johnson, when a speed of some 8½ knots was attained, without sails, being driven by a three-bladed 48 in. by 42 in. bronze propeller at about 325 r.p.m.

The engine-room while naturally not of a very spacious nature accommodates besides the engine three 200-gallon fuel-tanks and one 200-gallon fresh-water tank. While automatically charged by the engine the air bottle may in an emergency be loaded by a two stage hand air compressor which is provided.

The 100 b.h.p. Bolinder engine of the "Martin" while of standard design is not the very latest type of engines that the Bolinders Company are going to market here through their Branch Office at 30 Church Street, for in their latest design just announced both water and air injections are dispensed with, substituted by a new fuel injection device and a new method of obtaining a more efficient combustion of the fuel in the cylinders tending to increase the power of the engine at a still lower consumption of fuel than with the "Martin" engine which latter, however, is guaranteed not to consume more than a fraction over half-a-pound of fuel-oil per brake horse-power hour.

PROPELLERS OF THE MOTORSHIP "BACOI"

In our last issue it was stated that the new bronze propellers of the "Bacoi" were made at W. & A. Fletcher's plant. However, they were made at the Vulcan Iron Works, but were designed by Mr. Ebsen of the Fletcher Co., in conjunction with the Vulcan Iron Works.

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MOTORSHIP

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PRESIDENT HARDING AND THE MERCANTILE-MARINE

Every assurance that President Harding will stand at the back of the American merchant-marine was given in his address before the Senate at the opening of the Congressional session. Dealing with the subject of transportation and maritime commerce, he said:

"Linked with rail and highway is the problem of water transportation—inland, coastwise and transoceanic. It is not possible, on this occasion, to suggest to Congress the additional legislation needful to meet the aspirations of our people for a merchant-marine. In the emergency of war we have constructed a tonnage equaling our largest expectations. Its war cost must be discounted to the actual values of peace, and the large difference charged to the war emergency, and *the pressing task is to turn our assets in tonnage to an agency of commerce.*

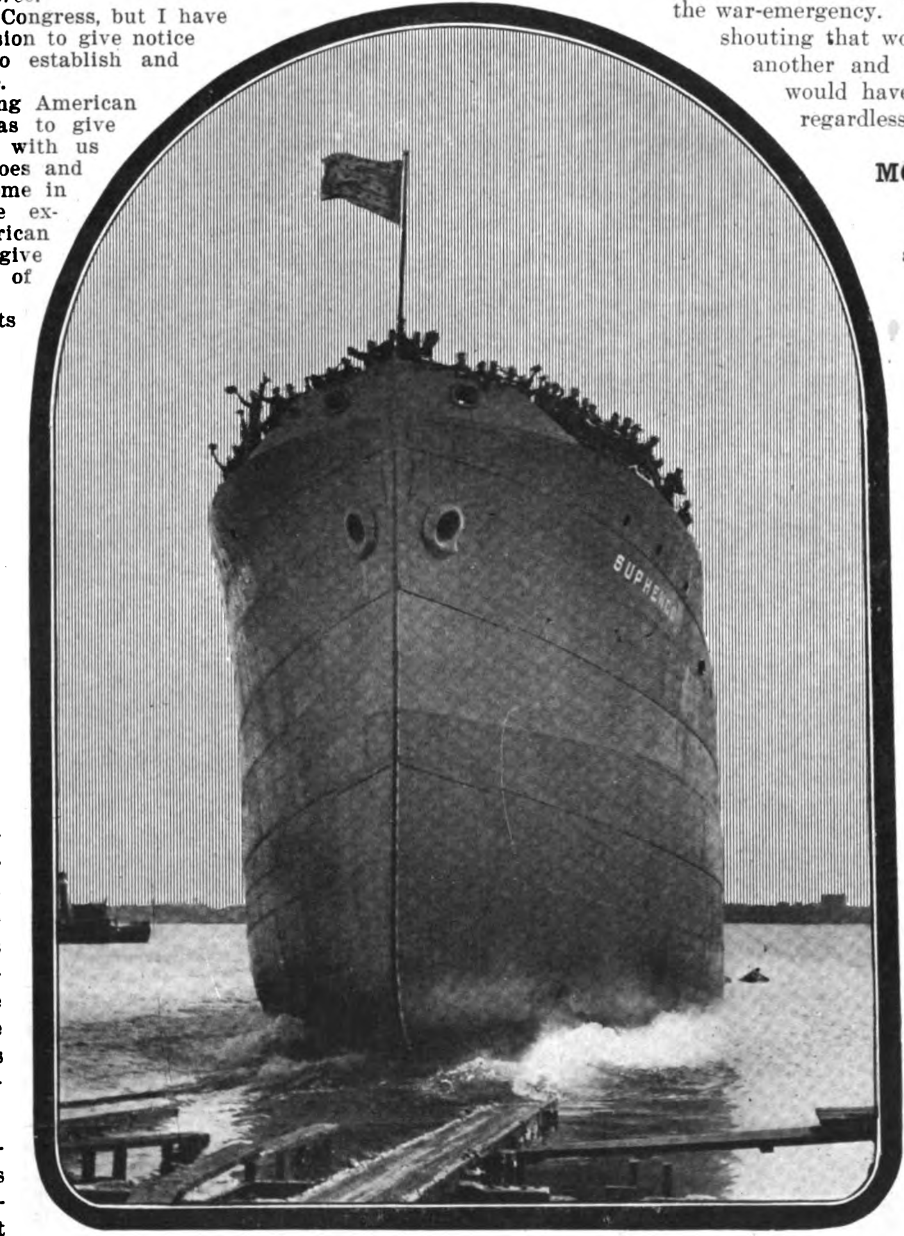
"It is not necessary to say it to Congress, but I have thought this to be a befitting occasion to give notice that the United States means to establish and maintain a great merchant-marine.

"Manifestly if our laws governing American activities on the seas are such as to give advantage to those who compete with us for the carrying of our own cargoes and those which ought naturally to come in American bottoms through trade exchanges, then the spirit of American fair play will assert itself to give American carriers their equality of opportunity.

"This republic can never realize its righteous aspirations in commerce, can never be worthy the traditions of the early days of the expanding republic, until the millions of tons of shipping which we now possess are co-ordinated with our inland transportation and our shipping has Government encouragement, not Government operation, in carrying our cargoes under our flag, over regularly operated routes, to every market in the world, because carrying is second only to production in establishing and maintaining the flow of commerce to which we rightfully aspire."

President Harding makes it clear that no matter if costly, the new Government will back the merchant-marine to a sufficient extent to ensure its success. A big problem is before the new Shipping Board in turning the present "war emergency" fleet to practical commercial vessels that can compete against the vessels of all nations without, if possible, permanent federal subsidies. We can echo the President's words in that—"the pressing task is to turn our assets in tonnage to an agency of commerce."

Undoubtedly, many of the existing freighters, passenger-vessels and tankers must have their existing uneconomical and inefficient propelling and auxiliary machinery removed and replaced with equipment of the most modern type in order that they may take their proper place on the high seas, and it will be necessary for Congress to appropriate some money for this purpose before these vessels can be turned over to private ownership. We feel absolutely sure that there are at least 100 steel ships laid-up that will never again go to sea in their present condition. With these craft direct-Diesel, or Diesel-electric power is the only solution.



ANOTHER STEP IN THE FULFILMENT OF PROGRESS

Launch of the Submarine Boat Corporation's first motorship, the "Suphenco." She is to be propelled by a six-cylinder 2240 i.h.p. Craig four-cycle Diesel-engine

REDUCTION-GEARS FOR MOTORSHIP WORK

Referring to the article on the operation of the Diesel-engined motorship "Libby Maine" published in our March issue, this vessel is noteworthy in that her main engines drive the propellers through reduction-gears. The owners of this vessel would form a valuable service if they would take careful measurements of the wear of the reduction-gears and also issue a general report regarding their operation. This would come at a time when the subject is alive, because of the two large Diesel-motor freighters now building in Germany for the Hamburg-America Line with which high-powered submarine engines in conjunction with reduction-gears are being used as propelling machinery.

SUPPOSING THEY HAD BEEN DIESEL-ENGINED MOTORSHIPS!

According to a report in one of the weekly marine-journals 40 geared-turbine ships built at one shipyard have to be overhauled, which work will include the relining of the turbines and gears due to faulty lay-out. The first of these vessels has already been dry-docked for that purpose, including rebuilding and will take a month—after which a decision will be arrived at as to what will be the best methods to put the other ships into shape. In one ship the gears have been stripped and new gears have already been put in. The marine publication in question goes on to say that certain modifications were made to the propelling-machinery and later ships have been more or less successful.

It is to be noted that all this has been going on very quietly and details have not appeared in the technical press. We wonder if that would have been the case if trouble to similar extent had developed to forty new Diesel motorships, had such been built by the Shipping Board during the war-emergency. We can well imagine the tremendous shouting that would have gone up from one coast to another and back again. In fact Diesel power would have been damned forever in America, regardless of its economy.

MOTORSHIP "ZOPPOT" TOWS BIG DISABLED STEAMER

In our issue of Sept., 1920, details and illustrations were given concerning the maiden voyage of the 17,000 tons d.w.c. German Diesel motor tankship "Zoppot." This vessel recently again crossed the Atlantic to New York. On this voyage she towed the 13,000 tons steamship "Baltic" a distance of 878 miles to the Azores at a speed varying from 6 to 7 knots. The steamer "Baltic" had become disabled owing to leaky boilers and clogged oil-burning system. This incident is exceedingly interesting for many reasons which need not be dwelled upon here, as they are so obvious.

An 8 inch cable was used for towing the "Baltic" and a break occurred to this cable at a point where it passed through the stern choc of the "Zoppot," but was satisfactorily remedied by winding with a layer of wire and a layer of hemp rope on top. It was then spliced to a 7 inch cable coming from the "Baltic" via a 60-meter anchor-chain giving a total length of 800 meters between the ships. At no time was the end of the "Zoppot's" cable visible and during the passage through relatively shallow waters it dragged on the bottom as indicated by abrasions. The towing work was transferred to another vessel as the "Zoppot" was light and was running short of fuel, not having anticipated the tow—otherwise she would have had ample fuel to have made the United States. During the run her engines functioned perfectly.

An American Oil Company's Motorship Fleet

Operation of Texas Company's Nine Oil-Engined Vessels

By L. B. JACKSON*, M. E.

*Member—American Soc. of Mach. Engrs.; Soc. Naval Atch. & M. E.; Diesel Eng. Users Asso. (England.)

NINE vessels propelled by oil-engines are now in the service of The Texas Company which is well-known as one of the big independent oil-companies. Seven of these vessels have the Diesel-type of engine and two have the surface-ignition type of engine. Of the Diesel-engined vessels two are twin-screw, therefore eleven oil-engines in all are used for propelling purposes. In addition to these engines twenty-one surface-ignition type oil-engines are used for auxiliary purposes such as driving electric-generators, air-compressors and pumps.

The first installation was started in April, 1916, when two engines were installed in the five-masted schooner "Kineo," which was renamed "Maryland." She has the following dimensions:

Length	259' 5"
Beam	45' 3"
Depth	22' 9"
Gross Tons	2498

The engine-room installation consisted of twin 320 b.h.p. "hot-bulb" type of surface-ignition engines of foreign manufacture; 1 Auxiliary set with a 15 HP Fairbanks Morse oil-engine direct-connected to a 10 K. W., 115v. D. C. electric generator and with clutch connection to a 250 lb. air-compressor; also a 5 H. P. electric motor-driven 5" x 6" fire and bilge pump. At the same time an oil-fired donkey-boiler, a steam steering-gear and two steam winches were installed.

When the installation was completed the "Maryland" went into the South American trade carrying the owner's products to that country and bringing back coffee or linseed or available cargo. Oil-engines were not very common in America at that time and very often it was found that the engineers in charge did not thoroughly understand the operation and maintenance of the machinery in their care. This resulted in frequent and expensive delays; furthermore engines manufactured abroad were built on the metric system and used Whitworth threads, which increased time necessary for repairs. Due to the war it was often impossible to secure repair parts and this made it necessary to make patterns, cast the same and machine to foreign measurement standards, a very slow and expensive proposition.

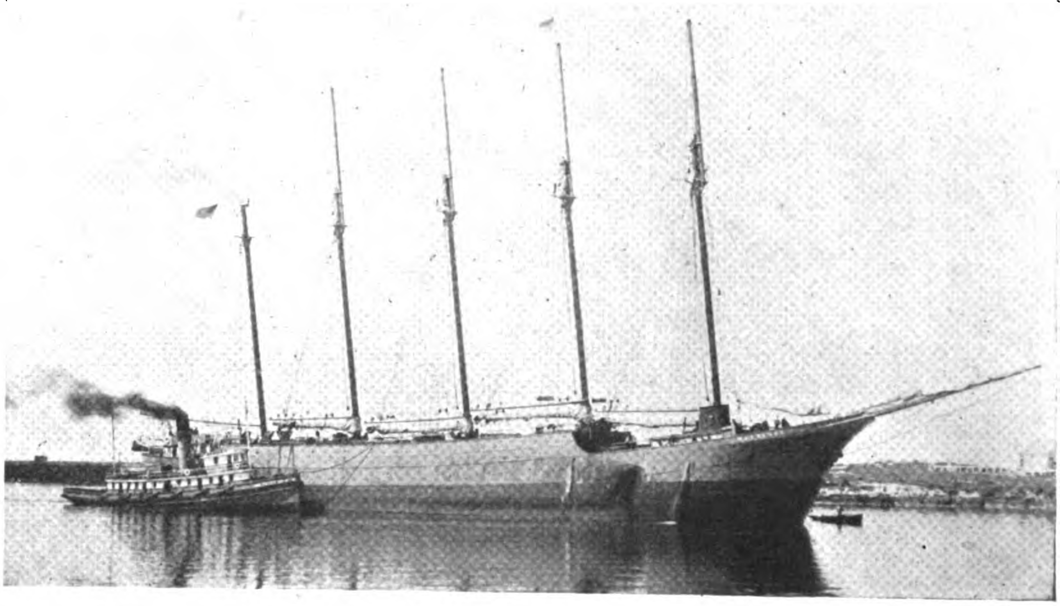
Owing to above difficulties and also to better fuel economy possible with the Diesel-type engine, it was decided that it would be advisable to replace the original engines with Diesel-engines of American manufacture.

In January 1919 the "Maryland" went into service again, in the South American trade. The machinery installation in the engine-room consisted of:

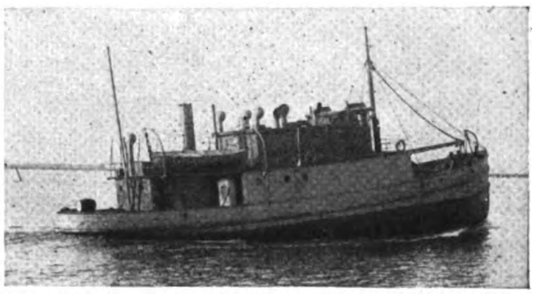
Twin 300 b.h.p. McIntosh Seymour Diesel-engines.

Auxiliary set, as follows:

- 1-30 b. h. p. Fairbanks Morse "C-O" oil-engine
- 1-15 K. W. 125v. Electro-Dynamic Co. generator
- 1-92 cu. ft. 1200 lb. Craig Air-Compressor
- 1-7½ H. P. motor-driven centrifugal circulating-pump
- 1-5 H. P. motor-driven 5" x 6" fire and bilge pump
- 1-6" x 6" x 6" steam auxiliary circulating pump
- 1-96 cell A-4-H Edison Storage battery



Texas Co.'s motor-vessel "Maryland."



"Texaco 125."

Since the installation of these engines there has been practically no engine trouble and the consumption of fuel and lubricating-oil has been greatly reduced. Though the total propelling power is but 600 b.h.p. the vessel makes an average speed of 6½ knots loaded and 7 knots light on a daily fuel-consumption of 25 bbls. (including donkey-boilers and auxiliary set).

The Power Lighters "Alma R" and "Emma R" were completed May 28, 1917, at the shipyard of The Texas Steamship Co. at Bath, Me. These boats have the following dimensions:

Length O. A.	90' 0"
Beam	17' 0"
Draft	4' 5"
D. W. Tons	73

They are both propelled by a three cylinder 10½ in. x 12½ in. "CO" Fairbanks Morse oil-engine equipped with reversing clutch. Having but one hold which is 26 ft. long x 17 in. wide x 5 in. deep, they are particularly adapted for the carrying of pipe and general supplies used in the oil fields. After a few hours trial run in the Kennebec River they proceeded under their own power to Tampico, Mexico, reaching there without any trouble or mishaps. Since their arrival there, about three years ago, they have been in continuous service, manned with a Mexican crew, and giving complete satisfaction.

During January and February, 1918, two more Diesel-engined vessels, "Texaco 124" and "Texaco 125" were completed at the shipyard in Bath, Me. Both were designed for harbor and bay service for delivering gasoline and kerosene in bulk.

The following table gives a brief description:

Length O. A.	101' 0"
Beam	23' 0"
Depth	11' 0"

Cargo-Capacity, 71,400 gals.

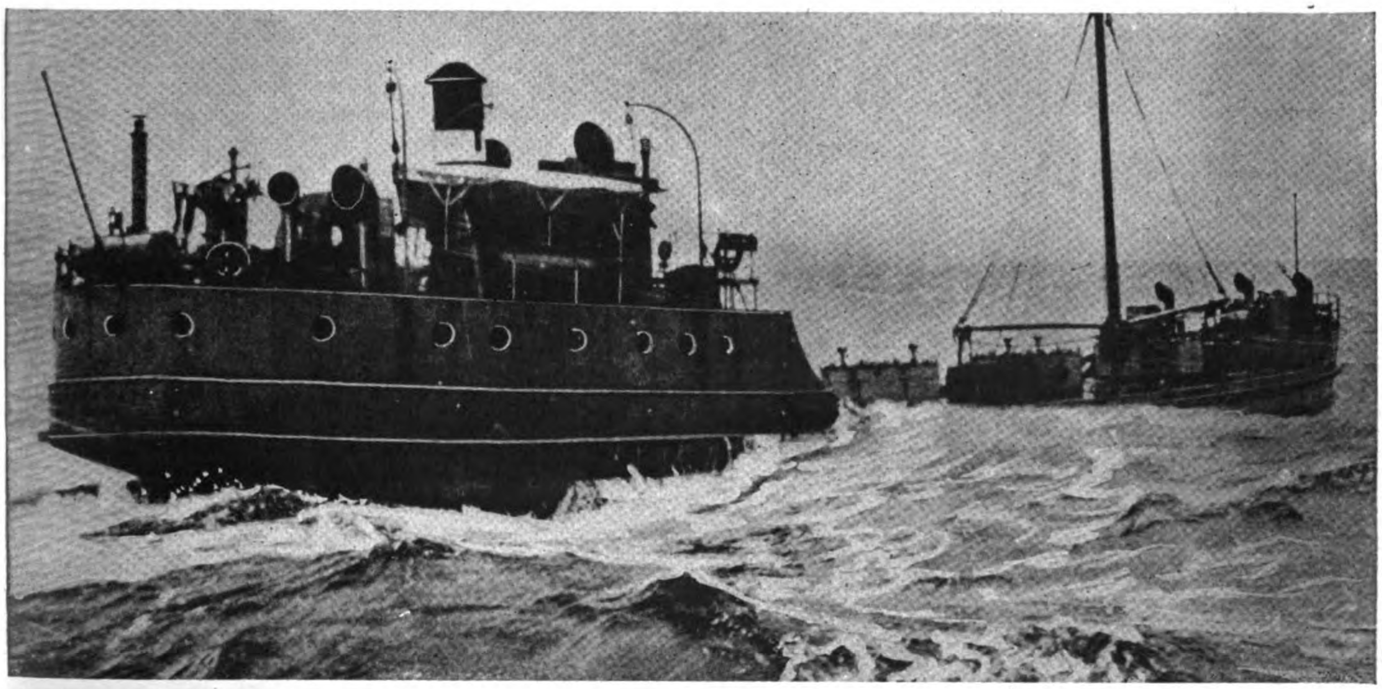
Main Engine, Craig Diesel 6-cylinder, 4-cycle, 12½" x 15", 250 b.h.p.

Auxiliaries—

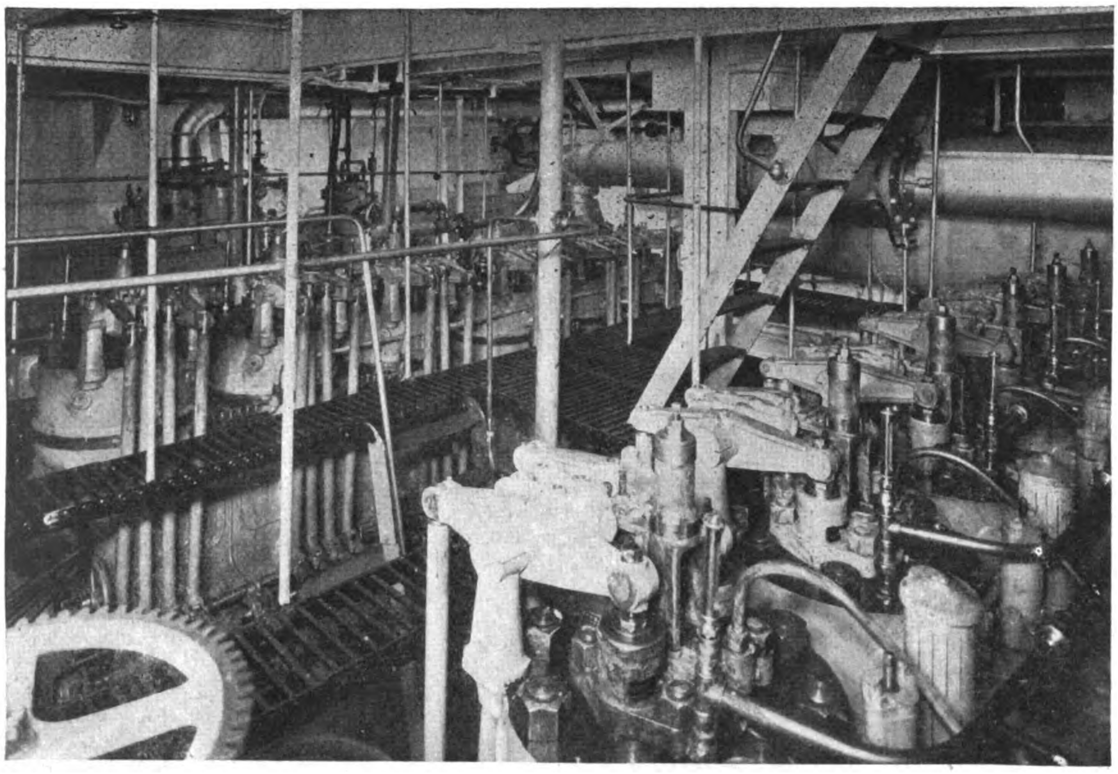
Craig gasoline engine, compressor, electric generator-set.

30 H. P. "CO" Fairbank Morse oil-engine driving three cargo-pumps.

The next motor-vessels completed at the shipyard were the "Texaco 145," "Texaco 146" and "Texaco 147," which went into service in the above order, during May, June and July, 1919. As far as the hulls



The tanker "Texaco 146"



Engine-room of m. s. "Maryland," showing twin McIntosh & Seymour Diesel-engines.

gines have proven to be very reliable in operation, repairs have been negligible and fuel and lubricating-oil consumption has been up to expectations. These boats average 8 to 8½ knots on a fuel-consumption of 10 to 11 barrels per day. As an example of their reliability it should be noted that one of these boats in the first year of service was laid up only nine days on account of overhauling machinery.

The last motor-vessel to be completed was the M. V. "Solitaire" which went into commission April 17, 1920. Although the deadweight capacity is 4,600 tons and the b.h.p. but 1,000, yet the average speed for the nine months ending January 17, 1921, was 8.97 knots and the average fuel-consumption (for all purposes) was 0.38 lb. per I. H. P. or about 0.35 lb. per I. H. P. for main engines alone. The lubricating-oil consumption for all purposes, for the same period averaged 9½ gals. per day.

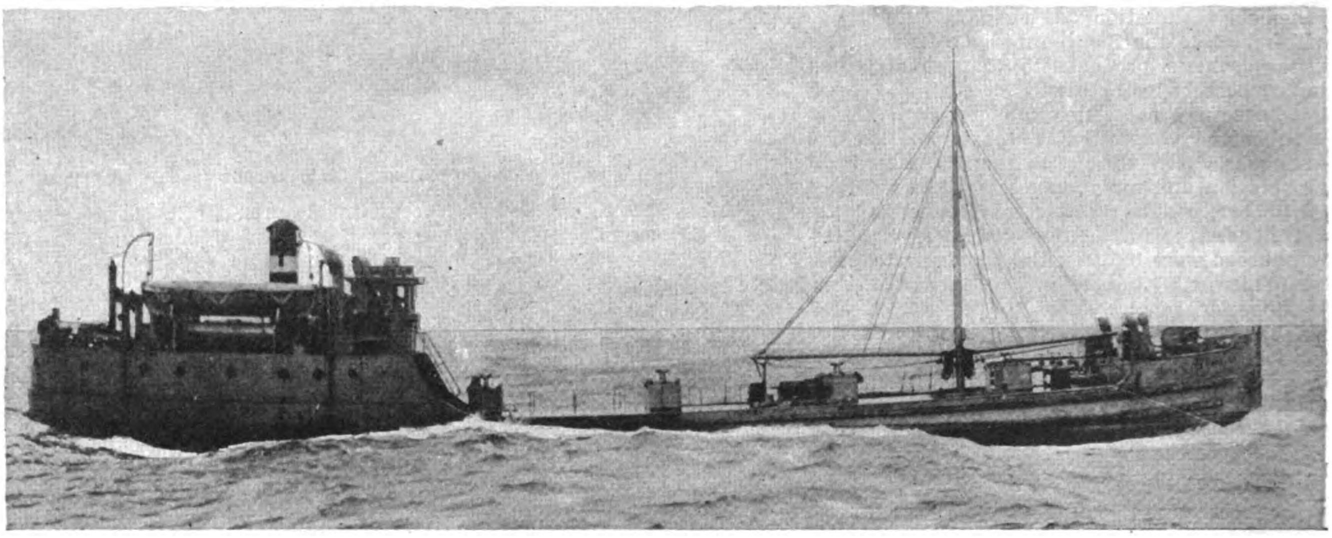
Six different types of engines have been installed in ten sizes varying from fifteen horsepower auxiliary engines to five hundred horsepower propelling-engines. The installations have been made in five different types of vessels varying from inland lighters and harbor tankers to a full-powered sea-going motorship. As a result considerable experience and knowledge has been obtained not only in regard to different types of engines operated under different conditions, but also as to suitability of the various types for certain services.

and auxiliaries are concerned these vessels are exact duplicates: "Texaco 145" has a 400 b.h.p. Craig Diesel-engine whereas the other two each have a 300 b.h.p. McIntosh & Seymour Diesel-engine. All three are miniature tankers for refined petroleum products and so constructed as to be suitable for coastwise or inland service.

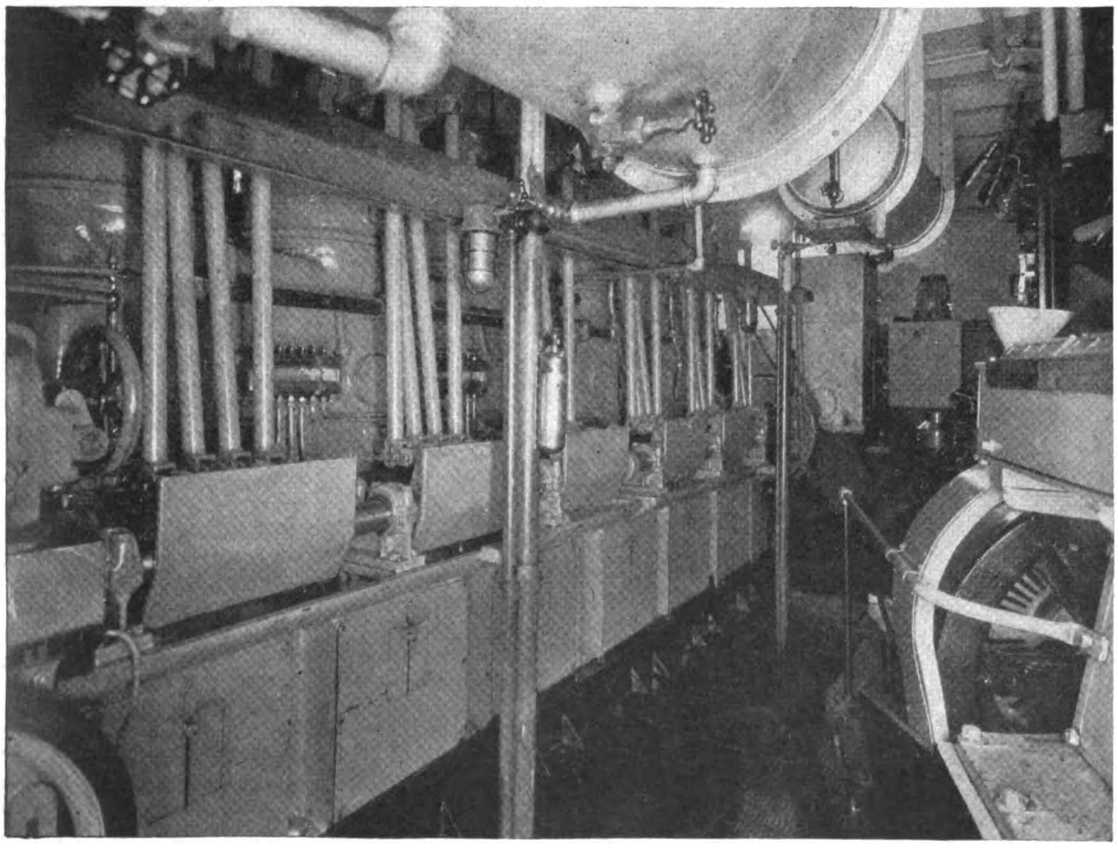
Principal Dimensions:

Length...... 152′ 11″
Beam......... 30′ 0″
Depth......... 12′ 6″
Cargo-Capacity, 5,980 bbls.

Results to date have been most satisfactory; the en-



The tanker "Texaco 145"



300 b.h.p. McIntosh & Seymour Diesel engine in engine-room of "Texaco 146."

As a result of experience gained in connection with the operation of these vessels the writer has formed a few general conclusions which probably have been verified by the experience of others. The idea that the Diesel-engine is complicated, also that an accuracy of workmanship hard to obtain is required in their manufacture, is a fallacy. With the possible exception of fuel-pumps and atomizers there is no work but which any ordinary good machine shop is capable of handling; a heavy construction, in general, being more important than super-fine workmanship.

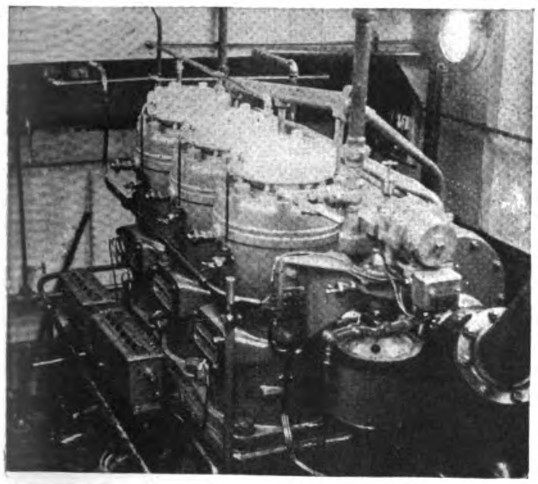
In regard to the open-type construction versus the closed-type of construction it is possible to have an engine of open-type construction which may have certain important parts less accessible than the same parts in an engine of the closed type. In other words more consideration should be given to the accessibility of cams, fuel-pumps and compressor-valves than to whether engine is of the open or closed type.

Another point that merits most careful consideration is the lubricating system. The heavy-oil used for lubrication Diesel-engines will not, in cold weather, flow freely with wick lubrication and unless continually watched and assisted by hand oiling an engine with this type of lubrication is likely to have considerable trouble with hot bearings. Where force-feed lubricators are used the viscosity of the oil in winter need not be considered, engineers are freed from this worry and bearing repairs practically eliminated. It is very important also that the lubricating system should be so designed that the oil will not become contaminated by fuel-oil leaking from the engine fuel-

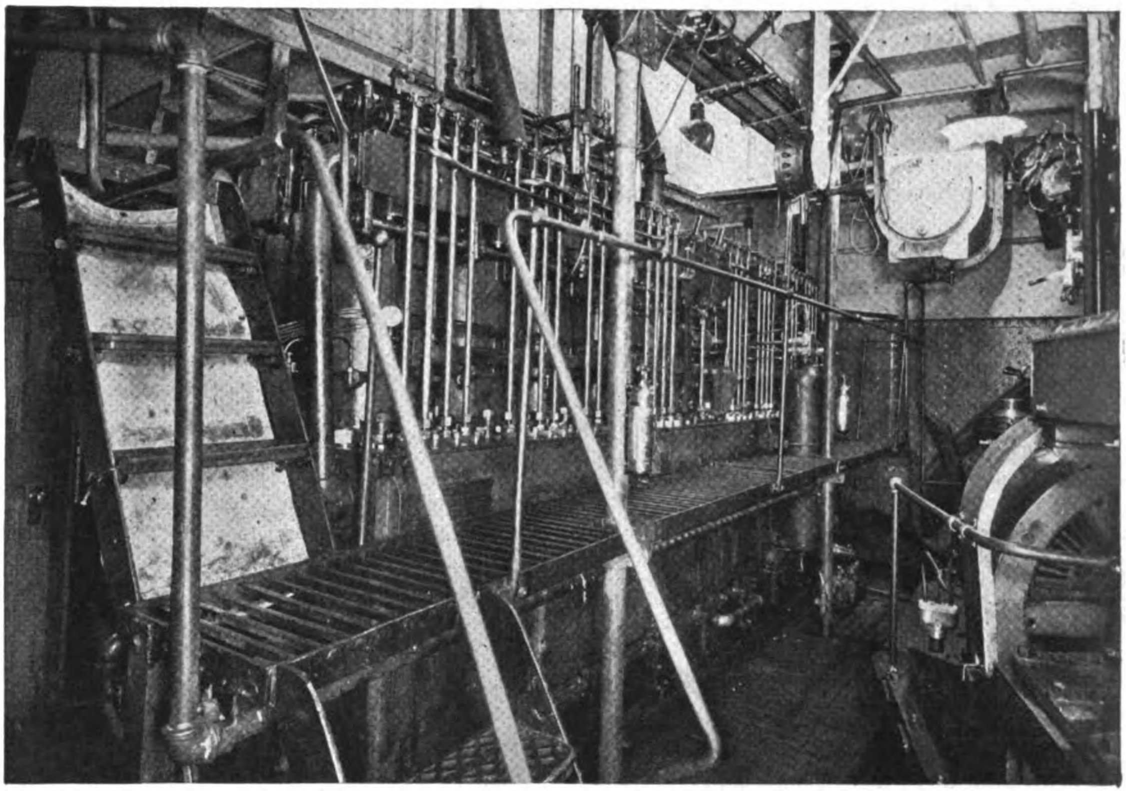
The "Alma R."

pump, or from salt water in case of a leak in the cooling system.

With engines in which but one fuel-pump is used the unit is larger and more rugged also more simple. These advantages however are more than offset by the fact that if this pump fails to function, or if there is a leak in any part of the system, the engine shuts down. In an installation where there is an individual pumping unit for each cylinder the engine can be kept running if two or three units fail.



Engine-room of "Alma R."



400 b.h.p. Craig Diesel-engine in the "Texaco 145"

Our experience to date proves conclusively that there is no basis in fact to warrant the statement that a Diesel-type engine is superior to the surface-ignition type of oil-engine for all purposes. In vessels in which the propelling-engine is not 300 b.h.p. or over, and where the trips are, on the average 24 hours or less, such as vessels used for sounds, harbors and rivers, the fuel and lubricating oil economy of Diesel-engines will not be enough to overcome the added interest, insurance and depreciation charges resulting from difference in initial cost of the two types.

Furthermore the small two-cycle surface-ignition design produces an engine of extreme simplicity, and does not require an engineer of as much experience and skill as is required by the Diesel-engine. When the engines are over 300 b.h.p., or the trips are of long duration the saving in lubricating-oil by using the Diesel-type will alone more than offset the increased overhead charges, due to the fact that with an ordinary two-cycle surface-ignition engine the lubricating consumption is generally about 250 horsepower-hours per gallon, whereas with the Diesel-type the consumption is about 3,000 horsepower-hours per gallon, a ratio of 12 to 1 in favor of the Diesel-type, which is quite a consideration.

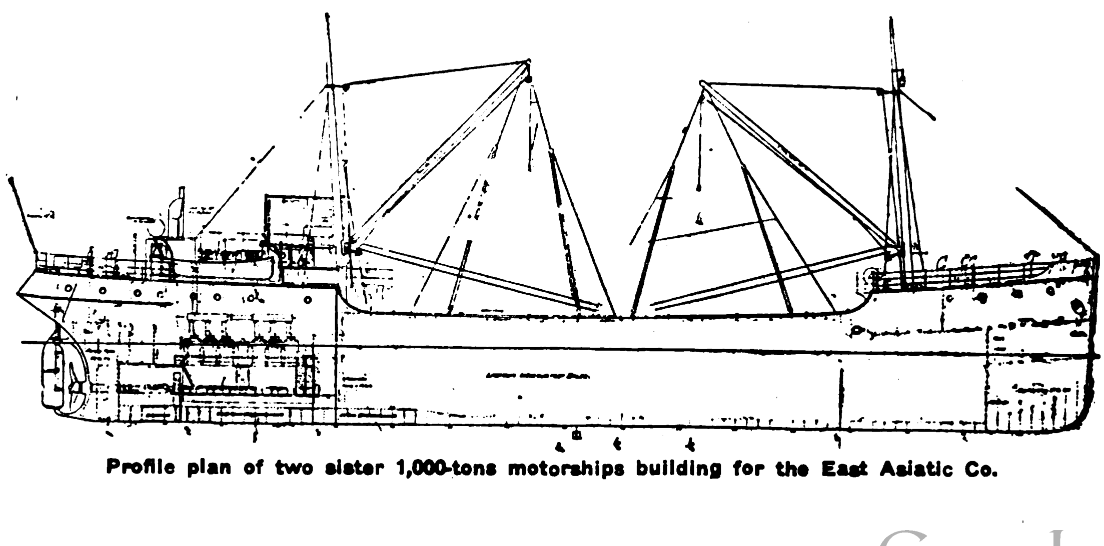
Small Motorships for East Asiatic Co.

Two Vessels of 1,000 Tons Deadweight With Holeby Diesel-Engines

REFERENCE has already been made to the three motorships that are shortly to be launched from the Nakskov shipyard, Nakskov, Denmark, and all are of interest, as they differ from the standard Scandinavian type. The two first vessels will add to the increasing number of small motorships that augment the field of motorshipping activities; both are to the order of the East Asiatic Co., and one of the latter is illustrated and described herewith. Known yet only by the yard No. 5, this 1,000 tons d.w. motorship may be employed for trade either in the Baltic or along the Siamese coast to Singapore, though no final decision has yet been made. The main dimensions are:

Length between PP	170 ft.
Breadth on frame	31 ft.
Depth	14 ft. 3 in.
Mean draught	12 ft. 10 in.
Hold capacity	41,800 cub. ft. bales
Power	560 i.h.p

The main engine is a 6-cylinder direct-reversible Holeby-Diesel four-cycle type trunk-piston motor of 14.567-in. bore and 22.441-in. stroke, developing 400 shaft h.p. (560 i.h.p.). The auxiliary machinery comprises a 2-cylinder 30 h.p. Diesel engine of same make, to which is clutched a 20-kw. generator that supplies the current for the electric deck-machinery and the light. With a friction-clutch as intermediate link, a spare air-compressor can also be driven. There also is a 6 to 8 h.p. Holeby four-cycle kerosene motor of the electric-ignition type that drives an emergency air-compressor and a ballast-pump. The main motor is a new model, force-feed and with oil-cooled trunk pistons. A three-step compressor is fitted and direct-driven pumps for cooling-water, bilge and lubricating-oil. In another publication this vessel has been referred to as a lighter, but she is a motorship. Forward, above the fore-peak tank holding 37 tons seawater, chain-lockers will be found, and the windlass with $1\frac{1}{4}$-in. chain, is driven by a 14 h.p. electric-motor. The two masts are provided with 42 ft. 3-ton derricks and an electric-winch of same lifting-capacity is mounted by each. These 3-ton winches are of the Nakskov Yard's own manufacture, they making a specialty of this machinery. The double-bottom increases in depth aft where fuel is carried, 23.7 tons being stored in the compartment below the main motor and 29 tons in the space in front of it, above which two fresh-water tanks of $2\frac{1}{2}$ tons capacity each are mounted, while the lubrication-oil is stored aft in the twin-bottom below the thrust-bearing.



Profile plan of two sister 1,000-tons motorships building for the East Asiatic Co.

PALM-OIL FUEL FOR SURFACE-IGNITION ENGINES

In tests made by the Belgian Colonial army with Drott surface-ignition oil-engines of 120 b.h.p. down to $3\frac{1}{2}$ b.h.p., palm-oil was used as fuel. It costs but 250 francs per metric-ton compared with 2000 fracs per ton for mineral crude-oil in the Belgian Congo. Fatty acids were completely burned and did not corrode the cylinders. The oil was of 16,610 B.T.U. and the consumptions registered was 310 to 557 grammes per b.h.p. hour respectively. The exhaust-gases were used to partially liquify the palm-oil. The annual exports of palm-oil from West Africa now amount to about 130,000 tons.

Conversion of the "Astmahco III" and "Astmahco IV" to Full-Powered Diesel-Ships

Two War-Time Built Freighters Made Practical and Economical Post-War Commerce Craft

By E. B. STOCKMANN, Marine-Superintendent, Astmahco Navigation Company, Inc.

SOME months ago the Astmahco Navigation Co., Inc. of New York purchased the vessels "Astmahco III" and Astmahco IV," formerly the "Lake Mohonk" and "Lake Oneida" respectively, which have recently been converted to full-powered Diesel-ships, have as a result of their conversion introduced many features which are of interest not only from the engineering standpoint, but from the aspect of economical operation as well. In order to have a clearer understanding it may be well to go into the history of these ships and their operation prior to the installation of the new power plant.

The "Lake Mohonk" and "Lake Oneida" were built by the Manitowoc Shipbuilding Corporation, Manitowoc, Wisconsin, for a Norwegian firm and were completed in the fall of 1917. At this time the United States, just having entered the war, and acting through the United States Shipping Board, requisitioned both these ships. At the time no engines had been installed. It is believed that the firm for whom they were originally intended, had in mind larger engines than those which were subsequently installed. Suffice it to say, however, that both of these ships were fitted two 320 B. H. P. engines, of the two-cycle, hot-bulb type. From the following table of specifications it will be seen that these engines—as intimated in "Motorship" at the time—were much too small for the ships in which they were installed and accounted in no small measure for the high cost of operation.

Table 1

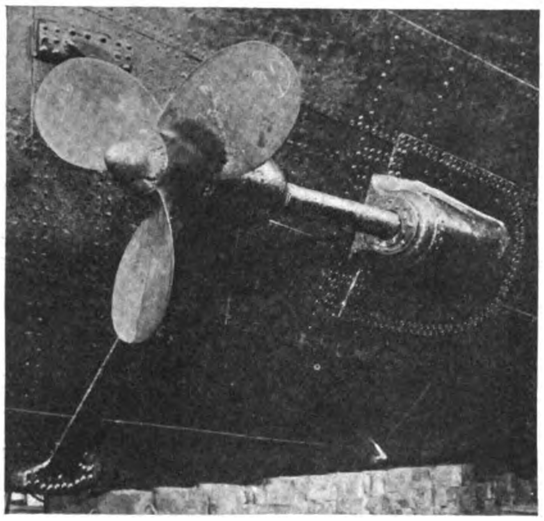
General Specifications:

1	Length O. A.	261 ft.
2	Length B. P.	251 ft.
3	Breadth moulded	43 ft., 6 in.
4	Depth moulded	23 ft.
5	Mean draft loaded	20 ft., 2 in.
6	Deadweight tonnage	3,600 tons
7	Gross tonnage	2,124 tons
8	Net tonnage	1,667 tons
9	Block co-efficient	0.72

Before their acquisition by the Astmacho Navigation Co., these vessels were under the operating management of the Clyde Mallory Steamship Co. But it was not long before it was found that the speed which could be obtained was so small and the fuel and lubricating-oil consumption so high relative to the speed, that economical operation with the power available was doubtful. As a consequence, both ships were tied up until the cessation of hostilities, when they were purchased by the present owners. It was decided at once to install two 500 B.H.P. McIntosh and Seymour Diesel-engines, but while waiting for the delivery of the engines the ships were operated with their original engines. Under favorable conditions of wind and weather a speed of approximately 5 knots with a fuel-consumption of 0.56 pound per B.H.P. per hour was made.

ORIGINAL EQUIPMENT

The "Astmahco III" and "Astmahco IV" while they were called motorships, nevertheless depend-



Depicting the arrangement of propeller bracket, and hull connection

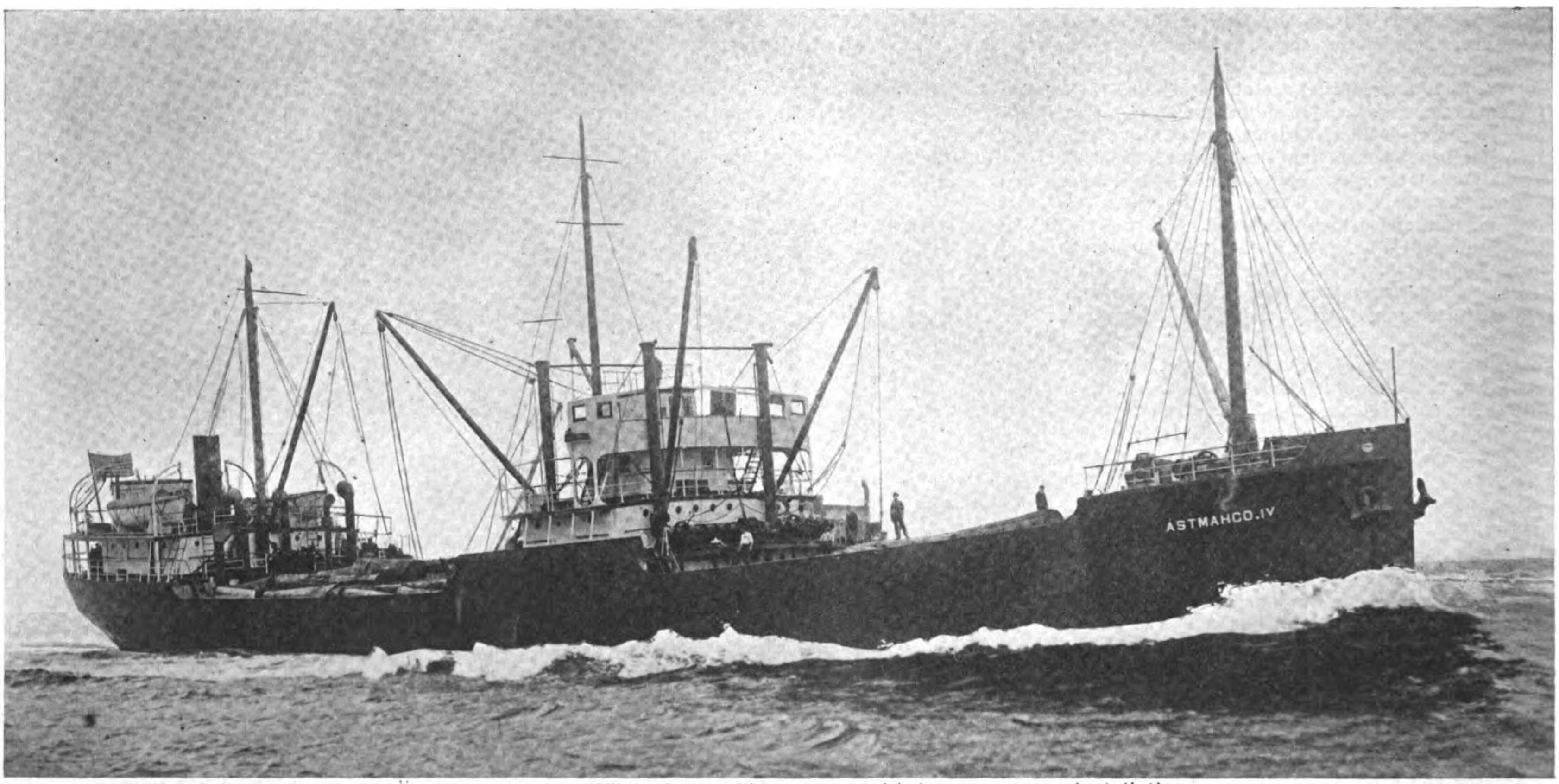
ed at sea for her auxiliaries upon a small donkey-boiler of the Scotch type, oil-fired, using the Dahl system. This boiler supplied steam for taking care of the various pumps including bilge, fire, general service, circulating-water, fuel-oil transfer, combined air and circulating-water, and a steam steering-gear, besides the deck-winches, capstan and anchor-windlass. In order to provide additional ventilation to cool the engine-room down to somewhat near normal temperatures, an electrically-driven American blower was installed with air-ducts passing around and between the engines and admitting cool-air through deflecting cones at different points. An Engberg 7½ K.W. steam-driven generator and a 12½ K.W. Sturtevant electric-generator supplied current for the blower, wireless alternator and lights. The remaining equipment consisted of one steam-driven Brunswick one-ton ice-machine, and one Wheeler surface-condenser, having a cooling-surface of 200 square-feet.

CHANGES IN HULL STRUCTURE

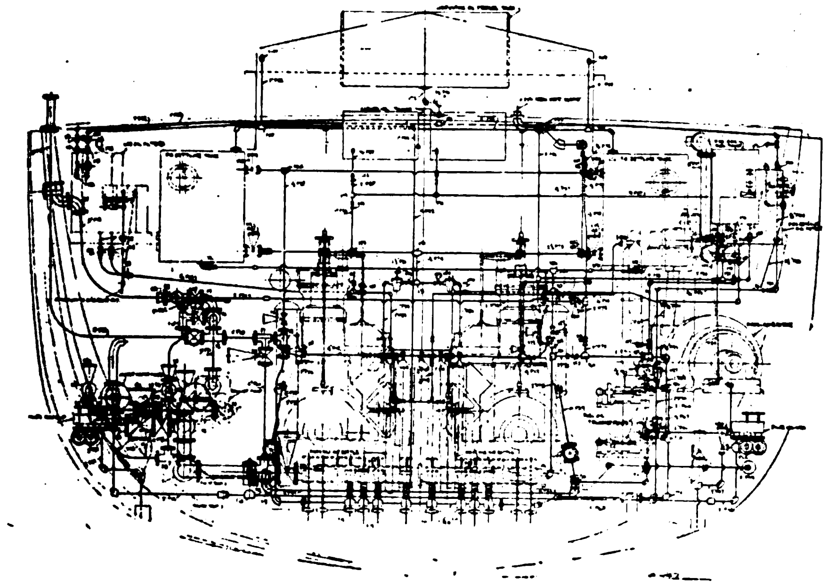
Installation of the McIntosh and Seymour-Diesel engines introduced two principal changes in the hull. First, in order to accommodate the length of the engines, the forward engine-room bulkhead had to be moved ahead eight feet. Second, in order to put on larger propellers the distance between center lines of the engines had to be increased. The forward engine-room bulkhead was removed in as few sections as possible and the old engines were then rolled out into the No. 2 hold and hoisted-up through the hatches. The remaining machinery was removed in the same way, such as was to be used again being stored in the No. 2 hold and the balance taken away from the ship.

As soon as the engine room was clear, the work of putting in the engine foundations began. These foundations were built directly on top of the No. 5 tank top-plating and consisted of a bult-up girder of the conventional H section. The upper and lower plates and the web are of ⅝ in. material and the angles are 6 in. x 3½ in. x ⅝ in. and 3½ in. x 3½ in. x ⅝ in., the longer flange on the former being necessary for bolting down the engine bed. Two such girder sections are used for each engine and both girders are suitably connected with 8 in. channels and fastened with 6 in. x 6 in. x ½ in. x 6 in. clips.

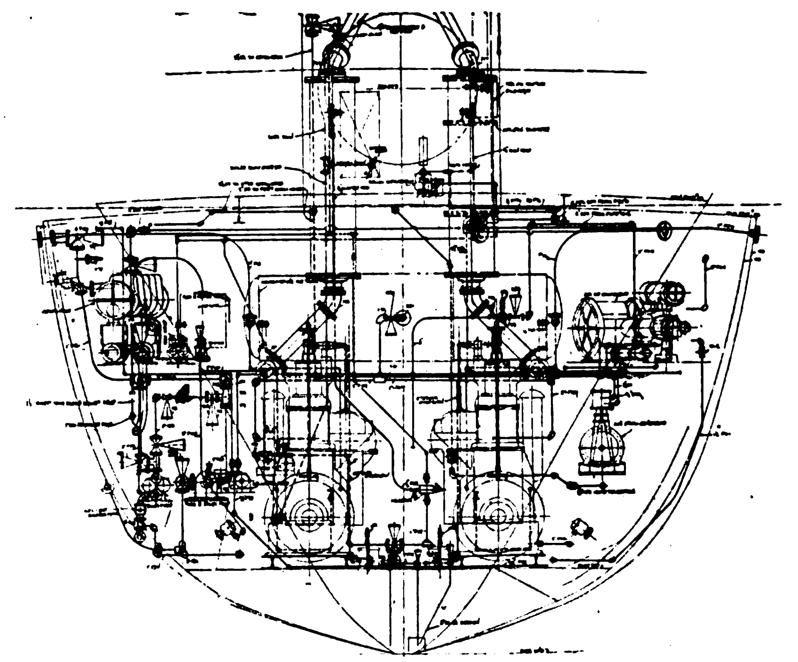
The distance between centers of the engines is 10 ft., 6 in., and the engine room is 36 feet long extending from frame 97 to frame 115. From the inside of frame 115 and extending through frame 118 a cast-iron stern-tube is fitted which in turn passes through a large cast-iron shaft-boss. This boss is fitted with a flange and webs, the former riveted to frame 118 and the outboard web to the hull plating. The after end of the stern-tube is threaded and a forged-steel nut fitted which brings



Motorship "Astmahco IV" on her maiden voyage with her new power installation



M.S. "Astmahco IV." Section at forward end of engine-room



M.S. "Astmahco IV." Section at after end of engine-room

up against the shaft boss. Lignum vitae is provided as the bearing material which is fitted inside a composition bearing and held in place from without by the usual form of composition bearing-ring. Riveted to the boss and to the hull plating is the large boss plating. The work of bending this plate and fitting it in place called for very accurate work on the part of the plate shop and reflects considerable credit to the Vulcan Iron Works which carried out the re-conditioning. The struts are of the usual form made of cast steel and having the upper palm riveted at frames 123 and 124 and the lower palm to the keel. In this connection it may be mentioned riveting for the lower was done with fitted rivets. The rivets were force fitted and then merely heated at the end and riveted in place. The reason for this is obvious when it is borne in mind that the rivets were 13 inches long and 1¼ inches in diameter. The shaft-boss and plating, outboard strut-bearing and propeller are shown in one of the drawings.

A new bulkhead at frame 97 was constructed in the same manner as the old forward engine-room bulkhead at frame 101. As much of the old plating as could be was used, such additional plating and stiffeners as required being fitted in accordance with requirements. Stiffening brackets were provided on both sides of this bulkhead under deck and very substantial brackets on the hold side at the bottom. The details of line-shafting are shown in another drawing.

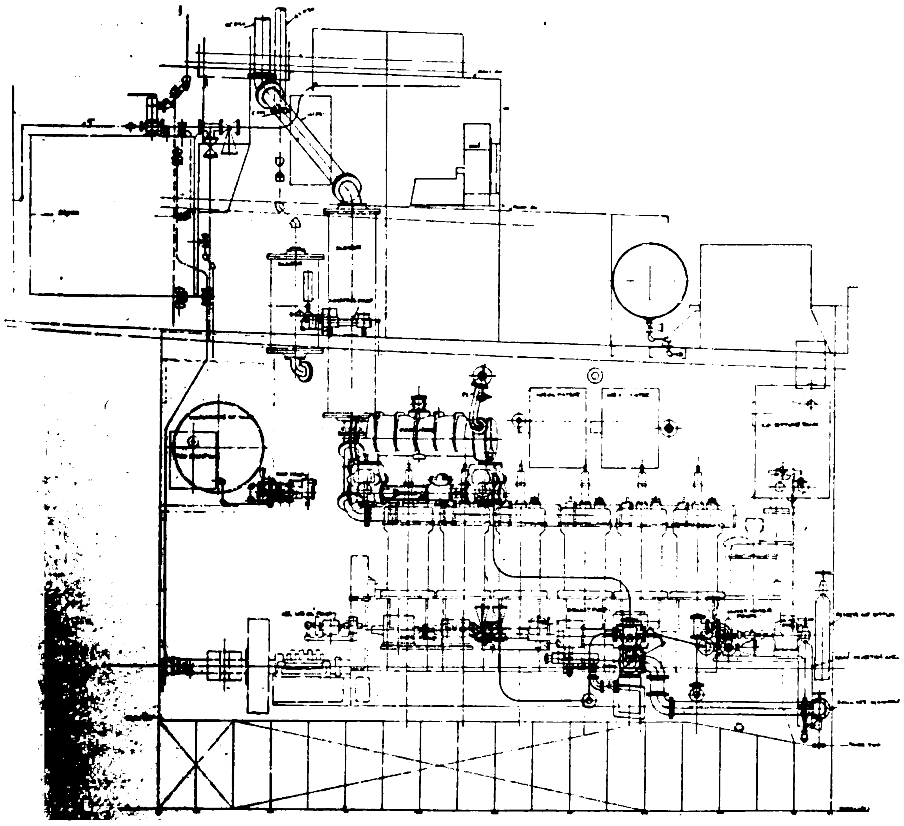
MACHINERY AND EQUIPMENT

As before stated the new main power plant for the "Astmahco III" and "Astmahco IV," consists of two 500 B.H.P. McIntosh and Seymour engines. These engines are fitted with horseshoe thrusts and transmit their power through a 9 in. shaft to cast-bronze propellers 8 feet in diameter and 6 ft., 5 in. pitch. Each engine has six cylinders 16 in. diameter by 24 in. stroke and has a normal speed of 190 R.P.M. A three stage air-compressor is fitted to each engine and is directly conneeted to the main engine crank-shaft. The capacity of each compressor is almost sufficient for both engines should one become disabled for any reason. An auxiliary steam-driven Bury air-compressor 8 in. x 10 in. x 5½ in. x 8 in., capable of producing 75 cubic-feet of free air per minute and an ultimate pressure of 1000 pounds per square-inch is also provided.

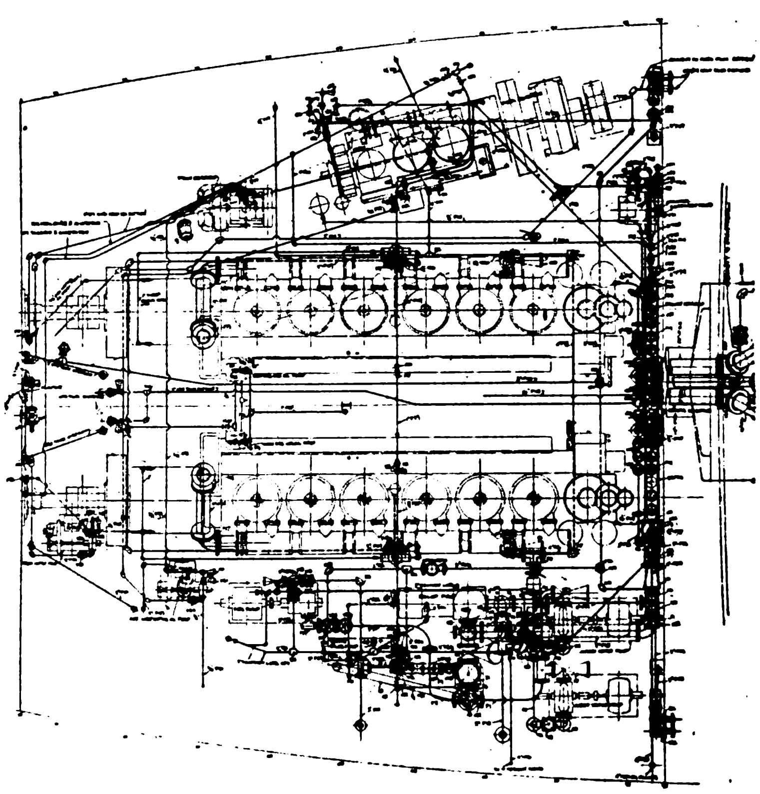
The general layout of the engine-room is shown the drawings. On the starboard side lower level are two Gould centrifugal circulating-pumps direct-connected to General Electric motors. Directly aft of this is a main bilge-pump which is also connected for use as a circulating pump. Following this in order are a small auxiliary steam bilge-pump, a three-stage Gould centrifugal fire and general-service pump direct connected to a General Electric motor, a Kinney rotary-piston lubricating-oil pump motor-driven through gears, and then a small Kinney rotary-piston fresh-water pump, Morse silent-chain drive.

On the port side lower level are located the electric-generating units. These consist of one Sturtevant steam-driven generator of 10 K. W. capacity and one 100 H. P. two-cylinder Diesel-engine direct-connected to a General Electric 70 K. W. generator running at 260 R.P.M. While inport loading or discharging when steam is used for the winches the former is used; at sea no steam is used at all and the larger unit supplies power for all pumps and auxiliaries including the Hyde hydro-electric steering-gear. It may be mentioned in passing that the Hyde steering-gear is one of the latest type of electric steering-gear. The operation of the valve for this gear is not done electrically, but directly through shafting and gearing from the pilot-house. A 10 H. P. electric-motor furnishes power for the pump supplying the hydraulic medium to the ram cylinders.

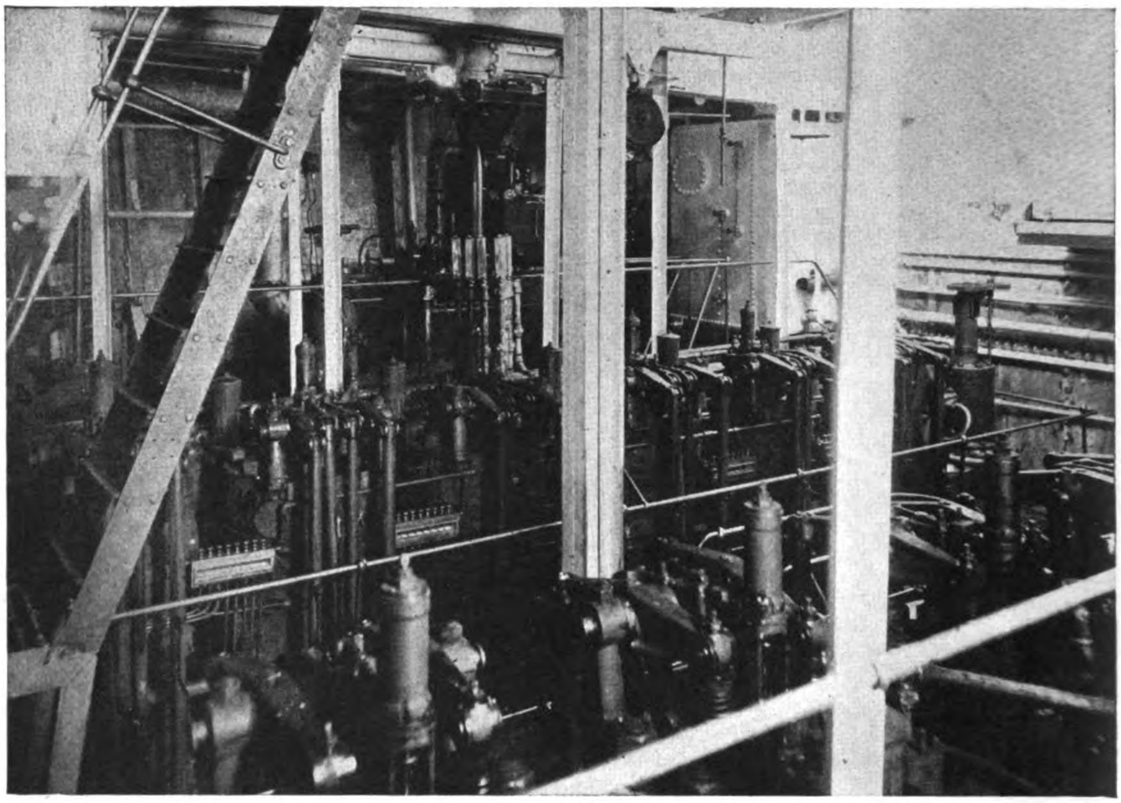
Alongside the bulkhead lower level are two Kinney rotary-piston type fuel-oil transfer pumps, Morse silent-chain drive from Robbins and Meyers electric-motors. Situated against the bulkhead is



M.S. "Astmahco IV." Arrangement of main Diesel-engines



M.S. "Astmahco IV." Engine-room plan



Engine-room of the "Astmahco IV" showing twin 500 shaft h.p. McIntosh & Seymour Diesel-engines

the ballast manifold which communicates with the double-bottom tanks carrying fuel-oil.

Starting from the starboard forward end of the upper level, there are located the engineers store-room, settling-tanks for fuel-oil, Richardson-Phoenix lubricating-oil filters fitted with Cutler-Hammer heating-coils; Alberger surface-condenser of 400 square-feet cooling-surface capacity; fitted Dean combined air-and-circulating pump size 7 in. x 9 in. x 9 in. x 10 in.; Worthington steam-boiler feed-pump size 5¼ in. x 3½ in. x 5 in., and a hot well. Alongside the after bulkhead is the large maneuvering air-tank capable of holding air at pressure of 300 lbs. per square-inch.

On the port side upper level are located the Bury auxiliary air-compressor. Next to this comes the 100 H. P. auxiliary Diesel engine projecting up from its foundation on the lower level, together with its air-bottles. A smaller Richardson-Phoenix lubricating-oil filter for this engine is situated alongside, and beyond the engine are the switchboards and another fuel-oil settling-tank. On the forward bulkhead directly under the engine-room skylight are located two kerosene tanks for use when starting and occasionally when stopping the engines. The larger of the two switchboards is designed to carry the load of the units handled by the large generator and distribution is made from the board to the electrically-driven pumps, steering-engine and lubricating-oil filters. The smaller switchboard is connected to the smaller generator and distribution from this board is made for the lighting circuits, wireless charging, etc. A double-throw switch is mounted below the large board for connecting the circuit from the Sturtevant generator to the steering-engine circuit on the large board. This is used in case the large generator is shut down at sea for any reason.

The boiler-room floor is on the main-deck level and in this space are a Blake and Knowles fuel-oil pump for the donkey-boiler; three McIntosh and Seymour silencers, two for the main engines and one for the auxiliary engine are located here. The silencers as well as all exhaust piping to and from the silencers is covered with 85% Magnesia, and the whole covered with galvanized sheet iron.

The American blower is located above the engine-room grating on the poop deck level, and takes air through the forward bulkhead and delivers it directly down into the engine-room. The lubricating-oil tank is placed on deck amidships directly aft of the engine-room skylight and is fitted with steam coils for heating in cold weather.

The Brunswick Ice Machine has had a gear fitted to the flywheel of the steam-engine connecting by means of silent chain to a sprocket on a 3 H.P. General Electric motor. When running without steam, the connecting-rod is disconnected.

One important addition to the engine-room was the placing of a hinged skylight over the forward end. Besides providing additional ventilation, the additional light which is admitted is very considerable.

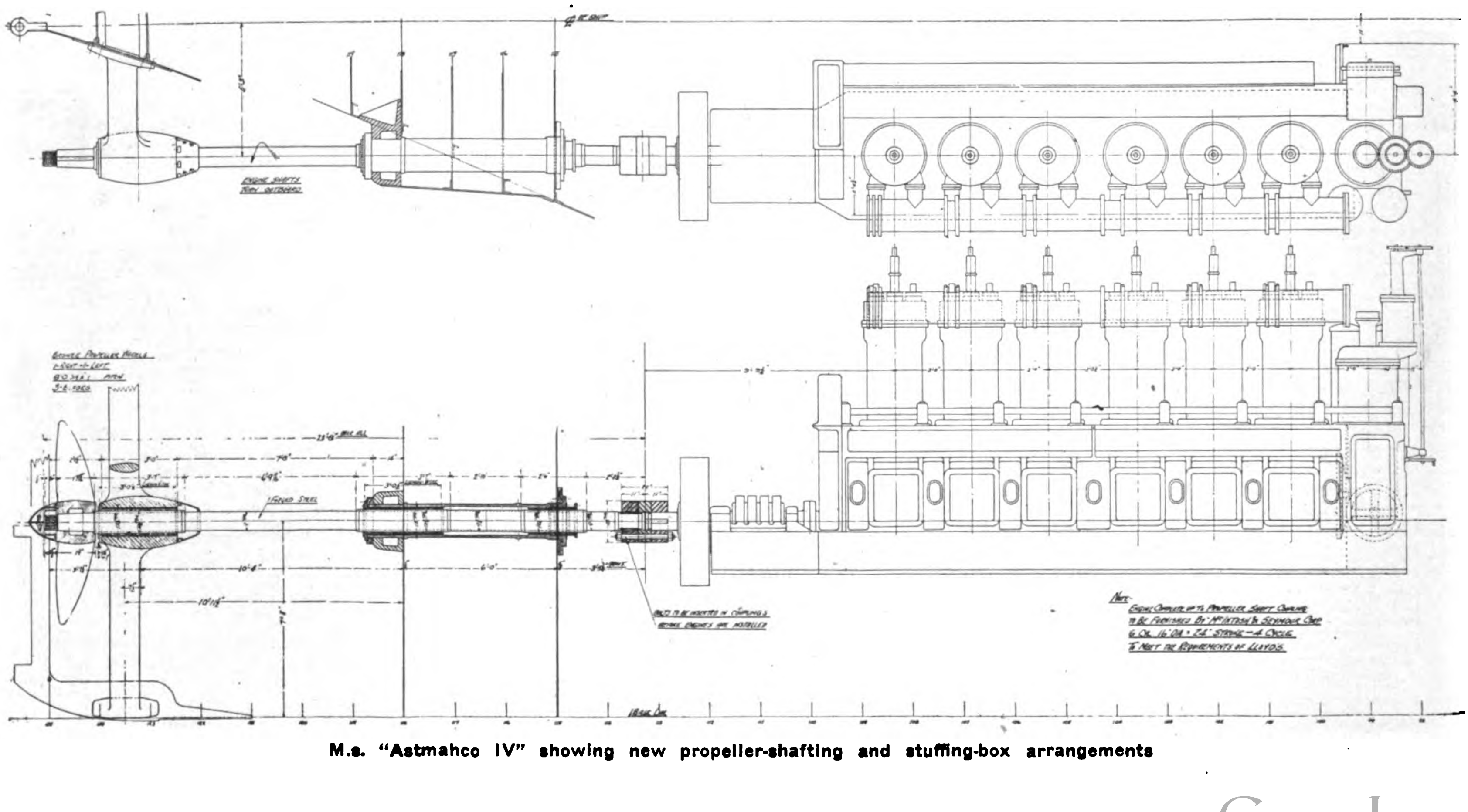
The sea trial of "Astmahco IV" was made on March 15, 1921, but owing to very heavy fog in the lower harbor, no extended speed trials could be obtained. Nevertheless, a very good opportunity for witnessing the ability of the engines to maneuver presented itself. A total of 253 bells was answered during a period of approximately 6 hours. A short speed run up the Hudson indicated a speed of about 10 knots running at 195 R.P.M. in the light condition. The more important data collected on this trip are given in Table III.

Since the trial, the "Astmahco IV" has made her first voyage to Mexico with the new engines. An average speed of 9 knots was obtained running for the most part of 170 R. P. M. with a fuel-oil consumption of *four tons* per day.

In summing up, it may be pointed out that these possess the following distinctive advantages:

1. Full-Powered Diesel propulsion.
2. Low fuel-oil consumption.
3. Independence of steam at sea.
4. Compact power space.
5. Decrease in size of engine-room crew.
6. Perfect maneuvering flexibility.

It would not be quite fair to conclude this brief description without making acknowledgement to those who were associated in carrying out the work of installation. In this connection, special mention must be given to the Vulcan Iron Works and their staff. The material and workmanship that has gone into these ships is of the very highest order, and the organization adheres to the traditions exactness and rigid rules of older American and European practise. The work of assembling and installing the main and auxiliary Diesel engines was done under the direction of Mr. Hugo Haas, erecting engineer for McIntosh and Seymour, also chief-engineer of the "Astmahco III." To the many other engineers who were associated with the author in this work, including Chief-Engineer Peter Elduck of the "Astmahco IV," his thanks are extended.



M.s. "Astmahco IV" showing new propeller-shafting and stuffing-box arrangements

Data on Sea Trial of M. S. "Astmahco IV"

Time	R. P. M. Port Engine	R. P. M. Starb'd. Engine	Port Engine			Air Starting Tank	Starboard Engine			Temp. Cir. Water Disch. Main Engs.	Temp. of Oil in Filter Main Engs.	Diesel Generator				Boiler Press	Vacuum	Pressure of Oil at Boiler	Steam Air Compressor	Port Electric Cir. Pump	Starboard Electric Cir. Pump	Steam Fire Pump	Auxiliary Bilge Steam Pump	Main Bilge Pump
			Injection Air	Air 2nd Stage	Air 1st Stage		Injection Air	Air 2nd Stage	Air 1st Stage			Injection Air	R. P. M.	Volt	Ampere									
10:02	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Start	...	...	...	...	...
10:10	...	...	...	...	...	...	...	...	...	...	...	...	Star	ted	...	...	...	...	...	...	...	...	...	...
10:20	192	194	975	180	50	295	1010	230	40	...	...	1000	256	112	250	124	1	58	...	Start	...	Start	...	...
10:40	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Stop	...	Stop	Start	...
10:45	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Start
11:15	...	...	...	...	...	...	...	...	...	...	...	...	260	112	200	...	...	...	...	...	Start	Start	...	Stop
11:20	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Stop	...	...	...	...	...
11:30	198	198	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Stop	...
12:00	Half	Speed	800	175	50	280	850	225	40	...	...	820	...	...	...	...	...	...	Start	...	...	Stop	...	...
12:15	...	...	...	...	...	...	...	...	...	...	...	...	256	112	220	...	...	...	...	...	...	...	...	...
1:10	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Stop	...	...	...	...	...
1:15	...	...	...	...	...	...	...	...	...	...	...	...	256	112	170	...	...	...	...	...	...	...	...	...
1:20	192	188	990	210	62	305	1010	320	70	110 to 125	...	1000	...	...	...	115	2	55	...	...	...	...	...	...
1:37	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Start	...	...	...	...	...
2:15	...	...	...	...	...	...	...	...	...	...	...	...	260	112	190	...	...	...	...	...	...	...	...	...
2:30	200	196	1010	220	62	250	1090	310	60	85 to 105	80	1010	...	110	138	120	2	60	Stop	...	...	...	...	...
3:00	200	194	990	200	62	300	1010	180	30	85 to 105	...	1010	...	110	138	126	1	65	...	...	...	...	...	...
3:15	...	...	...	...	...	...	...	...	...	...	...	...	256	110	110	125	0	60	...	...	...	...	...	...
3:30	200	194	1000	220	62	...	1020	175	30	70 to 110	80	1020	...	111	138	...	...	...	...	...	...	...	...	...
3:45	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Start	...	...	...	...	...
4:15	...	...	...	...	...	...	...	...	...	...	...	...	260	110	90	...	...	...	...	...	...	...	...	...
5:00	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Stop	...	...	...
5:15	...	...	...	...	...	...	...	...	...	...	...	...	260	110	50	...	...	...	Stop	...	...	...	...	...
6:00	...	...	...	...	...	...	...	...	...	...	...	...	Stop	ped	...	...	...	...	...	...	...	...	...	...

STARTING AIR TANK

Drop of pressure with aux. air compressor stopped

281 to 271 to start 2 engines.
271 to 252 full ahead to full astern 2 engines
252 to 248 full ahead to full astern 1 engine
248 to 240 to start 2 engines

MANEUVERING ON SEA TRIAL

Port engine	118 bells
Starboard engine	135 bells
Total	253 bells

Air-Injection or Mechanical-Injection

By J. L. CHALONER

Part IV—Conclusion

(*Continued from page 311, April issue*)

Exhaust temperatures are also very useful in drawing up comparison regarding the relative degree of combustion for the two systems, and whilst the following table is recorded for purposes of general comparison, the actual values must be taken with a certain amount of reserve. Position of the recording instrument in the exhaust-line, the number of cylinders, the cooling arrangement of both exhaust-valves and exhaust-pipe, are all factors which influence the actual temperature. The ideal method would be to design an experimental engine, in which all conditions could remain unchanged except, of course, the method of fuel-injection. Experiments should be made with the same class of fuel.

EXHAUST TEMPERATURES

Horse-Power per cylinder	Degrees Fahrenheit Air-injection.	Mechanical-injection
40	....	620
50	585	....
80	700	730
115	....	755
125	800	....
150	840	....

Fuel-consumption has, of course, also an effect on the degree of combustion, and gives an indication of the relation of the degree of combustion to the load on the engine. Air-injection consumption increases with a decreasing load owing to the present form of fuel-valve design. The consumption, therefore, increases in an inverse proportion to the load, and in fact the tests have shown that the rate of increase in the fuel-consumption below five-eighth load is more rapidly with air-injection than with mechanical-injection.

It is proposed to give a series of actual tests in some other discussion to be published at a future date, when several series of tests have been completed and analyzed. For the present let it suffice to state that for cylinders up to a rating of 80 b.h.p. per cylinder the fuel-consumption is about 5% in favor of mechanical-injection, and for powers of 125 b.h.p. per cylinder and over the reduction is up to 7½%. On the indicated horse-power rating the relation was not as favorable, which indicated the limitations of the present mechanical injection method. However, it should be remembered that the laws of progress will help to remedy any discrepancy in this direction.

A recent test on a 260 b.h.p. engine has resulted in a fuel-consumption of 0.40 lb. per b.h.p. being attained, the fuel-oil used being about 0.90 specific gravity. At half-load the consumption had only increased to 0.43 lb. per b.h.p., which shows the remarkably low increase of fuel used over a comparatively wide range of load.

General Practical Notes

With the above it has been attempted to deal at length with some of the more important thermo-chemical and thermo-dynamical relations, which exist inside a heavy-oil engine generally, and the fuel-valve and combustion-chamber in particular.

In dealing with the design of a mechanical-injector, it should be remembered that the essential point is not so much a question of a perfect spray, but a complete atomization. The spray has, of course, been applied successfully, but from an economy point of view, there was one apparent draw-back. A well-designed engine should be capable to deal with as wide a range of fuels as possible, and with that object in view, an atomizer is more effective than a sprayer.

Again, for starting-up the cooling effect of the injection-air has a retarding influence on a prompt ignition, whilst with the direct injection no difficulty is experienced in bringing the first part of the fuel-charge in immediate contact with the hottest zone inside the combustion-chamber, hence a positive ignition is ensured.

Again whilst the injection of the fuel with the air method may be classed under two distinct operations, i. e., fuel-pump deposits requisite amount of fuel in fuel-valve casing; fuel-valve controls the actual injection period, the fuel-pump of the mechanical system has both the fuel-charge and the injection period under control. Such an arrangement is of decided advantage particularly in the case of a fuel-valve sticking up, when in the case of air-injection the compressed-air will cause excessive pressures.

Variable injection-pressure in relation to the load is still a necessity with present-day designs, although more or less successful constructions have been applied to control either mechanically or even electrically the air-pressure relative to the load. The rate of injection depends on the pressure difference between the fuel-valve casing and the combustion-chamber, and only a slight increase in the combustion-pressure will influence this rate, when using the air system, whereas with the other system the pressure difference is fundamentally so much higher, that a slight variation in the combustion-pressure has no effect on the rate of injection.

Generally speaking, it can be stated that with air the opening phase of the injection period requires the closest attention to provide correct mechanical and thermal conditions. On the other hand the mechanical method demands that specific attention be paid during the closing phase of the injection period, so that no "after-drip" may occur and interfere with the highest possible degree of combustion. The problem connected with the after-drip is of primary importance with a simple mechanical-injection device, and its solution will bear an important relation to the general development of this type of engine.

Actual design of the nozzle for direct injection is also still the object of careful examination. As already shown, the leading dimension of the fuel-orifices in the nozzle or flame-plate are somewhat delicate proportions and difficulties have been experienced when using the conventional designs in connection with the burning of heavy residual-fuels. The actual fuel-pump pressure is also still a matter of much experimental investigation. The high pressures, which are said to be used in connection with the mechanical system, are certainly not as essential as it has been made out to be, and tests so far made show that a combination of medium compression-pressures and injection-pressures are quite sufficient to give satisfactory running results.

There is no doubt that with mechanical-injection there are still various points which require the closest attention in order to ensure that an engine running on this system shall be in every respect as reliable, flexible and economical as the engine using the air-injection principle. On the other hand, the surface-ignition oil-engine uses mechanical-injection, has proved its practical utility for a number of years.

It is of no moment that most of the leading continental oil-engine manufacturers have attempted unsuccessfully to solve the problem of "Mechanical Injection." In the first instance the testing plant of leading manufacturers consisted generally of a small or medium powered unit. As mentioned before, the conditions for mechanical-injection become more favorable with larger powers, a condition which has to a large extent retarded the completion of the experimental work. The perfection of the two-stroke engine, the practical construction of a 400 B.H.P. per cylinder unit, are all factors which will help to solve the problem.

FINIS

NEW ITALIAN 4,500 I.H.P. MARINE DIESEL-ENGINE

We have before us drawings and details of a new high-powered merchant-marine Diesel-engine to be built by Ansaldo San Giorgio of Turin, Italy. This engine has six cylinders 730-mm. (28.740 in.) bore by 1,050 mm. (41.338 in.) piston-stroke, and develops 4,500 i.h.p. at 120 r.p.m. But this engine can operate with an overload and develop 5,200 i.h.p. (4,000 shaft h.p.) at 130 r.p.m.

An interesting feature is the construction of the crankshaft in three sections. Although the scavenging-pump air-injection and manoeuvring air-compressors, also the cooling and lubricating pumps are driven off the main engines direct, the fuel-consumption is only 183 grams (0.405 lb.) per shaft h.p. hour, or 0.312 lb. per ind. h.p. hour. This is probably the lowest consumption yet claimed for a two-cycle Diesel engine. An article will be published very shortly.

From Sailing-Vessel to Full-Powered Motorship

Conversion of the "Caupolican," ex-"Poseidon," to Oil-Engine Power at a South American Port.

BY ALL the laws of progress the old iron sailing-ship hulk "Caupolican," ex "Patria," ex "Poseidon," should have gone to the happy hunting-ground of good ships long ago; but, through the foresight of the Chilian firm of Broquez y Cia of Valparaiso, she has been converted to an economical full-powered passenger and cargo ship and is now attracting favorable comment along the South American Coast. Two

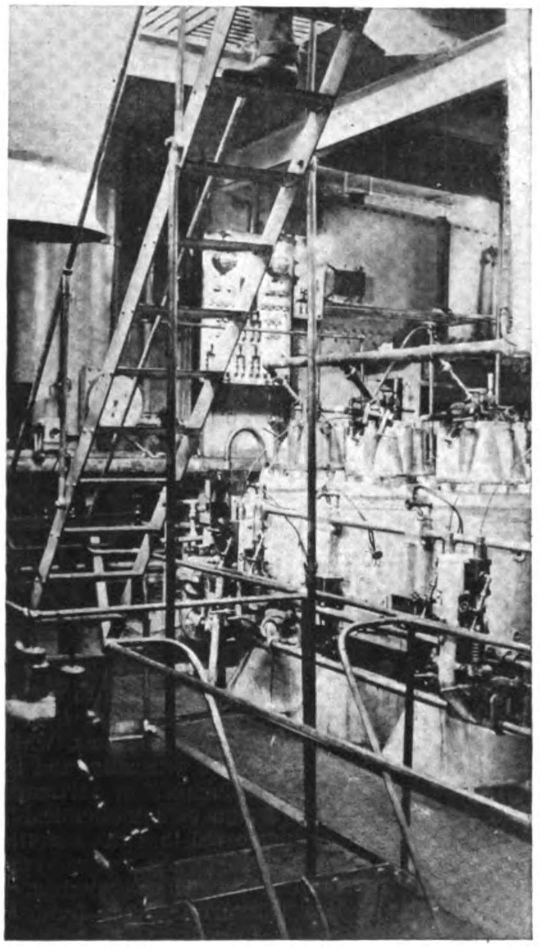
Bow view of the 1,200 shaft h.p. Chilian motorship "Caupolican"

600 b.h.p. Sumner heavy-oil engines of the surface-ignition type have been installed aft, and these give the craft a speed of 11 knots on a fuel-consumption of 5 tons per day. Her dimensions are as follows:

Cargo-Capacity	2,800 tons
Length	264 ft. 6 in.
Breadth	39 ft. 8 in.
Depth	25 ft.
Draft	21 ft.
Passenger Accommodation	28 first-class
Power	1,200 shaft h.p.
Daily fuel-consumption	5 tons

As a sailing-ship she originally carried about 3,000 tons of cargo, but had a variable and indefinite speed, but now she carries 500 tons less freight, has a definite and better average speed, while the added passenger-quarters more than compensate in income what is lost in space. Also she is manned almost as cheaply as when a full-rigged German ship, taking all things into consideration. So material benefits are resulting from the conversion. Her present crew consists of 45 officers, engineers and men. On her maiden voyage a cargo of coal was carried.

Through the courtesy of Reg. Brett, Chief-Engineer of the vessel, we are enabled to give the interesting information about this vessel. Mr. Brett



Engine-room of the motorship "Caupolican," showing part of one of the twin 600 shaft h.p. Sumner oil-engines

is an engineer for Gaston, Williams & Wigmore of New York and Valparaiso, and was sent down to superintend the work on the ship and to get her into shape, as the original work of installing the first part of machinery had not been very satisfactorily carried-out. Upon inspecting the preliminary work on the installation he found that the engine-bases were in, as well as the shaft and stern-tubes, but they were out of line, and things generally were hardly shipshape. The stern-tubes had been put-in with the hull in the water, working from the engine-bases back. They had to be relined and two new plates inserted in the after bulkhead. All this had to be carried-out with the vessel in the water with her bow weighed-down seven hundred tons of rocks and moored in an open bay, often so rough that the workmen could not be sent home at night. At other times they could not reach the ship in the mornings.

The twin 600 b.h.p. Sumner oil-engines are of the surface-ignition type with open crank-pits, crossheads and guides, and were constructed in Seattle, Wash. Mr. Brett says that he found them remarkably free from vibration and they maneuver with the greatest of ease. Full-speed ahead to full stern is carried-out in from 8 to 10

Left to Right—Chief-Engineer R. H. Brett; Captain Nicolas Urrutia, and First-Officer Valentin Broquez of the motorship "Caupolican"

seconds after receiving the bell from the bridge. By use of an electric-heating device which he designed and made in Valparaiso, these engines can be started from cold instantly and with a greater degree of surety than obtained even with a Diesel-engine in cold weather.

For auxiliary power in the engine-room there is a 25 b.h.p. Fairbanks-Morse horizontal oil-engine connected to a Sullivan air compressor; a 12 b.h.p. Robey oil-engine driving an electric dynamo; a 5 b.h.p. French-built gasolene motor operating another dynamo. Then there is a 3 kw. Delco electric-lighting set which gives perfect satisfaction. It is Mr. Brett's intention to remove the British and French engines and install three more Delco sets.

The engine-room crew consists of Chief-Engineer Reginald Brett; three student engineers, three greasers and three wipers, none of whom had previously seen an oil-engine. A number of trips have been made, without even an "overly" hot-bearing, or any of the "troubles" often met with in a new installation. The cast-iron propellers, however, are unsuitable as the slip often runs from 40 to 50% and never under 20%. With a good set of bronze-propellers Mr. Brett believes that 1½ to 2 knots better speed would be gotten from the installation. We understand that Chief-Engineer Brett is anxious to utilize his experiences gained with getting this vessel in shape by undertaking a similar task on the behalf of some American shipowner who has a vessel that needs converting, and would return to the States for that purpose.

MOTORSHIP "MALIA" LAUNCHED.

The twin-screw passenger and cargo motorship "Malia" was launched on March 8th at the yard of Wm. Hamilton & Co., Port Glasgow, Scotland. She is specially interesting by reason she will be powered with two 500 shaft h.p. Cammellaird-Fullagar opposed-piston Diesel engines. Her dimensions are as follows:

Deadweight capacity	5,800 tons
Length	315 feet
Breadth	50 feet
Depth	27¼

Her owners are the Anchor-Brocklebank Line (T. & J. Brocklebank) of Liverpool, England.

Instead of equipping the "Malia" with twin 1,000 shaft h.p. engines, two 500 shaft h.p. Cammellaird-Fullagar Diesel engines will be installed instead, by order of the Anchor Brocklebank Line managers, and the higher-powered sets will go in a larger motorship now building.

LAUNCH OF MOTORSHIP "LOSADA."

The twin-screw cargo motorship "Losada" built to the order of the Pacific Steam Navigation Co. was successfully launched by Harland & Wolff, Ltd., at Govan, on the 10th inst. Her principal dimensions are: Length overall 420 ft.; breadth 54 feet; depth to shelter deck 35 ft. 3 in.; with a gross tonnage of 6,750. There is a heavy derrick fitted at the after side of the foremast suitable for lifts up to 40 tons. The steering-gear, windlass, and the ten winches are all electrically driven, steam being used for heating and cooling purposes only, and will be supplied by an oil-fired donkey-boiler. The propelling machinery consists of two six-cylinder four-cycle Diesel oil-engines of Harland & Wolff's standard type, built on the well-known Burmeister & Wain system, and develop 3,200 i.h.p. at 115 revs. per minute. "The Losada" is the third motor-driven vessel built by Harland & Wolff Ltd. for the Pacific Steam Navigation Co., the others being the "Lobos" and "La Paz."

CALEDON CO. BUILDING 15,000 TONS MOTORSHIP.

It is expected that the 15,000 tons d.w.c. motorship ordered last fall from the Caledon Shipbuilding Co., Dundee, Scotland, by the Ocean Steamship Co., Ltd. (A. Holt & Co., Blue Funnel Line), India Building, Liverpool, England, will be ready about July next. Two eight-cylinder Diesel engines aggregating 6,400 i.h.p. are nearing completion at Burmeister & Wain's works in Copenhagen. Three 150 b.h.p. B. & W. auxiliary Diesel-engines also will be installed for driving electric generators.

SHIP BUILDING REVIEW NUMBER OF "HET SCHIP."

We recently received a copy of the annual review number of "Het Schip," the well-known Dutch ship-building magazine. The same contains a resume of the ships built during 1920 in Dutch ship-yards.

Interesting Notes and News from Everywhere

BROWN-CAMMELLAIRD-FULLAGAR ENGINE.

John Brown & Co.'s first Cammellaird-Fullagar type marine Diesel engine will be of 2,500 shaft h.p. from six cylinders, 22 in. bore by 23 in. stroke.

ROWAN-CAMMELLAIRD-FULLAGAR ENGINE.

The marine Diesel-engine of the Cammellaird-Fullagar design now being built under license for a single-screw vessel by David Rowan of Glasgow, will develop 1,500 shaft horse-power.

MOTORSHIP BUILDING AT RANGOON.

"Kungnan," a 1,500 tons d.w. auxiliary-schooner is nearing completion at Rangoon, Burmah. She is building to the order of Maganlal Pranjivan & Co. of Rangoon, and is being equipped with a 400 b.h.p. Avance surface-ignition oil-engine.

BIG LOANS FOR MOTORSHIP CONSTRUCTION.

Loans recently applied for from the Swedish Government by shipowners have been granted. Of these loans Kr. 900,000 have been granted for three large Götaverken built Diesel vessels.

OUR N. Y. STATE CANAL ARTICLES

Owing to great pressure on space we are obliged to hold-over until next month the third of our Special Commissioner's series of articles on the New York State Canal.

"ROSANA" A SMALL FREIGHTER WITH WESTERN DIESEL ENGINES

Recently placed in service was the "Rosana," a 300-ton freighter owned by the Alberto Fait Co., Puntarenas, Costa Rica. She is propelled by two 75 b.h.p. Western Diesel engines built at Los Angeles, Cal.

OIL-ENGINED GENERAL-SERVICE MOTORSHIP LAUNCHED

A general service motor lighter of about 126 ft. length is now under construction by the Vinyard Shipbuilding Co., Milford, Del., for the Elizabeth Lighterage Co., of Elizabeth, N. J. In this vessel a 240 b.h.p. Worthington marine oil-engine will be installed.

"OLIVE BRANCH" A BURMESE AUXILIARY.

Among the many hundreds of Bolinder-engined merchant craft in service is the "Olive Branch," a wooden auxiliary-bark of 744 gross tons built and placed in service by A. V. Joseph of Rangoon, Burma, and powered with a 240 b.h.p. Bolinder oil-engine. She is 165 ft. long by 32 ft. breadth.

SPANISH DIESEL-DRIVEN TUG.

Last year the 127 tons motor-tug "Arin Mendi" was placed in service by Cie. de Remolacadores Ibaizabal (Sota y Aznar, managers) of Bilbao, Spain. The little craft was built by the Cia Euskalduna de Constr. of the same city, and is propelled by a 4-cylinder, two-cycle 13⅜ x 21¼ in. Sulzer Diesel-engine.

HIGH-POWERED ADMIRALTY LAUNCH.

Trials of the 1,600 b.h.p. gasolene-engined motorboat built for the British Admiralty by John I. Thornycroft & Co. were recently carried out in England. With a load of over 4 tons a speed of 37 knots was attained and with a load of 1½ tons 41 knots was reached. The vessel is 75 ft. long and is equipped with twin 800 b.h.p. Thornycroft gasolene engines.

LAUNCH OF MOTORSHIP "AMERIA"

The first motorship of the Norwegian-Mexico Line has been launched at the Akers Yard, Christiania, and named "Ameria." She should not be confused with the Danish motorship "Amerika" illustrated some time ago in this journal. The "Ameria" is practically a sister ship to the "Borgland," one of Fred Olsen's lines, and is of 7,500 tons d.w.c. Her dimensions are as follows:

Length	377 ft.
Breadth	51 ft., 3 in.
Depth	34 ft.
Power	2,200 i.h.p.

Akers' built Burmeister & Wain type four-cycle Diesel-engines are installed. All the auxiliaries will be electrically-driven and there will be 14 derricks and 10 winches, all electric windlass and steering-gear. She is the fourth motorship built by Akers.

NAVY BUILDING AUGSBURG DIESEL ENGINES

A number of 3,000 b.h.p. and 1,258 b.h.p. Augsburg type four-cycle submarine Diesel-engines are now under construction at the Brooklyn Navy Yard.

MOTORSHIP BUILDING PROFIT.

During 1920 the net profit realized by Burmeister & Wain, the Diesel engine and motorship building firm at Copenhagen, amounted to Kr. 10,260,125, including the amount brought forward from the previous year.

SMALL SWEDISH STEEL MOTORSHIP.

The Svenska Sockerfabriks Aktiebolaget, of Stockholm, have taken delivery of a 450 tons gross steel motorship named "Fringilla," built in 1920 at the Nya Varvsakt Vastervik. She is propelled by a 370 i.h.p. Polar two-cycle Diesel engine.

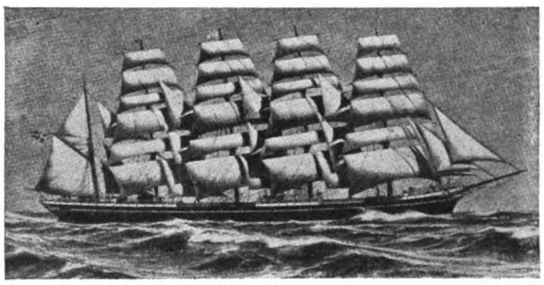
Another vessel completed in 1920 is the "Gunlog," a wooden boat of 450 tons gross and powered with twin 120 b.h.p. Bolinder oil-engines. She is owned by the Frode Shipping Co. of Kalundborg, and built by the Marstal Staalskibsbyggeri, Denmark.

CRAIG-ENGINED MOTORSHIP "SUPHENCO" LAUNCHED

"Suphenco," the Submarine Boat Corporation's new 5,350 tons d.w.c. motorship, was launched at their Newark yard on February 12th. This vessel will be equipped with the 2,240 i.h.p. Craig four-cycle Diesel engine recently completed at Jersey City. This engine weighs 275 tons, and develops 1,850 shaft h.p. at 105 r.p.m. It has six cylinders, each 30-in. bore, with 48-in. piston stroke.

EAST ASIATIC COMPANY'S TRAINING VESSEL.

When the war broke-out Ramage & Ferguson, Leith, Scotland, were building a Diesel-engined training-ship for the East Asiatic Company. The hull was commandeered for the British Admiralty and used for a tanker. The engine for this vessel was a non-reversible Burmeister & Wain 600 b.h.p. four-cycle trunk-piston model. This has been completed and shipped for installation in a



second training-ship named "Kobenhavn" now nearing completion at the same yard. She is an auxiliary craft, as will be seen from the illustration on this page, and is of 6,000 tons d.w.c. and 7 knots speed under power alone in calm weather; but with sails and power an average speed on voyages of 9 to 10 knots is expected. Each of her five masts weigh 25 tons, the smallest being 90 ft. high. The sail area is 56,000 sq. ft. Modern sail hoisting methods are employed. In addition to the regular crew of 50 officers, engineers and men, twelve training-boys will be carried. Her length is 340 ft., with 48 ft. 4 in. breadth, and 27 ft. depth. Her gross tonnage is 3,420 tons. A reversible propeller is fitted.

ANOTHER OIL-ENGINED TUG FOR MUNSON LINE.

By the time this appears in print an interesting oil-engined tug boat will have been launched ready for trials by the Nyack Shipbuilding Co. of Nyack-on-Hudson, N. Y., for the Munson Steamship Line's service in Cuba. This vessel will be named "Mineviatas" and is equipped with a 200 b.h.p. Fairbanks-Morse surface-ignition marine oil-engine, length 80 ft. by 18 ft. breadth and 5 ft. 6 in. draught. She is the second tug-boat which the Munson Line has equipped with a Fairbanks-Morse oil-engine, the sister boat having been in service for about a year.

STANDARD OIL ORDERS ANOTHER MOTOR-BARGE.

An order for a 350 tons d.w. motor tank-barge has been placed with the Baltimore Dry Dock & Shipbuilding Co. by the Standard Oil Co. of New Jersey. Gasolene or kerosene engines of 350-400 b.h.p. aggregate will propel this little vessel.

ADMIRAL BENSON AND DIESEL ENGINES.

In an address recently delivered before the New York Press Club, Rear Admiral W. S. Benson, Chairman U. S. Shipping Board, made the following statement—

"We have found it necessary to lay up a certain number of our vessels, but these to a great extent have been such as were temporarily unseaworthy and which we could very easily spare. We could rehabilitate them in short order. We are experimenting now with Diesel oil-engines and these will be used in greater number all the time and will be of estimable economic benefit to our merchant marine."

THE BALTIMORE 1,000 H.P. MARINE OIL-ENGINE.

In the table of high-powered Diesel-type engines published in our last issue, no reference was made to the experimental mechanical-injection type of reversible marine oil-engine recently completed under Wygodsky patents by the Baltimore Oil Engine Company. This engine operates on the two-stroke opposed-piston cycle, developing 1,000 shaft h.p. at 400 r.p.m. and is a radical departure from any other engine yet completed. It is of the valveless double V-type with sixteen cylinders and pistons 10 in. by 10 in., but has only eight combustion chambers. Scavenging is by means of ports, leaving the combustion-chambers free of all valves and valve-mechanism, there being only one orifice for the solid-injection fuel-sprays. This engine was laid-down during the war for submarine propulsion from designs by Leon Wygodsky and is now being developed for Diesel electric-drive for merchant-ship propulsion. It is of very light weight, weighing only 35,000 lbs. or 35 lbs. per brake horse-power. We recently saw the engine running and later on full details and illustrations will be given in "Motorship." We were advised by Mr. A. W. Gieske, Munsey Bldg., Baltimore, who has financed the development of this unique engine, that he will be glad to have shipbuilders, shipowners and enginebuilders inspect the engine at their plant at any time mutually convenient.

MERCHANT SHIPYARD TO ENTER GENERAL ENGINEERING FIELD

To Specialize in Ship Power Conversion and Repairs, Including Diesel-Electric Drive

The Merchant Shipbuilding Corporation, which operates a modern fifty-acres plant at Chester, has decided to immediately branch-out in general engineering lines, embracing steel construction in general, manufacturing, power plant equipment, machinery, railroad equipment and plate shop-work. This will be in addition to the general shipbuilding business now conducted, including ship conversion and repair work. The yard is adequately equipped for extensive work along these lines, especially in shipbuilding and kindred work. Ships up to 15,000 D.W.T. capacity are now being built. Every facility is available for the conversion of previously-built steamships to Diesel motorships, Diesel-electric driven or geared-turbine drive.

It is also stated by the Company's publicity-department that this Corporation wil be one of the few in America to be licensed to build Diesel-engines. This branch alone will give employment to hundreds of additional men in the Chester Yard. These new lines were recently decided upon by the Directors of the Merchant Shipbuilding Corporation.

However, judging from a conversation with an official we are inclined to think that the Merchants Shipbuilding Co., is more likely to enter into an arrangement with some leading Diesel-engine manufacturer to supply engines for vessels that they expect to convert, rather than undertake the building of engines themselves.

"GROTIUS" A SMALL DUTCH MOTORSHIP

There has been launched in Holland to the order of De Roode Ster of Rotterdam, the 68 ft. Skandia oil-engined motor-vessel "Grotius."

MOTOR LIFEBOATS FOR WHITE STAR LINERS.

A number of motor lifeboats for White Star liners are under construction at the Bootle Plant of Harland & Wolff. They are 32 ft. and 28 ft. craft to be equipped with 20 b.h.p. Gardner kerosene-engines.

NEW MEXICAN AUXILIARY

In a wooden hull purchased by Manuel-Angel Fernandez, of Vera Cruz, from Christopher Hannevig of New York, a 250 b.h.p. surface-ignition Skandia oil-engine will be installed. The vessel is named "Jayo." Reference to this vessel have previously been made in "Motorship."

TEST OF ENTERPRISE SOLID-INJECTION MARINE ENGINE.

Recently a 30 days' test was made of a 100 h.p. Enterprise marine Diesel-engine of the mechanical-injection type, which was recently described and illustrated in "Motorship." The oil used in this test was of 40 degrees gravity.

NEW ZEALAND COASTWISE MOTOR SCHOONER

On the schooner "Huia" owned by Mr. Leo Walsh, Auckland, New Zealand, a 160 B.H.P. Beardmore surface-ignition oi-engine is being installed. Three 80 B.H.P. twin-screw Beardmore oil-engine sets are also being fitted in other wooden schooners owned by Mr. Walsh in addition to one 60 B.H.P. engine in a fifth vessel.

"KIRKETIN" RE-NAMED "WM. DONOVAN"

The Wm. Donovan Lumber Co. of San Francisco have re-named their recently acquired wooden motorship "Kirketin" to "Wm. Donovan." She is propelled by twin 350 b.h.p. Winton Diesel-engines.

THE "LADY CARMICHAEL" RE-NAMED "HOBGOBLIN"

Arthur Tate & Company's iron twin-screw Vickers-Petters engined motorship "Lady Carmichael" has been re-named "Hobgoblin." She is of British registry, and is one of a large fleet of motor-vessels.

AUXILIARY "MABEL STEWART" CHANGES NAME.

Referring to the wooden auxiliary "Mabel Stewart" built in 1917, at Vancouver, and powered with a 320 h. p. Bolinder oil-engine, this vessel is now owned by D. N. Calmeris, of Piraeus, Greece, and recently had her name changed to "Calmeris."

RE-POWERING TUG

In a towing-tug formerly powered with gasoline-engines a Skandia Pacific oil-engine of 100 b.h.p. will be installed. The vessel is owned by N. Fay & Sons of Rio Vista, Cal., and will be used to tow barges from Stockton, Cal., to the San Francisco Bay region.

"KADUSKAK," AN AUXILIARY FOR SALVAGE COMPANY

Last year the Southern Salvage Co., Ltd., of Le Havre, Nova Scotia, took delivery of the wooden auxiliary schooner "Kaduskak," 196 tons gross. She is fitted with a four-cylinder 10½ in. by 12½ in. Fairbanks-Morse surface-ignition oil-engine.

OPERATION OF TANKER "TREFOIL"

In a recent statement to the Institute of Marine Engineers of London, and following his interesting paper on Solid Fuel-Injection, Mr. C. McTameney said that the Vickers-engined Diesel motor-tanker "Trefoil" from the time she left the builders till she went for a refit, 18 months had expired. During all that time the ship was under one hour's notice to be ready for sea. "I must say," he continued, "it was astonishing how these engines ran so long without having any repairs done—the only part of the engine we had adrift was one of the exhaust-valves spindles which had stuck; as for any other parts nothing had been touched, not even a bearing of any sort, in fact the main Diesel-engines could have carried on another twelve months without a refit."

CONVERSION OF THE "INGVID"

An old Russian three-masted schooner named "Ingvid" is being converted to motor-power by the Exe Transportation Co. of Falmouth, England, and a 240 b.h.p. Tuxham surface-ignition oil-engine is being installed.

INDIAN MOTORSHIP WITH AMERCAN ENGINES

The wooden twin-screw vessel "Binod" 460 tons gross, owned by M.C.B. Sethi of Calcutta, India, has been powered with twin Fairbanks-Morse oil-engines. She was built by Kali Kurmar De Chittagong.

JOHN F. METTEN TO READ DIESEL-ENGINE PAPER

On May 26th, at 8 P. M., John F. Metten and J. C. Shaw will read a paper entitled, "The Internal-combustion Engine as Applied to Marine Propulsion," before the Society of Naval Architects, at Assembly Room No. 1, Engineering Societies Building, 29 West 39th Street, New York City. Messrs. Metten & Shaw are Chief-Engineer and Assistant-Engineer, respectively, of William Cramp & Sons Ship & Engine Co., Philadelphia, Pa.

ANNOUNCEMENT

There has been an unavoidable delay in connection with the publication of the MOTORSHIP YEAR BOOK, but the work is being rushed with all possible speed. Readers who have already ordered copies will receive the first copies to be ready.

MOTORSHIP "SULINA" RUNS TRIALS

"Sulina" is the name of Swedish Orient Line's 4,450 tons d.w.c. single-screw motorship, built by the Oresunds Varvet, Landskrona, Sweden, and Diesel-engines by the Gotaverken. She recently ran her trials and a speed of 9 knots attained. Drawings and a description were given in our issue of January, 1921, page 44.

TRIALS OF MOTOR COASTER "CORBIE HILL"

Trials have lately been run of the British coastwise 275 tons-gross motor-vessel, "Corbie Hill," built for the Fraserburgh Shipping Co., Fraserburgh, Scotland, by Nobel & Co., of the same city. Twin 75 b.h.p. Gardner surface-ignition oil-engines are installed. Speed 9 knots loaded.

LATEST VOYAGE OF THE MOTOR TANKER "NARRAGANSETT"

As we close for press, the Vickers Diesel-engined motor-tankship is in New York Harbor. By the time this issue is published she will be en route back to England, and by May 14th will have completed one year's service. She then will have covered in excess of 40,000 nautical-miles.

On this trip from London to New York, a distance of 3,235 nautical-miles, she took 12 days, 15 hours, 3 minutes, from Light to Light, averaging 10.75 knots on a total fuel-consumption of 119.4 tons for the main engines, and 33.8 tons for the auxiliary-boiler. Lubricating-oil consumption totalled 169 gallons. The port engine averaged 117.0 r.p.m., and the starboard engine 117.2 r.p.m.

With reference to the auxiliary-boiler's consumption of 33.8 tons it is interesting to learn that the sister motorship, "Seminole," will utilize the exhaust-gases for generating steam to maintain the oil-cargo in a liquid state. This will afford a saving in fuel-consumption, and is very important, particularly as in New York tankers are not allowed to use their own steam, but are obliged to utilize steam from the shore.

Chief-Engineer Rawes advised us that when the "Narragansett" was placed in service none of his engine-room crew had previous experience with Diesel-engines, with the exceptions of the engineer from the works and himself.

MONITOR, NOW MOTOR TANKER

The British motor-monitor No. 18 has been reconstructed and is now a tanker owned by the Anglo-Saxon Petroleum Co. of London, who now own about half-a-dozen similar converted craft. She has been renamed "Annan" and is propelled by twin 320 Bolinder oil-engines and carries about 600 tons deadweight. She operates between Curacao and Venezuela and her speed is 7½ knots. The conversional work was carried out by the Rotterdam Dry Dock. A number of sister motor monitors have been converted to tankers

LECTURE ON DIESEL-ELECTRIC DRIVE

Diesel-electric drive as a type of marine propulsion, considered from both a standpoint of reliability and as an investment to a shipowner, was the basis of a recent lecture before the Marine Engineers' Beneficial Association, by Mr. W. E. Thau, electrical-engineer of marine-propulsion for the Westinghouse Electric & Manufacturing Co., who predicted that many present installations of the older type of propulsion would be replaced very shortly with the Diesel-electric drive, and that as soon as the new shipbuilding program planned by steamship lines was under way this type of drive would predominate on the smaller ships.

CONVERSION OF THE "FIONASHELL"

The old 2,444 tons gross steel sailing-ship "Fionashell" ex-"Fennia" built in 1892 by Workman, Clark has been fitted with twin eight-cylinder 14½ in. by 15 in. Vickers Diesel-engines. She is now owned by the Anglo-Saxon Petroleum Co. of London and is 284 ft. 2 in. long, by 42 ft. 1 in. breadth and 24 ft. 5 in. depth. The "Oweene," also owned by the same firm has been re-named "Ortinashell."

NEW POLAR EXPLORATION VESSEL

Donald B. McMillan's new auxiliary schooner "Bowdoin" was launched on April 9th at Hodgdon Brothers Shipyard, East Boothbay, Maine. She will be used by her owner for North Polar exploration work, and has the following dimensions:

Length	80 ft. 10 in.
Breadth	19 ft. 7 in.
Draught	9 ft. 6 in.
Displacement	115 tons
Power	45 b.h.p.

For auxiliary power she is fitted with a Fairbanks-Morse surface-ignition type oil-engine.

OPERATION OF THE "BORGLAND"

"Borgland," Fred Olsen's 750 tons d.w.c. 2,000 i.h.p. cargo-motorship, described in our issue of February, 1919, has run 95,000 nautical-miles without an involuntary stop at sea. She is propelled by Akers-Burmeister & Wain Diesel engines turning at 150 r.p.m. and driving twin 10 ft. 4 in. dia. by 8 ft. 3 in. pitch propeller. She averages 10 knots loaded on a fuel-consumption of 7 tons per day. With 900 tons of bunker-oil her radius is 120 days at full speed. She has a crew of 32 men, including 11 in the engine-room.

OPERATION OF THE EAST ASIATIC CO.'S BIG FLEET OF MOTORSHIPS

State-Councillor Andersen of the East Asiastic Co., Copenhagen, recently made some interesting statements in a past-war review of the operation of this great trading company, as follows:

"As a result of the experience gained with the motorships the company resolved in the middle of 1915 to adopt exclusive motor service on its routes over the oceans. In this connection the following information may be of interest. The motorship "Selandia," placed in service in 1912, and the motorship "Siam," placed in service in 1913, have up to the middle of 1919 covered distances corresponding respectively to about 16 and 14 times the circumference of the earth at the equator, in practically uninterrupted runs under all sorts of climatic and weather conditions. The experience gained all the time, is turned to account both for the ships already in service, and in the new ones to be built.

"In agreement with the mentioned decision 21 twin-screw motorships of an improved "Siam" type have been ordered during the few last years. Nine of these are of about 10,800 tons, six of about 12,500 tons and six of about 14,500 tons loading capacity, and these together with six later-planned vessels of various size according to the purpose, for which they are destined, comprise in all about 325,000 leading tons.

"The first mentioned 21 motorships that have been ordered from Messrs. Burmeister & Wain, Ltd., should according to the contract have been delivered by and by, the last one in March, 1921. But owing to the influence of the war, especially failing supplies of shipbuilding materials, this new building program has progressed but little. Since 1914 the company has received the following new motorships. In 1915 'Falstria,' 'Australien,' 'Panama' and 'Chile' in 1916, 'Peru' in February, 1919, 'Asia.' The company probably will not receive all the remaining vessels of the program till 1924 at earliest.

TRIALS OF SHIPPING BOARD'S 12,375 TONS D.W. MOTOR

NEW YORK SEATTLE

MOTORSHIP

Devoted to Commercial and Naval Motor Vessels

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JUNE, 1921
Vol. 6 No. 6

—and at Hong Kong

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EXCLUSIVE technical and non-technical articles on design, construction and operation of oil-engines and motorships by the world's foremost writers on marine engineering.

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PROFUSELY illustrated with photographic reproductions of the newest designs in international merchant motorship and Diesel-engine construction.

Vol. VI | New York, U. S. A., June, 1921 | No. 6

Cable Address—Freemote, New York

The Shipping Board's Motorship

"William Penn," a Twin-Screw B.&W. Diesel-Propelled Freighter of 12,375 Tons Deadweight and 4,500 i.h.p. Runs Trials.—Built on the Isherwood System.

AFTER a series of delays covering a period of nearly three years, the Shipping Board's first and only Diesel-driven motorship, "William Penn," has run trials on the Delaware. Although she is not an ideal ship, for reason we will presently outline, she attained a fuel economy that will never be equalled by anyone of the two thousand other merchant-vessels built under the jurisdiction of the Board, nor will her economy be nearly approached by any of the steamers now being converted to turbine-electric drive by the Board's order, for a fuel-consumption of 0.308 lb. per i.h.p. hour for all purposes was attained on the test trip. Her trials were completed with every success. Every other ship built by the Board has had a fuel-consumption of 300% (or over) higher.

The hull of the "William Penn" was a war-time contract, and was the last of a series of steamship hulls built at the Gloucester Yard of the Pusey & Jones Corporation, which is now closed down owing to no further steamship construction being available. Her propelling and engine-room auxiliary machinery were supplied by Burmeister & Wain of Copenhagen, Denmark, who built the Diesel-engines, while the installation work and sundry changes to the hull were carried out by their American licensees, the Wm. Cramp & Son Ship & Engine Building Company, Philadelphia, Pa., who also supplied and installed the deck machinery. She will be operated by the United American Lines of New York in the U. S.-Far East service. This vessel was constructed on the Isherwood system and has the following dimensions:

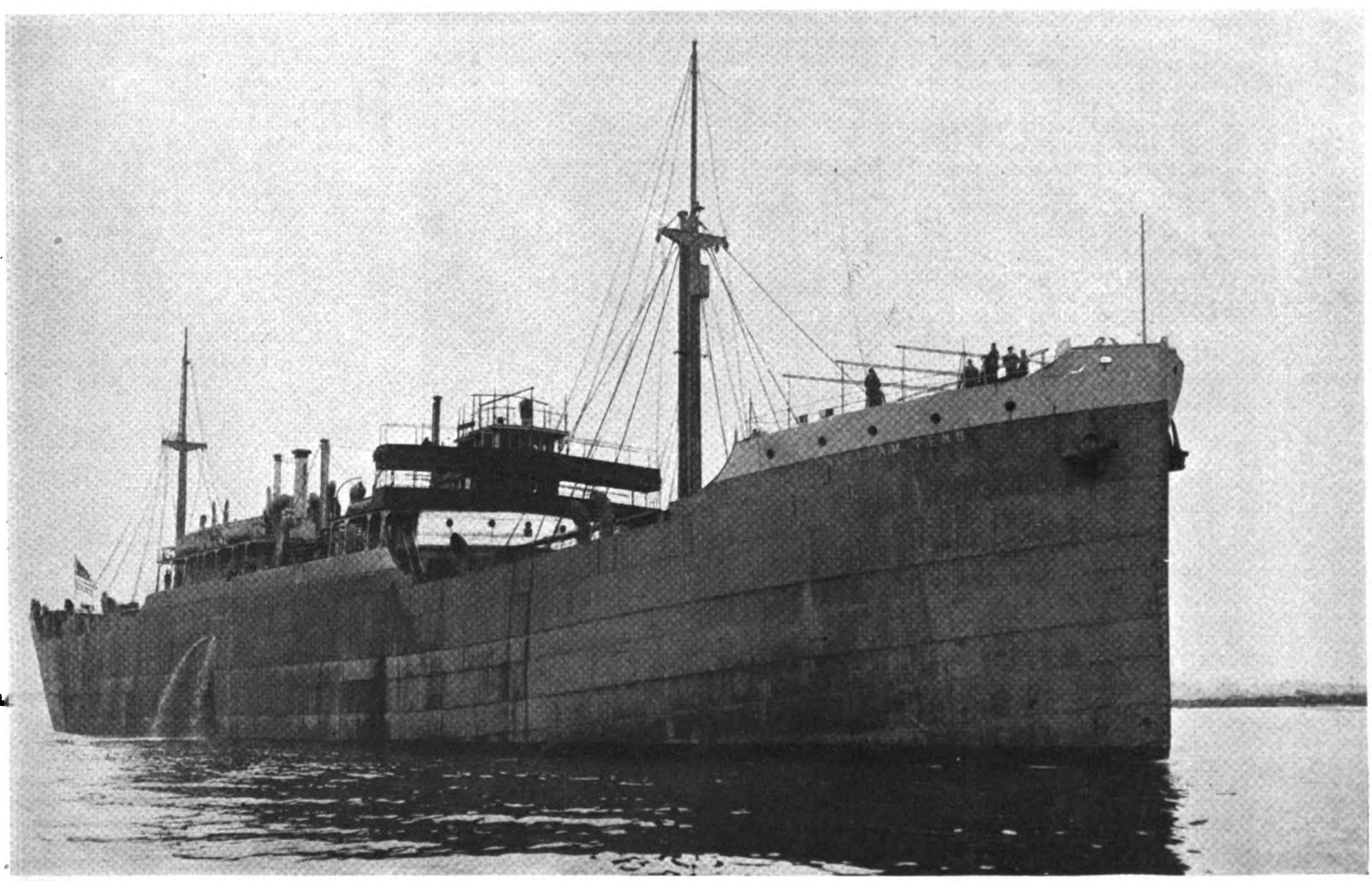
Loaded Displacement	17,100 tons
Dead-weight-capacity	12,375 tons
Net cargo—capacity on 10,000 miles voyage	11,725 tons
Fuel required on 10,000 miles voyage averaging. 4,000 i. h. p. & 10½ knots	500 tons
Most suitable loaded-speed	11 knots
Mean speed on trial	12.592 knots
Actual-cost of fuel for 10,000 mile voyage at 11 knots average speed	$7,335
Fuel-Bill of Sister Steamer at 10½ knots average speed, with fuel at $12.60 per ton	$15,632
Fuel-Consumption of Sister Steamers for 10,000 miles voyage at 10½ knots average speed	1,320 tons
Cost in Fuel saved by "Wm. Penn" on 10,000 miles voyage	$8,297
Length (O. A.)	455'0"
Length (B. P.)	445'0"
Breadth (M. D.)	60'0"
Depth (M.D. to S.D.)	36'8"
Draught (loaded)	28'4¾"
Gross tonnage	8,168 tons
Net tonnage	5,214 tons
Block Co-efficient	0.80
M. S. Co-efficient	0.983
Power (Indicated)	4,500 h.p.
Power (shaft)	about 3,500 h.p.
Fuel-capac. (inc'l 57 tons in settling tank)	1,343 tons
Deep tank (for dry cargo or water ballast)	994 tons
Cubic-capacity of deep tank	34,770 cu. ft.
Hold capacity	520,550 cu. ft.
Total cubic capacity for cargo below decks	555,320 cu. ft. (bales)
Propellers (bronze twin four-bladed)	13'6" dia. by 11'9" pt.
Propelling engines	Burmeister & Wain 6 cylinder-four cycle
Cylinder bore	740 mm (29⅛")
Piston Stroke	1150 mm (45¼")
Engine speed (designed)	115 R.P.M.
Draft on trials—Consumption trial	13'0½" (fresh water)
Duration of Trials	6 hrs.
Total power developed (English)	4334.5 i.h.p.
Total power developed (Continental)	4275 i.h.p.
Mean Revolutions	113.30 per Min.
Port engine	112.72 per Min.
Stbd. engine	113.88 per Min.
Mean indicated pressure	82.2 lb.
Total number engine-room crew	14 men.
Full Ahead to Full Astern	32 Seconds
Daily fuel consumption in port	¾ ton
Daily fuel consumption at sea	13 to 14 tons

THE SPEED TRIALS

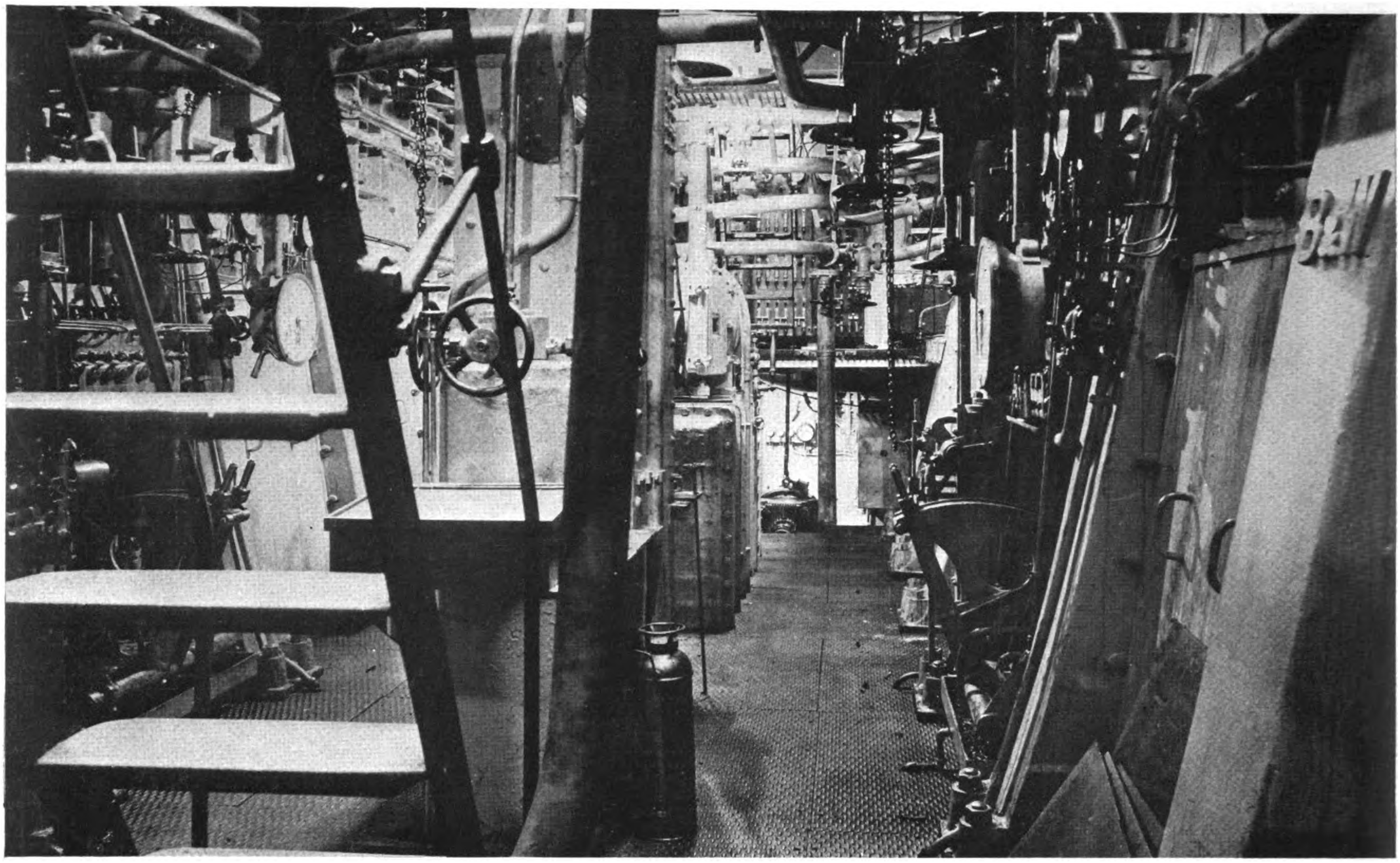
(Mean of 3 Runs over Mile)

Speed averaged	12.592 knots
Indicatedhorse-power (Continental)	4,756 h.p.
Indicated horse-power (English)	4,690 h.p.
Revolutions	121.23 P.M.
Propeller-Slip	10.6%
Mean indicated pressure	84.6 lbs.
Maximum i.h.p. attained over one mile	4848 (Cont.)
Maximum i.h.p. attained over one mile	4780 (Engl)
Maximum Revolutions	122 P.M.

It is to be noted that the contract stipulated that over 6 per cent of the designed revolutions of 115 per minute was not to be exceeded.



The Shipping Board's Diesel-driven motorship "William Penn," 12,375 tons d.w., and 4,500 i.h.p.



M. S. "William Penn." View from after end of control-floor between the two 2,250 i.h.p. main Diesel-engines.

On the six hours' run a total of 3½ tons (7,918.24 lbs. to be exact) of 28 degrees Baumé fuel-oil was consumed, including for a 100 b.h.p. Diesel-engine driving a 65 K.W. electric-generator carrying an actual load of 55 k.w.

In order to bring her down in the water as far as possible, about 1,250 tons of 30 degrees Baumé fuel oil was pumped into her double-bottoms and tanks. This oil was supplied by the Atlantic Refining Co. of Philadelphia to the Shipping Board and cost 4.8 cents per gallon. This price figures out at $14.11 per ton, or practically the same as the cost of boiler-oil to-day. Only under unusual circumstances will she need to take as much oil at one time, because this quantity will drive her nearly 30,000 miles at 10½ knots loaded.

The hull of the "William Penn" was originally designed as a steamer of lower power, and has very full lines, her block-co-efficient being 0.80, consequently her present Diesel-engines are of too high power to give the best operating economy. Although no doubt she would attain an average of 11½ knots loaded with full power of 4,500 i.h.p. on a daily-consumption of 14 tons of fuel, the Cramp Company believe it will be best to propel her at 11 knots, which she will attain when developing 4,000 i.h.p. on a daily consumption of 13¼ tons.

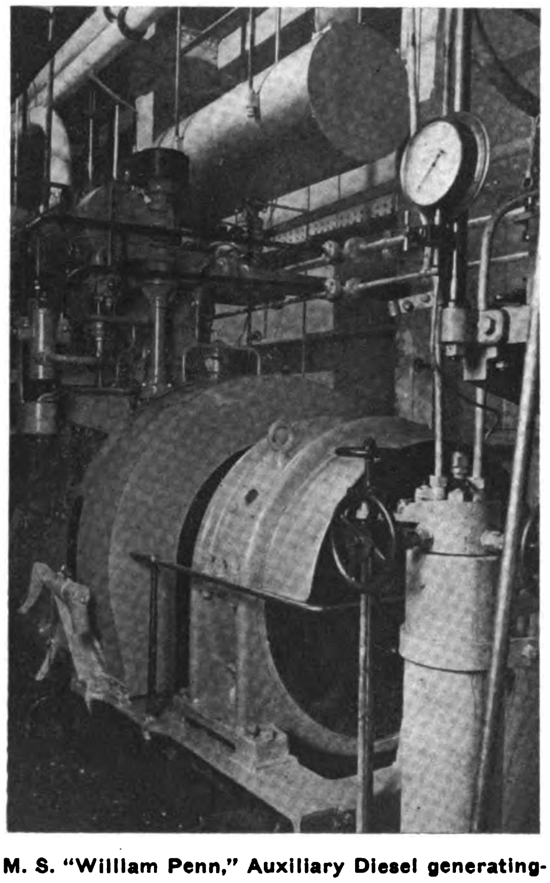
On the trials vacuum D.T.E. heavy lubricating-oil was used for the general working parts of the main engines, and D.T.E. extra-heavy for the working-cylinders, and D. T. E. for the air-compressors.

Comparisons of her operation in service will be made against the Shipping Board's turbine-electric ship "Eclipse" also trading on the same route. While we have no doubt as to what will be the outcome, we point-out that the comparison is not a fair one, because the "Eclipse" is a much finer-lined vessel and was designed to average 10 knots with 3,000 shaft h.p. She is longer, less beam and has a better block co-efficient. Her dimensions are as follows:

Turbine-Electric Steamer "Eclipse"

Length (O.A.)	457'6"
Length (B.P.)	440'1½"
Breadth	56'0"
Draught	28'7"
Deadweight capacity	11,867 tons
Total cubic-capacity of cargo	526,420 cu. ft. (bales)

Thus it will be noted that the steamer "Eclipse" is two feet longer over-all, but four feet shorter b.p. than the motorship "William Penn," and has four feet less breadth. Nevertheless, we feel confident that the "William Penn" will maintain at least one mile per hour better round-voyage speed (light and loaded), and the S. S. "Eclipse" will have nearly three hundred per cent (300%) greater fuel-consumption, while the "William Penn" will be able to carry about 10% more dead-weight cargo. This means a triple advantage, so the results will be most interesting when available. The "William Penn" has 29,000 cubic feet additional cubic-capacity for cargo below decks. Also it has only to carry 77 tons of fresh water, compared with 263 tons for the "Eclipse." Here also is a distinct gain.



M. S. "William Penn," Auxiliary Diesel generating-set at aft end of port side of engine-room.

It is up to the new Board, when appointed, to make the best ships of their fleet thoroughly modern by installing Diesel power, and furnish the remainder as targets on the Pacific and Atlantic Coasts for our navy, writing off their cost as a war loss.

The advantage of this would be enormous, and regardless of other conditions such as higher cost of construction and higher wages, America then could compete against the world.

Just at the moment we have before us some figures regarding the speeds of six steam-driven sister-ships, the hulls of which were built at the same yard as the "William Penn."

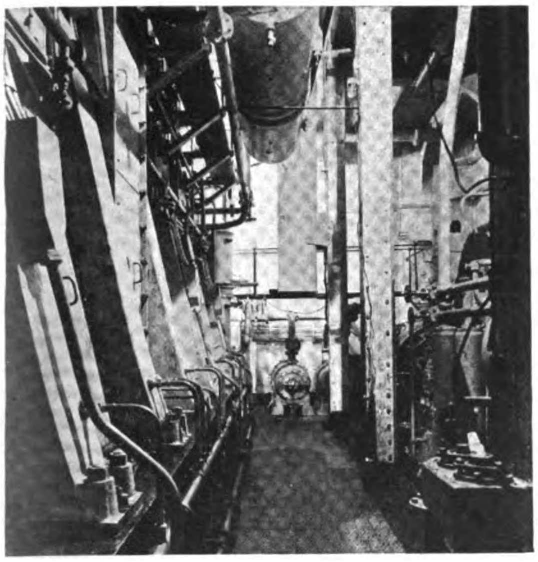
These steamers are as follows:

Mean Trial Speeds of Six Steam-driven Hulls Built at Same Yard

Type of Ship	Power	Revolutions	Mean Speed (Knots)
Geared-turbine	3,000 s.h.p.	70.2 / 90.2	7.7
4-cyl. quad	3,600 i.h.p.	76	10.6
Geared-turbine	2,750 s.h.p.	90.6 / 85.7	10.5
Geared-turbine	2,750 s.h.p.	90.4 / 88.6	7.7
Geared-turbine	2,750 s.h.p.	91.9 / 90.6	9.8
4-cyl. quad	3,600 i.h.p.	77.0	10.8

The above results, when compared with the 12.6 knots mean speed attained by the motorship "Wm. Penn," which had a greater trial displacement, and with the hundreds of foreign motorships that have visited our harbors carrying away American products, many of which have been in service for nearly ten years, will justify the remarks we have made regarding cargo steamers being practically obsolete to-day. It is pleasing that Admiral Benson has fully realized this situation, and has strongly recommended the conversion of many vessels. Unfortunately, his hands are more or less tied.

The "William Penn" will have been a very expensive vessel, owing to her engines having been purchased during the war with its high prices, and because a considerable number of structural



M. S. "William Penn." Starboard side of engine-room, looking forward.

changes and additions had to be made to the hull after her delivery from Pusey & Jones to Cramps. Consequently, half her cost should be wiped-off and the "William Penn" started on her maiden voyage to Java with a clean sheet. We will mention that her Diesel machinery was purchased by Mr. Edward N. Hurley when in Europe during the war.

Generally speaking, the propelling-machinery of the Burmeister & Wain type motorsips is so well standardized that descriptions are merely repetitions of previous installations, although, of course, there have been a number of improvements and modifications since the initial vessel, "Selandia." The "William Penn's" two main engines are of the regular four-cycle single-acting crosshead type, designed to develop 4,500 i.h.p. together at 115 r.p.m., and are direct-coupled to twin 14-in. dia. propeller-shafts via the old-type horseshoe thrust. They drive bronze propellers 13 ft. 6 in. dia. by 11 ft. 9 in. pitch, with four blades, designed and cast by Cramps for 11 knots speed. They will be in charge of Chief-Engineer Oscar Olson, and Oscar Mattsson, ex-Chief-Engineer of the motorship "George Washington," will go as guarantee-engineer for the Cramp shipyard for the first voyage. The vessel is in command of Capt. J. A. Meech.

All the engineers are old steam-men selected from the American-Hawaiian Steamship Company's fleet of steamers. This includes Mr. Olson, who has been in the Cramp shops for several months, and is therefore familiar with the construction as well as the operation of the engines. This follows the policy put forward many times by "Motorship," namely, that when a motorship is ordered, the shipowner should select several of his best steam men, and send them to the engine-builders' works and bring them up with the engines, which is the practice adopted with success by European owners.

The engine-room arrangements also follow the most recent standardized practice, with three 100 b.h.p. Diesel-engines driving electric-generators, two being for use in port and one being a reserve. At sea only one engine is run. The generators were built by Thomas B. Thrige, of Odense, Denmark, and this is the first time we have seen this particular mark on a B. & W. vessel, although it is used on many Werkspoor vessels. The usual B. & W. practice is to instal generators built by the Almanna Svenska (Swedish General Electric Co.) These generators furnish current for the engine-room and deck auxiliary machinery, including for 10 cargo-winches built by the American Engineering Co. of Philadelphia, and equipped with 30 b.h.p. Westinghouse motors, especially wound for low revolutions. These winches operate at 150 ft. per minute when lifting 2½ tons (5,000 lbs.) on the first gear, or 10,000 lbs. at 75 ft. per minute on the second gear. There is one warping-gear in addition, also equipped with a Westinghouse motor. The control-panels throughout the ship are Westinghouse, but are of a land type, and not of the maker's latest marine-model.

Reference to the plans will show that the three auxiliary Diesel engines are arranged on the port side of the engine-room, while on the starboard side are the electrically-driven bilge, sanitary, and piston-cooling pumps; the electrically-driven maneuvring air-compressor, the motor for which is also supplied by the Thrige Company; bilge and ballast pump, and the cooling-water pumps. At the forward end of the starboard side of the engine-room is arranged an electrically-driven lathe made by the Philip Smith Manufacturing Company, of Sidney, Ohio, and a drill-press supplied by the Champion Blower & Forge Company, of Lancaster, Pa.

Between the thrusts at the after end of the engine-room is a small oil-fired water-tube boiler for steam-heating the ship, and which will also supply steam in case of need to a small reserve air-compressor.

Between the main engines at the forward end there is an innovation; namely, a fresh-water cooling-tank and pump. Sea-water is used for cooling the air-compressors and the pistons of the main engines, but fresh-water is used for circulating around the liners and cylinder-heads. This is in accordance with the latest B. & W. practice, as with some makes of Diesel-engines fresh-water is used for the pistons and salt-water for the cylinder liners and heads. The B. & W. designs regard it as an extra precaution against mud deposits in the water spaces of the liners and heads when navigating in harbors and rivers with deep draft vessels.

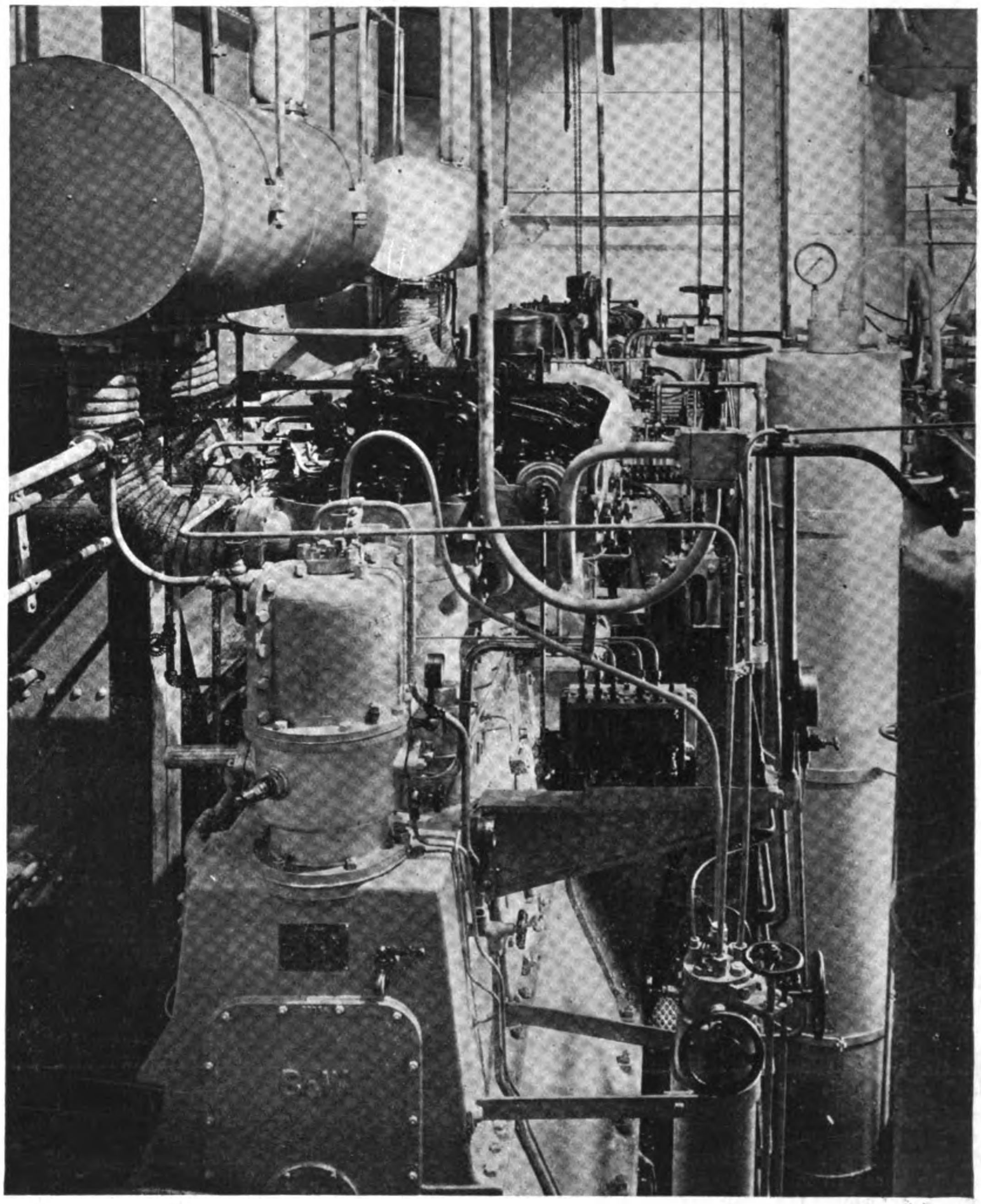
Referring to other equipment on this vessel, there is a Brunswick refrigerator-set driven by a Diehl 5 h.p. motor for supplying ice-water and for cooling the ship's stores, for the use of the crew, no passengers being carried on this vessel.

A number of chemical fire-extinguishers are carried, and these are of a type manufactured by S. F. Hayward & Company, of New York City. The engine-room telegraphs were supplied by Chas. Cory of New York, and the binnacle by John I. Hand & Sons Company, of Haddenfield, N. J. A wireless outfit is fitted, and this consists of a 2 K.W. set made by the Federal Telegraph Co. of Palo Alto, Calif., with a De Forrest control-box.

Discussing the question of the high cost of the "William Penn" with the Cramp officials, which as mentioned was due to the conditions under which the ship was constructed and to the large number of alterations that had to be made in conjunction with the installations, we are advised that it would cost 10% more per deadweight-capacity ton to build a similar sized Diesel-driven vessel to-day at the Cramp Yard than to build a steam-driven vessel of similar size. However, if it came to the question of the cost of the two types of ships the motor-vessel could be built to carry the same amount of cargo as the steamer at approximately the same cost, because she could be made ten to twelve per cent smaller over-all, including power. This would reduce her complete cost, and at the same time would reduce the cost per net-cargo-capacity-ton to practically the same as the cost per net-cargo-capacity-ton of the steamsip. This shipowners should bear in mind when figuring-out the cost of new motorship construction at the present time.

MR. CALCOTT'S ADDRESS WANTED

Will Mr. D. S. Calcott, late of Newport News, send us his present address, as copies of "Motorship" recently mailed him have been returned by the Post Office.



M. S. "William Penn." The three auxiliary Diesel-electric generating sets on the portside

One of the many well-equipped State Canal Terminals, Pier 6, East River, New York City. The freight-handling machinery is modern and efficient, and provides the means for systematizing Canal Transportation

Economical Transportation on the New York State Canal

A Series of Exhaustive Articles on Barge-Commerce Along the World's Greatest Inland Waterway

By OUR SPECIAL COMMISSIONER

Part III.—Business Aspects and the Systematization of Canal Traffic. Accomplishments and Prospects.

OUR investigations bring out in striking relief the known fact that the resources of commerce and industry which are tapped by the New York State Barge Canal are staggering in their wealth and vastness. At one end of this magnificent transportation route is Buffalo, the converging point for an industrial traffic that originates in the heart of the richest country in the world and at the other end is situated New York City, whose towering eminence as a seaport long ago ceased to be disputed. The pressure of traffic between these centers is enormous.

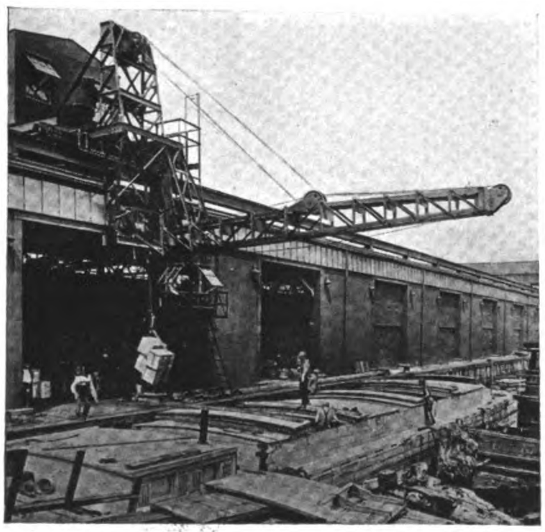
Modern industry and transportation are complementary and inseparable. Because of the division of labor and the specialization of functions, a high degree of fluidity in the processes of interchange and assortment is absolutely essential; conversely, also, freedom of movement and efficient traffic facilities foster industrial development. It is significant, therefore, that the two great commercial centers, Buffalo and New York City, are located at the termini of two of the world's most comprehensive and efficient transportation systems—the Great Lakes and Ocean shipping.

This strategic location of Buffalo is reflected in her diversified and voluminous industries, an adequate recital of which would take us far afield from the scope of this article. Her grain elevator capacity exceeds 28,000,000 bushels and her output of flour is more than 5,000,000 barrels yearly. One concern turns out 21,000 barrels a day. 2,000,000 tons of steel products are turned out annually and the coal required for this and fifty-eight per cent of all the different industries enumerated in the U. S. Census amounts to more than 15,000,000 tons.

Just as Buffalo forms the clearing-house between raw products and manufactured articles, so New York City is the clearing-house between manufactured products and foreign commerce. The assessed real-estate value of this great harbor city exceeds $8,000,000,000, more than two-thirds the value of the remainder of the State of New York. Practically every business enterprise in the entire United States has headquarters or at least some form of permanent representation in New York City.

Although it would be difficult to overemphasize the great importance of all the transportation systems that link-up these great centers, it must be borne in mind also that the intervening district, of which the transportation route is a veritable backbone, teems with commercial and industrial activity. The warp and woof of it is interwoven with the innumerable strands of traffic that tie New York and Buffalo together.

The growth of this great complex of human activity was originally and basically due to water transportation along the Hudson, and in the valley of the Mohawk. So stupendous and rapid was the development that not only one but several parallel railroads along this same route came into being and to this day the full demand for traffic facilities of any and all kinds are far from being met. Nothing could be further from the truth than to suppose that there is anything of a mutually exclusive nature as between railroads and waterways. The fact that canal and rail transportation figures have until recently borne an inverse ratio to one another is not founded on necessity or on any intrinsic circumstances, but on fortuitous and accidental conditions.



Close-up view of freight-handling machinery at Pier 6, East River, New York City

Whereas it has been customary in dealing with this subject to lay much stress on the comparative rates of rail and water transportation, we shall note merely in passing that they have in the past favored canal traffic in the ratio of between two and three to one and shall urge a much broader consideration of the matter. The vital relation which transportation bears to industry consists in the high degree of specialization which is practised and which calls for continuous re-arrangement and re-assortment of products over the length and breadth not only of an industrial district, but of the whole world. In the devious path that leads from the origin of production to the destination of consumption, nearly every stretch of the journey is accompanied by a change in the ownership of the product, by the modifications of technical processes, and by re-classification for marketing.

An early philosopher conceived society and its organization as a great body; if he had lived today he would undoubtedly have called transportation its life-blood. Regularity and certainty of its circulation transcend in importance every other characteristic that it may possess.

The history of railroading shows that the criterion of co-ordination and dependability has not been fully met and it is not being met now. In the early days, we had wild-cat lines, rate-wars, and an overdose of those things which are evil in our competitive system. Railroads are what are known as natural monopolies and we are far from knowing how to handle them. Unregulated competition has been found to be most inimical to the development of that feature of transportation which we have seen to be its most vital one—stability. Although government regulation has been worked-out on an elaborate scale through the Interstate Commerce Commission and even government ownership resorted to, a solution is still far off. There has never been a time when it could be said that the railroad system was in working order.

It is the waterways that are bringing a solution of their own into sight and the field in which this happy development will manifest itself will be the industrial area served by the New York State Barge Canal.

It possesses a strategic advantage in not being a natural monopoly. For one thing it is State-owned and can be offered on like terms to all. Almost an unlimited number of individual lines can be operated on it simultaneously; boats can pass each other in the same or in opposite directions without the iron-bound limitations of railway schedules and all that that implies of unitary management. Although the lines will be parallel, they will not suffer in any way, shape, or manner from the evils of parallel-line competition such as have been known in railroading. Paradoxical though it may seem, this very freedom of competition is the very thing that will give the desired results, because, as we shall see in what follows, it has the same characteristics as the ordinary business relations of other industries upon which American business success is founded.

Some of our great corporations have already begun to fall in line with this development. The Standard Oil Company is developing its own Barge Canal transportation service in the same elaborate and thorough manner with which they do everything else. Besides building a private boat-landing on the new Canal near their supply depot in Rochester at a cost of $100,000, their remaining investments in Canal transportation run into the millions. Although the use which they made during the first opening of the Canal in 1918 may be considered experimental, it amounted even then to 16,000 tons of fluids. Nevertheless, this is probably only a straw which shows how the wind will blow: the 1919 season showed almost a threefold increase in tonnage transported, or 46,000 tons and this was doubled in 1920. The Standard Oil Company is now using or has on order a total of 16 of their own tank-barges specifically designed for tank transportation on the New York State Barge Canal.

Each of the boats is 148 ft., 9 in. long, has a depth of 11 ft., 10 in. and a beam of 28 ft.; the net cargo-capacity is 788 tons. Since the motive power is a 300-H.P. Standard gasoline engine, the fleet marks the first and most significant use of the internal-combustion engine on the Canal. In view of this oil traffic, fuel should always be available for canal motor-vessels.

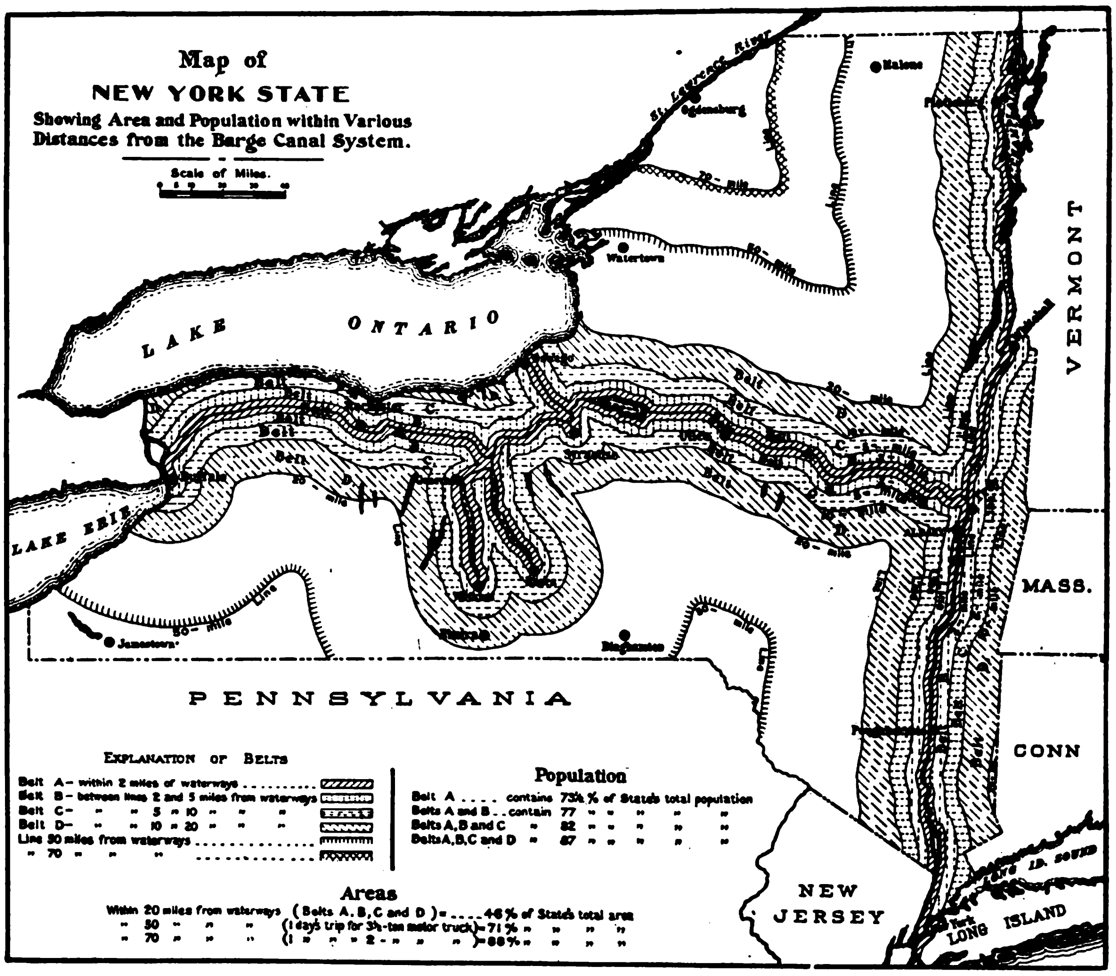
The General Electric Company, who operate a huge plant at Schenectady on the Barge Canal, has also given an emphatic endorsement of this magnificent waterway. When the Canal was opened in the Spring of 1918, they prepared a harbor of their own and secured three barges and a tug. The barges are of wood, well-built and substantial. They average 125 ft. in length, have a 26-ft. beam, and a fully loaded draught of 10½ ft. Since each boat carries 350 tons, the combined capacity of the fleet exceeds 1,000 tons and with it they made five round trips during the first season and hauled 4,100 tons of freight valued at $2,000,000. At the end of their 1920 season they had increased the use of their fleet to the extent of hauling 22,000 tons for a total distance of 12,000 miles in 30 round trips covering a period of 7 months. The value of the material hauled is being kept confidential.

The motive power for the General Electric Company's fleet is a wooden tug having a length of 81 ft. and displacing 70 tons. It is driven by a 240-H.P. steam-engine and requires 7 tons of coal per day. Owing to the fact that part of the coal is obtained under contract at $5 per ton while some of it is bought at spot prices as high as $15, the fuel-cost of the tug is indefinite, but it is safe to say that it does not come to much less than $50 per day. A Diesel-engined tug which we hope soon to be permitted to describe, and which develops 225-H.P. would meet the General Electric Company's needs and would require a daily outlay for fuel of less than $10 per day.

These great companies naturally arrange these private services to suit themselves and they have no special problems of organization to cope with. Because of the fact, however, that there are not many such, who have enough traffic of their own to make it worth while for them to provide their own transportation, the full possibilities of the Canal can be realized only if an extensive common-carrier service is also established. This is where comprehensive organization will come in. With some notable exceptions, of which we shall treat presently, the only common-carrier service that has been offered in the past has been that of the individual boat owner or charterer, here today and gone to-morrow. We have seen how important it is that transportation service be regular and dependable. If these individual boatmen had carried cargoes free-of-charge, it is doubtful if they would have done much to increase traffic on the Canal, because the cost of transportation is entirely secondary to its dependability.

One of the exceptions referred to is the Inland Marine Corporation, formerly Shippers Navigation Company, financed by Syracuse capital. Although they have not organized regular schedules for barge trips, and have contracted for cargoes merely as they became available, they have rendered service in a business-like manner. As they had contracts practically to the full extent of their capacity during the entire season of 1919, their operations were most successful. According to available reports, their 1920 operations left nothing to be desired. Their large resources in equipment, which consists of fifty 240-ton Erie Canal barges and nine cargo-steamers and which enable them to contract for service on a large and well organized scale, account for their success even more than the low rates which they charged. Needless to say, they can make themselves a handsome present in the way of additional profits by using economical oil-engine propulsion and cutting thousands of dollars off their fuel-bills.

What may be called a specialized common-carrier service is offered by the Ore Carrying Corporation. They concentrate almost exclusively on the transportation of quarry products originating on the shores of Lake Champlain. With their fleet of 60 barges they transported 132,128 tons of iron-ore in 1920, an increase of practically 200% over their 1919 business.



A common-carrier service about which a great many misconceptions have been spread abroad was that offered by the United States Railroad Administration and subsequently the Inland and Coastwise Service of the War Department. The officials who had charge of this work were confronted with three formidable sets of difficulties: namely—building and putting into service newly designed equipment, inherent governmental inefficiency, and the chaos of post-war conditions. Although this transportation enterprise was undertaken theoretically in order to blaze the way for private initiative, its poor showing, entirely excusable though it was, certainly could not have produced that result. More serious even than this was the unhappy psychological effect produced on the minds of prospective shippers by the likelihood that they might be put in the position of competing with the United States Government. Actually, independent operators had no difficulty in taking business away from the Government, as is shown by the fact that independent lines carried as much as 75% of their capacity, whereas the government boats carried only 16%. The Government charged absurdly high rates, lost business and incurred heavy deficits. Nevertheless, unsympathetic interests played up "government competition" so effectively that they succeeded in preventing a certain amount of business from coming to the Canal. Many people seriously believed that service such as that offered by the Government could compete with private enterprise, but we have yet to learn of a single authentic case in which its officials did any rate slashing.

With bids recently opened to private parties for the government equipment, the episode may be considered closed. Anything like sufficient experience with the barges to permit an estimate of their merits, simply does not exist. All that can be said now is that some very expensive boats are to be had cheap and could be converted to more economical motor power, and that one more opportunity is being presented favorably situated parties to benefit at the expense of taxpayers. It is very much to be hoped that somebody will benefit. We shall give a detailed description of the Government fleet in a later article.

In striking contrast with the Government's service has been the work done by the Transmarine Corporation of Port Newark, N. J., whose strategic geographical and business situation endow it with unusual qualifications for conceiving and executing a highly developed Canal Transportation service. It is one of the component companies of the Submarine Boat Corporation, whose other subsidiaries are the Electric Boat Company, the New London Ship and Engine Company, the Electro Dynamic Company, the Atlantic Port Railway, and the Newark Bay Shipyard. They are specialists in every branch of work that might enter into Canal transportation. They have their own shipyard and can design exactly the right kind of Canal craft with promptness and despatch. Association with the New London Ship and Engine Company makes available to them on excellent terms and short notice economical oil-motor power such as Canal operation will demand as the New London Co. builds Diesel engines of moderate power. But by far the most important aspect of Transmarine Service is the fact that it will be co-ordinated on a large and comprehensive scale with Ocean shipping, the nucleus of which is the fleet of 32 new steamers belonging to the Transmarine Corporation.

At Buffalo the Transmarine Line connects with the Great Lakes Transit Corporation for Duluth, Minneapolis, and St. Paul. Nightly schedules are maintained from Buffalo to Detroit and Cleveland via the Buffalo Transit Company (C. & B.) and the Detroit and Cleveland (D. & B.) lines. We have here an admirable concrete example of a systematized water transportation that links up the Great Lakes region with the focus of Ocean commerce at New York City.

It need hardly be mentioned that the physical and floating equipment of the Transmarine Corporation is of a high order of excellence. Last year they placed in service eight 400-ton steel barges 100 ft. long with a beam of 22 ft. and 36 more are being made ready for service during the coming season. Elaborate freight-handling machinery for transferring cargo directly and with high economy from the barges to the holds of ships. It is a feature of signal importance, because handling charges are a large item in transportation and anything that can be done to reduce them yields a substantial increase in profits. Efficient freight handling, as thus exemplified, and as provided for in millions of dollars worth of barge terminals and grain elevators built by the state, will be a big factor in the success of the New Canal.

Although it is more than probable that the biggest immediate prospects for business on the Canal are for through shipments of bulk cargoes, a speedy pick-up of way traffic in package freight is to be expected as soon as regular and dependable through movements have demonstrated themselves to the shippers. Without exception, way traffic on every railroad of which there is any record exceeds through traffic and in some cases it amounts to as much as eighty percent. Far-sighted recognition of this fact is embodied in the construction by the State of warehouse terminals in 44 of the 131 municipalities situated on the line of the Canal at an expense of something like $25,000,000. The appended map shows an estimate of what may be expected in the way of local traffic: it speaks for itself.

A consummate grasp of the situation which we have only been able to outline here is reflected in the formation of The Great Lakes, Hudson and Atlantic Waterways Association early in March. The moving spirit of this organization is the Transmarine Corporation, whose business-like attitude towards the Canal has already been commented on, and it comprises men interested in Canal affairs, traffic men representing various industries, as well as some large Ocean shipping companies. Its preliminary committee is headed by Dr. Henry Moskowitz, Industrial Consultant of the Transmarine Corporation as Chairman; W. W. Nicholson, President of the Inland Marine Corporation, operating 75 boats and barges; R. H. Barnwell, Vice-President, Barge Canal Freighting Corporation, operating 30 boats and barges; Samuel MacClurkan, Traffic Director of the Transmarine Line, operating 20 modern steel barges; A. Miller McDougall, McDougall-Duluth Shipbuilding Co., operating three 1600-ton self-propelled barges; Roy S. Smith, Executive Director of the Albany Chamber of Commerce; C. L. Ferguson, Traffic Manager, American Papeterie Co., of Albany; John G. Barry, General Sales Manager of the General Electric Co. of Schenectady; and C. J. Beck, Traffic Director of the United American Steamship Lines. Temporary headquarters are the National Marine League at 268 Pearl Street, New York City.

A preliminary statement, which will be amplified at a convention of the Association to be held in June, announces these three objects of the Association:

"(1) To bring about co-operation between shippers and water-carriers;

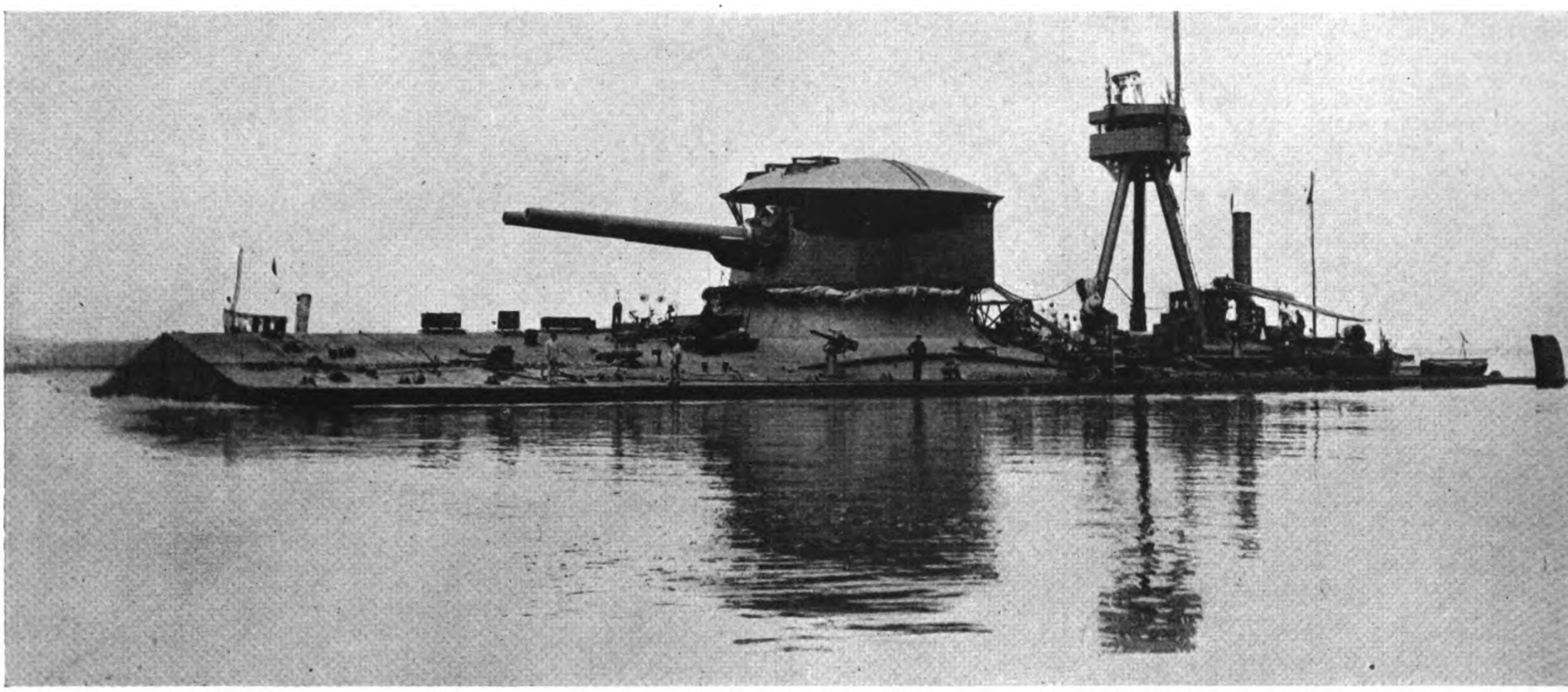
"(2) To co-ordinate the transportation facilities between the Middle West, Atlantic Seaboard and foreign ports, via existing American water routes and

"(3) To further waterway projects and port developments in the region embraced in its title, namely: the Great Lakes, Middle West, New England, and North Atlantic States."

There is little that we might add to this that could further emphasize the potentialities of the shipping industry on the New York State Barge Canal. In the very near future questions of floating equipment and motive power will come up for settlement and the purveyors of economical motor transportation will be presented with rich opportunities.

Before concluding this installment it is interesting to record that the first motor-vessel of the fleet now being constructed by the McDougall-Duluth Shipbuilding Company for the Inter Waterways Line Inc. left Duluth for Buffalo, N. Y., on the morning of May 20th, loaded with a cargo of oats. This vessel is propelled by Skandia surface-ignition type heavy-oil-engines.

(To be continued)



"Faa di Bruno," a floating-battery of the Royal Italian Navy, propelled by a Diesel oil-engine. She carries two 15-inch guns, two 14-pounders and two 1½-pounders. The stack is for the exhaust-gases. She and her sisters did deadly work against Austrian forts in 1918. Photo courtesy of the Ministry of Marine

Lubricating-Oils for Diesel-Engine Air-Compressors

At a recent meeting the Diesel Engine Users Assocation was quite unanimous on the point that whatever quality of lubricating-oil was used in the air-compressor, whether this be a straight-mineral-oil or a compounded-oil, the smallest practicable quantity should be introduced.

The following are the specifications regarding oils suitable for use for lubricating air-compressors which were finally adopted.

LUBRICATION

The lubricating-oil used in the air-compressor should be an oil of the highest-grade obtainable and must be used only in the *smallest practicable quantity.*

The following properties are necessary in all lubricating-oils for Diesel-engine compressors:

(a) The oil should be entirely free from suspended particles of water.

(b) The oil must be entirely free from sand or other inorganic material. No mechanical impurities must be visible in the oil when it is viewed by holding a sample in a glass vessel against a light.

(c) The oil must be entirely free from inorganic acids.

(d) Oils should not be lower in viscosity than 300 seconds Redwood at 70 degrees Fahrenheit nor higher in viscosity than 3,000 seconds Redwood at 70 degrees Fahrenheit.

(e) Oils should in no case be lower in closed flash point than 350 degrees Fahrenheit.

(f) If the oil is to be used on an enclosed crankcase high speed engine in which the same lubricant is used both for the compressor and in the crankcase, it should have a closed flash-point of not less than 400 degrees Fahrenheit. (It should be borne in mind that "Open" flash-point tests give results 20 degrees to 30 degrees Fahrenheit higher than the closed tests on these types of oils).

For further guidance it may be pointed out that from past experience it has been found that the oils which have met with most success in Diesel-engine air-compressor lubrication, besides complying with the foregoing stipulations, have generally possessed properties lying within the following limits:

Specific gravity ....0.870 to 0.915 at 15° C.
Viscosity (Redwood) .400 to 1,000 seconds at 70° F.
Viscosity (Redwood)..75 to 125 seconds at 140° F.
Closed flash point ....Not less than 400° F.
Color......Red or yellow by transmitted light, but clear (not misty or smoky).

Both straight mineral oils and compounded oils containing small quantities of saponifable oil have met with success on Diesel-engine compressor service, but the majority of successful oils have been straight mineral-oils.

FLEET OF MOTORSHIPS FOR NEW YORK

At the end of May quite a large fleet of motorships were in New York harbor, loading and unloading cargo. Included were the British 10,050 tons d.w. Vickers-Diesel-engined tankers "Seminole" and "Narragansett" of the Anglo-American Oil Co.; the Alaska Steamship Co.'s 6,500 tons McIntosh & Seymour Diesel-engined freighter "Kennecott"; the Swedish Götaverken-built 7,500 tons motor-freighter "Stureholm," and the German 17,000 tons d.w. tanker "Zoppot," fitted with Krupp Diesel-engines.

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MOTORSHIP

Trade Mark, Registered

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WHAT'S ALL THE SHOOTIN' FOR?

Few of our readers who recently saw an amusing play in New York, realized that they were being fooled—delightfully perhaps—until just before the final curtain, although the key to the situation had been very subtly suggested by the constant repetition of the above and other similar remarks. To-day the curtain is dropping on the play on the stage of the theatre of shipowning and shipbuilding, which is very serious for both the actors and audience. Although they are not all yet ready to openly admit it, many shipowners and builders have been unconsciously taking part in a play which has become almost a tragedy. When the shipping boom was at its height, almost anything that would float would make money, with the result that most American shipowners wouldn't even consider the problem of developing and building types of cargo and passenger carriers that would effect economies of a few "paltry hundred-thousand dollars a year," and which would be able to keep the seas in the face of severe competition, so bright did the present and future of shipping then seem. For similar reasons few shipbuilders used technical pressure upon shipowners to build economical motorships, which in their own interests they should have done. The result everyone knows, and to-day our ships—and the uneconomical steamships of foreign countries—are having great difficulties to run on the high-seas without heavy loss, whereas, so far as we have been able to ascertain, only one ocean-going foreign motorship has been laid-up through inability to obtain cargo at terms which paid to run her, whereas thousands of steamers are tied-up and most motorships are working with full cargoes. Shipping men who sat in arm-chairs through the boom now realize "what all the shootin' was for," and why this publication has fought so hard for the adoption of oil-engine power for the last five years, and that in our pages we clearly indicated that a grave mistake was being made. There's one chance left for this play of the American Merchant Marine to become a success, namely, for it to be partly re-written to convert several hundred existing freighters and passenger-freighters to economical Diesel, or Diesel-electric power without further hesitation. The Shipping Board, as co-author of the unsuccessful play, must do its part in the revision. Will it be done before the final curtain rings down?

BRITISH MOTORSHIP CONSTRUCTION

Taking into consideration that during the war only one British firm was allowed to build Diesel-engined merchant-motorships for ocean-going traffic, the recent development of this new type of vessel has made remarkable progress in Great Britain since the Armistice and standardized-craft of 15,000 tons and 14 knots speed are now normal and regular products, with building periods and costs less than those of steamers per ton net cargo-capacity.

Lloyd's returns for British shipbuilding for the three months ending March 31, 1921, must be mortifying to those of our own shipyards, that missed the golden opportunity a short time ago. The list given elsewhere in this issue shows that on that date there were 66 motorships of approximately 418,639 d.w.c. tons on the ways in the British shipyards, of which thirty were between 5,000 and 10,000 tons gross-register each. The greatest activity is on the Clyde, where Harland & Wolff and other big yards are forcing the pace, there being no fewer than 27 motorships of 173,630 tons gross building at Glasgow, Govan, Greenock, Dumbarton and Dalmuir. Barrow is second on the list, with five vessels aggregating 34,445 tons gross. Contrasting with this comparative "boom" in motorship building, *steam*ship construction in Gt. Britain is in the same very depressed condition as the United States.

As has been illustrated in "Motorship," several big American shipbuilders recently turned their attentions to motorship construction, and a number are engaged in building one or more large Diesel engines; but the day of securing orders for large fleets of new motor-freighters is not yet with us again, and will not be until the world's business conditions take an upward trend. So our shipyards will do wisely if they follow the example of the Merchant Shipbuilding Corporation and prepare their facilities for the conversion of existing steamers to Diesel motor power, and urge upon shipowners to have this done. Otherwise many additional shipyards will close down before long.

MOTORSHIP CONSTRUCTION IN GERMANY

Realizing the great importance of economy in connection with the re-construction of Germany's merchant marine, her shipbuilders and ship-owners during the last twelve months have very actively taken-up the construction of Diesel-driven motorships. One new shipyard alone has devoted practically its entire production to this class of vessel, and has 19 ways ranging from 140 ft. to 820 ft. on a river frontage of 6,000 ft., and has 6,000 employees engaged. Also 1,500 more employees are to be added. We refer to the Deutsche Werft at Hamburg, which, as already announced in "Motorship," is constructing a fleet of freighters in which will be installed Burmeister & Wain type Diesel-engines now building under license by the A.E.G. In this project the Hamburg American Line are financially interested. Krupps of Kiel are also building a large fleet of Diesel-driven motorships, and their plans were outlined in our pages by the Chief-Engineer some months ago. Blohm & Voss of Hamburg, who for many years have worked hard on developing a double-acting Diesel engine, are now completing a new ship equipped with engines of this type and have just received an order for eight motorships from the Hamburg-American Line. Then again the Howaldtswerke of Kiel are constructing two motorships in which Sulzer-type Diesel-engines are being installed. Meanwhile America looks on, but does very little.

FIFTH TURBINE-ELECTRIC FREIGHTER ORDERED

A contract to convert the 11,800 tons steam-driven freighter "Victorias" has just been placed by the United States Shipping Board, and she is the fifth of twelve vessels to be thus changed. In an article on other pages in this issue are given details of the Shipping Board's solitary motorship, the machinery for which was ordered about three years ago, and which has been in this country for nearly two years. As yet the Shipping Board has not ordered the conversion of a single steamship to economical Diesel power or to Diesel-electric drive, but seems to have plenty of money for converting steamers from one class of steam-machinery to another type of steam-drive. We draw the attention of the Board to Lloyd's returns of motorships launched in the world (exclusive of Germany) during 1920 and 1921, as follows:

1920		1921	
No. of Ships	Gross Tonnage	No. of Ships	Gross Tonnage
100	189,977	194	503,844

Total for two years, 294 motorships of 693,821 gross tons

This represents approximately one-million tons deadweight, and the advance in tonnage between 1920 and 1921 is most noteworthy. The turbine-electric-driven vessel absolutely cannot compete against Diesel motorships on the same routes.

INTERNATIONAL SURFACE-IGNITION OIL-ENGINE TESTS

American surface-ignition oil-engine manufacturers should seriously consider sending an engine to France for the series of tests to be run in October next under the supervision of the Technical Commission of the Automible Club of France, the Agricultural Commission, the Legue Maritime Francais, and the yachting division of the Automobile Club of France. Any engine of this type suitable for fishing-boats or agricultural purposes can be entered by firms in America, France, Great Britain, Denmark, Belgium, Holland, Norway, Sweden and Switzerland. Powers range from 2½ to 50 b.h.p. In the 35 b.h.p. to 50 b.h.p. units, the engine must have two cylinders. Powers must be developed at speed ranging from 450 to 300 r.p.m., respectively, with 20 per cent allowance over or under. All engines must be ready and in France by October 15th, and entries must be made by August 1st, the entry fees varying from 200 to 400 francs, according to power. Full details regarding the trials can be secured from the Commission Technique de L'Automobile Club de France, 8 Place de La Concorde, Paris. In view of the recent big financial grants made by the French Government to encourage the adoption of oil-engines in fishing-vessels, it would at least be well-worth the while of American manufacturers making full investigations, with a view to entering an engine for the trials and establishing selling agencies in France.

OUR CONTEMPORARY ERRS

Recently we stated that Harland & Wolff were building a duplicate of the 14,000-ton 12½ knots Diesel motorship "Glenogle" of the Glen to the order of the Holland-American Line. In its issue of May 7, 1921, "Nauticus," of New York, states that this report is without foundation. We beg to contradict our esteemed contemporary, as we have the information direct from Harland & Wolff. Furthermore, the Holland-American Line's directorate has advised our Netherland correspondent that two such motorships are on order with Harland & Wolff, but that they are not yet named. The report that the "Statendam" was to be Diesel-engined (not published in "Motorship") was due to an error on the part of the head of the New York office of the Holland-American Line.

Single-Screw Motorship "Sardinia" Runs Trials

First of the 2,140 i.h.p. Werkspoor-Diesel Engines Exceeds Anticipation in New Freighters for Otto Thoresen Line.—Three American Companies at Work on Similar-Powered Engines of Modified Werkspoor Design

THREE American shipbuilding and engineering firms are each now engaged in producing a modified Werkspoor-Diesel marine-engine of 2,140 i.h.p. under the supervision of experts from the licensors in Amsterdam, and we understand that two of the engines are actually under construction, namely, at the plants of the New York Shipbuilding Corporation and the Newport News Shipbuilding & Dry Dock Company, respectively. The third engine has been designed by the Pacific Coast licenses of Werkspoor, namely, the Skandia Pacific Oil Engine Company, of Oakland, California; but we are not aware of actual constructional work having yet commenced up to the time of closing for press, although a number of 1,100 i.h.p. sets have been completed.

In Holland, the Werkspoor Company's first completed engine of this new size has just successfully run sea trials near Rotterdam in a new motorship of the Otto Thorensen Line of Christiana, Norway, although the engine was not run in the Amsterdam factory prior to being installed in the ship. In view of the differences in the construction of these four Diesel-engines, and because of their direct relation to future American shipbuilding, comparisons between the same of not a little importance at this time, as well as of general interest. Although these engines differ in a number of individual constructional features, all conform to the principal characteristics of Werkspoor design and experience, but each of the respective American companies has modified the engine in accordance with their own conception of the requirements of the American Merchant Marine and American shop practices. So far as we are aware the various British, Swedish and French licensees have not departed in any way from standard Werkspoor practice.

In no previous period of the development of the marine Diesel-engine has a similar situation arisen and the position of the American concerns in the shipbuilding world makes the matter one over which considerable technical discussion will arise sooner or later, particularly when more details of the three American engines are available. Their general specifications are as follows:

	Amsterdam Werkspoor	New York Werkspoor	Newport News Werkspoor	Skandia Werkspoor
Indicated horsepower	2,140	2,000	2,000	2,000
Brake horsepower	1,540	1,500	1,450	1,500
No. of cylinders	6	6	6	6
Cylinder diameter	26.378"	27"	27"	27½"
Piston stroke	47.244"	47"	48"	47¼"
Revs. per minute	110	110	110	100
Piston-Speed (per Min)	866'	862'	880'	787'
Brake h.p. per cyl. d.	257	250	242	250
Ind. h. p. per cyl. d.	357	333	325	333
Weight (short-tons)	235 tons	270 tons	240 tons	235 tons
Weight per i h.p.	220 lbs	270 lbs	240 lbs	235 lbs
Weight per b.h.p.	305 lbs	360 lbs	330 lbs	313 lbs
Mean effective pressure (per sq. in.)	72 lbs	72 lbs.	63.3 lbs	92 lbs.*
Length over all (without thrusts)	33'11½"	34' 0"	35' 8"	40' 10"

*m. i. p.

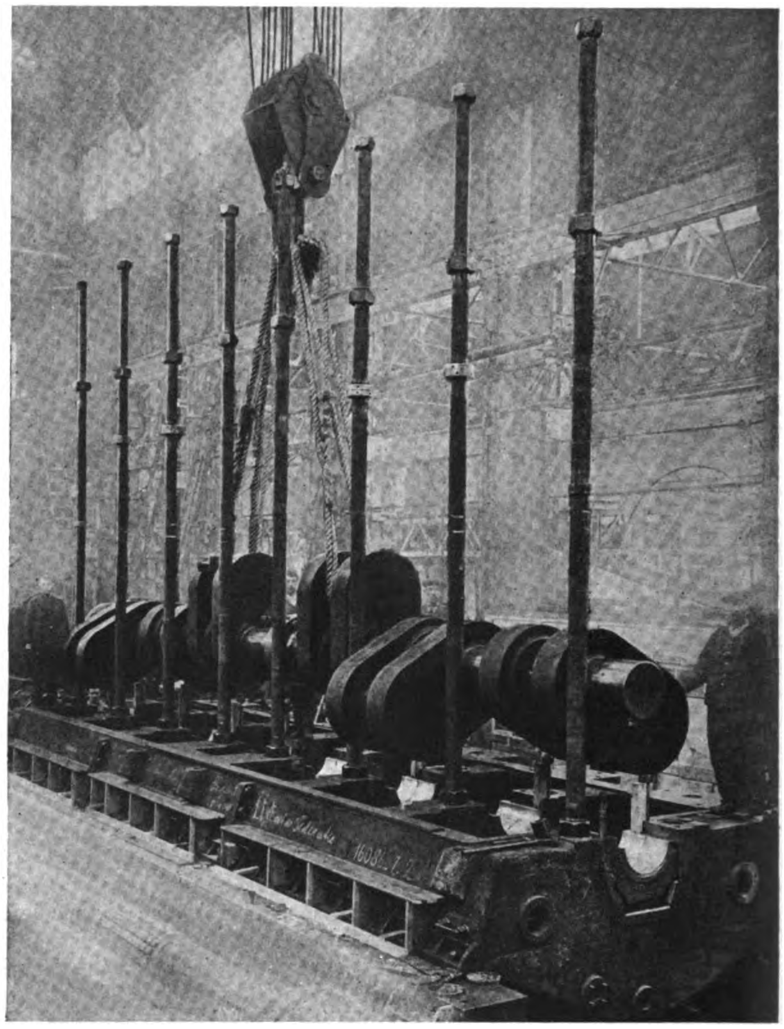
In the table we have quoted the maximum power of the Amsterdam Werkspoor engine, but the builders conservatively rate it as developing 1,940 to 2,140 indicated horsepower (1,400 to 1,540 b.h.p.) at 106 to 110 revolutions per minute with 72 per cent mechancial efficiency, and with a mean indicated-pressure of 89 to 98 lbs., according to respective power output. A fuel-consumption of 0.33 lb. per indicated horsepower hour is guaranteed, but in actual service with smaller sizes has proved to be well under this figure. In service the power is equivalent to 1,800 steam i.h.p. In the case of the engine the "Sardinia," it is intended to run regularly at 106 r.p.m. with a mean indicated-pressure of about 94 lbs. per sq. inch (6-5 Kg) and developing about 1,400 shaft h.p., which the builders regard as a safe average for long distance voyages.

It is not generally known that apart from twin-screw vessels about half-a-dozen single-screw Werkspoor Diesel-engined motorships have been in regular service since prior to the war, because some of them are consistently operating in the Dutch East Indies and have never left those waters since taken over by the owners, but the highest-powered of these boats, "Juno" and "Loudon," have only 1,400 i.h.p. on the single shaft, also in six cylinders. All Werkspoor engines are of course of the single-acting four-cycle type and are directly reversible by compressed air.

To return to the "Sardinia," she is not a large vessel, but has a fair turn of speed for a vessel of this size, being designed for 11 knots loaded, but unfortunately a heavy fog prevented actual speed being registered on the trial run. The vessel has the following dimensions:

Deadweight capacity	3,000 metric tons
Gross tonnage	2,644 tons
Net tonnage	2,014 tons
Length (B.P.)	303' 6"
Breadth (M.D.)	42' 2"
Depth (to main deck)	20' 4"
Draught (Loaded)	19' 3"
Speed (loaded)	11 knots
Power	1,940 to 2,140 I.H.P.
Average daily fuel consumption	6½ tons

She was built by J. & K. Smit & Co. of Kinderdijk & Krimpen a/d Lek, near Rotterdam, and was engined by Werkspoor of Amsterdam. She was constructed on metric lines and to metric dimensions, which her builders consider to be the most economical and scientific method. This

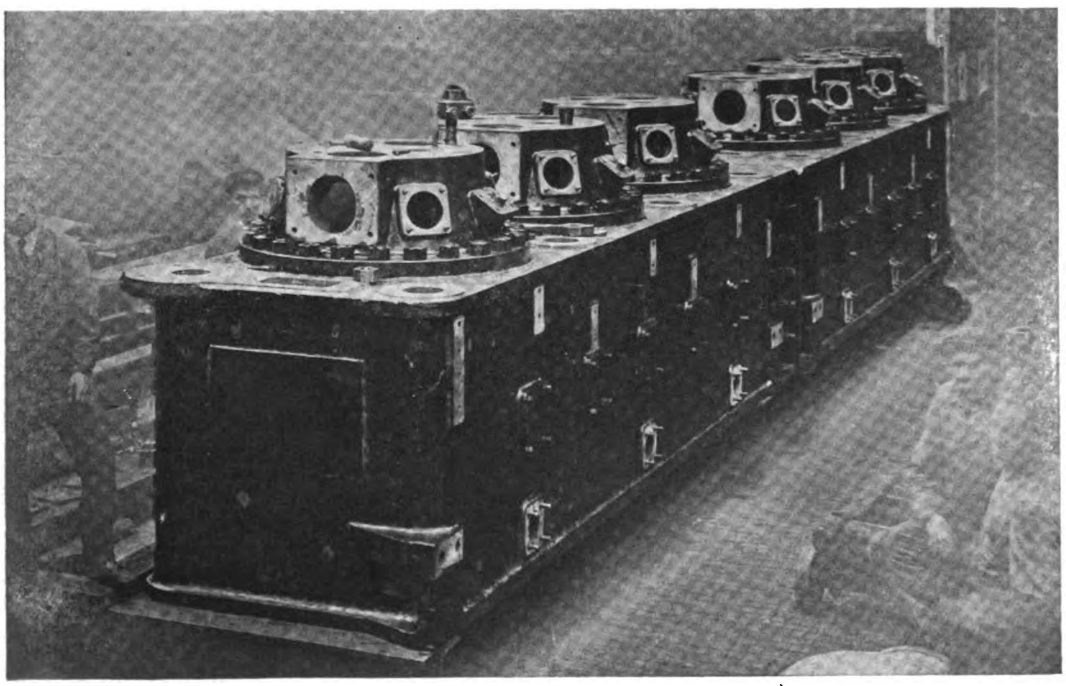


View showing bed-plate and one set of steel columns, also built-up crankshaft

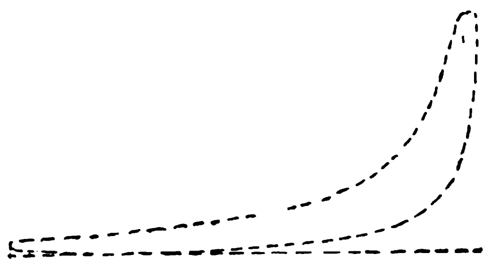
claim suggests that American shipbuilders should study the metric-system as applied to domestic ship-construction, with a view to ascertaining if production costs could be reduced. The Skandia-Werkspoor engines are built to the metric system.

Our Netherlands editorial-representative, who was present at the trials of the "Sardinia," remarked that as her big Diesel-engine had not been given any shop tests, it would be remarkable if it ran for the ship's trial without trouble of some sort. However, everything worked even more smoothly than would have been expected if the engine had had extensive tests prior to being installed in the hull, regardless of it being the first of its power and in spite of the fact that difficulties of design grow with each increase in the cylinder dimensions. Also because 26 1/3-in. diameter is no mean size, although already exceeded by other makers. An engine developing 3,000 i.h.p. in six cylinders, or 500 i.h.p. per cylinder, is now being produced by Werkspoor, as previously announced in "Motorship," but we doubt if it will be ready this year. Also a Skandia-Werkspoor engine of 2,500 i.h.p. has been designed.

While designed to carry general cargo, the "Sardinia" also has accommodations for eight



Cylinder-box of the 2140 i.h.p. Werkspoor-Diesel engine showing cylinders in position. The steel columns run through these boxes down to the bed-plate



Card taken on trials at 106 R.P.M. The mean effective-pressure is 91 lbs.

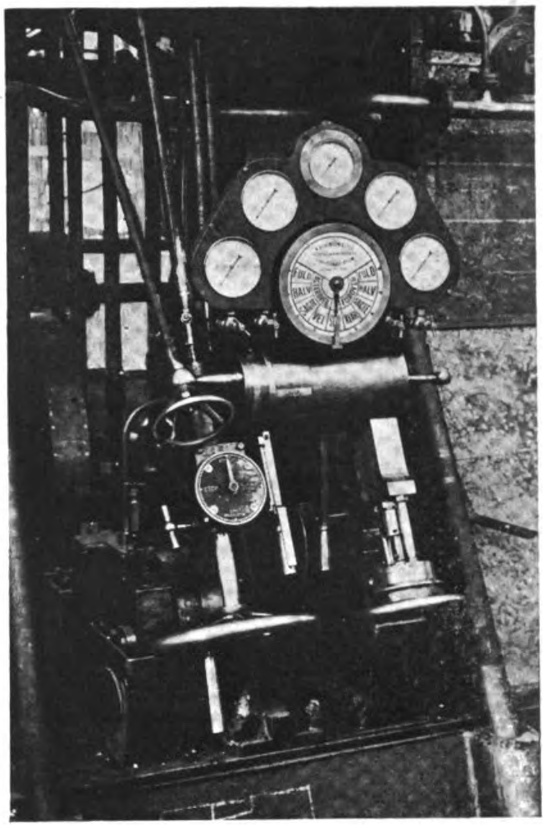
passengers, four roomy cabins, a saloon panelled in polished mahogany, bathroom, etc.; all the accommodations, including offices, are steam-heated by the Low system. With a total daily-fuel consumption of under 7 tons at 11 knots average loaded-speed, she obviously will be a very economical ship to operate, especially as only a small engine-room crew will be required. Also she will have unusual earning-capacity for her dimensions and power, because 300 tons of fuel will carry her over 10,000 nautical-miles, enabling her to carry about 2,650 tons of net, or actual, cargo on a voyage of that length in addition to the necessary fresh-water and stores.

We doubt if a steamship of her overall dimensions and power could be operated with profit in the ocean trades, under to-day's conditions, because her fuel-consumption would be excessive and because she would be unable to carry more than about 2,000 tons of net-cargo. But, obviously, the "Sardinia" can be operated with an excellent showing, for the reasons given.

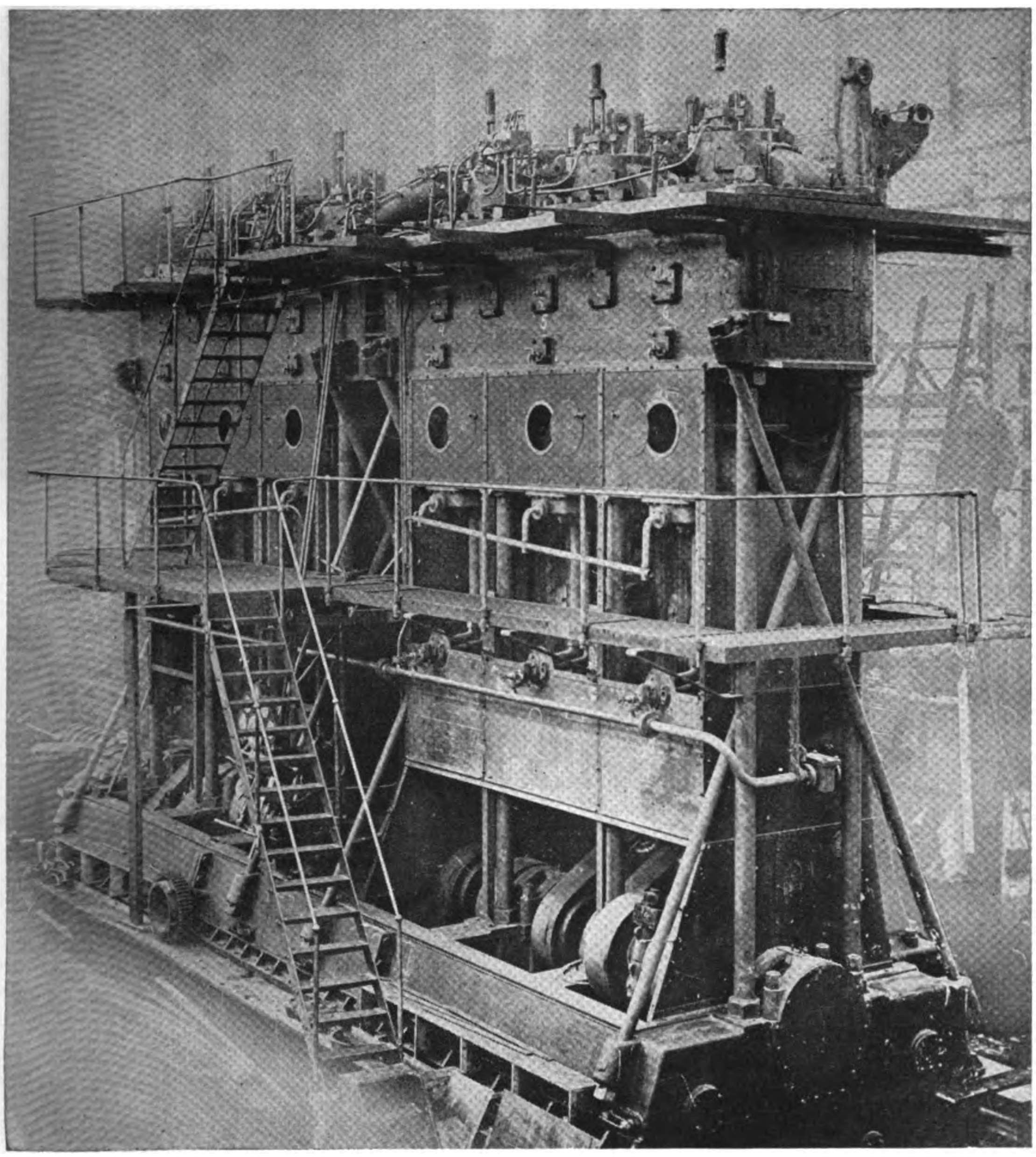
As in the case of the trials of the motorship, "San Paulo" during February last, a dense fog prevailed on March 26th, when the trials of the "Sardinia" were run, and up to noon it looked as if they would have to be postponed. But the fog lifted a little, and at 12:27 P.M. the order "Slow Ahead" was rung down to the engine-room and, 4½ seconds later to be exact, the engine was turning its first revolutions under power, propelling the ship. Soon the speed was increased to 90 r.p.m., and at 1:35 p.m. she overtook the steamer "Eastminister Abbey." At 2 p.m. the engine-speed was brought up to 95 r.p.m., and an hour later was turning at 106 r.p.m., developing the full normal-load.

After the vessel had been an hour in the open sea, the fog descended again, and was so dense that the pilot decided to turn back and "creep" into the mouth of the New Waterway as quickly as it could be found. From then until 7 P. M. the vessel was run up-and-down the river at full speed. It is to be recorded that from the time the engine was started, a period of 7½ hours, they ran smoothly and without a suggestion of trouble, performing every manoeuvring order from the bridge within five to ten seconds. For starting, stopping and speed variation five seconds were taken, and ten seconds from full-ahead to full-astern, or vice-versa. The exhaust-gases were perfectly clear, no noise emanated from the engine-room, and the vibration of the ship was hardly noticeable, although she was in a light condition. In fact, in the saloon it was difficult to tell whether the main engine was running or not. The slight trembling perceptible came from the three auxiliary Diesel-electric generating-sets that were kept running throughout the trip for trial purposes. All cylinders gave excellent indicator-diagrams of which two examples accompany this article.

It is possible that the situation of the main engine on the centre line of the ship and a well-balanced propeller may partly account for the absence of vibration, but no doubt the excellent balancing of the working parts of the main engine are largely responsible. Because of the short run, no fuel and lubricating-oil consumptions were taken with a degree of accuracy, but these will be available after the maiden voyage. Also the builders did not desire to crowd the engine-room with more or less useful "experts" merely taking readings, but otherwise obstructing the movements of the regular engine-room crew, owing to the fog. As the trials were not held in the open sea, but in the New Waterway, it was not possible to use the log, and the tide in the estuary caused elements of uncertainty. But, in view of the ease with which she overtook the "Eastminster Abbey," no fears regarding not obtaining her designed speed need be entertained.

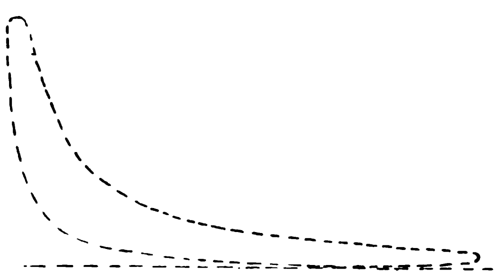


New control-gear of Werkspoor engine



The 2150 i.h.p. Werkspoor four-cycle Diesel engine of the new single-screw motorship "Sardinia"

The main engine follows the general design of the 1,400 i.h.p. Werkspoor Diesel engine with its combination of steel and cast-iron, diagonal stays, columns and cylinder-box construction, already described in these pages, so need no lengthy description. The crankshaft is of Siemens Martin steel of the built-up type 415 mm. diameter, and with main-bearings 530 m.m. long. The crank-pin is 3770 m.m. long, and the piston-rod 110 m.m. diameter



Indicator card from Werkspoor 2140 i.h.p. engine at 106 revs. per min. taken on ship trials. M.E.P. 89 lbs. per sq. in. Temperature of exhaust, 707 deg. Fahr.

Recent improvements developed with this design, including the new reversing system, the improved air-intake which is very silent, and the adjustable crankshaft bearings, also the simplified system of manoeuvring levers, have been incorporated. Possibly, however, the form of manoeuvring levers may be changed with later engines because rounding-off the ends and arranging for the largest diameter at about three-quarters from the end may give a more ideal grip. This, of course, is a matter of minor importance, but sometimes such apparent trifles are overlooked by engineers who have far greater problems to solve.

As regards auxiliaries in the engine-room, one of the most important units is a two-crank three-stage air-compressor driven by an electric-motor of 150 b.h.p. at 275 r.p.m., the motor having been made by the Electrotechnische Industrie voorheen Willem Smit of Slikkerveer, Holland, and the compressor was built by Werkspoor. This is installed at the forward end on the port-side. Next there is a three-crank pump, also electrically-driven. One pump serves as an emergency air-compressor, one for bilge and deck-service and, the third for emergency cooling-water circulation. Then there is a small steam-driven air-compressor, also for emergencies, and it is supplied with steam from a small Werkspoor-built Scotch-type donkey-boiler. It hardly is necessary, as there is a little compressor driven by a 6 b.h.p. Kromhout surface-ignition oil-engine at 550 r.p.m., so we presume it is fitted to comply with Lloyds regulations. This oil-engine also drives a small electric generator.

On the starboard side of the engine-room there are two centrifugal pumps each connected to a 24 b.h.p. electric-motor turning at 1,450 r.p.m. These serve for bilge, ballast and cooling-water purposes, and are at the after end. Nearby it is the switchboard. There is a 11 h.p. 6½ K.W. 220-volt motor-driven dynamo for lighting purposes. The short oscillations to be found in the current from the Diesel-driven generators are compensated by it and a steady current results. Possibly if fitted with a flywheel of about a thousand pounds running on ball-bearings, such an arrangement could be made to form an excellent emergency generator. And, if by any chance the main current became cut-out, this set would continue to produce current for lighting for several minutes, allowing time to change a fuse or start another engine.

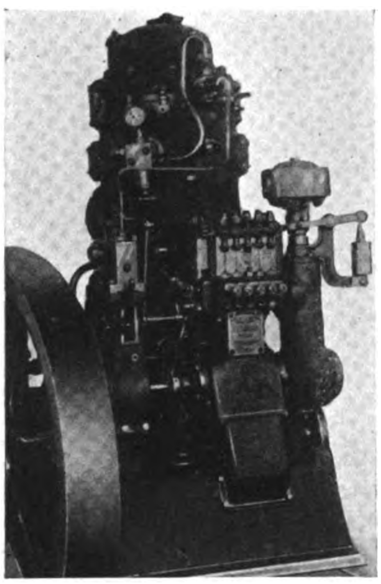
It is very unfortunate that we are unable to give any engine-room plans of this ship because the arrangement of auxiliary Diesel-engines is quite novel. It differs from the usual plan in that they are installed diagonally on the port side of the engine-room, and so allow ample space for the engineers to walk around. It will be realized in a ship of but 42 ft. breadth, and such high power, there is none too much room in the machinery compartment.

These auxiliary Diesel-engines are the Werkspoor standard four-cycle type, and each develops 100 b.h.p. at 250 r.p.m. from two single-acting cylinders 320 mm. bore by 450 mm. stroke. Each is direct coupled to a 65 K.W. "Electro" generator, the latter being the trade-name of the Willems Smit Company already referred to.

VEGETABLE-OILS AS FUEL FOR SURFACE-IGNITION OIL-ENGINES

Interesting experiments with vegetable-oils as fuel for surface-ignition oil-engines have been carried out at the worke of Ansaldo-San Georgio Ltd., Turin, Italy. The engine used was a standard single-cylinder model of 20 b.h.p. at 400 r.p.m., taken from stock. With this design the admission of scavenging-air to the cylinder is controlled, and there is no injection of fresh water, the latter feature now having been abandoned by most makers, and the cylinder-head is water cooled instead.

With the Ansaldo-San-Giorgio design, the cooling of the cylinder-head consists of a large oblique canal, connecting the cylinder cooling-chamber to the hot-bulb on the head, and prevents the bulb attaining too high a temperature, thus dispensing



Ansaldo-San Giorgio 20 b.h.p. surface-ignition oil-engine that ran tests on vegetable-oils

with water injection. By means of the device to control admission of scavenging-air, the vulpmetric efficiency of air drawn in can be maintained as high as possible, but proportioned always to the quantity required for scavenging. Better combustion results and a higher efficiency of power, with suppression of the resistance offered to the air by the ordinary automatic valves. This device is shown by rotary cylindrical valve B, in Figure 1.

The first series of experiments was made, employing ordinary heavy-oil with a specific gravity of 0.9. The results were as follows:

Rev per min.	B. H. P.	Consumption per B. H. P. Hour
405	23.5	260 gross
411	27.3	293 gross

Being a high-speed engine, and as the power developed is overload, the consumption is noteworthy low.

The second series of experiments was made with Winter Cotton-Oil, having following characteristics:

Colour = yellow (straw).
Limpidity = opalescent.
Density at 15° = 0,092.
Inflammability temperature = 185° C.
Ignition temperature = above 250° C.
Reaction = neutral.
Calorific power = 9573.

As it may be seen, the values of viscosity and density, and the points of inflammability and ignition are all high—in comparison to the heavy-oils usually employed; therefore the use of above oil as fuel should not seem to be possible with all types of engines. The experiments gave the following results:

Revs. per min.	B. H. P.	Consumption per H. P. Hour
412	22.8	299.1 gross
413	25.7	340.9 gross

While with heavy-oil the discharge of the burnt gases was absolutely invisible, it presented with cotton-oil slight smoky traces.

The third series of experiments was made with palm-oil having the following characteristics:

Colour = yellow.
Consistency = buttery.
Density at 15° = 0.9
Engler viscosity at 50° = 3.5.
Inflammability temperature = 280° C.
Ignition temperature = 325° C.
Calorific power = 9350.

Following have been the results of this third series of experiments:

Revs. per min.	B. H. P.	Consumption per B. H. P. Hour
423	21.1	312 gross
395	24	328 gross

The consumptions, compared with those of heavy-oil, are higher, but the ratio is nearly equal to that of the calorific powers. Also here the discharge of burnt gases was almost invisible. After the experiments, the bulb was removed, and only very slight traces of carbonious deposits were found.

The above experiments have a very important interest, owing to their essentially practical nature, which leads to further experimenting of use of hot-bulb engines. This is important because a wider field is opening to their employ in the extended colonial territories, as well as in all those countries where vegetable-oils abound, and where natural conditions of ground, difficulties and poor transport facilities, distance from oil-wells, make the supply of mineral-oil scarce and expensive.

PERFORMANCES OF ITALIAN MOTORSHIPS

The "Ansaldo San Giorgio" motorships of Società Nazionale di Navigazione, of Genoa, are continuing very successfully their operating in trade between Italy and Valparaiso through Panama Canal. Over 60,000 nautical miles have been covered by each of these motorships with complete regularity, so that their engines have demonstrated to be thoroughly reliable and economical, two-cycle Diesel engines. Following are two statements referring to a voyage of motorship "Ansaldo San Giorgio II" from Genoa to Valparaiso and return.

Consumption Schedule

Consumption	Propelling—engines Hours run	Density	Fuel	Lub. oil	Donkey-boiler Hours	Fuel
Harbor.....	......	.....	......	......	1,209	132.4
At sea.....	894.4	0.9	360	16.912	132	15.6
Total..	894.4	0.9	360	16.912	1,341	148.0

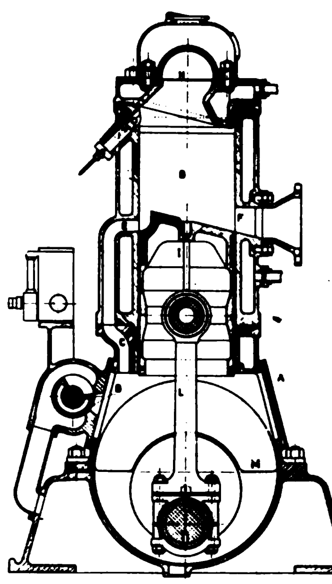
Mean Consumptions

Consumption per shaft H.P. hour. Fuel: 191 grams. Lubricant: 4 grams.

These figures relate to the voyage during which the following harbors were touched:

	Arrival	Departure
Genoa....................		5th of April
Marseilles....................	6th of April	6th
Barcelona....................	7th	9th
Cadiz....................	12th	13th
Teneriffe....................	16th	17th
Trinidad....................	27th	28th
La Guaira....................	29th	1st of May
Porto Cabello....................	2d of May	2d
Curacao....................	3d	3d
Sabanilla....................	5th	9th
Cartagena....................	10th	11th
Colon....................	13th	13th
Panama....................	13th	15th
Bonaventura....................	16th	21st
Puma....................	23d	24th
Guayaquil....................	26th	25th
Callao....................	28th	1st of June
Mollendo....................	3d of June	3d
Arica....................	4th	4th
Antofagasta....................	6th	6th
Valparaiso....................	9th	14th

From above dates it will be easily seen that the engines were stopped only for very short times, the ship anchoring in open bays, not in harbor,



Section of the Ansaldo-San Giorgio surface-ignition oil-engine

always ready to start at a moment's notice. The voyage was accomplished without any delay. The consumption schedule of the return voyage was as follows:

Consumption Schedule

Consumption	Propelling—engines Hours run	Density	Fuel	Lub. oil	Donkey-boiler Hours	Fuel
Harbor.....	......	.....	......	......	686	68.4
At sea.....	1,008	0.9	415.9	17.614	.....	.....
Total..	1,008	0.9	415.9	17.614	686	68.4

Mean Consumptions

Consumption p. HP. hour Fuel: 195 grams; Lubricant, 4 grams

These figures, referring to a complete voyage chosen among the usual voyages of the above-mentioned motorship, are a clear testimony of reliability.

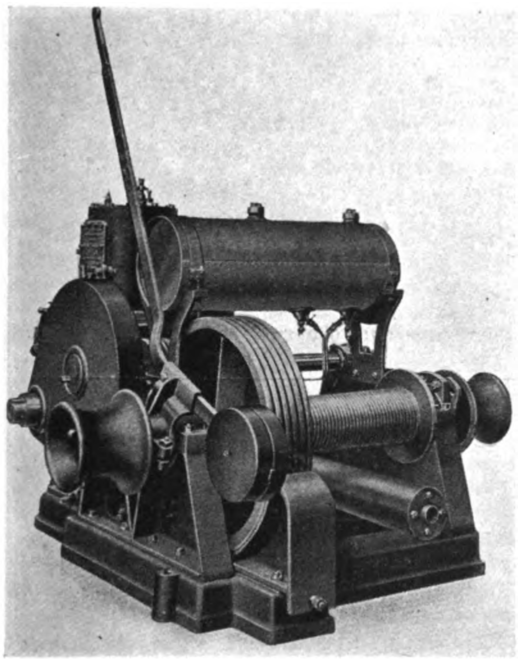
The aforesaid reliability is demonstrated by the fact that the "Società Nazionale di Navigazione" have decided to operate two of these motor-freighters on new routes. On the 15th of April inst. the "Ansaldo San Giorgio I" and the "Ansaldo San Giorgio III" will start from Genoa: the first for a voyage for the eastern ports of South America, viz., Rio de Janeiro, Santos, Buenos Aires, etc.; while the "Ansaldo San Giorgio II" will touch the Asiatic ports: Port Said, Bombay, Colombo, Calcutta, Singapore, etc., etc.

A Simple Motor-Winch

On both coasts of this country a large number of sailing-vessels, both cargo-carriers and fishing-boats, have no mechanical propelling-power. To such a craft a power-winch is a boon and an economy, because of the big saving of time and labor. In such installations the power has to be furnished directly with the winch, and it is usual to have the same provided by a gasoline-motor operating direct.

We have before us details of a motor-winch of this type built in England by a well-known company specializing in gasoline and kerosene engines, namely, Smart & Brown, of Erith, Kent, and reference to the illustration will show that it is of a very practical design. It was nearly 10 years ago we first saw one of these winches, and now note that except for minor modifications and improvements the design and construction is still virtually the same as it was then, as it has been thoroughly standardized. By means of the particular arrangement adopted the slipping-clutch problem, for long the great stumbling block in motor-winches, has been overcome successfully.

The equipment is mounted on a cast-iron bed-plate, which is hollow, and contains the cylinder cooling-water, thus being entirely self-contained. The winch itself is merely a drum driven off the engine by a large friction-pulley entirely controlled by one lever, which throws the friction-drive in or out of action as required. The friction-drum has four grooves on the driving pulley. It is driven by a Smart & Brown single-cylinder gasoline or kerosene motor of the four-cycle type having a 4-in. bore and stroke and 4 h.p. is developed at 950 r.p.m. High-tension Bosch magneto-ignition is fitted, the magneto being chain-driven off the camshaft. Over the engine is a double tank of three gallons capacity, allowing for two gallons of kerosene and one of gasoline, so that the engine can be run on either fuel. This allows for about nine hours running without replenishing. Although it would hardly be possible to construct a more simple winch, it is quite capable of dealing with the work required, and can lift 5 cwt. at 140 ft. p.m.



Smart & Brown cargo motor-winch designed to meet British Admiralty requirements. Will lift 1½ tons at 88 ft. P.M.

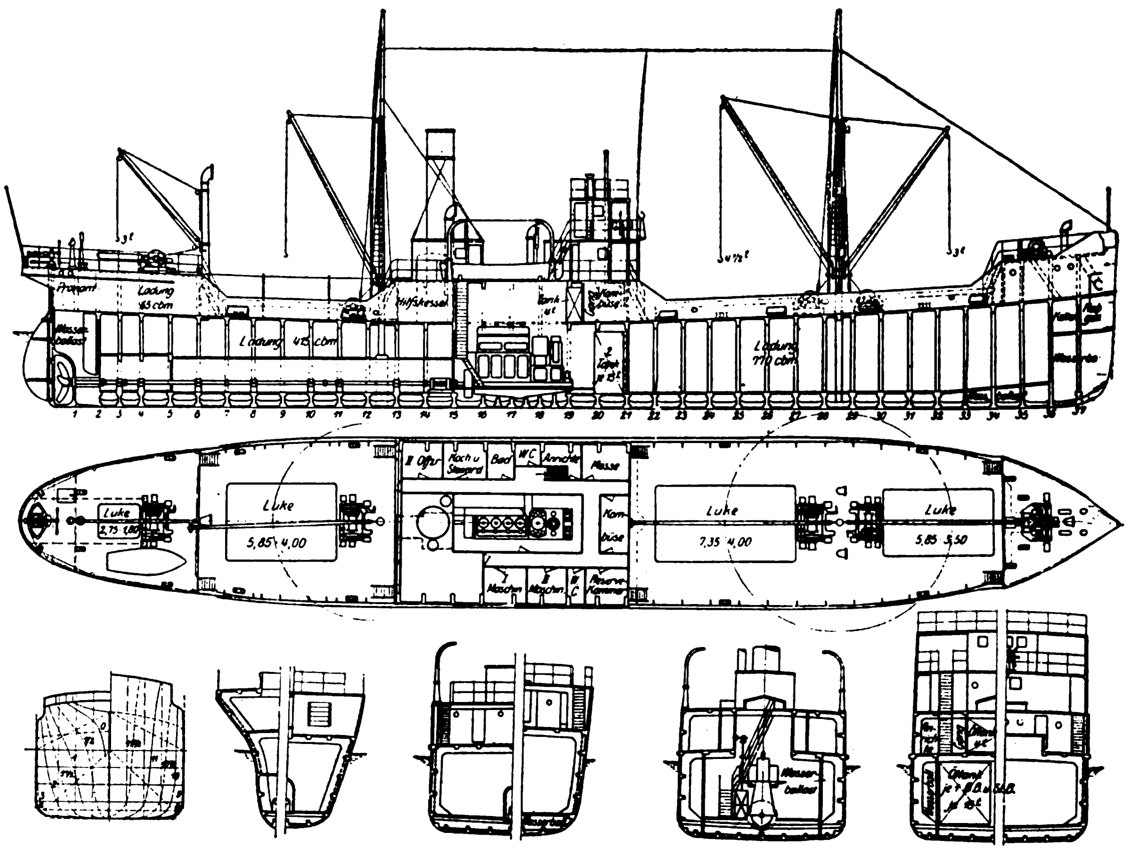
Besides doing the work quicker when in use on barges, sailing-ships, etc., a chain-wheel can be had for raising the anchor, also a pulley can be applied for pumping the bilge-water or even to drive a propeller in a calm. In cases where small vessels have oil-engine propelling power, and oil-engine-electric auxiliary power, we presume that this winch could be fitted with an electric-motor, instead of the oil-engine.

GERMAN CONCRETE MOTORSHIP "GOTAALF"

Practically every maritime country turned to the construction of concrete motorships during the latter stage of the war. On this page we give drawings of the German concrete 800-tons motorship "Götaälf," built for the Baltische Reederi (August Bolten), of Hamburg, by the Reederi Motorfrachtschiff eus Eisenbeton. This vessel is propelled by a four-cycle two-cycle type Sulzer-Diesel engine of 410 shaft h.p. and the auxiliary air-compressor is driven by a 12 b.h.p. oil-engine. She has the following dimensions:

Length	184 ft. 8 in.
Breadth	27 ft. 4 in.
Depth	14 ft. 4 in.
Deadweight capacity	800 tons
Power	410 i.h.p.
Speed	9 to 9½ knots

The Götaälf was launched on October 27 last, and interesting illustrations showing her under construction appeared in a recent issue of "Werft & Reederi." The Sulzer engine was built at Wilhelmshaven.



Plans of German concrete motorship with 410 b.h.p. Sulzer-Diesel engine

Operation of American Motorship "James Timpson"

ONE of the functions of this publication is to follow the progress of old motorships in order to satisfy our readers and ourselves of their reliability and efficiency under regular sea-going conditions. Particularly interesting are the performances of American wooden motorships built under war-time conditions, especially because of the absolute failure of the wooden steamer fleet as post-war carriers and their doubtful value as emergency vessels. Many of our readers will remember the 1,700 tons d.w.c. wooden motorship "James Timpson," built early in 1918 by the G. M. Standifer Construction Company of Portland, Oregon, for the Resolved Corporation of New York City (Ichabod T. Williams & Co.) from designs by Cox & Stevens, and powered by twin Winton 450 shaft h.p. Diesel-engines.

Under recent date her owners wrote us regarding the operation of the "James Timpson" as follows:

"At present we are operating her motors at 220 revolutions per minute, with the result that the vessel attains a speed of 7½ knots. Formerly we ran the engines at a somewhat higher rate, but find that fewer repairs are necessary when they are run at a moderate speed.

"We feel that one of the great needs of the American merchant-marine is the proper training of a large number of motor-engineers and mechanics, which would greatly facilitate the making of proper and speedy repairs on our American motorships, and also would insure their efficient operation at all times.

"In the case of the 'James Timpson' we have succeeded in building up an organization in our engine-room which is admirably efficient, especially as we are now securing splendid co-operation from the deck department. The reason for our success in this matter is very largely due to the efforts of Captain R. E. Hocken and Mr. H. Christensen, Chief-Engineer of the vessel.

"American shipyards also have been gradually improving in the quality of the mechanical personnel available for Diesel repair work, and no doubt if further efforts are made it will be possible in the future to find proper repair conditions in all parts of the United States.

"One warning should be sounded, however, in regard to the conditions which prevails in the bunkering of motorships at American ports. Certain oil advertised for Diesel purposes is not well adapted for motor use, and unless a careful test is made of all oil on board ship before using it in the engines, considerable trouble is likely to eventuate. We believe that Diesel fuel-oil should have a paraffin basis, and there should not be more than a trace of the sulphur content.

"An almost incredible efficiency has been obtaining on the 'James Timpson' as regards the daily consumption of fuel-oil. While making a speed of seven knots, the vessel has an average consumption of 14 barrels of high-grade fuel-oil daily, which is at least 50 per cent better than the manufacturers guaranteed. We have not seen any record of any motorship afloat which equals in this respect that of the 'James Timpson.'

"During the last few months the vessel has been running steadily in the mahogany trade without any stoppage or delays due to engine trouble, and we append her record in this respect as follows, commencing with the vessel ready at New Orleans January 26, 1921:

		Days
Voyage 9	—New Orleans to Belize (in ballast)	5
	Loading mahogany at Belize	7
	Belize to New Orleans (with cargo)	5
	Discharging mahogany at New Orleans	5
Voyage 10	—New Orleans to Belize (in ballast)	5
	Loading mahogany at Belize	7
	Belize to New York	10
	At New York, discharging, fumigating and bunkering	8
Voyage 11	—New York to Bluefields (in ballast)	13
	At Bluefields for orders	2
	Bluefields to Belize	3
	Loading mahogany at Belize	7
	Belize to New Orleans (with cargo)	5
		82

Electricity Applied to Ship Auxiliaries

Extract from Paper Presented at the Joint Meeting of the N. Y. Section of the American Institute of Electrical Engineers and the Metropolitan Section of the American Society of Mechanical Engineers, New York

By H. L. HIBBARD

(*Continued from page* 309, *April issue*)

For merchant vessel work open or ventilated motors are usually employed. If for the direct connected electrical type they would be compound wound and for th hydraulic system shunt. wound. For the control of the direct electric type, contactor panel would be supplied in the steering gear room with steering stations at such points as desired, with a selective switch on the control panel to delegate the control to any one of these. For the hydraulic system the control equipment resolves itself usually to simply a starting panel for the main motor and in merchant work the control of the valve with the hydraulic gear has frequently been by means of a hydraulic telemotor or tiller rope transmission. Electric-pilot motor-control, however, can and has been supplied either of the follow-up or non-follow-up type.

For ships operated by Diesel engines or Diesel-electric drive, it is obviously of great advantage to operate all the engine-room auxiliaries by electricity, as it is largely a question of the efficiency of electric transmission with a large and reliable generating unit, against a number of small inefficient oil or steam engines.

Aside from the engine-room auxiliaries referred to above, attention is particularly drawn to the deck auxiliaries which are located some distance from the generating plant and where great losses would take place in the steam pipes feeding them. In these cases the electric drive is by far the most efficient method, irrespective of whether the vessel is steam or oil engine propelled. It has always been noted by the writer that there is an almost complete absence of reliable figures on steam consumptions of steam driven auxiliaries and inquiries usually bring out simply the information that an 8 by 10 engine for instance, etc., is used, without any data as to its actual efficiency or steam consumption. Some idea can be obtained of the loss of steam on the steam type of auxiliary when it is remembered that it is frequently considered essential to keep steam on the winch and windlass engines in cold weather to prevent the cylinders cracking or pipes bursting from freezing. The steam steering-engine is a particularly noteworthy example of the wasteful use of steam as it is in effect only a steam ram taking steam full-stroke with valves always left "cracked" a small amount.

The electric motor is always operating at a point of high efficiency and does not suffer in this respect from change of climatic conditions. Furthermore, the power transmitted through electric cables is practically a constant quantity regardless of temperature conditions, while steam transmission is affected very decidedly thereby. Electric drive in addition to its convenience, adaptability and ease of operation, has the further merits of being available at any instant without preliminary warming up, or as above stated, the losses while standing idle with the steam plant.

Space, Weight and First Cost. Comparative figures which have been reliably obtained indicate generally some increase in the weight and space occupied for the electric over steam drive. In some cases however, such as the steering gear, an actual saving in space and weight is usually effected with the electric, and in other cases the difference is very slight. In the matter of first cost, it is also apparent from such figures as have been available to date, that electrical auxiliary machinery is roughly about 20 per cent. more expensive than steam, except in case of deck winches where the difference is more, sometimes 100 per cent.

These figures of first cost, however, we feel are influenced to a considerable extent at the present time by the lack of a developed line of apparatus on the part of many manufacturers and that in many instances full development costs have been charged against the first installations of electric auxiliaries which would be absorbed in later installations.

As against these disadvantages of first cost and weight, are obtained the advantages of:

1. Suppression of heat in spaces adjacent to the gear and transmitting lines which is of importance in certain cases.

2. Elimination of accidents due to freezing and bursting of steam pipes, cylinders, etc.

3. The reduction of vibration and noise and an increase in the habitability of the ships due to these factors. This is particularly marked in the case of the steering gear.

4. The simplification and flexibility of control, operation being obtained readily from the most convenient point.

5. The obtaining of mechanisms as outlined above which are very much more efficient in operation than the steam equipments. This is the most important consideration.

Economy of Operation. That without question a very appreciable saving in the fuel consumption can be obtained by the use of electric drive.

Another important consideration is the fact that experience shows on motorships already constructed with electrical auxiliaries, that in port the power required during the period that the deck winches are handling the cargo is about three times the amount required with the auxiliaries at sea. Investigation of cargo handling vessels in general has shown furthermore that winches are idle five to eight times the amount of time they are in operation during an eight hour day of work. With electric drive power is completely shut off while the winches are out of operation, but in the case of the steam equipments condensation and leakage continues the same.

While we have numerous general advices to the effect that the fuel consumption of steam driven auxiliaries is at least ten times that of electric, etc., we have some specific figures from oil-engine driven vessels of the *Benowa* and class which are in operation on the Chilberg line and plying between Australian points and the Pacific Coast. The following figures are given for two vessels, the *Benova* equipped with electrical auxiliaries, and the *Cethana*, equipped with steam auxiliaries, as follows:

	Benowa	*Cethana*
Net registered tonnage...	1788	1800
Propulsion..............	2–500 h.p. Diesel Engs.	2–500 h.p. Diesel Engs.
Average daily fuel-consumption-main engines.	1350 gal.	1365 gal.
Average daily fuel-consumption-donkey-boiler.	Nil	557 gal.
Average daily fuel-consumption-auxiliary Diesel Engines..........	42.5 gal.	Nil
Total daily fuel-consumption.................	1392.5 gal.	1922 gal.
Per cent of total fuel used for auxiliaries.........	3.4%	29%

The above shows a saving of approximately 25 per cent. in fuel consumption due to Diesel-electric auxiliaries. Examination of the records of other ships shows a similar percentage gain.

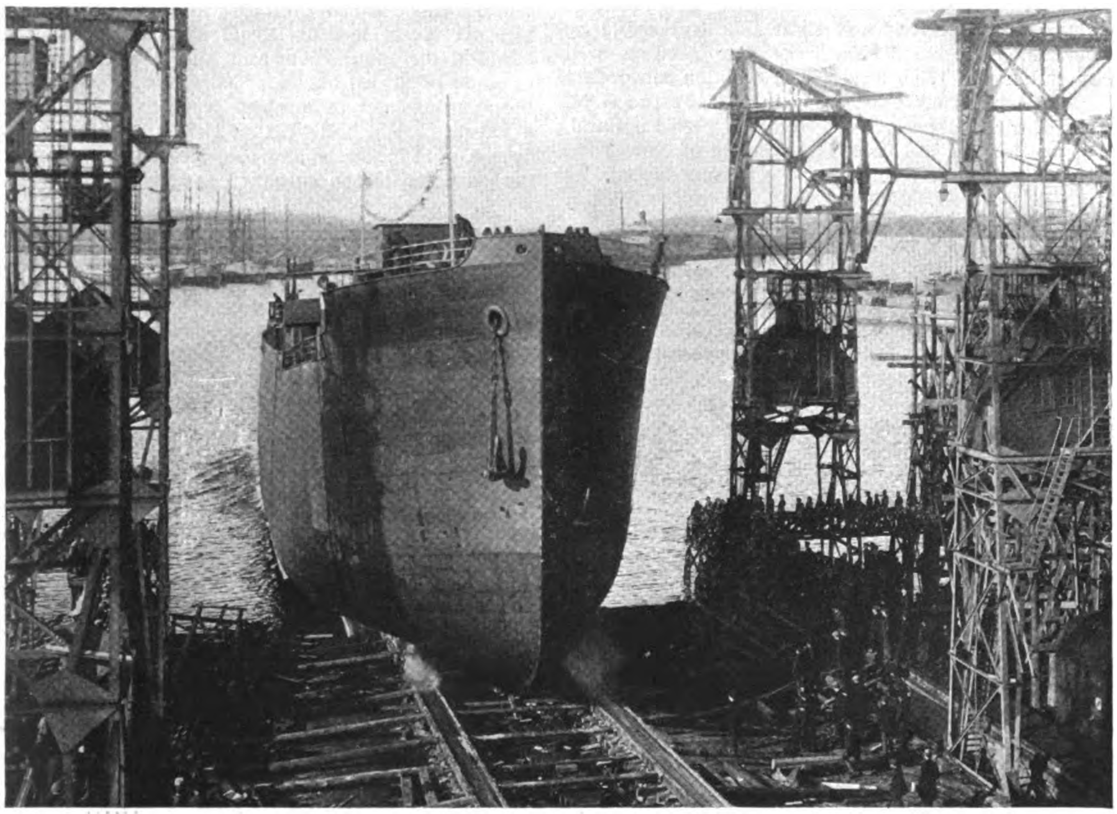
[Mr. Hibbard's percentages are a little misleading, as in figuring the economy as 25% he has included the "at sea" consumption of the main engines in each. When in port the "Benowa" consumes 42½ gallons and the "Cethana" 557 gallons per day, or a saving of over 1,000% in favor of Diesel-electric auxiliaries. His error was due to taking the total fuel-consumptions instead of only the port-consumptions.—*Editor.*]

In handling miscellaneous general cargo during this period also, approximately 20 per cent. more cargo was estimated as handled with electric-winches than with steam.

We have incidentally, furthermore, advices that for two sister ships recently constructed and operating in the Pacific, one equipped electrically and the other with steam auxiliaries, for a period of six months the repair bill on boilers and steam winches was $3800, while repairs to the generating sets and electric equipment for the same period was only $92.00. We appreciate the fact of course that this was undoubtedly an unusual condition, some accident probably happening to the steam plant, but we emphasize the point that repairs are necessary to steam equipments and that if some repairs are occasionally necessary for the electric, it should not be considered a matter of discredit to the electric drive.

Electricity Applied to Ship Auxiliary

This direct method of drive is accompanied usually by a very inefficient mechanical transmission, the screw-gear for instance giving an efficiency usually of 30 to 40 per cent. As a means therefore, of providing more efficient transmission, the hydraulic speed gear is now frequently employed particularly for installations of large horse-power where the saving, owing to the more efficient transmission, is very marked.



Launch at the Oresunds Varvet, Landskrona, Sweden, of 4,450 tons d.w. motorship for the Swedish Levant Line. She will run trials this month. A Götaverken B. & W. long-stroke Diesel-engine of 1,600 i.h.p. will be installed. (See page 44, January, 1921, and page 216, March, 1921.)

Further Performance of Motorship "California"

Has Completed 41 Voyages Aggregating 253,829 Nautical Miles at 9.71 Knots Average Speed Since Sept. 30, 1913, Carrying Full-Cargoes During Entire Period.

WHEN in January, 1919, we published the results of thirty-one voyages of the Danish motorship "California," we found that she had covered a total of 180,144 nautical-miles in 18,496 hours at an average speed of 9.73 knots. Forty-one voyages have now been rounded out, making a total of 253,829 nautical-miles at an average speed of 9.70 knots. That is running close to the old figure for a boat that began her voyaging September 30, 1913. She was operating at practically full load during most of this period. Variations in the speed occurred, sometimes on account of the inequalities of the fuel, and at other times because of accumulations on the bottom from sailing in torrid waters.

On March 23, 1921, the "California," which is owned by the United Steamship Co., of Copenhagen, completed a voyage from Buenos Aires to New York with a cargo of linseed, which was discharged promptly and economically by means of pumps. This ship, the New York agents for which are Funch Edye & Co., is a Diesel merchantman that has seen nearly eight years of service and is good for many more similar periods. Her recent trip of 12,516 nautical miles was made in 1,271 hours, at an average speed of 9.85 knots and on a daily fuel consumption of 9,500 kg.

Captain P. G. C. Pedersen of the "California" emphasizes the absolute necessity for a well-trained engineering staff. Twelve picked men constitute this department, with C. V. Hendriksen as chief-engineer. It would be difficult to convince the Captain that anyone but a Scandinavian would come under the class of best engineers. Without question, the Scandinavian Peninsula has produced sea-roving men for hundreds of years. Some of the fiercest pirates have come from that bleak country, as well as some of the best pilots and some of the most efficient engineers. Let us admit all that by all means. We can say also that no boat could be better manned and officered than the "California."

But we must not forget for one instant, however, that there is no country in the world better equipped for the study of engineering subjects than the United States of America. We have good schools, good teachers and good students. How, then, do we account for the position of our merchant marine? That is another story and a long one, too, but the day may not be far distant when American Diesel-driven ships will dot the ocean in vast numbers.

If more Americans would engage in a seafaring life, conditions might improve more rapidly. Because life at sea is becoming more and more attractive, young men of this country would do well to consider it as a possible vocation. The old-time hardships of such a life have been gradually disappearing. Many changes for the better have taken place aboard ship during the last few years, and chief among the causes for such betterment may be mentioned the internal-combustion oil-engine.

What could be more attractive and interesting than the recent voyage of the "California" from Buenos Aires to New York? It was very different from the old-time coal-shoveling trips with their dust and dirt and fiery furnaces. Even the discharge of the cargo at the end of the recent voyage entailed no hardships. The linseed was simply drawn-up through large pipes, while Captain Pedersen and Chief-Engineer Henriksen lounged about and read the latest number of "Motorship." Such a picture is not much overdrawn, for sea life is passing through kaleidoscopic changes. The young engineer of ability should think twice before discarding thoughts of the sea as the scene of his labors. Such a life has an immediate future that is worth a serious consideration on the part of those inclined that way and fitted for such an occupation. In some forceful manner, the youth of America should have brought to their attention the many advantages of a life on the highsea, for the prospects are continually broadening. Shipowners should train young engineers to Diesel engine operation and include sea-experience as part of the educational course.

According to the figures secured by the writer while on board this interesting vessel, her dimensions differ slightly in several respects from those previously published in "Motorship," but are approximately the same:

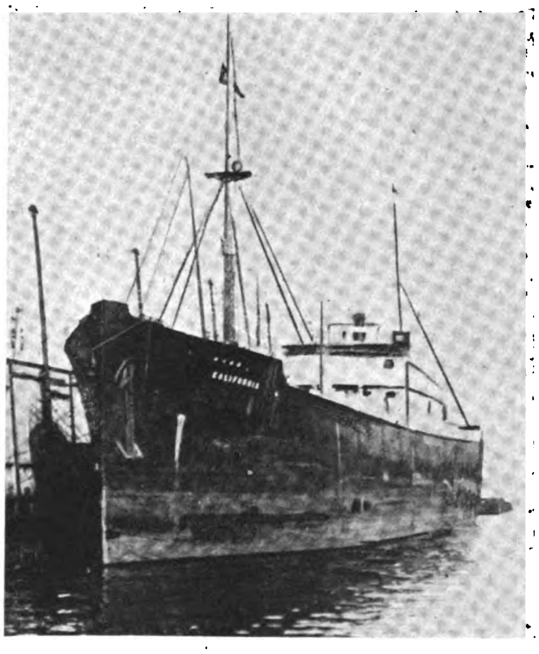
Loaded Displacement	12,000 tons
Light Displacement	3,800 tons
Deadweight Capacity (on 10,000 mile voyage)	8,100 tons
Net Cargo-Cargo Capacity (on 10,000 mile voyage)	7,680 tons
Cubic Capacity (grain)	478,000 cu. ft.
Cubic Capacity (bales)	442,000 cu. ft.
Bunker Capacity	840 tons
Cruising Radius	20,000 miles
Fresh Water Capacity	45 tons
Gross Tonnage	4,611 tons
Power	2,400 I. H. P.
Length of Machinery Space	42 ft.
Length of Ship (O. A.)	425 ft.
Length of Ship (B. P.)	405 ft. 4 in.
Breadth (M. D.)	54 ft. 2 in.
Draught (Mean Loaded)	25 ft. 1 in.
Daily Fuel Consumption at Sea	8¼ tons
Daily Fuel Consumption in Port	¾ ton
Consumption per I. H. P. hour	160 grams*

She was built and engined by Burmeister & Wain of Copenhagen, Denmark. Her engine-room crew consists of 12 men.

*453.6 grams equal 1 pound.

Performance of the Motorship "California," Nov., 1913 to March, 1921:

Voyage Number	Distance in Nautical Miles	Number of Hours	Average Speed in Knots
1	8,054	809	9.95
2	4,743	568	8.35
3	4,174	408	10.16
4	4,874	545	8.94
5	3,999	379	10.55
6	4,951	498½	9.99
7	4,444	421¼	10.64
8	4,605	498½	9.24
9	4,701	486¾	9.63
10	4,570	570	8.01
11	4,462	459¾	9.70
12	4,653	479	9.86
13	4,366	417¼	10.51
14	5,812	510¼	11.38
15	4,991	500	9.98
16	4,461	462	9.65
17	4,761	492	9.77
18	3,925	357¼	10.98
19	5,336	521¼	10.23
20	4,019	387¼	10.37
21	4,086	460½	8.87
22	4,202	461¾	9.10
23	4,020	433	9.28
24	4,237	498½	8.53
25	4,404	448¼	9.82
26	4,583	432¾	10.59
27	8,331	805¼	10.41
28	13,857	1,402½	9.88
29	12,295	1,291	9.52
30	11,989	1,207¾	9.92
31	12,266	1,285¼	9.54
32	6,057	631	9.60
33	5,929	570	10.40
34	13,919	1,459	9.54
35	7,006	655	10.69
36	7,074	822	8.60
37	4,242	412	10.29
38	3,927	395	9.94
39	4,453	445	10.00
40	8,562	962	8.89
41	12,516	1,271	9.85
Total	253,829	26,118	9.70



The m.s. "California" at New York

Surprise was expressed by the officers of the "California" at the lack of enthusiasm over Diesel propulsion for American ships. It is true that much progress has been made, but considering the fact that the United States is so plenteously supplied with oil, leadership in Diesel construction is naturally expected to be found in this country. There is great economy obtained by converting old-style ships to the internal-combustion type, and the sooner our ship-owners find this out the better for them and for the American merchant-marine. That would seem to be a natural conclusion to draw from the very obvious premises, and yet why all this hesitation?

Insufficient publicity of a general nature is probably one reason for the absence of enthusiasm. No great movement nowadays takes place without a great amount of "advertising." People look for publicity and expect it. The public is even suspicious of occasional statements that are not continuously advertised and paid for in good hard cash. "It is the steady pressing down of the seal that creates the impression," said Edgar Allen Poe, referring to the literary efforts of his day.

Many firms are beginning to realize the necessity for further publicity for the general idea of Diesel construction and equipment and are doing their share in that respect. A sufficient number of firms are "pressing down the seal" to insure ultimate success. The Diesel-engine is here to stay.

H. C. R.

VOYAGE OF THE MOTORSHIP "ISONZO."

Regarding the motorship "Isonzo" built in Italy and illustrated in our issue of Nov., 1919, we have received data concerning voyages she has made during the period between Jan. 25th, 1920, and Dec. 15th, 1920, a total of 16.670 nautical-miles having been covered in 1,739 hours, or a mean speed of 9.5 knots. Her voyages are as follows:—

Date 1920	Departure	Arrival	Nautical Miles	Hours
Jan. 25	Genoa	Spezia	45	5
Feb. 9	Spezia	Tunis	455	40
Feb. 18	Tunis	Genca	503	50
Feb. 28	Genoa	Catania	557	52
Mar. 1	Catania	Malta	120	10
Mar. 12	Malta	Genoa	642	67
April 4	Genoa	Spezia	45	5
April 20	Spezia	Songuldak	1378	132
May 16	Songuldak	Genoa	1330	130
June 4	Genoa	Civitavecchia	206	23
June 12	Civitavecchia	Tunis	324	31
June 17	Tunis	Naples	304	31
June 19	Naples	Bacoli	10	1
June 20	Bacoli	Fenoa	332	36
July 21	Genoa	Constantinople	1296	132
July 28	Constantinople	Varna	148	15
July 29	Varna	Sulina (Mouth of the Danube)	180	17
July 31	Sulina	Galatz	80	10
Aug. 1	Galatz	Braila	11	1
Aug. 10	Braila	Constantinople	360	36
Aug. 14	Constantinople	Genoa	1296	137
Sept. 2	Genoa	Sfax	653	64
Sept. 8	Sfax	Livorno	598	63
Sept. 16	Livorno	Civitavecchia	117	11
Sept. 17	Civitavecchia	Sfax	501	50
Sept. 25	Sfax	Genoa	654	72
Oct. 13	Genoa	Marseilles	205	18
Oct. 19	Marseilles	St. Louis, Rhone	22	2
Oct. 22	St. Louis, Rhone	Palermo	508	55
Oct. 25	Palermo	Piraeus	583	73
Nov. 2	Piraeus	Salonicca	274	35
Nov. 4	Salonica	Constantinople	484	61
Nov. 9	Constantinople	Varna	138	16
Nov. 13	Varna	Constanza	115	10
Nov. 15	Constanza	Sulina	100	9
Nov. 16	Sulina	Kilia (Danube)	90	8
Nov. 24	Kilia	Braila	100	12
Nov. 27	Braila	Sulina	90	11
Nov. 28	Sulina	Constantinople	259	27
Nov. 30	Constantinople	Palermo	951	98
Dec. 6	Palermo	Tunis	135	30
Dec. 15	Tunis	Genoa	471	53
			16,670	1,739

Average speed, 9.59 knots.

The motorship "Isonzo" is of 1,600 tons d.w.c. and is propelled by twin Sulzer 420 b.h.p. Diesel-engines of the two-cycle type. There were no break-downs during the entire period.

Opinions on Naval and Merchant Shipping Matters

Importance of Diesel Motorships in War Time—The Question of Electric Drive—Possibility of Semi-Submerged Diesel-Driven Battle-Ships

THE thirty-second volume of Brassey's Naval and Shipping Annual (1920-1), dealing with Naval matters, will be turned to by all interested in matters of the sea, because of the possibility now of dealing fairly openly with the lessons of the Great War, and of the incorporation for the first time of a section treating of merchant shipping. In no previous issue has the scope been so wide, nor have such a collection of experts of international reputation in affairs of the sea been comprised within one volume. The welding of matters concerning the naval and the mercantile marines is the logical outcome of recent experiences, since in so many matters, not least of all concerning means of propulsion and the latest developments of the oil-engine, reciprocity of experience has been a gain alike to naval as to commercial engineering.

Nevertheless, it is somewhat surprising that no reference is made by any of the Contributors when dealing with war experience to the importance of the question of smoke making and elimination. It is well-known now that many vessels during the war were fitted with apparatus to enable a smoke-screen to be produced, so to hide a change of course to baffle pursuit and to enable safety to be sought. Of perhaps greater importance, still is the question of the elimination of the normal smoke of combustion to which "Motorship" repeatedly drew attention during the submarine campaign period of the war. In many cases undoubtedly the trail of smoke left by steamers gave indication to hostile submarines, of the whereabouts of their prey, as well as often showing the course and speed. As a palliative smoke, smoke deflectors, short funnels and so forth effected a certain improvement. The Diesel motor-ship, however, with its smokeless exhaust has a very great advantage over all steamers—even those with oil-fired boilers—in this important war-time advantage, but none of the men responsible for allied merchant-ship construction took this seriously into consideration with the results we all know of.

The subject of passenger-liners is dealt with by Sir J. H. Biles, who, it is interesting to record, is of the opinion that on account of the increased cost of working the average steamer, reliance for the future must be placed in improved systems of construction. The only hope at present in sight, is truly stated to be the more general adoption of the Diesel-engine. The opinion is expressed that it may be possible before many years, to get enough Diesel-driven engines into one large ship.

In this connection mechanical and electrical gearing between the engines and the propellers are suggested as a possible solution, although it is confirmed that the electrical method will probably not be able to compete either in first cost or weight with the mechanical method. Where the reciprocating oil-engine is concerned with its uneven torque, geared-drive is hardly a satisfied solution, but it is reasonable to hold that any disadvantages of weight and extra cost will be outweighed by the better subdivision of prime movers, the increased reliability of ship, and the greater simplicity of the Diesel-engines installed with the electric system of transmission. Wherever possible the direct drive is to be preferred on the score of simplicity and lower first cost.

Under the heading of "The Sailing Ship's Salvation," Mr. J. W. Eason points out that under present conditions of first costs, fuel and wages, the sailing-ship for certain cargoes assumes a new aspect of attractability. Especially is this the case when more regular sailing is achieved, towing dues are minimised and greater safety under severe weather conditions result from the installation of an auxiliary oil engine. So useful has the oil-engine proved in this field that the decease of the sailer is certainly not yet.

To the marine oil-engine proper is devoted a comprehensive chapter by one of "Motorship's" technical contributors, namely—Mr. James Richardson, B. Sc., of Messrs. William Beardmore & Co., Ltd., Dalmuir, Scotland. This subject which is nearest to the aims of the "Motorship" is treated evidently with the special purpose in view of convincing shipowners of the economic advantages of the adoption of marine oil-engines for marine propulsion. The safety of oil-fuel at sea is proved. The disadvantages of coal are emphasized, an instance of an Atlantic liner, the pre-war speed of which was 18 knots, being reduced to 14 knots, due to bad coal, dirty fires, and difficulties with firemen, etc. The unique economies attained by the adoption of the principles of internal-combustion are only maintained when it is realized that in harnessing such forces to do useful work a higher degree of mechanical ingenuity, and the application of scientific structural design and construction are called for.

On a very conservative basis, it is shown that in costs per ton mile the Diesel-engined ship shows a saving of 70 per cent over the coal-fired steamer and 90 per cent over an oil-fired steamer with triple-expansion engines and 50° F. of superheat. Examples of actual sea-going consumptions are given showing the steamer in less favorable light, and the reason is no doubt to be found in the statement that whereas with steam installation the fuel-consumption is liable to substantial increases consequent upon fouling of the internal heating-surfaces of the boilers, sooting up of the tubes, deterioration of the condenser, leaky glands and valves, erosion in turbine nozzles, increased tip leakage of blades and many other causes. The Diesel engine presents no parallel.

In an appendix to the Shipping Annual are given tables indicating the progress in marine-machinery over the period 1880 to 1920, for various classes of steamers including Atlantic liners, intermediate ocean liners, cargo and cross-channel steamers.

In connection with cargo-steamers of 7,000 s.hp. the figure for oil-consumption per s.hp. hour for all purposes of 0.85 lb. with cylindrical boilers working at 200 lbs. pressure and giving superheated steam is somewhat misleading, since this low figure of consumption has not yet been attained to our knowledge in actual service. Similarly with the other figures, it should be emphasized that whilst they represent the ratio of progress, they must be multiplied in many cases by a factor of somewhere about 1.15 in the case of cargo vessels to give actual every day sea-going experience to date with steamers, even those fitted with the best and latest machinery.

Piston-rings and valves with the Diesel oil-engine must be kept clean and tight for safe operation, and with reasonable periodic inspection, cleaning and grinding, the economy is in no way impaired even after years of service. This periodic inspection is necessary apart from considerations of economy of fuel and can be reduced by running the engine at a moderate rating of power output, using a poor quality of fuel-oil and with intelligent operation. The Diesel motor-ship will sail at a higher average-speed due to being immune from questions of boiler condition and operation, and because of the regularity of the propeller revolutions in both calm and heavy weather.

In dealing with the difficulties overcome, Mr. Richardson points out, as has frequently been done in our columns, that the question of the rating of oil-engines is all-important and that it is now realized that for continuous operation at sea the engine must be rated at a definite and reasonably low fraction of the maximum power that can be sustained on the test-bed in the engine-makers' shops.

As with all engineering, the metallurgical side of the problem is being more gradually realized as not the least important, and it is increasingly clear that the future of the high-powered oil-engine is bound up as much with the regular supply of high-grade materials—particularly castings as with any question of design proper. Within the last few years, much earnest research work has been undertaken, and when in time the results and discoveries of such investigations can be translated into practical politics in the foundry, progress will undoubtedly be more rapid and sure.

First cost is an argument against the Diesel-engine. Mr. Richardson states that a 10,000 tons dead-weight capacity 11-knot oil-tanker costs, if fitted with single-screw steam-engines, approximately, 10 per cent. less than does a ship of the same d.w. capacity fitted with twin-screw oil-engines. In a number of cases, however, this 10 per cent. may be reduced owing to the fact that the fitting of oil-engines and absence of large fresh-water tanks, smaller bunkers, etc., reduces the weight and space occupied by the machinery, and so permits of a larger earning capacity from the same size of hull; or alternatively of a smaller ship being able to perform the same duties. The main point, however, is reliability of operation in service at sea.

Details are given of the large fleets of Diesel engined vessels owned by a number of successful shipping companies, to which reference is being made in these columns each month.

Naturally, the subject of the utility of the capital ship commands at the present time considerable attention. This subject has recently been very largely dealt with in the daily and technical press of Britain, France and Italy. In the last named country, it is interesting to record that as a substitute for the "Dreadnought" a design of warship—virtually a monitor—capable of partial submergence for defence and carrying six of the heaviest guns of 15 in. bore has been proposed by Engineer Nabor Soliani. The propelling-machinery is to consist of four twelve-cylinder Diesel engines of 500 B.H.P. per cylinder gives a total per ship of 24,000 B.H.P. and the relatively low speed of 18-knots at normal draught and 1½ knots less when partially submerged. She was illustrated in a recent issue of "Motorship." It is doubtful if this ship is any advance on the British submarines of the "M" Class costing for construction and operation only a fraction of these proposed monitors which, when equipped with two twelve-cylindered Diesel-engines, have the same speed on the surface, are capable of complete submergence, and a fair under-water speed and which carry one 12-inch bore gun.

In Brassey's Annual, Sir George Thurston deals very thoroughly with this absorbing question, and it is interesting to quote his finding—

"It is of course, absurd to suggest the possibility of constructing a capital ship capable of withstanding any offensive effort that might be opposed to it, but speaking from a long practical experience and taking into account the capital vessels of the present day, the lessons of the war, and the possibility of present-day construction and enterprise, the writer is convinced that it is possible to produce a capital ship that would withstand, without foundering, a torpedo attack, that would at ordinary fighting-range remain in action though heavily punished with gunfire, that would have her main and auxiliary armament and her directing officers and staff adequately protected, and that would have a chance to live through any action however severe."

To turn, however, to the present position of Naval engineering, a very thoughtful and constructive chapter is contributed by Engineer Vice-Admiral Sir George G. Goodwin, Engineer-in-Chief of the British Fleet. The great influence in the past of Naval engineering upon mercantile construction and conversely, is described justly and in some detail.

In view of the altered conditions operating at present in Britain, where no warship building is proceeding in private yards, Admiral Goodwin calls for an extended programme of research and experimental work.

A warning note of grave importance is issued, pointing out that experimental and research work is not cheap, and that tangible results are not always immediately forthcoming. Due consideration must be given to the negative as well to the positive results. Research, however, must always prove economical as well as assuring.

Mention has only been made of a small number of the eminent Contributors and their essays, yet sufficient has probably been said to explain the appreciation felt for this comprehensive review of the marine field and of the place therein given to the latest method of propulsion by Diesel-engines, with which we are more directly concerned.

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Injection and Combustion of Fuel-Oil

Experiments With Solid-Injection and Air-Blast in Marine Diesel Engines

By ENGR. COMMANDER C. J. HAWKES, R.N.

PART III.

(*Continued from page* 306, *April*, 1921)

A typical diagram taken from the fuel-injection system is shown in Fig. 9. In this instance the indicator-drum was running at engine speed and the fuel pump at camshaft speed. The pump dead centres are marked by the diagram.

Referring again to Fig. 8, curve "*e*" represents the unbalanced oil-pressure on the valve on the assumptions that the full pressure is acting during the opening and closing periods of the valve, and that the pressure drops uniformly in the system from 4,500 to 3,500 lbs. per square-inch. The former is not, of course, correct for all positions of the fuel-valve but the latter is approximately correct. Curve "*f*" shows a similar curve, but it assumes that the pressure in the system drops uniformly from 3,000 lbs. to 2,000 lbs. per square inch, giving a mean working pressure of about 2,500 lbs. per square inch—which was the pressure for which the system was originally designed.

The critical period is undoubtely when the valve begins to close, and if the full pressure acts on the underside of the valve during this period—and it probably does during the early portion of the closing period—it will be seen that the balance of spring-load available to overcome gland-friction is practically negligible with the higher-fuel pressures assumed. Gland-friction is acting against the spring during the closing period, whilst the unbalanced pressure on the valve is always acting against the spring.

Fuel-valve gland-friction is difficult to estimate in an engine running in Service. In the case of the experimental engine it was ascertained that with the fuel-valve gland carefully packed (and tight) a force of 8.5 lbs. was required to overcome gland friction (diameter of valve spindle 7/16 inch). This should, be regarded as being about the minimum figure. It will be seen that the 618 lb. spring provides only a small margin to overcome an increase in gland friction, or an increased fuel-oil pressure beyond that for which the system was originally designed. So far as spindle friction is concerned the use of a "ground" fuel-valve spindle is an advantage—as a gland is then unnecessary. Difficulties following the adoption of higher pressures can be surmounted by fitting stronger springs or by a further modification of the design.

The 0.016 inch-hole sprayer used in the tests so far recorded was made, as already mentioned, by caulking over the ends of the holes of a 0.019 inch sprayer and then opening out each hole with a tapered reamer to 0.016 inch. This sprayer showed signs of wear, but it was not excessive, although it had been in use for an appreciable time. Later, suitable drills were obtained and the 0.016 inch holes were drilled in a sprayer of the standard shape. After carrying out a number of tests it was found that the best results were obtained with the 0.016 inch-hole sprayer by filing flats in the vicinity of each hole and so reducing the length of each hole to about 1/32 inch. This sprayer was used throughout the tests recorded in Tables 3 and 4, and in subsequent tests, and so far there has been no sign of wear.

It may be of interest to refer to some experiments which were carried out with the object of ascertaining the effect of reducing the lengths of the holes in the sprayer on the quantity of fuel-oil pumped and also on the pressures reached is the system. For this purpose a full-scale model of the fuel-valve and operating mechanism of the experimental engine, complete with fuel pump, fuel-measuring tank, etc., was used. The camshaft is driven by a small electric-motor at a speed corresponding to the engine speed, viz., 190 R.P.M. Valve-lift diagrams can readily be taken, and the fuel can be sprayed either into the atmosphere or into a cylinder filled with compressed-air. This apparatus has proved of the greatest value in carrying out preliminary experiments in connection with fuel-injection.

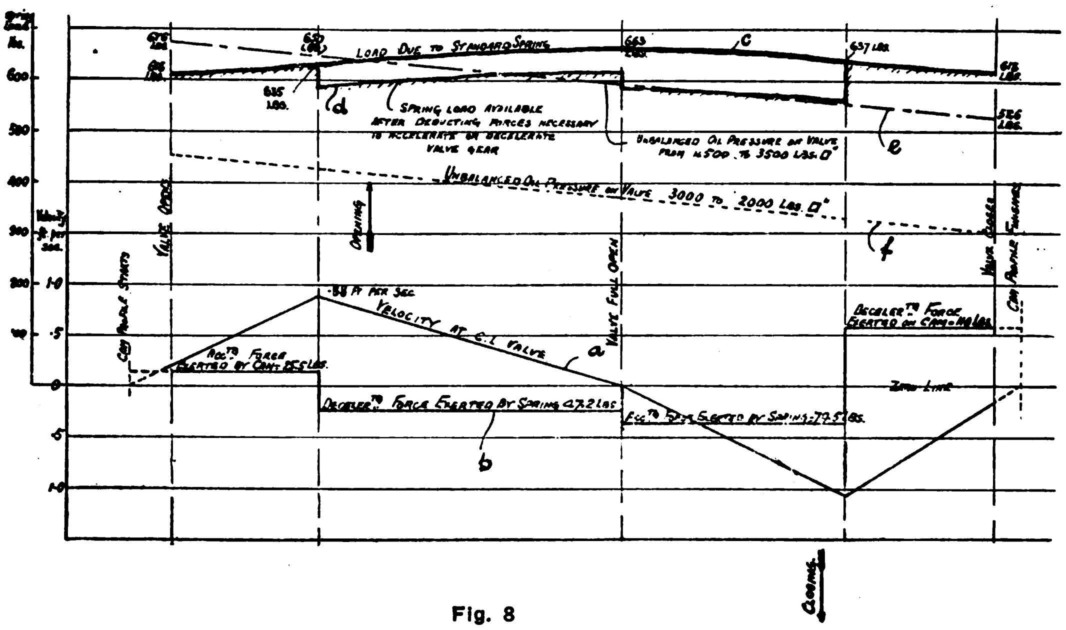


Fig. 8

The results obtained with the apparatus with two sprayers drilled with five 0.016 inch diameter holes, one fitted with flats in the vicinity of each hole and the other without flats, are shown plotted in Fig. 10. The length of each hole in the sprayer with the flats is about 1/32 inch, *i.e.*, about half the length of each hole in the sprayer with no flats.

In Fig. 10 the quantity of fuel-oil pumped per hour (full lines) and the pressure in the system for each sprayer (chain-dotted lines) are plotted against the *effective* pump stroke—the fuel-valve spring being loaded to 750 lbs. in each case. Against each recorded point is a number which represents the total period of opening of the fuel-valve in degrees, obtained from fuel-valve lift diagrams. It will be seen that for the same effective pump stroke the quantity of fuel pumped is greater in the case of the sprayer *with* flats than in the case of the sprayer *without* flats, until the "jumping" of the fuel valve with the latter becomes excessive. It will also be seen that the fuel-valve begins to "jump" when the pressure in the system exceeds about 4,300 lbs. per square inch.

Similar experiments were carried out with these sprayers with a spring loaded to 900 lbs. The effect of the stronger spring was to reduce the "jumping" of the valve with each sprayer, but the fuel-pressures throughout were generally higher and the value of flats was more marked.

A large number of experiments were made with the sprayers under varying conditions, and the results may be summarized as follows:—

(1) It was noticed that the valve-lift diagrams obtained when the apparatus was barred round was shorter with a 900 lb. spring than with a 750 lb. spring—due to a slight deflection of the fuel shaft and lever at the increased spring load.

(2) The difference between the quantity of fuel-oil pumped when spraying into a cylinder filled with compressed air at 430 lbs. pressure and when spraying, with the same sprayer, into the atmosphere was inappreciable.

(3) When pumping the same *weight* of fuel-oil other conditions remaining the same, the pressure in the system when using Broxburn oil of 0.816 s.g. was slightly less than when using shale oil of 0.862 s.g.

(4) It was thought that there might be a slight difference in the results obtained with sprayers drilled with twist-drills and similar sprayers drilled with flat drills. Two sprayers were therefore made similar in all respects, but the holes in one were drilled with flat drills 0.155 inch in diameter, and in the other with twist drills .01575 inch in diameter. The sprayers when tried in the spraying apparatus did not indicate any difference in the amount of fuel-oil pumped, nor was there any difference in the fuel pressure in the system.

(5) The spindle friction of the valve used in these experiments was 15 lbs., *i.e.*, the valve required a force of 15 lbs. to draw it through the packing with the spring removed. (The previous figure mentioned was 8½ lbs.)

(6) When the fuel-pump was pumping with an effective stroke of 15/16 inches against atmospheric pressure only its volumetric efficiency was about 95 per cent. The volumetric efficiency when pumping against the maximum pressure averaged about 75 per cent.

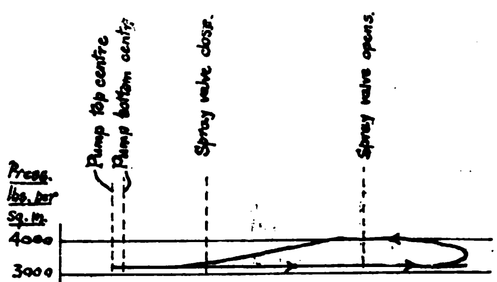


Fig. 9

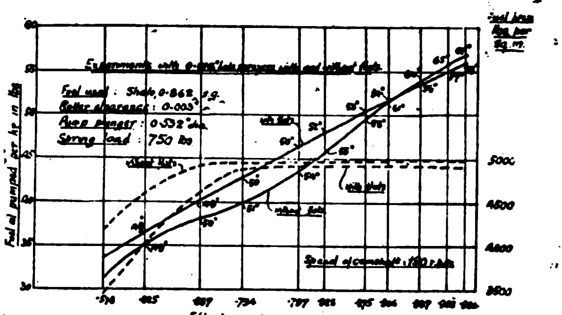


Fig. 10

Although the "jumping" of the fuel-valve is of no great moment, so long as it is not excessive, it should be avoided if possible, especiaaly at high engine-speeds. It can be reduced by reducing the fuel-pressure in the system, but this would mean that the size of the holes in the sprayer would have to be increased. With larger holes, and with a shorter period of injection, it is possible to obtain smokeless combustion at the full power (100 B.H.P.) of the experimental engine, but from the point of view of smokeless combustion at all loads it appears desirable to work with holes in the sprayer as small as practicable—and after many experiments the best all-round results were obtained with the 0.016 inch-hole sprayer provided with flats as described.

(*To be continued*)

MOTORSHIP BUILDING AT NAKSKOV.

It was recently stated in a British publication that the 3,800 tons d.w.c. motorship built at the Nakskov shipyard for the East Asiatic Company is a single-screw vessel. This, however, is incorrect as she will be a twin-screw vessel equipped with two 800 i.h.p. Burmeister & Wain Diesel engines.

Internal Combustion Engine as Applied to Marine Propulsion

**Paper Read Before the Society of Naval Architects & Marine Engineers, May 26, 1921*

By John F. Metten, Esq., Member, and J. C. Shaw, Esq., Visitor, of the Wm. Cramp & Son, Ship & Engine Building Co., Philadelphia, Pa.

THE fall in ocean freight rates in recent months to pre-war levels should bring forcibly to the attention of American shipowners the great economic importance of the internal-combustion engine for ship propulsion, although it is not claimed that the Diesel engine is a complete remedy for the present predicament of the American merchant-marine. The situation in which American shipping now finds itself is analogous to the early transition from sail to steam. This country then failed to keep pace with Great Britain, who gained a lead which was only partly overcome, due to the condition brought about by the late war.

"Motorship's" Warnings

In the recent shipbuilding emergency, efficiency of type was subordinated to the expediency of rapid construction and quantity production. **Many warnings were sounded to those in authority at the time in regard to the danger of entirely ignoring the larger motorship in the emergency construction.** However, this defeat in building could have been greatly remedied by recasting the uncompleted program immediately after the armistice, as carried out by other countries, to meet the inevitable competitive conditions of peace.

Contrasted with our past policy in reference to motorships is that of Great Britain and Scandinavian countries in particular who fostered the motorship during the war, and since the armistice two-and-a-half years ago, have rapidly built motorships almost to the exclusion of the less efficient steam cargo-vessels.

What to do With Present Fleet

As matters now stand we find ourselves in the possession of a large government-owned fleet, almost wholly steam driven, which private owners are reluctant to purchase or operate. The question accordingly is presented to us, as naval-architects and marine-engineers, as to the best method by which the inadequacy of the situation can be met, whether to advocate the conversion of the most inefficient of the existing steam-vessels to Diesel-drive or build new motorships, and the best systems to be recommended.

It is hardly necessary to state in detail the particular advantages of the motorship over the steamer which are fairly well conceded and undoubtedly well known to the members of the Society. More in regard to detail of the application of the internal-combustion engine, pointing out the various advantages and the defects of the different systems, will be attempted to be presented. A critical analysis of two vessels of a given size, propelled by steam-turbines and Diesel-engines, will also be given to show the economic importance of the latter. It is to be hoped the authors will be pardoned if undue reference is made to Burmeister & Wain, of Copenhagen, with whose work they are mostly familiar.

A Huge Fleet of B & W Motorships

As commonly recognized, this pioneer company has been mostly responsible for the present accepted high standing of the motorship. There will be completed this month sixty-seven vessels to their system representing 580,000 tons deadweight and 214,000 Diesel indicated horse-power, totaling more tonnage than all the other makers combined for this class of vessel. Of other continental builders who have done much also to promote development of the motorship with their respective designs may be mentioned Werkspoor, Sulzer, Ansaldo San Giorgio, Krupp, Polar Diesel and Vickers of England.

A brief review of Burmeister & Wain's work in this field will be given. This maker, like Werkspoor, has always held to the four-cycle engine as best suited to this class of service, where utmost reliability combined with economy is of first consideration.

Their epoch-making first vessel, the Selandia, was put into service in February, 1912, being 7,400 tons deadweight, having twin screws, and designed for 10½ knots. The two main engines, which have eight cylinders each, develop 2,500 total indicated horse-power when running at 140 revolutions per minute. This vessel, now entering her tenth year, with a total mileage of nearly 500,000, has proven the same unqualified success as her successorsand **is today in steady service, while hundreds of steamships completed eight years later are laid up on account of their greatly inferior operating economy.** Eight cylinders were used to limit the diameter to 530 mm., or 21 inches, which was the same as Burmeister && Wain's largest land engine at that time. Later the number was changed to six, which is cheaper to build, requires less engine-room length and has fewer parts to take care of. The size of the cylinders was increased by degrees to meet the power requirements of the larger vessels employed. The largest cylinders so far built by this company are 740 mm., which is six and eight cylinders give respectively 4,500 and 6,000 indicated horse-power for two screws, turning at 115 revolutions per minute, and suitable for cargo vessels of, say, from 11,000 to 14,000 tons deadweight and 12 to 12¼ knots speed. The six-cylinder engine is the same as is being installed by the Cramp Company in the United States Shipping Board's motorship William Penn, shortly to be placed in service.

A Large B & W Engine

It might be mentioned that the same Danish builder has drawings completed for Diesel-engines having cylinders of 800 mm. or 31½ inches diameter, and 500 indicated horse-power per cylinder adaptable to intermediate liners. As with the steam-engine, there is a limit in size of cylinder for a Diesel-engine, and it would appear that the 31½-inch is nearing this limit, due principally to liner thickness required. Considerations of convenience for handling the parts on board vessel are also involved. It would seem that the next logical step with the four-cycle engine for increasing the power to more than 500 indicated horse-power per cylinder is to resort to the double-acting piston. From the standpoint of elimination of heat troubles, the condition is believed to be more favorable for the double-acting four-cycle engine than for the single-acting two-cycle engine, as the maximum temperature at the first part of the power strokes is alternately distributed to the two ends instead of continually to one end of the cylinder as with the two-cycle.

The adaptability of the motorship in having its auxiliaries electrically driven, and the advantages resulting from the same, were at the beginning recognized by Burmeister & Wain and incorporated in their first vessel. As the internal-combustion engine by nature requires an external source of power for starting and maneuvering, the same power can be effectively used for other purposes as for driving pumps in engine-room and deck machinery. The saving in fuel thus made, being about one-tenth that of a steam-vessel when in port, it should be observed, is due primarily to the efficiency of the Diesel-engines driving generators and not so much to the electrical transmission as some have been led to assume.

Systems for Auxiliaries

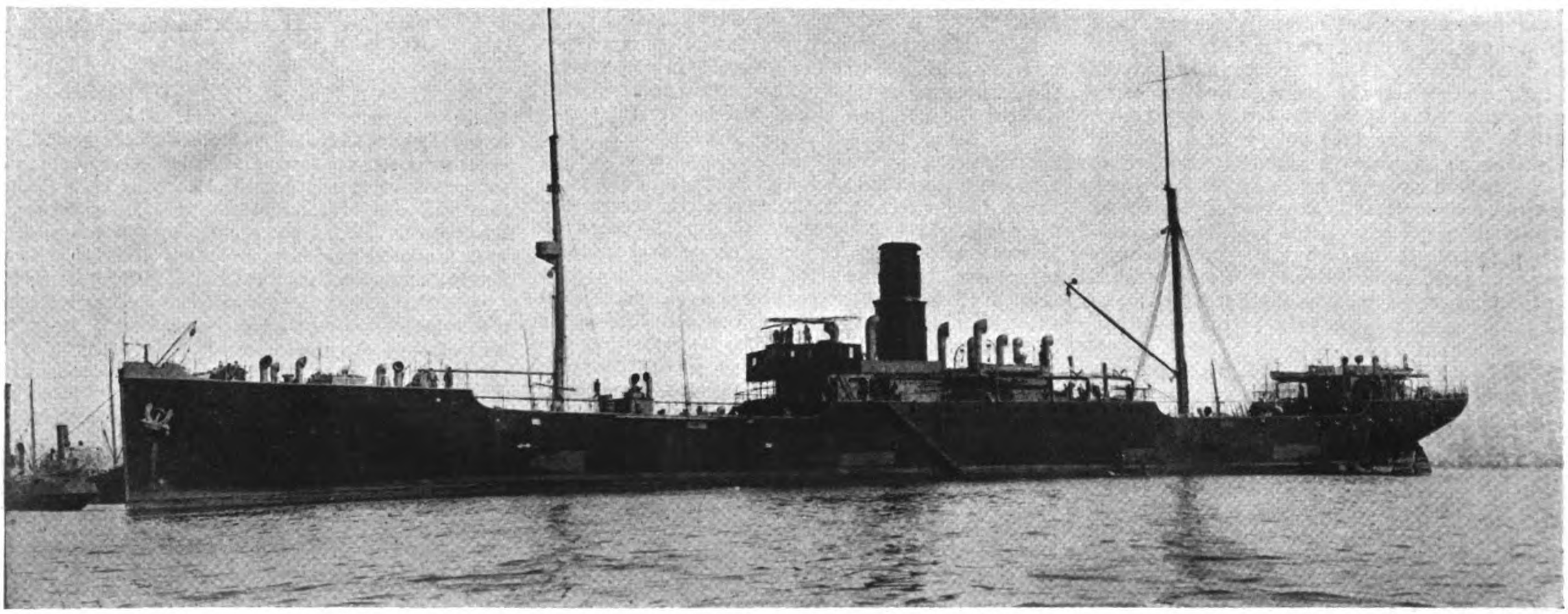
In the early installations two large auxiliary engines were used, each driving a generator and compressor in tandem, the latter being uncoupled when in port. This was soon replaced by three, and now, as in some of the larger vessels, by four, small sets having generators only. The compressors on the main engines at the same time were changed from single high-stage compressors, taking their air from the maneuvering air system to independent three stage compressors. For the two low-pressure air-compressors, one of which was always operated at sea, was substituted one motor-driven compressor for maneuvering purposes only. This latter arrangements is better in that the high and low-pressure air systems are not interdependent and the auxiliary power-plant is more flexible. From an operating standpoint it is also better, as by having more than two sets and being small in size, they can be overhauled in turn at sea, relieving the work of the engineers' personnel in port, whose time should then be given to more important port duties.

Two-cycle or Four-cycle

There has been much discussion as to whether the two or four-cycle engine is better. Judged in the light of the number of motorships in successful operation, at present the four cycle has the decided advantage. The special claims made for the two-cycle engine is that more power can be obtained per cubic space of cylinder, from having double the power strokes of a four-cycle, and hence less weight and space occupied; also that the two-cycle, having no exhaust-valves to cause trouble, can burn the lower grade oils of high sulphur content.

The four-cycle advocates dispute these claims by saying that the two-cycle engine cannot run with as high mean pressures in the cylinders as the four-cycle if internal heat troubles are to be avoided, and that the combustion is not apt to be as complete as in the four-cycle. They also point out the lower mechanical-efficiency, resulting from negative work required for scavenging, and hence higher fuel-consumption. With the rings passing across the open ports wearing conditions are not so good as with the unbroken liner surface of the four-cycle, and the cylinder lubricating-oil consumption is much higher than the four-cycle due principally to the oil being scraped into these ports and blown-out through the exhaust. It is also stated that with the long pistons required, scoring is apt to result from misalignment caused from wear at crossheads and guides. The two-cycle originally dominated the field of the light high-speed submarine engine, but after some ten years have been spent in its development it has been superseded in this field to a great extent by the four-cycle. This would not have been possible if there is any inherent advantage in the two-cycle as to weight for a given output. Moreover, in the long trade routes, which is the merchant motorship's chosen field, it must be obvious that the conceded superior economy of the four-cycle will give an advantage in cargo-capacity more than sufficient to offset the advantage in weight of machinery claimed, but not yet proved, by the two-cycle advocates.

Some makers, who originally built four-cycle engines and changed to two-cycle, have in recent years changed back to four-cycle, and others, who have always built the four-cycle, are known to be experimenting with the two-cycle. All experienced builders are fairly well agreed, however, that the Diesel-engine works best at low speeds due to the nature of the injection and burning of the oil, and that the large cylinder engines better burn the lower-grade oils. Oil of higher sulphur content, though, as commonly used under boilers, is not to be recommended, as the sulphuric acid formed in the burning not only affects adversely the exhaust-valves of the four-cycle engine



"Glove," a Diesel-driven oil tanker of the Royal Italian Navy. Displacement, 10,310 tons; capacity, 6,000 tons; length, 416½ ft.; breadth, 50¾ ft.; draught, 24 ft. She is fitted to carry six 14 pounder guns in war time.

but attacks impartially the exhaust-pipes and other parts of either the four or two cycle.

Solid or Air-Injection

Some makers have advocated the solid-injection (injection of the fuel by pressure alone,) with which Vickers has been most successful. The chief difficulties encountered with such a system are in getting good combustion at all running speeds and loads and the elimination of the shock in the cylinder, which is apt to occur with the sudden rise in pressure when fuel is injected. The advantage claimed is that compressor troubles are entirely eliminated with a correspondingly higher mechanical efficiency obtained than with air injection. The fuel-consumption, often erratic, however, under the most favorable conditions, is no better than the air-injection Diesel. It is also questioned if an oil-pressure from 2,500 to 4,000 pounds per square-inch is more to be preferred than an air-compressor and its corresponding air system having a pressure of 850 to 900 pounds.

Disadvantages of Diesel-electric Drive

The Diesel-electric drive has been suggested by some, using direct-current supplied by several high-speed engine sets working in series. The sponsors of this system apparently have either taken their cue from the turbine-electric drive or are more familiar with the electric end than the shortcomings of the high-speed Diesel-engines. To reduce the weight of the engines and space occupied sufficiently to compensate for the additional electrical equipment involved, the engines must necessarily be high speed and of the trunk piston type. The engines would correspond in design to that halfway between land and submarine practice.

The disadvantages of such a system compared with the direct drive are as follows:

(1) Loss in reliability in the prime movers.

(2) More major overhauls, as lifting of cylinder covers and drawing of pistons, due to poorer combustion and passage of lubricating oil from crank case.

(3) About 30 per cent more fuel per knot, 15 per cent chargeable to higher fuel-consumption of engines, and at least 15 per cent electrical losses with the small-size generators used.

(4) Lighter grade and more expensive fuel-oil required.

(5) Much higher lubricating-oil consumption associated with high-speed and trunk-pistons.

(6) Possible vibration troubles associated with high revolutions.

(7) Necessity for using objectionably large motors of the commutator type for transmissions of power from engines to propellers.

(8) Greater complication of controls and more expert knowledge required of the engineer personnel.

(9) Tendency to overwork the personnel with the frequent overhauls required with high-speed engines when operated continuously at full power.

(10) Danger of short circuits.

(11) Short life of high-speed engines compared with slow-speed engines.

(12) Higher first cost and maintenance charges.

With the higher consumption of fuel and lubricating-oil per indicated horse-power combined with the el ctrical losses involved and the better quality of fuel-oil required, the total expenditure for these items will be about 50 per cent more than with the direct-drive system.

Converting Existing Steamers

The Diesel-electric system has been specially recommended for converting existing steamers. It is believed by the authors that this can be far better accomplished by using a long-stroke engine turning at the low revolutions required. Work has been done along these lines by Doxford and Cammell-Laird, using the doubled opposed-piston, and also Burmeister & Wain have developed a line of long stroke engines, with a stroke bore ratio of two to one, specially adapted to single-screw vessels. These latter engines are to be recommended for new vessel, as well, of 5,000 tons deadweight and less, on account of less engine-room personnel required, important in small vessels, and the dispensing with one shaft alley, which is also important in this size ship.

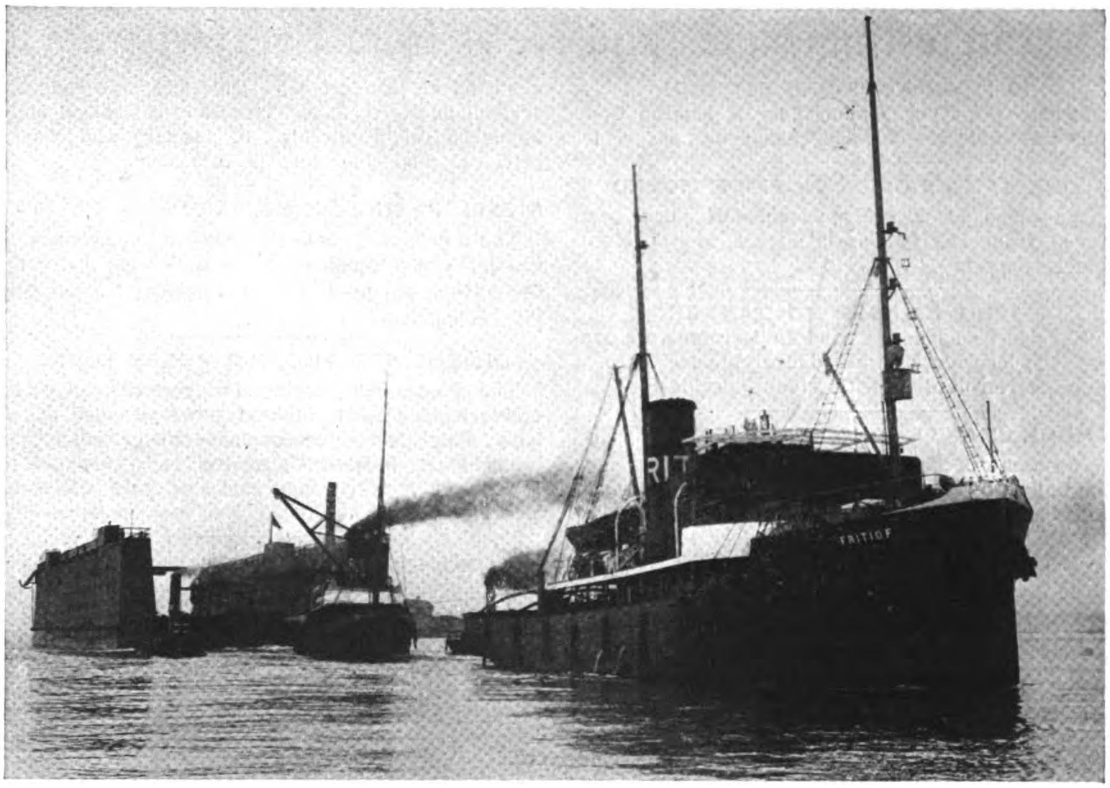
For new motorship construction, over 5,000 tons deadweight two screws are to be recommended. In smaller vessels there is little difference in propulsive efficiency between single and twin screws. For larger ships, however, the efficiency is more favorable with the two-shaft arrangement due to well-known conditions affecting propeller performance, including the better immersion of the two smaller propellers under all conditions of draught. In the larger vessels, also, the saving in space by having only one shaft alley is not so important, and the length of engine room will be less with the higher-speed standard-stroke engines.

Motorship Versus Steamship

A comparison will be given showing the estimated increased earning capacity of a motorship over a corresponding oil-burning steamer as can be anticipated in actual service. The size of vessel chosen has the same general dimensions as the motorship Afrika, owned by the East Asiatic Company, and which is similar to the "William Penn" and the two motorships building for the United American Lines.

The steamer is single screw with double-reduction gearing and compound turbines and Scotch boilers. The revolutions for the propeller is taken as seventy, which is conservative practice, to favor propulsive efficiency which for convenience here is assumed the same as the twin-screw vessel.

The ships are of the awning-deck type having a nominal deadweight carrying capacity of 13,000 tons when loaded to 31 feet 5 inches draught. They are 445 feet between perpendiculars, 60 feet beam and 42 feet moulded depth, with a block coefficient of .782. The shaft horse-power of the turbines is taken as 3,500 which is equivalent to the 4,500 indicated horse-power of the Diesel-engines. The cost of the vessels to build, based on probable cost of labor and material in the immediate future, is assumed $150 per ton for the steamer and $165 for the motorship. The $200,000 additional cost of machinery for the motorship, including deck machinery, is considered fair where the Diesel work is well standardized.



Diesel-driven salvage-vessel "Fritiof," built and engined by the Götaverken, and was fully described in our issue of December, 1920. She is propelled by B. & W. type Diesel engines.

Great Difference in Fuel-consumption

The fuel-oil consumption at sea for the steamer with 16° Beaumé oil is taken as .95 pounds per shaft-power, all purposes, which should be realized in service with properly designed turbines and double reduction gears and coordination of auxiliaries. For the motorship, with oil of 22° Beaume, the consumption is taken as 0.31 pounds per indicated horse-power all purposes, which is usual with motorships belonging to the East Asiatic Company. The cost of oil in American port, per recent quotations, is $2 for fuel oil for steamer and $2.30 for Diesel-oil of gravity indicated. It is necessary for the steamer to take on additional oil in a foreign port which is assumed double that in an American port.

The route chosen is from San Francisco to the Far East and return, calling, for example, at Yokohama, Hong Kong, Manila and Honolulu, with a total distance of 15,500 knots. The number of days at sea and in port is taken from percentages for similar vessels operating over similar routes, and the number of days in port include that for loading and unloading, repairs and docking, holidays, etc.

The cost of personnel is based on scale of wages in effect the first part of this year with sustenance at $1.25 per man. This is estimated with 27 for the deck officers and crew for either vessel, and for the engine room 19 and 14 men respectively for the steamer and motorship.

The freight rate for bulk cargo is estimated as $27 per 100 cubic feet and for deadweight cargo as $13.50 per ton which is fairly well in accordance with present rates.

The itemized figures are as follows:

	Steamer	Motorship
Displacement, (tons)	18,690	18,730
Gross tonnage, (tons)	9,050	9,050
Actual mean sea speed, knots	11.5	11.5
Revolutions per minute	70	115
Indicated horse-power	....	4,500
Shaft horse-power	3,500	....
Total weight of machinery (tons), including pipes, ventilators, ladders, floor plates, spares, tools, outfit, propellers, shafting, etc.	690	911
Water in system, (tons)	115	14
Weight of deck machinery, (tons)	140	155
Weight of hull, fittings, equipment, etc., (tons)	4,575	4,600
Light displacement, (tons)	5,520	5,680
Capacity deadweight, (tons)	13,170	13,050
Capacity (bales) cubic feet	590,000	620,000
Oil bunker capacity, tons (double bottoms)	1,320	1,350
Oil-bunker capacity, tons (tank between tunnels)		120
Oil-bunker capacity, tons (settling tanks)	80	20
Total oil-bunker capacity, (tons)	1,400	1,490
Oil consumption per shaft horse-power, main engines all purposes, pounds	.95	....
Oil consumption per indicated horse-power, main engines, all purposes, pounds	......	0.31
Oil consumption per day at sea (tons)	35.65	14.95
Oil consumption per day in port, (tons)	5.5	0.7
Number of days at sea, per annum	220	220
Number of days in port, per annum	145	145
15,500-Knot Voyage		
Days at sea	55.5	55.5
Days in port	36.5	36.5
Total oil consumption at sea, (tons)	1,980	830
Total oil consumption in port, (tons)	200	26
Reserve oil-bunker (for about six days), tons	220	90
Total oil carried outbound, (tons)	1,400	946
Total oil burned on trip out, (tons)	1,090	428
Total oil necessary, homebound, (tons)	1,310	518
Oil to be purchased abroad, (tons)	1,000	0
Weight of crew and stores, (tons)	50	50
Fresh water on board at start of each leg, (tons)	300	75
Total weight of vessel, including fuel, water, etc., outbound, tons	7,270	6,751
Total weight of vessel, including fuel, water, etc., homebound, (tons)	7,180	6,323
Cargo-capacity, outbound, (tons)	11,420	11,979
Cargo-capacity, homebound, (tons)	11,510	12,407
Cargo capacity, average (two ways), tons	11,465	12,193
Cost of Operation Per Voyage		
Insurance (4%); depreciation (5%), 92 days	$44,200	$48,800
Brokerage, at $0.15 per ton cargo capacity	3,440	3,660
Overhead and general expenses at $20 per gross ton, per annum	45,600	45,600
Fuel oil	45,900	15,260
Water, at $1 per ton	600	150
Deck officers, crew, stewards	12,200	12,200
Engineer personnel	9,300	7,600
General stores, deck, engineers and stewards	5,000	5,000
Totals	$166,240	$138,270
Loading and discharging of deadweight tons at $1 per ton and 75% of cargo capacity	$17,200	$18,280
Total cost for deadweight cargo (per voyage)	$183,440	$156,550
Loading and discharging of bulk cargo at $2 per 100 cubic feet at 75% capacity	$17,700	$18,600
Total operating cost for bulk cargo (per voyage)	$183,940	$156,870
Comparison of Earnings With Deadweight Cargo Carried		
Tons per voyage outbound at 75% capacity	8,580	8,980
Tons per voyage homebound at 75% capacity	8,640	9,300
Rate per ton	$13.50	$13.50
Gross revenue per voyage at 75% capacity	$232,500	$246,780
Cost of operation per voyage	$183,440	$156,550
Net revenue per voyage	$49,060	$90,230
Net revenue per annum	$195,000	$358,000
Per cent earned on investment	10	16.65
Comparison of Earnings With Bulk Cargo		
Cubic feet of cargo carried out and return at 75% capacity	885,000	930,000
Rate per 100 cubic-feet	$27	$27
Gross revenue for bulk cargo	$239,000	$251,100
Cost of operation per voyage	$183,940	$156,870
Net revenue per voyage	$55,060	$94,230
Net revenue per annum	$218,500	$374,000
Per cent earned on investment	11.2	17.4

From the foregoing it will be seen, for the particular conditions chosen, that the motorship has an increased earning capacity over the steam-vessel of 66 per cent on deadweight and 55 per cent when bulk cargo is carried. In addition to the bulk cargo, there can be carried on the outbound trip 544 tons of oil, which at $13.50 per ton, will increase the amount earned on investment from 17.4 per cent to 18.73 per cent, or 67 per cent better than the steamer. The above figures can be used as a basis for working-out a comparison for any route which will vary directly with length of voyage and the size of the vessels employed.

Interesting Notes and News from Everywhere

IS IT AN AMERICAN RECORD?

To-date the New London Ship & Engine Company has built 450 Nelseco Diesel-engines.

OUR SAN FRANCISCO OFFICE MOVED

Our office at San Francisco, Cal., has been moved from 149 California Street to 417 Montgomery Street.

FROM CRUISER TO TANKER

Plans have been prepared in Germany to convert the cruiser "Ersatz Leipzigklasse" into a Diesel-driven tanker with steam auxiliaries.

"F.H.HILLMAN" CHANGED TO "H.T.HARPER"

The name of the Werkspoor-Diesel tanker now completing by the Moore Shipbuilding Co. of Oakland, Cal., has been changed to "H. T. Harper."

FIVE BRITISH-BUILT WERKSPOOR ENGINES

The North Eastern Marine Engineering Co., Ltd., of Newcastle-on-Tyne, are constructing five Werkspoor-Diesel marine-engines of 1,400 i.h.p. each.

GERMAN MOTORSHIP "HELENE JENSEN"

The Vulcan Shipbuilding Co. of Stettin, Germany, have completed and delivered the motorship "Helene Jensen" to the order of the shipping firm of F. J. Jenson & Co.

SMALL GERMAN MOTORSHIP

A shipping company at Stettin, Germany, has just been placed into service a new 600 d.w.c. Diesel motorship of 300 b.h.p. Further details are not yet available.

MOTORSHIP'S GOLD CARGO

With 227 boxes of gold specie value over $6,000,000 on board, the Swedish 7,500 tons d.w.c. motorship "Stureholm" recently arrived in New York. She has frequently been illustrated in "Motorship."

EIGHT 6,000 TONS MOTORSHIPS FOR HAMBURG-AMERICAN LINE

A fleet of eight 6,000 tons gross Diesel-driven motorships has been contracted with Blohm & Voss of Hamburg, Germany, by the Hamburg-American Line.

BLOHM & VOSS MOTORSHIP, "LEOPOLD DAVID"

The cargo motorship completing at Blohm & Voss's yard, Hamburg, Germany, has been named "Leopold David." Double-acting two-cycle type Diesel-engines are being installed.

OIL-ENGINED DREDGER BUILDING

Now completing at San Francisco, Cal., to the order of the Conway Ranch Co., Woodland, Cal., is a dredger for canal work. A 60 b.h.p. Fairbanks Morse heavy-oil engine is being installed.

PETTER ENGINES IN ROYAL ITALIAN NAVY

We are advised by the Ministry of Marine that now under construction for the Royal Italian Navy is a small tanker for local service named "Arsa," in which Petter surface-ignition oil-engines are being installed

DIESEL-DRIVEN CANNERY TENDER

Recently launched at Schertzer Bros. Shipyard, Lake Union, Wash., was the 65-ft. cannery-tender "Grisby II," which is having a 100 b.h.p. Enterprise solid-injection type Diesel-engine. Her owner is Frank N. Nordland.

REGISTER OF ISHERWOOD SYSTEM SHIPS

Just as we close for press we received a very handsome volume from J. W. Isherwood, the well-known naval-architect, the same being a register of vessels built on the Isherwood system, including the years 1920 and 1921. We are obliged to hold over a review of this volume until our next issue.

HAMBURG AMERICAN LINE AND DIESEL ENGINES

In the shipyards and engine construction of the A. E. G. Deutcher Werft and Gutte Hoffnungshutte, now building Burmeister & Wain Diesel-engines and motorships, the Hamburg-American Line has acquired an interest, says Dr. Cuno, who recently arrived in the U. S. A. Details of orders on hand appeared in "Motorship" of January and March last, and also elsewhere in this issue.

DIESEL ENGINE ON S.S. "ARUNDEL CASTLE"

The new Union Castle passenger liner, "Arundel Castle," is equipped with a 75 K.W. Diesel-electric generating set on deck for emergency light and power.

OIL-ENGINED TUG FOR PUGET SOUND

The Pacific Creosoting Co. recently accepted delivery of a 53-ft. tugboat powered with a 100 b.h.p. Fairbanks-Morse surface-ignition oil-engine, built by the Ballard Maine Railway. A speed of 10½ m.p.h. was attained, and the craft will work on Puget Sound.

KINCAIRD'S B. & W. DIESEL LICENSE

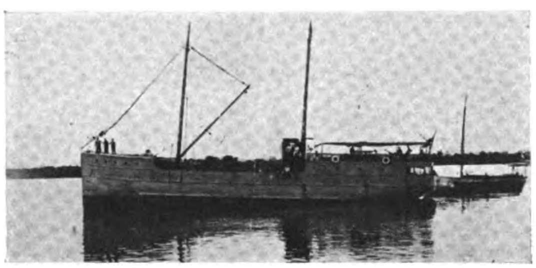
Previously announced in "Motorship" an official announcement has recently appeared in the British marine-press to the effect that John G. Kincaird & Co., of Greenock, Scotland, has acquired a Burmeister & Wain Diesel sub-license from Harland & Wolff.

ANOTHER CAMMELLAIRD-FULLAGAR LICENSE

The English Electric Company, which incorporates a number of large British engineering companies, has acquired a Cammellaird-Fullagar license, and an engine of 750 b.h.p. in six-cylinders is being built at Willans & Robinson's works at Rugby.

"ROSANA," A COSTA RICAN MOTOR-VESSEL WITH AMERICAN OIL ENGINES

We recently referred to a 300 tons d.w. freight and passenger cargo-vessel named "Rosana," owned by the Empresa de Navegacion Centro-Americana Puntarenas (Alberto Fait & Company). She is of particular interest, as she is propelled by twin 75 b.h.p. Western Diesel engines, and the



craft has been in service since June, 1920. It is understood that this vessel is operating between Puntarenas and the Panama Canal. In a letter to the engine-builders from the owners of the ship, they stated that returning from Costa Rica to Panama they had a splendid trip averaging 8 miles per hour, and that in 62 hours of continuous navigation running the engines at 300 to 320 r.p.m. only 720 gallons of oil was used, part of which was lost on account of heavy balancing of the boat.

DESTROYERS "WHIPPLE," "WORDEN," STEWART," PERRY" AND "TRUXTON" CONVERTED TO MOTOR POWER

Five old U. S. destroyers have been converted to motor-power by the E. R. Clinton Shipbuilding & Dry Dock Co. of Philadelphia, Pa., to the order of M. Snyder of New York. These vessels are the "Whipple," "Worden," "Stewart," "Perry" and "Truxton," and each has been fitted with twin 200 b.h.p. Wolverine engines. Two of them are engaged in the fruit-carrying trade between Gulf ports and Houston, Texas, while the "Truxton" has left for Bluefields on April 29th with the Nicaraguan flag as its national emblem. Further particulars are not available at the present time.

TWO NEW 1,000-TON MOTORSHIPS PROPOSED

Preliminary plans for the construction of two 1,000-ton d.w.t. motorships are being prepared by Seabury & de Zafra, Inc., 150 Nassau Street, New York City, who have been commissioned by clients to provide for most up-to-date vessels in every way. These vessels will be of steel construction operated by Diesel-engines, and all auxiliaries will be electrically operated. A speed of 11 knots is to be provided. There will be accommodations for 25 first-class passengers. It is not expected that the order will be placed before next Fall.

——Says the "MARINE JOURNAL"

With the release of the New York Barge Canal from Governmental control, that waterway is to have a miniature merchant-marine of its own, privately owned and operated. Introduction of Diesel-powered barges in large numbers will bring one branch of American shipping abreast of the times. When Government control goes, the motorship comes.—*"Marine Jourani,"* April 30, 1921.

MOTORSHIP "TOSCA" OPENS NEW LINE

Representatives of the "La Campagnie Russe de Navigation" a Vapeur et Commerce have been visiting the Levant ports for about six months to organize a new line, and the motorship "Tosca," described in our issue of April, 1921, recently loaded at Hamburg and sailed for the Levant. Winge & Co., Christiania, are the managers of this line. Their new motorships "Geisha" and "Indra" will be delivered this and next month, respectively. All the ships are Werkspoor-Diesel propelled.

CAST-IRON FOR INTERNAL-COMBUSTION ENGINES IN THE PHILIPPINES

Existence of large deposits of magnetic iron-ore has been discovered near the Abo-Abo river in the Bataan and Pampagne provinces, Philippine Islands, and probably will be worked and explored by the Bataan Power Co., who are installing a hydro-electric power station. This iron stands a high degree of temperature, and is said to be very suitable for cast-iron for internal-combustion engines. Further information should be obtained from the Bureau of Comemrce of the Philippine Islands, 280 Broadway, New York City.

A 300 H.P. MOTOR-TUG FOR PHILADELPHIA

A 300 h.p. motor-tug has been designed for the Diamond P Boat Line of Philadelphia by E. A. Edwards, naval architect in the Marine Department of Fairbanks, Morse & Co., Philadelphia, Pa. The boat is intended principally for inland coastwise towing and consequently was limited to 7 ft. draft. The principal dimensions are as follows:

Length, O. A.	82' 6"
Breadth, moulded	16' 6"
Depth, moulded	9' 0"
Draft	7' 0"
Shaft H.P.	300

She will be fitted with a 300 b.h.p. Fairbanks-Morse oil-engine of the two-cycle type.

WAR DEPARTMENT'S 39 CONCRETE MOTORSHIPS

We understand that the fleet of concrete motorships, in which eighteen Union 300 b.h.p. distillate-oil engines, were installed by the U. S. War Department, have been giving excellent service at the various assigned stations on the Atlantic Coast. Details of these unique craft were published in "Motorship" for September and December, 1918. Altogether there were 32 motor craft, some having other makes of engines. Very shortly the first of the fleet of seven new twin-screw 1,000 b.h.p. concrete passenger-cargo motorships building for the War Department will be ready. Winton Diesel-engines are installed.

STEEL CASTINGS FOR AMERICAN-GERMAN DIESEL ENGINES

For the Augsburg (German) type submarine Diesel-engines of 3,000 b.h.p. building by the U. S. Navy Department, difficulty was encountered in getting domestic steel foundries to undertake to produce the necessary steel castings, so they have been made at the League Island Navy Yard, Philadelphia, with electric furnaces. A three-ton furnace was employed, and experimenting indicated that the trick is in the coring. The steel is poured into the mold and the minute that the metal has set the mold is broken down to get the casting out. The cores are destroyed so that the casting cannot shrink on a stiff hard core. In some of the difficult castings the core is made so that it will crush, and, so far, the results have been satisfactory.

BIG AMERICAN MOTOR-LINER TO BE BUILT

Plans for an 18-knot Diesel-motor passenger-liner to carry 2,000 people are being prepared for the Puget Sound Navigation Co., of Seattle, Wash.

ANOTHER PACIFIC COAST MOTORSHIP

Now under preparation by Ted Geary, the Seattle naval-architect, are designs for a Diesel motorship of approximately 2,400 i.h.p. to the order of the Puget Sound Tug Boat Co.

SHIPPING BOARD MAY GET ABOUT $60,000,000

In the efficiency appropriation bill passed by the House of Representatives on May 26th, was included $61,852,000 for the U. S. Shipping Board. It is anticipated that this will also be passed by the Senate.

PROPOSED DIESEL-ELECTRIC FERRY FOR SAN FRANCISCO

The Golden Gate Ferry Co. are considering building a Diesel-electric ferry-vessel for operation between San Francisco and Marin County. Plans have been prepared by D. W. & R. Z. Dickie and two 450 b.h.p. Winton engines in conjunction with Westinghouse electrical equipment will be installed if the order is placed. Harry E. Speas is the president of the Ferry Company.

LLOYD'S MOTORSHIP-BUILDING RETURNS

Returns of British motorship construction for the first quarter of 1921 have just been issued by Lloyd's. The listing of oil-engined vessels under construction on March 31st, are very interesting, and tally very closely with the figures recently given before the U. S. Senate committee by Mr. W. Denman. The totals are as follows:

	No. of ships	Gross tons
Steel Motorships	60	260,731
Concrete Motorships	4	2,094
Wood & Composite Motorships	2	355
Totals	66	263,180

This means a deadweight-capacity tonnage of approximately 418,639 tons, or an average of 6,343 tons d.w.c. for each of the 66 motorships. Mr. Denman stated that on Dec. 1, 1920, there were 65 ships of 583,600 tons d.w.c. actually building in Great Britain, but he did not list any vessel smaller than 1,200 tons d.w.c., and several large vessels have since been launched, so are not included in Lloyd's figures. Therefore, his list was faily accurate.

The above list is sub-divided into the principal towns where the craft are building, but some towns are not included, so only 61 boats given in the following list, viz.:

Town	Country	No. of ships	Gross Tonnage
Aberdeen	Scotland	1	150
Barrow	England	5	34,445
Belfast	Ireland	2	11,600
River Clyde	Scotland	27	173,630
*Dundee	Scotland	2	600
Hull	England	1	227
Leith	Scotland	1	3,845
Liverpool	England	8	2,612
Newcastle-on-Tyne	England	5	12,081
Southampton	England	6	1,480
Sunderland	England	3	15,500
Total		61	256,170

Obviously, it does not include the 15,000 tons B. & W. Diesel-driven motorship building by the Caledon Shipbuilding Company of Dundee, Scotland, for the Ocean Steamship Co. of Liverpool, so probably her keel had not been laid by March 1st. Seventeen of the above motorships are of between 6,000 and 8,000 gross tons, and nine are between 8,000 and 10,000 gross-tons, without including the Caledon 15,000 tons vessel. Five are between five thousand and six thousand tons gross.

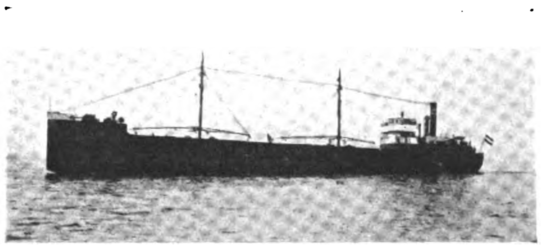
LAUNCH OF DIESEL-TANKER "SCOTTISH STANDARD"

On April 8th the launch took place of the first of the four Diesel-driven tankers now building at Vickers Ltd., Barrow, to the order of Tankers, Ltd., London. She is of 10,050 tons d.w.c., 14,050 tons loaded-displacement, and is propelled by two 1,250 shaft h.p. Vickers solid-injection Diesel-engines. That is to say, she is practically a duplicate of the Vickers Diesel-driven tankers "Narragansett" and "Seminole" owned by the Anglo-American Oil Company.

After the launch, Sir James McKechnie stated that the new vessel expressed in a practical manner the recognition by a progressive company of what has undoubtedly proved itself to be the most economical mode of sea-going propulsion, and that the internal-combustion engined ship has come to stay. Also, that the "Scottish Standard" typifies the latest Vickers design, and includes all the improvements suggested by the merit of science and the ocean experience they have gained to date from the "Narragansett." The fuel consumption of the latter was 9 lbs. of oil per thousand tons per mile traversed.

Mr. Douglas Stewart, Managing-Director of Tankers Ltd., referred to the "Scottish Standard" as being an oil-transport de luxe of exceptional size and with exceptional machinery. He said that he must confess he had been skeptical about the class of engines installed in their new ship, but after witnessing the success that has attended the "Narragansett," and which would have been greater if the "Narragansett" had been burning the special Anglo-Persian Diesel-oil, all his prejudices are disappearing and that they may look forward with confidence to even finer results with the "Scottish Standard" than have been obtained with the "Narragansett."

Continuing, Mr. Stewart said, "We have four of these motorships building, and had the times been more prosperous, there is no reason why it should not have been eight." He then referred to the drop in freight and oil, from 80 shillings per ton in November to 20 shillings per ton to-day, and then said he was confident when many of the steam-driven oilers are unable to run, the "Scottish Standard" with her economical Diesel-engines will be able to keep to the water, and fly the flag they desire to keep flying.



The motorship "Holsdorf," converted from the German destroyer "H. 186," together with the "H. 187," to Diesel power

TWO GERMAN TORPEDO-BOATS CONVERTED INTO MOTOR-FREIGHTERS

"Beating swords into ploughshares" is not exactly a sea-going term, but we are strongly reminded of it in considering the reconditioning job which has been carried out with the German torpedo boats H-186 and H-187 as described in the April issue of "Werft und Reederei" by chief-engineers Mau and Lange, of Neumühlen-Dietrichsdorf. The undertaking was favored by the fact that the ships were still on the ways when the decision was reached to re-build them into sea-lighters and that hauling-out or redocking was not necessary. Whereas the hull work of the torpedo boats was practically complete, hardly any machinery had been installed.

Since the pointed bow of the torpedo-craft appeared ill-adapted to a freight ship, its length was reduced by about 33 ft. and an existing bulkhead was retained as a collision bulkhead. For the purpose of marine classification a reduction in length was also desirable from the point of view of increasing strength-ratings. The stern of the ship remained unaltered, but the twin-screw shaft-extensions were removed, a matter to which a commission of the Entente attached great importance. In order to accommodate a single screw, a portion of the cast-steel stern-post was cut-out and a section containing a propeller-boss was fitted.

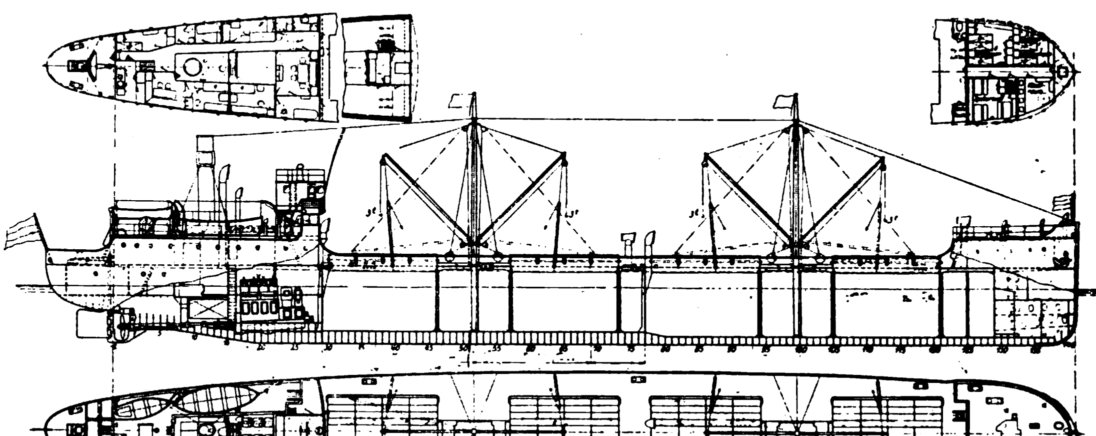
The re-built hulls have the following dimensions:

Length B.P.	235 ft.
Length O.A.	251 ft.
Breadth, M.D.	30 ft.
Depth M.D.	17 ft., 8 in.
Draught	12 ft., 10 in.
Displacement	1,674 long tons
Carrying-Capacity	1,181 long tons
Cubic Carrying-Capacity	56,900 cu. ft.
Gross Registry (Approx.)	950 tons

Weights are distributed as follows:

Hull of Torpedo-Boat	251 long tons
Removed Structures	74 long tons
Remaining Weight of Torpedo-Boat	177 long tons
Added Structures	98 long tons
Hull of Cargo-Ship	275 long tons
Fittings	79 long tons
Power-Plant	59 long tons
Fuel	47 long tons
Feed-Water	16 long tons
Drinking-Water	9 long tons
Total	485 long tons

Motive power for each of these ships is furnished by a single-acting direct-reversible four-cylinder Sulzer Diesel marine engine of 410 shaft H. P. built at the shops of Messrs. Sulzer Bros. Stock Company at Ludwigshafen. These are machines of a type of which 100 have been built in this size alone. They have all the characteristic features of the Sulzer two-cycle marine Diesel engine built at the Winterthur plant, such as port-scavenging, super-charging, simple reverse-gear, piston cooling, simple cylinder-head construction and many others. At a speed of 8 knots and with a fuel-consumption of 0.485 lb. per B.H.P. hour, it is possible for the ship to be under way for 22 days and to have a cruising radius of more than 4,200 sea-miles. The engine and propeller speed is 200 R.P.M.



Plan of one of two German destroyers converted to Diesel-engined freighters. A 410 b.h.p. Sulzer engine is installed in each boat

Diesel-Electric Ship Propulsion

Questions Pertaining to Installation and Operation

By W. E. MARTIN
Marine Department, Westinghouse Electric & Mfg. Company

OF the various systems for propulsion of vessels in vogue at the present time, the Diesel-electric type of drive is the latest to arouse the interest of naval-architects, marine-engineers and ship-builders. As is always the case with a new scheme it is necessary to overcome amount of scepticism and ordinary Yankee "show me," before it will take its proper place as a means of propulsion.

In entering the marine field, the Diesel-electric adherents find already established, reciprocating steam-engines, geared-turbines, turbine-electric drive and Diesel-engine drive, all of which have certain merits for particular applications, but the Diesel-electric system has certain inherent advantages which should in general make it very desirable from several standpoints.

Some of the foremost people in shipping circles today are products of the school of "hard knocks," having spent years at sea with the old reciprocating-engine which accounts in part for the tendency on the part of marine-engineers towards conservatism and hesitancy to try out new methods of drive. When turbines for ship drive were introduced, they hesitated but finally saw the light and as newer and better machinery is brought out, they will again be convinced. It is the policy of the Westinghouse Company to recommend Diesel-electric drive only when it is better suited than some other form of drive. In this way the full merits of the system will not be placed at a disadvantage by a mis-application.

In this type of propulsion Diesel-engines are used as the prime movers furnishing power to the ship's propeller through generators, direct-connected to engines, which in turn supply power to the driving motor. The Diesel-engine driven generator-sets can be arranged in convenient sizes to give the total power required, these small comparatively high-speed sets weighing much less than would single low-speed engines connected directly to the propeller. Direct current is advocated rather than alternating current on account of simplicity of operation. Using direct-current generators makes it possible to run the engines at constant speed, and connecting the generators in series eliminates the necessity of close governing which would be necessary with machines in parallel.

If alternating current were used, it would probably be necesary to vary the speed of the engines in order to vary the propeller speed while with the direct-current series operation the speed of propelling-motor is varied by simply regulating the excitation of the generators. Motor speed variation may be obtained from zero to the maximum in either direction by means of a reversing rheostat, which will control the excitation of the generators supplying power to the motor. The motor will be separately excited at a constant value, and consequently the speed will vary directly with the generator voltage which will be regulated by the reversing rheostat. This arrangement makes it possible to operate the ship at almost any speed desired, either ahead of astern. This scheme of operation permits reversing of motor without interrupting the main circuits since only a relatively small generator field current is handled in the control.

Electrical Equipment

The motors are slow-speed direct-current type. Two pedestal sleeve-type bearings are furnished arranged for bolting directly to the ship structure and the shaft is furnished with forged flange for coupling to the propeller-shaft. The motor frame is split horizontally, the top half being readily removable for inspection and repairs. Feet are cast on the lower half of the frame, for bolting to the ship's structure. Motors are supplied usually of open self-ventilated type, but where space is limited it is possible to reduce the diameter and use forced ventilation, in which case a separate ventilating set is usually mounted directly above the motor. It is further possible to reduce the motor diameter by going to the double armature type similar to motors installed on submarines.

The generators are similar to the motor in construction, except that one pedestal bearing is supplied. A flanged shaft is provided for coupling to the engine-shaft. The exciters are small D. C. generators and can be supplied either for direct-connection to the main generator, arranged for chain-drive from the generator shaft, or for separate drive as an independent unit. The arrangement for excitation can be made as is best adapted to the particular installation. A complete spare exciter unit is recommended.

The switching equipment consists of a black marine switchboard for generator and motor, on which is mounted necessary switches, meters, and circuit-breakers including a panel of meters switches, and rheostats for control of the exciters. A reversing rheostat is mounted behind the switchboard and operated through rods and bevel gears, from levers on a pedestal which is mounted in front of the switchboard.

Where pilot house control is furnished, a polished brass operating pedestal is located in the pilot house, the reversing rheostat being mounted beneath the pilot house deck directly below. In front of the pedestal is a meter panel enclosed in a watertight metal cabinet with plate glass front, on which is mounted a voltmeter and speed indicator for the propelling motor.

The complete equipment has been especially designed for marine service. The apparatus is rugged; windings insulated and impregnated against moisture; bearings built to prevent oil leakage, and non-corrodible material used where necessary.

Advantages

Among the principal advantages of Diesel-electric drive can be enumerated:

1. **Flexibility and Reliability.**—With this system, the power plant can be divided into any convenient number of units depending upon the total power required and the available space for location. This allows of laying-out the ship most conveniently for handling the particular cargo to be carried. Further, and of great importance in case it is necessary, one or more generating units can be cut out, allowing the ship to proceed at a slight reduction in speed. This prevents complete shutdown in case of accident as it is hardly conceivable, that with three or four generating sets, all would be out of commission at the same time. By throwing the double-throw switch for any single generator the remaining machines will supply current at reduced voltage to the main motor. The voltage delivered being three-fourths of the total available it might be assumed that the motor would operate at three-fourth's speed, but by adjustment of the motor field through a small rheostat it is possible to increase the speed to a point absorbing the full power of the three remaining generator units giving the ship about ninety per cent of its full rated-speed. Taking the extreme case, that all generating units being down, which is of course improbable, it would still be possible to obtain steerage-way by supplying power from the small auxiliary set.

2. **Operation of Engines in One Direction.**—With Diesel-electric drive, it is only necessary to turn the engines in one direction, thus overcomming the necessity of a mechanical reversing devices as with Diesel engines direct-connected to the propeller.

3. **Simplicity of Operation.**—The form of control used with this type of drive is extremely simple and very effective. By voltage control through the generator fields, only comparatively small currents are handled (about one-half of one per cent of the main current) involving the use of no large cables, except for the motor leads. The motor can be started easily and quickly in either direction.

4. **Cost To Operate.**—This type of drive is very economical, using approximately one half the fuel required for propulsion by means of geared-turbines or turbine-electric equipment, either of the latter using less fuel than the reciprocating steam engine. For cruising at lower speeds one or more engines can be shut down thus effecting further economy.

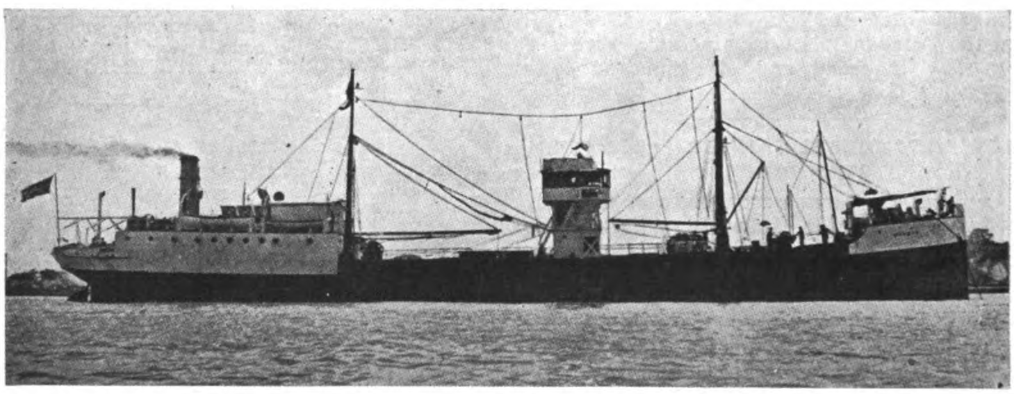
Possibilities Presented

Although the initial cost of an equipment of this kind compares favorably with other machinery it should be possible to further reduce same by quantity manufacture of both the engines and the generators.

By standardizing on a moderate size engine, it would be possible to use the same unit on almost any ship, one, two, three, four, or six units being installed according to the total power required. For example, take a cargo ship of 2,500 shaft H.P., which is about the power required for a large percentage of the ordinary tramp freighters of from 8,000 to 10,000 D.W. tons, and allowing for generator and motor efficiencies there would be required a total in engines of 3,000 B.H.P. This would require the use of four 750 H.P. engines, and if a fleet of four ships were involved it would allow the building of 16 similar engines. Smaller or larger vessels could use the same engines, in different quantities, making an ideal proposition from a manufacturing standpoint.

A particularly good application for Diesel-electric drive is found in the ordinary ferry-boat. With motor-drive the pilot can obtain almost instantaneous response, starting, changing speed, and stopping the motor at will. By connecting a motor directly so each screw of a double-ended ferry and placing the generating-units amidships, considerable space is saved since boilers and long propeller-shafting are no longer required. This allows additional carrying-capacity and subsequent saving in transportation costs. It is of interest to note that on the double-ended ferry boat, the apparent transmission loss of approximately fifteen per cent in the electrical equipment is fictitious and becomes an actual gain as compared with the ordinary method of driving both screws by one engine. This condition would apply where the after propeller is designed to deliver all the power required to propel the ship, the forward propeller being turned over at a speed just great enough to keep it from acting as a drag on the ship.

For yachts, Diesel-electric drive is also proving popular as evidenced by the fact that yacht owners and naval architects have indicated a strong interest, investigating in great detail the merits of the scheme. Two Diesel-electric propelled yachts with Westinghouse equipment have been built, one of which has an excellent record after a year's operation, the other to be put in service early this year.



"Drente," a 1,500 tons d.w.c. tanker built in 1908 as a lighter, but recently equipped with a pair of 320 b.h.p. Kromhout surface-ignition oil-engines, turning at 225 r.p.m. She is owned by the Nederlandsche Indische Tankstoomboot Co., and operated by the Anglo-Saxon Petroleum Co.

Our Readers' Opinions

(The publication of letters does not necessarily imply Editorial endorsement of opinions expressed)

WORLD'S HIGHEST SPEED DIESEL ENGINE.

To the Editor of "Motorship,"

Enclosed is a photograph of my laboratory oil-engine, which is the smallest, highest and fastest running Diesel engine ever made in Japan, having four-cylinders 5⅝ in. bore by 9 in. piston stroke turning at 1,120 revs. per minute. It swings a 26 in. propeller. The injection of fuel is by the pneumatic system.

Yours very truly,
TANADA T.

560 Imahiraki, Nishinoda,
Kitaku, Osaka, Japan.

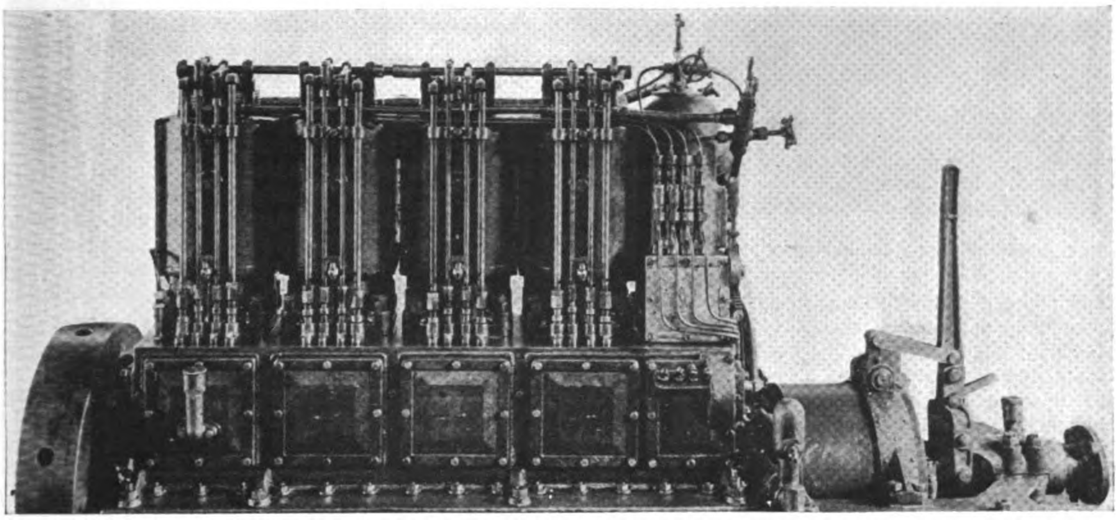
[So far as we have been able to trace, this Diesel-engine must hold a world's record for high speed of operation.—*Editor.*]

practically nil and I think it is generally agreed everywhere that they compare in reliability and efficiency with vessels built anywhere.

These ships are fitted with double-reduction gears and General Electric turbines, have engine-room auxiliaries of simple and rugged type, and were all sent on their initial voyages with guarantee engineers and competent personnel. The records of the Hog Island A-type ships are open for inspection both at the Shipping Board and in the offices of any of the Operators who have handled them and will speak for themselves.

Very truly yours,
V. V. WOODWARD,

U. S. Shipping Board,
Div. of Construction & Repairs,
45 Broadway, New York City.



A Japanese marine Diesel engine that operates at 1,150 R.P.M. built by a reader of "Motorship"

CARGO SHIPS FOR REDERI STJARNAN

To the Editor of "Motorship,"

Under the heading **"Two Motorships for the Rederi Stjarnan,"** on page 205 of your May issue, it is stated that two motorships are being built for the account of the said owners and that Bergsund's surface-ignition oil-engines are being installed.

That, however, is not quite the fact, as of the two vessels dealt with in your article the first one is provided with a steam engine of Bergsund's construction. With regard to the other vessel the owners decided on a Polar Diesel engine of our make which develops normally 500 b.h.p. at 150 revs. per minute. Compared with the steamship a gain in space of about 500 cb. ft. is obtained by this, which is of the greatest importance, considering that the vessel is frequently to carry wood.

With reference to the motorship "Scania" on the same page of the same issue, she is propelled by one of our Polar Diesel engines of 500 b.h.p. and the speed of 10 knots referred to by you was obtained when the vessel was fully loaded.

Yours very truly,
AKTIEBOLAGET ATLAS DIESEL,
Stockholm, Sweden.

CONVERTING THE HOG ISLAND SHIPS.

To the Editor of "Motorship,"
Sir—

My attention has been called to a paragraph on page 292 of the April number of "Motorship" headed "Shipping Board to Convert Seventy Steamships to Diesel Power," in which you state that seventy of the A-type vessels built in Hog Island are to be converted to Diesel and Diesel-Electric propelling power as most of them are laid up because of shipping depression *and needful repairs.*

While we are replacing a number of defective gears and turbines of various types built during the war and which more than served their purpose at that time, the vessels in which such conversions are being made are not Hog Island A-type ships, and it is common knowledge to all Operators as well as to ourselves that these vessels have given a magnificent account of themselves, their upkeep and voyage repairs being

[The statements regarding the proposed conversion of 70 Hog Island ships, etc., were taken from a lengthy news article in the N. Y. "Tribune," which apparently emanated from the Shipping Board. We are glad to give publicity to your remarks and correct any erroneous impressions that may have arisen. Since publication of our April issue we have been advised by Admiral Benson that undoubtedly a number of the Board's vessels will soon be converted to Diesel and Diesel Electric drive.—*Editor.*]

DIESEL ENGINES OF BATTLE-MONITORS

To the Editor of "Motorship,"
Sir—

We have read in the March issue of your review "Motorship," the note relating the semi-submerged Diesel-driven Battle-Monitors, recently outlined by Ing. Nabor Soliani.

We have the honour to inform you that the internal-combustion oil-engines forming the propelling sets are four 6,000 b.h.p. "Ansaldo San Giorgio" type two-stroke engines; but, as the same are the first engines in the world designed and projected of so large power for such purpose, we regret not to be able to supply any further and more complete particulars on these engines, that we have studied for installing on board of naval war-craft.

Yours very truly,
THE DIRECTOR,
Ansaldo San Giorgio.

Via Cuneo, 20,
Torino, Italy.

PRODUCING AN AMERICAN ENGINE

To the Editor of "Motorship."
Sir:—

Now that the war is over, what is the answer to a question in the Nov., 1918, issue of your magazine; "What will the nation say if after the war it discovers itself saddled with hundreds of merchant-ships of an uneconomical type that cannot be operated against foreign motor-ships without imposing a heavy burden upon the people? American steam-ships cannot compete against the motor-ships of other countries." We only need to glance over shipping reports, newspapers or take a stroll down along the water front where there are many of the uneconomical steamers idle either for the want of cargos or companies who can operate them at a profit, to realize that this question is here to be answered.

It is a proven fact that steam-ships cannot compete with the motor-ships which our neighbors across the waters are building in large numbers. Are we still going to let them lay idle or convert them into "the best and most efficient type for the establishment and maintenance of service on steam-ship lines deemed desirable and necessary by the board, and such vessels shall be equipped with the most modern, the most efficient, and the most economical machinery and commercial appliances," which the Jones-Greene bill calls for?

Recently I have had the opportunity to witness the conversion of a turbine-driven tanker into a reciprocating steam-engine driven tanker and the complete removing of machinery in other ships in order that the hull might be remodeled. Is this practice still to continue or are the shipbuilders going to develop a Diesel-engine that they can stand back of which any farsighted ship-owner contemplating the remodeling of their ships would readily accept? But why should we expect the ship-owners to equip their ships with Diesel engines when many shipbuilders do not either build, handle or advocate these engines?

If there ever was an opportune time it seems that it is here for some of our well-equipped ship-builders to enter this new field and reap some of the large profits that are sure to be derived therefrom.

Look at what has been done by the Bethlehem Steel and the Worthington Pump people. Many others are going to follow and it is the ones that get the early start that will establish themselves for some time to come.

With the idea of extreme simplicity in view and the designing of an engine that could be called an All-American engine, and one which carries some of the advantages claimed for both the two and four cycle types of engines, I have drawn some plans which are my ideas of how such an engine should be built.

Mr. Tornin has the right idea when he says: "Condemn the engine that has vital parts which can't be replaced without the help of the builders of the engine in any port of the world; condemn the engine that has parts which the average engineer will not understand by simply looking at them; condemn the engine which you cannot get at the most important parts without first clearing away a number of pipes and breaking a score of joints; condemn the engine which presents itself so nicely to the eye, but which is a perfect monster if you want to get at the crosshead-pins; condemn it, if you don't, it will condemn itself in a few years and you will be sorry you ever went in for Diesel engines. Which you should not be, as they have all the advantages claimed for them. You will not be sorry if you look before you leap!"

I believe that such an engine should be built without any great departure from the standard practice or design that has been so thoroughly tried out in Europe for several years. It seems that the four-cycle engine has advantage over the two-cycle where the large powers are not desired, and that the two-cycle has advantages over the four-cycle when its comes to economy of starting air and the flexibility of the engine.

My design is of the vertical single-acting, cross-head, direct-reversible type which operates on the four-stroke cycle when under power but which operates on the two-stroke cycle when maneuvering levers are in a start position at which the engine is operating on compressed air. Otherwise it is the same as a single-acting steam or air engine when starting.

The general design does not depart to any great extent from that of the old Burmeister & Wain or the Worthington engine. It is of the enclosed type with cast-iron columns in combination with steel rods or bolts, mounted on a heavy bed-plate which is in two sections. These cast-iron columns and steel bolts support a cylinder-base or entabulator and are so spaced that the after columns support the cross-head guide and the forward ones so that all moving parts are accessible when oil-guards are removed. This entabulator supports the cylinders which are cylindrical in form and arranged in sets of three that are controlled separately from each other.

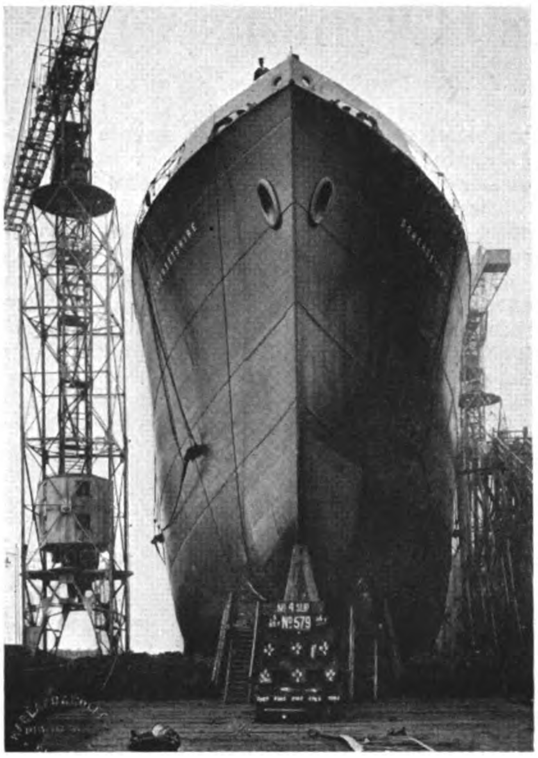
The control is by means of three levers which are mounted at the center of the length of the engine and operatable from the engine-room floor. There is one lever to control the speed of the engine and one to control each helf of the cylinders. The first movement from a central or stop position of the levers which control the maneuvering of the engine will admit starting air and a further movement will close starting air and admit fuel oil. For reversing these same levers are moved in the opposite direction from the central or stop position. All levers are so inter-locked as to make it impossible to operate other than in the proper sequence.

The construction of head and number of valves used does not vary any from that used by most any four-cycle engine. The only additional parts I have used to cause this engine to start on the two-stroke and afterwards shift to the four-stroke cycle when under power, is two cams and an additional cam-roller.

When the levers are in a start position and the engine is operating on compressed-air there is no compression to overcome, which enables the engine to get under motion at once with the consumption of a minimum amount of compressed-air. After the engine is under motion first one lever is thrown to the run position and the other following it up as soon as the first cylinder develops any power. If it is desired to use only one-half of the power cylinders one of the levers is left in a start position with the starting-air stop-valve left closed and the other is put in run position.

When the levers are so set but one-half of the engine is developing any power and the other half is simply revolving with the exhaust-valves opening every revolution. While one half is idle or powerless the other half is receiving a double amount of the fuel-oil to keep the engine going at the same speed, thus insuring regularity in the burning of the fuel and increasing the flexibility of the engine.

Simplicity in design and accessibility for overhauling are two points that should be borne strongly in mind all through the designing of any success motor for marine purposes. To those who have never made a trip to sea or had any experience with marine work such as repairing and installing of machinery it may be hard to impress upon them the importance of putting in a few hours thought in order that a piece of machinery may be made the simplest way possible. It is the man who has to worry his head day in an day out in order to keep one of those complicated engines going that can appreciate the value of an engine properly designed and manufactured.



Bow view of the new motorship "Somersetshire"

Every part is made as accessible as possible. In order that the piston and cylinders may be inspected it is only necessary to remove oil-guards and disconnect the top end of the connecting-rod in order to fetch the piston, piston rod, and cross-head out on the after side of the engine where they can be worked on with ease. It is not necessary to break any joints that are subject to high-pressures such as removing the piston head, etc., as is the customary way of doing. The oil-tight case for lubricating-oil is enclosed separately from the pistons so that it is impossible for carbons or water from piston cooling-pipes to get into lubricating-oil. As stated before columns are so spaced that all moving parts are clear when oil guards are removed and so that the forward one support the cross-head guides, and so that the main-bearings can be worked with to the best advantage.

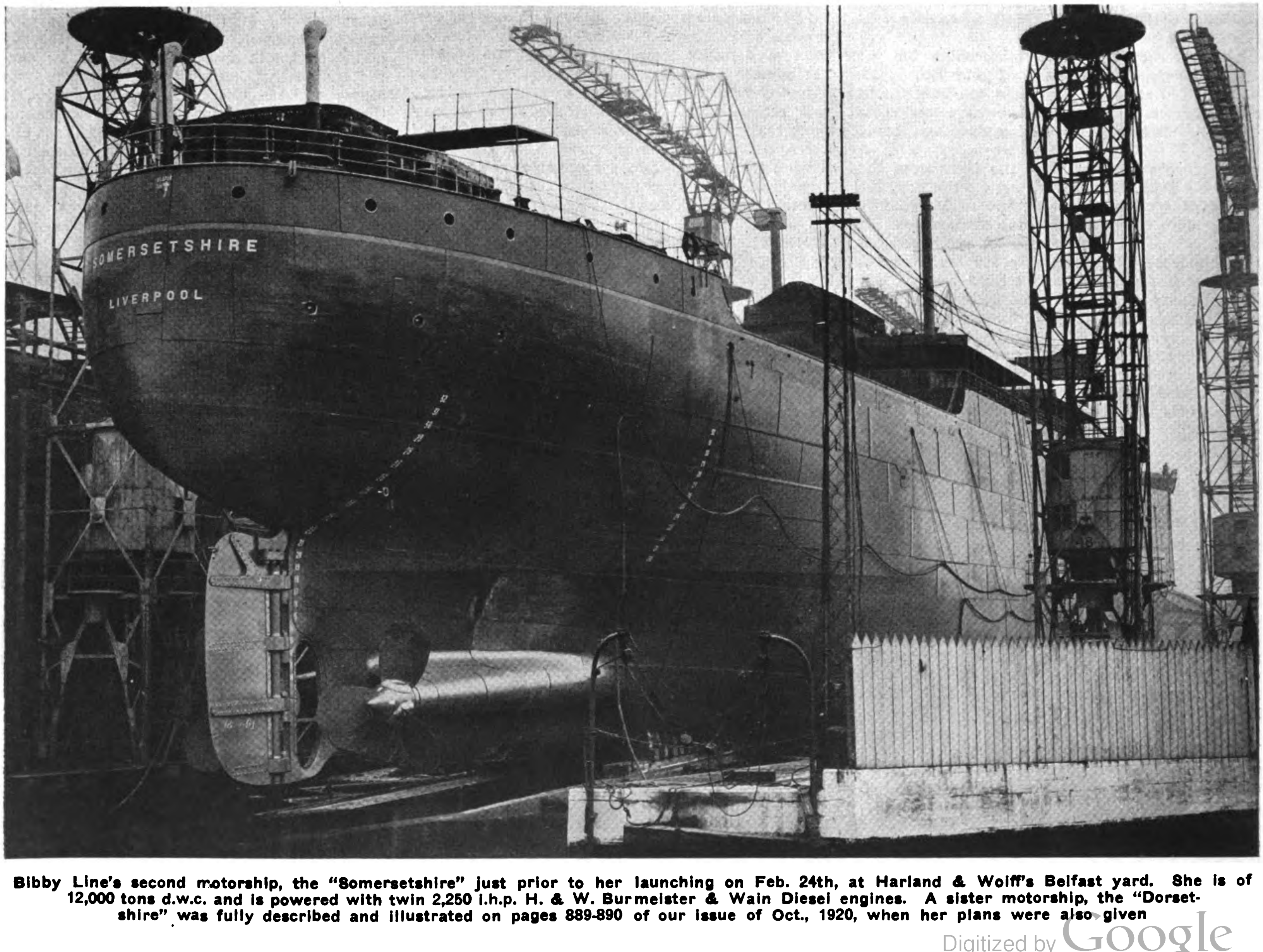
Steel bolts and rods are so arranged that the cast-iron is not subject to any tension stresses at any part of the engine.

On the forward end of the engine is mounted the usual air-compressor for furnishing air to the fuel-valves and starting-air. It is of the three-stage type with the second stage being obtained by a differentiated piston. This is the usual way of providing a good distribution of loads. The first and third discharge on the up-stroke and the second on the down-stroke. The fuel-pumps are arranged in sets of three.

Finally, may I again ask. Is this practice of prodigality still to continue or is not there some way that the ships already built at a tremendous cost can be made to produce instead of having them blocking up the channels to navigation?

Yours very truly,

Oakland, Cal. ERNEST V. PARKER.



Bibby Line's second motorship, the "Somersetshire" just prior to her launching on Feb. 24th, at Harland & Wolff's Belfast yard. She is of 12,000 tons d.w.c. and is powered with twin 2,250 i.h.p. H. & W. Burmeister & Wain Diesel engines. A sister motorship, the "Dorsetshire" was fully described and illustrated on pages 889-890 of our issue of Oct., 1920, when her plans were also given

SINGLE-SCREW MOTORSHIP OF 3,000 HORSE-POWE[R]

NEW YORK SEATTLE

MOTORSHIP

Devoted to Commercial and Naval Motor Vessels

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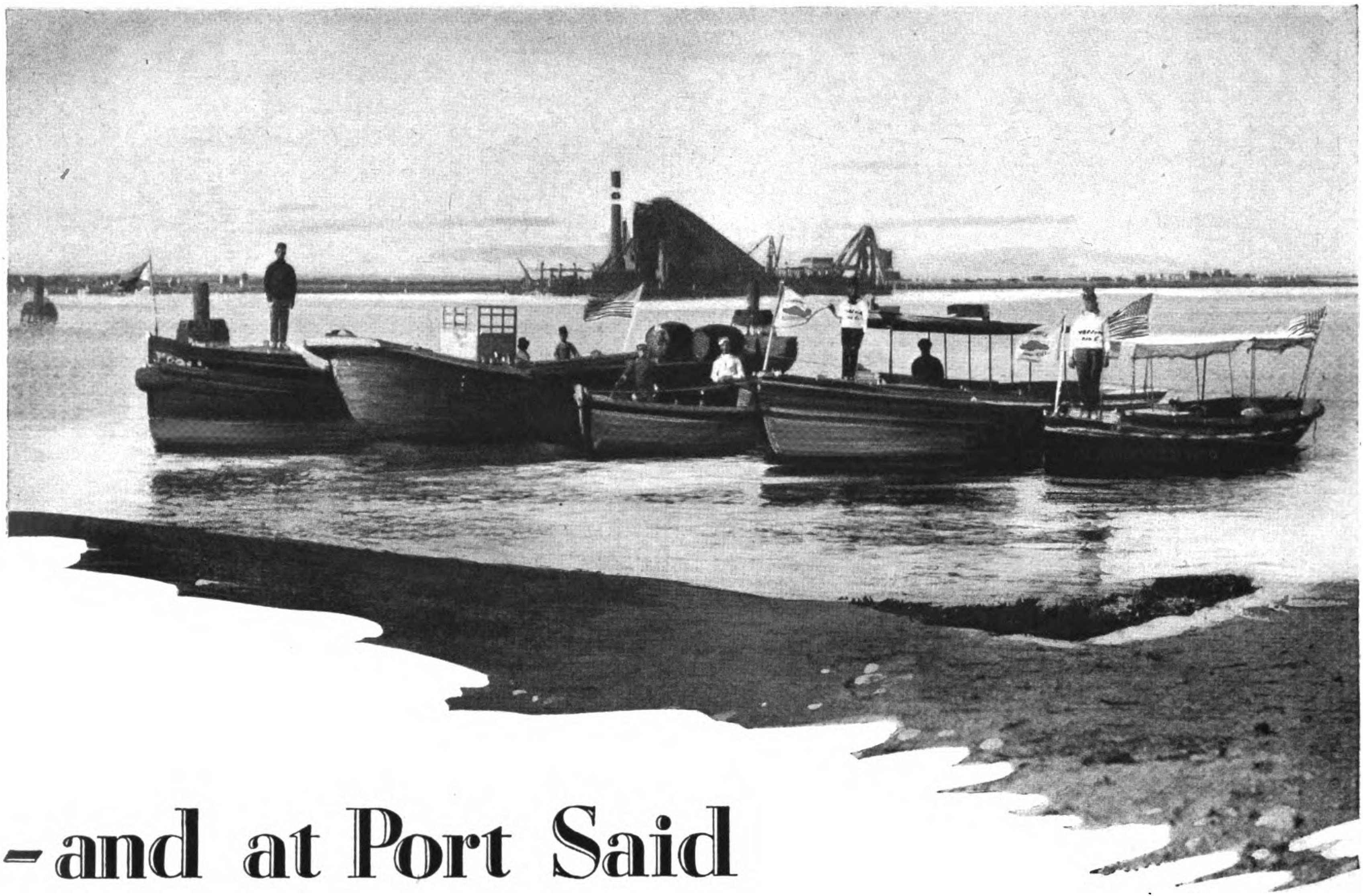

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Cable Address—Freemote, New York

First of the Doxford Motorships

"Yngaren," One of Four 9,350 Tons Deadweight Single-Screw Freighters with 3,000 I. H. P. Low-Speed Solid-Injection Opposed-Piston Oil Engines of New Design

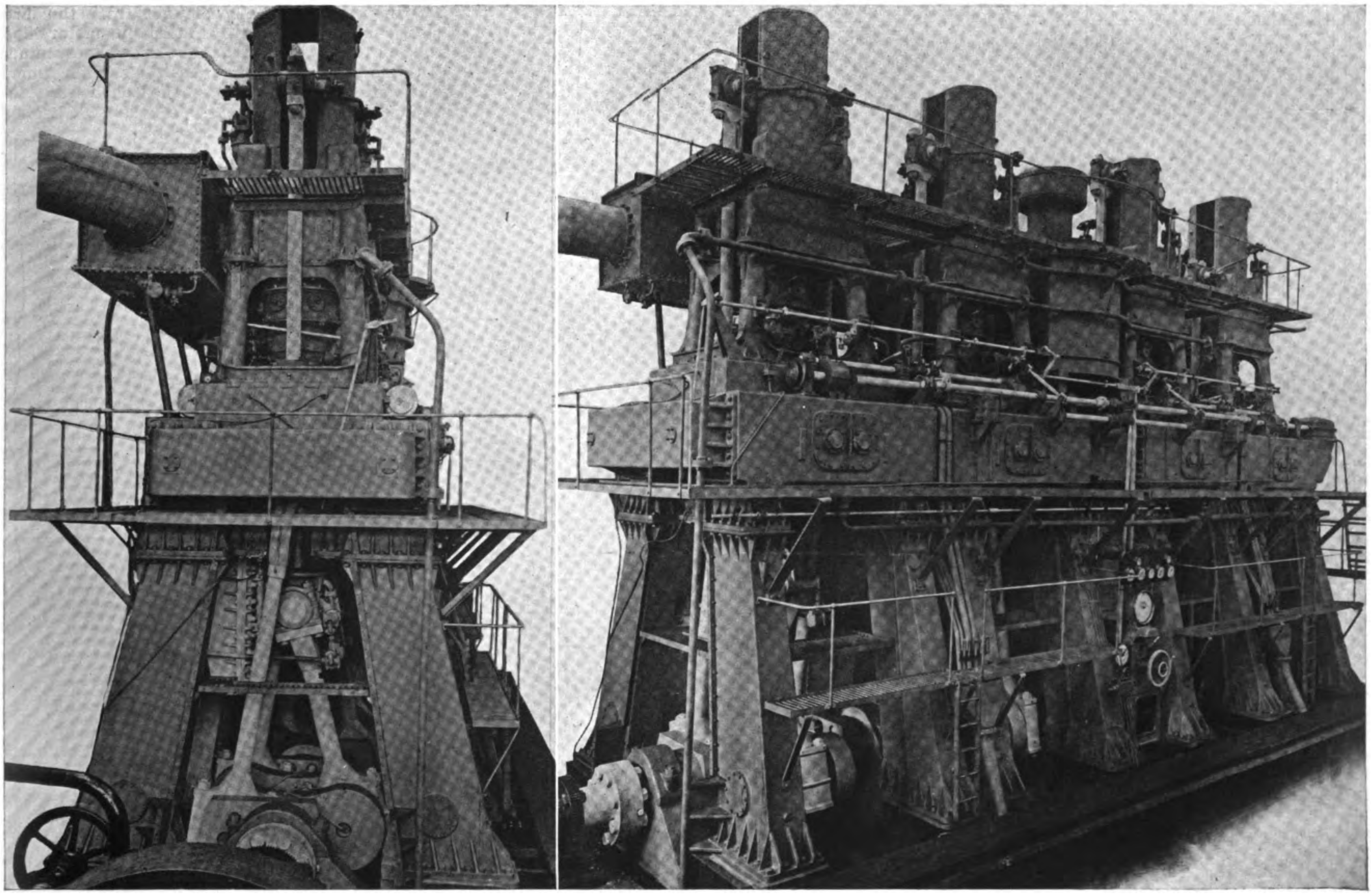
ONE of the most interesting maritime events of the year in the Old World was the recent trial of the new cargo motorship "Yngaren" of the Rederiaktiebolaget Transatlantic of Göteborg, Sweden, built by the English shipbuilding firm of William Doxford & Sons, Ltd., Sunderland. The special interest is in her machinery as she is propelled by the new high-powered, low-speed, medium-compression, mechanical-injection, internal-combustion oil-engine developed by Doxfords from the Junkers-Ochelhauser opposed-piston two-cycle principle from designs by Mr. K. O. Keller. As only about 300 lbs. compression-pressure is used in the working-cylinders, and as the injection of fuel is carried-out by pump-pressure only—no compressed-air being used, this engine cannot accurately be described as following the true "Diesel" principle. That the designers consider it an improvement over the straight Diesel-cycle is indicated in their action of having adopted this design after having constructed and tested a regular single-piston two-cycle Diesel-engine, in addition to a single-cylinder opposed-piston engine of large output. They have been experimenting for eleven years, at an expenditure of over two million dollars; finally resulting in the present engine, which they believe will be a very important factor in the World's merchant marine. Because of its short length and slow-speed it should have particular merits for installations where steamers are to be converted to motor power. Details of the early Doxford experiments were given in "Motorship" for June, 1917.

This shipyard altogether has four large sister motorships under construction including the "Yngaren," of which three are for the Rederi. Transatlantic, and one for the Grindon Steamship Line (B. & J. Sutherland & Co.) of Newcastle-on-Tyne, England. All four are of 9,350 tons d.w.c. and of 3,000 i.h.p. The second motorship for the Transatlantic Co. was recently launched.

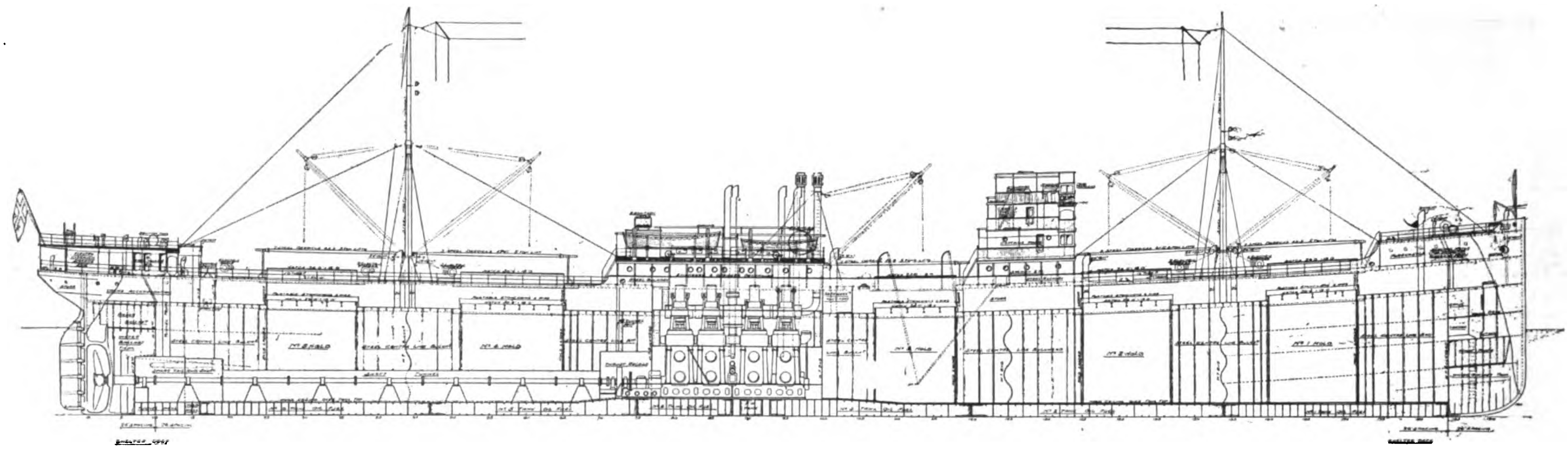
The general dimensions are the same, except that the Grindon boat has no deep-tank, and consequently has 10,000 cubic-feet greater hold-capacity. But, as we presume the Transatlantic Co.'s ships will use the deep-tank for either oil-cargo or dry-cargo, and never for fuel purposes, it may be considered that the net-carrying capacities of all these vessels are the same on given voyages.

The dimensions of the "Yngaren" are as follows:

Displacement (loaded)	12,750 tons
Displacement (light)	3,400 tons
Deadweight capacity	9,350 tons
Net cargo-capacity on 10,000 miles voyage (not included fuel, etc.)	8,900 tons
Fuel required on 10,000 miles voyage	360 tons
Fuel-capacity (double bottom)	1,130 tons
Cruising radius	32,000 miles
Cubic capacity of holds	560,000 cu. ft.
Loaded speed	10½ knots
Trial speed	? knots
Power (indicated)	3,000 i.h.p.
Power (shaft)	2,700 b.h.p.
Engine and propeller speed	70 r.p.m.
Daily sea fuel-consumption	9 tons
Daily oil-consumption	16 gallons
Daily port fuel-consumption	1 ton
No. of engine-room and boiler staff	11 men
Length O. A.	435 ft.



End and front views of the 3,000 i.h.p. Doxford two-cycle type opposed-piston marine oil-engine installed in the "Yngaren"

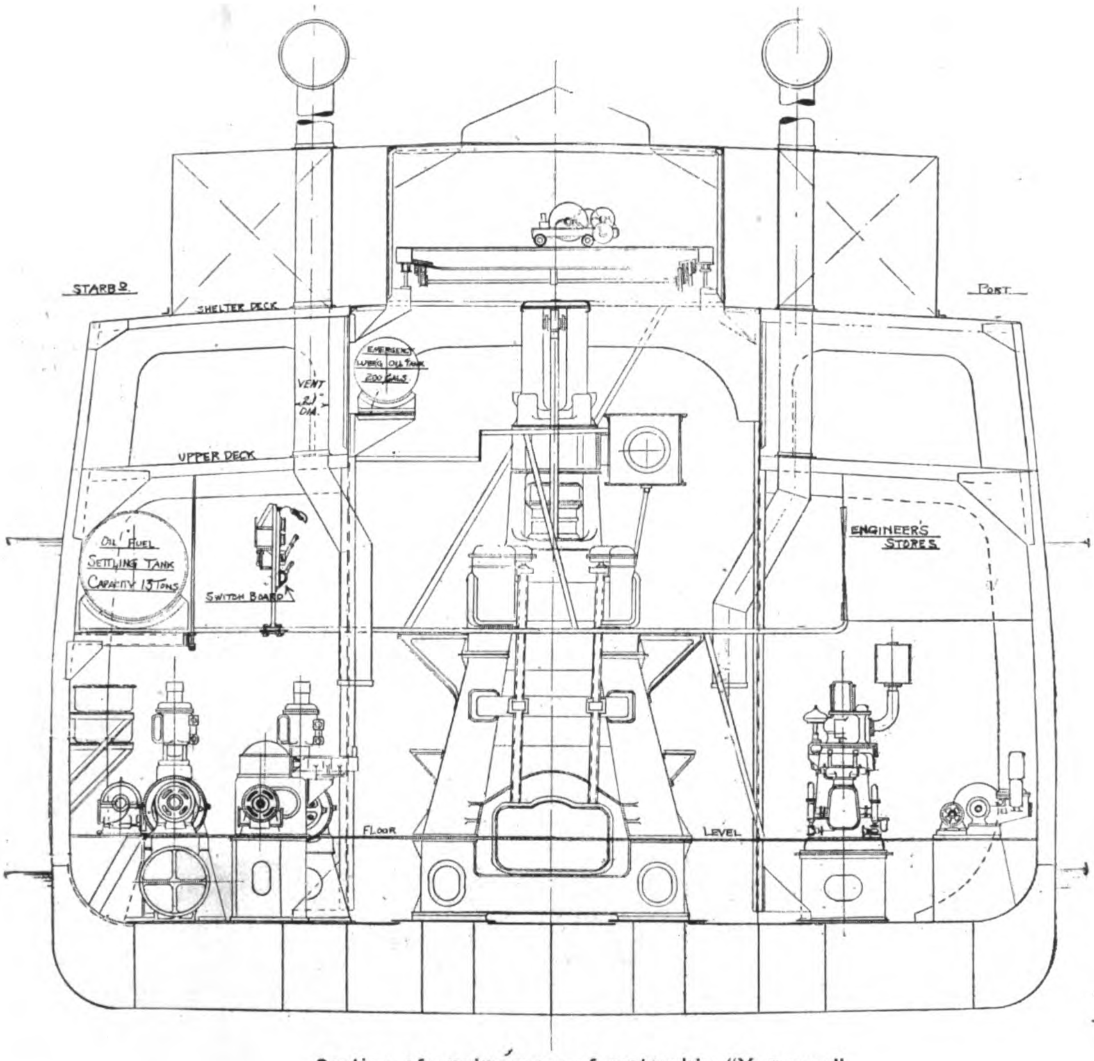


Longitudinal section of Rederi Transatlantic's Doxford motorship "Yngaren."

In the engine-room of the "Yngaren" there are three 70 K. W. electric generating-sets arranged on the port side and driven by three Doxford 2 cyld. oil-engines. On this side there also are four electric-driven pumps. On the starboard side of the engine-room there are two electrically-driven aid-compressors for manoeuvring the main-engine, one being a spare; two starting-air tanks; a high-pressure fuel-oil pump; cylinder-circulating water-pumps; two force-feed lubricating-oil pumps; oil-fuel transfer-pump, the Cochran donkey-boiler and evaporator for the same; lubricating-oil filters, and the main switchboard. The main high-pressure fuel-oil pump is located at the after end of the propelling-engine, between the latter and the thrust-block and is driven through spur-wheels off the thrust-shaft. Forward of the main engine is a small steam-driven air-compressor and an emergency jacket water-supply tank of 1950 gallons capacity.

An innovation, and a very excellent one at that, is the installation of a 7-ton electric-crane over the main engine to facilitate handling the heavy parts when overhauling and making repairs, should an occasion arise.

Standing-out radically distinct from the propelling-machinery usually fitted in motorships, this Doxford oil-engined ship will be examined with more than usual interest if she visits American waters, and her performance on her maiden voyage will doubtless carry considerable weight



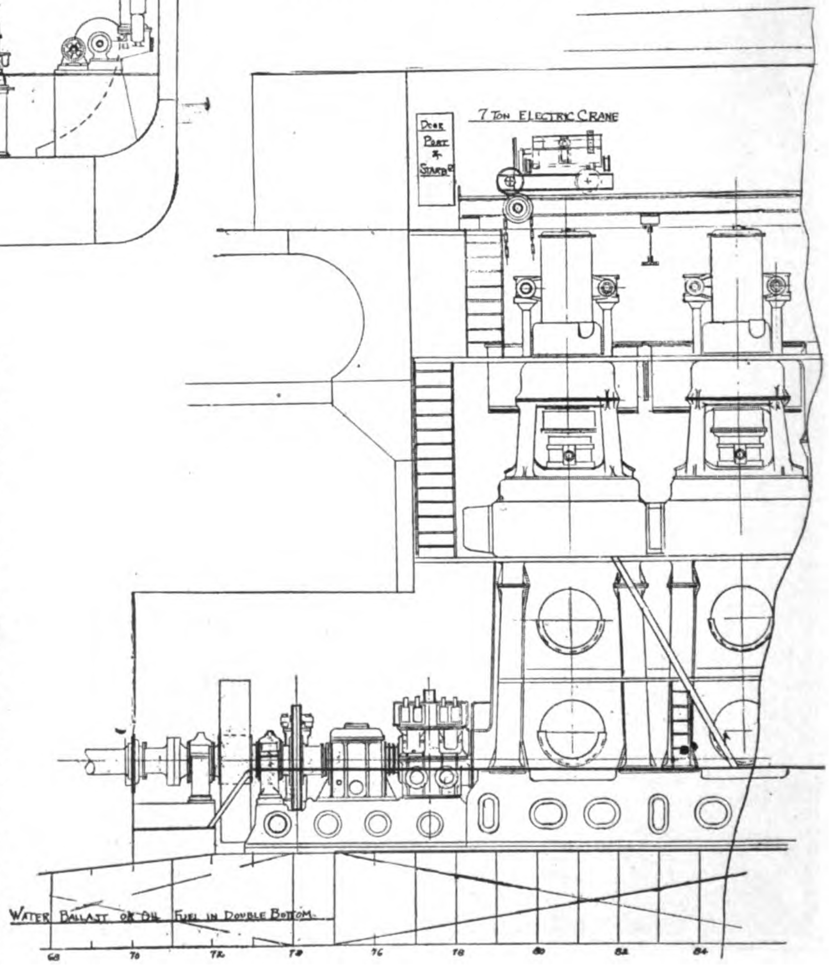
Section of engine-room of motorship "Yngaren."

Length B. P. ....420 ft.
Breadth (extreme) ....54 ft.
Depth M. D. ....29 ft.
Draught (loaded mean) ....25 ft., 6 in.
Cyld. bore and stroke of main engines,
580 mm. (24.84 ins.) by 1,160 mm. (45.66 in.)
Total stroke of both opposed-pistons..7 ft., 1/32 in.
Piston speed ....586 ft. per min.
Weight of main-engines without propeller shafting ....370 tons
Weight of complete engine-room machinery including propellers and shafting.........550 tons
Propeller ....17 ft., 6 in. dia. by 17 ft. pitch and 960 sq. ft. surface area
Length of machinery space ....49 ft., 10 in.

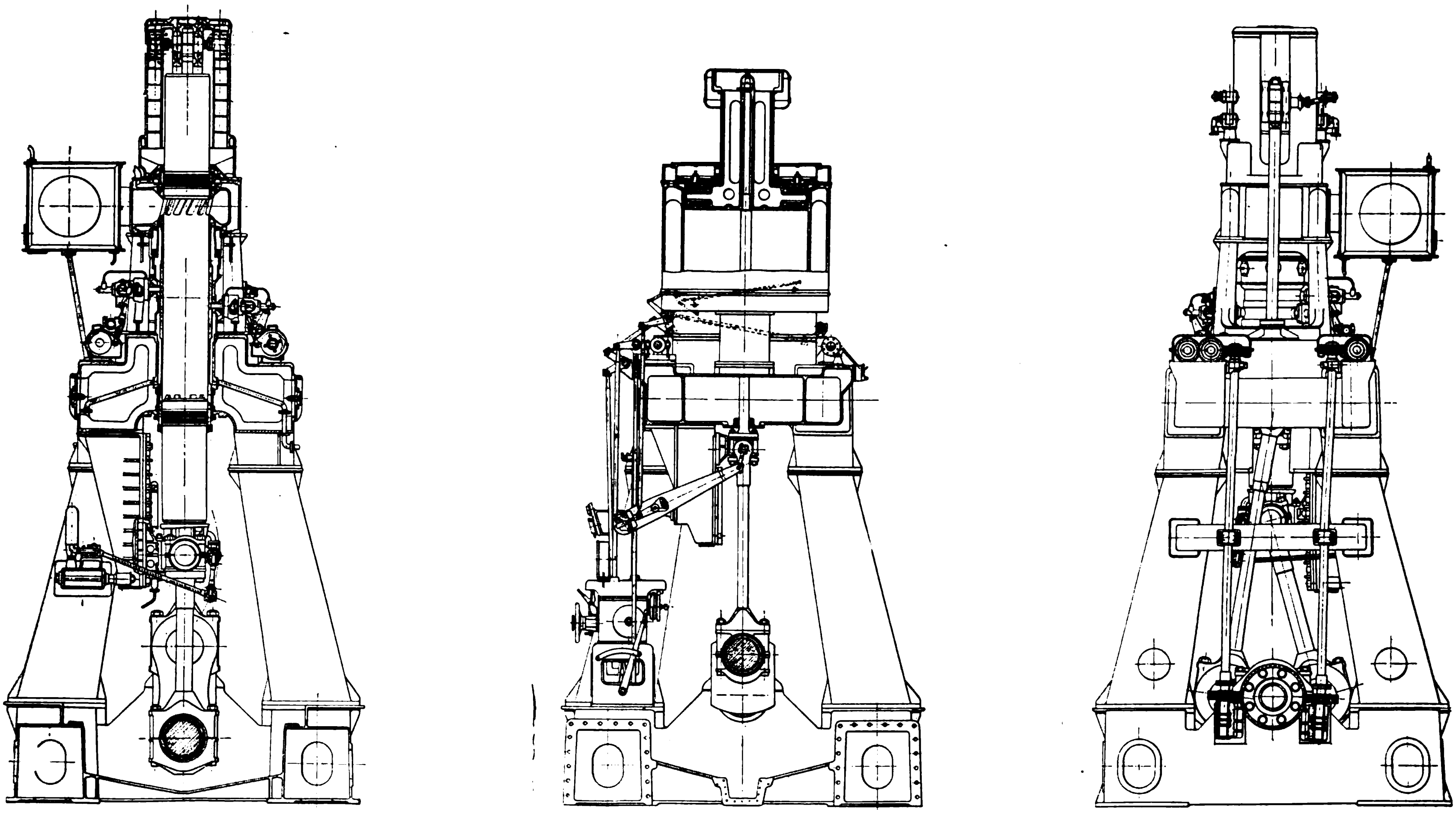
Referring to the fuel-consumption of one ton per day when in port, this low figure is obtained by Diesel-electric auxiliaries; but as the Grindon Line's vessel will have steam-driven auxiliaries, her daily port consumption will be 4 tons, or 400% greater than that of the "Yngaren." At the same time she will carry one man less in the engine-room.

Nevertheless, the "Yngaren" and her sister-motorships will carry one donkey-boiler of 200 sq. ft. for steam-heating the ship and for warming the main engine when starting from cold. The Grindon ship will have two donkey boilers with a total heating-surface of 1,700 sq. ft. At the sides her engine-room length will be 37 ft. long and 49 ft. long in the center.

Sea-trials of the "Yngaren" were run on June 9th and 14th respectively with highly satisfactory results. A mean-speed of 12.83 knots was maintained over the measured-mile during a six hours trial, which was attended by representatives of leading shipowners, who expressed high approval. For a single-screw ship of her power and tonnage the speed is very satisfactory, the guaranteed trial-speed being 12-knots. Obviously the loaded sea-speed of 10½ knots will be easily maintained in service.



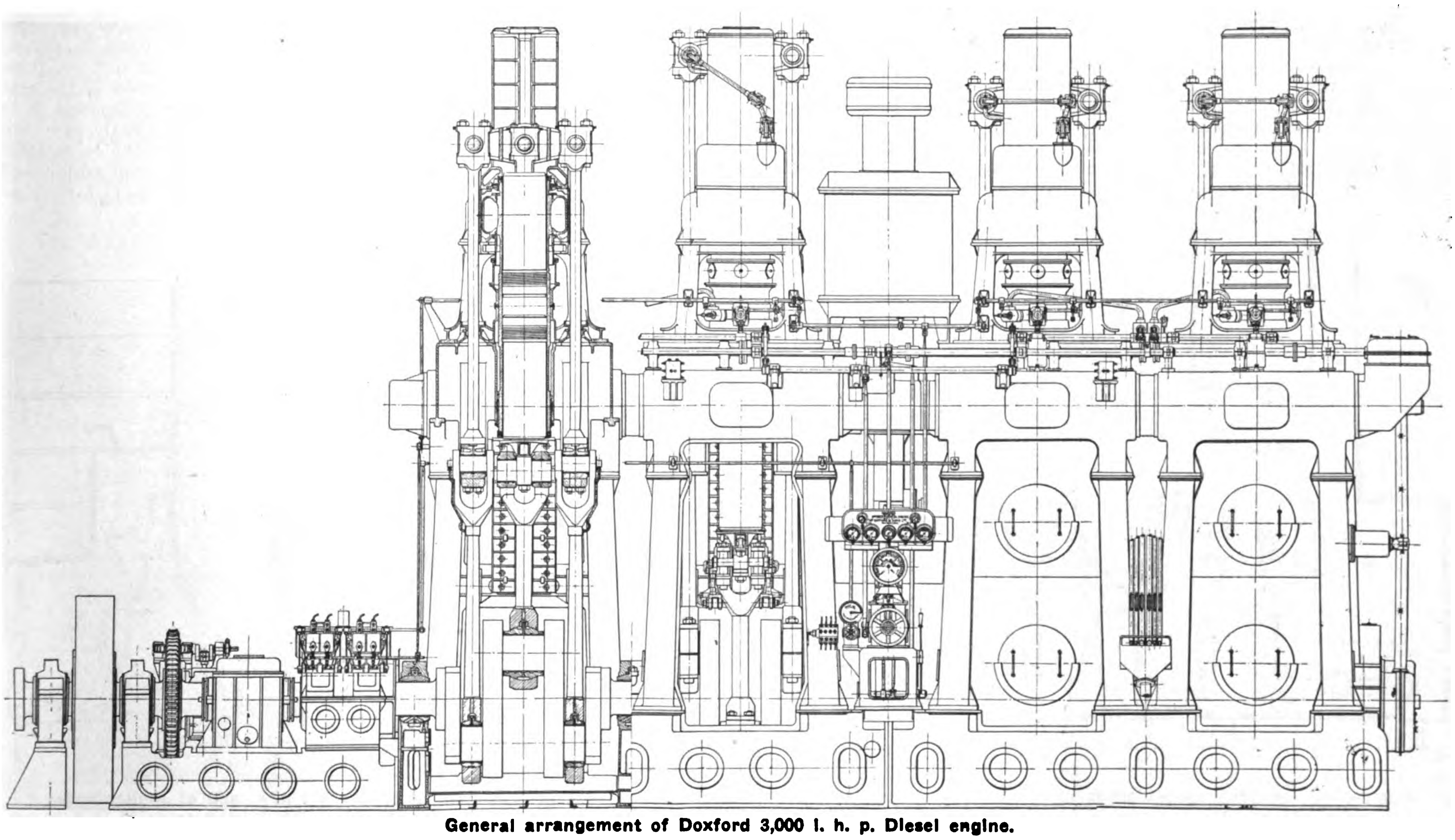
Showing Michell thrust-bearing and pumps between thrust and engine



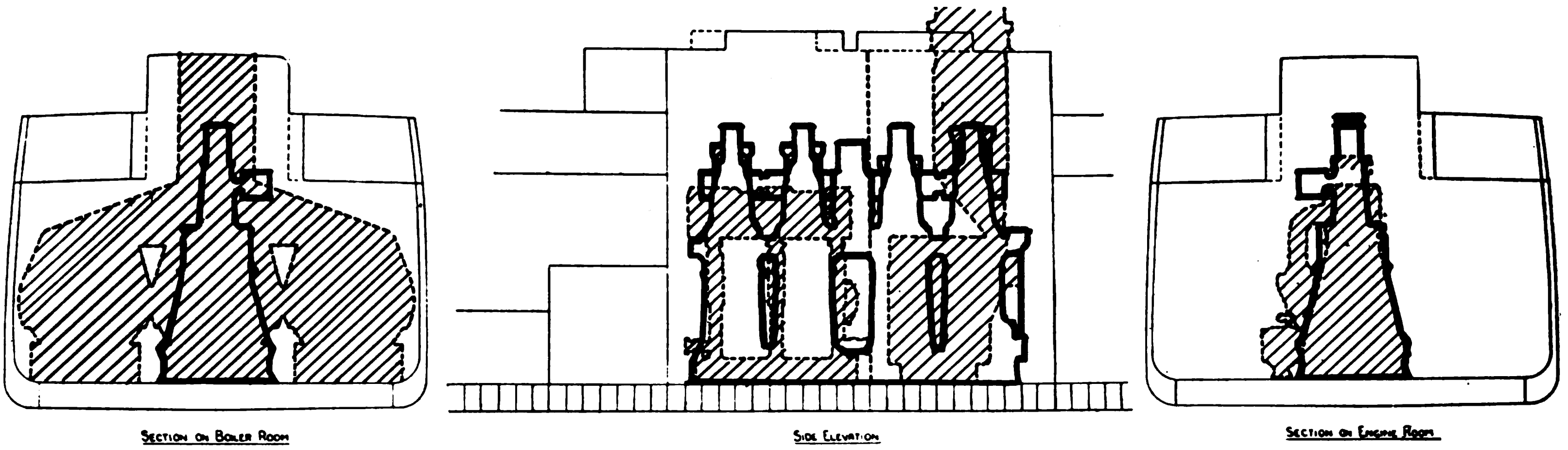
Section of working-cylinder, section of scavenging-pump and end view of Doxford 3,000 i.h.p. engine

with shipowners and shipbuilders in regard to their attitude towards the opposed-piston design. As a matter of fact we hear one prominent shipbuilding concern on the East Coast of the United States is acquiring a license, but we believe that definite construction will largely depend upon the performance of the Doxford ships. As the shipyard in question is closely linked with important oil-interests, it will be realized that the outcome may have considerable bearing upon the development of the motor-tanker in this country.

In this 2,700 shaft h.p. (3,000 i.h.p.) Doxford engine of the "Yngaren" there are no gas-pressure reactions on the main-bearings, no tension stresses in the framing, no bending loads in the bed-plate, negligible shaking forces due to inertia, and no cylinder heads. Owing to the fact that there are two pistons working in each cylinder-barrel, twice as much displacement is secured as in ordinary machines of the same bore and stroke, as though double-acting cylinders had been used. These remarkable results, and the development of 650 brake h.p. on a bore-and-stroke basis which on the usual four-cycle engine would yield at the most 150 brake H.P. per cylinder, have been attained by a thorough-going work-out of the two-cycle principle as applied to the Doxford-Keller design of the well-known Junkers system. The distinguishing features of this arrangement are the use of a set of three-throw cranks between each pair of main-bearings and a pair of oppositely moving pistons of which one is coupled by means of a pair of rods with the outer two cranks standing at the same phase and the other is linked to the center crank standing 180 degrees away from the outer part. When the central cranks is at the bottom dead-center, the outer ones are at the top and a rotation of the crank-shaft then produces an upward motion of the



General arrangement of Doxford 3,000 i. h. p. Diesel engine.



Comparisons between spaces occupied by Doxford oil-engine and triple-expansion steam set of 3,000 i. h. p. and of similar speed. Cylinders of steam-engines are 27 in. by 44½ in. by 75 in. by 54 in. stroke and 71 R. P. M. Overall length of steam machinery 43 ft. 6 in. Overall length of Diesel machinery 42 ft. 7½ in.

lower piston and a downward motion of the upper piston. Whatever air has been caught between the two is then compressed until both pistons have again reached opposite dead-centers.

Since the pressure-load is borne alike by both pistons, no unbalanced force remains for producing stress in the framing, in fact, there is no fixed member corresponding to the cylinder-head of an ordinary engine against which a pressure-load could react. The reaction itself is transmitted through the rods to the crank. Except for connecting-rod angularities, equal and opposite forces must therefore always be applied to the crank-arm and there can be no force left for producing pressure on the main-bearings. Exactly the same considerations apply to the inertia forces and the only static reactions of any consequence that can be discovered anywhere are the hoop-stress in the cylinder-liner and the side-forces at the crosshead shoes. There was a tendency, however, on the part of the early originators of this type of engine in Germany to lay too much stress on these facts and they produced machines which lacked the *sine qua non* of oil-engine success—rigidity. There are a multitude of forces and deflections in oil-engines—varying according to the design—of which keenest reasoning cannot always take account, but which in most cases must be guarded against by a more or less general and universal provision of deep and massive metal sections. A glance at the illustrations of the Doxford-engine makes it apparent that the designers of this machine have given ungrudging recognition to this important lesson of experience.

With the Doxford design all the main direct-stresses are taken by forged members mathematically proportioned with a high degree of certainty. Of these forgings, only the central connecting-rod is subject to compression and the long-rods for the upper piston are always in tension. Since they are applied by means of a toggle-beam, they are insured at all times against unequal load distribution and it is impossible for them to produce undue cocking in the guides of the upper piston.

Although, as we have stated, none but nominal loads are applied to the stationary parts of the engine, its framing, fully illustrated in the photographs and drawings, exhibits the same ruggedness and rigidity as though it had to withstand the same forces that must be allowed for in the usual designs. The bed-plate is of deep section and is well adapted for resisting hull deflections. This is a point which cannot be over-emphasized in the case of engines wherein the bedplate participates in the working-loads, and its careful observance which we find here in an engine structure not exposed to these loads, is highly to be commended. There are four massive buttress-like columns under each cylinder—four over each main-bearing.

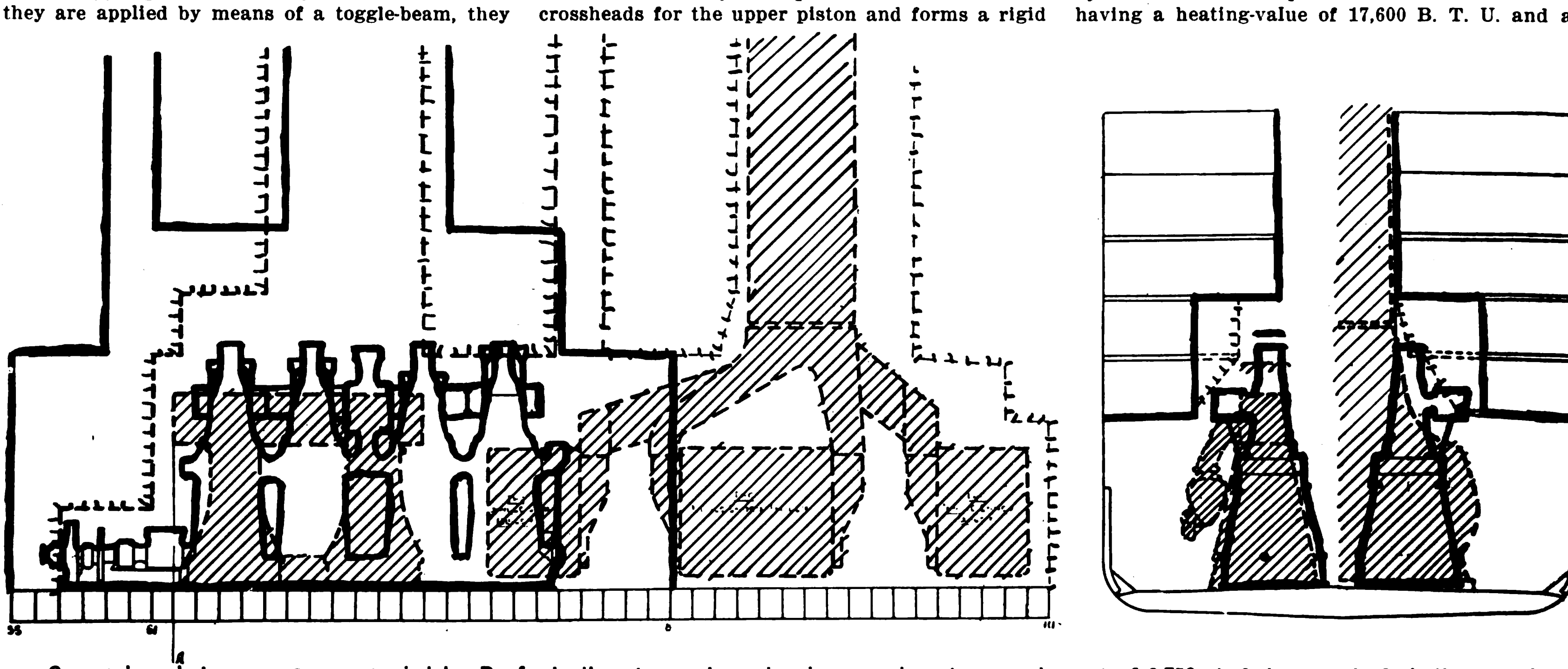
Here again is a departure from the usual designs, in which only single pairs of columns are placed over the main-bearings. Because of this arrangement, if any stresses come through the columns at all, they could at the worst produce only transverse deflections in the bed-plate, a consideration of prime importance from the point of view of crankshaft alignment. Even in this matter the designers of the Doxford engines have taken no chances; they have made the shells of the main-bearings spherical and self-aligning. In other words, Doxford journal-bearings can be made self-aligning because the shaft-journals transmit nothing but pure torque and are not subject to appreciable lateral bending.

Surmounting each group of four columns is a deep entablature in which several functions are neatly combined. Since it is cast hollow, it can serve as the scavenging-air duct; it is bored to receive the lower end of the cylinder and provides for remarkably free flow of scavenging-air to the circumferential cylinder-ports. It contains the crossheads for the upper piston and forms a rigid bridge on which is carried the standard for supporting the upper cylinder structure.

The fuel-pumps have unpacked plungers and their delivery is controlled by an Aspinall governor, or by hand-regulation of the suction-valves. In order to be able to cut-out a leaky pump and at the same time to secure the benefits of a common discharge and equalized fuel-pressure on all the cylinders, the delivery-tubes from all eight pumps are brought together in a steel distributor-block located near the control position. Screw-plug valves in these permit of ready switching from individual pump deliveries for individual working-cylinders to a common delivery for all cylinders. A spare fuel-pump, independently steam or motor-driven, can be cut-in at short notice if the need arises.

There are two camshafts on the engine, one on the front and one on the back, and each is independently driven through spiral gears from the crankshaft. The reason for this is that there are two fuel-valves in each cylinder, as in the original large Junkers engines previously referred to. The front camshaft drives a single starting-valve in each cylinder and the rear shaft also drives indicator-gears and cylinder lubricators. Only the front camshaft is reversible and the rear fuel-valves are not operated during astern running.

Other radical departures from accustomed Diesel practice which are reported as highly successful, are the use of steel-capped partially-cooled pistons, low compression (300 lbs. per sq. in.) steam-heating of the jackets during starting, and the solid-injection of fuel at a pressure of 10,000 lbs. per sq. in. It need hardly be pointed out that all these features are inter-related. The purpose of the high metal-temperatures of the combustion-space is to offset the handicaps due to solid injection and low compression and its accomplishment is attested by the clean consumption of Mexican residual-oil having a heating-value of 17,600 B. T. U. and an

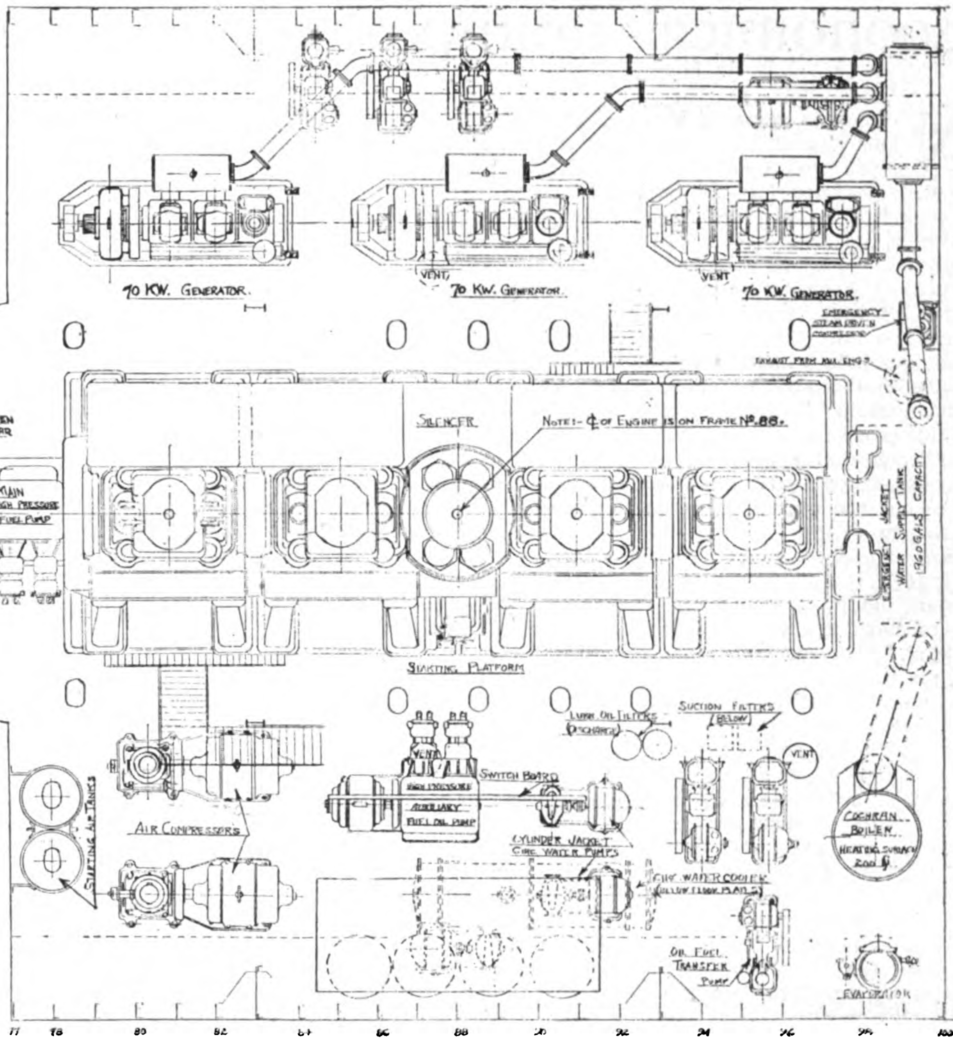


Comparison between spaces occupied by Doxford oil-engine and quadruple-expansion steam-engine set of 3,750 shaft h. p. and of similar speed. Cylinder of steam-engines are 26½ in. by 37 in. by 53 in. by 74 in. by 54 in. stroke at 85 R. P. M. Overall length of steam machinery 114 ft. 4 in. Overall length of Diesel machinery 50 ft. 6 in.

asphalt content of 22 per cent. Since an engine having a compression of only 300 lbs. per sq. in. would naturally not start from cold, steam from the small oil-fired donkey-boiler is used for heating the cylinder-jackets during starting and manoeuvring. Even during ordinary running, jacket and piston-cooling water temperatures are maintained at a point where the discharges give off visible vapor, and the use of fresh-water in both systems becomes necessary in order to avoid the depositing of salt that would accompany the use of sea-water. This means the carrying of about 3,000 gallons of fresh-water in tanks for this purpose.

In order to eliminate the well-known heat distress ordinarily resulting from the use of high jacket-water temperatures, cylinder liners having a wall-thickness of only one-inch are used, and they are provided with the necessary strength by means of ribbing, a feature which also increases the rate at which the desired heat-transmission is effected. The tops of the ribs, according to our understanding, are machined cylindrical and permit the liner of being made a tight fit in the water-jacket over a length of about three feet and of thereby transmitting a part of the hoop-stress to the outer jacket.

Inherent in the construction are excellence in the shape of the combustion-space and an elegance of the scavenging process which we have not yet seen exhibited by any other two-cycle design of "Diesel" engine. The combustion volume is really the space by which the pistons miss touching each other, and has a shape ideally suited to the burning of fuel. Inlet-ports having an unusually generous area are cut near the bottom dead-center of the lower piston and extend over 360 degrees, while somewhat higher exhaust-ports are similarly located near the top. Towards the end of the pistons' outward travel, the earlier opening of the exhaust-ports permits the pressure in the cylinder to blow down, whereupon admission of scavenging-air through the inlet openings commences. Owing to the fact that entrance of air is completely circumferential and that it can travel the length of the cylinder, practically as a solid column without having to double back on itself, a rare degree of perfection in the scavenging process is attained. It amounts, in effect, to uniflow scavenging.



Plan of engine-room of the motorship "Yngaren"

The practical consequences of this are that a very complete substitution of fresh-air for burnt-gases is made, that low-grade fuel can be consumed with a high degree of cleanliness and perfection, low scavenging-air pressure can be employed, power-consumption of the scavenging-pump reduced and certain operation even with greatly diminished scavenging pressure is made possible at remarkably low revolutions per minute. Absolutely steady running at 17 R.P.M. is claimed for this Doxford engine whose normal designed speed is 77 R.P.M. We have personally witnessed the single-cylinder experimental engine running at 20 R.P.M. on load burning heavy Mexican residue. Such flexibility is unattainable to-day in a six-cylinder four-cycle engine because it has too few power impulses per revolution, although, of course, the average reputable four-cycle engine has ample flexibility to cover all regular manoeuvering of a ship. In two-cycle engines as ordinarily built, a reduction in speed causes so sharp a falling-off in scavenging efficiency, unless the scavenging-pumps are separately driven, that poor cylinder filling and unsteady firing manifest themselves considerably earlier than seems to be the case with the Doxford engine.

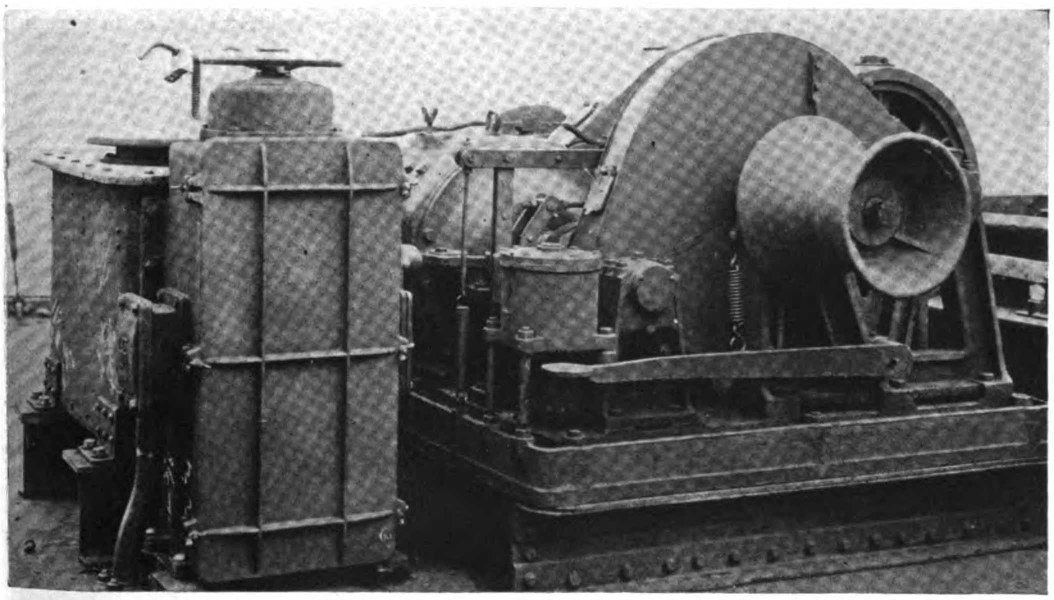
The bore of this machine is 22.84 inches and the stroke of each piston by itself is 45.66 inches. Although the piston-speed is only 586 ft. per min., the pistons actually approach and recede from one another with a mean velocity of twice that amount, namely 1,172 ft. per min. and their total stroke is *seven feet* and 7 1/32 inches. A full-grown man with a child sitting on his shoulders could stand erect on the lower piston while the latter was on the outer dead-center without letting the child's head touch the upper piston, as the addition of the clearance space brings the extreme distance between pistons to more than eight feet. Finally, at the risk of making an anti-climax, we call attention to the fact that the development of 650 brake-horse-power in a "commercially-applied" engine-cylinder is a record which will probably remain unexceeded for a while, although the new Ansaldo San Giorgio Diesel-engine develops the same power per cylinder at normal load and at 100 R.P.M. We understand that three additional Doxford engines of this power in their own plant and two more are about to be built by a licensee. Doxford licensees in Europe are the Fairfield Shipbuilding & Engineering Co. of Govan, Glasgow, and the Motala Verkstad of Motala, Sweden (A/B Lindholmen-Motala, Göteborg.)

TURBINE-ELECTRIC DRIVEN SHIP "ECLIPSE"

In our next issue we shall have some further comments to make regarding the 12 vessels which the Shipping Board is changing to turbine-electric drive, because the result of the "Eclipse" in service with her new machinery makes it obvious that further work on conversions should be suspended and the installation changed to Diesel-electric drive or direct Diesel, the "Eclipse" showing an even higher consumption than with her original geared-turbine. We have before us figures regarding her first voyage; namely, from New York to Batavia and back.

Shaft h.p. fuel consumptions were taken only for 10 stages of this round voyage, aggregating 23,611 nautical-miles, which was covered at an average speed of 9.68 knots. This consumption figured out at 1.28 lbs. per shaft h.p. hour, or slightly over three times the fuel-consumption of the Shipping Board's Diesel motorship "William Penn."

Had not the boilers been fitted with super-heat, the "Eclipse's" fuel-consumption would have shown a 20% increase over the geared-turbine drive, whereas the increase is actually 10%. Other figures will be given next month.



One of the cargo-winches on the Doxford-built motorship "Yngaren"

Economical Transportation on the New York State Canal

A Series of Exhaustive Articles on Barge Commerce Along the World's Greatest Inland Waterway

PART IV.

Types of Canal Craft

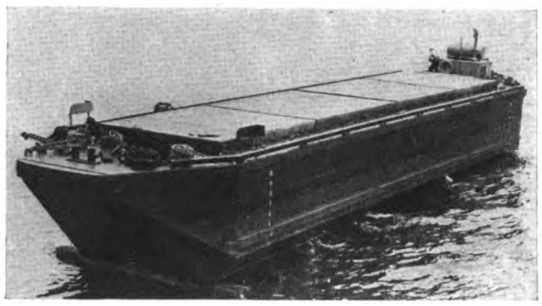
NO one has operated boats on the new Canal long enough to be able to say, "This is the most profitable type of vessel that can be used!" Cargoes just as diverse as those which are carried on the high seas are available for shipment, and problems of handling and transshipment equal in complexity to those of ocean transport have to be met in working-out good types of boats for use on the New York State Barge Canal. Conditions of navigation are simpler, but it is a mistake to assume that operating boats on the new waterway between New York and Buffalo is "like sailing in a bathtub." Weighty as these still-to-be-solved problems are, our study of transportation along the Barge Canal has convinced us that the Canal's future is assured and that the excellent prospects already in view make inevitable the necessary development of means and methods of navigation.

Indeed, the opportunities for "getting in on the ground floor" of this new development are such as to make it a highly attractive business undertaking. The very fact that conditions have not as yet become stabilized and that experience and business footholds have not been cornered by long-established concerns leaves open the way for enterprise and determination.

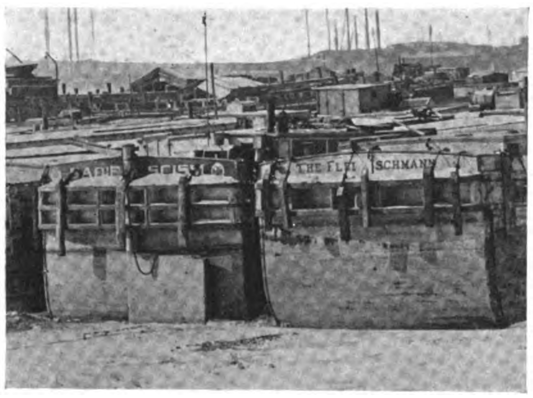
Although it would obviously be wrong to attempt to operate on the newly-completed Barge Canal with the same boats and methods that were used on the old Erie Canal, it would also be a mistake entirely to ignore the experience with which epoch-making results were achieved on the old waterway. Little need be said of man-poling that was used in the early forties, or of mule-towage that persisted until the spacious new waterway and large modern boats put an end to it during the first decade of the present century. There was, however, a good deal of steam towing of fleets of barges from about 1870 on, and self-propelled steam-barges came into use to some extent a little later on. It is the experience on power-towed and automotive craft that is of interest from the point of view of the modern Canal.

In applying the knowledge gained on the old canal to the new one, it should be remembered that the two waterways differ not only as to size, but also in the fact that the old Erie was a real canal, cut in dry earth and rock along a route that everywhere avoided contact with lakes and natural streams, whereas the New York State Barge Canal consists for more than two-thirds its length of "canalized" rivers and lakes. Stupendous engineering works have been built which make the new Canal absolutely safe to navigate, but this does not alter the fact that during some seasons of the year strong currents (5 to 6 knots) are encountered in certain regions, notably in the Mohawk River, and that appreciable storms must be weathered by boats passing through fairly large lakes such as Oneida and Onondaga.

Towing a fleet of passive barges by means of a regular steam tugboat was the most up-to-date method in vogue on the old Erie Canal. It did not, however, mark an entirely complete advance over mule towage, since no attempt was made to speed up the barges. In fact, practically all of the barges were of the 240-ton "Erie Canal" type, which permitted comfortable towing by mules and entirely satisfactory manoeuvring at a speed not greatly exceeding 3 miles per hour. Since all these boats had squarely-chopped-off sterns, which greatly interfered with the free flow of water around their rudders, any attempt to speed them up made them quite unmanageable. The application of steam towing to barge transportation did not therefore do much to increase the speed of the boats, because their sterns would have had to be rebuilt in order to make this possible.



Transmarine Line 400-tons barge to be used for linking-up Great Lakes and Ocean Commerce under the organization plan of the Great Lakes, Hudson & Atlantic Waterways Association



Bow and stern views of antiquated canal craft showing ineffectiveness of rudder

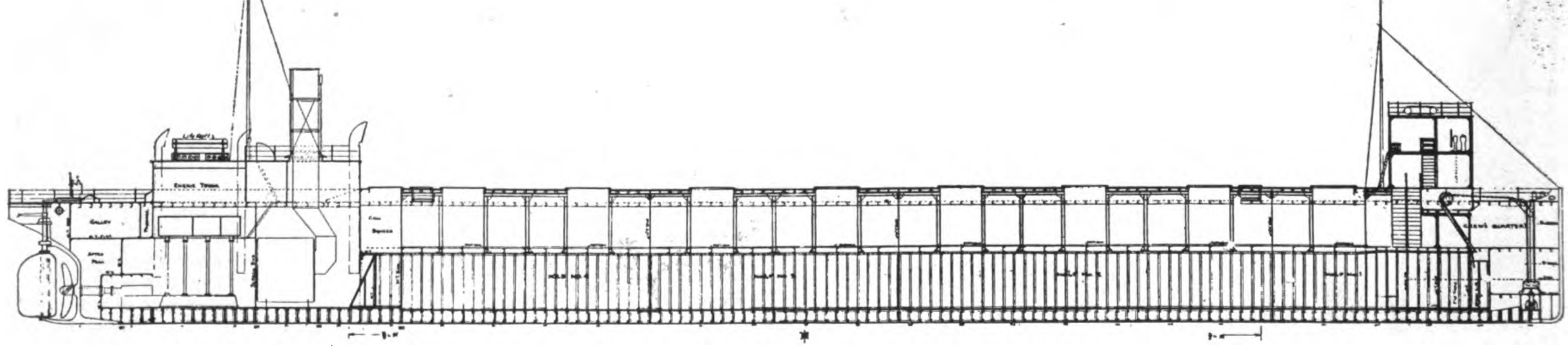
Certainly the need for such a drastic step did not even occur to many Canal men at that time, and it is beginning to be acknowledged only slowly at present.

Response to the helm is nevertheless a very important matter in canal craft, because of the rather sharp bends that are found in the new as well as in the old canals. Steering a tow through tight places is no child's play under any circumstances, a fact which led to the employment of special devices for directing a string or "sausage" of barges. The most successful of these, which, by the way, is being employed by the Transmarine Corporation on their 400-ton modern steel barges, consists of a triple lashing between bows and sterns of successive barges, disposed to permit of slacking off and tightening the outside ropes by means of a special hand windlass in such a way as to point the ahead barge either to port or starboard. A log fender hung between the ends of the boats forms a fulcrum against which they are hauled together firmly enough by the centre lashing always to maintain contact, and just slack enough to permit them to pivot, according to the complementary playing-out and hauling-in of the outside ropes.

Naturally boats handled in this manner do not require great rudder responsiveness; on the other hand, the men in charge of them must know what they are doing far more than is required of ordinary helmsmen. By no means all of the existing canal barges are equipped with this type of steering device and its adaptability under the new conditions, is one of the problems which will require solution. In any case, barge architects will play safe by giving the sterns of their craft sufficient fineness to insure free flow of water around the rudder at all speeds.

Whatever may be the difficulties that are presented by the steering of tows, there can be no doubt of the advantages of the towed passive barge in certain other respects. Especially for hauling bulk cargoes of a low class, for which barges must necessarily wait both to load and unload, the absence of interest and depreciation charges for power-plants in each barge is of importance, and it is usually possible to arrange for practically continuous employment of the power plant in the tug. The machinery crew of the tug also serves for all the barges, whereas self-propelled barges must each have an engine-crew of its own. Different conditions of navigation can also be readily met by simply changing tugs. For example, tows of barges coming through New York Harbor and up the Hudson might need a powerful and expensive tug as far as the locks at Troy; after locking through a smaller tug could take them through Lake Oneida as far as Syracuse. Since there is "bathtub sailing" practically all the way from there west as far as Tonawanda through the "land line" in the neighborhood of Rochester, a still smaller towboat would be employed. This, of course, implies considerable organization and regularity, and will undoubtedly be made much of in the near future.

The expedient of taking a passive barge and putting enough power aboard it to propel itself and at the same time tow a fleet of passive barges has some advantages, but there were only about twenty-four of this type on the old canal, and the ones that have been put on the new canal have not had a proper try-out. The older type is built of wood, and, with the exception of the stern, was modeled closely after the 240-ton type of Erie canal-boat. Like the latter, it was 96 ft. in length, had a beam of 17½ ft. and drew 7 ft. of water when loaded. The steam-engine which it carried was 14 in. by 16 in., ran condensing, swung a 5 ft. by 6 ft. wheel at 135 r.p.m., and gave the boat a



"Sea-going Canal Boat" built by the McDougall-Duluth Shipyards. Same general type as five oil-engined vessels furnished to Mr. Julius Barnes of the Erie Canal Transportation Co. for carrying grain. The steam plant shown was changed to Skandia surface-ignition oil-engines

speed of from 8 to 9 mi. per hr. light. Carrying a load of 150 tons and towing three loaded 240-ton Erie canal-boats, the combination is said to make only 3 mi. per hr. A curious feature was the use of rigid arms to connect with the passive barges, which were shoved ahead instead of being pulled from astern in the usual manner. All the steering had to be done by the steam barge, and it is difficult to see how bends in the canal were negotiated. That such a combination could weather a storm on Lake Oneida or buck the current of the Mohawk River during a spring freshet, hardly seems probable.

A somewhat similar arrangement was put on the new canal by the Division of Inland Waterways of the United States Railroad Administration, and subsequently operated by the Inland and Coastwise Service of the United States War Department. The passive steel barges are 150 ft. in length, have a beam of 20 ft., and a depth of 12 ft.; their deadweight capacity is 560 short tons on a draft of 9 ft. From these were evolved the self-propelled barges by the simple process of fairing-up the stern a little and installing two 200-h.p. steam-engines with a boiler, fuel and water tanks, extra crew's quarters, etc. The molded dimensions are exactly the same as those of the passive barges, but the deadweight capacity is reduced to 390 short tons.

The method of operating these craft was to use one loaded steam barge for towing three loaded passive barges. As the dimensions of the combination were slightly more than 300 by 40 feet, it could be accommodated as a unit in the new 310 by 45 ft. locks.

Owing to the disturbed conditions under which these government boats were operated, anything like a real judgment as to their merits is out of the question. As a tentative estimate, however, it appears justified to state that they did not have sufficient fineness of stern to permit of safe manoeuvring at the speeds which their large power gave them. The fitting of twin rudders to the steam barges was resorted to and yielded some improvement.

Little can be said in defense of installing steam on these vessels, particularly since a well-known and successful firm of oil-engine builders offered to place on the dock alongside the boats oil-engines excellently suited for the service without charge except if the government decided to keep them after a four months' trial. Oil-burning water-tube boilers supplied steam at 200 pounds per square-inch pressure, and should consumed oil-fuel at the rate of 600 pounds per hour. But, the last-named figure has been supplied by ourselves, because those given on page 40 of the Report of Inland and Coastwise Waterways Service of the U. S. War Department indicate an abnormal fuel-consumption—the report definitely stating 1,150 gallons per hour, or more than is used by the biggest ocean-going Diesel ship afloat. Presuming the "gallons" is a misprint and that "pounds" is meant the consumption is still enormous. On the other hand, we have been advised that some of the stern-wheel tugs on the Mississippi River burn as much as 7 pounds of coal per b.h.p. hour. As the capacity of the fuel-tank of the New York State Canal craft is given as 45.5 tons, we estimate that the cruising radius of the steam-barge is limited to six days, barely sufficient for a return trip between New York and Buffalo. Had oil-engines been installed, three such trips could be made on a single bunkering of fuel.

An oil-engine installation would also have permitted placing the forward engine and boiler-room bulkhead 10 feet further aft, and would have increased the cargo space and earning capacity by 13 per cent. One member of the crew at least could have been dispensed with at a clear saving per season of $600.

In due fairness to the War Department it should be made perfectly clear that these craft were not designed and built under its supervision, but were planned by the U. S. Railroad Administration's Inland Waterway & Coastwise Service. The War Department has demonstrated that it is strongly in favor of internal-combustion power for propelling vessels, and during and since the war built a total of 38 craft with Diesel and other types of motors for other services.

A fleet of these steam-barges have just been sold by the Government, and as they can be of little profit to anybody in their present condition, we hope that the purchase-price was a sufficiently low figure to permit altering them for economical oil-engine power in the manner suggested at a very reasonable ovar-all cost. No expense was spared in building them; they are rugged and substantial, and should make a first-class set of boats after they are reconditioned. They would furnish excellent means for building-up Canal traffic.

Self-propelled cargo-carrying units have the important advantage of not requiring the organization and maintenance of a towing service, and at the same time they permit of towing passive craft should it become desirable at any time to do so. For an immediate entrance into the Canal transportation business without the delays incident to the establishment of dependable and regular tugboat service self-propelled barges are very much to be commended. State towing has been abolished and our study of conditions does not indicate to us that private individuals will be quick to respond to the demand.

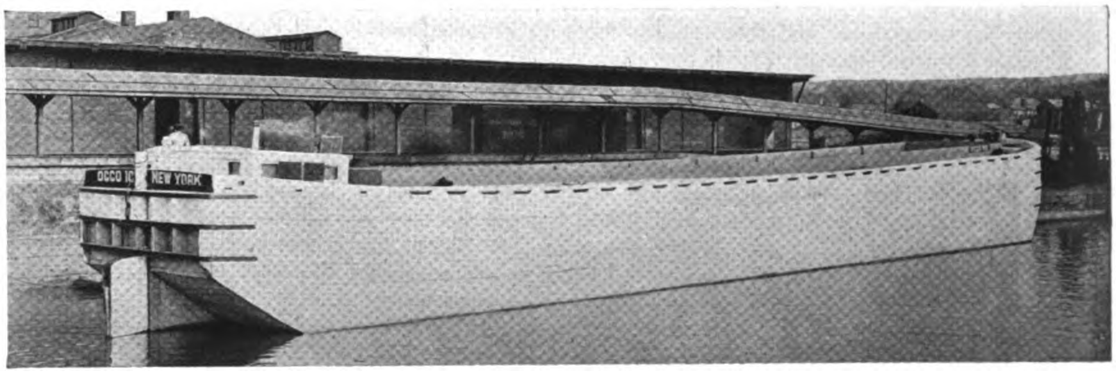
It will be a puzzle to us, however, if the possibilities of oil-engine tug-boats will not be recognized in the near future. To the advantages of separate towing which we have pointed out can be added many others if oil-engine propulsion is used. The elemination of such heavy stand-by losses as those to which steam-craft operating through the many locks of the Canal are subject is a matter of great economic significance. Internal-combustion engined tugs can also easily accommodate all the power that is needed within a length that avoids the heavy hand of the Steamboat Inspection Service and the classifications as to personnel imposed by labor unions. "Two-man" tug boats are brought within the reach of useful and economical application by the use of oil-engine power.

Good results with sixteen Diesel-engine tugboats on inland waterways in France were reported in a recent issue. Two types are mentioned as having identical hull structures, but powered respectively with Polar and Sulzer Diesel engines. Hull dimensions are as follows:

Length B. P.	85 ft.
Length O. A.	92 ft.
Beam	16 ft.
Draft	9 ft. 6 in.
Displacement	145 tons
Power	350 and 420 b.h.p.

Both kinds of motors are of the four-cylinder two-cycle type running at 200 r.p.m.; the Polar machine develops 350 b.h.p. and the Sulzer 420. The auxiliaries consist of a combination air-compressor and dynamo built-in with a 12 b.h.p. Polar oil-engine, which is also belted to a small bilge and ballast pump. Living quarters are provided forward for the captain and engineer, and aft for an oiler, deck-hand and cook. The weight of the main engine and auxiliary machinery is 40 tons. Sixteen of these craft have been built or are on order for the French Government for use on the river Seine, and all the trial runs which have been made thus far have been highly satisfactory. These vessels were described and illustrated in "Motorship" of August, 1920.

The New York Canal System is better supplied with passive barges than it is with the tugboats to tow them. Although steel barges are coming into use, it is not established that they will replace wooden ones. There is no doubt that the employment of steel for craft less than 120 ft. in length is at a disadvantage in comparison with wooden construction, and the range of usefulness of wood unquestionably extends up to lengths as great as 175 ft. A design of barge which retains all the homespun goodness of the wooden canal boat and which at the same time takes into account modern operating conditions is the "Occo" type of the Ore Carrying Corporation. Four 1,000-ton barges like this have been built and are in service; they have a length of 152 ft., beam 25 ft., depth 15 ft., and can carry 800 tons deadweight.



"Occo" type of modern wooden barge suitable for economical towing by up-to-date oil-engined tugs

Sixteen 400-ton steel barges of up-to-date design will be operated during the present season by the Transmarine Line. They, too, have considerably more fairness than the Erie canal boat, and should be responsive to the helm at the speeds at which they are likely to be used. The designers have played safe, however, in providing the double-hand steering-winches already described.

A new type of Canal craft, which can be classed neither as self-propelled barge, or as tug, is the so-called "sea-going canal boat." Since these vessels are fully capable of handling themselves, and can develop a speed of something like 8 knots in open water, the reason why the name barge does not exactly fit them is apparent. They also differ essentially from the self-propelled barge in that they are not adapted for towing. Against a possible criticism that if these boats are built to stand open water service, they are incurring unnecessary overhead while passing through the canals, must be weighed the fact that the modern Canal permits a speed of 6 miles per hour. Moreover, the vessels can carry cargoes from Duluth to Delaware Bay with a speed to which that of no other actual transportation method can compare.

Credit for originating this type of craft belongs to Mr. Alexander McDougall of Duluth, whose foresight in choosing oil-engine propulsion for the first of them actually to be placed on the Canal is also to be commended. We have at our disposal cuts only of Mr. McDougall's steam-driven sea-going canal boats, but they show in a general way how the new oil-engined vessels will look, the first of which is en route to New York with a big cargo of grain. Their most distinguishing characteristics are their strong resemblance to lake freighters, their generous utilization of the dimensions afforded by the modern locks, and their removable superstructures.

Five of these sea-going canal boats will soon be operated by Mr. Julius Barnes of the Erie Canal Transportation Company (Interwaterways Line Inc.). They are 250 ft. in length, have a beam and depth of 36 and 14 ft. respectively, displace 2,150 tons at 10 ft. draft, and carry 1,500 tons. Each one will be driven by two 140 b.h.p. Skandia surface-ignition oil-engines. Cargo-handling and steering equipment is electric and of the most modern design, having been furnished by the American Engineering Company of Philadelphia. Nothing has been spared to put these boats on a par with the most highly developed ocean freight-carriers now known.

It need hardly be added in conclusion that this brief review of some of the progress which has been made in devising efficient Canal craft, corroborates the view that Canal transportation is on the threshold of a new era, in which the application of economical oil-engine propulsion is destined to play a brilliant part.

JULIUS KUTTNER, Special Commissioner.

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MOTORSHIP

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ACTIVE MOTORSHIP CONSTRUCTION ON THE PACIFIC

A motorship construction revival is just starting on the Pacific Coast. In the past shipowners on the Pacific Coast of the United States have paid more attention to visiting foreign motorships than have shipowners in the East, probably because several important motorship lines have been established between Pacific ports and Europe, and these foreign Diesel-vessels have lately been carrying American products while our own steamers have been tied-up. About eighty motorships were built on the Pacific Coast during the war, of which many were underpowered wooden auxiliaries and unsuitable for post-war commerce competition. Over a dozen were full-powered wooden motorships, and these vessels have all given splendid service and nearly all are to-day in regular operation.

Recently Pacific Coast shipowners turned their attention to full-powered steel motorships and the first big vessel of this class—the 6,500 tons 2,200 i.h.p. Diesel-freighter "Kennecott" has been in most successful service for several months. Her performance, also the splendid service of the Diesel-tanker "Charlie Watson," combined with knowledge previously gained by studying foreign vessels, have converted practically every shipowner in the West. Those who several years ago considered the Diesel-driven ship a very hazardous proposition have now veered round like a changing wind, and to-day are numbered among the most powerful advocates. It may be said with accuracy the situation on the West coast to-day is that all shipowners, operators, designers and builders have all come to the conclusion of the superiority and practicability of the ocean-going motor-vessel.

Consequently, the "Kennecott" is to be immediately followed by a number of new motorships. The Puget Sound Towboat Co. are having a new Diesel freighter of similar power, while the Puget Sound Navigation Company are having a 2,000 h.p. motor ferry-vessel to carry 2,000 passengers and 60 automobiles from Seattle to Bremerton, and will convert their existing steamers to Diesel or Diesel-electric power. The Alaska Steamship Co.—it is reported—will follow the same procedure and convert their steamers commencing with the "Alameda." Also, the Carey Davis Tug Boat Co. are to convert their nine steam-tugs to Diesel-motor power, and work on three will be commenced this Fall; while the Dollar Steamship Co., of San Francisco, are figuring converting seven steel German hulls to motor power. Then again the Hibbard-Swenson Company are to have a motor-auxiliary built to replace the "Kamchatka" lost by fire last season. Thus three new motorships and many conversions are on the immediate constructional programme and soon may be followed by others which makes the Pacific Coast a bright market in these dull times for engine-builders, and equipment manufacturers. Also, it probably will stir Atlantic Coast shipowners into quick action converting their steamers into motor power.

Our August issue will be a Special Pacific Coast Number, and complete stories dealing with all these new orders will be given. Support this motorship movement, by advertising in this feature number.

COST OF DIESEL VERSUS STEAM ENGINES

Conversations with a number of American shipowners have revealed that some of them are convinced in their own minds that it would not pay to operate motorships on short routes, and that taken all-round steamers are better in cases where voyages do not exceed several days in length. They argue that because no large quantity of fuel need be carried, the gain in cargo space made by the motorship due to her lower consumption and saving in machinery weights is not sufficient to cover the bigger interest on capital-cost, greater depreciation, insurance, etc. And, that for sufficient economies to be shown to warrant adoption for vessels running on such routes as New York to Cuba the first-cost of motorships must be brought nearer to that of steamers, instead of remaining about 10% higher.

While we cannot coincide ourselves with this finding, we believe the adoption of the Diesel-engine will be substantially assisted if the cost of this type of machinery can be reduced to a figure nearer steam-engine, boilers, and condensers. Ordering Diesel-engines in considerable numbers and so allowing thorough standardization and quantity production will do much in assisting to bring this about. Up till now our oil-engine builders have been badly handicapped by being awarded with orders for only one or two engines at a time. Shipowners' attentions, too, should be drawn to the possibility of making a motorship from 5% to 12% smaller overall in accordance with the voyage-distances, and in this manner lower the cost of the hull, shafting, propellers and power, also cost of the engines, to an equivalent percentage. This can be done and the vessel will still lift the same amount of net-cargo as the larger steamer. In this manner the first cost of a motorship can be reduced to at least that of a steamer.

STEAMSHIPS AND THEIR FUEL-BILLS

Things exactly as they are, and when given in their most concise form, often carry their greatest lesson without comment. A case in point: Last year the income of the Cunard Line was $15,000,000 over the previous year, but which was more than counterbalanced by increased costs, of which the a motorship can be reduced to at least that of a steamer.

A well-known American firm of steamship owners on the Pacific Coast, who have just decided to build a large motorship and to convert their present fleet of steamers to Diesel power, were partly influenced by the fact of their oil-fuel bill having suddenly been increased by $1,000 per day. This also applies to another Pacific coast steamship company who recently took delivery of their first ocean-going Diesel freighter. The difference in the fuel-bills is so great that they have decided to convert one of their oil-fired steamers to oil-motor power. Both vessels are burning the same grade of fuel, the steamer using 300% more than the motorship, which is a tremendous difference. The head of one of these two steamship companies recently advised a representative of "Motorship" that he wouldn't take all the steamships in the United States as a gift, because they simply cannot be run successfully in competition with motor-vessels.

TANKER SELLS BUNKERS AS CARGO

The remarkable economy of her Diesel-engines enabled the new motor-tanker "Seminole" to discharge 200 tons of her bunker-oil at Avonmouth after crossing the Atlantic from New York and she still had sufficient oil for the next passage to Baton Rouge, La. She is a vessel of 10,050 tons d.w.c. and when she left New York she had on board 9,123 tons of oil-cargo and 672 tons of bunkers in addition to a large number of cases of oil-stoves. Altho she averaged 11.4 knots, her total engine fuel-consumption across the Atlantic was only 138 tons. This is a result impossible for any steam-driven tanker to attain.

CONVERT THEM TO ECONOMICAL DIESEL POWER

A fleet of five steamships have been laid-up for several months by the Garland Steamship Company, 511 5th Avenue, New York—says W. M. Campion, the Vice-President and General Manager—because the rates then, as well as now, did not produce a gross income sufficient to meet the *actual operating costs,* not including interest or depreciation, and the owners can see no hope for resuming operation until a remedy is found. This state of affairs is exactly what "Motorship" accurately forecasted. We have also indicated the remedy, namely convert the ships to economical Diesel power, and thus reduce the operating costs and increase their cargo-capacity. We suggest that some enterprising Diesel-engine builder work out the conversional costs with the Garland Co. and submit a bid in conjunction with some dry-dock company.

FUEL IS GREATEST EXPENSE OF SHIP OPERATION

The cost of fuel in American merchant vessels is about 43% of the total operating expense, says Mr. G. W. Yarus, Chief-Fuel Inspector of the United States Shipping Board, N. Y. We will add that steamships use 300% more fuel than do motorships, so an enormous saving can be effected by conversions to Diesel power.

THE DAY OF THE HIGH-POWERED MOTORSHIP

It would appear that the day of the high-powered motorship is much nearer than steam interests would have shipowners believe. Some time ago we referred to some German engines of 12,000 to 16,000 shaft horse-power having been completed for battleship purposes. Now several leading shipbuilders are at work on Diesel units of high-power for merchant ships. It is known that Burmeister & Wain are at work on four engines of 4,000 i.h.p. for an 18-knot Swedish passenger motor-liner, but it is not so generally known that Harland & Wolff have practically completed a pair of 4,000 i.h.p. merchant-marine Diesel-engines. For several months we have had drawings and details of a 4,500 i.h.p. Ansaldo San Giorgio engine that recently ran tests in Italy, while Sulzer Frérés of Switzerland are now prepared to build and guarantee up to 10,000 b.h.p. per shaft. In fact a twin-screw set of 6,000 shaft h.p. is actually under construction in their German factory for a motorship building in a yard in that country; and one of their English licensees is building a single-screw 5,000 shaft h.p. engine. Now comes the news that Cammellaird are constructing a marine Diesel-engine to develop 5,000 shaft h.p. in six opposed-piston cylinders at 90 r.p.m.

TRANSPORTING WHEAT FROM VANCOUVER TO LONDON

With freight rates at their present level, we doubt if it would pay oil-fired or coal-burning steamers to carry wheat from Vancouver, B. C., to London, England, via the Panama Canal. This, however, was recently done with a substantial profit in the case of the 9,400 tons d.w. Swedish Diesel motorship "Buenos Aires"—altho she made a detour to New York en route in order to "pick-up" her owner. The story of her voyage given in our April issue produced great interest all over the world.

TURBINES AND SUPER-HEATED STEAM

Because of the reduced fuel-consumption thereby obtained, the use of super-heated steam for ship's turbines has been recommended and used in this country. But, a well-known British turbine expert has issued a warning regarding this practice, pointing-out among other things that danger arises from the differential expansion when hot steam is admitted to a reverse turbine. The temperature of the steam suddenly admitted to the idle turbine is generally lower than that in which it has been rotating while idle, which may have risen to 1,000 degress Fahr. or close upon the combustion temperature in a Diesel cylinder. Also that if the same degree of heat were used in marine as in land turbines, impossible conditions would be set-up in the reverse turbine. This is another strong argument in favor of economical Diesel-power as opposed to oil-fired turbines for merchant ships. Superheat was used in the S.S. "Eclipse" to increase the economy.

SEVENTEEN NEW LIGHT SHIPS PLANNED

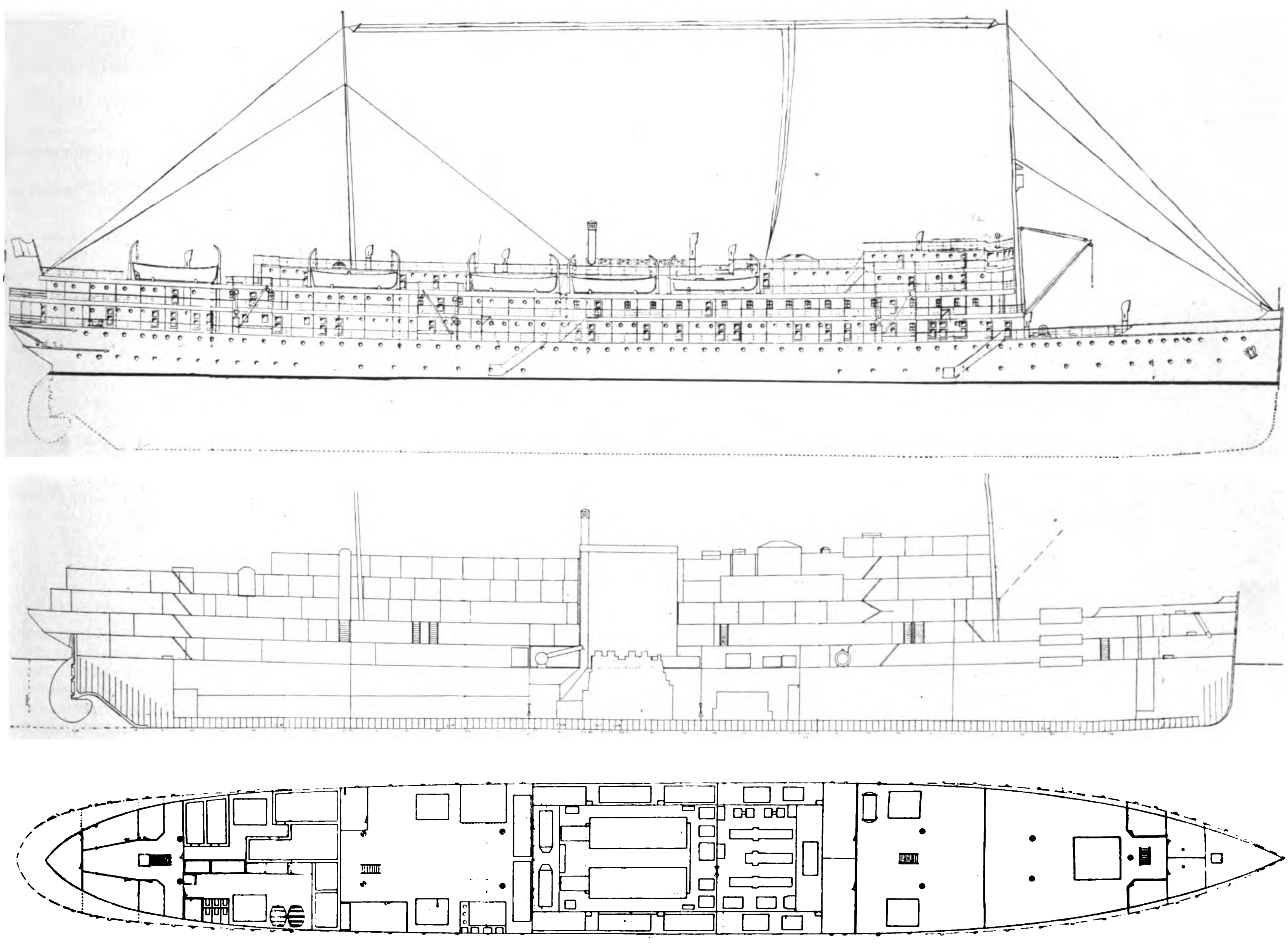
An appropriation of between $4,000,000 and $5,000,000 will be asked from Congress by the Commissioner of Light Houses for the purpose of constructing seventeen light-ships and tenders that are urgently needed by his organization. There are in service in this country a number of light-ships in which the equipment consists of surface-ignition marine oil-engines and we understand these vessels have given very good service. Diesel and other oil-engine manufacturers should do their utmost to induce the Commissioner of Light Houses to build new vessels of the most economical type—that is to say, equip them with heavy oil-engines. Possibly Diesel electric-drive would be very suitable for such craft.

THE RIGHT IDEA

Shortly before the new Shipping Board was announced a prominent shipping man on the Pacific Coast was approached by the press—it having been reported that a position with the Shipping Board would be offered him. He stated that if he was named, he would take all the Shipping Board's wooden ships, and some of the steel steam-ships, have them put into the ocean and sunk. And, if any new vessels were built he would insist upon them being motorships. This is much along our own ideas only instead of scuttling those ships that were not of much use, we would suggest that the Navy use them for target practice.

IMPORTANCE OF ECONOMICAL OPERATION

Recently the big Shipping Board liner "Golden State" left San Francisco for the Orient partly loaded with 4,000 tons of cargo and 19 truck-loads of mail, but the slower Japanese vessel "Shinyo Maru" sailed a few hours earlier fully loaded with cargo and with 3 truck-loads of mail. Had the American vessel been Diesel or Diesel-electric propelled her operating costs would have been sufficiently reduced to have enabled her to have offered a lower rate for cargo than the Japanese ship could have carried it for at a profit. When there is only a limited amount of domestic products to leave this country they should go by American ships, but our vessels must first be changed so that they can offer the lowest rates, and still make a profit. Otherwise they will not get the cargoes.



NEW MOTOR PASSENGER-LINER FOR AMERICAN FIRM

Plans of a passenger and cargo Diesel motor-liner prepared by Ansaldo San Giorgio Ltd. of Spezia, Italy, at the request of an American firm. Construction has not yet commenced, nor are similar motorships building for the Societa Transatlantica Italiana, as recently erroneously reported in other publications. The design shows a vessel of 9,900 tons displacement, 5,800 tons cargo-capacity, accommodation for 350 first and second-class passengers, twin 2,000 shaft h.p. two-cycle Diesel engines, and 13-knots speed. This design is of special interest because of the decision of the Puget Sound Navigation Company to build an 18-knot, 2,000 passenger motorship

New Diesel Tanker "Seminole" in New York

Here Together With Sister Motorship "Narragansett"

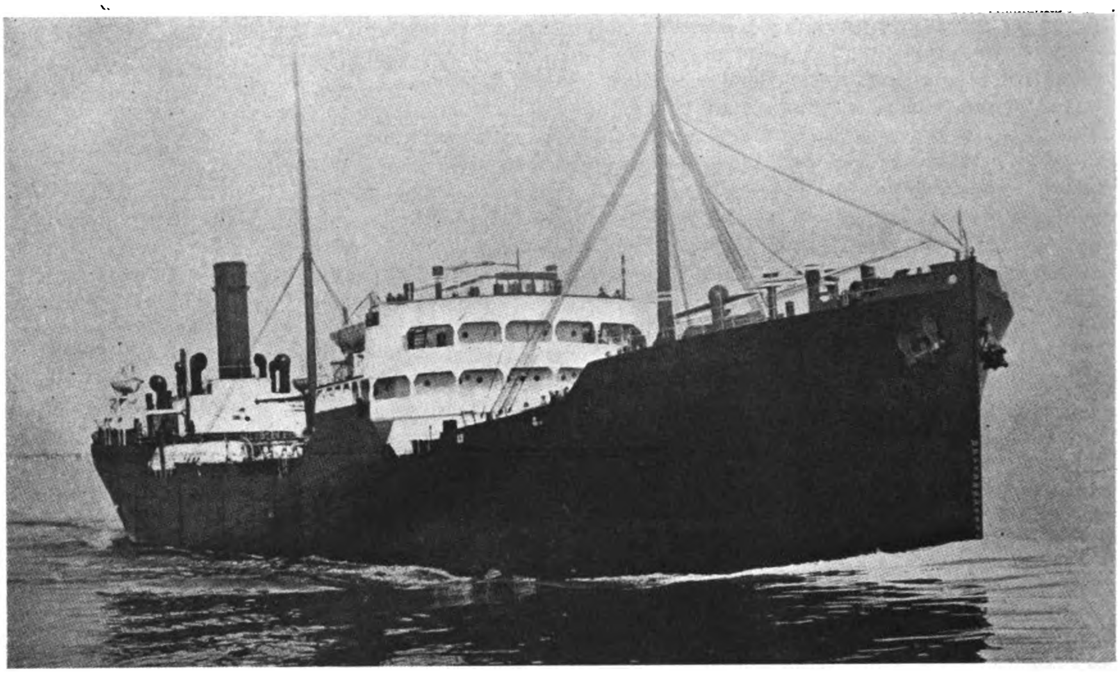
By a strange coincidence half-a-dozen important American and foreign motorships were in New York harbor at the same time a few weeks ago. Among these vessels were the Vickers Diesel-engined tankers "Seminole" and "Narragansett," both of 10,050 tons d.w.c. and both owned by the Anglo-American Oil Company. The motorship "Seminole" was here on her maiden voyage and is practically a duplicate of the motorship "Narragansett," although she has some minor modifications to her main engines, resulting from the experiences with eleven trips across the Atlantic of her sister, the "Narragansett." Both vessels are built on the Isherwood system.

The "Narragansett" has done splendid work, having averaged 10.2 knots over a distance of 38,465 nautical-miles on a daily consumption of 9¾ tons of fuel for the main engines.

A rather remarkable result was obtained on the maiden round-voyage of the "Seminole" from England to the United States and return, a total time of 31 days having been taken from Barrow-in-Furness, England, to New York, U. S. A., and back to Avonmouth, England, on a total consumption of 299½ tons of fuel-oil for the main engines, the average speed for the round trip being 10.55 knots.

It is very interesting to note that on the return voyage, fully-loaded, her main engines only consumed a total of 138 tons, yet she averaged 11.4 knots. Whereas on the voyage over in ballast she averaged 9.7 knots and consumed 161.5 tons, or 23½ tons more. However, the higher consumption included donkey-boilers for the auxiliaries.

A non-stop sea passage was maintained on the maiden run from Barrow to New York. The "Seminole" covered 3,115 nautical-miles in 13 days, 10 hours, with unfavorable weather, the engines averaging 2,640 indicated horsepower on 10 tons of fuel per day, so we presume the actual consumption for the main engines only was 30½ tons. The fuel-consumption figured out at 0.348 lb. per i.h.p. hour.



Anglo-American Oil Co.'s 10,050 tons Vickers Diesel-driven tanker "Seminole," the second of six sister motorships

She made a passage back to Avonmouth, England, in 11 days, 11 hours, on a daily consumption of 10.4 tons. The average power developed was 2,873 i.h.p., so that the fuel-consumption was equivalent of 0.339 lb. per i.h.p. We are advised by the owners that everything worked satisfactorily on both runs.

Visitors on the "Seminole" at New York (See following page)

One of the most interesting features of the return trip is that the "Seminole" had on board 9,123 tons of oil-cargo, a large number of cases of oil heating-stoves and 672 tons of bunker-oil. But, she landed 200 tons of her bunker-oil in the form of cargo at Avonmouth, and still had sufficient oil on board to return to Baton Rouge, La.

A large number of visitors went aboard at the invitation of the Anglo-American Oil Company and Messrs. Vickers, Ltd., the builders. Also, Mr. Powell and Mr. Hamilton, directors of the owners, were aboard and made interesting speeches regarding the excellent performances of the two ships. Mr. Bedford also spoke warmly of their performance. Mr. William Huskisson, of Vickers, Ltd., in reply, said among other things:

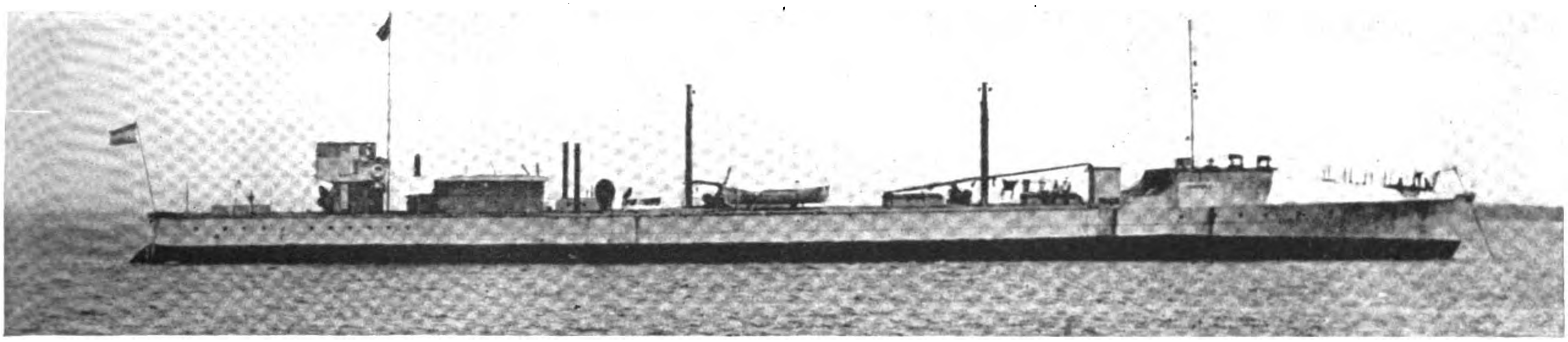
"For many years the great economy of the internal combustion engine as a means of propulsion has been recognized, but shipowners have hesitated to install it in their ships because of their doubts as to its reliability in working. These doubts had been raised in their minds owing to some of the Diesel-engines in the past having proved failures and having been replaced by steam-engines. Some years ago the late Sir William Preece defined an oil engine as 'A machine that barked like a dog, stank like a cat and was as wayward as a woman.' If this was the view of one of the foremost consulting engineers at that time, it is small wonder that shipowners hesitated, and therefore progress was slow.

"The striking improvement in these engines that has made absolute reliability possible is the system of mechanical-injection of the fuel invented by Sir James McKechnie. This invention has not only simplified the engine by abolishing all the air-blast injection compressor with all its pipes, receivers, etc., but has also secured a more economical engine. Messrs. Vickers have built about 500,000 b.h.p. of these engines, which are working satisfactorily in all parts of the world, and it is very gratifying to hear speeches such as those we have just listened to, proving that the owners are satisfied."

The motorship "Seminole" has the following dimensions:

Displacement	14,000 tons
Deadweight capacity (maximum)	10,500 tons
Deadweight capacity (normal)	10,050 tons
Cargo capacity on 26-ft. draft	9,450 tons
Fuel capacity	750 tons
Cruising radius	68 days
Cruising radius	18,000 Nautical miles
Capacity of main tanks	434,000 cu. ft.
Capacity of summer tanks	52,000 cu. ft.
Total cargo capacity	486,000 cu. ft.
Length	425 ft.
Breadth (moulded)	56 ft., 8 ins.
Depth (moulded)	33 ft.
Draft	26 ft.
Contract speed	10.50 knots
Trial speed (on 26 ft., 2 in., draught)	11.24 knots
Brake horse-power	2,500 H. P.
Engine speed	118 R. P. M.
Cylinder bore and piston stroke	24½ x 39 in.
Auxiliary machinery	Steam driven
Auxiliary oil engine	Vickers-Petter

Regarding the main engine:—Fuel-injection is effected by means of a small four-throw pump driven by gearing off the cam-shaft drive. The oil is delivered—without any air—at a pressure of about 4,000 lbs. to the fuel-injection valves placed on the cylinder-head in between the air-inlet and exhaust-valves, depending on the power being developed by the engine. Each fuel-injection valve is driven by a bell-crank lever and push-rod, spring controlled, off the cam-shaft, placed at the top and front of the engine. The atmospheric air-inlet-valves and the exhaust-valves are similarly driven off the same cam-shaft. Lever gear is provided, operated from the starting platform, to cut-out any fuel-injection valves separately, and also, to alter the timing and period of injection, thus controlling the power developed. The air-inlet valves each take their suction from a short vertical stand-pipe, closed in at the top and fitted with a suitable number of narrow slots. The exhaust from the cylinders is led into a common pipe—one for each set of engines—suitably lagged, and then passes through the silencer and up the stack into the atmosphere. (*Continued on page 563*)

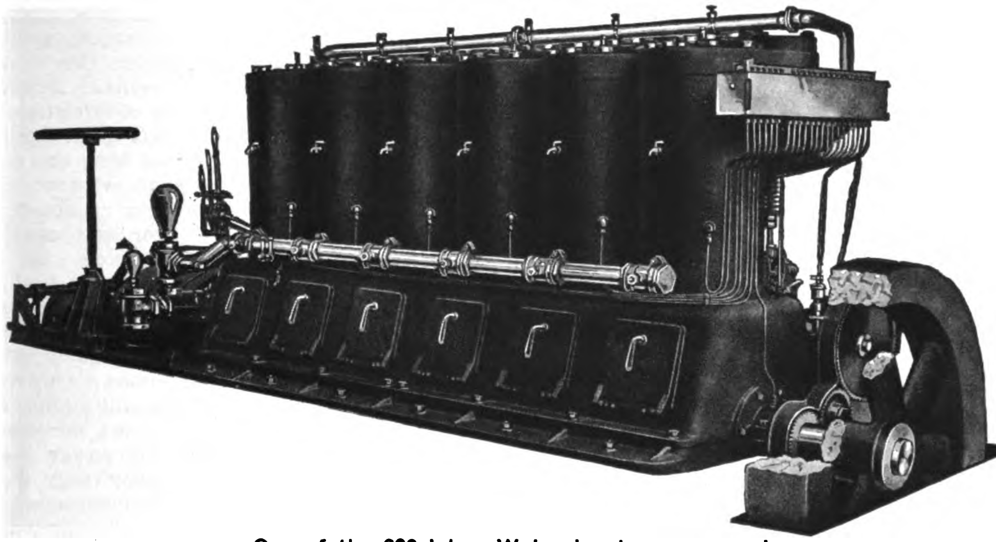


Motorship "Whipple," one of three U. S. destroyers converted to Wolverine motor-driven banana carrier

Conversion of American Destroyers to Motor Power

As has been illustrated in "Motorship," a number of German warships have been converted into economical freighters by removal of the old steam machinery and the installation of economical motor-power. This was proposed in connection with three American destroyers purchased some time ago by the New London Ship & Engine Company, but the actual work was never carried out.

Three other American destroyers, however, have been converted and are now in service in the fruit-carrying trade between Houston and Puntenaro, Mexico. It is probable that two additional destroyers recently purchased by the same owners will also be changed—as briefly indicated in our issue of June, 1921. These three old destroyers are the "Whipple," "Worden" and "Truxton," the other two being the "Perry" and "Stewart," and are operated under the Nicaraguan flag. The conversional work was carried out by the E. R. Clinton Shipbuilding & Dry Dock Company of Philadelphia to the order of Mr. M. T. Snyder, of Houston, Texas. Their route is about 750 miles each way, and three trips are made per month, or a total of 4,500 miles per month. Power for each of these vessels is now furnished by Wolverine kerosene engines in two units of 200 shaft h.p. each, which give the vessel a speed of 12 knots when carrying 15,000 bunches of bananas.



One of the 200 b.h.p. Wolverine kerosene engines

The illustrations which we give of the "Whipple" and "Worden" show that the outward appearance of the vessels has been very little changed, with the exception that the smoke-stacks have been removed and two exhaust-pipes placed in their stead. The principal dimensions are as follows:

Length over all	248 ft.
Breadth	22 ft. 3½ in.
Draught	6 ft.
Power	400 shaft h.p.
Capacity	15,000 bunches of bananas

Each of the engines is of the four-cycle electric-ignition type with electric starter, and is in 6 cylinders, 11-in. bore by 15-in. stroke, and turn a 60-in. diameter propeller at 330 R.P.M. through a mechanical reverse-gear. The weight of this equipment is about 8½ tons, or about 20 tons for the entire engine-room machinery, including auxiliaries. It was constructed by the Wolverine Motor Works, Inc., Bridgeport, Conn. We believe that the constructural changes were carried out at a moderate cost, while the machinery, including propellers and shafting, cost about $25,000. This, however, did not include the small Wolverine kerosene-driven blower-fan on deck for ventilating the cargo holds, nor a small Wolverine kerosene-engine for operating the anchor-hoists, bilge pumps, etc.

MOTORSHIP "KANGAROO" RE-CONDITIONED

The West Australian Government's twin-screw 5,800 tons Burmeister & Wain Diesel-driven motorship has been re-conditioned by John I. Thornycroft & Co., Southampton, England, in order to bring her in line with the Commonwealth's regulations. Also the accommodation has been increased and 52 passengers can now be carried. A large Hall refrigerating equipment has been installed, power for which is furnished by a new 200 b.h.p. Diesel engine and a 150 K.W. electric-generating set. The "Kangaroo's" power is 2,200 shaft h.p., giving her an average sea-speed of 9 knots. She was built before the war by Harland & Wolff.

——SAYS FIELDS PENDLETON

In pointing out the merits of the sailing-vessel, also shipping-general, Fields Pendleton, a well-known New York shipowner, said:

"The real economic carriers of the future will be those of moderate speed with passenger and freight accommodations, and which will not require too much fuel nor a large crew. Such a ship should develop a speed of 14 or 15 knots in order to make them attractive to passengers."

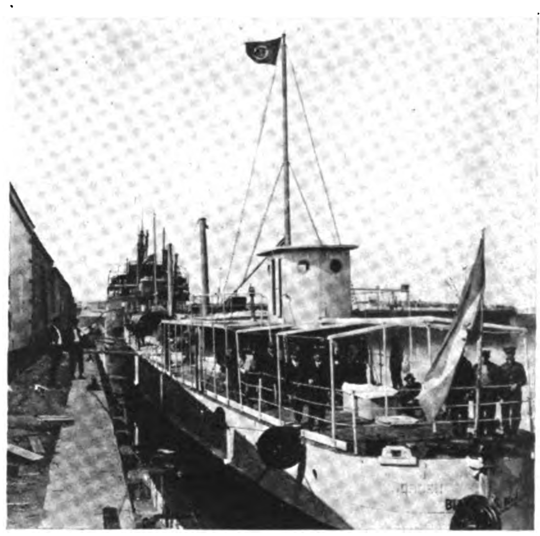
This exactly describes the "express" type of combination passenger-cargo Diesel-driven motorships so frequently advocated by "Motorship."

MOTOR TANKER'S SPLENDID RECORD

By the time this appears in print the Vickers Diesel-engined tanker "Narragansett" will have made twelve Atlantic crossings in the service of the Anglo-American Oil Company. The results of her first eleven voyages make very excellent showing. She has covered a total distance of 38,465 nautical-miles at an average speed of 10.2 knots on a daily engine-consumption of 9¾ tons of fuel-oil.

NINE AMERICAN TUGS TO BE CONVERTED

Three tug-boats owned by the Carey Davis Tug Boat Company will be converted to Diesel power this fall; 200 b.h.p., 300 b.h.p. and 500 b.h.p. engines, respectively, will be installed. This company owns a fleet of 9 tugs, and the remainder will shortly be converted—probably during the coming year.



Motorship "Worden" at the fruit docks

MOTOR-TANKER "SEMINOLE" IN NEW YORK

(*Continued from page 562*)

Referring to the picture of the group of visitors, they are as follows:

Extreme top—

Members of crew.

Top (standing)

G. H. Orton (Vacuum Oil Co.), O. Doust (Ship's Steward), Mr. Thorold (from London), Surveyor from Bureau Veritas, G. D. Ali, Mr. Smith, F. S. Fales (all three Standard Oil Co. of N. Y.), F. E. Powell (Chairman of Anglo-American Oil Co.), Messrs. Clear and Huskinson, Messrs, G. H. Greene, W. C. Chaloner, E. M. Clarke and E. J. Sadler (all four Standard Oil Co. of N. J.). J. Morrell of Tide Water Oil Co. stands just in back of Messrs. Clark and Sadler. Fllowing Mr. Sadler is Chief-Officer Elliot and other members of the crew.

Middle (standing)

Messrs. J. A. Moffett, T. J. Williams and S. B. Hunt of Standard Oil Co. of N. J.), James Hamilton (Vice-Chairman of Anglo-American Oil Co.), Captain Hudson, Messrs. F. H. Bedford and F. D. Asche of Standard Oil Co. of N. J., Dr. L. Waldo, Mr. Plymert of Standard Oil Co. of N. Y.

Front (sitting)

Messrs. W. H. Settle, W. P. Hamilton, E. B. Brouard, L. K. Blood (all of Anglo-American Oil Co.), G. E. Pendergast (Marine-Oil Co.), G. E. Pendergast (Marine-Supt. of Union Petroleum S. S. Co.), Chief-Engineer Hoar.

Manoeuvring of Tug-Boats and Harbor Service Craft

New Type of Magnetic Clutch for Marine Oil-Engines

By CHAS. G. BARRETT

THE application of the oil-engine to tug boats and other types of small harbor craft, where fine manoeuvring qualities are an absolute necessity, has lagged so far behind its ever increasing adaptation to other classes of service that a few words of explanation as to why this condition exists together with a suggestion toward its improvement may be of interest. Every harbor of any consequence in the country has its quota of steam-driven tugs, ranging in number from a dozen or more at the smaller places to several hundreds in New York Harbor, while on the other hand, the oil-engined tug is decidedly a "rare bird" and unfortunately is regarded by some tug-boat interests as a hopeless proposition. There is, of course, a very definite reason for this state of affairs, and if this reason can be met and overcome, it will be only a matter of time, and in all probability a very short time, before the oil-engine with its superior operating economy will be driving the steam-engine from one of its most exclusive fields.

Primarily, the trouble has been the inability of the tug-boat with its relatively light hull to manoeuver with any degree of satisfaction or fineness when engined by a direct connected oil-engine of relatively large horsepower. The starting characteristics of oil-engines are inherently such that when solidly coupled to the propeller shaft, it is difficult to go through the frequently recurring routine of starting, stopping, and reversing incident to docking operations without experiencing a few unpleasant bumps with an occasional snapping of tow lines. This is, of course, due to the fact that a tug-boat is necessarily largely overpowered, inasfar as the requirements of its own hull are concerned, resulting in a tendency to be entirely too jumpy for comfort when manoeuvring in close quarters.

This tendency can be obviated somewhat by resorting to the use of compressed-air for very short periods of operation, but this practice necessitates the use of a starting-air equipment out of all proportion to the size of the engine, and is at best only a palliative and not a cure, and is in general impractical because it leaves too much to the judgment of the operating engineer. The ideal solution from the operating point of view is, of course, the electric-drive, but the high cost of such an equipment, together with the fact that the average tug-boat owner regards electrical apparatus in general as something more or less mysterious and beyond the abilities of his crew to operate and maintain, has prevented it from receiving favorable consideration as yet. What is needed, therefore, is an arrangement of drive which involves no serious increase in cost over the direct-connected engine, but which at the same time retains as nearly as possible the advantages of the electric drive as to ease and fineness of control.

Of course, the above criticism does not refer to oil-engines fitted with the conventional reverse-gear and clutch. However, such equipment is mechanically impossible, generally speaking, on heavy-duty engines of over 150 horsepower, and inasmuch as the ordinary tug boat engine will range between 150 and 600 horsepower, the possible solution of the problem by resorting to this type of drive may be disregarded. Also, if a reverse-gear for these larger engines were a mechanical possibility, there would still be the objectionable reduced towing effort when going astern which is characteristic of the planetary type of reverse-gear, and which is always objected to by the tow-boat man. Other types of gears have been devised, giving a one to one ratio on the reverse, but the planetary type is undoubtedly the most satisfactory, particularly in the larger sizes of 100 to 150 horsepower.

It might seem, then, that if the engine itself were made direct reversing, and a suitable clutch installed between the engine and the propeller shaft, most of the operating troubles could be eliminated. This is in fact the case, the difficulty being that until very recently there has been no suitable clutch available. Such a clutch, to function properly, must have the following characteristics:—

1. It must be capable of positive and instantaneous operation at all times.

2. It must be capable of operation or control by the engine reversing lever.

3. It must be adaptable to remote control.

4. It must be capable of picking up the propeller shaft from at rest, with the engine turning at full speed, without shock or injury .

5. It must be practically wear proof in order to stand up under the severest conditions of service without necessitating frequent adjustments or renewals.

6. It must be noiseless in operation, of small bulk, light weight, and reasonably inexpensive.

It will be seen at once that there is no mechanical clutch available which meets all of the above conditions, and if such a type of clutch were to be used, it would, of course, be necessary to examine the various designs and select that which gives the nearest approximation to what is desired. This is not necessary, however, because of the fact that we have in the Sperry design a type of magnetic clutch which fulfills all requirements. This clutch, if applied to tug boat service in conjunction with a direct-reversing oil-engine, will give to the boat all the delicacy of cóntrol and manoeuvring of the electric-drive equipment, with the single exception of long periods of operation at very low speeds. Also, by the possibility of remote control, the actual manoeuvring of the boat may be done by the captain from the pilot house, leaving the reversal or speed control of the engine itself to be effected by the engineer on signals as usual.

With such an arrangement, the engine would, of course, be running continuously throughout periods of manoeuvring, the captain or engineer, according to the system of control in use, throwing in the clutch when required and with the engine previously adjusted to the proper direction of rotation. In addition to affording a delicate manoeuvring control, this system of operation has the added advantage of greatly reducing the use of starting air, which is accomplished in two ways:

First, when manoeuvring with direct-connected engine, it often happens that the engine is stopped and then started up again in the same direction a few seconds later. On the other hand, when using the magnetic clutch and keeping the engine constantly running, it is only necessary to press the control-button and throw in the clutch when desiring an additional push in the same direction, thus saving the starting-air which would otherwise be required.

Second, with the direct-connected engine, the greater part of the reversals will be made after the engine has been at rest for a short time, necessitating what is in reality a fresh start in each instance, while with the clutch arrangement, each reversal will be made with the engine already in operation. It is a fact that an oil-engine, particularly of the solid-injection type, will reverse more quickly and positively and with a decidedly less consumpton of starting air, if reversed directly from one direction of operation to the other, than if allowed to stand idle for a short time between the two periods of operation, the promptness of the start varying in an inverse ratio to the length of the period of idleness. Incidentally, with the main engine always running while manoeuvring, and with its attached compressor consequently always supplying air to the tanks, it is quite possible on a moderate tank capacity to go through these manoeuvring periods without the necessity of starting up or bothering with the auxiliary compressor—a feature which will be much appreciated by the operating-engineer.

The Sperry clutch referred to above is a comparatively recent development and perhaps deserves a few words of description and explanation. Inasfar as its clutch action is concerned, its construction and operation are simple and obvious, consisting essentially of a specially designed electro-magnet and armature. The magnet element is mounted on the engine shaft, and the armature on the driven shaft, the design being such that a strong magnetic field is set up around the winding in the magnet element, completing its circuit across the permanent air gap separating the two parts and through the armature on the driven shaft. The pull of this magnetic field is sufficient to cause the two clutch parts to rotate at exactly synchronous speed but without mechanical contact between the two elements. Any angular displacement between the two members tends to elongate the lines of force and is resisted by the magnetic action which produces the required torque. This angular displacement is always present, and increases with the load up to the point of maximum clutch capacity, when slippage occurs. It is, of course, only necessary to choose a suitable factor of safety in the selection of a clutch for a given drive to avoid working the clutch to its "pull out" capacity.

However, the clutch will function as a magnet only when the two parts are at approximately synchronous speeds, so that if its magnetic action were its only feature, it would be impossible to have the engine pick-up its load while running. The method by which the clutch is given torque characteristics at non-synchronous speeds is its especial point of interest and is the feature which makes it so particularly adapatable to marine service. Briefly stated, this is as follows:

The rotating magnet element on the engine-shaft produces a rotating magnetic field which may be compared to the rotating field of the stator winding of the induction motor. Whenever there is any speed difference between the two halves of the coupling, this rotating field sets up strong induced currents in the specially constructed armature element constituting the driven half, which currents, of course, react on the field and produce a torque exactly as in the case of the induction motor, the value of the induced currents and the resultant torque depending, of course, on the speed differential. We thus have a clutch which functions as an induction motor when throwing on the load with the engine running, and which quietly and without shock brings the driven shaft up to engine speed, and then automatically changes over and continues operation as a pure magnetic clutch. As compared to electric drive, it is evident that this clutch gives practically the same advantages for manoeuvring purposes, while at the same time it permits continued operation at full load without the same percentage of power losses. An exciting current of a few hundred watts will suffice for a clutch transmitting several hundred horsepower, and inasmuch as this is the only power loss involved, its transmission efficiency may be regarded as practically one hundred per cent.

In regard to the question of exciting current, every oil-engined boat of any size will have a lighting outfit, including a storage battery which will serve as a satisfactory source of supply. Or, if necessary or desirable, a small generator may be mounted on the main engine and directly connected up to the clutch winding, so that this feature need not be a question of any concern to anyone contemplating the use of such a clutch.

There is thus available a type of clutch which eliminates the mechanical weaknesses of the friction clutch, such as wear on the clutch surfaces and necessity for readjustments, by maintaining a positive air gap, without mechanical contact, between the clutch members. Also, its electrical operation inherently insures instantaneous, positive and extremely delicate control over the propeller operation, which is all that is needed to adapt a powerful engine to a relatively light hull. The reversibility and speed control of the direct-reversing oil-engine are both eminently satisfactory, and when these features are supplemented by an electro-magnetic clutch such as is described above, making the propeller operation independent of the engine and placing the manoeuvring of the boat directly in the hands of the captain, a tug so equipped will certainly have all the excellent manoeuvring abilities of the electric drive without being handicapped by its increased first cost, its operating power loss, and its increased complexity due to the addition of the usual electrical apparatus.

Operation of the American Motorship "Kennecott"

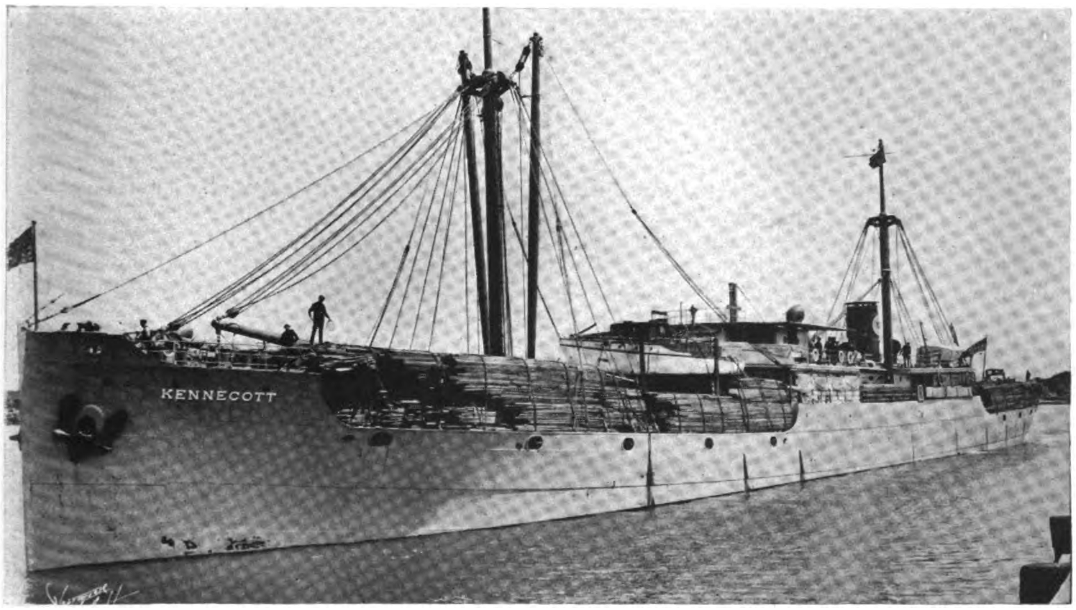
Visit to New York of This Interesting New 6,010-Tons Diesel-Driven Vessel

AS may be anticipated, the recent visit to New York of the new all-American motorship "Kennecott" caused considerable interest in this shipping district and she was inspected by a considerable number of shipowners and shipbuilders. This splendid vessel, it may be remembered, was exclusively fully described and illustrated in our May issue. She is of 6,010 tons d.w., was built at the Todd Shipyards Corp., Tacoma plant, and Diesel-engined by McIntosh & Seymour of New York, the total propelling power being 2,200 i.h.p. Her fuel bill is about $110 per day.

One of the most note-worthy features in connection with the operation of this ship on her first voyage is that she has been exclusively using regular boiler-fuel of 16.7 gravity, and we will place on record the fact that to date the engines have run without any trouble on this heavy fuel, contrary to the opinions of many shipowners that this could not be done. On the first day she logged 292 nautical-miles on 9 tons of fuel.

We will give a few details regarding the voyages made to date. On her maiden run she left Bellingham and made San Pedro in 4 days 5 hours with 3,500,000 ft. of lumber. Then she discharged and returned light to San Francisco, a distance of 335 miles, in 1 day, 6 hours, 45 minutes. At San Francisco she loaded 600 to 700 tons of general cargo and proceeded to Victoria, then Seattle, a distance of 742 nautical-miles, which she covered in 2 days 16 hours. At Seattle she loaded part of a cargo of 3,000,000 ft. of lumber, and it is interesting to note that it only took 31 bbls. of fuel to operate the auxiliary machinery for loading; the rest of the lumber cargo was loaded at Aberdeen (Grays Harbor), Wash. Next, she called at Tacoma and took aboard 1,200 tons of copper bars. She left Grays Harbor on May 5th, arrived at Panama on the 20th, and reached New York on the 28th, her engines averaging 126 to 130 revolutions per minute. This latter voyage occupied 23 days and 7 hours, the total distance being 5,994 nautical-miles—the longest leg being from Aberdeen to Panama, a distance of 3,960 miles.

The fuel used cost $1.78 per bbl. Unfortunately, on these voyages no accurate fuel-consumption was obtained, but the actual consumption was about 60 bbls. or 8½ tons per day. Because of the heavy fuel a special exhaust heating-device is fitted, which heats the oil before it flows to the day-tank. The result of heating this oil is expansion. Consequently, the day-tank when full of heated oil actually contains considerably less than its designed barrel capacity. In order to secure accurate figures on her next trip, the fuel will be measured prior to entering the day-tank, and we hope to publish the results. The following is an extract of the voyage from Aberdeen to New York, furnished us by the Chief-Engineer of the ship.



Alaska Steamship Co.'s Diesel motorship "Kennecott" loaded with 3,500,000 ft. of lumber and 1,200 tons of copper ingots

Abstract of Engine-Room Log—M. S. Kennecott, Voyage No. 2, Aberdeen to New York

Date May	Port R.P.M. Average	Stbd. R.P.M Average	Distance Miles
5	......	......	....
6	132	128	267
7	127	123	253
8	129	123.5	252
9	128.5	123.5	255
10	130	126.6	261
11	131.3	126.5	267
12	132	127.5	259
13	133	131	270
14	132.1	130.1	261
15	132.8	130.8	267
16	132.2	130.1	260
17	131.1	129.7	259
18	131.1	129.6	250
19	132.4	130.9	265
20	133	131	....
21	124.4	123.5	129
22	122.8	121.8	221
23	126.9	126.3	226
24	130.2	130	247
25	132	130.5	258
26	131.5	129.5	250
27	131.1	129	238
28	130.7	129	271

From Gray's Harbor to Balboa, 15 days, non-stop run; from Cristobal, Panama, to New York, 8 days, non-stop run.

"MEDWAY" CHANGED TO "MYR SHELL"

The Vickers 1,600 shaft h.p. Diesel-engined tanker "Medway," 2,636 tons gross, owned by the Anglo-Saxon Petroleum Co., has had her name changed to "Myr Shell."

HUDSON BAY CO.'S MOTORSHIP

"Lady Kindersley" is the name that has been given to the 616 tons gross wooden motor-auxiliary schooner recently built for the Hudson Bay Co.'s Vancouver station, by the British Columbia Engineers & Shipbuilders Ltd. of that city. A Beardmore oil-engine is installed.

MOTORSHIP OF NEW TYPE

What is said to be a new motorship of entirely new type was recently launched at Tonning to the order of Leopold David. This vessel is of 600 tons net and of 750 i.h.p. in twin-screws, and has a speed of 12-knots.

AMERICAN OIL-ENGINE BUILDERS, PLEASE NOTE

Mr. James A. Kennedy, president and manager of the Inter-Island Steam Navigation Co., Honolulu, H. I., recently came to the U. S. A. to have plans prepared for a new 3,000 tons 15-knot passenger vessel, but will place no order until returning to Honolulu. We suggest that he be urged to adopt Diesel or Diesel-electric power. The vessel will cost nearly $1,500,000.

"KOSMOS I" A SMALL GERMAN MOTORSHIP

During March last, the 900 tons-gross motorship "Kosmos I" was launched by the Actiengesellschaft Eiderwerft of Tonning. Two Diesel engines are installed, driving twin screws.

NEW FRENCH SUBMARINES

Construction is to be started immediately on twelve of thirty-six large ocean-going submarines for the new French naval programme. We understand that Schneider & Sulzer two-cycle type Diesel-engines will be installed.

SECOND DOXFORD SHIP LAUNCHED

The second of the standard single-screw motorships for the Rederiaktiebolaget Transatlantic was launched May 21st by Wm. Doxford & Sons, of Sunderland. She is a duplicate of the "Yngaren," described elsewhere in this issue.

DISCUSSION OF PAPERS READ BEFORE THE S. N. A. M. E.

Owing to the typewritten reports of the discussion on the various papers recently read before the Society of Naval Architects and Marine Engineers of New York not yet being available from the Secretary, we are obliged to hold over publication until our next issue.

"DWARKA" AND "DUMRA"

The above will be the names of the two 2,050 tons d.w. motorship building by Chas. Hill & Co. Ltd., Bristol, for the British India Steam Navigation Co. Ltd., in which twin 600 i.h.p. North British Diesel-engines are to be installed.

BRITISH FIRM BUILDING 5,000 SHAFT H.P. ENGINE

Plans have been completed and the preliminary work started on a 5,000 shaft h.p. six-cylinder two-cycle Diesel-engine of the single-acting type by a well-known British steam-engine building concern in the Newcastle district, who recently acquired an European license. We hope to say more about this engine at an early date, but it will not be completed for about two years.

ANOTHER ITALIAN FIRM ORDERS MOTORSHIP

An 8,100 tons d.w.c. motorship similar to the "Ansaldo-San Giorgio" class of freighters has been ordered by the Societa di Navigazione Roma, from Ansaldo-San Giorgio Ltd. of Spezia & Turin. She will be named "Veio," and twin 1,100 i.h.p. A.S.G. two-cycle Diesel engines will be installed, but steam will be used for the auxiliary machinery.

RECONDITIONING BOARD'S STEAMSHIPS

In rejecting bids of approximately $20 d.w. ton recently offered for the three 12,000 d.w.c. steel steamships "Marica," "South Bend" and "Edellyn," Admiral Benson stated that the lowest the Board could accept was $47 per d.w. ton and that the cost of reconditioning these ships would be about $30 per ton. Furthermore, he stated that if it is necessary to undertake extensive reconditioning of ships, the Shipping Board will install the electric or modified form of Diesel power, because the ships are admirably suited for this change. The vessels are only three years old. The original price was about $157 per d.w. ton.

FIVE-THOUSAND HORSE-POWER OPPOSED-PISTON DIESEL-ENGINES

Work has been commenced on a 4,000 to 5,000 h.p. opposed-piston type of marine Diesel-engine by Cammell-Laird & Co., Birkenhead, England. This engine is of the Cammellaird-Fullagar design with four cylinders, and will operate at 70-90 R.P.M. The cylinder diameter will be 26 ins. and each of the eight pistons will have a stroke of 42 ins. or 84 ins. per cylinder. This gives a cylinder output of over 1,000 h.p. In the tests with the 1,000 h.p. engine of this design, a fuel-consumption of 0.39 lb. per shaft h.p. hour was recorded, which is very low for the two-cycle system and almost equal to the best four-cycle practice.

The North British Diesel-Engine

Description of One of the Twin 2,300 h.p. Motors of the Passenger-Cargo Liner "Domala"

IN our May issue we published completely illustrated details of the first of the British India Steam Navigation Company's new combination passenger and cargo motor-liners, namely the "Domala," a vessel of 10,500 tons d.w.c. and 13½ knots loaded speed. But only a brief description was given of the main propelling units, which consist of a pair of North British Diesel-engines, together developing 4,600 i.h.p. at 96 R.P.M. These engines are of particular interest as they are the first of their type to be completed and installed, being of a new design, and are the products of a large plant in the Clyde district erected to construct Diesel-engines exclusively. Many more engines of this power and in smaller sizes are now nearing completion.

The North British Diesel-engine follows the line of the simplest form of internal-combustion engineering, being of the 4-cycle, single-acting, crosshead type, although in the constructional and detailed features to be described, certain departures from general practice and many points of individualistic merit, which have been incorporated in the design, will be made clear.

These engines are each of eight working-cylinders of 26½ ins. diameter, with 47 ins. piston-stroke, developing normally at 96 r.p.m. 2,330 i.h.p. each, 292 i.h.p. per cylinder, or a total power for the ship equivalent to 4,500 i.h.p. with steam machinery. The shaft horse-power is 2,000 b.h.p. or 250 b.h.p. per cylinder, and the piston speed at 96 r.p.m. is 817 ft. per minute. The weight of each engine is approximately 300 tons, or 336 lbs. per b.h.p. In connection with this it is to be noted that the engine is rated at the very moderate mean-effective pressure (on a b.h.p. basis) of approximately 80 lbs. per sq. inch. In considering the foregoing figures it must be remembered that the fuel-injection air-compressors are not driven from the main engines, but are in twin sets in duplicate driven by auxiliary Diesel-engines of the same type as the main engines, but with trunk pistons and run at 250 r.p.m.

The general appearance of this fine motor can be seen from the illustrations published on pages 384 and 386 of our May issue. It will be appreciated that single-acting Diesel-engine construction, whilst yet far from the same state of rigid standardization as applies to its reciprocating steam rival, is gradually crystallizing into generally accepted practice. The framing of this engine has the unique feature of combining cast-iron for rigidity with turned steel through-bolts to take the tension, without the one performing any of the functions proper to the other. The bedplate is in four sections bolted together.

Between each crankthrow are the usual trestle columns, ten in number. Each leg is cast separately and the two are bolted together. Between these trestles, bolted to a flange, on each are the water-cooled ahead and astern guide-plates, and passing through the legs are the through-bolts supported in the middle for rigidity. These through-bolts in turn carry an entablature in four pieces into which the cylinders are set. The through-bolts extend to the bottom of the bedplate as shown. It will thus be clear that the cast-iron cannot take any tension. All such stresses are borne by the through bolts. The function of these trestle castings forming the framing of the engine is to carry the guides and to give rigidity to the whole engine, and for this purpose the trestle columns are constructed of castings of three-quarters-of-an-inch in thickness. In this way any difficulties consequent upon asking two such different materials as cast iron and steel, to share the piston loads, are entirely obviated. The cylinders of cast iron have close-grained iron liners pressed in and the head is secured to them by eight studs.

Notable construction is incorporated in the cylinder-head design, the joint between it and the cylinder being made lower down than usual, so permitting of large recesses for the inlet and exhaust valves, which are widely spaced from the centre to give ample cooling around the fuel-valve, as will be readily seen from an inspection of the elevation and plans on page 386 of our May issue.

To turn to a consideration of the running-gear, the crankshaft, as is becoming more common practice for marine work, is of the completely built up type; the web being shrunk on to the journals, and the pins, and secured by dowels. It is built up in two interchangeable pieces each of four throws, and drilled throughout for forced lubrication. The connecting-rod is of approximately 4.5 cranks in length, drilled for forced-lubrication to the top end bearings. It is not forked at the top end, having simply a flat to which the crosshead bearings are bolted. All the bearing-bushes are of cast-steel, white-metal lined The piston accommodating eight rings has a large concave recess and is attached by studs to the large flange on the top end of the piston-rod. Attachment of the piston-rod to the crosshead and guide slippers calls for special mention. The gudgeon-pin is a press fit on the end of the piston-rod and the slipper forms a vertical cap to the forked end of the rod, the whole being held together by six bolts.

In accordance with the very best practice, the cylinders are entirely isolated from the crank-chamber by a diaphragm-plate in halves with a gland for the piston-rod. Any passage of oil from the forced-lubrication system to the main cylinders is prevented and any piston-ring leakage of partially burnt or carbonized oil cannot contaminate the crankchamber system. The diaphragm-plates being in halves permit of the main pistons being withdrawn from below or alternatively by disconnecting the top gear and lifting off the heads they can be withdrawn from above.

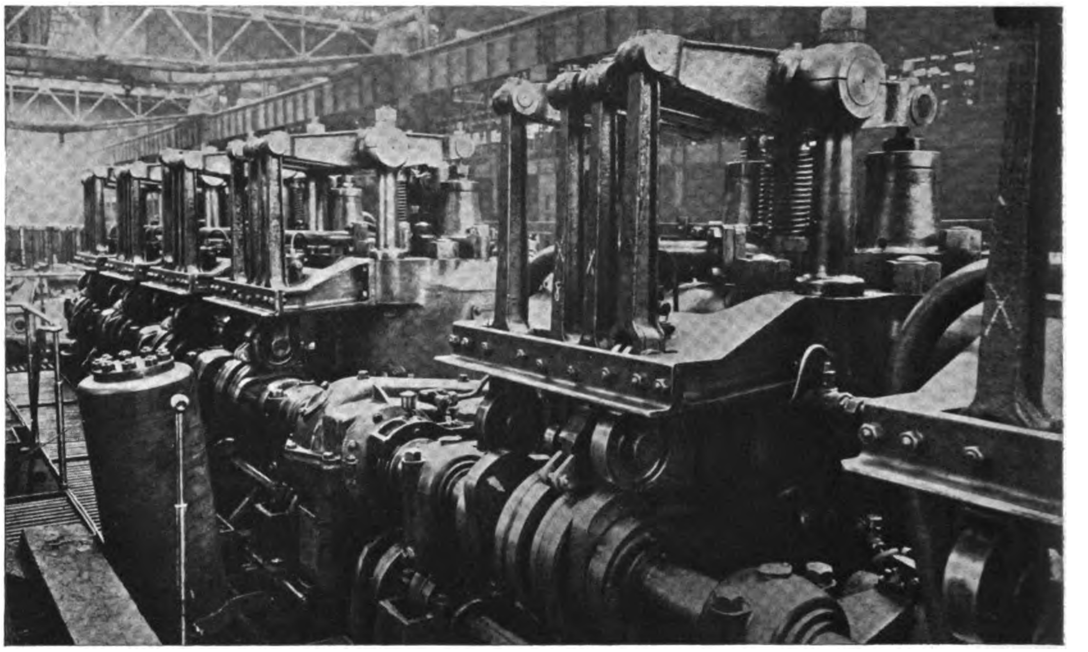
As regards the pistons, these are internally water cooled, a telescopic-pipe and jet system being employed, as will be clear from the illustrations already referred to.

In the cylinder-head in separate cages are the usual fuel, starting-air, inlet, exhaust and relief valves, operated through cams, rods and levers. The fuel-valve is of the outward opening type, so that the usual double-levers are fitted. Since the camshaft is lower than the cylinder-heads, the cam-rollers are attached to the end of forked cast-steel push-rods, pin jointed to the ends of the four valve-levers per cylinder. The push-rods are guided, as shown, by an angle plate. The valve-levers are pivotted on the fulcrum shaft. On the cam-shaft, driven by a vertical shaft with a combination of spur and spiral gearing in the centre of the engine, are two sets of cams for each cylinder, one for ahead and the other for astern.

Reversing of the valve-gear is accomplished in a novel manner. The cam-shaft bearings are contained in levers free to swing in an arc centrally pivotted on brackets in the cylinder entablature. Underneath the camshaft runs a shaft with eccentrics which support the cam-shaft bearings. Rotation of this shaft and its eccentrics causes the cam-shaft to fall, fuller rotation by means of a pin running in a slot serves to pull the cam-shaft froe and aft and so put in the cams for the opposite direction of rotation under the rollers. In this position the cylinder relief-valves, which are horizontally placed in the front of the cylinder-heads, are opened against their springs by a special cam, so relieving any pressure that may be in the main cylinder. Continued revolution of this shaft lifts the cam-shaft again into its operating position. This secondary shaft carrying the eccentrics is rotated through geared-up spur-wheels by a compressed-air piston, with its motion, suitably damped by an oil-cushioning cylinder. In the normal running position the eccentrics for raising and lowering the cam-shaft are vertical, so that the thrust due to the valve springs does not tend to revolve this shaft.

When compressed-air, at from 250 to 300 lbs. per sq. inch, is turned on, small plungers attached to each push-rod of the cylinder-head starting air-valves operate, and the starting-air valve-rollers are brought into contact with their appropriate cams; the starting-air valve in the cylinder-head of that line, the crank of which is at the correct angle, opens, starting-air enters the cylinder and the engine rotates; on gaining speed, the air is cut off from half the engine and fuel admitted; when combustion takes place the remaining four cylinders are immediately changed from air to fuel.

The fuel-pumps, one for each main cylinder, are driven by skew-gearing from the vertical shaft, and are located below the cylinder entablature and are controlled on the suction-valves in the usual way from a hand-lever on the starting platform. An Aspinall governor is fitted to cut-out the pumps in the event of overspeed.



Camshaft and valve operating gear of the North British engine

Forced-feed lubricators for the main cylinders are driven-off a longitudinal shaft from the same gear as the fuel-pumps. A flywheel in halves at the after end of the engine has worm-teeth cut in the periphery and an electric-motor suitably geared serves to drive the turning-gear. As is required by the adoption of forced-lubrication, the engine is totally enclosed. Light, easily removed sheet iron doors give ready access.

These engines are the product of the only factory on the Clyde specially designed and laid-down for the building of marine Diesel-engines, and have been designed and constructed without the assistance of any license, foreign or otherwise.

Before installation on board these engines were subjected to severe and prolonged tests in the makers' works, including a continuous full-power run of seven days against a Heenan & Froude water-brake with most satisfactory results.

To summarize the leading figures: The revolutions varied from 95 to 97 per minute; the average of the cylinder mean pressures was 101.5 lbs. per sq. inch, giving an i.h.p. of 2,550. The blast-air was maintained at 1,000 lbs. per sq. inch, and the starting-air at 250 lbs. per sq. inch.

The following are the principal other pressures and temperatures:

Pressures, lbs. per square inch

Lubricating-oil	15.5 lbs. per sq. in.
Circulating water to cylinders	17.5 lbs. per sq. in.
Circulating water to pistons	37 lbs. per sq. in.

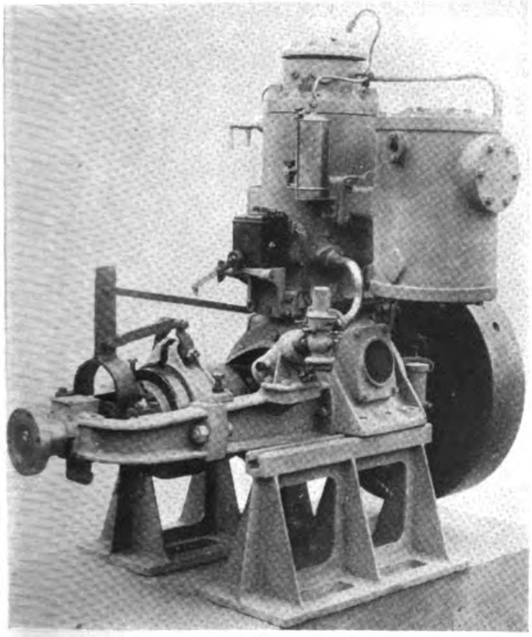
Temperature in Degrees Fahrenheit

Atmosphere	73
Crankcase	91
Circulating-water to cylinders	53
Circulating-water from cylinders (average)	117
Piston cooling inlet	52
Piston cooling outlet	144
Guides outlet	78
Lubricating-oil inlet	68
Lubricating-oil outlet	97

The fuel-oil consumption was 0.42 lb. per b.h.p. hour, or taking a mechanical-efficiency of 80% as recorded, 0.33 lb. per i.h.p. hour. The fuel used was Anglo-Persian of a density of 0.90. The combustion was smokeless and the engine ran noiselessly and steadily. Manoeuvring trials were successfully carried out, the engine reversing readily from ahead to astern in 10 seconds.

As those who read our previous article will remember, the whole complex machinery equipment of this liner is on an equal plane with the main engine. The pumps are all separately and electrically driven, suppied with current from Diesel-electric generators by the same makers.

Being installed in such important ships, the performance of this and similar machinery at sea will be watched with intense interest, and we look forward to being able to record in due course the complete success of this and of the many other sets of Diesel machinery for the same and other progressive shipowners now on hand at this engineering plant, namely, the North British Diesel Engine Works, Whiteinch, Glasgow, Scotland.

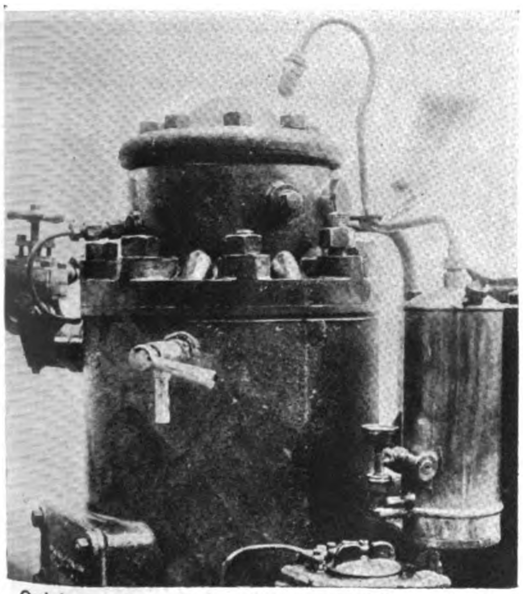


Kromhout marine oil-engine equipped with quick-starting device

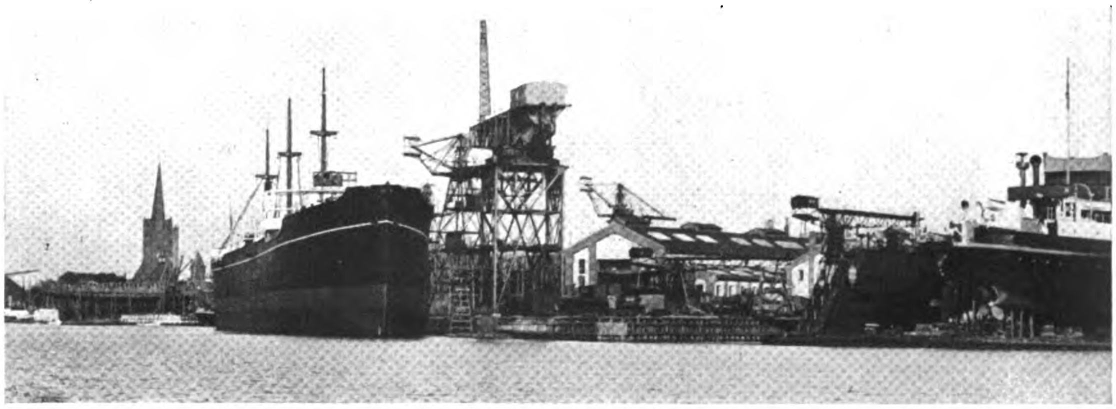
NEW QUICK-STARTING DEVICE

With surface-ignition oil-engines, combustion is dependent upon a bulb, disc, ball or tube in the cylinder-head that is kept hot by the heat of the combustion itself, so generally speaking some form of outside ignition or heating is necessary to start the engine, as the heat of compression of the air is insufficient with the pressure used to cause combustion of the fuel. Consequently many engines of this type require ten to twenty minutes heating of the ignition-surface before they can be started. Various devices have been produced to overcome this slight delay, which after all is usually unimportant. Some makers use spark-plug, others an electric-coil, while several have adapted a form of torch that heats the ignition-surface in a very short time.

This latter system has been developed by D. Goedkoop, Jr., Amsterdam, Holland, builders of the Kromhout surface-ignition oil-engines.



Quick-starting device on Kromhout oil-engine



New Danish Burmeister & Wain-engined motorship "Java" fitting-out at Copenhagen. In the background in front of the church is an 800-ton wooden auxiliary for the East Asiatic Co. She is to be Holeby Diesel-powered

Vessels in Service Powered with Winton Diesel-Engines

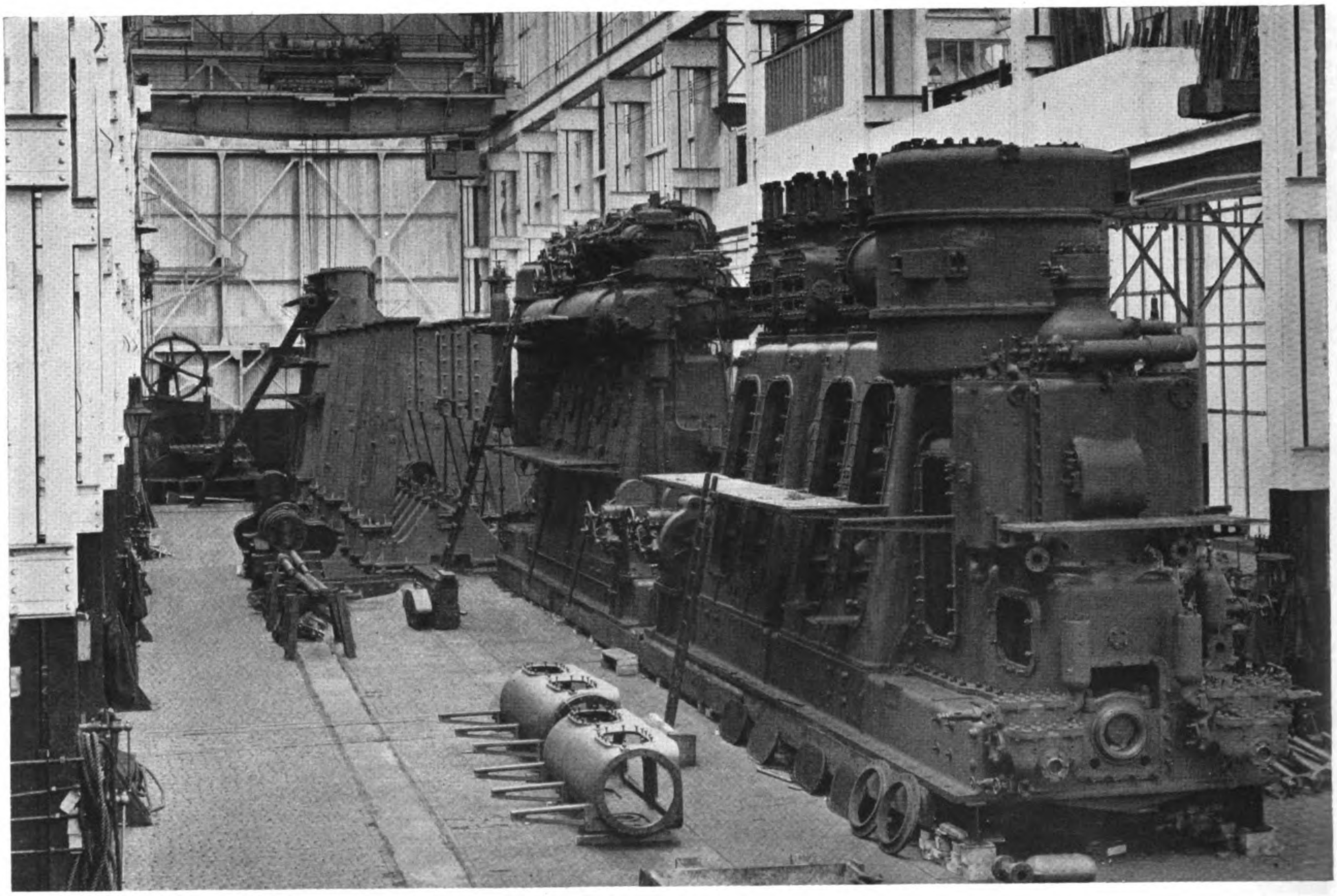
Name of Ship	D. W. C. Tonnage	Shaft H. P.	Owner	Builder
"Mazatlan"	1500	700	Long Beach Shipbldg. Co., Long Beach, Cal.	Long Beach Shipbldg. Co., Long Beach, Cal.
"Mt. Baker" (Ex-"Mt. Shasta")	4800	1000	Globe Line, N. Y. C.	Supple-Ballin Shipbldg. Co., Portland, Ore.
"Mt. Hood"	4800	1000	Gaston, Williams & Wigmore, N. Y. C.	Supple-Ballin, Shipbldg. Co., Portland, Ore.
"Trolltind"	3350	1000	American Motorship Co., Christinia, Norway	Elliott Bay Shipbldg. Co., Seattle
"Wm. Donovan" (Ex-"Kirketind")	3350	1000	DonovanLum ber Co., Aberdeen, Wash.	Elliott Bay Shipbldg. Co., Seattle
"Semmeltind"	3350	1000	American Motorship Co., Christiania, Norway	Elliott Bay Shipbldg. Co., Seattle
"James Timpson"	1700	1000	I. T. Williams & Sons, N. Y. C.	Standifer-Clarkson Construction Co.
"Chas. S. Gawthrop"	1960	600	American Car & Foundry Co., Wilmington	Jackson & Sharp Plant of Amer. Car & Fdry Co., Wilmington, Del.
"Sherewog"	1700	600	R. Lawrence Smith, 17 Battery Pl., N. Y.	Savannah Engr. & Con. Co., Savannah, Ga.
"Adrien Badin"	2100	600	Compagnie France, Atlantique, Paris	Peninsular Shipbldg. Co., Portland, Ore.
"Erris"	2100	600	Erris Motorship Co.	Peninsular Shipbldg. Co.
"Pechiney"	2100	600	French Interests (Amer. Agent J. Cablat, 2 Rector St., N. Y.)	Peninsular Shipbldg. Co.
"Esperanca"	2300	600	French Interests (Bowman Bros. Agents)	Peninsular Shipbldg Co.
"Hussar III" (Ex-"Haida")	Yacht	600	E. F. Hutton, 61 Broadway, N. Y.	Kyle & Purdy
"Elfay"	Yacht	125	Russell A. Alger, Jr., Detroit, Mich.	Herreshoff Mfg. Co., Bristol, R. I.
"Guinivere"	Yacht	600	Edgar Palmer, New York	Geo. Lawley & Sons Corp.
"Marold II"	Yacht	178	C. Harold Wills, 1760 Jefferson Ave., Detroit, Mich.	John Dialogue & Sons
"Whitemarsh"	Yacht	125	E. W. Marland, Marland Refg. Co., Ponca City, Okla.	Unknown

This gives 13 merchant motorships aggregating 35,110 tons d. w. c., and of 10,300 shaft horse-power, and five yachts aggregating 1,628 brake horse-power.

Vessels Under Construction To Be Powered with Winton-Diesel Engines

Name of Ship	D. W. C. Tonnage	Shaft H. P.	Owner	Builder
"Nourmahal"	Yacht	700	Vincent Astor, Rhinebeck, N. Y.	Robt. Jacobs, City Is., N. Y.
Seven Concrete River Steamers	600 tons each	1000 each	Quartermaster Dept., A. T. S., U. S. Army	Newport Shipbuilding Co.
Yacht	....	500	Tams, Lemoine & Crane (Designers)	

The Winton Engine Co., are also building 4 stationary-type Diesel engines of 200 b. h. p., each for R. T. Wilson Co., 120 Broadway, N. Y. C.



Engine erecting-shop of Sir Wm. Armstrong, Whitworth & Co., Newcastle-on-Tyne, England, showing a pair of 1,000 shaft h.p. Sulzer-Diesel marine-engines in foreground. These engines are fitted in the motorship "Conde de Churruca," launched for the Cia Generale de Tabacos de Filipines

NEW SPANISH MOTORSHIP BUILT IN ENGLAND

A new twin-screw motor-tanker named "Conde de Churruca" was launched on June 6 by Sir W. G. Armstrong, Whitworth & Co., Newcastle, England, to the order of the Cia Generale de Tabacos de Filipines, of Barcelona, Spain and Manila, P. I. She has the following dimensions:

Length	370 ft.
Breadth	48 ft. 3 in.
Depth	30 ft.
Power	2,000 shaft h.p.

This vessel is propelled by twin Sulzer-Diesel engines built under license by Armstrong, and is constructed on the Isherwood system, with machinery aft. For auxiliary purposes and for steam-heating the coils there is a donkey-boiler of 2,340 sq. ft. area burning oil-fuel. In addition there are two 100 b.h.p. Armstrong-Sulzer four-cylinder Diesel-engines driving 70 k.w. electric-generators at 300 r.p.m.

EAST ASIATIC COMPANY'S MOTORSHIP ORDERS

An announcement appears in the New York "Journal of Commerce" of June 20th to the effect that the East Asiatic Company had cancelled contracts for the construction of 17 motorships out of a fleet of 22, of which five had been delivered. However, we have been advised that this cancellation was made because the builders could not complete them at the original low prices made in 1915.

HAMBURG-AMERICAN NEW FLEET

According to Dr. Wm. Cuno, chairman of the Hamburg-American Line, plans have been made for the construction of a large fleet of ships from 5,000 to 12,000 d.w. Eight will have Diesel-engines and some will have reciprocating steam engines.

GERMAN 2,500 TONS MOTORSHIP LAUNCHED

To the order of J. M. J. Blumenthal of Hamburg, Germany, the 2,500 tons d.w. motorship "Ida Blumenthal" was launched on April 30th at the yard of the Lübecker Maschinenfabrik Gesellschaft, Lübeck. A Diesel-engine built at the same plant is installed.

GERMAN 9,000 TONS MOTORSHIP LAUNCHED

A motorship of 9,000 tons, named "Behrenfelds," was launched by the J. C. Tecklenborg A. G. Geestemund, Germany, during May, to the order of the Hansa Steamship Co. of Bremen. The Tecklenborg Co. and licensees of the Carels two-cycle Diesel-engine who built the Standard Oil Co.'s big motor-tanker, "Wotan."

Injection and Combustion of Fuel-Oil

Experiments With Solid-Injection and Air-Blast in Marine Diesel-Engines

By ENGR.-COMMANDER C. J. HAWKES, R.N.

PART IV.

(*Continued from page 483, June issue*)

IN VIEW of the improved results obtained with the 0-016 inch-hole sprayer it was decided to carry out a series of comparative tests with this sprayer and the 0-019 inch-hole sprayer. The results are given in Tables 3 and 4, but before referring to these results it is proposed to give any necessary particulars of the fuel pumps, etc., used during the tests.

Fuel-Pump.—The fuel-pump used during the first series of tests had a plunger 17/32 inch in diameter and 1-inch stroke. The volumetric efficiency of a fuel-pump decreases as the pressure in the system increases, and this has to be taken into account when working with higher pressures. In service it is necessary to have a margin for leakages of glands, valves, etc., and for this reason a larger pump-plunger is a distinct advantage, especially as the adoption of higher fuel-pressures in existing engines provided with the standard fittings, which were originally designed for lower working-pressures, would increase the chances of leakages occurring.

A ½ inch bore fuel-pump was used during the tests recorded in Table 4.

Fuel-Valve Spring—During the tests with the 0.019 inch-hole sprayer a 618 lb. spring was used, but with the 0-016 inch-hole sprayer the spring was, for the reasons previously stated, washered up to give a load of 750 lbs.

Compression—During all the tests recorded in Tables 3 and 4 the compression pressure was 380 lbs. per square inch at 380 r.p.m.*

A series of tests was carried out with the 0.019 inch and 0.016 inch-hole sprayers at about 100 b.h.p., 90 b.h.p., 75 b.h.p., 50 b.h.p., 25 b.h.p., and at the maximum possible powers. The results are shown in Table 3. The fuel-consumptions obtained with the two sprayers during the tests included in Table 3 have been plotted and are shown in Fig. 12.

The success of the solid-injection engine in service, from the point of view of smokeless combustion, depends very largely on the fuel-valve and fuel-pump design, correct settings, clean sprayers and tight joints in the system.

During the 50 b.h.p. and 25 b.h.p. tests it was found necessary to work with a later injection to enable the engine to run steadily at these powers. Also, during the 25 b.h.p. tests it was necessary to allow a small quantity of fuel-oil to leak off on the pressure side of the pump, as with the larger fuel pump and the existing suction-valve actuating-gear the quantity of fuel-oil pumped was in excess of that required.

It will be seen that with the modified sprayer lower fuel-consumptions were obtained throughout, and the exhaust water was clear excepting during the overload test and the 100 b.h.p. and 90 b.h.p. tests with a fuel-valve roller clearance of 0.003 inch.

As the mechanical-efficiency of the experimental engine is slightly lower than a multicylinder engine of the same design it follows that for the same average mean indicated-pressure the b.h.p. of the former will be slightly less than the average b.h.p. per cylinder in the latter. It was thought that a b.h.p. of 100 per cylinder in a multicylinder engine would probably, from the point of view of mean indicated-pressure, correspond to about 95 b.h.p. in the single-cylinder experimental engine, and it was therefore decided to run an additional six hours' test at 95 b.h.p. with the 0.016 inch hole sprayer at 380 r.p.m. and 0.030 inch fuel-valve roller clearance. A slightly heavier shale-oil was used during this test than in the former tests and a ½ inch diameter plunger pump was fitted. The results are given in Table 4, and it will be seen that the fuel consumption recorded is in agreement with the results given for the corresponding tests in Table 3.

(At a later date a test was made with the experimental engine with a sprayer having fine 0.016 inch holes, with flats, with a fuel-valve roller clearance of 0.003 inch, and an average fuel consumption of just under 0.4 lbs. per b.h.p.-hour was recorded when developing 100 b.h.p. at 380 r.p.m. This slight improvement in the consumption was no doubt due to fitting an obturator ring.*)

There should be no difficulty with leakage of connexions so long as substantial fittings are provided, but it is advisable to reduce the number of joints to a minimum. It is imperative that every precaution should be taken to ensure the thorough filtration of the fuel-oil on its passage to the fuel-valve. Although fine filters are fitted occasionally it is found that a choke of one or more holes of a sprayer does occur—especially when the valves and fittings are new. The occasional choking of sprayers on service is probable largely due to pieces of packing working down from the fuel-valve spindle glands, and for this reason, as well as from the point of view of spindle friction, it is advantageous to design the valves so that glands are unnecessary. Pieces of packing from fuel-pump glands also find their way to the sprayers and this points to the desirability of dispensing with packing glands in fuel-pumps as well as in the fuel-valves.

In the experiments referred to in this Paper the best all-round results were obtained with a sprayer provided with five holes 0.016 inch in diameter. Sprayers containing more, and also less, than five holes were tested, but the five-hole sprayer gave the best results within the limits of fuel-pressure which the system as designed was capable of withstanding satisfactorily. All the experiments pointed, however, to the desirability, within practical limits, of using smaller holes and higher fuel-pressures; and had it been possible to employ higher fuel-pressures in the experimental engine there is no doubt that its flexibility would have been increased.

The number and size of the holes in a sprayer depend on the mean pressure in the fuel-injection system; on the viscosity of the fuel-oil; on the mean indicated pressure aimed at; on the distance the jets have to penetrate into the combustion-chamber and also on the speed of the engine. The angle of the holes, i.e. the angle of the cone on which the holes are drilled, is dependent on the shape of the combustion-chamber. So far as the author is aware there are at present no formula which can be used to determine the number, size and angle of holes necessary in a sprayer for a given engine to ensure the best results—it is largely a question of trial and error.

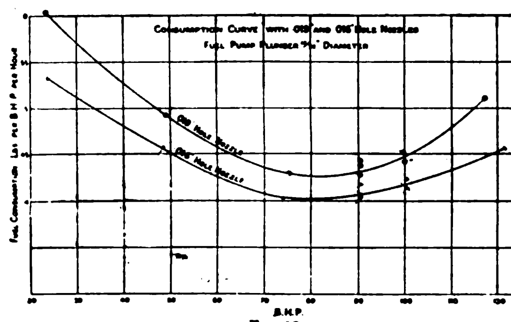


FIG. 12.

TABLE 3.—RESULTS OF TESTS CARRIED OUT WITH STANDARD AND EXPERIMENTAL SPRAYERS PROVIDED WITH FIVE HOLES, ·019" AND ·016" DIAMETER RESPECTIVELY.

Ref. letter of Test.	Period of Test. Hours.	R.P.M.	B.H.P.	Fuel Oil. Consumption Lbs. b.h.p.-hr.	Fuel Oil. Pressure. Lbs. per sq. in.	Fuel Valve. Diam. of holes in Sprayer. Inches.	Fuel Valve. Roller Clearance. Inches.	Fuel Valve. Opening before d.c. Degrees.	Initial pressure. Lbs. per sq. in.	Condition of Exhaust Water	Remarks
						100 B.H.P. TESTS.					
A19	1½	379·0	99·8	0·451	2,300	0·019	0·003	26·5	630	Dark.	Higher consumption obtained during Test E19 with the 0·019" hole sprayer is probably due to the valve roller leaving the cam and to the increased energy of the spray at the higher pressure adversely affecting the distribution of fuel oil in the cylinder.
A16	1½	381·5	100·3	0·423	4,200	0·016	0·003	27	630	Shaded.	
B19	1½	380·0	100	0·441	4,300	0·019	0·060	21·5	630	Dark.	
B16	1½	380·5	100·1	0·414	5,800	0·016	0·060	19·5	630	Clear.	
						90 B.H.P. TESTS.					
C19	1½	380	90·3	0·436	2,100	0·019	0·003	31	630	Dark.	
C16	1½	381	90·5	0·417	3,200	0·016	0·003	31	630	Slightly shaded.	
D19	1½	379·3	90·1	0·427	2,400	0·019	0·030	25·5	630	Do.	
D16	1½	381	90·5	0·406	4,000	0·016	0·030	28·5	630	Clear.	
E19	1½	380·5	90·4	0·441	4,500	0·019	0·112	19	630	Dark.	
E16	1½	381	90·5	0·404	5,800	0·016	0·112	21	630	Clear.	
						75 B.H.P. TESTS.					
F19	½	342	75·2	0·428	4,600	0·019	0·112	17·5	630	Clear.	
F16	½	340	74	0·402	5,600	0·016	0·112	19	630	Clear.	
						50 B.H.P. TESTS.					
G19	½	292	48·9	0·491	3,600	0·019	0·112	1	400	Slightly shaded.	Late timing necessary to work at this power
G16	½	292·4	48·3	0·456	4,200	0·016	0·112	0	360	Clear.	
						25 B.H.P. TESTS.					
H19	½	219·3	23·3	0·604	1,400	0·019	0·112	0	340	Shaded.	Fuel by-passed on discharge side
H16	½	224	23·8	0·531	1,800	0·016	0·112	0	340	Clear.	
						MAXIMUM OVERLOAD TESTS.					
J19	½	381	117·5	0·51	3,900	0·019	0·003	22	630	Black.	
J16	½	384	121·3	0·455	5,900	0·016	0·003	22·5	630	Dark.	

TABLE 4.—SIX HOURS' TEST WITH SPRAYER PROVIDED WITH FIVE ·016" HOLES.

Time.	R.P.M.	B.H.P.	Fuel consumption Lbs. b.h.p.-hr.	Remarks.
16 June.				
7·5 p.m.	—	—	—	*Compression pressure*: 380 lbs. per sq. in.
7·35 ,,	380·5	95	0·411	
8·5 ,,	379·4	94·8	0·411	*Opening of fuel valve before d.c*: 23·5°
8·35 ,,	380·2	95	0·409	*Initial pressure*: 630 lbs. per sq. in.
9·5 ,,	379·1	95	0·409	
9·35 ,,	381·3	95·3	0·408	*Fuel valve roller clearance*: ·030".
10·5 ,,	380·2	95	0·409	*Fuel oil pressure*: 4,400 lbs. per sq. in.
10·35 ,,	379·4	95	0·409	
11·5 ,,	378	94·5	0·410	*Fuel oil used*: Shale of s.g. ·87 at 60°. F.
11·35 ,,	381·6	95·4	0·408	*Exhaust water*: Clear.
17 June.				
12·5 a.m.	379·8	95	0·408	*Fuel valve spring load*: 750 lbs.
12·35 ,,	379·9	95	0·408	
1·5 ,,	378·9	94·7	0·410	
Average	379·8	95	0·409	

Although generally the fuel-pump worked satisfactorily during the tests, such pumps should, in the author's opinion, be made from forged-steel blocks or steel stampings, when working with fuel-pressures of the order mentioned in this paper.

In a multi-cylinder engine an appreciable reduction in the number of working parts follows the adoption of, what is frequently termed, the "common-rail" system instead of a self-contained system, with its fuel pump, for each cylinder. In the former system a three-throw pump is usually provided which supplies fuel-oil to the common-rail, from which branches are taken to each fuel-valve. Should a fuel-valve act sluggishly with the common-rail system it follows that more than the requisite quantity of fuel-oil will pass in the cylinder in which this fuel valve is fitted. On the other hand, in the case of the single-fuel-pump-er-cylinder system (referred to hereafter, for convenience, as the multi-rail system) a sluggish fuel valve will not result in a larger quantity of fuel-oil passing into the cylinder than is sup-

*Tests were subsequently carried out with a compression of 440 lbs. per square inch, and it was found that a slight improvement in the fuel consumption was obtained, but it was not very marked, being of the order of 0.005 lbs. per b.h.p. per hour.

* During the tests previously referred to the piston of the experimental engine was fitted with six cast-iron rings and one scraper-ring. Subsequently the ordinary piston rings were removed and a phosphor-bronze obturator ring of L section, 1-2 mm. in thickness, was fitted in the fourth groove from the top and a cast-iron ring, which was designed to give a radial pressure of about 1 lb. per square-inch, was fitted in the first groove with the object protecting the obturator-ring from the rush of hot gases. The fitting of the obturator-ring resulted in increasing slightly the mechanical-efficiency of the engine.

plied by the pump. Further, with this system, should a fuel sprayer be partly choked it will be clearly indicated by the pressure-gauge, and there is also the possibility of the increase in pressure clearing the restriction; whereas a choked sprayer in the case of the common-rail system will not be readily detected, and it will result in overloading slightly the remaining cylinders. The principal objection to the common-rail system, in the author's opinion, is the possible results which may follow the sluggish closing or "sticking" of a fuel-valve spindle; but should the fuel-valve design be such that the chances of seized spindles are remote, then the system has many points in its favor. These remarks are intended to apply to high-speed engines of comparatively low power per cylinder. In the case of an engine consisting of a small number of cylinders of comparatively large power the author would prefer, in the present state of the art, to fit the multi-rail system.

In existing standard submarine engines fitted with the multi-rail system it is possible to change to the common-rail system by means of the hand charging connexions. It has frequently been stated that when an engine running on the multi-rail system is changed to the common-rail system it appears to work more smoothly. This is no doubt true. Various reasons have been put foward to account for this, but, in the author's opinion, the smoother running is due to the fact that with the multi-rail system it is not readily possible, with the fuel pumps used, to ensure that the same quantity of fuel-oil is delivered to each cylinder; whereas with the common-rail system, with all sprayers clear, etc., the fuel-oil is more evenly distributed—which results in each cylinder doing an equal share of the work.

*Fig. 13 will be given with the next installment.

In view of the experience obtained with the direct-lift fuel valve it was decided to design an automatic valve which would completely control the fuel-spray, and which would also avoid the necessity of fitting a spindle gland—thus reducing the chances of the valve sticking in the open position or closing sluggishly.

Many engines of the semi-Diesel and low-compression types have been running successfully for some years with solid-injection automatic valves. Theoretically these valves have an advantage over the direct-lift type of valve. Perhaps this advantage is not so marked when using distillate oils, e.g., shale fuel-oil, but the automatic-valve is likely to prove of greater value when other brands of fuel-oil have to be dealt with. It is usual in engines fitted with automatic valves for the fuel-pump to time the instant of injection; and the fuel-pump discharges the fuel-oil, against a pressure not less than that to which the automatic-valve is loaded, during the time the engine-crank passes through a comparatively small angle. This means that the effective stroke of the pump-plunger is small and consequently the area of the pump-plunger must be made correspondingly larger. This, in large engines, brings a heavy momentary load on the camshaft (assuming that the fuel pump is driven from the camshaft) and the gears have therefore to be of stouter design to withstand it. In the case of the single-cylinder experimental engine already mentioned it was extremely doubtful whether the existing gears would stand up against such a load any length of time, and with the object of overcoming this difficulty a valve was designed on the lines of that shown in Fig 13*. With this arrangement the automatic valve is controlled by means of the mechanically-operated spindle or stop A so that the ordinary fuel-pump can be used. To operate the valve a lever (not shown in the figure), actuated by the ordinary fuel-cam, lifts the spindle A against a spring which corresponds to the spring in the direct-lift type of fuel valve. The fuel-pressure in the solid-injection system acting on the piston D then lifts the automatic valve, which is loaded by spring E, and fuel is sprayed into the cylinder. The closing of the automatic valve is brought about either by the fuel pressure falling below that necessary to keep the valve lifted or by the closing movement of the spindle A. It will be seen that the fuel pressure available for spraying is not less than the loading on the valve due to the spring E; and this is a distinct advantage, especially when running at low powers.

In the direct-lift type of solid-injection fuel-valve the spray is obtained by forcing oil at high velocity through small holes in a sprayer; and the pressure available for producing velocity is controlled by the valve. When the valve commences to lift this pressure, due to wire-drawing past the seat, etc., is less than that available in the system, with the result that the spray at the commencement of injection is probably not particularly good. In a similar manner when the valve closes the pressure in the sprayer gradually falls and it seems reasonable to assume that the last drop of oil goes into the cylinder in the form of a dribble. For this reason it is desirable to close the valve as rapidly as possible. The defects of this type of valve are more marked as the speed of the engine is reduced or the lift of the valve decreased—both of which have an adverse effect on the quality of the spray. This, as already mentioned, is likely to be of greater importance when oils are used which do not come under the heading of "clean" oils.

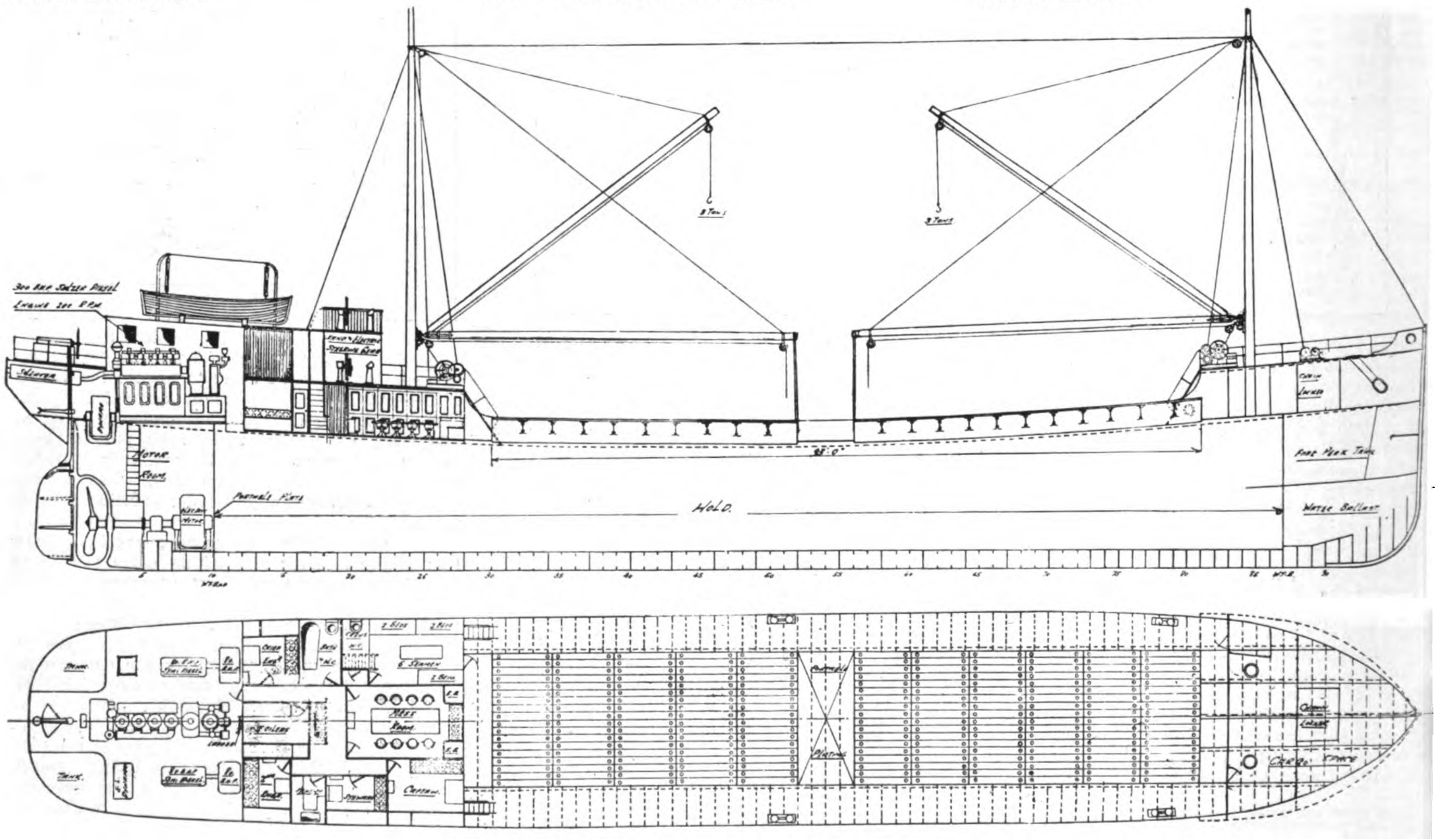
(To be continued)

DIESEL-ELECTRIC DRIVE IN COASTWISE VESSEL

Now building in England is a very interesting motor-vessel for coastwise trading in which Diesel-electric drive will be installed as propelling power. She is under construction at the yard of Dibbles (1918) Ltd. Bellvidere, Southampton, by designs from Robert MacGregor. The construction of a sister motorship has also been commenced in connection with the transportation of barges, the hull being divided longitudinally, as already referred to in our pages.

The ship with Diesel-electric drive is propelled by a 300 b.h.p. Sulzer Diesel-engine driving a generator, this set being installed in the deck-house aft with the electric propelling-motor in the compartment underneath. In the lower engine-room there are also two surface-ignition oil-engines of 80 b.h.p. each driving generators. These two oil-engines can be used as auxiliary propulsion of the ship and a speed of 5½ knots obtained with the two auxiliary motors working alone, or 8 knots if the main engines are running, or 9 knots with combined power.

One auxiliary motor can be hand or air-started, and then serves to start the other, and one or both of them start the larger main engine, which is of high-speed type, so that no heavy starting-bottle, compressors or reversing-gear is required for this engine. The electric-motor on the propeller-shaft is reversible. The vessel carries nearly 20 per cent more cargo than a vessel with the ordinary steam-set, whilst her consumption is only about 2 tons of oil per day under full power. For discharging the cargo there are four electric-winches and four derricks.



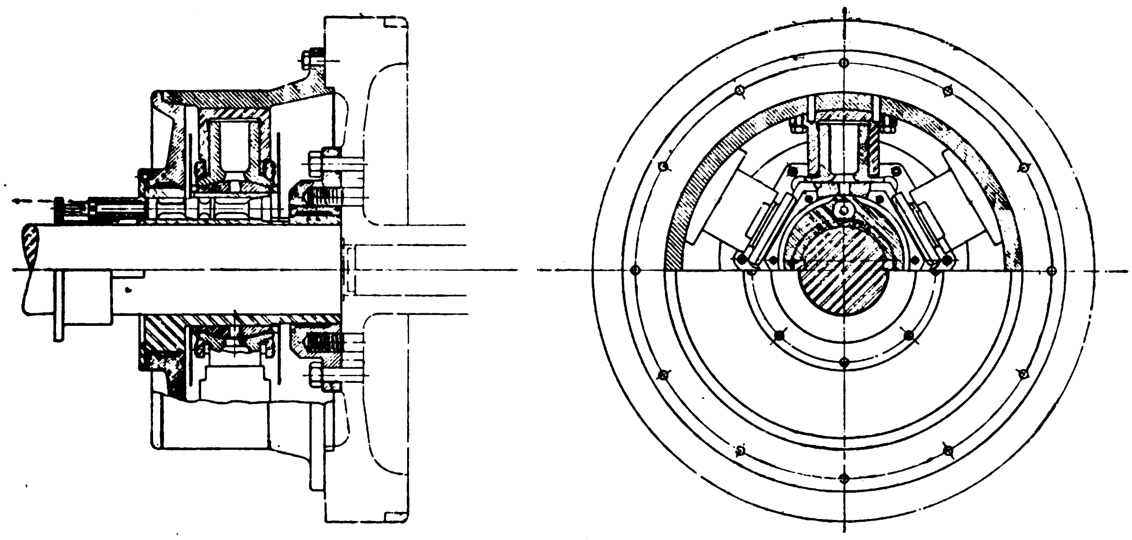
Novel arrangement of Diesel-electric drive for new coastwise vessel now building. The two auxiliary surface-ignition oil-engines can also be used for propelling power

High-Powered Hydraulic-Clutch for Diesel-Driven Tankers

Possibilities of Use of New Hele-Shaw Device for Motorships — Tested on 1,200 B.H.P. Diesel Engine By British Admiralty.

ONE of the "objections" raised by some oil-companies against the adoption of Diesel-engines for tankship propulsion has been the necessity to install a complete set of additional auxiliary machinery for operating the cargo pumps. This could be overcome by utilizing a new design of hydraulic clutch perfected in England from Dr. H. S. Hele-Shaw's designs by W. H. Dorman & Co., Ltd., Stafford, which has been brought to our attention. If any American concern is constructing a similar product we will be glad if they will communicate with us.

If this clutch were interposed between one of the main engines and the propeller shaft, it would be a simple matter to disconnect it when in port, and by means of similar clutches forward, the Diesel engine could at once be connected to the cargo-pumps. Of course, in this event the pump-room would be arranged just forward of the engine-room and the shafting carried through bearings in the bulk-head. An additional advantage would be gained, as the hot exhaust-gases from the main engines could be run under a donkey-boiler both at sea and in port, and the steam thus generated run through the coils in the cargo-holds and fuel-bunkers, always keeping the oil in a fluid state for pumping, as when pumped into the ship it would be warm and sufficient steam could be obtained from the exhaust-gases to maintain the oil-cargo in a fluid state until discharged.



Dorman design of Hele-Shaw hydraulic-clutch for marine Diesel-engines

This clutch, which we illustrate, can hardly be regarded as experimental, as it has been thoroughly tried-out, including with success on a 1,200 b.h.p. Diesel engine by the British Admiralty. It can be made in sizes from 10 b.h.p. to 100,000 shaft h.p. In large powers its dimensions are very small, being only 4 ft. 8 in. diameter for 2,000 b.h.p. It is of the oil-transmission type, with no wearing parts or surfaces, is noiseless and vibrationless, and there are no wearing parts or surfaces. Control is by a single central valve. It consists of a series of cylinders and pistons working with oil as the fluid. Its pistons are reciprocated in the cylinders by means of cam mechanism incorporated in one of the shafts. The other shaft (or loose pulley) has a casing fixed to it, which serves the double purpose of holding the cylinders and constituting a reservoir for the operating oil. The chief essential is a series of valves operated from the outside and controlling the passage of oil either between the respective cylinders or between the cylinders and the interior of the casing. If these valves are open the oil flows freely in the system, and there is nothing to prevent the casing with its cylinders revolving while the other shaft with the cam mechanism remains stationary, in which case the pistons are reciprocating freely in the cylinders. If, however, the valves are closed the oil is locked and cannot flow so that for all practical purposes the casing might consist of a solid casting forcing round the other shaft by means of the cam mechanism.

It can be more accurately controlled than a friction-clutch. As the valves are closed the oil has a greater difficulty in passing, this raises the pressure in the cylinders and the pistons begin to reciprocate more slowly as the other shaft approaches the primary one in speed. If the valves are closed the pistons do not reciprocate at all and the clutch is transmitting full power. Should the valves be slightly opened and the oil pressures still remain high, but some of the oil is permitted to flow and this allows the pistons to slowly reciprocate and so the one shaft revolves at a slightly slower speed than the other. The measure of the loss in horse-power is the pressure on the oil multiplied by the area and travel of the pistons. Obviously it is possible to operate valves with very small openings and so slip the clutch very slowly and very definitely this being impossible with a friction-clutch.

The difficulty of the heavy pressure on the eccentric is completely overcome as all rubbing surfaces are lubricated by oil at the same pressure as the oil in the cylinders themselves. This is a feature of the greatest practical importance as in consequence very high pressure may be employed, making a small compact clutch and eliminating all wear. This high oil-pressure may be even led to the bearings, thus enabling it to run for a month out of gear as it is completely self-lubricating.

In the Dorman design the method of freeing and keeping the cylinders from air or oil vapour is efficient. There are two main systems employed depending on the conditions required. In one case the pistons during the suction stroke separate slightly from the face it slides on. In the other the piston is always in contact with this face but as it slides to and fro (under the influnce of the cam mechanism) a port is uncovered or a valve opened on the suction-stroke. This port or valve communicates with the reservoir of oil in the casing, so that oil can flow into the system from the casing. This refilling is necessary owing to the slight leakage of oil which must result as a consequence of the heavy pressures.

REVIEWS.

We have received copies of the following publications from the American Society of Mechanical Engineers, 29 West 39th St., N. Y. C.:

"The Diesel Engine and Its Application in Southern California"—By Walter H. Adams.

"Discussion of Certain Problems in Regard to Marine Diesel Oil Engines"—By John W. Anderson.

"Crude-Oil Motors vs. Steam Engines in Marine Practice"—By J. W. Morton.

These are pamphlets that are reprints from papers read before the Society.

NEW EDITION OF DIESEL ENGINE BOOK.

A new and revised edition with appendix of "Marine & Stationary Diesel Engines" by A. H. Goldingham, M. I. M. E. etc., is now ready for distribution. The previous edition having been quickly exhausted and as many unfilled orders were still on the books, a new edition was required. This book is of a thoroughly practical nature and treats of design and construction as well as of the operation and correction of Marine and Stationary Diesel Engines. Although enlarged with an appendix on the foundry practice of Diesel Engine piston castings, the price ($3.00) is the same as that of the former edition.

NEW BOOK ON SUBMARINES.

Though not a text-book for the engineer's library, "Le Lous-Marin," just published in Paris, is a useful historical narrative of submarine invention, development and use. It serves the purpose of presenting from a national standpoint other than our own the various contributions made to the art by engineers of other countries, and of course this volume gives prominence to French accomplishments. The narrative is continued down to the end of the war. In the familiar paper cover of the French libraries and issued at 7 frs., this book costs today about 50 cents, plus mailing charges and duty. Author, G. C. Toudouze; publishers, Librairie Alphonse Lemerre, 23-33 Passage Choiseul, Paris.

BOOK ON LUBRICATION

It is not often that useful technical information regarding lubricating-oil can be had gratis, particularly where issued regularly in the form of a magazine or booklet. Readers of "Motorship" will certainly be interested in the publication known as "Lubrication" issued by The Texas Company which can be had by merely dropping a line to them at 17 Battery Place, New York. This publication is issued regularly and contains valuable technical information based on practical operating experience. On page 450 of our May issue there is a coupon which properly filled-out will ensure our readers receiving regular copies of this publication without charge.

OUR REGISTRY OF MOTORSHIP ENGINEERS.

B. W. Becks, member of M. E. B. A. No. 82, Bath, Maine, address 427 Broadway, Bayonne. Has license for chief-engineer unlimited motorship tonnage. Diesel-engine experience dates back to 1907 in stationary work, but for 5 years has been motorship engineer. Is machinist by trade. Was second-assistant on "Texaco 145," and chief-engineer on "Texaco 125."

John L. Nelson, 2758 Filbert St., San Francisco, Cal. Unlimited license, was second-assistant engineer on Norwegian motorship "H. C. Hansen," and has had altogether about 8 years' experience on internal-combustion engines.

HOLLAND-AMERICA COMPANY'S MOTOR LINERS

Referring to the large motor-liner building at Harland & Wolff's to the order of the Holland American Line, first announced in "Motorship," we are advised that two Diesel motorships are on order, both similar to the "Glenogle" of the Glen Line, and will carry principally freight, also a few passengers. Twin 4-cycle Burmeister and Wain 3,300 i.h.p. Diesel engine will be installed, and the vessels will be of 14,000 tons d.w.c.. Length 502 ft., breadth 60 ft., speed 13½ knots.

PROPOSED MOTORSHIPS FOR THE DUTCH EAST INDIAN GOVERNMENT.

Recently Mr. R. G. Leegstra arrived in the United States from the Dutch East Indies, with a view to having some Diesel-engine propelled patrol-vessels built in this country for the Dutch East Indian Government. However, he advises us on account of the prices in the United States being out of proportion in comparison with the building costs in Europe, the possibilities of placing an order for these motorships are very small at the present time.

Diesel Power for Passenger-Freighter Liners

Advantages of Oil-Engine Propulsion in Ships of the Combination Type

SEEING that over half-a-dozen of the leading Diesel-engine builders have now standardized twin-screw marine-sets of 6,000 horsepower, and that several American & European companies are constructing, or are ready to construct with the regular guarantees twin-screw Diesel sets up to 10,000 shaft h.p. there is no reason why all combination passenger-freighters now laid down cannot be internal-combustion engine powered, with the resulting of an enormous annual saving of fuel-oil.

Such vessels as the "Panhandle State," "Albania," etc. certainly should never have been steam-driven, because there is no technical or engineering reason why they could not have been successfully powered with Diesel-engines, because they come within the limits in power of a number of leading makes of Diesel-engines.

Undoubtedly there is a great future for the motor-driven "expess freighter" and for the motor-driven combination passenger-cargo classes of ships, as with Diesel-power good speeds such as 15 and 16 knots can be maintained without the fuel-consumptions exceeding those of 11 to 12-knot geared-turbine steamers of similar dimensions.

In order to give a comprehensive conception of the economies possible with the combination passenger-freighter type of vessel, we give herewith some approximate figures regarding the Cunard Line's new oil-burning geared-turbine liner "Albania," together with the operating figures of a sister hull if the same were propelled by Diesel oil-engines of average design.

As a basis for fuel-consumption we have taken 1 lb. of oil-fuel per shaft h.p. hour for the "Albania," because this figure is rarely bettered in actual service over several voyages. Whereas, for the motorship we have taken 0.42 lb. per shaft h.p. hour in order that two-cycle engines may be included in the comparison, as well as four-cycle sets.

Furthermore, after several months or even after several years service, the consumption of a Diesel-engine is nearly always reduced, whereas this is the opposite with steam-machinery, the latter even changing during a voyage. The following are the comparisons that we have figured-out from data available to us.

chinery alone is about 30% higher in first cost at the present time.

While we feel convinced that it is only a matter of a very short time before Mexican, Texas, Russian and Taraken residual-oils, and tar oil will be generally used as motorship fuel, and that it is only the question of training good engineers and giving them bonuses when steady operation is maintained on heavy residual-oils, we have nevertheless quoted the motorship as using a grade of oil at present costing $4.50 per ton more than the heavy-oil used by the S.S. "Albania," yet the Diesel-drive effects a saving of $15,642.00 per round transatlantic voyage, or say $93,852.00 per annum.

This alone is sufficient to mean a difference between profit and loss to a shipowner in bad times. But there are other gains to be effected. Namely, the absence of boiler-water and the great reduction in the quantity of fuel to be carried enables the motorship to carry about 1,670 tons more cargo than the steamer, or a possible extra earning power of close upon $15,000 per one-way voyage, or $180,000 per annum if fully-loaded each way every voyage with cargo at $10.00 per ton and with six round voyages every year.

This gives a gain of approximately $273,852 per annum in favor of Diesel drive. Then again the benefits of no firemen or trimmers must be a great boon and will avoid many a sailing delay with its loss and should enable about ten more passengers to be accommodated.

With some makes of Diesel-engine, such as the North British, Burmeister & Wain, McIntosh & Seymour and Worthington, it is possible that the machinery may weigh a little heavier than a geared-turbine plant, and occupy nearly the same space, but not if the boiler-water supply and water-in the boilers are taking into consideration as they should be to make a fair comparison.

On the other hand with such Diesel-engines as the Sulzer, Werkspoor, Ansaldo-San-Giorgio, Doxford, Cammell-Laird-Fullagar, both weight and space are less compared with geared-turbine plants of the same power, without taking the boiler-water into account.

The weight and dimensions of the leading designs of Diesel engines of this power vary as much as 15 ft. overall and 250 tons in weight, as will be

Estimated Comparison Between the New Cunard Combination Passenger-Freighter "Albania" and a Sister Motorship

(Fuel-Consumptions Based on 1.00 lb. and 0.42 lb. per shaft horse-power hour respectively, the steamer using cheaper oil).

	S.S. "ALBANIA" (Geared-Turbines)	SISTER MOTORSHIP (Diesel Oil-Engines)
Length B.P.	522 ft	522 ft.
Breadth M.D.	64 ft	64 ft.
Depth M.D.	46 ft., 9 in	46 ft., 9 in.
Power	6,800 shaft h.p	6,800 shaft h.p.
Deadweight Capacity	12,000 tons	12,000 tons
Net Cargo-Capacity (less fuel, water & Stores)	9,400 tons (approx.)	11,070 tons (approx.)
Fuel	Crude-oil	Diesel-oil
Cost of fuel per ton	$15.50	$20.00
Daily Fuel-Consumption at Full Power	73 tons	20½ tons
Daily Fuel-Consumption in Port	15 tons	2 tons
Daily Fuel-Bill	$1,181.50	$490
Fuel-Bill for One-Way Voyage (11 days) and 4 days in port	$13,371	$5,550
Passengers Accommodated	480	490
Number of Firemen and Trimmers	11	None
Bunkers for 35 days (incl. 8 days port-consumption, 22 days at sea and 5 days sea-reserve)	2,190 tons	570 tons
Total Fuel-Bill for 22 days at sea and 8 days in port	$26,742	$11,100
Boiler-Water Carried (included in Dead-weight-capacity	200 tons for main boiler	25 tons for donkey-boiler
Total Weight Drinking-Water and Stores (included in the dead-weight-capacity)	210 tons	210 tons

Although the steamer costs about 10% less to build, the complete motorship is actually slightly cheaper to construct per net-ton of cargo carried, because she carries over 12% more cargo and more passengers on the same hull dimensions and quantity of structural steel. The Diesel machinery

seen from the table in our April issue. We have noticed that most comparison articles produced by other than those of our staff have always taken the heaviest Diesel-engine on the market as a basis for their figures instead of taking a fair average design.

BOOK REVIEWS

Hilfsbuch Fur Den Schiffbau, by Johow and Foerster. Published by Julius Springer, Berlin. We have received a copy of the 1920 edition of this well-known book on naval architecture and shipbuilding. This edition is in two volumes, a second volume being necessary for the 645 illustrations and 32 tables, many of which are folding plates, including all the plans of vessels. Unfortunately our personal knowledge of the German language is far too limited for us to attempt a review, but as it happens this work is far too well-known to need review. The latest issue has been brought up to date, except that it contains very little motorship matter.

Cooling and Quenching of Oil and the Heat Treatment of Steel, by Kenneth B. Millett.—This interesting 29-page brochure describes the necessity for heat treatment, the various quenching mediums and systems commonly used, the advantages of continuous circulation of the medium and the excellent adaptability of the Multiwhirl Cooler to the cooling of quenching oil. Typical installations are featured, showing the layout of the piping with recommendations for the proper size and number of coolers to meet the requirements. It has been published by the Griscom-Russell Co., 90 West Street, New York City. Copy will be sent upon request without charge.

LITERATURE ON ELECTRIC BRAKES

Electrically-Operated Brakes are described and illustrated in a 16-page, 8½ x 11 booklet with the above title, and published by the Cutler-Hammer Mfg. Co., of Milwaukee, Wisconsin. Publication 850, as the booklet is known, takes up shoe-brakes for both direct and alternating current service. Tables give dimensions and ratings of each type of brake, and it is explained how the correct size of brake for any particular installation may be calculated. The direct-current shoe-brake is described as being very compact with low head room, and operates with a direct magnet action. Its rigid construction and few moving parts make it adaptable for the most severe service. The alternating-current brake operates by means of a rotating magnet, which largely eliminates noise and wear.

ITALIAN DIESEL WARSHIPS

"Jane's Fighting Ships 1920"—Published by Samson Low, Marston & Co. Ltd. Price £-2-2-0. Probably this latest edition of Jane's well-known naval book is the most interesting ever published, as it contains illustrations and details of practically all surface warships and submarines constructed during the war. Also, the British Admiralty have allowed illustrations of their capital ships to be reproduced once more, all silhouettes and photographs having been eliminated during the war period.

To Diesel-engine builders the Italian section will be of particular interest, as some very interesting oil-engined war-craft are illustrated, to which references were first made in "Motorship" early in 1918. There are four classes of surface-craft propelled by Diesel-engines. The "Grappa" class consists of four vessels of 575 tons, "Montello", "Grappa", "Monte Moregno" and "Monte Cengio", and carrying one 15 in. gun and one Colt M. G. They are propelled by twin 350 shaft h.p. Ansaldo-San Giorgio Diesel-engines, and were built at the Castellamere Dockyard from designs by Major-Gen. G. Pruneri.

The "Faa di Bruno" class are box-shaped monitors, or "mobile batteries", with two 15 in. guns, two 14-pounders and two 1½-pounders, but are only of 100 b.h.p., one Diesel-engine being fitted. Over three years ago we were privileged to see "moving-pictures" of this vessel in action against the Austrian coast.

The "Carso" is another Diesel-driven gun-vessel. She is of 360 tons and is propelled by two 300 b.h.p. Polar-Diesel engines. She carries two 7.5 guns. Like the "Faa di Bruno" she was built at the Venice dockyard.

Then there is the "Monte Santo" class consisting of two vessels, the other being the "Sabotino", with one 15 in. gun each. They are of 540 tons displacement, and propelled by a Tosi 350 b.h.p. Diesel engine. The "Pasubio", "Vodice" and "Cucco" are similar to the "Carso", but carry smaller guns. They were laid-up in 1920.

First of Fleet of 16 Diesel-Driven Ore Carriers

Launch of the Motorship "Strassa" at Goteborg—To Carry Both Oil and Ore Cargoes

THE third of the 18 ore-carrying vessels which the great Swedish ore company Grängesberg-Oxelösund ordered from Götaverken, at Gothenburg, has now been launched. She was named "Strassa," after the great ore-fields of the company in the middle of Sweden.

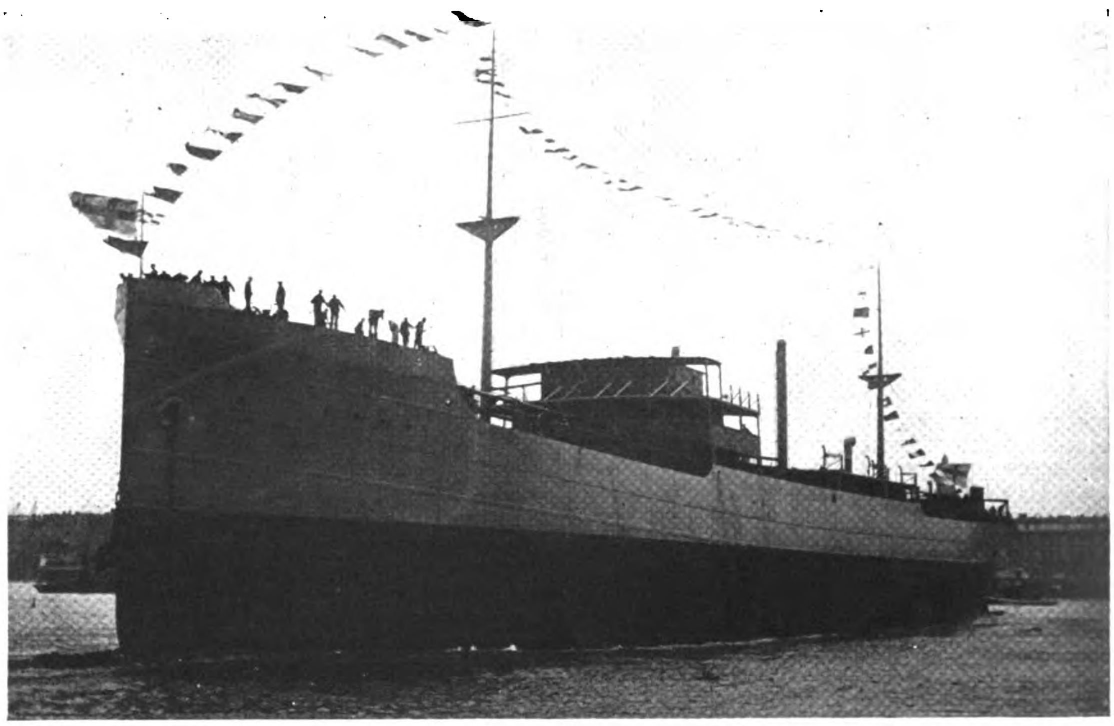
The construction of the M/S "Strassa" is in many ways remarkable, and quite different from the two preceding vessels built by Götaverken for this company. It is to be remembered that the two first vessels were steam driven, but that the company after very careful investigation went in for Diesel-motor-drive. A special committee was appointed to investigate which kind of propelling-machinery was the most suitable for the ore-carrying vessels of the company. The committee came to the conclusion that it was not only more economical to have the vessels Diesel-motor-engined, but that it also allows a much better distribution of the load, owing to the engine room being shorter, which has a decided influence on the strength and tends to diminish the stresses in the ship.

The M/S "Strassa" has a shelterdeck and is provided with forecastle and cruiser stern. She is built to the highest class of the British Lloyd. The dimensions are: Length over all, 339 ft. 3 in.; moulded breadth, 53 ft. 5 in.; moulded depth to shelterdeck, 34 ft. ¾ in. Her dead weight is 8,200 tons.

The steam-driven ore-carrying ships have four cargo holds, whereas the "Strassa" has five cargo holds. In order to carry home oil to those of the company's ships which do not go to any oil-producing countries the "Strassa" is provided with deep tanks below the No. 1 hold, going from the bulkhead of the machine room to the peaktank through the whole aft of the ship. The deep and peaktanks have a capacity in all of 1,800 tons of oil. Besides, there is room for 500 tons of oil in the bottom tanks serving as bunker for the ship.

The main machinery consists of two of the Götaverken B. & W. Diesel-motors of 2,600 I.H.P.

For the captain's accommodation a deckhouse is erected between No. 2 and No. 3 holds. On the top of this is the bridge. Accommodations of the officers are around the engine-casing. Accommodations of the crew are aft. The ship is rigged with two masts and is in every way modern and up-to-date and will shortly be in service.



Combined ore and oil carrier built and Diesel-engined by the Götaverken for the Grangesberg Company

CONVERSION OF "LUYS CASANOVA"

Now being installed in the sailing-vessel "Luys Casanova" at Barcelona, Spain, is a 320 b.h.p. Atlas-Polar Diesel-engine.

"CHRISTOBAL LLUSA" BEING CONVERTED

Work fitting a twin-screw set of Bolinder oil-engines is now being carried out in the sailing-vessel "Christobal Llusa" at Barcelona, Spain.

ENTERPRISE ENGINE'S 30 DAYS' RUN

In the brief report, on page 402 of our May issue, of the 30 days' test-run of the Enterprise 100 b.h.p. Diesel engine, it was stated that the fuel used was of 40 degrees gravity, instead of 14 degrees. The error of course was a typographical one. In service the engine operates on oil varying from 14 to 26 degrees gravity.

BURMEISTER & WAIN PRODUCTION FOR 1920

During 1920 Burmeister & Wain delivered two motorships aggregating 15,713 gross tons and 7,600 i.h.p. also marine Diesel-engines of 12,720 i.h.p. for motorships built at other yards, while B. & W. licensees completed eleven motorships of 43,000 i.h.p. In addition, they delivered 14 stationary Diesel-engines of 3,160 b.h.p. This makes a total of 23,480 horsepower for 1920.

ROBERT WARRINER'S PAPER BEFORE THE S. N. A. M. E.

Because Mr. Robert Warriner's paper before the Society of Naval Architects and Marine Engineers chiefly dealt with reduction-gears for ship propulsion and only touched lightly upon motorships, we are not reproducing the same, but on this page is a table included in his paper giving comparisons of four types of combination ore and oil-carriers of 20,000 tons d.w.c.

The table shows the relation as to the weight, space, cost and operating expense for reciprocating-engines, turbines and reduction-gears, Diesel, and electric drive on these particular tankers, all of which are twin-screw. In this the Diesel-engine is rather at a disadvantage owing to the necessity of fitting considerable boiler power for heating the cargo-oil. We think that the daily consumption of 24 tons for the motorship would be very much lower if the exhaust-gases were used to generate steam for maintaining the cargo in a fluid state when at sea; because, at some oil-docks the ship's boilers have to be drawn and steam supplied from shore stations. This would then give the motorship a daily consumption of 14½ tons, and so will effect a big saving, and automatically increase her carrying capacity.

	Reciprocating	Turbine	Diesel	Electric Drive
Speed of ship, knots	11.5	11.5	11.5	11.5
Diameter of propellers	17′ 6″	15′ 8″	15′ 8″	15′ 8″
Revolutions per minute	76	105	105	105
S. H. P. for 250 sea miles per day	4135	4350	4350	4350
S. H. P. maximum	4600	5800	5000	5800
Weight of machinery and water-tons	1060	914	1267	981
Weight of machinery in lbs. per max. S. H. P.	517	353	567	379
Space occupied by machinery, cubic feet	171,826	171,826	192,251	171,826
Total weight of hull and machinery, tons	9350	9200	9700	9267
Net carrying capacity of ship bunkered for 20 days steaming' and 8 days' reserve fuel, tons	18,775	19,220	19,482	19,153
Comparative cost of machinery	100	98.3	123.5	128.3
Fuel consumption per day 250, sea miles, tons	60	48	24	48
Estimated cost of operating per day*				
Crew	13.33	13.33	14.46	13.33
Repairs	11.34	11.34	11.34	11.34
Stores	4.82	4.82	7.89	4.82
Provisions	3.97	3.97	4.26	3.97
Depreciation	27.10	27.00	29.83	30.10
Insurance	17.60	17.53	19.40	19.67
General	1.42	1.42	1.42	1.42
Fuel-oil	20.42	16.34	8.18	16.34
Total	100.00	95.74	96.38	100.99
Per deadweight ton	100	90.7	93.2	99.3

* Based on total of 100 for reciprocating machinery.

Comparison table of operating costs of four different types of ships given before the S.N.A.M.E. by Robert Warriner, Chief-Engineer of the Bethlehem Shipbuilding Corp.

Our Readers' Opinions

(The publication of letters does not necessarily imply Editorial endorsement, etc.)

A STEAM SHIPBUILDER AND "MOTORSHIP"

To the Editor of "Motorship,"

Sir:—

You deal with the subject of Diesel engineering, in a broad-minded manner, realizing that it is fundamentally an economic competition between steam-engines and internal-combustion engines for marine propulsion.

After about thirty years' close contact with the building and operation of vessels, of many types, I am strongly impressed with the progress and possibilities of Diesel-type internal-combustion engines in economic competition with steam-engines. I believe the internal-combustion engine will win out in this competition. The rapid advance and refinement of Diesel-engineering in Europe indicates very strongly that we are on the verge of a great transition, from steam-engines to internal combustion engines, especially in merchant vessels for ocean freight service. I believe that motorships will make steamships economically obsolete as rapidly as steamships made sailing ships obsolete. Present and future expensive fuel and operating personnel will force us to design, build and equip vessels in an up-to-date way to reduce the operating cost.

Present maritime transportation in all trades is extravagant and wasteful because of innumerable unnecessary varieties in types, sizes and equipment of vessels, and also because of unnecessary varieties, sizes and shapes of shipbuilding materials. I have no doubt that the world's ocean transport costs can be reduced enormously by standardization of types, sizes and equipment of vessels, and standardization of shipbuilding materials and construction practices. Probably the first great economy to be accomplished will be reduction of costs of fuel and operating personnel through the adoption and use of internal-combustion engines to replace steam-engines. A large movement is already on in that direction, and I believe it will rapidly increase. I understand there is now about 500,000 tons of motorships under construction in the world. This is very substantial evidence of transition from steamships to motorships, and should be especially gratifying to you.

I recall that you were a pioneer in this country, urging the adoption of Diesel-type engines for marine propulsion. You were an enthusiastic champion, and optimistic on this subject, when most of us were skeptical pessimists. I congratulate you for your foresight and good judgment on this subject, and as editor of "Motorship" you are successfully prompting us to a serious realization that American shipbuilders and ship-owners must prepare to meet the coming urgent demand for motorship building and Diesel engineering. I believe that the great majority of the present freight tonnage of all nations is now economically obsolete and must be replaced as rapidly as possible with up-to-date economical ships.

Yours very truly,
WALLACE DOWNEY, President,
Downey Shipbuilding Company.

New York, May 31st, 1921.

THE CREW OF THE M. S. NARRAGANSETT

To the Editor of "Motorship,"

Your article headed "Latest Voyage of the Motor Tanker 'Narragansett,'" which appeared in the May issue of "Motorship," seems to invite comment, especially where Chief Engineer Rawes advised you that when the "Narragansett" was placed in service none of his engine-room crew had previous experience with Diesel engines, with the exception of the engineers from the works and himself.

This is entirely wrong, as the remaining engineers had considerable previous experience on this class of engine, their total experience amounting to over 30 years.

Wishing your worthy paper every success,

Yours very truly,
WILLIAM SLESSOR,

413 St. Vincent Street,
Glasgow, Scotland.

SOLID, PUMP, OR MECHANICAL INJECTION

To the Editor of "Motorship",

The term "Solid Injection" seems to have come into quite universal use in referring to Diesel oil-engines and other similar types, where the fuel-oil is injected into the cylinder by a pump, instead of by the more general use of highly-compressed air.

The term "Solid Injection" is really a misnomer and does not convey the correct idea. There are two principal methods of injecting the fuel-oil into the engine cylinder. One is by highly compressed-air and the other is by means of a pump working against very high-pressure and forcing the oil through the spray-valve in a corresponding manner, as is done by the highly compressed air.

What would be more explicit and convey the correct idea would be to use the term "Pump-Injection" instead of "Solid-Injection." We would then have the two terms "Air-Injection" and "Pump-Injection," each conveying the idea by its name, as to how fuel oil is forced into the engine cylinder.

With the pump injection method the oil is not sprayed into the cylinder in any more of a solid state than takes place with the air injection method, therefore why should this word "solid" be used? In either case, when the oil passes through the spray valve, it is broken up into the finest particles possible. In one case the necessary pressure is exerted by highly compressed air, in the other case it is accomplished by a pump working against very high pressure. The term "Pump Injection" is therefore logical and conveys the idea in its name.

Why, then, not the term "Pump Injection," instead of "Solid Injection"?

Yours very truly,

New York, N. Y. H. R. HOWELL.

WHAT CONSTITUTES A DIESEL ENGINE

To the Editor of "Motorship,"

In your May issue of "Motorship," Volume 6, No. 5, on page 409, there is an advertisement by the Atlas Imperial Engine Company of Oakland, California, on their "Mechanical-Injection 'Full' Diesel-Engine," wherein they explain the engine as follows:

No High-Pressure Air
No Hot-Surfaces
Positive Governor
Low-Compression
Clear Exhaust
100 to 350 Revolution

According to my understanding of the Diesel-engine the above representation of a Diesel-engine is in error. Will you please advise me your understanding of the "full" Diesel-engine and its method of injection and ignition, stating whether or not the engine as advertised by the Atlas Imperial Engine Company is a "full" Diesel-engine?

Thanking you for an early reply to this letter, I am, yours very truly, D. N. WOMMACK,
Southern Engine & Pump Company.

Houston, Texas.

[A very complete discussion of what constitutes a Diesel engine was published in the February and March, 19.., issues of "Motorship." The title of the article was "Oil Engine Nomenclature." We stated that the three fundamental features of the true Diesel cycle are as follows:

(1) Compression of pure atmosphere to a degree that the temperature produced is adequate for the inflammation and combustion of the fuel.
(2) Injection of fuel at such a rate that the burning proceeds without rise of pressure in the combustion space. (This condition is not realized with absolute precision, there always being a slight rise of pressure when the fuel begins to burn.)
(3) The injection of fuel by air-blast that produces turbulence needed for good combustion. (This is essential but not distinctive or exclusive to the Diesel cycle.)

In our March, 1917, issue we gave the opinions of the leading American oil-engine builders as to what constitutes the Diesel cycle.—Editor.]

THE MOTORSHIP ENGINEER QUESTION

To the Editor of "Motorship,"

Sir—

I have read with interest the article proposing an "Engineers Registry Bureau" in the March issue of Motorship. There have been several other articles about not being able to get in touch with competent Diesel-engineers.

It seems to me that if the shipowners and the trade in general were informed of the facts of the case such a Registry Bureau is entirely unnecessary and would not be used by the best engineers. There is a society called the Marine Engineers Beneficial Association that has offices in all the main seaports of the U. S. and they are prepared to furnish engineers for steam or Diesel-ships at any time and men who have had experience with Diesel-engines of any size or type. Men who compare with foreign engineers in the same manner that U. S. built Diesel-engined ships or any other U. S. product compares with foreign.

It has been my pleasure to put in 3½ years with one of the foremost marine Diesel-engine firms in the U. S. who have built or building over 500 Diesel-engines from 120 to 1,000 h.p. for U. S., Chile, Spain, England, Russia and others too numerous to mention. During that time I have seen a great many marine engineers come to the shop and put in from 4 months to severals years on the erecting and testing floor for a whole lot less money than they could have received on the ships they had left. These men have put themselves to a great deal of expense to get Diesel experience where it could be acquired in the shortest time.

A great many of these men not being machinists to go work as helpers or 3rd class machinists for the reason mention above and stick to it until they get what they came for. I know for a fact, that this same thing has been going on in other shops around the country and men going after this "on their own hook" are worth as much or more as any other man.

Diesel-engine training ships and schools might be very fine if necessary, but as we have plenty of ex-steam and gas engineers who have gone to a lot of trouble to learn as well as Diesel engineers and machinists who have followed the Diesel business from the very beginning I don't believe such schools and ships are at all necessary.

At the same time I know of a great many steam-engineers who have put in time as oilers on Diesel-ships and with their previous experience have obtained unlimited licenses for Diesel. At the same time we have hundreds of engineers who put in time in U. S. submarines during the war where they were running Diesel-engines averaging twin 500 h. p. and even up to four of 1,000 h. p. in our largest subs.

Trusting that I have shown that we have the goods I will add a word as to where it can be obtained. The Marine Engineers' Beneficial Association is what its name implies and is not a radical society under the name of a labor union as some of the propaganda that has been in circulation tries to make the public believe all Associations are. Any time you go down in the engine-room of any U. S. steam or Diesel ship you will see the engineers with a little button on their shirt collar with a propeller and the letters M. E. B. A. No.—— and V. and F. on it.

Any ship-owner who gets his engineers through the M. E. B. A. (as do the Standard Oil Co. and all the other big operators) and find such engineers incompetent they have the privilege of sending them back with the facts of the case, and the Association, if the facts warrant will gladly furnish others who are competent.

The trade in general should not forget that all Diesel-engineers are licensed by the U. S. Steamboat Inspection Service and anyone who thinks it is easy to get a License I would advise them to go to an Inspectors Office and ask to see a set of questions—answers and experience that was written out by some Diesel engineer when he was up for examination.

Hoping this will meet with your favor and help to put the U. S. Diesel-engined and American operated ships on the map, I remain

Yours very truly, GEORGE W. HAGGETT.
Chief-Engr. M. S. "Ambassador."
Member M. E. B. A., No. 52, Seattle, Wash.

PACIFIC COAST NUMBER

NEW YORK SEATTLE

MOTORSHIP

Devoted to Commercial and Naval Motor Vessels

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Vol. 6 No. 8

BIG DIESEL-ELECTRIC SHIP FOR WESTERN UNION

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EXCLUSIVE technical and non-technical articles on design, construction and operation of oil-engines and motorships by the world's foremost writers on marine engineering.

MOTORSHIP

(Trade Mark Registered)

PROFUSELY illustrated with photographic reproductions of the newest designs in international merchant motorship and Diesel-engine construction.

Vol. VI — New York, U. S. A., August, 1921 — No. 8

Cable Address—Freemote, New York

Sink 1,000 Steamers or More

Suggestions to Chairman Lasker of the Shipping Board

By IMPORTER AND EXPORTER

YOUR great problem, Mr. Lasker, is to stop the flow through the broken dam. Nearly $200,000,000 a year is pouring through the break. The little Dutch boy who stuffed a finger into the hole in the dyke to prevent the trickle of water enlarging a passage, which the wild North Sea would use to break the dyke and flood the land, lost his hero life to save a waste of other lives and property.

That boy had the makings of a Harriman. Wasn't it Harriman who piled the loaded freight trains into the break in the dam to stem the waters that defeated every effort of the engineers to rebuild the work?

Why not sink 1,000 worthless steamers or more to hold back the flood of money pouring to waste through the Shipping Board? You are getting on the right track. You told the reporters the other day that what we had spent on the building of our ships was money we had already dug out of our pockets, but every dollar short on the operation of the fleet has to be made good by taxes we still have to pay. In the usual phase, this is throwing good money after bad!

Why ask the nation to bear taxes for the maintenance of a lot of junk? You don't have to go over the Shipping Bard Fleet with a fine haircomb to discover there is a lot more junk than the million tons of wooden vessels.

There is a lot of junk in the 10,000,000 tons of steel steamers. Why not admit it now? There is no magic in steel. Steel does not of itself make a good ship. With the right design and the right care and workmanship steel can be formed into a good hull. Yet even a good hull does not make a merchant vessel. You have to get the right machinery. And how much good machinery do you have in the whole Shipping Board Fleet?

Shippers of merchandise are skeptical about Shipping Board steamers. They have to be shown. Cargoes delayed through steamer repairs and shipments spoiled through the same cause or through salt water were commonly spoken of until the time when the laying-up of the steel vessels permitted the vessels in service to be handpicked. A large number of those now laid up ought never to be put back into service; they ought not to have another dollar spent on them; they ought to be scuttled and sunk.

There are about 650 Shipping Board vessels in operation. Some of them are first-class vessels, particularly those built in the old established yards. Many of them, however, are outclassed for general service. They are too expensive to operate; they cannot make money in competition with the foreign ships, and they will be a losing proposition long after the foreign vessels are profitably operating again. Sink them. We paid for them, as we paid for aeroplanes, tractors, guns and many other things in the stress of war. But don't let us waste money on them in peace.

When General "Hell and Maria" Dawes was winding up the business end of the A. E. F. in France he made a deal with the French Government that saved us a lot of money. He sold the army supplies "as is, where is and what is" for $400,000,000. Most people thought it a poor deal, because the supplies had cost $1,500,000,000 or more. Time has proved that Dawes was right. The British army haggled over the terms of sale, and as a result, millions and millons of dollars worth of British supplies lie rotting in France today.

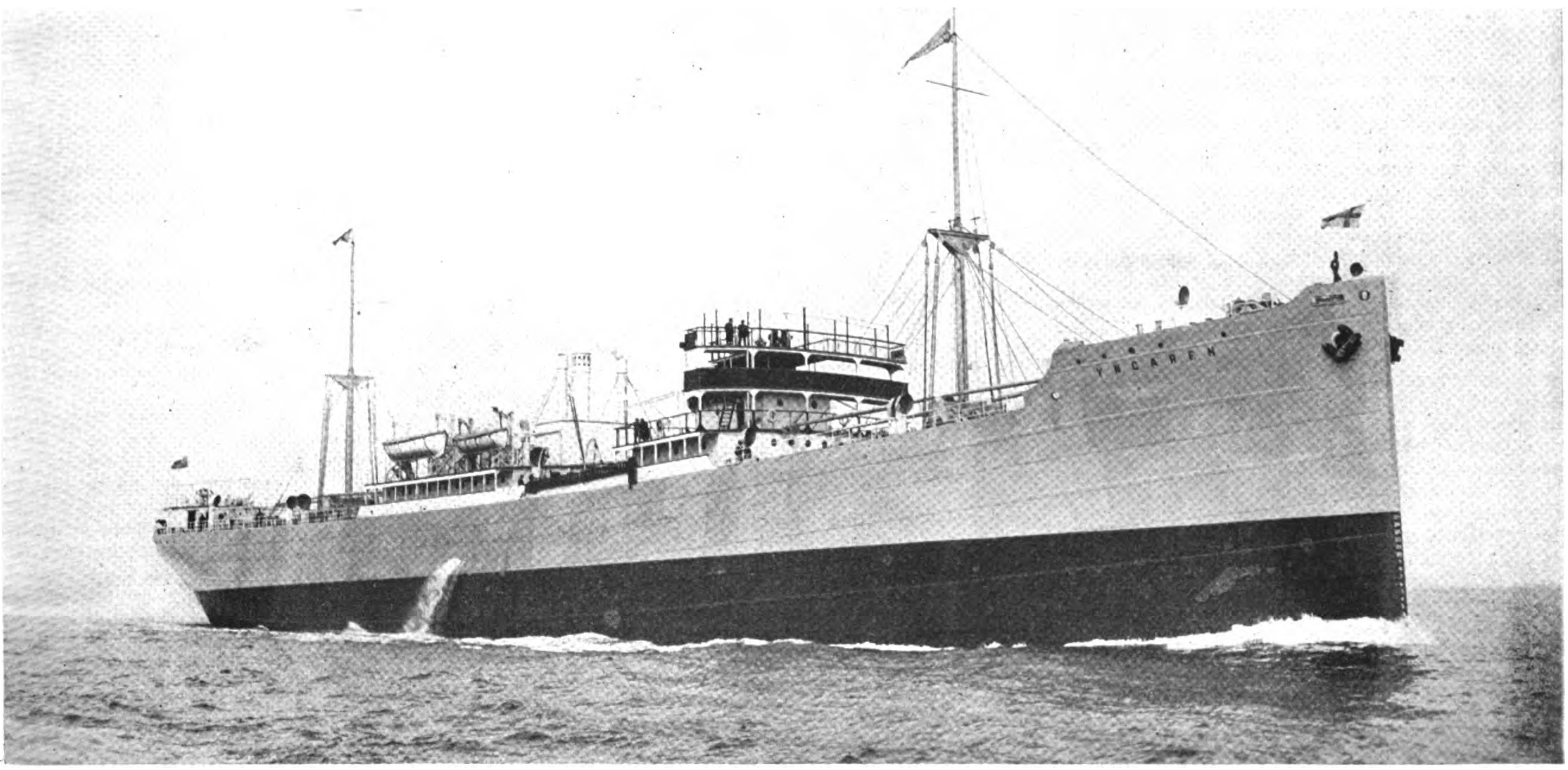
General "Hell and Maria" is Director of the Budget today, and he will want to know what you are doing to stop the waste of money, Mr. Lasker. Take a leaf out of his book: make a sacrifice today in order to save the money to-morrow.

Let our shipowners build motorships. The orders will save our shipyards. The motorships will save our merchant marine. The saving in oil will conserve our oil resources.

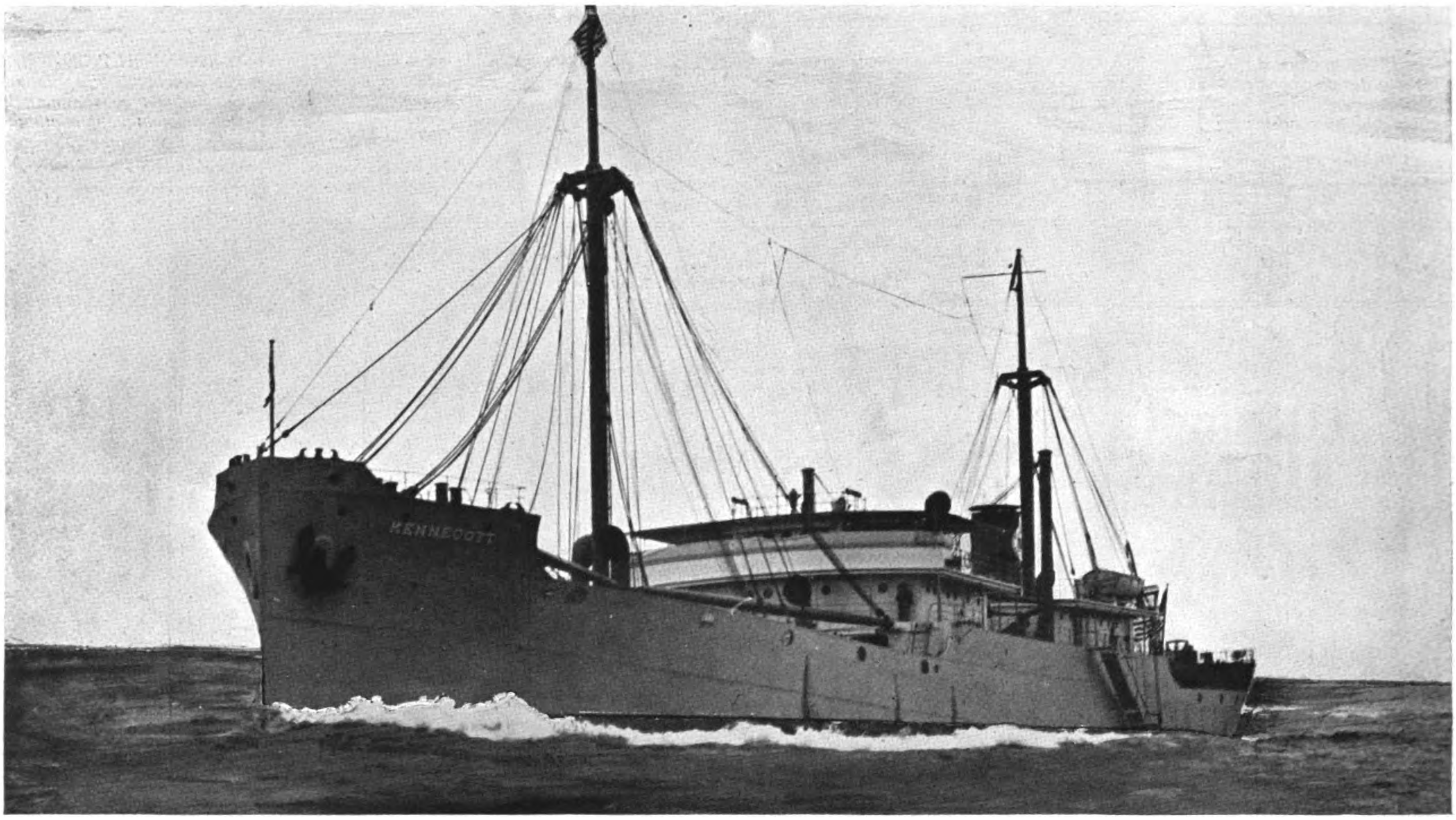
As an advertising adviser, you would not counsel a client to sell an out-of-date service, because you know the public would not buy and your client's business would fail. If you apply the same standard to the Shipping Board, you will see to it that the Shipping Board does not sell "steamer service," which will be undersold by "motorship service."

Nero fiddling while Rome burned had nothing on our previous Shipping Boards. Europe is operating motorships and building many more of them to take our trade whilst the Shipping Board before your guidance has been occupied in endeavoring to excuse itself. Excuses don't help us to keep our shipping business. Motorships are what we need.

Keep the best of our steamers, but only the best ones—and convert many of these to economical motor power. Sink the rest of them! American shipbuilding to-day is in critical position. American shipbuilding must be saved! American shipyards must be protected! They cannot be left to rust out of existence. Build some modern ships and save the ship building industry.



The 12,750 tons single-screw Diesel motorship "Yngaren," built for the Transatlantic Line of Stockholm, by Doxford & Sons, Sunderland, England. She was fully described and illustrated in our issue of July, 1921



Pacific Coast built motorship "Kennecott" owned by the Alaska Steamship Company and propelled by twin 1,200 i.h.p. McIntosh & Seymour Diesel-engines. She averages about 265 nautical-miles per day on 8⅛ tons of 16.7 Baume fuel-oil.

Pacific Coast Marine Interests Turn to Motorships

Immediate Future to Bring Important Developments In Every Line of Shipping and General Marine Activity.—Pacific Coast on Verge of Motorship Boom

WHILE American shipping interests generally have been slow in awakening to a realization of the significance of the development of the internal-combustion motor for general marine transportation and have fallen far behind many of the foreign maritime countries in this respect, there is one section of the country, at least, where transportation men have seen the handwriting on the wall and are making ready to discard their out-of-date steam carriers in favor of the modern, economical and practical motor vessel. The record made by the new steel motorship "Kennecott," built this spring by the Alaska Steamship Company of Seattle, and the consistent performance of the Standard Oil Company's Diesel tanker "Charlie Watson" has opened the eyes of Pacific Coast shipping-men to the fact that the Diesel-type of engine has at last become an inevitable factor in transportation on the high seas and that the modern motorship offers the most economical and at the same time reliable means of transportation that the world has ever known. As a consequence a number of important transportation companies have announced their intention of not only confining all of their future shipbuilding activities to motorship types, but also as rapidly as possible of converting the steam vessels which they now own to Diesel power.

Programs of Important Shipowners

Most significant among the announcements which have been made along this line is that of the Puget Sound Navigation Co., which controls most of the freight and passenger traffic of the Puget Sound district, that this company will proceed with the construction of a new motorship for their Port Orchard Route, and are planning as fast as business conditions will permit to convert others of their fleet of twenty steamers to oil-engine power. This is a very important and significant proposal.

Another big company, the Puget Sound Towboat Co., which owns and operates some of the largest offshore steam-tugs on the North Pacific Coast, has had plans drawn for a new motor tugboat which will be powered with twin Diesel-engines of 1,200 b.h.p. each. Orders are also to be placed shortly by the Hibbard-Swenson Co. for a new motorship to engage in trade between Seattle and Siberia, while a number of smaller tugboat companies operating in coastwise and harbor work announce that their entire fleets will be converted to Diesel or surface-ignition oil-engine power as rapidly as the cost of conversion can be financed. In fact, a general survey of the marine field on the coast shows that it is on the verge of a motorship boom and that many significant developments may be looked for within the next twelve months.

Success of the "Kennecott"

The Alaska Steamship Company's new Todd-built "Kennecott" is not the only motorship by any means that has been built on the Pacific Coast, for there have been many motor-vessels constructed there in the past few years and most of them have been successful. But the fact that she was a steel vessel of unusual size and also that she marked the inauguration of a new policy by one of the largest and most prominent shipping companies in the American merchant-marine, focused the attention of shipping men upon her record to an unusual degree and therefore made her successful showing all the more conspicuous. Big shipping men who held the old-time traditional prejudice against any departure from steam and who were still imbued with skepticism on account of the unfortunate record of some of the hurriedly built and poorly equipped motorships constructed during the stress of wartimes, have been forced by the perfect record of this boat and her obvious economy of operation to admit that the motorship has at last won for itself a permanent and vital place in navigation on the high seas.

The operation of the tanker "Charlie Watson" is also being watched with great interest because she is now being followed by a larger motor-tanker with the same make of Diesel-eengine. She has been employed regularly in the run between Puget Sound and Seattle, carrying petroleum products to the latter port from the Standard Oil Company's refinery at Richmond. She arrives one day, loads and departs the next morning, her engines running with even regularity.

It seems appropriate that the Pacific Coast, always in the lead in the utilization of internal-combustion engines for smaller types of vessels, should be the first to assume a progressive attitude in the adoption of Diesel-power for big ship propulsion and that big companies on the western seaboard like the Alaska Steamship Co., the Puget Sound Navigation Co., the Puget Sound Towboat Co. and others, should be in the van among all the shipping concerns in the country in adopting and putting into effect a definite motorship program.

Probable Conversion of Kennecott's Sister Ship

While the Alaska Steamship Co. has not made any statement as to its program for the immediate future, yet the daily papers recently announced that it was contemplating converting the "Alameda," another of its steamers, to Diesel power, and it was thoroughly understood at the time the "Kennecott" was built that if it worked out successfully, the future policy of the company would be strongly in favor of vessels of this sort. E. T. Stannard, the vice-president and general manager of the company, has very modern ideas along these lines, having been entirely convinced of the practicability of the Diesel engine in his experience with some large installations of stationary engines in the Kennecott mines in Alaska, and his progressive policies are having a far-reaching influence at the present time among Pacific Coast shipping men generally. We understand that he was converted to motor-power for ships by reading Motorship.

The decision of the Puget Sound Navigation Co. to build a Diesel-powered ship for one of their most important runs out of Seattle is also a very significant step, as it undoubtedly marks the beginning of a revolution of passengeer and freight transportation on inland waters. This company has for many years been the largest concern engaged in the steamship business on Puget Sound. It practically controls the local water transportation routes and operates most of the boats making the intercity and inter-island runs, including the routes between Seattle and Tacoma, Seattle and Everett, Seattle and Bellingham, Seattle and the Puget Sound Navy Yard, and many other runs of importance. It owns a fleet of twenty ships, all but one of which are steamers, the exception being the "Aloha," a small freighter powered with a Fairbanks-Morse "C-O" engine.

During the past two or three years, with the cost of transportation soaring and labor and fuel costs far beyond all previous levels, many of the company's runs on which patronage has not been heavy, have not proven profitable for the expensive type of steamers which the company has been operating. It has long been obvious that the only solution for these minor runs, and for all of the different routes, in fact, was greater economy of operation and that the only way this could be obtained was by the use of cheaper power, such as is offered by the use of Diesel or surface-ignition engines.

18-Knot Diesel-electric Motorship

The recent decision of the Puget Sound Navigation Co. to build the new boat for the Bremerton-Navy Yard Route is undoubtedly the first step in this direction and marks the adoption of a definite policy, which undoubtedly will encompass the ultimate equipment of their entire steam-driven fleet with Diesel-type motors. The new boat will be a ferry, designed to carry passengers and automobiles. According to present plans she will be a vessel 213 feet long, with a beam of 45 feet, and will be powered with twin 750 shaft h.p. Diesel motors. She will handle 2,000 passengers and 60 automobiles. The engines will operate through electric-drive as designed by the General Electric Company, and the ship will have a speed of about 18 knots, which will permit her to make the trip from Seattle to Bremerton in an hour. Bremerton is the site of the Puget Sound Navy Yard, now one of the greatest naval stations in the country, and not only is the passenger patronage heavy between the smaller city and Seattle, but it is also the natural route for automobiles making the trip over the Olympic highway, so that this traffic also had to be taken into consideration. Undoubtedly if the new motor ferry works out advantageously, the company will adopt the ferry boat type for many of its shorter inland runs in place of their present type of steamers with their small carrying capacity.

2400 Horse-Power Diesel Tug

The Puget Sound Tug Boat Co.—distinct from the Navigation Co.—formerly owned a number of large ocean-going steam-tugs which they operated out of Puget Sound and off the Columbia River. This company is associated with the Puget Mill Co., one of the largest lumber and logging concerns on the Coast, and the tugs were used in connection with their own work and also in handling shipping in and out of the two harbors. They recently sold the "Tyee," "Holyoke," "Wanderer" and "Prosper," but still retain the tug "Pioneer." Whether their disposal of the steam-tugs was in preparation for carrying out a policy of replacing them with more modern heavy-oil vessels is not definitely known, but it is significant that they have had plans drawn and will proceed shortly with the construction of at least one new Diesel-equipped deep-sea tug. The plans as prepared by L. E. Geary, naval architect of Seattle, call for a boat 245 feet in length with a tonnage of 2,600 and twin 1,200 h.p. Diesel motors. She will be used for towing heavy barges overseas and in coastwise work and will be, according to our information, the most heavily-powered Diesel tugboat so far built, anywhere in the world.

New Motorship for Alaska Service

Another important motorship to be built is the one that will be constructed by the Hibbard-Swenson Co. of Seattle to replace the motorship "Kamchatka," which was lost at sea through fire this spring while on her way to Siberia. The "Kamchatka" was formerly a steam bark, known as the "Thresher," and was purchased by the Hibbard-Swenson Co. last year and converted into a motorship, a 300 h.p. McIntosh & Seymour Diesel engine being installed. She was a vessel 144 feet in length, with a beam of 31½ feet. The new vessel to take her place will be considerably larger than this, although the details have not been made public. The trade between Siberia and Puget Sound has attained such vast proportions, however, and promises so much greater expansion in the future, that it is understood the company contemplates going into the business on a big scale, and that the new vessels will be built of sufficient size to be a big cargo carrier. It is also believed that she will be the forerunner of a number of big motorships built for this trade.

Diesel-electric Ferry for San Francisco

Another interesting development in a very important transportation field is the announcement by the Golden Gate Ferry Co. of their plans to build several Diesel-powered ferry boats for use on San Francisco Bay. The plans of these vessels which are shown elsewhere in this issue, provide for twin Diesel-engines operating with electric-drive, and the introduction of boats of this type into the ferry business on the Bay will undoubtedly affect the policy of the older companies now operating there, as the competition of the more economically operated boats would soon be felt. Question of general financial conditions, however, has delayed an actual order being placed as yet. The Southern Pacific Railway Co. at present operate a fleet of 13 big steam ferries and the Key Route a fleet of four which would provide some big installations for Diesel-engine manufacturers if it were found advisable to convert them to oil power. The Oakland & Antioch Railway Co. for a number of years have been operating one motor ferry, the "Bridgit," which is equipped with a 500 h. p. Union distillate-oil engine, and it is understood that she has been very satisfactory and successful.

Another big market for heavy-oil engines that is developing is to be found among the numerous companies engaged in harbor and bay towboat work along the coast. In San Francisco, Oakland, San Pedro, San Diego, Seattle, Tacoma, Portland, Vancouver and in fact in all Pacific Coast ports are numerous companies owing some very large fleets of gasoline and steam tugs engaged in this work, and one by one these companies are deciding to convert their fleet to heavy-oil engine power.

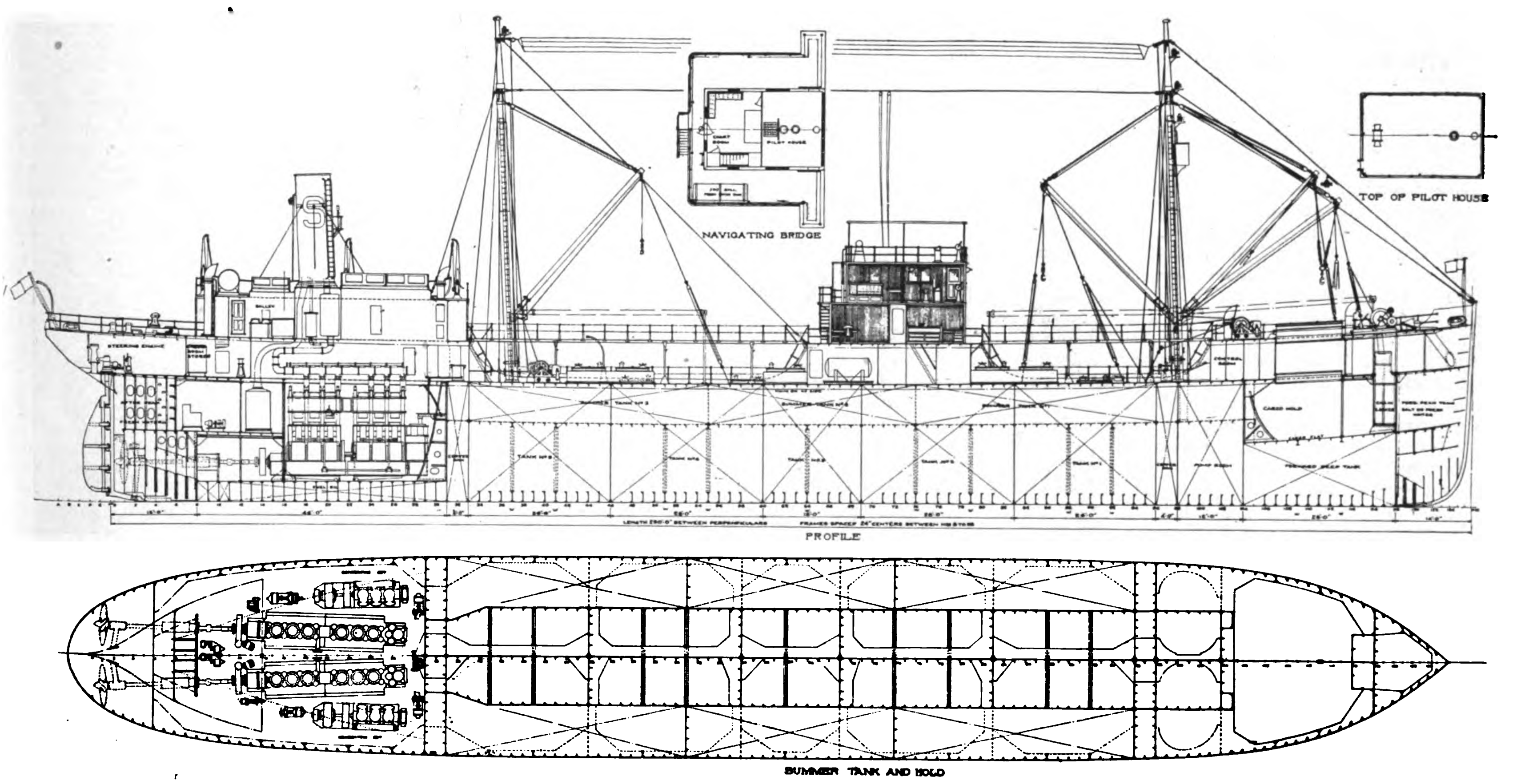
Many of the companies already have installed Diesel and surface-ignition engines and it will be only a question of time until their entire fleets will be so converted. This is especially true of the companies whose fleets are made up largely of steam-tugs where the cost of operation is more of a vital feature than with those operating boats powered with distillate-burning engines.

Steam Tugs to be Converted to Diesel Power

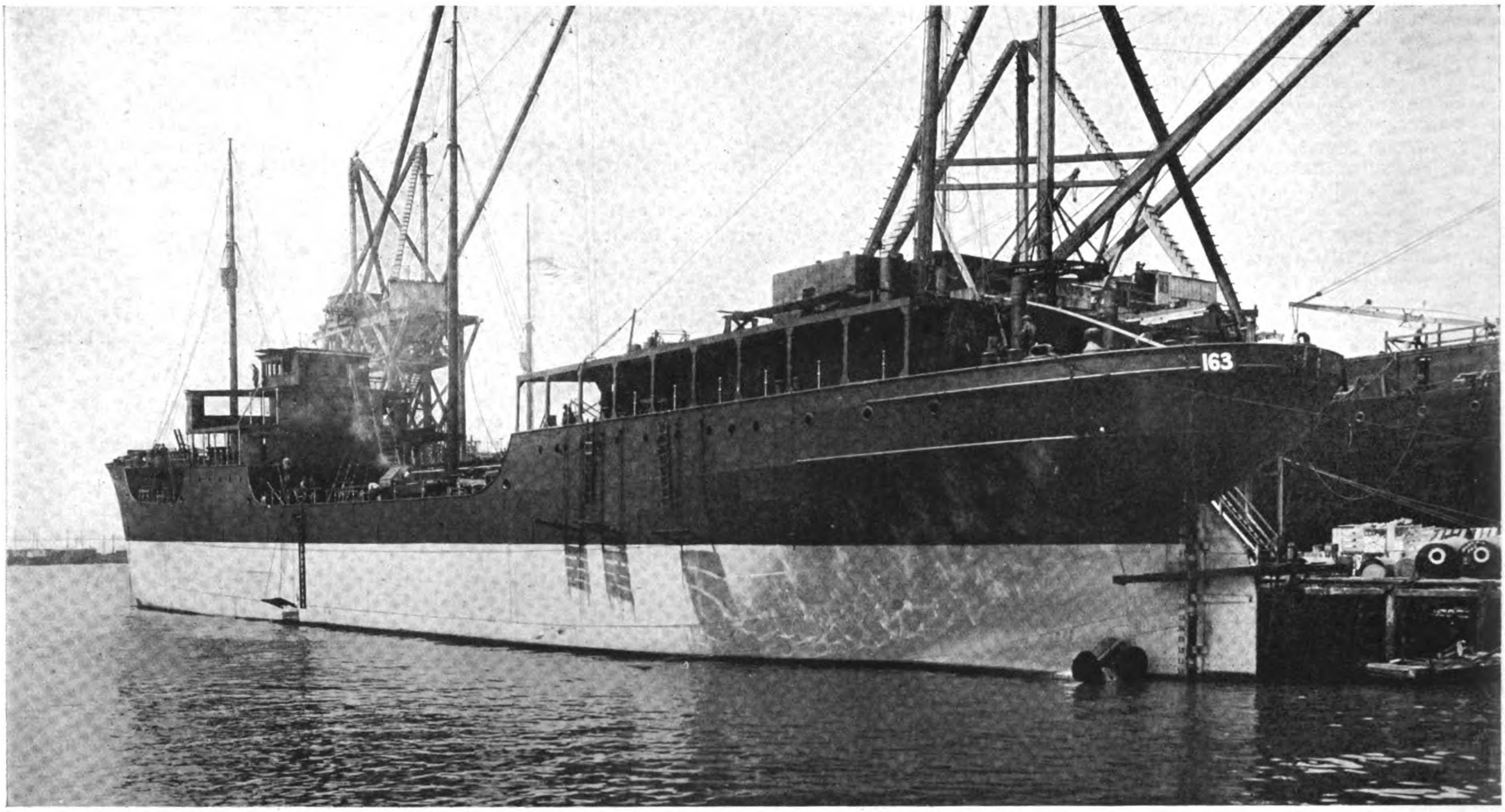
As an instance of one company of this sort may be cited the case of the Carey-Davis Towboat Co. of Seattle. This company owns a fleet of nine steam-tug boats and recently acquired the "Deep Sea," a heavy-oil engined tug which was originally built as a cannery tender for the Southern Alaska Canning Co. of Seattle. The company of the latter boat as well as the success of other oil-engined tugs operating out of Seattle has decided them to convert all their steam-tugs to Diesel power. The first tug to be convered will be he "Equator" which is now equipped with a steam-engine. She will be equipped with a 300 h. p. Diesel-motor of a type not yet determined. As fast as business conditions will permit, the "Katahdin," the "Holyoke" and the other boats will also be changed over until the entire fleet is Diesel-equipped.

The Pacific Towboat Co. of Seattle is another concern where similar changes in the fleet are being contemplated. This concern has reason to know of the economy and advantage of the heavy-oil tug as they built the first Diesel-equipped tug on the Pacific, the "Chickamauga." This boat was built in 1915 and is a 70-footer powered with a 240 h. p. Niseco Diesel-engine. She has been the most successful and most economical tug boat on Puget Sound and has given good satisfaction during six steady years of hard service.

The Lillico Launch & Towboat Co., which is the largest waterfront towboat concern operating out of Seattle, is also going in for heavy-oil power, having recently announced that their tugboat "Lillico No. 20," now equipped with a gas-engine



Plans of the Standard Oil Company of California's Werkspoor Diesel-driven tanker "Charlie Watson," built by the Union Construction Co., Oakland, Cal.



Standard Oil Company's new motor-tanker "H. T. Harper" fitting-out at the Moore Shipbuilding Company's yard. She is equipped with two 1140 i.h.p. Werkspoor Diesel-engines built under license by the Pacific Diesel Engine Company, Oakland, Cal.

is soon to be equipped with a 150 h. p. Diesel. This company owns eight towboats, 29 lighters and one car-ferry, and has always used motor-tugs, the present fleet being powered with distillate motors. The equipment of the "No. 20" is undoubtedly the beginning of the conversion of their entire fleet to engines burning heavy-oil.

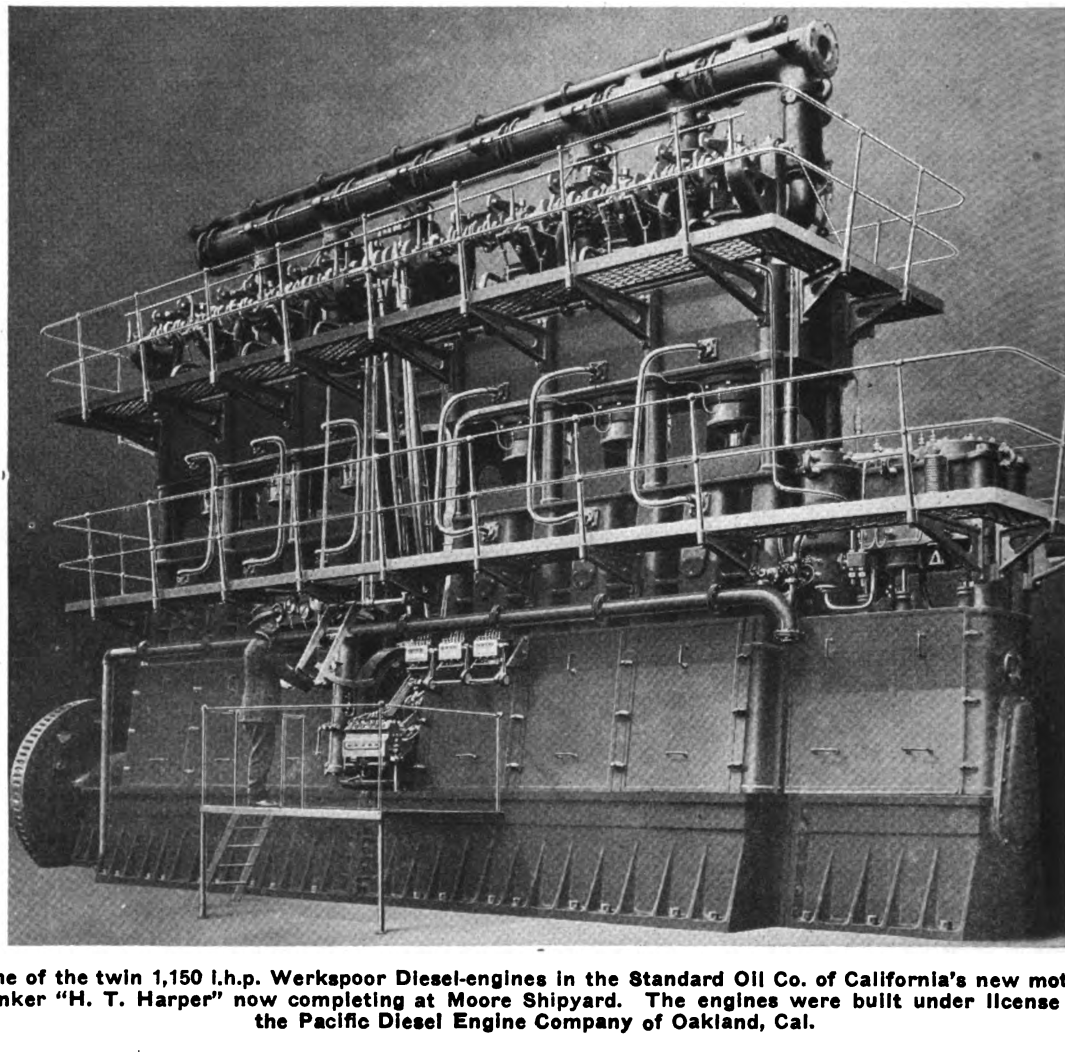
Owns Four Heavy-oil Engined Tugs

The Independent Towing Co. of Seattle which is one of the largest towing companies on the North Pacific Coast, owns a fleet of fourteen tugs and has already equipped four of these tugs with heavy-oil engines. Two of these, the "Wasp" and the "Hornet," were built last year and of the other two, the "Bee" was formerly a steam-tug known as the "Nellie Pearson" and the "Cricket" was formerly powered with a distillate motor. These boats are all equipped with Fairbanks-Morse surface-ignition engines. The company are figuring on changing some of their old steamers into heavy-oil boats and all of the new boats they build will be powered with engines of this type.

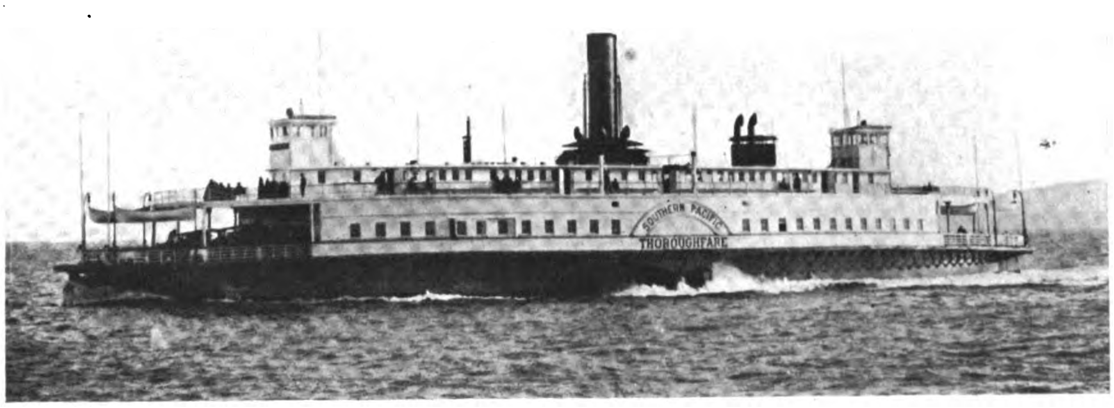
Another concern that has seen the advantage of the heavy-oil motor tug is the Foss Towboat Co. of Tacoma, which has the largest fleet of gas tugboats on the Sound. The Foss company at present own a total of 23 boats, two of which are steamers and the others motor vessels. Most of the boats are equipped with distillate motors and have been very successful but the high cost of distillate has influenced the company in deciding that all boats added to their fleet from now on will be powered with heavy-oil burning motors. The company already has three tugs of this sort, the "Foss No. 16," a 68 footer powered with a 200 h.p. Fairbanks-Morse "C-O," the "Lillian D. Foss," a 50-footer with a 45 h. p. "C-O" and the "Rouse," a 55-footer powered with a 100 h. p. Avance surface ignition engine made in Augustendal, Sweden. The latter boat belongs to the Rouse Towboat Co. of Seattle which is controlled by the Foss Company.

The Great Fishing Industry

In the Pacific Coast fishing industry, which has probably provided a greater market for internal-combustion engine than any other field in the in the world, we find the tendency toward motors of the heavy-oil type even more marked than among the towboat companies. In this field, there are eight types of boats which predominate, the cannery tenders or towboats used for fish carriers and general work around the salmon canneries, the salmon purse-seine boats, the tuna purse-seine boats, the Japanese tuna boats which fish with hook and line, the salmon trollers and gillnetters the big halibut schooners and the long-line hand boats. In addition, there are numerous miscellaneous types such as oyster-boats, crab-boats, shrimp fishing-boats, etc. In the smaller sizes of boats such as the trollers and gillnetters, the distillate-engine still has the field and will probably continue to hold it, at east until the Diesel and surface-ignition engines are perfected for smaller power, as these boats use engines ranging from 4 to 36 h. p. In the larger types, however, such as the halibut-schooners, cannery-tenders and purse-seiners, the heavy-oil engine is rapidly gaining a hold. Practically all of the cannery tenders built during the past two years have been powered with oil engines, the surface-ignition types such as the Fairbanks-Morse and the Kahlenberg predominating. This year a number of Diesel-engines



One of the twin 1,150 i.h.p. Werkspoor Diesel-engines in the Standard Oil Co. of California's new motor-tanker "H. T. Harper" now completing at Moore Shipyard. The engines were built under license by the Pacific Diesel Engine Company of Oakland, Cal.



Type of ferry used in Frisco Bay, now steam-driven but likely to be converted to Diesel-electric power.

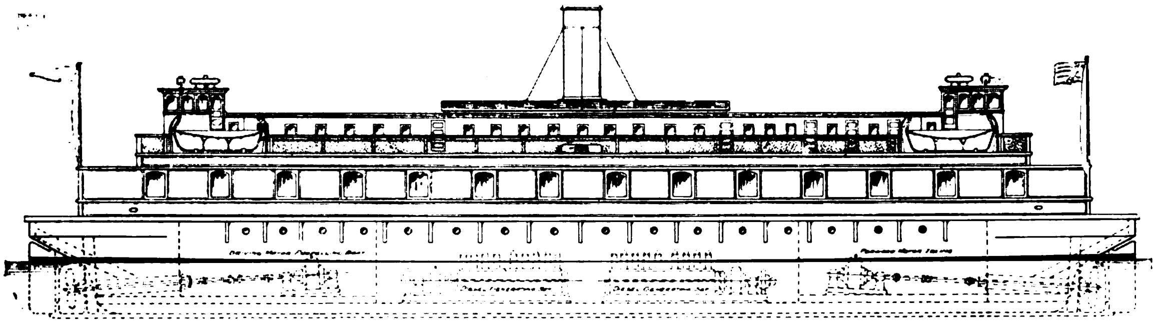
have been put on the market in smaller power and several installations of motors such as are made by the Enterprise Engine Co. of San Francisco, the Atlas Imperial Gas Engine Co. of Oakland and the Western Machinery Co. of Los Angeles, have been made, these motors going into cannery tenders and towboats built for charter. Nlseco Diesel-engines have also been operating for a number of years in cannery tenders such as the "Warrier" and the "Chomley." The seineboats, which use motors of smaller size, ranging from 48 to 65 h. p., and usually do not have trained engineers, have been slower in adopting the heavy-oil motors, but during the last two years, quite a number of these boats have been powered with Fairbanks-Morse and Kahlenberg oil-engines and undoubtedly from now on the greater portion of these boats will be so equipped.

The same is true of the Japanese tuna boats. Very few oil engines have been installed in the halibut schooners, but this is probably because none of these boats have been built during the past three years owing to the growing scarcity of fish and the greater success of the smaller boats known as "long-liners."

The Pacific Diesel Engine Co. of Oakland, formerly known as the Skandia Pacific Oil Engine Co. have installed a number of Werkspoor-Diesel and Skandia surface-ignition oil engines in boats built on the Coast, mostly in auxiliary cargo-schooners and in full-powered tankers.

The market on the Pacific Coast for Diesel and surface-ignition oil-engines is almost unlimited for vessels both large and small. In addition to the types mentioned, there are many miscellaneous boats, such as passenger-boats, powder-boats, oil-boats, South-Sea and Arctic-Trading Schooners, and number other types. Large numbers of new boats of these types built every year and the thousands of boats already in commission will sooner or later have their old engines removed and new ones installed that will burn heavy-oil.

Not only has the day of the big motorship arrived, but the opportunity is at hand to develop a market which will include every type of oil engine ranging all the way from 15 to 3,000 b.h.p. and the manufacturers that get in now on the ground floor and get their products well-known and established will be the ones that reap the greater part of the harvest.



Proposed Diesel-electric ferry-vessel for San Francisco. (See page 647 for details)

MARINE CONSUMPTION OF FUEL-OIL

Practically complete returns to the American Petroleum Institute from companies engaged in the marine fuel-oil business and from the United States Navy show that in 1920 a total of 44,487,319 barrels of fuel-oil were delivered for ships' bunkers, as compared with 27,102,616 barrels in 1919, an increase of 64.1%. The figures compare as follows:

Deliveries of Fuel-Oil

	1920 (Barrels)	1919 (Barrels)	Per Cent (Incr. or Decr.)
To Merchant Vessels	38,436,300	18,188,974	Inc. 111.3
To U. S. Navy..	6,051,019	8,913,642	Dec. 32
	44,487,319	27,102,616	Inc. 64.

For vessels engaged in coastwise and foreign trade, including those of the U. S. Shipping board, 21,990,612 barrels of Mexican fuel-oil and 16,445,688 barrels of domestic fuel-oil, a total of 38,436,300 barrels were delivered in 1920 at ports of the U. S. and Insular Possessions. This compares with 8,590,406 barrels of Mexican oil and 9,598,568 barrels of domestic oil, a total of 18,188,974 barrels, in 1919. The oil used by the Navy is a blend of domestic and Mexican oils and the statistics as to the relative quantities are not available.

The bulk of the fuel-oil delivered to merchant vessels in 1920 was handled at Atlantic Coast ports, the total being 19,326,410 barrels all except 208,976 barrels of this was Mexican oil. In 1919 the total was 7,240,358 barrels. The following table gives fuel-oil deliveries made for ships' bunkers in 1920 by companies reporting to the American Petroleum Institute.

Fuel Oil Delivered for Ships Bunkers, 1920 and 1919

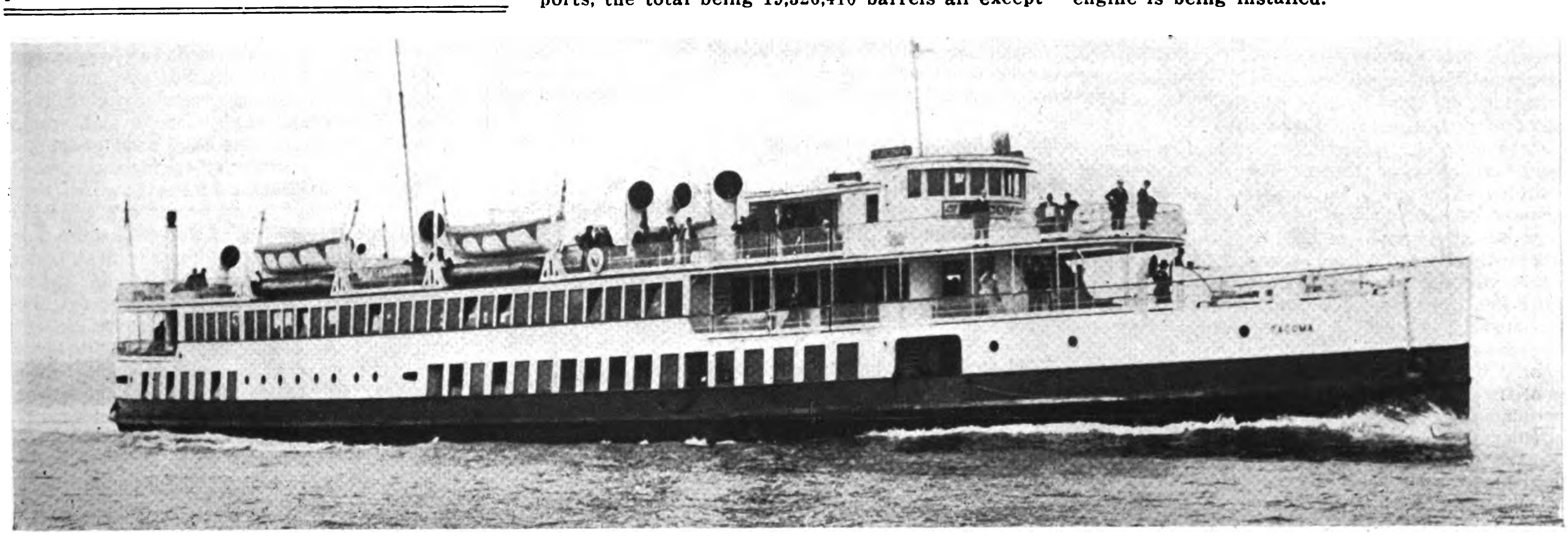
	Domestic Oil (Barrels)	Mexican Oil (Barrels)	Total (Barrels)
At Atlantic Coast Ports			
1920	208,976	19,117,434	19,326,410
At Pacific Coast Ports			
1920	*12,264,245		12,264,245
At Gulf Coast Ports			
1920	2,164,539	1,922,981	4,087,520
At Insular Possessions			
1920	1,807,928	950,197	2,758,125

*Includes small quantity of Mexican oil blended with domestic.

"Equator," one of the steam tugs of the Carey-Davis Tow Boat Co., Seattle, which will be changed to Diesel power. A 300 h.p. engine will be installed

OIL-ENGINE IN CANNERY TENDER

In a 65-ft. cannery-tender recently launched at Sunde & Olsen's yard, Lake Washington Canal, Seattle, Wash., for Capt. Ca. W. Isaacson of Seattle, a 75 b.h.p. Kahlenburg surface-ignition oil-engine is being installed.



"Tacoma," one of the Puget Sound Navigation Co.'s steam-driven ferry on the run between Seattle and Tacoma. We have painted-out the smoke stack to show how their new 18-knot Diesel-electric ferry vessel will look. This company operates 20 steamers and as soon as practicable will convert them to Diesel or Diesel-electric power

"Warrior," the first Diesel-driven commercial motor-vessel in America

"Chickamauga," the first Diesel-driven tow-boat in America

History of Heavy-Oil Engine Development on the Pacific

By DANIEL L. PRATT
Editor of "Motorship's" sister publication, "Pacific Motor Boat"

THE Pacific Coast has always led in the utilization of the marine internal-combustion motor for commercial purposes. The first marine gasolene engine successfully marketed was manufactured on the Pacific Coast, and the small commercial craft of the western seaboard were quick to take the lead in the development that followed. Peculiar industrial requirements, such as those of the lumber and fishing industry, lack of railroads of any kind, long stretches of inside waterways, protected from bad weather and open to navigation at all seasons—all of these things contributed to make the development of great fleets of commercial motor boats and motor vessels a natural and logical outcome.

For many years before any talk of Diesel or surface-ignition engines penetrated from Europe to the western waterways, the people of the Pacific Coast knew marine internal-combustion engines, understood how to use them and were exceedingly progressive in adopting any improvements that tended toward increased reliability, durability or economy. The matter of economy, perhaps, had not concerned them so greatly as in other parts of the country, owing to the fact that for fuel purposes they had the benefit of distillate, a by-product peculiar to California oil that was sold as cheap or even cheaper than kerosene and on which all of the motors on this coast and a number of those made in the East, would operate.

Nevertheless, when rumors began to reach the West coast about a remarkable type of motor which had been developed in Europe, that would operate on crude-oil, at a cost then of about two cents a gallon, they were interested; more interested, probably, than any other part of the country because of the great number of motor workboats in service on this coast and their value to industry and commerce. The Westerners read eagerly all the news about the perfection of this motor, of its record of operation and especially of its success in large units as against steam. They even sent to Europe for catalogues and literature. The one great question that was most discussed was as to whether or not the Diesel-motor would operate on the asphaltum base oil used on the Pacific Coast. Tests that were made of this oil in Europe and on stationary engines in the East, revealed some difficulty of operation as compared to the paraffine-base oils. But in those days there were no Diesel engines manufactured by American concerns and none of the European makes were available for installation on this coast, so that the subject was all one of theory and conjecture.

It was not until an American concern finally commenced the manufacture of a Diesel engine that the heavy-oil motor first began to seem close enough to the Pacific Coast to become a considered factor. The first news of this new engine reached the people of the Pacific Coast in June, 1912, through a four-page advertisement in our sister journal, "Pacific Motor Boat," inserted by the New London Ship & Engine Co., of Groton, Conn., announcing the fact that they had taken over the United States rights of the Nurnburg (German) type for America, and would start manufacturing these engines immediately. The announcement created immediate interest, and the Seattle office that was opened by this company was flooded with inquiry concerning the new motor, although there was still a great deal of skepticism as to whether or not any Diesel-engine would work on California fuel.

The first engine of the Nelseco type was not installed in a commercial vessel on the coast until the fall of 1913, the factory having been busy with engines for submarines for the United States and other navies, several of which were installed in boats on this coast and worked with success on western oil. Earlier in the same year, however, before the first Diesel-engine was installed in the "Warrior," another heavy-oil engine manufacturer started advertising for coast business. This was a concern in Massachusetts which had started manufacturing a surface-ignition or hot-bulb type of engine. Their first advertisement appeared in *Pacific Motor Boat* in March, 1913, and stated that they had installed engines in two new halibut schooners, the "Bay State" and Knickerbocker," which would soon leave Boston to sail around the Horn to this coast where they would be operated on the Pacific halibut banks. Almost at the same time, an announcement appeared among the advertising columns from the Heaps Engineering Co., a Vancouver concern, stating that they had taken over the rights to manufacture on this coast the Junkers opposed piston Diesel engine, but this was followed the next month by a statement that the company had taken the agency for certain European surface-ignition or heavy-oil engines, and advertising these engines for installation. Several of these engines were installed in British Columbia but were not very satisfactory, with the exception of an installation of an Avance engine made in a Prince Rupert boat, which is working satisfactorily to this day, the engine having afterward been installed in a tug for the Rouse Towboat Co. of Bullard.

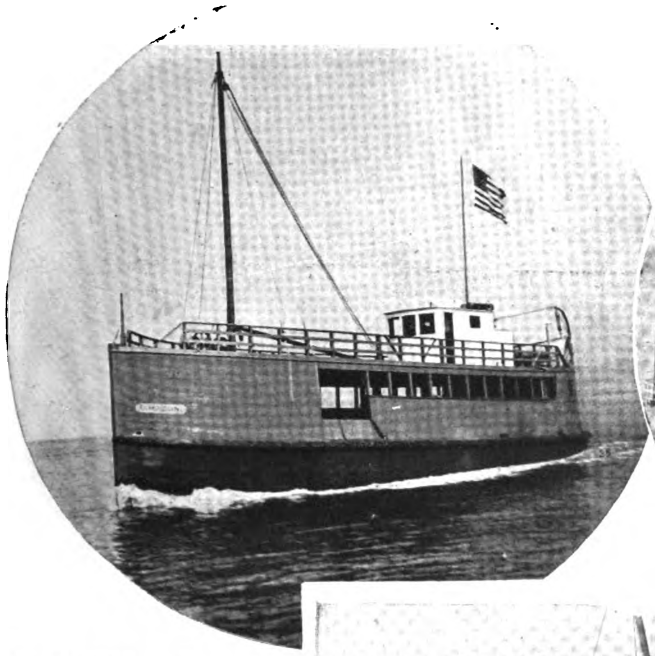
"Chomly," the record Pacific Coast Cannery tender to be Diesel-powered. Like the "Warrior," and "Chickamauga" she has Nelseco engines

In the meantime one of the schooners built at Boston with the surface-ignition engines in it sailed for the coast, arriving there in the summer of 1913. Its record was watched with interest by many motor boat owners on the Pacific, as it was the first actual example of a heavy oil boat that had ever appeared on the coast. Unfortunately, however, the manufacturers were a little premature in marketing their motor, not enough tests having been made, and the engines in the schooner reaching the coast did not give a good account of themselves, especially on Pacific Coast fuel, with the consequence that the vessel was afterwards equipped with heavy-duty gas engines, consequently they have not built oil-engines since. This first example of heavy-oil engine operation in west coast waters was unfortunate, as it undoubtedly established an unfounded prejudice against such motors for a time that was hard to overcome.

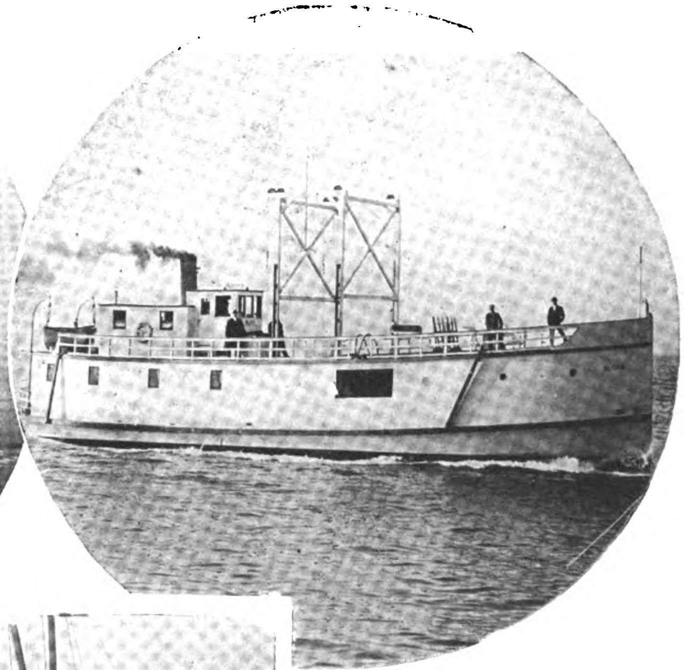
As stated before, the first Diesel-engine installed on the coast was the 120 h.p. "Nelseco" that was installed in the cannery tender "Warrior" for the Pacific American Fisheries of Bellingham. The "Warrior" was built at Seattle during the Fall of 1913, and was launched and put in commission in the early Spring of 1914. Without practically any preliminary adjustments or difficulty, she started on her trial trip with her engine working perfectly on California asphaltum-base oil and her exhaust as clear as that of a well-controlled gas-engine. She left soon afterwards for Alaska, but even before she left she had demonstrated in several trips that a heavy-oil engine could and would operate on California oil, and thus a lot of doubts were dispelled and the heavy oil-engine commenced to loom up as a real factor in Pacific work boat navigation.

Before leaving the subject of the "Warrior" it is interesting to note her record for the first seven months of her Alaska season. She is an 87-foot cannery tender used for carrying fish and for towing heavy pile drivers, scows of fish, etc., in the rough waters of the North Pacific. In the seven months' season she ran 1,658 hours, covering a total of 11,606 miles. Her entire fuel cost for the season was $214.07, her lubricating cost $80.09, her repairs and upkeep $148.58. In other words, her fuel cost per hour was 13 cents and her lubricating cost 4½ cents. She has continued to give good satisfaction throughout seven years of steady service since that time.

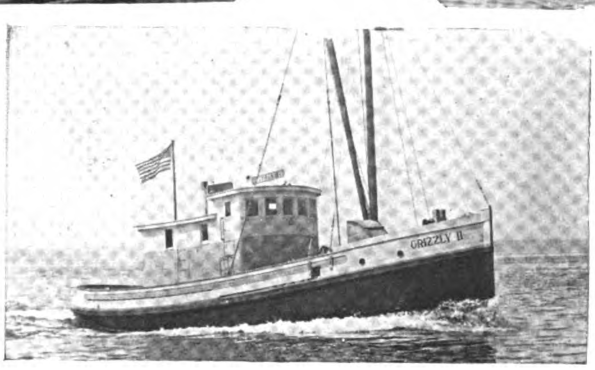
About the time the "Warrior" was launched and successfully tried out, another heavy-oil engine appeared on the Pacific Coast market. This engine was the Bolinder, made in Sweden, a surface-ignition engine much used in the old country. It



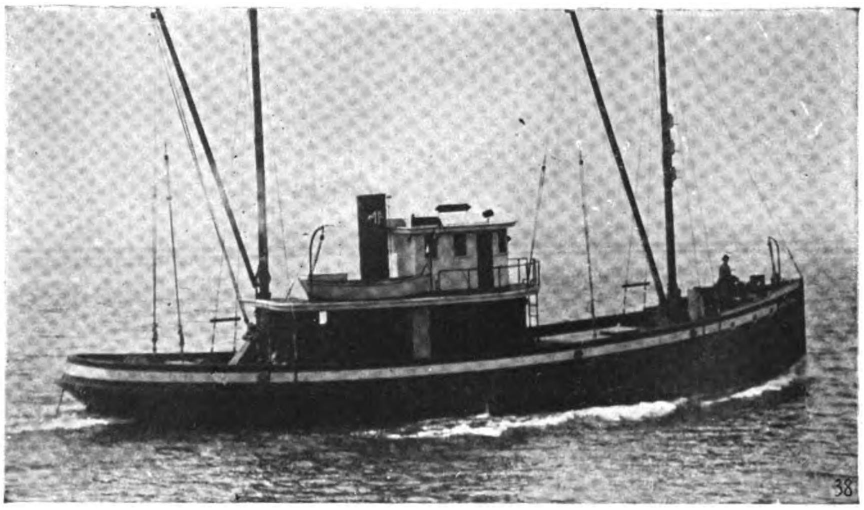
The freighter "Amazon" Driven by a Fairbanks-Morse oil-engine



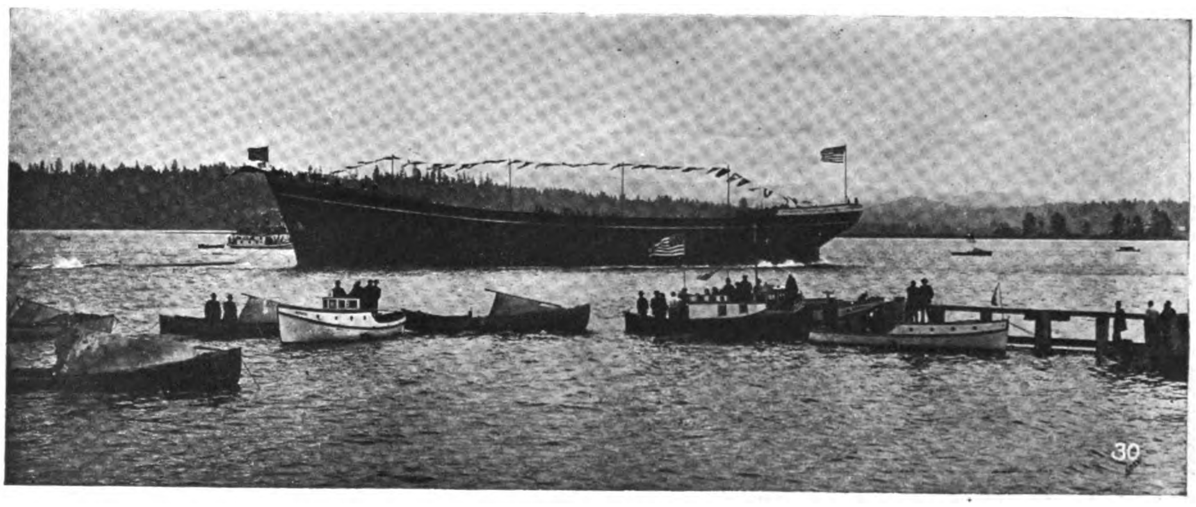
The freighter "Aloha" powered with a Fairbanks-Morse oil-engine



"Grizzly II"—A Diesel-powered cannery tender built at Seattle for Capt. Frank Nordland. She is powered with a 100-h.p. Enterprise Diesel engine



"Mutual"—A cannery tender for the Mutual Packing Co. of Anacortes, Wash., and powered with a 100-h.p. Fairbanks-Morse engine



Launch of the wooden motorship "City of Astoria" at Astoria, Oregon, for A. O. Anderson & Co.

was introduced to the Pacific Coast market by Henry Lund & Co., of San Francisco, their first advertisement appearing in *Pacific Motor Boat* of February, 1914. Later in the season an engine of this type was installed in the "Gracie S.," a San Francisco Bar Pilot schooner, and it worked very successfully, as did also an installation made soon afterward in the tugboat "Mary L. Hanlon" of San Francisco. Dozens of Bolinder engines have since been installed on the Coast.

In 1914 Nelseco Diesel-engines were also installed in the new passenger boat "Suquamish," owned by the Kitsap County Transportation Co., a 92-foot vessel operating on regular passenger runs out of Seattle. This boat is now running 132 miles a day, or 24,300 miles a season, at a fuel cost per mile of 1 1/3 cents and a cost for 12½ hours of running each day of $1.76. The record of this boat is more fully covered elsewhere in this issue.

In 1914, the Fairbanks-Morse Co. also announced a surface-ignition engine, and an installation was made in the tug "Lorens" of the Porter Fish Co., of Anacortes, the first semi-Diesel engine installed on Puget Sound. This installation has since been followed by many others, all of which are now working very successfully.

In the spring of 1915, Nelseco Diesel-engines were installed in the cannery tender "Chomley," owned by the Alaska-Pacific Fisheries Co., and in the tug "Chickamauga," owned by the Pacific Towboat Co., of Seattle. Thus the Pacific Coast had the honor of having the first Diesel vessel of any kind (aside from demonstrating boats) in America, and also the first Diesel tugboat and the first Diesel passenger-boat. The West Coast also showed its progressiveness in being quick to seize upon the advantages of the surface-ignition oil-engine.

With the success of the heavy-oil-engined boats built in 1914 and 1915, and with the additional impetus given by the demand created by the war for vessels of all kinds, the beginning of 1916 saw the Pacific Coast in the midst of a veritable heavy-oil engine boom. There was a demand for Diesel and surface-ignition engines of all kinds, but especially for vessels of larger sizes. The sudden recovery of the lumber market brought on a demand for lumber carriers both for the coastwise and the foreign trade that could not be supplied. The advantages of the large sailing-schooner equipped with heavy oil-engines for auxiliary power became very apparent. Before the beginning of the year a keel was laid for a large vessel at St. Helens, Oregon, to be equipped with Bolinder heavy-oil engines for auxiliary power. Then another was started at Aberdeen, and soon there was scarcely a wooden shipbuilding yard on the coast that was not busy building motorships.

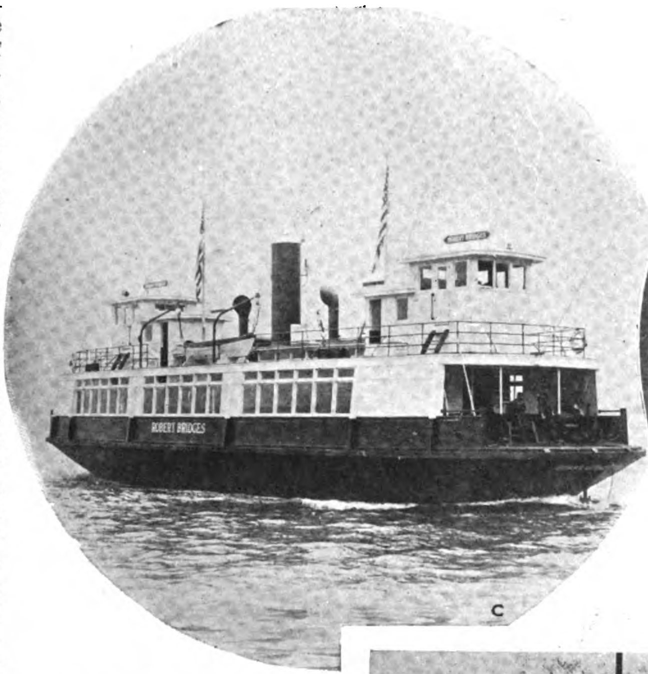
This was not all the result of a war-time boom. In fact, the first motorships that were built were American-owned boats for the lumber trade. Some of these were auxiliary vessels and some full-powered motorships. The first vessel to be launched, as previously mentioned, was the "City of Portland," built at St. Helens, Oregon, for the Charles R. McCormick Co. of San Francisco, and was the first of six boats ordered for this concern, some of which were afterward sold to other interests. She was the largest single-deck vessel ever built on the Coast, and was launched in the summer of 1916. She was an auxiliary schooner 278 ft. in length, with a beam of 48 ft. and a depth of 22 ft. She carries 1,200,000 ft. of lumber, and was powered with twin 320 b.h.p. Bolinder surface-ignition oil-engines.

On her first trip across the Pacific she made an excellent record, leaving the Columbia River on August 3, 1916, arriving at the San Francisco lightship at 5 P. M. August 6th, at Honolulu, August 19th, and at Port Pirie, Australia, Sept. 28th. No trouble was encountered, the motors running smoothly, and from Sydney to Port Pirie she developed steamer speed.

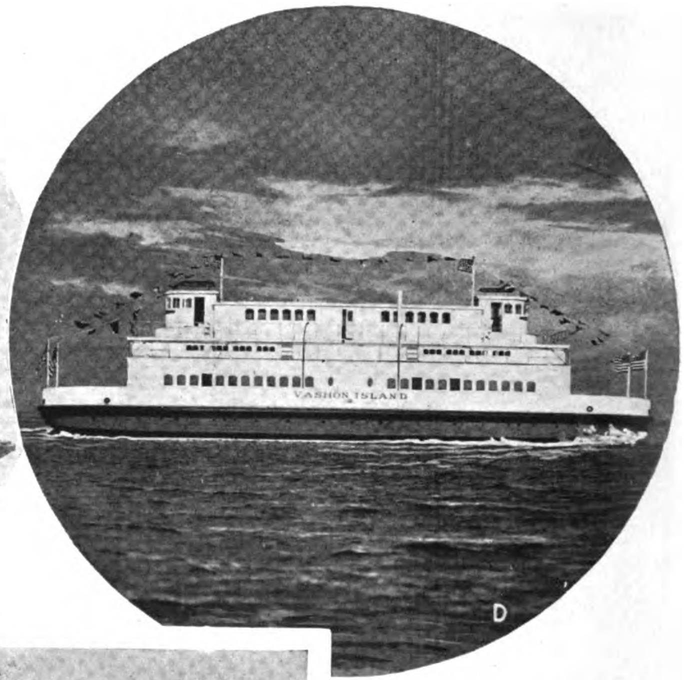
The success of this vessel and of others which followed led to the building of many other vesesls of the same type. The shortage of tonnage due to the European war was beginning to make itself felt, and there was a demand for ships of every type. The Pacific Coast with its almost unlimited supply of big timbers naturally became the seat of the wooden shipbuilding industry, and practically all the wooden ships built with the exception of the ill-fated Ferris types, were motorships. The first full-powered motorship to be built was the "Sierra," which was built the same year for the E. K. Wood Lumber Co. at Aberdeen, Wash. She was at first designed for the Coastwise lumber trade, but upon completion was found superior to this trade and was altered somewhat to make her suitable for offshore business. She has a length over all of 218 ft., a beam of 42 ft. and a depth of hold of 15 ft. She was powered with twin four-cylinder Bolinder engines of 320 b.h.p. After several local trips on the Coast to give her a thorough try-out, she was sent on her first long voyage to Valparaiso with a load of lumber and made the 11,000-mile trip very successfully, averaging in her fuel consumption only 21.6 barrels of Star fuel-oil a day at a cost then of $1.15 a barrel. Like the "City of Portland," she was the forerunner of a number of other vessels of her class.

In April, 1916, "Motorship" was started at Seattle by Miller Freeman, and in two years became of such international importance that the publication office was transferred to New York in June, 1918.

To go into details regarding the scores of wooden motorships of the straight and auxiliary type that were built in the next two or three years would require too much space here to be practicable. Every plant that could possibly be used for building ships was put into service, and scores of new plants were established from San Diego to Vancouver, B. C. For a while the yards were launching new motorships at the rate of several a day. In Portland and Seattle, especially, a ship-launching was a daily occurrence. Aside from the earlier boats built for the lumber trade, the bulk of these vessels were for Norwegian owners, although many were also built for the French, Australian and other foreign governments. Then the war ended suddenly and the wooden shipbuilding boom collapsed.

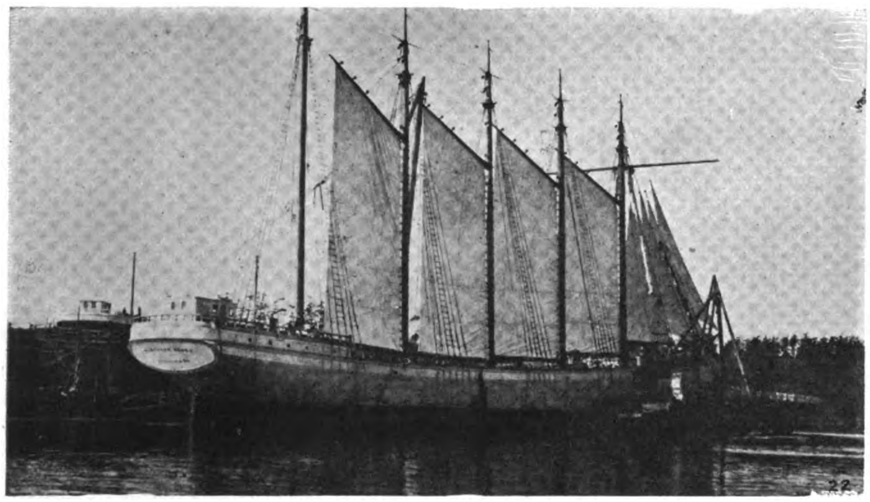


Diesel Ferry "Robert Bridges"

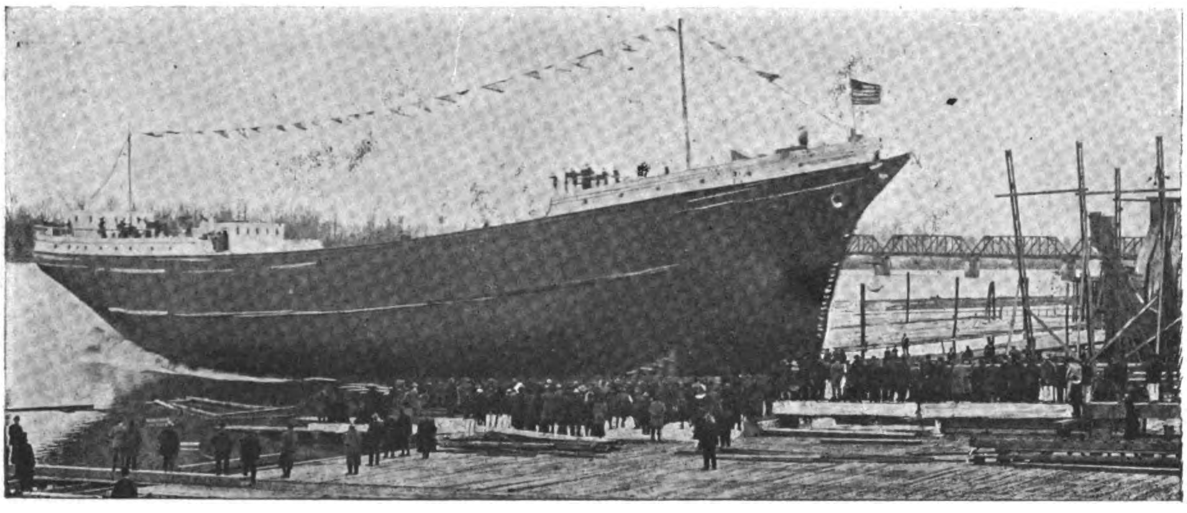


Atlas Diesel-driven Ferry "Vashon Island"

Heavy-oil engined passenger boat "Carlisle II"



"Margaret Hanley," one of the motorships built at the Cameron Yards at Victoria, B. C. They are five-masted vessels powered with twin 160-h.p. Bolinder auxiliary oil-engines. Owners, Canada West Coast Navigation Co.



Launch of the motorship "W. F. Burrows" at Portland for Libby, McNeil & Libby of Seattle, who use her as a salmon carrier between Puget Sound and Alaska. She is powered with twin 240-h.p. Skandia oil-engines

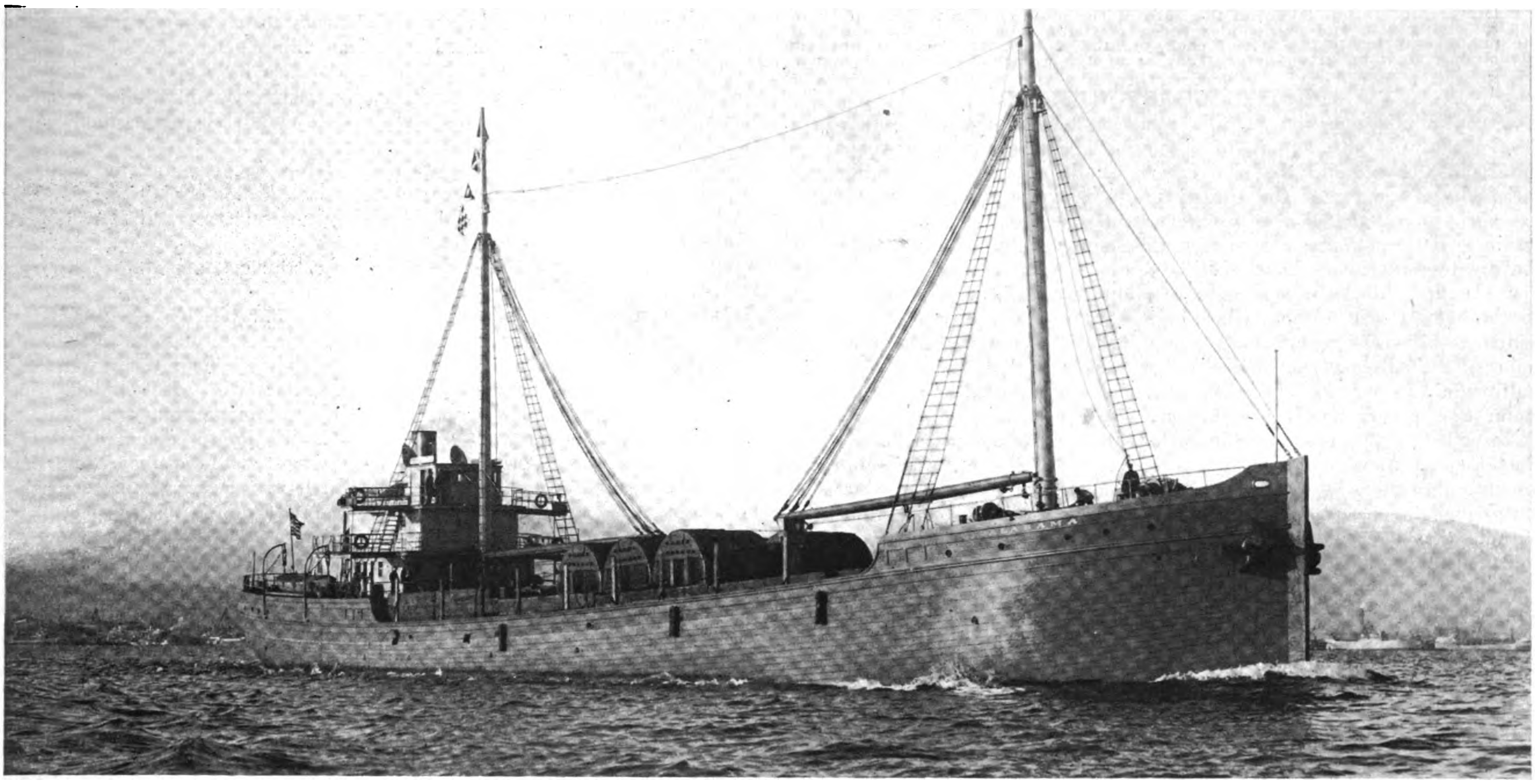
Most of the ships built for foreign accounts were powered with foreign-built engines that were shipped in. These, unfortunately, were poorly installed and poorly operated and many of the wooden hulls were poorly built. The consequence was that many of them—in fact most of them—have trouble and lots of it. Few facilities for spare-parts and repairs were available. This left a bad taste in the mouths of Pacific Coast shipping men, and made them skeptical for a while of oil-engines in general. It was a handicap that was hard for American oil-engines manufacturers to overcome, and in fact is only now beginning to be overcome, as the result of the success of Libby, McNeil, & Libby's freighter, "Libby Maine"; the Alaska Steamship Company's new motorship, "Kennecott," and the Standard Oil Co.'s motor tanker, "Charlie Watson," whose records have demonstrated to Coast shipping interests generally that internal-combustion motors in large power have been perfected that are just as reliable as steam, and that are so much more economical that they must be taken into consideration henceforth as the most vital factor in marine transportation. That is the reason why concerns like the Puget Sound Navigation Co., the Puget Sound Tow Boat Co. and many others are now planning the immediate construction of oil-engined vessels. The Diesel-engines of the "Charlie Watson" were built by the Pacific Diesel Engine Co., who in 1918 acquired a license to build the Werkspoor Diesel engine. Mention must be made of the very successful Winton-engined motorship "James Timpson," built on the Pacific Coast, but owned in New York.

This skepticism which the war-boom motorships caused in general shipping circles toward the oil-engine did not, however, affect the field of smaller motor vessels. The success of boats like the "Warrior," the "Chomley" and other fishing-vessels previously mentioned was so marked that the progress of the oil-engine in this field has been steady. This was augmented to a large extent by the shortage in fuel that existed for a time and the high price that still prevails that makes the operation of many of the high-powered gas-engined boats very expensive, if not almost prohibitive. Last year the shortage of fuel became so acute that distillate was practically withdrawn from the market, and this condition has resulted in operators of cannery tugs, fishing-vessels and general towboat men turning to the oil engine for relief.

During the last two or three years there have been many new cannery tenders built that were equipped with motors burning heavy-fuel, most of these being of the surface-ignition types, the Diesel-engine in small sizes not having, until recently, been available. To give some idea of how extensive this business has been, it might be stated that the Seattle branch of Fairbanks-Morse & Co. has, since this company's "C-O" type of surface-ignition oil-engine was put on the market, sold more motors than any of this company's other branches in the country, having installed, largely in the last two years, a total of more than 70 engines totalling over 6,000 h.p., the motors being mostly in 75 and 100 h.p. sizes. An excellent record has also been made by the Coast distributors of other surface-ignition motors.

Not all of these engines by any means have gone into fishing-vessels. Many of them have been installed in freighters and towboats and a few in passenger boats. On Puget Sound are a number of small freighters such as the "Aloha" and "Amazon," running on regular schedules in successful opposition to the steamers in carrying cargo. In the San Joaquin Delta country of California, freighters powered with oil-engines are becoming very numerous, and are drawing the steamers out of business entirely. Nearly all the big waterfront towing companies at Seattle, San Francisco and other points now have one or more tugs powered with motors burning heavy-oil, and most of these companies plan to convert their old steamers over to this power as rapidly as possible.

And so it may be seen that the Diesel and surface-ignition engines have arrived on the Pacific Coast to stay, and that the motorship and smaller motor-vessel both have already become indispensable factors in commerce and transportation. Just as in the matter of small motor-vessels, the Pacific Coast has always led all other parts of the country; so also has it fallen to the lot of the Western seaboard to produce the "Kennecott," the second largest all-American built steel motorship now on the high seas. And judging from present indications, it will be Pacific Coast shipping companies that will take the lead in producing the first real fleets of modern, up-to-date steel motorships sailing under the American flag.



"Isle de Java," ex "Alabama," a wooden motorship built in 1918 for the Alaska Pacific Navigation Company, but sold to French interests. She is propelled by twin 625 b.h.p. McIntosh & Seymour Diesel engines

MOTORSHIP BOUGHT FOR PACIFIC SALMON TRADE

P. E. Harris & Co., of Seattle, Washington salmon-packers and selling agents, recently purchased the 2,450-ton wooden motorship "General Pershing," and will use her for the transportation of canned salmon and supplies between the mainland and Alaska canneries. Mr. Harris announced the purchse on returning from a hurried trip to the Atlantic Coast, where the deal was closed. The vessel was bought at a U. S. marshal's sale at Norfolk, Va., on terms that are considered very advantageous to the company, and she will be brought to the Pacific as soon as possible.

The novel feature of the matter is the intention to load canned salmon at various points in Alaska, taking it direct through the Panama Canal and distributing it among various Gulf and Atlantic seaports, returning with tin plate and other cannery supplies for the following season. In this way it is expected that important economies in transportation and handling costs will be effected, the expenses connected with landing and loading cargo at Pacific terminals being entirely avoided.

The prospect of success is materially increased by the low operating cost of a vessel of this type. She is an auxiliary wooden vessel, rigged as a 5-masted bald-headed schooner, powered with two 350 h. p. Sumner surface-ignition engines. She was built in 1918 by the Olympia Shipbuilding Company, Olympia, Wash., for Norwegian interests, and operated successfully for some time in the Atlantic trade. She is 266 ft. long, 48 ft. wide and 24 ft. deep, with a tonnage of 2,451 gross.

DIESEL-ELECTRIC FERRY FOR VANCOUVER

Plans have been prepared for a Diesel-electric propelled ferry-vessel for the City of Vancouver, B. C.

SKANDIA COMPANY CHANGES NAME

We have been officially advised that the Skandia Pacific Oil Engine Co. of Oakland, Cal., recently changed its name and hereafter will operate under the new name of PACIFIC DIESEL ENGINE COMPANY, devoting its entire plant to the manufacture of marine and stationary Diesel-engines. This firm owns the sole manufacturing rights on the Pacific Coast of the U. S. A. for the well-known Werkspoor-Diesel engine, and have constructed about a dozen engines of 650 to 1,150 i.h.p.

MOTORSHIP "CANADA" VISITS VANCOUVER

Recently the 9,400 tons motorship "Canada," sister to the "Buenos Aires" of the Johnson Line, visited Vancouver, B. C. She discharged 2,200 tons of sugar at the B. C. Sugar Refinery Wharf and then loaded salmon and general merchandise at the wharf of Evans, Coleman & Evans.

BETHLEHEM SHIPBUILDING COMPANY AND MOTORSHIPS.

Renewed interest in motorship construction has recently been shown by the Union Plant of the Bethlehem Shipbuilding Corporation of San Francisco, and Mr. Neitzel, Superintendent of Construction, has been abroad investigating the entire motorship and Diesel-engine situation. Recently Mr. Charles M. Schwab visited the Pacific Coast, and it is reported that he made a special trip for the purpose of taking up the question of constructing motorships at both plants.

CAR LOAD OF PISTON RINGS FOR PACIFIC COAST

An entire freight car load of American Hammered Piston Rings has just been shipped all the way across the country, from Baltimore to the Pacific Coast. The car contains nearly a half-a-million piston-rings of about five hundred different sizes, and will form a stock from which the company's Western Distributors can supply the piston-ring requirements in that section.

RETURN VOYAGE OF THE "KENNECOTT"

The new 6,000 tons d.w. motorship "Kennecott" arrived at Los Angeles, Cal., from New York and Baltimore at 10 A.M., July 8th, having made the run from Baltimore in 19 days, her Diesel-engines operating perfectly during the entire voyage on regular boiler-oil of 16.7 gravity.

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MOTORSHIP

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PACIFIC COAST NUMBER

A considerable portion of this issue is devoted to past and recent development in the adoption of oil-engined commercial motor-vessels on the Pacific Coast, and the near-future conditions are enlightening and satisfactory. So far as the United States is concerned, the West Coast has always been the pioneer in the use of oil-engines for the merchant-marine. Being a younger section of the country may possibly account for the greater enterprise shown. It is to the credit of Pacific Coast men that the first All-American general-freight motorship was recently built on the West Coast (although her engines were constructed in the East), and that this vessel to-date has made a splendid record. Furthermore, she followed an All-American Diesel-motor tanker of half her size built in California. In her turn she is being immedately followed by a new Diesel-motor tanker very nearly her size, also All-American.

Nevertheless, this is not our intention to decry the enterprise of a great East Coast firm who previously built a large All-American Diesel-driven ore-and-oil-carrier, but about which extremely little has been revealed. But, complete success does not appear to have resulted. It is interesting to note that a considerable amount of new motorship construction and conversional work is contemplated to be carried-out on the Pacific Coast in the near future, including building an 18-knot Diesel-electric passenger and automobile ferry-boat. In fact, the Pacific Coast may soon be the centre of activity to a great motorship building boom.

TURBINE-ELECTRIC DRIVE FOR SHIPS

Last month we stated we would have something further to say regarding the Board's turbine-electric ships. From a fuel-consumption aspect this system cannot compare with Diesel-electric drive, and our contention was demonstrated by the performance of the cargo steamer "Eclipse" on a hundred-days' voyage. From a mechanical aspect we have no criticism to offer, as the reliability of modern steam and electric machinery is fully established, except that boilers and condensers often are more responsible for delays than Diesel-engines of to-day. It is from the economy point of view that our comments are directed, and the fact that nothing has been done by the Board to develop the Diesel-electric drive simultaneously.

Last month we briefly touched upon the voyage around the world of the "Eclipse," pointing out that her fuel-consumption is slightly over three times that of the Board's Diesel motorship "William Penn," and that it would have been 10 per cent higher had not superheated steam been used, and expert opinion has been put forward that superheated steam is inadvisable for marine turbines. The fuel-consumption of the "Eclipse" figured out at 1.28 lbs. per shaft h.p. compared with 0.40 lb. for the "William Penn." Available records of Diesel-electric drive show a consumption of about 0.60 lb. per shaft h.p.-hour, or about fifty per cent less than the turbine-electric system. Furthermore, after several years' service, the fuel-consumption of the turbine-electric drive ship will increase, whereas with the Diesel or Diesel-electric motorship the fuel-consumption will slightly decrease with each year of operation until a standard and definite figure is reached and maintained.

Altogether the Board has arranged for twelve geared-turbine ships to be converted to turbine-electric drive, and five contracts have actually been awarded. Yet, the Board has not contracted for a single vessel to be converted to Diesel-electric or direct-Diesel drive—not even for the purpose of giving the system a trial. No answer has been made as to why money was not made available for this purpose for at least one experimental ship. Both direct-Diesel and Diesel-electric methods of propulsion can show great economies over oil-fired geared-turbine machinery and over turbine-electric. Although at the present time the first cost of the turbine-electric machinery is lower, which is offset by it occupying more space, so that less cargo is carried. We herewith append some data concerning the "Eclipse" and her operation.

S. S. "ECLIPSE"

Original Machinery	*Present Machinery*
Curtis geared-turbine of 3,000 shaft h.p. with three Scotch Boilers having Milne Super-Heater of 50 degs. Fahr. superheat.	Curtis Turbine of 3,180 shaft h.p. and an A. C. Generator of 2,350 k.w. at 3,000 r.p.m. supplying a 3,000 shaft h.p. A. C. electric-motor on the propeller-shaft.
Results of Voyage With Original Geared Turbine (Mostly heavy weather)	*Results of Voyage With Turbine-Electric Drive* (Mostly mild weather)
Distance ....23,611 miles	Distance ....25,759 miles
Time ....2,419 hours	Time ....2,608 hours
Average speed ....9.68 knots	Average speed ....9.87 knots
Daily fuel consumption..30.04 tons	Daily fuel consumption..33.03 tons
Consumption per shaft h.p..1.03 lbs.	Consumption per shaft h.p..1.28 lbs.
Average power developed.....2,422	Average power developed.....1,990

The better speed with the turbine-electric is due to her having met good weather, whereas her voyage with geared turbines was mostly through heavy weather.

There is no doubt but that the motorship "William Penn" will show much better results, and it is to be hoped that cargo to fully load her can be found in order that she will show her efficiency to the best advantage. She will be operated by the United American Lines after about a thousand faulty rivets are replaced in her hull; who also have been operating the "Eclipse." The "William Penn," making nearly two knots better speed, has a fuel-consumption of under 14 tons, although she carries more cargo than the turbine-electric ships.

Since the above was written we had pleasure in attending the trials of the Board's cargo ship "Archer," fitted with turbine-electric drive. Undoubtedly all those responsible deserve the fullest credit for having made a very excellent installation—clean and simple to operate, and compact in space compared with reciprocating steam-engines; although there is far more auxiliary machinery in the engine-room than is to be found in the average motorship. The latter, however, has no closer connection with turbine-electric drive than any other class of steam machinery as it has is part or parcel of steam power. The six-hour trials were run without a hitch, and manoeuvring was carried-out with great rapidity that equals the best Diesel-drive, the actual time to change from full-ahead to full-astern being about five seconds. Naturally, improvements have been made based on the experience with the "Eclipse," and we understand that the fuel-consumption has been reduced a little in the case of the "Archer," although figures had not been checked at the time of the trials.

NEW SHIPPING BOARD AND MOTORSHIPS

As yet the policy of Chairman Lasker of the Shipping Board and four of the Commissioners towards motorships has not been announced, but we believe that they are all very warm towards adoption of this economical power. Admiral William Benson and Commissioner George E. Chamberlain have already expressed themselves strongly in favor of motorship construction and conversion of existing steamers. Another strong friend of the motorship has come out in the person of Mr. Wm. J. Love, one of the two experts chosen by the Chairman to direct the operation of the Board's ships. In an announcement to the daily press Mr. Love stated that steps are to be taken to provide a fleet of motorships as part of the merchant-marine, and that the Diesel-engines which have been built for the Board would be used whenever possible when machinery replacements are required. It is expected that a definite motorship program and policy will be announced before our next issue goes to press, after the new Board has settled down to its work and has had time to make thorough investigation.

MORE SUBMARINES FOR U. S. NAVY

Although the general tendency of Congress is for economy, the importance of national-defence should always overrule economy, as the expenditure of an additional hundred-millions for this purpose may save another expenditure of billions. Without doubt or hesitation a fleet of modern cruiser-type submarines should be built for protection of our Pacific interests. Our submarines are noticeably behind those of other nations, regardless of the claim made by the ex-Secretary of the Navy during his office. Japan is building a formidable fleet of submarines and submarine-cruisers, some of which are understood to be triple-screw boats of 12,000 shaft h.p., propelled by three two-cycle Diesel engines of 4,000 horsepower each. Great Britain is experimenting with the equipping of one of the big 27-knot K-boats (originally turbine driven) with Diesel-engines, and the result will be most interesting if the Admiralty publishes the same, which we very much doubt.

Naval records show that during the last few months of the war the allied navies had the German submarine campaign well in hand. But, all reports seem to have overlooked the fact that during the particular period in which submarine warfare lost some of its deadliness, Germany was on her last legs, morale in her navy was at a low ebb, so she was not capable of operating and maintaining submarines in the same conditions as when their submarine warfare was at its height. It is not difficult to imagine the seriousness of a big submarine campaign commenced by a country not demoralized by internal troubles, but with her navy at its height of efficiency.

Proposed Diesel Electric Ferries for San Francisco

ONE of the transportation companies of San Francisco Bay that has become convinced of the advantage and economy of the heavy oil engine as a motive power for its boats is the Golden Gate Ferry Co. of San Francisco. Harry E. Speas, president of this company, recently announced that the propelling machinery of several new ferries which the company plans to build for service across the bay would be of the Diesel-electric type, as he had become convinced that by using this method of propulsion, a saving could be effected of at least $50,000 a year per boat in fuel alone, as compared with steam ferries making the same speed.

The introduction of boats of this type in the ferry service on San Francisco Bay would be a significant step, as all of the heavy freight and passenger traffic across the bay between Oakland, San Francisco, Alameda, Berkeley and the other Bay cities, is handled by ferry boats, and it would only be a question of time with the competition of Diesel-driven vessels until all of the big ferries of the Key Route, Southern Pacific and other companies would have to be equipped with similar power in order to hold their own in economy of operation. In practically all the Bay ferries at present, most of which are double-end screw-propeller boats, the prime mover is a reciprocating steam-engine driving a single shaft with a wheel at each end, a very inefficient arrangement, amounting to only 50 to 60 per cent of the efficiency of a steamer of the same form and size with the power concentrated at one wheel in the stern, and having, of course, a high cost of operation as compared with a Diesel-driven boat.

In the new ferries a double economy will be effected, for not only will the motive power be supplied by oil-engines, but separate electric motors will be supplied for each wheel, which will reduce materialy the horsepower required. For instance, one of the steam ferries with wheel at each end attached to the same shaft recently lost one of her wheels, and was compelled for a time to operate on only one propeller. It is a fact that with less consumption of power, she made the trip in the same running time she had been making previously, but of course lost her efficiency in manoeuvring at the slip. This led to experiments which showed that with both wheels in operation, one at each end, to make a maximum speed of 14.77 knots required 3,010 i.h.p., while with the forward wheel off, the speed was made with 1,740 h.p. The reason for this is that a propeller forward exerting a powerful pressure upon the water stream increases the hydrostatic pressure at the bow, and increases the resistance of the water to the passage of the hull, so that the energy put into the wheel at this point is practically lost.

With the use of the Diesel-electric drive it will be possible to operate each wheel with a separate motor where the speed can be controlled independently, which will permit a very large proportion of the power to be delivered to the propeller in the stern of the ship, and only enough applied to the bow wheel, when the vessel is under way to eliminate skin friction. This would give better speed for the same power, and still give the boat the advantage of the forward wheel for manoeuvring in making landings.

The new ferries will have a length over all of 220 ft., an extreme breadth over the guards of 64 ft., a beam at the water line of 40 ft., and a depth of hold of 17 ft. 3 in. The displacement will be approximately 910 tons.

The power will consist of two Winton - Diesel - Westinghouse electric generator units, giving an available s.h.p. of 810, which it is calculated will drive the boats at a speed of 11 knots. 250-volt generators will be used, which will be separately excited machines with armature current flowing in closed circuit from the two-generator armatures to the armatures of the two motors in parallel. Separate exciters mounted on the ends of the generator shafts will be compound-wound for 125-volt direct current, constant potential, one exciter having capacity for carrying the entire load of the fields of both generators and both motors.

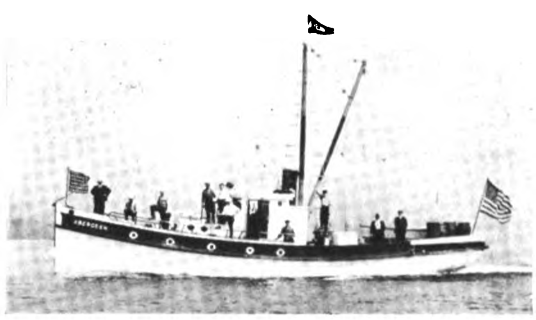
The excitation of the fields of the main driving motors, which are shunt-wound, is governed by means of a rheostat operated in such a way by a contactor controller that the speed of the motor can be maintained at any rate desired, and the speed control of the installation is governed by the excitation of the generator fields, the field circuit being extended to rheostats under the pilot house floor. The varying resistance of these rheostats is introduced by a controller operated by the navigator, so that the vessel may be manoeuvred at any point from full speed ahead to astern by direct electrical control from the pilot house. The astern action is obtained by reversing the field current so that full power is delivered to the wheel forward and the reduced power (about 71 h.p.) to the wheel aft.

The economy in fuel and saving of power and the absolute ease in control and manoeuvring offer advantages in this type of ferry which will undoubtedly cause their records to be watched with much interest by other ferry companies on the bay, and also by ferry operators on other waterways of the country.

NEW DIESEL-POWERED TUG-BOAT "GRIZZLY II"

"Grizzly II" is one of the most interesting work boats built this year on the Pacific Coast. Not only is she a well designed and well constructed craft, but she is equipped with the first of the new Enterprise Diesel-type engines installed in the Northwest. In length, the boat is 65 feet overall, with a beam of 17½ feet and a draft of 8½ feet. She was built at the plant of Schertzer Brothers on Lake Union, Seattle, the lines having been designed by L. H. Coolidge and the arrangement of the boat being worked out by her owner, Frank Nordland of Ballard. Her owner will use her for charter either as a cannery tender or towboat.

The engine in the "Grizzly II" is entirely a product of the Pacific Coast, having been designed and



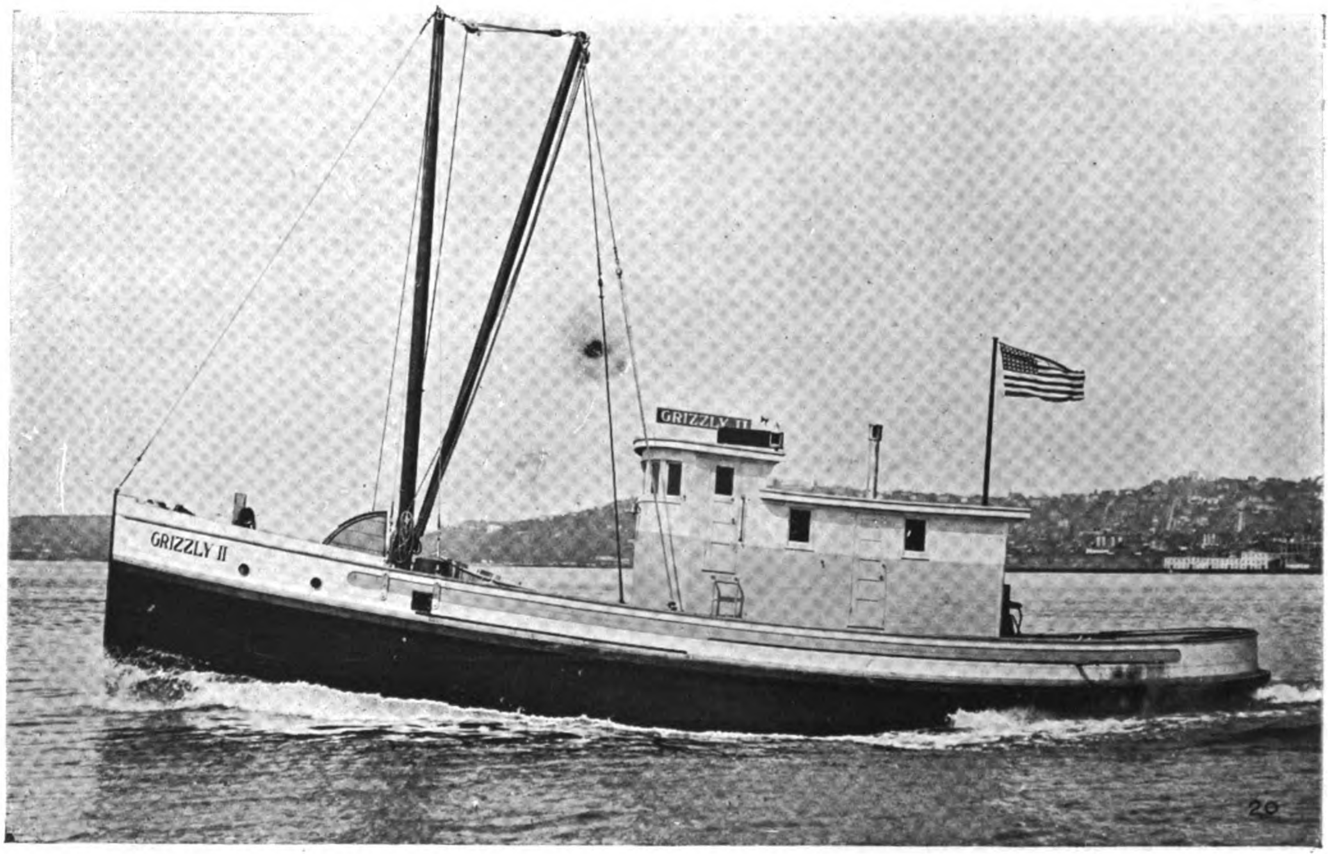
"Aberdeen," one of the first Puget Sound Purse Seine fishing boats to adopt heavy-oil-engine power. Many of the fleet since have had surface-ignition oil-engines installed

built by the Enterprise Engine Company of San Francisco. It is a 100 h. p. 4-cycle solid-ignition Diesel type, with four cylinders each having a 9¼-inch bore and a 14-inch stroke. Its normal speed is 325 r. p. m. The Enterprise Engine Company, in developing this engine, decided not to experiment but to use a proven principle, so they purchased the shop rights to use patents developed by John H. Suter which had been used and proven successful for four years in stationary engines of the Western type. The highest compression reached in the cylinders prior to injection of fuel is 520 lbs. which rises to less than 600 lbs. at time of injection. The engine is non-reversible but is equipped with an improved Enterprise heavy-duty reverse gear.

On the trial trip of the boat she operated very successfully and made a speed over a measured course of 11.2 statute m. p. h. In subsequent runs she has shown a normal cruising-speed of 10.54 m. p. h. The fuel consumption is 17 h. p. hours per gallon or a total of 5 15/17 gallons per hour for the boat. With 16 gravity oil costing 5 cents a gallon or $2.10 per barrel, the operating cost of the Grizzly for fuel is less than 30 cents an hour. The engine is equipped with a force-feed lubricating system which uses the oil over and over again, the lubricating-oil consumption being less than one gallon for eight hours, or 80 h. p. hours per gallon.

SAN FRANCISCO MOTOR FISHING-VESSELS

According to the reports issued by the Customs House for the year ending June 30, 1921, there are 3,374 motor fishing-boats engaged in the San Francisco district.



New Seattle-owned tug-boat powered with 100 b.h.p. Enterprise solid-injection Diesel engine

Development of the Nobel Diesel-Engine

The Nobel Engine of To-day, and a Resumé of Development Work of the Past With This Design—Progress of the Two-Cycle System at the Nobel Works

By EDWIN LUNDGREN
(Formerly Shop-Superintendent Ludwig Nobel Maschinenfabrik, Petrograd, Russia)

[*Previous articles on Nobel-Diesel engine installations appeared in* MOTORSHIP *for November, 1916, March, 1917 and April 1917, but Mr. Lundgren's contribution contains much interesting unpublished information and illustrations.*—EDITOR.]

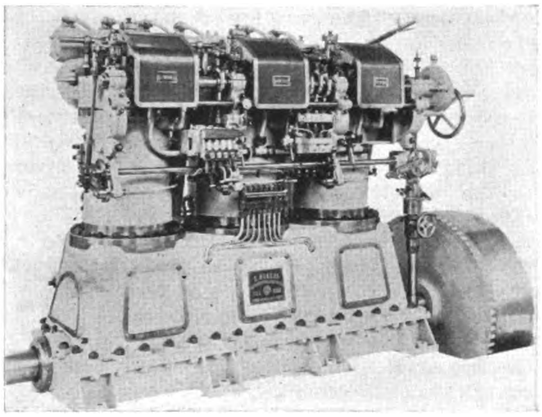
According to a recently published statement there were a year ago not less than 150 motorships of at least 2,000 tons capacity each in the course of construction, German production not included. Of these ships by far the majority, about 80%, were equipped with engines according to the four-cycle principle, but there is a growing tendency in favor of the two-cycle, which will readily be understood from the following.

Use of Diesel engines is to a certain extent limited by the size of the cylinder. Ordinary conservative practice has not dared to build much larger cylinders than of 30 in. dia. For this reason higher power required by large fast passenger-ships would mean too many cylinders, which would result in too complicated and cumbersome machinery with many chances of breakdowns and occupying entirely too much valuable space. As for practical reasons up to this time the diameter of the cylinder cannot safely be increased very much, it seems quite natural that attempts are made to obtain a larger power and with it a bigger field for the engine by making the engine double-acting or by resorting to the two-cycle principle. The first method is by all designers regarded with suspicion on account of the difficulty and trouble which a stuffing-box and a piston-rod going right through the combustion space involve, as well as of the difficulty of arranging the fuel-valves properly. But on the other hand the second method of increasing the power per cylinder by employing the two-cycle is finding many friends and has, as generally known, already brought forth a number of successful designs.

Advantages claimed by the two-cycle engine as compared with the four-cycle are in short the following ones: Less weight and less space occupied for the same power, easier and simpler means for reversing and maneouvering, less parts, less valves and consequently greater mechanical simplicity and with it greater reliability, better balancing with the same number of cylinders, also better or more uniform turning effort.

These advantages are of course more or less pronounced in the different designs. One prominent Italian manufacturer, Franco Tosi, Legnano, who has been building both four-cycle and two-cycle engines, cannot find any advantages at all for the two-cycle, but judging from the tests published, this manufacturer has not been very successful with his two-cycle engines and has not obtained as good results as other manufacturers. It must be remembered that, in spite of the greater mechanical simplicity, the design of the two-cycle engine requires far more skill and experience than the design of the comparatively simple four-cycle engine.

The most serious objection that is generally made against the two-cycle engine, is that the fuel-consumption is too high; but conceded that even in a well-designed two-cycle engine the fuel-consumption is about 5% higher than in a four-cycle engine of the same size, this advantage is more than offset by the decrease in weight and the saving in space which is so valuable in a ship.



The first Nobel direct-reversible 4-cycle type Diesel engine. It is of 120 b.h.p. and built in 1907

In due recognition of the advantages offered by the two-cycle a number of very prominent firms of the highest standing are devoting their energies to the development of large, reliable two-cycle engines. Among them we find: in the U. S. A. the Bethlehem Steel Co., the Busch-Sulzer Diesel Engine Co., Nordberg Manufacturing Co.; in France Schneider & Co., in England Doxford & Sons, Cammel Laird & Co., Swan Hunter & Wigham Richardson, Alexander Stephens, Walsend Slipway & Engineering Works, Denny Brothers; in Germany Maschinenfabrik Augsburg-Nürnberg, Howaldtswerke, etc.; in Switzerland Sulzer Brothers and in Sweden A. B. Atlas-Diesel and A. B. Nobel-Diesel.

The last named concern is in a way representing Russia, as it was started by Mr. Ludwig Nobel, formerly director of the Nobel Works in Petrograd, Russia, with a number of his most experienced designers and foremen. This Russian concern has ever since 1899 been actively engaged in the building of Diesel-engines. Backed by enormous resources the firm laid down a vast amount of experimental work, various designs and constructions, and has thereby in a very high degree contributed to the development of the Diesel engi .

In passing it may be said that Russia always has been an exellent market for Diesel-engines, and—in that country all the prominent concerns of the world met in eager competition. It may be of further interest to state that during the war the Nobel Works had to repair several compressors belonging to some high-speed engines delivered by a prominent American concern to the Russian navy. While the workmanship was fairly good, the design showed some serious faults. The compressor-valves for instance were entirely too heavy and after only a short time running, they battered their seats to pieces and had to be replaced by valves of a superior design. This is mentioned to emphasize the value of using really experienced designers and also to demonstrate the fact that American shops often are liable to disregard the finer requirements of the design and to pay too much attention to the ease of manufacturing and machining of the details. This condition can possibly be responsible for the comparatively slow development of the Diesel-engine in the U. S. A.

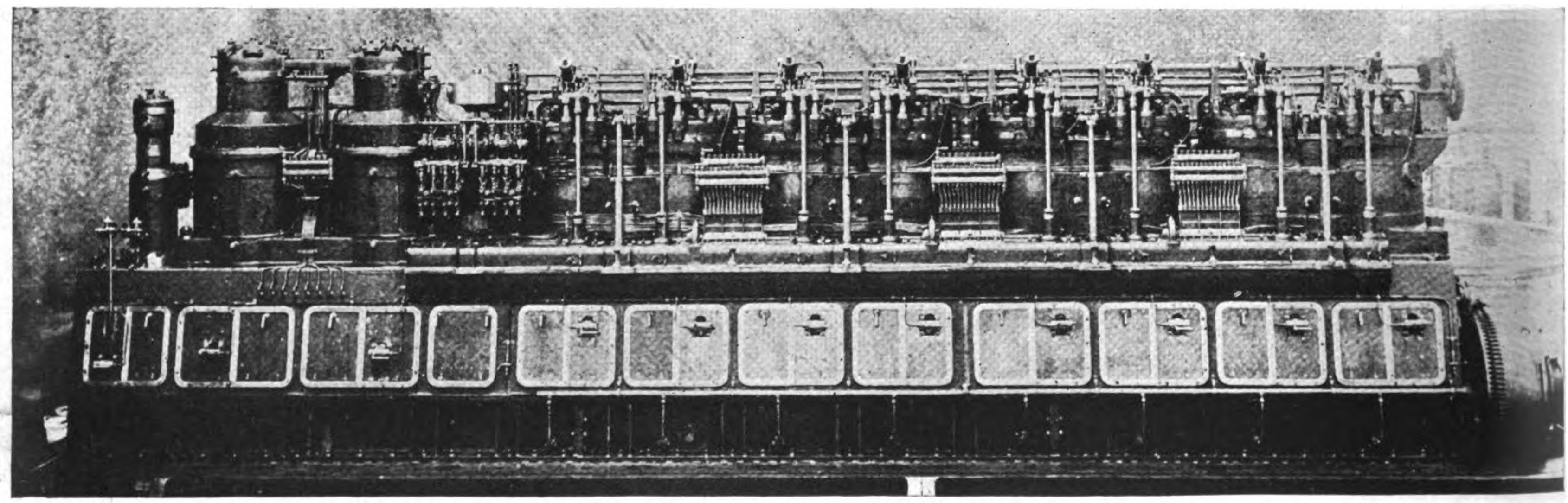
But to return to the development of the Diesel engine in Russia, it may be interesting for "Motorship" readers to recall that in the year 1904 the Nobel Works installed a Diesel-engine in the tank boat "Sarmat," on the Volga. The power was in this boat transferred to the propeller shaft according to Del Preposto's system, that is, the engine shaft was either directly coupled to the propeller-shaft or it was driving a dynamo and in that case the power was transferred electrically to a motor keyed upon the propeller-shaft. This was the first Diesel-electric drive in a ship.

In 1907 the first reversible four-cycle Diesel engine in the world was built by the Nobel Works. It was a three cylinder 120 H.P. engine, which was installed in the Russian submarine "Minoga," and in 1915 was doing in every respect satisfactory service. It is illustrated with this article.

Among other highly interesting Nobel constructions may be mentioned a 200 B.H.P. reversible marine-engine in which the eight-cylinders were arranged in V-shape and which weighed but 4,500 lbs. or 22.5 lbs per B.H.P. Further, a particular heat construction of a 150 B.H.P. 3-cylinder four-cycle engine which was installed in a small submarine and which had to conform to exceedingly rigid specifications of the Russian navy. It weighed only 2,000 lbs or 40 lbs. per H.P., was working very efficiently and running as smoothly as a watch.

While nearly all stationary and all submarine engines were built according to the four-cycle principle, the two-cycle was not entirely neglected. In 1903 an experimental two-cycle engine developing 15 H.P. was built and gave fair results, but as the shop at that time was very crowded with orders for its other types, the work was not immediately continued.

In 1913 a 320 H.P. two-cycle engine of very original design was built according to the ideas of Mr. Axel Lagersten, Chief-Engineer of the Nobel Works. This engine is still working daily supplying the machine shop with power.



First picture to be published of the 1,320 shaft h.p. 2-cycle type Nobel Diesel engine for Russian submarines

Large Opposed-Piston Engine

At the same time work on a large Junkers Diesel-engine with opposed-pistons was started and many parts for it were already finished when the great war broke-out and pushed other then more important tasks ahead. It may be said, however, that this construction although it has given remarkably good results in England, was regarded with a certain apprehension on account of its mechanical complicacy, as it has a three-throw crank and three connecting-rods for each cylinder.

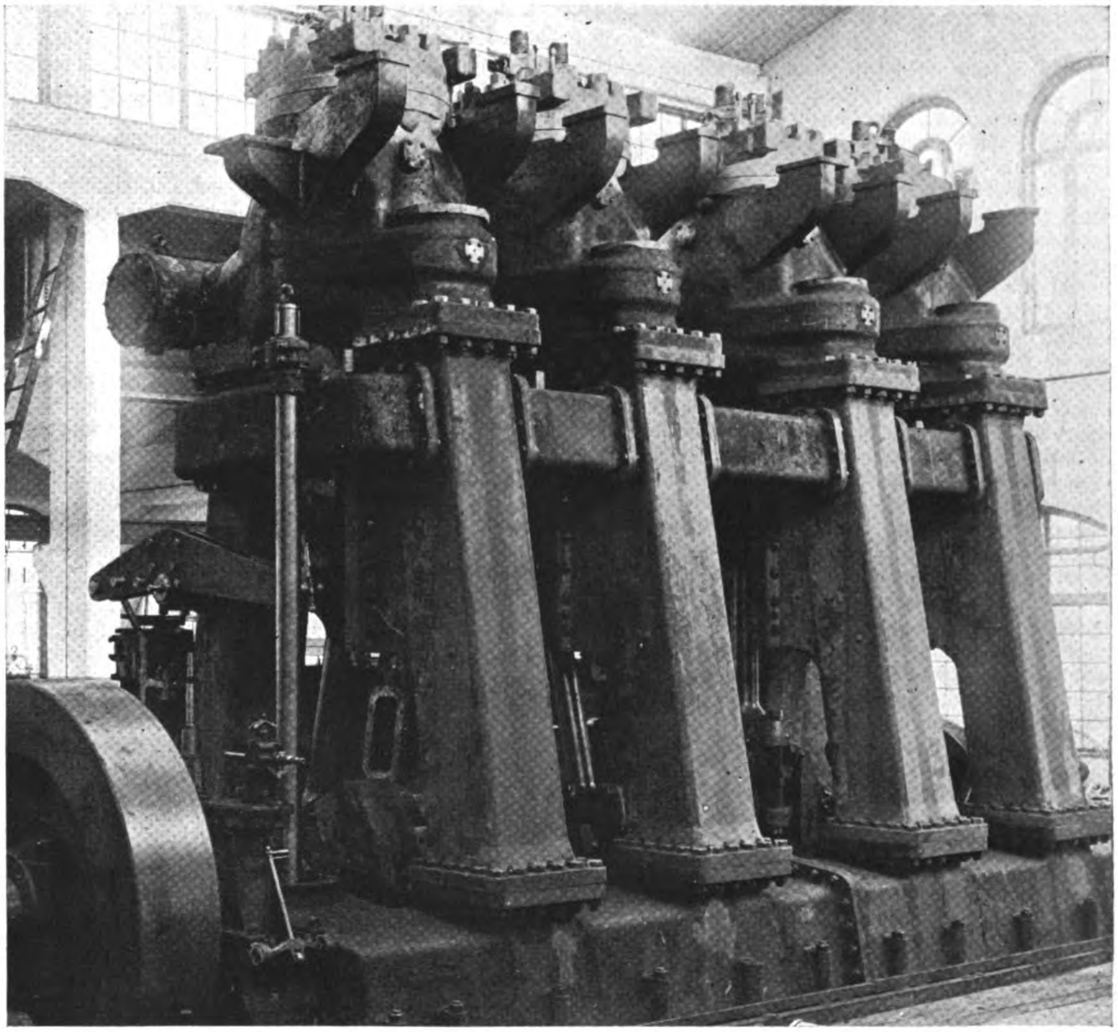
[We did not previously know that Nobels had commenced construction of a big Junkers-type opposed-piston oil-engine. Thus we all live and learn.—*Editor.*]

Of particular interest and characteristic of the thorough methods with which the various problems in connection with the two-cycle were attacked were a series of experiments undertaken in order to determine the influence of different factors upon cylinder scavenging. In these experiments a glass cylinder was used of the same dimensions as the actual working-cylinder with inlet and exhaust ports, and with a piston of proper shape moveable in it. This cylinder was filled with exhaust-gases taken from an engine on the test stand and stored in a reservoir. By taking a sample from the gas in the cylinder and analyzing it, it was made sure that the gas had the ordinary composition of exhaust-gases. The scavenging-ports were connected to an air-tank in which air of a certain pressure was kept and opened and closed again by the piston just like in actual service. The speed of the piston was accurately recorded by a registering device. After one scavenging had been tried, again samples were taken from three different points of the interior of the cylinder and analyzed. By now systematically changing one or the other factor, it was ascertained which air-pressure gave the best results, which form and dimensions the inlet and exhaust ports should have, which shape of the piston head was the most favorable one, what influence the piston-speed could have and so forth. It was also found that under certain conditions the scavenging was perfect, that is, all the three samples taken showed the composition of pure air.

The first two engines according to Mr. A. Lagersten's design which were built for a customer's order were two engines each developing 600 B.H.P. at 210 r.p.m. and intended to supplant the steam-engines of the passenger ship "Imperatritza Aleksandra," belonging to the steamship and transportation Company Kaukas-Merkur." These engines showed such good results during the trial tests and embody so many original and good ideas that they deserve general attention and a short description of them should be justified. They were illustrated in "Motorship" of March, 1917, together with details of the ship, but no description of the engine design was given at that time.

General Arrangement and Main Dimensions

The engines are arranged symmetrically to each other in two separate units, each consisting of 4 working-cylinders, in front of them a double-acting air-pump for the scavenging air, a three-stage compressor for the high-pressure air for injection and maneuvering and finally upon special order a single-stage compressor which delivers compressed air for various purposes on board.



First picture of the 1,600-1,800 shaft h.p. 2-cycle type Nobel merchant-marine Diesel engine. Some interesting new features of design are incorporated in this engine. This engine has just completed erection at Nynashamn, Sweden

Output of engine at 210 r.p.m.	600EHP
Working cylinders:	
Diameter	410 mm (16⅛")
Stroke	500 mm (19¾")
Scavenging-air pump:	
Diameter	710 mm (28")
Diameter of lower guide cylinder	210 mm (8¼")
Stroke	500 mm (19¾")
Three-stage Compressor:	
Diameters	330, 295 and 70 mm (13", 11⅝" and 2¾")
Stroke	360 mm (14¼")
Auxiliary Compressor:	
Diameter	220 mm (8⅝")
Stroke	360 mm (14¼")
Length of engine, over all	6,000 mm (19' 8")
Height of engine, over all	2,600 mm (8' 6")
Width of bedplate	1,500 mm (5' —)

Total weight of engine, excl. flywheel 32 ton–53 kg–HP (118 lbs–BHP)

Details of Construction

All details are characterized by their simple rational design in which due attention was paid to the requirements of the foundry and machine shop.

The bedplate is made of cast-iron, and is entirely closed in the bottom. It consists of two parts, the main part under the engine proper and a lighter section under the air-pump and the compressors.

The crankshaft is also composed of two parts; the lighter shaft of the air-pump and compressors is connected to the main shaft by means of a flange coupling. On its other end the main shaft carries a light flywheel, 1.25 m. in dia. (about 4 ft.), which at the same time forms one half of the coupling to the propeller-shaft. This coupling can be taken apart within a very short time, if this should be desirable for a thorough examination of the engine. The throws of the 4-cranks are arranged at 90 deg. and 180 deg. to each other. Consequently the engine can be started regardless of which position the crank occupies. In a two-cycle engine this can be achieved with a smaller number of cylinders than in a four-cycle engine.

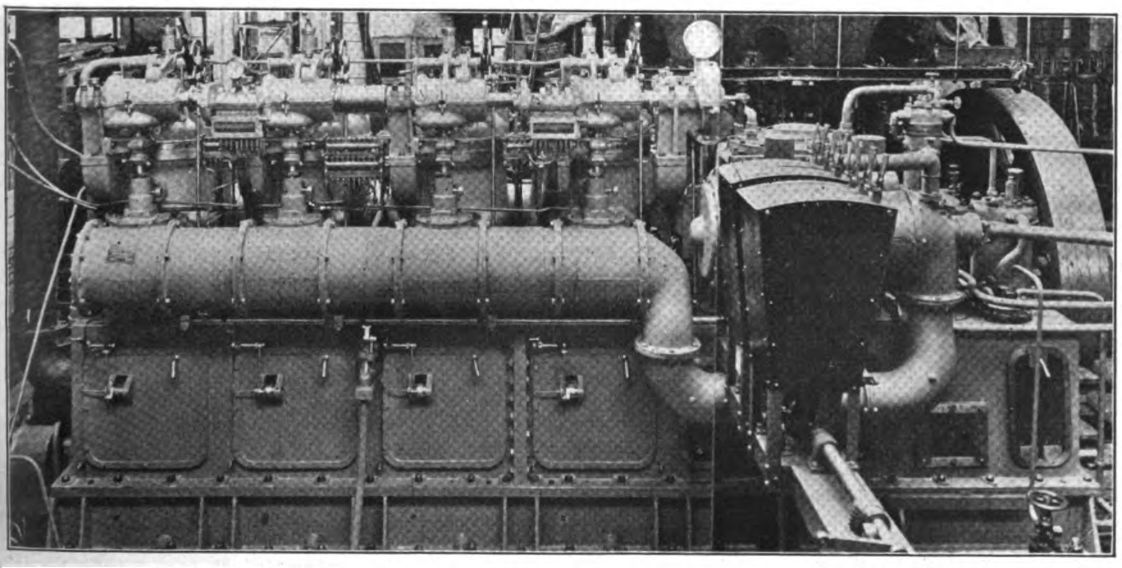
The connecting-rod is of the standard marine type and adjustable by means of shims. Its length is 5½ times the crank-throw.

Pistons are watercooled, which has proved to be necessary for this size and kind of engine. The cooling-water is admitted and carried off by a system of pipes which are united to form a rigid trussed frame-work, fastened to the piston. The outer telescopic-pipes are moving in the stuffing boxes of air chambers attached to the frame of the engine where they always are easily accessible.

The frame is of the ordinary box type and kept relatively light, as the working-pressure is taken-up directly by ten 3 in. bolts which unite the cylinder with the bed-plate. Through large openings with easily removable doors the interior of the frame is conveniently accessible.

The main cylinders are arranged singly; they consist of two parts, one outer jacket and one inner cylinder bushing which is forced into the jacket while this one is slightly heated by steam. The inner cylinder is provided with ports for the scavenging air and the exhaust gases. As indicated above the size and location of these ports have been chosen after extremely carefully made experiments.

(To be continued in our September issue)



Nobel 2-cycle Diesel engine, 600 shaft h.p., showing receiver for scavenging-air, valve-gear, and manoeuvring-levers

Discussion of Diesel Engine Paper by Metten and Shaw

Conflicting Statements Are Made—Some Misleading Figures Quoted

IN our June issue we published an interesting paper read before the Society of Naval Architects and Marine Engineers by Messrs. Metten and Shaw. An interesting discussion followed this meeting.

Mr. Benjamin C. Fernald stated that he agreed with their conclusions as to both reliability and fuel-economy of certain types of Diesel-engines, and that this power had unquestionably established its rights to fair and equal consideration of its merits. However, he criticised the operating data furnished by Messrs. Metten and Shaw, which he stated was based on a specific ship on a specific route and showed the motorship to be a better investment than turbine-operating steamers. He pointed out that in obtaining authentic records of performance and operating costs there is seldom that degree of co-operation between builders and operators of ships, which is necessary to accomplish the ultimate end of all commercial activities; namely, earning the highest return on a given vessel.

Mr. Fernald furthermore said he could not agree that continuation of the American merchant-marine marine would depend upon the wholesale conversion of the propelling equipment of steamships to Diesel-engine drive, or the building of new motorships—and that it was his opinion that such a conclusion was not warranted by a critical analysis for one ship for one trade route. Assuming equal reliability and fleexibility of operation, he pointed out that a type of machinery must have the advantages of all the following six points over all others to be recommended for universal application.

1. To deliver a unit of power with less fuel and supplies.
2. To have a lower first-cost installed (including any extra cost of hull construction).
3. To weigh less.
4. To occupy less space.
5. Require lower operating labor cost.
6. Lower maintenance cost.

The real reason for the abnormal delay in the development of the Diesel-engine, said Mr. Fernald, was because it was inherently weak on points 2 and 3; namely, first-cost and weight.

On these matters we cannot agree with Mr. Fernald, because the larger cargo-space of a motorship reduces the first-cost of the motorship per net-cargo-capacity-ton to practically the same as that of a modern steamship; even though the Diesel machinery costs more than that of a steamer. Secondly, there are many well-known successful Diesel-engines whose weights are less than that of steam machinery, and which occupy considerable less space. The average weight of ten leading cross-head-type Diesel-engine is only 339 lbs. per shaft horse-power.

We draw Mr. Fernald's attention to the table of weights and dimensions of well-known Diesel-engines in our issue of April last, or in the Motorship Year Book, which confirms our figures.

Mr. Fernald evidently overlooked the question of the supply of coal-tar oil and vegetable-oils for Diesel-engines in the event of anything occurring to the world's supply of mineral oils, as he pointed out that economical conditions may bring about a reduction in the cost of coal and wages of firemen without corresponding degrees in the price of fuel-oil. He also overlooked the fact that widespread adoption of the Diesel-engine would make America's fuel-oil supply last three times as long, even before it became necessary to turn to tar-oils or vegetable-oils.

Finally, Mr. Fernald gave a summary of the investigations he made for a foreign client on the Diesel-engine situation in November, 1919. He stated that a complete operating analysis was made, based on a 8,800 tons vessel in service between San Francisco and Tokyo, and the operating balance sheet showed advantages of a net operating-service of 10 per cent for the geared-turbine over reciprocating steamer engines, and 9 per cent over the Diesel-engines.

We suggest that there must be something radically wrong with his basic figures, where the motorship is concerned. He stated he was submitting copy of this balance-sheet for printing in the Society's Transactions, but as yet we have not had an opportunity to see the same, so cannot offer further comments. Mr. Fernald stated that there were many half statements published in the technical press, misleading from their incompleteness, and were publications seemingly conducting propaganda in favor of certain types of propelling-machinery. Then he referred to the Hague report on comparisons of motorships with steamships. At the time the report was made we protested to the Shipping Board against its adoption, because the figures were inaccurate, owing to being formed on an incorrect basis and omitted many factors.

Mr. Chester B. Mills, Chief-Engineer of the of the Sperry-Gyroscope Company, gave some interesting details regarding the development of a compound oil-engine by Mr. E. A. Sperry, which had a number of new characteristics, including low capital charge because of the greatly simplified construction, low weight per b.h.p., great economy of operation, and with a noticeable saving in machinery space. He stated that this engine with the same revolutions and power is one-third and one-fourth and will occcpy one-third the boiler space. Efficiency is gained through the carrying out of compression and expansion of two stages, with expansion to practically atmospheric-pressure, resulting in absence of noise, and burning ordinary bunker-oil without smoke. Also high speeds up to 1,500 r.p.m. are perfectly practicable in conjunction with the electrical magnetic-clutch they have developed. Details of this, by the way, have been published in "Motorship."

To illustrate his remarks Mr. Mills showed a slide of 180 h.p. engine turning at 400 r.p.m. connected to an electric generator, which engine has been operated over 2,000 hours with every satisfaction. One of the slides illustrated pistons of the engine and showed the proportionate size of the high-pressure cylinders and low-pressure cylinders, the two high-pressure cylinders exhausting into low-pressure. The engine operates on the four-cycle principle.

Mr. John Martin said he had represented the American Bureau of Shipping on the sea-trials of the motorship "William Penn," and that the machinery in this vessel operated and maneuvered perfectly, with noticeable absence of vibration in all parts of the ship.

Mr. William W. Smith, Chief-Engineer of the Federal Shipbuilding Company, referred to the question of converting steamships to Diesel power recommended by the authors of the paper. He stated that the entire replacement of the machinery is very expensive and the savings would have to be very large to justify this. He recommended the installation of super-heaters to steamships instead.

Mr. Smith referred to a consumption of 0.95 pound of oil being given by the authors of the turbines, which he stated was a good performance, but was not the best which could be obtained by using a higher degree of super-heat.

However, we point out that some turbine experts considered it very dangerous to use super-heat for turbines, particularly with reversing turbines. Mr. Smith referred to the 0.40 pound per s.h.p. hour having been given by Messrs. Metten and Shaw as the consumption of a Diesel-engine, and stated that for all purposes he allowed in comparisons made by himself 0.45 pound per shaft h.p. In this connection we would like to ask Mr. Smith if he has ever seen any four-cycle Diesel-engined motorship which has shown a consumption in service higher than 0.42 pounds per shaft h.p. hour for all purposes?

Mr. Smith then stated he noted Mr. Warriner used 0.515 pound per shaft h.p. hour for two-cycle engines, and that on that basis the fuel-consumption of the two-cycle engine is 7 per cent more than the four-cycle one, which would give 0.48 pound for the latter. However, we can frankly say that these consumptions are very high for a modern two-cycle engine. Practically all the leading two-cycle engine-builders are now securing consumptions of 0.42 pound per shaft h.p. hour and even less.

We have before us the fuel-consumption report of the new Ansaldo-San Giorgio 4,000 shaft h.p. two-cycle marine Diesel-engine, and the builders state that the consumption is 0.405 pound per shaft h.p. hour, or 0.313 pound per i.h.p. hour. Furthermore, Sulzer-Freres guarantee a consumption not exceeding 0.42 pound per b.h.p. hour for their two-cycle type marine Diesel-engine.

Mr. Smith then gave some information regarding the comparison figures which he had worked out. He stated that he used the same number of men for both vessels, and as higher-grade men were required for Diesel-vessels, the costs were somewhat greater, and that he allowed fifteen men in both cases. Obviously this is incorrect, because of the absence of firemen on a motorship. There are many points we could criticise in connection with Mr. Smith's comparison, but unfortunately space does not permit. However, he refers to the weight and first-cost of the installation, both being extremely high. To this our comments on Mr. Fernald's statement above will apply.

It is curious that every steamship or boiler builder who makes a comparison always selects the heaviest and most expensive Diesel-engine on the market for comparison purposes, instead of taking a general average. In his comparison Mr. Smith makes no use of the advantage to be gained by a motorship selling bunker-oil as cargo, as in the recent cases of the "Buenos Aires," "Seminole" and other Diesel ships. Therefore, we suggest that Mr. Smith revise many of his figures.

Of the statements made during the discussion, those of Mr. J. G. Dalcher obviously showed the best balance and absence of prejudice. In giving his figures Mr. Dalcher drew attention to the design used in connection with his comparison, being based on conservative ratings throughout, taking into consideration that as this was to be the first venture in the motorship field he was justified in this step. He took as a fuel-consumption for the main Diesel-engines 0.43 pound per b.h.p. hour, 0.007 pound for the auxiliary oil-engines, and for the donkey-boiler 0.0312 pound per i.h.p. of the main engines, making a total of 0.35 per i.h.p. hour, or 14.55 tons per day for twin four-cycle engines aggregating normally 3,078 shaft i.h.p. at 105 r.p.m. While this consumption would be a little higher than the average motorship consumes, it is fair, in view of the reasons stated. The vessel in question had a displacement of 14,050 tons and a normal sea-speed of 12 knots. The steamer had turbines and reduction-gears developing 3,100 shaft h.p. at 90 r.p.m., oil-fired Scotch boilers fitted with super-heaters of 50° Fahrenheit. Taking the total operating costs per year of the steamship as 100 per cent the motorship's operating expenses were 94 per cent. The total net earnings of the motorship on initial investment was 119 per cent, compared with 100 per cent for the steamship.

Mr. W. Huskisson referred to a statement in the Metten and Shaw paper as follows:—

"The chief difficulties encountered with such a system are in getting good combustion at all running speeds and loads and the elimination of the shock in the cylinder, which is apt to occur with a sudden rise in pressure when fuel is injected."

This is a remarkable statement, said Mr. Huskisson, because no difficulties such as those mentioned have occurred. Fortunately, one of their ships happens to have arrived in this port today, so he took the opportunity of ringing up the chief-engineer and speaking to him on this point. He stated that during the voyage out they ran into a fog and had to reduce the revolutions from 118 to 80 revolutions per minute for over one day. He also mentioned that in coming up the Manchester Canal it was necessary to reduce the revolutions to 40 r.p.m (this run takes about eight hours), and the combustion was perfect, as shown by the transparent exhaust at all speeds. He could not understand why any sudden rise in the pressure of the fuel should be anticipated, as special means are taken to avoid this, and I think that the authors' fears of trouble on this score are born of ignorance of the subject.

The authors further go on to say that the advantage claimed is that the compressor troubles are entirely eliminated with a correspondingly higher mechanical-efficiency obtained than with air injection. This is quite true.

No one would think from this that the advantage mentioned was the only advantage that is obtained by the use of this system, but as a matter of fact there are many, and it was because of these advantages that Messrs. Vickers some years ago decided to abandon the use of the air-blast system. Since that time every single engine that they had previously built fitted with this air-blast system has been altered to the mechanical-injection system.

He briefly mentioned the advantages of the mechanical injection:

1. **Saving in weight**—In a high-duty light-weight engine of 600 b.h.p. a total net saving in weight of 4,887 lbs. is effected by the substitution of the small fittings required for the mechanical spraying system, for the air compressor and its attendant complication of fittings and pipes.

2. **Saving in space**—In the case of the above engine, the overall length of the engine is reduced by 3' ft., while further space is saved by the omission of the h.p. and l. p. cooler pipes and their connections.

3. **Reduced cost**—The air-compressor is an expensive auxiliary to the engine, and in view of the simplicity of the mechanical injection system it follows that the relative cost of manufacture of the engine is less than that of the other type.

4. **Economy of fuel**—Consumptions down to 0.38 lb. per brake horse-power per hour, or 170 grammes per force de cheval have been obtained on ordinary official trials. This figure has not been attained in any other type of engine of which we have knowledge.

5. **Number of fittings and pipes reduced**—Less attention and adjustment of the engine are required as compared with the air-spraying system, due to the elimination of the valves and pipes in connection with the air compressor, relieving the engineers in charge of the engine and reducing the cost of upkeep and repairs.

6. **Economy of air for starting the engine**—Experience has demonstrated that the engine will get under way more rapidly with mechanical spraying than with air spraying, this effecting a considerable saving of starting air. Greater certainty is also obtained when manoeuvring the engine.

7. **Blast action on pistons**—There is a complete absence of blast or blow-pipe action on the piston top, and of local heating of the piston, both of which faults have a tendency to crack the pistons.

With regard to the high-speed Diesel-engines for the electric drive, the consumption of these engines is as small as that on the larger type. On looking through the official trials of over twenty submarine engines running at 380 r.p.m. the figures are in the neighborhood of 0.382 to 0.386 per b.h.p. per hour.

Of course, said Mr. Huskisson, every one must quite agree with the authors that if American ship-owners desire to run their ships in competition with European companies they must employ internal-combustion engines.

Mr. L. Armstrong, Mr. Edgar D. Dickinson, Mr. Robert Warriner and Mr. Alexander Schein also spoke.

Six-Thousand Tons Cable Motorship for Western Union Telegraph Co.

Diesel-Electric Drive to Be Adopted for Propulsion and Cable-Laying

SPECIFICATIONS have just been issued to shipbuilders for one of the most interesting steel motorships ever planned. This is a cable-laying ship of 6,000 tons displacement for the Western Union Telegraph Company of New York from designs by J. W. Millard & Sons, naval-architects also of New York. It is anticipated that the contract will be placed within a few weeks, unless the cost of construction is too high, in which event the vessel may be built abroad. In any event the order will be soon placed and the ship completed, as she is needed for work on the ocean.

It is very noteworthy that steam drive will not be considered for this ship, and that shipbuilders who have no Diesel-engine of their own must include in open bids the McIntosh & Seymour, Worthington, or other equivalent makes of Diesel engines that can be installed in the space available, in conjunction with Westinghouse electric transmission.

Coming at a time when steamship-building is suffering from a terrific slump this vessel will do much to center additional attention from shipbuilders on the importance of Diesel-engines for propelling purposes, as there are still about a dozen important American concerns who have not yet undertaken the commercial construction of Diesel-engines, although several have been negotiating for licenses or hovering on the brink of doing something tangible in this direction, including the Federal Shipbuilding Co., Bath Iron Works, Staten Island Shipbuilding Co., Merchants Shipbuilding Co., Texas Steamship Co. (shipyard at Bath, Me.) Moore Shipbuilding Co. South Western Shipbuilding Co., American Shipbuilding Co., Great Lakes Shipbuilding Co., and Downey Shipbuilding Co.

In this particular instance Diesel-electric drive is ideal, because the vessel will have to operate very slowly, except when proceeding to her destination at sea, which may mean only about four days at full speed. At times she will have little more to do than drift around, with most of the power shut down. With this class of machinery the standby charges will be very low, and at any time she is ready for full-speed ahead or astern in ten seconds, without being obliged to maintain a head of steam.

There will be two 1,000 shaft h. p. 500 volt direct-current electric motors connected to the propeller-shafting, and these will turn at 120 revs. per minute. Kingsbury thrust-bearings will be fitted. Current for the operation of the motors will be furnished from four 410 K.W. 250 volt direct-current compound-wound electric-generators driven by four 600 b.h.p. Diesel oil-engines.

For the auxiliaries there will be two 120 b.h.p. Diesel-engines driving two 90 K. W. 250 volt direct-current compound-wound generators at 375 r.p.m. These generators in addition to providing power for the auxiliaries of the ship, will provide current for two 250 volt, 1750 R.M.P. motors that will drive two 20 K. W. electric-light generators that will supply power for lights at 125 volts. They can also take current for the excitation bus. Power for lights thus will be taken from the auxiliary generators, through the motor-generator sets when at sea, and at such times as the auxiliary generators are being operated when in port. A small oil-engine driven 125 volts generator will furnish current for lights when the large auxiliary units are idle.

The general dimensions of the ship are as follow:

Displacement	6,000 tons
Gross Tonnage	3,000 tons
Power	2,000 s. h. p.
Registered Length	340 ft. 6 in.
Length B.P.	324 ft. 0 in.
Breadth (Moulded)	42 ft. 6 in.
Depth (Moulded)	25 ft. 0 in.
Register	Lloyds 100 A1
Speed	12 knots

We note that when using fuel having a heating-value of 18,000 B.T.U., the consumption at sea must not exceed 0.51 lb. per *shaft* horsepower per hour. This, of course, makes any form of steam-electric drive utterly out of the question even if the owner's specifications on page 14 (clause 3) did not definitely state that the propelling-machinery is to consist of four Diesel-engines driving generators.

However, we think that even for Diesel-electric drive the margin is too close, because the Diesel-engines will be of fairly high speed, namely 200 to 250 R. P. M. and so will have a fuel-consumption of about 0.45 lb. per b. h. p. hour, unless of the solid-injection type. To this an allowance must be made for the loss of power in transmission through the electrical apparatus of 12 to 15%. Therefore, if a consumption at the propeller-shaft, of 0.575 lb. were maintained it would be a very good result.

With direct Diesel-drive and slow-speed cross-head-engines consumption of under 0.42 lb. per shaft h.p. hour could be guaranteed, but the benefits to be derived from electrical drive probably outweigh the difference in fuel-consumption in this particular case. With any form of steam-electric drive the best consumption will be 1.15 lb. and there would be many other fuel losses when laying cables, because the boilers could not be shut down or started at a moment's notice, like the Diesel-engines. Consequently, we suggest that the specifications of the machinery be changed to read a consumption 0.60 lb. per shaft h.p. hour, or else protect the Diesel-engine builders by inserting a clause to the effect that the consumption must not exceed 0.45 lb. per brake horse-power hour, for they must not be held responsible for losses in the electrical transmission.

We note that complete sets of spare parts must be carried. For instance, each of the main Diesel-engines must have two sets of piston-rings for two cylinders, and one set of piston-rings for one piston of each of the two auxiliary engines. This in addition to four spare main-engine pistons and two spare auxiliary-engine pistons equipped with rings.

This will provide good business in these quiet times for piston-ring manufacturers, as it means about 56 spare rings of about 18 in. dia. and about 18 spare-rings of about 12 in. dia.

As the four main-engines will probably have six-cylinders each and seven piston-rings per piston, and the two auxiliary-engines three cylinders with six rings per piston, it means that no fewer than 168 piston-rings of 18 in. dia. will be on the main-engines when installed, and 36 of about 12 in. dia. on the auxiliary engines. Or a grand total of 224 rings of 18 in. dia. and 54 rings of 12 in. dia. including spares. We draw attention to this because there are a number of firms specializing in the manufacture of piston-rings who do not seem to realize the extent of business in this particular field today.

On deck there will be three electric-winches of the Lidgerwood, or other approved single-drum type, and an electric anchor-windlass. The steering-gear will also be electric and will be controlled by a MacTaggart-Scott telemotor and operated by a Waterbury hydraulic variable speed-gear. A Hasties friction rudder-brake will be installed. A Sperry gyro compass, and two 24 in. Sperry searchlights will be carried. In fact, the electrical equipment throughout the ship will be very complete and will include heaters in the officers' cabins, bath-rooms and saloon, 500-watt flood-lights, fans, bells, Edison storage-batteries, log and speed indicator. Other parts of the ship will be heated by steam from an oil-fired 9 ft. by 8 ft. donkey-boiler at 125 lbs. pressure. There will be two 2-ton refrigerating-plants of the Brunswick, York, or other approved type, electrically driven by a 250 volt D. C. motor. There also will be a Paracoil or other water-distilling plant.

When the contract for this novel and interesting motorship is placed we shall publish plans, and give further details regarding the auxiliaries and equipment.

THE LOMBARD DIESEL ENGINE

A new four-cycle type Diesel engine is being developed by the Lombard Governor Co. of Ashland. Mass., from designs by Mr. McCardy, formerly Chief-engineer of the Midwest Engine Co., Indianapolis. Details will shortly be published in "Motorship."

Interesting Notes and News from Everywhere

LAUNCH OF MOTORSHIP "SCOTTISH MAIDEN"

The 10,050 tons d.w.c. Diesel-driven motor-tanker "Scottish Maiden" was launched on July 7th by. Vickers Ltd., Barrow-in-Furness to the order of Tankers Ltd., London.

SAYS MR. DE GANAHL

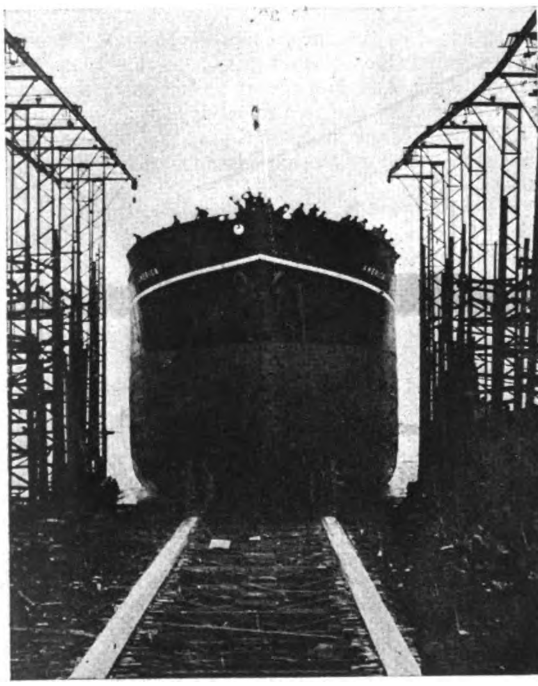
"Reflections have convinced me that every motorship launched is a greater force for the readjustment of the world's economic balance than all the artificial and political remedies that have been or can be applied. The nation that controls the greatest number of tons of oil and transforms that oil into power for engines will hold the economical trade of the world."—*Chas. F. De Ganahl, President, Scottish-American Oil Co., Ltd., 120 Broadway, at the launch of the Diesel-driven tanker "Scottish Maiden."*

THE NEW FRENCH SUBMARINES

Regarding the 36 submarines recently authorized under the new French naval shipbuilding program, the fleet will include submarine-cruisers, mine layers and a number of 800 to 1,000 tons surface-displacement craft.

MOTORSHIP CONSTRUCTION AT THE DEUTSCHE WERFT

On December 31, 1921, the Deutsche Werft A. G. Hamburg, Germany, had a total of ten motorships aggregating 61,200 tons d.w.c. on order with them. Burmeister & Wain type Diesel engines built by the A. E. G. are being installed.



Launch of motorship "America" at the Akers Shipyard, Christiania

LLOYDS MOTORSHIPBUILDING RETURNS

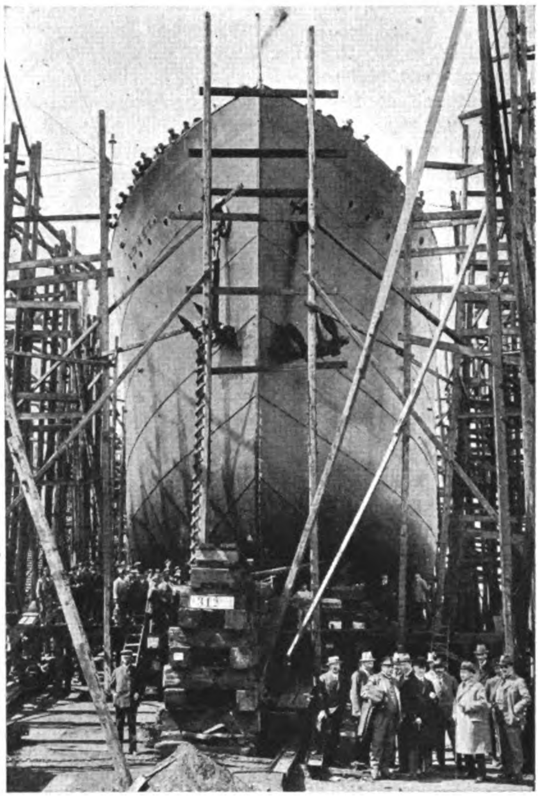
According to Lloyds shipbuilding returns for June 30, 1921, there were no fewer than 127 motorships between 100 and 10,000 tons gross actually under construction in the leading countries, excluding Germany. Outside of Great Britain there were 70 vessels aggregating 239,075 tons gross. In Italy there were 8 steel motorships building totalling 37,706 tons gross and 32 wooden motorships aggregating 10,740 tons gross.

LAUNCH OF MOTOR TUG

"Rocott," a 320 b.h.p. Bolinder oil-engined motor-tug of 75 ft. length, 16¼ ft. breadth and 8¾ ft. depth, was launched at Pollock's yard, Faversham, England, on July 7, to the order of A. J. Humphrey & H. Grey, Jr., of London.

BRITISH OIL-ENGINE TO BE BUILT IN INDIA

It has been reported that because of the increasing demand for motor-craft and oil-engines in India, the firm of W. & S. Pollock, Glasgow, Scotland, will establish oil-engine works and a shipyard in the Bombay district.



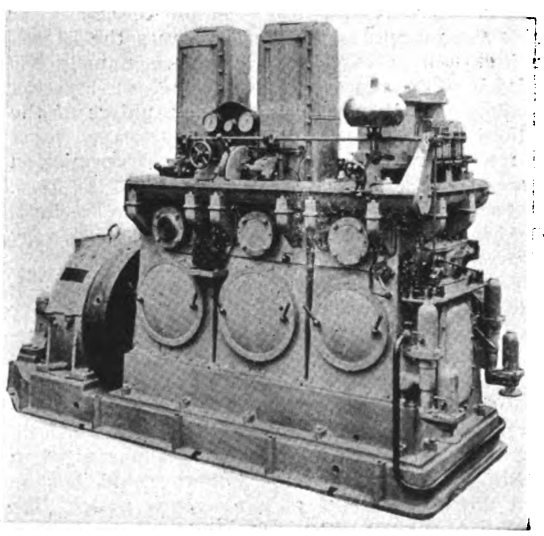
Motorship "Cometa" of the Johnson (Nordstjernan Line) just prior to the launch at Burmeister & Wain's shipyard at Copenhagen

STEAMSHIPS BRING NOTHING BUT LOSS—SAYS JOHNSON LINE

Authorization to sell abroad four steam-driven liners aggregating 24,400 tons gross has been applied for from the Swedish Government by the Johnson (Norstjernan) Line of Stockholm. The company in its application states that it intends to purchase and operate motorships exclusively, because present steamship activity brings nothing but loss. The head of this company is Consul-General Axel Johnson, who recently visited New York in his motorship "Buenos Aires."

FIVE NEW MOTOR-TANKERS

Now under construction in Great Britain are five oil-engined motor tankers of 500 tons d.w.c. each, to the order of British Tanker Co. Ltd., and the first of these has run her trials. Se was built by J. S. White & Co., of East Cowes, who are constructing two more of the fleet. She has been named "Perso," and is propelled by a 180 b.h.p. Kromhout surface-ignition oil-engine with four cylinders, 13-3/16-in. bore by 13-13/16-in. stroke turning at 300 r.p.m. The length of this ship is 125 ft.; breadth, 25 ft. 6 in.; depth, 12 ft. 3 in.; loaded draft, 10 ft. 9 in.



Doxford opposed-piston auxiliary electric-generating set in engine-room of the motorship "Yngaren"

SECOND DOXFORD MOTORSHIP

The second Opposed-Piston engined-motorship for the Trnsatlantic Line now completing at the Doxford Shipyard, Sunderland, will be named "Eknaren."

FROM SCHOONER TO AUXILIARY

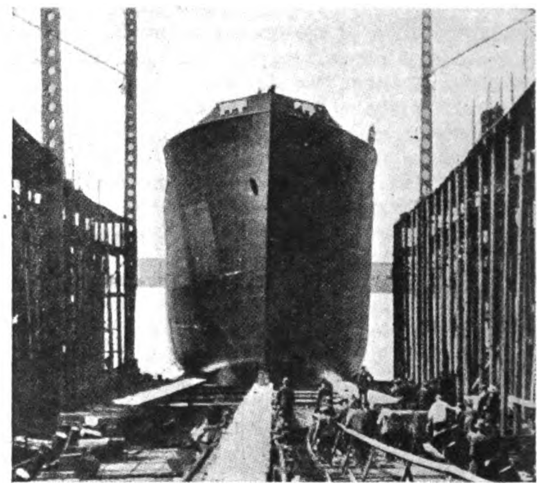
The 300 tons d.w. motor-schooner "Cargo Shipper" has been installed with a 150 b.h.p. Vickers-Petters surface-ignition oil-engine, to the order of Cargo Carriers Limited.

NEW WORTHINGTON ENGINE

A new engine for Diesel-electric drive purposes has been designed by the Worthington Pump & Machinery Corp. It will develop 750 h.p. and will have six cylinders 18-in. bore by 18-in. stroke at 257 r.p.m.

PAPERS READ ON MARINE OIL-ENGINES

Before the Institute of Marine Engineers on March 15 a useful paper was read by M. D. Shannon, entitled, "Some Observations on Marine Oil Engines." A discussion followed. A paper was also read by Lieut. Col. D. P. Lamb, entitled "Practical Notes on the Installation and Running of Petrol, Petrol-Paraffin, and Semi-Diesel Oil-Engines." Col. Lamb was responsible for the upkeep of about 600 marine types of internal-combustion engines in motor-craft on rivers in Mesopotamia during the war. Both papers are published in the June issue of the Transactions of the Institute of Marine Engineers, The Minories, Tower Hill, London, E., England.



Launch of Winge & Co.'s new Werkspoor Diesel-engined motorship "Geisha"

BACK COPIES OF "MOTORSHIP" WANTED

Any reader who has a copy of "Motorship" for July, September and November, 1919, will kindly oblige by communicating with Mr. Leigh M. Griffiths, Senior Staff Engineer, National Advisory Committee for Aeronautics, Langley Memorial Aeronautical Laboratory, Langley Field, Hampton, Va., who is very desirous of obtaining the same.

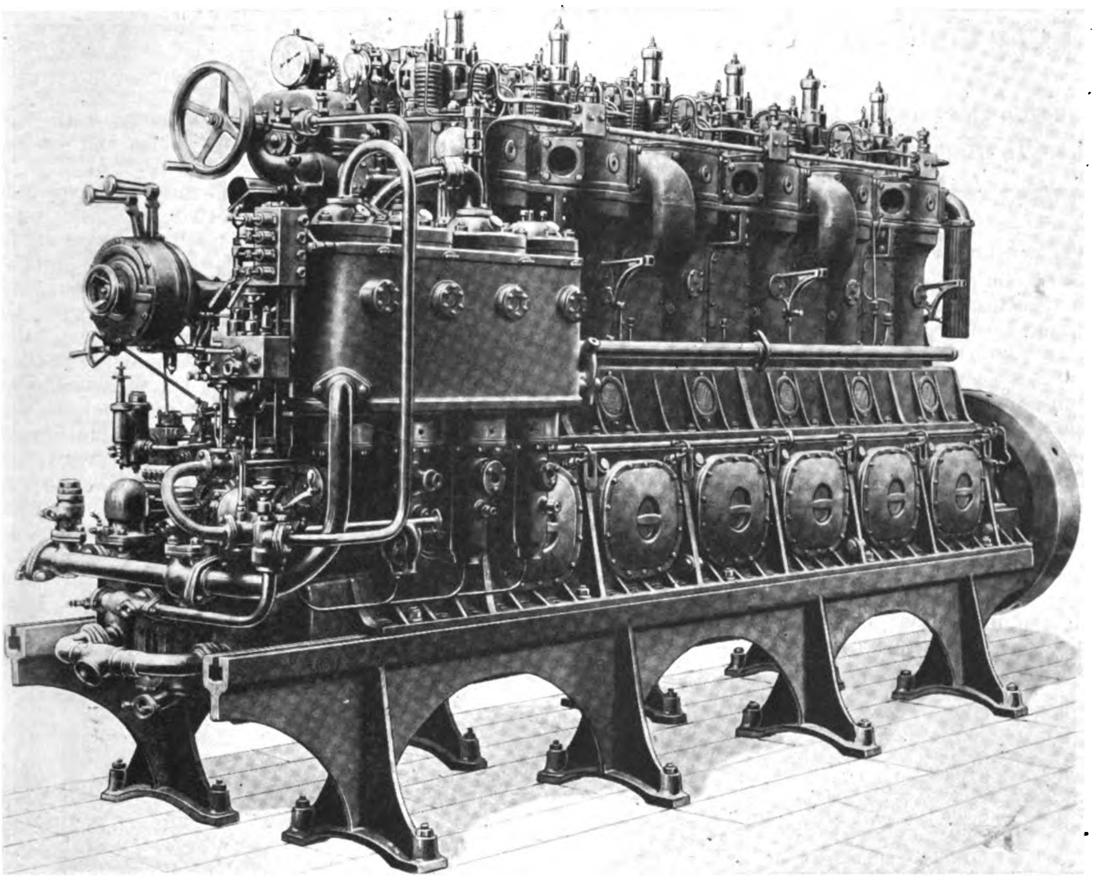
MOTORSHIP "GEISHA" LAUNCHED

One of the numerous Werkspoor-Diesel motorships ordered two years ago, namely the "Geisha," sister to the "Tosca" recently described and illustrated in "Motorship," was launched last month at the yard of the Netherland Shipbuilding Company, Amsterdam, Holland. She is a general cargo vessel of 6,850 tons d.w. c. and 10,260 tons displacement. Accommodation for twelve passengers in six two-berth cabins.

The main propelling engine consists of two 6-cylinder 1,400 i.h.p. Werkspoor Diesel-engines of the four-cycle type, which will give the ship a speed of 11 knots loaded on a fuel-consumption of 9 tons per day.

"MOTORSHIP'S NEW ADDRESS

On July 1st "Motorship" moved into its new offices at the corner of Eighth Avenue and 25th Street, over the Baltic States Bank. We had intended using the Eighth Avenue number, which is 294 as indicated in our last issue, but for the convenience of callers and to simplify direction, we have decided to use the 25th Street number, namely 282. The telephone is Watkins 9848.



The new trunk-piston Diesel marine-engine built by Usines Renault, Billancourt, France. Further details will shortly be given

24-Hours' Endurance Trial of 1,000 b.h.p. "Camellaird-Fullagar" Oil-Engine

A Fuel-Consumption of 0.391 lb. per B.H.P. Hour Recorded

Engine:—Four-Cylinders. Pistons 18½in. diameter by 25 in. stroke. Rated at 1,000 B.H.P. at 115 R.M.P. Air-injection.

This engine ran steadily during the whole trial without a hitch or any signs of heating, and the power developed varied between 1,060 B.H.P. and 940 B.H.P., the variation being due to unsteady water pressure in the brake.

At the termination of the 24 hours' trial and continuous with it, a fifteen minutes' overload trial at 1,200 B.H.P., or 20% overload, was carried out, proving that all parts were in perfect condition.

Previous to this trial time had not permitted of more than two hours intermittent running on full load, and the preliminary tuning up was of short duration.

The average fuel-consumption was low, being only 0.391 lb. per b.h.p. per hour, and another notable feature was also the low scavenging-air pressure of 1¼ lbs. per square-inch, which to some extent accounts for the low fuel-consumption.

The following are the average results for the 24 hours:

B.H.P. 1,000
I.H.P. 1,400
Mechancial-efficiency 71.5
Fuel-consumption ....0.391 lb. per B.H.P. per hr.
Fuel-consumption ......0.28 lb. per I.H.P. per hour
Scavenging-air pressure ......1¼ lbs. per sq. in.
Blast air......1st stage ......40 lbs. per sq. in.
2nd stage ....225 lbs. per sq. in.
3rd stage ....1060 lbs. per sq. in.
Lubricating-oil pressure ....12½ lbs.
Circulating-water pressure ....20 lbs.
Temperature....Circulating-water inlet....58° F
Circulating-water outlet....94° F
Lubricating drain ....94° F.
Piston-cooling water Upper.102° F.
Piston-cooling water Lower..66° F.
Fuel used....Anglo-American..........S.G. 0.92
Flash point above........................150° F

At various periods during the trial representatives were present from many engineering and shipbuilding firms, and also the superintendent engineers from numerous shipping companies.

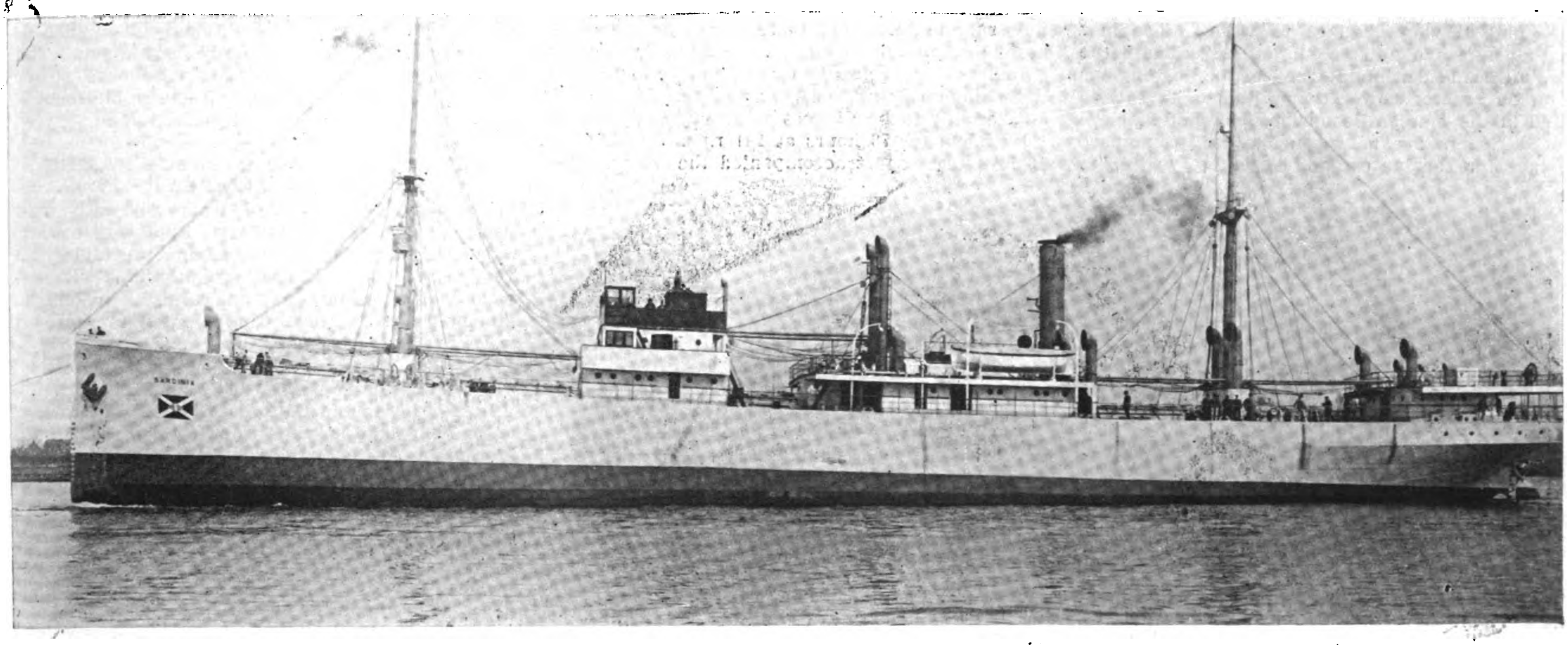
RECORD OF THE WOODEN MOTORSHIP "LIBBY MAINE"

One of the most remarkable performances that has been made by any motorship so far built for deep-sea service is that of the cargo vessel "Libby Maine," which is owned and operated by the Salmon Department of Libby, McNeil & Libby in salmon carrying and general freighting out of Seattle. It is claimed by the navigators, and so far as we have been able to determine is a fact, that this vessel, since going into commission, has made more actual running time than any other full-motorship type so far built in this country, having since her launching in 1918 travelled over 60,000 miles.

This record is especially interesting in view of the fact that the vessel was built on the Pacific Coast and is powered with Diesel-engines which are the product of a Pacific Coast factory and which, up until the time this installation was made, were practically unknown. The "Libby Maine" was built in 1918 in Portland, Oregon, by the Standifer Construction Co., and is a full-powered motorship, equipped with two 320 b.h.p. Dow Diesel engines, built by the Dow Pump & Diesel Engine Co. of Alameda, Cal. Her owners operate a number of salmon canneries in Alaska and also numerous fruit and vegetable canneries along the Pacific Coast and built her for the primary purpose of carrying supplies to these northern plants and bringing back salmon, and secondarily to carry salmon and other canned goods to the Atlantic Coast and foreign markets. When not engaged in any of the above work she has been used in general service and has made trips to South America and the Orient on several occasions. She will carry 50,000 cases of salmon or 2,000 tons of miscellaneous cargo.

In the time she has been in service she has proven not only very economical but also very reliable. When first put into service she burned on an average between 17 and 18 barrels of fuel daily, but a year ago a pair of specially-designed propellers were installed that gave her much better efficiency, and cut her fuel-consumption down to between 11 and 12 barrels. Never since the boat was placed in commission have her engines really been out of commission and the only repairs have been minor upkeep repairs made in port.

Since 1918, the "Libby Maine" has made sixteen different voyages, mostly to Alaska, although among them was a voyage to the Orient which totalled 14,170 nautical miles. A record of these trips, showing the distance covered, the time taken was published in "Motorship" a few months ago.



New single-screw 2,000 i.h.p. Werkspoor Diesel-engined motorship "Sardinia," described on pages 476-77 of our June issue

Electric Stoves for Ship's Cooking

Electric Auxiliaries Aboard Motorships Cause Wider Adoption of this System

TO-DAY the average motorship of five-thousand tons or over has at least 200 horsepower in auxiliary electrical-power which is used for various purposes, mostly for operating engine-room and deck machinery. Some motorships have as high as 1250 b.h.p. in electric generators and motors driven by oil-engine power apart from the main Diesel-machinery, as for instance, the "Domala" and other motor passenger-liners of the British India Steam Navigation Company, with which all the cooking, heating, power and lighting is carried-out by means of electricity.

Danish shipbuilders and shipowners were responsible for originating the use of electrical auxiliaries aboard motorships, and it will be recalled that the 7,500 tons d.w. motorship "Selandia" placed in service in 1912 dispensed entirely with steam for power, with the exception of a small donkey-boiler used for heating. So successful and economical did Diesel-electric auxiliary power prove, that practically every modern vessel of this class is now equipped in this manner, with the exception of a few tankers where a large quantity of steam is sometimes required for heating the oil-cargo. Nevertheless, in the port of New York tankers are prohibited by regulations from employing open fires in the galley or elsewhere on the ship during the loading of oil-cargo, so even on motor-tankers Diesel-electric devices play their part. To quote an example the Danish Diesel-tanker "Mexico," which carries bunker-oil for use of the big fleet of motorships of the East Asiatic Company, found her electric galley very useful when in port, and this avoided the necessity of the crew going ashore for all their meals.

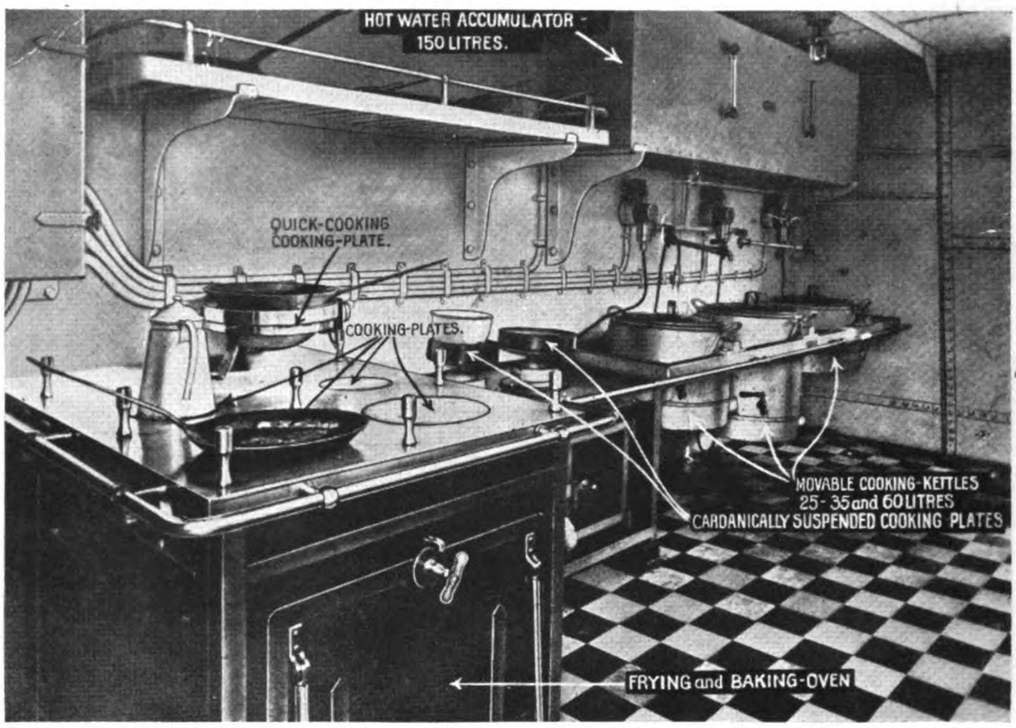
The electric cooking-equipment installed in this vessel is quite of interest, and we are enabled to give some details and illustrations through the courtesy of the makers, the Vesta Electric Works, Ltd., Copenhagen, Denmark. The galley has a capacity for serving a crew of 30 to 40 men, and comprises three cooking-kettles, one hot-water accumulator, and two kitchen ranges. The electric-range has dimensions 400x620x900 mm. and is provided with an oven for baking and frying. There is one element each for top and bottom heat of respectively 3,000 and 5,000 watts, the total consumption of current aggregating 8 kilowatts at full heat development—the latter can be regulated in 3 stages by contacts. The oven is efficiently insulated on all sides.

Arranged on the oven plate are three cooking-plates of 175, 225 and 275 mm. diameters, for respectively 550, 1000 and 1500 watt, each being regulable in 3 stages. The switches are placed in front of each plate and the provision includes further a roller frame.

The second kitchen range is fitted with two cooking-plates in cardanic suspension, the plates being regulated as just described. They are 225 and 275 mm. in diameter respectively, and are provided with a low gravity center which prevents the kettle and pan from slipping as a result of shocks or pushes. The three 4-kilowatt cooking-kettles are of 25, 35 and 60 litres capacity respectively with 3 pitch switches mounted on the kettles, which are made of tinned copper and surrounded by a massive non-conducting casing, equipped with plug-cocks and pivots for their suspension and thwartship movement.

The 3-kilowatt hot-water accumulator holds about 150 litres. It is fitted out as the kettles, further with partition, water glass gauge, termometre and the necessary plug-cocks, inlet pipes, etc. The cooking-kettles are connected with the fixed lines by means of flexible cables and water-tight branch contacts.

Among the extra apparatus supplied are two rapid cookers and a plate fitted with the new patented Vesta thread-pipe heating-body that is arranged direct below the bottom of the kettle. Very quick heating is attained which is mainly used for roasting. The total consumption with all apparatus in full operation amounts to 39.6 kilowatts. However, actual experience has proved that only one-third of the apparatus on an average is in use at the same time developing but half the heat, so that the actual kilowatt consumption is much reduced in daily service and can be neglected at sea when the generator set is already running. When accustomed to the electric system, few cooks desire to return to the older, dirtier and slower system. Electric galleys have been supplied by Vesta Ltd. to Russian submarines both before and during the war, also to the East Asiatic Co., Burmeister & Wain, the Royal Danish Navy and others. The company is now negotiating to equip American motorships.

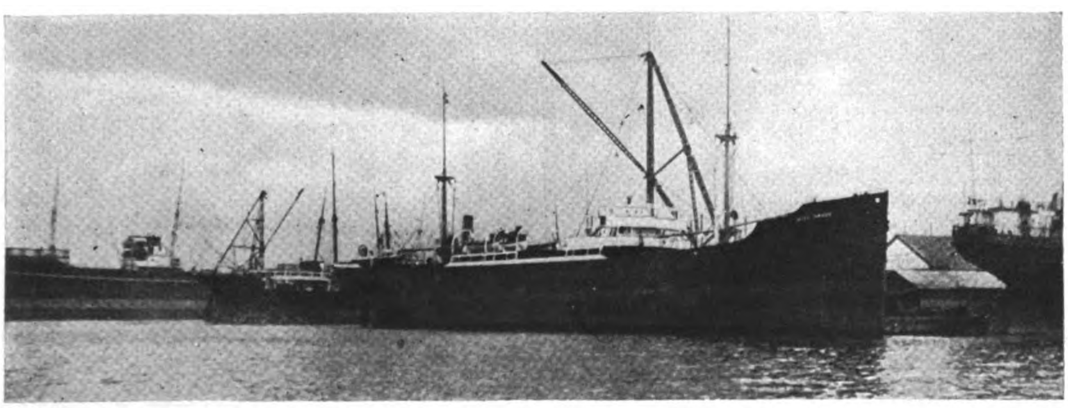


Galley of motor tankship "Mexico" showing arrangement of the electrical cooking equipment

LARGE CYLINDER ENGINES

In an interesting paper before the Institution of Civil Engineers, London, dealing with Internal-Combustion Engines With Large Cylinders, Sir James McKechnie stated that so completely has the point of view changed regarding oil-engines that owners are now seeking to investigate the possibilities of marine internal-combustion engines of much greater power than hitherto have been fitted in the mercantile-marine, and that builders and designers are being encouraged to prepare designs for the largest and speediest vessels to be constructed. Also, that orders for motorships in some cases are being carried-on while similar steamships have been cancelled.

Regarding cylinder sizes Sir James said that marine oil-engines up to 30 inches diameter are now running, and that there seems no reason to assume that they cannot be made with larger cylinders. He referred to a single-cylinder two-cycle double-acting Diesel-engine 30" dia. by 36" stroke built at the Vickers plant having developed 1,042 b.h.p. for 73 hours at 141 r.p.m. in 1913. A 10-days test report accompanied the paper. The fuel-consumption dropped as low as 0.363 lbs. per b.h.p., which is very remarkable for a two-cycle engine. Copies of tests of an engine having 340 b.h.p. cylinder output at 375 r.p.m. were included in Sir James' paper. Also tests of one of the twin 1,250-shaft h.p. Vickers oil-engines of the tanker "Scottish Standard" were given. The aggregate i.h.p. was 1,760 and the brake power about 1,342.8 at 120.6 r.p.m. Sir James McKechnie is the Technical-Director of Vickers, Ltd.



Motorship "Leise Merske" fitting out at the Burmeister & Wain shipyard. In the background can be seen the motorship "Malaya." The "Leise Merske" is of 3,015 tons gross, and is owned by the Svendborg Steamship Co. (See page 217, March, 1921.)

RECENT PROGRESS IN LARGE MARINE DIESEL ENGINES

The above is the title of a paper recently read before the Institution of Civil Engineers by Mr. James Richardson. Accompanying the table is a very useful list of 20 leading motorships with various makes of Diesel engines giving their general dimensions and output. Unfortunately pressure on space prevents our publishing the same.

"MOTORSHIP" PRODUCES FRIENDSHIP

In a letter to the Editor of "Motor," a Swedish automobile and marine publication, Mr. Hugo Moren, one of the engineers of the Swedish motorship, "Elmaren," stated that when in Australian waters the pilot and himself became good friends after the captain loaned the pilot his copies of "Motorship." These, by the way, gave many on board a great deal of pleasure. Mr. Moren is the Swedish civil-engineer who took a position on board the "Elmaren" during the strike of ships' engineers in Sweden.

Injection and Combustion of Fuel-Oil

Experiments With Solid-Injection and Air-Blast in Marine Diesel-Engines

By ENGR.-COMMANDER C. J. HAWKES

PART V

(Continued from page 567, July issue)

IN the case of the automatic-valve, shown in Fig. 13, it will be seen that the full fuel-pressure is close up to the point of exit of the fuel-oil from the sprayer. As soon as the automatic valve lifts the full available pressure causes a fine spray to pass the valve seat. When the valve lifts beyond a certain small amount the spray is formed by the oil being forced through the grooves G at a high velocity and the valve ceases to have any appreciable effect on the quality of the spray. Similarly when the valve closes the control of the spray is taken up by the valve end and a much finer spray is obtained at the instant of closing than is possible with the direct-lift type of fuel-valve. The spray past the valve-seat, as distinct from the spray resulting from the fuel passing through the grooved plate at high velocity when the valve is clear of its seat, can be made so fine that it has little or no penetrating effect, and therefore such a fine spray is to be avoided, at least in the case of high-speed engines. With the automatic-valve, therefore, the closing and opening of the valve should be as rapid as possible.

With the valve shown in Fig. 13 considerable trouble was experienced, as in the case of experimental valves of other designs, due to the inclination of the fuel-valve to the axis of the cylinder of the single-cylinder experimental engine. Experiments were made with different types of nozzle plates with the object of turning the spray, and although nearly 100 B.H.P. was developed at 380 R.P.M. the results were unsatisfactory. A very fine spray could be produced with the automatic valve, but the moment an attempt was made to deflect the spray the particles of oil coalesced and the energy of the spray was largely lost.

At a later date a new cylinder cover, designed to take a vertical fuel-valve, was fitted to the experimental cylinder. When the new automatic-valve was made it was tried in the atmospheric testing apparatus (shown in Fig. 10) and a very fine spray was produced. The shape of the combustion space of the experimental engine necessitated, however, the use of a spray of wide angle and it was found that considerable energy was lost in producing it. The valve was then tried in the experimental engine, with various numbers and sizes of grooves in the nozzle plate, but only 66 B.H.P. at 380 R.P.M. was reached satisfactorily. Better results would doubtless have been obtained had it been possible to use higher fuel-pressures; as the energy of the fine sprays produced would thereby have been increased, resulting in an improvement in the penetration, and consequently in the distribution, of fuel-oil in the combustion space. At low speeds the automatic-valve was very satisfactory and it was found that the engine could be run for long periods at 6 B.H.P. and 116 R.P.M., whereas with the direct lift type of injection-valve it was difficult to run the engine below 25 B.H.P. at 140 R.P.M. without misfiring. When the automatic-valve was in use at the lowest power an indicator diagram was taken with the pencil held on the paper during six successive injections of fuel and only a single line diagram was recorded, indicating that the firing was certain and regular, and that the automatic-valve was superior to the direct-lift injection valve for low-speed running.

From the experience gained it was evident that with an automatic-valve on the lines of Fig. 13 satisfactory results could not be obtained with the fuel-pressure used owing to the shape of the combustion-chamber of the experimental cylinder. to use solid-injection satisfactory it is necessary to pulverize the fuel-oil as finely as possible, and at the same time to produce a spray with sufficient penetration to ensure that the fuel is brought in contact with the air required for its combustion. Unfortunately these two requirements are incompatible and it is necessary therefore to effect a compromise—and this compromise can only be reached largely by trial and error. In the case of the automatic valve shown in Fig 13 the pulverization was excellent but the penetration was poor i.e., the energy of the sprays, owing to their finely-divided state, was rapidly lost when they entered the compressed air in the combustion space, and this resulted in the presence of a rich mixture in the vicinity of the fuel sprayer; which was followed by late burning. The lack of penetration of the automatic valve sprayer was more marked as the angle of the spray was increased.

As it was not possible to modify the shape of the combustion space of the experimental engine without considerable structural alterations, or to employ higher fuel-pressures, the automatic valve described was put aside. In nearly all the fuel-valves subsequently experimented with at the

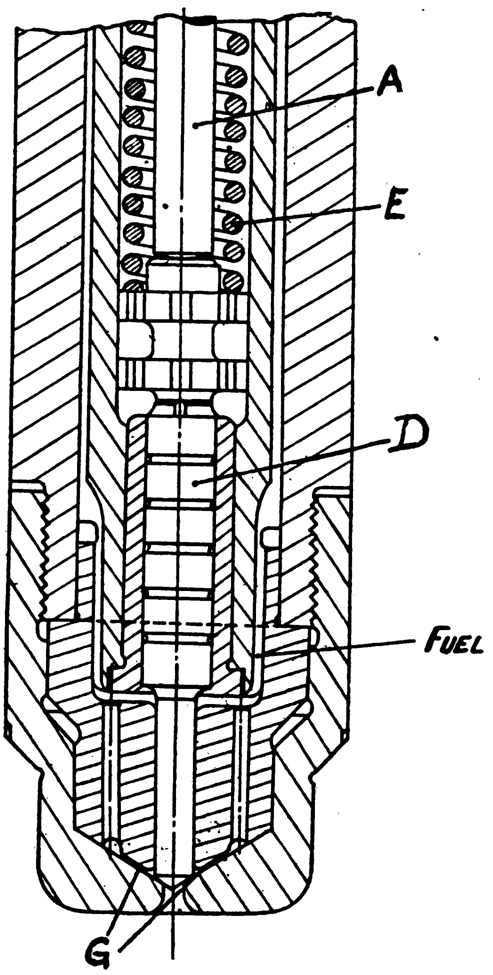


Fig. 13

Laboratory, both air and solid-injection, the principle of the automatic-valve was, however, retained; but in order to obtain the necessary penetration of the sprays multi-hole sprayers were employed on the lines of the direct-lift fuel valve previously referred to.

Referring again to Fig. 13 it will be seen that the plunger of the valve D has to be a very good push fit in the bush to avoid leakage at high fuel-pressures, and it is desirable for machining purposes that this plunger should be not much less than 0.5 inch in diameter. The spring which loads the spindle A must at least be strong enough to withstand the full fuel-pressure on the underside of the plunger D. In cases, therefore, where it is necessary to fit a plunger of a diameter much larger than 0.5 inch it might be desirable to fit a balanced type of valve and so avoid the use of a heavy spring. It might be mentioned that the common-rail system cannot be used with the automatic type of valve unless it embodies the principle shown in Fig. 13.

Good results have been obtained at the Admiralty Engineering Laboratory with solid-fuel injection but in nearly all cases shale fuel-oil has been used in the tests. A few tests were carried out with Texas and American distillate-oils and satisfactory results obtained but no other fuel-oils have so far been tested. It would be interesting to hear whether smokeless combustion has been obtained with fuel-oils other than those referred to above, in an engine running at 380 R.P.M. and at not less than 100 lbs. mean indicated pressure. The problem is perhaps less difficult in the case of engines of slower speed working at comparatively low mean pressures.

Experiments were carried out with the object of ascertaining whether improved results would be obtained with the solid- injection system by increased turbulence, due to increasing the velocity of the air through the induction-valve. These experiments indicated that there was no improvement due to increased turbulence; in fact, the fuel-consumption was slightly increased and the exhaust was slightly shaded. In the explosion-engine ignition commences at one point of the inflammabe mixture of air and fuel vapour, by electric spark or other means, and turbulence is essential for the rapid propagation of the flame. In the Diesel-type of engine the fuel-oil is sprayed into air which has been compressed until the temperature of the greater portion of it is above the ignition point of the oil. The time required for complete combustion is consequently dependent on the fineness of the spray, on the speed of vaporization of the oil globules and on the speed with which the oil vapour is brought in contact with the air required for its combustion.

On the face of it, therefore, it would appear that turbulence would also assist combustion in the case of the Diesel-engine—but it will be seen that a high degree of turbulence might have a harmful effect by distorting the spray and causing a portion of it to be brought in contact with the comparatively cool walls or cover of the engine before the oil globules had completely vaporized. This action would produce a smoky exhaust. It is very essential that a fuel spray should not strike a cool surface, and as a high degree of turbulence would have a tendency to bring this about it is considered that turbulence is not so desirable in the Diesel-engine as it undoubtedly is in the explosion engine. The turbulence referred to is, of course, that due to high air-speeds through the induction-valve and not to the use of blast-air in air-injection engines. Blast-air splits-up and distributes the fuel-oil in the combustion space, but its acts symmetrically about the centre line of the sprays and its direction of action is under control (depending on the position, size and shape of the holes in the distributor or flame plate); consequently it is much less likely to drive a portion of the fuel on to the cool walls of the liner and cover.

There is no doubt that solid-injection has much to recommend it, so long as it is in every way satisfactory on Service. By its adoption it is not necessary to make provision for an air compressor for supplying blast-air—and the high-pressure compressor, as is well known, has in some instances been a continued source of trouble. Air-injection is, however, principally used to-day and it seems fair to presume, therefore, that many manufacturers have largely, if not entirely, overcome their compressor troubles. So far as present experience is concerned it is considered that a greater variety of fuel-oils can be used satisfactorily with air injection than with solid injection. With the fuel-oils experimented with at the Laboratory it has been found that up to about 100 lbs. mean indicated-pressure the fuel-consumption with solid-injection is approximately the same as the fuel-consumpton with air-injection, at the same power and speed, after taking into account the power required to drive the injection-compressor.

This means that whilst the consumption per B.H.P. is the same with both systems the consumption per I.H.P. is less with the air-injection engine than with the solid-injection engine—i.e., the combustion of the fuel-oil in the air-injection engine is slightly better than in the solid-injection engine. This difference is no doubt largely due to the better and more rapid distribution of the fuel-oil mist in the compression space which naturally follows the use of air for injection purposes, as the sprays have more energy, and the air when it expands in the combustion space carries the fuel-oil mist with it. Owing to the cooling effect of the injection-air, however, a higher compression is necessary with air-injection.

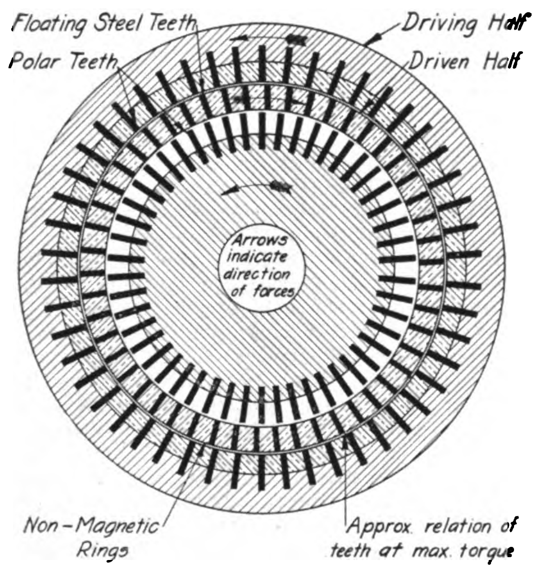
(To be continued)

Electro-Magnetic Clutch for Marine Oil-Engines

WIDER application of the Diesel and surface-ignition types of engines to certain classes of small commercial and pleasure boats has been severely limited in the past due to certain characteristics of the engines which render them somewhat unstable in control, or in other words, have insufficient maneuvering qualities to suit the small boat requirements, especially at slow-boat speeds. The accepted and orthodox method of solving this problem has been through the use of speed-changing gears involving mechanical clutches of various forms in order to adapt the Diesel engine limitations to the propeller speed requirements.

Characteristic defects of the orthodox types of mechanical clutches have been known and struggled with for many years with varying degrees of success, and have been endured because there has been no other device known to the mechanical arts which offered a reasonable hope of solving the vexatious problems constantly encountered. Engineers familiar with the installation and application of power-transmitting devices, have had in their mind's eye for years an deal form of coupling which would be self-aligning without restraint and be flexible in torsion by the use of a "weight-less" spring.

These ideals have long been recognized and striven for and until the advent of the Sperry type of magnetic coupling have been impossible



of attainment. In this form of clutch coupling torsional resistance is developed due to the bending or distortion of the magnetic-flux stream passing from the teeth of one polar projection through floating steel-teeth embedded in non-magnetic material and into the teeth on the opposite polar projection.

The component parts of this coupling are so arranged as to enable this distortion of the flux stream to be made in the plane of revolution and a perfect "weight-less" torsional spring is thus provided, see Fig. 1. It will be noted that the magnetic flux passes through the two gaps in series and is thus utilized twice. In this double use of the same flux there is a reversal of the old maxim—"The mill will never grind with the water that has passed."

As there is no mechanical contact in the plane of revolution there can be no shock due to sudden changes in the power transmitted or due to the stretching or failure of the organic material or steel springs as used in the ordinary type of coupling. It will be thus seen that this coupling is a true magnetic coupling and does not depend for its power transmitting capacity through the medium of friction, springs, links, pins, bushings, or other of the old and familiar arrangements which have been known to the art. This clutch has been described as having a "velvet" touch and its nearest analogy is the pneumatic cushion of the type in familiar use on automobiles.

Component parts of the coupling are of an extremely simple form, as may be noted from Fig. 2, all parts being of substantial and rugged form. As there is no mechanical contact in the plane of revolution, the component parts are not sub-

Details of the Sperry Clutch Designed for Small Commercial and Pleasure Craft—Many Benefits Claimed to Be Secured by Its Adoption

By C. B. MILLS

Chief Engineer, The Sperry Gyroscope Co.

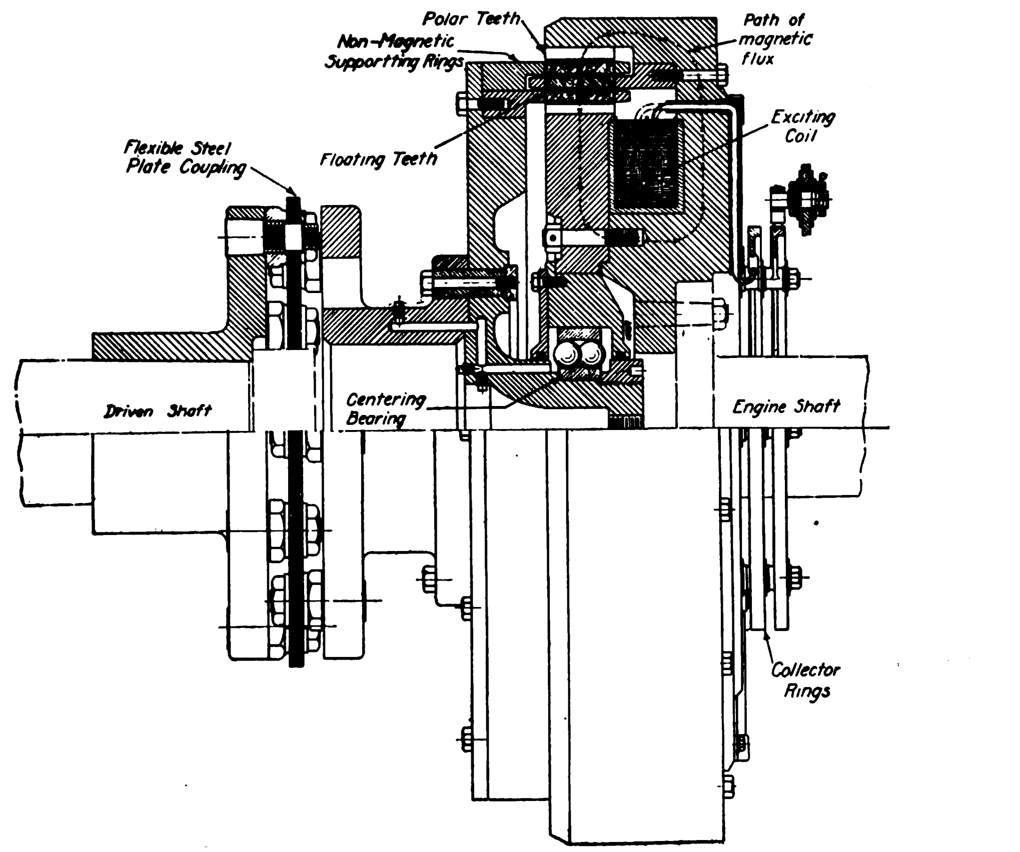
jected to shock of any kind and there is no liability of parts becoming loosened, worn, or broken due to the severest service condition.

The half coupling carrying the floating teeth is normally centered by a sleeve or ball-bearing projection from the opposite half of the coupling. This centering projection maintains a normal condition of the air gap and prevents exterior forces due to shaft misalignment or other conditions disturbing the proper relation of the coupling parts. The air gaps maintained in the coupling are relatively large and the floating magnetic-teeth are cast solidly in a non-magnetic ring which is made by a process insuring permanent retention of the teeth and safety against all of the working and handling conditions which may be encountered in assembly and fitting.

tions as a guard against overloading some particular part of the system. No detrimental effect is caused by starting continuously even under load.

The characteristic speed torque curve as shown in Fig. 4 will serve to illustrate very clearly the effect of the high conductivity metal surrounding the magnetic teeth. The torque due to magnetic induction only, when one half of the clutch is fixed and the other half revolving at speed, falls off very rapidly and is reduced practically to zero at a speed difference of approximately 1,000 feet per minute. This reduction of torque at high speeds is due to the inherent inertia of the fluc lines and their inability to build up to any high value in the time in which a floating tooth is passing under the polar tooth projections.

Inversely, it will be noted that as the speed difference between the two halves approaches zero the torque builds up very rapidly as the clutch halves approach synchronism. One of the unique and novel features of this clutch design is that the magnetic teeth are embedded in and are entirely surrounded by a material of high electrical conductivity. This mass of material moving rapidly in a strong magnetic field has induced in it



Flywheel type clutch coupling as used with 700 h.p. Diesel engine

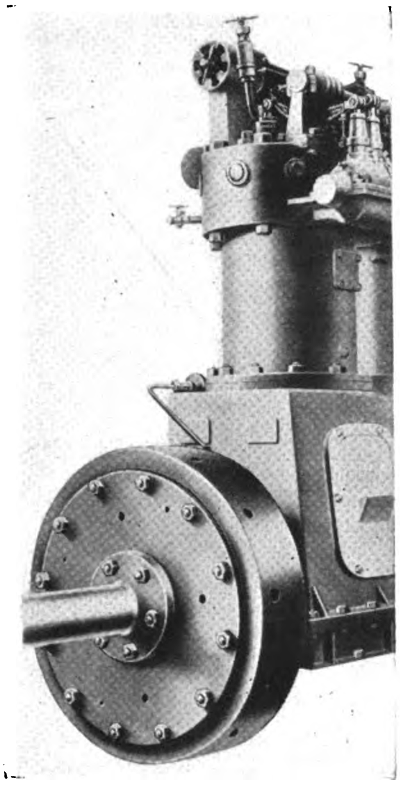
The energizing coil of these couplings consists of a simple circular coil of relatively large size wire which is wound in a form and impregnated with Bakelite. It is insulated to withstand the worst conditions of temperature, dampness and operation. The amount of current required for energizing is extremely small for the power transmitted, as but a few watts are necessary and only a fraction of a kilowatt is required for a coupling of large capacity. The exciting current is led into the coil through a simple form of brush holder bearing on collector rings which are mounted on and form part of one of the coupling elements.

Standard couplings are designed to be operated at a potential of 110 volts, D. C., although exciting coils may be wound for any voltage up to 500. The couplings are adapted only for operation on direct-current circuits and will not operate on alternating-current systems of any voltage.

The clutch is energized by the simple pressing of a button and the driven part is gradually speeded up and brought into synchronism with the driving part. After clutch is synchronized no slipping takes place unless a load is thrown on clutch greatly exceeding its rated capacity. This characteristic may be utilized in many applica-

eddy currents especially in the metal between the teeth, and circulating currents in the metal around the teeth, so that a very powerful drag is devel opened which is effective as starting torque to get the load in motion. The magnitude of the currents flowing is at any time roughly proportional to the difference in speed between the two halves of the clutch and it will, therefore, be evident that with a larger speed difference the torque developed will be higher on account of the greater current flowing in the conducting material.

This characteristic is extremely valuable in that the maximum of starting torque is developed at the instant or at the time when the static friction or "friction of rest," of the load to be started is the greatest, as, for instance, in picking up a propeller. As soon as the load is in motion and turning over, the torque, naturally, drops off as the speed increases until it reaches a point where the starting torque curve intersects the curve of torque due to magnetic induction only. In practice, this point is taken as approximately the rated capacity of the clutch. From this intersection the torque will be seen to rise very steeply and the load is rapidly accelerated up to synchronous speed.



Clutch installed on engine

This characteristic, it will be noted, provides a possibility for continuous operation at any speed between zero and the speed indicated by the bottom of the loop in the speed torque curve shown in Fig. 4, it being possible to adjust the exciting current in the coil to a value which will just maintain the magnetic conditions required to pull the load at a definite speed. What this means in a Diesel engine boat can be readily appreciated as the engine can be kept running at its lowest stable speed and manipulation of the clutch will allow of propeller speeds anywhere ebtween zero and engine speed.

It will be obvious that the use of such a clutch will greatly reduce the demands on the air-pressure system and make, therefore, a simplified and cheaper equipment, at the same time greatly increasing the flexibility and maneuvering qualities.

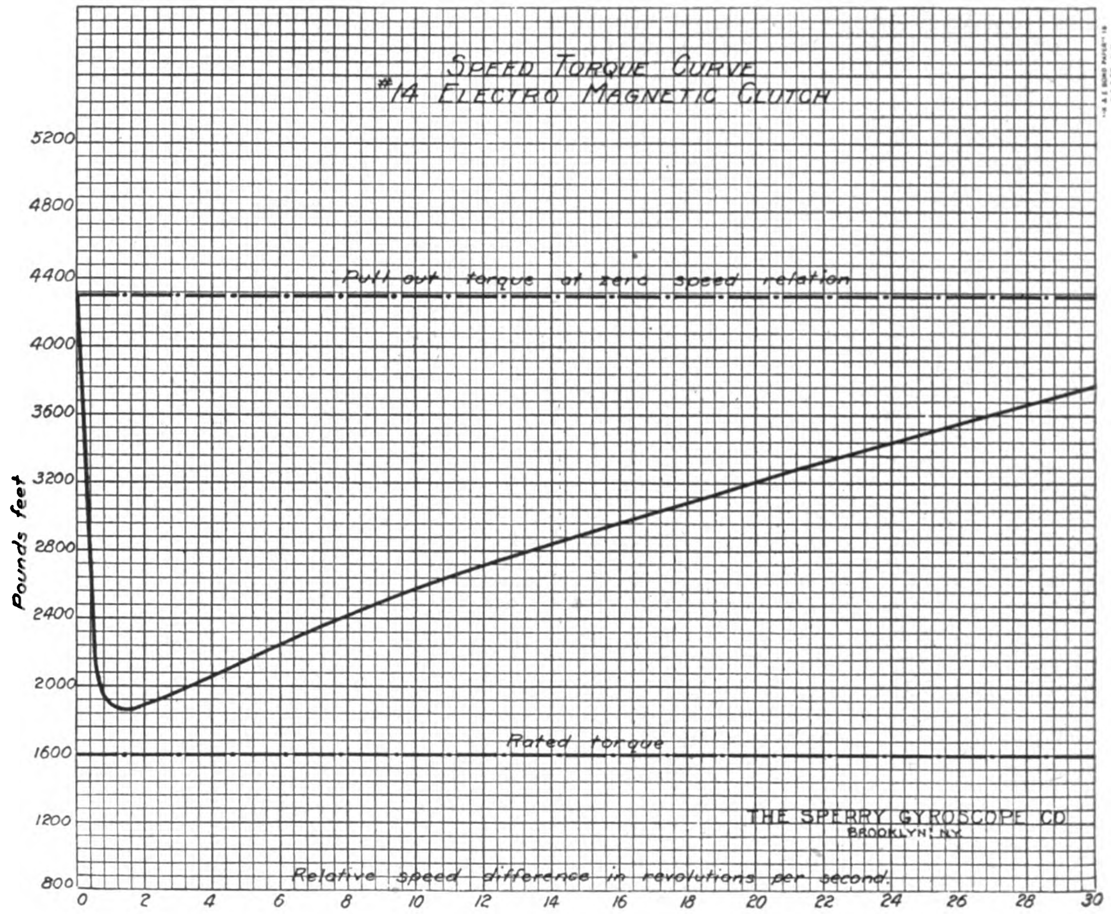
When running under normal conditions, in carrying its rated load, there is no slip whatever between the halves of the clutch and the efficiency of transmission is extremely high. A torque of considerably more than 200 per cent of its rated capacity is required to pull the clutch out of step and this very definite torque capacity at adjustable excitation values may be used as a safety valve in predetermining the exact overload which may be allowed on a shaft system. The efficiency of transmission is very high, as is indicated by the fact that 525 h.p. has been transmitted with a total expenditure in the exciting coil of only 256 watts. This amount of energy is much less than that used to start an ordinary automobile engine. The efficiency of transmission, however is not usually of moment in the solving of ordinary clutch or coupling problems, as the losses due to improper functioning and in the care and maintenance of the average mechanical clutch is such as to make these factors predominate.

This new Sperry type of electro-magnetic clutch coupling is especially adapted to:

- Transmitting power from Diesel or other oil engines.
- Operating air-compressors, cement and steel mill machinery.
- Connecting synchronous A. C. motors to their loads.
- Tandem connection of A. C. generators to source of power.
- The suppression of critical speed conditions in a shaft system.
- Transmitting large powers where accurate shaft alignment cannot be a condition.
- Transmitting large powers where perfect torsional flexibility is a condition.

This new type of clutch has:

- The velvet touch of the electro-motor without its mass and intertia.
- Axial freedom for end-play allowance on motors, generators and similar apparatus where same is essential.

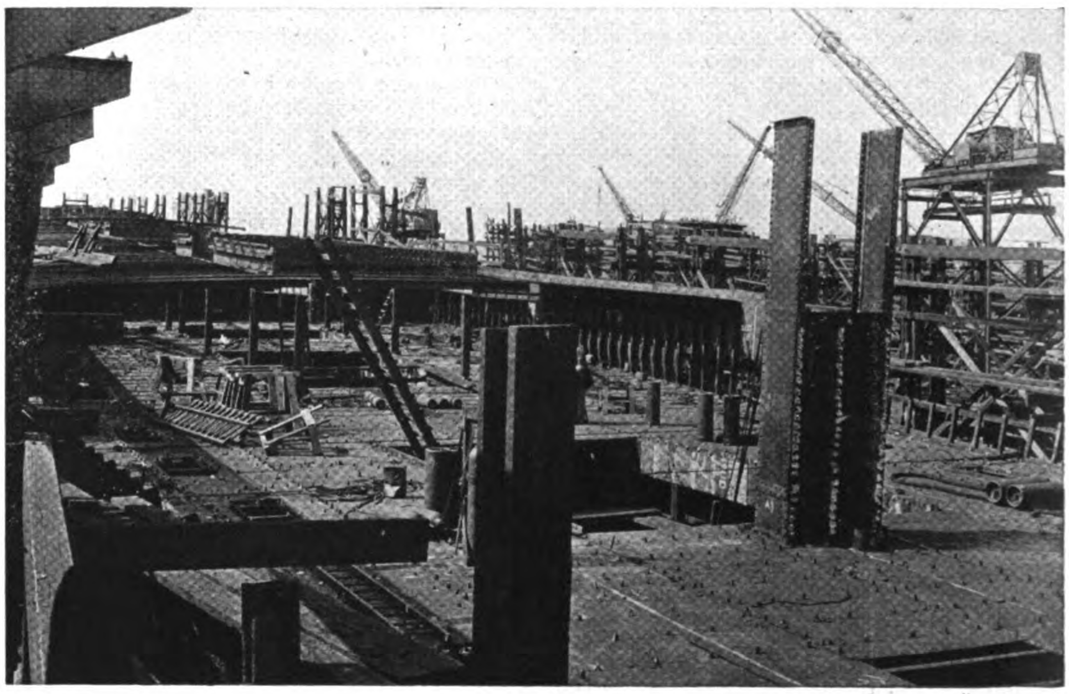


- Facility for remote control with simplest apparatus.
- No parts subjected to mechanical strains, or friction surfaces to wear out.
- No parts which are affected in any way by water, oil, dirt or conditions arising from the severest service operations.
- Capabilities of operating at speeds beyond the range of mechanical and other types of clutches.

This company is placing this clutch coupling on the market with the greatest confidence that it will solve satisfactorily many of the vexatious transmission problems which have confronted mechanical engineers in the past. Problems which have been difficult to solve with the old and familiar means at hand, as the rotational speeds met with in recent years have shown a constant tendency to work to higher magnitudes where the effect of mechanical shock and reaction on the moving mechanisms involved are greatly magnified. Engineers who have witnessed the operation of these clutch couplings have stated that the commercial introduction of this coupling will mark an epoch in the history of the art of power transmission.

CLUTCH CAPACITIES AVAILABLE

Clutch Coupling Number	Max Pull-out Torque lb. ft.	NORMAL RATING Constant Torque lb. ft.	H. P. per 100 rev.	Max. speed r. p. m.	Max. starting torque at 30 rev. per second speed difference	Amperes Reg. at 110 volts	Approximate Wt. lbs.
5	450	175	3.25	3,000	390	1.00	120
7	800	325	6	2,500	780	1.15	265
9	1,300	500	9.0	2,500	1,640	1.25	395
14	4,300	1,600	32	2,00C	3,750	1.50	500
18	6,000	2,200	42	1,600	5,000	2.00	1,100
24	10,000	4,500	85	1,200	8,000	3.00	2,200
32	20,000	9,000	170	900	10,000	4.00	4,000
40	40,000	16,000	305	750	15,000	5.00	6,000



Showing present stage of construction of the two motorships of the American-Hawaiian Steamship Co. now under construction at the Chester Yard of the Merchants Shipbuilding Company. Burmeister & Wain type Diesel engines now building at the Wm. Cramp Ship & Engine Works, Philadelphia, will be installed

Our Readers' Opinions

(The publication of letters does not necessarily imply Editorial endorsement of opinions expressed)

STEAMSHIP OPERATOR STUDIES MOTORSHIP QUESTION

July 11, 1921.

To the Editor of "Motorship":

We will probably get into new construction again when business becomes normal and when ship costs reach an attractive level. Prior to this time, I should be very glad to keep in touch with the design, construction and operation of Diesel-engines, inasmuch as we may find it desirable to go into Diesel-engine propulsion.

Yours very truly,
A. S. HEBBLE,
Superintendent-Engineer,
Southern Pacific Company,
Pier 49, N. R., New York.

MOTORSHIPS AND "MOTORSHIP" IN SOUTH AMERICA

To the Editor of "Motorship":

Having just returned from a South American trip I thought it might be of interest to you to know how motorships are regarded in that country and what they think of your magazine.

A good many motorships call at ports on both coasts and shipowners are interested. One owner said they come into port so silently, get their cargo, depart with no fuss and never seem to get any fuel.

I saw your magazine on sale in Valparaiso and several engineers asked me if I had any spare copies. It is unquestionably the authority in South America on all matters pertaining to oil-engines and motorships.

Yours very truly,
HARRY SUMNER.
Seattle, Wash.

ADVANTAGES OF THE DIESEL-ELECTRIC DRIVE APPLIED TO MARINE PROPULSION

To the Editor of "Motorship":

In a recent paper (by Messrs. J. F. Metten and J. C. Shaw) which has attracted considerable attention, the Diesel-Electric Drive system was referred to in rather unfavorable terms. Like the majority of other questions, there are two sides to it, and the ship-owner who contemplates the use of Diesel engines—and there are very many who are always in the van of progress, seriously taking thought of the morrow—should and would carefully consider all the factors before making a decision.

In the selection of the motive power for any vessel, various factors enter into the problem, in about the following order:

1st. First cost.
2nd. Suitability for the required type of ship.
3rd. Space and weight occupied.
4th. Cost of operation.
5th. Reliability.
6th. Life of the installation.

If it were possible to assign numerical values to each of the pros and cons affecting each of the factors it would then be possible to arrive at a definite conclusion free from prejudice and opinion. But unfortunately these factors cannot be so valued excepting where certain definite propositions are put up, one against the other, and where actual experience and data are available. It is to be regretted that at the present time sufficient experience is not available, so the problem reduces itself to a comparison of actual bids and guarantees, together with the exercise of considered judgment and common sense towards any factors not covered by such bids and guarantees.

With the data and experience that has been obtained the following statements may be made relative to the several factors.

First Cost.—The most direct answer to this question is to get bids from the builders of the direct-drive and the electric-drive systems. The New London Ship and Engine Company, whilst ready to bid and build on both systems, has worked in conjunction with manufacturers of electric equipment and is prepared to make bids on the complete electric-drive system. Its estimates and experience to date indicate a slightly cheaper first cost for the electric drive installation. There are two reasons contributing to the above result, one of which is that the total weight of such an installation is less, and consequently the cost of material is less, and the other is that both the engines and electrical machinery are standard, and so can be manufactured in quantity, thus taking advantage of the well-known saving due to mass production.

A further reason is that it is not necessary for the auxiliary generating units in the Electric-Drive installation to be so numerous or so large as in the case of the direct-drive, for when handling cargo, assuming electric power is utilized as is the case of practically all Diesel installations, one unit of the main engine is used, efficiently and economically, while one, two, or three auxiliary units of fairly large capacity are required for this work when the main engines are direct connected. Add to this that the provision made for supplying maneuvering air and its storage for this type is greatly in excess of that required for starting purposes only of the other type, and that this costs money, it can be readily seen that the cost of main propelling machinery for electric drive includes a large part of the cost of the auxiliary machinery, which is not so included in the first cost of a direct drive proposition.

Suitability of the Machinery for the Required Type of Ship.—The type of ship depends in many cases on the individual preferences of ship-owners, based for the most part on practical experience. A single-screw ship is considered essential by many, partly for the sake of higher propeller efficiency, partly because shipbuilders construct this type more cheaply than that with twin screws, partly to enable decent afterbody lines to be obtained with machinery placed aft, and partly to prevent, so far as possible, damage to propellers when coming alongside. The electric drive is ideal for any or all of the above considerations, as the main engines may be arranged without much regard to position so long as they are in the machinery space, and thus the lines may still be fine without the machinery space being too far forward. Single screws can be used without sacrificing the advantage of having two, at least, similar sets of main engines. Fortunately these same advantages can be obtained when the electric-drive system is installed amidships. At the present time there are many shipowners who would not consider Diesel propulsion, reliable though it has proved to be, unless the vessel had more than one set of machinery capable of operating the propeller. Furthermore, there are very few single-screw installations of the power required for ships of 5,000 tons and above, and for this class once again the electric drive is ideal, as it has practically no limitations as regards power with single screws.

Space and Weight.—The slow-speed direct-drive engine is exceedingly heavy—over 400 lbs. per horsepower. Its over-all dimensions are necessarily large. Therefore a correspondingly large space must be devoted to it. The Electric-Drive system, being divided into a number of smaller units, can utilize spaces not available for the larger engine. The greater the amount of power required, the greater this advantage shows up. [Weights of the 10 leading American slow-speed Diesel engines were given on page 293, April issue, and they average 339 lbs. per brake h.p.—*Editor.*]

Cost of Operation.—This includes many things. It is not only fuel, lubricating oils, and attendance, but in a broad way includes depreciation, repairs, maneuvering ability and reliability. An accident, or a long time under repairs would add enormously to the cost, and make a big hole in the profits at the end of a year. Many of these factors are so great that they would completely absorb a slight difference, say 15% in the fuel bill There is a tendency to over-evaluate the advantage that exists between a fuel consumption of 0.42 and 0.45 lb. per b.h.p.-hour, and undervalue the claims of simplicity, ease of repairs, and possibility of obtaining any casting or part in the majority of comparatively small engineering establishments in any part of the world. Apart from these considerations, with the smaller electric-drive engines, all identical, the outfit of spare parts will not be much larger than that required for one engine, so that it is feasible to carry every conceivable part so that every conceivable emergency may be met, without actually carrying so much weight on board compared with the direct-drive larger engine supplied with normal spare part equipment that only touches the high spots, so to speak, of possible replacements.

Repairs to the large direct-drive engine, when they become necessary, are often expensive and should an accident occur in a foreign port and the necessary spare parts not be carried on board, the resulting delay might well run into months, while the electric-drive installation with a similar accident will always be able to make the repair and still operate or, if beyond available resources, can still return to the home port, limping, it is true, but getting there.

To date there have been many types of direct-driven Diesel engines put into service, but only a few have made reputations. The failures were mostly experimental in nature, the products of over-enthusiasm and misplaced confidence. The successes are the products of conservatism and care. The design was exceedingly heavy with few if any untried features and the operating engineers were carefully trained by the builders. It is to overcome these very difficulties that the electric-drive is proposed. The engines being of moderate weight, moderate speed, and simple in the extreme, should not rquire a very highly specialized or numerous personnel. One engineer and one oiler can give all the attention necessary to an entire group of engines, and the electrician, usually carried in Diesel-engined ships, attends to any electrical upkeep necessary.

The question of reliability is so closely connected with that of cost of operation that it has been fairly well covered in the preceding paragraph. The great reliability of the Diesel-Electric Drive comes from two principal elements, to-wit, the inherent reliability, flexibility and smoothness of performance of electric motors; and from the reliability inherent to multiple units.

Life of Installation.—So far as can now be told, there should be no appreciable difference in the life of the two systems. The wear that will and does take place has two causes, viz.: piston speed and pressure. No matter how large or small the Diesel-engine may be, these two elements remain about the same, and are the same in good design, irrespective of size within wide limits.

The ideal internal-combustion engine would be a machine, absolutely standard, enclosed in a box with a few levers projecting, so that it could be started, maneuvered and controlled under all conditions by the movements of these levers. After a certain period of operation, it would be removed bodily for refit, being replaced by one exactly similar, the original being placed into condition for a further period of service. Connect up some such machines to electric generators and let them furnish current to the main motors and the power problem is solved. Such an ideal machine is not yet in existence, but the Diesel-Electric Drive is a step in that direction and is considerably nearer the goal than the direct-drive especially for powers of the order required for passenger and large freight vessels.

It is fitting that the firm which originated electric-drive also has the longest experience of Diesel-engine direct-drive in the United States, so that it can look upon the question quite dispassionately due to its experience of both types and is not committed to any one type to the exclusion of the other with the enthusiasm that is often born of knowledge of one type only.

Yours very truly,
THE NEW LONDON SHIP & ENGINE CO.
E. Nibbs,
Groton, Conn. Marine Engineer.

[Through pressure of space we have been obliged to hold-over many interesting letters until our next issue.—*Editor.*]

MOTOR-TANKER "DOEWA," EX MONITOR

Recently at the Panama Canal was the motor-tanker "Doewa," 497 gross tons. This vessel was a light-draught motor-monitor in the British navy, and was lately converted for merchant purposes. She is now owned by the Curacaosche Petroleum Maatschappij, of Curaco, and was built at Middlesboro, England, in 1915. Length 177.3 ft. Breadth 31.2 ft. Draught 12.2 ft. She is propelled by twin 320 b.h.p. Bolinder oil-engines.

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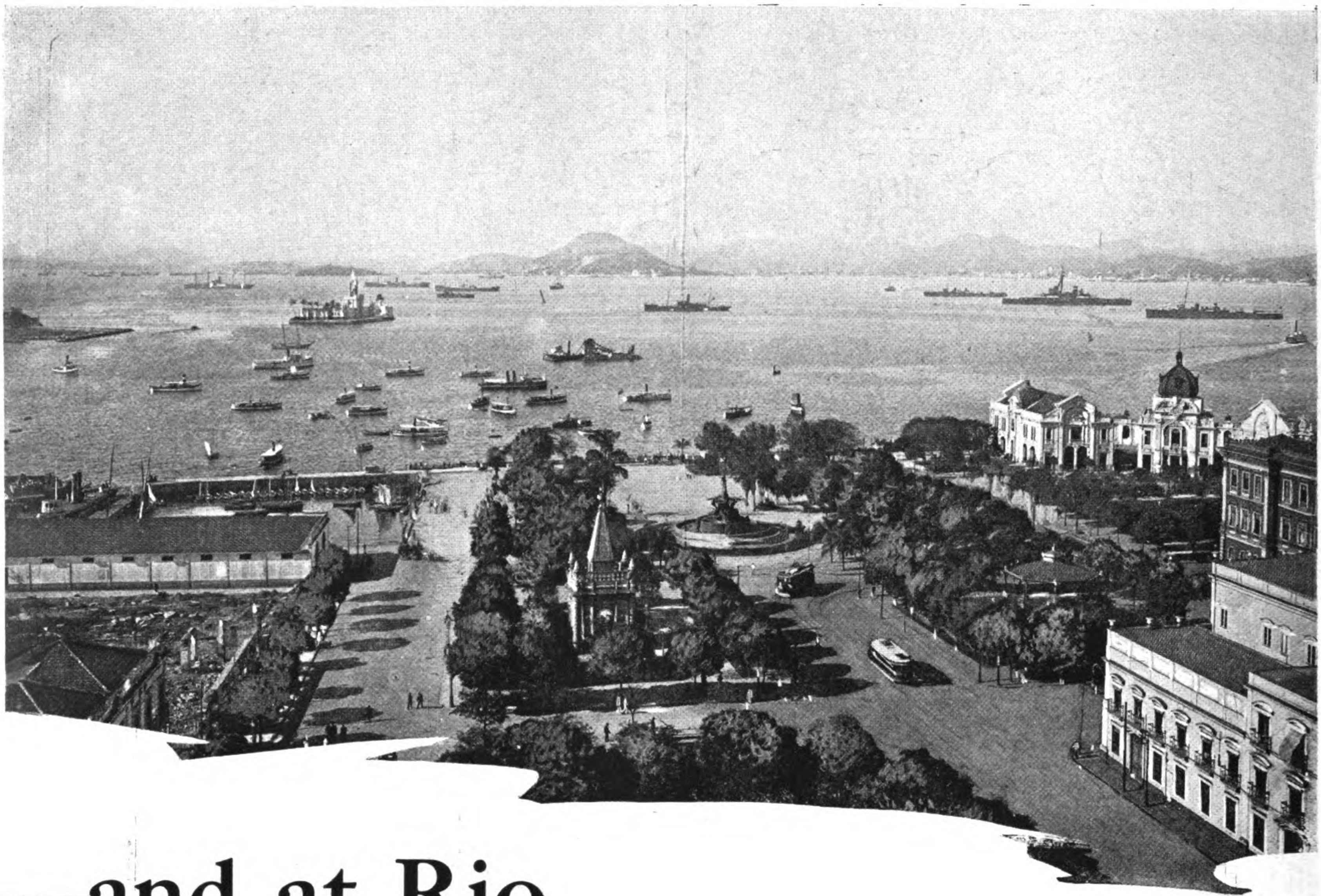

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Cable Address—Freemote, New York

Electrical-Drive for Diesel Motorship Propulsion

TO quite a few of us the question of electrical transmission of propelling-power aboard ship always has been absorbingly interesting; and, although there have been many experiments and many trials with Diesel-electric vessels of moderately large size and power the problem as yet has not satisfactorily been answered.

While it must be admitted that electrical power offers many very attractive features, the naval-architect must not let the attraction of the advantages outweigh other problems that arise, without first thoroughly probing their relative values, both from an engineering standpoint and from an owner's aspect. The steam-engine merely is a transmitter of power and it is not a power producer, and be the fuel supply ever so plentiful it cannot generate power, but only can transmit power produced by heat from water in a boiler to the propeller-shaft. The internal-combustion engine is a power producer and directly transmits its own power to the propeller-shaft, hence the use of any intermediate means of power-transmission is equivalent to turning the Diesel-engine into a boiler, with loss of power in transmission. But, both use the same fuels. These differences in principle have to be taken into consideration when figuring upon electrical drive for ocean-going ships.

Therefore, if economy be the principal objective of the electrical drive, its general use hardly can be the most desirable of systems for the propulsion of oil-engined motorships for reasons that presently will be explained. While many well-built and well-designed motor-vessels have demonstrated themselves to have flexible enough maneuvering qualities for all ordinary marine purposes, and to have a reliability even better than the average steamer, it must be admitted that there undoubtedly have been some which unfortunately have not come up to the standard of the best. This, of course, has been due more to the lack of experience of individual builders rather than direct fault of the type of propelling power.

In other words, if all Diesel-driven vessels were developed to the degree attained by the best, there absolutely would be no need for any system of power transmission between the propeller-shaft and the engine, at least so far as flexibility and reliability are concerned. But, if it be possible to attain further economy, then every effort should be made to develop and utilize electrical transmission-drive. Failing reasonable promise of economy, is it not logical that the using of electrical, pneumatic, and hydraulic power-transmitters, or any form of reduction-gears, is not the truly ideal line of development to follow except for special ships in special services.

Perhaps all of us do not grasp with its deserved intensity the fact that the steam-engine merely is a transmitter of power, and that it neither is a power producer nor a power generator. And instead of developing power it actually loses much of the power while transmitting the same. In other words, a steam-engine without its boiler cannot produce power, and it is the boiler that produces the power from the fuel and water, and the steam-engine transmits it to the propeller shaft. Hence if electrical-transmission is used in conjunction with a steam-engine, it merely means an increase in the number of power-transmitter units and does not change the basc functions of the engine or boiler, the power, or energy, reaching the propeller in six stages, with a direct loss in each stage. This alone is sufficient to condemn steam-turbine-electric drive when seeking economy, and it is surprising that electrical companies recommend it for moderate powers, because the system will soon die a natural death. Diesel-electric drive is a much better target, although not the bull's-eye because with some types of ships Diesel-electric drive will be ideal.

An Interesting Theoretical Argument Against This System.

[Of late the interest in Diesel-electric drive has become re-doubled in the United States, and a number of shipowners have practically decided to adopt the same as soon as they build new vessels or convert existing steamships. Numerous requests have come into our office to give both the "fors and against" the system, in order that shipowners may be familiar with both sides. By request we are republishing on this page the principal parts of an article contributed to "Motorship" during 1918, in which a number of interesting arguments were brought out. If there are any flaws in his claims it is to the interest of electrical-engineers to reveal them in a vigorous manner, and our columns are open for the purpose. Additional articles giving the reasons why Diesel-electric drive should be adopted will be given in subsequent issues. Our opinion is that one of the best applications of the Diesel-electric drive is for converting existing steamships. Unfortunately, the author of the article on this page does not touch upon this particular field. Both sides of every technical question always should be given, and the various "fors and againsts" thoroughly debated, such correspondence then becoming a valuable and permanent record of the experiences and beliefs of those who are vitally concerned.—Editor.]

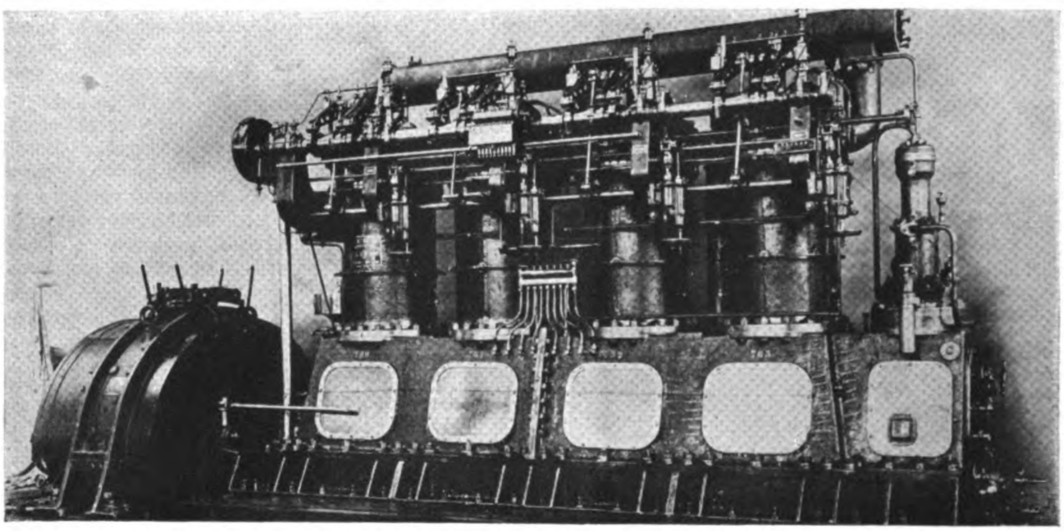
How different is the case of the self-contained internal-combustion oil-engine. This form of mechanism is a power producer in itself, and it directly produces and transmits its own power to the propeller. That is why it only uses one-third the quantity of oil-fuel. Utilizing an electrical or other form of power transmitter in conjunction with a Diesel-type engine is equivalent to turning the latter into a boiler, because it then merely acts as a generator of power from the fuel, and does not transmit the power direct to the propeller. Seeing that one of the most beautiful features of the oil-engine is its dispensation of the boiler, it easily can be understood why it cannot be logical to utilize a separate power-transmitter thereof, and, which under ordinary maritime conditions such cannot be so economical as the direct drive. Incidentally all this should help marine men to understand what a wonderful engine the late Dr. Rudolf Diesel gave to shipowners and why they all should use every effort to encourage its perfection and world-wide adoption, instead of "picking holes" in it on every slightest opportunity.

Let us all remember that an economical engine is an efficient engine, so an efficient engine is an economical power. And, as the greatest advantage of the Diesel engine is its remarkable economy, any lines of development that will impair this wonderful economy should not be regarded as the ultimate aim. This being so, shipowners should strive to make *all* designs of Diesel engines properly reliable, whereby they can be efficiently utilized when coupled direct to the propeller shaft. And let them co-operate and assist the oil-engine builder with that progressive and broad-minded end in view.

If the direct application of power at present be not everything to be desired, let us rapidly perfect it rather than resort to some intermediate means.

All this, of course, is more or less theorizing, so let us come down from the sky to the more practical side of the argument. But, let it first clearly be understood that these various remarks have no bearing whatever upon the use of electrical transmission of power for ships' auxiliary machinery, the requirements of which entirely differ, direct-Diesel drive not being practical. Electrical drive for the latter purpose is highly desirable.

In the earliest days of the Russian motorship fleets, before ocean-going motor-vessels were in service, there were no directly-reversible Diesel-engines, consequently the Russian engineers were forced to turn to some system of transmission. For at least 14 tankers and warships of 500 to 1,200 b.h.p. the electric-drive was used. There were no means of coupling the three oil-engines to the triple-screws, the electrical losses being sustained during the entire period of working. But with later craft electrical losses were present only during the astern motion and a slow-ahead speed.



One of the two 600 b.h.p. Nobel-Diesel and Del Proposto electric-drive generator-sets of the Russian cruiser "Ruenda," completed in 1913

Economical Transportation on the New York State Canal

A Series of Exhaustive Articles on Barge Commerce Along the World's Greatest Inland Waterway

PART V

HULLS, MOTIVE POWER, AND EQUIPMENT OF CANAL CRAFT

As motive power for the propulsion of modern canal craft the internal-combustion engine using heavy oil for fuel stands pre-eminently fitted. To those who have followed the progress and achievements made on the high seas with machinery of this type and recorded in the pages of "Motorship," emphasis of this point would be merely superfluous; but to others, who have not become fully acquainted with things accomplished in this field, we desire to submit, in the first place, the fact that for canal work only engines of medium and small powers come into consideration. The construction, maintenance, and operation of low-powered units is very substantially less than proportionate to the small size, and it is a well-known fact that things can be done with a small machine which would wreck a large one at the first revolution. Problems inherent in greatness of size such as are successfully met as a matter of every-day routine in ocean vessels do not even arise in the power plants of boats used on the Canal.

A further consideration of no small weight is the fact that in Canal operation long non-stop runs at full power do not occur. The difference between the essentially intermittent service required on the Canal and the long, hard grind, say, of a transatlantic voyage is so obvious that it need merely be mentioned; we would add, however, that if large engines successfully withstand the severities of ocean usage, small ones on inland waterways can more than meet every conceivable demand that may be made upon them. The proper working of heavy-oil engines on Canal vessels may be taken for granted, just as the shell-plating or the rivets may be taken for granted.

At the risk, also of overemphasizing the obvious, we submit that the fuel economy of internal-combustion oil-engines favors them in the ratio of three to one as compared to the only practicable alternative, steam power. If the stand-by losses of the latter are considered, the comparison is better than four to one in favor of the oil-engine. As we have previously pointed out, the stand-by losses incurred by the use of steam on a waterway averaging less than 8 miles of straight sailing between locks would be ruinous in competition with oil-engined-craft having no stand-by loss whatever.

Savings due to reduction of crews made possible by the use of oil-engines are a large item. Owing to a number of varying conditions such as length of run, hours operated per day, 24-hour operation, and the like, it is impossible to give a general example. If it is borne in mind, however, that a steam plant requires skilled feeding of fuel and water, neither of which functions even require an attendant in the case of oil-engines, the resulting economies are apparent.

Recruiting properly skilled oil-engine room staffs will be considerably easier along the route of the Canal than at seaports. In this case again, the fact that it is regularly possible to induce suitable men to face the hardships and solitude of deep-sea voyages is a very substantial guarantee that the right kind of oil-engined canal-boat operators will be available to the full extent of the demand. In the Canal service no long runs need be made which take the operator into foreign countries far away from his home; and the constant contact with land and sources of supply make the Canal engineer's job resemble that of the stationary plant operator a good deal more than that of the deep-sea engineer.

Certainly it would be difficult to imagine a section of the country better suited as a source of mechanically skilled personnel than the region traversed by the Canal. Buffalo, Rochester, Syracuse, Schenectady, and many other Canal cities rank among the foremost in the country as centers of mechanical industries.

In such a district, also, mechanical service and supply stations can be readily made available. Labor and plant facilities may almost be said to be waiting for utilization in connection with canal-borne power plants. In addition to this, "extraordinary repairs," involving the shipment of engine parts to and from the factories of origin would be far less burdensome in the Canal service. Since this waterway is paralleled by seven or eight railroad lines, and as it is very centrally located to begin with, practically every oil-engine manufacturer who will have furnished engines for Canal use will be in a position to make repairs and replacements at the shortest possible notice. Here again the facilities that are available are vastly superior to those on the basis of which enviable motor-shipping progress has been made on the high seas.

It is earnestly to be hoped that this splendid promise will not be made vain in Canal enterprises by indiscriminate and hasty applications of oil-engines under conditions insufficiently thought out and planned for. Like all things that are worth while, success in these undertakings will come as the result of a comprehensive grasp of all the technical considerations involved and of an objective study of the factors that enter into the design and construction of craft fitted to the environment in which they will be placed.

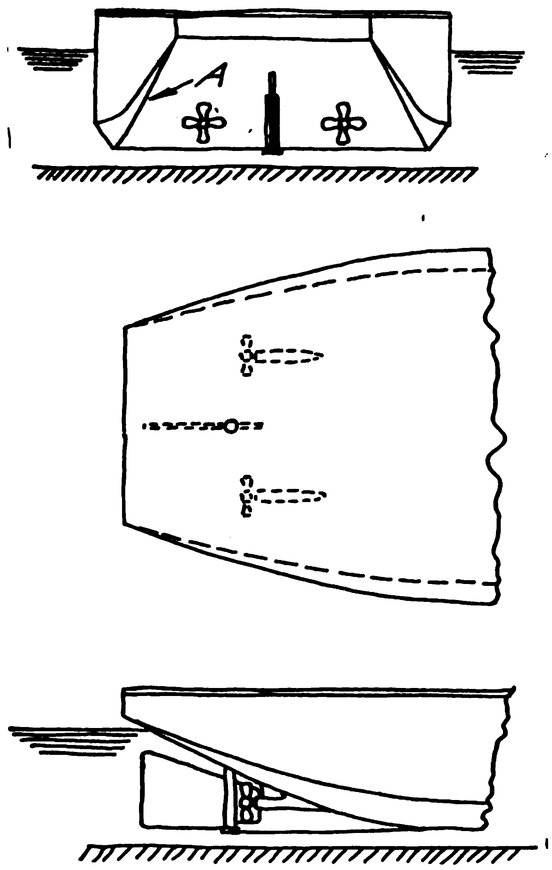
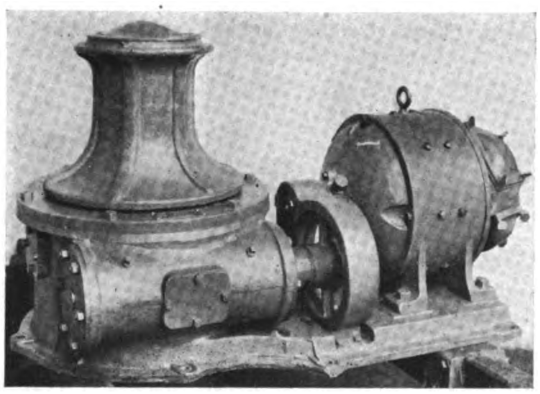


Fig. 1.



Electric capstan built by the American Engineering Co. for canal barges

The lessons taught by the old canal, to which we called attention in a previous article, hammer-home the point that you can't take any old design of a scow or barge, put an internal-combustion power plant in it, and expect to get a servicable canal vessel. It won't even do to take an old time barge and try to tow it at the speeds which the economics of the new Canal will demand.

The critical part of a hull intended for use on the Canal is the stern. Like in the designs of other vessels, the problem of merging streams of water flowing past the hull on both sides of and under it must be met by a compromise form which allows the parted streamlines to re-unite with a minimum of abruptness consistent with the avoidance of too attenuated a form. For vessels of a very moderate speed such as those which are to be considered for use on the Canal, these limits can be observed while using flat or rolled plates only; no furnace plates are required. This convenience lends itself to abuse, however, as will be evident from an attempt to drive by power a stern shaped like that shown in Fig. 1.

Not much reasoning is required to show that practically all the water which makes up the flow to the propellers and rudder comes from underneath the flat bottom of the boat, since the inadequate bevels A allow the streams on the sides to pass inward towards the center only after having made them turbulent. This condition would be serious even in deep water and is aggravated for canal work because the thickness of water under the boats is bound to be limited. The result of this alone is to make the boast suck and drag in the canal, a process very wasteful of power; but a more serious difficulty arises from the fact that the boat's "sense of direction," which depends almost entirely upon the proper flowing of the two side streams, is here seriously impaired.

Twin screws are indicated in Fig. 1, a provision which might appear at first glance to obviate the poor steering qualities of the design. And it is certainly true that twin screws are a most effective provision for accurate steering, but only on the condition that they are applied with discrimination. One element to be considered in the use of twin screws is the degree of flexibility of the power plant, about which more later, but from our present point of view the condition that the two water streams be separate, well-defined and at all times independent of each other is the governing one. The rudder-fin shown in Fig. 1 is not sufficient for this requirement and in cases where one engine is run at a speed differing from, or opposite to that of the other one in order to make a sharp turn, a condition of ill-defined turbulence, rather than a reliable and responsive steering action is apt to be the result.

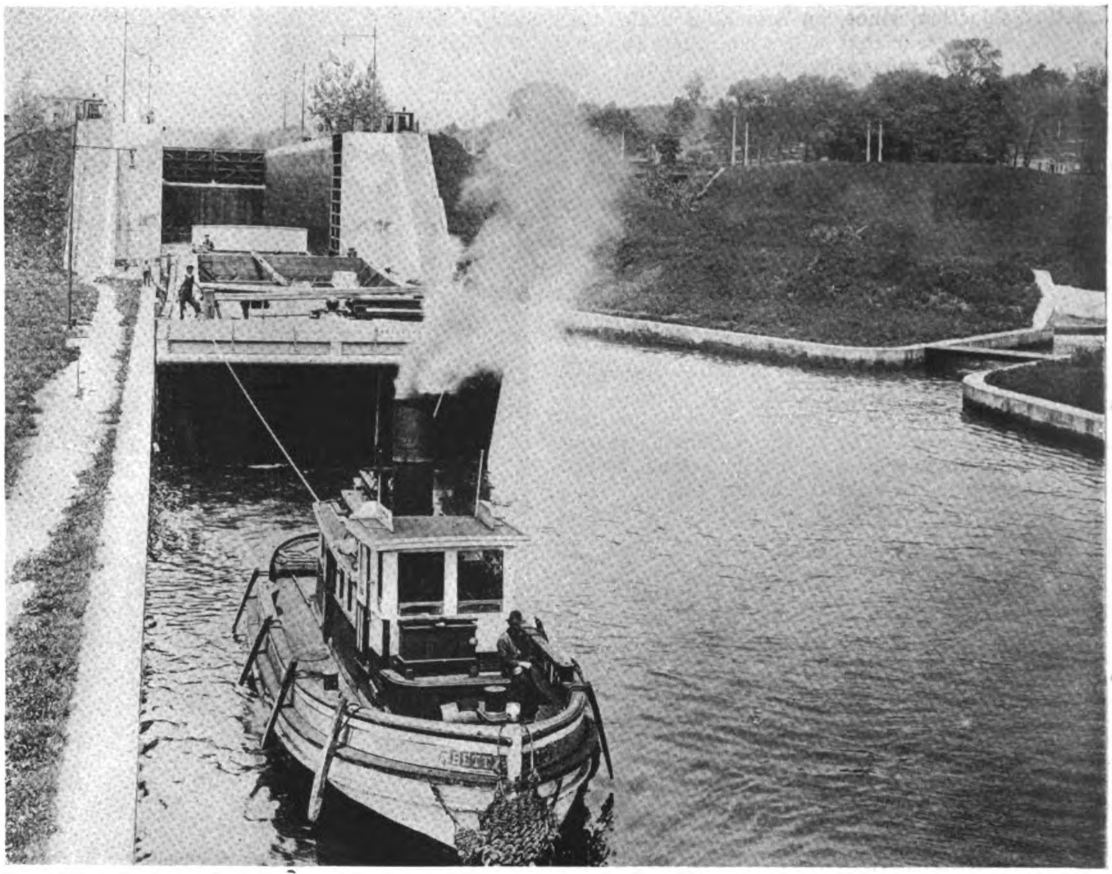
An obvious remedy is to move the centerlines of the propellers further apart. To the argument that this makes it increasingly difficult for a single engineer on watch to manoeuver two machines it may be answered that he cannot attend to more than one at a given time anyway and that the few extra steps which he would have to take as the result of this change are a small matter compared to the rest of the manoeuvering process. A further improvement in the conditions of flow may be had by making the stern more pointed and accentuating the bevels A. A complete, but expensive, solution of the problem would be the adoption of the conventional form of stern such as is found on ordinary cargo steamers.

Our illustration throws light on the disposition of internal-combustion power plants also. Owing to the fact that canal craft are not endangered, like ocean vessels, by total loss of power, and that the toal horsepower required can readily be developed in a single unit, the use of twin screws would appear to be recommended entirely as a means for better steering and manoeuvering in the bends and locks of the Canal. There can be no doubt that engines which are offered now more than meet all ordinary demands for flexibility, on the other hand, it is not fully determined whether they afford the extreme delicacy in handling which they would have to have in order to become adjuncts of the steering gear.

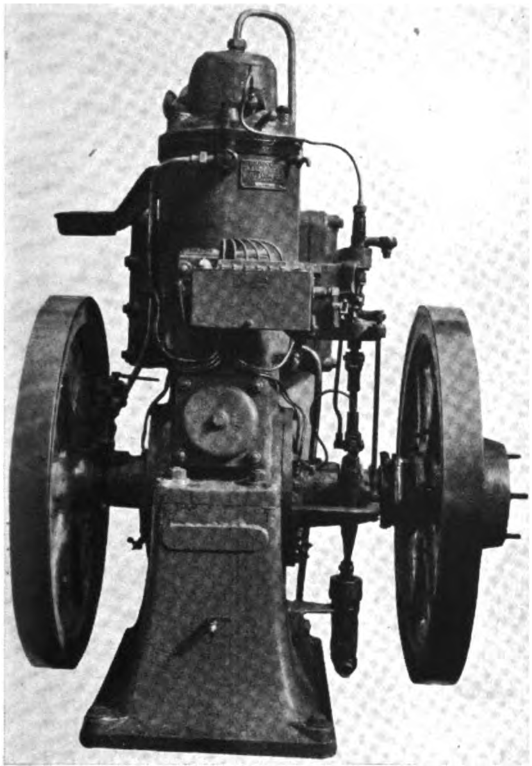
Engines which require external heating appliances are at a disadvantage in this respect because an engineer has enough to do answering bells without having to coax eight or twelve separate torches. Incidentally, since canal boats are in use mainly during the hot months of the year, torches are hardly a welcome addition to the sun's heat beating down on the deck overhead. Special and thoroughly adequate ventilating means should in all cases be provided. A further characteristic of externally heated machines is a certain indefiniteness in starting from rest, which is generally overcome by energetic hand-operation of the fuel pumps and the consequent production of heavy pre-ignitions in the cylinders. This item alone in the list of the watch engineer's duties is enough to make it incorrect to count on surface ignition engines as adjuncts in twin-screw manoeuvring.

The real field for the surface-ignition machine is the single-screw boat in which proper steering qualities are insured by the right form of stern and the provision of suitable steering gear.

For twin-screw installations, solid-injection, near-Diesel, and Diesel engines are suitable, provided, again, that the fact of simple observation on the Canal are taken into account. Boats of a size sufficient to warrant the use of two engines are apt, as we have seen, to have an engine-room layout in which that very facility of manoeuvering which two machines are intended to provide is somewhat interfered with. In the case of the high-compression machine, however, there is nothing to prevent extending the engine controls to a common operating stand.



Another lock of the famous Waterford flight. Note the contrast between the modern lock construction and the wasteful, "antiquated" steam-tug



The 16 b.h.p. Skandia auxiliary oil-engine

A further provision which suggests itself is the installation of an auxiliary air-compressor of a capacity sufficient to keep the main engines turning over indefinitely at a speed high enough to insure prompt ignition when it is required.

Low rotative speeds of the engines are better than high ones. Not only are considerably better propeller efficiencies secured at the relatively low boat speeds, but manoeuvering is also materially improved. Especially while reversing in a full headway, a high-speed propeller requires an appreciable time to "take hold," whereas an equivalent low-speed propeller of larger diameter and greater pitch will begin to push or pull the boat almost instantly. The fuller the shape of the stern, the greater will be the benefit derived from the use of low propeller speeds.

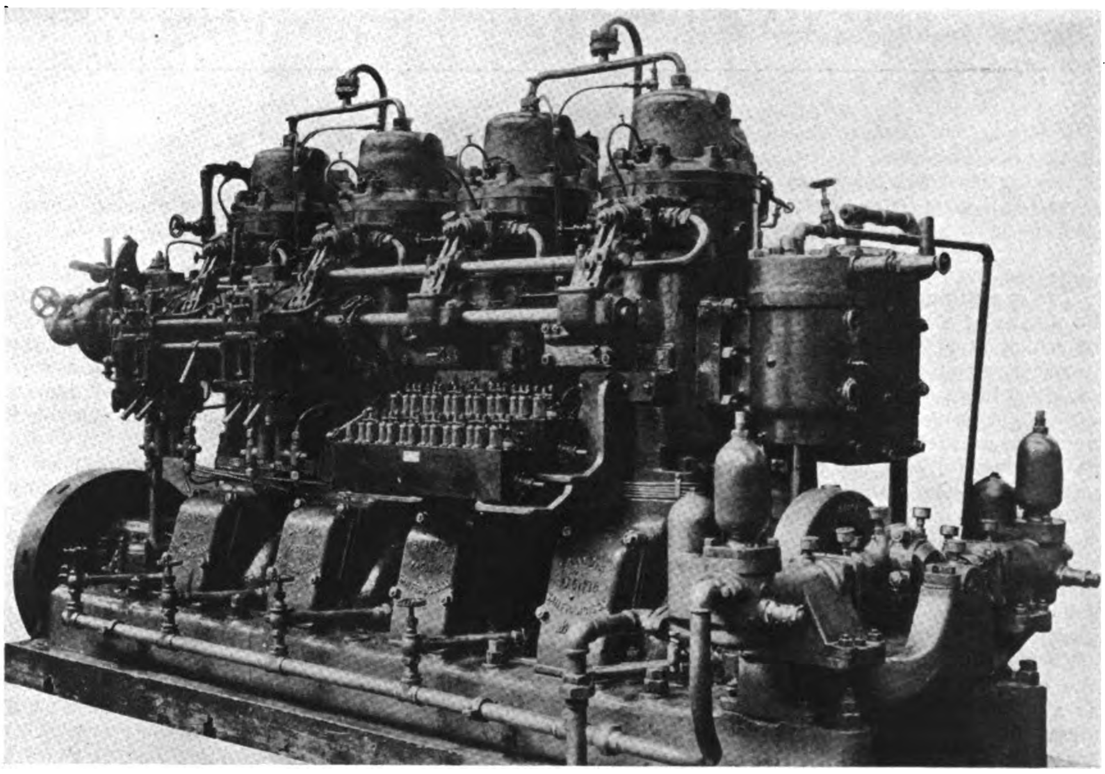
High-speed engines have their place, but not on canal boats. Bore-and-stroke-ratios less than 1.5 should not be admitted and piston speeds maintained at figures that will keep rotative speeds in the neighborhood of 275 r.p.m. The large forces occurring in all working parts of oil-engines make it possible to realize a substantial gain in staunchness and reliability by the simple expedient of reducing the number of force applications and reversals occurring per second. The greater weight of engines designed in recognition of these facts is a matter of zero consequence so far as canal service is concerned and the apparent saving in first cost on high-speed machines is transient and illusory. It has been reported that the Ford Company will use high-speed engines for its new barge fleet. This we should consider a very unwise step.

Diesel-electric drive commends itself emphatically for the service which we have been describing. The main power plant need not be split up into two units; any number of driving motors can be located almost anyhow and anywhere exactly to suit requirements; no auxiliary prime mover need be operated while under way; manoeuvering is done directly by the man who is handling the ship and with a degree of unfailing precision which is hardly attainable by other methods. From a purely technical point of view electric drive in this service is unmatched, or will be until it will have become possible to work out power drives according to the lines already indicated. Whether or not it will be possible to make a hypothetical purchasing agent O. K. a bill for electric drive on a canal boat is something which the future alone will tell.

The first five of a fleet of barges for the Barnes interests are already partly in commission and have been carrying cargoes of grain up and down the canal. They are built of steel, 250 ft. in length, with a beam of 36 ft. and a loaded draught of 10 ft. They are designed for a speed of eight knots.

They are Skandia oil-engine driven and equipped throughout with electrically operated deck and engine room auxiliaries. Current for these is furnished by three 16 b.h.p. single cylinder Skandia oil-engines direct connected to 10-kw General Electric d.c. generators.

The most notable and modern of these auxiliaries are the steering-gears, which are of the electro-hydraulic type. The designers and owners of the barges showed keen wisdom and foresight



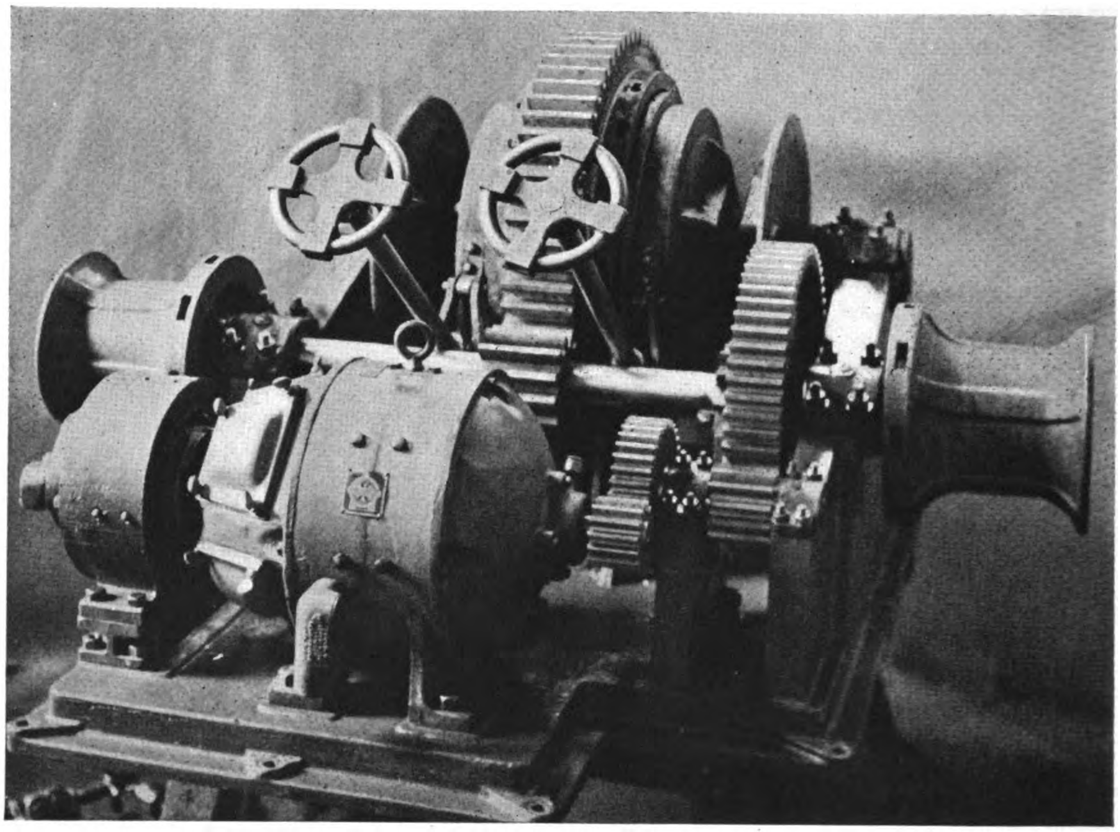
One of the 140 b.h.p. Skandia surface-ignition oil-engines installed in the five 2,150 tons displacement barges owned by the Interwaterways Lines, Inc. (Julius Barnes) in this selection, since, on a smaller scale, they are the same gear that will steer all the capital ships in our new navy, incuding the scout cruisers, battle cruisers, and battleships.

The steerers are of the Hele-Shaw Martineau design, and were built and furnished by the American Engineering Company of Philadelphia, who own patents in this country.

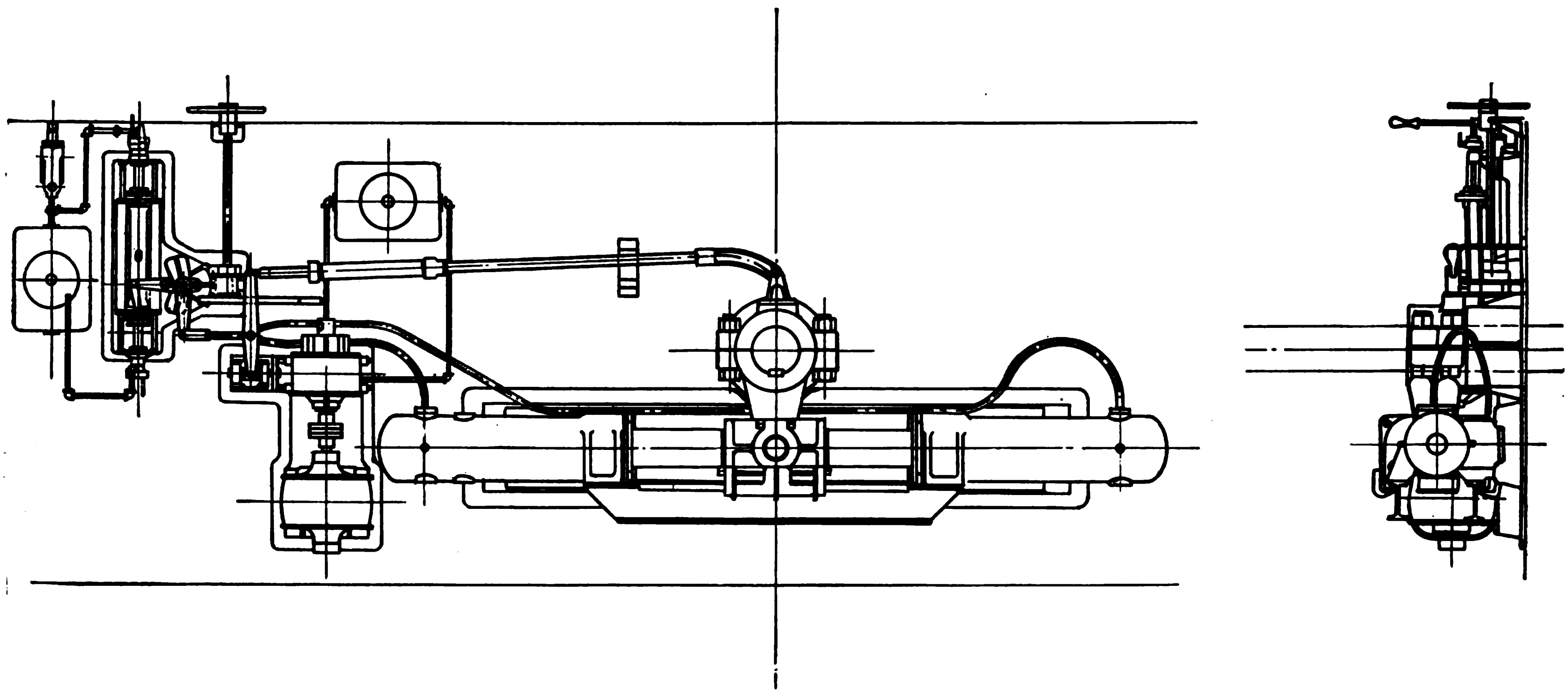
The electro-hydraulic steerer consists of two six-inch plungers of turned and polished steel tubing secured to a two-piece tiller yoke; one motor and pump unit, a complete hydraulic telemotor installation fitted with a trick wheel and follow up control.

The pump unit consists of a No. 3 Hele-shaw Hydraulic pump direct connected to a 3 h.p. motor, 115 volt, direct current, all mounted on a common bedplate. The motor is constantly running when in service. A make-up tank is provided and attached to the pump by piping. Since oil is used as a medium, perfect lubrication of moving parts is insured.

The pump is of the "sliding head" variable stroke type and functions through the action of seven radial pistons, constantly revolving around a common axis. When the guide-ring is concentric with the axis, the stroke is zero, no oil is pumped and the whole system is at rest. Eccentric displacement of the ring produces proportionate movement of the pistons, whose suction and delivery are reversed by giving the guide ring a diametrically opposite displacement. The oil drawn from one of the hydraulic cylinders is sucked into the pump and delivered under pressure to the other cylinder.



American Engineering Co.'s anchor windlass as fitted on the N. Y. canal barges



Hele-Shaw Martineau Hydro-Electric Steering Gear furnished by American Engineering Company to MacDougall-Duluth Ship Building Company for use on sea-going canal boats.

The operation of the control system takes place by means of a hydraulic telemotor, the after unit of which is mounted on a special bedplate and provided with a trick wheel attachment. The telemotor actuates the pump control stem by means of a floating lever, which is differentially connected to a bracket on the rudder tiller. This acts as a follow-up, bringing the pump to the neutral position whenever the steering wheel is at rest.

The claims made for this steerer, which we hope soon to be able to support by personal observation, are that it gives quick response to the helm in restricted waters, that it is economical in the use of power, sensitive, simple, reliable, and positive.

Each of the McDougall barges is equipped with one electric gypsey located on deck and serving as a warping winch. It is of the American Engineering Company combined worm and spur gear type, direct connected to a 5 h.p. d.c. water-tight motor which is mounted on a bedplate extension of the worm gear casing. Its normal duty is 3,000 pounds at a line speed of 26 ft. per minute. The resistance and drum-type controller is located underdeck, with controller handle shaft coming up through the deck at a point convenient for operation. Notable features of this electric gypsey are compactness of design, submerged lubrication of worm, extension of top bearing up into gypsey barrel to reduce bending on shaft, and non-overhauling worm gear to avoid necessity for solenoid brake on motor.

The electric spur-gear anchor-windlass furnished by the American Engineering Company is the same as the conventional steam-driven type, except that it is adapted for electric-motor drive. This design was made as light as possible consistent with requisite factors of safety and compactness was striven for with a view to reducing required deck space to a minimum.

The arrangement consists of a bedplate having an extension for the motor base, with integral bearing housings for main and auxiliary shafts. Three cut teeth spur-gear reductions are used between wildcat shaft and motor, and all gears are protected by suitable gear guards. The wildcat heads are a novel feature, being incorporated in and integral with the main spur gear.

Two warping winch heads are provided on the main pinion auxiliary shaft. A ratchet to prevent overhauling is also provided for this shaft and there are holes for hand-barring in case of motor failure. The warping winch heads may be independently operated by setting the brakes on the wildcats and releasing the locking keys.

The hand brakes are rugged in design and are located in a position convenient for operation.

A 5-h.p. 115-volt, d.c. watertight motor is used with this particular installation and braking is done with a disc-type solenoid brake. The weight of the anchors is 1,500 pounds apiece and they can be hoisted at a speed of six fathoms per minute by means of a 1-inch stud-link chain.

Although the machines are necessarily smaller than the average ship equipment, they are sturdy and well built for the uses to which they are put and particular study has been given to make their operation simple, convenient, and fool-proof.

This equipment, and the excellent hull work of the McDougall-Duluth sea-going canal boats puts them in the foremost ranks of modern American canal ventures. We heartily wish them every technical and commercial success.

JULIUS KUTTNER.
Special Commissioner.

Development of the Nobel Diesel-Engine

The Nobel Engine of To-day, and a Resume of Development Work of the Past with This Design—Progress of the Two-Cycle System at the Nobel Works

By EDWIN LUNDGREN
(Formerly Shop-Superintendent, Ludwig Nobel Maschinefabrik, Petrograd, Russia)

PART II

(*Continued from Page* 649, *August Issue*)

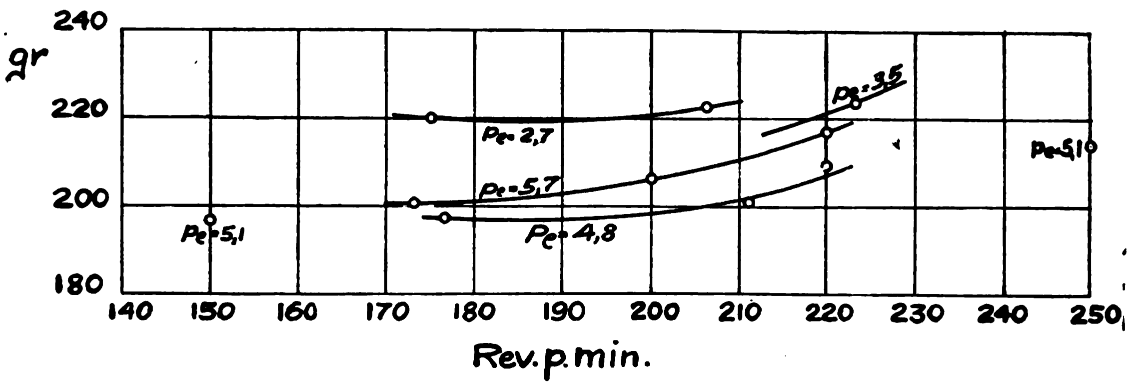
The cylinder-head is made of cast-steel and marked by its exceptionally strong and simple shape. Designers of large internal-combustion engines know by experience, how important this is, as otherwise the cylinder-head casting is liable to crack and thereby cause much trouble and inconvenience. The head of a four-cycle engine is at its best bound to be a complicated casting, crowded as it is by inlet and exhaust valves. The head of this particular engine carries only the fuel- valve, the starting-valve and the safety-valve which was prescribed by the customer and which also serves as a compression-relief valve.

The fuel-valve is also of standard design and provided with the customary small disks in which a number of small holes have been drilled. This traditional design was chosen after a number of other more elaborate, but also more complicated designs had been tried and found to be without particular value.

The valves are actuated by means of levers and cams on the camshaft which is driven by two pairs of spiral gears and an intermediate vertical shaft from the crankshaft. For each fuel-valve three different cams are provided: one for running ahead, another for running astern, and a third for running ahead at very slow speed, during which the engine is working like a four-cycle engine, which is an unusual feature.

It is a matter of common knowledge that the power required for the propulsion of a vessel is decreasing very rapidly with the speed. That means that at low speed of the vessel the engine is running under very light load and an engine of ordinary construction would be working very unfavorably, as it is extremely difficult to attain proper distribution and regular ignition of such small quantities of fuel as then are required. Moreover, the fuel-valve would remain opened entirely too long time, too much compressed-air would be consumed and the compressor would not be able to deliver sufficient air.

To avoid this, several means have been resorted to. In some cases the fulcrum of the valve-lever has been shifted, but this necessarily entails a rather complicated mechanical construction. In other instances the camshaft has been shifted so that another shorter cam has been actuating the fuel-valve, but also with this construction the evil of too small charges remains. A third method is entirely to cut out one or several cylinders. Also this method has its disadvantages, as the different cylinders will obtain different temperatures and it may be difficult to regulate the cooling water properly.



Fuel-consumption per b.h.p. at constant m.e.p.

In the engine described the purpose is achieved by simply letting the engine work like a four-cycle engine or, more correctly expressed, by cutting-out every other explosion. When doing this, evidently each cylinder receives considerably more fuel at the time and is working more efficiently, while at the same time less compressed-air is consumed.

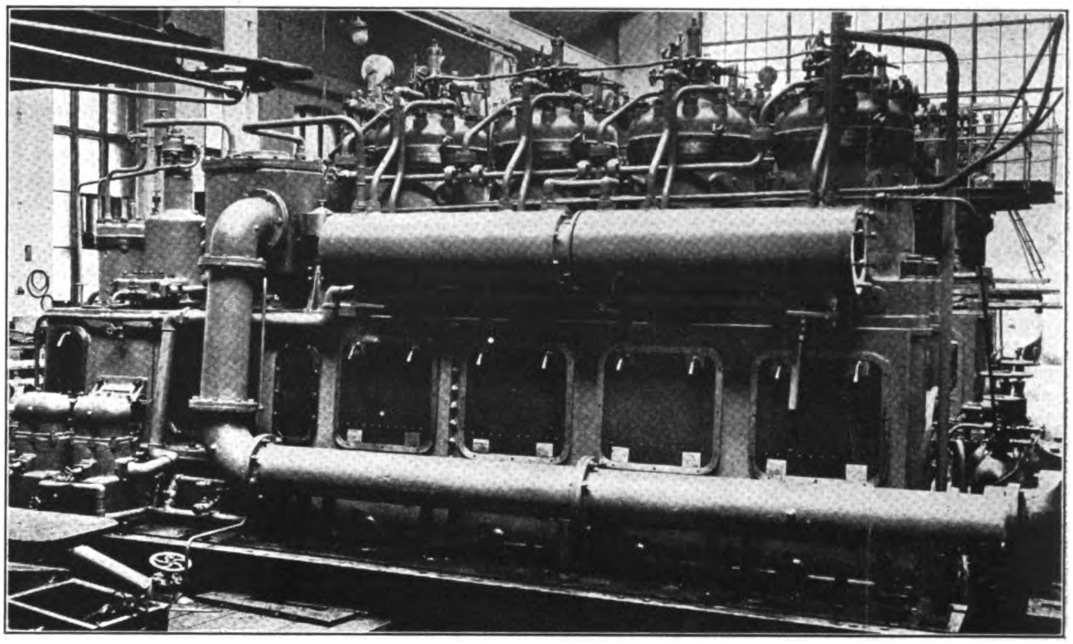
In order that this end may be accomplished with simple means, the camshaft is just like in an ordinary four-cycle engine running with half the engine speed, which with regard to wear undoubtedly is an advantage. The cams for normal running are provided with two lobes, at 180° opposite to each other, while the cams establishing the four-cycle of course only have one lobe. All three cams for each cylinder are keyed upon a sleeve which can slide upon the hollow camshaft. This sleeve is connected to a small shaft inside of the camshaft by means of a key which slides in slots of the camshaft.

All fuel-pumps are placed between the first working-cylinder and the scavenging pump and are driven by a small intermediate shaft which in turn receives its motion from the camshaft by means of spiral gears. One separate pump for each cylinder is always the most reliable construction, particularly on board of a vessel where all kinds of fuels may be purchased and not always sufficient facilities for cleaning the oil are to be found. The quantity of fuel for each stroke and with it the speed of the engine is, as usually, controlled by opening the suction valves of the pumps. This may either be accomplished by hand by means of the maneuvering-lever or mechanically by a Jahns governor, which prevents racing of the engine.

The scavenging-pump and the way in which the admission of the scavenge-air to the cylinder is controlled are of a decidedly original construction and have given excellent results. The air-pump is double-acting, and is calculated to deliver 1.4 times as much air as corresponds to the displacement of the working-pistons. The pump-piston consists of a plain disk, a steel casting of conical shape so as to give the piston itself as well as the cylinder-heads a strong form. The piston is guided by the trunk cylinder which is bolted to its lower side and which also serves as crosshead. Suction and pressure valves are replaced by a horizontally arranged cylinder which rotates at only one-third of the engine speed and therefore is provided with three channels for the suction and three channels for the pressure line.

The air is taken either directly from the engine-room, whereby a very efficient ventilation is established, or from the outside, which is to be preferred during the cold season.

The scavenging-pump delivers the air to a collecting pipe of large diameter. The connection between this pipe or receiver and the working-cylinders is controlled by vertically arranged rotary slides, driven by means of bevel-gears from the camshaft. These slides prevent the exhaust-gases from entering the receiver and thereby fouling the same as well as the scavenging-air and, what is of greater importance, they determine the beginning and the end of air admission to the cylinders, thereby greatly increasing the efficiency of the engine by using the scavenging-air economically.

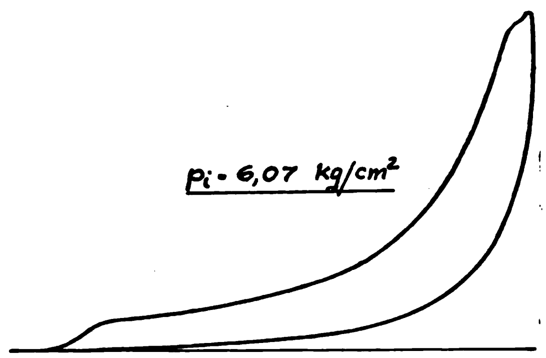


Back view of the Nobel 600-shaft h.p. 2-cycle Diesel engine showing air-suction and exhaust manifold

The compressor has three stepped stages The upper part of the piston serves the high-pressure, the intermediate part with the largest diameter serves the low-pressure with its upper side and the medium pressure with its lower side. As may be computed from the dimensions, the compressor is of ample capacity to take care of the largest consumption of compressed air which may reasonably be expected while maneuvering. The air receivers are watercooled and partly located within the engine frame, partly entirely separately from the engine.

By means of links and levers the connecting-rod of the compressor actuates three water-pumps; one for cooling the piston, the second for cooling the cylinders and cylinder-heads and the third delivers water for various purposes on board.

Force-feed lubrication is provided for the cylinders, main-bearings and by a system of swinging-



Typical indicator card

pipes also for the piston-pins. The crank-pins are as usually lubricated by centrifugal rings.

Maneuvering

The maneuvering platform is built up at a fair height between the two symmetrically arranged engines. From this platform all necessary maneuvers are easily controlled by means of three rather long levers for each engine which are within convenient reach of the operator. Also the necessary valves for compressed-air may be opened and closed from this platform.

The engine is started by placing the starting-lever into start position. Thereby compresesd-air is admitted to all cylinders and the engine is started, no matter which position the throws of the crankshaft occupy. After a few revolutions the lever is moved into its normal position; the air is thereby cut-off and fuel is admitted to all cylinders. It is of course excluded that fuel and compressed-air can get into the cylinder simultaneously. The starting-lever also actuates a valve which in a reliable manner admits or shuts-off the compressed-air, thus avoiding the inconvenience of opening or closing the air-reservoirs by means of hand-wheels.

The second lever controls the speed of the engine, as already mentioned, by regulating the fuel supply from the fuel pumps. In this way it is possible to vary the speed between 50 and 250 r.p.m.; it actually is possible to shut off the fuel supply altogether and thereby to stop the engine in this manner. This, however, is more suitably effected by moving the starting-lever into the stop position which puts the fuel-pumps out of action and removes the cams for the fuel as well as for the air-valves out of the reach of the corresponding levers.

When reversing, the engine is first stopped in the way just mentioned, thereupon the cams are, by means of the reversing lever, shifted into the position required for running astern, and the engine is started again as described above.

The levers are mechanically interlocked so that the reversing lever only can be shifted when the starting lever occupies its stop position.

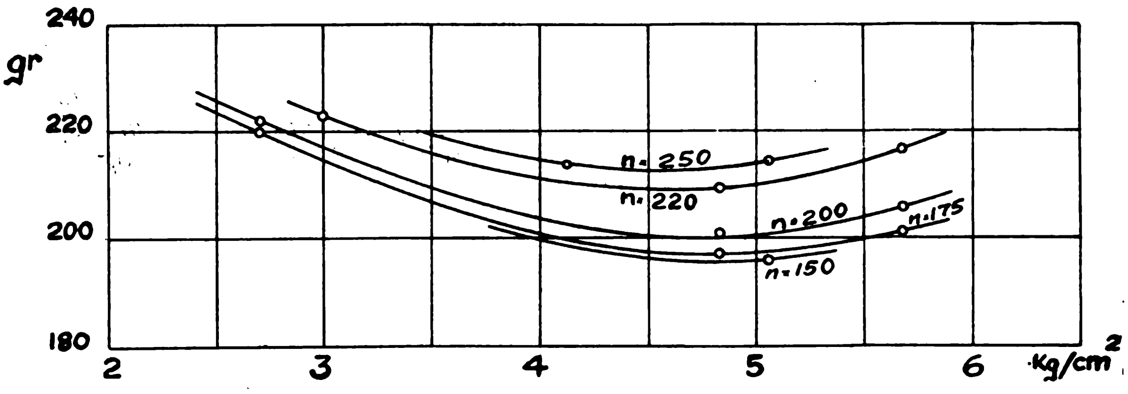
The extreme ease with the direct reversing is accomplished manually without any servomotors, neither pneumatic nor hydraulic, for the shifting of the cams cannot be emphasized strongly enough. The entire mechanism is simple, absolutely positive and foolproof.

Reversing can easily be accomplished within 10 as repeatedly demonstrated during the official trial seconds, but may even be forced within 6 seconds tests.

Official Tests

These tests took place during September, 1915, under the direct supervision of the director and a number of highly qualified engineers of the company which had ordered the machines. At first the engines were subjected to an endurance test at the rated load, then they were run under exceedingly varying loads under similar conditions as might be expected under actual operating conditions.

The load was established by an hydraulic Heenan & Froude brake N:r 6, the brake and the weights being carefully checked. As fuel a crude naphtha of Nobel Brothers' production was used, possessing a specific gravity of 0.885 at 15° C. and a heating-value of 10,000 cal/kg (18,000 b.t.u./lbs.). Besides the fuel, the lubricating-oil and the cooling-water consumptions were measured and readings of the temperatures of the air, water and exhaust gases taken at regular intervals. The exhaust-gases were analyzed with an Orsath apparatus, and of course at all loads indicator-cards were taken, of which a typical example, is given. The following table shows some of the most important results. Some of the figures are of considerable interest and are given here, as they may be of assistance to the student and to designers of similar engines.



Fuel-consumption per b.h.p. at constant speeds

The lowest fuel-consumption recorded was 196.3 g. or 0.43 lb. per b.h.p. hour. he consumption of lubricating oil was 3 gram/b.h.p., while the lubrication was very liberal as customary for new engines on the test-bed. It may be mentioned that in actual service lubricating of engines belonging to the Kaukas-Merkur (Caucus & Mercury S. S. Co.) was done very economically. The main bearings, for instance, were lubricated with masut, a cheap fatty oil, which afterwards was burned for firing the donkey-boilers on board.

Relations between fuel-consumption, speed and mean-effective pressure are shown in the above chart. It is to be noted that the engine worked more efficiently at lower speeds. While this is quite normal, as slow-running engines as a rule are showing better efficiency than high-speed engines, in the engine described also the scavenging exerted a great influence; at lower speeds the scavenging is done more thoroughly and with less loss through eddy currents. Moreover the air pressure and with it the power consumed by the pump is essentially decreasing with the speed. This is of course of the greatest effect upon the efficiency of the engine. At normal speed, that is at 210 r.p.m., the scavenging-pump consumed 44 ind. h.p. or 5.7% of the total i.h.p. of the engine.

TEST OF A NOBEL-DIESEL 2-CYCLE ENGINE

Number of tests	1	2	3	4	5	6	7	8	9	10	11	12	13
Rev. p. min. . . . n	211	200	206	175	176.6	173	149	145.4	223	220	220	247.5	250
Brake horsepower . . . Ne	598	667	326	276	500	577	446	291	391	624	733	598	749
Mean effective pressure . . . pe=kg/cm2	4.83	5.68	2.7	2.7	4.83	5.68	5.10	3.41	2.98	4.83	5.68	4.12	5.10
Mean indicated pressure . . . pi=kg/cm	6.24	7.23	4.17	4.03	6.18	7.12	6.52	5.18	4.66	6.34	7.45	5.92	6.69
Ind. horsepower . . . Ni	772	849	504	412	639	723.5	570.5	442.5	610.5	819.5	960	860	981
Mechanical efficiency . . . Ne/Ni . . %	77.5	78.5	64.7	67.0	78.3	80.0	78.2	65.8	64.0	76.2	76.4	69.5	76.3
Compressor pressures:													
Low pressure . . . kg/cm2	1.8	1.8	2.3	2.3	1.8	2	2	2	2	1.6	1.6	1.9	2
Medium pressure . . . kg/cm2	7	7	9	9	8	8.5	9	9	8	7	7	7.5	7.5
High pressure . . . kg/cm2	60	60	60	60	55	60	55	55	60	60	60	65	70
Scavenging pump:													
Temperature of the incoming air . . . °C	12	12.5	13	13	15	14	14	15	13	13	12	9	10
Temperature of the scavenging air . . . °C	38	39	40	36	37	37	37	36	43	43	43	44	45
Pressure of the scavenging air . . . kg/cm3	0.12	0.12	0.12	0.11	0.11	0.11	0.10	0.10	0.14	0.14	0.14	0.17	0.17
Fuel consumption:													
Total consumption per hour . . . kg	120.3	140.3	74.0	60.8	98.6	116.4	87.6	68.0	86.6	130.2	159	128.2	159.4
Per BHP and hour . . . gram	201	206	222	220	197.5	201.5	196.3	233	233	209.5	217	214	214.5
Cooling water:													
Temperature of water admitted . . . °C	9	9	9	9	9	9	9	9	9	9	9	9	9
Temperature of water discharged													
a) from the cylinders . . . °C	37	40	30	26	39	40	49	38	29	38	41	29	33
b) from the pistons . . . °C	37	42	31	30	35	35	37	33	28	33	38	31	40
Water consumption													
a) by the cylinders . . liter/BHP . . .	16	15.5	32	32	18	15.2	17	25	25.6	16	15.3	21.4	17.3
Exhaust gases:													
Temperature . . . °C	278	320	180	160	250	289	232	175	202	295	358	273	336
Percentage CO2 . . .	4.5	5.3	3.5	2.8	4.6	5.0	4.0	3.5	3.7	4.6	5.5	4.0	5.0
Percentage CO . . .	14.5	13.1	15.9	16.7	14.2	13.4	15.1	16.1	16.1	14.4	12.7	14.5	13.6
Barometric pressure . . . mm Hg	750	750	750	750	750	750	750	750	750	750	750	751	751

(1kg/cm2= 14.22 lbs/sq. inch)
(1 kg=2.2 lbs.)

Tests showed that the most favorable mean-effective pressure for this engine was 4.8 kg/cm² (68 lbs./sq. inch), a figure which had been chosen as a base when designing the engine.

Big Submarine Engines

Results gained must be considered as very good, especially as it was the first engine of its kind which was built at a time when everything was suffering from the stress of war; it was assembled and delivered to the customer without any alterations. Engines built according to the same principle were installed in a number of Russian submarines. They developed 1,320 b.h.p. at 350 r.p.m. in eight working cylinders.

Unfortunately political conditions prevented a further development of this engine in Russia, but the Nobel-Diesel Works have now succeeded, in spite of many obstacles, partly of an economic nature, to build a new engine, designed on the base of their former experience. This engine, which at the present time is nearing its completion, is to develop 1,600 to 2,000 b.h.p. at a speed of 110 r.p.m. It is equipped with crossheads and guides and is provided with a number of improvements. This engine was shown in your August, 1921, issue on page 649 in course of erection. Results obtained with this engine will be watched with great interest.

REPRODUCING "MOTORSHIP'S" ARTICLES

Frequently publications in various parts of the world reproduce articles of "Motorship" or make extracts from the same. We would be glad in the future if all publications would put the words "New York" in parenthesis after our name when making the usual acknowledgment. This courtesy will be greatly appreciated. All articles in "Motorship" are copyrighted.

DIESEL-ENGINE POWER IN FLOATING DRY-DOCK

In the 46,000 tons floating dry-dock at the Wilton Yard, Schiedam Holland, a 330 b.h.p Diesel-engine is used for generating power for driving the auxiliary machinery.

PETER B. KYNE AND MOTORSHIPS

Although a little late, we recently read a very excellent novel on Pacific Coast shipping entitled "Cappy Ricks," by Peter B. Kyne, the well-known author. It is one of the most interesting books on the shipping industry we have yet read. Incidentally, Mr. Kyne shows that he is fully conversant with the advantages of Diesel-driven motorships. Matt Peasley, one of the principal characters of the story, is negotiating for a steamship 455 ft. long by 58 ft. beam and 31 ft. draft and of 7,500 tons net register, propelled by a triple-expansion steam engine of 2,000 i.h.p. To the owners Peasley says:

"I'll give you two hundred and fifty thousand dollars for the steamer 'Narcissus'; but when you turn her over to me I want a ship, not a piece of floating junk. You'll have to ship a new crankshaft, rewind the main motor, renew the Manila lines, overhaul the standing, rigging, retube the condensers and dock her before handing her over to me. She's as foul as any hulk in Rotten Row."

"Why, that will cost in the neighborhood of forty thousand dollars—nearer fifty," MacCandless declared. "I know. But for three hundred thousand dollars I can go to Sweden, build a smaller vessel than the 'Narcissus,' have her right up-to-date, with two-thousand-horsepower oil-burning motors in her; and the saving in space due to motor installation, with oil tanks instead of coal bunkers, will enable me to carry fully as much cargo as the 'Narcissus.' Also, I'll burn six tons of crude-oil a day to your forty tons of coal a day in the 'Narcissus.' I'll employ eight men less in my crew, and have a cleaner, faster and better ship. The motorship is the freighter of the future, and you know it. Your 'Narcissus' is out of date, and I'm only offering you two hundred and fifty thousand dollars because I can use her right away."

High-Pressure Oil-Engines for Small Craft

Some Remarks on the Brons Type of Oil Engine

BY RICHARD D. WATSON

WHILE it is no doubt true that the Diesel engine, in its smaller sizes, has a serious rival in the hot-bulb type, it is equally true that they both have a competitor in the Brons engine. When it is considered that this engine can be, and indeed is, actually made in sizes as small as 1½ b.h.p. per cylinder, possessing at the same time practically all the advantages of the Diesel with only a fraction of its complication, the possibilities of this system are at once apparent. It has been argued the principle upon which the engine works, renders the actual firing point of the charge a matter of guesswork, depending largely upon the size of the holes in the fuel-up, and varying with different fuels. Theoretically this is true, but in practice it is found that the Brons engine is capable of very good regulation, more especially if it is provided with a fuel-pump, having a variable stroke, in place of the original gravity feed to the fuel-cup.

One of the most surprising features of the very small sizes of these engines is that the higher the speed the better the ignition device appears to function. The time-element which might very reasonably be expected to have an important bearing on the operation of the fuel-cup, owing to the period necessary for the compressed-air from the cylinder to enter the cup through the small holes, and the preliminary explosion to take place in the cup, seems to have little or no bearing in these circumstances.

As an example of the operation of the Brons engine in marine service, I quote from a letter recently received from the South Seas. The schooner on board which the letter was written is provided with a Deutz-Brons engine, and has been in commission for a number of years trading among the islands. The paragraph to which I have reference, reads, "The engine is giving excellent service, despite the facts that it is no longer in its first youth, and that it is left to the care of a native boy. The small holes in the cup give no trouble in plugging up with carbon, and the auxiliary valve in the interior of the cup requires only an occasional regrinding. There are several vessels in these waters using Brons-type motors for auxiliary power, and they are all giving the same class of service as this one."

Several concerns have taken up the manufacture of these engines, but as far as I am aware the system is little known. I am by no means an advocate of the employment of the unskilled operator, for no machine, however simple, will function efficiently without a reasonable amount of care, and the fallacy that it will do so has brought more than one excellent engine into disrepute. The sentence quoted above is merely referred to for purposes of comparison, for no one would ever consider leaving a Diesel engine to the care of a native oiler. In the matter of weight there is little or no difference, the compression pressure of the Brons engine being about the same as that of the Diesel, and consequently the general construction of the engine must be equally rugged, more so if anything, because of the tendency of the Brons type to pre-ignite, owing to change of fuels, this tendency being much more pronounced than in the Diesel engine. In the latter the point of injection is fixed mechanically, and the fuel entering the combustion-chamber in a highly atomized form, ignition is practically simultaneous, while in the other system under discussion, the chief actors in determining the actual firing-point are the specific gravity and flash-point of the fuel and the area of the holes in the fuel cup. Thus the point of ignition may be retarded by decreasing the size of the individual holes, but keeping the combined area the same by increasing the number. In the same way, a heavier fuel will call for the larger holes, and to obtain the best results the cup should be changed when a different grade of fuel is to be used. The fuel economy of the Brons-type is remarkably good, being superior to that of the surface-ignition engine, and is indeed on a par with that of the Diesel. The engine is in every way applicable to the different classes of work for which the Diesel is used, and being capable of close regulation, is used in many cases for the direct driving of electric generators. When properly constructed and maintained, the exhaust is practically clear and the operating troubles are very much less than those of an air injection engine. Being a vastly simpler machine in every way, it does not require the highly skilled attention, which contrary to all argument is, in my opinion, a sine-qua-non to the successful performance of the Diesel engine. The causes of failure to operate properly are few in number, and easy to trace and remedy.

Excessive smoking may be caused, in the gravity-fed type, by the fuel needle-valve failing to seat, and in those engines where the charge is supplied by a pump, a weak spring in the check-valve at the fuel-cup will produce the same results, owing to the fact that as the oil is timed to enter the cup on the suction stroke, the vacuum in the cylinder will cause the fuel in the pipe beyond the check-valve to be drawn into the cup. This latter condition only applies to those particular engines which are not provided with an auxiliary air-valve in the fuel-cup, and which depend upon the small holes to fill the cup from the air already in the cylinder.

In those in which the auxiliary valve is used, trouble has at times been experienced by the seat of its valve gumming up, with the result that the primary compression in the cup is lost, when of course ignition will not take place and the engine refuses to function at all. This is most noticeable when using heavy oils, or those with an asphaltum base, and the trouble can usually be avoided by running the engine on kerosene for a few minutes prior to shutting down. Occasionally the seat of the valve is found to have been made too wide in the first place, and a film of oil is deposited upon it, and soon baked to a hard carbon, which prevents the valve from closing. The obvious remedy is to reduce the width of the seat to little more than a knife-edge, when it will be found that grinding in is much less frequently required.

The Brons engine has not as yet made the headway in this country, to which its obvious merits entitle it, but I am strongly of the opinion that some modification of this type of prime mover will be adopted for the very small sizes of marine oil-engines in future. And nobody who is conversant with the conditions obtaining on the Pacific Coast, can deny that the "Small Boat Trade" is not a very important item, not only in the oil-engine business in general, but also in the entire industrial situation of the Coast. Another field which shows great promise is of course the tractor trade, and no doubt the remark that a marine engine builder can produce a good stationary engine, though a stationary engine manufacturer does not always build a good marine engine will hold good in this case.

[The Brons type of engine is manufactured in the U. S. A. under several names, including the Hvid, Burnoil, Cummins, Dodge, Pittsburg, etc., all under Hvid licenses.—*Editor.*]

WELDING REPAIR TO DIESEL ENGINES

"Shipbuilding & Shipping Record" of England gives an account of an interesting electric weld made to a 600 b.h.p. Sulzer Diesel engine. The parts in question were of cast-iron, and, as is well-known, the welding of cast-iron is at all times a difficult matter; in this particular case the difficulties were increased because the castings could not be preheated.

Some time ago in the normal running of the station a 600 b.h.p. three-cylinder Sulzer-Diesel engine was shut down for some minor adjustment and the jacket cooling water allowed to continue circulating. During the period of rest some water found its way into the cylinder through a porous part of the cylinder head. When the engine was again started by means of compressed air the presence of the water resulted in the fracture of the base of the main "A" column of the engine; the crack on one column extended right round the front half and about two-thirds round the back half of the column through metal varying from 2½ in. to 3½ in. thick, whilst the other column was cracked at the ends both inside and outside. After the accident the crack closed up to about one-eighth of an inch wide. Work was commenced by chipping-out metal surrounding the crack from both sides of the casting to form a "V" for the reception of the new metal. Approximately 700 ft. of A.W.P. electrodes were used, representing about 50 lb. of added metal. The necessary current was taken from the mains, the only equipment required consisting of a portable resistance, electrode holders and cables. A portable air compressor was used for the pneumatic tools for chipping the "V."

So successful was the welding process that the engine was running on load within four weeks from the commencement of the repair and at the time of our inspection was in normal operation. These notes perhaps convey but a vague idea of the size of the repair, but it is quite obvious that the time expended upon it must have been much less than would be necessary for obtaining a new "A" casting and its fitting and erection on the engine. In addition, of course, the welding cost much less than a replacement casting would have done, and the job is an excellent illustration of the possibilities of this type of work.

"Colon," a new San Francisco Tug Boat fitted with Atlas Imperial Diesel engines

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MOTORSHIP

Trade Mark, Registered

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THE QUESTION OF FUEL

One of the "kicks" against the marine Diesel-engine frequently made by domestic shipowners is that they are not successful when using heavy boiler-oils, and that difficulty is likely to be encountered in some parts of the world owing to lighter fuel-oil being unobtainable. We are inclined to think that there is considerable misconception in existence in regard to this fuel-question. Quite a number of motorships have been running on fuel known as Diesel-oil, which may be said to be practically gas-oil or Solar-oil. This is an oil used in every city by gas-works in connection with cleaning lighting-gas, and is now to be obtained almost anywhere in the world, because the various oil-companies are making a special point of maintaining a supply at all leading bunker stations. True, it was difficult to obtain during the war and during the two following years, but this is no longer the case.

Discussing the question of fuel-oil in our issue of April, we raised a query as to whether the question of fuel-oils was really important in the case of motorships for the following six reasons, and indicated that the grade of fuel should be decided by the particular requirement of each individual ship and her route. The reasons are as follows—

(A) Saving is comparitively slight if boiler-oil is used instead of Diesel-oil.

(B) Motorships are not dependent upon overseas bunker-stations, but can pick-up oil where it is cheapest.

(C) Need only bunker two or three times per year, unless selling part bunker-oil as cargo in Great Britain, Scandinavia, France or other countries that have little or no natural fuel-oil.

(D) When called upon, motorships can use heavy residues if the same are heated by utilizing exhaust-gases, although the use of crude-oil means more work for engine-room crew.

(E) Grade of fuel advisable largely depends upon skill and conscientiousness of engineers-in-charge.

(F) Using Diesel-oil on motor-ships engaged in the U. S. A. to Europe service has certain benefit of its own, because there is always a steady demand for this class of oil for new motorships leaving Europe on maiden-voyages, also because need of this oil for cleaning gas in large city gas-plants. This enables surplus bunker-oil to be sold at prices much higher than those paid.

While a motorship can sell her surplus bunkers at a considerable profit, a steamer cannot do so without infringing upon her cargo-space, also because the field for disposing of surplus crude oils is more limited.

Nevertheless, on a number of routes it is advantageous if a motorship can use regular low-grade boiler-oil, especially if her owners are also operating steamships on the same routes, because then they are only obliged to contract with the oil-companies for one grade of oil. Also, their motorships can furnish the surplus bunker-oil to the owner's own steamships when they meet in a foreign port, where to the cost of bunker-oil is added tanker transportation costs of the oil-companies. This will enable the motorship owner's steamships at times to carry more cargo, instead of having to carry sufficient fuel-oil for a return voyage, and in this manner increase the carrying-capacity of their existing steamship fleet, which opens a new argument in favor of motorships.

Incidentally it is worth noting that the Western Australian Government's combination cargo and passenger motorship "Kangaroo" has had a special fuel-tank of 500 tons capacity fitted in the hull for the purpose of supplying a refrigerating station at Windom, West Australia, with fuel-oil and the supply will be taken in at Singapore or Balikpappan. The refrigerating station is operated by twin Sulzer 200 b.h.p. Diesel engines. American motorships in a like manner could be used to supply foreign land stations with fuel-oil.

There is no doubt that Diesel-engines will operate on boiler-oils when in the hands of competent engineers, and additional competent operators can be obtained by the owners selecting good men and sending them to the engine-builders' works while the motors are under construction. This has been proven in the case of a number of vessels, notably that of the Alaska Steamship Company's motorship "Kennecott," which is the first large All-American steel general freighter. This vessel has been running with great success on boiler-oil of 16.7 gravity. Use of this oil is facilitated by the adoption of a simple scheme of heating the fuel-oil by means of a device on the exhaust-gas silencer.

Furthermore, Diesel engines have run for long periods on Mexican crude-oil of as low as 14 degrees gravity. Opinions of many American shipowners regarding the use of boiler-oil was formulated by the discovery that a number of foreign motorships were using Diesel-oil. This was largely due to the fact that the daily consumption was so low that there was little to be gained by using heavier oil at slightly lower cost. It is generally conceded among engine-builders that the lower the revolution speed of the engines, the heavier grade of oil that can be used. Possibly this is a partial reason for the successful operation of the Doxford Diesel-engine on 14 deg. oil. Various navies of the world found that crude-oils were not very suitable for running high-speed submarine Diesel-engines.

PROTECTION FOR DRY-DOCKED STEAMERS

Recently a large new American steamship caught fire while in a New York dry-dock, which has frequently occurred to a number of other steamers in similar circumstances. As the vessel was high out of the water her fires were drawn and her boilers dead, so that her pumps could not be started. Consequently, considerable damage was done before the city's fire-boats could reach her, altho the skeleton crew aboard vainly endeavored to put out the blaze with chemical extinguishers. When the steamship "Alaska" recently ran on a rock, flooding of her boiler-room, prevented her continuing wireless signals. And, we must not forget the awful horror of darkness in the terrible "Titanic" disaster.

We strongly urge that in the interests of the lives of the crew and safety of the vessel and cargo, every steamship carrying the United States flag be fitted with an independent 25 K.W. to a 100 K.W. Diesel-Electric generating-set in the engine-room flat, or in a deck-house, for the purpose of instantly supplying electric-current to the fire and bilge pumps at all times of emergency, such as when the vessel is on fire, or when her engine-room is flooded after some accident in harbor, or at sea. The same electric-current could also be used for the "wireless" and lighting when the main machinery is put out of action, the latter being an occurrence all too frequent at sea. The Diesel-electric set could be started in ten seconds.

So great is the importance of such an installation that the legislation to this effect should be enacted immediately. And, it would pay insurance companies to offer a special reduction in fire rates to steam-driven vessels thus equipped. The cost of such an installation will be from $3,000 to $15,000 according to size of ship and power of plant. The White Star and Holland-America liners are already equipped with Diesel-electric emergency sets on deck, with an engineer always on duty.

BETHLEHEM S. B. CO. AND DIESEL ENGINES

Some time ago we published a report that the Bethlehem Shipbuilding Corporation had acquired a Camellaird-Fullagar Diesel-engine license, but this was denied by the Company. However, Joseph J. Tynan, general-manager of the Union Plant of the Bethlehem Shipbuilding Corp., in an interview recently stated that they had secured the rights to build the best Diesel engine in the world, and would build them at the Union Plant; also that their experts had been making an intensive study of the *new* engine in Europe. Mr. Tynan believes that there is going to be an immediate improvement along the main lines of industry, and that we are on the eve of the greatest industrial revival the world has ever seen. Nothing is known regarding the above license at the New York offices.

REMARKABLE GROWTH OF MOTOR-SHIPPING REVEALED BY LLOYDS

Presumably the most accurate statistics of shipping are issued by Lloyds because of their unusual facilities for securing first-hand data in all parts of the world excepting Germany. Therefore, the growth in the number of mercantile motorships shown in the latest Register is most remarkable as well as interesting. There are now no fewer than 1447 motorships aggregating 1,263,000 tons gross (2,000,000 tons d.w.c.) in service, compared with 290 vessels totalling 234,000 tons gross in 1913. What makes this growth extraordinary is that it has taken place during a period when development-work was tremendously hampered, and vast sums of money and time that could not easily be spared were needed for the necessary experiments. Including motorships under construction the grand total reaches about 1,550 craft aggregating 2,500,000 tons deadweight capacity. In addition between 20 and 30 motorships of 4,000 to 12,000 tons d.w.c. are under construction in Germany, making another 200,000 tons. In connection with the increase in the number of motorships under construction it is of considerable significance to bear in mind that the only freighter ordered in Great Britain during the last five or six months is that for a 10,350 tons d.w.c. Diesel-driven motorship by a Newcastle shipowner, which order has recently been placed.

Through Some Oil-Engine Works In Germany

Report of Mr. R. Hildebrand, Engineer of the Oil-Engine Division of the Fulton Iron Works Co., St. Louis, Mo., after his return from abroad, relating to the development of Diesel Engines in Germany during the recent years.

OWING to the general industrial depression and to the very fluctuating cost of fuel-oil in Germany, the present demand for stationary Diesel-engines is small, and consequently comparatively few of these engines are under course of construction. Conditions in the line of marine Diesel-engines are generally slack. Before the war, Germany made great effort to develop large two-stroke double-acting marine Diesel engines. Two of its concerns undertook, at that time, to build each a two-stroke Marine Diesel engine of 12,000 h.p. in six cylinders. These large engines were thoroughly tested in the shop, as already indicated in " Motorship." Then they were taken down to make room for other work, as, due to the war, there was no immediate demand for engines of this sizes.

It is to be greatly regretted that the valuable experiences gained by these two large two-stroke

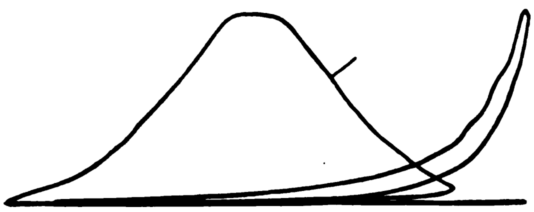


Fig. 1

marine engines are not published, because they unquestionably would be of great value to the engineering world.

The majority of the German Diesel engineers are still convinced that the two-stroke engine, if properly developed, will be the most suited type for larger Diesel units. Regardless of this fact at present, the development of the two-stroke engine seems to be dormant, because there is now not sufficient means to carry through expensive experiments. This accounts for the fact that some of the manufacturers who formerly did much for the development of the two-stroke marine engines are now building four-stroke sets.

The most interesting engines that Germany has built during the last seven years are high-speed engines as used for submarines and electric light on board ship. It cannot be denied that Germany has developed this kind of engine to a remarkable degree. As these engines have been well described in the "Motorship," no further comments are needed.

Germany, like other countries, takes a keen interest in solid-injection Diesel engines. The writer saw several engines of this type in operation. The most interesting of all was the Steinbecker engine, because its working principle is of a peculiar nature. As the majority of the Diesel engineers are interested in the development of solid-injection engines, the writer believes it will interest the readers of the "Motorship" to hear some practical results about the Steinbecker engine.

The Steinbecker engine has been described in the "Motorship" and it will be remembered that it is a Diesel engine without a compressor, which atomizes the fuel-oil by blowing it with great velocity into the combustion-chamber, by means of gases which are formed by exploding a small amount of fuel-oil in a hot retort.

The writer observed a four-stroke Steinbecker engine in operation with a cylinder 12 in. by 18.1 in., and with a speed of 210 r.p.m. The engine ran well! Using tar-oil as fuel, it gave a perfectly clear exhaust from no load up to 25 k.w., which was the maximum load obtainable. The latter is equivalent to about 40 b.h.p., including a belt-drive to and from a jack-shaft. Apparently the engine could have carried a considerably higher load. Figures 1 and 2 are cards taken during the

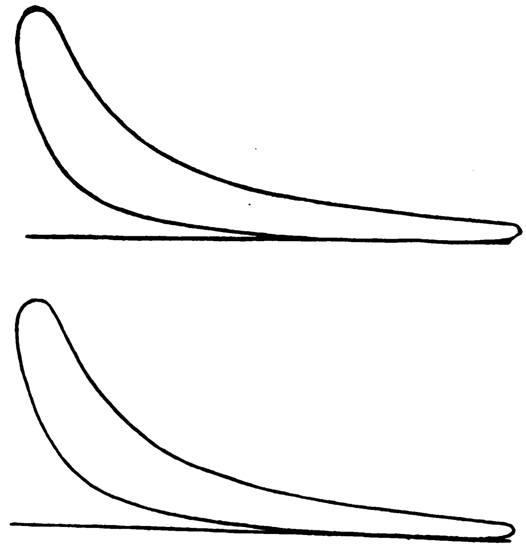


Fig. 3

presence of the writer, while Figure 3 is a card taken at a previous date. It can be noted from the cards that the initial pressure at normal load is somewhat higher than the pressure at the end of the compression. If the starting bottles were filled with products of combustions taken from the engine cylinder, i.e., if they are filled with gases up to a pressure equal to the initial cylinder-pressure, then the engine can easily be started with the said gases. Thus, the engine is started by means of accumulated products of combustion and not by high-pressure air. The fuel consumed is said to be 10 per cent below the one obtained with Diesel engines using compressed-air for injecting the fuel.

The writer did not check up the amount of fuel consumed, but common sense tells us that a solid-injection engine, provided it gives a clear exhaust, (i.e., a perfect combustion), must have a better fuel-consumption than a Diesel-engine which injects the fuel by means of compressed-air, because the compressor consumes power, and the admission of cold injection-air into the combustion chamber is undesirable from the thermal standpoint. The omission of cold injection-air accounts for the fact that the Steinbecker engine

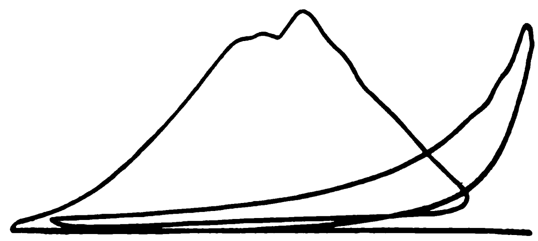


Fig. 2

showed a perfectly clear exhaust at no load, using tar-oil as fuel.

From the mechanical standpoint, the Steinbecker engine is a much simpler and cheaper engine—omitting the compressor, the fuel needle-valve, the injection-air bottle, and the high-pressure injection-air piping. All these parts are expensive and a source of more or less trouble. Thus the Steinbecker engine has many good features and it is a type of engine which will have a future demand. Recognizing this fact, Krupp and other German concerns have purchased Steinbecker license. The writer observed several engines of this type under the course of construction during his visits to various factories.

It may be interesting to hear that the writer was informed while at the Krupp Shipyards at Kiel that this concern made a test on a Steinbecker engine, using fuel-oil containing over 30 per cent asphaltum, before they decided to build this type of engine, and that with this oil the engine gave a clear exhaust.

R. HILDEBRAND.

[Complete articles and illustrations of the Steinbecker oil-engine appeared in "Motorship" of July and August, 1920, and considerable reference was also made to it by Otto Alt, Chief-Engineer of Krupp of Kiel in his interesting contributions last year.—*Editor.*]

Motorship Construction at the Deutsche Werft

Ten Diesel-Driven Tankers and Freighters Now Building. Higher-Powered Vessels to Be Soon Laid-Down

DEPRESSION in the shipbuilding industry does not appear to have affected the various German yards particularly where Diesel-driven motorships are under construction. A recent visit to the Duetsche Werft at Gross Flatbeck, Near Hamburg, by our Danish correspondent showed such building to be quite active at the present time, and confirms reports previously published in "Motorship." At the same time this state of activity does not tally with the report made by Mr. Hildebrand of St. Louis, Mo., given elsewhere on this page, who called upon eight German firms engaged in Diesel engine construction.

Our correspondent states that the Deutsche Werft occupies sites on both sides of the river Elbe, with a frontage of 6,000 feet, and has 19 building ways, varying from 140 to 824 ft. length and that 6,000 men are employed. As also stated in "Motorship" (January, 1921, issue) this yard is working in conjunction with the Hamburg-America Line, the Allegemeinen Elektricitats-Gesellschaft. (General Electric Co.) and its subsidiary the Deutsche Oelmaschinen-Gesellschaft (German Oil-Engine Co., Ltd.) and the Gutehoffnungschutte. All the electrical machinery is being built by the A. E. G. The D. E. S. are sole concessionaries for the Burmeister & Wain Diesel engine licenses in Germany and Italy.

It was last January that we stated twenty 1,250 i.h.p. Burmeister & Wain type engines were building by the A. E. G.'s subsidiary. These are destined for merchant-ships at the Deutsche Werft. including the following:

No. of Vessels	Type	D.W.C. Tonnage	I.H.P Power
3	Freighters	8,000	2,500
2	Freighters	6,500	2,500
3	Freighters	5,500	2,500
2	Tankers	4,000	2,500
10		61,500 tons	25,000 i.h.p

In addition the Deutsche Oelmaschinen is building four Diesel engines of 2,250 i.h.p. each or 4,500 i.h.p. per twin-screw set for some motorships of 8,000 tons deadweight and of higher speed, the above craft ranging from 10 to 12½ knots. These hulls will shortly be laid-down.

Extended tests have been carried out at the Tug experimental plant, and it has been found that the engine-speed of 126 revolutions per minute will not result in propeller inefficiency.

The three Diesel-tankers will have the following dimensions:

Deadweight capacity	4,000 tons
Length	94 meters
Breadth	13 meters
Depth	8 meters
Draught	6 meters
Power	2,500 i.h.p.
Speed	11½ knots

As regards the 6,500 tons freighters, these will carry a few first-class passengers as well as cargo. Also provisions have been made to carry live stock such as cows, pigs, sheep on the starboard side forward. Their fodder is stored abaft of the chain locker. On the port side forward is the workshop and store-rooms.

(*Continued on next page*)

The dimensions of this class ship are as follows:

Dead-weight-capacity	6,500 tons
Power	2,500 i.h.p.
Length B.P.	114.3 meters
Breadth	15.7 meters
Depth	8.63 meters
Draught (extreme)	6.9 meters
Classification	Germanischer Lloyd * 100 A 4
Cargo-capacity	253,285 to 275,040 cubic feet

There are two masts and the stern is of the cruiser type. Fuel is carried in the double-bottoms, as well as ballast-water, and fuel is also carried in three tanks between the propeller-shafts. There is a fresh-water space of 130 cubic-meters. The total fuel-capacity is 1,116 cubic-meters, and space is provided for 15 cubic-meters of lubricating-oil.

The cargo space is divided as follows:

Hold 1	45,569 to	47,995 cubic ft.
Hold 2	53,540 to	57,743 cubic ft.
Hold 3	53,540 to	57,743 cubic ft.
Hold 4	16,422 to	18,117 cubic ft.
Between decks	84,214 to	93,442 cubic ft.
Total	253,285 to	275,040 cubic ft.

The capacities of the fore and aft peaks are 71 cubic-meters and 97 cubic-meters respectively. Forward the three hatches of 11.22 by 5.2 meters are served by 12 derricks and 8 electric-winches of A. E. G. manufacture, each of 5 tons lifting-capacity. Grouped round the engine casing on the starboard side are the quarters (in single-cabins) of the four engineers, and two 2-berthed cabins of the four-assistant-engineers. On the port side are the steward's cabin, two cabins for the carpenter and boatswain, another for two cooks, besides a shower-bath, a mail compartment of 30 cu.m. capacity, and a hospital. In the poop four motormen are quartered in one cabin, three oilers in another, and 2 electricians and a boy in a third, on the port. While on the starboard side, the 12 men are berthed, four to each cabin. The men and the engine-room personnel have separate dining rooms.

Below the poop are the ice, chain and provision stores, while on the shelter-deck the 2nd, 3rd and 4th mates are accommodated together with the doctor, 2 stewards and 4 passengers in two-berthed cabins. Further, there are an office, bath, smoking and dining saloons and a pantry. Aft follows the kitchen with a separate wash compartment, next the fourth hatch of 8.58x5.2 meters dimensions, served by two derricks and electric-winches each of 5 tons capacity and by two 3 tons electric-winches and derricks. Here, on the port side, are also to be found the lavatory and on the starboard a lamp store. On the boat deck the captain has his sleeping cabin and saloon, and the first mate and the pilot each their cabin. On the flying bridge are chart pilot houses and the "wireless" compartment.

Next we will describe the 8,000 tons motor-freighters, which have the following dimensions:

Length B. P.	121.40 meters
Breadth	16.45 meters
Depth to S. D.	11.67 meters
Draught, loaded	7.49 meters

Following the usual practice all the deck-machinery is electric-driven, and comprises 14 winches, of which two are of 3 tons and the rest of 5 tons lifting capacity—all of A. E. G. manufacture. The steering-gear, the windlass and a warping-winch are also electrically operated.

The engine-room arrangement is along standard plans. There are three 75 h.p. B. & W. type Diesel-driven generators which supply the current for the drive of the number of pumps and for the electric-light, for which latter purpose there is a transformer to 11 K. W. 220/110 volts, another being for the steering-gear. Only the 5 h.p. emergency compressor of 13 cubic meters capacity per hour at 80 atm. pressure is steam-driven from the oil-fired Hetsch burner, horizontal-tube boiler of 8 atm., pressure and 14 square meters heating-surface, that also supplies the steam for heating purposes.

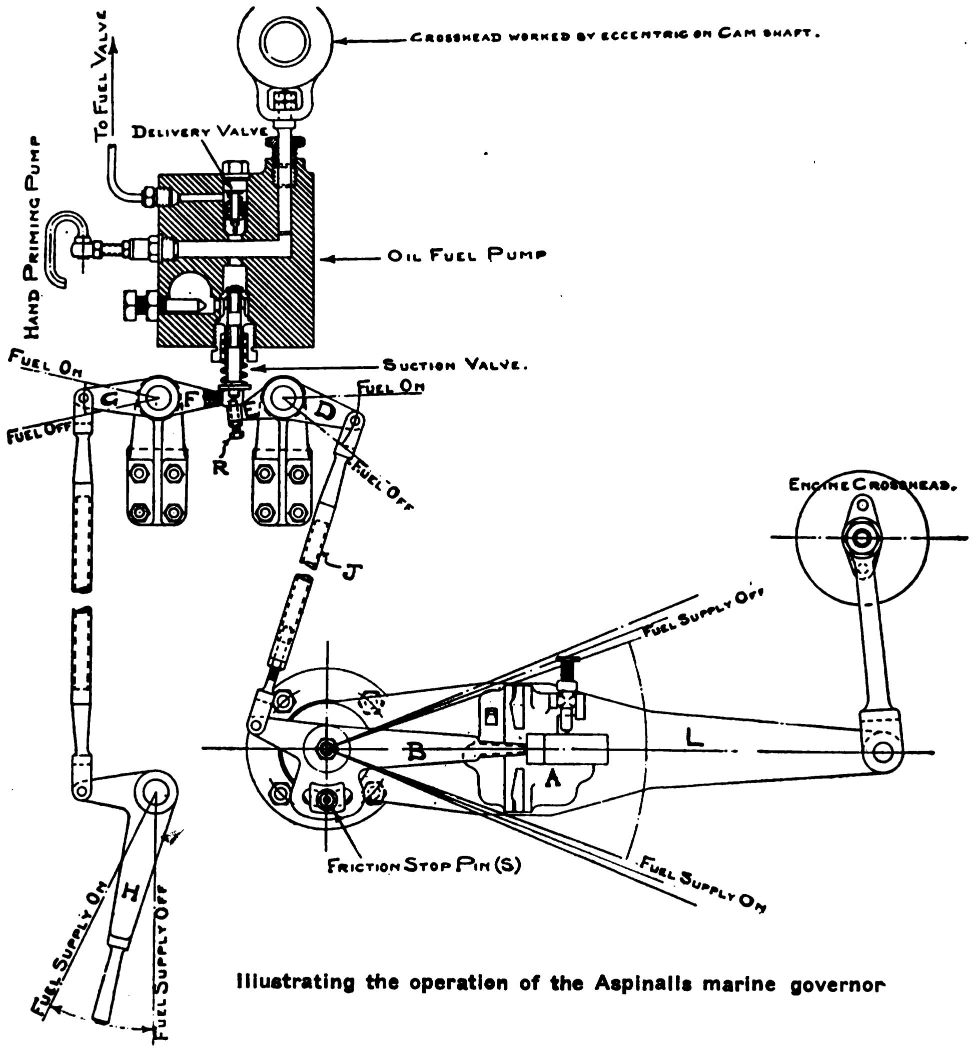
There is an electric driven air-pump of 75 K. W. and 360 cubic meters capacity per hour; two force-feed lubrication-pumps of 20 cubic meters capacity per hour; a spare force-feed lubrication pump of 2.4 cubic meters capacity per hour for the auxiliary Diesel engines; a daily fuel-pump of 50 cubic meters capacity per hour; two cooling-water pumps of 110 tons capacity per hour; a bilge-pump of 150 tons capacity per hour; two 3-cyl. crank-pumps; seawater box; a fresh water-pump of 3 tons capacity per hour; two 7 h.p. electric starting-motors, two starting-air tanks of 13 cubic meters content each; the main charge air-bottles containing 200 litres each; two spare ones holding 400 litres each; two silencers of 4 cubic meters content each; another of 0.6 cubic meters for the compressed-air; two daily fuel-tanks that have each a cubic-capacity of 7 meters; which suffices for 8 hours; a crude-oil measuring-tank of 1.1 cubic meters capacity; nine, 0.75 cubic meters lubrication-oil-tanks, main and auxiliary switchboards; and 11 K. W. 115-volt light dynamo; a 4 h.p. workshop engine; a blast engine of 14 cubic meters capacity per min.; a boiler feeding pump of a capacity of 0.8 ton per hour; an evaporator of 12 tons capacity in 24 hours for sea-water, and an evaporator pump of 0.75 ton per hour.

Other shipyards building Diesel-engined motorships are Blohm & Voss, the Tecklenborg Co., the Reiherstieg Co., the Weser Co., and the Howaldtswerke. The other steamship lines that have ordered these motorships are the Hamburg-American Co., Hugo Stinnes, the Hamburg-South America Line and the Hansa Line.

GOVERNORS FOR MARINE DIESEL ENGINES

Few ship's engineers are unfamiliar with Aspinall's governor, which has been adopted on many merchant steamships. In fact, its adoption on this class of vessel is so common as to be almost universally standardized. Therefore, it was only logical that the makers should have modified this governor to render it very suitable for the marine Diesel-engines of merchant motorships. So far as we are aware the Aspinall governor was first adopted for the motorship "Selandia" in 1912 by Burmeister & Wain, and has been installed in every motorship completed by them since that date, as well as by many other Diesel-engine builders. Therefore, some details of the design will be interesting to those engine-builders who till now have preferred to stick to governors similar to those used on land Diesel-engines. It is entirely automatic in its action, simple in construction and prevents racing in heavy weather, also shuts-off the fuel supply to the engines in the event of a broken shaft, or loss of propeller. It also prevents undue wear and tear to the delicate mechanism of this particular class of engine. It saves fuel owing to the fact that it cuts-off the supply when the propeller lifts out of the water, and at a time when it would not be doing any effective ship driving. With this governor fitted a vessel will make quicker voyages, and the engineers are relieved from standing-by the hand-regulating gear in heavy weather, and are thus at liberty to give proper attention to their numerous ordinary duties.

It is fitted to a suitable reciprocating-lever having for preference an angular movement of about 45 degrees and making about 80 double strokes per minute. The Governor "A" is adjusted to act at about 5 per cent above the running speed of the engines: when the predetermined speed is reached the large weight of governor is left behind on the downward stroke of the special lever "L," and on the upward stroke of the special lever "L" the bottom pawl on governor carries the engaging lever "B" into its upper position, which lifts the suction valve on oil fuel-pump off its seat through rod "J" and levers "D" & "E." When this action takes place the bulk of the oil-fuel instead of passing through the delivery valve to the cylinder is returned to the suction chamber, and the engines are then slowed down. The amount to which the suction-valve is lifted off its seat by the governor is regulated by the screw "R" which is set so that a small quantity of oil-fuel will pass through the delivery-valve and to the cylinder. When the speed of the engines has moderated, the large weight of governor drops into its lower position which allows the suction-valve for the fuel-pump to come on its seat, the full supply of oil-fuel is then discharged through the delivery valve to the cylinder. The lower "F" connected with the hand gear is fitted with a fork end which works outside the lever "E" of governor gear. With this arrangement the governor gear or hand-gear work independently of each other. The representatives in America for the Aspinall Governor Co. of Liverpool, England, are: John Platt & Co., 2 Rector Street, New York and the Plant Rubber & Asbestos Works, 537-539 Brannan Street, San Francisco, Cal.



Illustrating the operation of the Aspinalls marine governor

Further Discussion of Metten and Shaw's Paper

Including a Reply to Critics by the Authors—Comments of Motorship Virtually Endorsed

LAST month we published extracts taken from a number of comments on Messrs. Metten and Shaw's paper on Diesel-engines and motorships before the Society of Naval Architects and Marine Engineers, together with a few criticisms on the critics' remarks. Our opinions are virtually endorsed by the reply of Messrs. Metten and Shaw, as follows:

The Reply of the Authors

"**Mr. Fernald** has furnished an estimated formance of a comparatively small vessel having triple-expansion-engines, geared-turbines, and Diesel-engines, and for the last has selected engines of the B. & W. type He states that this comparison was worked up sometime ago when he was connected with the Shipping Board, and from which we are led to infer the Shipping Board based their decision not to embark on motorship construction at that time. If this is correct, this important decision was based upon incorrect data, as the B. & W. engines used in the comparison are two sizes larger than those in service on vessels of the same size and speed. The size assumed for the comparison is known as B. & W. type 6-275, and designed for 4,000 i.h.p. (total).

'The engine size that should have been employed in the comparison is actually two sizes smaller and known as B. & W. type 6-200, designed for 2,800 i.h.p. (for the two engines). These latter engines are the same as installed on the motorship "Oregon" and several similar vessels which have the same designed sea-speed as the Fernald vessel but have 5 ft. more between perpendiculars, 1 ft. more beam, and 6 inches more draft. The total weight of machinery, therefore, including spares, engineer's stores and water in the system is thereby reduced by using the proper installation from 795 tons to 540 tons. Also, the fuel-oil consumption is reduced from 13½ to 9½ tons per day, as actually obtained on the motorship "Oregon". For the motorship the cargo carrying-capacity, both cubic and deadweight, will be correspondingly increased, which taken with the decreased cost of machinery will show a decided economical advantage for the motorship over the steam vessels for the particular route in question. Mr. Fernald has failed to take cognizance of the fact that the twin Diesel-vessel will have a better propulsive efficiency than the single-screw vessel, due to the revolutions assumed for the latter. *The results arrived at by him are therefore incorrect and extremely misleading.*

"**Messrs. Smith and Dalcher,** of the Federal Shipbuilding Co., have also investigated what advantages there may be in the motorship and have furnished an estimated comparison by them of a vessel with geared-turbines and Diesel-engines. From the data given, the Diesel-installation is apparently based on an experimental engine, which is unusually heavy for the power. The shaft horse-power estimated as required for the motorship is about right, but the power used for the geared-turbine vessel is considered too small, due to the high turns of 90 r.p.m. employed for the single-screw, and which should not exceed 75 r.p.m. for the particular conditions, if the propulsive efficiency of the two vessels is to be kept the same.

"Had B. & W. engines type 6-275 (erroneously used in Mr. Fernald's comparison, and exactly suitable for the present vessel) been employed, the machinery would have been reduced from 1,052 tons, as given in Mr. Dalcher's figures, to 795 tons, or a saving of about 25%. Mr. Dalcher has used 0.35 lb. of fuel-oil per i.h.p. hour for all purposes at sea, giving 14.55 tons per day. If this is corrected to 0.31 lb., as obtained on B. & W. vessels, the consumption per day is reduced to 13 tons. Had a more suitable Diesel-engine installation been selected for the comparison, the 19% net earnings per year on the initial investment, as given, would have been very greatly improved, and would conform more with the figures of the authors in their comparison.

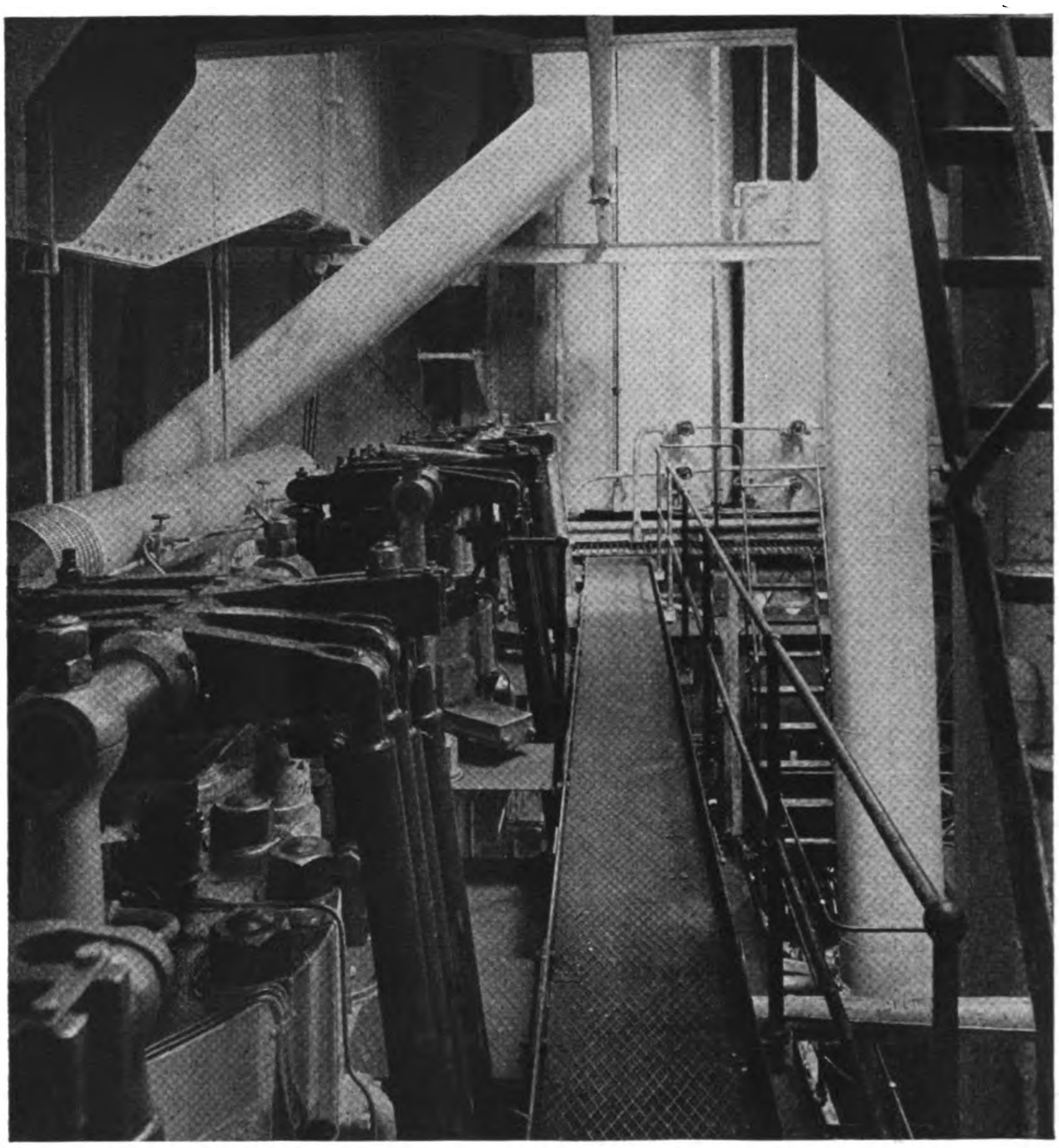
"Referring to Mr. Huskisson, of the Vickers Company, it was not the intention to criticize the Vickers engine in particular, which is known to be of fairly high-compression and is about the only margine engine of the solid-injection type to date that has met with any degree of success for marine purposes. As to the Vickers engine being entirely free from the troubles enumerated, reference is invited to some comments made by Mr. David P. Peel regarding his experience with Vickers submarine-engines, in which he discusses the smoking and knocking in cylinders. This is to be found in the Transactions of the Institute of Marine Engineers, Volume 31, Feb., 1920, Pages 566-572.

"The authors can also speak from experience gained with a four-cylinder 500 h.p. experimental engine of this type and the company with whom they are associated are building very satisfactory solid-injection stationary engines for lower powers.. It should be pointed out that Vickers' experience has been mostly with submarine work and, to the knowledge of the authors, they have only three merchant vessels in operation, which are of comparatively small power. Submarine engines are operated only for short periods at full power and frequently come into special bases prepared for their overhaul, while merchant motorships must operate a long time at full power and away from home without any special attention. We fail to see wherein the accident cited by Mr. Huskisson as occurring to an ex-German vessel has any logical bearing on the matter in the absence of trouble of this kind with standard air-injection engines.

"**Mr. Katzenstein,** representing the Worthington Company, has advocated and defended the proposed Diesel-electric drive on the ground that the higher speed trunk-type engine has been satisfactory as auxiliary engines on B. & W. vessels. It should be noted that the function of auxiliary engines and their operation is entirely different from the main engines as they are very seldom operated at full power, and then only for a specified time, when each in turn is shut down and another started up in its place. It might be stated in this connection that there is a strong tendency at present, on the Continent in particular, to replace the larger sizes of trunk-type engine for land purposes by the crosshead type, due to the generally recognized superiority of the latter, although the weight and cost is higher. For the main drive in a motorship it cannot be too strongly emphasized 'that the best is none too good' for reliability and continuity of operation, which are of the utmost importance. Mr. Katzenstein has also referred to their land engine of the horizontal type, commonly used for driving pumps of oil lines, which are known to be quite heavy and not permissable in a Diesel-electric drive, where the high-speed light-weight engine is a requisite to keeping the total weight of machinery and the space occupied within reasonable bounds.

"**Mr. Anderson,** representing the Parsons' Turbine, states that the motorship cannot make as good an average speed in bad weather as the steamer, when, as a matter of fact, the motorship has a considerable advantage in this respect. The larger diameter single-screw employed with the steamer has a tendency in bad weather to be longer out of the water than the smaller diameter twin-screws of much greater immersion in the motorship and it is apparently only when the screws are in the water that the power can be effectually applied to driving the vessel. Furthermore, there is no throttling of the power in the Diesel-engine, as with the turbines for the steamer, in rough weather.

"This is accounted for in the oil-engine being



M. S. "William Penn." Starboard side of eng ine-room looking forward and showing valve-mechanism of port main engine able to have all the power instantly cut off when the revolutions exceed a certain determined value, reached when the screws are out of water, and is instantly cut in again when the screws are returned to the water. *The average all-year propulsive efficiency will also be better for the twin-screws as a result of their better immersion under all conditions of draft.* Mr. Anderson considers the oil per s.h.p. of 0.95 lb. all purposes, for the geared-turbine, as used by the authors, can be improved on some 10% with 150° superheat. We are, however, dealing with operating conditions and higher economy implies a very good vacuum for the turbines, and it is a known fact that it is chiefly due to not realizing the designed high vacuum in actual service that accounts for the discrepancies between the trial data and actual performance of turbine vessels. This is particularly noticeable when the vessels are run over tropical routes.

"The efficiency of the steamer also has a tendency to fall-off in service as the boiler heating surfaces deteriorate. The above conditions do not affect the Diesel-engine, which actually improves in economy and which in no way is affected adversely by tropical conditions. Mr. Anderson questions the 0.31 lb. per i.h.p. for main engines, all purposes, used by the authors, and has referred to figures published in "Engineering" of February 15, 1915, which gives a mean of about one-third of a pound of oil per i.h.p. for B. & W. installations up to that date. The explanation for this is that the consumption then published represented the earlier design of B. & W. engines, in which the compressor for the injection-air had its first two-stages driven by separate auxiliary engines, which is a less efficient arrangement than now used, where a three-stage compressor is driven by the main engines alone. Some development in the art is to be expected in that time contributing towards improved economy, as likewise noted in the steam turbine.

"**Mr. Dickerson**, of the General Electric Company, has misinterpreted the meaning of the authors in reference to the importance of electrically driven auxiliaries for motorships, especially in regard to deck machinery. The individual Diesel-drive for the winches, as suggested by Mr. Dickerson, would no doubt be the most efficient arrangement, if such were practicable, as there would be no electrical losses involved. In a motorship, however, the electrical link is necessary to make the power of the auxiliary engines, primarily an accessory to the main engine, available for deck use.

"This does not imply, as we are led to suppose, that the electrical system is accountable for the low port-consumption with a motorship, as by replacing the auxiliary Diesel-sets by a steam-driven set, this oil-consumption in port will be more than trebled. Mr. Dickerson's strong defense of the Diesel-electric drive can readily be understood but the Diesel-electric drive, which is quite a parallel case to the steam-electric, runs contra to the history of all engineering development, which shows that efficiency, simplicity and cost are the deciding factors.

"The electric drive is deficient in each respect and the fact that twelve of the Shipping Board's geared-turbine vessels are being changed over to turbo-electric drive is due to good salesmanship and not good engineering. The first of these installations has been in service since November, 1920, and has steamed approximately 20,000 miles with the electric drive, during which her logs show that she actually consumed 10% more fuel than when equipped with her original geared-turbines, which, by the way, operated with 50° superheat, while the Turbo-electric drive operated under 200° *superheat.*

"**Mr. Warriner's** figures for a motor-driven ore-ship are of particular interest on account of being of two-cycle design, and we presume are based on the "CUBORE" installation. It again furnishes an illustration of the superiority of the four-cycle engine, had such been used in the comparison. By replacing the two-cycle engines with four-cycle of the same cylinder dimensions as the motorship "William Penn," but of eight cylinders each, the normal s.h.p. would be increased 7% and the total weight of machinery, including boiler, reduced at least 100 tons, since the total installation, without boiler, for the four-cycle will be 1,050 tons. The fuel-consumption per day becomes 19 tons instead of 24 tons, with a corresponding increase in cargo-capacity of 140 tons.

"Accordingly, the total increased cargo carrying-capacity will be 240 tons more than with the two-cycle vessel.. Using the same basis of comparison as used by the authors in their comparison, the cost of crew per day for the motorship becomes 12.3, with repairs and provisions same as for the steamer. The cost of fuel is reduced to 6.48, giving a total operating cost per day of 89.56, compared with the 96.38 for the particular two-cycle installation. The four-cycle will be seen to be better than any of the three other drives used by Mr. Warriner in his comparison. It can be safely stated that on the long trade routes the large direct-driven motorship, where proper care is made as to proven types, will show a greater earning-capacity on the investment over all other drives, irrespective of variations in freights-rates and fuel-prices. * * *

Further Discussion and Additional Comments by "Motorship"

Since publication of our last issue, which contained the comments of Mr. Benj. C. Fernald, we have had the opportunity of seeing the balance sheet which he afterwards submitted to the Society. Looking through the same we see he gives the cost of a ship with geared-turbine as $164.50 per deadweight ton, compared with $215.00 per deadweight ton for a single-screw motorship. Also that his turbine-ship is of 8,700 tons d.w. and his motorship of 8,360 tons d.w. These figures, of course, are very misleading as the cost per d.w. ton should not have been taken, but the cost per net cargo-capacity ton, because a vessel is built to carry cargo and relies upon the earnings from that cargo to pay the entire cost. In taking the d.w.c. tonnage fuel, water and stores have to be included, and the steamer, of course, carries three times the amount of fuel that a motorship does, and 150 tons more fresh water.

Furthermore, he quotes the weight of Diesel-engines with auxiliaries as being 795 tons compared with 355 tons and 100 tons additional fresh water for the geared-turbine ship. We fail to see where Mr. Fernald secured his figures for the weight of motorship machinery. We refer Mr. Fernald to the weights of leading American Diesel-engines now under construction or in service given on page 17 of the "Motorship Year Book." If he will select ten of the high-powered crosshead-type engines he will find that the average weight is only 339 pounds per shaft h.p., so that about 400 to 450 pounds per shaft h.p. should include all auxiliaries and would work-out at about 500 tons, and less with some engines. This is some difference from his figure of 795 tons. Our weights include among other engines the Burmeister & Wain, McIntosh & Seymour, Worthington, which are the heaviest marine Diesel-engines on the market.

He also gives the consumption of the motorship fitted with two 1,400 b.h.p. Diesel engines as 13½ tons per 24-hours day. In this connection let us point out that the consumptions of the "William Penn," "Afrika," "Bullaren," "Tisnaren" and similar ships fitted with engines of considerably higher power—namely, 4,500 i.h.p.—are only between 13 and 14 tons. Consequently his figures—starting on a wrong basis—are practically inaccurate throughout. Shipowners should first make certain that consulting-engineers have a thorough knowledge of the motorship and Diesel engine situation before employing them to make comparisons or recommendations.

Robert Warriner stated that it is not his intention to make out a case for the reduction-gear at the expense of the Diesel-engine, because personally he is very much in favor of the Diesel engine, as it means economy of fuel-consumption, and economy is the goal engineers are striving for. He referred to Mr. Fernald having stated that Great Britain and Scandinavia have for the past few years swung over to the motorship almost exclusively, but he considered that this is not an altogether fair remark as far as Great Britain is concerned. Because, on March 31, 1921, there were 794 steamships of 3,500,000 gross tons compared with 66 motorships of 250,000 gross tons under construction. In this connection we may point out to Mr. Warriner that the 794 steamships were practically all ordered before the 66 motorships, and that during the short period in which motorships were ordered at the end of the great ship-construction boom, hardly any orders were placed for steamships. Shipowners change over to motorships in Great Britain came suddenly and immediately followed the slump in orders for steamships. Then came the great slump for ships of all classes. The only recent order in Great Britain has been a 10,300 tons Werkspoor Diesel-engined motorship. Mr. Warriner also referred to the fuel-consumption for a two-cycle Diesel-engine stated by Mr. Smith as 0.515 lb. per shaft h.p, hour as being correct; but that the actual figures used in the calculations was 0.42 lb. for the main engines, the remainder being for auxiliary purposes.

However, there seem to be two methods of calculating shaft h.p. The correct way is to take the power of the main-engines and add to it the power of the auxiliary-engines used at sea, thereby getting the total power. Then take the fuel-consumption for all purposes and work-out the consumption per b.h.p. hour, in accordance with the correct power. Otherwise the figures will be misleading. This will bring the consumption down to about 0.43 lb. per b.h.p. hour for a modern two-cycle engined motorship, and a little lower for a four-cycle engined motorship.

Ernest H. P. Anderson.—This gentleman, who is the representative of the Parsons Marine Steam Turbine Company, stated he does not agree with some of the statements in the opening paragraphs of Messrs. Metten and Shaw's paper, and that it does not seem to him that progress in the construction of large motorship machinery in America warranted shipowners or the Board awarding contracts to engine-builders on a large scale. Also, that the authors to a large extent reviewed the progress made by foreign builders. Here we may say that similar propaganda on the part of the allied steam interests has done much to hamper the adoption of the oil-engine in America.

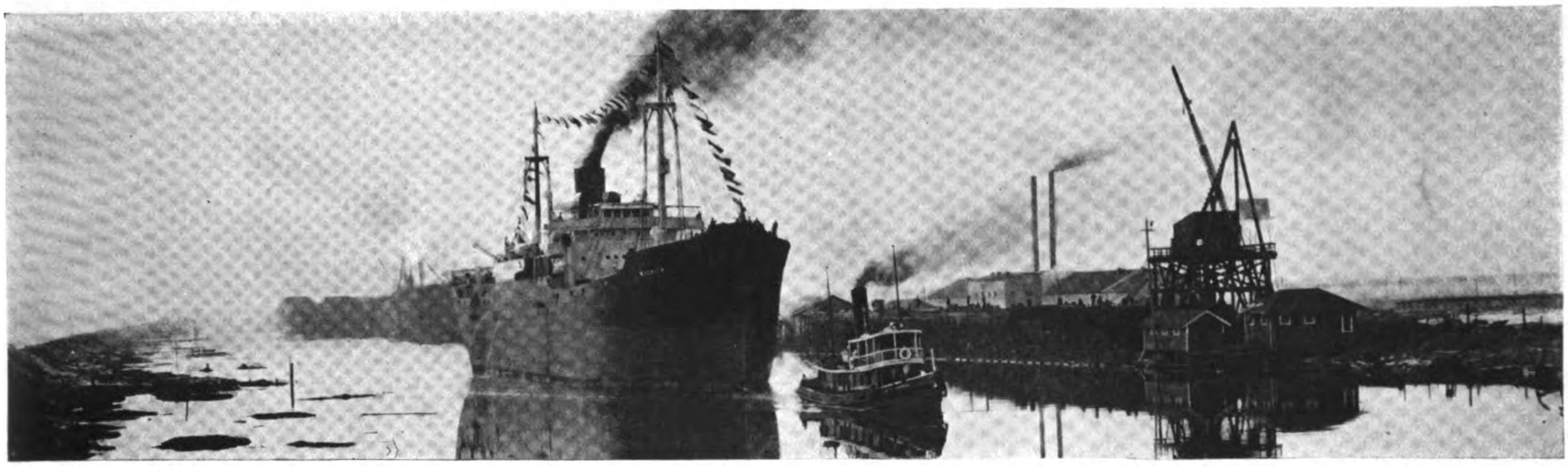
Apparently Mr. Anderson has not taken into consideration the fact that the majority of American shipbuilders have the benefit of a license and experiences of European Diesel-engine builders, together with the assistance of their engineering experts to ensure their successful construction in the United States. He also stated that with bad weather conditions at sea the motorship does not maintain full speed, and that estimates should make allowances for such conditions. We would point out that this condition applies to steam machinery to a greater extent than to Diesel-engines, and, consequently, a motorship will average better speed in bad weather than will the average steamship.

Mr. Anderson also states that Messrs. Metten and Shaw's oil-consumption of 0.310 lb. per i.h.p. hour was based on good trial conditions and that a usual sea performance would be between 0.33 and 0.370 lb. per i.h.p. hour. This statement, we can say, is absolutely incorrect as we can prove by extracts from the log-books of dozens of motorships now in service. We can endorse Messrs. Metten and Shaw's figure of 0.310 lb.

Theo. Lucas in his reply dwelled on the discussion of the possibilities of the development of the two-cycle engine and its development in larger sizes and among other things suggested fitting a forged-steel liner in the cylinder of the two-cycle engines with ports cut directly into the steel, which would allow reduction in the thickness of the liner, a more effective cooling and the avoidance of cylinder cracks. He furthermore stated that one could concur heartily with the authors about the conversion of old ships into long-stroke Diesel-driven units, which will probably be found the best solution of the shipping tangle.

Hubert C. Verhey endorsed Messrs. Metten and Shaw's figures from actual and practical personal experience secured during the round trip to the Orient on board the motorship "George Washington." Nevertheless, he considered the splendid performance of the four-cycle engine does not picture the actual situation from a heavy-oil engineering standpoint because of the limit in power, and he advocates resorting to double-acting two-cycle engines.

M. L. Katzenstein considers that the solution of the problem of the engines in many of the present Shipping Board vessels will be brought about by the use of moderately high-speed Diesel-engines transmitting their power through electricity or other means, to the existing single-screw shaft. That disadvantage of high-speed engines are no doubt justified, but when applied to moderate speed engines will not hold in the face of current experiences. As a support to this theory he referred to the reliability of the moderate-speed auxiliary-engine installed in the engine-room of the "Selandia," placed in service February, 1912,



Yard of the Doullut & Williams Shipbuilding Co., Inc., the only industry now in operation on the Inner Harbor and Navigation Canal at New Orleans. The ship shown is a 9,600 tons steel vessel built for the Shipping Board.

New Orleans Canal Completed This Year

Opening of a New $25,000,000 Inland Waterway Will Benefit Commercial Motorship Traffic

MOTOR-BOAT owners and operators throughout the South, including those interested in the 10,000 or more commercial motor craft in service along the Gulf of Mexico coast of the United States, expect great benefits from the use of the New Orleans Inner Harbor and Navigation Canal, now being completed at a cost of approximately $25,000,000. This canal was dedicated, it will be remembered, but will not be in actual operation until after the period of high water in the Mississippi river at the end of this summer, connects this big waterway with Lake Pontchartrain, running directly across the lower part of the city of New Orleans, with a length of five and one-half miles between the huge concrete lock at the river end and the tide level opening into the lake.

Whatever the value of this canal to deep-sea traffic and to general world commerce, there can be no question of its worth to small-boat traffic, and to coasting steamers, motor-freighters, schooners and barges. In the first place, it forms a most necessary and valuable link in the Intercoastal Canal, or will form such a link should a delaying government ever complete that important waterway. Through Lake Borgne and Ponchartrain, the new canal connects the Gulf of Mexico, Mississippi Sound and all the waterways east of the mouth of the Mississippi with that stream, thus giving close connection between every waterway in the Mississippi Valley with all the ports eastward to the western coast of Florida. It also cuts off about 40 miles of the distance from New Orleans to the Gulf of Mexico, for shallow-draft boats, which can use Lake Pontchartrain and Lake Sorgne and Mississippi Sound, all of which are protected waterways.

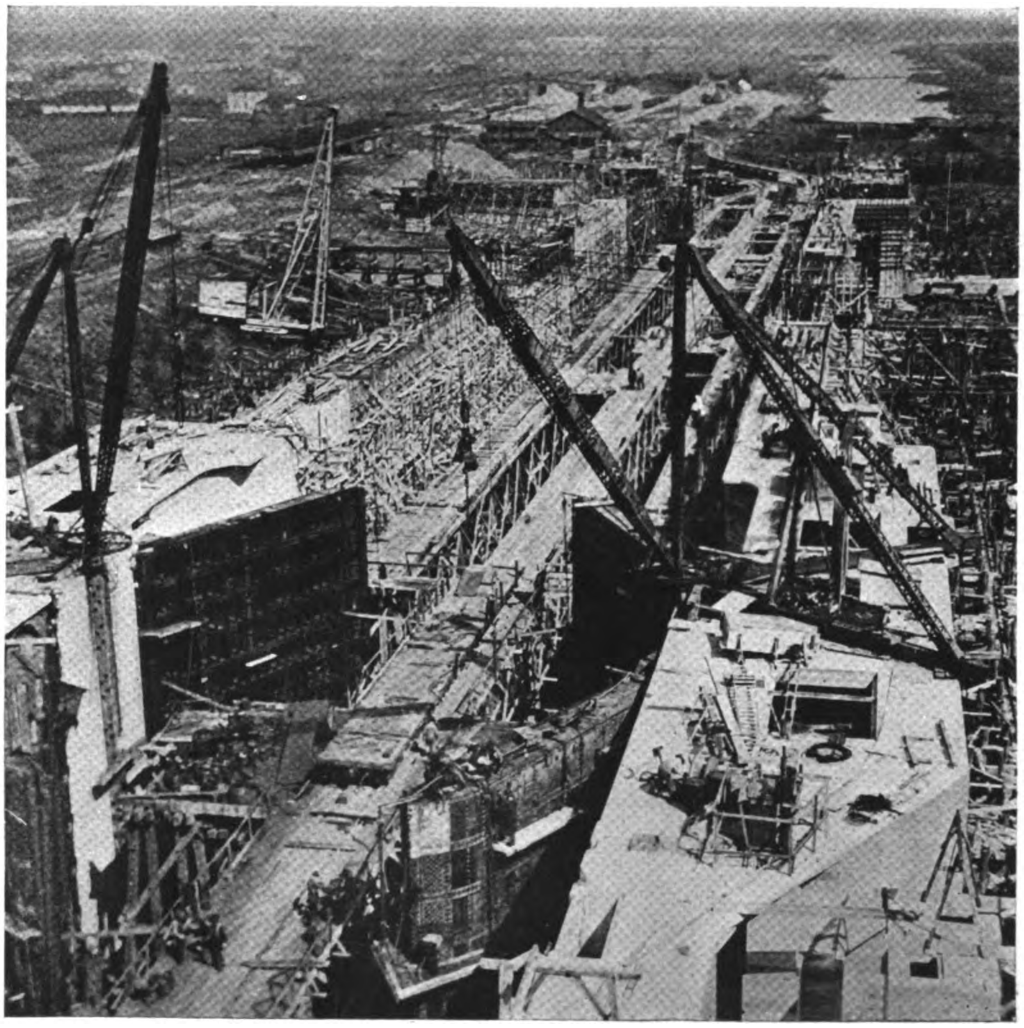
Likewise this new canal connects all these eastern waterways with the 5,000 or more miles of navigable inland streams, bays, bayous and lakes in western Louisiana, clear to the Texas line. Many of these waterways are navigable into other states to the north and west, but motor-freight and passenger carriers from this vast area always heretofore have been compelled to pass down and out of the Mississippi river to reach Mississippi Sound and the gulf coast ports of Louisiana, Mississippi, Alabama and Florida, or to pass through the Lake Borgne Canal into Lake Gorgne, and thus out to the Gulf—both circuitous and costly courses.

The Warrior river government barge-service, which annually handles hundreds of thousands of dollars worth of coal into New Orleans from the Alabama fields, has been compelled to come into New Orleans harbor at Violet, 12 miles below the city, and from there fight the heavy and treacherous current of the mighty Mississippi up to the port. Through the help of the new canal these barges now can pass more quickly, more safely and with less expenditure of fuel, through Lakes Borgne and Pontchartrain and directly into the center of the port of New Orleans.

To the fishing fleets alone, operating in the shrimp, oyster and salt-water fish industries of the Gulf coast, this canal furnishes a direct and protected gateway into New Orleans. The Crescent City, because of its distance from the fishing grounds, has lost virtually all the shrimp and oyster packing plants to the coastal towns of Mississippi, such as Biloxi, Gulfport and Pascagoula. The new cut-off furnished by the Inner Harbor and Navigation Canal, reducing the distance from the gulf approximately 40 miles, should bring back some of these industries, which are tremendously valuable, to New Orleans. This canal also opens the port of New Orleans to all the heavy schooner, barge and motor-freighter traffic of the northern and western shores of Lake Pontchartrain and Lake Maurepas and their tributary streams, as well as all the shores of Lake Borgne, its fisheries and the rivers which empty into it. Indeed, it is doubtful if ever a step has been taken which means so much to the motorboat industry.

One of the main drawbacks to the development of the American Merchant Marine today is the reticence of American capital toward investment in fleets; one of the main drawbacks to the development of the foreign trade of New Orleans is the failure of the Mississippi Valley and New Orleans interests to own their own fleets of freighters, but no such handicap lays on the "mosquito fleets" of motor-craft along the Gulf Coast, with the result that their development has been the greatest the writer has ever seen or of which he has ever read, along similar lines in any par of the world.

Of course, it is obviously impossible for these motor-fleets to pay the annual interest of more than $1,000,000 on the $25,000,000 cost of the New Orleans Canal, by their use of that waterway, so it must look to a deep-sea traffic of large merchant-ships to pay that interest as well as to sup-



Looking along the lock of the Inner Harbor and Navigation Canal at New Orleans from the Mississippi River and back northward toward Lake Pontchartrain. The completed part of the canal can be seen in the background ply a sinking fund with which to take up the cost of the canal, but the motor-fleets will do their share, and, for a number of years, at least until a 35-foot channel has been dredged across Lake Pontchartrain to the Gulf of Mexico, probably will furnish the larger part of the traffic through the new Inner Harbor and Navigation Canal.

As has been said, the New Orleans Inner Harbor and Navigation Canal is about five and one-half miles in length. The Lake Pontchartrain end is at tide level, without lock; the Mississippi river end passes through a large lock, second in size only to the Panama Canal locks in the New World, out into the big stream. The canal proper is 300 feet in width at the top, 150 feet wide at the bottom, and 30 feet in depth. It contains a large turning basin, and both banks furnish eleven miles of wide sites for ship and boatyards, warehouses, manufacturing plants and other similar industries.

The dedication of the canal is scheduled coincident with the annual convention of the Mississippi Valley Association, which will bring to New Orleans delegates from 26 states, representing waterways, shipping, manufacturing, exporting and other commercial interests. Most of the inland waterways men are also interested in the development of motor boat traffic on the inland waterways of the country, and plans are on foot for a tour of inspection of the canals—of which this is the sixth—leading into and out of New Orleans, and now in constant and heavy use by the motor fleets.

The lock is located approximately 2,000 feet from the Mississippi river, inside the main levees, which will be cut in September or October, after the period of high-water has passed, and the waters of the big stream admitted to the lock. The lock is connected with the river by a channel 300 feet wide on the surface, 150 feet wide at the bottom and having a depth of 30 feet at low water in the Gulf of Mexico. The lock masonry has a length of 1,050 feet over all, with a width, from outside to outside of 160 feet. The usable length of the lock is 600 feet and its clear width 75 feet. It will handle vessels up to about 20,000 tons. The walls of the lock rise 68 feet above the floor, and there is a depth of 30 feet of water over the sills. The steel gates to the lock weigh 400 tons, and the machinery for their handling, all electrical, has been installed.

Diesel-Engined Coastwise Vessel With Reversing Rudders

Since the bygone days of Columbus, and the Armada, history has seldom attributed to Spain the lead in any direction of national enterprise, including even navigation, in which the Spanish were at one time Europe's keen rivals. It is noteworthy, therefore, that one of the newest inventions for navigation, namely a reversing rudder, has been adopted by Spanish owners in one of their coasting motor-vessels, the "Alca," which at the present moment is one of the largest vessels thus equipped actually in service.

Some particulars of the vessel will no doubt prove interesting to our readers, particularly those concerned with the motor-driven vessels. The "Alca" is a steel vessel of 500 tons displacement, and 300 tons dead-weight carrying capacity, engaged in carrying coal and general cargo along the Atlantic coast of Spain. Her dimensions are: Length 140 ft., beam 22 ft. 3 in., and depth 10 ft. moulded; her loaded draft being 8 ft. 3 in. Originally built as a sailing vessel she has now been re-rigged and equipped with a 150 b.h.p. Sulzer stationary type Diesel engine, which turns a propeller of 4 ft. diameter. The engine has no reversing or clutch devices of any kind, all stopping, running astern, and maneouvering of the vessel being obtained solely with the reversing rudder, which is of the type designed and made by the Kitchen Reversing Rudder Co. of Liverpool, Eng., and also constructed by the McNab Co. of Bridgeport, Conn.

To install this rudder the original rudder-post was removed by cutting through at the top and bottom of the propeller aperture; and an extension to the stern-foot to take the bottom pintle was added and securely rivetted to the keel; at the top of the rudder a strong gudgeon or bearing was rivetted to the ship. The rudder blades are of mild steel-plate ½ in. thick; the inside dimensions of the blades are 64 in. by 58 in., the major axis being horizontal.

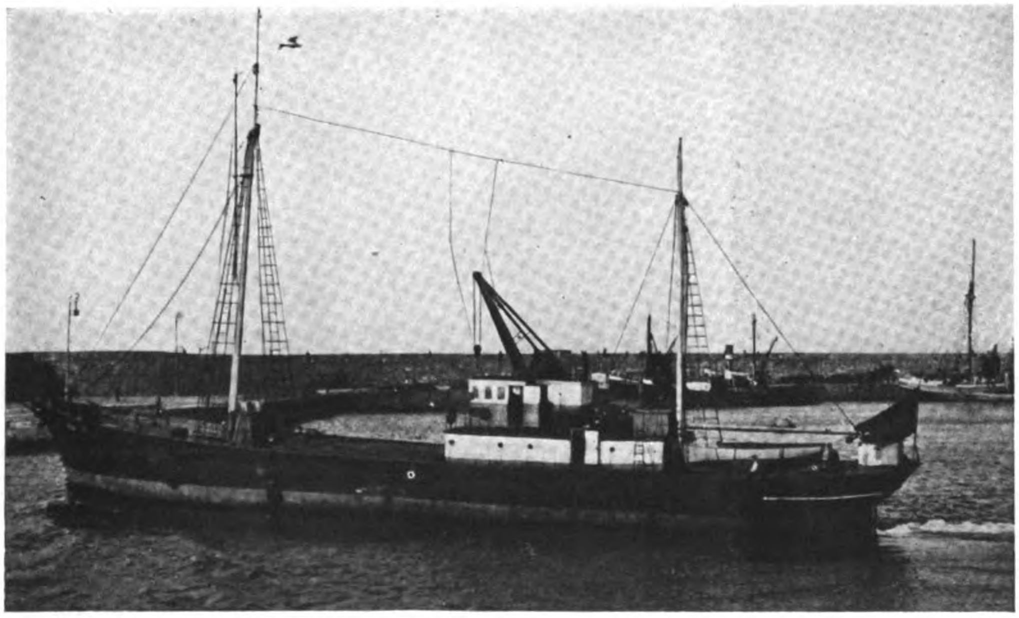
The speed and reverse control-wheel for operating the rudder is mounted in the wheel-house on the starboard side of the steering wheel. The motion from this control-wheel is conveyed to the rudder-head operating-gear by means of steel chains over guide sheaves and rollers and it is this wheel which regulates the opening and closing of the rudder blades, and of course all their intermediate positions.

Helm is controlled in exactly the same manner as with the ordinary type of rudder, the opening and closing of the rudder blades in no way interferes with their helm-carrying powers, as either of these operations can be carried out independently of the other as they are not inter-connected.

Depicting Kitchen reversing-rudder on stern of Diesel coaster "Alca"

The vessel attains a sea-speed under power of 6¼ knots and the results of manoeuvring trials are interesting. The astern speed was 2¼ knots. The time taken to bring the vessel from full-speed ahead to dead-stop was 34 seconds and the distance travelled was 200 ft. The diameter of her turning circle at full-speed ahead was 140 ft. The time taken to spin about an axis amidships, as if on a pivot through a half-circle, occupied 1 minute 25 seconds.

The rudder control is most efficient and practically instantaneous in effect and permitted the maneuvering and working of the vessel in and about the congested harbors and docks with the greatest ease and reliability. The Gijon representative of the Spanish equivalent to our Steamboat Inspection Service expressed complete satisfaction with the installation and the trial results, upon which he has to submit a report to headquarters at Madrid. The vessel has now been in operation for six months with every success and the rudder device has worked excellently.



The Spanish Sulzer-Diesel-engined coastwise motorship "Alca" propelled by a Sulzer Diesel-engine

FURTHER VOYAGES OF THE DIESEL-TANKER "MEXICO"

On pages 39-40 of our January, 1921, issue details were given of three round-voyages from America to Denmark and back of the new 4,450 tons d.w.c. 1,100 shaft h.p. Holeby Diesel-engined motor-tanker "Mexico." Since then we have received information regarding an additional round-voyage from her master, Capt. E. H. Jorgensen. She left New York on the 10th of December, 1920, at 4:50 p. m. with a cargo of petroleum and naphtha in bulk. Her capacity etc. was as follows:

New York-Copenhagen	Dec. 10th-Dec. 29, 1920
Total amount net-cargo	3,995 tons
Fuel-oil carried	266 tons
Dead-weight-capacity	4,300 tons (about)
Fuel consumed by main engines	100 tons
Fuel consumed by donkey-boiler	13 tons
Distance covered	3,706 naut. miles
Time at sea	459 hrs.
Time pumping cargo	30½ hrs.
Average speed	8.1 knots.

She arrived at Copenhagen Dec. 29th at 3 p. m. having covered the trip of 3,706 nautical-miles in 459 hours, or at an average speed of 8.1 knots which is very good for a vessel of her tonnage and low power. Best test run was 221 miles. She consumed 113 tons of fuel-oil, of which 13 tons was used for steam heating.

Copenhagen-New York	Feb. 7th-Feb. 21, 1921.
Total amount of cargo	In Water Ballast
Fuel-consumed by main engines	105 tons
Fuel-consumed by donkey-boiler	14 tons
Distance covered	3,652 naut. miles
Time at sea	490 hrs.
Best day's run	245 naut. miles

She left Copenhagen again on Feb. 7th at 2:35 p. m. in water ballast and arrived at New York, Feb. 27th at 6:20 p. m.—the voyage having lasted 490 hours, a distance of 3,652 miles. Thus she covered an average speed of 7.5 knots. Her best day's run was 245 miles. On this trip she consumed 119 tons, of which 14 tons was used for steam heating. It is well to draw attention to the fact that on the return voyage in ballast the main engines consumed 5 tons more than they burned on the outward voyage fully loaded, but the distance log was 54 miles greater. Frequently tankers make better speed loaded than when light.

Interesting Notes and News from Everywhere

NEW SURFACE-IGNITION OIL-ENGINES

A new marine oil-engine of the surface-ignition type is being developed by Cooper & Greig, Britannia Works, Dundee, Scotland.

DIESEL TANKERS FOR HUGO STINNES

"Oberschlesien" and "Ostpreussen" are the names of the two Diesel-driven tankers building at Krupps of Kiel to the order of Hugo Stinnes.

FRENCH SHIPBUILDER'S BIG PROFITS

Net profits of two and a quarter million francs were made during 1920 by the Chantiers et Ateliers St. Nazaire, one of the Werkspoor Diesel engine licensees in France.

LAUNCH OF MOTORSHIP "SAN ANDRES"

At J. & K. Smit's shipyard, Krimpen, Holland, the new 3,000 tons d.w.c. motorship "San Andres" was launched during July to the order of the Otto Thoresen Line of Christiania, Norway. She is propelled by a 1,250 i.h.p. Werkspoor four-cycle Diesel-engine.

NEW MOTORSHIP OF 5,200 SHAFT H. P.

Twin 2,600 shaft h.p. Sulzer two-cycle Diesel-engines are being installed in the 12,000 tons d.w.c. motorship now building for the Hamburg-South America Line at the Reiherstieg shipyard, Hamburg, where the Standard Oil Co.'s big single-screw Reiherstieg-Carels, Diesel-engined tanker "Wotan" was built.

MOTORSHIP RESCUES MOTORSHIP'S CREW

Recently, as reported, the American wooden motorship, "Balcatta," became waterlogged. Her crew was picked-up by the British steel motorship "La Paz" (illustrated in November, 1920). Later the crew returned to the "Balcatta," which was towed to Talechuano and repaired.

DIESEL-ENGINED AUXILIARY "BRAZIL."

The Lloyd Nacional, of Rio de Janeiro, have had their motor auxiliary schooner "Brazil" in service for some considerable time. This vessel is of 1,598 tons gross and is propelled by a four-cylinder 13⅜ x 21¼ Sulzer two-cycle Diesel engine. Her length is 22 ft. by 43 ft. breadth and 23 ft. 3 in. depth. She was built by the Empreza Brazileira de Const. Navals, of Rio de Janeiro.

DIESEL-DRIVEN SUBMARINE-CHASERS FOR JAPAN

Orders for Diesel oil-engines for submarine patrol-vessels to the value of 57 million francs have been placed by the Japanese Navy Department with Sulzer Freres of Winterthur, who are also building some 4,000 shaft h.p. two-cycle type Diesel-engines for big Japanese submarine-cruisers, as previously announced in our pages.

NEW MOTORSHIP SERVICE VIA PANAMA CANAL

Supplementing three coal-burning steamers, the Holland-America Line and the Royal Mail Steam Packet Line are jointly placing six 15,000 tons d.w. 13-knot motorships in service between the North American and European ports. Each vessel will have refrigerating space for 1,500 tons, for apples, oranges and other refrigerated products. The vessels are now completing.

NEW SOUTH AMERICAN SERVICE

For some time past the motorship "Oregon" has been laid-up together with large steamers, because of no available cargo in the Danish-American tramp service. But her owner, the United Shipping Co. of Copenhagen, have now inaugurated a Denmark-South American service with this vessel and her sister Diesel-ship "California." A third B. & W. engined motorship for these owners is building at the Nakskov plant in Denmark.

DICKIE'S VOYAGE ON A MOTORSHIP

A trip from San Francisco to Dublin, Ireland, on the Johnson Line motorship "Pacific" was recently made by R. Z. Dickie, a well-known Pacific Coast naval-architect and marine-engineer. Mr. Dickie states that the first fact which impressed itself strongly upon him was the continuous and entirely reliable operation of the Diesel-engines, with apparently even less attention required than had been his experience with reciprocating steam-engines. He mentions that in a period of seven months shop-repair bills amounted to less than $700. One trip of 52 days continuously was run in Texas paraffin-base oil, and one of 32 days nonstop on California asphalt-base oil.

FOURTH ORE-CARRYING MOTORSHIP

The keel of the fourth Diesel-driven motorship of a fleet of sixteen building for the Rederi. Grangesberg-Oxelosund at the Götaverken, Göteborg, was recently laid. The m. s. "Strassa," the first of the fleet will be ready for trial very shortly.

LAUNCH OF MOTORSHIP "ADRIA"

On July 16th the Swedish Lloyd's new twin-screw cargo motorship "Adria" was launched at the Götaverken, Göteborg, Sweden. This vessel has the following dimensions.

Deadweight Capacity (about)	8,200 tons
Power	2,800 i.h.p.
Length O. A.	396 ft.
Length B. P.	381 ft., 8 in.
Breadth M. D.	53 ft., 9 in.
Depth to S. D.	33 ft., 4½ in.
Draught (Loaded)	24 ft., 11 in.
Bunker Capacity	1,150 tons
Passenger Capacity	12 first-class
Loaded Speed	11 Knots
Aux. & Deck Machinery	Electric

Two Götaverken B. & W. type Diesel oil-engines of 1,400 i.h.p. are installed. For heating the ship there is a small oil-fired donkey-boiler that can furnish steam to an emergency air-compressor. The steering-gear is of the electric-hydraulic type. A Clarke, Chapman electric-windlass, and ten 5-tons electric-winches made by the General Electric Co. (A. S. E. A.) in Vasteras, Sweden, are installed. A "wireless" installation is carried.

Launch of the motorship "Adria" at the Gotaverken yard to the order of the Swedish Lloyd

FOAMITE FIRE FOAM DEMONSTRATION

An important demonstration of the apparatus of Foamite Fire Foam in connection with oil fires was given before the Imperial Japanese Naval Commission. The final demonstration consisted of a tank 50 ft. long, 15 ft. wide and 12 in. deep filled with fuel-oil primed with gasolene. The oil was ignited and allowed to burn for five minutes, the flame having reached the height of 100 ft. In one minute and 20 seconds from giving the signal the fire was completely extinguished. A number of important firms also sent witnesses, including the Mitsui Shipbuilding Co., New York Shipbuilding Corp., Wm. Cramp & Sons Shipbuilding Co., The Sun Co., and the Philadelphia Navy Yard. The demonstration was carried-out by Chas. Cory & Sons, Inc., of New York, marine distributors and installation engineers in U. S. A.

MAIDEN VOYAGE OF THE "WILLIAM PENN"

On her maiden voyage, the Shipping Board's new motorship "William Penn" will be operated by the Barber Steamship Company, instead of by the United American Lines. She has loaded 75,000 cases of oil and general cargo, and the first round trip to the Far East via the Canal is expected to last six months. Full details of this vessel appeared in the June issue of "Motorship."

MOTORSHIP "KENNECOTT" RETURNING TO NEW YORK

Recently the motorship "Kennecott" left San Francisco for New York via the Canal. Among her cargo is 300 tons of raisins shipped by the Associated Raisin Growers Association of Fresno, Cal. The raisins are being placed on the motorship, it is said, on the theory that this type of vessel is superior to steamships for the transportation of fruit, due to the fact that shrinkage is eliminated on account of there being no internal heat, thereby diminishing the chances of damage from condensation of moisture in the holds.

THE HANSA CO.'S MOTORSHIP

Regarding the 9,000 tons d.w.c. motorship with German constructed Diesel-engines now building for the Hansa Steamship Co. of Bremen, Germany, it is of interest to confirm our previous announcement that another motorship is being constructed for this big company at the Howaldswerke, Kiel. As the same yard is also building two 9,000 tons steamers with turbine and reciprocating steam-machinery respectively, some very interesting comparisons should soon be available to German shipowners. The second motorship is having twin 1,600 shaft h.p. Sulzer two-cycle Diesel-engines.

MARINE OIL-ENGINE BUILDERS OF THE WORLD

In the list of Diesel and surface-ignition marine-oil-engines of the world, published in the "Motorship Year Book" the following concerns were omitted.

Diesel Engine		
Lombard Governor Co., Ashland, Mass., U. S. A.	Lombard-McCarty	4-cycle
Surface-Ignition Engine		
Ing. Oscar Amrein Via Solferino 24, Milan, Italy	Grade	2-cycle
Cooper & Greig Britannia Works, Dundee, Scotland	Cooper & Greig	2-cycle

Also the builders of the G. M. A. Diesel engine were given as the G. M. A. Schiffsmaschinen, instead of the Waggon-und Maschinenbau Aktiengesellschaft Gorlitz, of Gorlitz, Germany.

We will be glad if our readers will furnish us with additional names of marine oil-engine builders not included in the list in the "Year Book."

ANOTHER MOTORSHIP ORDERED IN ENGLAND

In these days of the worst shipbuilding slump ever known in Great Britain, it is interesting to record the ordering of a new motorship in that country. A twin-screw 2,400 i.h.p. Werkspoor-Diesel-engines vessel of 10,350 tons has been ordered by Hunting & Sons, Milburn House, Newcastle-on-Tyne, England, from the Tyne Iron Shipbuilding Co. Hitherto they have exclusively operated steam-tankers. The two 1,200 to 1,400 i.h.p. Werkspoor Diesel-engines will be built under license by the North Eastern Marine Engineering Co., Wallsend-on-Tyne. The vessel will have the following dimensions:

Length	365 ft.
Breadth	51 ft.
Draught	25 ft.
Power	2,400-2,800 i.h.p.
Speed (loaded)	10½ knots

It is expected that she will be ready for service in about a year.

BIG CANAL COMPANY

During June the New York Canal & Great Lakes Corporation was registered under the laws of Delaware. The capital is $5,000,000.

TEN THOUSAND HORSE-POWER DIESEL ENGINES

Sulzer-Fréres are ready to construct marine-type Diesel oil-engines of 10,000 shaft h.p. for passenger-liners.

THREE MOTORSHIPS FOR WILHELM WILHELMSEN

Three motorships are under construction for Wilhelm Wilhelmsen of Tonsberg, Norway at the Burmeister & Wain Yard, Copenhagen.

MOTORSHIP "ATHENE" CHANGED TO "ESTRELLA"

The recently-built Werkspoor Diesel-engined motorship "Athene" has been purchased by Det Bergenska Dampskibsselskab of Bergen, Norway, and her name changed to "Estrella."

NEW TRANS-OCEAN MOTORSHIP SERVICE

A new service of motorships between Great Britain, Europe and west and South west Africa will shortly be inaugurated by Atlantic Motorships Ltd., Norwich House, Southampton Street, High Holborn, London, W. C. 1.

MOTOR COASTER "MACADAM" LAUNCHED

J. Samuel White & Co., East Cowes, Isle of Wight, England, recently launched the 350 tons d.w. coastwise motorship "Macadam," built for The Road Maintenance Co., Ltd. Propelling power is furnished by a 220 b.h.p. Vickers-Petters surface-ignition oil-engine running at 275 R.P.M.

DANISH PRINCE NOW MOTORSHIP CAPTAIN

Prince Axel, nephew of the King of Denmark, has taken a position as Captain of the East Asiatic Co.'s motorship "Asia." It may be remembered that the King of Denmark recently used the 7,500 tons luxurious passenger-cargo motorship "Fionia" as a yacht on his recent tour.

JOHN BROWN'S YARD LAUNCHES 14,000 TONS MOTORSHIP "LOCH KATRINE"

During the first week in August the 14,000 tons d.w.c. motorship "Loch Katrine" was launched by John Brown & Co., of Clydebank, to the order of the Royal Mail Steam Packet Co., for fruit, passenger and general carrying service from the Pacific Coast to England. She is being fitted with twin Harland & Wolff B. & W. Diesel-engines aggregating 6,600 i.h.p. Speed 12½ knots.

"CUBORE" IN OPERATION AGAIN

Recently the motorship "Cubore" of the Ore Steamship Company sailed from Baltimore for Cuba to load 10,000 tons of iron-ore. She has been laid-up at Sparrows Point for alterations since last December. This vessel is powered with a 3,500 i.h.p. six-cylinder two-cycle Bethlehem-West Diesel engine.

MOTORSHIPS IN THE FAR EAST

Among motor-vessels in service in the Far East is the "Aria," 250 tons d.w., built in Burma in 1918. She is propelled by a 100 b.h.p. Avance surface-ignition oil-engine. The largest motor-vessel constructed last year in the Far East was the "Kungram," 1,400 tons d.w.c., built in Rangoon. She is propelled by a 400 b.h.p. Avance surface-ignition oil-engine.

THE MOTORSHIP "COMETA"

In our last issue we illustrated the launch of the new Johnson Line motorship "Cometa" at the Burmeister & Wain plant in Copenhagen. She is the ninth standard motorship built at this yard for the same owners and a tenth Diesel ship is also on the ways. "Cometa," has the following dimensions:

Deadweight capacity	6,500 tons
Length	367 ft.
Breadth	51 ft., 3 in.
Depth	34 ft.
Power	2,600 i.h.p.

Some motorships for the Johnson Line have also been built at the Götaverken, Göteborg, including the "Buenos Aires" and the "Canada."

SAYS THE BRITISH PETROLEUM CO.

"The present acute condition of industry and transport is incidentally the golden opportunity for the motor-driven ship to prove its superiority.

BURMEISTER & WAIN SOLID-INJECTION ENIGNE

Diesel-engines of the solid-injection type are being built for stationary purposes by Burmeister & Wain of Copenhagen. Their marine engines are of the air-injection type.

OUR REGISTRY OF MOTORSHIP ENGINEERS

J. A. Finn was five years with the U. S. Navy Department operating submarine Diesel-engines, and for six months was trial engineer for the Electric Boat Co. Holds 500 tons motorship license.

George G. Carr, P. O. Box 350, New London, Conn., has unlimited license for motorships, was Chief-Engineer of American motorship. About 10 years' experience in machine-shop; has been foreman of installation work on engines and ships also erecting and testing Diesel engines.

BOLINDERS CO. OPEN NEW ENGLAND BRANCH

Bolinders Company, of New York, announce the opening of a New England branch at 411 Exchange Building, 53 State Street, Boston, Mass., for the purpose of building oil-engines for marine and stationary purposes.

MOTORSHIP FOR QUARTO COMPANY

A 500 tons d.w. motorship is to be built for the Quarto Steamship Co. of Copenhagen, in which Polar Diesel-engines are to be installed. The vessel is to incorporate all the benefits created from the experiences with their motorship "Lidsoe" in which a Tuxham surface-ignition oil-engine is fitted.

OIL-ENGINES IN CANADIAN FISHING-VESSELS

Very few Canadian craft have been heavy-oil engine powered, so it is of interest to record that a 35 b.h.p. Kahlenburg surface-ignition oil-engine is being installed in a new fishing-boat building for the British Columbia Canners Ltd. Another Kahlenburg oil-engine of the same power is also being fitted in a Canadian fishing-boat.

MOTOR TUG CROSSED ATLANTIC

During the war the British Admiralty brought the 118-ft. motor tug "Dreadful" across the Atlantic from Vancouver to England, via the canal, a total distance of 15,000 miles. This vessel is propelled by Bolinder oil-engines, and was originally built for the Canadian Western Lumber Co. of Vancouver. She is now operated by a large towing company on the river Thames.

MOTORSHIPS FOR RED SEA SERVICE.

Two 200 b.h.p. Beardmore surface-ignition oil-engined coastwise motorships of about 550 tons d.w.c. have been built at the London & Montrose Shipbuilding & Repairing Yard, Montrose, Scotland, for Mr. A. Besse of Aden, Arabia. They will be used in Red Sea trading. Their dimensions are as follows:—

Gross tonnage	386 tons
Length	132 feet
Breadth	25 feet
Power	200
Speed	9 knots

The first of these vessels has been named "El Ghazi" and was recently placed in service.

HAMMERHEAD CRANE INSTALLED IN NEW YORK SHIPYARD

A 200-ton hammerhead crane with an 85-ft. radius and a clear lift of 180 ft. has been installed at the New York Shipbuilding Corp.'s yard at Camden by Wellman-Seaver-Morgan Co. of Cleveland.

B. S. N. C. MOTORSHIPS

In a recent issue we gave complete details of the motorship "Domala," owned by the British Steam Navigation Company. Her sister motorships will be named "Durenda" and "Dumana." The former is being built by R. Duncan & Co., Glasgow, while the second is being constructed by Barclay, Curle & Co.

LUBRICATION OF OIL-ENGINES

An article on the lubrication of various kinds of engines and air-compressors appears in a recent issue of the "Compass" published by the Vacuum Oil Company. A section deals with Diesel-engines and another with surface-ignition oil-engines.

ANOTHER BRAZILIAN AUXILIARY

In the 1,598 tons-gross wooden auxiliary-schooner "Italia," built last year for the Lloyd Nacional of Rio de Janeiro, Brazil, by the Empreza de Constr. Nav. of the same city, a four-cylinder two-cycle 13⅜ in. by 21¼ in., 410 b.h.p. Sulzer-Diesel engine has been installed. Her length is 222 ft. by 43 ft. breadth, and 23 ft. 3 in. draught.

CAMMELLAIRD-FULLAGAR LICENSES

The following firms have acquired licenses to construct Cammellaird Fullagar engines:

John Brown & Co. Ltd., Clydebank, Scotland; David Rowan & Co. Ltd., Glasgow, Scotland; Dunsmuir & Jackson Ltd., Glasgow, Scotland; Cammell, Laird & Co. Ltd., Birkenhead, England; Palmers Shipbuilding & Engineering Co. Ltd., Jarrow-on-Tyne, England; Ateliers et Chantiers de Bretagne, Prairie au Du., Nantes, France. As indicated elsewhere it is possible that the Bethlehem Shipbuilding Corp. may have acquired a license.

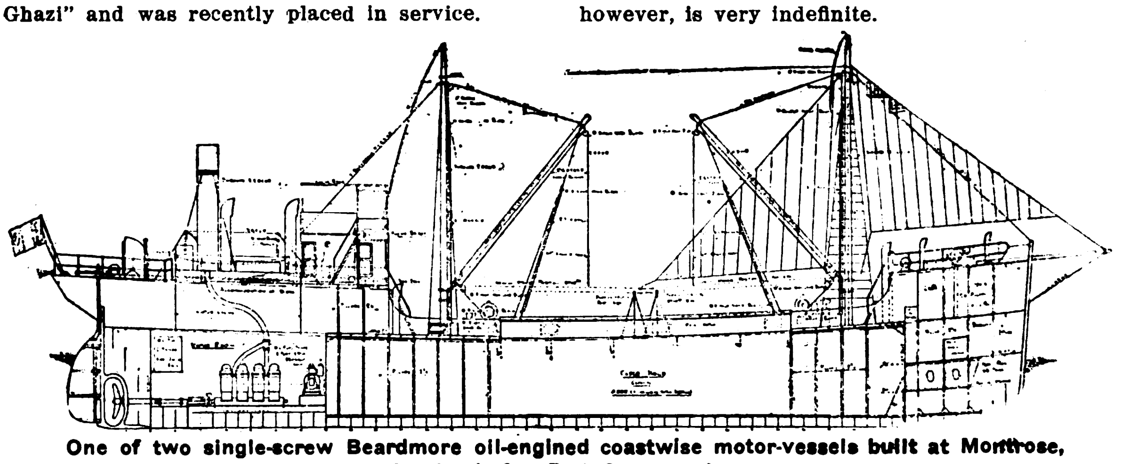
OCEAN MOTORSHIP COMPANY ORGANIZED AT SAN FRANCISCO

May Change from Wooden to Steel Hulls

W. L. Comyn and Co. recently announced that with the organization of the Ocean Motorship Company the affairs of the Pacific Motorship Company were finally adjusted as indicated last month. The new company has bought out all the claims of the Australian Government against the Pacific Motorship Company arising out of the original contract under which the Commonwealth was to purchase the seven motorships of the Pacific Motorship Company for about $1,250,000.

Officers of the new corporation, which will handle the outstanding obligations of the Pacific Motorship Company and operate the fleet on the Pacific Coast, are W. E. Gerber, Jr., President; R. M. Roberg, Vice-President; and C. N. Howard, Secretary. One of the fleet, a motorship of the type called "B" boats, which are of 4,300 tons deadweight, namely, the "Boobyala," recently arrived at Tacoma. Another, the "Culburra," of the "C" type, which are 3,000 tons deadweight, is now sailing from South America for Northwestern points.

Tentative plans of the company call for the removal of the McIntosh & Seymour Diesel machinery from the wooden "B" boats and its installation in steel hulls. When this will be done, however, is very indefinite.



One of two single-screw Beardmore oil-engined coastwise motor-vessels built at Montrose, Scotland, for Red Sea, service.

ARMSTRONG-WHITWORTH MOTOR TANKER FOR SPAIN

Regarding the new Sulzer Diesel-engined tanker "Conde de Churraca," recently built by Armstrong, Whitworth & Co. for Spanish owners, some reports have given the owners of this vessel as the Cia General de Tabacos de Filipines, while others state she is owned by the Sociedad Commercial de Orientede Sebastien. We believe the first mentioned firm is correct.

LLOYDS REGISTER SHOWS 1,447 MOTORSHIPS AGGREGATING 1,263,000 TONS GROSS

According to the latest issue of Lloyds Register of Shipping there has been an enormous growth of motorships since 1913, the total of such vessels in service now reaching one-and-a-quarter million tons gross, or approximately two-million tons deadweight-capacity. The total includes 740 auxiliary sailing-vessels, as follows:

Motorships in Service

1913

290 vessels, 234,000 tons gross

1921

1,447 vessels, 1,263,000 tons gross

If motor-vessels under construction are included the grand total will amount to about 1,550 craft aggregating 2,500,000 tons dead-weight-capacity.

LLOYD'S RETURN OF VESSELS UNDER CONSTRUCTION IN GREAT BRITAIN, JUNE 30, 1921

Gross Tonnage	Steam	Motor	Sail
*100 and under 500 tons......	88	17	17
500 and under 1,000 tons....	92	—	—
1,000 and under 2,000 tons....	77	6	—
2,000 and under 3,000 tons....	55	1	—
3,000 and under 4,000 tons....	62	3	—
4,000 and under 5,000 tons....	42	2	—
5,000 and under 6,000 tons....	80	4	—
6,000 and under 8,000 tons....	108	16	—
8,000 and under 10,000 tons...	48	8	—
10,000 and under 12,000 tons...	6	—	—
12,000 and under 15,000 tons...	27	—	—
15,000 and under 20,000 tons...	24	—	—
20,000 and under 25,000 tons...	5	—	—
25,000 and under 30,000 tons...	1	—	—
30,000 and under 40,000 tons...	—	—	—
40,000 tons and above.........	—	—	—
Total....................	715	57	17

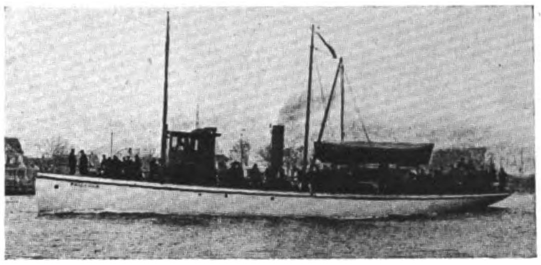
*Vessels of less than 100 tons are not included in Lloyd's Register Shipbuilding Returns. Only ships actually commenced construction included.

AMERICAN CUP CONTENDER NOW PASSENGER MOTORSHIP

The illustration on this page of a yacht-type passenger-boat is the "Priscilla," the old racing yacht of that name built in Delaware in 1885 especially to defend the American Cup. She was actually a contender, but owing to being of heavy iron build was outclassed by the "Puritan" which successfully defended the cup.

Some time ago the hull was purchased by Mr. A. E. England of Albury & Freeman, Miami, Fla., and 100 b.h.p. Fairbanks-Morse surface-ignition heavy-oil engine was installed. Last year she was run during the summer from the Battery, New York to the local fishing banks every day. She is now in operation on a weekly service between Miami, Fla. and Nassau, N. P., Bahama Islands, carrying freight and passengers on this 200 mile run.

The "Priscilla" has now had 18 months' service with her present engineers and has always given good account of herself, says Mr. England. Her length is 100 ft. overall by 23 ft. breadth, and she makes over 9 knots on 8 gallons of fuel-oil per hour. It is interesting to note that Mr. England also states that no vessel of her class can touch her in cost of operation, speed or sea-worthiness.



"Priscilla" a converted American cup defender now a passenger boat propelled by Fairbanks-Morse oil-engines

NORWAY-MEXICAN GULF LINE'S MOTORSHIP "AMERICA"

With regard to the motorship "America" (misspelt "Ameria" in our July issue) recently launched at the Akers Shipyard, Christiania, Norway, to the order of the Norway-Mexican Gulf Line, she has the following dimensions—

Deadweight Capacity ....7,500 tons
Power ....2,100 i.h.p.
Speed (loaded) ....10½ knots
Auxiliary Diesel Engines ....3 of 75 b.h.p.
Length O. A...........................377 ft.
Length B. P. ....362 ft.
Breadth over frames ....51 ft., 3 in.
Depth to Shelter deck ....34 ft.
Depth to Main deck..................25 ft., 6' in.
Cylinder Bore & Stroke....21.260 in. by 28.740 in.
Engine Speed ....150 R.P.M.
Type of Engine ....Burmeister & Wain 4-cycle

On deck there are ten electric winches and an electric-windlass manufactured by the Pusnaes Mechanical Works, Pusnaes, Norway, and a hydraulic steering-gear with telemotor control from the bridge. A refrigerator for the ship's stores is being installed by the Drammen Mechanical Works, Drammen, Norway. The "America" is virtually a sister ship to the "Borgland" already described and illustrated in "Motorship," so further details are superfluous.

ANOTHER AMERICAN STEAMSHIP COMPANY CONVERTED

We have been advised by a promient engineering official of one of the largest American Steamship Companies with headquarters in New York that his company is anxious to go forward with the Diesel-drive and that he will probably leave for Europe very shortly and make complete investigations of the situation over there. Looking up our records we find that the President, General-manager and Superintendent-Engineer of the Line in question are all subscribers to "Motorship."

STRANDING OF THE M. S. "ELMAREN"

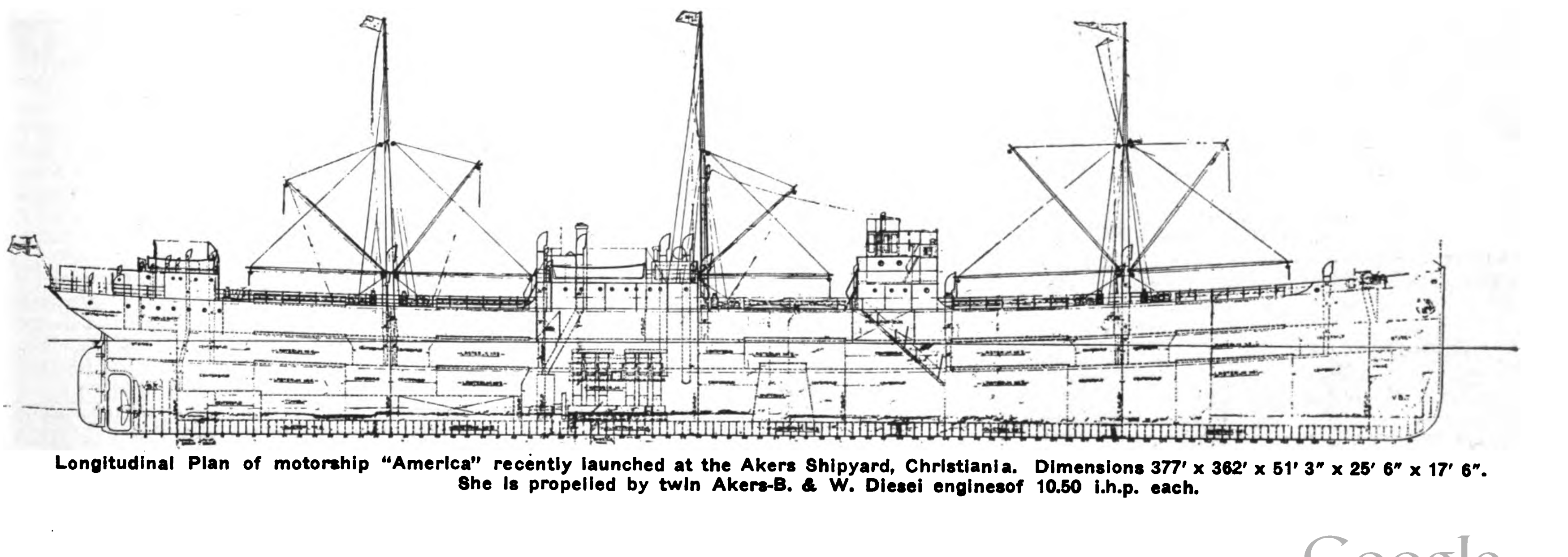
Rumors have emanated, evidently from steam-engineering interests, that the stranding of the motorship "Elmaren" on the "Chagos" Island in the Indian Sea, was due to her Diesel machinery. The builders advise us that this was not at all the case, because the ship ran ashore on account of fogs and current conditions. The chief engineer reported that the machinery worked excellently during the stranding. In fact, in a letter dated March 8th written prior to the stranding of the "Elmaren" Hugo Moren, an engineer aboard, wrote us as follows:

"We have never been there before, so we could not be trusted to find the way with a sufficient amount of accuracy, but the navigation officers tell us that judging from the tail log, the gyroscope compass and other really nice instruments, we will soon be in Torres Strait, though we cannot see it yet, and there we will be in a constant danger of hitting some huge coral reef or another such thing, thus disturbing the small coral-creatures in their nice building work. So we seem to be a good way from Gothenburg, anyhow."

This seems a very extraordinary coincidence, as a day or two later the vessel ran ashore in a fog.

FROM CRUISER TO MOTORSHIP

Further details of the conversion of the old German cruiser "Gefion" into the motorship "Adolph Sommerfeld" are to hand, showing that the job was by no means a very desirable one. The "Gefion," which was put into service in 1893, was about 360 ft. overall, 43 ft. beam and about 19 ft. mean draught. She was wood-sheathed, and in order to get the new engine-beds fastened down through the double-bottom there was quite a lot of stripping to be done. The double-bottom tanks were not oil-tight, nor could they very well be made so. It was necessary therefore to install fuel-tanks in the engine-room itself. In order to comply with the classification rules of the Germanischer Lloyd, a great deal of new framing had to be built into the ship to strengthen her, and the decks had to be rebuilt with new beams. A new after-part had to be built on, because during the war the original stern had been wrecked for the salvage of the bronze and been patched with light steel plates. At the time of the armistice the ship was being converted into a home for submarine crews, and had been partly gutted for the purpose. This was both a help and a hindrance during her conversion into a Diesel-freighter. Finally they succeeded in getting a cargo deadweight capacity of 3,200 tons on a displacement of 5,250 tons. With two old submarine oil-engines of 1,250 h.p. each slowed down to give 750 h.p. each at 270 r.p.m. a speed of about 10 knots has been attained.



Longitudinal Plan of motorship "America" recently launched at the Akers Shipyard, Christiania. Dimensions 377' x 362' x 51' 3" x 25' 6" x 17' 6". She is propelled by twin Akers-B. & W. Diesel enginesof 10.50 i.h.p. each.

Our Readers' Opinions

(The publication of letters does not necessarily imply Editorial endorsement of opinions expressed)

PLOUGHING WITH A CROOKED STICK SAYS A SHIP'S ENGINEER

To the Editor of "Motorship":

There is a question in my mind as to why America is so backward in motorship construction. Is there any precedent for such action, and if it had been as slow in its industrial policy on land where would it be today? If such a policy is allowed to continue, where is our shipping industry going to land? These questions are of vital importance, our prosperity and future defence of the nation depends on them.

Take our cotton mills, for example. I have seen 500 looms in one mill only three years old scrapped, and looms of later date put in because of cheaper production. If it had not been done the mill could not have withstood competition.

Look at the steel industry. How many millions of dollars worth of machinery has been scrapped to make room for modern machines that could cheapen the products so that competition could be met? Now what the writter cannot understand is that if such a policy has been successful on land and has allowed us to manufacture our goods cheaper and better, while paying higher wages and better labor conditions than other nations, why it is not followed out in our marine industry.

We now have marine Diesel-engines that can be absolutely guaranteed, and manufacturers can give examples of their products that have been running successfully for from five to eight years, that surely ought to be long enough to give assurance of reliable service and then look at the standing of the manufacturers behind them. Do you think that any of the firms like McIntosh & Seymour, Worthington Pump Co., Winton Engine Works, Nordberg Mfg. Co., and other firms of like standing would spend thousands of dollars on experimental work conducted by the best brains the country has, or what is more, risk their reputation (which is not to be counted in dollars and cents) producing an article that is not reliable?

There are two things that have to be done so that we can compete with foreign cheap labor, namely, build our ships so that they can be loaded and discharged with the minimum of expense and time and put the cheapest means of propulsion in them. If that is done money enough can be made so as to pay enough wages to attract the class of men that made a success of our land industries.

Fuel for a vessel is 45% of its expense, wages 12%. If two-thirds of the fuel-bill can be saved greater cruising radius can be had independent from foreign fueling-stations assured along with good management. What more is necessary to assure success?

We have plenty of precedent to go by. We once had the greatest fleet of merchant-ships in the world. We also had men who owned them who were, to be polite we will call them ultra-conservative, and did not believe in modern means of propulsion.

We now have another fleet; what is going to happen to that? Are we still going to be ultra-conservative? In Egypt they still plough with a crooked stick and we laugh at them when we think of our modern methods of tractor and plough. If our marine interests would realize what they are now using to plough the seas, I don't think they would laugh, especially while some of our foreign competitors are chartering some of their motorships to our shipowners at a profit carrying American freight. Meanwhile our own ships are rusting at the laying-up stations.

Yours very truly,
G. H. PENDLETON,
Member M. E. B. A., No. 14.
New York and New Orleans

SUPERHEATED STEAM FOR TURBINES

To the Editor of "Motorship":

I have just noted a paragraph in the editorial columns of "Motorship" in the July, 1921, issue, headed "Turbines and Superheated Steam." This paragraph is likely to lead to incorrect conclusions which I think should be corrected. In stating objections to the use of superheated steam on marine turbines, you cite the S.S. "Eclipse." The equipment on the S.S. "Eclipse" and also a number of other similar ships, consists in a turbo generator which operates continuously in one direction all the time, regardless of which direction the ship is proceeding. The propeller is driven by a motor, and reversal is accomplished by reversing the connections to the motor through switches. This turbine, of course, has no reversing stages, and the design lends itself admirably to the use of highly superheated steam.

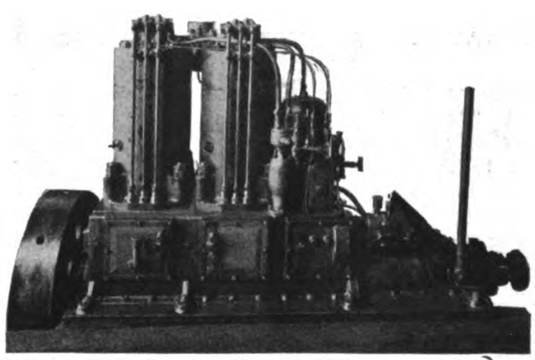
We thought you would undoubtedly wish to have this inadvertent reference brought to your attention.

L. F. DEMING, District Engineer.
General Electric Company, By W. E. Hannum.
Philadelphia Office.

SMALL DIESEL ENGINES

To the Editor of "Motorship":

I received my "Motorship," June issue, and I find my Diesel engines illustrated on page 489. I have just finished a new motor, a little larger



Another marine oil-engine built by Tamada T.

size and of heavier duty than before, having 200 x250 m.m. bore and stroke, with two cylinders, as per enclosed photograph. It was tested on land at 350 r.p.m., but has no indicator-hole, so I cannot take diagrams. I am building a 60x12 ft. boat for this motor. In the near future I will send you a picture of this boat.

TAMADA T.
730 Ikehukuro,
Tokyo, Japan.

THE ENGINEER QUESTION

To the Editor of "Motorship,"

Whereas, the Members of Marine Engineers' Beneficial Association No. 49 of San Francisco, California, having noticed many times, that "Motorship" seems to favor the policy of preferring, or advocating, that Steamship Companies when entering Motor-Vessel operation, shall select for the Engineering Officers from their staff of Steam-Men, having them attend assembling of engines in shop and block tests, and in your June issue descriptions of motorship "William Penn" state this follows the policy put forward many times by "Motorship," which is the practice adopted with success by European owners; adopted a resolution that write you a letter mildly protesting against this policy while there are many trained Diesel men in the field for employment who have successfully operated Diesel Propelled vessels on various trade routes.

Furthermore, we fail to understand why an Engineer having only steam experience at sea is better qualified with a few weeks shop experience to operate Diesel-engines than a man who had fought the game at sea from the time of the first commercial internal-combustion engines to their present stage of development and have handled electrical equipment in motors and generators far in excess of usual steamship equipment.

Therefore, we request for the betterment of the profession that mistakes or defects as now exist among Diesel-men which makes "Motorship" and successful European Operators prefer the breaking-in of steam engineers to the employment of men with actual and successful experience in the operation or surface-ignition and Diesel-engines on smaller ships. It seems to us that with such a policy for successful operation there is small incentive for a man to work for proficiency in internal-combustion engineering and also electrical, whereas he may become proficient in steam engineering and obtain a standing equal to any aboard ship.

Lastly as we are in perfect amity with Marine Engineers' Beneficial Association No. 35, the steam local in San Francisco we are attaching their signature to the above.

Yours very truly,
GEO. HUMPHOFF,
BUS. MANAGER, M.E.B.A. No. 49
ERNEST F. POGG,
BUS. MANAGER, M.E.B.A. No. 35
San Francisco, Cal.

[Apparently you are under a mis-conception regarding the attitude of this publication towards oil-engineers, probably due to more motorships having been constructed on the Pacific Coast than on the east Coast, with the result that more experienced men are available. Shipowners on the Atlantic coast are continually bringing forth the argument that only a few experienced Diesel-engineers are available to operate motorships if they place orders. Consequently, they seem to be in fear of a shortage of capable engineers and that their ships will be held up accordingly.

We have frequently pointed out to shipowners that plenty of skilled Diesel-engine operators could be obtained in a short period to fill the shortage by sending experienced steam-engine operators to the Diesel-engine builders plant for several months. There is no attempt on our part to suggest that such men should be used in preference to engineers already skilled and experienced in the operation of marine oil-engines.—*Editor.*]

BACK COPIES OF "MOTORSHIP" AVAILABLE

To the Editor of "Motorship":

We noticed your frequent calls for back numbers of "Motorship," and as a result of a search in our files we have found the following extra numbers we would like to dispose of at a reasonable price:

March, 1918; May, 1919; June, 1919; July, 1919; November, 1919; December, 1919; May, 1920; June, 1920; September, 1920; February, 1921.

DANCKWORTT & NICOLAYSEN,
511 Crary Building By Thom. B. Danckwortt.
Seattle, Wash.

RE-CONDITIONING THE M/S "STASIA"

To the Editor of "Motorship,"

We have read in your esteemed publication of March, 1921, an article signed by Mr. Leashot, "Overhauling the M/S 'Stasia' in China." Please let us complete this article so as to give to each one his share of credit in this job.

The overhauling of the "Stasia" hull and motors was undertaken by "Les Etablissements Brossard Mopin de Tientsin" and executed at their Hsin-Ho Shipyard. The ship was burnt more than one hundred feet from the poop to the middle. Only the hull till three feet above the water line was still in good condition.

In June, 1919, the ship, by the care of the underwriter, was towed to Hsinho. The overhauling started immediately under the direction of the management, Mr. Leschot being only one employee working under the supervision of the chief of the engineering department. We experienced some delay, owing to the difficulty to secure the spare parts from Sweden; the cylinders fitted up were case and machined in the Tientsin works of the Etablissements Brossard Mopin. These repairs were made not only by Mr. Leschot, but by all the people working in the respective departments.

The engineers who took charge of the motors after the completion of the repairs were ex-engineers of the French navy having a great deal of experience in oil-motors, and the "Stasia" went to Shanghai only for small repairs having nothing to do with the running of the motors.

We will be very pleased if you will insert the above rectification.

ETABLISSEMENTS BROSSARD MOPIN.
Tientsin, China.

MANY NEW MOTORSHIPS RUN TRIALS

NEW YORK SEATTLE

MOTORSHIP

Devoted to Commercial and Naval Motor Vessels

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Vol. VI — New York, U. S. A., October, 1921 — No. 10

Cable Address—Freemote, New York

Loaded Sea Trials of the Motorship "William Penn"

Most Successful Performance Made by the Shipping Board's Only Diesel-Engined Vessel.

IT is customary for the United States Shipping Board to run a loaded speed-trial of each of their vessels prior to their sailing on the maiden voyage, in addition to the builders' trials when light. So, on Sept. 3rd the loaded trials of the "William Penn" were run from the Ambrose Channel light-ship outside New York Harbor to Fire Island lightship and return, on which trials a representative of "Motorship" was present. In every way the trials were a complete success and were run-off without the slightest hitch.

Both in fuel-consumption and speed according to loaded displacement and power, the vessel gave results which put her in an American class entirely by herself—her performance being far ahead of any single one of the 2,280 merchant-steamships built under the supervision of the Shipping Board. The fuel-consumption attained was 0.308 lb. per i.h.p. hour for all purposes and the mean speed was 11.77 knots with a mean draught of 24 ft. and with the ship having a displacement of 14,250 tons.

Following the trials she made an excellent trip to Savannah, Ga., averaging nearly 11½ knots during the entire trip. It is obvious from the trial results that in service she will average 11½ knots fully loaded in fair weather. At times on trials she made over 12-knots through the water. She was not quite fully loaded on these trials as the balance of her cargo had to be taken aboard at Savannah. When between Jamaica and Colon, the "William Penn" wired to say a speed of 11.8 knots had been averaged for the previous 24 hours on 14 tons of fuel per day when she left Savannah the draught was 26 ft., 5 in. She arrived at Balboa at 4 P. M. Friday the 16th, six days from Savannah, and was reported 558 miles out of Balboa at 8 P. M. Sunday the 18th September. Assuming she stayed at Balboa taking oil as scheduled, the average speed figures out at 11.65 knots. During the loaded-trials near New York the vessel was found to be absolutely free from vibration and when sitting in the saloon it was not possible to tell by sound or movement whether the engines were running.

The exhaust was absolutely clear, while the temperature in the engine-room was only 82 degrees Fahr., altho it was a very warm day.

Maneuvring trials following the speed trials also passed off successfully, the engine reversing from ahead to astern with simplicity, and responding very quickly to all signals without any hitch.

A complete description of the "William Penn" appeared in our issue of June, 1921, together with drawings and photographs of the engine-room arrangement. We reproduce herewith the principal specifications and the light-draught speed trials:

Fully loaded Displacement	17,100 tons
Displacement on Loaded Trials	14,250 tons
Dead-weight-capacity	12,375 tons
Net cargo-capacity on 10,000 miles voyage	11,725 tons
Fuel required on 10,000 miles voyage averaging 4,000 i. h. p. & 10½ knots	500 tons
Most suitable loaded-speed	11 knots
Actual cost of fuel for 10,000 mile voyage at 11 knots average speed	$7,335
Fuel-Bill of Sister Steamer at 10½ knots average speed, with fuel at $12.60 per ton	$15,632
Fuel-Consumption of Sister Steamers for 10,000 miles voyage at 10½ knots average speed	1,320 tons
Cost in Fuel saved by "Wm. Penn" on 10,000 miles voyage	$8,297
Length (O. A.)	455'0"
Length (B. P.)	445'0"
Breadth (M. D.)	60'0"
Depth (M. D. to S. D.)	36'8"
Draught (loaded)	28'4¾"
Gross tonnage	8,168 tons
Net tonnage	5,214 tons
System of Construction of Hull	Isherwood
Power (Indicated)	4,500 h.p.
Power (shaft)	about 3,500 h.p.
Fuel-capac. (incl 57 tons in settling tank)	1,343 tons
Deep tank (for dry cargo or water ballast)	994 tons
Cubic-capacity of deep tank	34,770 cu. ft.
Hold capacity	520,550 cu. ft.
Total cubic capacity for cargo below decks	555,320 cu. ft. (bales)
Propellers (bronze twin four-bladed)	13'6" dia. by 11'9" pt.
Propelling engines	Burmeister & Wain 6 cylinder-four cycle
Cylinder bore	740 mm (29.134")
Piston Stroke	1150 mm (45.275")
Engine speed (designed)	115 R.P.M.
Total number engine-room crew	14 men
Full ahead to Full astern	32 Seconds
Daily fuel consumption in port	¾ ton
Daily fuel consumption at sea	13 to 14 tons

THE SPEED TRIALS WHEN LIGHT

(Mean of 3 Runs over Mile)

Speed averaged	12.592 knots
Indicated horse-power (Continental)	4.756 h.p.
Indicated horse-power (English)	4,690 h.p.
Revolutions	121.23 P.M.
Propeller-Slip	10.6%
Mean indicated pressure	84.6 lbs.
Maximum i.h.p. attained over one mile	4848 (Cont.)
Maximum i.h.p. attained over one mile	4780 (Engl.)
Maximum Revolutions	122 P.M.

Present at the loaded sea-trials several months later were the following:

Representing Construction Division U. S. Shipping Board

Mr. R. W. Robinson (Deck.)
Mr. O. H. Weise (Engine-Room).

Representing Repair Dept., U. S. Shipping Board

Mr. H. B. Taylor (Chief Turbine and Diesel Engr., in charg of trial). Representing Comm. R. D. Gatewood. Mgr. Maintenance and Repair.
Mr. P. J. Henning, U. S. S. B. Elec. drive, Diesel Inspector
Mr. W. D. Cosgrove, U. S. S. B.
Mr. D. S. Brierly, U. S. S. B.

Representing Wm. Cramp & Sons Ship & Engine Bldg. Co.

Mr. J. C. Shaw (Asst. Chief-Engineer).
Mr. Oscar Matteson (Guarantee-Engineer).

Representing Burmeister & Wain

Mr. Carstersen.

Representing "Motorship"

Mr. K. K. Dean.

Representing Barber S. S. Line

Capt. J. A. Hartley (General Mgr.)
Mr. S. P. Gledhill (Supt.-Engr.)
Mr. H. Barnes (Asst. Supt.-Engr.)
Capt. A. Wright (Commanding Officer).
Mr. P. Olson (Chief Engineer).
Mr. J. Sullivan (Pilot).
Mr. Trumble (Compass Adjuster).

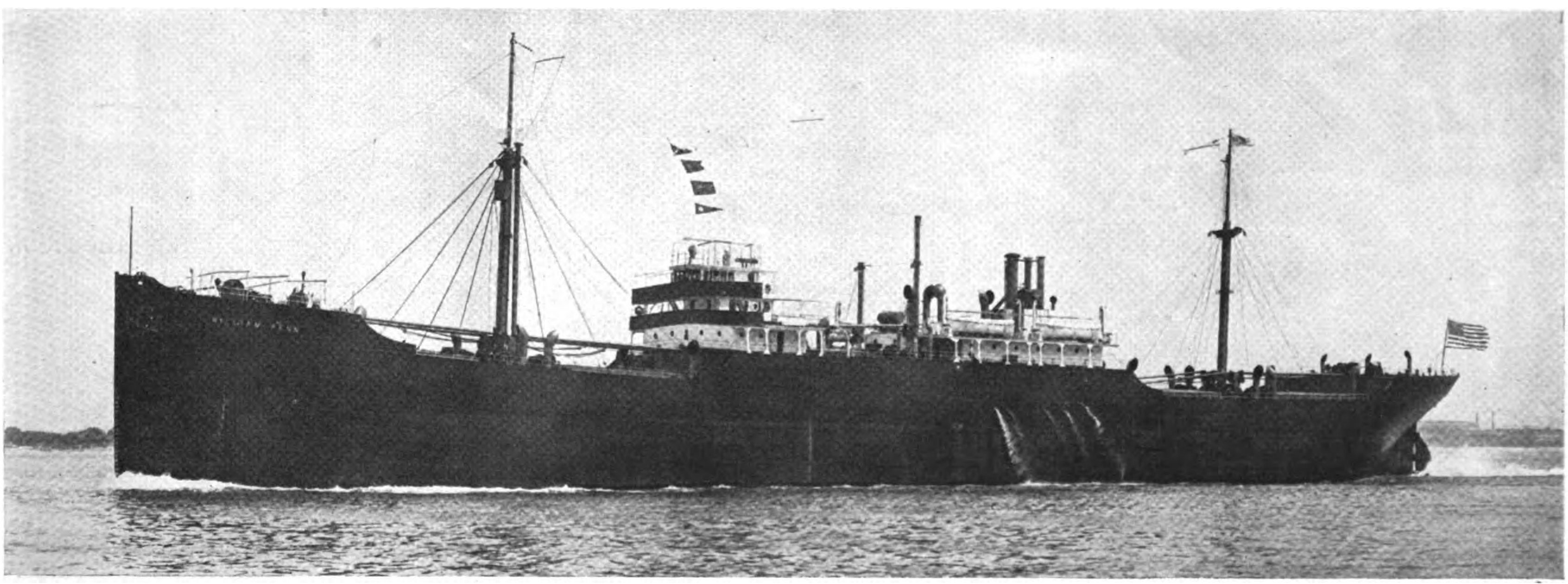
The master of the vessel is Capt. R. H. Wright, and the Chief-Engineer is Mr. Oscar Olson.

DEEP-DRAFT TRIAL OF M.S. "WILLIAM PENN"

September 3, 1921, Ambrose Channel Light-Ship to Fire Island Lightship and return.

Distance between light-ships	29.3N.-Miles
Speed over bottom Ambrose to Fire Island	11.98 Knots
Speed over bottom Fire Island to Ambrose	11.56 Knots
Mean speed of both ways	11.77 Knots

(Continued on next page)



U. S. Shipping Board motorship "William Penn," installed with Burmeister & Wain Diesel-engines by the Wm. Cramp & Sons Ship & Engine Co.

	To Fire Island With	To Ambrose Against
Tide Conditions	With	Against
Speed in Knots over bottom	11.98	11.56
R. P. M. Starboard Engine	111.8	110.3
R. P. M. Port Engine	107.6	109.1
R. P. M. Mean	109.7	109.7
Mean Indicated-Pressure (kg cm') Starboard Engine	5.97	5.91
Mean Indicated-Pressure (kg cm') Port Engine	5.76	5.93
Notches on Hand Control, Starboard	23	23
Notches on Hand Control, Port	23	25
I. H. P. Starboard (Metric)	2,200	2,150
I. H. P. Port (Metric)	2,043	2,131
I. H. P. total	4,243	4,281

Mean Revs. P. M. Ambrose to Fire Island	109.7
Mean Revs. P. M. Fire Island to Ambrose	109.7
Mean Revs. P. M. both ways	109.7
Slip in percent	7.5
Indicated H. P. Main Engines, Ambrose to Fire Island	4,243 (Metric)
Indicated H. P. Main Engines, Fire Island to Ambrose	4,281 "
Indicated H. P. Main Engines, Mean both ways	4,262 "
Indicated H.P. Main Engines, Mean both ways.	4,202 (English)
Oil Consumption Main Engines	1,250 Lbs.
Oil Consumption two Auxiliary Engines	46 "
Oil Consumption all purposes	1,296 "
Oil Consumption per I. H. P. (English) Main Engines, all purposes	0.3083 Lbs.
Oil Consumption per I. H. P. (Metric) Main Engines, all purposes	137.9 grams

Mean Draft 24 ft. 0" with 5" trim aft—Corresponding to 14,250 tons displacement

Run to Savannah

Mean speed from Ambrose Light-Ship to Entrance Buoy Savannah 10.84 knots from observation. Mean speed through the water estimated 0.6 to 0.7 knots more. Left Ambrose about 9 P. M. Saturday, Sept. 3rd, and arrived entrance buoy Savannah about 10 A. M. Tuesday, September 6th. Actual time 2 days, 13 hours, 37 minutes.

Distance over bottom—668 nautical-miles.

The vessel was not driven at full-speed due to undesirability of reaching Savannah earlier than noon, to go up the river on high tide.

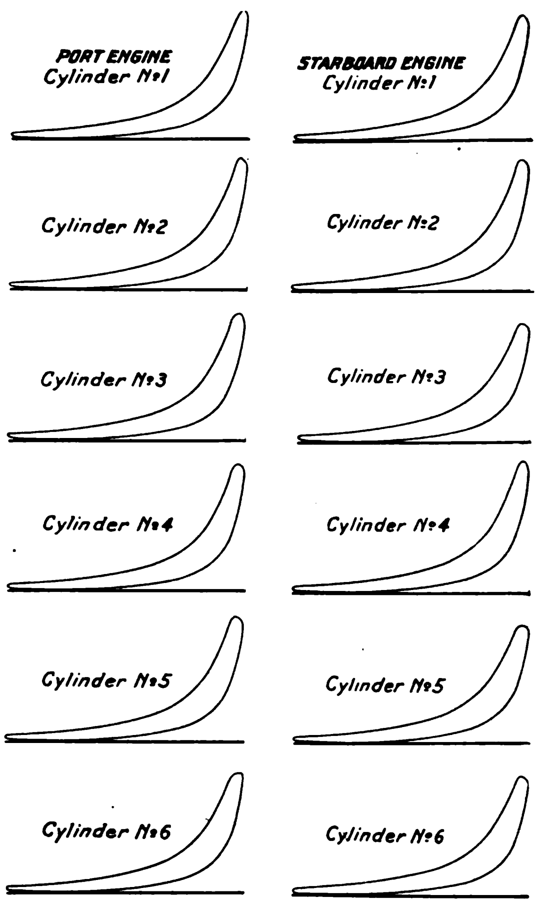
Mean Oil-Consumption per day....12.23 tons

On Monday, September 5th, data for an eight-hour period showed the following results:

R.P.M. 106. I.H.P. (Metric), 3,700. I.H.P. (English), 3,650. Oil-Consumption per I.H.P.H. (English), 0.315 lb. due, to reduced power. Fuel-Oil Consumption per day, 12.32 tons.

The vessel left Savannah Pier at about 2 P. M. Saturday, Sept. 9th, on high tide, and was reported Monday noon as averaging 11.5 knots over bottom, 110 R.P.M. and 4,275 (Metric) I. H. P. Draft leaving Savannah was 26 ft., 5 in.

The loading at New York consisted of 129,374 cases of oil and 500 barrels of grease, or 4,744 tons, which was loaded at the pier of the Tidewater Oil Company at Bayonne, and a miscellaneous cargo loaded at the Brooklyn Pier of the Barber Steamship Lines. The loading at Savannah consisted of 3,350 bales of cotton and 1,450 barrels of resin.



Indicator-cards taken on loaded trials of the "William Penn"

At New York 300 tons of addition fuel-oil at four cents per gallon ($1.68 per barrel) was put aboard, making 1,200 tons total. Due to the short time allowed for filling in New York from lighter, the tanks were not completely filled. On the way to Panama all tanks will be filled by gravity from settling tanks between shaft alleys, and tanks filled at Panama and Honolulu, which latter place the vessel will also call. On leaving Honolulu there will be sufficient oil with all bunkers filled until the vessel arrives in New York, returning via Suez Canal and England.

The fuel-oil used on the trial off Long Island, September 3rd, and on the trip down to Savannah is the same as used on the light draft trials run in May. It is Diesel-oil as follows:

Specific Gravity	0.879 at 60° F
Corresponding to	29.4° Be
Flash (open cup)	205° F.
Fire	226° F.
Viscosity (Saybolt) at 100° F.	42
Sulphur percent	0.756
B. T. U. higher value	19450 B.T.U.

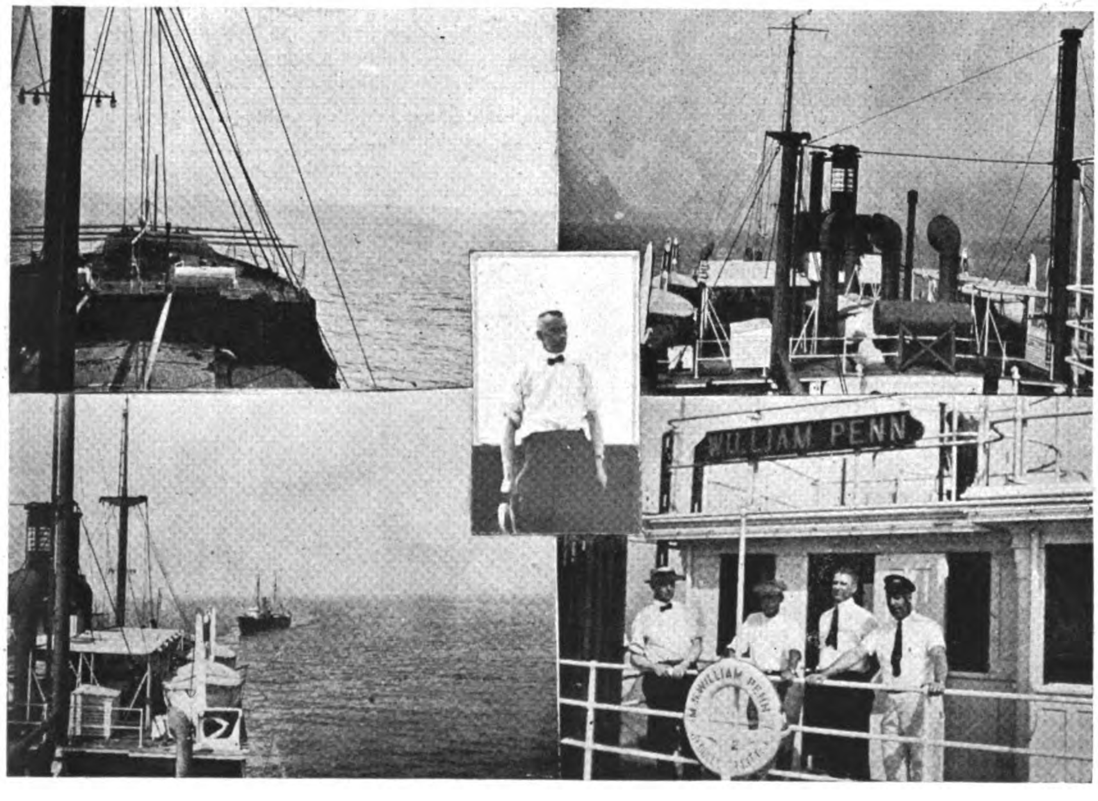
In figuring-out the total consumption per i.h.p. hour for all purposes the fuel-consumed both by the main-engines and the auxiliary-engine on the loaded sea-trials and light sea-trials was added together, but was divided by the total h.p. developed by the two main-engines only. To our mind, the total h.p. of the main-engines and one auxiliary-engine (two auxiliary engines if both are running) should be added together and use for figuring-out the total consumption. Therefore, in the case of the "William Penn" the fuel-consumption for all purposes should be calculated on a basis of 4,300 i.h.p., which would reduce the fuel-consumption per i.h.p. hour to below 0.30 lbs. because the main engines had an average out-put of about 4,230 i.h.p. and the auxiliary-engine about 70 b.h.p. As this was not actually done, the fuel-consumption per i.h.p. hour for all purposes is really less than that shown in the official figures. It will be interesting to receive the opinions of ship and engine builders on this particular point.

The electric winches were not used for putting case-oil on board, but a good test of them was made on the general cargo loaded at Brooklyn Pier and at Savannah. As holds No. 1 and No. 4 were completely filled with case oil only six of the ten winches were in operation on the three remaining holds.

The winches were remarkably free of trouble and were considered by the stevedores in both New York and Savannah as well as by the officers of the ship, as extremely satisfactory. The average load in New York, miscellaneous cargo, varied from 1 to 3 tons and at Savannah 1½ tons corresponding to six bales of cotton. The ease of operation and the speed of the winches was considered better than the average steam winch. The winches are particularly fast on light-hook, both raising and lowering, and it might be mentioned in this connection that heretofore criticism against the electric-winch has been due chiefly to too slow light hook-speeds.

These winches were developed by the Cramp Company to overcome the usual criticism of electrical winches as to speed, etc., the electrical equipment being supplied by the Westinghouse Company to special requirements and the winches constructed by the American Engineering Company.

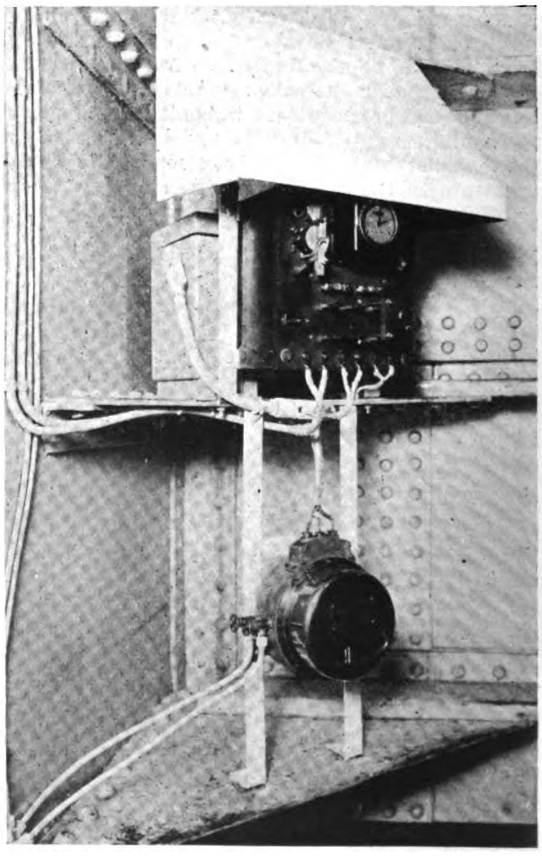
While loading in New York the fuel-consumption with the six winches in operation was from



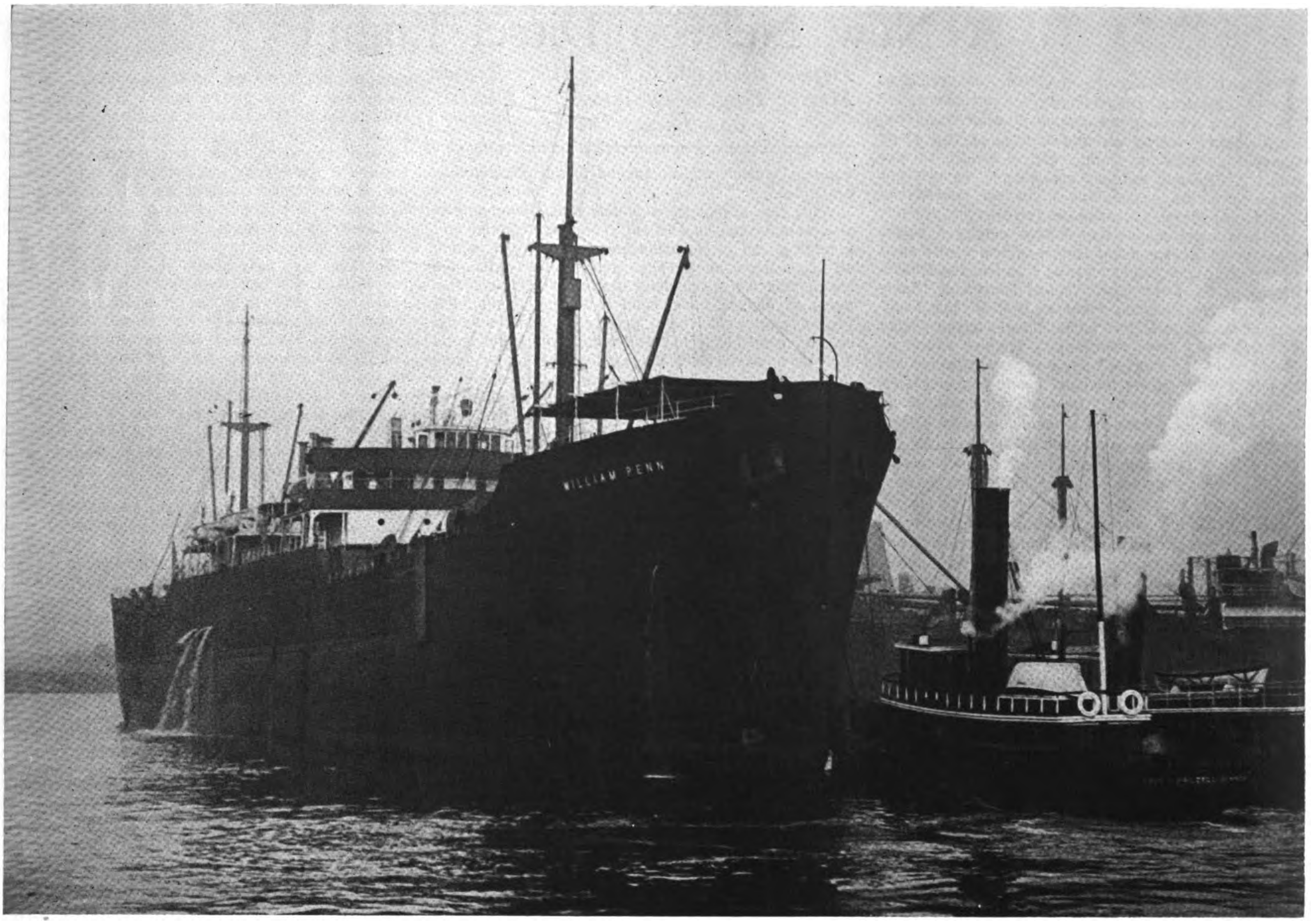
Scenes during trials of "William Penn"

1. Looking forward from bridge.
2. Looking aft, showing pilot vessel astern.
3. View of deck amidships showing exhaust-stack.
4. Left to right—H. B. Taylor, R. W. Robinson, J. C. Shaw and Capt. R. B. Wright.

Center—H. B. Taylor, in charge of trials.



Navigator Log installed in the engine-room of the motorship "William Penn"



American Motorship "William Penn" leaving the Tebo Basin prior to loading for her maiden voyage to the Far East.

90 to 100 gallons, or about one-third ton per day.

The cargo will be discharged at Yokohama, Kobe, Chinese Ports and Manila, and additional cago taken on in the Far East, the Barber Lines already having arranged for same, the return being via Suez and England. The vessel was not loaded to full draft 28 ft., 4¾ in. at Savannah, due to the large amount of bulk cargo carried. The cargo, however, is such that a good record should be made as to earning capacity. The deep-tank forward of engine-room, which in corresponding steamers going on such a long-voyage is used for fuel-oil, has been loaded with special cargo.

It is interesting to note that this vessel has a Navigator log installed in the engine-room for taking readings of the distance covered by the ship. This log is operated on the Pitot principle and consists of four main parts; namely, the bottom-cock, Pitot-tube, main instrument and distance recorder. In addition there is a storage-battery for electrical transmission and a panel for the same, the Bottom-cock is secured to the skin of the ship and a central hole is drilled for the Pitot tube. The Pitot-tube is pushed through the Bottom-cock and extends about 6 in. below the ship's bottom. This tube is held securely in place and no leakage of water is possible, although it can be readily removed for cleaning.

The Pitot tube is in reality two tubes in one, the innner tube being used for speed pressure and the outer tube for static pressure. A small hole at the bottom of the tube facing forward, permits entry of water for speed pressure and another hole of equal size, placed at the side, permits entry of water for static pressure. Both the speed and static pressure is led to either side of a diaphragm through small copper pipes. This diaphragm is located at the back of the main instrument which is placed in the engine-room below the water line. As soon as the vessel moves ahead the speed pressure increases and forces the diaphragm forward. This movement of the diaphragm is mechanically transformed to indicate the speed, and is in turn transformed by electrical means into the distance which is recorded by the distance recorders placed at any part of the vessel.

We have seen a communication sent from Savannah by Chief-Engineer Oscar Olson stating that the total distance of run was 668 miles by observation, whereas by the Navigator Log it was 668 1/3 miles. The following are records of readings shown by the Navigator log on the trials.

Time	Speed in Knots	Distance Reading Nav. Log	Distance Covered Nav. Log	Distance Covered T. R. Log	Chart Distance	Remarks
7.47 a.m.	....	902.65	....	....	....	Sailed 7.47 a.m. Pitot tube in place 7.55 a.m.
8.30 "	9.5	905.1	2.45	....	....	....
9.00 "	10.2	910.1	5.00	....	....	....
9.04 "	10.1	910.85	0.75	....	....	....
9.30 "	10.2	915.6	4.75	....	....	....
10.00 "	11.2	919.9	4.3	....	....	....
10.30 "	4.2	....	....	....	....	Maneuvering and adjusting compass.
11.06 "	11.0	923.45	3.55	....	....	Ambrose Light Abeam. T.R. Log put over.
11.30 "	11.3	927.8	4.35	....	....	....
12.00 noon	11.5	933.3	5.5	....	....	....
12.06 p.m.	11.6	934.65	1.35	....	....	....
1.06 "	11.75	945.8	11.15	21.5	....	Distance from Ambrose Light by Nav. Log 22.35 miles.
1.37 "	11.75	951.8	6.0	28.4	29.8	Fire Island Light Abeam. Distance from Ambrose Light by Nav. Log 28.35; by chart 29.8 miles. Adjusted Nav. Log to give higher reading.
2.15 "	12.5	957.55	5.75	....	....	Returning. Fire Island Light Abeam.
4.15 "	12.4	980.9	23.35	....	....	....
4.47 "	12.6	987.3	6.4	....	29.8	Ambrose Light Abeam. Dist. cov. Nav. Log 29.75 miles. By chart 29.8 No reading taken T. R. Log.
5.29 "	12.5	995.3	8.0	....	....	....
6.04 "	4.9	1000.2	4.9	....	....	At anchor Gravesend Bay.

Comparison of Log Distances and Chart Distances From Bearings

	Reading Nav. Log Knots	Reading Taffrail Log Knots	Chart distance Knots
Fire Island Light Abeam.........	543.5	0.0	...
Ambrose Island Light Abeam....	573.3	30.7	...
	29.8	30.7	29.8
Buoy No. 1 abeam. Distance run.	584.4	...	...
Ambrose Channel Light to buoy No. 1..................	11.1	...	11⅛

Record of Speed Indicated by Log on the Shipping Board's Turbine-Electric Steamship "Invincible" for Comparison with performance of the Diesel-driven "William Penn"

7.15 P. M. April 30th to 12.21 A.M. May 1st, 1921

Time	Knots	Engine telegraph signals
7.15 p.m.	11.00	Full speed ahead.
7.30 "	11.25	"
7.45 "	11.50	"
8.00 "	12.00	"
8.15 "	12.33	"
8.30 "	12.35	"
8.45 "	12.50	"
9.00 "	12.35	"
9.15 "	11.00	"
9.30 "	10.75	"
9.45 "	10.50	"
10.00 "	10.50	"
10.15 "	11.50	"
10.30 "	11.25	"
10.45 "	10.30	"
11.00 "	10.50	"
11.15 "	10.50	"
11.30 "	10.50	"
11.45 "	9.00	Slow ahead.
11.55 "	7.25	Half ahead to full.
12.00 m.	9.75	Full speed ahead.
12.03 a.m.	9.75	"
12.05 "	9.00	Half speed ahead.
12.15 "	8.00	"
12.21 "	7.75	Stop.

A New Nelseco Diesel Engine

Details of a 600 b.h.p. All-American Marine Engine Designed for Electric and Direct Drives

UNDOUBTEDLY in the foremost rank of American Diesel-engine constructors are the New London Ship & Engine Company, whose large works on the banks of the river Thames at Groton, Conn., are a credit to the country. As our readers are aware, we are not given to undue praise, but when we visited the leading oil-engine factories in Europe, we did not find any more modern or better equipped shops than the chief American Diesel-engine works such as the McIntosh & Seymour at Auburn, the Busch-Sulzer at St. Louis, the Winton Works at Cleveland, the Worthington plant at Buffalo, the Nordberg at Milwaukee, the Pacific Diesel Engine Works at Oakland, the Fairbanks Morse plant at Beloit, and the one in question at Groton, so we feel that there is no need of hesitation in giving them their due credit. In fact we know of no single European country whose combined Diesel and surface-ignition engine facilities can equal the above eight factories. Diesel-engine construction has only made further progress in Europe because of the whole-hearted support and co-operation extended to manufacturers by shipowners, whereas progress both in point of numbers of engines and power has been limited and even retarded in this country by the meagre and reluctant support given by private shipowners, and by the Shipping Board when it was responsible for the construction of 2,312 merchant ships aggregating 13,636,711 tons.

The Nelseco engine,—as the Diesel built by the New London Ship & Engine Company is named,—is not so well-known in commercial shipping circles as among naval men, because since 1910 the company's facilities have been principally devoted to constructing submarine-type engines for the United States and foreign navies, including thirty-two British submersibles. Nevertheless, the Company has completed about twenty installations in merchant-craft, some of which have shown over seven years' steady service. In the future more active attention will be turned to the commercial-craft field.

With this object in view the first Diesel-engine of a new design has recently been completed and a number of shop-tests run at Groton, in which all past experiences are incorporated, with the result that while the main distinctive Nelseco features of design have been retained, a much-improved engine has been produced. Two specific objects were borne in mind when laying down the design, namely, that the engine should be ideal for Diesel-electric-drive, and to also serve as a moderate-speed direct-drive engine merely by changing the cam-shaft, air-starting and fly-wheel. In this way engines are secured for two marine purposes with production costs at the lowest possible figure, and incidentally the stationary field is also covered.

At the time of our recent visit to the New London Company's plant to see this new engine, we noticed another economy being carried-out, namely the laying-down of four new Niles-Bement-Pond crankshaft lathes, with which crankshafts of all Nelseco Diesel-engines will in future be machined direct from solid-forged blanks, each blank being sawn vertically through center of original billet and from the two pieces the two halves of the shafts are machined. In addition to effecting manufacturing economy, the builders consider that greater strength will be secured as well as freedom from possible hair-cracks or segregations to which shafts forged from one billet are occasionally subject, owing to the original central pipe not having been entirely removed.

Through the courtesy of the builders we are enabled to give sectional and general arrangement drawings of this new engine, as well as a photograph, which will give a comprehensive conception of its design and appearance. It is a six-cylinder trunk-piston model of the four-cycle type rated at 600 b.h.p. at 225 r.p.m., but will actually develop close upon 700 shaft h.p. for continuous operation. In fact, during one of the tests 875 shaft h.p. was maintained for a short period with only a slight sign of smoke in the exhaust. At full power (rated) the mechanical-efficiency of this engine is just under 80%.

It was found on tests that from full-load to no-load there was only about 3½% variation in the revolutions. When the load of the electric-generator was thrown on or off suddenly there was virtually no momentary rise or fall in speed, except a first surge of a few revolutions when instantly changing from full-load to no-load, or vice versa, indicating that the action of the governor is most excellent. Smoothness and absence of vibration are noteworthy to the observer.

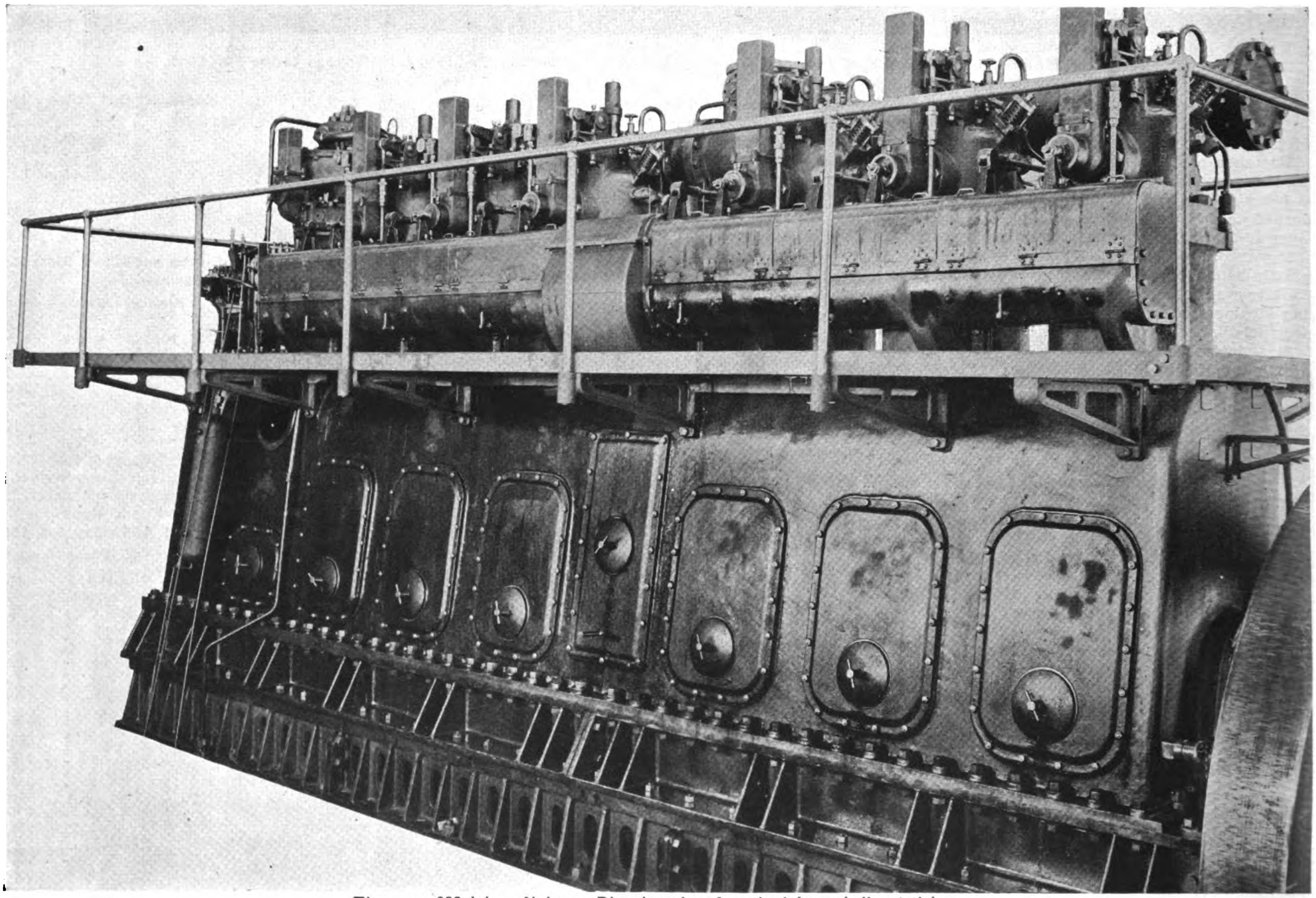
Another test was made with the speed varying as they may when direct-connected to a propeller on board ship. It was found that with the speed reduced to about two-thirds—when the output is only approximately one-fourth of full-power—the fuel-consumption figures-out at only 0.52 lb. per shaft h.p. hour.

At normal full-load tests showed the consumption of fuel to be 0.42 lb. per shaft h.p. hour, and no change when developing 25% overload. This is very excellent for an engine of medium speed and weight. It is interesting to note that the marine fuel-consumption curves are much flatter than the curve when operating on an electric-generator. The fuel-consumption results at constant speed on Diesel oil are as follows:

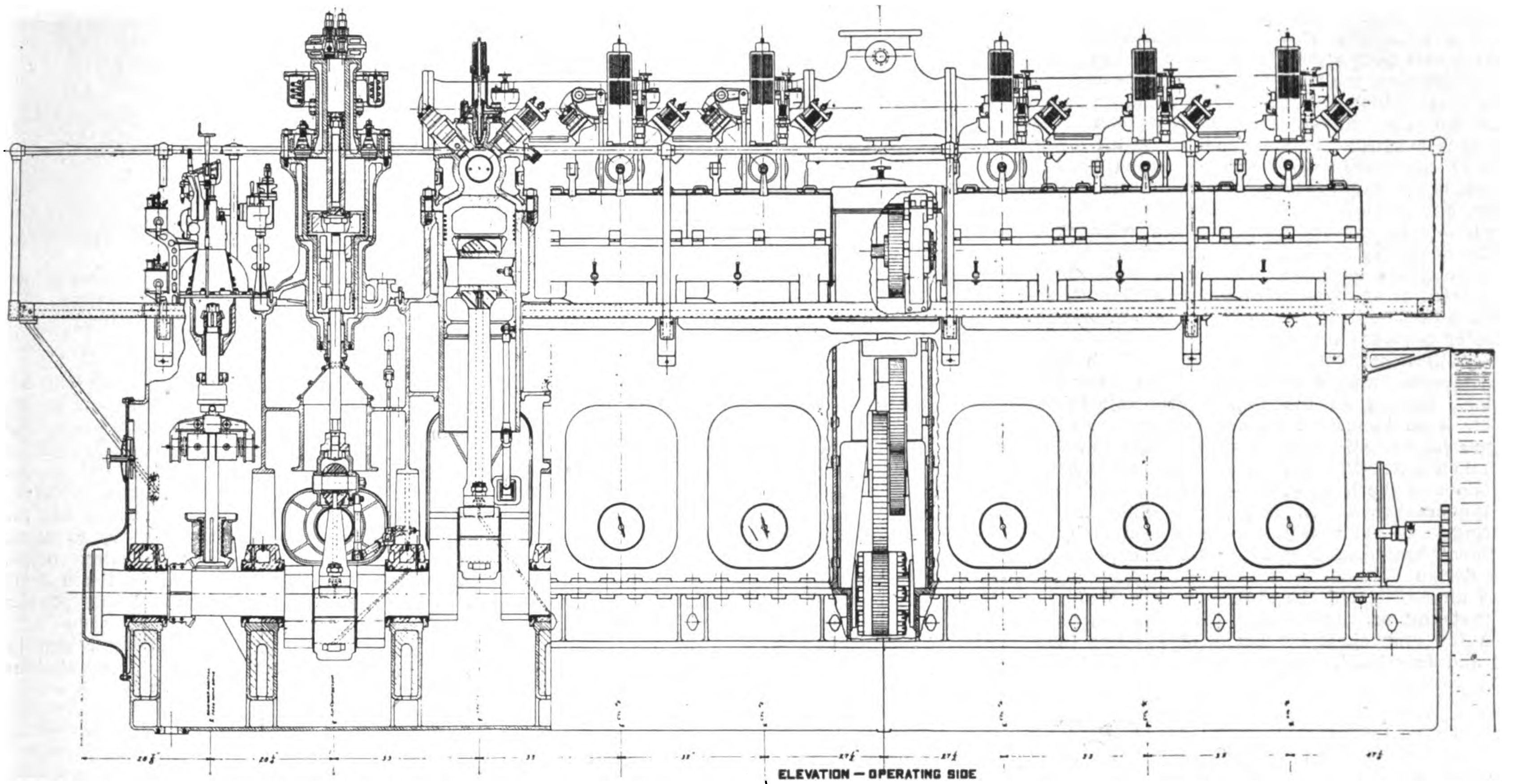
25% overload	0.42 lb. per b.h.p. hour
Full power	0.42 lb. per b.h.p. hour
¾ load	0.45 lb. per b.h.p. hour
½ load	0.51 lb. per b.h.p. hour
¼ load	0.67 lb. per b.h.p. hour

Before giving a technical description of the engine we will give its general dimensions:

Weight (short tons) ....53 tons



The new 600 b.h.p. Nelseco Diesel-engine for electric and direct drives



Sectional and general arrangement drawings of Nelseco 600 b.h.p. Diesel-electric drive marine-engine

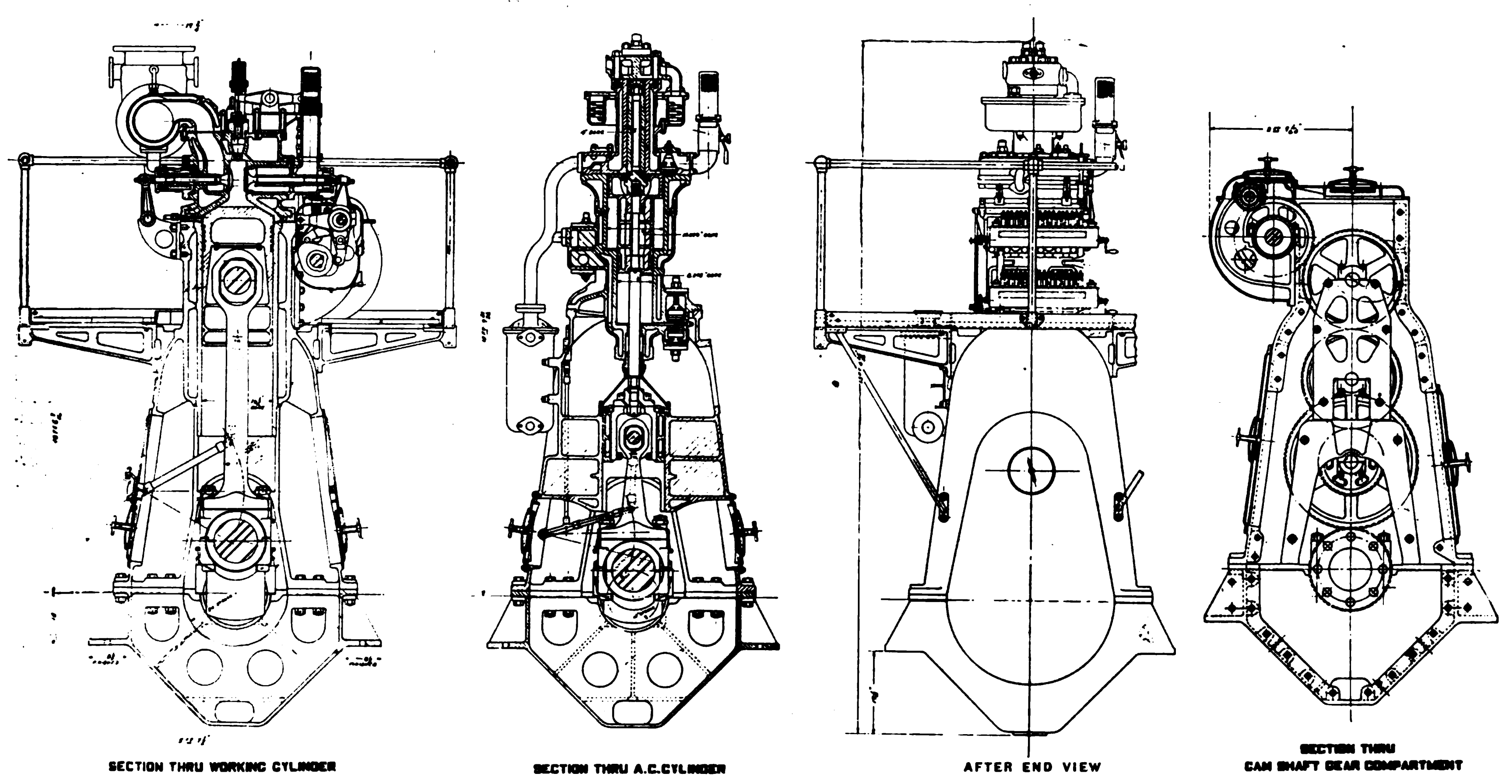
Weight per shaft h.p. (600 b.h.p.) ....191 lbs.
Length (O. A.) ....27 ft.
Width ....5 ft. 8 in.
Height above shaft center ....10 ft.
Overall height ....13 ft. 5 in.
Normal and rated power ....600 b.h.p.
Maximum power, for continuous running, 700 b.h.p.

Of course, this engine is not suitable for direct-drive with large cargo-ships, but for direct-drive with small commercial vessels such as trawlers, ferries, harbor-service boats, tugs, coastwise tankers, shallow-draft river-boats, and freighters up to about 1,000 tons d.w.c. in single-screw installations, or up to about 2,000 tons with twin-screw motorships. In these cases the engine is arranged to be directly reversible.

But, for large freighters, passenger-vessels and tankers up to about 12,000 tons d.w.c. and 4,000 h.p. this engine is made non-reversible and used in conjunction with electric transmission. In these cases several engines make up the total power required, although any one unit would be sufficient to bring the vessel home at reduced speed in case of accident to the others. At the same time it must be pointed out that a totally disabled modern direct-driven Diesel ocean-motorship is practically unheard of today.

For Diesel-electric drive of a cargo-ship requiring 2,000 shaft h.p. (about 2,600 i.h.p.) four of these 600-700 b.h.p. units, each connected to a 400 K.W. electric-generator, would be installed in the engine-room and these would provide the current for a single electric propelling-motor. Control of the latter can be placed on the navigation-bridge, or at any other part of the ship independent from the engine-room, thus eliminating delays or misunderstandings when maneuvering. Readers of "Motorship" will remember that the first American Diesel-electric vessel was the Gloucester trawler "Mariner," which was propelled by twin 240 b.h.p. Nelseco Diesel-engines, which has given the builders some very interesting experiences that will be found most valuable when carrying-out a large merchant-ship installation.

It will be noted from the illustrations that the six working cylinders of the engine are in line with the single three-stage air-compressor at the forward end. Forward of the air-compressor is the fuel-pump and governor. The bedplate and housing are of exceptionally rigid design and construction, the housing being carried right-up to the tops of the cylinders and the cylinder-liners forced into the housing with a space between which forms the water-jacket. Detachable cylinder-heads are bolted directly to the top of the housing. All of the valves in the cylinder-head are arranged horizontally, and are operated from the camshaft



which is carried in brackets on the side of the housing by means of vertical rocker-arms.

With this design there is a space of about six inches between the injection-valve nozzle and the piston top, which aids good combustion and prevents burning and cracking of the pistons. It has been suggested that undue wear of the lower side of the valve-stems may be caused by the weight of the valve being constantly borne at one point, but in actual practice this has not transpired, nor is any detrimental effect anticipated by the designers. The camshaft and much of the valve-gear, are enclosed in a casing and driven by a train of spur-gears from the crankshaft, located in the middle of the engine between working-cylinder numbers three and four.

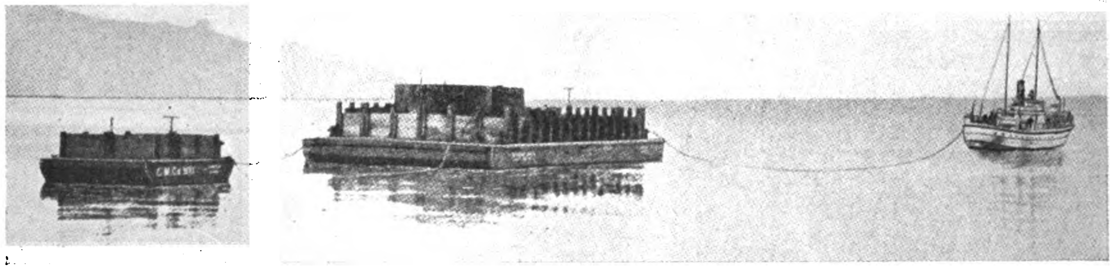
We will mention that the bearings at both ends of the connecting-rod as well as every other important bearing on the engine are adjustable, which is an important feature in the case of a marine-engine, where shims occasionally have to be taken out. Large openings are provided in the sides of the housing to permit of free access to the crankcase. In fact, accessibility to all bearings and parts requiring inspection and adjustment has been thoroughly taken care of in this design.

As already stated the air-compressor is of the three-stage type. In this case the piston is driven from the crankshaft by means of a connecting-rod and crosshead. Advantage is taken of this opportunity to separate the compressor-cylinders entirely from the crankcase, providing an accessible machine as well as avoidance of all trouble due to lubricating-oil in the cylinders, which was a fault found too frequently in early marine Diesel-engines, and occasionally met with even to-day.

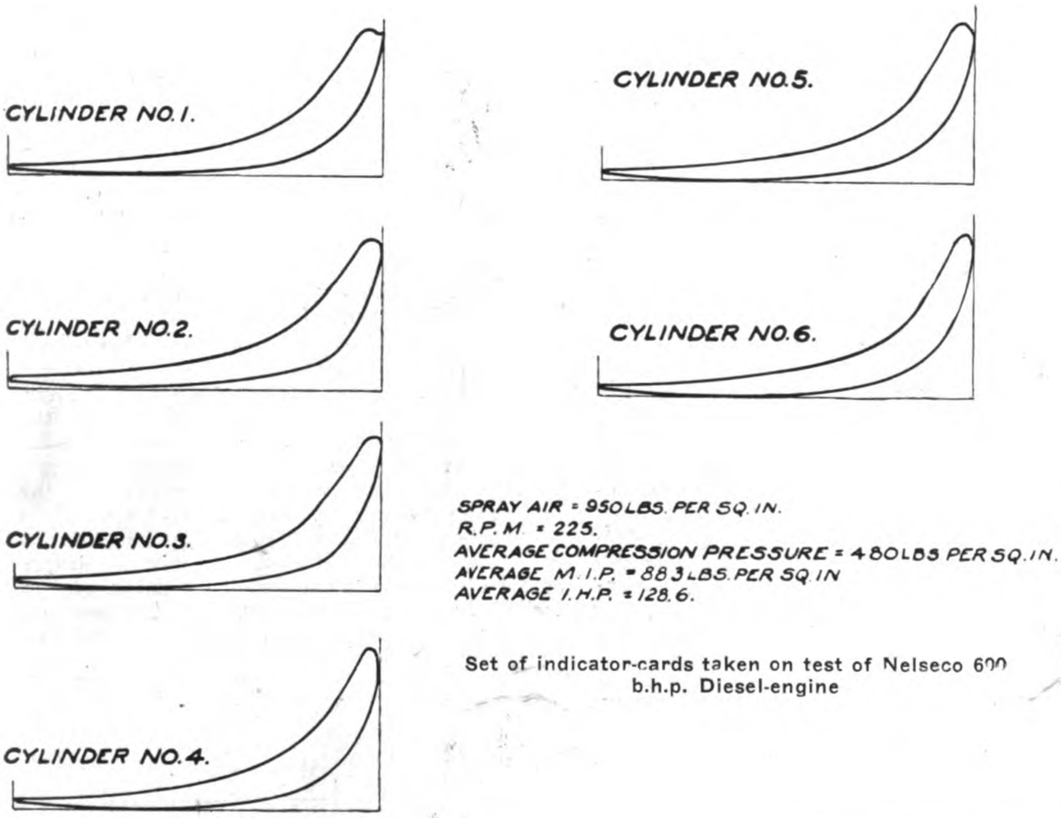
For fuel-injection fuel-pumps provide a separate plunger for each working-cylinder and is driven directly from the crankshaft by means of a vertical shaft and suitable gearing. On this vertical shaft is mounted the governor which is of the constant-speed type for engines designed to drive generators, and of the limit-speed type for direct-connected marine-engines. All controls and also the reversing-gear for the directly-reversible marine-engine are located at the forward end of the engine and on the upper platform that is at the fuel-pump and air-compressor end, and here, of course, the operator's station is located. In the case of generator engines, only three cylinders will be fitted up with air starting valves, but for direct-reversible engines it is necessary to fit all of the working-cylinders with air-starting valves. Starting-air for this purpose will be taken from storage tanks, and a maximum of 350 pounds pressure will be used.

Independently driven circulating-water and lubricating-oil pumps are provided, as the Nelseco designers consider this the most satisfactory method, but provision is made for fitting direct-connected pumps at the forward end of the engine in such special cases as it may seem advisable or necessary. Provision is made for ample water-jackets on all parts of the engine which require cooling, and the arrangements of connections and areas are such that there is a free flow of circulating-water from the inlet to the overboard discharge from the exhaust-header jacket.

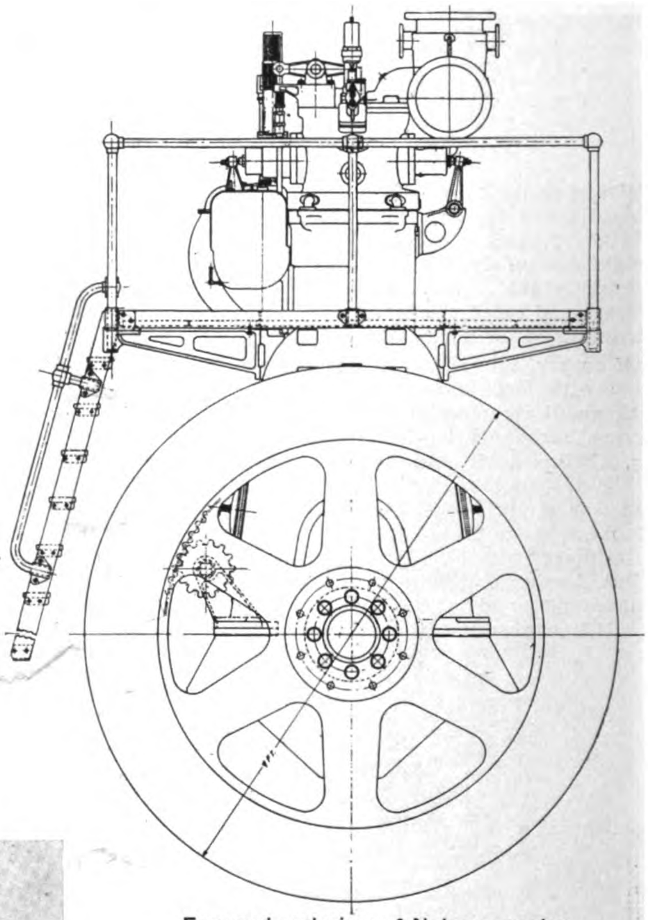
For the lubricating of the engine, the system used can best be described by calling it a gravity forced-feed. With this system the lubricating-oil flows from the gravity-tank which is at a sufficient height above the engine crankshaft to give the proper pressure to the main-bearings, then through holes in the crankshaft to the crankpins, and up the inside of the connecting-rods to the wrist-pins. The crankcase is enclosed and all surplus oil drains to a suitably formed trough in the bottom of the bedplate from whence it is pumped back through suitable strainers to the gravity tank. All of the important bearings are thus under forced-lubrication and a free flow of oil is circulating



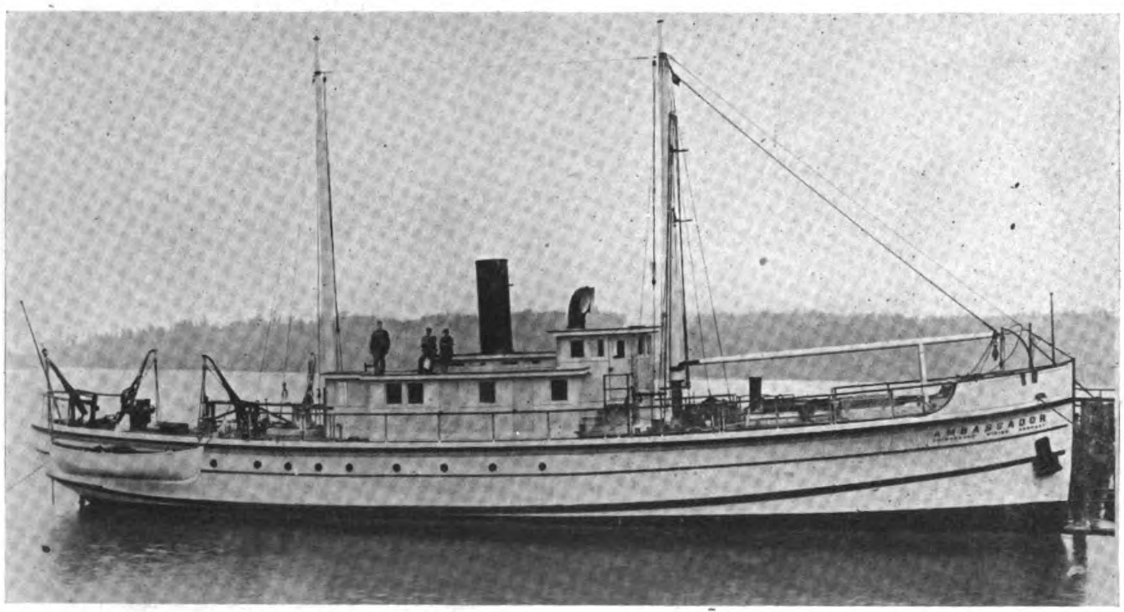
The Nelseco-Diesel powered "Ambassador," loaded with 50 tons cargo, and towing two loaded scows aggregating 1,000 tons deadweight from Tacoma to Chickagoff, a distance of 961 nautical-miles in 195 hours running time, averaging 190 R.P.M. and 5 knots. Fuel-used 3,217 gallons. Oil used 48¾ gallons



Set of indicator-cards taken on test of Nelseco 600 b.h.p. Diesel-engine



Forward end view of Nelseco engine



"Ambassador," a 100 tons motor-vessel owned by the Chickagoff Mining Co. of Tacoma, and in their Alaska service. She is one of the many American commercial craft propelled by Nelseco Diesel-Engines and has a 360 b.h.p. reversible motor running at 240 R.P.M. Speed 11 knots

through them at all times. The camshaft parts are oiled by splash from oil carried in the bottom of the trough of the camshaft casing. All cylinders and exhaust-valve stems are taken care of by mechanical oilers, and the minor valve-gear bearings are fitted with oil-cups for hand oiling.

In order to corroborate our remarks regarding the importance in the Diesel-engine building field of the New London Ship & Engine Company's factory, we will give a few general details of the same, as follows:

Area of plant	36.8 acres
Length of water front	3,140 lineal ft.
Main wharf length	150 ft.
L. head of wharf	100 ft.
Cove dock wharf No. 1	140 ft.
Cove dock wharf No. 2	310 ft.
Machine shop	717 feet x various widths from 105 ft. to 190 ft.

	Ground area	Floor area
	104,300	155,050
Store House and Pattern Shop 310 x 60	18,600	36,600
Heating plant 85 x 48	4,080	3,650
Iron and Steel Foundry 180 x 80	14,400	23,400
Auto Truck Garage 35 x 25	875	875
Ferry House 20 x 15	300	300
Pump House 15 x 10	150	150
Rigging Loft 40 x 15	600	600
Reclamation Dept. 90 x 40	3,600	5,200
Forge Shop 127 x 110	13,970	13,375
Forge Office 35 x 30	1,050	924
Gate House 12 x 40	480	394
Administration Bldg.	16,365	29,900
Office Garage	1,600	1,600
Vanadium Brass Foundry	15,780	16,350
Area Nelseco Park		10.0 acres
Area Farm Property		8.3 acres
Area Hotel Property		0.36 acres

Office annex Nelseco Park.
Twenty-four Cottages in Nelseco Park.
Two Barns Farm.
Nelseco Hotel Ground Area, 3,450 square feet. Floor Area 12,656 square feet.

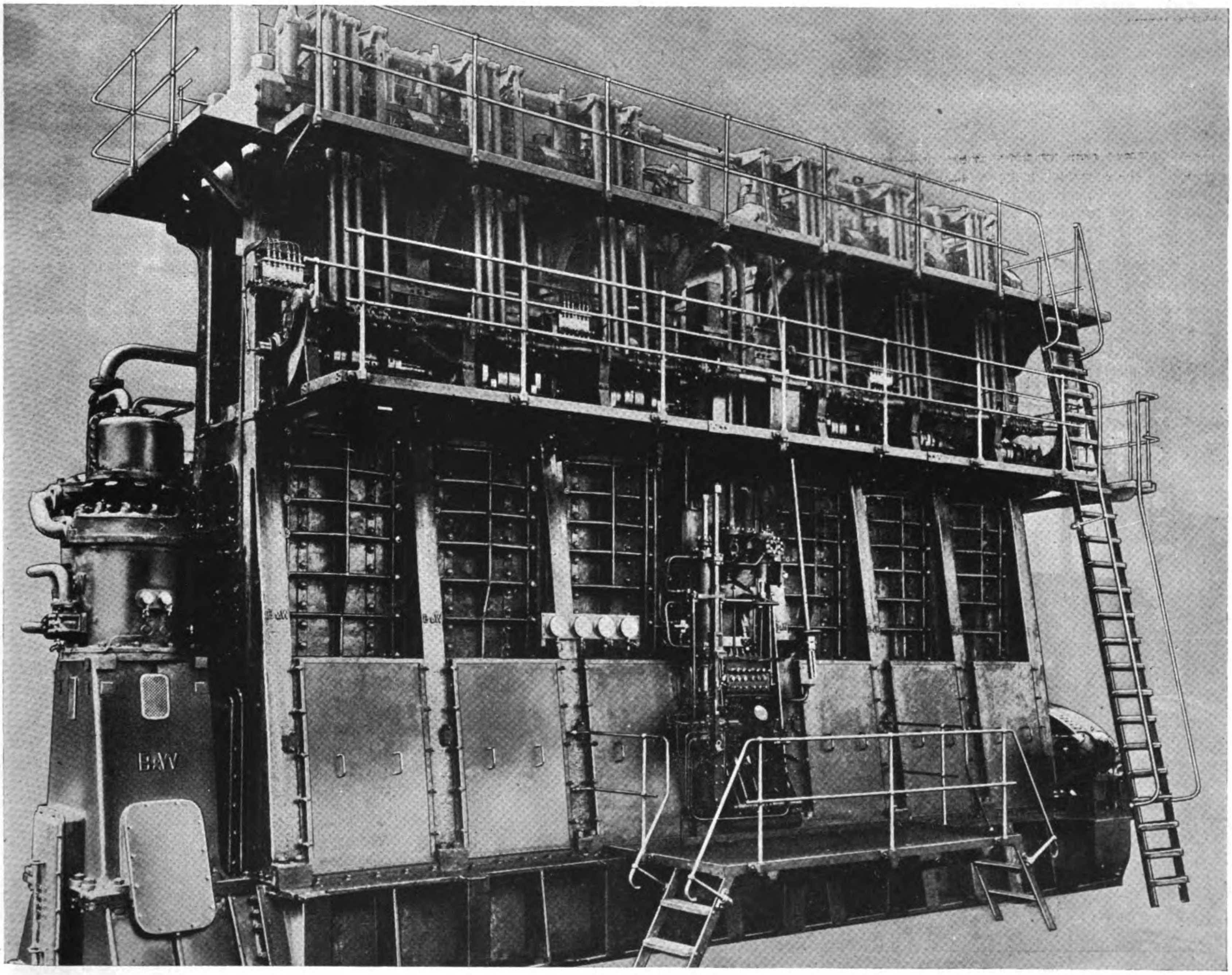
It will be noted that the machine-shop alone is over 700 ft. long by 130 ft. wide. Then it has to be considered that this entire plant is devoted to Diesel-engine construction and repair, no other product being manufactured, with the exception, we believe, of some torpedo-tubes during the war.

Single-Screw Slow-Speed Diesel Motorships "Sulina" and "Leise Maersk"

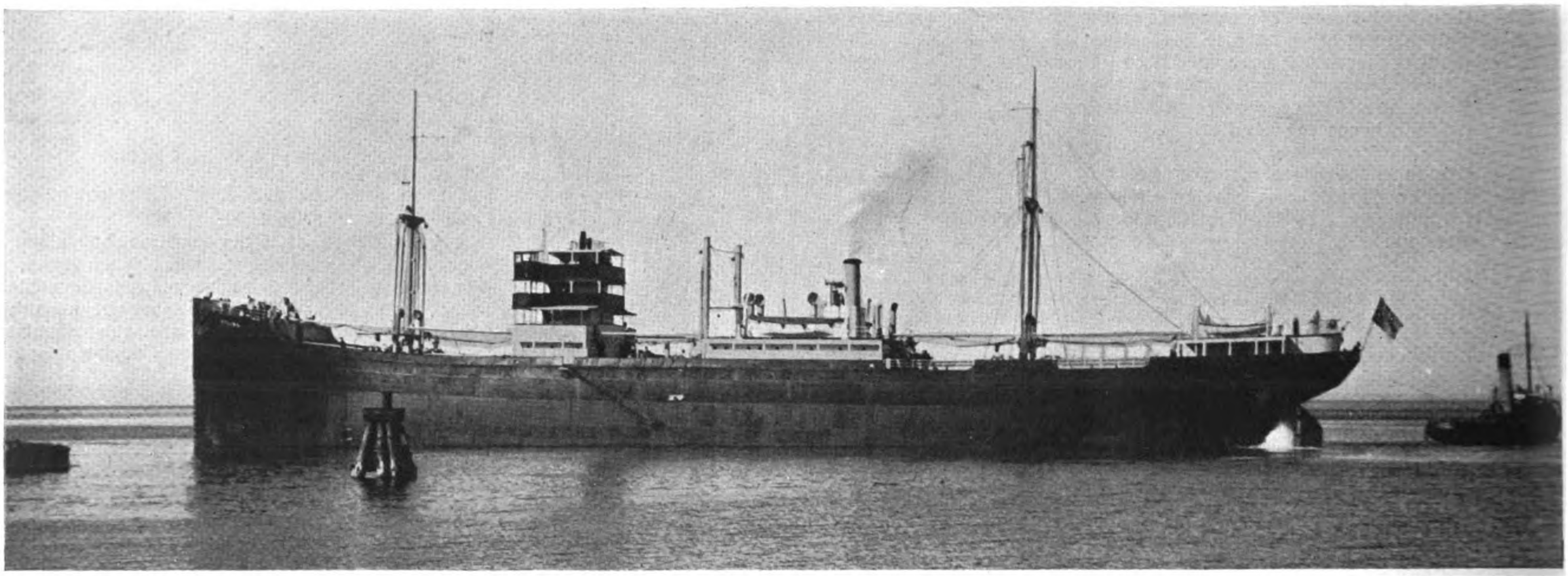
Sixteen Hundred Horse-Power At 85 R.P.M. In An Engine-Room 42 ft. Long.—Third Sister Motorship Now Building

TRIALS were recently run in Sweden of two very important merchant motorships the operation in service of which will be closely watched by shipowners and shipbuilders of all maritime countries because they are the first two vessels propelled by the new Burmeister & Wain—Götaverken slow-speed Diesel engine specially designed for single-screw ships. Their completion is another milestone in the progress of motorship development. Particularly in this country should the results of their design and working be known, because several domestic builders are working on plans for slow-speed engines, having in mind the probable conversion of many existing shipping board steamers without changing the present propeller-shafting and propellers, so as to reduce the conversional cost to a minimum. Another reason for local interest is that the Wm. Cramp & Sons Ship & Engine Co., may shortly start work on a similar engine, but of higher power, they being the U. S. licensees of the designers. No definite decision, however, has yet been made at this Philadelphia shipyard.

Our readers will remember that we gave exclusive details of the design of this new engine on page 216 of our issue of March, 1921, while in our issues of January (page 44) and March, 1921 (page 217), we gave drawings and preliminary descriptions of these vessels. At that time the vessels had not been named. They are the "Sulina"



The new 1,600 i.h.p. slow-speed Burmeister & Wain Diesel-engine for single-screw ships



The new single-screw motorship "Sulina" getting ready for her trial-run

built by the Oresunds Shipyard at Landskrona for the Swedish Lloyd and the "Leise Maersk," built by the Odense Shipyard for the Svendborg Steamship Co. (A. P. Moller) of Copenhagen, who controls the latter yard and a third single-screw ship is completing at the Eriksberg yard, also for the Swedish Lloyd. The Swedish Lloyd Line is controlled by the Dan Bröstrom & H. Metcalfe interests, who will shortly order a 20,000 tons 18 knot, 8,000 i.h.p. Diesel-driven transatlantic passenger liner for the Swedish-American Line.

Mr. Bröstrom recently stated that he will only consider motorships for future building, but does not believe in converting steamers to Diesel power. But for the existing high costs of construction, an oil-fuel storage barge would already have been laid-down, using the surplus fuel from his motorships to maintain the supply in the barge. Mr. Bröstrom stated that although the new big motor-liner might not be laid-down before next spring, this remarkable vessel will positively be built, but if the costs in Sweden are too high the order may go to Germany.

THE "SULINA"

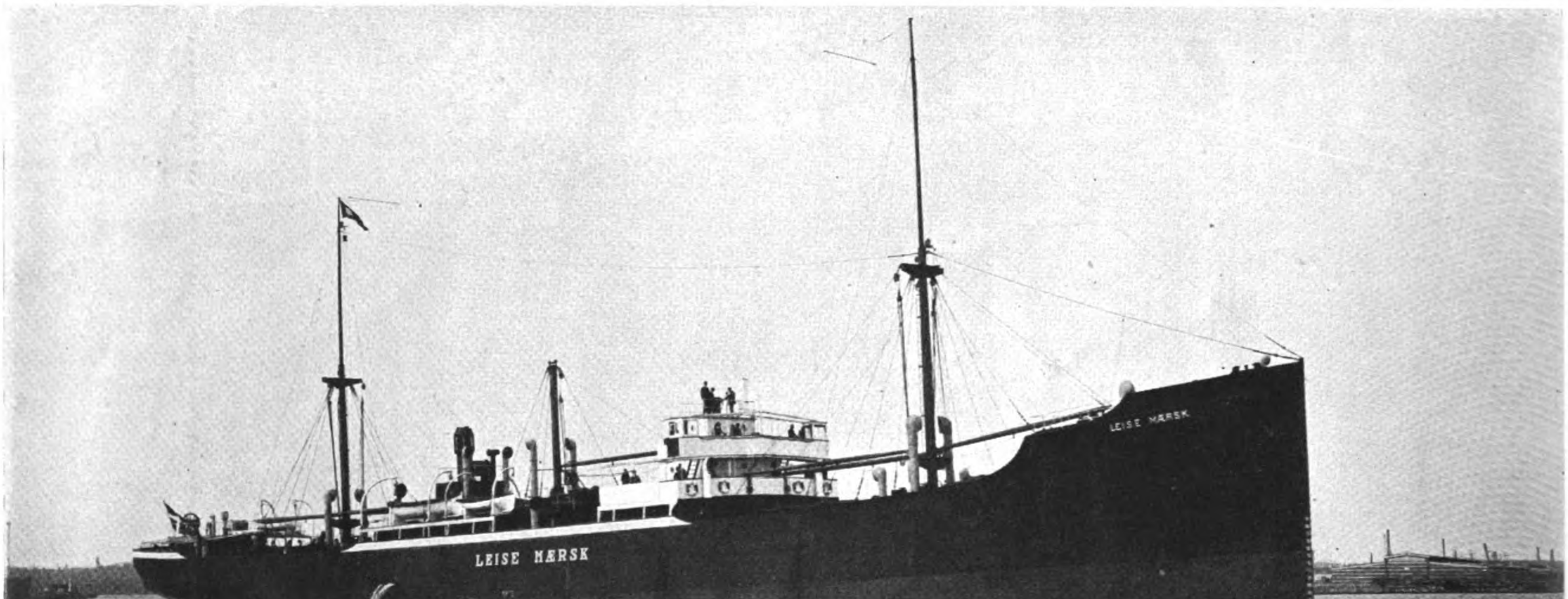
Regarding the motorship "Sulina" we will repeat her chief dimensions, with corrections according to minor changes made while the vessel was under construction—

Deadweight Capacity	4,537 tons
Cargo Capacity	239,600 cu. ft. grain
Fuel Capacity	555 tons oil
Cruising Radius	27,000 sea-miles
Net Cargo-Capacity (excluding fuel, etc.),	3,850 tons
Daily Fuel-Consumption on trials	5.1 tons
Power	1,500-1,750 i.h.p.
Engine-Speed	80 to 100 R.P.M.
Speed	12 knots light
No. of Engine-Room Staff	6 men
Length of Machinery Space	42 ft.
Fresh Water Carried	20 tons
Length (B.P.)	299 ft., 6 in.
Breadth (M.D.)	44 ft.
Depth (M.D.)	28 ft., 11 in.
Loaded Draught (Mean)	22 ft., 2¾ in.
Engine Bore & Stroke,	630 mm. (28.80 in.) 1,300 mm. (51.18 in.)
Classification	Lloyds + 100 A1
Type of auxiliary and Deck Machinery	Electric

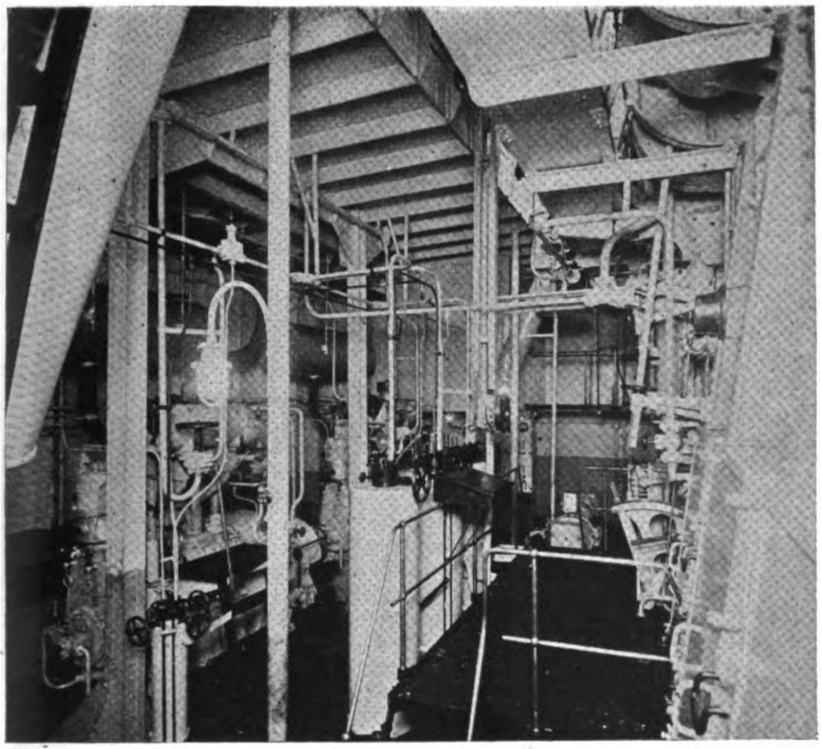
On her trials she attained a speed of 12 knots lightly loaded on a fuel-consumption of 5 1/10 tons per 24 hour day. Her engine was built under B. & W. license by the Götaverken of Göteborg who carried-out the installation work.

Our Danish correspondent advises that when turning at 95 R.P.M. and developing 1,600 i.h.p., a speed of 11 knots was attained on the trial run with a fuel-consumption of 133 grams per i.h.p. hour including all of the machinery. The speed of 12 knots was attained at increased revolutions.

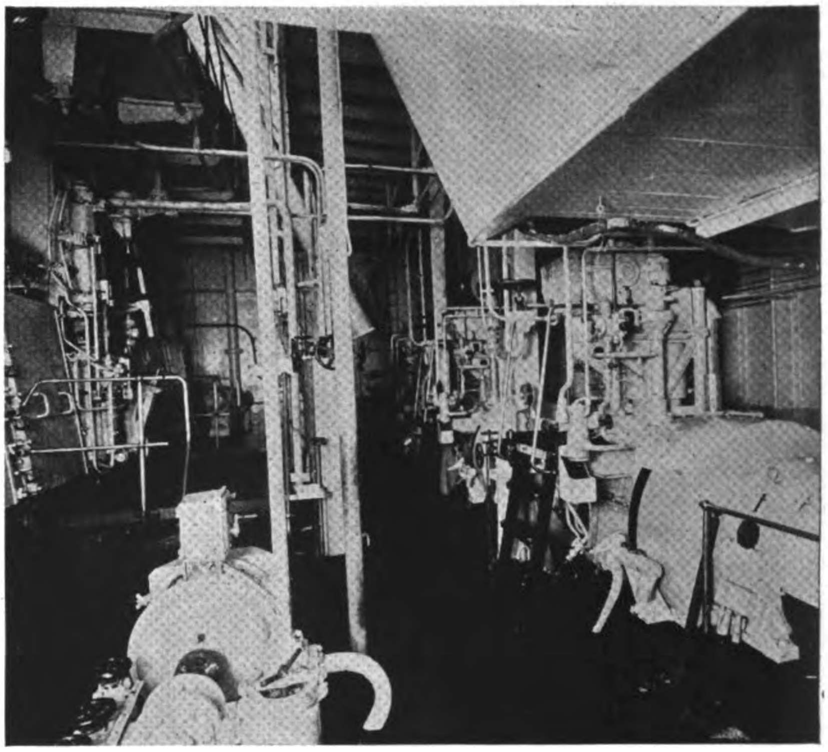
The auxiliaries of the "Sulina" consists of two 75 b.h.p. twin-cylinder Diesel-engines connected to electric generators and one single-cylinder 50 b.h.p. Diesel-electric set of B. & W. design, but built by the Götaverken. The installation of electrical equipment was carried out by the New Luth & Rosen Electric Co., Ltd., of Stockholm. There are ten 3-ton Asea electric winches serving five hatches. Clarke-Chapman electric-windlass and Brown electro-hydraulic steering-gear is installed. There is accomodation for several passengers. The engine-room crew, comprises chief-engineer, 2 asst.-engineers, one junior-engineer and one motorman, or a total of 7 men. But the junior-engineer is only on board as an apprentice, so the regular staff is six men, compared with 15 men for the steamer "St. Thomas"



The new slow-speed, Diesel-engined, single-screw motorship "Leise Maersk" leaving port for her trial



Looking forward in engine-room of the m.s. "Leise Maersk" showing controls on port side of the single 1,600-1,700 i.h.p. main engine

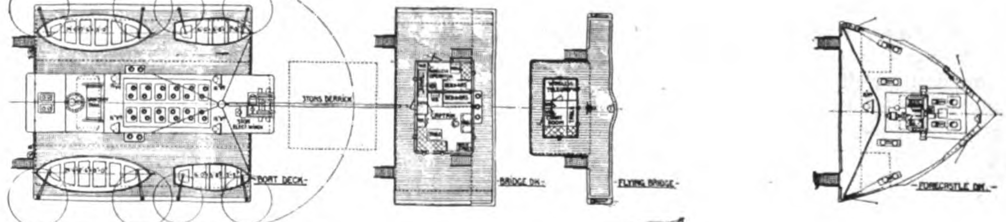


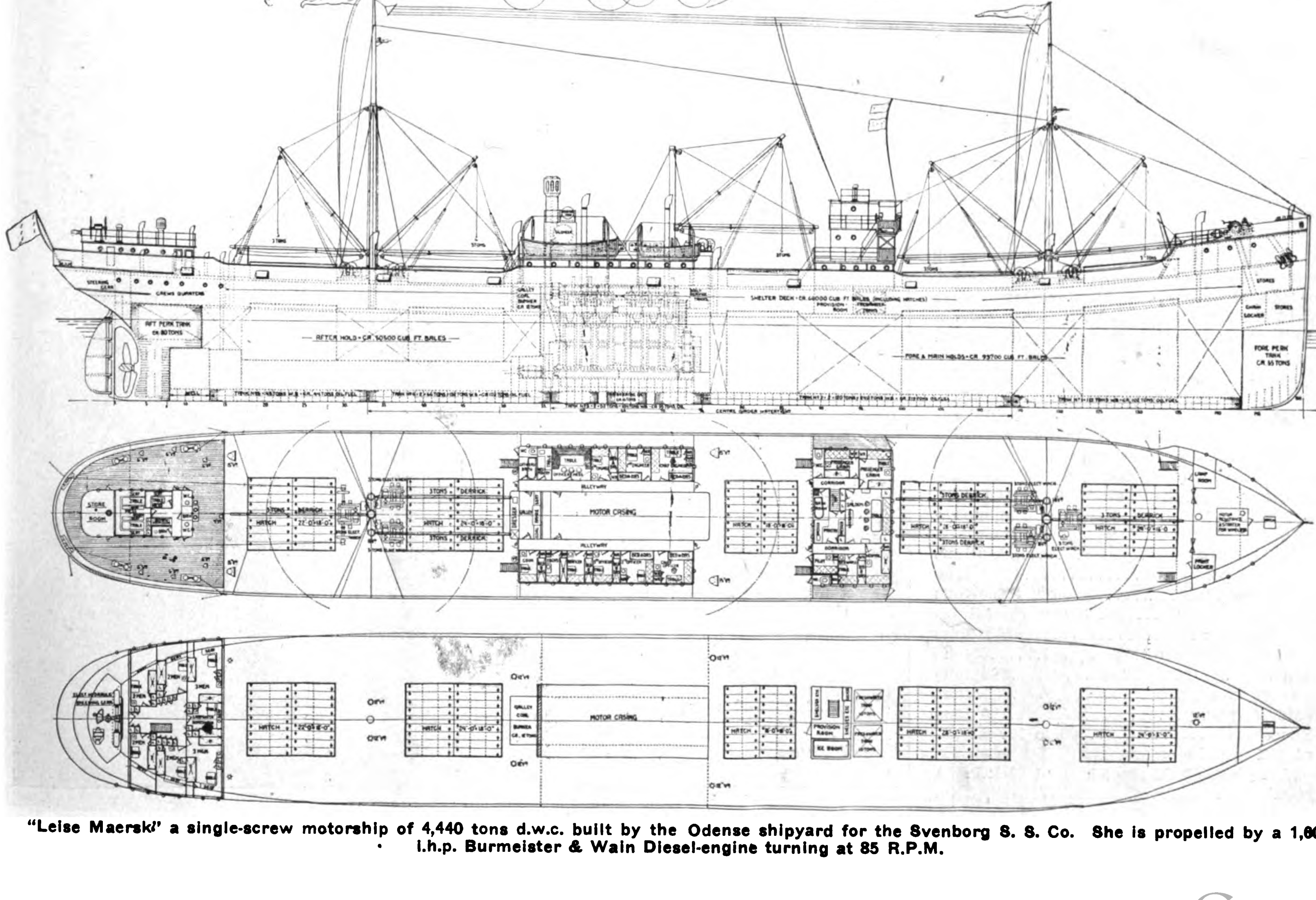
The three auxiliary Diesel-electric generating-sets on the port side of the engine-room of the m. s. "Leise Maersk"

It is interesting to note that the "Sulina's" engine was the first supplied by the Götaverken for a motorship built at a Swedish shipyard other than their own. At the dinner following the launch Mr. Ernst Hedén of the Götaverken referred to the excellent co-operation existing between the engine and hull makers who are competitors in the shipbuilding industry, particularly as the Landskrona shipyard was formed by Danish interests. Similar pleasant conditions have existed between Götaverken and Burmeister & Wain of Copenhagen, as well as with a number of other yards at home and abroad. Following Mr. Hedén, Mr. Dan Brostrom paid a high tribute to the great developments made by Burmeister & Wain from the days of the "Selandia" to the trials of the "Afrika" and to this new single-screw equipment.

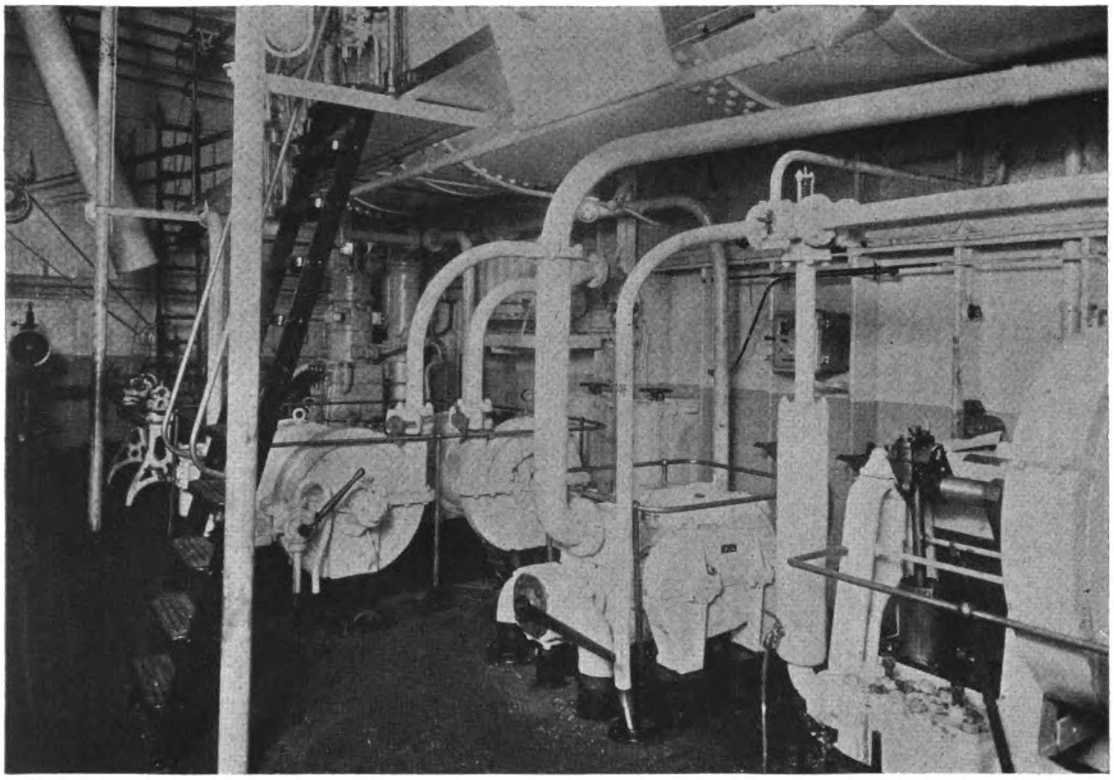
THE "LEISE MAERSK"

We will now turn to the other ship the "Leise Maersk" which is practically the same size and power as the "Sulina." Some very interesting comparisons will soon be available as the same builders some time ago constructed the steamship "St. Thomas" to the order of the East Asiatic Company of Copenhagen. We believe that this is one of the steam vessels sold by the latter company to the Orient Steamship Company. The "St. Thomas" is a single-screw vessel and her machinery is of practically the same power, con-



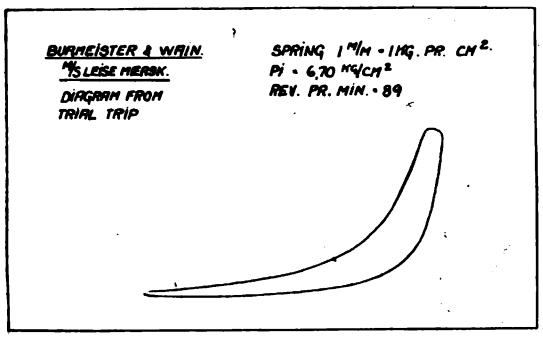


"Leise Maersk" a single-screw motorship of 4,440 tons d.w.c. built by the Odense shipyard for the Svenborg S. S. Co. She is propelled by a 1,600 i.h.p. Burmeister & Wain Diesel-engine turning at 85 R.P.M.



Starboard side of engine-room of m. s. "Leise Maersk" showing electric-driven air-compressor and pumps

sisting of a triple-expansion reciprocating steam-engine and two Scotch boilers. These weigh 337 metric-tons compared with 332 metric-tons for single-crew Diesel-engines of the motorship "Leise Maersk." The Diesel-engine weights include main-engine, shafting, propeller, auxiliary-machinery, floor-plates, gratings, ladders, air-storage bottles, piping, silencers, spare parts and workshop tools. **This should silence the critics who state that Diesel machinery is much heavier than steam plants'** Incidently, it may be mentioned that the Burmeister & Wain type Diesel-engine is one of the sturdiest and heaviest on the market so affords a comparison in one sense favorably leaning on the side of the steam-engine. Only 42 ft. is required by Diesel machinery, whereas the engine-



room of the steamer is 44 ft. long and cross bunkers 12 ft., making a total of 56 ft. Thus a saving of 16 ft. of space is effected by the Diesel plant.

It is interesting to note that in connection with the saving in space compared with steam-driven vessels, two additional frames space could have been added to the 7 saved. This was not done because the maximum deduction allowance from the gross tonnage for harbor and channel dues amounts to the 30 per cent. already effected.

We will repeat the main details of the motorship "Leise Maersk" with latest corrections—

Loaded Displacement	6,350 tons
Dead-Weight Capacity	4,440 tons
Net Cargo-Capacity	about 3,850 tons
Cargo-Capacity of Holds	210,200 cu. ft. of Bales
Stipulated Sea-Speed	10½ knots
Stipulated Daily Consumption of Fuel	5 tons
Total Fuel and Stores Carried	580 tons
Salt-Water Ballast	135 tons
Fresh-Water Capacity	20 tons
Engine-Speed	80 to 100 R.P.M.
Power of Main-Engine, 1,500—1,750 i.h.p. (1,150 shaft h. p. at 80 R.P.M.)	
Length (O.A.)	315 ft., 3 in.
Length (B.P.)	299 ft., 6 in.
Breadth (M.D.)	44 ft.
Depth to S. D.	28 ft., 11 in.
Draught Loaded	22 ft., 6 in.
Weight of machinery including all equipment and shafting	337 metric tons
Length of Machinery Space	42 ft.

She is intended for cargo-carrying, but has two large staterooms for passengers, in addition to a special cabin for the pilot. For handling the cargo there are seven 3-ton derricks served by seven Thrige electric-winches of the same lifting capacity. In the case of this vessel the engine was designed and constructed by Burmeister & Wain at their Copenhagen yard, and is of the 6-cylinder single-acting four-cycle type developing 1,500 to 1,750 i.h.p. at speeds from 80 to 100 R.P.M. This engine actually developed 1,150 shaft h.p. at 80 R.P.M. on test, the bore and stroke is 630 mm. by 1,300 mm. respectively. Winches, steering-gear, anchor-windlass are electric-driven. A current of 220 volts is supplied by three single-cylinder Burmeister & Wain Diesel-engines of 50 b.h.p. each, coupled to generators, of which only one needs to be used when the vessel is at sea, including for the lighting. For heating the ship there is a small vertical oil-fired boiler of 55 sq. ft. heating-surface.

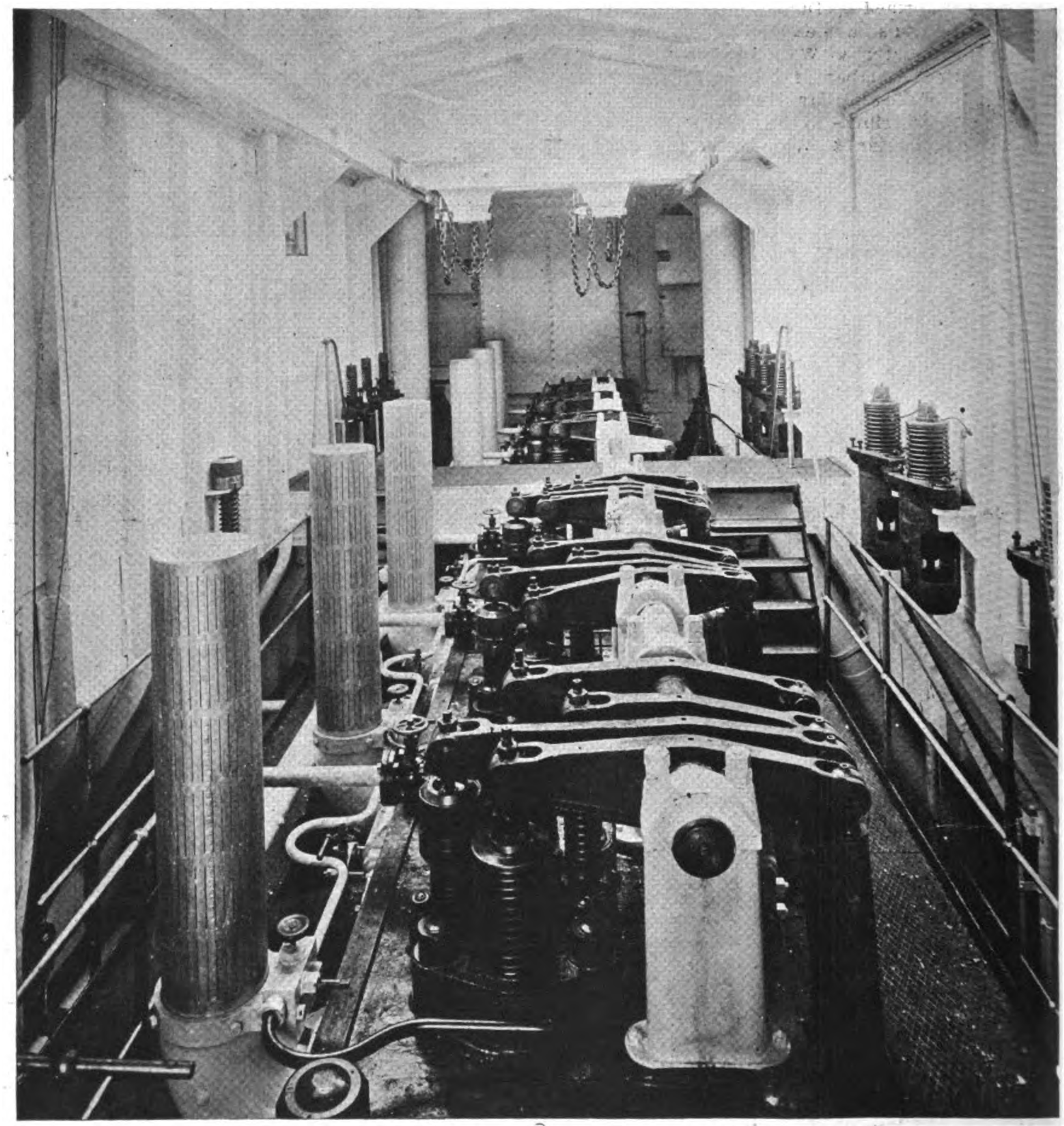
The engine-room and boiler staff consists of 9 men, represented by 3 engineers, two junior engineers, three motormen and one electrician.

As regards lubricating-oil, the total requirements for all machinery amounts to 8¾ gallons per day including the hand lubricating-oil and waste-oil in tanks. It is usual with Burmeister & Wain engines to adopt the Aspinall Governor, but we understand that on this particular engine a governor of Burmeister & Wain's own design is fitted, which cuts off the fuel instantly, the revolutions rise above the pre-determined limit.

For comparison purposes the dimensions of the steamer "St. Thomas" are—

Displacement	5,180 tons
Deadweight Capacity	3,750 tons
Bunker and Boiler-Water Capacity	985 tons
Daily Fuel-Consumption	about 25 tons
Net-Cargo Capacity*	about 2,765 tons

*As the steamer's bunker capacity is only 525 tons her cruising radius with 2,765 tons of net-cargo is only about one-third of the radius of the motorship with 3,850 tons of net-cargo.



View of engine-room of the m. s. "Leise Maersk" looking down on cylinder heads. Note the new cylinder-beam construction and off-set fuel-injection valve.

Length (B.P.) .... 311 ft.
Breadth (M.D.) .... 40 ft., 6 in.
Depth (to U.D.) .... 21 ft., 9 in.
Draught, Loaded .... 19 ft., 7 in.
Speed .... 11 knots
Cylinders .... 21½ in. x 34½ in. x 60 in.

39

Engine and Propeller Speed .... 80 R.P.M.
Weight of Machinery .... 337 metric tons
Length of Machinery and Bunker Space.... 56 ft.
Engine-room Crew .... 15 men

As previously mentioned, the first details of the new Burmeister & Wain-Götaverken engine were published in our issue of March, 1921, but we will repeat a few principal details as follows:

The dimensions are I.H.P. 1,750; shaft h.p. cylinder diameter 630 mm.; (24.803 in.) stroke 1,300 mm.; (51.181 in.) revolutions 100; length from aft coupling to front of compressor 10,500 mm.; height from center of crankshaft to top of valves 6600 mm.

The most interesting features of this new engine are the cylinder-head and cylinder liner. The heads are nearly square and are supported by distance pieces which stand on the "A" frames. The heads are bolted together, three and three. Long bolts pass from the main frame, thro the "A" frames and distance pieces, and between the heads, each nut pressing down on two heads. The long bolts also have nuts at the top of the "A" frames. The liners are bolted directly to the head, without any packing, iron to iron. Outside the liner, bolted to the head with a gasket is the water-jacket, which packs off against the liner near the lower end with a rubber ring. This allows the liner perfect freedom to expand. The inner shell of the cylinder-head is well braced by four stays. The cooling-water enters at the lower end of the jacket and most of it is made to pass into the cylinder-head at the opposite side by a baffle-ring inside the jacket. The water-space in the head is very large, insuring effective cooling around all valves.

In order that the removal of the piston downward instead of by removing the head, may not be too complicated, it has been made oil-cooled instead of water-cooled.

To remove the piston, it is brought almost to top center, the crosshead shoe is blocked-up, the crosshead bearings taken apart, and the connecting-rod lowered by turning the crank almost to bottom center while lowering the upper end of the connecting-rod with a chain hoist, so that it rests on the outboard side of the main frame. The outlet and inlet valves are removed, eyebolts screwed into the piston-head, and the piston is lowered through the top plate so that the crosshead pin rests on beams placed across the main frame. It can then be inspected or even removed. The top plate differs from the ordinary construction in that it has a hole large enough to permit passage of the piston, this hole being closed by two semi-circular plates, which contain a scrapering for the piston rod.

The frame for the gear-train stands in the center but is separate from the "A" frames. The three fore and the three aft cylinder heads are bolted together with horizontal bolts. This construction allows the engine to weave slightly, too great rigidity having been found detrimental.

The main frame and "A" frame are largely of "I" section. The air-compressor is of the latest Burmeister and Wain three-stage design, directly connected to the crank-shaft at its forward end, having its own base frame bolted to the main frame, though its "A" frame and cylinders stand free. Other parts of the motor are in general Burmeister and Wain standard, with such small refinements as experience has made desirable.

One new feature of this engine not previously discussed takes the form of a metric scale and hand-control wheel regulating the clearance or varying the lift of the fuel-valves, enabling the engine to run at very slow-speed.

Both the "Sulina" and the "Leise Maersk" are fitted with the Kockum air-siren, which is about to be introduced on the American market by A. O. Anderson and Co., of New York.

Immediately after her trial run the "Leise Maersk" loaded and started on her maiden-voyage carrying a cargo of Portland cement from Arhus to Java. Mr. A. P. Möller, managing-director of the owners said that in spite of the present low freight rates, the vessel was sufficiently economical to earn profits. But, he considers the price quoted by oil-companies too high even in the districts of oil production.

On the trials runs of the "Leise Maersk" four runs were made, the ship if light having a displacement of 2,240 tons and a mean draught of 8 ft., 2½ in. An average of 1,665 h.p. at 91.9 R.P.M. was made with the ship averaging 11.71 knots. Over the measured mile, however, a speed of 12.6 knots was attained with the engines developing 1,710 i.h.p. at 92 R.P.M. During the fuel-consumption tests the engines developed 1,565 i.h.p. at 88.9 R.P.M. with a fuel-consumption of 0.1,265 kg. per i.h.p. hour. The heating value of the oil was 18,350 B.T.U. In operation the engines of the "Leise Maersk" will be run at a slower speed than the engines of the "Sulina" and only 1,500 i.h.p. will be developed at 85 R.P.M.

Before concluding this article we will also refer to another single-screw motorship, but a little smaller in size and building at the Eriksberg shipyard at Göteborg in which an engine of the same power and slow-speed is being installed by the Gotaverken of the same city. This vessel is also to the order of the Swedish Lloyd, for whom the New York agents are Moore & MacCormack. Drawings and details of this vessel were given in our issue of March, 1921, pages 218-219. At the same time drawings were given of the sister steamship "Hibernia" also built at this yard for the Swedish Lloyd. Comparisons have been made, which show that the motorship had an additional underdeck cargo-capacity of 13,470 cu. ft. of grain, when loaded with fuel sufficient for a voyage 500 miles longer than the cruising radius of the steamer. Also, there was a saving of 20 ft.-3 in. in machnery space in favor of Diesel-drive. If, however, the "Hibernia" was converted to oil-fired instead of coal, the machinery space would not be so great, but would be 12 ft. which is quite considerable with a ship of her small size.

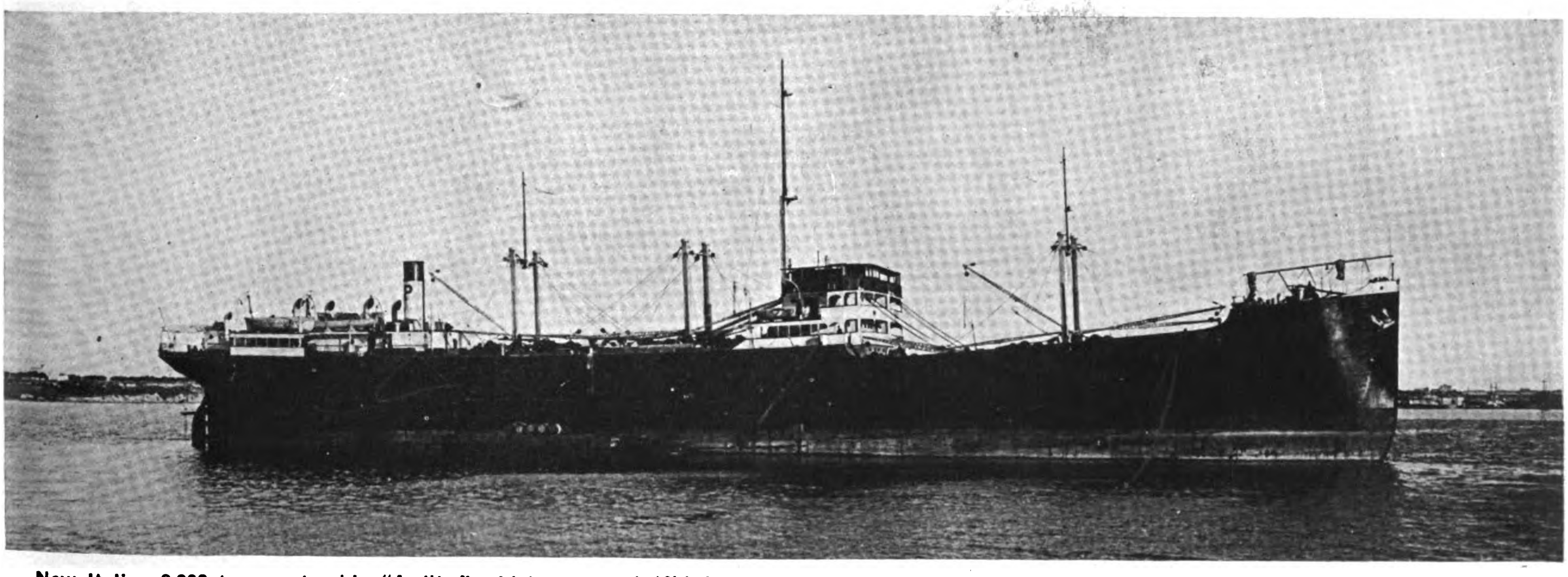
We have omitted to repeat the fact that both the Swedish Lloyd's motorship built at Eriksberg and the steamship "Hibernia" are of 3,750 tons d.w., but their net cargo-capacity on a round Transatlantic voyage are 3,425 and 3,000 tons respectively. The "Hibernia" has a daily fuel-consumption of 22 tons of coal, whereas the motorship has only a consumption of between 5 and 5½ tons, or a daily saving of 16 tons.

New Italian Motorships "Ardito" and "Primula"

Two Vessels with the Latest Design of Tosi Diesel-Engine—Excellent Performance on Maiden Voyage of the "Ardito"

During the last year or so not very much has been heard of the Tosi Diesel-engine, the builders having dropped more or less out of the American limelight following the war, during which period they built some very excellent submarine engines, as well as the Diesel-engines for several naval tankers. Two American shipyards secured licenses to build the Tosi engine, but the shipbuilding slump came before they had time to construct any commercial installations. Nevertheless, work has been progressing steadily at the works in Italy of the Franco Tosi Co. Also work is progressing on the British-built Tosi engines for two fruit-carrying motorships under construction at Wm. Beardmore's yard at Dalmuir, Scotland, which have been described in "Motorship."

Two large Italian-built motorships recently ran their sea-trials, and one of them has just completed her maiden voyage. This is the "Ardito," a freighter of 8,000 tons deadweight, owned by the La Platense Shipping Co. of Genoa, and built at the Taranto Shipyard of the Tosi Company. She is propelled by two four-cycle, single-acting, Tosi Diesel-engines constructed at their Milan plant. This pair of oil-engines was installed in the ship without any shop trials. When the vessel was completed the ship's sea-trials were run, and the "Ardito" proceeded in ballast for England, without



New Italian 8,000 tons motorship "Ardito," which averaged 12½ knots on her maiden voyage in heavy weather. Her twin 1,250 shaft h.p. Tosi Diesel-engines were installed in the ship without factory tests. Fuel-consumption 9¼ tons per day dismantling a single main item and without any alteration.

From Spezia to the Barry Docks, she averaged 12½ knots on 9¼ tons of fuel-oil per day, although heavy weather was encountered en route. As the engines operated continuously at 2,800 i.h.p. together, this consumption works-out at 0.31 lb. per indicated h.p. hour.

Only two involuntary stoppages of the main engines occurred during the voyage, one to tighten-up a bottom-end bearing on one engine. The other was due to defective inlet and exhaust valve springs on one cylinder, in which case the valve-tappet was screwed-back, and this valve put out of action. This cylinder thereafter operated with one inlet and exhaust valve without any material reduction in the power obtained. This was made possible because of the ample exhaust and inlet area throughout the valves allowed in this particular valve design.

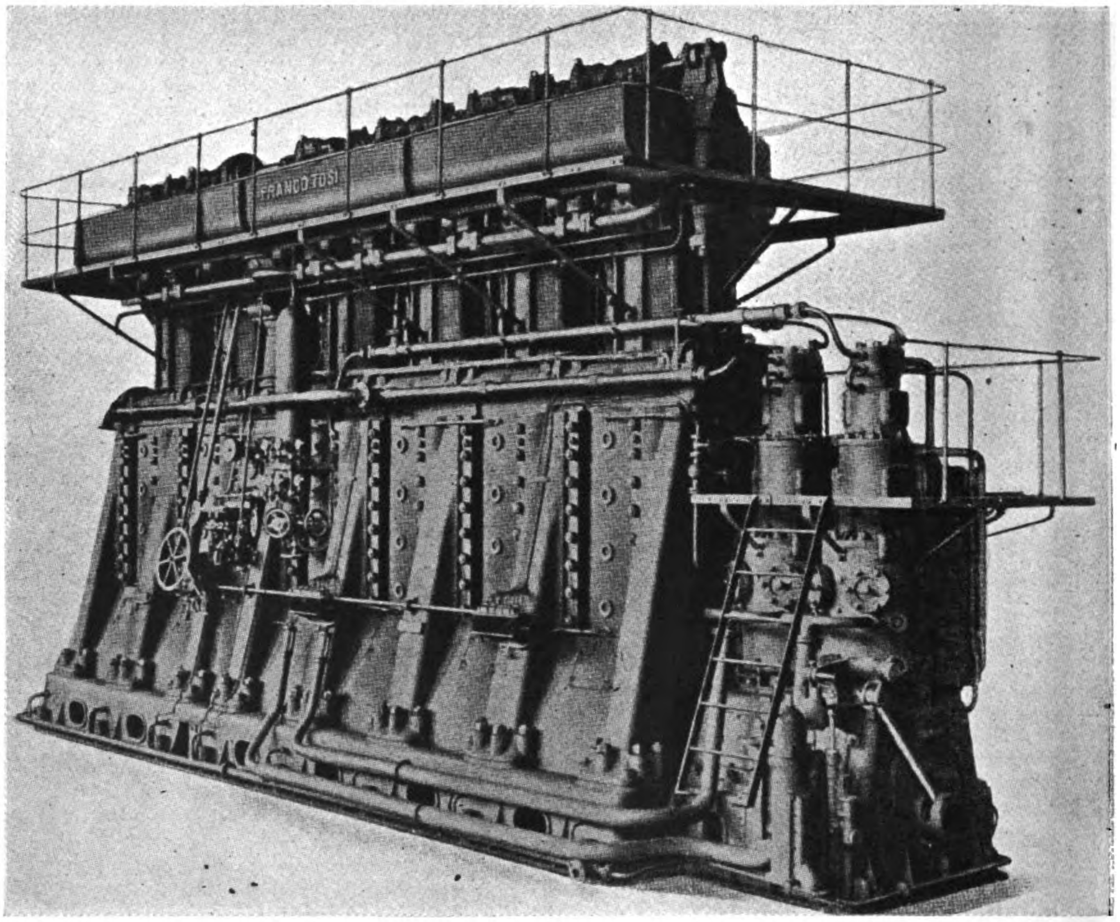
On the arrival of the vessel at Barry it was found unnecesasry to dismantle any of the parts of the main engines, but one "director-valve" was removed for inspection. It was most gratifying for the engineers to find that practically no deposit of carbon was to be seen. Manoeuvring of the engine was all that could be desired, any required speed from 125 r.p.m. down to 38 r.p.m. being easily obtained by manipulation of the fuel-lever, and reversal from full-ahead to full-astern was carried-out as easily as with steam machinery.

Description of the "Ardito's" Machinery

As we close for press the dimensions of the "Ardito" are not available; other than that she is of 8,000 tons deadweight capacity, but engine-room plans of a Tosi motorship of this tonnage were published on page 121 of "Motorship" for February, 1920. However, each of the engines is a six-cylinder model with 620 mm. (24.409 in.) bore by 975 mm. (38.385 in.) stroke, and operates at 125 r.p.m., at which speed the rated power is 1,250 shaft h.p. But on the sea-trials of the ship, the starboard engine developed 1,290 shaft h.p. (1,718 i.h.p.) at 115 r.p.m., and the port engine 1,280 i.h.p. (1,704) at 114 r.p.m., giving the vessel a speed of 12 knots. The exhaust was invisible, and there was an absence of vibration in all parts of the ship.

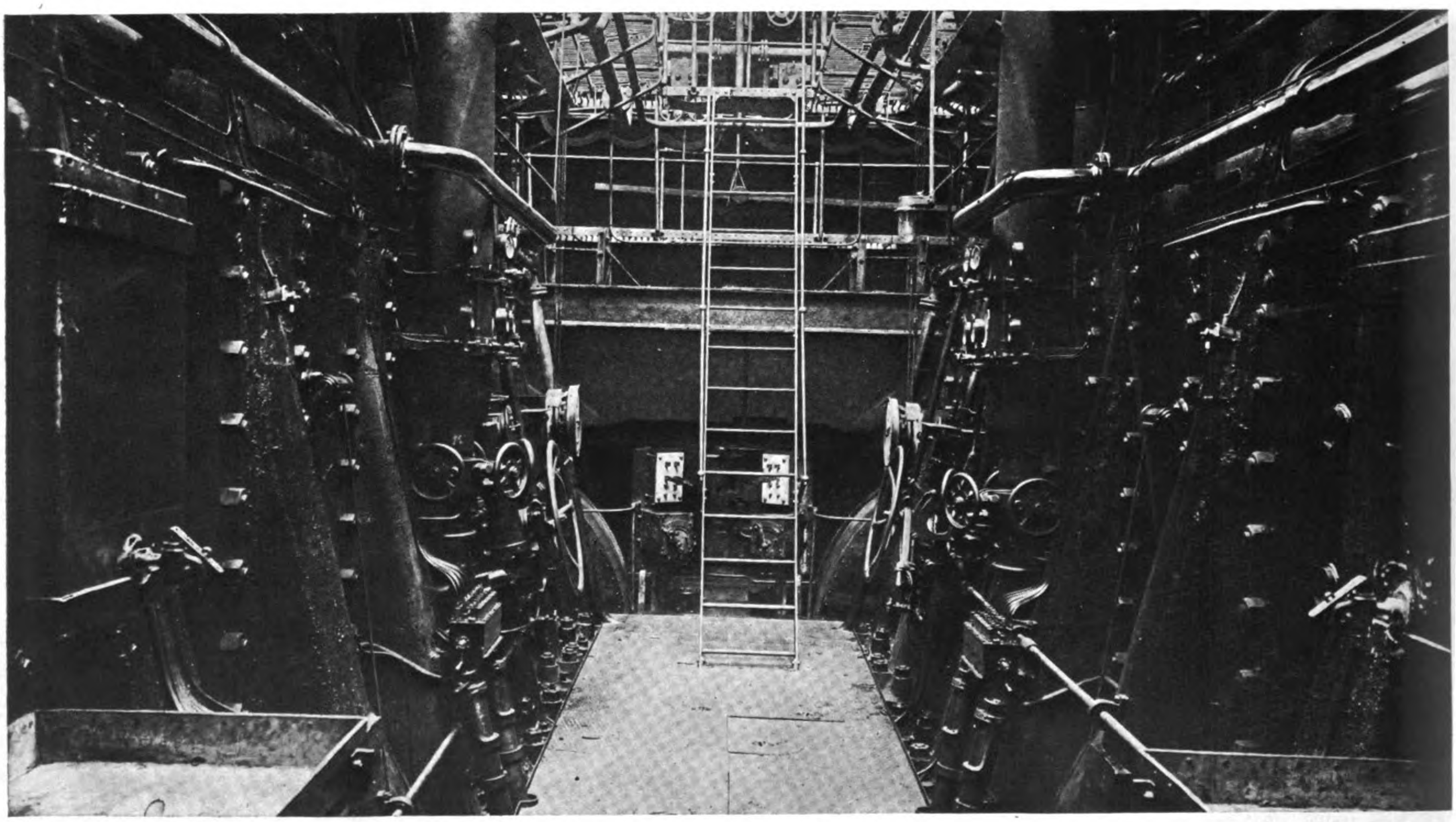
The following is an extract from the said sea trials:

	Port-Engine	Starboard-Engine
Indicated Horse-Power	1,704	1,718
B. H. P.	1,280	1,290
Mean Pressure	109 lbs. sq. in.	110 lbs. sq. in.
Revs. per minute	114	115
Fuel consumption per B.H.P. hour	0.43 lb.	0.43 lb.
Mean compression	470 lbs. sq. in.	470 lbs. sq. in.
Mean firing pressure	500 "	520 "
Injection-air pressure	1,000 "	990 "
Pressures—		
Circl. water system	10 lbs. sq. in.	9.75 lbs. sq. in.
Lub. oil system	7.5 "	7 "
Piston-cooling system	23 "	24.4 "
Temperatures—		
Circ. water outlet	42° C.	44° C.
Piston-water outlet	50° C.	52° C.
Exhaust Gases	212° C.	215° C.



One of the newly-designed twin 1,250 shaft h.p. Tosi Diesel-engines of the m. s. "Ardito"

While this new Tosi engine works upon the established four-stroke cycle, it embodies in its design and construction a number of special features of more than passing interest. The six cylinders of the engines are divided up into two groups, one of four cylinders and one of two cylinders, the latter being at the after end of the engine. This arrangement facilitates the removal in the ship for inspection or any other purpose, of the after length of the crankshaft. The vertical shaft for operating the valve camshaft is driven-off the crankshaft by spiral gears; the horizontal camshaft running along the tops of the cylinders and quite clear of the cylinder heads. The spiral



Control-floor of engine-room of the motorship "Ardito" looking aft between the two main Diesel-engines wheel on the crankshaft is mounted on the coupling between the two shafts in the usual way. These spiral wheels have specially formed teeth, making for easy engagement, and are produced by Messrs. Tosi in their own shops. The engine is totally enclosed, as is now standard practice, to permit of forced lubrication. Below each cylinder is the usual diaphragm containing a gland for the piston-rod to prevent contamination of the crank-chamber oil by any carbonized oil falling from the pistons. A feature unusual with merchant-ship engines, but found in some submarine motors, is that the induction-air for the working-cycle is drawn from the space underneath the main pistons. Any leakage of combustion gases past the main piston-rings is therefore drawn away and prevented from vitiating the engine-room atmosphere. Access to the underside of the pistons is obtained through doors at the back of the engine.

Each cylinder-head contains the usual valves for starting air, fuel admission, relief, and inlet and exhaust. The inlet and exhaust-valves are of much smaller size than normal, since both serve for the phase of inlet, and both for the exhaust. This is an unusual arangement, and is made possible by the provision of a "director," or oscillating flap-valve, situated in the cylinder-head at the back of these valves, driven from the camshaft by an eccentric and rod. This flap-valve serves to direct the air to these two poppet-valves on the inlet stroke, and to direct the combustion-gases from these valves to the exhaust-manifold on the exhaust stroke. The fact that these valves are much smaller than usual permits of a stronger cylinder-head and of better cooling around all the valve seats, as well as reducing the noise and wear of the valve-gear, since the inertia effects are minimized in proportion as the weight is lessened. These valves are opened and shut once per cycle of two revolutions, so that on the conclusion of the exhaust-stroke the valves are immediately cooled by the rush of air drawn over them by the downwards moving main piston, which air current also serves to sweep any carbon from the valve face. This arrangement is claimed by the designers to make conditions of working of these valves more favorable than has ever before been the case, as well as giving advantages by way of reducing to a minimum uneven temperature stressing of the cylinder-head itself.

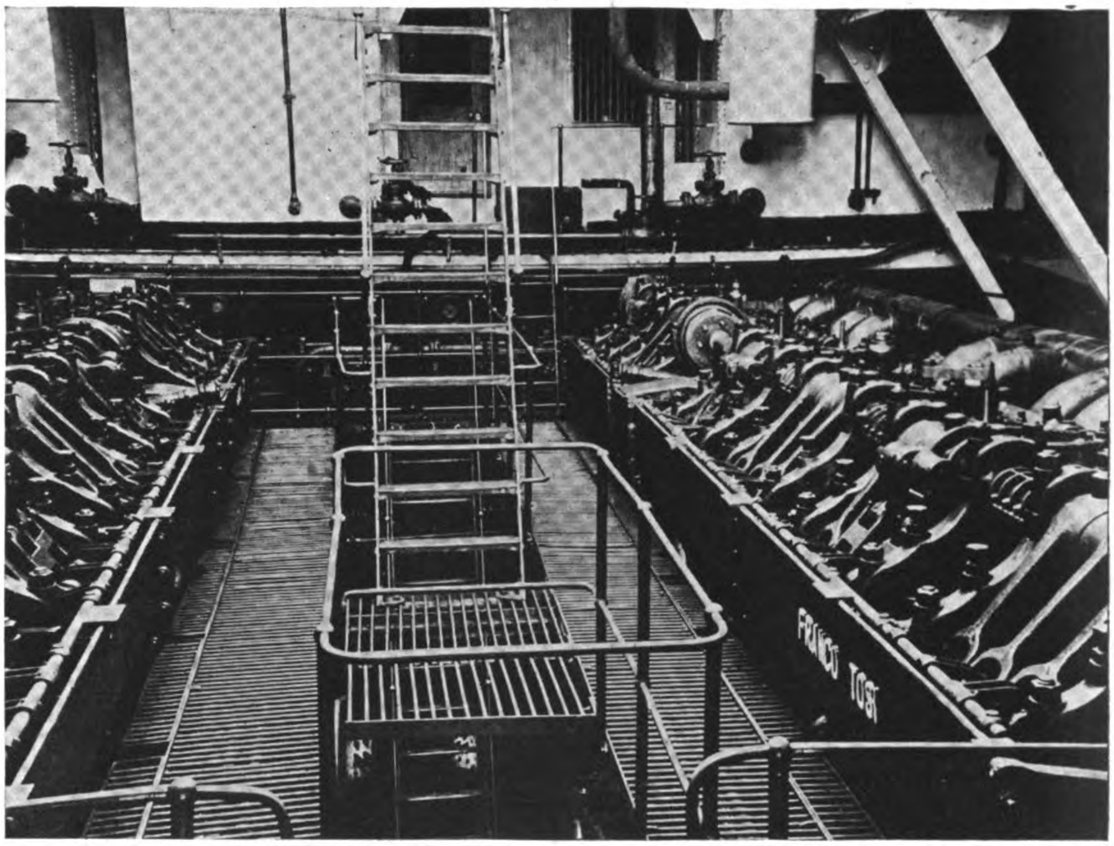
The design of the fuel-injection valve also calls for special mention, as it has no packing. The needle-valve itself is operated through an internal lever pivoted on a fulcrum. This lever serves to reverse the direction of motion to give an outwardly opening fuel-valve in the usual way, and it is operated by a small ground-plunger, the bottom of which acts as a valve. Its remoteness from the fuel precludes the leakage of oil, and in any case air can only leak for some 40 deg. out of the 720 deg. of the cycle, instead of the possibility of air and fuel leaking continuously, as may be and sometimes is the case with the normal design. In operation it is found that no air whatsoever leaks, the ground-plunger being quite effective in preventing this, and the advantage of having no gland, which is often too tightly packed, thus causing the needle to hang up with consequent burning of the valve, etc., is an important one.

There are two 3-stage fuel-injection air-compressors at the forward end of the main engine. Either of these machines is sufficient to supply the air for one main-engine; both serve when manoeuvring to recharge the depleted starting air-reservoirs.

Reversing entails two cams for the fuel, starting-air, and combined inlet and exhaust valves in each cylinder-head. The director flap-valve does not require to be reversed. Instead of moving the camshaft bodily fore and aft, as with some engines, the cam-rollers only are moved, to register either with the ahead or astern cam; the jaws of the valve-levers being widened out to permit this. A light lay-shaft directs this movement of the rollers, and this is operated by a lever movement worked by hand from the manoeuvring platform.

The manoeuvring-gear is of the "all round" pattern, and is operated by either hand or power. Starting-air, injection-air and fuel are automatically cut in or out when starting or stopping; suitable locking-gear is also provided for the reversing gear, etc. The fuel-pump is placed close to the manoeuvring platform and has a separate plunger for each working-cylinder.

The auxiliary machinery in the engine-room is principally electrically driven. Two auxiliary Diesel-dynamo sets each of 120 b.h.p. supply the necessary current. For manoeuvring purposes, etc., a twin electric motor-driven auxiliary air-compressor is installed; whilst as an emergency compressor a small steam-driven unit is fitted. Two circulating-water pumps each of 110 tons per hour, and two lubricating-oil pumps, both electrically driven, supply the main engines, one of each being a "stand-by" pump. The fuel-service pump, also a 40-ton bilge-pump, are driven off the end of the crankshaft; the "stand-by" pump for fuel service being of the semi-rotary hand type. Electric heaters are also used for warming the cabins and living quarters. Two small donkey boilers supply the steam for the deck winches, the steam-driven emergency compressor before mentioned, and a pump for filling the bunkers with fuel.



Upper platform of engine-room of motorship "Ardito," showing valve-operating mechanism

DESCRIPTION OF THE "PRIMULA"

As regards the smaller Tosi Diesel-engined ship, she is named the "Primula" and is of 3,600 tons d.w.c. Her owner is Edward Mazza, of Savona, Italy, and she was built by the Cantiere G. A. F. Migliardi, also of Savona. She is distinctive as being the first Diesel-engined freighter constructed in Italy on the Isherwood system of hull construction. Her engines differ from the engines of the "Ardito" in that they were built to the design of the Tosi cross-head engine previously described in "Motorship" and were constructed at the Legnano plant of Franco Tosi. Two 6-cylinder engines of the four-cycle type having 430 mm (16.929 in.) bore by 670 mm (26.378 in.) stroke are installed. Each develops 500 shaft h.p. at 165 R.M.P., or 600 shaft h.p. at 180 R.P.M., giving a total of 1,000 to 1,200 shaft h.p. to propel the ship.

The dimensions of the "Primula" are as follows:

Deadweight-capacity	3,600 tons.
Length (B.P.)	290 ft.
Breadth	41 ft. 4 in.
Depth	19 ft.
Power	1,200 shaft h.p.
Trial Speed	12 knots

Similar to the "Ardito" her propelling-machinery is placed aft following the practice of many other Italian motorships. Also, the auxiliary equipment is chiefly steam-driven—two Cockran boilers being installed in a compartment abaft the engine-room. Condensing plant for the steam-driven equipment is installed in the engine-room. Fuel-tanks of the ship have a capacity of 135 tons, while 7½ tons of lubricating oil can be carried.

On trials of the ship a speed of 12-knots was attained at 180 R. P. M., while reversing of the engines from full-ahead to full-astern was carried out in twelve seconds. Complete freedom from vibration and clean exhaust were features of the trials.

As is well-known to readers of "Motorship" many Diesel-engined merchant-vessels have been completed by Ansaldo-San-Giorgio for Italian ship-owners and a considerable number are still under construction. So the advent of these Tosi engined ships will be of quite a little importance. The bid now being made by Italy for her just share of the world's ocean-freightage is well known. In doing so she has wisely adopted the economical heavy-oil burning, internal-combustion engines for the propulsion of her ships.

PROPOSED 20,000 TONS WORLD TRADE-EXHIBIT MOTORSHIP FOR GREAT BRITAIN

Big Twin-Screw Diesel-driven Vessel

Apropos of the project of the Anderson Overseas Corporation of New York, to send the steam-driven liner "St. Louis" on a World Trade Cruise as a U. S. manufacturers-exhibit ship, plans have been gotten-out in England by British Trade Ship Ltd. to specially build a 20,000 tons-gross Diesel-engined motorship and send her on an eighteen months cruise of 43,000 nautical-miles to 34 important trade centres. Twin eight-cylinder Diesel engines will be installed aft, allowing the major part of the hull to be given over to the exhibit.

It is expected that she will sail from the River Thames in the summer of 1923, and after 358 days will sail for her home port. Four decks will be devoted to the exhibition proper. On the other decks, besides the numerous cabins set apart for the trade representatives who will undertake the journey, there will be provided a large reception hall, offices, an inquiry bureau, a bank, an insurance-office, interpreters'-offices, telephone-exchange, writing-rooms, a restaurant, a cinema for exhibition purposes, a library and other rooms.

The ship, which will be named "British Trader" has been designed by Swan, Hunter & Wigham Richardson Ltd. of Newcastle-on-Tyne, Sir G. B. Hunter being vice-president of the operating company. Among the directors are the Duke of Northumberland, Commander R. W. Day, Major G. P. Denton, Sir Maxwell Hicks, Messrs. J. W. Beaumont Pease, Noel E. Peck, T. E. Thirlaway, and Edmund Hill.

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MOTORSHIP

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THE DIFFERENCE

Many years ago the old British steamship-building firm of Yarrow Ltd., acquired a license to build Diesel-engines, but they did little more than carry-out some experimental work. Almost simultaneously with their recent announcement that they will completely shut-down their big Clyde shipyard on November 1st came the news that an order has been placed with the Tyne Iron Shipbuilding Co. of Newcastle, for a 10,350 tons d. w. Werkspoor Diesel-driven motorship. (See our last issue.) This is a significant indication of the trend of the times. Shipbuilders must advocate the economical oil-engine or go under!

THE SHIPPING BOARD AND MOTORSHIPS.

"Almost daily the Shipping Board is in conference and the question of Diesel-engines and Diesel-electric drive for ships in the American Merchant Marine is discussed at nearly every meeting," said one of the Commissioners of the Board to a MOTORSHIP representative during a recent interview. The Commissioner in question furthermore stated that he was almost daily in conference with engineers from the various Diesel-engine building companies, as well as with engineers or firms constructing electric-drive, and to all these men the Board has given problems to solve. One firm of Diesel-engine builders had completed their work and the only objection was the question of price. Our representative was given to understand that the Board is prepared to instal the type of engine which will prove the most economical in operation, and the data upon which they will form their opinion *is now being prepared.* "Operating results of the 'Eclipse' equipped with turbine-electric drive," said the Commissioner, "are now in the hands of the Board, and will be compared with the Diesel motorship 'William Penn' after she has completed her first voyage, the Board being very pleased with the results of the trials of the 'William Penn.'"

Surely the time has arrived for more action and less discussion. For four years the Board has been considering Diesel power, but nothing of note has been accomplished to date. There is absolutely no need to wait for the results of the maiden-voyage of the "William Penn," which is a long-distance one and will take nearly six months. Operating records of motorships, which are practically duplicates of the "William Penn" are available in our pages and elsewhere and are now a matter of common knowledge. To wait for the Board's motorship to return to the Far East is a waste of valuable time and seems to afford an opportunity to the Board of making another delay in carrying-out a businesslike motorship program. What is the matter with the complete report of the Far East voyage of the motorship "George Washington" made by the Board's own engineer, but pigeonholed because in its plain discussion of the facts it showed overwhelming advantages in favor of Diesel-drive compared with steam? Chairman Lasker could refer to this excellent report. Does the Board also know that there are 63 motorships aggregating 191,290 h.p. in service fitted with exactly the same design of Diesel-engine as installed in the "William Penn"? Some Diesel-engines for 5,000 tons ships were built by the Board two years ago. Several of these sets have been purchased by private shipowners from the Board and have given splendid service. Why is the Board making no use of the balance of these engines? Is the Board waiting for the "William Penn" to return from the Far East?

When the Shipping Board started its new fiscal year on July 1, the ship-construction program was about 90 per cent completed. On that date, the shipbuilding position was as follows:

	No.	Deadweight tons
Keels to be laid	0	0
Ships on ways	4	48,000
Ships outfitting	20	228,800
Ships delivered	2,288	13,359,911

Of the foregoing total of 2,288 ships aggregating nearly thirteen-and-a-half million tons, but one vessel is a Diesel motorship and she has just started on her six months' maiden voyage. To think that there is but a solitary motorship in all this fleet and that the Board proposes to wait until her return before deciding what they shall do! To be candid, the matter is a national disgrace and, as stated above, it is time discussions were stopped and definite action taken. Conversions and scrapping of existing steamships must be done now while they are not needed in service, and while our shipyards are closing-down for want of work.

FOREIGN MOTORSHIPS UNDER-CUTTING U. S. STEAMERS FOR AMERICAN CARGOES

As forecasted in MOTORSHIP, the under-cutting in the rates for carrying American freight has been begun by foreign motorships. From many recent instances the following may be quoted, which information was given us by a firm in New York who lost-out, as their bid was too high—although lower than others. During the middle of September the freight rates from Hampton Roads to Rio de Janeiro were quoted at $3.50 to $3.70 per ton. But the Danish Diesel-driven motorship "California" was fixed for 9,000 tons of coal at $3.25, under-cutting all U. S. steamer bids. Although steamships can generally be fixed slightly below the market quotation, a cut of this extent is very unusual to-day. Because of her very low operating-costs due to economical Diesel power, the motorship "California" will carry this cargo at a profit, and doubtless will take a cargo of grain from the Argentine back to Europe.

VERBUM SAT SAPIENTI

A contemporary devoted chiefly to general shipping and noted for its outspokenness, namely, "Nauticus", comments upon the lack of adequate advertising by the American shipping industry, and in its issue of August 27th says:

> "One of the great sins of omission in connection with American shipping is the failure to understand the value of advertising. Manufacturers of headache pills and ladies' garters have made the world believe that Americans are great advertisers. However, compare what is being done by European shipping and engineering firms in the line of advertising with similar efforts by their American competitors and it will be seen that the advantage is with the Europeans who are thus able to creat a bias in their favor amongst the international public to whom their names are almost household words."

We concord with "Nauticus" to the extent that at least part of American shipping fails to appreciate and understand the true value of advertising in its various forms. One day shipbuilders, shipowners, engine-builders, oil companies and marine equipment manufacturers will realize the imperativeness of supporting the leading domestic marine publications and co-operating with them in their efforts to keep the American flag on the High Seas. Advertising plays its part in this.

Take the conditions of to-day. Shipbuilding, marine-engineering, ship-operating and fuel-oil marketing all over the World are passing through a period of business re-action previously unknown in these four allied industries. Yet, in their own markets as well as in this market the shipping industries of the other Hemisphere are advertising to a far greater extent than they did before and during the war and immediately following the War, knowing that shipowners now have time to study their publicity, and that prestige must be maintained during slack periods.

If American firms continue to eliminate proper publicity while a number of important British and other European firms are far more active, what can they expect when shipowners once more are in the market for propelling and auxiliary units and accessory equipment.

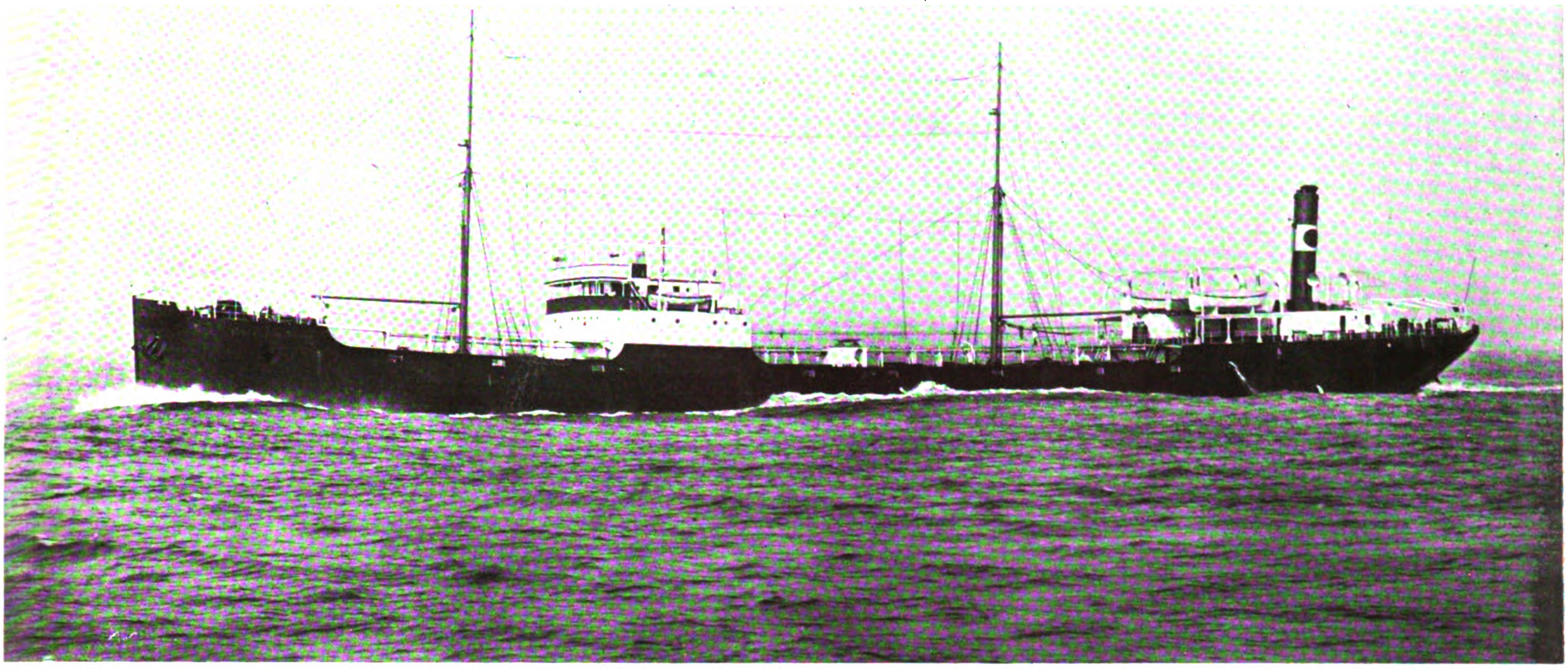
Obviously there is such a thing as false economy, especially where advertising is concerned. Prestige once lost or forgotten is hard to regain, particularly if superceded in the public mind by other products.

FUEL-CONSUMPTIONS OF MOTORSHIPS.

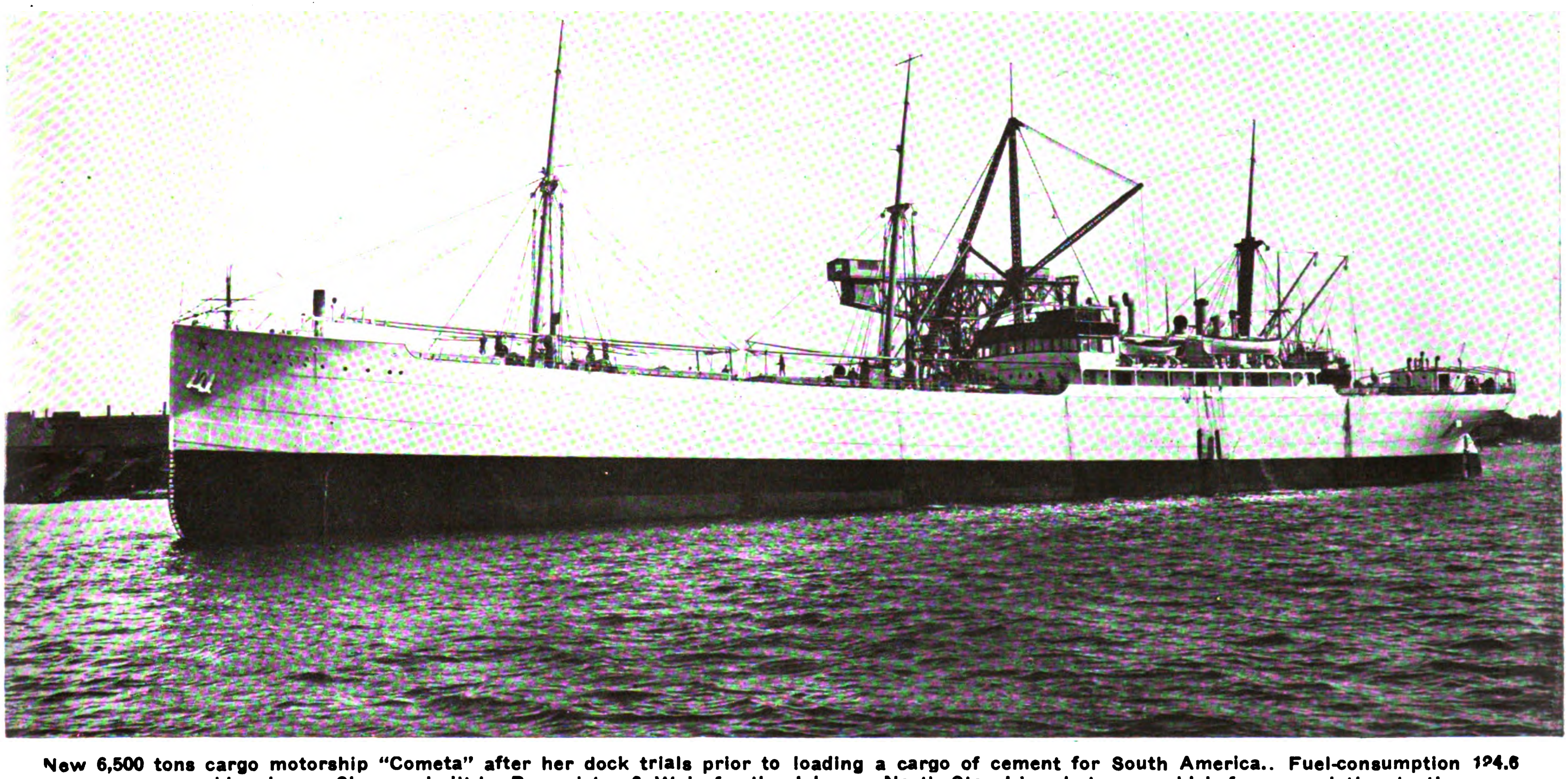
When consulting-engineers and shipbuilders more or less unfriendly to the Diesel-engine propulsion base their operating comparison costs (which they make on the behalf of shipowners) on correct average actual consumptions of existing motorships, this type of merchant-vessel will take another rapid advance in America. It was revealed in the recent discussion on Messrs. Metten & Shaw's paper before the Society of Naval Architects that several well-known steam engineers claim that the fuel consumptions of motorships are 0.45 lbs., 0.515 lb. per shaft h.p. hour, and 0.37 lb., 0.43 lb. and upwards per indicated h.p. hour, with the result that the final figures furnished to their shipowner clients are inaccurate and misleading. Attention of these engineers is drawn to the fuel-consumption of the Shipping Board's new motorship "William Penn" on her loaded sea trials reported elsewhere in this issue. An average speed of 11.77 knots was attained on a consumption of 13.6 tons of Diesel-oil per 24 hours for all purposes. According to the power developed this figured-out at 0.308 lb. per indicated horse-power hour. This is only about one-fourth the consumption of the average consumption of the Board's oil-burning steamer fleet.

While a Thousand American Steamships Lie Idle

An Unusually Large Number of New Diesel Motorships Have Just Completed Trials, Many of Which Are Illustrated or Reported in This Issue, Including the Two Fine Vessels Depicted Below. But, Only One Big Motorship Illustrated in This Issue is American, and She Has European Engines. When Will the Shipping Board and Private Shipowners Awake to the Change in Maritime Conditions?



Motor-tanker "Conde de Churruga" on her recent trial-run. A speed of 11.8 knots was attained by means of her twin 1,250 shaft h.p. Armstrong-Sulzer Diesel-engines. She was built for the Cia General Cie Tabacos de Filipines by Sir Wm. Armstrong Whitworth & Co., of Newcastle, England



New 6,500 tons cargo motorship "Cometa" after her dock trials prior to loading a cargo of cement for South America.. Fuel-consumption 194.6 grams per i.h.p. hour. She was built by Burmeister & Wain for the Johnson North Star Line, but was sold before completion to the Bergen Steamship Co., who own the new Werkspoor-Diesel engined freighter "Estrella" ex "Athene," the big Diesel auxiliary "Grossherzog Friedrich August," and two 6,500 tons motorships now building at Burmeister & Wain

Interesting Notes and News from Everywhere

BRITISH DOUBLE-ACTING DIESEL ENGINE

Successful trials of a double-acting Diesel engine have been run at Vicker's Works, England.

ANOTHER PAPER BY MR. BLACHE

At Gothenburg a paper on Twin versus single-screw drive was recently read by Director Blache of Burmeister & Wain.

POWERFUL WARSHIPS!

Eight new capital ships with 16 in. and 18 in. guns will be laid down by England during 1921 or 1922. The orders have been placed!

MORE HARLAND & WOLFF MOTORSHIPS

"Loch Goil," "Loch Manar," "Inverleith," "Windsor Castle" and "Montezuma," are the names of some of the new motorships completing by Harland & Wolff.

ROTTERDAM LLOYD'S MOTORSHIP

"Kedoe," is the name of the 6,500 tons d.w.c. motorship referred to in our September issue as building at Burmeister & Wain's to the order of the Rotterdamsche Lloyd Co.

WHITE SURFACE-IGNITION OIL ENGINE

To the list of surface-ignition oil-engine builders in our "YEAR BOOK" may be added the name of J. S. White & Co., Ltd., the well-known shipbuilders of East Cowes, Isle of Wight, England.

NEW FRENCH DIESEL-ENGINE

Construction of marine Diesel engines has just been commenced at the Bordeaux works of the Chantiers et Ateliers de La Gironde, which recently amalgamated with the Société Normande de Constructions Navales of Harfleur. This company should be added to the list of Diesel-engine builders in our "YEAR BOOK."

ANOTHER BRITISH MOTORSHIP

Now under construction at the yard of Charles Hill Ltd., is a 4,500 tons d.w.c. motorship to the order of Owen & Watkin Williams & Co., of Cardiff, Wales. Two North British Diesel-engines will be installed. This shipyard, it will be remembered, are also building two motorships for the British India Steam Navigation Co.

UNION STEAMSHIP COMPANY'S NEW 10,600 TONS D.W. MOTORSHIP "MAURAKI"

Reference has frequently been made in these columns to the Union Steamship Company's (New Zealand) new cargo-motorship building by Wm. Denny & Bros., Dumbarton, Scotland, and which is being fitted with twin 2,330 i.h.p. North British Diesel engines. The vessel was launched on August 24th, and was named "Mauraki." Her length is 450 ft. by 58 ft. breadth and 42 ft. depth.

PERFORMANCE OF THE "GLENAPP"

In seven months the motorship "Glenapp" of the Glen Line has covered 28,000 nautical-miles in 2,616 hrs., 56 mins. running time, on the London-Far East via Suez Canal route. One of the non-stop runs on this route is 5,160 miles. She is of 14,000 tons d.w.c., and at 11 knots speed she only burns 12.84 tons per day, or 21 tons at 12½ knots. Her maximum speed is 13 knots.

For the purpose of utmost economy she is run at 10¾ knots during present depressed trans-ocean freight conditions, effecting an additional saving of about $50.00 per day in fuel. The fuel burned is Mex-Diesel oil of 0.904 gravity at 60 degr. Fahr. Approximately every 45 days the exhaust-valves are ground in.

STERN-WHEELER FOR THE NILE

A shallow-draft motor-vessel for special survey work on the River Nile is now under construction at the Shipyard of Rennie, Ritchie & Newport Shipbuilding Co. Ltd., England, for the Egyptian Government. This vessel is of the stern-wheel pontoon type, 60 ft. long by 16 ft. breadth and 4 ft. draught. She is propelled by a 50 h.p. Plenty surface-ignition oil-engine at 300 r.p.m.

MARINE EXPOSITION AT NEW YORK

During the week of November 14th next, a marine exposition will be held under the auspices of the Marine Equipment Association of America, in the Central Mercantile Building, N. Y. C. Applications for space should be sent to the Association, Woolworth Bldg., N. Y. C.

ELDER DEMPSTER CO.'S NEW MOTORSHIPS

"Ediba," is the name of the new 10,000 tons d.w.c. motorship referred to previously as being built by Harland & Wolff for the Elder Dempster Co. of Liverpool, England. Twin 1,800 i.h.p. Harland & Wolff B. & W. Diesel-engines are being installed. The name of the new 14,000 tons 6,600 i.h.p. Diesel motorship also building for the same owners by this company has not yet been given out. Reference to their big motorship "Aba" is made elsewhere in this issue.

FATAL ACCIDENT TO J. A. PYKE

With sincere regret we note that one of our oldest subscribers and keenest readers, J. A. Pyke of Montreal, was killed on Sept. 7th at Toronto when his racing motor-boat "Claire III" was rammed and sunk by the "Leopard VI" following winning of a 20-mile race by the "Claire III." Mr. Pyke who was president of the Pyke Motor & Yacht Company, displayed much interest in "Motorship" and on a number of occasions personally purchased many copies of this publication for distribution to his business friends. We had the pleasure of meeting him on several occasions and found him of most genial and delightful personality. His firm are the Eastern Canada distributing agents for the McIntosh & Seymour Diesel-engine, and for the Gulowsen-Grei surface-ignition oil-engine.

BERGEN STEAMSHIP COMPANY ACQUIRES MOTORSHIPS

Having increased its fleet within the last six months by about 40,000 tons deadweight, the Bergen Steamship Company, of Bergen, Norway, is becoming one of the largest and most important shipowning concerns in Norway. Their success will be assisted by the fact that they are very much alive to the great efficiency and economy of Diesel-drive motorships during this existing period of low freight. Previously they have been steamship owners, but they have now added to their fleet the 6,500 tons Diesel-motorship "Cometa" now completing at Burmeister & Wain's yard at Copenhagen. This vessel they purchased from the Swedish North Star Line.

In addition they have secured the 9,700 tons d.w.c. motorship "Athene" which they have named "Estrella." This craft is fitted with twin 1,400 i.h.p. Werkspoor Diesel-engines of the latest type.

Then again, they have taken over the German training-ship "Grossherzog Friedrich August," which is a large Diesel-engined auxiliary sailing-vessel, with accommodation for 200 apprentices, as well as cargo. The power plant consists of a 600 b.h.p. Tecklenborg-Carels two-cycle Diesel-engine, which is of similar design to the engine built by the Nordberg Manufacturing Company, of Milwaukee, Wisconsin.

Furthermore, the Bergen Steamship Company have two 6,500 tons motorships on order with Burmeister & Wain. They are similar to the "Cometa."

LAUNCH OF THE MOTORSHIP "BALZAC"

At the Odense Shipyard the first of the 1,350 tons motorship to the order of Fred Olsen of Christiania was launched August 30th. She and her sister vessel were illustrated and described in our issue of March 1921, pages 217-218. Both these vessels are being equipped with the new trunk-piston type Burmeister & Wain engines similar to the two installed in the motorship "Fritzoe," now operated by Bugge & Oslon of Larvik. This engine was illustrated and described in our issue of Feb., 1921, page 119. In the case of the second ship for Fred Olson, an engine of similar type but of a little large size, namely 900 i.h.p. at 130 R.P.M. is being installed. On her vacated berth the keel was at once laid for the sister ship. The engines of the "Balzac" have a bore of 15.748 by a stroke of 29.527 and develops 450 shaft h.p. at 145 R.P.M. on a consumption of 1.9 tons per 24 hours.

TRIALS OF MOTOR PASSENGER LINER "ABA"

Recently trials were run in Scottish waters of the big motorship "Aba" ex "Glenapp," now owned by the Elder-Dempster Company, and to be placed along the West African run carrying passengers and cargo. This Diesel-engined vessel was originally built for the East Asiatic Company in 1916, but was taken over by the Glen Line during the war and employed for carrying troops and cotton between the U. S. A. and Great Britain. Recently she was purchased by the Elder-Dempster Co. and has just been converted into a passenger-liner. She is of 6,600 I. H. P. and was built by Barclay, Curle & Co., and engined by Harland & Wolff. Her dead-weight capacity if solely a cargo-ship would be about 14,000 tons.

LAUNCH OF DANISH MOTORSHIP "POLAR HAVET"

Some time ago the Atlantic Steamship Co. ordered a number of single-screw 8,000 tons turbine motorships from the new Southern yard of the Copenhagen Floating Dry Dock Co. of Copenhagen. As reported in "Motorship" they afterwards decided to arrange for the changing of one of these ships to Diesel power at considerable cost, having concluded that the economies effected in operation will soon mean a business economy. This vessel, the "Polar Havet" (Arctic Sea) was launched on August 31st and was towed to Burmeister & Wain's yard at the same port, where she is now being fitted with 2,800 i.h.p. Burmeister & Wain Diesel-engine set and standard auxiliary equipment.

SALE OF A DANISH WOODEN MOTORSHIP FLEET

Among "war babies" in Europe may be mentioned that of the "Dragor" Motorship Company of Copenhagen, which was formed in 1916 for the purpose of operating a number of small wooden motorships. These vessels were recently purchased by the Halla Company, the manager for whom is Mr. T. C. Christensen. This concern is said to be backed financially by the Diskontobank of Copenhagen. It is interesting to note the war-time value of the wooden ships of this fleet, compared with their present values as per the following list:

Vessel	Tons	Book Value Kr.	Sold for Kr.
M.S. "Drogden"	600	372,489	126,000
M.S. "Rosin"	600	574,060	81,000
M.S. "Karl"	600	372,993	29,000
M.S. "Olaf"	350	228,884	25,000
M.S. "Hans"	300	117,626	29,000
M.S. "Lynettin"	600	582,943	95,000
*M.S. "Dragor"	600	(See Foot Note)	
**M.S. "Kongedybet" .	600	....	....

*Lost in storm.

**Sold at profit of 140,000 kroner.

Nevertheless, it is also significant to note that these little wooden motorships were sold for considerably more than the wooden steamships of the Shipping Board's Fleet, which are seven times as large in tonnage per ship. The prices for these Danish wooden motorships were obtained at public auction.

PRESENT PRICES OF WOODEN MOTORSHIPS

By order of the U. S. District Court at Norfolk, Va., the sale of the wooden motorship "Trolltind" to F. S. Pendleton of New York for $3,450 was ordered "off." The U. S. Marshal had auctioned her, but the price was declared by the Court to be grossly inadequate. An upset bid of $5,000 was offered by the Colonna Marine Railway Corporation. The present day price of her twin Diesel-engines is far higher than either of the above two bids.

Recently the 1,800 tons d.w.c. Canadian-built wooden motorship "Cap Nord" powered with twin 240 b.h.p. Atlas-Imperial Diesel-engines was sold by the Wm. Lyall Shipbuilding Co. to J. H. Petersen of Birmingham for £2,000 (about $8,000). She cost about $250,000 to build.

However, in comparison with these prices it is interesting to note that the shipping Board's steam-driven wooden ships of larger tonnage which cost twice as much to build are only bringing about $2,500 each. We are glad to see that the Norfolk court decided that motorships are more valuable to-day.

[Thru pressure on space many interesting news notes have been held-over until our next issue.—*Editor.*]

Diesel-Electric Ferry for Poughkeepsie

New Winton-Westinghouse Powered Motorship Ordered for Service on the River Hudson

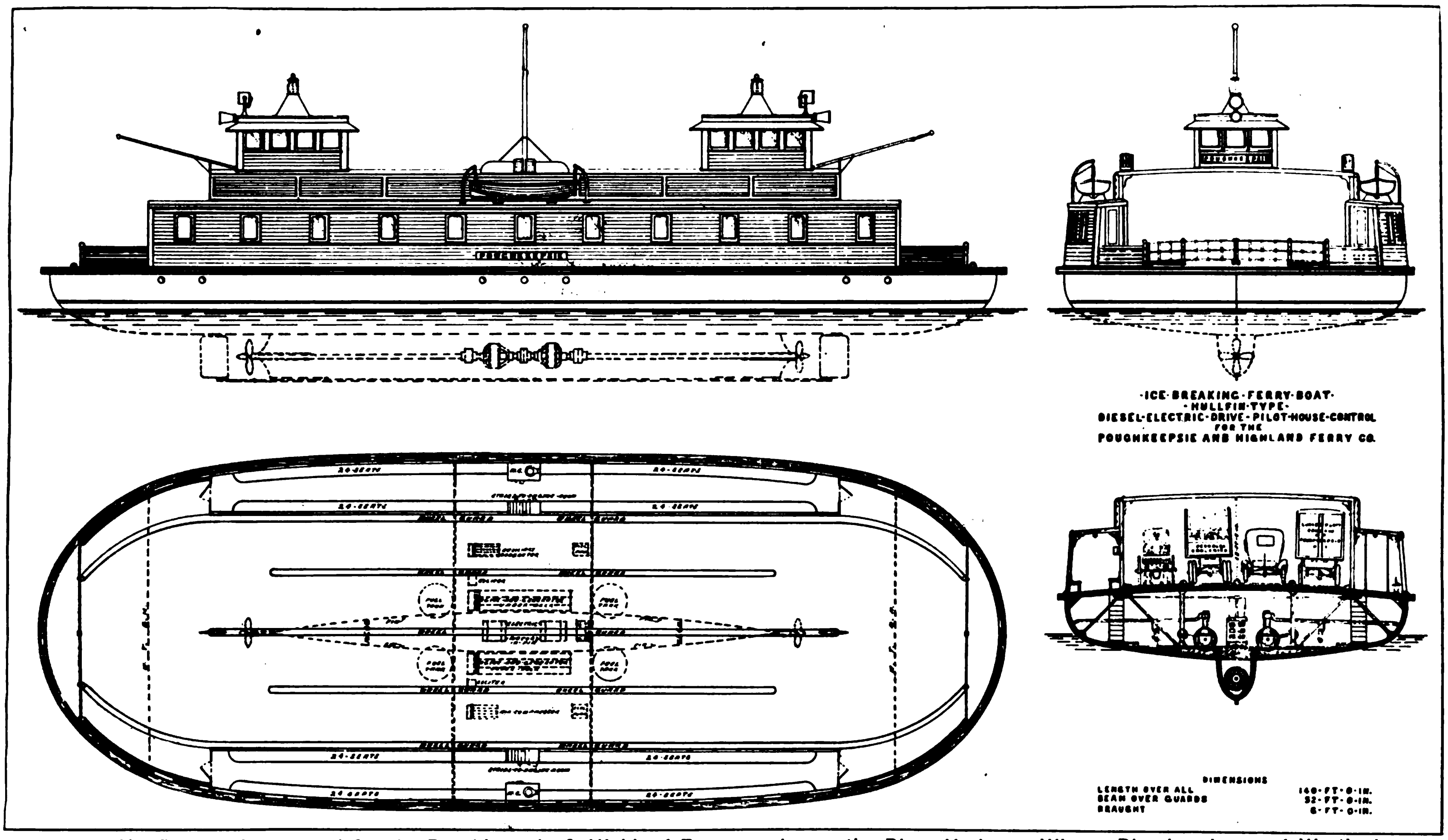
For many months a motor ferry-vessel has been under consideration by the Poughkeepsie & Highland Ferry Company for their service on the Hudson River, and recently the contract for this hull was awarded to the Atlantic-Gulf & Pacific Company, Mill Basin Shipyard, Brooklyn, N. Y. Designs of this vessel have been prepared on the "arconstruct" system by C. V. S. Wyckoff.

As yet the order for the propelling machinery has not been definitely placed, but probably the contract will be signed before this appears in print. It is proposed to instal twin six-cylinder four-cycle type Winton Diesel-engines of 150 b.h.p. at 450 R.P.M. coupled to two 90 K. W. Westinghouse D. C. generators. These will furnish current for two 100 b.h.p. Westinghouse electric-motors on the double-ended propeller-shaft, and either one or both of the motors at one time.

The ferry has the following dimensions—

Length over guards ....140 ft.
Length overall ....137 ft. 6 in.
Length of "fin" overall ....80 ft.
Breadth over guards ....52 ft.
Extreme Draught ....10 ft.
Power of Main Diesel Engines ....300 b.h.p.

The hull is shoal and broad, and is built according to the "arconstruct" or "hullfin" design similar to the canal-tug illustrated and described on page 389 of our issue of May, 1921, which by the way, has not yet been laid down. Among the advantages claimed for a ferry-boat constructed on this system is that it will accommodate twice as many automobiles as an ordinary ferry boat of the same size, on account of the fact that all the machinery is located below decks. In other words it permits four lines of vehicles instead of the customery two.



Plans of Hullfin type ferry-vessel for the Poughkeepsie & Highland Ferry service on the River Hudson. Winton Diesel-engines and Westinghouse electric-propulsion are to be installed

Some New Motorships

MOTORSHIP FOR HIGH SEA FISHERIES

Recently completed for the Hamburger High Sea Fisheries A/G was a cargo motorship 184 ft. long by 23 ft., 11 in. breadth and 18 ft., 4 in. draught. Twin Diesel-engines are fitted.

NEW GERMAN CONCRETE MOTORSHIP

Now completing at the Stoerwerft shipyard, Wewelsfleth, Germany, is a concrete motorship 183 ft., 6 in. by 28 ft., 4 in. by 15 ft., 1 in. in which a 500 shaft h.p. Diesel-engine is installed.

TWO MOTORSHIPS FOR SCHINDLER OIL CO.

Two of the 308 ft. 1,550 shaft h.p. Diesel-engined motorships building at the Deutsche Werft's Finkenwaerder shipyard are for the Schindler Mineral Oil Works of Hamburg, Germany.

LAUNCH OF FIRST HOLLAND-AMERICA LINE MOTORSHIP

"Dinheldijk," the first of the two new 14,000 tons deadweight 6,600 i.h.p. 12½ knot cargo motorships for the Holland-America Line of Rotterdam, was launched at Harland & Wolff's Govan shipyard on Sept. 1st. She is 502 ft. long by 62 ft. breadth and 38½ ft. depth and twin 3,300 i.h.p. Harland & Wolff B. & W. Diesel engines are being installed.

DEUTSCHE WERFT AND DEUTSCHE WERKE

Reference has already been made to motorships under construction at the Deutsche Werft at Hamburg. But, motorships and Diesel-engines are also building at the Deutsche Werke at Kiel-Friedrichsort (Bay of Kiel), Rustringen, Germany, which we believe is quite distinct from the Hamburg concern. The plant at Kiel is the old German Admiralty's navy-yard.

BLOHM & VOSS MOTORSHIPS

Regarding the four Diesel-engined cargo motorships building for the Hamburg-American Line at the Blohm & Voss shipyard, Hamburg. They have the following dimensions—

Length	Breadth	Depth	Stage of Completion
450	58	37½	55%
450	58	37½	40%
447	58	37½	6%
447	58	37½	2%

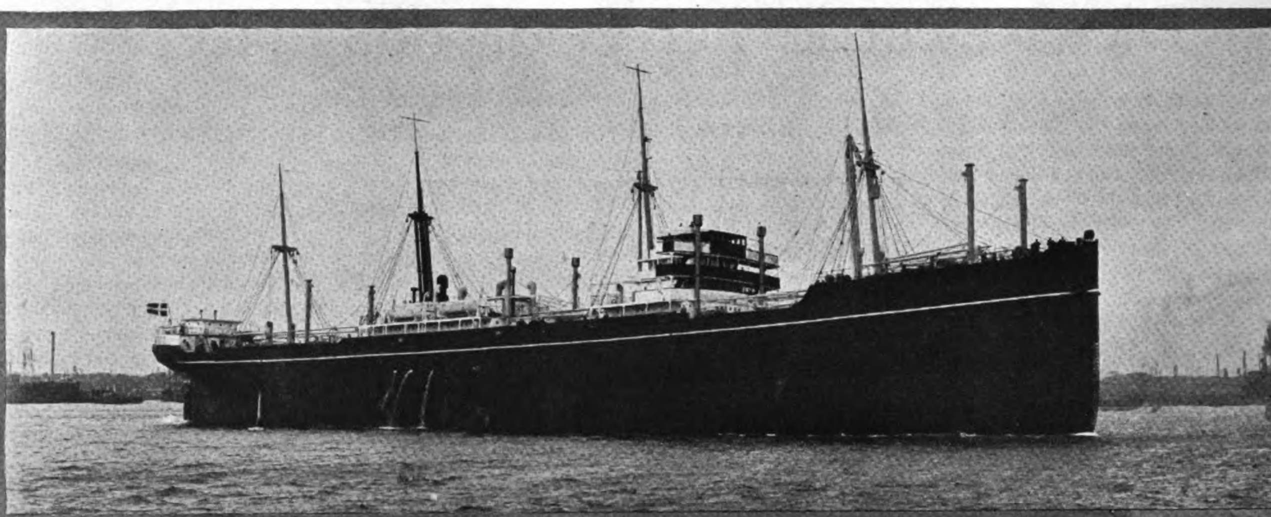
It is reported that the Diesel engines will be of the double-acting two-cycle type. Two 398 ft. Diesel-engined motorships are also building for the Hamburg-American Line at the Deutsche Werft, Finkenwaerder. Four-cycle, single-acting engines are being fitted.

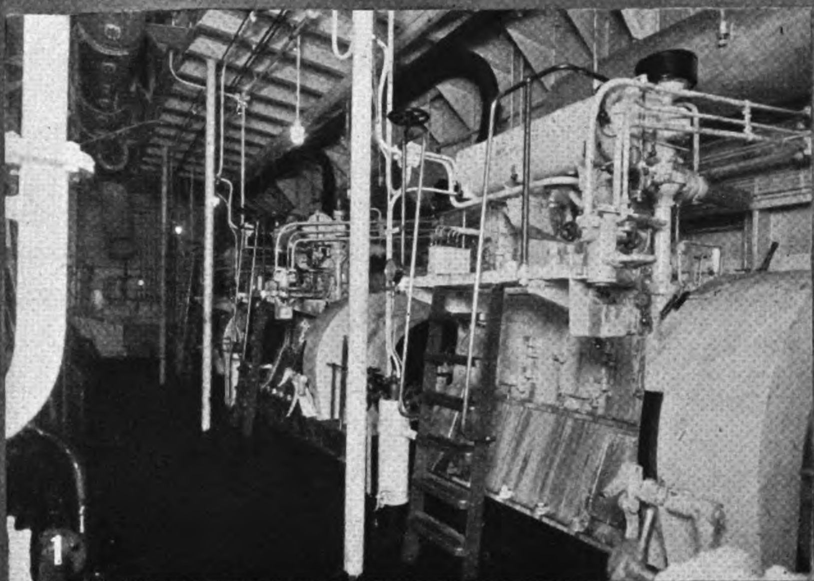
FURTHER DETAILS OF THE M.S. "LOCH KATRINE"

The Royal Mail Steam Packet Co.'s first new big motorship "Loch Katrine" (announced in our September issue as having been launched at John Brown & Co.'s Clydebank shipyard) has the following dimensions—

Displacement ....19,000 tons
Deadweight Capacity ....14,000 tons
Gross Tonnage ....9,000 tons
Cargo Capacity, Fruit....................1,500 tons
Cargo Capacity, General....................9,500 tons
Total Cargo Capacity (not including bunkers), 11,000 tons
Passenger Capacity....................12 first-class
Power ....6,600 i.h.p.
Speed (loaded) ....12½ knots

She has fourteen electric-winches, six being of the McFarlane-Pirrie 40 tons type, first illustrated in our issue of November, 1920, in connection with our exclusive article on the Pacific Steam Navigation Co.'s (a subsidiary of the R.M.S.P. Co.) motorship "La Paz," at which time we were privileged to make the first announcement regarding the "Loch Katrine" and her forth-coming two sister motorships. The "Loch Katrine" and her two sister motorships will be operated in conjunction with the Holland-American Line's 14,000 tons motorship "Dinheldijk" and her sister motorship, between the Pacific Coast of America to Europe carrying American products.

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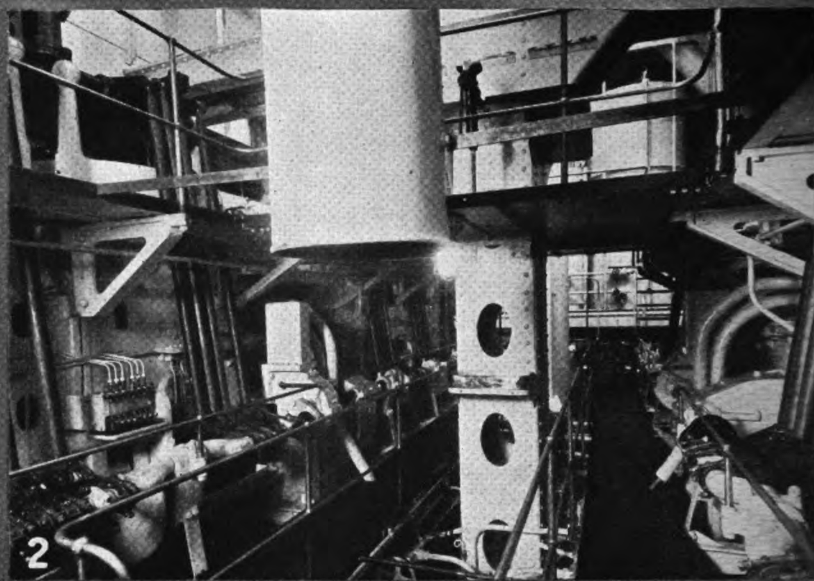
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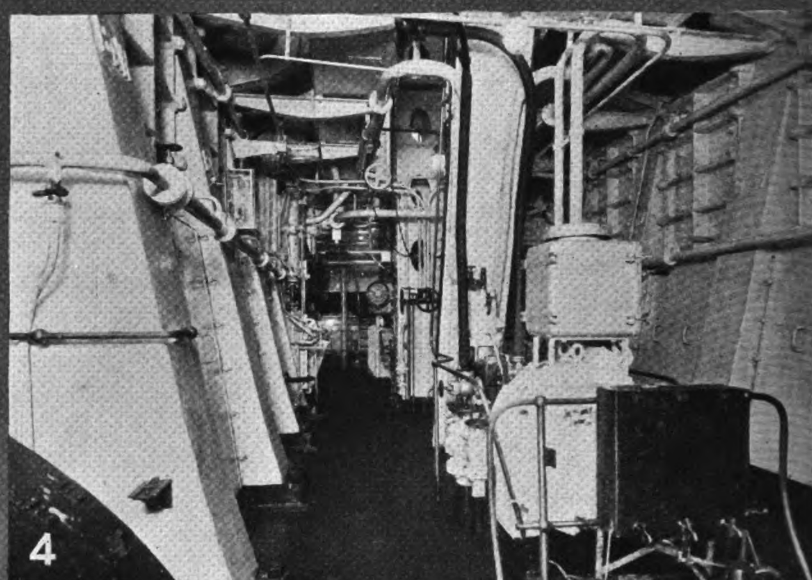
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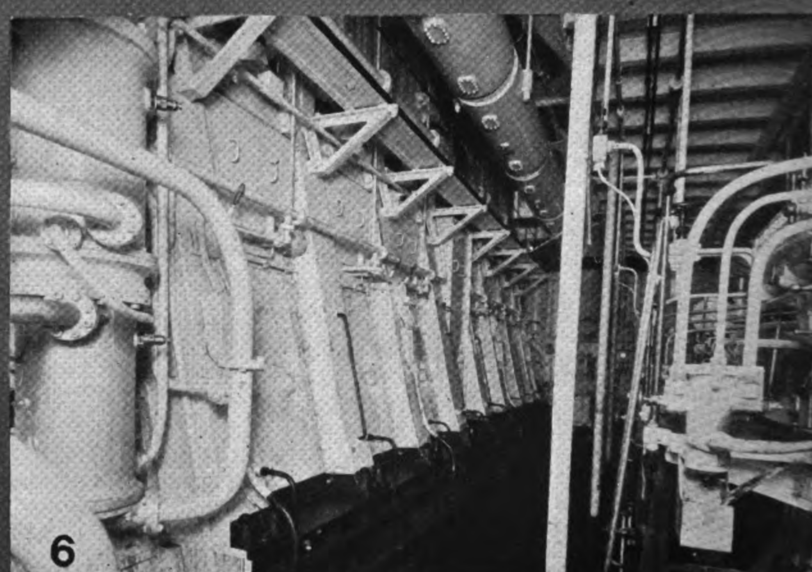
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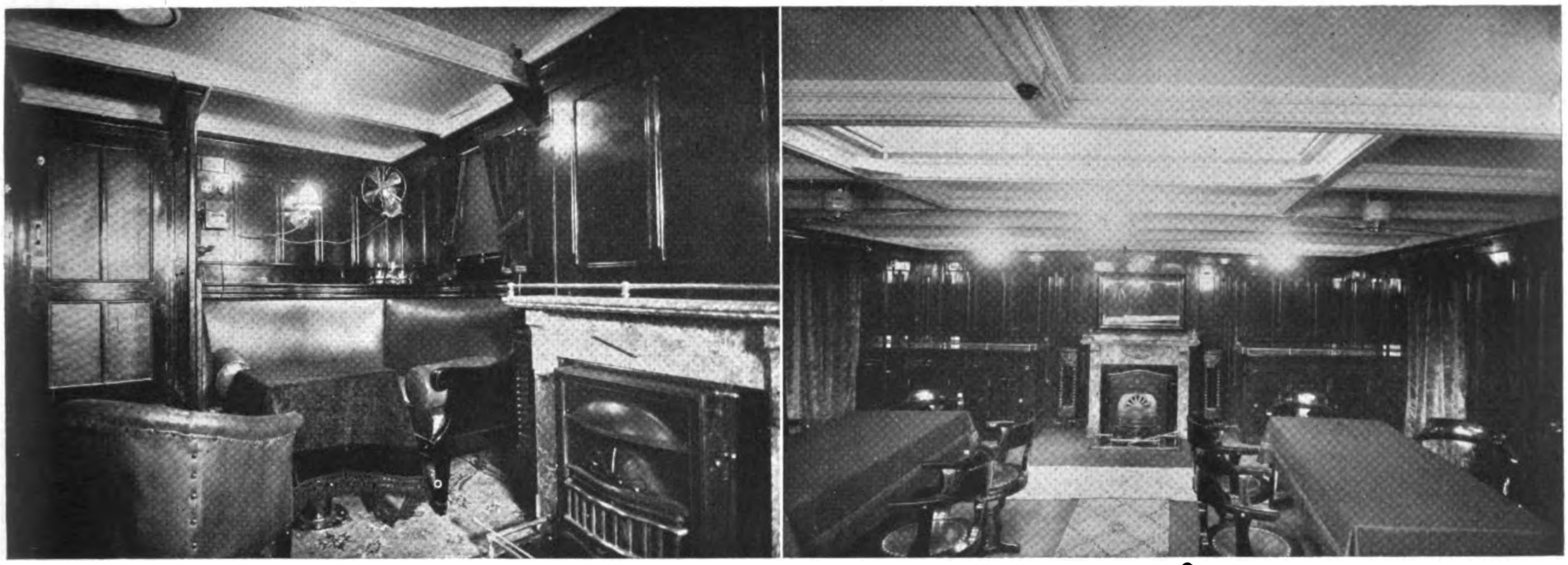


Smoking-room and dining-saloon of the Werkspoor Diesel-engined cargo motorship "San Paulo," illustrating the class of accommodation to be found where a few passengers are carried

NEW MOTORSHIP "MALAYA"

In previous issues we referred to the motorship "Malaya" built for the East Asiatic Company of Copenhagen by Burmeister & Wain, which recently ran trials. She is a vessel of 13,500 tons d.w.c. and of 4,500 I. H. P., so is of considerable importance. Furthermore, she is a sister vessel to the motorship "Afrika" placed in service in March of last year, and her propelling machinery is similar to that in stalled in the Shipping Board's vessel "William Penn." The principal dimensions of the "Malaya" are as follows:

Loaded displacement	19,000 tons
Net cargo-capacity (when fully loaded with general cargo and fuel for 20,000 miles, water, storage, etc.)	12,350 tons
D. W. C.	13,500 tons
Cubic capacity	700,000 cu ft. grain or 600,040 cu. ft. of bales
Length (O. A.)	464 ft., 6 in.
Length (B. P.)	445 ft.
Breadth (O. F.)	60 ft.
Breadth (A. D.)	42 ft.
Depth (U. D.)	33 ft., 3 in.
Depth (L. D.)	23 ft., 3 in.
Loaded draught	32 ft.
Fuel-capacity	1,472 tons
Cruising radius (maximum)	30,000 nau. miles
Gross tonnage	9,050 tons
Fuel-consumption	13 to 14 tons per day
Loaded speed	12 knots

She is a four-masted vessel and has 20 electric-winches installed by the A. S. E. of Vesteras, which is the Swedish General Electric Company. One of the derricks is of 50 tons capacity, another one of 30 tons, twelve of 5 tons and eight of 2 tons. Her steering-gear is of the hydraulic-electric type constructed by John Hastie & Co., of Greenock, Scotland. The windlass is also electrically driven.

In addition to the large amount of cargo that can be carried, excellent accommodation is provided for twelve passengers in the deck-house beneath the bridge. Accomodation for the crew is aft and arranged for two men per cabin. Her propelling machinery is arranged amidships and consists of two 6-cylinder four-cycle type Burmeister & Wain reversible Diesel-engines of the crosshead type developing together 4,500 I. H. P., the cylinders having a bore of 29.134 in. by 45.178 in. stroke.

It is interesting to note that on the trials an average speed of 13.1 knots was maintained with the ship light, displacing 6,180 tons. When averaging this speed the engines were together developing 4,585 I. H. P. with a fuel-consumption figuring out at 14.8 tons per 24-hour, or 135.3 grams per I. H. P. hour. The draught forward was 17 ft., 5 in. and 15 ft., 9 in. aft.

Her auxiliary machinery follows the usual plan with vessels of this class, namely, there are three 100 b. h. p. four-cycle B. & W. Diesel-engines each driving a dynamo of 66 K. W. 220 volts, furnishing power for all the engine-room auxiliary machinery, the electric steering-engine, windlass and winches. For lighting the ship the current is transformed to 110 volts by means of a rotating transformer. There is also an emergency electric-lighting set. Electricity is also used for driving the refrigerating machinery which is of the Sabroe type, described and illustrated in "Motorship" some months ago. For heating purposes there is a small donkey-boiler with a surface-area of 100 sq. ft. On July 16th the "Malaya" left on her maiden voyage for the Far East.

LAUNCH OF MOTORSHIP "HANDICAP"

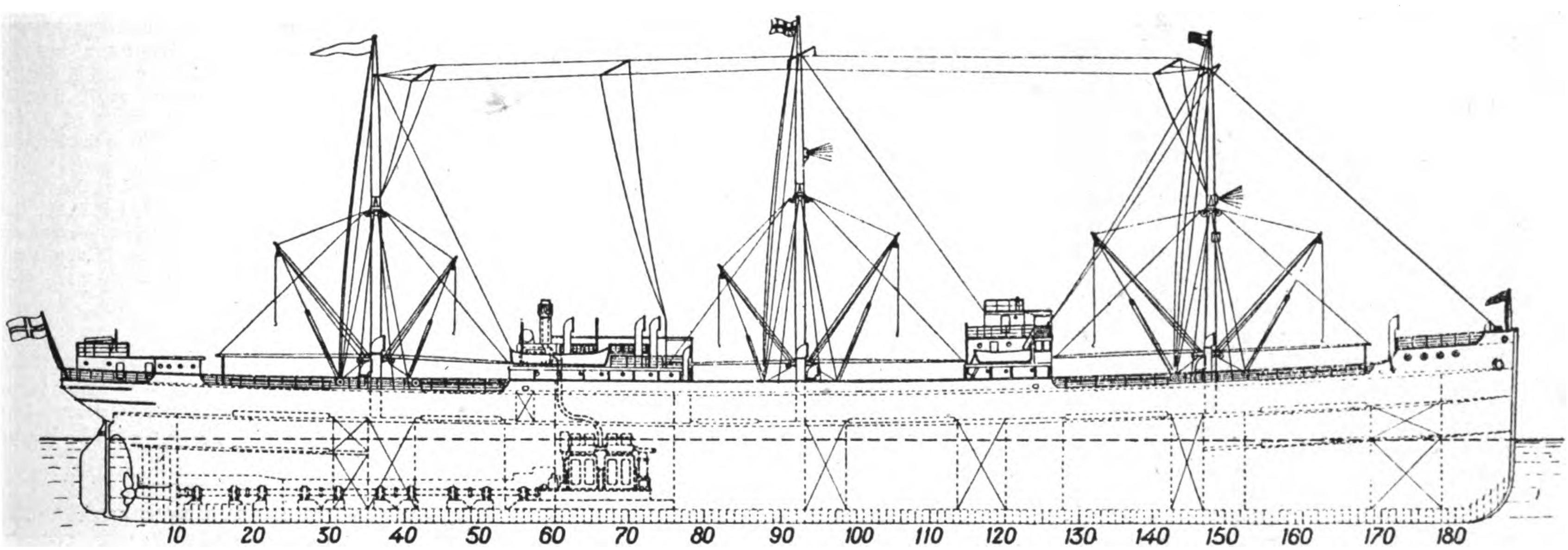
On the 4th of August the 9,000 tons motorship "Handicap" was launched to the order of Bruusgaard, Kiosterud & Co., Dramen, and it is expected she will be ready for her trials during November. This vessel is of 9,000 tons d.w.c. and is equipped with twin 1,600 shaft h.p. Sulzer two-cycle Diesel-engines. She is notable as being the largest motorship constructed in Norway. Originally she was contracted by Olsen Bros. of Stavanger, but afterwards taken over by her present owners.

ANOTHER SWEDISH MOTORSHIP

"Josef Bergendorff," a motorship of 1,150 tons d.w.c., has just been completed at the Bergsunds Shipbuilding Yard near Stockholm to the order of the Stjarnen Shipping Company of Karlstads. She is propelled by a 500 shaft h.p. oil-engine giving her a speed of nearly 9 knots when fully loaded. Her construction is to the Norwegian Veritas classification.

LJUNGSTROM COMPANY ABANDONS TURBINE-ELECTRIC DRIVE

It may interest you to know—writes a well-known Swedish engineer—that one of the first turbine manufacturers in Scandinavia who used electric transmission, the Ljungstrom Steam Turbine Company, recently abandoned the electric drive on account of its low efficiency, and installed mechanical-friction clutches, using friction disks for reversing and power transmission. Such friction clutches would of course be subjected to far more severe stresses in connection with a Diesel-motor with its varying turning effort than with a uniformly running steam turbine.



"Handicap," the 9,000 tons motorship with twin 1,350 b.h.p. Sulzer Diesel-Engines building at the Rosenburg Shipyard for Bruusgaard & Kjosterud of Dramen. She was launched on August 4th, 1921

Injection and Combustion of Fuel-Oil

Experiments with Solid-Injection and Air-Blast in Marine Diesel Engines

By ENGINEER-COMMANDER C. J. HAWKES

PART VI

(*Continued from page 655, August issue*)

At mean indicated-pressures at and above 110 lbs. per square-inch, the experimental engine running at 380 r.p.m., smokeless combustion could not be satisfactorily obtained with the solid-injection system and as it was desirable that higher mean indicated-pressures should be developed, it was decided to experiment with the air-injection system. The ordinary air-injection valve will be referred to later, but it is proposed briefly to refer, at this stage, to a valve which may be regarded as a combination of the air- and solid-injection systems.

In the ordinary air-injection valve the fuel is forced into the fuel-valve casing against the pressure of the injection air, but no advantage is derived from the pressure to which the fuel-oil is subjected. In the modified valve the oil is sprayed in the manner common to solid-injection systems; but inside the cylinder it meets a jet, or jets, of air so that the distribution is thereby improved. It was hoped that by the use of such a valve a smaller quantity of blast-air would be required than is necessary with the ordinary air-injection valve. Further, in the event of the air-compressor failing the engine would be able to run at a slightly lower power satisfactorily on solid-injection alone. Various valves were tried based on this principle, both with the air-jets surrounding the fuel-jets and also with the fuel-jets surrounding he air-jets, but it is not possible within the limits of this treatise to refer to more than one valve which has given promising results when using shale fuel-oil.

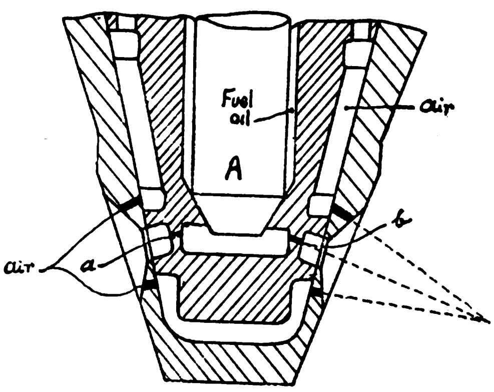


FIG. 14.

Fig. 14 shows diagrammatically a section of the sprayer end of the valve. A is lower end of the automatic-valve and the fuel-oil passes into the combustion space through the small holes *a*, *b*, etc., when the valve is lifted. Four air-holes surround each fuel exit, so that four small air-jets meet the fuel-spray in the combustion-space at a small angle. In the experimental engine an air-valve operated by a separate cam controls the supply of high-pressure air to the air channels shown. This arrangement was made to facilitate experiment, but it is probable that in a valve of this type for naval use one cam would be used for controlling the admission of both air and fuel. The engine can be started on the solid-injection system alone, and therefore it is possible to employ a lower compression-ratio than would suffice to ensure an easy start from the cold condition with the ordinary air-injection system in use,

It has so far been found that with this valve smokeless combustion can be obtained with a mean indicated-pressure of just over 130 lbs. per square-inch—the experimental engine running at 380 r.p.m. The consumption of blast-air is slightly less than with the ordinary air-injection valve. The fuel-consumption at about 130 lbs. means indicated-pressure, using shale-fuel-oil, is just under 0.41 lb. per b.h.p., but as the air-compressor is driven by an electric motor this does not take into account the power required to supply the blast-air. The valve combining the solid- and air-injection systems has some advantages over the ordinary air-injection valve, but it undoubtedly involves greater complication. Experiments are being continued and the question of its adoption will, of course, depend upon the results obtained after prolonged trials.

When using the ordinary air-injection system for developing comparatively high mean-pressures in high-speed engines it is necessary to use a distributor provided with holes so that a number of small jets are produced. Fig. 15 shows the lower end of a fuel-valve designed for a 20-inch by 20-inch experimental four-stroke cycle engine. The number and size of the holes in the distributor to give the best all-round results is a question of trial. The angle of the holes, as in the case of the solid-injection sprayer, is largely dependent on the shape of the compression space.

A few details of tests carried out with various fuel-valve distributors in a single-cylinder opposed-piston two-stroke engine may be of interest.

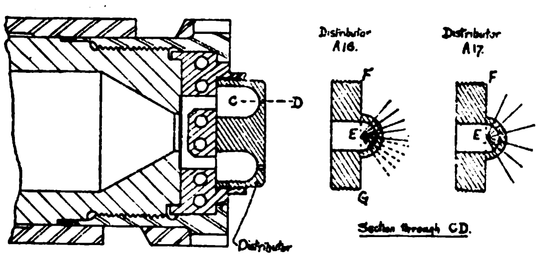


FIG. 17.

This engine was designed and constructed by Messrs. William Doxford and Sons, Sunderland, originally for their own use, but before the engine had been run it was transferred to the Admiralty Engineering Laboratory. The engine follows the firm's usual design and has a cylinder diameter of 14.55 inches and a combined stroke of 28.3 inches. It is fitted with two water-cooled fuel valves. The double-acting scavenge pump and four-stage air compressor are driven from two cranks on an extension of the engine shaft. The scavenge pump and compressor were made larger than necessary for ordinary running, for the purpose of supercharging experiments at a later date, and consequently this reduced slightly the mechanical efficiency of the engine. During the tests referred to in this paper the engine, owing to the lay-out of the Laboratory, exhausted into a pipe 180 feet in length. [This engine was referred to in the treatise by Commander Hawkes previously published in "Motorship."—*Editor.*]

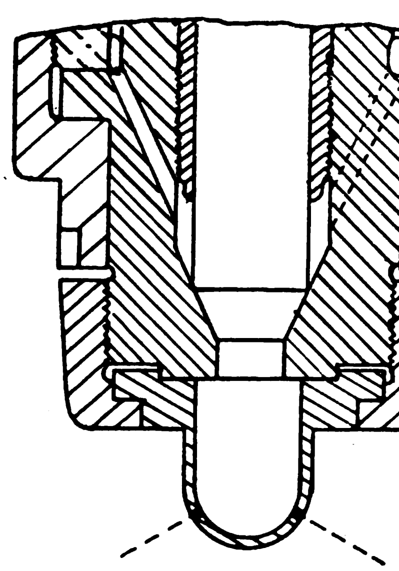


FIG. 15.

The sprayer, or distributor, of each fuel-valve as originally designed was provided with two narrow slits intended to give horizontal fan-shaped sprays. The centre line of each spray was about ½ inch from the top of the adjacent piston—the distance between the pistons at the end of compression being about 1.75 inches. A number of tests at various powers were carried out with the original distributors shown in Fig. 16 with various shapes of cams, etc., and it was found that the fuel consumption at the higher powers and speeds increased rapidly with an increase in mean-pressure.

From the experience gained with the experimental 14½ inches by 15 inches four-stroke engine it was clear that fuel-sprays having a comparatively large surface were not satisfactory, as when working at high speeds and high mean indicated-pressures late burning resulted. It was decided, therefore, that further improvements in the fuel consumption of the opposed-piston engine could only be obtained by replacing the original distributors by distributors provided with a number of holes. The design of the original valves was such that it was necessary to cut off the ends of the valve bodies and replace them by ends which could be adapted to take experimental distributors provided with circular holes. Fig. 17 shows the experimental distributors as fitted. This illustration will be given in the next installment.

Each distributor was provided with two rows of holes. The centre lines of the holes were made parallel to the flat tops of the pistons, and the angles of the holes in the horizontal plane were arranged to give the best distribution. The diameter of each hole depended on its distance from the cylinder liner in the direction of the spray and on the volume of that portion of the combustion-space which it had to feed, and it was arranged that each row of holes should sweep over approximately half the surface of the adjacent piston. (The centre lines of the two fuel-valves in the horizontal plane are parallel but slightly offset.) A number of distributors of this type were tested, and it was found that the best all-round results were obtained with the distributor A 16,

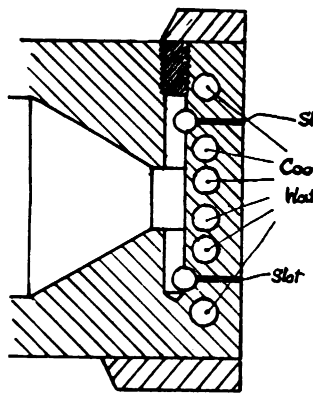


FIG. 16.

of which a horizontal section is shown in Fig. 17. The upper row of holes in each distributor is indicated in the figure by the full lines and the lower row of holes by the dotted lines. Table 5 which also will be given with the next installment gives the sizes and angles of the holes. The mean results of a series of tests carried out with the A 16 distributors are shown in Table 6 and Fig 18. The fuel used was Texas fuel-oil having a specific gravity of 0.91 at 60 deg. F., flash point 195 deg. F. (close test), viscosity 318 seconds at 70 deg. F. (Redwood No. 1), and a calorific value of 18,400 B. T. U. (lower heating value). The exhaust was clear throughout the tests.

The maximum power developed by the A 16 distributors was 406 B. H. P. at 364 R.P.M., the mean indicated pressure being 150 lbs. per square inch. The exhaust was not black at this power; but it was dark.

(*To be continued*)

MOTORSHIP "TOSCA" VISITS NEW YORK

The new 6,990 tons twin-screw Werkspoor-engined motorship "Tosca" left New Orleans, La., on August 27th for London. She is owned by Winge & Co., of Christiania.

WERKSPOOR PAYS DIVIDEND.

A dividend of 8 per cent. has just been declared by Werkspoor of Amsterdam, the well-known Dutch Diesel marine-engine builders.

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NOVEMBER, 1921
Vol. 6 No. 11

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Vol. VI — New York, U. S. A., November, 1921 — No. 11

Cable Address—Freemote, New York

First of the Hamburg-American Line's New Fleet of Motorships

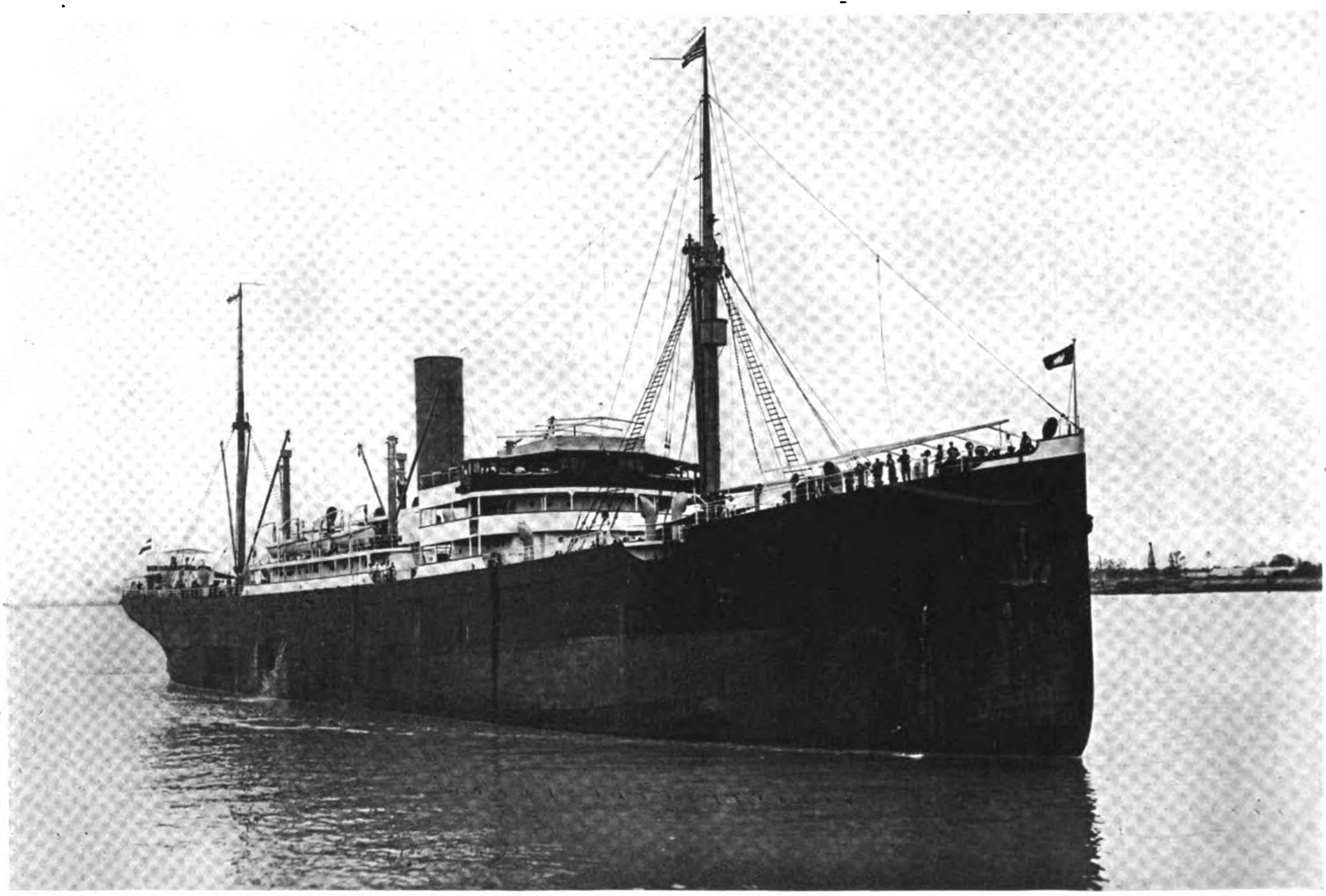
"Havelland," a 10,235 tons Deadweight Freighter with High-Powered Submarine Diesel-Engines and Reduction-Gears. Total of Ten Motorships Now Building For This Prominent German Shipping Concern—Eight to Have Double-Acting and Single-Acting Direct-Drive Two-Cycle Engines

BEING such a distinct innovation the Hamburg-American Line's new motorship "Havelland" will be closely watched in operation, and if the next year's performance is as successful as her maiden voyage from Hamburg to New Orleans, La., wholesale conversion of German steamships to motor-power may be expected, because the costs of power plants similar to that in the "Havelland" will be down to a low figure, due to the numerous high-speed Diesel-engines being available at low cost, and because of the very small engine-room necessary.

This vessel is propelled by twin high-powered four-cycle type submarine Diesel-engines driving slow-turning propellers through reduction gears. The original power of the engines was 3,000 shaft h.p. each at 390 R. P. M., on a weight of 15 tons but their running speed has been reduced to 230 revolutions. As the reduction-gear has a ratio of 1 to 2.7 the propeller speed is 85 per minute. At the speed in question the main engines now together develop 3,300 shaft h.p. or nearly 4,500 i.h.p., the piston-speed being 798 ft, per minute. Each engine, it will be remembered from the exclusive description published in "Motorship" of January, 1920 on pages 25 to 28, has ten cylinders 530 mm (20.866 in.) bore by a stroke of the same dimensions. For reliability and durability, the mean indicated-pressure has been reduced from 117.8 to 102.2 lbs. per sq. inch. As the overall length is only 37 ft., 5 in. it means that the length of the entire machinery space of this vessel obviously could be reduced from its 22 meters, but we understand that all the space that could be gained was not worth taking full advantage of under the German registration rules. By suitably proportioning the engine-room, an additional space of 18,000 cub. feet can be gained. However, compared with a sister motorship with direct Diesel-drive ,there is a saving of 330 tons in machinery weight, and a gain of 6,000 cubic feet, while the saving compared with a steamship is much greater. The machinery of the "Havelland" including reduction-gears weighs only 250 tons.

As we have very fully described and illustrated these engines we will not re-describe them now. But we recall that we urged the Shipping Board at that time to test-out the duplicate pair of engines (shipped to the U. S. by Capt. E. C. Tobey then head of the Fleet Corporation in London) in conjunction with electric-drive or reduction-gears, but it was left to German engineers and shipowners to be sufficiently enterprising to undertake this work. America's uneconomical steamers will be obliged to compete against them.

While several American Diesel-engined motorships have been placed in service with reduction-gears, including the "James Timpson" and the "Libby Maine," the power per engine did not in any case exceed 500 shaft h.p., so a single step from 500 to 1650 shaft h.p. per engine is quite a jump. The reduction-gears on the Ameri-

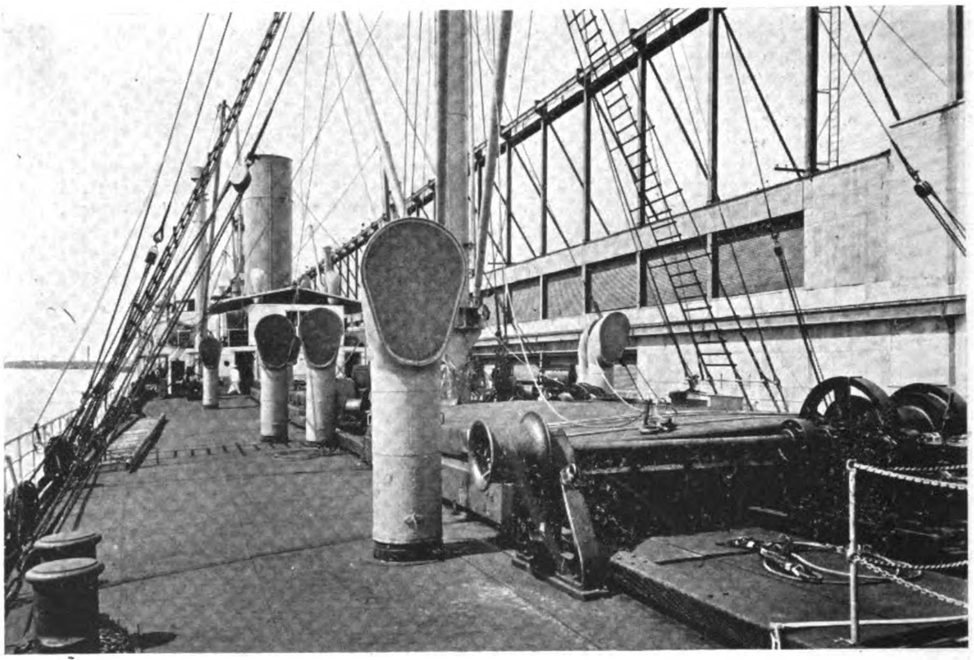


"HAVELLAND," first of the Hamburg-American Line's new fleet of motorships. She is propelled by twin high-powered submarine Diesel-engines operating the propellers through reduction-gearing. She averaged 11-12 knots from Germany to the U. S. A.

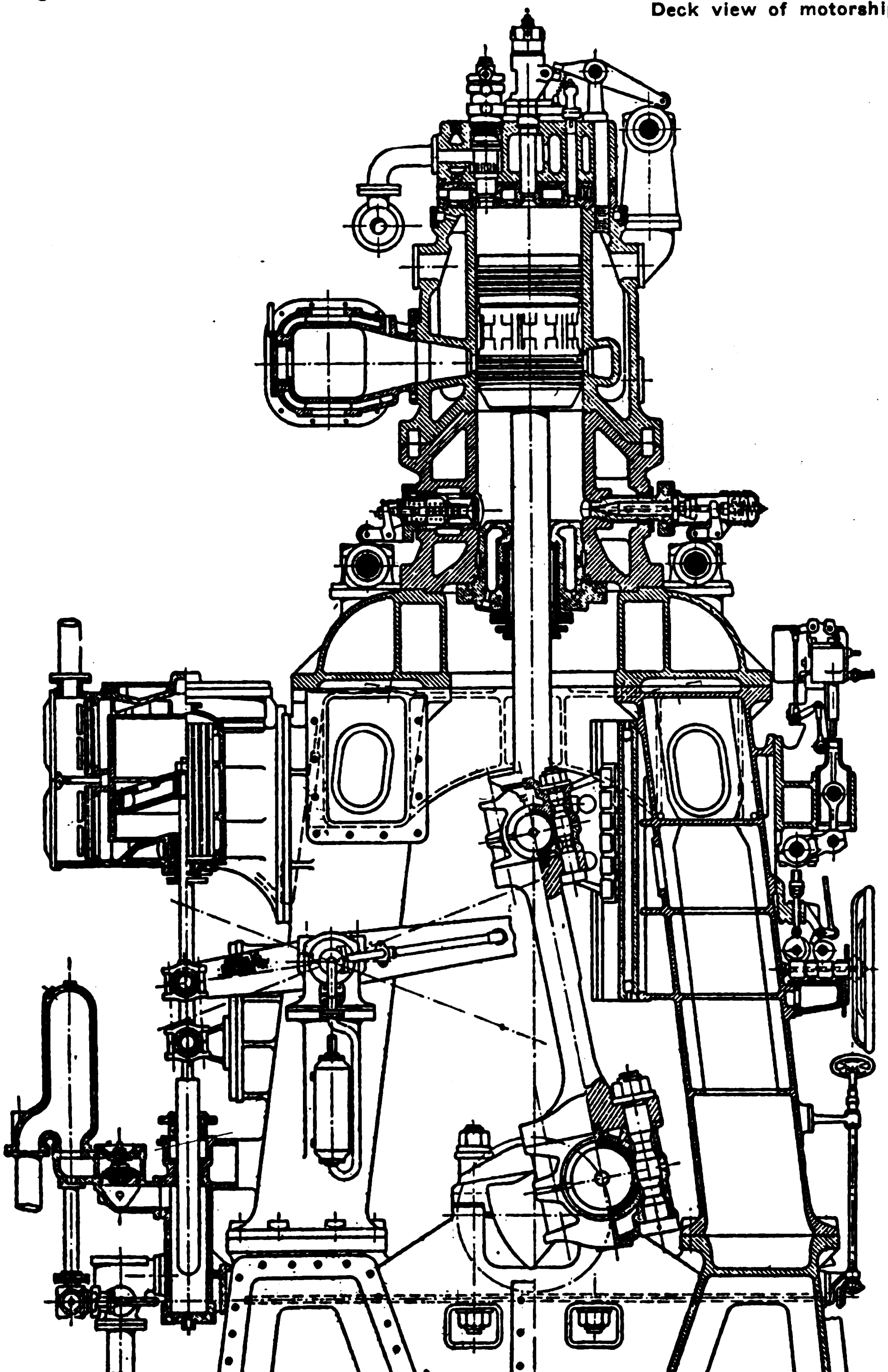
can ships were made by the Falk Co. of Milwaukee, who have made a special study of the same, while the big reduction-gears in the "Havelland" were made by Blohm and Voss.

The sister ship to the "Havelland" is the "Munsterland." Blohm & Voss also have an order for eight additional motorships from the Hamburg-American Line, of which several may have double-acting Diesel engines. We give for comparison with the "Havelland" a sectional drawing of the engine-room of the "Westerland," which is one of the Diesel direct-drive two-cycle vessels now building by Blohm & Voss.

Trials of the "Havelland" were run on Sept. 10th, 1921, and after maintaining an average speed of 11.12 knots, she reached New Orleans on her maiden trip from Hamburg on the afternoon of Saturday, Oct. 1st, 1921. The "Havelland" sailed from Hamburg within a few minutes of midnight, September 10th (European time.) Her engine-room record showed her engines together developed an average of 3,603 i.h.p. on a mean fuel-consumption of 136 grams per indicated horsepower-hour, or 0.299 lb. From this, we presume, at least 5% must be deducted for the loss of power in the reduction-gears. The lubricating-oil used averaged 105 kilograms per 24 hours, but her engineer believed that this high consumption was due to some reason which would be corrected very shortly and the amount accordingly reduced.



Deck view of motorship "HAVELLAND," showing electric winches



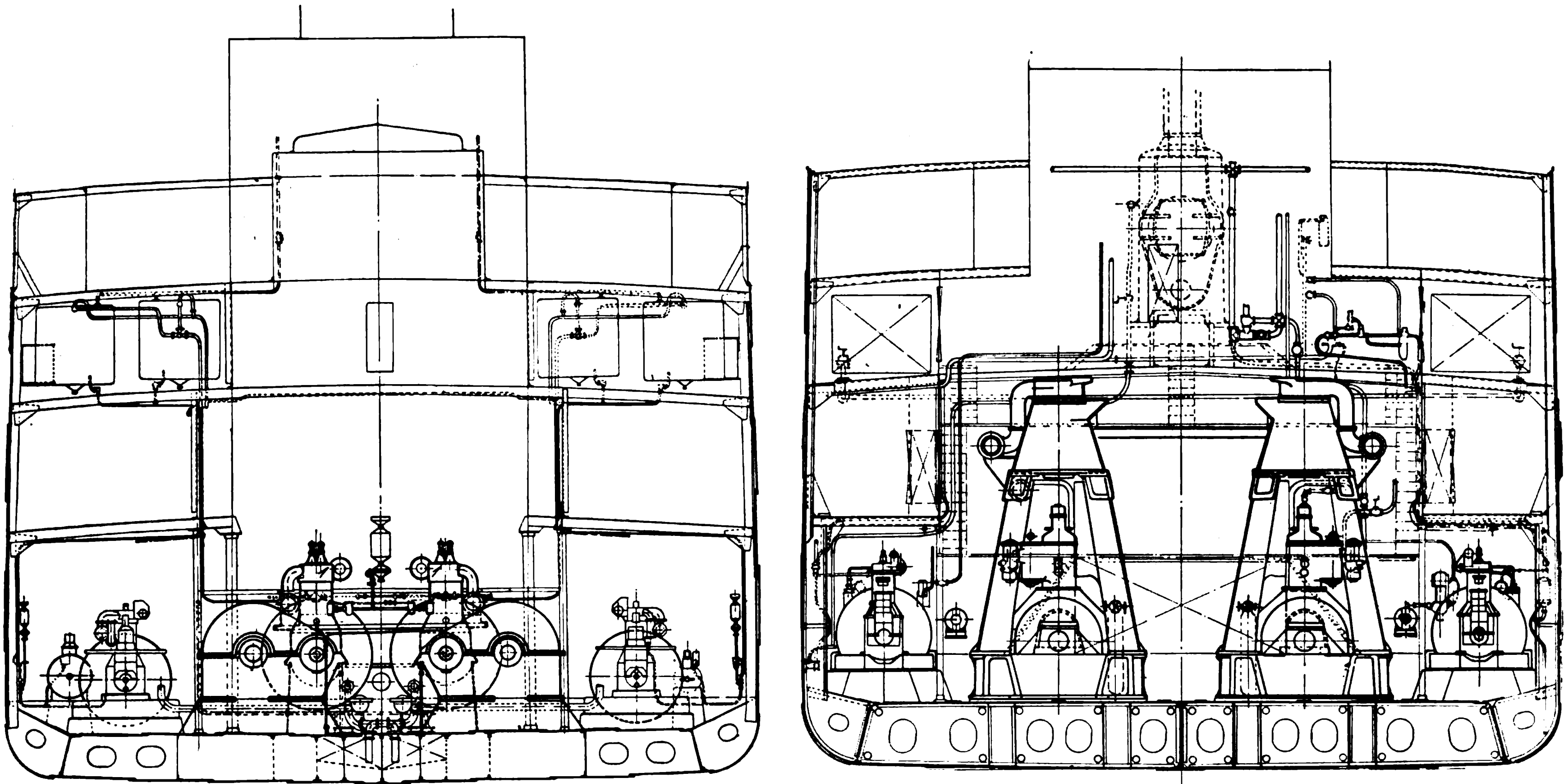
The Blohm & Voss-Nurnberg (M. A. N.) 850 shaft h.p. double-acting two-cycle Diesel-engine of the motorship "Fritz." This engine was fully described on page 301 of our issue of April, 1920

The "Havelland" was commanded by Captain E. Deinat, while the engine-room was in charge of Arthur Hampe. An attache of the engineering-staff of Blohm and Voss, Hamburg, was also on board in the person of Gerhard Stege, consulting-engineer. Herr Hampe and Herr Stege showed the greatest consideration to the representative of "Motorship," although they could only consent to one general photographic view being taken of the engine-room. Herr Stege, however, had prepared a detailed statement explaining the construction of the engines and their operations, and also brought over especially for "Motorship" a cross-section drawing of the engine-room of the "Havelland," and of a sister motorship now building at Hamburg, which will have cross head-type Blohm & Voss Diesel-engines directly connected to the propeller-shafts.

Before proceeding further with the description of the machinery we will give her leading dimensions—

Displacement (loaded S.W.)	14,700 tons
Displacement (light S.W.)	4,600 tons
Deadweight capacity	10,235 tons
Net-cargo capacity on 26,000 miles voyage	8,335 tons
Fuel-capacity (double bottoms)	1,400 tons
Fresh water	200 tons
Cruising radius	90 days at 12-knots or 26,000 miles
Speed (loaded)	12 knots
Speed on maiden voyage (partially loaded)	11.12 knots
Trial speed	12.4 knots
Cubic capacity of holds	10,846 cu. meters
Power (indicated)	4,500 h.p.
Power (shaft)	3,300 h.p.
Propellers (twin)	3.6 meters dia. by 4.7 meters pitch
Daily fuel-consumption	16 tons
Daily lubr.-oil consumption	700 kgr.
Brake h.p. hour fuel-consumption	0.299 lb.
Weight of machinery	250 tons
Length of ship (O.A.)	465 ft.
Length of ship (B.P.)	450 ft.
Breadth (M.D.)	58 ft.
Depth (M.D.)	29 ft. 6½ in.
Draught (mean)	25 ft. 1 in.
Type of auxiliaries	electric
Classification	German Lloyd A1
Gross tonnage	6,308 tons
Net tonnage	3,829 tons
Passenger accommodation	12 first class

Both Herren Hampe and Stege, as well as Captain Deinat, pointed out that the results of the voyage as shown by the engine-room records were most satisfactory, particularly in view of the comparatively light draft resulting from the small cargo aboard. Altogether, the cargo, fuel and ballast hardly exceeded 3,000 tons, whereas the net-cargo capacity of the ship when carrying fuel stores and water for a transatlantic round-voyage is over 9,000 tons apart from the said fuel, water and stores. Consequently her propellers were always less than half submerged, and it is believed she would have developed better speed with a larger cargo. She loaded much more than her



Section at engine-room of the motorship "HAVELLAND" and section of the sister motorship "WESTERLAND," showing size and space of machinery of the same power. Both vessels are being built by Blohm & Voss for The Hamburg American Line. One has high-speed 4-cycle Diesel-engines with reduction-gears, and the other slow-speed direct-driven 2-cycle engines

first cargo at New Orleans and was scheduled to stop at Savannah, and her engineers were confident that her speed would show up much better on this journey as well as on the way over the Atlantic on the return. Her economy is enabling her to carry away American products while American steamers are idle. When carrying fuel for a 26,000 miles voyage, she will carry 8,335 tons of cargo in addition.

Her engineers stated that no trouble whatever was experienced on the voyage over. They reported encountering rough weather during the first several days out but ideal condition on the mid-Atlantic and toward this side.

The view of the engine-room which we reproduce shows the cylinder-heads of the two engines and the control-bridge from which they and the auxiliaries are operated. The transmission gearing is located immediately below the point from which the picture was taken, but consent to a view could not be obtained. As a matter of fact such a photograph would have showed little of the construction features as the gearing on both engines is encased with a steel covering.

The ship is of the well-deck type with long poop and forecastle; she has two continuous steel-decks and is built to the highest class of the Germanic Lloyd. There are 8 water-tight bulkheads extending to the main deck. Accommodations are provided for 12 passengers.

Her two main engines were built during the war at the Augsburg Works of the Maschinenfabrik Augsburg-Nurnberg, for submarine-cruisers. The firm of Blohn & Voss is licensed by this firm to build these engines and has already built some, of which two have been in use in its power plant for several years. In design and construction they represent the highest degree of development of the high-speed, four-stroke cycle oil-engine, as was indicated when we described them nearly two years ago. Six re-designed engines are now being built by the U. S. Navy Yard, at Brooklyn, N. Y., and the New London Ship & Engine Co., Groton, Conn., have a license to construct engines to the M. A. N. design. The operating platform is located in front of and between the engines and is about 5 ft. 7 in. above the floor. All levers, etc., for starting and reversing are consolidated here.

The important question of perfect operation of reduction-gears between engine and propeller was thoroughly investigated on the test-stand, using gears of actual size. In this connection, it became necessary to offset the negative turning moments, which occur with oil-engines and are especially great in the neighborhood of the critical speed, in order to prevent excessive wear of the gear teeth. This end has been attained in the installation in question, not by the addition of separate and often unreliable elements, but by proper proportioning of the transmission shafting and a suitable distribution of revolving masses or balance weights.

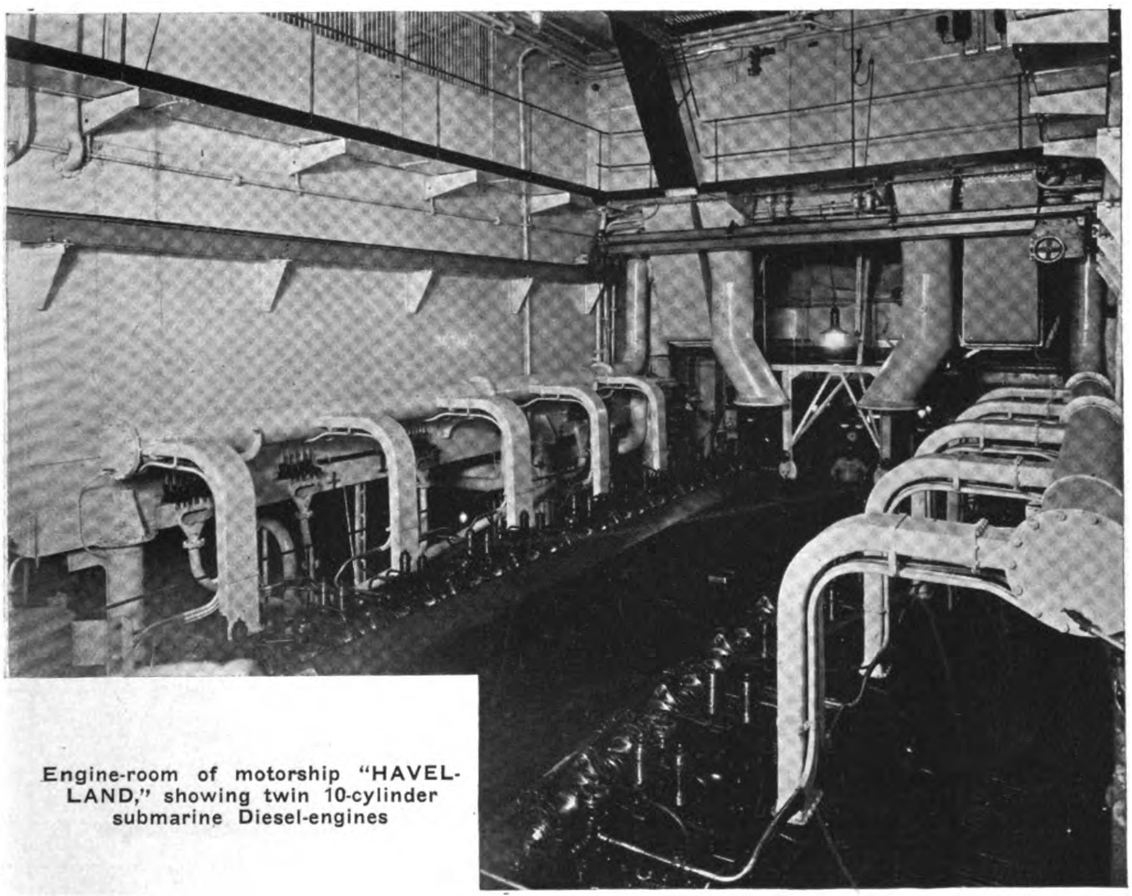
During the trial trip, by means of special apparatus, the twisting moments in the shaft, fore and aft of the reduction-gears, were measured photographically; this measurement revealed a uniformity of twisting moment in the shaft on a par with that of a turbine installation.

All auxiliary machinery, including the steering-engine and the thirteen cargo-winches, are electrically driven. Two 3-cylinder oil-engines developing 180 h.p. each and coupled to 95 k.w. dynamos are provided; the voltage is 220. In addition, each engine is connected through a clutch coupling to a compressor, intended for furnishing starting-air during prolonged maneuvering. Under ordinary circumstances, the compressors directly connected to the main engines are sufficient to supply the starting-air. The starting-air is stored in eight containers having a combined capacity of 226 cu. ft., under a pressure of 880 lbs.

A small compressor driven by a hot-ball surface-ignition motor of about 5 h.p. is provided for the initial filling of the tanks for the auxiliary engines. The lighting circuit has a voltage of 110 and the power therefore is generated by an 11 k.w. dynamo driven by a hot-ball motor.

The following are also provided:
- 2 main cooling-water pumps.
- 2 cooling-water discharge pumps.
- 1 auxiliary cooling-water pump.
- 1 oil-receiving and ballast pump.
- 1 fuel-oil pump.
- 2 lubricating-oil-pumps.
- 2 fire-pumps.

During the voyage and in cold weather, the engine-room, tunnel, and also the quarters are heated by hot air, utilizing the exhaust-gases.

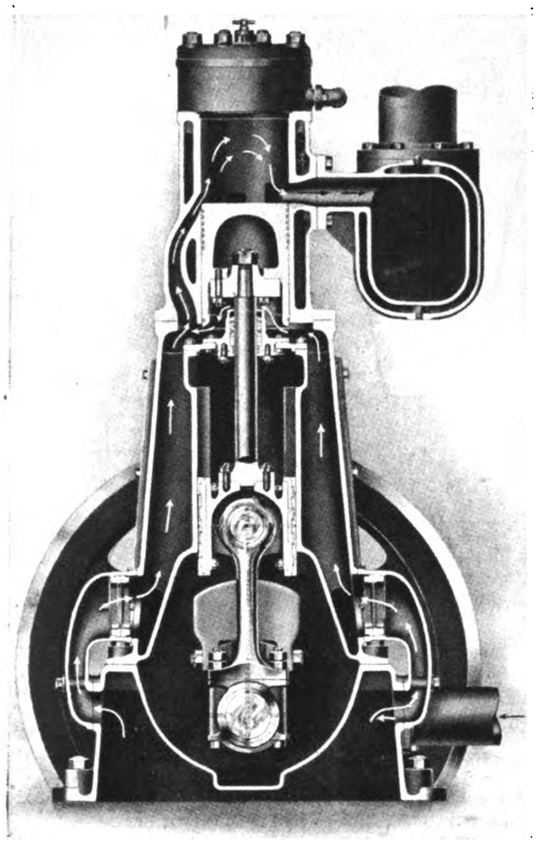


Engine-room of motorship "HAVELLAND," showing twin 10-cylinder submarine Diesel-engines

Worthington Airless-Injection Oil-Engine

First Details of a New Marine Motor For Small Commercial Vessels Developed at the Blake Works, East Cambridge—Successful Tests Run on Regular Steam-Boiler Fuel Oil with Low-Consumption Results

WHILE the Worthington Pump and Machinery Corp. of New York, were engaged in developing the big 2,400 h.p. merchant-marine Diesel-engine at their Buffalo plant, which engine we described in June 1920, the engineering-staff at their works in East Cambridge, Mass. were carefully studying the almost equally difficult problems coetaneous with the design and production of a marine oil-engine particularly suited to the different conditions of small commercial-craft, as well as for adoption with electric generating-sets. In both the latter cases, the first cost must be the lowest possible, consistent with good workmanship and reliable operation. Because, in engines of moderate power a few additional dollars to the overall cost of the engine may mean the loss of sales, as many fishermen and other work-boat owners often pay too close attention to the saving of a dollar or two on the first cost with the result that they are sometimes soon faced with a bigger burden on upkeep charges. While this viewpoint of fishermen may not be wise from a business aspect, it nevertheless exists and unfortunately has to be recognized by engine-builders catering to their requirements.



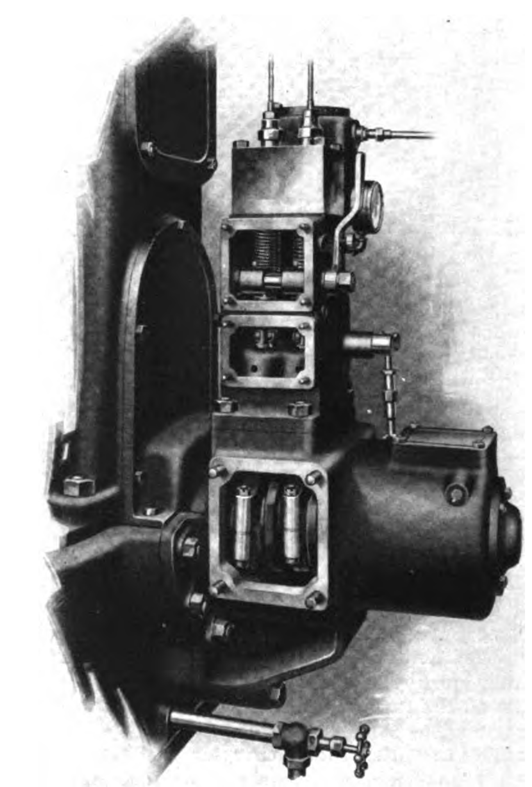
Cross section of Worthington engine, showing scavenging-air system

Therefore, in constructing an engine for the work-boat field, the Worthington designers were faced with the problem of producing an engine better than others already in use, but at a price that could enter open competition where an exceptionally high-grade engine is desired, such as a Diesel-engine, especially where common cheap fuel-oils available anywhere must be used, and which would withstand the hard usage generally met aboard craft of this type in the hands of untrained labor.

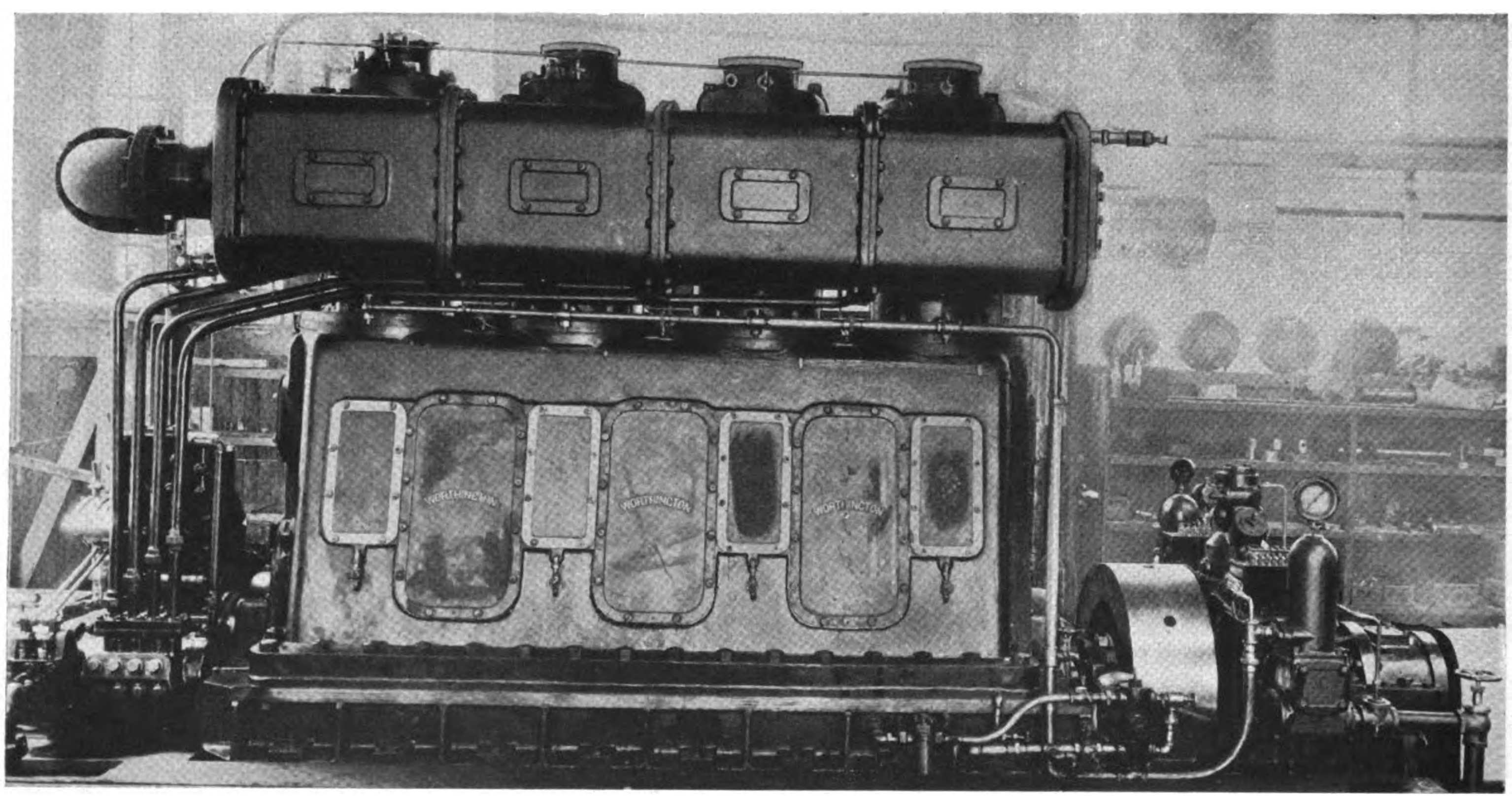
Obviously the answer was simplicty of design and operation, so while the economy of the Diesel cycle was highly desirable, they desired to avoid its complications, as the conditions are totally different from those existing aboard merchant-ships where skilled labor is nearly always available. Nor did they wish to adopt the surface-ignition principal, because they considered that this has been demonstrated to be a factor against the use of the heaviest fuel-oils in non-expert hands. Therefore, they hit upon a compromise, but which was not satisfactory until several years had been spent testing and experimenting and otherwise "ironing-out-the-kinks" in the design, some of which we were told about when recently visiting the Blake works at East Cambridge.

In fact we have an inkling that the task was even harder than they anticipated, in which case it is to the credit of the engineering-staff for persistence, as well as admirable of the executives in New York for their encouragement and consistent backing. For the result is an engine with which they can be highly pleased, and one which will take its proper place in the marine industry. There is a rapidly growing market for a marine-power plant of this character, and in developing along these lines the Worthington Co., together with this big slow-speed Diesel-engine, cover the entire commercial-marine field.

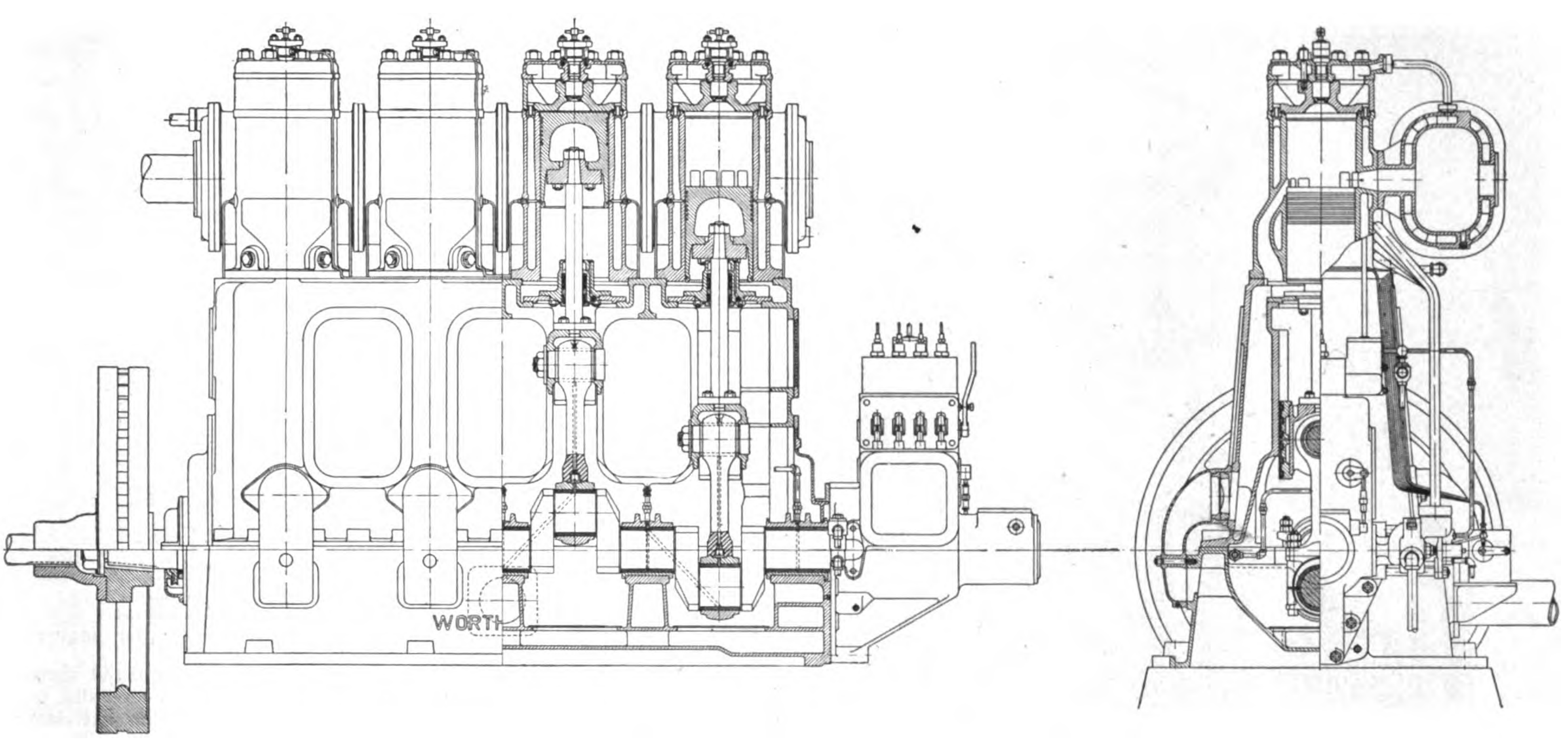
It will be noted that we have employed the term "airless injection" in connection with the new design, in order to denote that no compressed-air is used to blast-in the fuel. So many terms are being used today for high cylinder-compression engines, including solid-injection, mechanical-injection and pump-injection, few of which properly denote the principal, so we have adopted the expression "airless-injection" as best indicating its difference from the air-blast injection of the Diesel-engine. It is probable that we will standardize this term for use hereafter unless a better one is suggested.



Fuel pump and governor of Worthington engine



General view of the new Worthington airless-injection marine oil-engine



Section of 240 b.h.p. Worthington marine oil-engine

Opinions of engine-builders on this point are welcomed. We trust that designers will thoroughly discuss the matter in our columns.

With the new Worthington engine, which is of the valveless two-cycle type, fuel-oil is pumped to the engine by an attached service-pump, operated by an eccentric on the crank-shaft. This pump draws oil from the storage-tank and delivers it to a small reservoir attached to the fuel-injection pump on the engine. An overflow pipe from this reservoir returns to the storage-tank the excess oil handled by the service pump. In cases where the location of the storage-tank is such as to afford a gravity flow from the tank to the reservoir at the fuel-injection pump, the service-pump may be disconnected and left inoperative, but attention is here called to the Fire Underwriters objections to tanks so located. No starting-coil, fuse, torch or other auxiliary starting device is needed to start the engine, combustion taking place as will presently be described. Certain features of its design are quite different from the conventional engine of the valveless two-cycle type. Ordinarily, surface-ignition oil-engines in low powers are of the trunk-piston type, using the crank-case as a scavenging-air compression chamber. The Worthington engine, however, is of the crosshead type, with a separate compartment between the cylinder and the crank-case for scavenging-air. By such an arrangement, cylinder wear is reduced to a minimum, and it is possible to use a force-feed lubrication system which eliminates lubrication troubles and reduces lubrication cost to a small fraction of the prevailing figure for crank-case compression engines.

PERFORMANCE ON TEST.

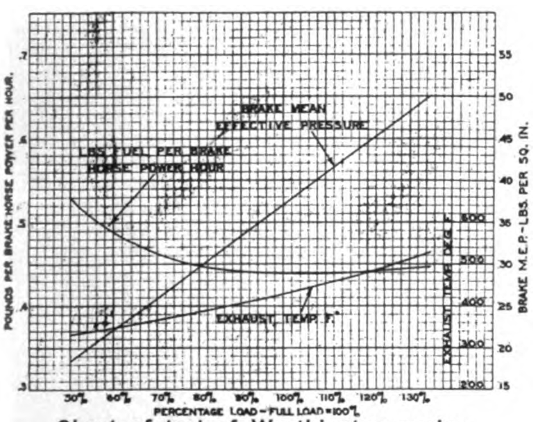
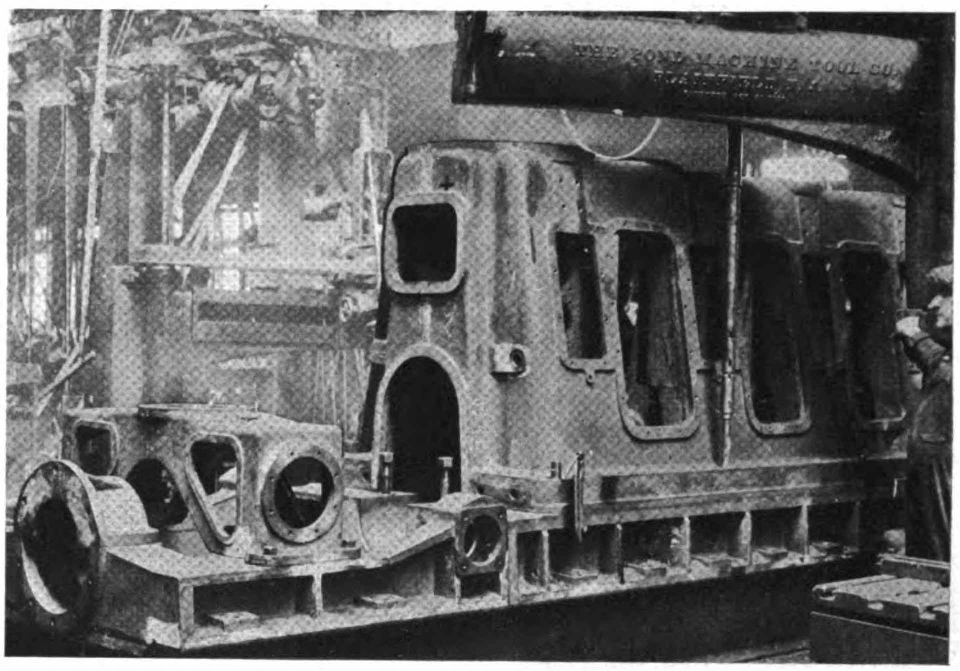


Chart of test of Worthington engine

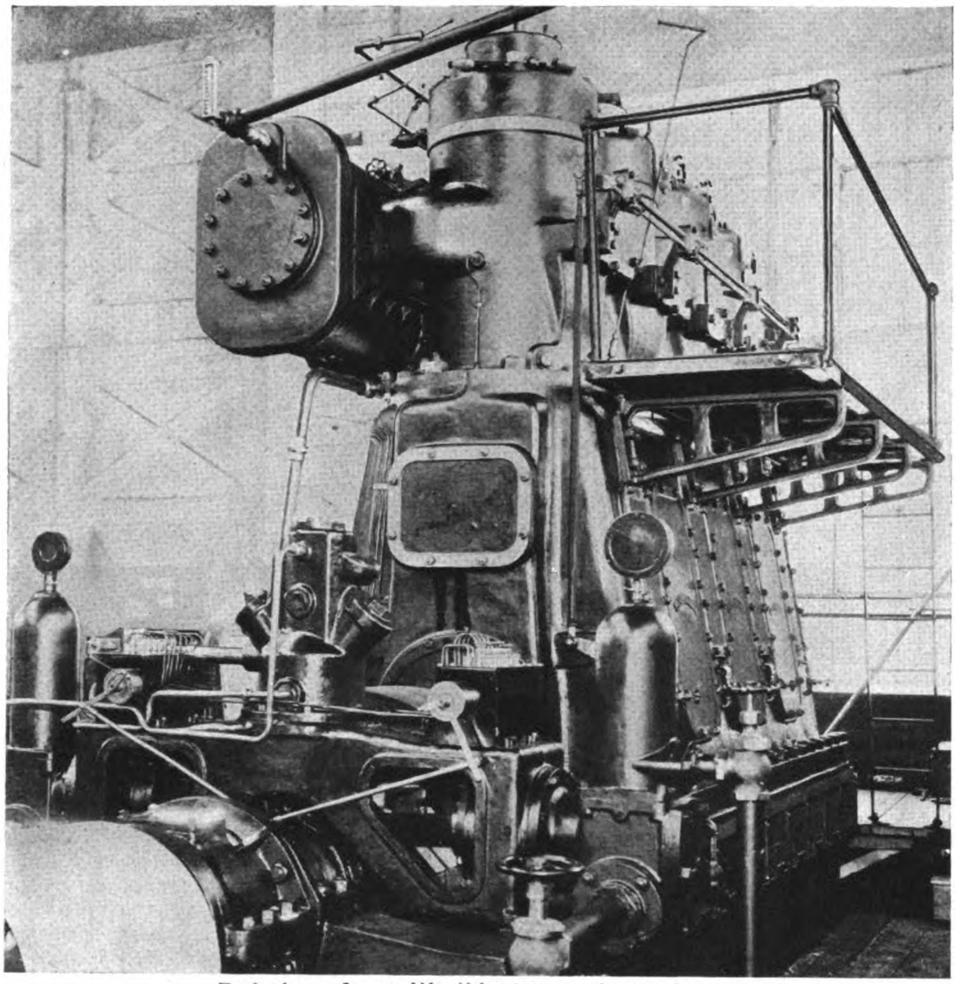


Worthington engine frame casting

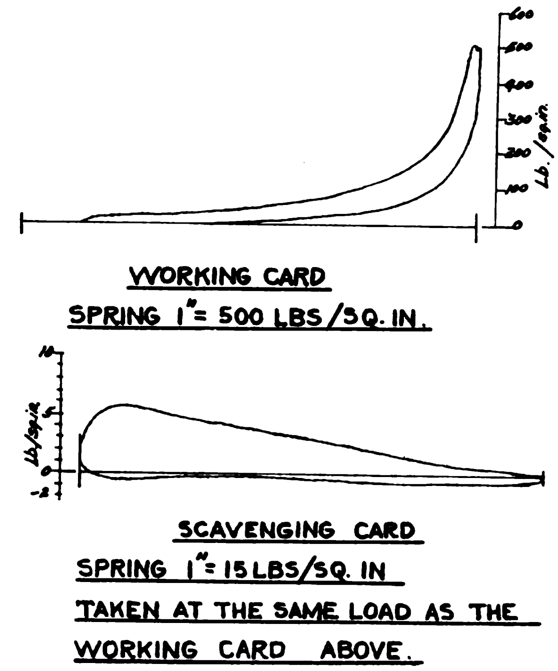
Engine. 32 HP 10¼ x 11½	Experimental Engine With Flat Top Piston							Date June 1, 1921	
No. of Test.	B.H.P of 375 R.P.M.	R.P.M.	B.H.P reduced to speed	Lbs. of Oil	Time to consume oil.	Fuel Oil Consumption: Pounds per hour	Lbs per Hr at 375 R.P.M.	Lbs. per B.H.P per Hour	Remarks.
1.	9.75	384	10	3	1359"	7.95	7.77	.795	
2	18.5	379	18.7	3	1073"	10.05	9.92	536	
3.	27.25	377	27.4	5	1402"	12.82	12.75	.468	
4.	36.0	374	35.9	5	1121"	16.05	16.1	.447	
5.	41.0	371	40.6	5	998"	18.00	18.2	.444	
6.	43.0	371	42.5	5	962"	18.72	18.9	.441	
7.	44.5	369	43.8	3	562"	19.20	19.5	.439	
8.	46.0	366	44.9	5	912"	19.73	20.2	.439	

Consumption chart of new Worthington oil-engine

One of the distinguishing characteristics of this engine is the use of a divided, or two part, combustion-chamber. The function of this divided combustion-chamber is to reduce explosive pressures and to create a condition of air turbulence in the main combustion-chamber during the combustion period. Shortly before top dead-center, fuel is injected thru the spray-valve in an atomized condition directly into the smaller of the two compartments, known as the "injection chamber," this being located above and directly in communication with the main combustion-chamber or cylinder clearance space. Ignition of the fuel is from the heat of compression, and the period of injection is so timed that the partial burning of the fuel-charge in the injection-cham-



End view of new Worthington marine-engine



Indicator cards from Worthington engine

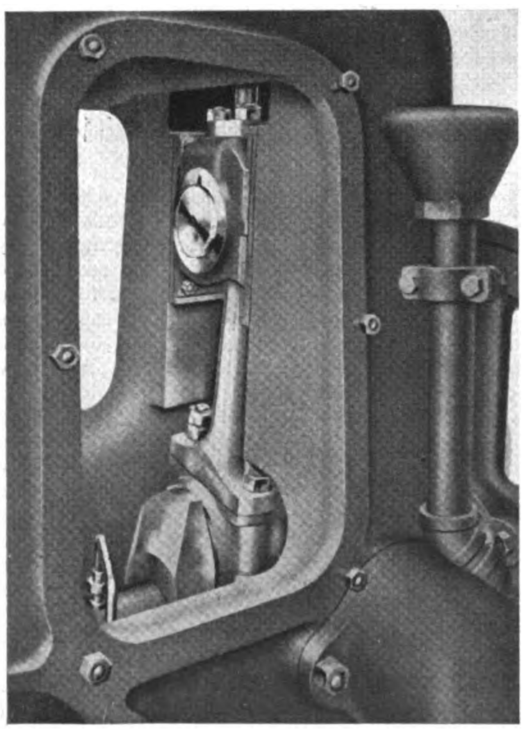
ber produces sufficient pressure to start the flow of the main part of the fuel-charge down into the cylinder until the jet of gaseous oil and air from the injection-chamber attains considerable velocity, producing a turbulent condition in the cylinder just as the piston starts on its downward stroke. This is accelerated by the downward motion of the piston.

Combustion then takes place in the lower chamber or cylinder, under conditions closely approximating the air-injection Diesel-engine, the resultant expansion of gases driving the piston down on its power stroke after which the cycle described above is again repeated. The pressure from the fuel-pump is high, but lasts only during injection about 15 degrees of crank angle. It will be noted that the time and rate of combustion are independent of time and rate of pump injection.

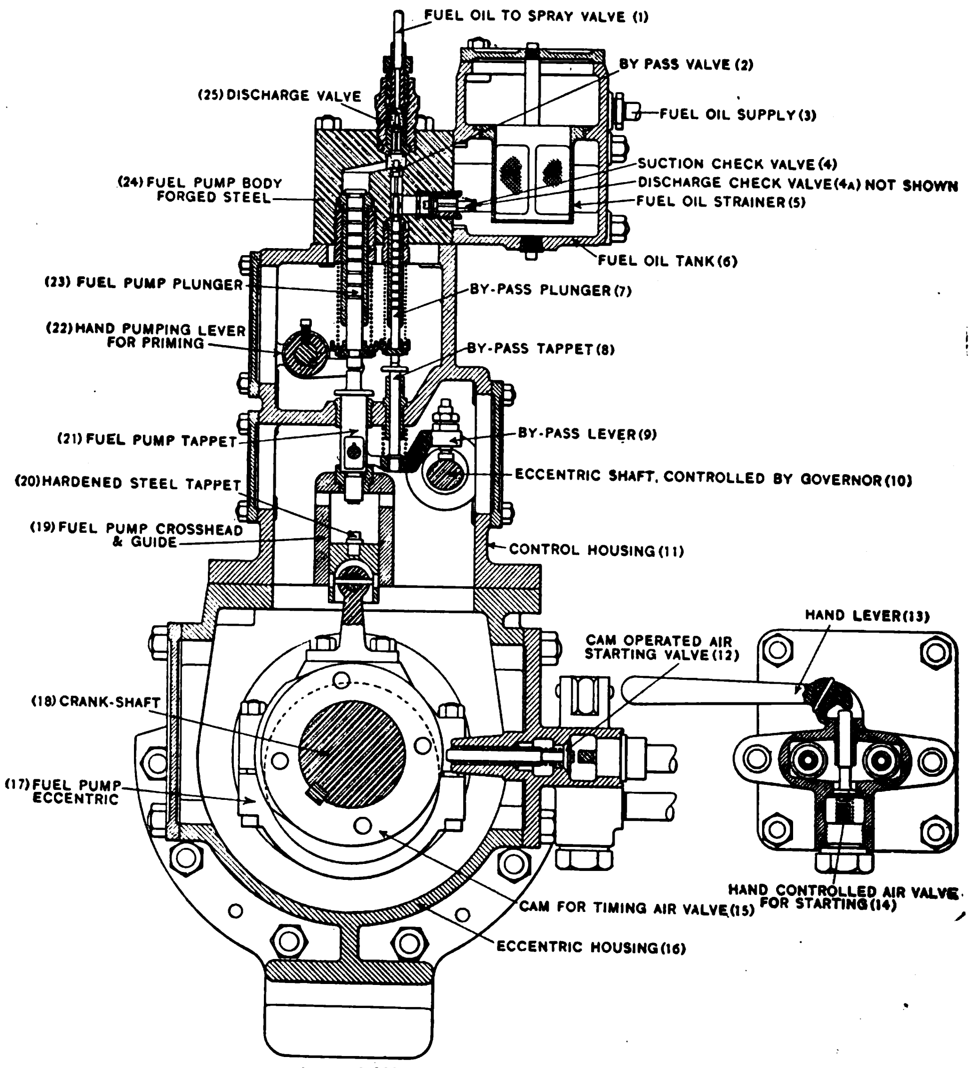
The Worthington designers have adopted the crosshead type of running gear and providing a scavenging-air receiver or compression space for each cylinder behind the crosshead guides separate and distinct from the crank-case. On the upstroke of the piston air is drawn into this receiver through a set of Laidlaw feather valves and compressed on the down-stroke. The air is thus forced into the cylinder when the piston uncovers the scavenging-ports in the cylinder-walls, as in the crank-case compression engine but without having entered the crank-case. It will be noted that the piston-rod works in a stuffing-box between the scavenging-air receiver and the crank-case, which seals the only connection existing between these two compartments.

Another refinement of the Worthington engine consists in providing a scavenging air-connection on the base of the engine which may be piped to the outside of the engine room. By this means, a supply of pure fresh air may be had for scavenging purposes in places where the air of the engine room is charged with dust, explosive vapors, or other objectionable impurities.

The fuel-injection pump is of the unpacked type, and as will be seen from the drawing, is driven by an eccentric (17) mounted on the crankshaft. Each cylinder has a separate and independent pump, complete in all its details. By avoiding the



Looking through door in crank-case frame, showing crosshead and guide

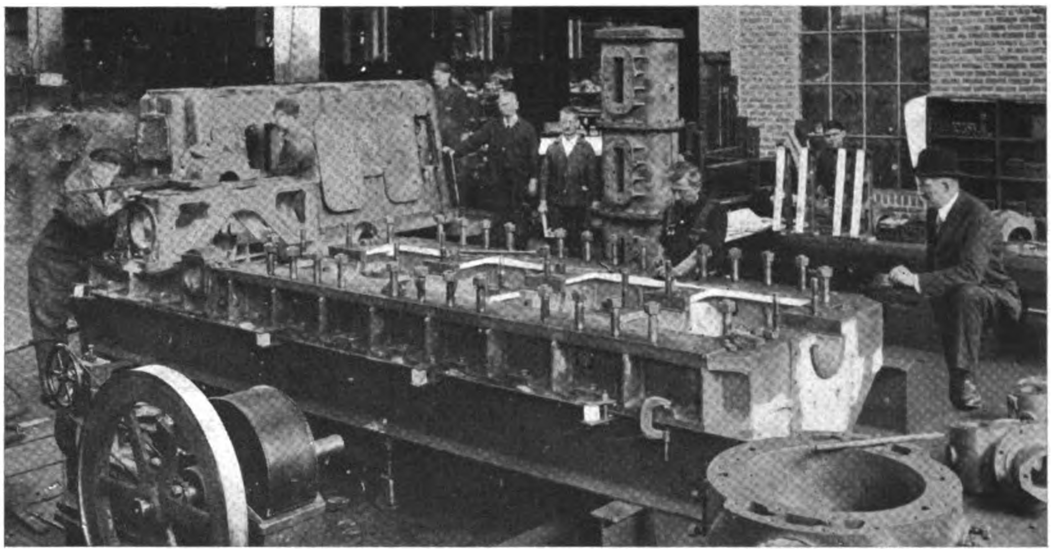


Section of Worthington fuel-pump

use of packing for the pump-plunger, danger of the plunger sticking is eliminated, and at the same time leakage past the plunger is considered less than in the usual type of packed pump. The pump body (24) is made from a solid block of steel, designed and constructed with great care, and the plungers and valves are assembled in this body as a unit.

Actuation of the pump plunger is by the eccentric (17), the crosshead (19) engaging the tappet (21), which in turn pushes the plunger upward on its injection stroke, the plunger being returned to its at rest position by the spring as the eccentric passes its top position. The actual instant at which the pump-plunger begins to move upwards determines the instant of injection of oil into the injection chamber.

For control, a centrifugal governor is fitted, acting through a series of rods and levers to rock the control-shaft (10). This shaft is turned eccentric at a point in line with each fuel-pump plunger, and a so-called "by-pass lever" (9), actuated at one end by the pump-plunger, rests at the other end on the eccentric part of the control-shaft thru the medium of an adjustable set-screw. As the end of the by-pass lever moves upward with the pump-plunger, the by-pass tappet (8) and plunger (7), resting on the lever, will move upward also, closing the gap between its upper end and the suction or by-pass valve (2). When contact is established at this point, the continued upward movement of the plunger will open the valve, permitting the oil to by-pass back to the fuel-reservoir instead of being forced thru the spray-valve, and thus ending the injection or effective pump stroke. It will be seen that by rocking the control-shaft (10) one way or the other from its normal running position, the instant of opening of the suction-valve by the by-pass plunger may be retarded or advanced, thus increasing or decreasing the effective pump-stroke and feeding more or less oil into the cylinder, according to the load requirements. Also, by regulation of the set-screw in the end of the lever (9), the instant of by-pass opening for each cylinder may be individually adjusted for purposes of initial setting and load balancing.



Bed-plate of Worthington engine, showing cylinder-head in foreground, and engine-frame and exhaust-manifold in background

The 300 b.h.p. engine has four-cylinders 15¼ in. bore by 16 in. stroke, and turns at 240 R. P. M. Fuel used on a demonstration run before and while we were at the Blake plant is a Mexican boiler-fuel of 15.6 degs. gravity at 18,198 B. T. U., with a flash-point of 222 degs. Fahr. The rating of the engine is very low, being only 37 M. E. P., but she will pull 49 without losing any perceptible economy. This fuel was supplied by the Atlantic Refining Co. and contains 3.2% sulphur. Even Soya Bean oil supplied by Marsden Wild & Co. of Boston has been used on the test-bed with excellent results. On the above Mexican oil she pulls 44 M. E. P. without trouble. With fuel of 18,500 B. T. U. per pound, a fuel-consumption not exceeding 0.50 lb. is conservatively guaranteed, but in actual practice the engine will consume about 0.44 lb., which is excellent for an engine of its power and speed.

A New German Marine Diesel-Engine

Crosshead Heavy-oil Motor of 950 Shaft H.P. Building at the Deutsche Werke, Kiel

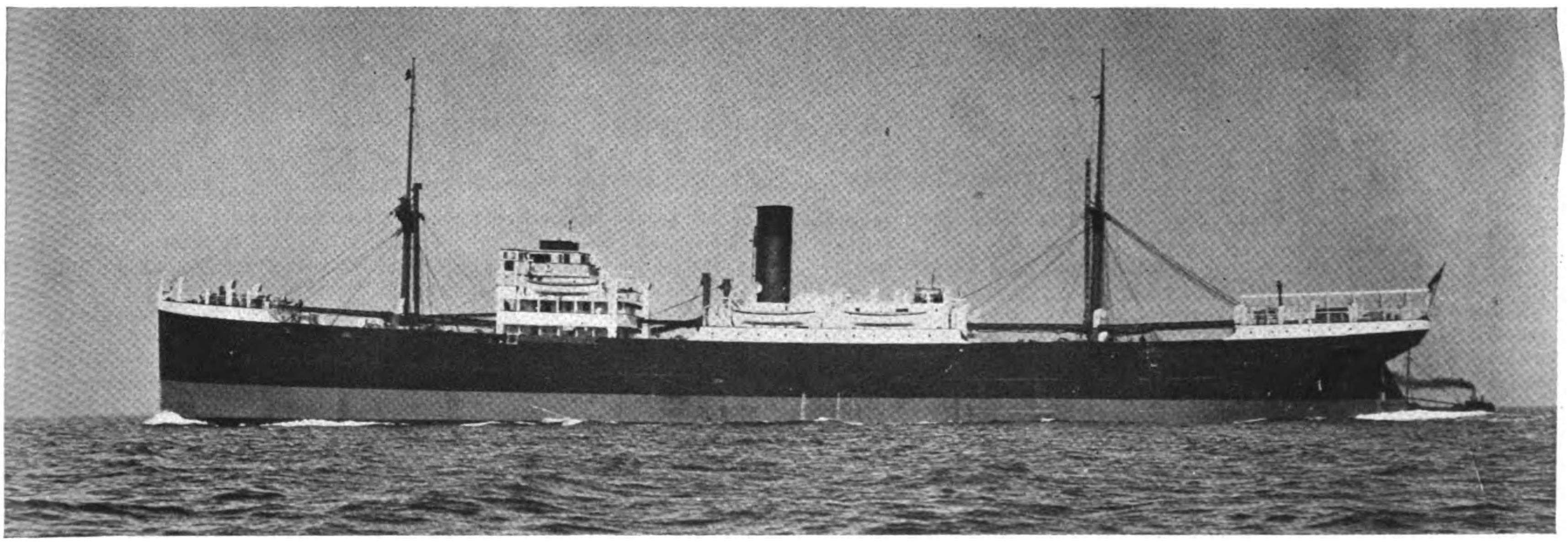
(Drawings on page 902 of this issue)

LAST month we referred to the distinction between the Deutsche Werft of Hamburg and the Deutsche Werke of Kiel, motorships being under construction at both yards. Details of work under progress at the Hamburg shipyard were given in our September issue. Recently our Danish correspondent visited the Deutsche Werke at Kiel, which is the old Imperial yard that, together with the munition plant at Spandau has been turned into a private company for peace-time production, and is under the management of Dr. Rembold, formerly with Krupps Germania works at Kiel.

At the time of our representative's visit their first Diesel marine-engine was running tests. It is of the single-acting, four-cycle, six-cylinder crosshead design, developing 950 brake h.p. at 135 R.P.M. With a view to securing a short overall length the three-stage air-compressors are mounted at the back of the engine and driven by rocking-beam levers, as are the water and oil pumps. An overall length of 28¼ ft. has resulted, which will allow of a short engine-room, say between 35 and 40 ft. Without the thrust-bearing the engine is 26¾ ft. long. Its height is 11½ ft. Should compressed-air be used for the steering-gear, an extra compressor can be fitted on the engine, and also driven by rocking beam levers. Drawings are given on another page in this issue of "Motorship."

Being of the crosshead type, the designers have been enabled to completely enclose the crankcase and shut-off the same from the cylinders by means of an entablature, thus preventing carbon from the cylinders from dropping into the crankcase, also keeping any possible cooling-water leakage from the pistons from dropping into the lubricating-oil. Generally speaking, the frames and all moving parts and the bearings follow marine steam-engine practice. Cooling of the engine is by sea-water via telescopic-tubes.

Each cylinder has a separate fuel-pump, arranged near the control levers, where they may be easily watched. The front and rear frames are cast separately with sufficient space between to remove the crankshaft without taking-out a frame. Also the piston can be lowered-out instead of having to take-off the cylinder heads, and a patented device enables easy removal of the piston. For the camshaft drive there are a pair of spur-wheels and two clutch-rods. The cam-shaft itself is mounted on a level with the cylinder heads, with the cams engaging directly on the roller of the rockers. Reversing is effected by sliding the camshaft after lifting the rockers clear of the cams.



Glen Line motorship "GLENTARA," which was placed in service a year ago last April. She is one of four sister Diesel-ships, and part of a fleet of over a dozen motorships owned by the Glen Line, some of which are of 14,000 tons d.w.c. and 6,600 i.h.p. The "GLENTARA" is of 10,000 tons d.w.c. and of 3,500 i.h.p. Built by Harland & Wolff. Speed, 11 knots. Fuel-consumption, 11 tons per day

Twin-Screw Freighter With Cammellaird-Fullagar Diesel Engines

Trials of the Anchor-Brocklebank Line's First Ocean-Going Motorship

TRIALS were run on the Clyde on September 29th and 30th of the twin-screw cargo motorship "Malia," built by William Hamilton & Co., Port-Glasgow, for T. & J. Brocklebank (Anchor-Brocklebank Line) Liverpool, which is notable as being the first ocean-going vessel fitted with Cammellaird-Fullagar internal-combustion engines as the main propelling power. A coastwise vessel—the all-welded-hull "Fullagar"—has already been tested with this type of machinery, but she was an experimental ship, both in hull and machinery, and her single-screw installation was found to be more powerful than was necessary as has been previously indicated in these pages. It will be remembered that it was removed and replaced by a set of Beardmore oil-engines. The original "Cammellaird-Fullagar" set now forms the port propelling-engine of the "Malia" while the starboard engine of that vessel has been constructed to the same design and of the same power, so that the "Malia" is a twin-screw ship of double the power of the "Fullagar." She is 365 ft. in length overall, 350 ft. between perpendiculars, 50 ft. in breadth, 27 ft. 3 in. in depth moulded, of 3,880 tons gross, and 6,000 tons deadweight on a draught of 23 ft.

On the trials the combined indicated horsepower of the two engines when running at 125 R.P.M. was about 1,570, or 1,100 B.H.P. On the 29th the average revolutions of both engines was 118, giving an I.H. P. of 1,480, while the speed of the ship is 10.7 knots.

The fuel-consumption of these engines works out at 0.42 lb. per shaft h.p. hour or 0.29 lb. per I.H.P. The oil used was supplied by the Anglo-Mexican Petroleum Co., and is their standard Diesel fuel-oil having a specific gravity of 0.904. After the first trip or two practically any of the fuel-oils available will be used. The lubricating-oil consumption was 0.003 lb. per b.h.p. hour, which will be reduced as soon as the starboard engine has run itself in.

A mean speed of 10¾ knots was attained at 116 R.P.M., or over a knot more than that which will be required on regular service, and 1,100 B.H.P. was developed. The fuel-consumption worked out at from 4½ to 5 tons per 24 hours, which at a price of £4.15s per ton, makes a total cost for the day's running of from £21 to £23, 15s ($84 to $95) as compared with an estimate of £34 for a coal-burning steamer of similar size and speed. To this must be added the very important facts of space saved by the abolition of boilers, water and bunkers, while it is estimated that, as compared with other internal-combustion installations now on service, there is a saving in fore-and-aft space of about 50 per cent. Therefore, it will be of interest if the builders publish the exact dimensions and weight.

The vessel carries a sufficient amount of fuel for the voyage from the United Kingdom to India and back. Oil-fuel is also used for a Vickers-Petters auxiliary engine, while a donkey-boiler supplies steam for the cargo winches. Each of the main propelling-engines weighs about 47 tons, and on the trials they worked with the slightest amount of vibration, and were almost noiseless in operation. The engines, as is well known, are of the four-cylinder, opposed-piston type, the cylinders being 14-in. in diameter and the stroke of each piston being 20-in. which means an actual stroke of 40-in. The pressure was about 1,000 lb. per square inch.

There was on board a large number of engineers and others representing shipbuilding and engineering firms, and the opinion was expressed by all of them that the machinery installation was one of the most perfectly balanced of which they had never had experience, and ran with remarkable smoothness and lack of vibration. In the reversing trials, it may be added, the vessel was put from full-speed ahead to full-speed astern in the short time of six seconds.

It is interesting to note that only two days were required to tune up the engines before commencing official trials, and it is therefore unlikely that Cammell Laird & Co. will go to the expense of running any more of this particular size of engine on the test-bed, but will follow the steam-engine practice and the practice of several other leading Diesel-engine builders, of installing them in the ship direct without official tests. The trial results of a similar engine have already been published and need not be repeated. It should, however, be stated that the second of the two engines for the "Malia" was run at a B. H. P. of 540 with a perfectly smokeless exhaust, and that, due to improvements in the ports, the scavenging-air pressure was reduced to the low figure of 1 lb. per square inch. The turning-gear for both engines is driven by one 4 B.H.P. English Electric Co., electric-motor with a cross-shaft and worm-gear.

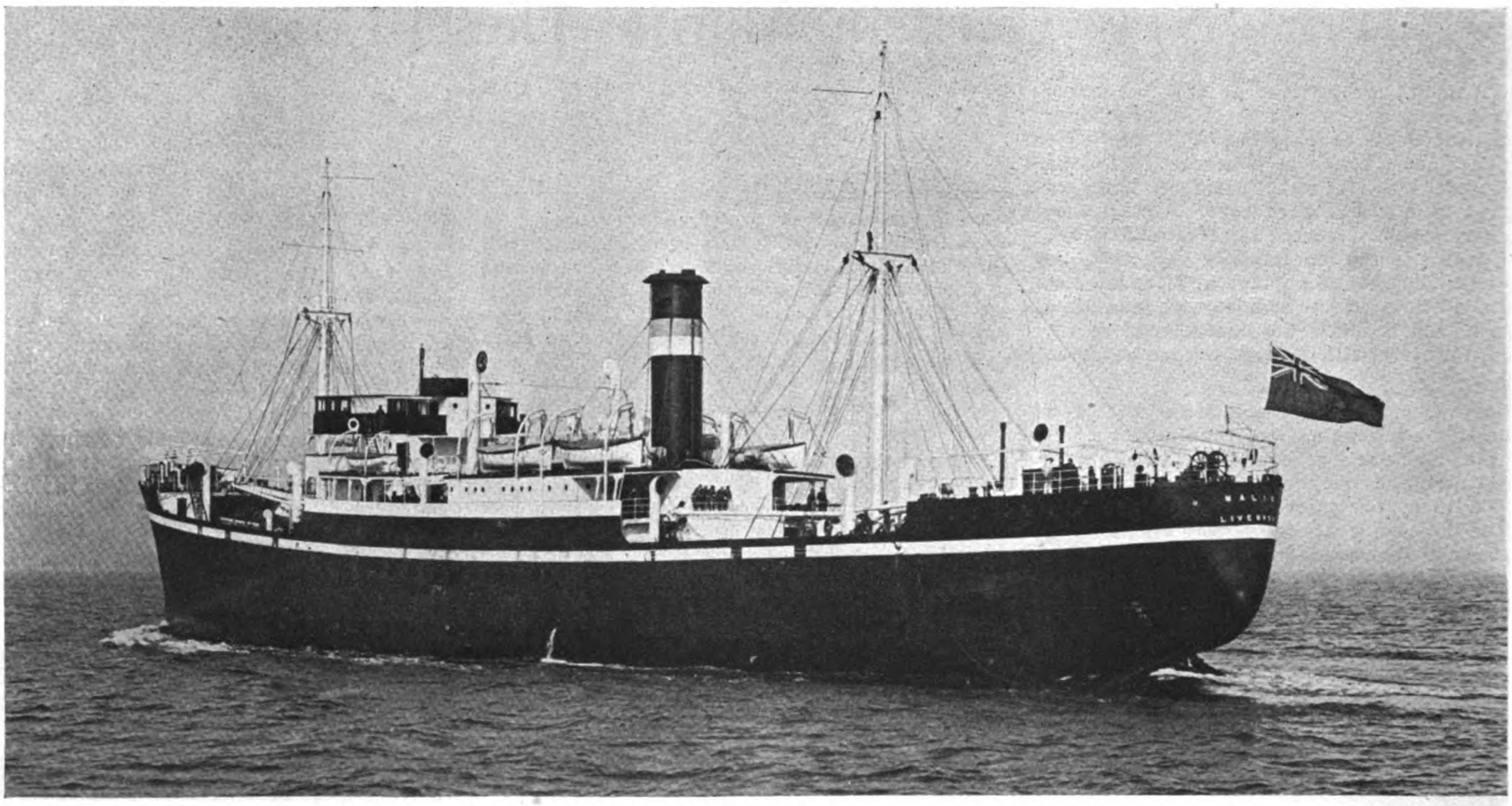
The engines were built and the whole of the machinery installed under the supervision of Messrs. G. S. Goodwin & Co., of Liverpool.

An electric steering-gear of the Hele-Shaw type is fitted, enabling the donkey boiler to be completely closed-down when the ship is at sea.

It is the builders' practice to arrange for each engine to drive all pumps and auxiliaries necessary to make it a self-contained propelling unit, and the fuel-consumption of "Camellaird-Fullagar" engines hitherto published have been for such engines. In the present installation, however, for particular reasons of the owners, the oil and water circulating pumps are separately driven. Seawater, freshwater circulating and lubricating oil-pumps have all been duplicated, each pump being of capacity enough to supply all necessary water or oil as the case may be for running both engines.

Two combined dynamo and air-compressor sets are installed, one on the port and the other on the starboard side of the engine-room. Each set is driven by a two-cylinder Vickers-Petter hot-bulb engine developing 78 B.H.P. at 300 R.P.M. Three small air-bottles are supplied with each set for starting purposes. Each engine is direct coupled to a 45 K. W. Allen dynamo, and through a clutch to a Reavell 3-stage quadruplex air-compressor capable of pumping 125 cubic-feet of free air per minute to the bottle storage-pressure of 1,000 lbs. per square inch. Twelve air-bottles are fitted on the forward engine-room bulkhead for storage of the starting air.

An auxiliary air receiver of 30 cubic feet capacity, storing air at a pressure of 200 lbs. per square inch is fitted in the 'tween deck at the port side, for supplying air to the windlass, donkey-boiler feed pump, oil firing gear and ballast pump, when the donkey boiler is not in use or when steam is being raised. In addition to the main generators, an emergency lighting set is fitted on the port side at the main deck level. This is driven by a single-cylinder Vickers-Petters hot-bulb oil-engine developing 10 H.P. at 425 R.P.M. The Allen dynamo is of 5 K.W.



Anchor-Brocklebank's new motorship "MALIA," propelled by twin Camellaird-Fullager Diesel-engines

Notes on Motorship Operation

Personal Experiences, and Observations of Conditions on Domestic and Foreign Diesel-engined Vessels

By OLD TIMER

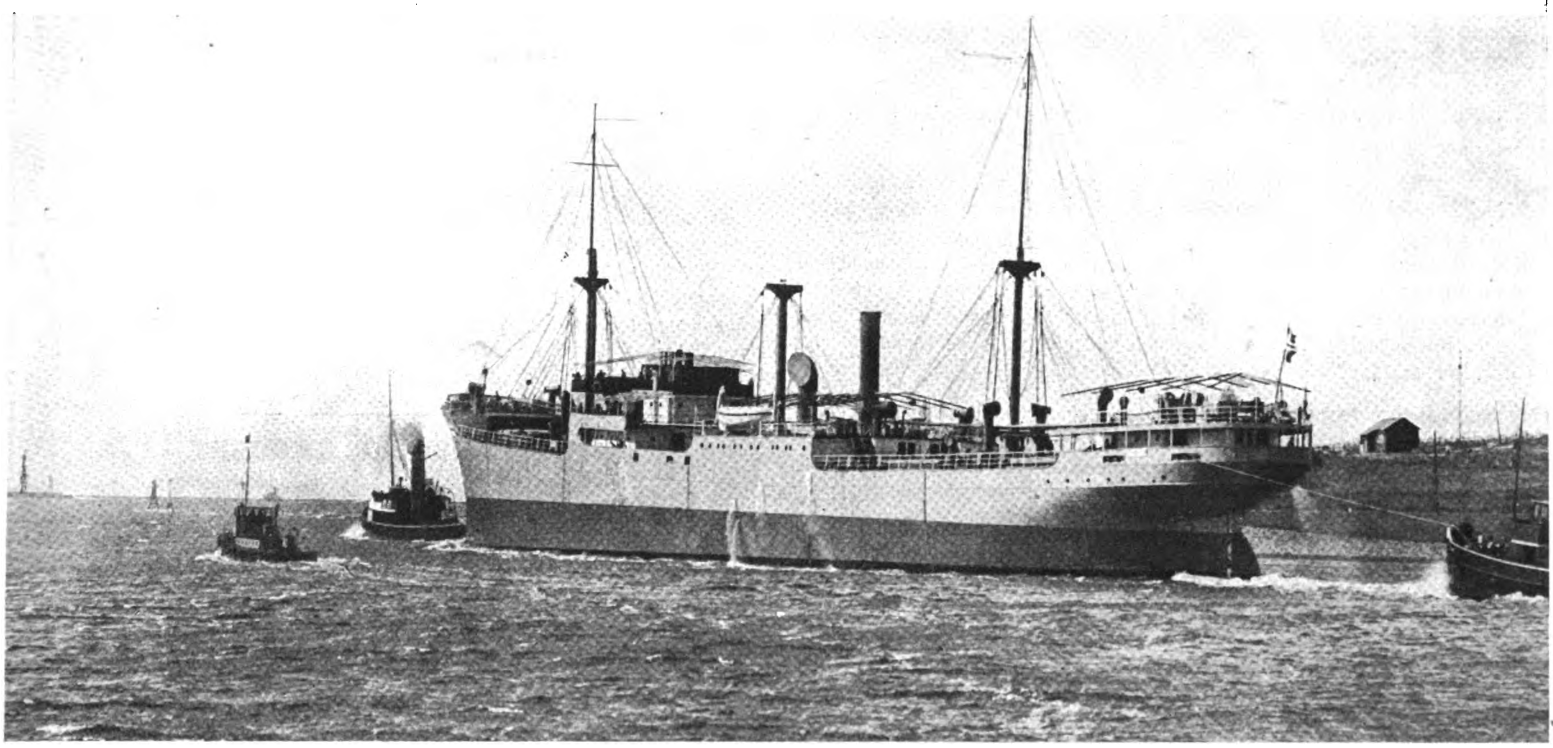
I WAS one of the first men in U. S. A. to operate a twin-screw American built Diesel oil-engined boat, the machinery installation of which was carried out by myself on Chicago River, Ill. Without any dock trials, the engine-builder and the owner ordered the Captain to proceed to Mackinac Island, a run of 340 miles from Chicago. A non-stop run was made with engines turning at 300 revolutions. The present Editor of "Motorship," (at that time Power Editor of "Rudder") was aboard. I operated this boat for three seasons on the Great Lakes and the Craig engines did not cost $25.00 to the engine-builder or owner for repairs or alterations. Since that time, I have visited many American-built Diesel-engined yachts and commercial boats, and had talks with the different chief-engineers about their experiences and their little troubles. I find that all their troubles are small ones compared with the repairs that have to be done on reaching port with steam-engines.

The usual work on the Diesel-engine in port, comprises of grinding-in the valves, namely fuel, air-starting, exhaust, inlet and safety valves, which should be done in routine at each end of a voyage so that every valve will get attention in its turn, using the log-book as a guide. As the compressor is the life of the Diesel-engine, its valves should be attended to with regularity. If they should begin to leak the pressure-gauges will give a warning. Main bearing and crank-pin boxes will soon let you know when clearances becomes too great.

The writer was in Mobile, Ala., some months ago, and upon going aboard an American motor-vessel at dock undergoing a general overhaul for Lloyd in the engine-room, found a gang of machinists stripping the main motors. Three men were trying to remove a fuel-valve, a one-ton chain-block was hooked to the valve and two 4 ft. crow-bars were used to remove the valve. After it was removed and placed on engine-room floor I carefully examined it with others. They were in such shape that they had to be put in lathe and faced-off before using again. On making enquiry from the 1st engineer, I found that fuel-valves had not been out of the cylinder heads in 12 months. Such neglect leaving the valves so long in the heads and having to machine the same, adds to the cost of upkeep, and causes men who are investigating cost of maintenance and so forth of the Diesel-engine to ponder. Upkeep is so great on some ships caused by loose methods in the engine-room, that they are afraid to adopt Diesel power.

Some weeks ago I was aboard the Dutch built Norwegian 9,500 tons motorship, "Tosca" in New Orleans. She is equipped with twin 1,400 i.h.p. Werkspoor Diesel-engines. As it was my first visit aboard such a large motorship, I was surprised at the equipment. Two 100 h.p. auxiliaries on the starboard and one 100 h.p. on the port side, everything in dual, with all pumps on port side making a very fine layout. Certainly it was very interesting to me.

The 1st assistant engineer operated the port engine for my benefit, not only on air but three cylinders on oil, then six cylinders, both ahead and astern. The eccentric reverse-motion is of the latest Werkspoor type. Three stage air compressors on three cranks at forward end of engine, used for fuel injection also for the starting-bottles. One of the auxiliaries was running supplying lights also charging starting-bottles, getting ready for sea, and it was practically noiseless. After two hours in the engine-room, I felt as I would like to make a trip on "Tosca" in any capacity in engine-room for my own benefit. However, my wife went to London as a passenger, and it will be interesting to have a woman's view of a voyage on a motorship. This ship had been in port eight days when I made the visit. The engine-room was perfection, all the hand-rails were highly polished, also all bright parts of the Diesel-engines, and was a credit to the chief and engine-room force.



Winge & Co.'s new Werkspoor Diesel-engined motorship "GEISHA" passing out at the Hook of Holland en-route for her sea-trials. She is a sister motorship to the "TOSCA," also referred to on this page

Werkspoor-Engined Motorship "Geisha"

On this page is an illustration of Winge & Co's new motorship "Geisha", of which drawings were published in our issue of February, 1920, prior to her completion. She was placed in service during September last. Further details and revised dimensions are now available, and her general dimensions are as follows:

Displacement (loaded)	10,260 tons
Displacement (light)	3,255 tons
Deadweight capacity	6,990 tons
Net-cargo capacity on 10,000 mile's voyage	6,150 to 6,250 tons
Cubic-capacity of holds	381,454 cu. ft.
Capacity of deep-tank (cargo only,	9,719 cu. ft.
Total cargo capacity	391,173 cu. ft.
Capacity of fuel-bunkers (D. B.)	37,215 cu. ft.
Power	2,880 I.H.P.
Engine and propeller speed	125 R.P.M.
Propellers, 11 ft. 9¾ in. dia. by 10ft. 2 in. pitch with 3.6 sq. meters projected area	
Diameter of tail shaft	12.204 ins.
Ship's loaded speed	11 knots on 23 ft., 1 in. draft
Mean indicated-pressure	100 lbs. per sq. inch
Daily fuel-consumption	10 tons
Number of machinery staff	six engineers, eight oilers
Weight of complete engine-room machinery	550 tons
Weight of twin main-engines	275 tons
Length of machinery space	46 ft.
Type of auxiliary machinery	Diesel-electric
Length of ship (O. A.)	119.175 meters
Length (B. P.)	114.300 meters
Breadth (M. D.)	15.620 meters
Draught (loaded)	7.342 meters

Consulting-engineers who maintain that Diesel-engines are heavier than steam-machinery and occupy more space, will do well to check-up the weight of the machinery of the M. S. "Geisha." As will be seen by referring to the drawings we previously published, the total machinery space for nearly 3,000 horse power is but 46 ft.; while the complete engine-room machinery (main engines, auxiliary-engines, generators, gratings, pumps, thrust-blocks, fuel and air-tanks, etc.), only weighs 550 tons. The engine-speed is not high, being rated at 125 R. M. P., but in service about 110 to 115 revolutions are generally maintained.

The propelling plant consists of twin six-cylinder four-cycle type, Werkspoor Diesels, each 22.047 in. bore by 39.370 in. stroke, built at the Werkspoor Works, Amsterdam, Holland. The hull was built by their adjoining yard, the N. V. Nederlandsche Scheepsbouw (Netherlands Shipbuilding Co.). The vessel operates under the Norwegian flag, with Christiania as her home port.

BURMEISTER AND WAIN OPEN AMERICAN OFFICE

With a view to furthering the sales of their Diesel-engines in America (which they are able to do under their license agreements) and for general business purposes, Burmeister and Wain of Copenhagen have opened a New York office at 27 Whitehall St., with H. C. Hallings in charge. Mr. Hallings is also marine-superintendent of the United Steamship Line.

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MOTORSHIP

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"Motorship" is published on the 25th of the month prior to date of issue, and all changes in and new copies for advertising must be in the hands of the publisher prior to the 5th of each month. Notice of discontinuance of advertising must be given before the 1st of the month, preceding issuance.

WANTED—A MAN OF RESOLUTE PURPOSE, FINANCIALLY BACKED BY CONGRESS!

Everyone, including farmers and others in the Middle West, realize that steps bordering upon radical action must be taken if our merchant-marine is to continue carrying the American flag at the taffrail to all parts of the world. Yet some marine-men are inclined to consider "Motorship" a little over-enthusiastic in publishing suggestions to sink a thousand of the worthless wooden and steel ships, and convert several hundred of the better steel hulls to economical Diesel power, which, of course, would be radical and would require the sound common sense and unshaken nerve of a big man with vision like General Dawes to take the initiative and responsibility, and who would do what he said, not dally for week after week without accomplishing anything tangible—or, in other words, a man who would not play politics in Washington!

Something can be saved from the ship-wreck by carefully throwing a little additional good money after the bad. The country is too deeply involved—too many billions have been spent, to let our entire fleet rust. So we believe the nation will be willing to spend a hundred millions or so if it can be demonstrated that a number of idle ships can be converted to first-class motorships capable of competing against foreign vessels. But whether the nation is willing, or not, for the Shipping Board to spend the money is another matter!

Probably the solution rests with the Board being empowered to turn such hulls over to shipowners at an extremely low cost on the understanding that oil-engines are to be installed, and at the same time make a financial grant towards the conversional costs, and this to be in accordance with the final cost to the shipowner on the basis that by the time the vessels are ready for sea they do not cost him more than similar ships can be purchased today in Great Britain and Continental Europe. This to be guaranteed by the Board. The shipowners, of course, will select and buy the engines.

That the various "radical" proposals made in "Motorship" are worthy of most serious consideration is indicated by the recent speech of that worthy and experienced American shipowner, Frank E. Munson, president of the Munson Steamship Line, who said:

> "Each of the approximately five hundred steel cargo ships of the United States Shipping Board, ranging from 3,000 to 7,000 tons, and now tied up, should be equipped with Diesel engines or electric drive and sold. Suppose it cost $150,000 to $250,000 to re-engine the ships, they could be sold readily at $350,000 to $500,000. They could be placed in profitable service and the board not only relieved of this large amount of tonnage which is now hanging over the market, but it would also receive cash working capital. This is one of the first powers Congress should give the board."
>
> "With this work begun thousands of unemployed men would be given work; buying capacity would be partially restored so that every line of business would profit and the ship-yards would again be active. The owners of these ships, many of them as fine vessels as are afloat to-day, could laugh at all this talk of foreign competition. Higher wages would be more than offset by the economies of operation, quick turn around and the driving force of American organization.
>
> "The wooden ships should be dismantled and sunk," Mr. Munson said. "They were a war experiment and served their purpose. Recognize it and get rid of the junk."

A sentiment in favor of such action is growing among congressmen, including Senators Wesley L. Jones, Duncan U. Fletcher, Representative G. W. Edmonds and others. In a recent letter to us, Mr. Edmonds said:

> "It was with pleasure that I listened to the speech of Mr. Frank Munson, made during the voyage of the "Southern Cross" from Philadelphia to New York. Mr. Munson is one of our most able shipping operators, and when he praised so highly the "motorship" as the coming vehicle of trade, he only confirmed my convictions made in 1916, *and urged by me upon the various chairmen of the Shipping Board, I regret to say without any action on their part.* Perhaps it was not possible to carefully develop or study the various motors during the war, with positive assurance of the results desired, but it is now becoming more evident every day that the motor for economy and efficiency is far in advance of any other type of propulsion for shipping. It will be absolutely necessary for us whenever opportunity occurs, or changes can be made reasonably, to endeavor to instal and place in operation ships of this type. In my opinion the future control of commerce will be attained by the nations using this method of propulsion for their ships."

If the Chairman of the Board has more vision than his predecessors he will find in this "conversion to economical motorships" proposal an excellent platform to put before the country, and the Board afterwards can gracefully retire, leaving shipowners with a fleet of vessels that can hold their own in competition with all nations. Economy is paramount today, but the nation will agree to a moderate additional expenditure if assured of economy resulting. Is Mr. Lasker the big man for the job and sufficiently far-sighted to see the splendid opportunity, or will he follow the lead of most of his predecessors and play politics?

PROMINENT BRITISH NAVAL ARCHITECT'S OPINION

In a review of the present shipbuilding and ship-operating position, Maxwell Ballard, a well-known British naval-architect, recently stated:

> "It would be an oversight in passing the replacement question to ignore the handwriting on the wall. There is not a progressive shipowner to-day who is not alive to the inevitable—the substitution of the vastly more economical motor-vessel in place of steamers. The next few years will see considerable such building, or Germany will quickly lead in efficient and economical tonnage. Without doubt the American Fleet contains many fine and well-constructed vessels, also a lot of junk. It is surely not without reason that an American shipping journal, in addressing Mr. Lasker, soberly suggests that he should sink 1,000 worthless steamers or more to hold back the flood of money going to waste."

As British shipping men have many more years of ship-operating experience than most Americans, and as they are closely watching America's merchant-marine, they are in a position to see a little further ahead than Washington appears able, so the Shipping Board as well as shipowners should ponder awhile over Mr. Ballard's remarks. Incidentally we note with interest that he reads "Motorship," as he quotes from the article published on page 635, of our issue of August last.

CAUSE FOR THOUGHT

Directly contrasting with shipyards where steamship and steam engine construction is carried out exclusively, Burmeister & Wain, of Copenhagen, are working three shifts per day in their engine-shop. Motorships and Diesel-engines are constructed exclusively at this well-known yard. This position of affairs is worthy of serious consideration by the various American shipyards who have not yet turned to merchant-marine Diesel-engine construction. Twenty-four hours per day building Diesel engines is worthwhile.

EVERY DAY WE LEARN!

All this talk about Diesel-engines for the American merchant-marine is British propaganda, says Edgar Pennington Young, publisher of *The Marine Journal.* If this is really so we must call motorships "hush-hush ships," and re-name this publication "Hush-Hush!"

AN OPPORTUNITY LOST

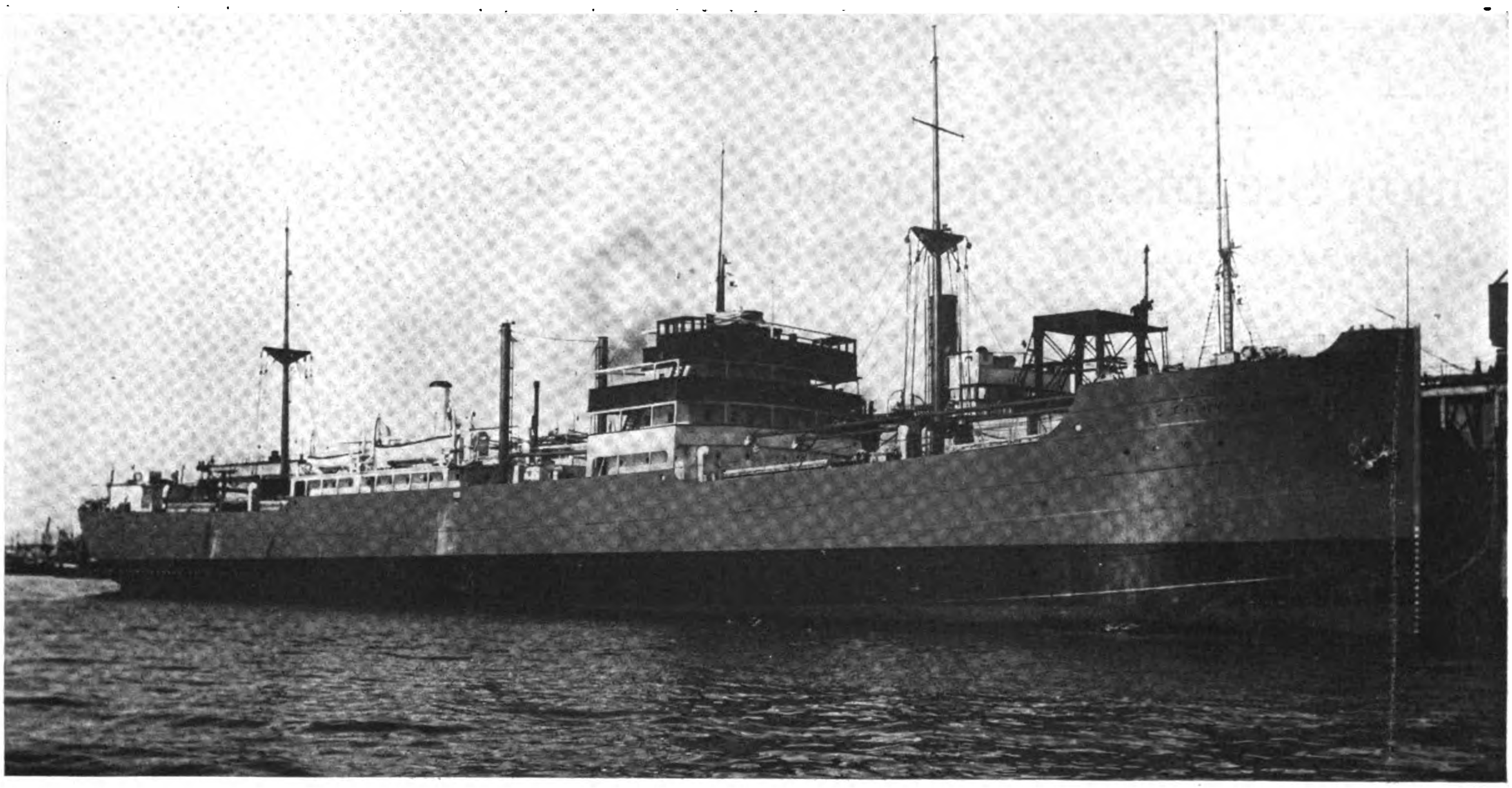
Recently the Ward Line awarded a contract for reconditioning the passenger steamship "San Jacinto," including the installation of four new boilers, new reciprocating steam-engines and the installation of fuel-oil tanks as well as changes to the accommodation. We understand this will cost more than a million dollars. The "San Jacinto" is a ship 6,069 tons gross, 380 ft. long by 53 ft breadth, so appears to be an ideal vessel for the installation of Diesel-engines or Diesel-electric drive—this time being a splendid opportunity to do the work at low cost. It seems extraordinary that the Ward Line should have arranged to put new but uneconomical steam-engines and boilers in these days of absolute reliability of the Diesel engine, and with so many excellent makes of Diesel engines available in the United States. A somewhat similar case is that of the Mallory Line's vessel "Henry R. Mallory," for which the contract has just been awarded to the same yard for rebuilding engine foundations and the installation of new auxiliary machinery at a cost of $45,700. The "Henry R. Mallory" is of somewhat similar size, being 6,063 tons gross, but a little longer overall.

First of Sixteen Diesel-Driven Ore-Carriers Runs Trials

Reference has been made at various times in "Motorship" to the fleet of 18 ore-carrying ships ordered by Trafikaktiebolaget Grangesberg-Oxelosund of Stockholm, Sweden, from the Götaverken of Göteborg of which sixteen are to be Diesel-driven—the first two having been steam-driven. The first of the motor vessels is the "Strassa" 8,350 tons d.w.c. Her trials were run on Sept. 24th, in very rough weather with a wind of 14 meters a second, yet the result was very excellent. The ship was light with the exception that the double-bottoms were filled with fuel-oil, giving her a displacement of 5,800 tons on a draught of 11 ft. 3 in. forward and 15 ft. 11 in. aft. She was described on page 581 of our July number.

During the full-power trials the twin engines together developed 3,085 i.h.p. at 145.8 r.p.m., giving the ship a speed of 12.4 knots. For the trials proper, the engines developed 2,643 i.h.p. at 136.8 r.p.m., the ship averaging 11.70 knots with a propeller slip of 5.07 per cent. The fuel-consumption was registered as 0.142 kg. per i.h.p. hour for the main engines, or 0.149 kg. per i.h.p. hour, including all auxiliary machinery.

It will be remembered that this well-known Swedish Ore Company only adopted Diesel-drive after very careful investigation. The results of the trials have made the builders confident that the owners will very soon discover that the practical results will be the same as the theoretical conclusion arrived at by a Committee who had to decide upon the question of Diesel or steam drive.

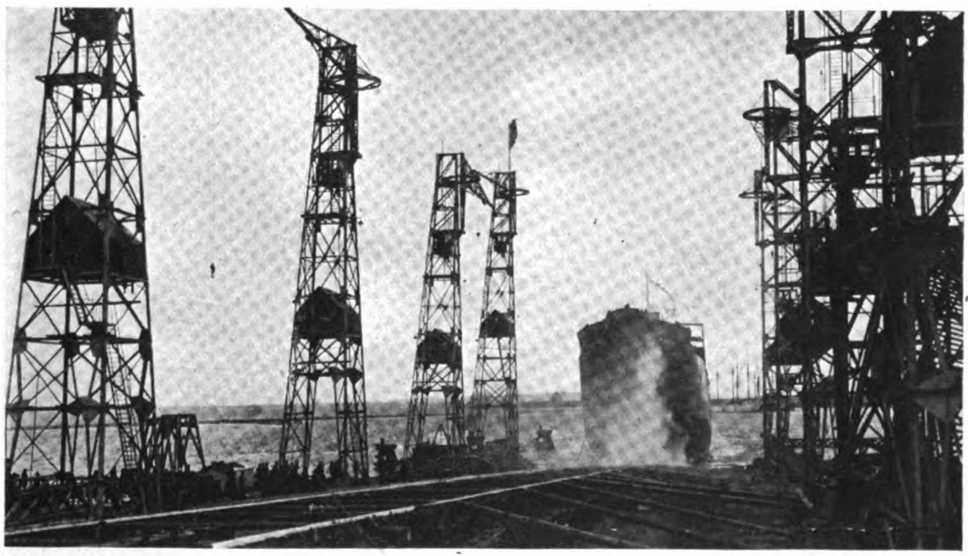


"STRASSA," the first of sixteen Diesel-driven ore-carriers at the Göteverken for the Grangesburg Oxeslund

LAUNCH OF MOTORSHIP "CANTON"—SWEDEN'S LARGEST MERCHANT SHIP

Drawings of a 10,400 tons deadweight motorship building at the Oresundsvarvet, Landskrona, Sweden, were given in our issue of January last. This vessel, the "Canton", was launched on Sept. 24th, and is noteworthy as being the largest merchantship yet built in Sweden. Her overall length is 440 ft. At that time we stated that she was building to the order of the Swedish Orient Line. However, she will be operated by another of Dan Brostrom's enterprises; namely The Swedish Asiatic Company, that also owns the motorship "Formosa". The twin 2,000 i.h.p. B. & W. Diesel-engines of the "Canton" were built by the Götaverken, and are similar to those in the "Bullaren," "Tisnaren", and "Elmaren". They will turn at 100 R.P.M. and are expected to give the ship a speed of 12½ knots. Their cylinder bore is 740 mm (29.134 in.) by 1100 mm (43.307 in.) stroke, or 50 mm (1.968 in.) less stroke than have the 2250 i.h.p. engines of the "William Penn".

It is significant to note that the motorship "Afrika" is the largest merchant-vessel ever built in Denmark, while the Sulzer-engined motorship "Handicap" is the largest vessel ever built in Norway, so motorships have set the size record in three Scandinavian countries. Very shortly motorships of 15,000 tons d.w.c. will be built in Denmark at the Nakskov Yard.



Launch of Swedish East Asiatic Co.'s new Motorship "CANTON"

ANOTHER DIESEL-MOTOR CABLE-SHIP

Bids have been asked by the Great Northern Telegraph Company of Copenhagen on a twin-screw cable-laying motorship of 350 ft. length and of 2,400 shaft h.p. for service in Chinese waters. Unlike the Western Union's Diesel-electric cable-ship, this vessel is to have direct Diesel drive; but there will be an auxiliary Diesel-electric generating-set for operating the cable-laying plant. It is probable that two 1,200 i.h.p. Burmeister and Wain engines will form the propelling plant.

DIESEL-DRIVEN TRAINING MOTORSHIP RUNS TRIALS

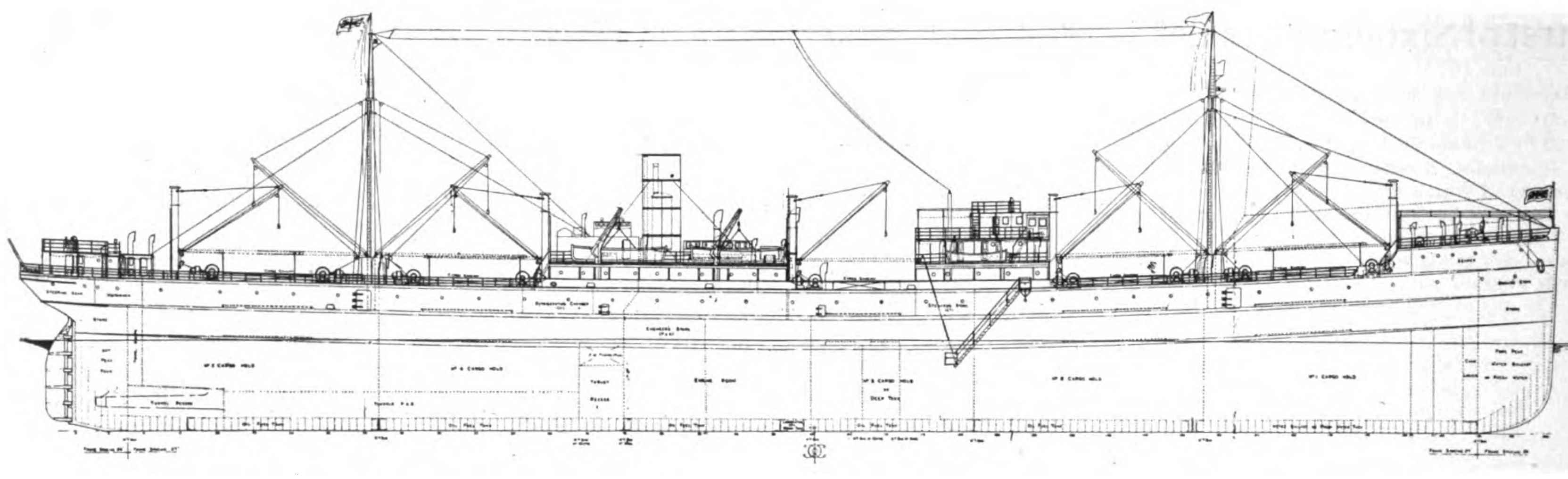
Following her sea-trials the East Asiatic Company's new fully-rigged Diesel-auxiliary "Kjobenhavn," 6,000 tons deadweight, arrived at Copenhagen on October 5th. She carries a crew of 50 men and 12 apprentices.

MOTOR-TANKER "SCOTTISH STANDARD" RUNS TRIALS

Trials were run on Sept. 29th of the Vickers Diesel-engined tanker "Scottish Standard," 10,000 tons deadweight, built by Vickers Ltd. for Tankers Ltd. of London. The owners are associated with the Scottish-Mexican Oil Company of 120 Broadway, New York, who advised us nearly three years ago that they would construct a fleet of motorships. Three sister motorships are now nearing completion to their order at Vickers.

MOTORSHIP AND STEAMER COLLIDE

The steamer "Edam" collided with the motorship "Glenogle" on September 29th. Both vessels were badly damaged, but the "Glenogle" reached Rotterdam safely.



Union Steamship Company's Big Motorship "Hauraki"

Details of New 10,600 tons d.w.c. North British Diesel-Engined Freighter Which Has Big Cargo Capacity.

ONE of the principal features about the new cargo motorship "Hauraki" built for the Union Steamship Company of New Zealand for trade on the Pacific and Indian Ocean with New Zealand and Australia, is that no other class of vessel can circumnavigate the world without taking fuel enroute and yet carry such a large general cargo in proportion. Had this freighter (which was referred to in our October issue as "Mauraki") been coal-fired, she would consume 66 tons per day and average only 11½ knots; whereas her fuel-consumption with Diesel drive will not exceed 16 tons per day, while her average loaded speed will be 12½ knots.

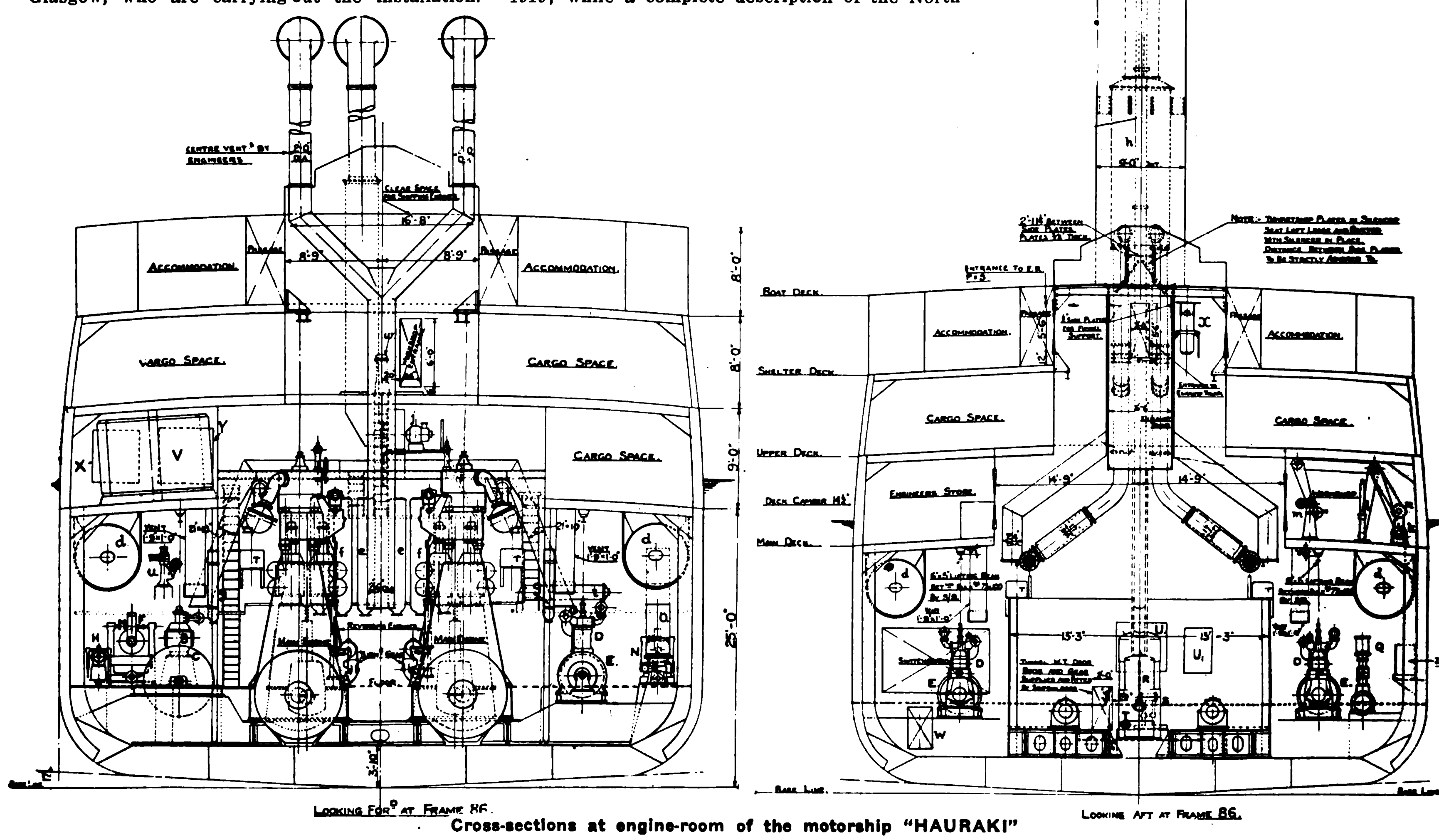
It is interesting to record at this time that the owners of this ship have been subscribers to "Motorship" for several years, carrying subscriptions for their London and Glasgow offices, as well as for their head-office in New Zealand. So we think it very probable that their decision to order this vessel was to an extent influenced by the useful information published in various issues of this publication.

She is an unusually fine-looking vessel for a freighter and was launched Aug. 24th last by Denny Bros. of Dumbarton, Scotland, while her Diesel machinery was constructed by the North British Diesel Engine Company, of Whiteinch, Glasgow, who are carrying-out the installation. The fuel is carried in all double bottoms and peak and if necessary the deep-tank can be loaded with fuel-oil totaling about 2,950 tons in all. But it is doubtful if fuel-oil will ever be carried in her deep-tank because less than the above quantity will enable her to circumnavigate the world. Therefore, we presume that her deep-tank will be used for cargo only. On a 6,999 nautical-mile voyage, taking in fuel at each terminal point, the "Hauraki" will carry 1,000 tons more weight cargo than a similar vessel with steam-engines coal-fired, and take one day less to cover the distance. Her overall dimensions are as follows—

Deadweight	10,600 tons
Power of main engines	4,000 i.h.p.
Power of auxiliary engines	600 b. h.p.
Speed	12½ knots
Daily fuel-consumption	16 tons
Length (BP)	450 ft.
Breadth	58 ft.
Depth	34 ft.
Loaded draft	27 ft. 6 in.
Passenger-accomodation	8 first class

It will be remembered that first reference to this vessel was published in our issue of Nov., 1919; while a complete description of the North British Diesel engine appeared in our issues of May and July, 1921, only the engines described were of 2,300 i.h.p. at 96 R.P.M.; whereas the engines of the "Hauraki" are a little smaller in power. Two engines are installed, each six-cylinder sets of the four-cycle type, 26½ in. bore by 47 in. stroke, having an output of 1,750 I.H.P. each at 96 R.P.M. Otherwise the general design follows the larger sets with, of course, a few minor modifications. There are three auxiliary Diesel-engines, two of which are arranged at the starboard side and one on the port-side of the engine, all coupled to electric-generators at 220 volt. They are four-cylinder sets 11½ in. bore by 14½ in. stroke each developing 200 b.h.p. at 375 R. P. M.

The vessel is not insulated for meat cargoes, but her provision chambers are insulated and an ammonia plant is installed. The captain and officers are berthed near the bridge, and the engineers around the engine casings all in large comfortable cabins. In addition, there is accommodation for 8 passengers. It is interesting to note that main air-compressors are driven-off the crankshaft of the main engines and consist of twin three-stage sets. The following are details of the auxiliary machinery installed.



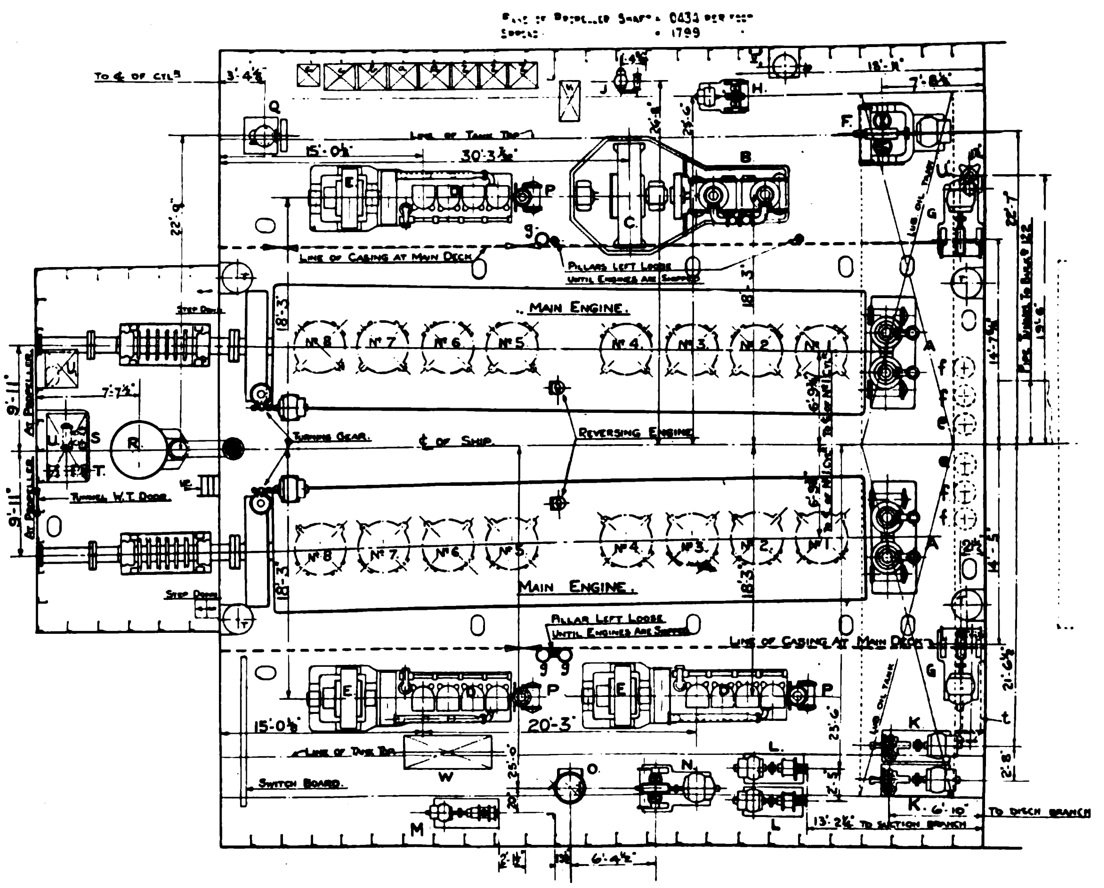
Cross-sections at engine-room of the motorship "HAURAKI"

Number ot cylinders—3 in each set
Dia. of H. P. .... 4¼ in.
Dia. of M. P. .... 15 5/16 in.
Dia. of L. P. .... 17½ in.
Capacity per minute .... 250 cubic-feet each
Capacity for 1 main-engine ...... 500 cubic-feet each

Auxiliary Machinery

Auxiliary Compressor, electric motor-driven
Number of cylinders .... 3 in each set
Dia. of H. P. .... 3¾ in.
Dia. of M. P. .... 13 9/16 in.
Dia. of L. P. .... 15½ in.
Stroke .... 11¼ in.
Total capacity per min ...... 480 cubic-feet in one machine at 1,000 lbs. pressure.
Revs. per min .... 250. Each compressor is a two-crank machine, each crank coupled to a 3-stage compressor.

Steam Emergency-Compressor
Number of Cylinders 2
Dia. of H. P. cylinders .... 2¼ in.
Dia. of L. P. cylinders .... 6½ in.
Stroke .... 6 in.
Capacity per min .... 28 cu. ft. at 900 lbs. pressure
Revs. per minute 350
Pumps—piston cooling (2)
  Type .... Centrifugal
  Capacity .... 50 tons per hour
Pumps—Cylinder cooling (2)
  Type .... Centrifugal
  Capacity .... 150 tons per hour
Pumps—Lubricating (2)
  Type .... Reciprocating
  Capacity .... 50 tons per hour
Pumps—Ballast (1)
  Type .... Reciprocating
  Capacity .... 200 tons per hour
Pumps—Fuel Supply (1)
  Type .... Reciprocating
  Capacity .... 15 tons per hour
Pumps—Bilge (1)
  Type .... Reciprocating
  Capacity .... 50 tons per hour
Pumps—Emergency Bilge (1)
  Type .... Centrifugal (submersible)
  Capacity .... 50 tons per hour
Pumps—Sanitary (1)
  Type .... Centrifugal
  Capacity .... 30 tons per hour
Pumps—Fresh Water
  Type .... Reciprocating
  Capacity .... 5 tons per hour
Oil Purifier (1) "De Laval"
  Capacity .... 120 gallons per hour
Starting air Reservoirs—350 lbs. pressure
  Four cylindrical tanks .... 5 ft. 9 in. dia.



Engine-room plan of the motorship "HAURAKI"

Total capacity about .... 1520 cu. ft.
Daily fuel-tanks (2) at top of engine-room
  Capacity in each .... 12 tons
Lubricating-Oil Tanks in double bottom (2), each with about 12 tons capacity fully.
Settling-Tank for dirty lubricating-oil of 1½ tons capacity.
Donkey-boiler (1), Cochran make, oil-fired
  Working pressure .... 100 lbs.
  Diameter .... 4 ft. 3 in.
  Length 11–0
Evaporization .... 1,100 lbs. per hour
Steering-gear built by Brown Brothers of Edinburgh. Electro Hydraulic and Williams Janney transmission gear.
Windlass—Electric by Clarke Chapman.
Winches—18 MacFarlane Patent, winch drums driven by 11 motors all made by Clarke Chapman

Some motors drive two drums and the other only one drum. Each winch motor is of 35 b.h.p. and is continuous running.

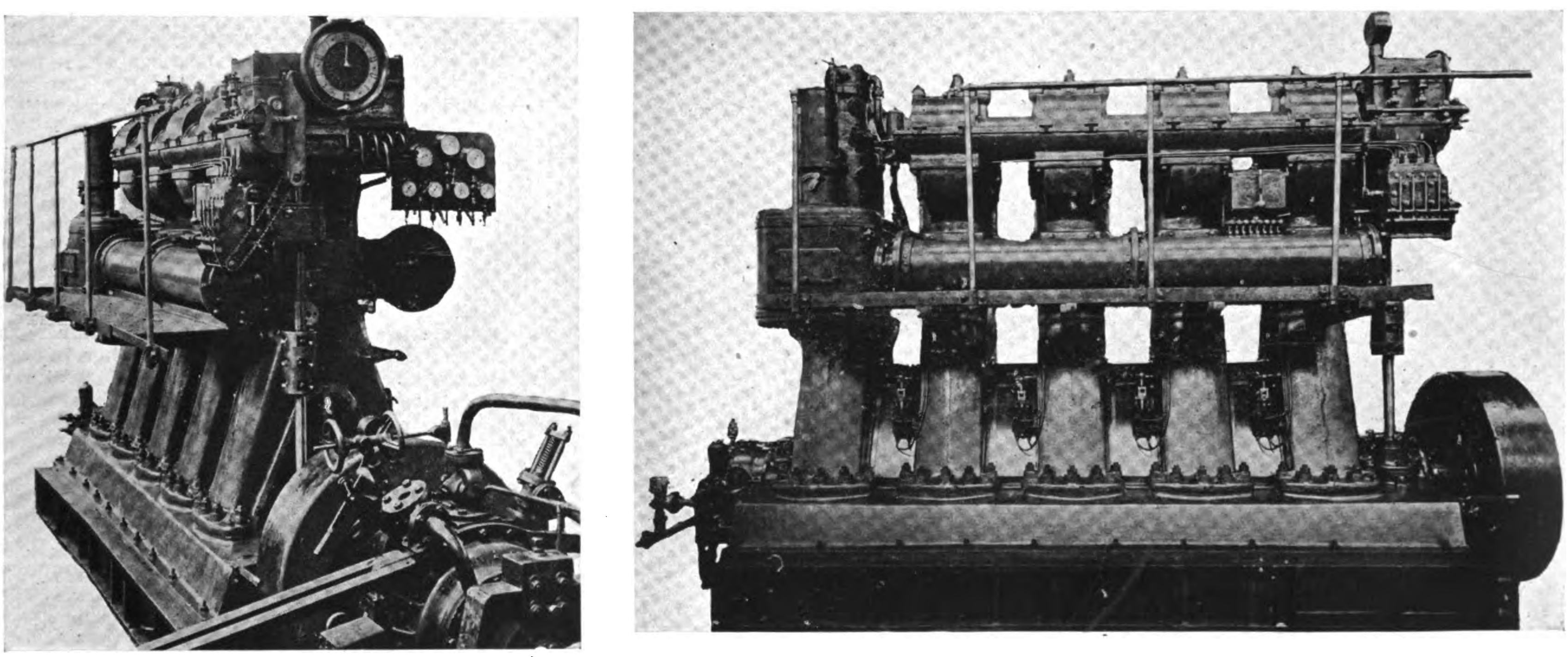
An unusual feature of the engine construction is that the main-engine pistons are of cast-steel with ordinary cast-iron piston-rings. The piston can be withdrawn from the top or below each cylinder. Cylinder covers of the main engine are of box-section, water cooled, and fitted with independent motion, exhaust, fuel, starting and relief valves. All the valves open inward except the fuel-valve which opens outward. The crank-shafts of steel are entirely built-up. Each shaft is in two pieces. The propeller is 3-bladed of bronze. The whole of the machinery is to Lloyds & B.O.T. requirements.

SABATHE DIESEL-ENGINE IN AMERICA

From time to time information regarding the Sabathé Diesel engine has been published in this magazine. It will be remembered that by means of a special system of double fuel-injection whereby combustion is carried-out by means of constant-volume and constant-pressure this engine was the first to obtain a fuel-consumption in practical operation below 0.40 lb. per shaft h.p. hour with high-speed naval types. This was prior to 1914.

The engine in question is constructed by the Societe des Moteurs Chaleassiere of St. Etienne, France and is now represented in the United States by M. Jules Cablet, 280 Broadway, both for the marketing of engines and the disposal of constructional rights. The Sabathé engine has been designed by Mr. Leflaive and M. Bordeulle, formerly engineers of the French Navy and is sometimes known as the Leflaive engine. Mr. Cablet, the new American representative was formerly Minister of Marine of France.

Lately this Company has turned more extended attention to a commercial engine, and designs have been produced in the 2-cycle and 4-cycle types ranging from 75 h.p. to 3,000 shaft h.p.



Two views of a four-cylinder two-cycle Sabathe-Diesel marine-engine built by The Societe des Moteurs Chaleassiere

Heavy Oil-Engined Oyster Dredger

Interesting Tandem Installation of Mianus Motors in a New England Vessel

AFTER their initial prejudice wore away, the fishermen of the New England Coast took—metaphorically speaking—to the gasolene motor like ducklings to water. In a similar manner they have been a little apprehensive in changing to the more economical oil-engine, especially because in these days of abnormal prices the outlay is greater than the cost of the previous change from sail (or steam) to gas. Nevertheless, the obvious success of a number of fishing-craft recently built or converted to Diesel and surface-ignition oil-engines by several progressive owners is awakening their interest, driving away their fears with every indication that there will be a considerable number of boats converted to heavy-oil before the height of next summer's fishing. Many owners intend to take advantage of the period during the winter when some of their craft are laid-up, and thus avoid loss of operating time.

The oyster dredger, "SEA COAST"

Recently we went on a test-trip of the New Haven 91 ft. oyster-dredger "Sea Coast," owned by the Sea Coast Oyster Co. of that port. This vessel was built about six months ago by the Eastern Shipyard Co. of Greenport, and equipped with a 100 b.h.p. gasolene motor. But after a couple of months' service the owners decided to make her more economical in operation, and to increase her speed, inasmuch as the original power-plant could not turn-up the propeller at the designed speed, although rated higher in output than the present twin engines together. The wheel is a Columbian bronze 48-in. dia. by 36-in. pitch and is now turned at 360 R.P.M. giving a speed of 10½ knots, whereas the former motor would only turn this propeller at 270 R.P.M. resulting that a speed of 8 knots only was attained.

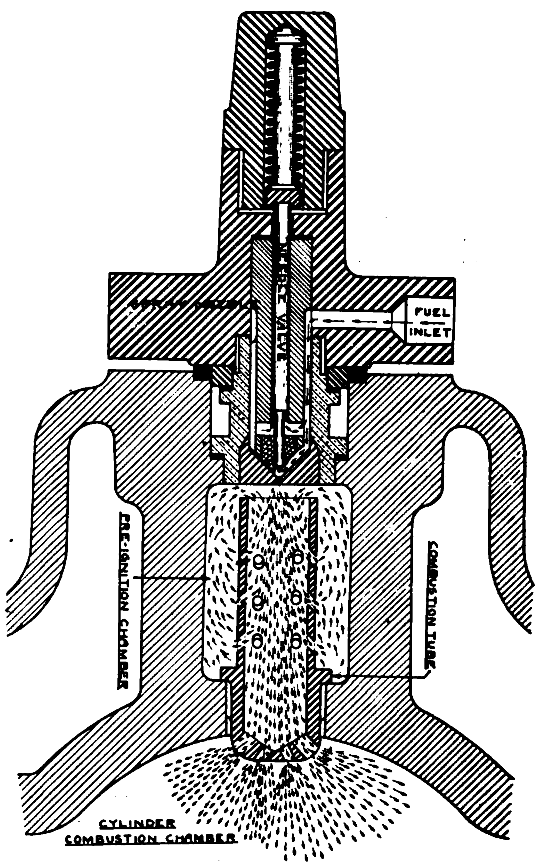
Prior to the conversion the owners of the "Sea Coast" paid $240 per 1000 gallons of gasolene; they now pay $70 per 1000 gallons for Diesel-oil which quantity runs the ship one-third as far, because of the lower fuel-consumption.

The oil-engines were built and installed by the Mianus Motor Works of Stamford, Conn. To avoid structural changes to the hull the twin 40 b.h.p. engines were installed tandem and coupled to the single propeller shaft, which while very unusual in marine practice, is working out very well in this case, particularly as there is not much head-room for a single oil-engine of larger power. Officials from the owners who were aboard during the test trip off New Haven watching the operations of laying buoys and dredging for oysters, expressed themselves to us as being exceedingly pleased with the entire job and its installation.

As is now known, the Mianus oil-engine is made in the U. S. A. under Leissner license and patents by the Mianus Company, and is of the high-compression type with airless—or mechanical—injection of fuel, using a special device to assist the initial combustion when starting, and having both a pre-combustion and a main combustion. Thus the engine is not a Diesel engine or of the surface ignition class.

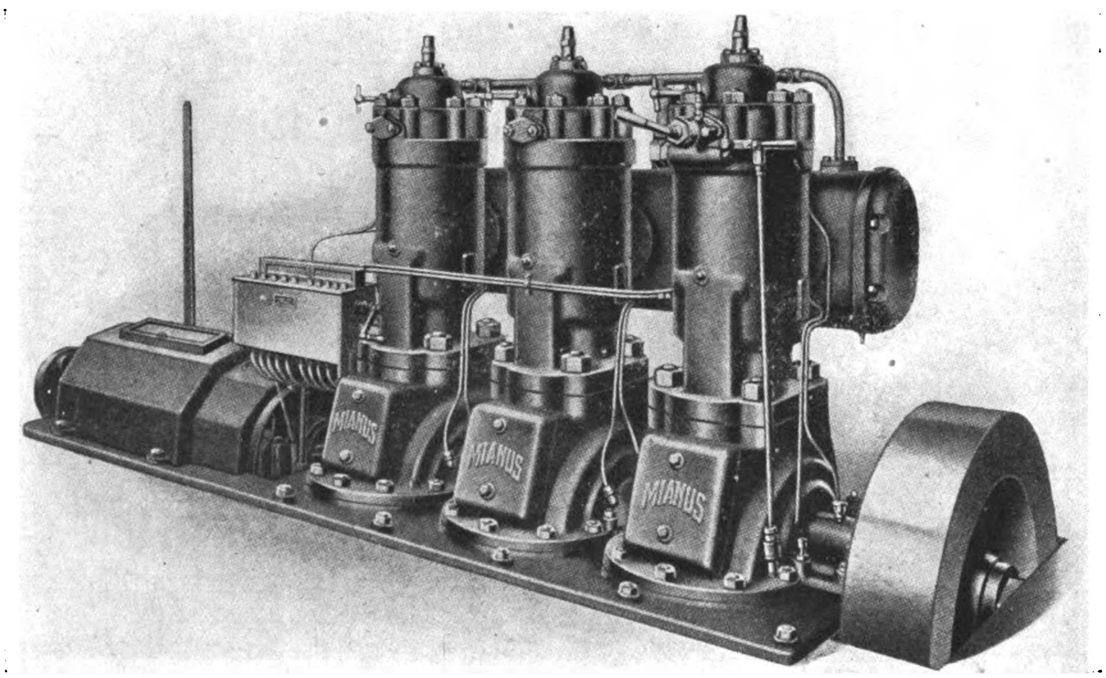
Consequently, a brief description of its system of operation will be of interest. A pump forces the oil at high pressure, via the regulating needle-valve shown in the sketch on this page, into a small chamber in the cylinder-head above the combustion chamber proper, which contains a perforated combustion-tube, and partial combustion occurs in this little space, that by the way is water cooled. The auxiliary igniting device consists of an easily detachable starting-plug that holds a small roll of chemically treated paper that burns with a glow like punk. This ensures starting when the engine is cold.

There is a separate pump for each cylinder arranged at the rear-end of the engine and operated by keyed eccentrics. The pumps supply an amount of fuel slightly in excess of that required, and the amount admitted into the combustion chamber is positively controlled by a cut-off valve which permits exactly the right amount to enter and by-passes the remainder back into the fuel line. The automatic governor operates on these valves, determining with perfect precision the amount of fuel required for any load. Contained in the pre-ignition chamber and directly underneath the spray-nozzle is the combustion-tube, the upper end being open and directly in line with the spray-nozzle. The lower end of the combustion-tube is closed, except for the drilled perforation, which communicates with and projects into the cylinder combustion-chamber directly over the piston. The fuel is led from the fuel-pumps to the spray-nozzles through a small pipe or tubing. When the fuel is compressed in this fuel line to 700 pounds, the pressure overcomes the needle-valve-spring allowing the needle to lift from its seat and spray into the combustion-tube at which time the piston is nearly at the top of its stroke.



Showing principle of fuel-injection and combustion with Mianus-Leissner engines

As a result of this upward piston-stroke, the compression within the cylinder, which is about 450 pounds per square-inch, forces air into the combustion-tube through the small holes in the closed end, thus preventing the oil vapors which are being sprayed into the open end of the combustion tube from entering directly into the cylinder. The mixture within the combustion-tube is too rich to be explosive, but suppressed combustion takes place as soon as the spray starts. A portion of the oil enters through holes inside of combustion-tube into the surrounding pre-ignition chamber, mixing therein with a larger quantity of highly compressed air. Explosion and greatly increased pressure occur within the latter chamber, the gases flowing back into the perforated combustion tube at a temperature of about 2,000 degs. Fahr. gassifying all oil vapors contained therein and discharging them during the down stroke of the piston into the cylinder chamber where they burn as fast as they mix with air.



One of the two three-cylinder 45 b.h.p. Mianus oil engines of the "SEA COAST"

THE "GENERAL PERSHING" SUNK

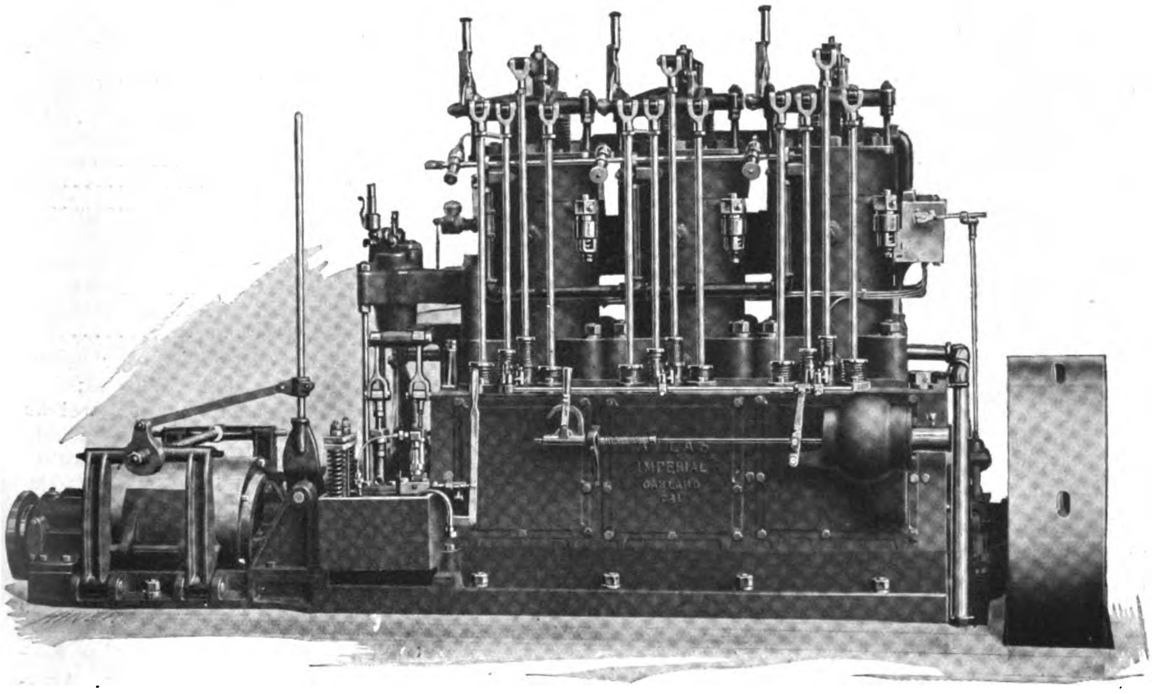
In our Aug. issue (page 645) we referred to the wooden motor-auxiliary "General Pershing" 2,450 tons gross having just been purchased by P. E. Harris & Co., Seattle, Wash., from J. Broch of Trondheim, Norway. She was recently wrecked on Endymion rock en route from Norfolk, Va. to Bremerton, Wash. We presume that the accident occurred prior to her delivery to the purchasers.

Diesel-Engine Construction on the Pacific Coast

Development of the Atlas Diesel Marine Motor—Fourteen Sets Now on Order

WHEN the Diesel-Engine commenced to be extensively adopted for marine work, both in large and small powers, engine-builders on the Pacific Coast were building distillate and gasolene motors of the constant-volume combustion type up to 600 b.h.p. in six cylinders. Seeing that the more economical heavy-oil burning engine was bound to take an important position in the field, several of the more enterprising Western concerns started to develop a Diesel-engine of their own design or else bought a foreign license. Among the former was the Atlas-Imperial Engine Co. of Oakland, Cal., then known as the Atlas Gas Engine Co., who built their first experimental Diesel-engine eight years ago using the well-known air-injection principle, which up to now has been commonly used by the majority of Diesel-engine builders. This experimental engine was the second Diesel-engine to be built on the Pacific Coast. It was eventually sold to the Riley Investment Company of Iditarod, Alaska, for the purpose of running a gold dredger, and was installed in the summer of 1917, where it has been in successful operation ever since.

As a result of the success of this engine a neighboring dredging company also at Iditarod purchased a duplicate of that engine the following season. This engine has also been giving excellent service and Beaton & Donnelley of Iditarod, the owners of the dredger in which the engine is installed, cannot speak too highly of the efficiency, economy, and good running qualities of that machine.



One of the several models of Atlas Diesel marine engines

In February, 1917, the Atlas Co. built and installed a 250-h.p. 6-cylinder Diesel-engine in the ferry-boat "Vashon Island," which goes on record as being the first Diesel equipped ferry-boat in the United States. The success of this engine is well known to readers of "Motorship." She has been in constant operation ever since and has had a record of never losing a trip due to any shortcomings of the machinery. Ferry-boat service is one of the hardest services to which a Diesel-engine can be put, and this ferry-boat has to run thirty days a month all year around, starts early in the morning and does not quit running until long after midnight. A recent letter from Mr. Anderson, superintendent of Transportation for King County, states that up to the present time the engine is running splendidly and giving excellent service, that it is economical, reliable and satisfactory in every respect.

In 1917 the company built four air-injection Diesel-engines for the Bolivia Tin Mine Corporation at Bolivia. These engines are running at an altitude of 12,000 feet above the sea level and have proved very satisfactory. In 1918 they built a 350-h.p. 4-cylinder engine which was installed in Vancouver, B. C., in the "Balan Quesada," formerly the steamer "Zaphiro," which was Dewey's dispatch ship during the Spanish-American War. The dimensions of this vessel are: Length, 213 ft. 7 in.; beam, 32 ft. 6 in.; depth of hold, 21 ft. 3 in. She is a twin-deck vessel built at Aberdeen, Scotland, in 1884. She is now flying the Costa Rican flag. A recent letter from her captain written at the port of New York informed her engine-builders that the engine is performing very satisfactorily and economically.

The same year they also built a 350-h.p. 6-cylinder engine which was installed in the motorship "Apex," then owned by Lee Wakefield & Company of Anacortes, Wash., but we believe is now owned by the Wilson Fisheries. We have been informed that the usual yearly run of that vessel during each fishing season since the engine has been installed has been approximately 30,000 miles and that the vessel has carried approximately 28 cargoes (14 cargoes up to Alaska and 14 cargoes back to Seattle) during each of the five seasons that she has been in service.

In 1917 the Atlas Co. built and installed a Diesel-engine in the tug "Ajax" for Lee Wakefield of Anacortes, Wash. In 1918 they built six Diesel air-injection type engines, which were installed in the three sister-ships "Cap Nord," "Cap Vert" and "Cap Horn." The engines were installed in these vessels at Vancouver, B. C., each vessel being loaded with a million-and-a-half feet of lumber in the North West and proceeded from Vancouver to Liverpool, England, each one of them making splendid runs, arriving in England in good condition and in remarkably short time. These three vessels are now engaged in trade between England and other European countries.

At the time these engines were installed the demand for Atlas-Imperial gas engines had become so great that they found it necessary in order to take care of their old trade to turn their attention exclusively to the manufacturing of the heavy-duty Atlas-Imperial gas-engines in order to satisfy their old customers. For that reason the company did not accept Diesel-engine orders during that busy period. When they finally arrived at the point where they had filled all their long overdue gas-engine orders they were at a practical standstill owing to the Metal Trades strike which was inaugurated all over the Pacific Coast at that time and which lasted for many months.

At the end of the strike they were in the middle of a business depression due to the reconstruction period after the great war. When finally the opportunity offered itself the Atlas Co. set to work and designed an entirely new type engine with the view of creating an engine sufficiently simple that it could be properly operated by the average crew of a fishing-vessel. Having had good experience and success in the building of air-injection Diesel engines, and having had nearly thirty years' experience in designing and building internal-combustion marine and stationary engines, they felt that they were qualified for such an undertaking. The result of their efforts has been the creation of the Atlas Imperial "airless" or solid-injection Diesel-engine which has proven a far greater success than anything the builders had expected it would be.

About six months ago they installed one of the new type solid-injection Diesel-engines of 55 h.p. in the Oakland Launch & Tugboat Company's "Colon." This engine has proven a wonderful success in point of reliability, power, economy, and ease of operation. About three months ago they installed a 4-cylinder 80-h.p. solid-injection Diesel-engine in the passenger-boat "G. W." owned by Garbutt & Walsh of San Pedro, Cal. One of 55 h.p. was shipped about two months ago to a client in the East.

At the present time they are installing two 55-h.p. engines in the freighter "Suisun City" owned by Hunt Hatch Company of Oakland and one 125-h.p. 3-cylinder is being installed in the freighter "Lark" for the same people. One 100-h.p. will be installed the coming week in the tugboat "Halcyon" for the E. V. Rideout Company. One 100-h.p. 3-cylinder engine to be installed in the tug "Panama" for the Oakland Launch & Tugboat Company. One 100-h.p. engine was sold to be delivered to the San Francisco International Fish Company for one of their fishing-tugs. One 55-h.p. engine is now being installed in the halibut schooner "Atlas" at Seattle. Several weeks ago the Atlas Co. received an order for six 80-h.p. engines, and one 100 h.p. engine from one concern. Judging from the amount of inquiries they have at the present time they expect to book at least $100,000.00 worth of additional orders for their new Diesel-engines before the end of the year.

A recent test of one of the new Atlas 100-h.p. 10½-in. bore 14-in. stroke, solid-injection 4-cycle Diesel-engines showed the following: Pulling 100 brake horsepower load at 230 revolutions, the fuel-consumption was 18¾ horsepower per gallon of crude-oil of approximately 18 degrees specific-gravity; 140 horsepower load was pulled for a number of hours at 250 revolutions; 182 horsepower load was pulled at 325 revolutions. Variation in speed when throwing the clutch in-and-out from no load to 125 h.p., less than 1½%. Lubricating-oil used, one gallon per twelve hours' work. Starting of engine as easy as starting a steam-engine. Using compressed-air it required 100 lbs. or over when the engine was cold, but after the engine was warmed up it started on 30 lbs. air-pressure.

The arrival of the little vessel "Suisun City" at the wharf of the Atlas Imperial Engine Company on Sept. 26th under her own power marks an epoch in heavy-duty gasoline-engine industry. The "Suisun City" was powered with a pair of 65-h.p. heavy-duty gas engines functioning perfectly, and driving the boat at good speed. These two reliable engines are now resting in the warehouse and are offered for sale at $750.00 each; and there are now being installed in the "Suisun City" two 55-h.p. Atlas-Imperial airless-injection Diesel-engines. The two 55-h.p. Diesels will give greater actual power than the two 65-h.p. gas-engines, with a big fuel-bill saving.

FEBRUARY AND MARCH COPIES WANTED

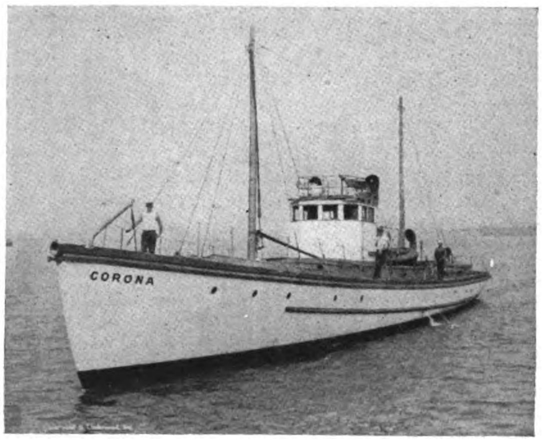
If any subscriber has a copy of February and March, 1921, that he can spare we will be glad if he will send same to Mr. A. Sybrant, 153 Rokin, Amsterdam, Holland, but first advise us, we will send stamps for mailage. Mr. Sybrant's copies were lost in the mail, and we are completely sold-out of those numbers.

AUXILIARY SCHOONER "MAGDALEN VINNEN"

Now building at Krupps, Kiel, Germany, is the 5,200 tons d.w.c. auxiliary bark "Magdalen Vinnen." She is 323 ft. long by 48½ ft. breadth and 24½ ft. draught. She has a single 500 b.h.p. submarine-type Diesel engine installed. Her canvas area is 3,392 sq. meters.

Utilizing Sub-Chasers for Commercial Work

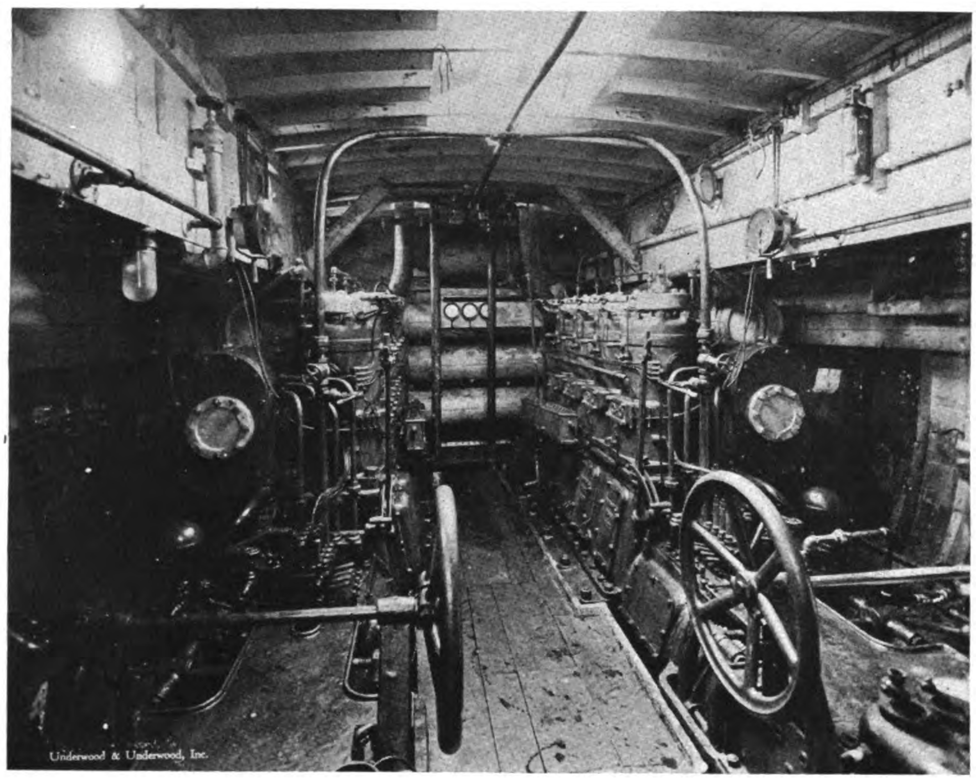
Conversion of One of the U. S. Navy's 110-Footers Into a Lobster Carrier



The converted sub-chaser "CORONA"

FOLLOWING the war a wholesale scrapping of out-of-date war-craft, together with a number of minor naval-boats that were built for special purposes, took place. Quite a number of vessels were converted into motorships, including destroyers, submarines and even battleships, although to our mind the conversion of the last-named class of ship is not an economy judging by the results of such installations recently carried-out in Germany. The same does not apply to the big fleet of 110-ft. submarine-chasers constructed for the U. S. Navy, most of which craft have been sold by the Navy Department to private-owners for use in commercial work. One Philadelphia firm purchased about a couple hundred of these boats for re-disposal, and we understand have already successfully marketed a number of them. Some have been converted into fast fish-carriers, passenger-craft, pilot-boats, and pleasure craft. To these uses these former war-craft are admirably suited, often with but slight alteration. That they are very seaworthy and staunchly built none need be told who know their war record on the European, as well as on our own, coasts. In view of the possibilities offered by these trim little craft we believe that our readers will be interested in reading about the "Corona," owned by Frank E. Davis, of San Diego, Cal.

In the early summer of 1921 Mr. Davis contracted with the Liberty Dry Dock and Repair Co. of Brooklyn, N. Y., to make the necessary changes and install two surface-ignition type oil-engines, which work was done under the personal supervision of the owner, with a manufacturer's engineer assisting in the machinery installation. Fortunately for those making such changes in machinery there is a portable section of the cabin-house over the entire length of the engine-room. After her trials the "Corona" made a trip from New York via the Panama Canal to San Diego, in very good time, where she now operates as a fast lobster-carrier. In converting this boat to her present use, the original three 220-h.p. 6-cylinder 10 in. by 11 in. single-acting gasoline-engines were removed and in place of the two wing engines, after rebuilding the beds to suit, two 100-h.p. 4-cylinder 10½-in. x 12½ in. Fairbanks Morse engines were installed. As these two engines occupy practically the same amount of space as the former wing engines there is ample access to all parts of the machinery, and the various engine-room auxiliaries such as the Standard gasoline-engine driving a 4½-k.w. electric generating-set, air-compressor, bilge, fire, and "handy billy"-pumps, the electric ventilating-blowers, the engine-room telegraph system, air-tanks, etc., were not disturbed.

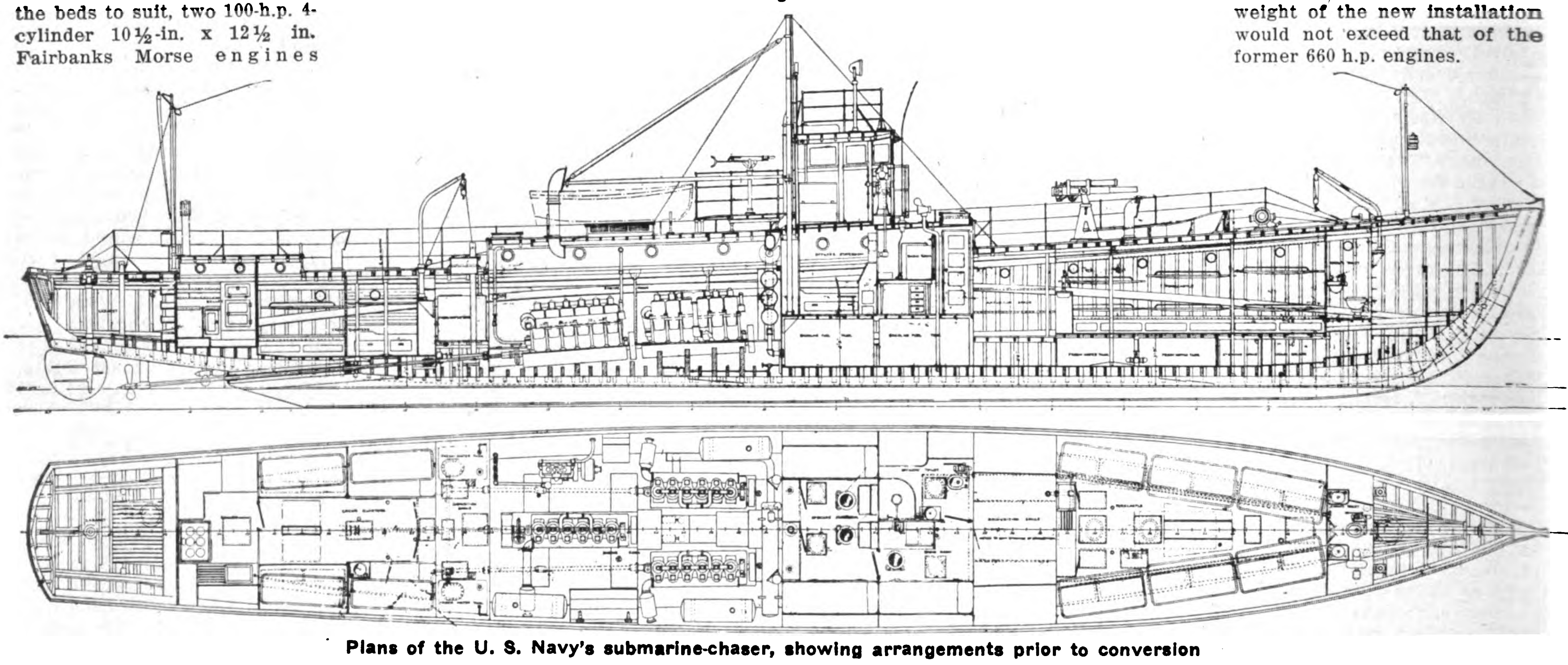


Engine-room of converted sub-chaser "CORONA," showing her two Fairbanks-Morse oil-engines

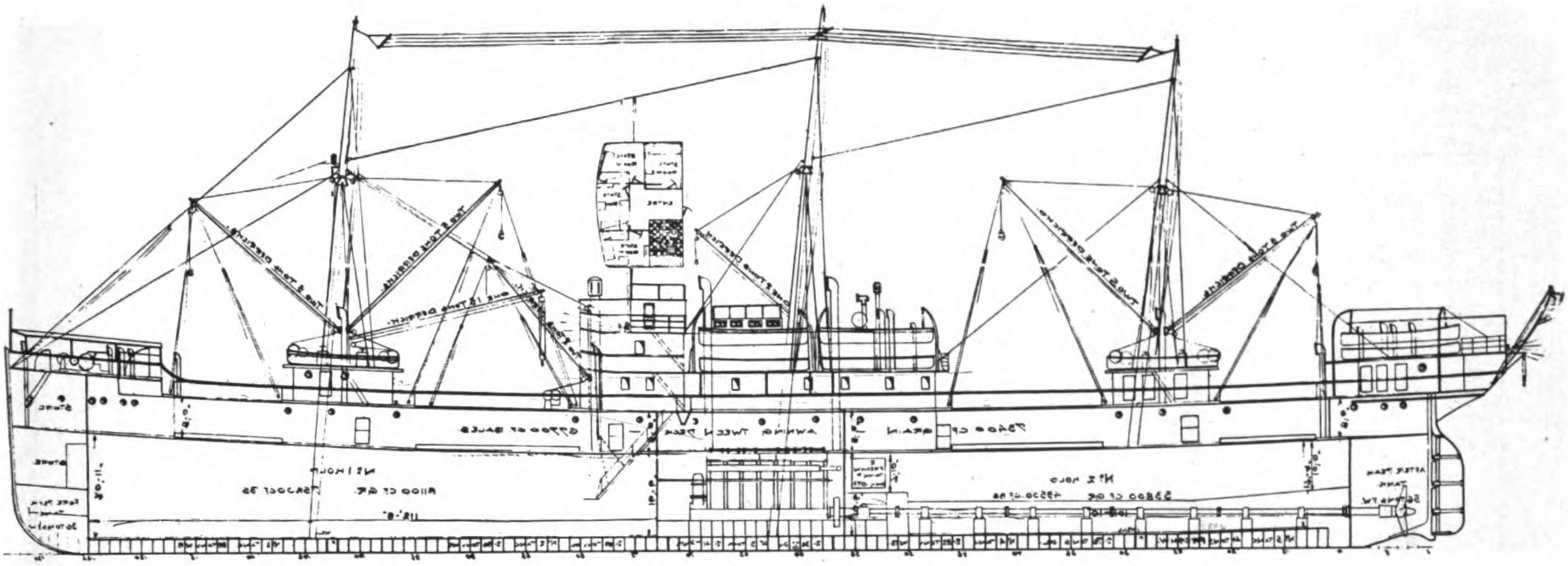
From the plans it will be noted that the space formerly occupied by the center engine is available for free passage back-and-forth by the engineers, as no center engine is now installed. The original fuel-tanks with a capacity of about 2,400 gallons of fuel-oil give the "Corona" a radius on one fueling of about 2,000 miles at a maximum speed of 15 knots propelled by two Columbian bronze propellers of 39 inches diameter, 58 inches pitch with three broad-tip blades turning at about 340 r.p.m. The engine manufacturers advise that on the trip to her home port the "Corona" used Gulf 28° Baumé fuel-oil costing 4½ cents per gallon, and that the fuel-consumption was about 16 gallons per hour at maximum speed, which is equivalent to a fuel-consumption of 0.60 pound per brake horsepower-hour. The general dimensions and characteristics of the "Corona" are as follows:

Length over-all	110 ft.
Breadth over planking	14ft. 8¾in.
Depth at side	8 ft. 8 in.
Draft, extreme	5 ft. 4 in.
Freeboard, least	4 ft. 4 in.
Tons, register	79
Tons, net	13
Displacement (light)	65 tons
Fuel capacity	8 tons, about
Cruising radius	2,000 miles, about
Speed, maximum	15 knots
Speed, normal	13.8 knots
Horse-power	200

The original power plant wieghed about 9½ tons; but the present plant weighs about 18 tons. Much of this increased weight over that of the original installation is off-set by the removal of many tons of equipment and parts of the structure and interior work which are not needed in the boat for present use, so that the net increase in light displacement of the boat over formerly is not so great. However, for commercial use two 60-h.p. oil-engines should drive one of these boats at a speed of 11 to 12 knots and the net-weight of the new installation would not exceed that of the former 660 h.p. engines.



Plans of the U. S. Navy's submarine-chaser, showing arrangements prior to conversion



Plans of the East Asiatic Co.'s new 3,500 tonner

New 3,500 Tons Motorship for East Asiatic Co.

It stands forever to the credit of the East Asiatic Co. to have first backed their faith in the large motorship for the long routes, having first secured cheap-fuel contracts at the principal ports of call. Since the inauguration of the m. s. "Selandia" this concern has continuously increased the size of their Diesel-driven vessels, the 13,500 tons "Afrika" class being the last milestone. But for the present universally bad shipping conditions the construction of a number of 15,000 tons deadweight motorships would not have been postponed. In this development the owners have worked hand-in-hand with the Burmeister & Wain shipyard, and it has already been recorded how this latter concern has not rested, but together with the Götaverken recently introduced a new long-stroke motor for single-screw vessels.

With their unrivaled experience of operating the largest motorship fleet, the East Asiatic Company are also in the front rank with regard to acquiring medium-sized and small motorships. This policy was first embarked upon with the twin screw 4,450 tons motor-tanker "Mexico", the successful operation of which has repeatedly been recorded in these pages.

The East Asiatic Co. now has building at the Nakskov Yard, Denmark (in which it is financially interested) the 350 b.h.p. Holeby-engined single-screw 1,000 tons motorship "Virginia", which is designed for Baltic or alternatively tropical trade. This vessel has been completed ahead of the yard No. 4 ship for the same owners, which will be a 3,500 tons Burmeister & Wain-engined motorship. Could the war time delay in getting materials have been foreseen, it is likely that Holeby Diesel-engines similar to those of 800 i.h.p. in the m.s. "Mexico" would have been installed in the 3,500 tonner, as the East Asiatic Co. is also interested in the builders of this engine, namely, the Holeby Diesel Motor Works.

The Nakskov "No. 4" is an awning-deck twin-screw vessel of the following dimensions; length 284 ft., beam 44 ft., depth 19½ ft. The grand total cargo-capacity amounts to 193,000 cu. ft. bales, or 203,000 cu. ft. grain, in two holds and in the awning 'tween deck.

Four hatches are provided, two being of the dimensions: 30 ft. 4 in. by 16 ft., the forward one: 21 ft. 8 in. by 14 ft., the aft: 19½ by 14 ft.

The vessel is fitted with 3 masts and equipped with 12 derricks, of which four are of 5 tons lifting capacity at the fore and aft masts, one of 15 tons at the foremast, two of two-tons at the kingpost, and a third of similar capacity at the main mast. The derricks are served by four 5-tons and one 1½-ton winches, mounted on the deck-houses and by two 1½-ton winches arranged on the main deck, all being electrically driven like the windlass. The fifth 3-ton winch with extended pulleys for warping purposes is fitted aft, ahead of the steering-gear.

The engine installation comprises two of Burmeister & Wain's four-cycle type marine Diesel-engines of 900 i.h.p. each, and three 2-cylinder 75 h.p. auxiliaries driving generators and with the usual electric drive of the stand-by compressor and of the various pumps. The engine-room takes up 14 frames. As usual no funnel is provided. At the time of writing the fitting-out has not been definitely settled upon. On the flying bridge are three state-rooms, presumably for the captain and a few passengers. The vessel is to be run in the Siamese coast service, which is a great compliment to the faith placed in the reliability of the motorship, as facilities for proper overhauls are not available, whereas the big motorships occasionally call on the home port.

CHARGEURS REUNIS' NEW MOTORSHIP "CAMRANH"

Prior to publication elsewhere, "Motorship" announced about a year ago that a big Sulzer-Diesel-driven vessel was to be built for the Chargeurs Reunis of Paris, France, at the Chantiers de la Loire's Nantes Shipyard. This motorship is named "Camranh," and has the following dimensions—

Loaded displacement	17,100 tons
Light displacement	5,400 tons
Net cargo capacity	10,000 tons
Cubic capacity of holds	18,000 cu. meters
Dead-weight-capacity	11,700 tons
Power	3,400 h. p.
Length (O.A.)	143.00 meters
Length (B.P.)	137.00 meters
Breadth (M.D.)	18.00 meters
Depth (M.D.)	12.18 meters
Draught (mean loaded)	8.92 meters
Length of machinery-space	16.00 meters
Propeller dia. and Pitch	5.10 meter x 4.50 meters

For propelling power twin two-cycle type Sulzer Diesel-engines are installed. Each develops 1,700 h.p. from four-cylinders, 680 mm. (26.771) bore by 1,200 mm. (47.244) stroke at about 100 R.P.M. The machinery space is only 52 ft. long. All the deck and engine room auxiliary machinery is electrically driven, current being supplied by several Sulzer Diesel-driven generators.

SPLENDID PERFORMANCE OF THE MOTOR TANKER "NARRAGANSETT"

We draw attention of American oil-companies to the performance to-date of the 10,050 tons Vickers Diesel-engined motor-tanker "Narragansett." It is noteworthy that after over a year's service her mean-speed is increasing, while her fuel-consumption is less than ever. The following is a resume.

	Average of first 14 Atlantic Crossings	Average of first 16 Atlantic Crossings	Average of first 17 Atlantic Crossings
Total distance	45,025mi.	56,303 mi.	60,946 mi.
Mean speed	10.17 knots	10.29 knots	10.33 knots
Daily engine consumption	9.90 tons	9.82 tons	9.84 tons

This vessel, together with the sister motorship "Seminole," is owned by the Anglo-American Oil Co.

MORE WARSHIPS TO BE CONVERTED TO DIESEL MOTORSHIPS

The owners of the German ex-cruiser "Odin," now a Diesel-driven motorship, have purchased three more vessels of this class and will convert them to motor-power. It may be remembered that the "Odin" was described in a recent issue of "Motorship."

BOOK REVIEWS

Ocean Shipping, by Erich W. Zimmerman, Ph.B., Professor of Commerce, James Milliken University, Decatur, Ill., U. S. A. Published by Prentice-Hall, Inc., New York. Price, $4.00. Undoubtedly one of the most complete and authoritative volumes dealing with the timely subject of ocean transportation with its many attendant problems is this comprehensive book by Professor Zimmerman, which has only recently come from the press. It has, therefore, been possible for the author to deal in an interesting manner with the particular problems and developments growing out of the war. Recent legislation, shipping combines and agreements, charters, rates, organization, insurance, classification, oil and coal bunkering, principles of construction, handling and stowage of cargo, port terminals, etc. are covered in considerable detail, a large number of the most up-to-the-minute references contributing to this feature of this book of 30 chapters. The motorship with its past history, present success and future development are dealt with at some length in Chapter VIII. None can read this book without having it impressed very forcibly on his mind that the motorship is here to stay and is fitted in every way to carry the world's commerce.

"Mex. Fuel-Oil"—Issued by the Anglo-Mexican Petroleum Company, London and New York. Price £10-6-0 net. This is the second edition of a book published under the same title in 1914 in English, Spanish and Portuguese. It is a semi-technical review of all the different industries in which fuel-oil is used. A section is devoted to marine Diesel and surface-ignition types. In it are given illustrative descriptions of six well-known engines of each class, as well as descriptions of a number of stationary Diesel-engines. In the appendix there is a list of 75 manufacturers of Diesel and surface-ignition engines. We are sorry to note that throughout the book the term "semi-Diesel" is used instead of surface-ignition. England seems to be the only country that is still retaining the word "semi-Diesel" in its technical vocabulary. In the United States and the majority of other countries the term "surface-ignition" has been standardized, which name incidentally, was first started in England. The term "semi-Diesel" indicates and means nothing, and the sooner it disappears the better it will be.

OUR REGISTRY OF MOTORSHIPS' ENGINEERS

Mr. R. A. Meyer, 918 Oak St., Oakland, Calif., 7 years' experience with hot-bulb and Diesel engines, chief on four motor-vessels, and two Diesel-electric power plants.

VINCENT ASTOR
Nº 23 WEST 26TH STREET

New York, September 23rd, 1921.

T. Orchard Lisle, Esq.,
Editor, "Motorship",
282 West 25th Street,
New York, N. Y.

My dear Mr. Lisle:

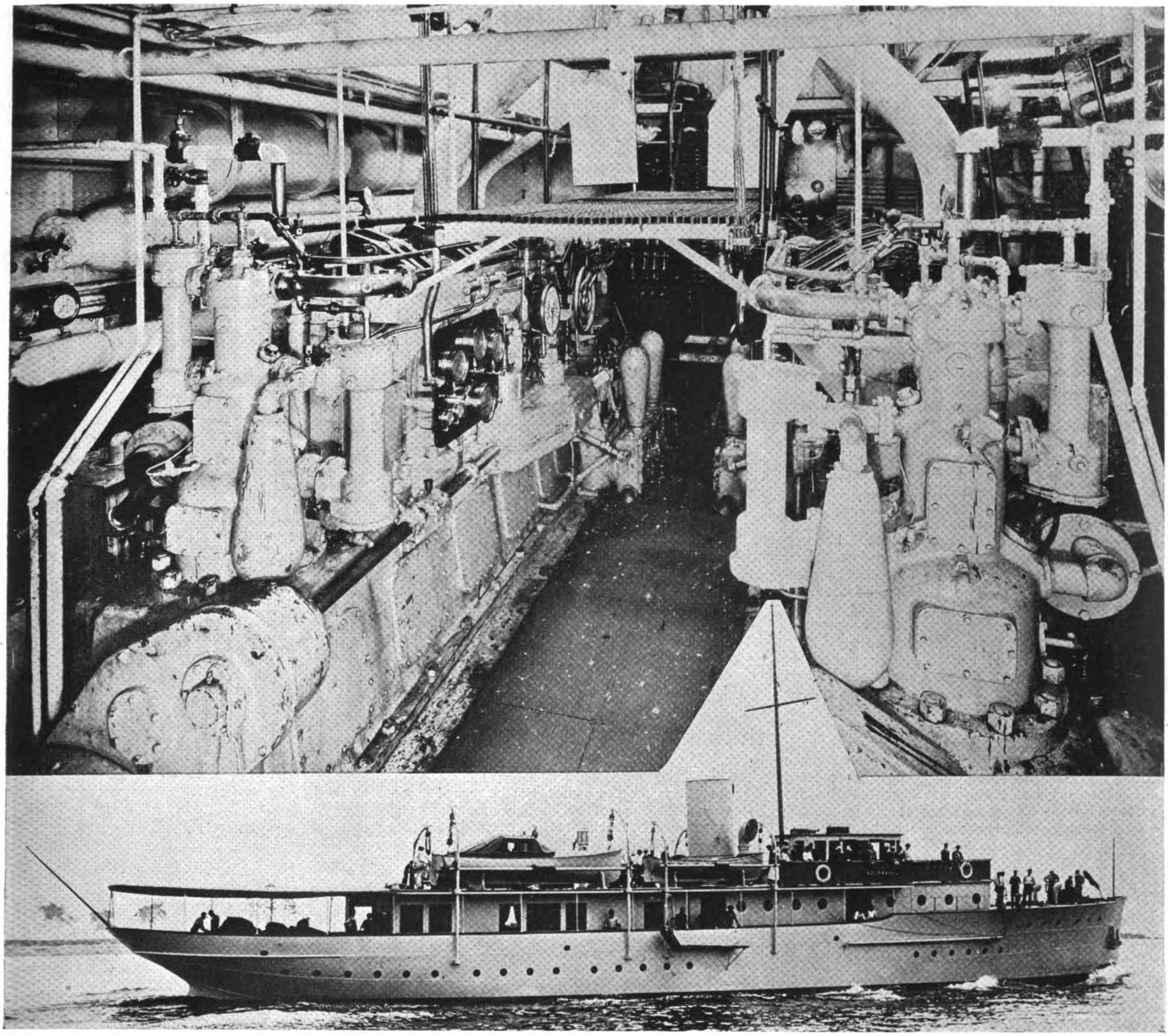
In answer to your letter of September 21st, it may interest you to know that "Motorship" was to some extent instrumental in influencing me to adopt full Diesel type of propelling machinery in my new yacht, for your magazine brought the subject largely to my attention.

You will, I am sure, be glad to know that the machinery of the ship to date has been successful in every way, and operates to my entire satisfaction. In economy of operation, it is, of course, incomparable to any type of power plant.

Yours very truly,

Vincent Astor

VA:SW



Above—Engine-room of Vincent Astor's new yacht "Nourmahal" showing twin Winton Diesel motors similar to engines used in conjunction with Westinghouse electric-drive for merchant ships. Below—The "Nourmahal"

NEW TYPE OF OIL-ENGINED FISHING VESSEL

A year or more ago one of our subscribers walked into our office and said that he was going to build a new type of oil-engined fishing vessel, which he called an "ocean-harvester," with the idea of catching, packing and refrigerating 600 tons of fish every 24 hours. This man was the late Captain Niels A. Lybeck of the little hamlet of Lybeck, Fla.

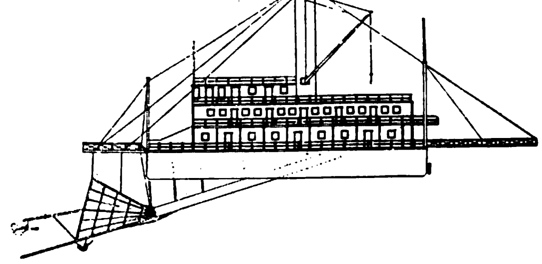
His novel vessel was launched in the spring, and recently ran preliminary tests. She is propelled and operated by three 75 b.h.p. Dodge Hvid-Brons type oil-engines and has the following dimensions—

Displacement............................400 tons
Length ....104 ft.
Breadth...................................50 ft.
Power...............................225 b.h.p.

On trials the power was found too low, so the owners are figuring on Nelseco Diesel-engines aggregating 1,000 shaft h.p.

As will be realized from the sketch she is a freak vessel. Whether she will be practical or unsuccessful will be known a few months after she has been in service. She has been named the "Liberator." Even presuming the vessel was successful as a trawler, another problem will face the operators; namely, the marketing of such large quantities of fish when caught and landed.

The boat has complete lay-out and equipment for receiving, sorting, packing and refrigerating fish, machinery for stripping-off skin and extracting oils, for electrolysis and dehydrating, facilities for recovering out of the scrap, every particle useful in the manufacture of glue, soap, cooking-fats, paint, stock-food and fertilizer, and reducing these to least bulk, and to the best conditions for handling or further conditioning. Conveyors carry the materials to each required operation, then to the most convenient point for unloading. A seaplane is to be used for locating fish.



Sketch of the oil-engined ocean-harvester "Liberator"

The net which is 50 feet wide and 20 feet deep, is held forward of the boat, supported by cables attached to counter-balances that work up and down the hollow masts. The idea of the designer is that the forward movement of the vessel will force fish of any and all sizes back to the throat of the large steel net, when they land on an endless conveyor. Whales, sharks, etc., that are too large for the opening are cut up by knives before being conveyed to the deck. At night the harvester's searchlights are to be employed as a means of attracting fish into the path of the oncoming vessel.

DIESEL-ELECTRIC DRIVE FOR NEW YACHT CRUISER "RUENDA"

With reference to the illustration of the Diesel-electric drive set for the cruiser "Ruenda" illustrated in our September issue, we have just been advised that her machinery was ready and accepted, but owing to the Russian Naval authorities having taken so long to come to a decision regarding this old vessel she was scrapped in the meantime. The engines and electric generators were then used on land at Sabastopol for the purpose of charging storage-batteries of submarines.

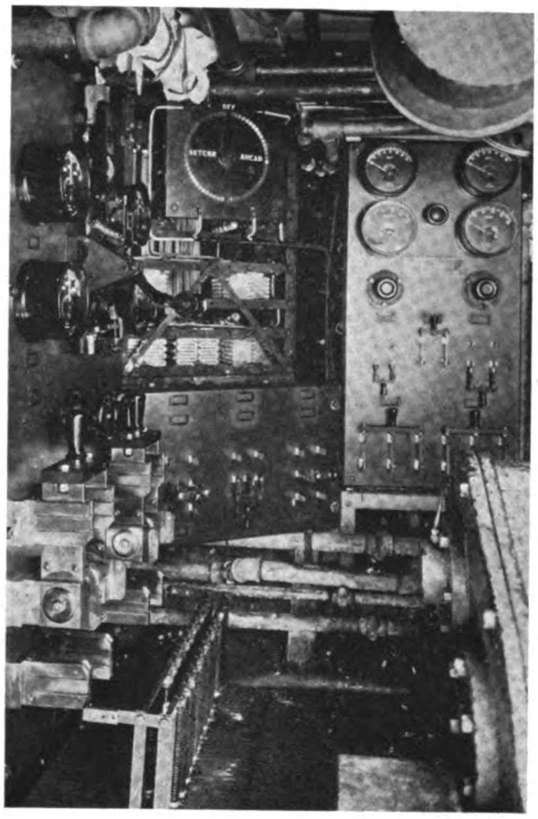
Diesel-Electric Auxiliary "Guinevere"

Interesting Installation of This Much-Discussed System of Propulsion in Edgar Palmer's Big Yacht, Equipped with Winton-Westinghouse Machinery

Lately the size of motor-yachts has increased to such an extent that they are fast taking the place of palatial steam-driven private-craft, and are of a size equal to many coastwise merchant-ships. That remarkable space and fuel saver, the Diesel oil-engine, has recently been finding favor with owners of such craft, and the installations in these vessels have become of engineering importance on a par with commercial ships.

Consequently, Edgar Palmer's new big auxiliary "Guinevere" should interest "Motorship" readers from this viewpoint and not because of her beautiful form and palatial accommodations. She is noteworthy because of her complete oil-engine driven electrical equipment, the most comprehensive yet installed in a boat of her size. Other Diesel-electric vessels have been dealt with in the pages of "Motorship," but, from the stand-point of the electrical-engineer this big yacht stands alone as a record of achievement along the lines of a complete electric ship. Not only is she propelled by electricity generated by Diesel-driven generators, but electricity handles all cooking, heating, anchor, boat and sail hoisting, steering, making ice, driving pumps for washing decks, pumping bilges, fighting fire, operating gyro stabilizer and compasses, vacuum cleaner, laundry machines, ship's telephones, ventilating-fans, searchlights, rudder and propeller direction indicators, wireless telegraph, etc. No steam or other power is utilized.

Mr. Palmer's former yacht of the same name, which was lost in naval service during the war, was approximately the same design and size, but was propelled by a 700 h.p. quadruple-expansion steam-engine and Scotch boiler, making necessary a smoke-stack which not only occupied valuable space, but created dirt and heat on deck. In the new boat the space formerly taken up by the stack is given over to a comfortable deck-house while the exhausts from the engines are carried out below water at the stern. These features are valuable in any vessel carrying guests or passengers. Likewise of great value are the added accommodations for the owner, the increased store-room, the decrease of six men in the crew, and the increase in cruising-radius from 4,000 miles with 160 tons of coal to 11,000 miles with 95 tons of oil. It is unnecessary to enlarge upon the convenience of telephones, lights, fans, toasters, etc.



Main control board and direction indicator

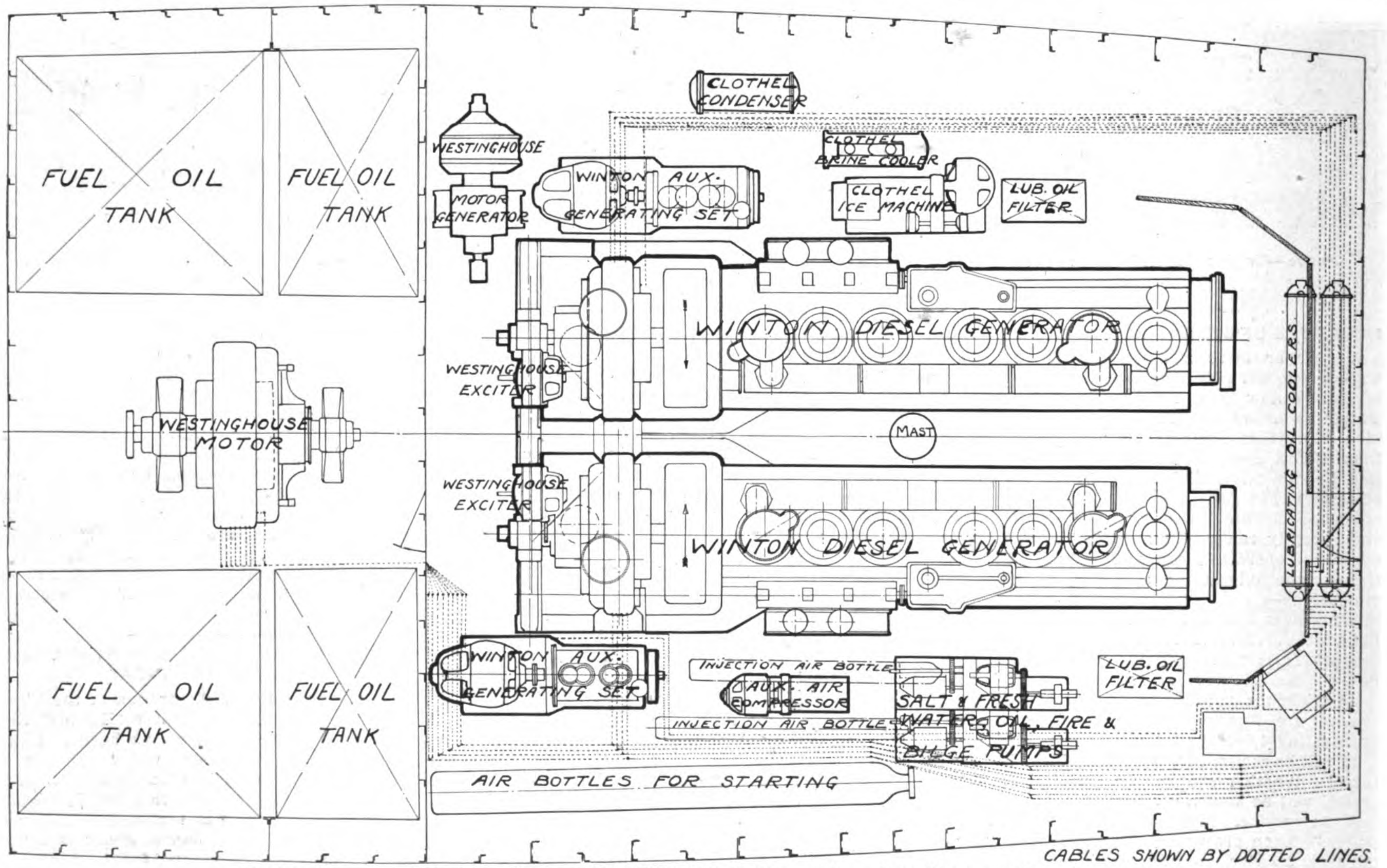
The principal characteristics of the "Guinevere" are as follows—

Construction	Steel
Length overall	195 ft.
Length water line	150 ft.
Breadth, molded	32 ft. 5 in.
Draft	15 ft.
Displacement	642 tons
Speed under power	11.35 knots
Horse-power main Diesel-engines	700
Power of elec. generators	450 k.w.
Power of propelling motor	550 h.p.

Designed by A. Loring Swasey, naval-architect of Taunton, Mass. and built by George Lawley & Son Corp. at Neponset (Boston) Mass. for Edgar Palmer of New York, the "Guinevere" represents the best of a new era in big yacht building and the co-operation of the Winton Engine Works and the Westinghouse Electric & Manufacturing Co., assured the success of this largest of Diesel-electric yachts.

We illustrate, herewith, the general arrangement of the "Guinevere's" engine-room, in which are found two 6 cylinder 13 in. by 18 in. 350 h.p. Winton Diesel-engines operating at 225 R.P.M., each engine direct-connected to a 225 KW 125 volt Westinghouse shunt-wound generator, each operating by chain-drive a 15 KW 125 volt direct-current compound-wound Westinghouse exciter turning at 1150 R.P.M. This power supplies current to the 550 h.p. 250 volt Westinghouse electric-motor operating at 220 R.P.M. located aft of the main engine, the motor being direct-connected by a flange-coupling to the propeller-shaft, which drives a 2-blade 8 ft. 4 in. diameter Bevis propeller. In the engine-room is an electrically-operated indicator giving R.P.M., total revolutions, also ahead and astern directions.

All the electrical equipment is designed with special reference to marine use, being very rugged and with windings specially insulated and impregnated against moisture, non-corrodible material being utilized wherever possible. In order to provide for efficient lubrication of the pedestal bearings of the generators when the vessel lists to one side not only ring-oilers are used, but special provision is made to flood them continuously with oil from the oiling system of the Diesel-engine. Also this bearing is placed relatively low down. The bearings of the motor are of the pedestal type, not only ring-oiled but flooded with oil under pressure by means of pump geared to the motor-shaft. The exciters are ball-bearing. The main motor is enclosed at the forward end with an inlet at the top for the entrance of air to ventilate the motor,



Engine-room arrangements of the "GUINEVERE" showing main and auxiliary machinery this air being driven by a centrifugal-fan direct connected to a 1¾ h.p. motor of 3,500 cubic-feet per minute capacity.

On each side of the vessel abreast the driving motor are the fuel-oil tanks holding about 19,500 gallons. Outboard of the aft end of each Winton Diesel-generating set is an auxiliary 15 KW 115 volt electric generating-set driven by a 25 h.p. Quayle surface-ignition oil-engine operating at 600 R.P.M. At the aft end of the engine-room on the port side is a 125 volt 45 KW Westinghouse motor-generator. Forward of the auxiliary generating-set on the port side is the 2-ton Clothel refrigerating-set consisting of ice-machine, brine cooler and condenser, driven by a 10 h.p. electric-motor of 115 volts, this set cooling the cold-storage rooms located under the crew's quarters and galley.

Operated by 115 volt 5 h.p. electric-motors are the Kinney oil-transfer, fire and bilge pumps, while 1 h.p. 115 volt electric-motors operate Kinney sanitary, salt and fresh water-pumps; the circulating water-pump is handled by a ½ h.p. 115 volt electric-motor, while a Ramsey vertical centrifugal sump-pump is operated by a 1 h.p. 110 volt electric-motor. Sturtevant ventilating fans are driven by a 1 h.p. 125 volt motor. For charging the air-bottles a Winton 12 h.p. 125 volt air-compressor is provided.

Cooking facilities are all of 110 volts, and are very complete, the electric-ranges, hot-water heaters, broilers and warming closets in both owner's and crew's galley being furnished by Duparquet, Huot, and Moneuse, coffee and hot-water urn by Morandi-Proctor. A laundry containing 115 volt mangle, washing-machine and extractor will be found useful on the long cruises. Most complete electric-lighting is provided, consisting of 200 25 watt 110 volt lamps and two 18 inch Sperry high-intensity searchlights throwing a very powerful beam and operating on 110 volts, these searchlights being mounted on the navigating bridge.

On this bridge, at each end from which the vessel is entirely controlled, is an operating station, consisting of steering-wheel connected with a highly-developed electric steering-control which operates the Lawley 10 h.p. 115-volt electric steering-gear aft, a magnetic compass, Sperry repeater gyro-compass, Sperry helm-angle indicator showing every movement of the rudder, and telegraph to engine-room. In the "Elfay" (a somewhat similar schooner yacht owned by Russell A. Alger, also powered with Winton Diesel-Westinghouse-electric drive, which has been run over 14,000 miles without any machinery trouble whatsoever), the control of the propelling-motor is on deck beside the wheel, whereas in the "Guinevere" all these controls are in the engine-room.

In addition to the repeater compasses on the bridge, repeaters are found in the owner's stateroom as well as in the various parts of the ship, operated by the master gyro-compass, which also runs an electric-log giving actual speed, desired speed, trip mileage, average propeller revolutions and making a permanent record on graph paper showing exact compass courses maintained over a period of one month. Also there is a dead-reckoning equipment, known in the Navy as a "bug," which travels over a chart, following every movement of the direction of the vessel, being operated for direction by the master gyro-compass and for speed by the electric log.

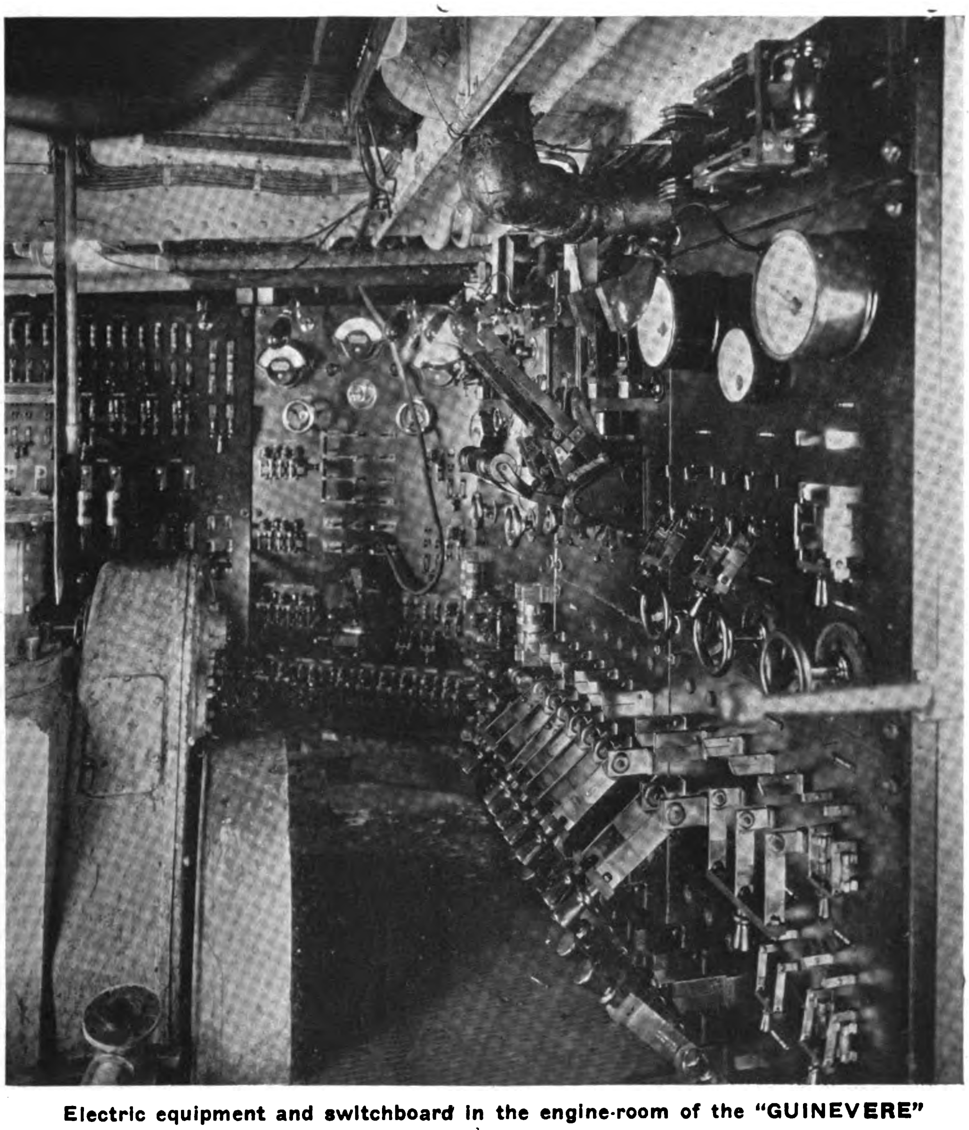
Edgar Palmer's Diesel-electric driven auxiliary "GUINEVERE"

A small Sperry Gyro operates a roll-and-pitch recorder equivalent to a pendulum 2,000 yards in height and with period of 70 seconds, which traces very accurate curves of roll and pitch of ship. One item of equipment which will be greatly appreciated is the Sperry gyro-stabilizer, having rotor 6 ft. in diameter revolving at 1700 R.P.M., reducing the rolling and motion of the vessel to only 2 or 3 degrees each side, adding to the comfort and enjoyment of those aboard as well as reducing the fuel-consumption and increasing the cruising radius.

The Wireless Specialty Apparatus Co. of Boston furnished a 3 KW wireless-outfit having a range of 1,000 miles. This set has remote control which is handled on apparatus in the chart-room from which messages are received or sent, the transmitter being installed in the engine-room. In view of the large amount of electrical apparatus in that room the 100 cells of Edison 115 volts 800 ampere-hour batteries are installed on deck in a special box removing any danger in case of gases forming. On deck are also 8 h.p. 115 volt electric-motors operating hoists at the small launch and boat davits and at masts for hoisting sails, and a Hyde windlass is operated by a 20 h.p. 110 volt electric-motor.

For normal operation at full power, the two main generators are connected in series, furnishing power to the motor. The generators and motor are arranged for separate excitation at 125 volts from the exciter curcuit. The speed of the motor from zero to maximum in either direction is controlled by means of a reversing rheostat, which controls the excitation of both generators, thus controlling the generator voltage and therefore the speed of the motor. Consequently the ship is operated at any desired speed and the main circuit is not interrupted when reversing. Mounted at the rear of the main switch-board panel is the reversing rheostat operated by hand-wheel. Automatic circuit breakers for overload protection, meters, knife-switches for generator and motor field circuit and a 2-pole, double-throw knife switch for each main generator armature-circuit, by means of which switches each generator may be connected in series with the other generator or disconnected leaving the other generator connected to the motor are provided. This arrangement makes it possible to operate at reduced speed when one generator is shut down or when it is desired to operate the ship at low speed for considerable time.

On the trial trip recently run the wonderful ease of speed control and quickness of reversing were fully demonstrated, a speed of 11.35 knots being attained with both engines, 8 knots with one engine, and while running full-speed ahead we are advised that full-speed astern was attained in 25 seconds and the ship put back into full-speed ahead in 15 seconds.



Electric equipment and switchboard in the engine-room of the "GUINEVERE"

Propeller Efficiency of Twin-Screw Motorships Versus Single-Screw Steamers

Interesting Paper Recently Read At Goteborg, Sweden, by Director Blache of Burmeister & Wain of Copenhagen

I DO not intend to give a comparative calculation showing the economic advantages of Diesel motorships over oil-fired or coal-burning steamers as has been done on numerous occasions. This should be of interest, but can be better accomplished by shipowners and their experts who possess the detailed knowledge of conditions on the various routes on which they have their vessels running.

One of the largest motorships we have built, the motorship "Afrika," belonging to the East Asiatic Co., 13,300 tons d.w. 4500 i.h.p. and a speed of 12 knots, has completed her first voyage to Australia and return on a mean-consumption of 14.1 tons of fuel-oil per 24 hours and a lubrication-oil consumption of 0.53 grams per i.h.p. per hour. The latter figure includes all lubrication, both cylinder and hand lubrication and waste in the forced lubrication system. Furthermore, the ship had an engine-crew of but 14 men in all. In good weather a speed of 12.5 knots was attained on a draught of 22 ft. 11 in. for'd and 25 ft. 6 in. astern, and mean 24 ft. 2½ in., corresponding to 14,000 tons displacement. The full-load displacement is 19,000 tons with a mean draft of 32 ft. The mean speed on a voyage from Port Said to Singapore under favorable weather conditions worked out at 12.05 knots.

The question of fuel-oil has been to the fore during recent years, as following the war the consumption was so large that the demand was rather out of proportion to the supply and to the available tonnage of tankers. These conditions have changed and the fuel-oil prices have a continuous falling tendency with crude-oil, suitable for Diesel motorships, and Diesel-oil is easily obtainable in all parts.

The oil companies, especially last year, have been emphasizing to us and to the owners of motorships the necessity of having engines burn the very heavy and impure grades of Mexican fuel-oils. The latter has a gravity of 0.95 to 0.96 specific gravity at 15 Cent. and flows at normal temperatures so slowly that it cannot easily be pumped, besides containing 3 to 4 percent sulphur and other undesirable impurities. I have, however, carried out various tests with this heavy fuel which shows that it is possible to design our four-cycle Diesel-engines so that they will be able to burn the same. Various alterations in the engine itself are required, including the intensive heating of all pumps, pipes and filters. Further, the fuel must be filtered, extra carefully, and the daily supply tanks, as well as the bottom tanks must be heated in order to pump-out the oil.

It is, however, my opinion that the use of this heavy fuel-oil offer no advantages for motorships, when it has to be stored in the double bottom-tanks of the vessel. When this heavy fuel is put into these tanks of the ship only a certain part of it can be pumped out again, as much of it will stick to the cold sides of the large flat tanks. Accordingly the effective bunker capacity of the vessel is reduced by 25 to 30 percent, also being in direct contact with the large ship's flat bottom, the fuel can only be heated intensely at a very great cost in steam consumption.

If ships are to be adapted to use this grade of fuel they should be provided with deep-tanks where the fuel can be heated, so that the whole contents of the tank can be kept liquid without too heavy a loss of heat supplied; also that the full amount of fuel that has been pumped into the tanks can be pumped out again.

Regarding the burning process of the fuel itself, this is satisfactory and gives actually slightly better resuts than the usual fuel-oil, based on useful heating value. I have taken-up with the East Asiatic Company as to whether they are interested in such vessels, or in having their existing motorships altered to use this heavy fuel, but they state they see no reason to depart from the lighter fuel, as the difference in price is not enough to make them consider the alterations required. It is my impression that the question is really of little interest, and has mainly been raised by the oil-companies to increase the sales possibilities of the heavy fuel.

According to the latest information to hand, the price of oil in England is 105 shl. per ton for Diesel-oil and 90 shl. per ton for the heavy fuel-oil. For the U. S. Shipping Board's motorship "William Penn," Diesel-oil of 0.88 gravity was bought at 4.8 cents per gallon ($2.02 per barrel) last May in Philadelphia. The price of heavy Mexican oil was at the same time $1.95 per barrel. As the Diesel-oil has about 5 percent greater heating-value than the thick oil it will be seen that the saving is immaterial.

I will next deal with the relative merits of the single and twin-screw motorship, as it has been observed that this is generally not clear to many. Even some of our licencees do not fully understand why we build our motorships chiefly as twin-screw vessels.

The opinion generally expressed is that Burmeister & Wain's motorships have been constructed as twin-screw vessels with a view to safety and the reason they have recently started to build single-screw ships is that the reliability of the single-screw engines has so increased that they can venture upon the building of the single-screw vessel.

The question of reliability in service was an influence when building the first motorship as a twin-screw vessel, as we considered that these first engines might disclose some faults in design, also that it may be necessary to inspect some of the engine parts, requiring short stops of one engine at a time. We did not have in mind reliability in the general meaning as usually expressed, that is that breakdowns would often occur, requiring stoppage of engines for longer periods. This later consideration had no deciding influence in our subsequent motorship designs. If it is a fact that with the marine Diesel-engine there was to be expected frequent breakdowns of one engine, or in other words, if a vessel, say of 11 knots speed, must make part of the voyage at about 9 knots, then the Diesel-engine would have been unsuitable for economical reasons, and never would have been developed to such an extent. After building Diesel-engines for nine years there are 66 motorships representing a total horsepower of 197,490 in engines of our make sailing the seas.

It has been proved that the Diesel-motorships carry-out uninterrupted non-stop runs of 50 to 60 days duration, and there is a report of one ship that actually made an uninterrupted voyage of 83 days, broken only by a few short calls in harbors. During this time the engines were not touched, which practice, however, we do not recommend.

In originally choosing twin-screws, the consideration as to the size of the cylinders was of importance, as we did not consider it advisable to embark upon the larger cylinder dimensions until certain experience was gained. At the same time shipowners desired to get larger and speedier ships, so we realized the advantage of remaining steadfast to the twin-screw system in high powers.

Now that our workshops have been extended and improved, we can adopt larger dimensions than previously. We now are able to build single-screw engines up to 4,000 i.h.p. and expect shortly to produce even greater horsepowers, if the demand is for such sizes. Thus, we are left quite free to choose between single and twin-screw ships.

The chief reason which made us decide in favor of the twin-screw system is as follows: In ships the relation between length, beam and depth characterize the craft, so the deciding factor in the ratio between engine-cylinder bore and stroke. Originally we took this ratio at about 1.33 on the basis of experience in the manufacture of stationary Diesel engines. Thus the "Selandia" had a cylinder bore of 540 mm. and a stroke of 740 mm., and the "Suecia" 500 mm. cylinder bore and 660 mm. stroke, or a ratio of about one and one-third. With this bore-stroke ratio, and with due regard to the velocities that are permissible through the inlet and exhaust valves normally fitted in such an engine, the most suitable number of revolutions was 100 to 150 p.m. We then strived to attain the same efficiency with the twin propellers at the above number of R.P.M. as is generally obtained in cargo-ships with single-screws at the lower revolutions at which steam engines operate.

We based our screw calculations upon well-known data, such as Taylor curves, taking into consideration the influence of the speed of the wake, which is a very important factor in calculating screws, in accordance with the formula of Professor McDermott. We find that our screws come-out very close to the correct results, and naturally continuously verify our later calculations with the results we have achieved with the previously-built ships.

Results attained with these first twin-screw ships proved to be fully equal to what can be attained with single-screw vessels. This was clearly shown by the trials of the motorship "Suecia" and later with the motorship "Kronprinsessan Margareta" built for the North Star Line. The latter company showed such an interest in the matter, that they had trials run with full-load and clean bottom, and also made similar tests with the steamer "Prinsessan Ingeborg" previously built at our yard. Such tests are of the utmost interest to naval-architecture, as it is very seldom that shipowners go to the expense and trouble involved in carrying out tests of this nature.

With the "Suecia," trial runs were carried-out up to 11½ knots and the curves of the results with S.S. "Prinsessan Ingeborg" are shown on fig. 2, the maximum speed of the latter vessel also being 11½ knots. In fig. 3 the results taken from these curves represent a comparison of these two ships at 11 and 10.2 knots respectively, the latter speed being the usual one of a steamer like "Prinsessan Ingeborg." It will be noted that the motorship "Suecia" ran at 149 R.P.M. corresponding to a speed of 11 knots. If the speed is corrected for the speed of the wake the speed through the water is 9.45 knots, and, with the above number of R.P.M. gives a maximum efficiency of the propeller of 62.9%. The corresponding revolutions of S.S. "Prinsessan Ingeborg" is 67.5% and correcting for the speed of the wake gives a corresponding relative speed of screw through the water of 8.03 knots. This gives an estimated propeller-efficiency of 63%, the same as for the twin-screw ship. **(The figures and drawings referred to will be given next month, they not yet having arrived by mail.—Editor).**

For 10.2 knots the number of R.P.M. for motorship "Suecia" is 136.4. The correction for the speed of the wake giving a relative speed of 8.76 knots and a corrsponding maximum propeller-efficiency of 62.9%. The relation works-out again exactly the same for S.S. "Prinsessan Ingeborg," the latter also having a propeller-efficiency of 62%.

The results of the trials show that the motorship "Suecia" took 2,140 i.h.p., or 1,710 shaft h.p. to make 11 knots. The tow-rope resistance, without taking into consideration the thrust or deduction, gives 1,150 h.p. and the propulsive-efficiency or combined efficiency of hull and screw, or the ratio of tow-rope h.p. to shaft h.p., is 67.2%.

For the S.S. "Prinsessan Ingeborg" the corresponding i.h.p. is 2,050 or say 1,750 shaft h.p. The tow-rope horsepower is 1,080 and the total efficiency of the ship and screw is 61.8%, or less for single-screw ship than for twin-screw vessel. But, as this speed (the economical one for this vessel) has also been exceeded here, I have worked out the comparison for 10.2 knots also, which gives for motorship "Suecia" 1,710 i.h.p. at 1,350 shaft h.p. and 900 effective tow-rope h.p., the total efficiency of ship to screw being accordingly 66.7%. The corresponding figures for S.S. "Prinsessan Ingeborg" are 1,650 i.h.p. or 1,400 shaft h.p. and 855 effective tow-rope h.p. and an efficiency of 61%. The result showed that we had obtained with the twin-screw ship an equally good, or better, total efficiency than with the single-screw ship.

The trial with motorship "Suecia" was carried out in the Christiana Fjord in smooth sea. We later made an analogous trial with motorship "Pedro Christophersen" at Göteborg, but outside the belt of rocks and islands girding the coast. There was little swell that day, but some current ran across the course so that the latter had to be changed during the run. This resulted in somewhat inferior results to the previous trials with motorship "Suecia," so we thought that errors had possibly slipped-in at the readings for motorship "Suecia." With the motorship "Kronprinsessan Margaretha" a test was again carried-out with full-load in the same way as with motorship "Suecia" on the Christiana Fjord and the results coincidenced exactly with those for motorship "Suecia" and proved thus clearly that the test with the latter was correct, and that the poor results were entirely owing to the more open sea on which the runs of "Pedro Christophersen" had taken place. The runs of S.S. "Prinsessan Ingeborg" have been carried-out in the Oresund off the Isalnd, where the conditions are no doubt equally good as on the Christiana Fjord. Perhaps there is sometimes some current, but the latter runs at any rate direct in or against the course.

Both S.S. "Prinsessan Ingeborg" and motorship "Suecia" are equipped with bronze propellers, so it is safe to presume that the comparison of the two ships is complete and fair.

On the basis of these results we continue to build our motorships as twin-screw vessels, although in case of the larger ships we reduce the number of R.P.M. somewhat in order to attain the same efficiency. So the larger engines have been built with a corresponding slightly larger relation between cylinder bore and stroke. Thus we have passed from the ratio of 1.3 to one nearer 1.5.

We built the "Tongking" class in this manner. These are Diesel-driven vessels of 425 ft. length with 3,100 i.h.p. in twin-screw engines of 125 R.P.M. and a speed of 11.5 knots fully loaded. Their displacement is 13,500 tons. With correction for the speed of the wake, the relative speed in relation to the screw is 9.6 knots for these vessels, the propeller efficiency working-out at 63%.

Also we built for the East Asiatic Co. the large motorships "Afrika" and "Malaya." These vessels are of 19,000 tons displacement and designed for a speed of 11.8 knots fully loaded. The engines together develop 4,500 i.h.p. at 115 R.P.M. The relative speed between screws and water is 10.15, which gives a maximum theoretical propeller-efficiency of 63.6%.

The motorship "Fionia" is a specially fine-built ship of 12.5 knots fully loaded and 13 knots with a lighter cargo. Besides being a cargo-vessel she is equipped to carry 40 first-class passengers, as the cabins are especially well fitted. For this vessel we tried to make the propulsion condition still better than our previous achievements. The engines together developed 4,000 i.h.p. at 100 R. P.M., and at a speed of 12.5 knots a theoretical propeller-efficiency of 67.3% could be attained.

The Götaverken built the same size engine as we installed in the motorship "Fionia," i.e. of 4,000 i.h.p. at 100 R.P.M. for the motorships "Bullaren," "Tisnaren" and "Elmaren," which were designed for a speed of 12 knots, when a maximum theoretical propeller-efficiency of about 66% can be attained.

Whether these ships could attain the same propulsion relation as with a single-screw depends upon the number of revolutions chosen in the latter case. It is my opinion that for the "Tongking" class the number of R.P.M. must then be lowered to about 70 to 75 R.P.M. and for vessels of the size of "Afrika" to 65 to 70 R.P.M.

The wake gain is here the deciding question, the relation of which is of a very complicated nature. The highest speed of the wake for single-screws placed in the central plane of the ship than for the twin-screws located more in free water, results in a lower ratio of the relative speed of the water in relation to the screw for the single-screw ship than for the twin-screw one. For the number of R.P.M. in question for these cargo-vessels the characteristic relation for the screws is such that the efficiency will increase when the relative speed between screw and wake is increased.

In other words, it is detrimental to the propeller efficiency of the single-screw vessel having the propeller where the wake has the greatest speed. The gain due in thrust deduction is not available as it is spent in overcoming friction and producing a whirling motion in the water. It is thus evident that one should strive to produce a shape of ship giving the smallest possible wake. This is what we have attained with our stern of vessel, and in my opinion, have been confirmed from the above mentioned trials with "Suecia." There has been no opportunity yet to have made by any full-power runs fully-loaded carried-out with the larger ships over the measured mile. We have certain confirming data from reports of the voyages of the ships results, where fully-loaded with a fairly clean bottom and good weather conditions and where the logged and observed distances almost agree. Thus the motorship "Theodore Roosevelt" has with a displacement of 14,960 tons and a draft of 28 ft. 11 in. made 11.58 knots at 133 R.P.M. and 3,331 i.h.p. which corresponds to 1,610 tow-rope h.p. The corresponding maximum theoretical efficiency that can be expected is 63.4%.

The motorship "George Washington" has, with 13,550 tons displacement and 26 ft. 5 in. draft two different readings, one of 11.83 knots at 129 R.P.M., with 3,298 i.h.p., and one of 11.5 knots with 3,213 i.h.p. and 129 R.P.M., which corresponds to a total propulsive-efficiency of 67.4% and 63.1% respectively with a corresponding maximum propeller-efficiency of 64.1% and 63.6%.

These readings as above mentioned have been obtained in the open sea during the voyages of the ships, and thus give less reliable results as when the readings are obtained over the measured mile. The results would no doubt be improved if the trials were carried out in the Oresund, the Christiania Fjord or similar calm waters, as demonstrated by the experience obtained from the results of "Pedro Christophersen" outside Goteborg, compared with those of motorship "Suecia."

The same applies to motorship "Fionia," and I have readings which extended over 4 days, the total efficiency of the propellers being 60.4%, while their theoretical-efficiency is 67.7%. The condition is thus not so favorable as in the above mentioned cases. Yet I must draw attention to the fact that the results obtained are better than those estimated for the ship, or in other words the ship has completely maintained the guaranteed speed and horsepower.

As mentioned above, I believe that these results have come from giving the stern the proper shape, whereby the following wake becomes as small as possible permitting the water to enter the propeller under most favorable conditions. The gain in total propulsion caused from the working of the screw in the water following the ship, is counteracted by the influence of the hull in front of the screw, causing the water to rise in whirl formation along the side of the ship. In the twin-screw ship it is of importance to arrange the shaft bossing correctly. If they are placed wrongly it results in a very considerable increase in resistance. For the shape of ship used by us the bosses are placed as far as possible horizontal, so that the current of water passing up along the stern is by means of the bosses led perpendicular to the plane of the propellers. Similar conditions are not to be met with with the single-screw.

So I have come to the conclusion that it is still correct to build the larger motorships as twin-screw vessels, and the bigger the ships are and the higher the horsepower to be transmitted through the screws, the greater is the advantage of using twin-screws.

The relation between single and twin-screws is, however, of a very complicated nature. During late years, research work has been carried-out by Mr. Luke in England, published in the Institution of Naval Architects 1910 and 1917, and by Herr Schraffran of Germany, published in Schiffbau 1919. However, reliable figures and actual test results with similar ships are of the greatest importance for the solving of this question.

I have in the table given the figures of the motorship "Yngaren" belonging to the Trans-Atlantic Steamship Company, and equipped with a single-screw Doxford oil-engine of 3,000 b.h.p. at 77 R.P.M. The speed of the ship is 12 knots which gives a maximum theoretical propeller efficiency of 62%. If this is compared with the motorship "Bullaren," "Tisnaren" and "Elmaren" of the same company, which have twin-screw engines of our type, built by the Götaverken it will be seen that the theoretical propeller-efficiency of the twin-screw ship is greater. Here the question of the wake gain comes in again, and it would be of great interest if the Transatlantic Company would show its interest in the matter in having these vessels carry-out speed trials with fully loaded condition and clean bottoms over the measured mile. But the trials should be run over the same course and under same equal and calm weather conditions as otherwise the results obtained might differ more than those obtained between the propulsive efficiencies of the single-screw and twin-screw ship run under same conditions.

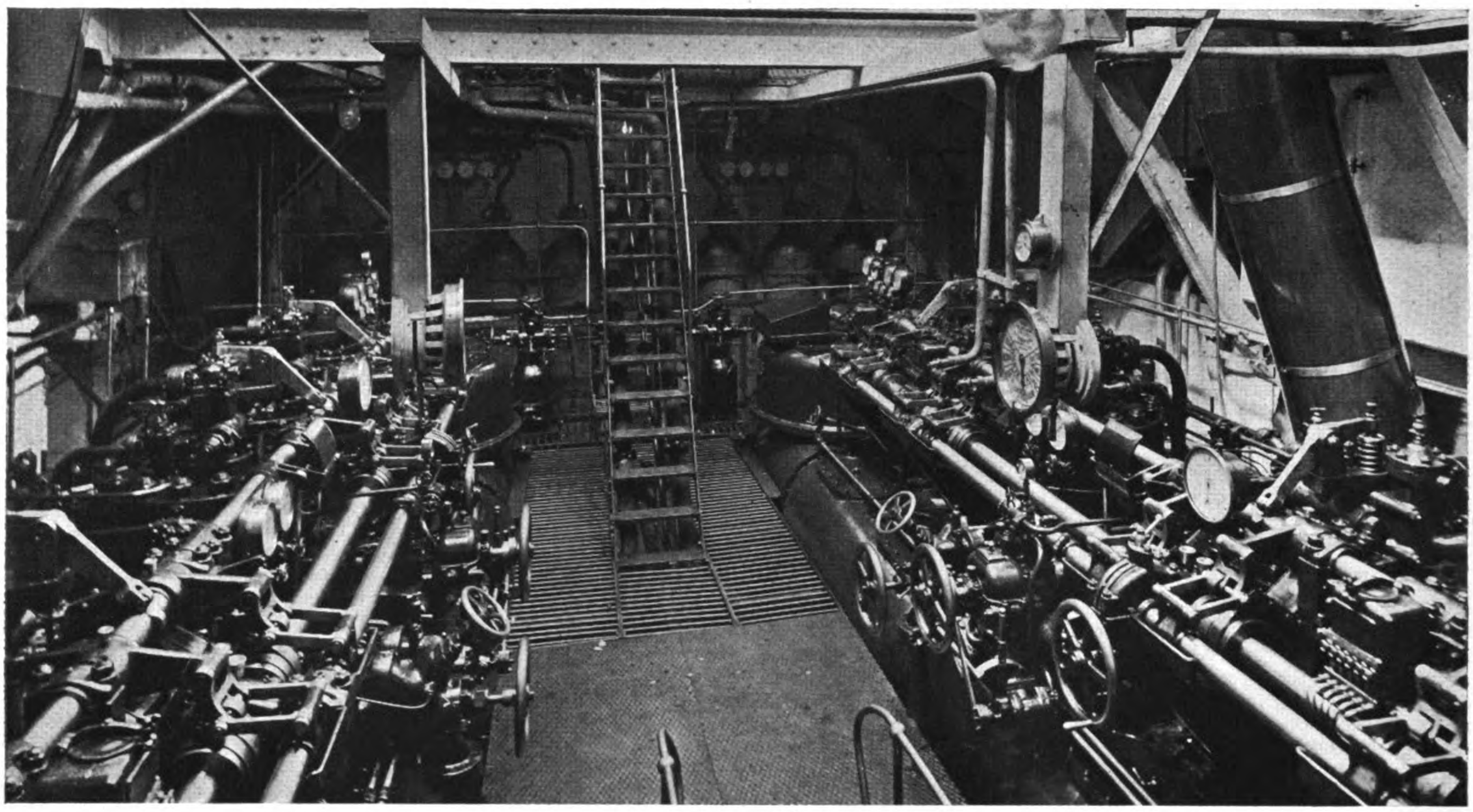
The equal advantages in using single and twin-screws lies in my opinion at about the 2,100 h.p. with 150 R.P.M. for the twin-screw installation and 90 R.P.M. for the single-screw installation.

Fig. 4 shows such a twin-screw installation with the necessary auxiliaries in our most modern type of vessel. I would like to call attention to our new two-collar type of forced-lubricated thrust-bearings which occupy, as you see, less space than the Michell thrust-bearings that have been so much referred to and employed during later years. **(Kingsbury in the U. S. A.—Editor).**

Fig. 5 shows the corresponding single-screw engine of 2,100 h.p. and 90 R.P.M. The weights of such two installations are nearly the same as the two shafts with tunnels, bosses and propellers for the twin-screw installation weighing almost the same as the one heavier shaft and the single large screw for the single-screw installation. The main machinery in the single-screw ship is about 8 to 10 tons lighter than in the twin-screw ship; but, at the same time it should be remembered that the displacement of the bosses gives a corresponding larger carrying-capacity. The engine-room in the single-screw ship can be made narrower, but requires a long engine casing and recess in the forward bulkhead. As to the deck arrangement this can generally be taken care of very easily. The two engine-rooms are shown compared in fig. 6, from which it will be seen that they take up practically the same cubic-space. However, in cargo ships of the size in question, and built as awning or single-deckers, the engine-room comes out smaller than the prescribed deduction in tonnage so that for this reason the engine-room generally has to be made larger than necessary.

The conditions are different in the small ships where the two tunnels in the twin-screw ship will take up such a large proportion of the useful space in the after hold, and where the smaller horse power to be transmitted to the propellers can easier be arranged with equal good propeller efficiency with the single-screw.

For such single-screw ships we have brought out a completely new type of engine where the characteristic main dimensions of the engines the ratio of stroke to bore has been increased to 2. At a low number of R.P.M. a favorable piston-speed is thus obtained for getting the full effect of the engine. The dsigning, nevertheless, must be carried out very carefully, otherwise the engine is apt to become too heavy. We have constructed this engine on the basis of experience we gained previously when building Diesel-engines for submarines, in which we succeeded in lowering the weight very much through having the parts that have to sustain the high combustion and compression pressures, and which accordingly have to be solidly constructed to form the strong and rigid elements in the engine. This system has been carried out with long stay bolts extending from the top of the engine to the lower side of bed plate for absorbing the large combination pressures.



View in engine-room of the "CONDE DE CHURRUCA," showing twin Armstrong-Sulzer engines

Spanish Motorship "Conde de Churruca"

Sulzer Diesel-engined Tanker Built in England—A Vessel With Many Interesting Features

READERS of "Motorship" will have noticed that during the last few months an unusually large number of new Diesel-engined merchant-vessels have been launched and run trials, making it practically impossible for "Motorship" to properly describe and illustrate them all in the month following. This includes the Spanish motor-tanker "Conde de Churruca" recently completed by Sir Wm. Armstrong, Whitworth & Co., of England and propelled by twin 1,250 shaft h.p. Sulzer two-cycle type Diesel-engines. This vessel, however, was illustrated in our October issue and we are now enabled to devote sufficient space to an adequate description. At the trials of this vessel, one of our British editorial correspondents, named Mr. J. L. Chaloner was present and the following article is one of the most comprehensive descriptions of this vessel's machinery yet published.

Whatever degree of intensity and vigor the debate on the relative merits of the 4-stroke and 2-stroke oil-engine has reached to-day, it must be remembered that the controversy—and of such there exists no small measure,—has up-to-now centered largely around performances and running data of stationary plants. It is, therefore, for this reason alone, if for no other, that the completion of the "Conde de Churruca" has been awaited with great interest. Her initial career will be watched very closely by all parties, following the development of the Diesel engine, mainly for the specific reason of obtaining some sound practical information on the behavior of large type marine 2-stroke engines. The vessel will materially assist in straightening-out the many arguments which have been put forward to prove both the merits and demerits of this type of engine.

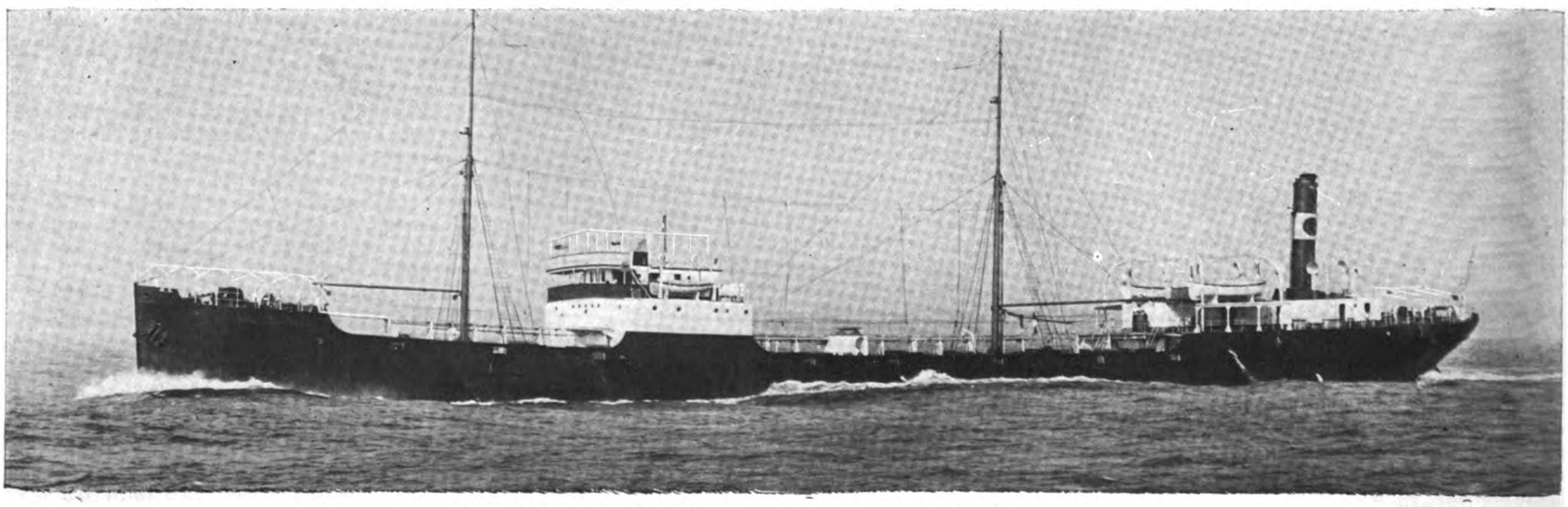
The vessel has been built by Sir W. G. Armstrong, Whitworth & Co., Ltd. at their Walker Yard, Newcastle-on-Tyne, England, for the Sociedad Commerciale de Oriente de San Sebastian, which firm took delivery last month after a very satisfactory official trial off the Tyne. We believe that this company may be associated with the Cia General Cie Tabacos de Filipines, whose name has frequently been given as owner. The ship is built to meet Lloyd's requirements for 100A1 class, and is a steel, twin-screw, 2-masted motor-tanker with 2 decks (steel) and machinery aft. She is fitted out to carry oil in bulk, and is equipped on modern lines including electric light and wireless.

She has the following dimensions—

Deadweight capacity	6,500 tons
Gross tonnage	4,500 tons
Power	2,500 shaft h. p.
Engine-speed	100 R. P. M.
Ship's speed	11½ knots at 24 ft. 11 in. dft.
Length O. A.	383 ft.
Length B. P.	370 ft.
Breadth	48 ft. 7 in.
Depth (Md.)	30 ft.
Mean loaded draught	24 ft. 3 in.
System of construction	Isherwood
Classification	Lloyds 100 A1

The nature of the cargo necessitates the main cargo-tanks to be steam-coiled, which first of all accounts for the comparatively large donkey-boiler installed, and furthermore for the deck-machinery being steam-driven. One steam-windlass and two steam-winches comprise the main gear on deck. The steering-gear is of the electric-hydraulic type, hence when under ballast, no steam need be carried on the boiler. The donkey-boiler is 10 ft. 6 in. dia. by 11 ft. 6 in. long, with a working pressure of 120 lbs. per sq. in. The two furnaces are fitted with the Wallsend Howden single-unit pressure-jet system designed for natural draft. The equipment includes a surface-condenser of 600 sq. ft., a small feed-pump, feed-filter and float-tank. The machinery is placed aft and the general arrangement is shown on the accompanying drawing.

There are in the engine-room two 4-cylinder



The m.s. "CONDE DE CHURRUCA" on her trial run—Reproduced from our October issue

2-stroke Armstrong-Sulzer marine oil-engines, each developing 1,250 shaft h.p. at 100 r.p. min. with cylinder dimensions of 23¾ in. dia. x 37½ in. stroke. At the forward end of each unit the extension of the main crankshaft carries a double-acting scavenging-pump and a single crank 3-stage air-compressor working up to 1,200 lbs. per sq. in. Special automatic suction and delivery valves of very small lift are fitted to the scavenge-pump. Valves of similarly low lift design are fitted to the compressor and are arranged for the whole of the suction or delivery valves of any stage to be withdrawn and replaced or examined without breaking any important joints.

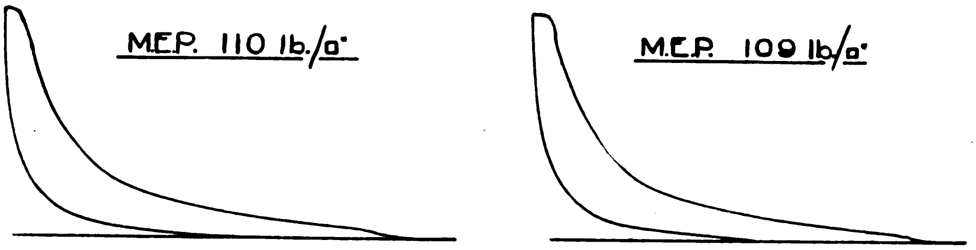
On the extreme forward end of the crankshaft a crank is fitted for driving the circulating-water (jackets, etc.), pumps and the lubricating-oil pump, each of sufficient capacity to supply both main engines in case of emergency. Three single-acting plunger-pumps are driven by levers off the scavenging-pump crosshead, and do duty as piston-cooling water (sea-water) bilge and sanitary pumps respectively. The fuel-pump is of the multi-plunger type; the oil supply to each cylinder is under separate control and the quantity proportionate to the load on the engine is hand-controlled by timing the lift period of the fuel-pump suction-valve.

Any cylinder may, therefore, be cut out as required. A series of illustrations of the Sulzer engine were given in our issue of November, 1919. The general design of the Armstrong-Sulzer engine follows the modern Sulzer practice, which of course includes the controlled port-scavenging valve. The scavenging-air under very low pressure passes through a series of ports arranged around half the circumference of the cylinder at the bottom of the piston stroke, the exhaust-gases being expelled through a similar set of ports arranged in the opposite side of the cylinder. The scavenging-ports are arranged in two rows, one above the other. The opening and closing period of the bottom row is controlled by the piston, which also controls the opening and closing of the exhaust ports.

The admission of scavenging air to the top row of ports is under the control of a rotary-valve, whereby scavenging-air is only admitted when the exhaust-gases have reached their lowest pressure; furthermore, the auxiliary scavenging-air is not cut-off until the exhaust ports are closed, hence there is a slight super-charge pumped into the cylinder for the subsequent power stroke. This arrangement permits of a symmetrical cylinder head, the only hole in the centre being provided for receiving a casing containing both the fuel-valve and air-starting valve, together with a safety-valve.

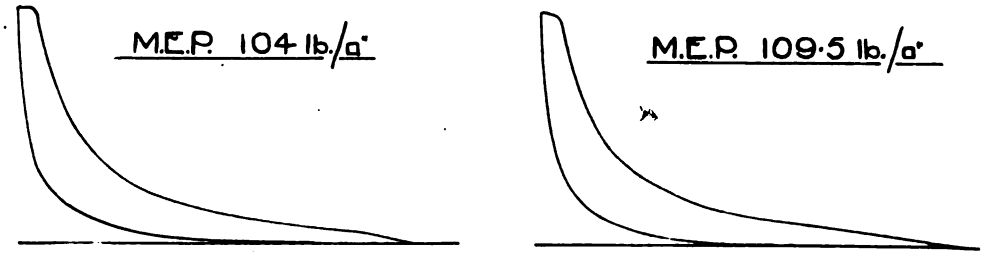
The pistons are water-cooled and owing to the whole system working under atmospheric pressure, sea-water has been found quite suitable. The water enters the upper part of the piston in form of a spray, impinging on the underside of the piston-top, and is carried away by telescopic piping to open funnel discharges fixed to the main engine framing. The discharge is, therefore, under constant observation by the engineer on watch.

To grasp the fascinating simplicity of the reversing gear, one must have seen it at work. A double set of cam-rollers are provided which engage corresponding cams for fuel and starting-air

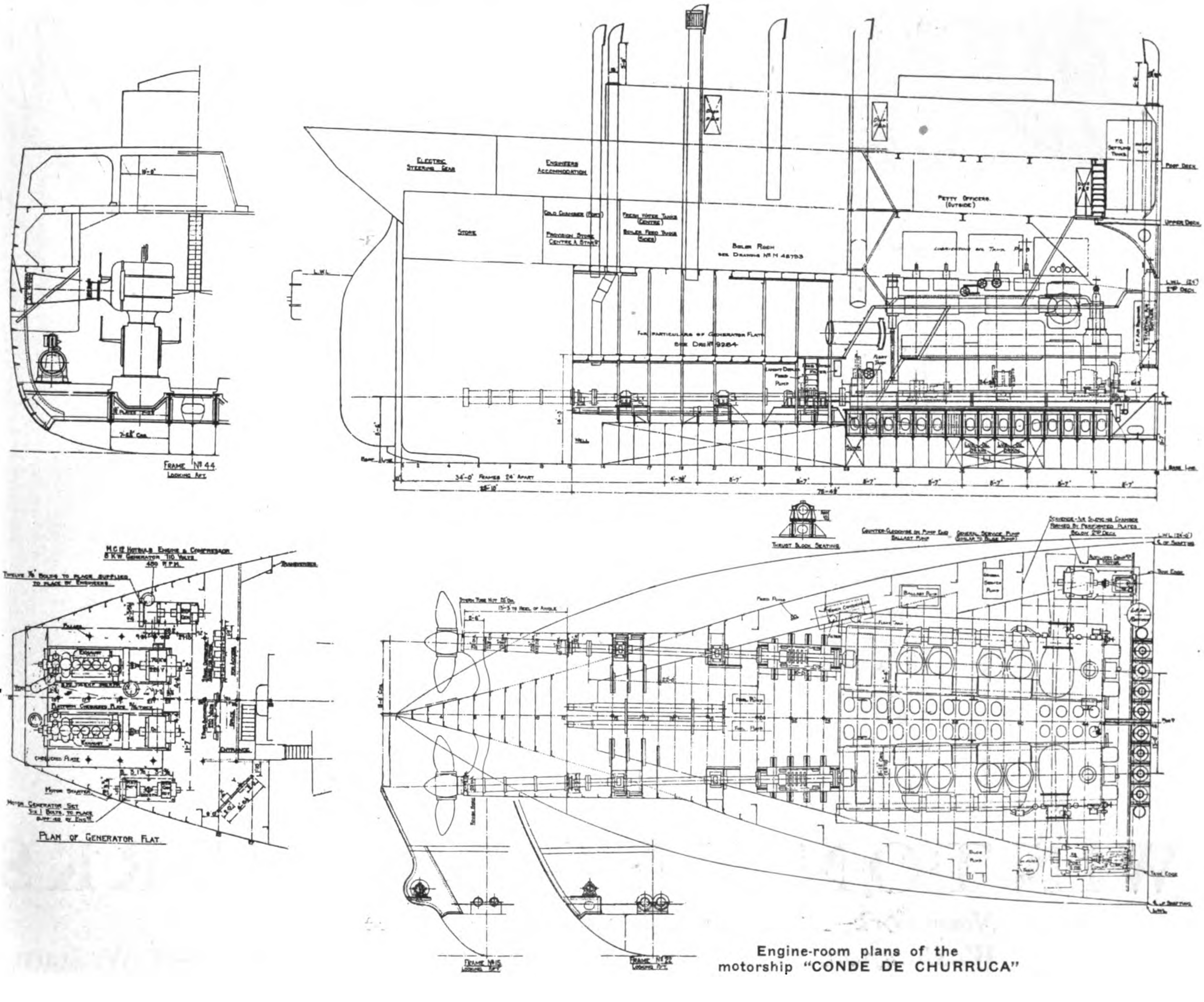


Time of taking cards, 8:00 A. M.

Speed	98 r.p.m.
I. H. P.	1,739
B. H. P.	1,251
Mechanical Efficiency	72.25%



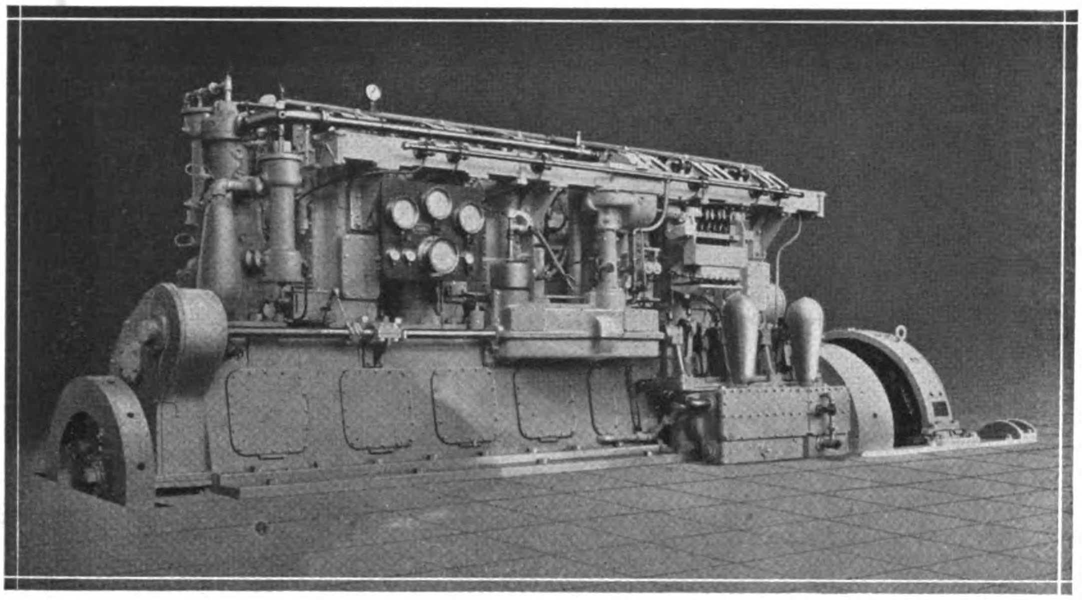
Indicator cards taken on trials of the motor-tanker "CONDE DE CHURRUCA"



Engine-room plans of the motorship "CONDE DE CHURRUCA"

Win

OIL DIESEL TYPE

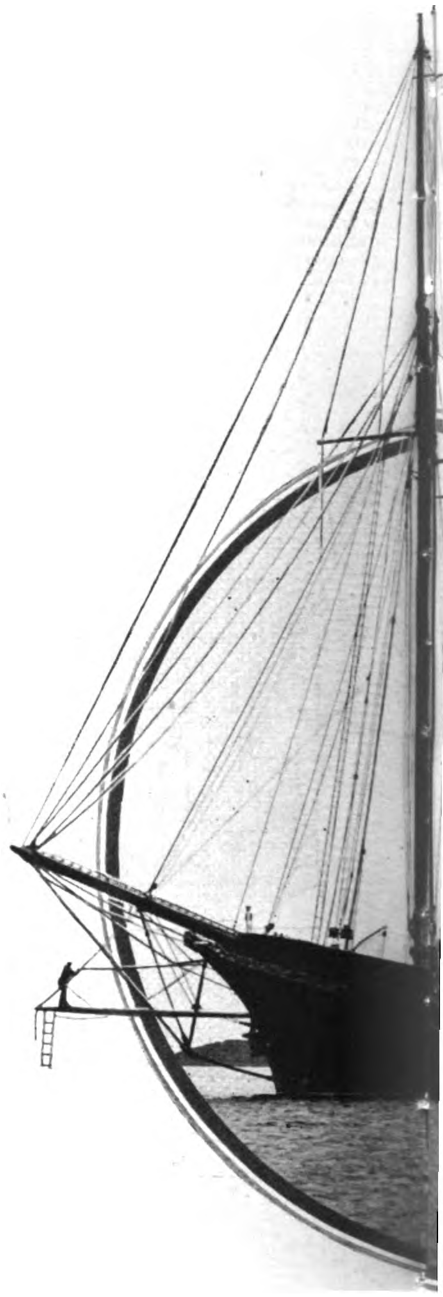


"GUINIVERE'S" POWER PLANT

"Guinivere" is the latest addition to the fleet of highly successful Diesel-Electric Driven Ships to be powered with Winton Oil Engines.

"Guinivere" is owned by Mr. Edgar Palmer, was designed by A. Loring Swasey and was built by Geo. Lawley and Son Corp. 195' x 32' x 15'. Speed, 11½ knots. Cruising radius, 11,000 miles.

Power plant consists of a pair of six-cylinder 350 H.P. Winton Oil Engines direct connected to 225 K.W. Westinghouse generators, which in turn operate a 550 H.P. electric driving motor in the stern.



GUI

WINTON ENGINE WORKS,

New York—A. G. Griese, Inc., 30 Church Street
Washington, D. C.—R. L. Fryer, 817 Albee Bldg. *Seattle*—H. W. Starrett,

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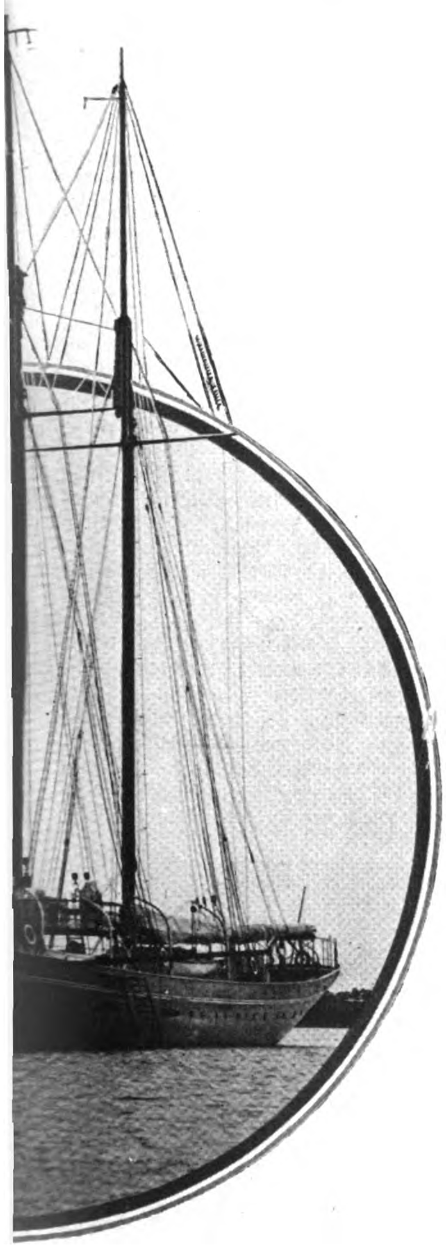
NGINES



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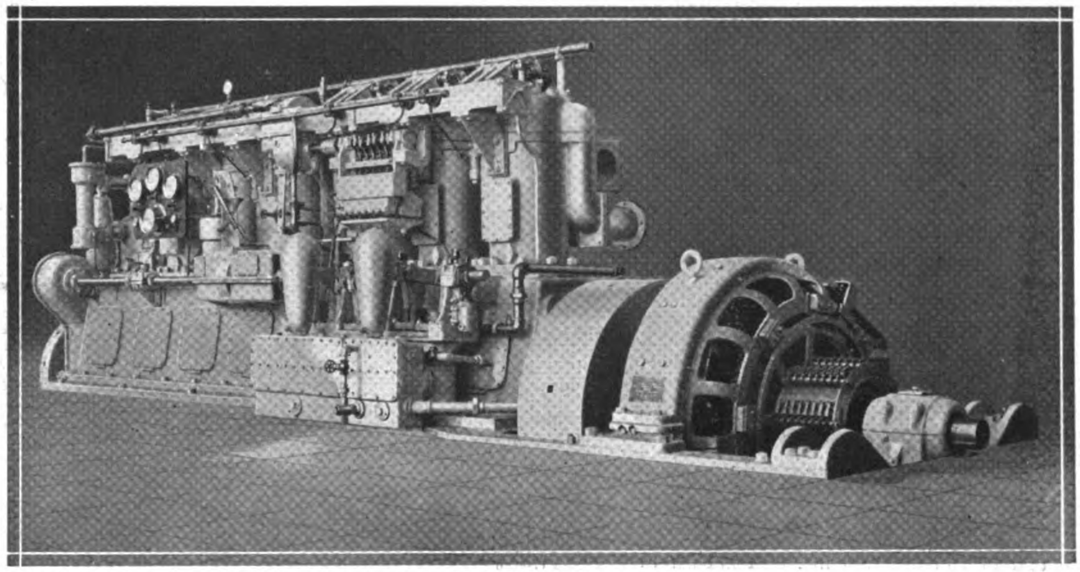


"GUINIVERE'S" POWER PLANT

WINTON ELECTRIC DRIVE UNITS

Model 67 3-cylinder	45 K.W.
Model 43 4-cylinder	60 K.W.
Model 59 6-cylinder	80 K.W.
Model W-66 6-cylinder	140 K.W.
Model W-86 6-cylinder	225 K.W.
Model W-87 8-cylinder	340 K.W.

WINTON OIL ENGINES FOR DIRECT DRIVE

Model W-54 6-cylinder	125 H.P.
Model W-58 4-cylinder	150 H.P.
Model W-35 6-cylinder	225 H.P.
Model W-24 6-cylinder	300 H.P.
Model W-40 8-cylinder	450 H.P.

WINTON AIR COMPRESSORS

Model AC-3 90 cu. ft. free air
Model W-18 38 cu. ft. free air

CLEVELAND, OHIO, U. S. A.

San Francisco—F. G. Bryant, 593 Market Street
Sunset Engine Co. *Jacksonville*—D. J. Carrison & Co.

on a camshaft, driven in the usual way from the crankshaft by vertical shafting. A simple hand operating-gear engages the correct roller with its corresponding cam according to ahead or astern order from the bridge. The manoeuvering-shaft, illustrated, carries the fuel and air valve levers, mounted eccentrically, the whole of the operations being carried out by a small servo-motor driven by low-pressure air. A hand-operated emergency sets is provided as a standby. The change-over from the four cylinders on air to the same four cylinders on oil, after passing through the intermediary stage of two-cylinders on air and two on oil, is done automatically by simply opening the control-valve of the servo-motor, which thus controls the whole range of manoeuvering operations of one engine by the simple turning of a small hand-wheel.

There are two starting-valves arranged in each valve-cage in the cylinder head. One is controlled by a master-valve and is open during the whole time the cylinder is on air, the other is the mechanically controlled one for manoeuvering purposes. The starting-valve proper can, therefore, be dismantled and cleaned while the engine is running, certainly a most practical feature, when one remembers the great tendency which these valves have for sticking or gumming up.

Manoeuvering was carried out with a precision, which came as a revelation to the many steam-engineers, who were present during the trials. From full-ahead to full-astern not more than 12 seconds were required, and as low a pressure as 200 lbs. was still sufficient to continue the manoeuvering operations. The controls are on the top platform. There is no difficulty of arranging the controls on the bottom platform, and this would seem preferable. It is more conventional and would make the average motor-engineer, who today is mainly drafted from the ranks of steam-engineers, feel more at home with his job. This may only appear a sentimental reason, but even if so, it is in this case a very important one.

Very light, but large aluminum doors are fitted to the main-engine framing, facilitating the inspection of the working-parts while the engine is running. The top halves of the doors may be removed from the middle grating, and the bottom halves from the bottom platform. The engine is, therefore, completely enclosed, this being necessary, as all main bearings, connecting-rod top and bottom ends, crosshead guides and other important bearings are supplied with oil under pressure.

At the aft end of the engine-room is the dynamo flat, where two 4-cylinder Sulzer 2-stroke Diesel, 70 k.w. electric generating-sets are fitted. Each engine is rated at 100 b.h.p. when running at 300 r.p.m. The general design is on similar lines to that of the main engines. One set is sufficient to deal with the whole of the load at sea, the working voltage being 220 volts, controlled by switchboard on the fore end of the dynamo flat and shown in Fig. 8.

Two motor-driven auxiliary air-compressors are used for charging up the air-reservoirs, of which eight are fitted on the forward bulkhead of the engine-room. In addition the auxiliary air-compressors are available for augmenting the main engine compressors during uncommonly long maneuvering periods, and for acting as standby sets, in case the main-engine compressors give out.

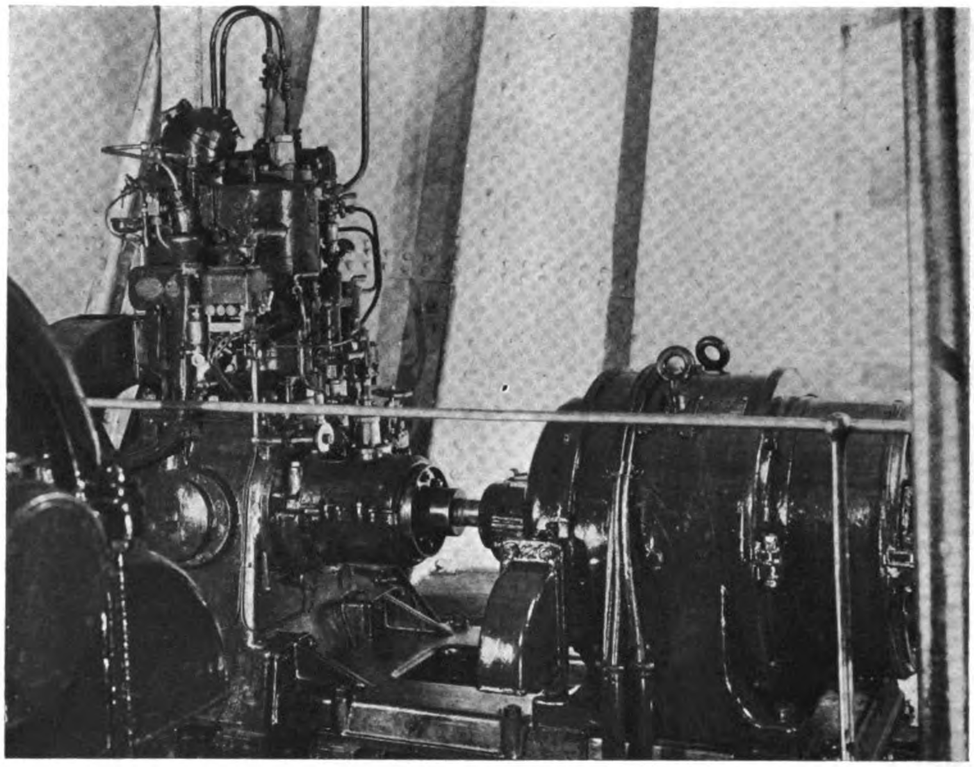
They are designed for pressures up to 1,200 lbs., and there is a complete system of cross connections between the compressors of the main engine, either of the two auxiliary-sets, and the air-reservoirs. There is a further cross-connection to a standby compressor-set consisting of a 12 b.h.p. 2-stroke Sulzer hot-bulb engine combined with a two-stage compressor capable of delivering air of 1,200 lbs. p. sq. in. This unit can be started by hand, hence if all the air in the reservoirs is lost, this set can be started, till sufficient air is available for getting one of the auxiliary lighting-sets started for pumping up the bottles.

There is also a low-pressure air-receiver, which can be charged through a reducing-valve from the h.p. bottles. This air is used for the servo-motor (manoeuvering-gear), the turning-engine, the small duplex Worthington (air-driven) for lubricating-oil work, and the whistle. In addition there are on board: **One** rotary ballast-pump (electrically driven), which can circulate the auxiliary condenser, and act as a standby to the circulating pumps for the cylinder jackets, driven off the main crank. **One** 2-throw double-acting vertical plunger-pump (electrically-driven), for general service, and also as standby for the piston-cooling system, or circulating system for the auxiliary generating-sets. **One** duplicate of the above, acting as a bilge-pump. **Two** oil-fuel transfer-pumps, electric-driven and of the roto-plunger type, one acting as a standby. They each are rated at 12 tons per hour.

For the ship's lighting, etc., a small rotary transformer (110 volts) is fitted, and as a standby an 8 k.w. generator is coupled to the hot-bulb engine (Fig. 11). There are, of course, the various cross connections to the different pumps for use in emergency cases.

Two grades of fuel are carried for the main engines, auxiliaries, etc., on one hand (Diesel-oil), and for the donkey-boiler on the other (fuel-oil). The oil is stored in the cross-bunker forward of the engine-room, and in the double-bottom tanks under the engine-room. The roto-plunge transfer pumps keep the daily service-tanks (settling-tanks) supplied, of which there are two of 12 hours capacity each situated at the forward end of the engine-room (on the upper deck level).

The lubricating oil is carried in 6 tanks (3 on either side) fixed in the engine-room. There are two drain-tanks situated in a recess in the double-bottom oil-fuel tanks, whence the oil is pumped back into the lubricating-tanks for re-use.



Emergency air-compressor and electric generating set

During the trial a large and distinguished party watched the behavior of the engine both as regards speed trials as well as manoeuvring qualities, with an engine-speed varying from about 100 down to 30 r.p.m.

The following records were taken during the official trial and a set of indicator cards are reproduced:

OFFICIAL SEA-TRIAL

	Port	Star	
Duration of trial			6 45 a. m. to 12.45 p. m.
Counter reading, beginning of trial	152,347	18,268	
Counter reading, end of trial	188,530	54,690	
Average revs. per min	100.5	101.2	
Average B. H. P.	1,215	1,245	
Total			2,460
Total fuel used			716 gallons
Actual time of consumption test			5 hours, 55 minutes
Grade of oil used			Mex Gas-Oil, Sp. Gr. 0. 873 Flash point 169 ° F
Fuel used (by weight)			6,250 lb
Fuel used by main engines			6,136 lb
Fuel used by auxiliaries			114 lb
Fuel (main engines) per B. H. P. hour			0.421 lb

Air Compressor Readings

	Port	Star.
	Lbs. per sq. in.	
Injection-air pressure	955	965
Air compressor readings—		
L. P. Stage	18	21
I. P. Stage	137	142
H. P. Stage	955	965

The daily consumption for the engines and auxiliaries works out at 11½ tons of Diesel-oil, and the donkey-boiler can burn up to 5½ tons of fuel oil according to the requirements of the heating-coils.

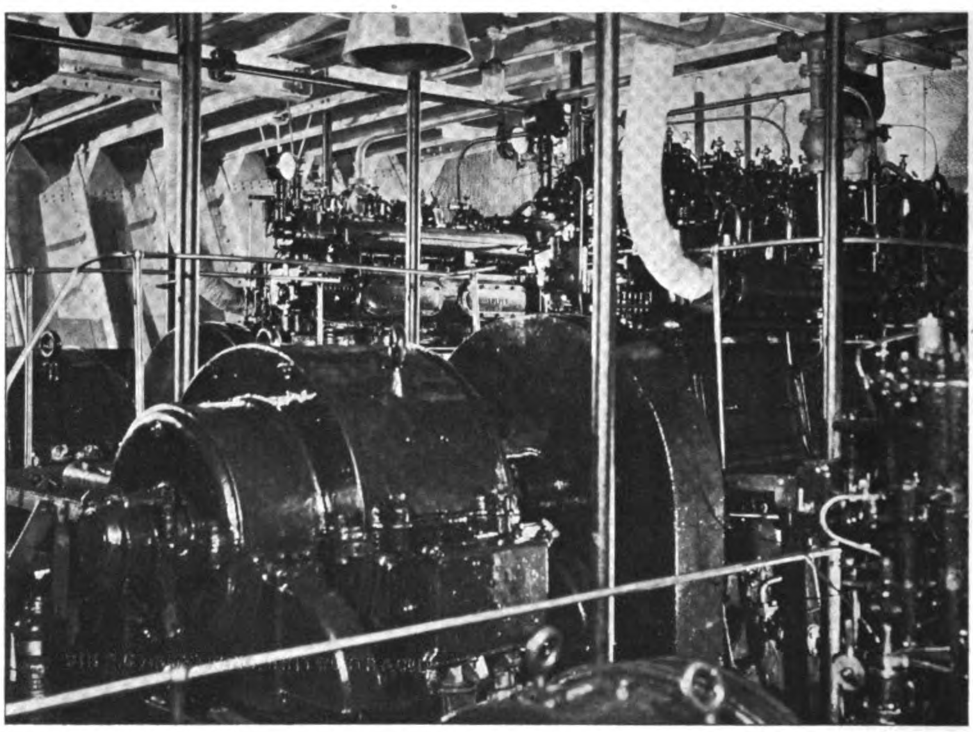
Among noteworthy men at the trials was Dr. Hans Sulzer, who is one of the directors of Sulzer Freres of Winterthur, Switzerland, and who until recently was Minister from Switzerland at Washington, D. C. In a speech he referred to the U. S. authorities having sent a formal invitation to the Swiss Naval authorities to be present at the opening of the Panama Canal. While they had no admiral in Switzerland, says Dr. Sulzer, he was sure no one could be prouder than the Swiss who stood on the bridge of a vessel propelled by Swiss Diesel marine-engines. He felt this engine would be a success and that there is a great future for it.

FURNESS-WITHY WILL OPERATE NEW MOTORSHIP

The sister single-screw motorship of the "Yngaren," building for the Transatlantic Steamship Company of Goteborg, Sweden, by Wm. Doxford & Sons of Sunderland, England, has been taken over by Furness-Withy & Co., who for some years have been general agents in the United States for this well-known Swedish firm.

NEPTUNE DIESEL-ENGINE TANKER BUILDING

Now under construction at Swan, Hunter & Wigham Richardson's shipyard at Wallsend-on-Tyne is a 6,500 tons motor-tanker in which two 2,000 b.h.p. Neptune-Polar Diesel-engines completing at their Newcastle works will be installed.



Electric light sets in dynamo flat

Interesting News and Notes From Everywhere

WILL BUILD TOSI DIESEL-ENGINES

Licenses to construct Tosi Diesel marine-engines have been acquired by Richardson Westgarth of Middlesbrough, and by W. H. Allen, Sons & Co., Bedford, Eng. The success of the motorship "Ardito" was partly responsible.

WESTERN UNION CABLE MOTORSHIP

We understand that the awarding of the contract for the construction of this vessel has been held-up pending checking-up bids from Great Britain and France. Incidentally, in view of the fact that Diesel-electric-drive only is being considered, we wonder why many magazines insist upon referring to her as a "steamer."

NAMES OF AMERICAN-HAWAIIAN STEAMSHIP CO.'S MOTORSHIPS

"Californian" and "Missourian" are the names of the two motorships for the American-Hawaiian Steamship Company now building at the Merchants Shipbuilding Corp. yard at Chester, Pa., which are being Diesel-engined by Wm. Cramp & Sons Ship & Engine Company. The namesakes of these vessels were steamers and were sunk during the war. They will be launched this month.

AN EXPENSIVE SHIP

In connection with the construction of the 850 tons d.w. Diesel-driven motorship "Granit" for the Harald Grenske Steamship Co., the "Scandinavian Shipping Gazette" says a huge bill was presented by the builders, namely, the Trosvik Slipway & Engineering Company of Brevik, Norway, which the owners naturally refused to pay. The vessel was ordered on the conditions that payments were to be on a sliding scale, and an invoice for 1,400,000 kroners was delivered, or 1,650 kroners per ton.

DISCUSSION ON METTEN AND SHAW'S PAPER

In our September issue, in connection with the above Discussion, it was stated that Mr. Verhey advocated double-acting, four-cycle engines. However, what Mr. Verhey did actually say was—"It is suggested that the two-cycle single-acting engine be given serious consideration. This engine can also be converted to a double-acting engine with equal chances for success, if properly designed. We cannot help but keep an eye on the development in Germany with the two opposed-piston type engines."

1,000 tons d.w. motorship "VIRGINIA" shortly after her launch at the Nakskov Shipyard. She is owned by the East Asiatic Co. and propelled by a 350 shaft h.p. Holeby Diesel-engine

NEW SWEDISH MOTORSHIP "ARATOR"

The 7,200 tons d.w.c. motorship building at the Kockums shipyard, Malmo, to the order of the Swedish Farmers Steamship Co. was launched at the end of August. Twin 1,100 i.h.p. B. & W. Diesel-engines are being installed. Her length is 367 ft. by 51 ft. breadth. During the launch her rudder-post was damaged. After the repair she will be towed to the Burmeister & Wain plant, and have her Diesel-engine installed. A government loan has been granted towards her construction.

RECENTLY READ PAPERS

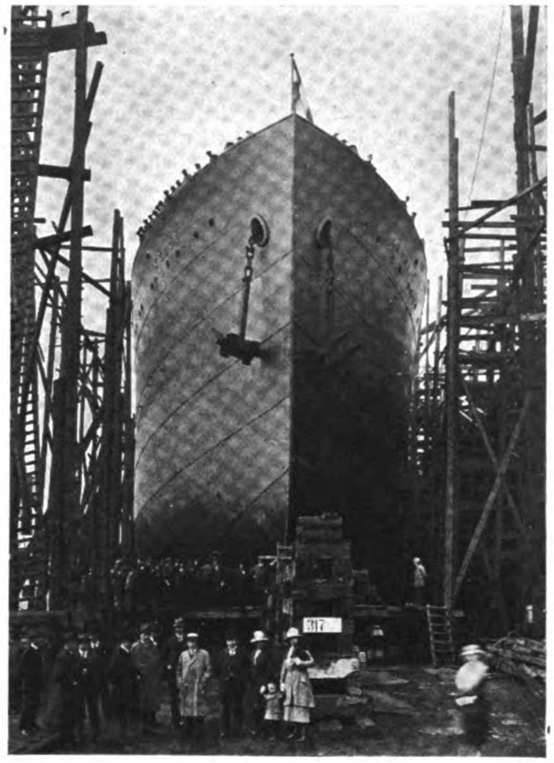
So many papers on Diesel engines and motorships—some of them of great interest—have recently been read in Great Britain before the various Societies that it is impossible for "Motorship" to reproduce extracts from them all. At the Olympia exhibition James Richardson read a paper entitled "Progress of Motorships." Before the Institute of Marine Engineers of England, F. G. Butt-Gow read a paper entitled, "The Open-Fronted Surface-Ignition Engine", and before the same Institute Andrew J. Brown read a paper called "The Reliablity of the Marine Diesel Engine in Service."

On October 18th, before the Institution of Engineers and Shipbuilders in Scotland, Engineer-Vice-Admiral Sir Geo. G. oodwin (Engineer-in-Chief of the British Navy) read a paper entitled "Developments in Modern Diesel Engines," while Sir Archibald Rennie read a treatise on the Still Oil Engine for Marine Propulsion," and David Bruce read a paper entitled "Some Factors Limiting the Power of Diesel Engines."

Before the Armstrong College Naval Architects Society, J. Tutin will read a paper on Motorships.

MOTOR-AUXILIARY SOLD TO IRELAND

The 360 tons motor-schooner "Venturer" has been sold by her London owners to R. Keron of Ireland. A 2-cycle Steywal oil-engine is installed.



Rotterdam-Lloyd's 6,500 tons d.w. motorship "KEDOE" just prior to the launch

WESTERN DIESEL ENGINE

In the list of Marine Diesel Engine Builders of the World in the "MOTORSHIP YEAR BOOK" (page 22) the Western Machinery Corp. thro a clerical error are quoted as building Tosi engines. This, of course, is incorrect as they are building the Western Diesel engine.

THE QUESTION OF AUXILIARY POWER

Professor Carl Hansen of the Polytechnic College, Copenhagen, Denmark, recently told the first convention of Scandinavian Shipowners at the meeting in Göteborg, Sweden, that he, together with Engineers Vogt & Petersen made some exhaustive studies of the operation of sailing-ships with and without power, using as a basis the Danish Sugar Works' auxiliary "Hvalen." The results, which were strongly in favor of auxiliary motor-power were given at length in his paper.

NEW SURFACE-IGNITION MARINE OIL-ENGINE

A new marine oil-engine of the surface-ignition type in powers from 3 b.h.p. to 30 b.h.p. has been produced by G. C. Ogle & Sons, Ltd. of Ripley, Derby, England. The trade-name of this engine is the Ogle.

FIFTY AMERICAN-ENGINED TUGS IN FRANCE

It is not generally known that some time ago 50 tugs were constructed of reinforced concrete in France and are now in operation on the Seine. Each of these vessels is propelled by a 200 b.h.p. motor operating a gas-generator from an anthracite gas-producer. The engines were built by the Wolverine Motor Works, of Bridgeport, Conn.

THE MARINE EXHIBITION.

Don't forget to go to the Marine Exhibition held by the Marine Equipment Association of America at the Central Mercantile Bldg., 45 West 18th St., N. Y. C., during the week of Nov. 14th. Many important concerns in the industry have very interesting exhibits. In connection with this exposition this issue of "Motorship" has been especially enlarged.

THIRTY DIESEL-ENGINES AVAILABLE

Ship and boat owners requiring immediate delivery of four-cycle type Diesel-engines will be interested to know that the New London Ship & Engine Company of Groton, Conn., have about 30 marine and auxiliary engines of 120 to 600 b.h.p. in stock, the prices of which will meet any domestic or foreign competition.

PUGET SOUND NAVIGATION CO'S NEW MOTORSHIP

The steamer "Whatcom" will be converted into a ferry-boat for operation on the Puget Sound run until next summer, when Puget Sound Navigation Company will build a Diesel-electric driven 18-knot steel motor ferry-boat. Bids will be asked from shipyards at both the Atlantic and Pacific Coasts.

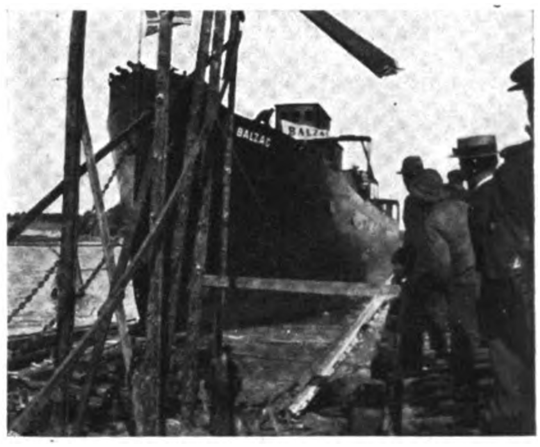
ARDROSSAN YARD LAUNCHES MOTORSHIP "LOUISIANA."

Built to the order of the Det Forenede Dampskibs-Selskab (United Steamship Co.) of Copenhagen, the 10,000 tons deadweight motorship "Louisiana" was launched by the Ardrossan Dry Dock & Shipbuilding Co. at Ardrossan, Scotland, on October 4th. The vessel is of the closed shelter-deck type, her dimensions being: L.B.P., 497 ft.; breadth moulded, 55 ft.; depth moulded, 27 ft.; 9 in. to upper deck, 36 ft. 6 in. to shelter deck; deadweight, 10,300 tons on 28 ft. 4 in. draft; gross tonnage, 6,600 tons.

Her propelling machinery consists of a pair of 1,400 i.h.p. Burmeister & Wain Diesel-engines turning at 140 R.P.M. In the way of auxiliary machinery there are three Diesel-driven 60 KW sets.

MOTORSHIP CARRIES OIL FOR STEAMER

When the Hudson Bay Co.'s new motor-schooner "Lady Kindersley" left Vancouver, B. C., fully loaded on her maiden voyage to northern waters she carried, among other cargo, a supply of fuel-oil for the steamship "Casco." The "Lady Kindersley" also carried four motor launches.



Launch of Fred Olsen's 1,350 tons motorship "BALZAC" at the Odense Shipyard

BEACHING MOTORSHIP TO LOAD

Once every round voyage the West Australian Government's 5,800 tons d.w. motorship "Kangaroo" will be beached at Derby, West Australia, where the tide recedes to such a distance that she will be left high-and-dry two miles inland. Loading will be carried-out by means of horse-trucks.

BACK COPIES OF "MOTORSHIP"

We have been advised by Mr. B. D. Cullings, 1646 Lincoln Ave., Lakewood, Ohio, that he has a complete set of "Motorship" in good condition commencing with April, 1918, to date, which he is willing to dispose of. Recently we have had a number of inquiries for back copies, which we have been unable to supply.

HAWTHORN-WERKSPOOR DIESEL ENGINE

A pair of 1,400 i.h.p. Werkspoor Diesel engines are being built by R. & W. Hawthorn, Leslie & Co., St. Peters, Engine Works, Newcastle-on-Tyne, England. Larger sizes are being designed.

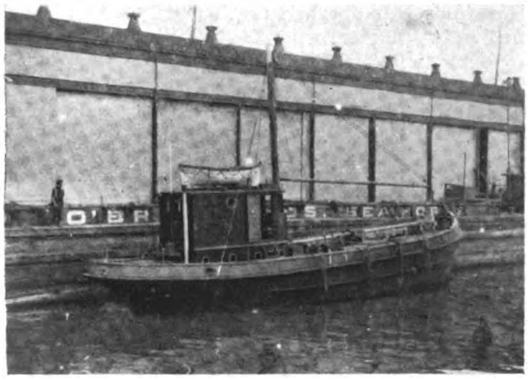
MOTORBOAT IN SODA LAKE

For operation on the Soda Lake of Mogodai, East Central Africa, by the Mogodai Soda Co., have had a 42 ft. stern-wheeler built in England. This little vessel is powered by two 30 b.h.p. Bolnes surface-ignition oil-engines.

"AURORA" AN ECONOMICAL HARBOR LIGHTER

While many steam-lighters in New York harbor are laid-up for lack of work during the present dull period, the new motor-lighter "Aurora" owned by the Marine Transportation Co. is steadily at work, operating at a profit on jobs which steam-lighters cannot touch because of higher operating costs. Her 100 h.p. Bolinders oil-engine drives a three-bladed 48 inch by 38 inch Trout propeller at 320 r. p. m., giving a speed of 9 knots at a fuel cost of 30 cents per hour, using fuel-oil. She can carry 35 tons in the hold and 40 tons on deck, with a 1½ ton motor-winch handling the derrick hoist. "Aurora" is 64 feet long, 18 feet breadth, 8 feet depth of hold, and draws 8 feet when loaded. A captain, engineer, and deck-hand constitute the crew. She was designed by J. Murray Watts and built by the Cambridge Manufacturing Co., Cambridge, Md., and placed in commission this past summer.

Engine-room crew of the motorship "HAVELLAND"; she is described elsewhere in this issue. Left to right (standing) Herr Ebst, Asst. Engr.; Herr Brocks, Asst. Engr.; Herr Brinkner, Fourth Engr.; Herr Leps, Elec.; Herr Pless, Asst. Engr.; Herr Wittenburg, Asst. Engr. Left to right (sitting) Herr Trepken, Third Engr.; Herr Stege, Const. Engr. from Blohm & Voss, Hamburg, (not a member of the crew); Herr Hampe, Chief Engr.; Herr Noask, Second Engr.; Herr Cahnnbley, Third Engr.



The harbor-lighter "AURORA" in service in New York.

TESTING THE U. S. NAVY'S NEW BIG SUBMARINE DIESEL-ENGINES

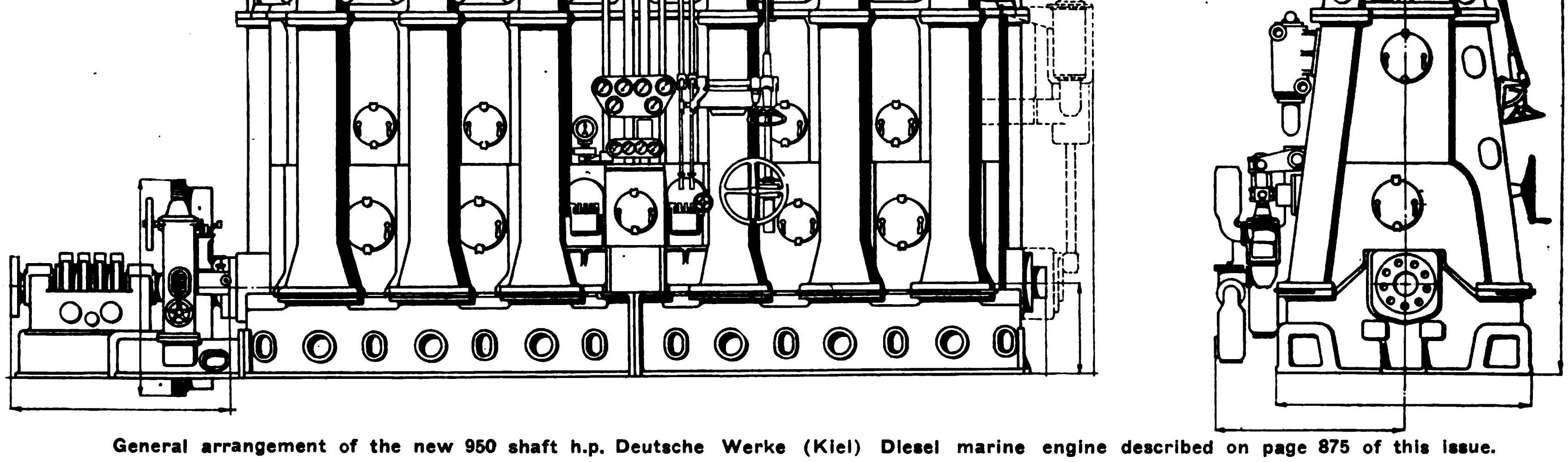
The U. S. Navy Dept. has recently placed an order with the C. H. Wheeler Mfg. Co. of Philadelphia, for a large size Froude dynamometer, which will be used in the first instance for testing the big Diesel-engines for submarines, which are now nearing completion at the New York Navy Yard. The Froude dynamometer in question will have a maximum rated capacity of 4,000 B. H. P. at speeds of from 310 to 500 R.P.M., and its operating range will be sufficiently wide to permit of testing as low as 50 B.H.P. at 200 R. P. M.

One of the most prominent features of the Froude dynamometer is its typically wide capacity range in both power and speed. Another feature particularly advantageous for marine-engine testing is its reversibility, whereby it may be employed for testing in both directions of rotation without uncoupling from the engine on test, the dynamometer automatically reversing its action when the engine is reversed. The manufacturers claim, and their claim is warranted by the operation of hundreds of installations, that the Froude Dynamometer gives the utmost of reliability and sentitiveness and at the same time combines these with ease of operation, either continuously or intermittently, and with practically no wear, since all friction is developed hydraulically.

The use of dynamometers for testing-prime-movers before their installation on shipboard is not nearly so universal in America as in Europe, but with the development of the oil-engine industry there will no doubt be a more general use of testing instruments in order to insure the most satisfactory results after installation. That a good beginning in this direction is being made is illustrated by the forthcoming installation at the New York Navy Yard of this new Dynamometer, and also by the present use of Froude dynamometers for Diesel-engine testing by such prominent Diesel-engine builders as the McIntosh & Seymour Corporation of Auburn, N. Y., Busch-Sulzer Bros. Diesel Engine Co. of St. Louis, Mo., Pacific Diesel Engine Co. of San Francisco, Cal., and the Dow Pump and Diesel Engine Co. of Alameda, Cal.

THIRTY-FIVE AUXILIARY SCHOONERS BUILDING BY KRUPPS

Orders for a total of 35 large oil-engined schooners and barks have been received by Krupps of Kiel, of which several have been placed in service. They vary from 115 tons to 5,200 tons deadweight, most of them being under 600 tons. Some have surface-ignition oil-engines, and others are of the Diesel type.



General arrangement of the new 950 shaft h.p. Deutsche Werke (Kiel) Diesel marine engine described on page 875 of this issue.

MOTORSHIP "BALCATTA" SOLD TO FRANCE

The wooden motorship "Balcatta" fitted with McIntosh & Seymour Diesel engines has been sold to French owners.

SAYS A BIG BRITISH SHIPBUILDER

"The opinion of those best qualified to judge is that the reciprocating steam-engine will be gradually replaced by the internal-combustion motor, ultimately leading to a new type of ship. Other builders and engineers are of the same opinion and have expended hundreds of thousands of pounds on perfecting the various types of engines." —*Sir Glynn Hamilton West, Chairman of Sir Wm. G. Armstrong, Whitworth & Co., Newcastle-on-Tyne, at the annual meeting of Stockholders.*

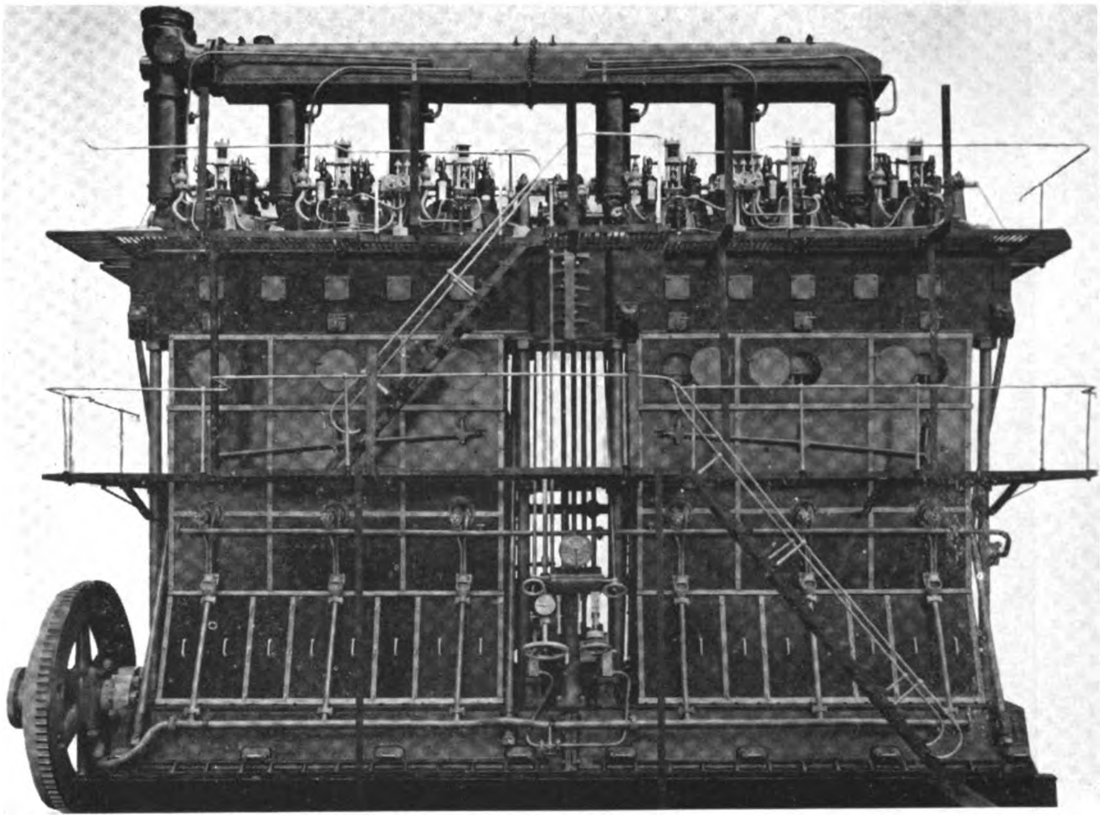
WHILE AMERICA SLEEPS!

In our last issue an unusual number of new motorships were described or illustrated, of which ten had just completed trials and five just launched. Altogether there were 43 big motorships described as follows—

Launched	Trials Run	Under Construction
1 Danish	1 American	10 British
2 Norwegian	2 Danish	1 Swedish
1 Dutch	2 Italian	1 Dutch
1 British	2 Swedish	1 Danish
—	1 Spanish	2 Norwegian
5	1 Norwegian	10 German
	1 German	—
	—	25
	10	

Newly Ordered	Projected
1 American	1 British
1 British	
—	
2	

The 25 vessels under construction does not mean that these are all the motorships now building, but only refers to the particular craft that happened to be mentioned in our September issue, about which little information was previously available. It gives, however, an idea of the increasing adoption of the Diesel engine abroad.



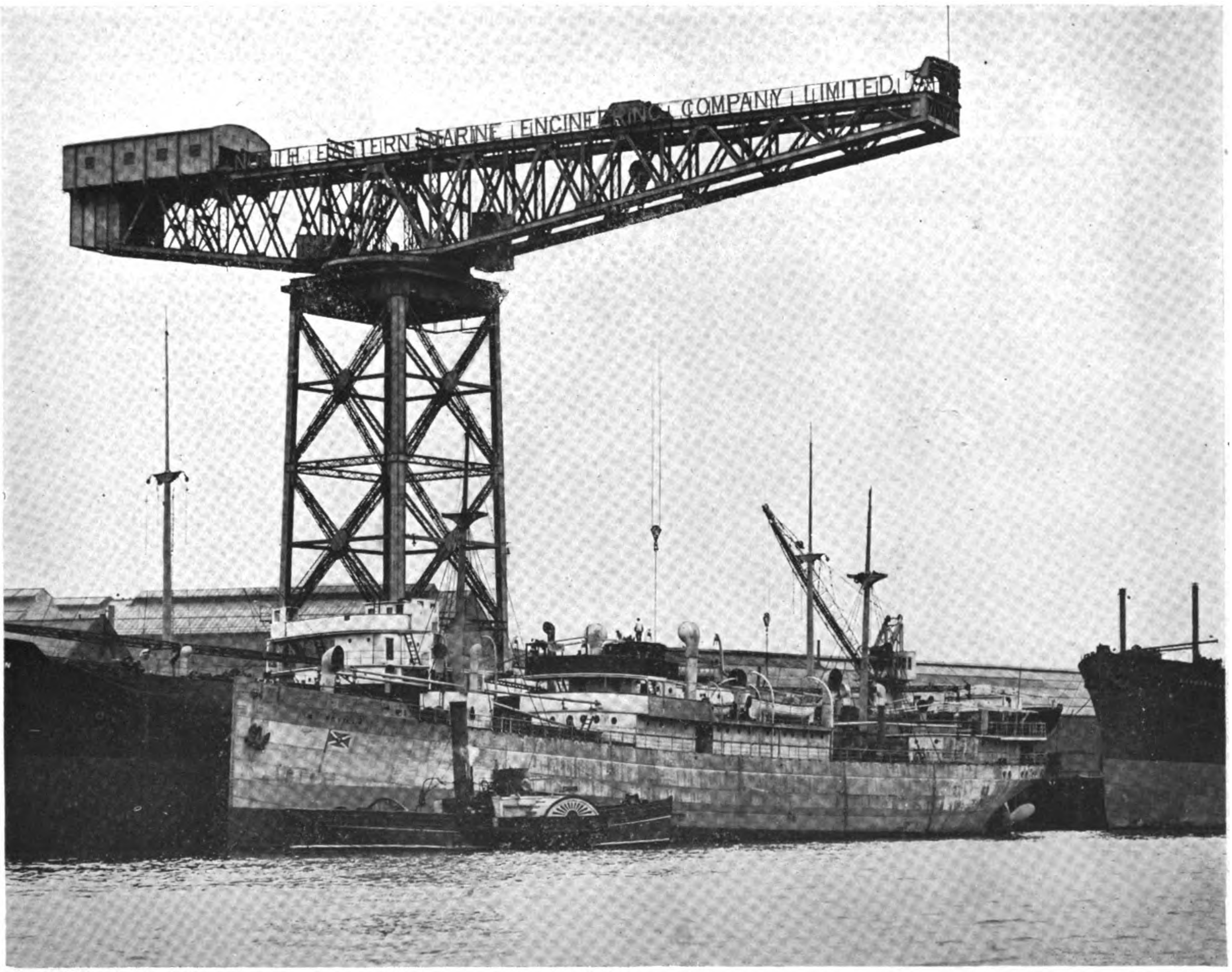
The 1,500 I.H.P. North Eastern-Werkspoor Diesel marine engine of the new motorship "SEVILLA."

CONCRETE MOTORSHIP SOLD TO FRANCE

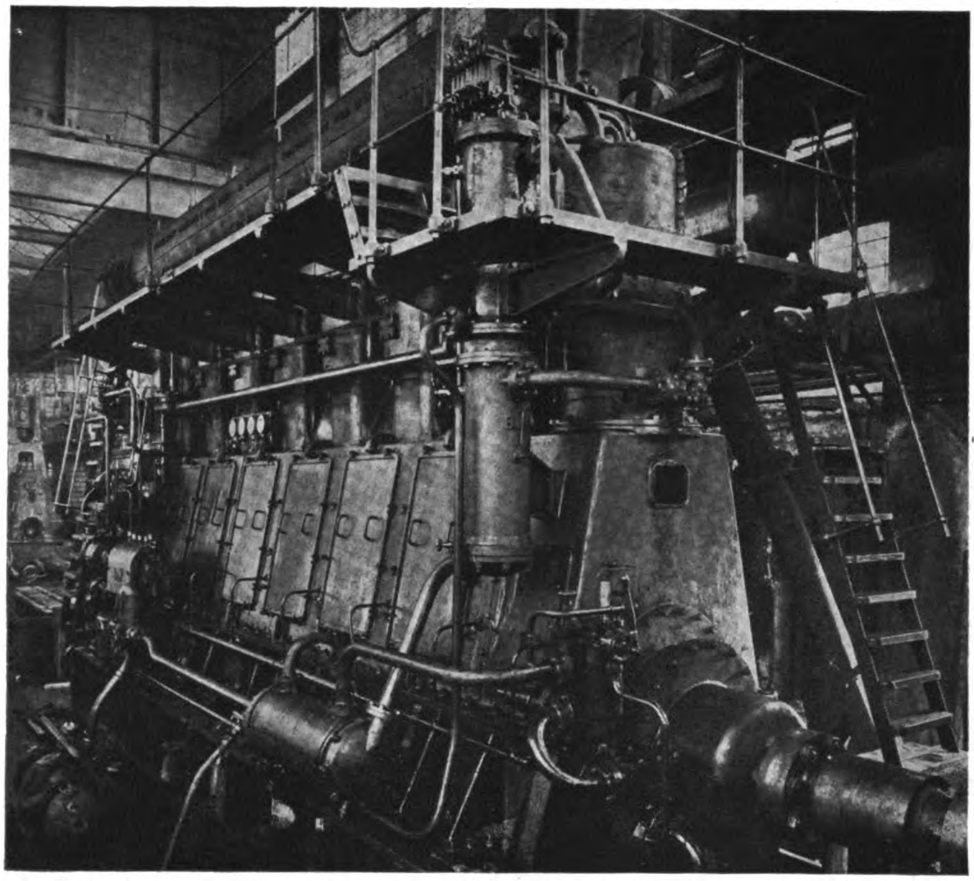
The 505 tons gross concrete oil-engined motorship "Prim," built in Norway last year, has been sold to I. M. Allum, shipowner, Boulogne-sur Mere, France, for Kr. 75,000.

OUR REGISTRY OF MOTORSHIP ENGINEERS

John E. Hough, 131 Lincoln St., Amherst, Ohio, has Chief's unlimited license for internal-combustion and electric drive, also a 1st Assistant unlimited for steam.



Single-screw motorship "SEVILLA fitting-out at the yard of the North Eastern Marine Engineering Co., Wallsend-on-Tyne, England, who built her 1,500 I.H.P. Werkspoor Diesel-engine under license. Her owner is Otto Thoresen of Christiana.



The new six-cylinder 900 shaft h.p. trunk-piston type Burmeister & Wain Diesel marine-engine. Drawings of a ship in which two of these motors are installed are given on another page. Owing to great pressure on space we are obliged to hold over a description of the engine and additional pictures until next month.

105 STEEL MOTORSHIPS AGGREGATING 229,325 GROSS-TONS NOW BUILDING, EXCLUDING GERMANY, SAYS LLOYDS

American shipyards that are closing-down for lack of work should note that according to Lloyd's Register's report for the quarter ending September 30 last, there are now actually under construction no fewer than 105 steel motorships of 229,325 total gross-tonnage (about 385,795 deadweight tons), excluding the fleet of 30 large Diesel-driven ships building in Germany. Of these, 49 aggregating 229,325 gross-tons are building in Great Britain. Perhaps it is saying "we told you so," but the force of the fulfillment of our forecasts is now being felt. Incidentally, another British yard exclusively building steamers has had to shut-down, but neighboring yards lately secured Diesel-ship orders.

In addition to the above steel motorships there are building abroad 29 wooden motorships aggregating 23,146 gross-tons. This makes a total of 164 motorships of 100 tons upwards under construction to-day, aggregating nearly half-a-million deadweight tons.

AMERICAN ENGINEERING CO. AT MARINE SHOW

Because the Naval Architects' Society will specialize on electrical propulsion and electrical auxiliaries this firm confine their exhibit at the Marine Exhibition (Central Mercantile Bldg., New York, week of Nov. 14) to electrical deck and deck machinery. Their space is at booths 81 and 82. P. E. Kniebel, marine sales manager, will be in charge. D. C. Spencer (Advt. Mgr.), E. B. Bryant, C. V. Koons, F. W. Kay, R. C. Lamond and H. Buckholtz.

NEW BOOK ON FUEL OILS

The Economical Utilization of Liquid Fuel. By Carl A. Norman, Professor of Machine Design, The Ohio State University. Published as Engineering Experiment Station Bulletin No. 19 by the Ohio State University, Columbus, Ohio. In this 206 page 6 by 9 Bulletin, the author in addition to the recording the results of his own experiments has drawn on every conceivable source of data and compiled a valuable addition to literature on liquid-fuel, brought right up to the year 1921. Oil is a subject which, not only because of its increased use in various forms by thousands, but because of its present importance in world politics holds an important place in the thought of those associated with its production and use. Prof. Norman's bulletin reviews the liquid-fuel situation in the United States in the following phases:

(1) Available resources; (2) main reasons for the shortages in domestic supply of petroleum products which have occurred; (3) a study of the substitutes which have been proposed for petroleum products; (4) possibilities for relieving shortages by economy in production and use of petroleum and development of substitutes.

Part I, The Oil-Fuel Situation, discusses oil resources and consumption, the various forms of oil fuel and their use on land and sea and the steps which have been taken to develop substitutes in the form of alcohol from coal, farm and waste products, colloidal fuel, shale oil, etc.

Part II. is a technical discussion of the chemical nature, combustion and heat value of fuel, steam and internal-combustion engines being impartially compared from an engineering standpoint as regards the economical production of power for automotive purposes both on ship and shore. Two conclusions reached by the author are worthy of quotation.—"The fuel utilization obtained by the steam has inherent limitations because of the heat spent in evaporating the water." "The injection (solid-injection Diesel-type) engine in large sizes is at present a perfect success for marine and for stationary service; it is at present the most economical prime mover built and meets the requirements of the present fuel situation in that (1) it can utilize even cheap, heavy, non-volatile fuel, such as crude-oil, residue, and even coal tar, and (2) its high fuel-economy is well maintained at reduced load."

Part III. is a number of scientific articles on combustion engine processes.

CAMILLO EITZEN LINE WOUND-UP

Because two 6,500 tons d.w. Diesel motorships ordered for delivery in 1918 and 1920 were not delivered, the Camillo Eitzen Line, Christiana, Norway, started in 1915 with Kr. 4,000,000 capital, has just been voluntarily wound-up.

East Asiatic Co.'s new motorship "JAVA." She is propelled by Burmeister & Wain Diesel engines. After completing her trials she started on her maiden voyage to the Far East without re-entering harbor.

FIRST BOLINDER-ENGINED NEW ENGLAND FISHING VESSEL

Recently trials were run at Gloucester, Mass., of the fishing schooner "Pioneer," which is the first New England fishing vessel to be fitted with the new type of Bolinder oil-engines. This vessel was built in 1892, but last year was purchased by O'Hara Bros. Inc., of the Boston fish Pier, who changed the vessel's name from "Edward A. Rich" to "Pioneer." The work of installing the machinery was carried out by Burnham Brothers Marine Railways Company, under the supervision of engineers from the Boston office of the Bolinder Engine Company.

She is a vessel of 83 tons gross with a length of 81 ft., by 23 ft. breadth and 9 ft., 2 in. depth. The oil-engine is of 70 b. h. p. and drives a Columbian bronze propeller of 44 in. diameter and 30 in. pitch at 350 R.P.M. On trials a speed of 7 knots against the tide and winds was attained, and a speed of 8-knots on the return trip. It is interesting to record that several more installations of Bolinder engines in fishing-boats will soon be carried-out, including that of the 100 b.h.p. engine of the schooner "Blanche Ring" now being completed at Rockport, Mass., for Captain Herbert W. Nickerson, of Malden, Mass.

Recently John F. O'Hara, president of the owners of this fishing-schooner wrote to the engine-builders that the vessel had just returned from a four weeks' fishing trip and that the engine was run for 299 hours without a hitch, consuming only five gallons of Standard Oil Company's crude-oil per hour, and less than a quarter-of-a-gallon of lubricating-oil. The vessel attained a speed of 7½ knots with ease when driving the 30 in. x 44 in. wheel. He is convinced that the engine has made good all that is claimed for it.

DIESEL-ELECTRIC DRIVE FOR NAVAL YACHT

Two 6-cylinder Winton Diesel-engines, 7½ in. bore by 11 in. stroke, coupled to two 90-K. W. direct-connected generators are to be installed as propelling power in a new yacht to be built for Mr. G. A. Hancock, the well-known oil magnate of Los Angeles. The main driving electric-motor will be of 125 h. p. turning at 275 R. P. M. Heating and lighting will be by electricity throughout.

AUXILIARY DIESEL-ENGINE OF THE "MAJESTIC"

As with all White Star liners, the new mammoth ship "Majestic" now completing in Germany, has an independent 80 b.h.p. Diesel-electric generating-set installed 19 feet above the bulkhead deck for emergency purposes, including handling the boat-lowering machinery, the wireless and the navigating and signalling instruments. It also feeds 800 lamps distributed all over the ship.

MORE GERMAN MOTORSHIPS BUILDING

Two full-powered motorships, a 1,000 tons canal motor-barge, and a 200 tons d.w.c. auxiliary-schooner are building at the Schulte & Bruns Werft, Emden, Germany. The latter vessel was recently launched.

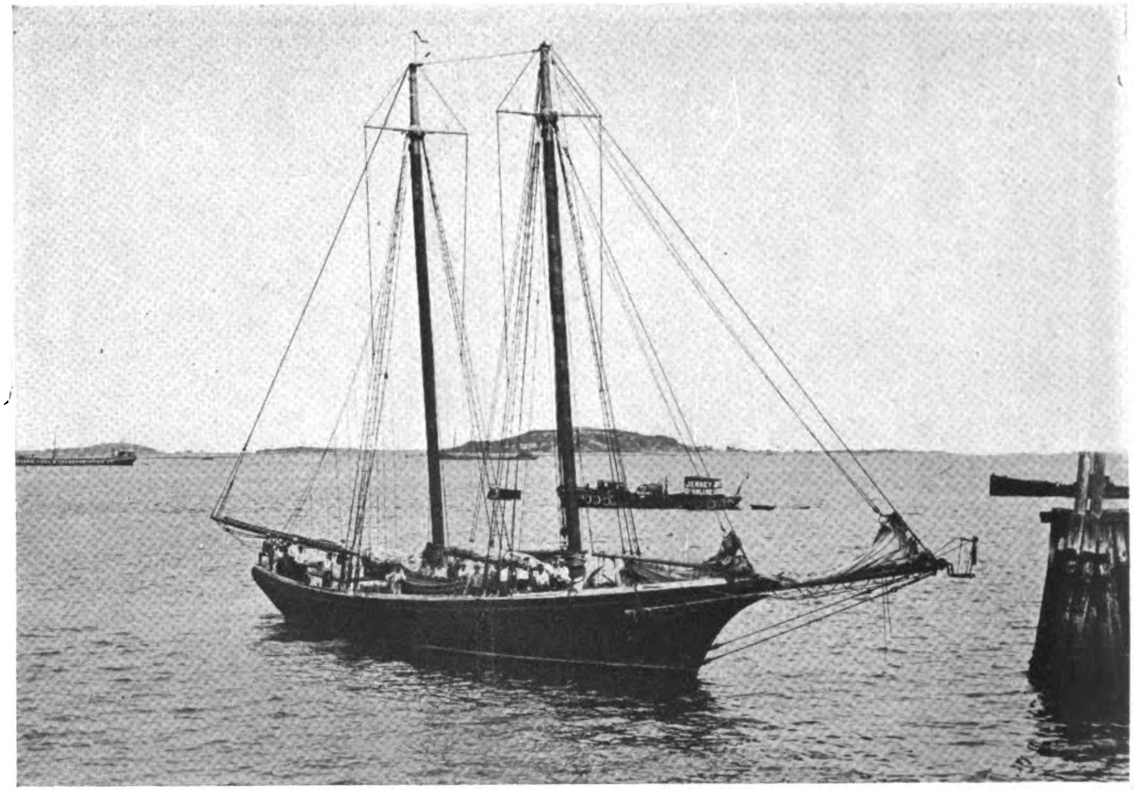
A 500 tons d.w.c. motor-schooner was launched on July 30th, at the D. W. Kremer Sohn shipyard, Elmshorn, to the order of the Rederi Rheinland of Duisburg, Ruhrort. A sister oil-engined ship was launched on Aug. 8th, at the same yard.

SUB-CHASER NOW SALMON CARRIER

"Gloria West," ex Sub-chaser No. 291, is now engaged in carrying salmon on the Pacific Coast in connection with the curing station of H. T. West of Seattle, at Tofino, Clayoquot. She is one of the 110-ft. class boats, and now has two holds, one 30 ft. and the other 20 ft., carrying a total of 70 tons of fish. Cargo is worked by an one-ton Western Electric hoist that derives its power from a two-cylinder, four-cycle, Eastern-Standard gasolene-engine driven generating set of 4½ K.W. The main power plant now consists of twin 220 b.h.p. Eastern-Standard gasolene engines. A total of 2,700 gallons of fuel is carried.

TRANSFER OF MOTORSHIP "PINTHIS"

The American motorship "Pinthis," built in 1919 for the Sugar Products Co. of New York, has been transferred to the Cuban flag. She is of 1,750 tons d.w.c. and is propelled by a four-cylder 500 b.h.p. Bolinder oil-engine.



Bolinder-engined fishing-schooner "PIONEER"

NEW MOTORSHIP'S CARGO HANDLING CAPACITY

Four of the big 40 tons Pirrie-McFarland electric-winches illustrated in our issue of November, 1920, are installed on the new British motorship, "Loch Katrine" of the Royal Mail Steam Packet Company. Ten smaller electric-winches are also fitted. The big winches each will lift three tons at 310 ft. per minute.

ANOTHER ITALIAN-ENGINED MOTORSHIP

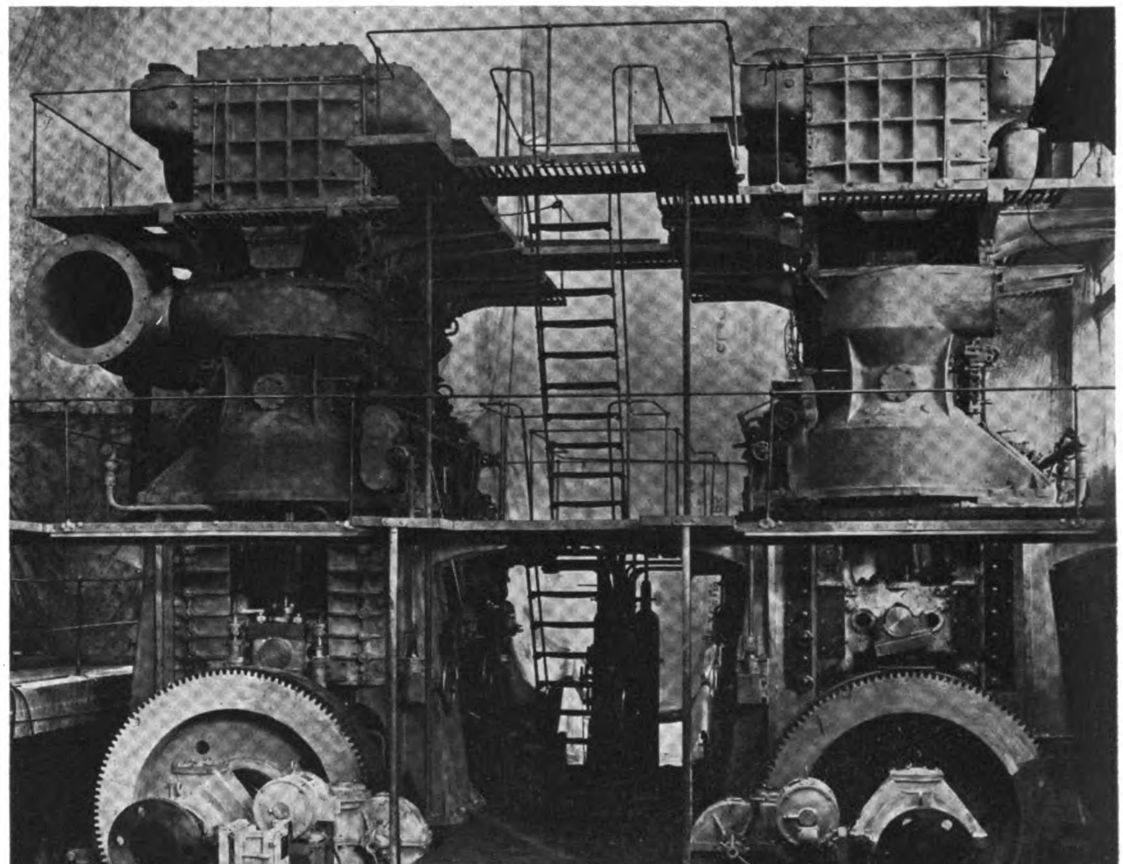
Now under construction at Trieste is a 9,000 tons d.w. motorship in which twin 1,200 shaft h.p. Tosi Diesel-engines are being installed.

TRIALS OF THE MOTORSHIP "ODIN"

Trials of the German cargo motorship "Odin," converted from a warship, were recently carried out by the Deutschen Werke A/G of Rustringen. She is owned by the Reederi Arnold Bernstein of Hamburg, and is propelled by twin six-cylinder 400 b.h.p. Diesel-engines. Length 260 ft., breadth 51 ft., depth 14 ft., 9 in. She loaded engines for "Ruona" for her maiden voyage.

LAUNCH OF MOTORSHIP "BANGOLI I"

On Sept. 22nd the 9,000 tons deadweight motorship "Bangoli I" was launched at the Ilva Shipyard, Italy.



A pair of 1,000 shaft h.p. Cammellaird-Fullagar opposed-piston type Diesel marine-engines. The motorship "MALIA" which has twin 500 shaft h.p. sets described and illustrated on page 876 of this issue.

PLAN FOR REGENERATION OF AMERICA'S MERCHANT MA

NEW YORK SEATTLE

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Devoted to Commercial and Naval Motor Vessels

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DECEMBER, 1921
Vol. 6 No. 12

TRIALS OF NEW AMERICAN MOTORSHIPS

EXCLUSIVE technical and non-technical articles on design, construction and operation of oil-engines and motorships by the world's foremost writers on marine engineering.

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(Trade Mark Registered)

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Vol. VI — New York, U. S. A., December, 1921 — No. 12

Cable Address—Freemote, New York

Ensuring a Future for America's Merchant-Marine

Practical Proposal for the Conversion of Ships in a Manner That Should Be Satisfactory to Shipowners, Government and to the General Public

LAST month "Motorship" suggested that something should be saved from the flotsam and jetsam now lying in our harbors, left there by the tidal waves of war and post-war conditions and by our various Shipping Boards. It was also stated that the nation will be willing to spend some additional money if it could be demonstrated that a number of these vessels can be converted to first-class economical motorships capable of competing against foreign fleets. "Motorship" has devised a program which was briefly touched upon in our last issue, which, if followed, undoubtedly will have the approval of the entire country, altho some modifications or improvements, of course, may be necessary.

This policy has been submitted to a number of leading shipowners and shipbuilders, and all regard most favorably the plan outlined. In fact, an executive of one of the largest shipbuilders in the country stated that he considered that it was the only feasible plan, and that undoubtedly something along these lines must be done. Also that it may be the means of saving the shipyards, tiding them over until such time as international commerce causes a demand for new ship construction.

"Motorship's" plan is that the Board shall dispose of a large number of the idle steel hulls—particularly the 8,800 ton boats—to shipowners at a very low cost, on the understanding that the present uneconomical oil-wasting steam-machinery be removed, and sold abroad if possible, and replaced by modern up-to-date marine Diesel engines—preferably of American construction. The tentative price of the hulls is to be figured out in accordance with the estimates for the cost of conversion of each individual ship and balanced after the work is completed, enabling the shipowner to decide if he will go ahead. The costs will vary according to the ship.

PLAN FOR REGENERATION OF AMERICA'S MERCHANT MARINE

Turn best and most suitable ships over to shipowners at low cost, on understanding they convert them to economical Diesel or Diesel-electric power under supervision and jurisdiction of Government's experts and at their own expense within limits.

Shipowners to select type of engines, and to secure bids for Conversion from shipyards.

Tentative price shipowner pays for hulls to be based on these conversion estimates, the Government Committee to pass upon plans and control price to within reasonable limits. Easy terms to be given.

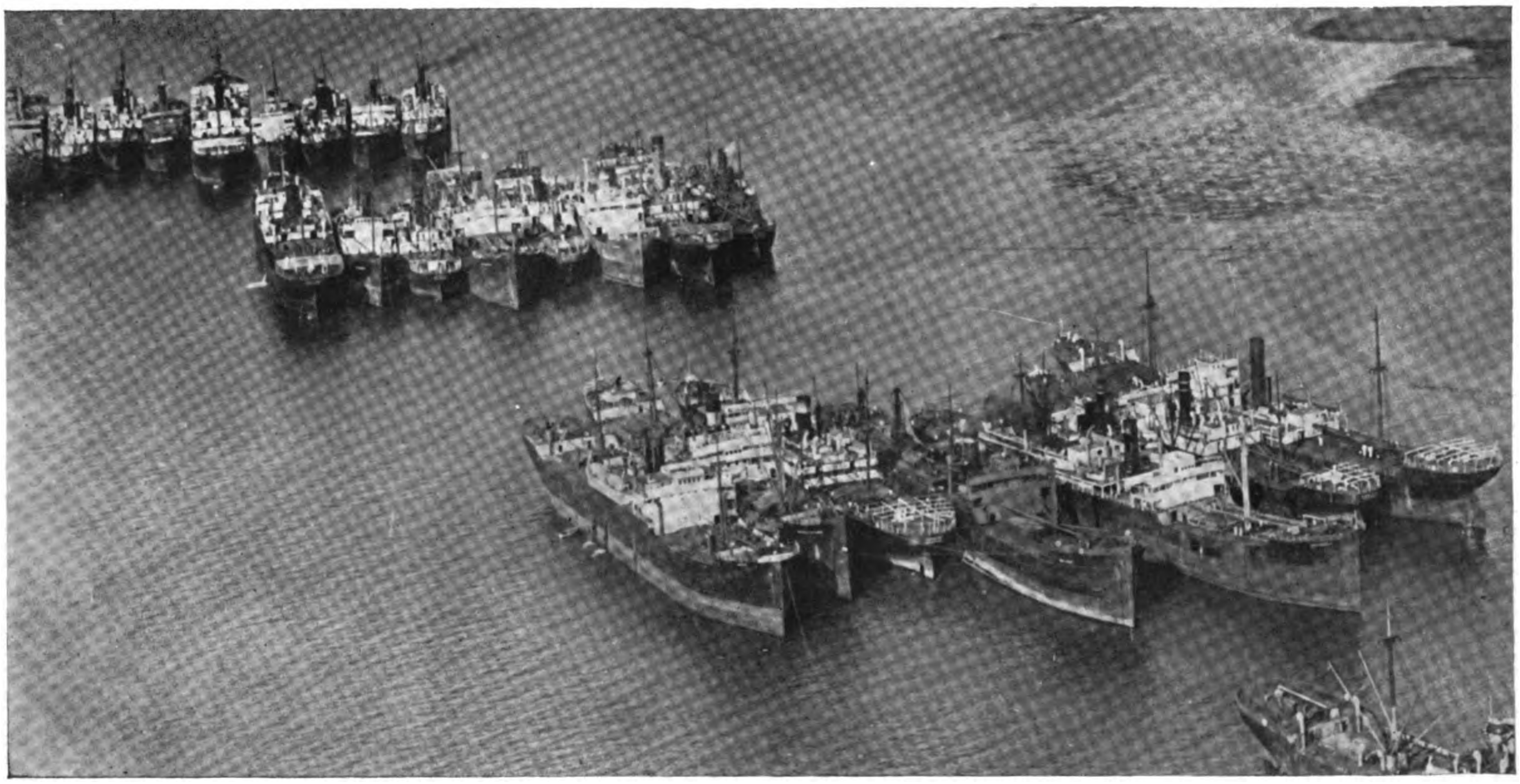
Work to be carried out, if approximate cost mutually satisfactory, and ship taken over by ship-owner.

Definite price to shipowner to be finally based upon actual cost, the Government guaranteeing that same shall not exceed current prices foreign shipowners have to pay for ships in their countries.

Use of Section II Jones Act to assist financing.

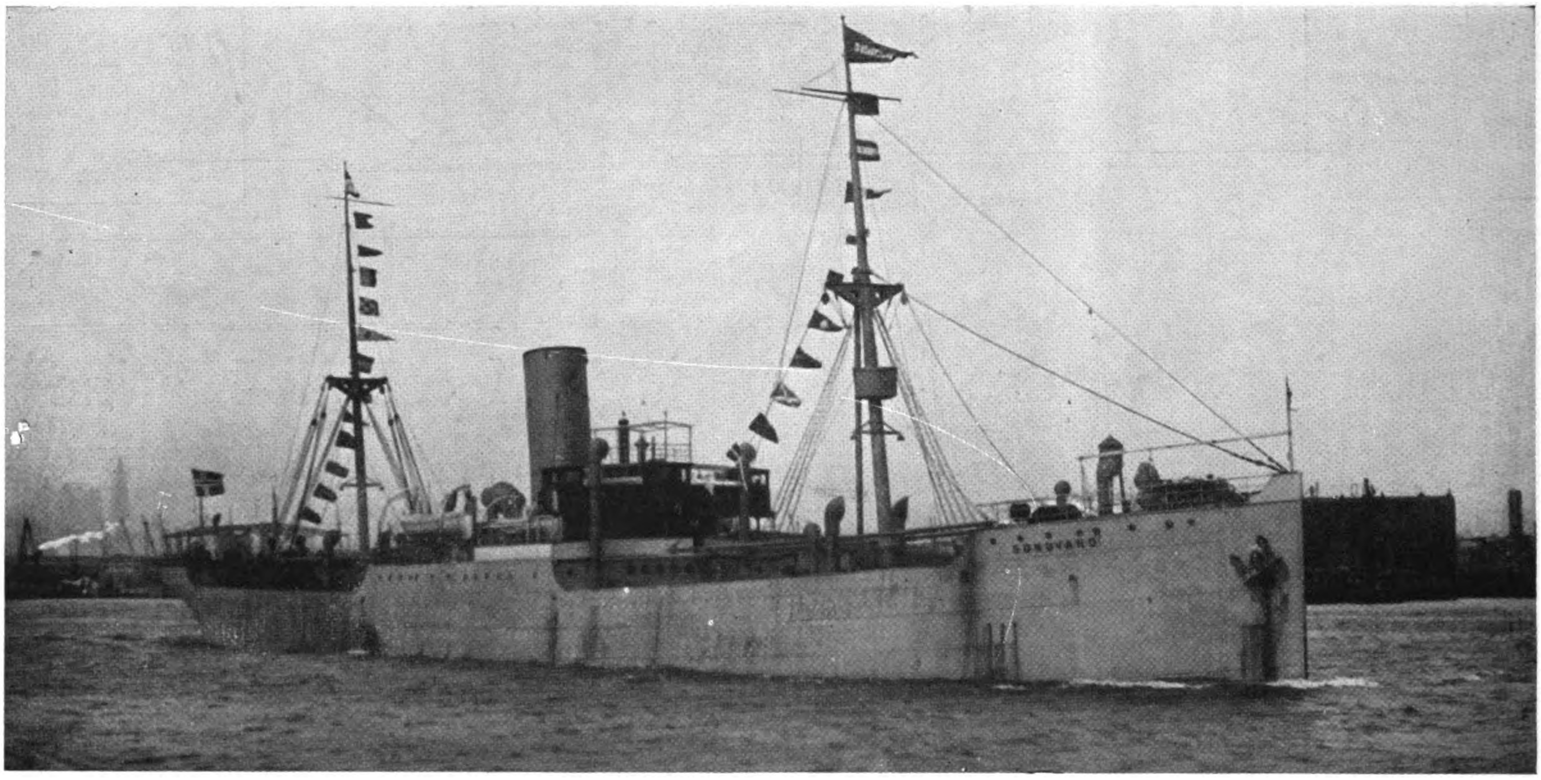
All conversional work shall be carried out at the expense of the shipowner in conjunction and in co-operation with the Technical Department of the Shipping Board, or preferably with a special committee of experts appointed by the Government, who shall supervise and pass upon the plans for the machinery and for the conversion and on the costs of the work, leaving the shipowner to an extent free to select the type and make of machinery to be installed; also the shipowner shall be allowed to select the shipyard at which the work is to be undertaken.

There are two principal methods of making the change to these ships at moderate cost and with few structural changes. One is to instal Diesel-engines of the long-stroke, slow-speed



Copyright, International.

Diesel and Diesel-electric power will make idle American ships economical, and will enable them once more to take their place carrying American products to all parts of the world



"SONGVAND" one of three single-screw steamers successfully converted to single-screw Diesel power. They are owned by S. O. Stray & Co. of New York. Operating details were given in our issue of January last

type—several excellent designs of which can now be obtained to develop their power at from 80 to 90 revolutions. The alternative is to instal Diesel-electric drive. Existing moderate-speed direct-drive engines will do for some types of ships. Furthermore, the question of reduction-gear drive should be investigated. In many cases we believe that the present inadequate cargo-handling machinery on the deck will have to be changed to electric power in order to be able to handle cargo rapidly at any extremely low cost, and to reduce stand-by charges in port.

It is quite possible, however, that the cost to the shipowner will not be sufficient to necessitate the Government providing any financial aid, if the hulls are sold at a sufficiently low figure on the stipulation that the machinery change be done. It will be a simple matter to make arrangements whereby the final price of the hull should be determined afterwards, and based upon the actual cost of the installation, figuring out the tentative hull price from the estimates from the shipyards.

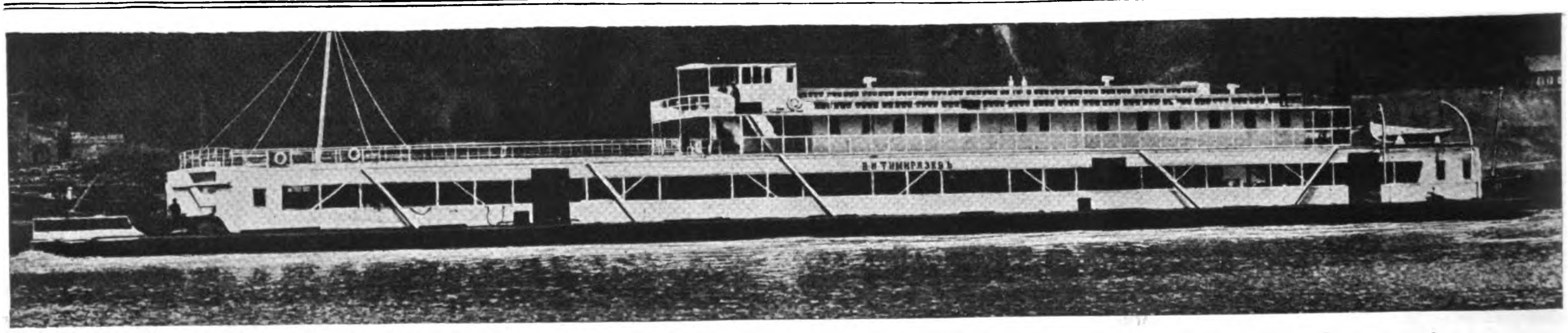
The Shipping Board shall be empowered by Congress to guarantee that when each ship is completed, the total cost to the shipowner, including the hull and conversional work, also any reconditioning or repairs necessary, shall not exceed the current cost that modern steam or motorships can be purchased by European shipowners; after having made a certain allowance for the difference in exchange-rates. To aid the conversion of steamers already owned by American shipowners, a subsidy should be given by Congress equal to about half of the cost of the work.

That the conversion plans will be carried out under the supervision of the Shipping Board, or Special Committee, will ensure that a shipowner does not spend too much money on vessels and make the Government pay the bill. On the other hand, it ensures that shipowners receive modern up-to-date ships at reasonable cost, capable of competing against foreign vessels. Furthermore, it will provide work and employment for our shipyards and repair plants which is badly needed at this time—especially at the yards where naval construction is likely to be stopped in the very near future. In many cases shipyards will be saved from closing down and demoralizing shipbuilding in this country.

But the main point is that such a proposal will provide the United States with an efficient and thoroughly up-to-date mercantile fleet capable of taking cargo at the lowest possible rates, but with a reasonable operating profit when pressed by severe competition. The country is too deeply involved—too many billions have been spent, to let our entire fleet rust. Probably Clause Eleven of the Jones' Act could be changed to give the Shipping Board the necessary authorization to make these arrangements and furnish any money, should any be necessary. In Clause Eleven the provision of $25,000,000 per annum for five years is legalized for aiding shipowners to build motorships. The tide of public thought is swinging strongly in this direction. and any evasion by the Board or Congress will only temporarily postpone the inevitable, meanwhile shipyards will go bankrupt, and more ships will be laid up, and the nation's expense-bill will increase.

We realize that building motorships or converting steamers to Diesel-power are not the only steps to be taken to the future of our merchant-marine. But, all the other things together, such as subsidies, preferred tariffs, preferred rail-rates, lower wages, and smaller crews, etc., would be insufficient in themselves to offset the constant drain imposed by inefficient steam-machinery.

At the present time the attitude of the Board is favorable towards converting ships, but this doesn't mean anything, because their attitude was favorable four years ago, and the subject has been debated ever since without any action. "Motorship" is advocating a safe, simple and feasible plan, which should be adopted with any necessary modification. Weeks pass into months and months into years, with remarkable progress meanwhile being made abroad, and now the Board wishes to wait for the return of their solitary motorship "William Penn" from a voyage around the world, half of which she already has covered in splendid time. For all the good of its intentions the Board is still lost in a maze of petty technicalities, so "Motorship" puts forward this plan, believed to be sound in theory and practical in operation, for immediate consideration and adoption.



"V. J. TIMIRIASEFF," one of five Weyland Diesel-engined passenger and freight motorships built by the Russian Government

Turbine-Electric or Diesel-Drive

Discussion of the Installations in the "Cuba" and "San Benito"—Its Comparison with Light-Weight, Heavy-Duty Diesel Machinery

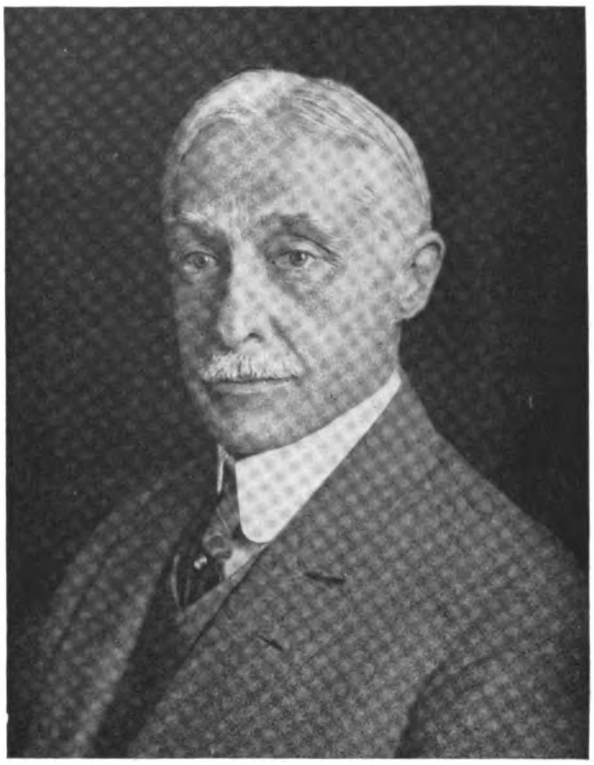
By ELMER A. SPERRY
President, Sperry Gyroscope Company, New York

AFTER having been shipmates for a day of inspection on the "Cuba," which was heralded as a very great simplification of the turbo-electric ship proposition, I must confess that I came away very much disillusioned as to the plant being simple. There was nothing short of an amazing array of machinery, including auxiliaries, and the electrical control which, with the synchronous system, I had expected to have disappeared almost completely, was still very much in evidence and really formed a large component part of the equipment. However, the main object had been attained in that the deficiencies of the non-reversible turbine were covered, even though it takes a lot of expensive equipment and high transmission losses to do it.

I remember that in the "Cuba" I made some measurements, spread-out a newspaper on one of the out-of-the-way elevated positions and sat down, pondering the mass of machinery that was spread out before me. While there I visualized a complete light Diesel equipment with duplex engines together with all necessary electric-sets for lighting, etc., occupying in toto but a small portion of this engine-room space alone and weighing actually less than the water in the boilers. I was impressed with the marvelous simplification when using Diesels, where practically no auxiliaries are necessary. Taking the boiler and engine room, I found that no less than 28,000 cu. ft. of space could be released as cargo space and that no less than 7½ times the useful tonnage of the ship is devoted to the propelling plant compared with the requirement in the case of the Diesels, at twice the first cost and probably four times the cost of installation. This, of course, wholly outside the fuel-consumption of from three to four times the amount required for the same power with Diesels, and, what is more interesting still, with the enormous combustion chambers of the new light engines the same quality of bunker oil that was being fired under the boilers.

These facts I have pondered over much since my visit to the "Cuba," so I was glad to avail myself of an invitation to visit the "San Benito" in order to compare the "Cuba" with another "synchronous" plant of about the same size as well as the same type, built in England. Here I had expected that the greater experience of England would have been able to realize the simplicity claimed for this electric type of propulsion. I was accompanied by some men who have devoted a lifetime to engine-room equipment and operation of fleets of ships at sea.

When we finally descended into the engine-room and commenced to familiarize ourselves with the detail of the equipment crowded into this room, we looked at each other and agreed that here again we failed to find the simplicity that was expected. Every available foot of space seemed to be occupied by machinery. One had to climb over and on top of one after the other to get about. In fact, there were so many auxiliaries that their proper accessibility was difficult. For instance, there seemed to be no way to get at the condenser tubes for replacement or very readily even for inspection. And what was most surprising of all was the relative location of boilers, turbo-generator condensers and the array of auxiliaries on the one hand, and the motor at a point very remote aft, on the other, in a compartment by itself which seemed very difficult of access. I doubt if the motor-room would be visited very often or very willingly, especially in heavy seas. It seemed that the "Cuba" arrangement in this point was superior, where both motor and generator were in one room, though the "San Benito" seemed to have the simpler control equipment.



ELMER A. SPERRY
Inventor of the Sperry gyroscope, Sperry high-pressure marine oil-engine and many other valuable devices

Far be it from me to discourage electrical equipment. I have been closely identified with electric development all my life. In 1879 I built my first generator and the lighting system that went with it, which had a wide use, and I have set it to many a useful task in the years that have followed. I am of course a thorough booster of "do it electrically," but it must be remembered that Mr. Edison himself on more than one occasion has pointed-out that sometimes electricity is dragged-in by the ears when there are other methods that are better suited. Of course we should not allow the mere desire to employ electricity to cause us to make this kind of a mistake.

I am constantly struck with the complexity and maze of machinery, fittings, pipe connections, etc., that go to make the ensemble that one now encounters in the engine rooms of steamships.

As an engineer I cannot but believe that the hour has struck on this ever increasing complexity. A well-known engineer, in speaking on this subject recently, stated that a new steam auxiliary was born every day and that he was literally putting down a separate building to accommodate them. It seems to me that marine engineers should stop long enough to think where this is leading them. Especially is this true in face of what light and low-cost Diesel plants would be able to do, where there are practically no auxiliaries and where the fuel is burned drop by drop, directly driving powerful pistons, instead of the wasteful bulk firing, with all its attendant losses, indulged in wherever steam is employed. The single matter of doing away with the boilers and their troubles and the boiler auxiliaries and their troubles is of paramount importance as an item by itself.

The Engineering Experimental Station Bulletin No. 19, by Dr. Norman, states that the Government should intervene and suppress the enormous waste of the irreplaceable liquid-fuel supplies, especially in view of the fact that from 1/4 to 1/5 (including the standby losses) only may be consumed for the same shaft horse-power delivered with equal reliability and with very great reduction in engine room personnel and expense.

I was present when M. L. Requa, former Fuel Administrator of the United States, stated most emphatically at the recent Petroleum Congress in Washington that "steam equipment on board ships should from now on be regarded as obsolete."

Now that the heavy-duty Diesel equipment has arrived at a capital charge not exceeding that of steam, and at only a fraction of its weight and space requirement, there is no farther excuse for not adopting the vastly simplified and more powerful engine-room equipment, placing our engine rooms completely aft, thus releasing along with the most valuable space in the ship, hundreds of tons of weight, thousands of cubic-feet in space, and quadrupling our cruising radius with a given bunker capacity, and this in the double bottom.

This will help us to keep our fleets in service in competition with those of any other nation and our flag on the seven seas.

ELMER A. SPERRY, E. D.

NEW TYPE OF SHIP'S MOTOR TOW BOAT

Thirty-Foot Tugs Carried on Shipping Board Vessels

AT many ports on the coast of Africa the water is not sufficiently deep to permit steamers going alongside of docks; the cargo is lightered from ship to shore in boats handled by natives. Much delay and uncertainty has resulted from this method, and the United States Shipping Board has equipped steamers running to these ports with a small motor tow-boat which is carried on the ship's davits and lowered over the side on arrival in Africa. For handling a half-dozen heavily-laden boats thru rough surf, often bumping against the side of the ship and other lighters a sturdy boat is required. Strong davits are also needed to safely handle a boat so much heavier than the usual life-boat. The situation has been well met in the six craft designed by the Shipping Board's Department of Maintenance and Repair, and constructed by the New York Yacht, Launch and Engine Co., of Morris Heights, New York. Our illustration shows one of these boats on official trials.

Each of these tugs is powered with a Frisco-Standard twin-cylinder 7 in. by 9 in. motor operating on kerosene and developing about 21 h.p. at 385 R.P.M., at which speed a 34 in. diameter by 28 in. pitch 3-bladed Columbian propeller drives the boat 8.6 statute miles per hour. Controls for boat and engine are provided under the steel shelter, from which one man operates the boat. The following are the principal particulars:

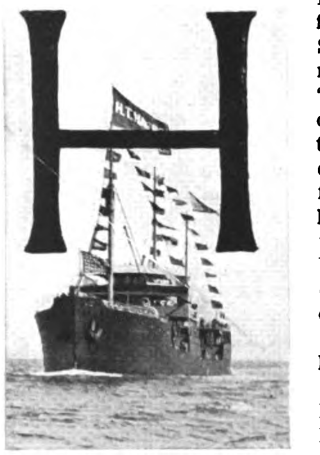
Length over all	30 ft.
Breadth, extreme	7 ft.
Draft, extreme	3 ft. 6 in.
Weight, total	7 tons
Power	21 B. H. P.
Speed	8.6 st. miles

One of the U. S. Shipping Board motor launches

Such serviceable little tow boats powered with surface-ignition oil-engines should be more often found on our waterways, especially for working around piers, terminals, etc., where a small but powerful motor tug can work quicker than the present large steam-tugs. On canals and rivers passing thru cities where several bridges have to be negotiated, small, low motor tugs prove of great advantage in efficiently handling scows, barges and lighters, it being unnecessary to wait for bridges to be opened as does the steam-tug with her high funnel. Also, fuel-consumption in the motor tug stops when the day's work stops, while the steam-tug must consume fuel thru the night, keeping up steam. One man operates the motor-tug, with a deck hand to handle lines, as compared with a captain, engineer, fireman and deck hand on a steam tug. The majority of small motor-tugs require relatively more power than this Ship-Board ship's motor-tug, of course, but for many purposes a boat exactly like this is eminently suited.

Trials of Standard Oil Diesel-Engined Tanker "H. T. Harper"

Pacific-Werkspoor Engines of New Motorship Develop 3,018 *I.H.P.* (2,203 *Shaft H.P.*) *Although Only Rated at* 2,260 *I.H.P.* (1,700 *Shaft H.P.*)



HERE are at least four reasons why the Standard Oil Company's new steel vessel "H. T. Harper" is one of the noteworthy merchant-ships of the year. In the first place she is the largest Diesel-driven tanker built in the United States; secondly she is the largest motorship of which both propelling engines and hull were built on the Pacific Coast; thirdly she is the largest American vessel with Werkspoor-type Diesel engines in service; fourthly she shows remarkable economies and gains in cargo-space compared with a sister steamer owned by the same company. For the latter reason we draw the especial attention of all domestic concerns operating tankers on the High Seas.

Trials of this interesting ship were carried out with success, as the accompanying record will confirm, on October 27th last. She has been built to American Bureau classification, whose requirements for Diesel-engine construction are even more stringent than Lloyds. Her owners are the Standard Oil Company of California, San Francisco, Cal., and she was built by the Moore Shipbuilding Company at Oakland, Cal., while her main Werkspoor Diesel-engines were constructed under license from the Werkspoor Company of Amsterdam, Holland, under supervision of Dutch experts, by the Pacific Diesel Engine Co. also of Oakland, who control exclusive Werkspoor rights on the Pacific Coast of the United States. Her three auxiliary Diesel engines were built by the Dow Pump & Diesel Engine Co. of Alameda, Cal., under license from Willans, Robinson & Co., of Rugby, England, while the electrical machinery was furnished by the General Electric Company of Schenectady, N. Y.; the winches, capstans and windlass are by Allan Cunningham of Seattle, Wash., and the steering-gear a production of the Hyde Windlass Co. of Bath, Me.

Thus in this ship are incorporated the skill and knowledge of domestic and foreign concerns whose rank is second to none in the particular branch of the marine industry each is a part of, and the owners no doubt have a vessel which in reliability and economy, will be a distinct advance over any of their present tanker fleet, with the possible exception of their smaller motor-tanker "Charlie Watson," which has similar makes of Diesel engines to the "H. T. Harper," and which has been giving consistent service without trouble since she was placed in service.

Some time ago the New York Shipbuilding Corp. of Camden, N. J., built the steam-driven tanker "El Segundo" to the order of the same owners, namely the Standard Oil Company of Cal., and in regard to general dimensions she is practically a duplicate of the "H. T. Harper." But the difference in machinery has made a vast difference in the carrying capacities and fuel-consumptions, as will be seen from the following comparison table for the information in which we are indebted to the courtesy of the builders of the two ships in question. As it happens, the New York Shipbuilding Corp. is also a constructional-licensee of Werkspoor, so the data following herewith, no doubt will be of considerable value to them. They have kindly checked the following data of the "El Segundo" and certified it as correct. Our figures on the "H. T. Harper" have been checked by her builders.

	Steamer El Segundo	Motorship H. T. Harper
Loaded displacement	7,586 tons	7,713 tons
Light displacement	2,604 tons	3,016 tons
Cubic cargo-capacity of holds	222,132 cu. ft. (oil)	228,250 cu. ft. (oil)
	7,826 cu. ft. (dry)	26,672 cu. ft. (dry)
Total	229,958 cu. ft.	254,922 cu. ft.
Capacity fuel-bunkers	4,846 bbls.	3,586 bbls.
Carrying-capacity (with 30 days fuel-supply on 22½ ft. dft.)	27,000 bbls.	29,100 bbls.
Weight of complete engine-room machinery, including propellers and shafting	390 long tons	330 long tons

No two ships, of course, are even exactly alike, but it will be seen that the "H. T. Harper" is several hundred tons heavier than the steamer, but this is not due to the Diesel machinery as the two main-engines only weigh 220 tons together, compared with 300 tons for the steam-engines and boilers of the "El Segundo." But it will be noted that the motorship has a larger carrying-capacity by 2,100 barrels on a trans-Atlantic or trans-Pacific round voyage, the exact gain in hold-space being 24,964 cubic feet. Here it is worth while pointing-out once more as to the misleading nature of the term "dead-weight capacity" in denoting the carrying ability of a vessel, because the "dead-weight capacities" of these ships at loaded draft are as follows:

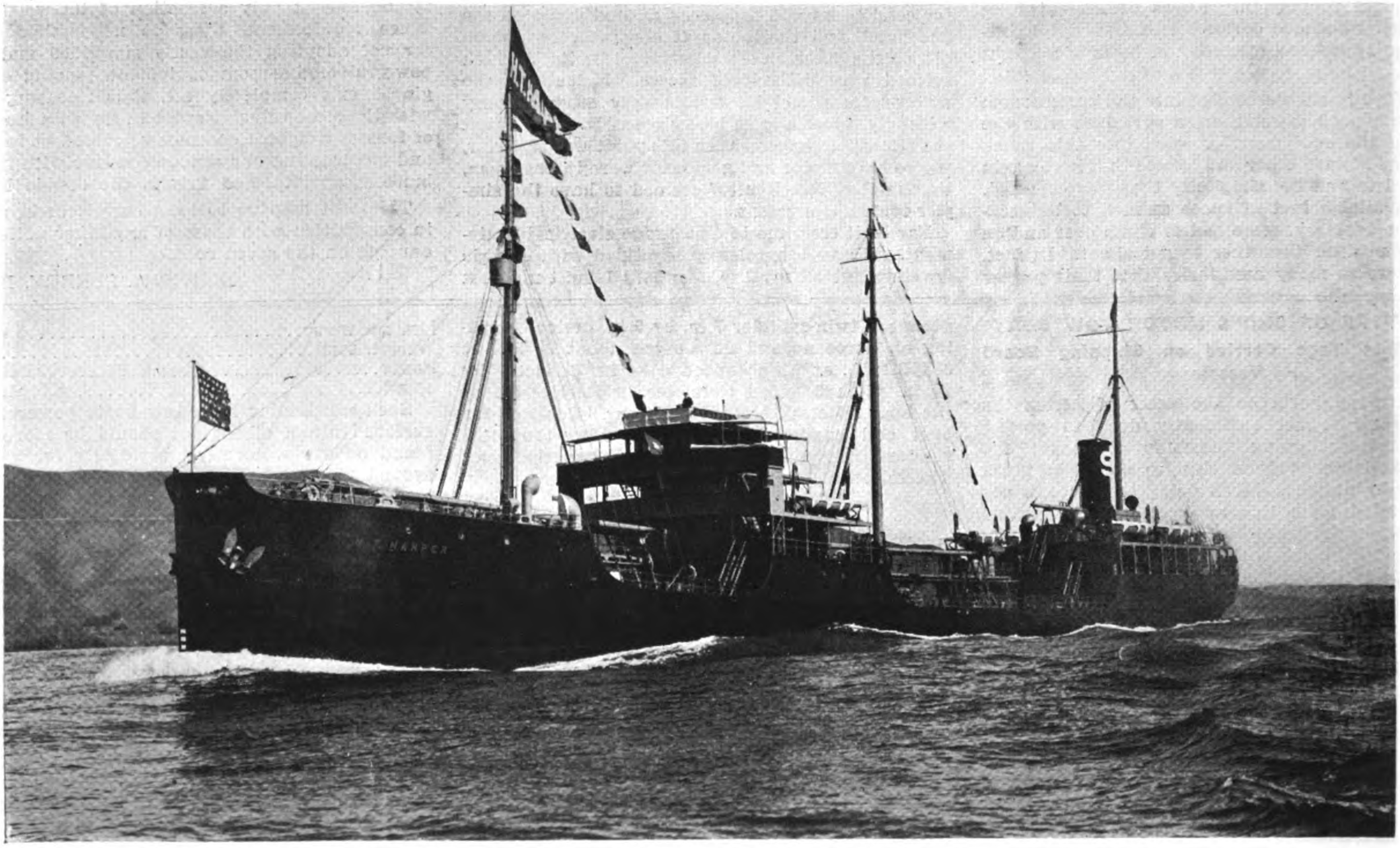
	Steamer El Segundo	Motorship H. T. Harper
Dead-weight capacity	4,982 tons	4,697 tons

The deadweight of the above steamer is distinctly greater than that of the motorship, nevertheless she cannot carry so much cargo. But shipowners should bear in mind that they sometimes unwittingly purchase ships at "so-much per deadweight ton," or at least use the definition as a base. If this was done in the present cases it would make the motorship more expensive than the steamer per ton, whereas she probably was actually cheaper per net-cargo-ton capacity. The term "deadweight-capacity" became decadent with the advent of the motorship and should no longer be used. With freighters this is even more important than with tankers, because of greater cubic-capacity gains. In accordance with the cubic-capacity of the main and summer tanks, the cargo-capacity of the "H. T. Harper" is 6,087 tons at 37.5 cubic feet per ton.

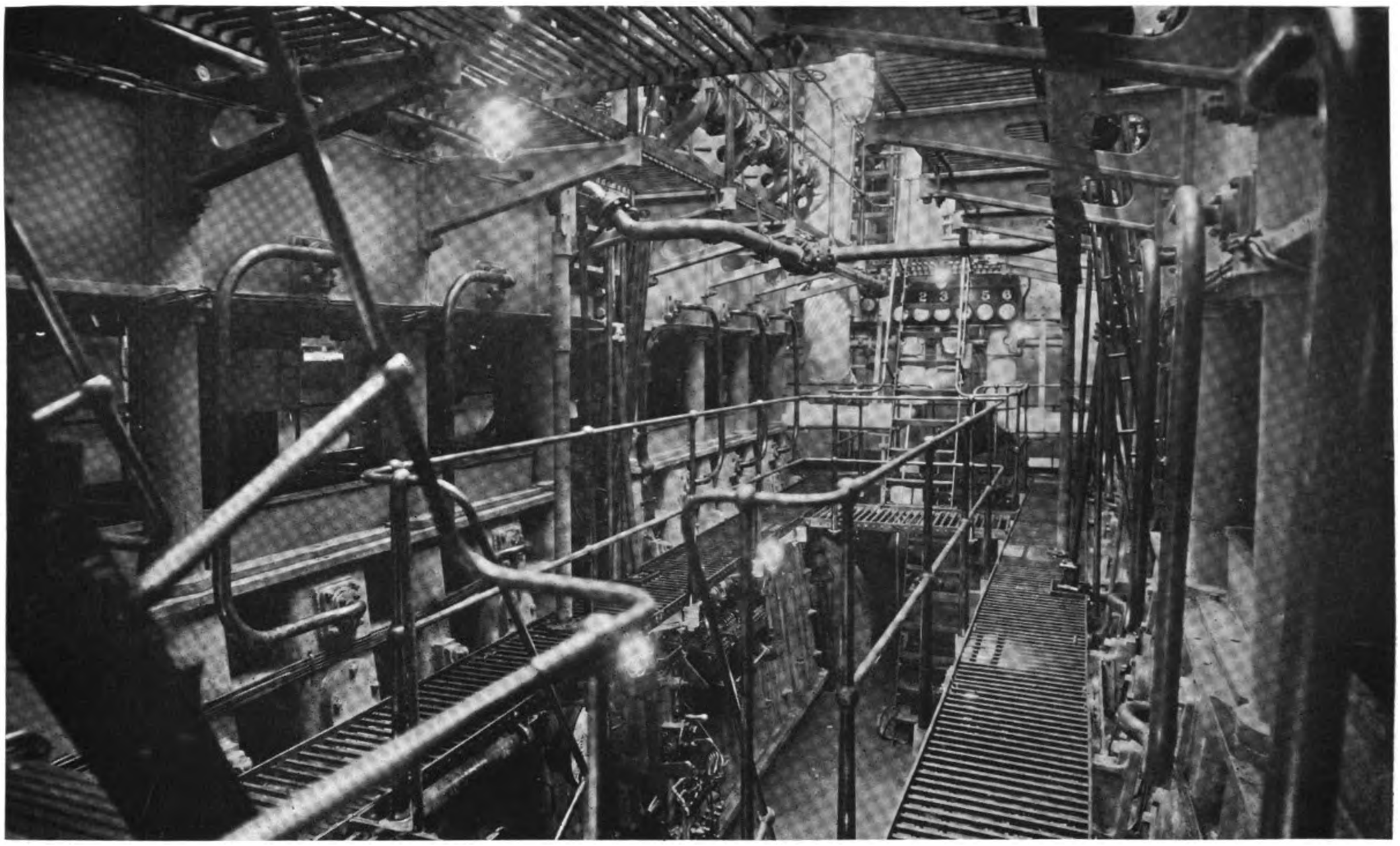
The leading dimensions of these ships are almost identical and are as follows:

	Steamer El Segundo	Motorship H. T. Harper
Length (O. A.)	343 ft. 4 in.	342 ft.
Length (B. P.)	330 ft.	330 ft.
Breadth (M. D.)	46 ft.	46 ft.
Depth (M. D.) to spar-deck	27 ft.	26 ft. 11¾ in.
Loaded draft (Mean)	22 ft. 5½ in.	22 ft. 5¾ in.
Cruising radius	7,300 nau. miles	20,000 nau. miles
Block co-efficient at load line	0.780	0.790
Co-efficient at midship section	0.975	0.985

Also the power of these two ships is almost the same, although the steam-engines turn at a lower speed and swing bigger propellers, so theoretically should drive the vessel faster.



Standard Oil Company's new Werkspoor Diesel-engined tanker "H. T. HARPER"

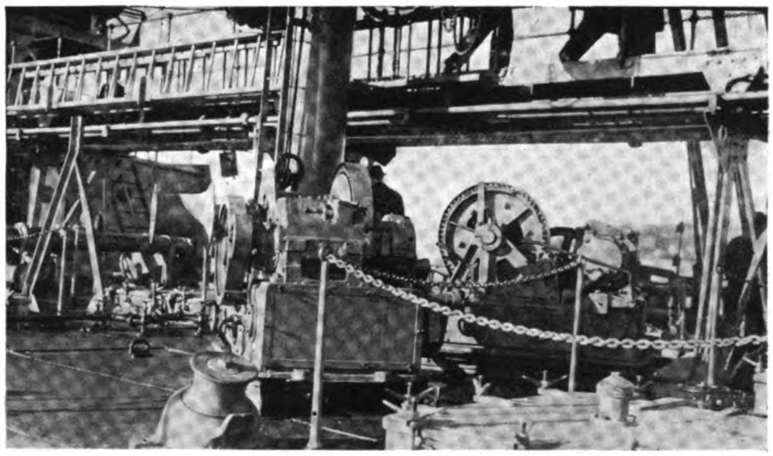


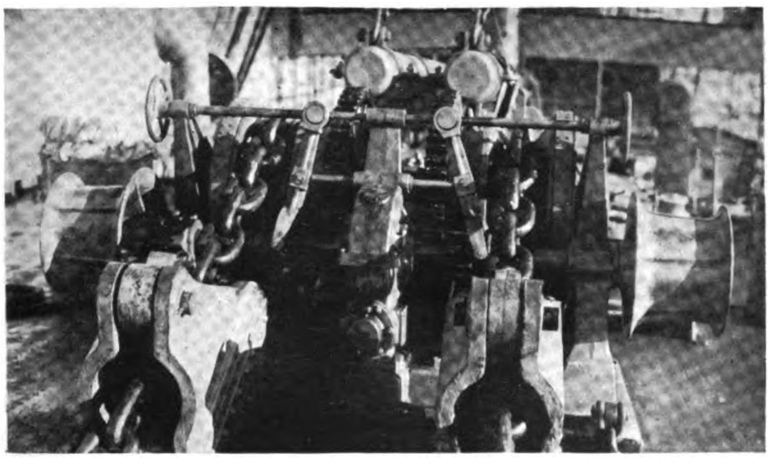
View of engine room of "H. T. HARPER" showing the cylinder-box, entablature, and frames of one of the main Pacific-Werkspoor Diesel engines; also the space between the cylinder-box and entablature into which the pistons can be lowered.

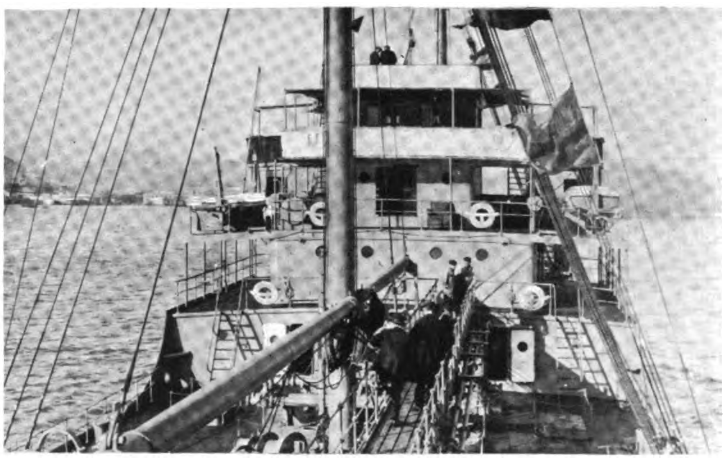
	Steamer El Segundo	Motorship H. T. Harper
Designed shaft horsepower	1,650 H. P.	1,700 H. P.
Rated indicated H. P. of main engines	1,900 H. P.	2,260 H. P.
Engine-speed	91 to 95 R. P. M.	135 R. P. M.
Power developed on sea trials	?	3,018 I. H. P. (2,203 shaft H. P.)
Power of three auxiliary Diesel engines	(Nil)	550 B. H. P.
Designed loaded speed of ship	10 knots	12 knots
Mean draft on trials	?	21 ft. 3 in.
Trial speed of ship (mean)	?	11.8 knots
Daily fuel-consumption (24 hrs.)	23 to 24½ tons	7½ tons
Propellers	15 ft. dia. by 13 ft. pitch	11 ft. dia. by 10 ft. pitch, with 30.55 sq. ft. proj. area.

We understand that the designed speed of the motorship was 12 knots, but consider that this is higher than should have been expected. For instance, the designed speed of the steamer "El Segundo" was only 10 knots loaded, although several hundred tons lighter on the same dimensions and of the same shaft h.p. at lower revolutions. Therefore, we should think that the trial speed of 11.8 knots for the motorship "H. T. Harper" is most excellent, particularly as it was accomplished on one-third of the amount of fuel. The latter fact should cause all shipowners to deeply ponder.

Of one thing we are assured; namely, the average sea-speed of this motorship during the next year will be much better than that of the steamer, because it will be more consistent, due to the virtual absence of propeller-racing, and because the speed will not drop each four hours just prior to the change in watch. This "often-overlooked" factor is of importance in the ship's earning power. As a matter of fact the "H. T. Harper" averaged 11.305 knots on her round maiden voyage of 1,570 nautical-miles. We refer again to the speed of this ship later in this article.

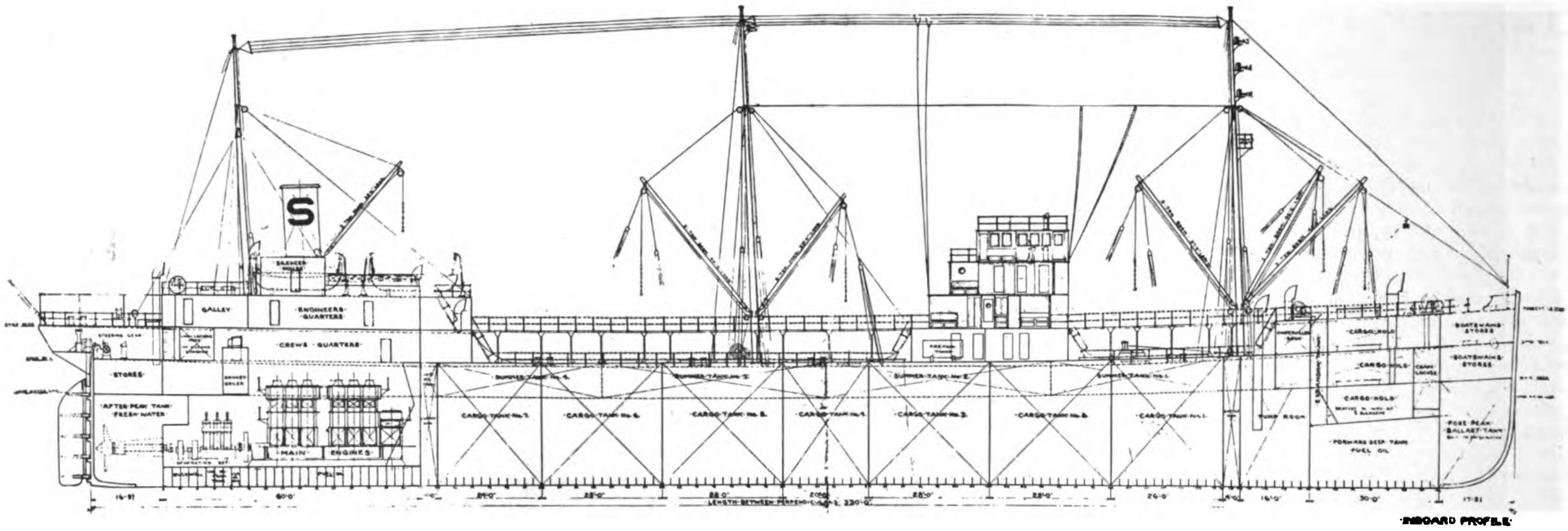






SCENES ON THE MOTOR-TANKER "H. T. HARPER"

Looking from midship-house aft. **Allan-Cunningham electric winches.**
Anchor windlass and chain-stoppers. **Looking forward from poop.**



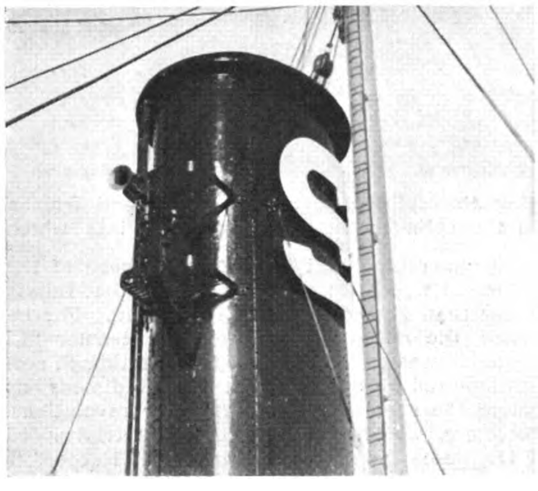
Arrangement plan of motor-tanker "H. T. HARPER"

Let us now turn to the space occupied by the machinery of these respective ships. In the case of the motorship a total of 60 ft. is given over to the engines and auxiliaries, all the fuel being carried in double bottoms and in tanks right forward. Whereas, in the steamer the engines take-up 40 ft. and the boilers 24 ft. while forward of these spaces is a deep-tank for fuel, rendered desirable by her greater fuel-consumption. This it will be seen from the drawings is 22 ft. long by the width of the ship. Thus we get the following:

	Steamer El Segundo	Motorship H. T. Harper
Space occupied by propelling machinery and deep tank	86 ft.	60 ft.

As regards fuel-consumptions, we have before us a copy of the records of the motor-tanker "H. T. Harper" on her sea-trials. We note that the two main-engines together with the two 200 b.h.p. auxiliary engines consumed 127.8 gallons per hour. (42 gallons = 1 barrel; 6.67 barrels = 1 ton.) On the shop tests of the main engine boiler-fuel oil of 16 degrees Baumé was used.

Seeing that the main engines averaged 2,203 shaft h.p. and the two auxiliary Diesels about 200 b.h.p. each, we have a total power developed during trials of 2,600 b.h.p. (we presume that the 150 b.h.p. auxiliary Diesel was not running). The two main-engines consumed 128 gallons of fuel-oil in 1 hour 23 minutes, or 92½ gallons per hour. The grade of fuel is not included in the report, so we cannot figure-out the exact shaft h.p. hour consumption. The latter is given in the report as 0.45 lb. But, if the builders took the total fuel-consumption and divided the same by the power developed by the main engines, it is not quite correct, because the total consumption should be divided by the total power of all the units developing power. This will make the b.h.p. hour-consumption lower than that given, especially as the auxiliary Diesels also were economical. These



The siren on the "H. T. HARPER'S" stack

points we would like to have cleared-up by the builders in our next issue. The fuel oil and water capacities of the ship are as follows:

FUEL-OIL CAPACITY

	Bbls.
Deep tank, P. & S.	2,010
Aft coff., P. & S.	720
Dbl. bottom, P. & S.	856
Total F. O.	3,586

LUBRICATING-OIL CAPACITY

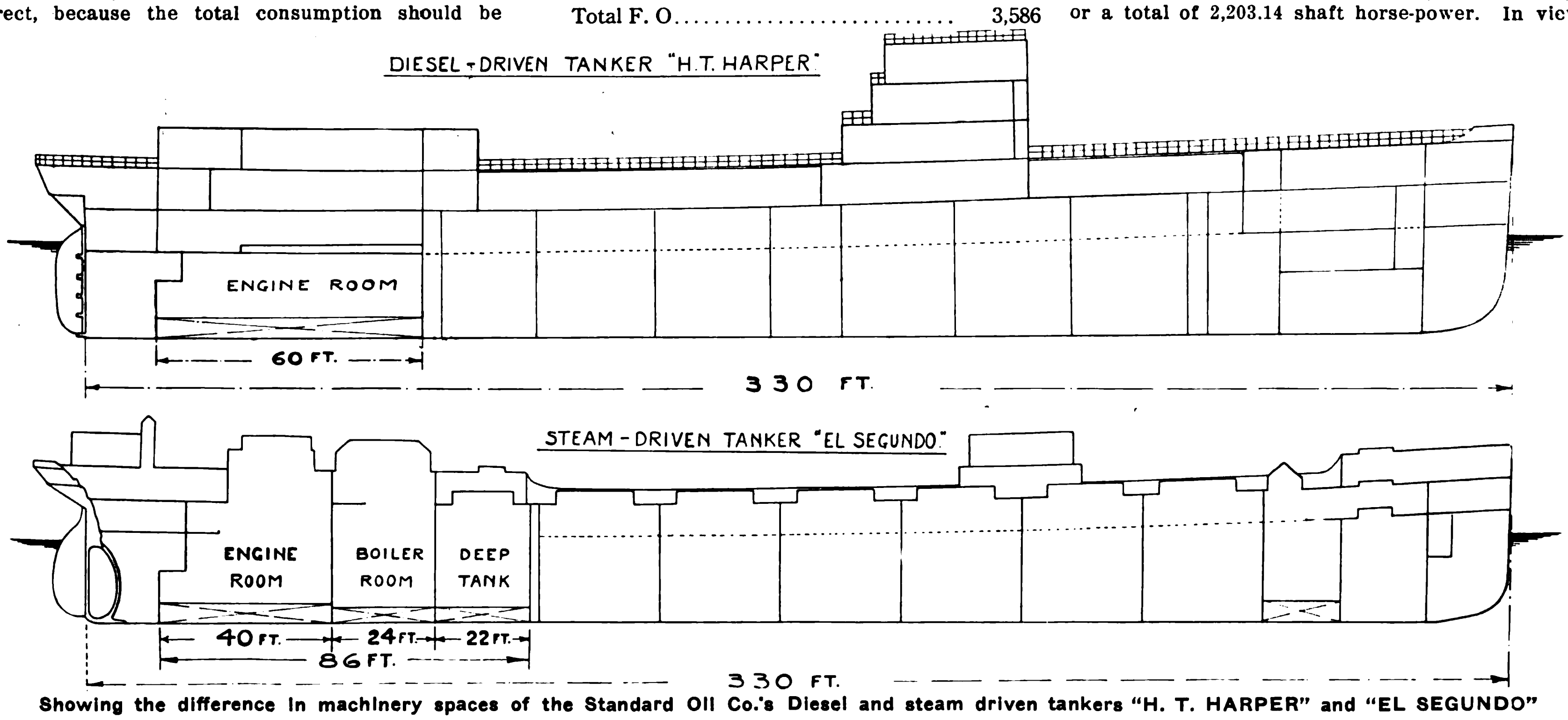
	Gals.
Wing tank, P. & S.	5,680
Drain tank, No. 1 P. & S.	857
Drain tank, No. 2 P. & S.	2,121
Total L. O.	8,658

FRESH-WATER CAPACITY

	Gals.
Fore peak	21,320
After peak	21,140
Culinary tanks (2)	3,000
Gravity tanks (3)	2,100
Total F. W.	47,560

Some oil companies are more or less opposed to the use of electrical-equipment for operating the cargo-pumps of a tanker; but this can now be arranged with as much safety as with steam, even when the ship carries very light oils. In the case of the "H. T. Harper," the switchboard is so arranged that it is impossible to start the cargo-pumps before the blower-motor of the forced draft system is started. This is accomplished by means of a time relay, set so that there must be 15 seconds delay after starting the blower-motor before the cargo-motors can be started.

We now will deal with the propelling machinery. These are twin six-cylinder Werkpoor four-cycle type Diesels, of the direct-reversible, cross-head, air-injection design, 520 mm. (35.433") cylinder bore, by 900 mm. (20.472") piston-stroke designed to develop 850 shaft h.p. (1,150 i.h.p.) each at 135 r.p.m. But, it will be noted that on trials starboard engine averaged 1,638 i.h.p., and the port engine 1,380 i.h.p. respectively, both at 135 revs. per minute. At 73% mechanical-efficiency this gives 1,195.74 and 1,007.4 brake h.p. respectively, or a total of 2,203.14 shaft horse-power. In view



Showing the difference in machinery spaces of the Standard Oil Co.'s Diesel and steam driven tankers "H. T. HARPER" and "EL SEGUNDO" of this excellent power it is no wonder that a speed of 11.8 knots was averaged on a 21′ 3″ mean-draft. So we consider that great credit is due to both the hull and engine builders. As a matter of fact we think that more powerful engines are really required to regularly turn her two large propellers at 135 r.p.m. and that engines incapable of developing considerably more than their designed output of 850 b.h.p. could not have driven them up to that speed on the trials. We think that with the present propellers about 120 revs. and say 10¼ knots, will be very good indeed if maintained in service with A1 reliability. It will be interesting to know the average sea-speed that has been maintained by the "El Segundo" with her much lower propeller speed. Perhaps the owners will oblige with this information.

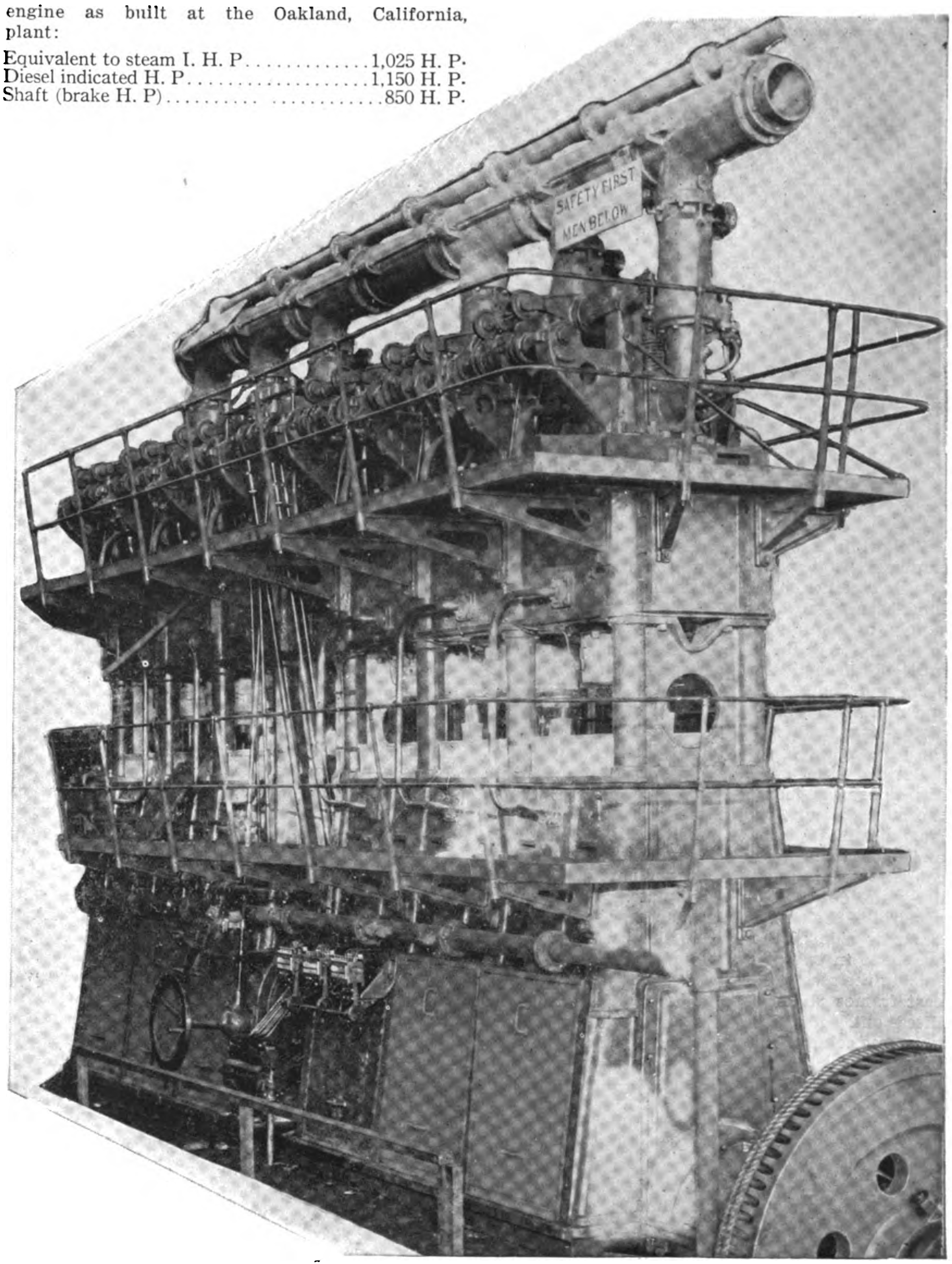
As mentioned, the two main engines were built by the Pacific Diesel Engine Co. under Werkspoor license, and were a twin-screw set similar to ten engines built to the order of the U. S. Shipping Board and now lying idle in storage for some unknown reason, instead of being publicly offered to shipowners, or installed in hulls.

When the Pacific Diesel Engine Company first decided to build Diesel motors, they figured that the success could be obtained more rapidly and at less expense if they adopted a well-tried-out and standardized European engine, and worked under license than if they designed and developed a Diesel of their own. At the same time the Pacific Diesel Co. considered that certain changes could be made in the European design which would produce conformity with present American practice without interfering with the general and well known characteristics of the original design which has given such excellent duty in many freighters and tankers. For instance, the Holland-built Werkspoor engine has the cylinder-beams carried on vertical steel-columns with diagonal steel bracing-rods, and the crosshead-guides are carried on heavy cast-iron columns at the back of the engine. Whereas in the American engine the diagonal braces have been deleted and the vertical steel-columns carried through cast-iron frames on both sides of the engine.

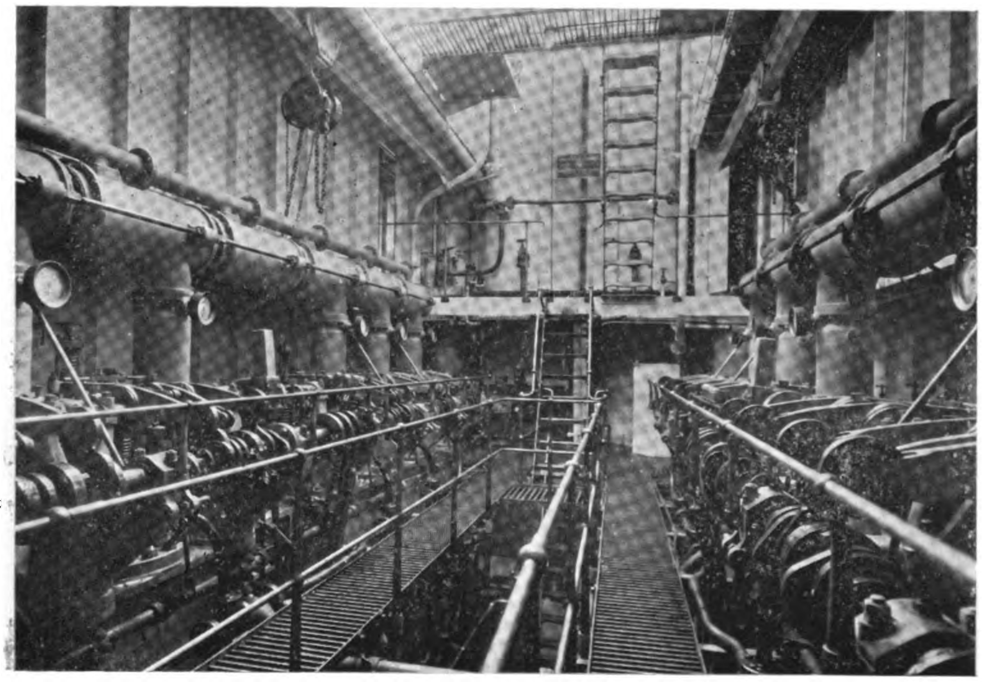
These changes were made by their own engineers in collaboration with three expert engineers from the parent factory in Amsterdam, and the results are a credit to American engineering. While for marine work the engineers at Amsterdam lean toward their own steel column design for cargo-ship installations, this combination cast-iron and steel column construction is to be found in their submarine-engine and in some of their stationary sets; also in their engines in the tankers "Sembilan" and "Vulcanus." So, strictly speaking, the American licensees have made a transfer of application rather than produced a new design, except for certain minor features.

The following are the main dimensions of the 850 shaft H.P. (1,150 Indicated H.P.) marine engine as built at the Oakland, California, plant:

Equivalent to steam I. H. P.	1,025 H. P.
Diesel indicated H. P.	1,150 H. P.
Shaft (brake H. P)	850 H. P.



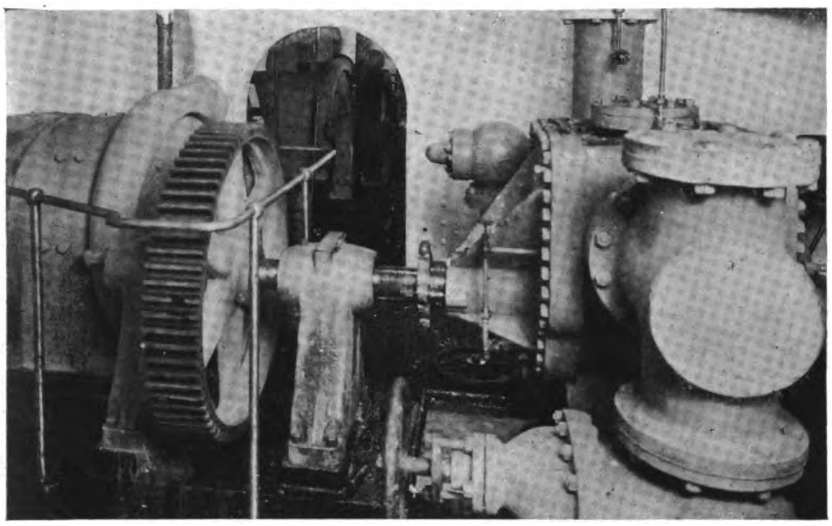
One of the twin Pacific-Werkspoor Diesel-engines of the tanker "H. T. HARPER"



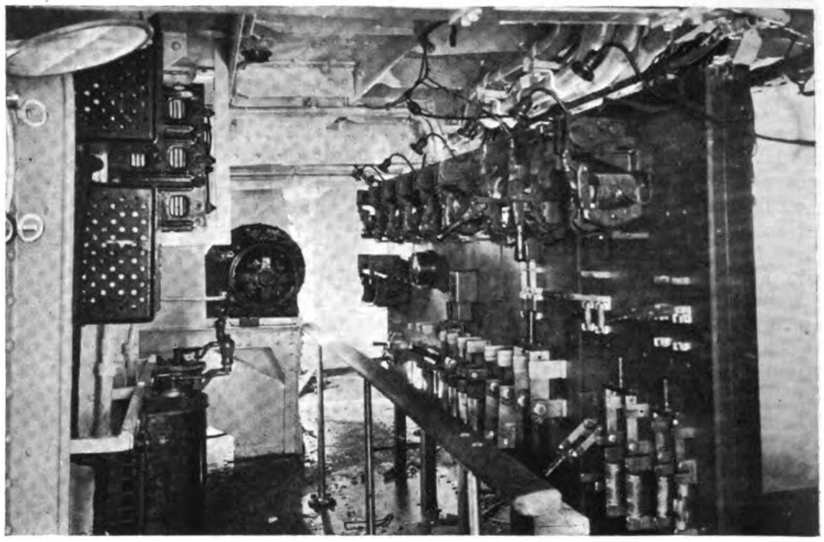
Upper platform of engine-room of the "H. T. HARPER," showing diagonal-eccentric valve operating and reversing mechanism; also arrangements of water-cooled exhaust manifolds.

Shaft H. P. of starboard engine on sea trials of the "Harper"	1,195.74 H. P.
Engine-speed	135 R. P. M.
Weight, including flywheel, thrust-block, compressor, pumps, etc	120 tons
Length (including above)	38 ft. 5 in.
Height (from center of crankshaft to top of cylinder-head	15 ft. 3 in.
Overall width	7 ft. 6 in.
Mean indicated-pressure	92 lbs. per sq. in.
Diameter of crankshaft	12$\frac{3}{16}$ in.
Diameter of crankwebs	7.874 in.
Number of working-cylinders	6
Bore and stroke	20.472 in. by 35.433 in.
Piston-speed	800 ft. per minute
Diameter of piston rod	5.118 in

This engine, while a little longer fore and aft than the Amsterdam production—due to the air-compressor being at the forward end, instead of being operated by rocking-levers off the crosshead or by an auxiliary engine as with one Werkspoor ship—is still very compact and allows of an engine-room of 45 feet, giving ample room to walk around the engine. *This means a great gain of cubic cargo-capacity compared with a steamship of the same size*, especially if we take into account the absence of boiler-water tanks, deep-tanks, and 'tween deck bunkers. But in the "H. S. Harper," 60 ft. has been given over to the machinery as more cargo "space" cannot be used, because she is a tanker.



One of the electric-driven cargo-pumps



The electric control-board

Following the parent design the cylinders are arranged in two large cast-iron boxes or tanks, bolted together, which may be termed a "cylinder-beam," as in addition to holding a big supply of cooling sea-water they afford rigidity to the engine itself. The lower part of the cylinder projects through the underside of the cylinder-beam and has a detachable piece, permitting easy and rapid removal or inspection of the piston and piston-rings. This also is a well-known feature of the parent design, so needs no further description.

Between the cylinder-beam and the cast-iron frames are cast-iron distance-pieces through which the steel columns run, allowing the entire engine from head to base being bolted rigidly together, and so eliminating vibration and weaving, the steel columns running from the upper part of the cylinder-beam down to the bed-plate. Nevertheless, removal of the crank-shaft is an easy matter, as on the rear side of the engine the cast-iron frames are made in two pieces, bolted together, and upon raising the steel columns the lower sections of the cast frames slide out, and the crankshaft can be lifted out. As there is no side strain on this two-piece column casting, it is a practical engineering job.

Between the cylinder-beam and the upper part of the cast-iron frames there is a cast-iron drip-tray running the engine's length for collecting all carbon or dirty oil from the cylinders, and all waste cooling-water, so that nothing can leak on to the bearings or into the crankpit. The piston-rod passes through simple stuffing-boxes in this tray, and which are not exposed to heat of any kind.

The lower halves of the main-bearings are set into saddles in the bed-plate, and the faces of the saddles are scraped until they fit, and the bearing-shells are scraped into the saddles. Adjustments for wear can be made by inserting the shims under the saddle. Single-shin guides have been adopted and are on the operating (front) side of the engine.

As the Werkspoor system of casting the cylinder-head in one piece with the cylinder has given such good results and freedom from cracks, it has been retained, because of the unusual cooling facilities afforded. There is no cylinder jacket in the general sense of the word, the cylinder itself being immersed in the tank of water. It is fitted with a light liner hydraulically pressed into position.

Much engineering interest will be taken in the compressor, as, while this follows the well-known Werkspoor practice of separately operated stages, they are not rocking-lever driven as is usual, but are driven off the forward part of the engine by an extension of the crankshaft. The lowest stage is furthest away from the engine, and each stage has a separate crank. The high-stage has a detachable liner, and the second stage is arranged between the high and low stages without liners. A compressor of similar design was originally adopted with the Werkspoor submarine-engine.

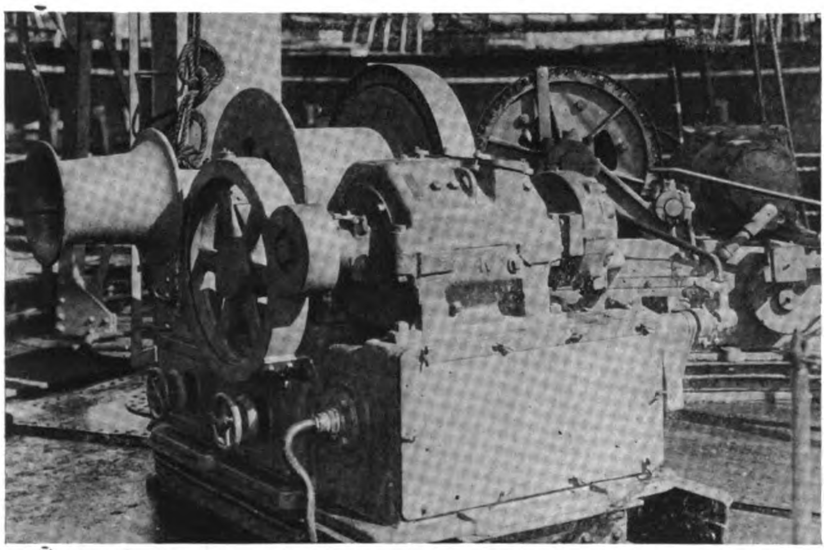
As may be expected, the Pacific Diesel Co. has adopted the simplified design of Werkspoor reversing mechanism brought-out in 1919, and which at the time was quite a radical change, and considerably speed-up manoeuvring, as well as reducing constructional costs. With the previous Werkspoor design there were two camshafts carrying the ahead and astern cams respectively, and when it was required to reverse the engine, the entire set of shafts and cams were moved forwards and backwards, as the case may be, on sliding brackets, bringing the desired set of cams under the rollers of the valve rockers.

With the device on the "H. T. Harper's" engines referred to there is only one camshaft, and this does not move except to continuously rotate at half engine-speed. In fact, it remains stationary while the reversing operation is performed, and merely serves the purpose of carrying two sets of fixed cams that are rigidly secured on it. Incidentally we may mention that Werkspoor's practice of using cast-iron for the inlet and exhaust cams has been adopted. Years of sea-going experience have demonstrated that this is the best material for the purpose, and the majority of builders of slow-speed Diesel engines have standardized cast-iron for this purpose. The surfaces of the rollers, of course, are chilled.

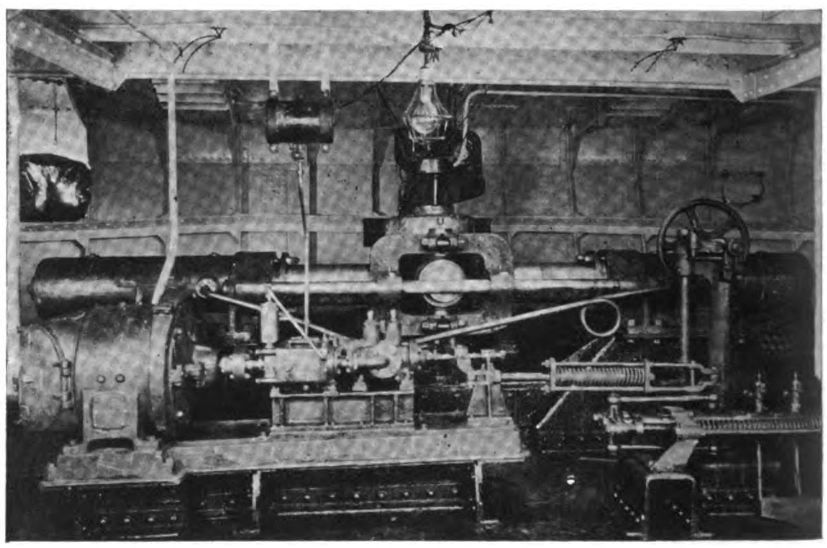
All the reversing motions are carried out by the valve-rockers, and like all eccentric movements the action is very peculiar, yet exceedingly simple. There are four rockers per cylinder, for the inlet, exhaust, air-starting and fuel valves, respectively. Each rocker is mounted on a diagonal-eccentric, the eccentric being secured to the shaft, and is free to move in the hub of the rocker. To shift the rocker-rollers from one cam to another, it is merely necessary to rotate the rocker-shaft 180 degrees, in the neutral position at 90 degrees the rollers are clear of the cams. The turning of this rocker-shaft requires very little effort, and actually can be done by hand. But, to facilitate the operation, a little double-acting air-engine with an oil-cushion is provided, and this reciprocates a ratchet that is in connection to a ratchet-wheel on the rocker-shaft.

When the valve-rocker moves from the ahead-cam to the astern-cam the position of its valve-tappet and also changes, and this is arranged for by the provision of a double head, or tappet, with an adjusting screw on each. The setting of the rocker-rollers is so arranged that when running "ahead" the roller-face is square on the cam, but in the "astern" position the face of the roller is not absolutely square on the cam, it resting at a slight angle, which is of no consequence because the wear of the astern position is exceedingly slight, partly owing to the very limited periods during which the engine runs astern, and partly because of the large size of the roller.

Of course, it would be possible to design the faces of the rollers and cams whereby they would rest quite square on their surfaces in both ahead and astern positions, but this the designers think



One of the Cunningham-G. E. C. electric cargo-winches



The hydro-electric steering-gear of the "H. T. HARPER"

OUTPUT — MAIN ENGINE																									
Hour	Date of Shop Test: Day	Date of Shop Test: Hour	Running Hours: Run	Running Hours: Stop	Rev Counter Reading	R.P.M.	Load on Brake	B.H.P.	Load Factor	Cyl. 1 MEP	Cyl. 1 I.H.P.	Cyl. 2 MEP	Cyl. 2 I.H.P.	Cyl. 3 MEP	Cyl. 3 I.H.P.	Cyl. 4 MEP	Cyl. 4 I.H.P.	Cyl. 5 MEP	Cyl. 5 I.H.P.	Cyl. 6 MEP	Cyl. 6 I.H.P.	Total I.H.P.	Average I.H.P.	Average MEP	Mech. Eff. in %
	6/1/21	1.45		None	201455	141	3100	874	1.059	90	187	88	183	95	197	101	210	98	203	94	195	1175	196	94	74
	"	2.45	1		209861	140	-	868	1.052	95	186	89	183	84	173	87	180	91	188	91	191	1111	185	90	73
	-	3.45	2	-	218140	138	-	866	1.037	84	170	85	173	91	185	92	187	93	189	92	187	1091	182	90	78
	-	4.45	3	-	226610	141	-	874	1.058	85	177	86	179	88	183	92	191	94	196	91	189	1115	186	89	78
	-	5.45	4	-	234730	136	-	843	1.022	85	171	89	179	88	177	91	183	96	191	95	191	1092	182	90	77
	-	6.45	5	-	243065	139	-	862	1.045	85	173	85	173	87	178	92	188	97	199	93	191	1102	184	90	78
	-	7.45	6	-	251290	137	-	849	1.029	86	174	97	196	98	198	102	206	98	198	106	214	1186	198	98	72
	-	8.45	7	-	259606	139	-	862	1.046	83	170	89	182	90	184	99	203	100	206	97	199	1143	191	93	75
	-	9.45	8	-	267960	139	-	862	1.046	93	191	94	192	91	187	93	190	91	187	97	198	1145	191	93	75
	-	10.45	9	-	276118	134	-	843	1.022	82	165	95	191	97	195	103	207	98	197	102	205	1160	193	96	73
	-	11.45	10	-	284244	135	-	837	1.015	96	191	98	195	95	190	99	198	99	198	105	203	1181	197	99	71
	6/2/21	12.45	11	-	292507	139	-	862	1.045	96	197	98	202	93	191	103	212	93	191	100	205	1198	200	97	72
	-	1.45	12	-	300918	139	-	862	1.045	101	207	100	205	92	189	101	207	96	197	101	207	1212	202	99	71
	-	2.45	13	-	309378	141	-	874	1.058	96	198	95	198	94	196	99	206	98	205	98	205	1208	201	97	73
	-	3.45	14	-	317647	138	-	856	1.037	100	204	96	196	96	193	103	210	98	201	98	201	1205	201	98	71
	-	4.45	15	-	325703	134	-	831	1.006	94	190	94	190	96	192	105	210	102	205	100	201	1188	198	99	70
	-	5.45	16	-	333690	133	-	826	1.000	90	177	98	192	97	190	105	207	97	191	103	201	1158	193	98	71
	-	6.45	17	-	341806	135	-	837	1.016	96	191	99	198	98	195	102	204	97	194	99	197	1173	197	99	71
	-	7.45	18	-	349818	133	-	826	1.000	91	179	96	188	93	183	101	198	98	193	97	191	1132	189	96	73
	-	8.45	19	-	357863	134	-	831	1.006	94	186	96	189	97	191	99	195	98	194	98	193	1148	191	97	72
[illegible]	-	9.45	20	-	365264	123	-	763	.924	89	162	99	180	96	175	98	178	104	188	93	169	1052	176	96	72
	-	10.45	21	-	373587	138	-	856	1.037	96	196	101	206	95	193	96	196	101	205	101	206	1202	200	98	71
	-	11.45	22	-	381670	136	-	843	1.022	93	187	95	191	97	195	99	199	101	203	88	176	1151	192	96	73
	-	12.45	23	-	389820	136	-	843	1.022	97	195	103	207	98	196	103	207	103	206	101	202	1213	202	101	69
	-	1.45	24	-	397958	136	-	843	1.022	98	197	98	197	100	200	106	213	101	203	101	203	1213	202	101	69
Average						136	3100	847	1.027	92	185	95	191	94	189	99	199	98	197	98	197	1158	193	96	73

Cyl. #1 in all cases is first forward Cyl. of both Port & Stbd Engine.

Hour (Day/Hour)	Air Compressor L.P. Stage MEP	L.P. Stage I.H.P.	I.P. Stage MEP	I.P. Stage I.H.P.	H.P. Stage MEP	H.P. Stage I.H.P.	Total I.H.P.	I.H.P. Comp / I.H.P. Eng	Fuel Oil Lbs per 24 Hours	Lbs per Hour	Lbs per I.H.P.	Lbs per B.H.P.	Tons per Day @ 2240
6/1/21 1.45	13	16	51	15	350	15	45	3.8					
2.45	13	16	51	15	334	14	45	4.1	9334	389	.350	.448	4.16
3.45	13	15	49	14	338	14	43	3.9	9000	375	.344	.438	4.01
4.45	12	14	50	15	361	15	44	3.9	9288	387	.347	.443	4.14
5.45	13	15	53	15	352	14	44	4.0	8976	374	.342	.444	4.00
6.45	15	18	60	17	382	16	51	4.6	8904	371	.337	.430	3.97
7.45	16	18	59	17	420	17	52	4.4	8688	362	.306	.426	3.88
8.45	16	19	53	17	405	17	53	4.6	8856	369	.322	.428	3.95
9.45	15	18	58	17	406	17	52	4.5	8808	367	.321	.425	3.93
10.45	15	18	60	17	407	17	52	4.6	8496	354	.305	.420	3.80
11.45	16	17	57	16	400	16	49	4.1	8496	354	.300	.423	3.80
6/2/21 12.45	15	17	57	17	387	16	50	4.2	8712	363	.303	.421	3.89
1.45	15	17	56	16	382	16	49	4.0	8640	360	.297	.418	3.86
2.45	14	17	55	16	382	16	49	4.1	8808	367	.304	.415	3.93
3.45	14	17	55	16	382	16	49	4.1	8620	355	.295	.415	3.85
4.45	14	17	58	17	388	16	50	4.2	8256	344	.290	.414	3.69
5.45	15	17	59	16	394	16	49	4.2	8184	341	.295	.413	3.65
6.45	15	17	58	16	387	16	49	4.2	8376	349	.296	.417	3.74
7.45	15	17	59	17	380	15	49	4.3	8256	344	.304	.417	3.69
8.45	15	18	60	17	400	16	51	4.4	8448	352	.307	.424	3.78
9.45	15	15	59	15	400	15	45	4.3	7704	321	.305	.422	3.44
10.45	15	18	59	17	394	16	51	4.2	8544	356	.296	.416	3.81
11.45	16	18	61	17	413	17	52	4.6	8376	349	.303	.414	3.74
12.45	16	18	56	16	406	17	51	4.2	8520	355	.292	.421	3.81
1.45	16	18	58	17	410	17	52	4.3	8496	354	.292	.421	3.79
Average	15	17	57	16	386	16	49	4.2	8612	359	.312	.424	3.85

Hour (Day/Hour)	Lub. Oil Main Cyl. & Comp. Cyl. Sight Feed: Lbs per 1 Hour Eng.	Gals per 1 Hour Comp.	Air Ratio per Min. to Gen. Cyl.	Lbs. per Total	Gals. per Total	Number & Size of Drops Fed L.P.	I.P.	H.P.	Bearing Lub. Total Lbs.	Bearing Lub. Total Gals.	Cooling Lbs.	Cooling Gals.	Ratio Lub. to Fuel: Main Cyls.	Comp. Cyls.	Main Bearings	Cooling	Total %	Heat Balance: Thermal Eff. %	Useful Work	Losses: Cooling Water	Losses: Exhaust Gases	Losses: Friction and Radiation
6/1/21 1.45																					
2.45	5.8	3/4	70	.35	.045	9	9	9	156 Lbs. for 24 Hours	2 Gals. for 24 Hours	156 Lbs. for 24 Hours	20 Gals. for 24 Hours						30.6	30.6			
3.45	5.8	3/4	70	.35	.045	9	9	9										31.3	31.3			
4.45	5.8	3/4	70	.35	.045	9	9	9										30.9	30.9			
5.45	5.8	3/4	70	.35	.045	9	9	9										30.9	30.9			
6.45	5.8	3/4	70	.35	.045	9	9	9										31.8	31.8			
7.45	5.8	3/4	70	.35	.045	9	9	9										32.1	32.1			
8.45	5.8	3/4	70	.35	.045	9	9	9										31.9	31.9			
9.45	5.8	3/4	70	.35	.045	9	9	9										32.2	32.2			
10.45	5.8	3/4	70	.35	.045	9	9	9										32.6	32.6			
11.45	5.8	3/4	70	.35	.045	9	9	9										32.4	32.4			
6/2/21 12.45	5.8	3/4	70	.35	.045	9	9	9										32.5	32.5			
1.45	5.8	3/4	70	.35	.045	9	9	9										32.8	32.8			
2.45	5.8	3/4	70	.35	.045	9	9	9										32.7	32.7			
3.45	5.8	3/4	70	.35	.045	9	9	9										33.0	33.0			
4.45	5.8	3/4	70	.35	.045	9	9	9										33.0	33.0			
5.45	5.8	3/4	70	.35	.045	9	9	9										33.1	33.1			
6.45	5.8	3/4	70	.35	.045	9	9	9										32.8	32.8			
7.45	5.8	3/4	70	.35	.045	9	9	9										32.8	32.8			
8.45	5.8	3/4	70	.35	.045	9	9	9										32.3	32.3			
9.45	5.8	3/4	70	.35	.045	9	9	9										32.4	32.4			
10.45	5.8	3/4	70	.35	.045	9	9	9										32.9	32.9			
11.45	5.8	3/4	70	.35	.045	9	9	9										33.0	33.0			
12.45	5.8	3/4	70	.35	.045	9	9	9										32.5	32.5			
1.45	5.8	3/4	70	.35	.045	9	9	9										32.5	32.5			
Average	5.8	3/4	70	.35	.045	9	9	9	.65			6.5	.015	[illegible]	.018	.0418	3.33	32.3	32.3	30.2	22.1	15.4

REMARKS— Note:— Suction Valve in #1 Cylinder Sticking. Valves changed while running. Time to change valves 20 minutes.

REMARKS— Mechanical Efficiency with Air Compressor Horse Power Deducted = 76.5%

REMARKS— REMARKS— REMARKS— REMARKS— REMARKS.

Log of the shop-test of one of the "H. T. Harper's" Diesel-engines. Fourteen degrees Baumé fuel-oil was used

entirely unnecessary, as very satisfactory results are obtained with the way they now are arranged. To operate the camshaft the old system of long hollow rods and cranks which pull and not push has been retained, no trouble ever having occurred from this source with any engine, also the movement is unusually silent and free from vibration. The rods are sawn down through the centre, opened-out and held apart and strengthened by struts.

The three principal auxiliary Diesel-engines are of Dow construction, two being of 200 b.h.p. in four-cylinders at 250 r.p.m. each, coupled to a 150 k.w. compound-wound 240-250 G.E.P. electric-generator. The third is of 150 b.h.p. in three-cylinders and coupled to a 100 k.w. generator. The bore and stroke of these Diesel-engines is 12 in. by 18 in. respectively, and they are of the four-cycle type. In addition, there is a 16 b.h.p. Pacific Diesel-engine of new design driving a 10 k.w. auxiliary generating-set at 360 r.p.m.

Power for the following auxiliary machinery is provided by the above three Dow-Diesel G.E.C. generating-sets, namely:

AUXILIARIES IN ENGINE ROOM

2. Circulating-water pumps for main and auxiliary engines, centrifugal type, 5 in. suction, 4 in. discharge, direct connected to General Electric motor of 15 H. P. Pumps manufactured by Alberger Pump and Condenser Company, New York.
1. Fire and bilge-pump, 3-stage Alberger pump, 4 in. suction, 3 in. discharge, direct-connected to General Electric motor of 40 H. P.
1. Bilge-pump duplex horizontal-plunger type, 4 in. suction, 3 in. discharge geared to General Electric motor of 7½ H. P. 850 R. P. M. Set manufactured by the Worthington Pump and Machinery Corporation, Deane Works, Holyoke, Mass.
1. Sanitary-pump, 2-stage, Alberger centrifugal pump, 3 in. suction, 2½ in. discharge, direct-connected to General Electric motor of 7½ H. P.
2. Lubricating-oil pumps, 6 x 4, suction, 4 in. discharge, 4 in. geared to General Electric Motor, 7½ H. P. Manufactured by Kinney Mfg. Company, Boston, Mass.
1. Fresh-water pump, centrifugal, 1½ in. suction, 1½ in. discharge, direct-connected to General Electric Motor 5 H. P., 1,700 R. P. M. manufactured by Krough Manufacturing Co., San Francisco, California.
1. Fuel-oil service-pump, 2½ in. suction, 2½ in. discharge, geared to 2 H. P. General Electric Motor. Manufactured by Kinney Mfg. Company, Boston, Mass.
1. Auxiliary compressor, duplex-tandem type, size 9 x 4 x 6, 350 lbs. air pressure, geared to General Electric Motor, 50 H. P., 1,075 R. P. M., 230 volts, 18.3 amperes. Manufactured by Rix Compressed Air and Drill Company, Los Angeles, California.
1. Air-booster compressor, Rix type, size 1⅛ x 4½, 1,000 lbs. air pressure direct connected to General Electric Motor 5 H. P., 1,700 R. P. M., 19 amperes 230 volts.
1. Fan for ventilating rooms, Sturtevant No. 3 multivane, direct-connected to Sturtevant Electric Motor 2 H. P. type 2-B. Manufactured by B. F. Sturtevant Company, Hyde Park, Boston, Mass.
1. Donkey-boiler, vertical 72 in. dia, 10 ft. 7 in. long, fitted to burn oil with Ray type fuel-oil burning equipment. Contains 203, 2½ tubes 48 in. long, with total heating surface of 600 sq. ft. Built by Moore Shipbuilding Company, Oakland, California.
1. Donkey-boiler feed pump, Worthington duplex-horizontal, size 6 x 4 x 6.
1. Balancer, General Electric D./C. 220/125 volts, 24 amperes, 1,700 R. P. M. type 26A. 1 Balancer set 4¾ K. W., 2,000 R. P. M. 250/125 volts, amperes 38.
1. Air-starting bottle for each auxiliary engine, 1,000 lbs. pressure supplied by Dow Pump and Diesel Engine Company, Alameda, California.
3. Air-reserve bottles, 16 in. dia. x 23 ft. long, 1,000 lbs. pressure per main auxiliary engine.
6. Air tanks, 4 ft. dia., 19 ft. 9 in. long, 300 lbs. air pressure.
2. Daily service fuel-oil tanks, 4 ft. 6 in. dia, 13 ft. long, total capacity about 2,900 gals.
1. Kerosene tank, 4 ft. 6 in. dia.
1. Whistle air-tank, 2 ft. 6 in. dia., 6 ft. long. 150 lbs. air pressure.

DECK AUXILIARIES

1. Windlass, horizontal type direct-connected to 35 H. P. General Electric Motor, 500 R. P. M., 230 volts, suitable for 2 in. chain. Manufactured by Allan Cunningham Co., Seattle, Washington.
6. Winches, horizontal type, single drum double geared, direct-connected to General Electric Motor of 15 H. P., 230 volts, 600 R. P. M. Manufactured by Allan Cunningham Company.
1. Steering-engine, hydro-electric type fitted with hydraulic telemotor control, size of plungers 9 in. dia., Pump motor, General Electric of 12 H. P. 600 R. P. M., 230 volts. Manufactured by Hyde Windlass Co., Bath, Maine.
3. Capstans, vertical type 11½ in. dia., direct-connected to General Electric Motor of 10 H. P. Manufactured by Allan Cunningham Company.
1. Refrigerator-machine, 1½ tons capacity, of the Ethyl chloride type. Manufactured by the Clothel Company, New York.

AUXILIARIES IN PUMP-ROOM

3. Cargo-oil pumps, Kinney 10 in. suction, 10 in. discharge, size 5. D 14 x 9, geared to General Electric Motor 90 H. P. 300 R. P. M. of pump.
1. Bilge and Ballast pump, duplex horizontal, size 7 x 6 Worthington type, 6 in. suction, 5 in. discharge, geared to General Electric Company's Motor 10 H. P.
1. Fuel-oil transfer-pump, Kinney 4 in. suction, 4 in. discharge, size S. D. 8 x 4, geared to General Electric Motor 20 H. P., 400 R. P. M. of pump.
1. Forward oil and ballast pump, Kinney 4 in. suction, 4 in. discharge, size S. D. 8 x 4, geared to General Electric Motor 20 H. P.
1. Hand Pump, 2½ in. Hooker type installed in Controller Room.
1. Ventilating fan, multivane Sturtevant type, direct-connected to 5 H. P. Sturtevant electric-motor.

TRIAL TRIP OF MOTORSHIP "H. T. HARPER"

San Francisco Bay and Vicinity of S. F. Light Ship, Farallone Islands, October 27, 1921

Vessel left the Moore Shipbuilding Company's yard at 7 A. M. and proceeded to San Francisco Bay for purposes of completing the ballasting of the vessel to the required draft and adjusting compasses, preparatory to the trial trip. The ballasting and adjustment of compasses was completed at about 10:30 A. M., while the vessel was cruising in the bay.

At about 11 A. M. the vessel was then headed full-speed ahead outside the Golden Gate toward S. F. Light Ship and Farallone Islands for the endurance run and for establishing the speed of the vessel, on the run between these two points. The first run (outward run) commenced at 11:55, at which time the S. F. Light Ship had been sighted and the vessel returned back to the yard at about 5:30 P. M. While at the trial trip the auxiliaries were tested out and found in good working condition, and the trial trip as a whole has been declared to be successful and satisfactory to the owners. A large number of prominent shipping men from San Francisco attended the trial trip.

Detailed results of the trial trip are tabulated, and the results of test of speed of the vessel on the measured distance between S. F. Light Ship and the Farallone Islands are as follows, the distance being 16.5 nautical miles.

1st Run S. F. Light Ship to Farralones:

Time	1 hr. 26 min.
Speed	11.5 knots
Total revolutions, port engine	11,008
Total revolutions, starboard engine	11,094
Average revolutions, port engine	128 R. P. M.
Average revolutions, starboard engine	129 R. P. M.
Slip of propeller, port engine	9.7%
Slip of propeller, starboard engine	10.5%
I. H. P., port engine	1,318 H. P.
I. H. P., starboard engine	1,577 H. P.
Total I. H. P., both engines	2,895 H. P.

2nd Run Farralones to S. F. Light Ship·

Time	1 hr. 20 min.
Speed	12.1 knots
Total revolutions, port engine	11,120
Total revolutions, starboard engine	11,040
Average R. P. M., port engine	139 R. P. M.
Average R. P. M., starboard engine	138 R. P. M.
Slip of propeller, port engine	10.84%
Slip of propeller, starboard engine	10%
I. H. P., port engine	1,430 H. P.
I. H. P., starboard engine	1,685 H. P.
Total I. H. P., both engines	3,115 H. P.

Run: Between S. F. Light Ship and the Farralone Islands.
Draft: Forward 20 ft. 6 in., aft 21 ft., mean 21 ft. 3 in.

AVERAGE DATA

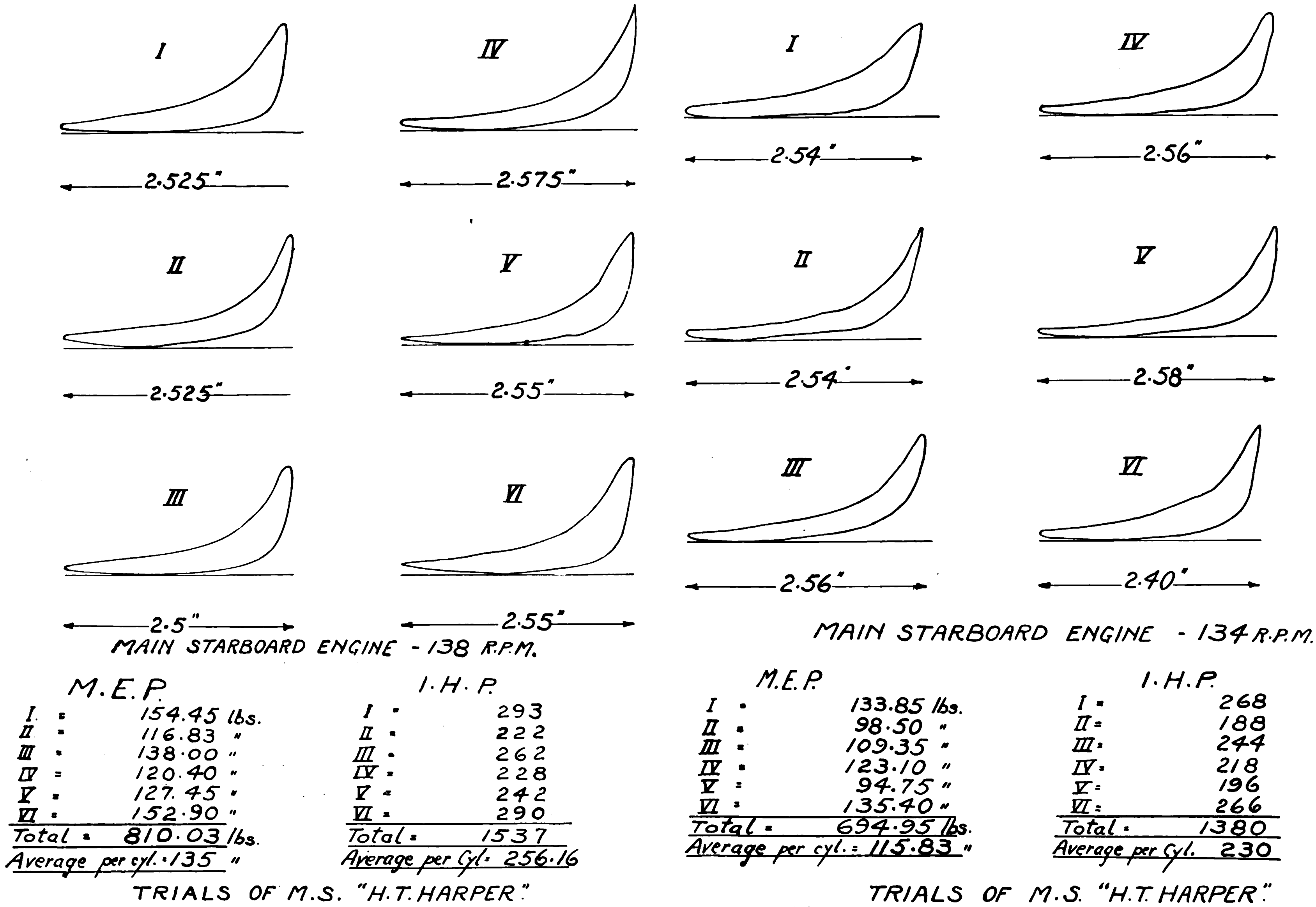
Speed of vessel	11.8 knot.
Time on run	1 hr. 23 min.
Revolution of port engine	134 R. P. M.
Revolution of starboard engine	134 R. P. M.
Slip of propeller, port engine	10.27%
Slip of propeller, starboard engine	10.25%
I. H. P., port engine	1,380 H. P
I. H. P., starboard engine	1,638 H. P.
Total	3,018 H. P.
Brake H. P., port engine at 73%	1,007.4 H. P.
Brake H. P., starboard engine at 73%	1,195.74 H. P.
Total	2,203.14 H. P.
Port generator, volts	230
Port generator, amperes	210
Starboard generator, volts	230
Starboard generator, amperes	300
Pressure, main air tanks	300 lbs.
Pressure, air bottles	750 lbs.
Pressure, whistle tank	125 lbs.
Pressure, starting main port engine	300 lbs.
Pressure, low main port engine	15 lbs.
Pressure, intermediate port engine	162 lbs.
Pressure, injection	900 lbs.
Pressure, starting starboard engine	300 lbs.
Pressure, low	17 lbs.
Pressure, intermediate	182 lbs.
Pressure, injection	925 lbs.
Temperature exhaust main port engine	464°
Temperature exhaust main starboard engine	520°
Pressure, injection aux. engine port	630 lbs.
Pressure, intermediate engine port	40 lbs.
Pressure, injection aux. engine starboard	750 lbs.
Pressure, intermediate engine starboard	53 lbs.
Fuel oil consumption, main engines, per hour according to meter reading	129 gal.
Fuel oil consumption of aux. engines, per hour according to meter reading	15.3 gal.
Fuel oil consumption for main and aux. engines per hour, according to soundings	127.8 gal.
Fuel oil consumption per B. H. P. hr	.45 lbs.
Temperature refrigerator room	39°
Temperature meat room	32°

The vessel returned to Moore's shipyard at 5.30 in the afternoon, in order to have some electrical work completed. The engines operated absolutely perfect during the whole trial-trip and the owner's representatives on board as well as everybody who attended were highly pleased with the performance of the engines.

Her Maiden Voyage

The "H. T. Harper" started on her maiden voyage, leaving Richmond on November 4th at 4.30 P. M., loaded with petroleum products for the Puget Sound, and arriving at Point Wells on November 7th at 4.35 P. M., covering a distance of 785 miles. Her average speed was 10.90 knots; maximum speed 11.4 knots.

She left Point Wells on November 10th at 11.02



Indicator-cards taken on sea-trial.

A. M., arrived at Point Richmond November 13th at 6.05 A. M., covering a distance of 785 miles. Average speed 11.71 knots, although the average speed for the first 725 miles was 12.10 knots when a heavy fog was encountered and the engines had to be slowed down; maximum speed on return trip 12.8 knots.

Indicator-cards taken on the outgoing trip to Point Wells, loaded, were as follows:

Nov. 5, 1921, 10:00 a. m.—

Port........	132 R.P.M.	1,102 I.H.P.	804 Shaft H.P.
Starboard...	135 R.P.M.	1,253 I.H.P.	915 Shaft H.P.

Nov. 6, 1921, 9.00 a. m.—

Port........	134 R.P.M.	1,168 I.H.P.	855 Shaft H.P.
Starboard...	134 R.P.M.	1,194 I.H.P.	870 Shaft H.P.

Nov. 7, 1921, 3.00 p. m.—

Port........	138 R.P.M.	1,225 I.H.P.	894 Shaft H.P.
Starboard...	139 R.P.M.	1,285 I.H.P.	938 Shaft H.P.

Indicator cards taken on the return trip show as follows:

Nov. 11, 1921, 11.00 a. m.—

Port........	135.8 R.P.M.	1,222 I.H.P.	892 Shaft H.P.
Starboard...	136.5 R.P.M.	1,362 I.H.P.	994 Shaft H.P.

Nov. 12, 1921, 9 00 a. m.—

Port........	133.9 R.P.M.	1,132 I.H.P.	826 Shaft H.P.
Starboard...	135.6 R.P.M.	1,216 I.H.P.	888 Shaft H.P.

Average pitch of 3-bladed port propeller..............9 ft., 11 in.
Average pitch of 3-bladed starboard propeller.............10 ft.
This gives an average speed of 11.305 knots for the round voyage of 1570 nautical miles.

The engines performed absolutely perfect both during the outgoing and the home-coming trips. There was not the slightest adjustment to be made on the engines upon arrival at Point Richmond, and as soon as the vessel made fast, the engineers left the engine-room and the ship was immediately loaded, remaining at Point Richmond only twenty-four hours and proceeded with a full cargo for San Pedro, California.

The successful performance of this vessel and her machinery no doubt is gratifying to all concerned with her construction, including her owners and the engineering companies in Holland and England, under whose licenses the main and auxiliary Diesel engines were built, and will do much to convince shipowners that this class of machinery can be built in this country.

TWO NEW DIESEL-YACHTS AND TWO CONVERSIONS ORDERED

A big Diesel-engined steel yacht 178 ft. long, 24 ft. breadth, and 13 ft, 6 in. depth has just been ordered from the designs of Cox & Stevens, of New York, who are also superintending the construction of this craft at the yard of the Newport News Shipbuilding and Dry Dock Co. Two 550 h.p. Winton Diesel-engines are to be installed. Ten years ago such a yacht would likely have been steam-driven, five years ago gasoline-driven. We are progressing.

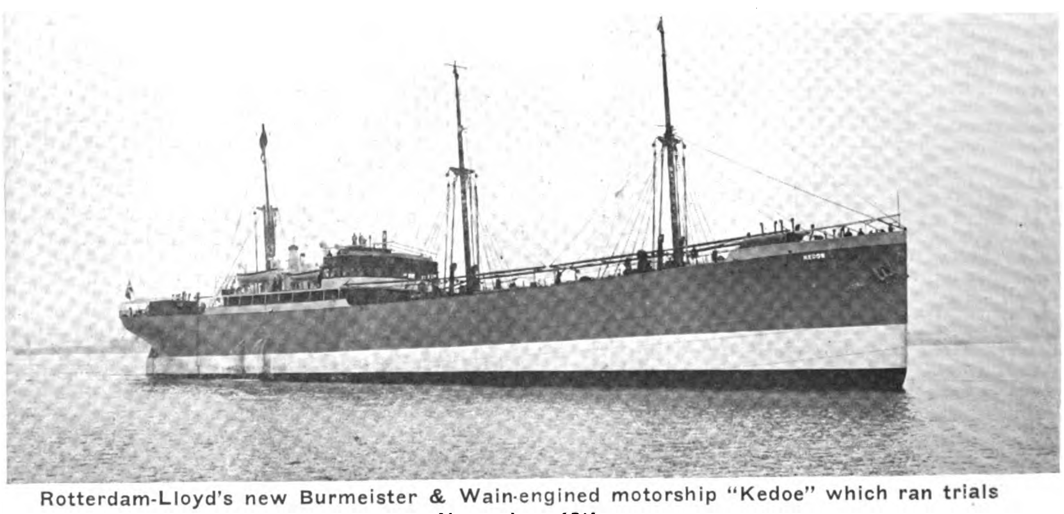
Another large pleasure-boat to be powered with Diesel-engines is under construction at the yard of Kyle & Purdy, City Island, New York, under the superintendence of Henry J. Gielow, who designed this 101 ft. motor-houseboat for Louis H. Eisenlohr. Two 120 h.p. Neseco Diesel-engines will afford Mr. Eisenlohr long and economical cruises.

The three-masted schooner yacht "Alcyone" is now being converted from steam to Diesel-electric drive at the yard of the Tebo Yacht Basin Co., Brooklyn to whom the contract was awarded on October 19th. The "Alcyone" is very similar to the "Guinevere" which was illustrated in our November issue. Two 300 h.p. Winton Diesel-engines, Westinghouse electric-generators and motor, a new steel deck house and other equipment are being installed under the supervision of Tams, Lemoine & Crane, naval architects of New York.

Further progressive work is being done in the conversion from gasoline-drive to Diesel-drive of the 140 ft. yacht "Saballo" at the yard of Robert Jacob, City Island. Two 300 h.p. Winton Diesel-engines are being installed under the supervision of Tams, Lemoine & Crane.

ROTTERDAM LLOYD'S LINE MOTORSHIP

Sea trials of the new motorship "Kedoe" of the Rotterdam Lloyd Line were run on the 10th of November and a speed of 12.4 knots was averaged at 142 R.P.M. The vessel has a displacement of 3440 tons. The fuel consumption including auxiliaries was 139 grams per I.H.P. hour.



Rotterdam-Lloyd's new Burmeister & Wain-engined motorship "Kedoe" which ran trials on November 10th

Launch of American Motorship "Californian"

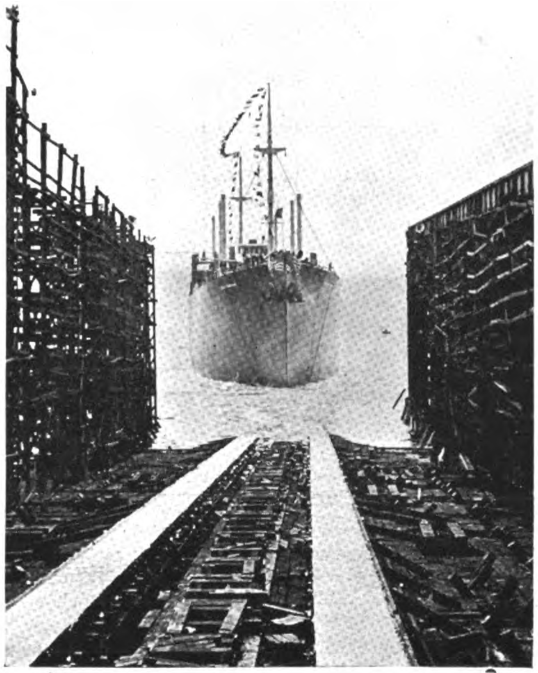
First of American-Hawaiian Steamship Co.'s Two New Diesel-Driven Freighters Takes the Water—Sister Vessel "Missourian" to Be Launched Dec. 14th

"CALIFORNIAN," the first twin-screw motorship originally designed and completely constructed on the Delaware River, was launched November 14th at the yards of the Merchant Shipbuilding Corporation, Chester, Pa. The "Missourian," a sister-ship, will be launched this month. The launching of these motorships marks the advent of the Merchant Shipbuilding Corporation into the field of large full-powered Diesel-engined freighters, and the placing of this corporation in the foremost rank of progressive shipbuilders who have recognized the growing importance of ships of this modern type. The only American-built ship comparable in size with the "Californian" and "Missourian" is the "William Penn," whose engines were built in Denmark, and installed in a hull originally intended for geared turbines, but the "Californian" is an all-American product throughout.

For long and economical voyages the motorship is rapidly gaining in prestige because of the many points in its construction which make for economical operation, and judging from the numerous inquiries which have been received by the Corporation in reference to the "Californian" and "Missourian" it is apparent that widespread interest has developed, not only among ship-operators but among the prominent shipbuilders of the country.

The initial cost of equipping this type of motorship with internal-combustion engines did not deter the directors of the American-Hawaiian Steamship Company—who are operating under the United American Lines—from appropriating funds for the additional investment, because they were assured by the officers and technical staffs of the owners and builders that the efficiency and economy effected would finally justify the expenditure. Furthermore, this publication did much to influence the directors' decision in this respect, by means of many personal calls and by means of useful data in our editorial pages.

It is believed by advocates of the motorship, says the Merchant Shipbuilding Corporation, that it would be a progressive step in the upbuilding of the American Merchant Marine to convert at least fifty-per-cent. of our existing freighters and passengers-freighters, which are tied-up, to Diesel or Diesel electric power, and it is reported that the Shipping Board already contemplate the conversion of several units of its aggregate tonnage to that type.



Launch of the new American motorship "Californian"

The "Californian" and "Missourian" are considered the most acceptable type of motorship for the establishment and maintenance of long distance voyages for both cargo and passenger carrying trade or for combined cargo-passenger routes. Both are equipped with the most modern, efficient and economical machinery and commercial appliances known today. Their size and tonnage are the outstanding features for economical service.

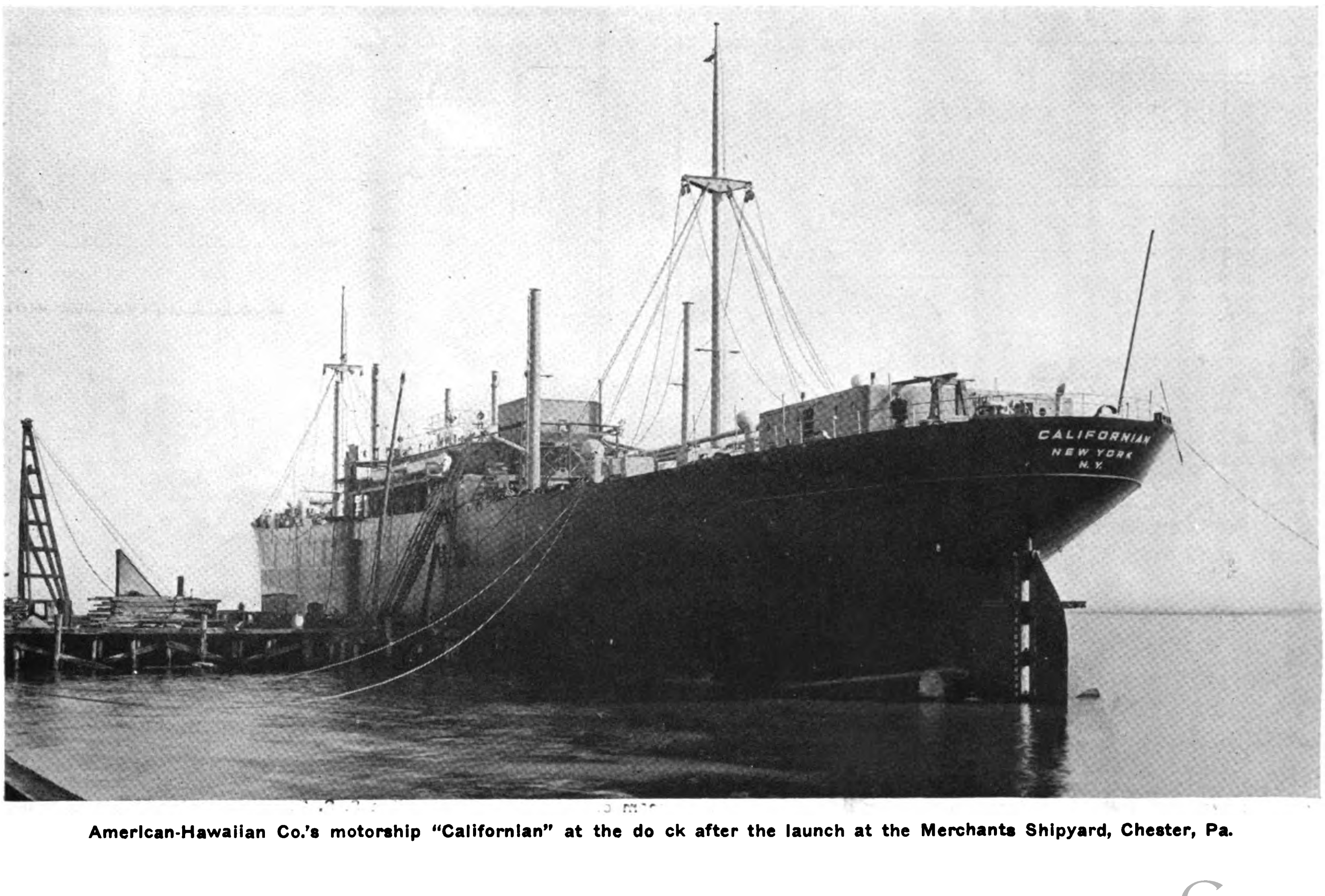
Their principal dimensions are as follows:

Length overall	461 ft.
Length between perpendiculars	445 ft.
Beam, molded	59 ft., 8 in.
Depth, molded to shelter deck	39 ft.
Contract draught	28 ft., 6 in.
Displacement at contract draft	16,500 tons
Deadweight at contract draft	11,000 tons
Cargo capacity, incl. deep tank, bales	560,000 cu. ft.
Contract speed	11.5 knots
Normal fuel capacity	1,400 tons
Reserve fuel capacity in deep tank	760 tons
Normal radius	25,000 miles

Drawings have already been published in "Motorship". In order to conserve length, the quarter amidships in these vessels are two decks high and relatively short, giving a maximum length for hatches and cargo-handling gear. They are rigged with two masts and six king-posts, carrying twenty-one booms, one of 30 tons capacity, one of 10 tons, 11 of 5 tons, and 8 of 3 tons. These serve seven hatches, all 18 feet wide and of varying lengths, the longest being 35 feet. All masts, posts and booms are of steel, the masts being of steel right up to the trucks, eliminating the usual wooden plug top masts.

Cargo-handling machinery for these ships has been most carefully selected, and consists of fourteen double-geared winches, and two Shepard Crane & Hoist Company's winches on each ship, the fourteen winches for the "Californian" were manufactured by the American Engineering Company and the winches for the "Missourian" were made by the Maine Electric Company. Each winch is driven by a thirty H.P. electric motor of the "Mill Type." The motors and the controllers for the "Californian" were supplied by the Westinghouse Manufacturing and Electric Company. Those for the "Missourian" were furnished by the General Electric Company.

The propelling machinery consists of the Cramp-B. & W. Diesel-engines illustrated elsewhere in this issue. Thrust bearings are of the horse-shoe



American-Hawaiian Co.'s motorship "Californian" at the do ck after the launch at the Merchants Shipyard, Chester, Pa.

type, and the 14 foot diameter propellers are of manganese-bronze.

Electricity for engine-room auxiliaries, deck machinery, etc., is generated by four 65 K.W.D.A. 230-volts generators each direct connected to a two-cylinder four-cycle Diesel engine. At sea, only one set will be required, and in port a maximum of three, so that there always will be a "stand-by" set.

All deck-machinery, including windlass and steering gear and all engine-room auxiliaries, except one small auxiliary steam driven air compressor for charging air-bottles, are electrically operated. The steering gear is electric hydraulic drive. There is one 120 H. P. electrically driven two-stage auxiliary air-compressor. A donkey-boiler 48 in. dia. x 108 in total height is installed to generate steam for heating purposes and for fire-extinguisher service. The Rich fire-detecting and extinguishing system is also fitted, in conjunction with steam and CO_2, the latter being carried in flasks located on deck.

No effort has been spared in these vessels in obtaining only the best in workmanship and material, and in the selection of auxiliaries, so that, when they go into service, it is expected that they will rank with the best freighters in the world in economy and reliability. They will stand as a "living" denial to the assumption that America cannot build big Diesel-driven ships.

Maiden Voyage of the "William Penn"

Excellent Performance Put-Up by the Shipping Board's Diesel-Driven Motorship

As we anticipated the only motorship owned by the U. S. Shipping Board has put up a convincing argument in favor of the Diesel-drive by the result of the first half-stage of her maiden voyage around the world. And, she has made a showing against which the turbine-electric ship "Eclipse" can make no near comparison in speed, economy of operation, or cargo-capacity on a similar test trip.

Regardless of the very heavy weather encountered, which caused her captain to heave-to for five hours and "crawl-along" for another ten hours to save the deck-cargo during a hard gale following one of the well-known China Sea typhoons, the "William Penn" averaged better than 11 knots from New York to Yokohama on a daily consumption of 13 tons of oil with a full load of cargo aboard.

Compared with any class of steamship this is an almost unbelievable performance; but, while well up to the average of Diesel-driven vessels, it is by no means unusual, as it is now more or less a regular practice with modern motorships to put up performances of this nature.

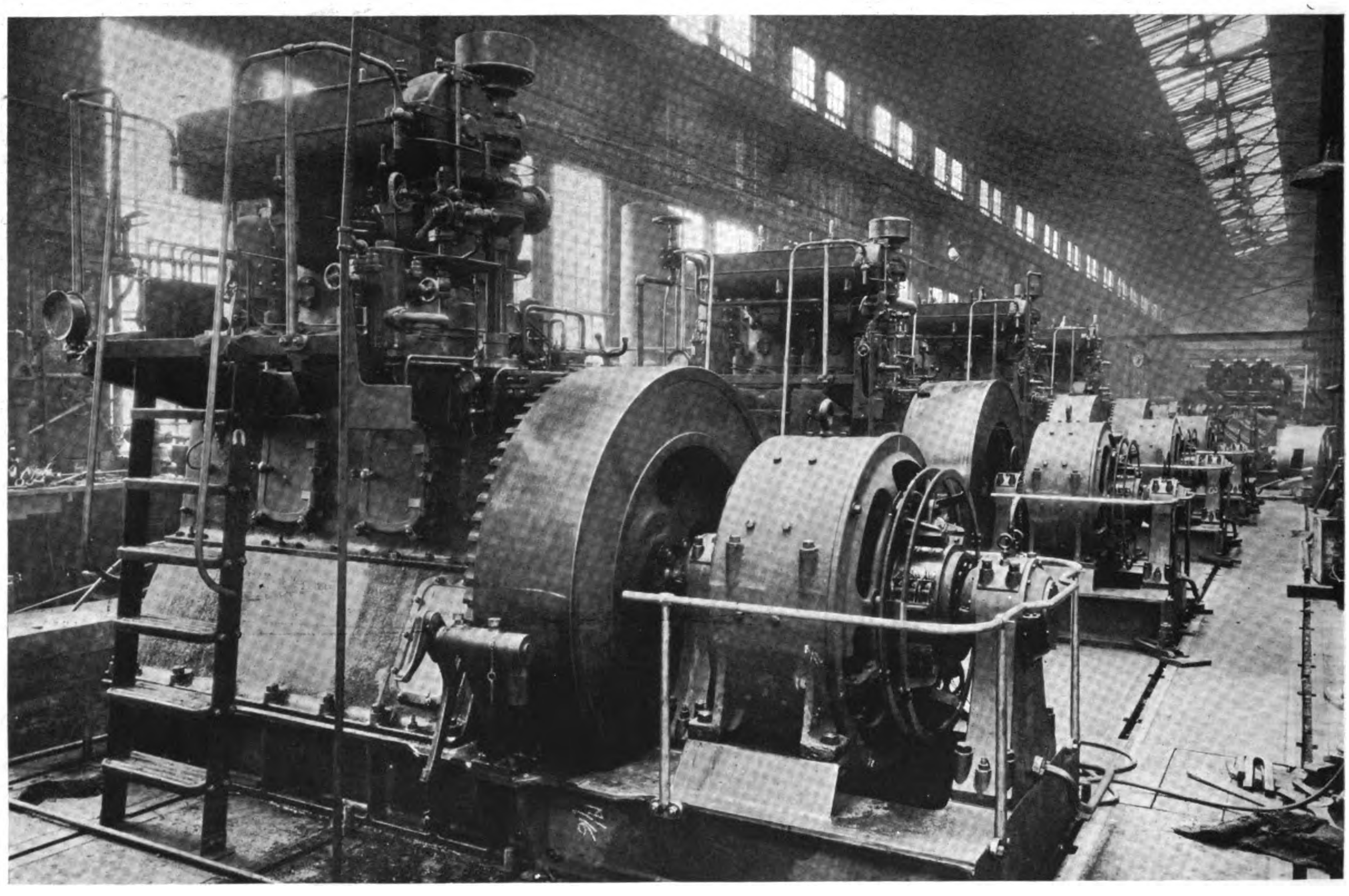
It will be remembered that the "William Penn" has a capacity of about 11,725 tons cargo besides the fuel, stores, and water, when on her fully-loaded displacement of 17,100 tons. On this trip she had on board approximately 11,000 tons of cargo, of which included 500 bbls. of rosin put on deck at Savannah, and much bulky cotton below decks, in addition to some deck-cargo put aboard at New York. She took on some fuel at Philadelphia, some at the Panama Canal and the balance at Honolulu—the total being more than sufficient to take her entirely around the world. She has a crew of 42 men, or several less than would be required on a steamer of the same size. Captain Wright told newspaper men at Yokohama that the operation of this vessel has been 100% and he is delighted with her. In every port at which they called the "William Penn" was the object of interest and admiration. She has an all-American crew with the exception of Chinese in the steward's compartment. Full details of this ship and illustrations were published in "Motorship" for October, 1921, and in previous issues.

Diesel-Engine Construction at the Cramp Shipyard

Visit to This Philadelphia Plant Where Four 2,250 h.p. B. & W. Engines Are Nearing Completion for the American Hawaiian Co.'s Motorships "Californian" and "Missourian"

Many domestic shipping men seem to have been under the impression that Diesel-engines of large power cannot be properly constructed in this country because of the difficulties of workmanship, lack of facilities, and non-availability of suitable materials. Various public statements to this effect have also been made by men wholly unfamiliar with the true position and who, undoubtedly, have never seen the inside of some of the great American Diesel Engine factories. Some of the marine journals also, either through carelessness or ignorance, frequently let such view-points appear in editorial articles that they publish. Evidence given before congressional committees by prominent naval architects also display similar lack of knowledge on the splendid Diesel-engine building plants that this country has, several of which have been illustrated heretofore in our pages.

It is therefore distinctly encouraging to learn that a number of American shipowners have recently visited the shipyard and engine plant at



Four of the Cramp-B. & W.-Diehl electric-generating sets for the engine-room of the American-Hawaiian S. S. Co.'s two motorships "Californian" and "Missourian" in the erecting shop at the De La Vergne Plant, New York

Philadelphia of the Wm. Cramp & Sons Ship & Engine Building Company, and that they have been agreeably surprised to see such excellent progress being made with the four 2,250 i.h.p. main engines and auxiliary machinery of Burmeister and Wain design for the two 12,000-ton motorships "Californian" and "Missourian" of the United American Lines. The first of these vessels was launched on the 14th of November at the Merchants Shipyard, Chester, Pa., and is to be towed to the works of the Cramp Company for the installation of the machinery.

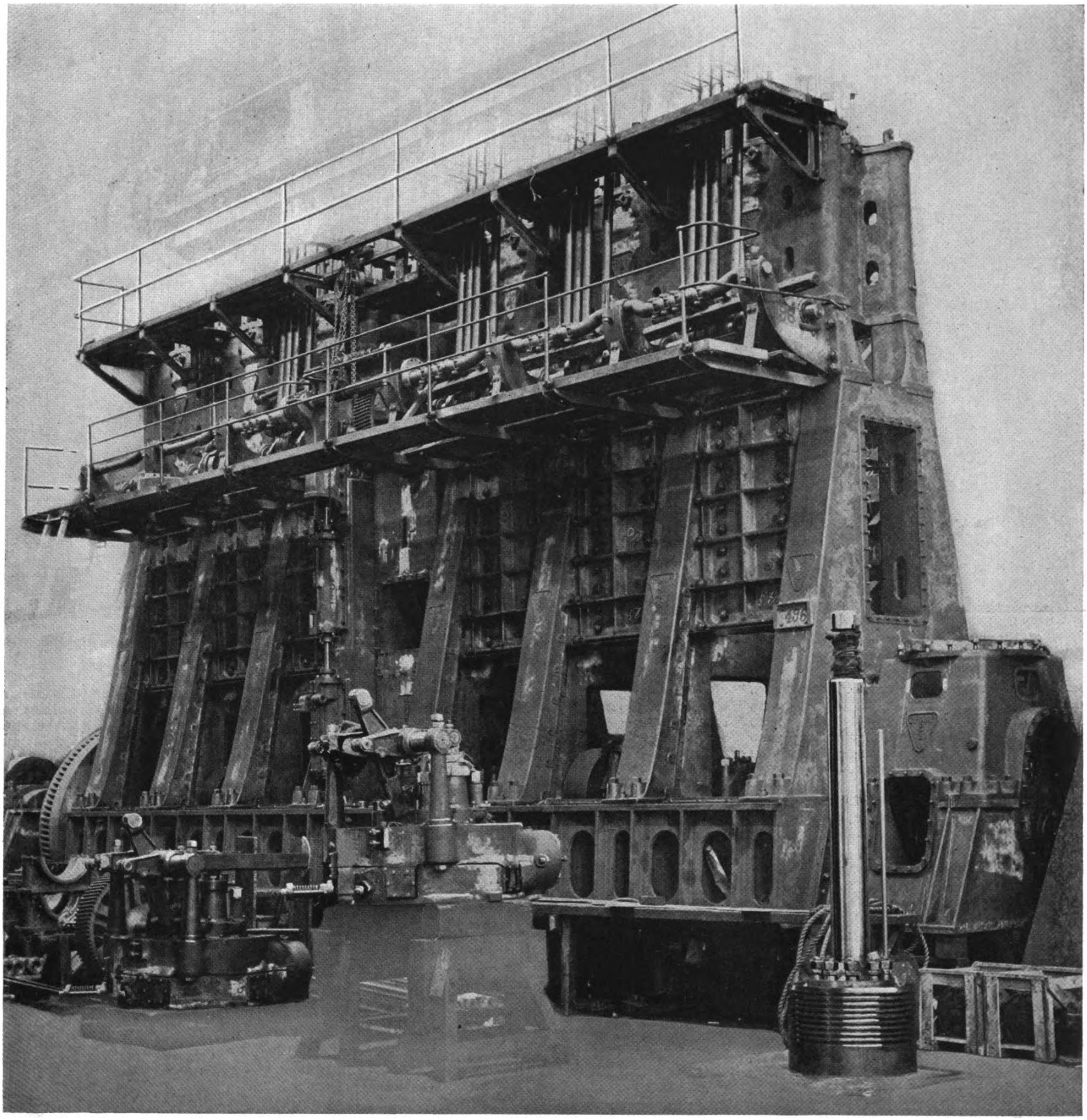
to the plant in order to keep fully posted as to the progress of the work. The accompanying illustrations portray the extent of construction up to the middle of last month. They also show the builder's facilities and should dispel any doubt as to their ability for carrying out this class of work. The facilities and the standard of workmanship are equal to the best leading European Diesel factories where Diesel Engines have been building for ten times as long a period.

As to materials for the construction of Diesel-engines, Cramps, and other domestic concerns, are

continent of this particular size by Burmeister and Wain and other licensees, and the great care being exercised in their manufacture, the Cramp engineers do not consider it necessary to test the main engines in the shops. After assembling and turning-over, they will be taken down and re-erected in the ships.

The four auxiliary Diesel-engines for the first vessel are shown in one of the illustrations on the test floor, and have been tested and are ready for installation.

The Cramp Company have plans for extending



One of the 2,250 i.h.p. Cramp B.& W. Diesel marine-engines showing recent stage of construction. Since the photograph was taken the cylinder-heads have been placed in position. In the foreground two cylinder-heads and one of the pistons can be seen

In recent months domestic shipowners have been displaying more interest in the Diesel Engine, due no doubt to the world-wide economic pressure, they seeing in the oil engine an outlet for relief from the high operating costs of deep sea merchant vessels.

During the course of the erection of these engines at Cramps we have made a number of visits

considerably better off in the choice of suitable pig-iron for making the special cast-iron mixtures required than are the European builders. Consequently, there is no foundation for the mistaken idea that large sized Diesel-engines for the Merchant Marine cannot be satisfactorily constructed in the United States.

Due to the large number of engines built on the

their facilities for the construction of Diesel-engines should the demand justify it. A large part of the shops used during the war for building the highest class of naval machinery is now converted over to the Diesel work.

The main erecting shop is 332 feet long by 142 feet wide. A bay of the adjoining hydraulic shop is given over to the erection of such auxiliary ma-

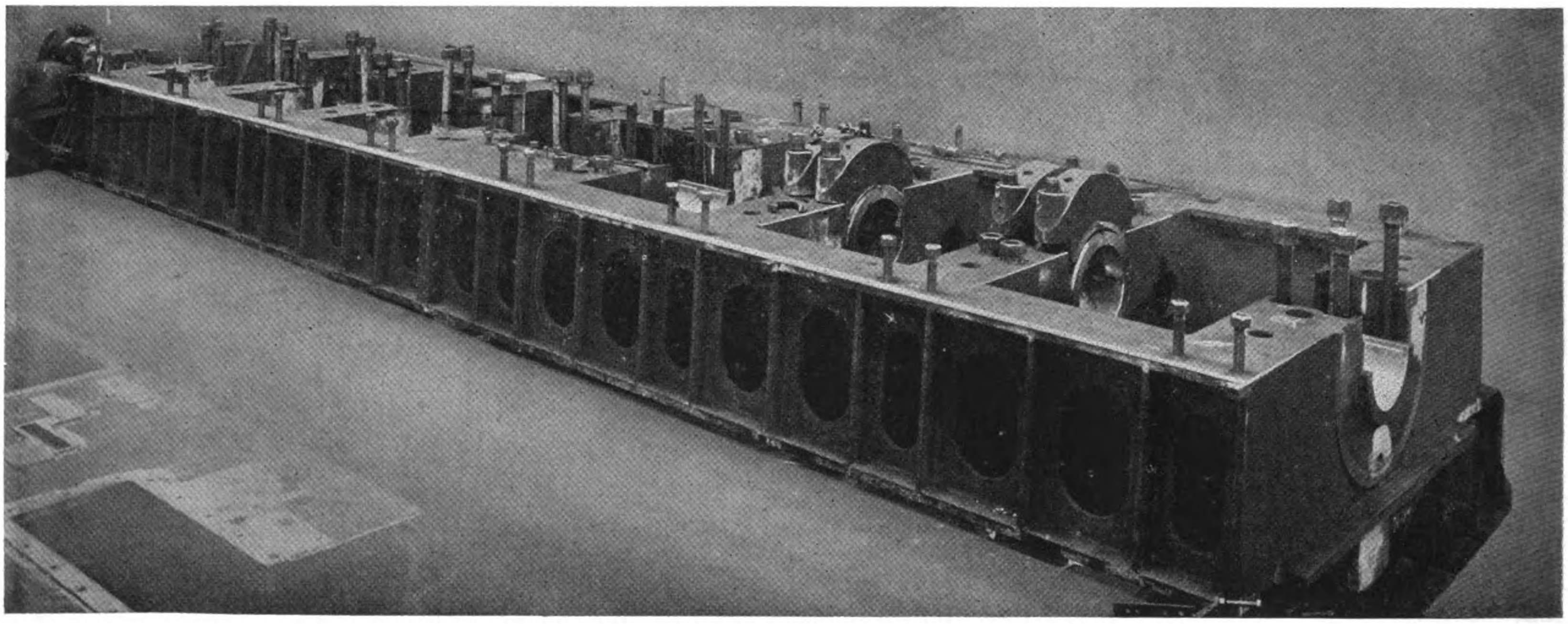
View of the main machine-and-erecting shop at the Cramp shipyard showing four 2,250 i.h.p. Diesel marine engines under construction in the foreground

chinery as air compressors, ballast pumps, etc., the auxiliary Diesel-engines for the present being built at their New York plant, the De Lavergne Company, who are now a subsidiary of the Cramp Company and have had many years of experience in constructing stationary oil engines.

No special machine tools have yet been installed, the existing equipment having been found adequate for the machinery now under construction. They have, however, been aided greatly by an elaborate system of jigs, over $80,000 having been spent on these alone for their Philadelphia and New York plants, and which is carried out to a greater extent than in Copenhagen. These save much valuable time and ensure great accuracy, as well as interchangeability of parts.

Should the size of the Diesel-engines increase in the near future, Cramps will be able to take care of very large castings, as they have a boring mill in the hydraulic shop which can swing 35 feet, and 15 feet under the tool; also other tools of large capacity. These machines, of course, are not used at present on Diesel work, because the castings are not sufficiently large to make it an economical proposition, so the smaller tools suffice. The Cramp Company plans to add other special machine-tools to handle the work when orders justify the investment involved.

The left bay to this machine-shop is served by two 30-ton Niles overhead cranes, these serving



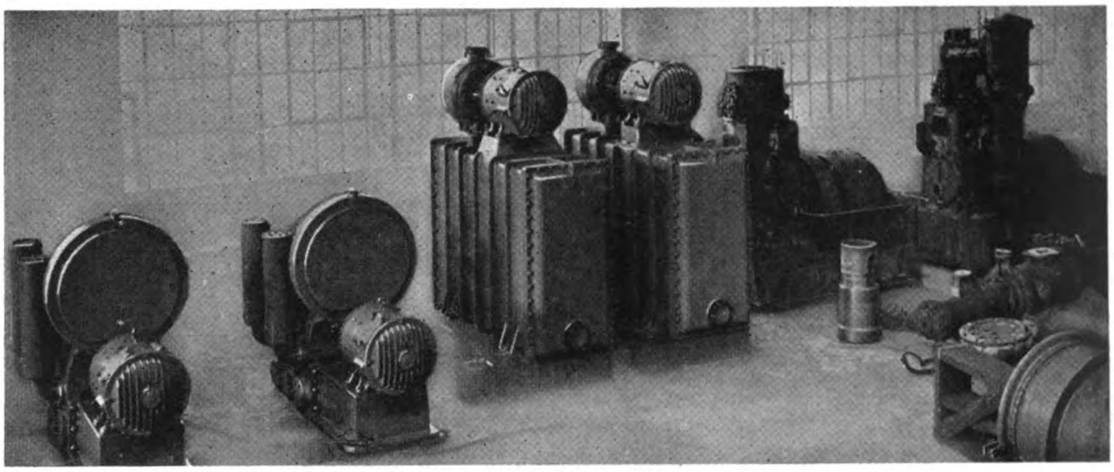
Bed-plate of one of the Cramp B. & W. Diesel-engines for the American-Hawaiian company's motorships the large machine tools, while the smaller tools in the right bay are served by two 10-ton Niles cranes. In the center bay there are two 50-ton electric cranes made by Wm. Sellers & Co. of Philadelphia. In the lofty galleries round the main shop are the machining and erecting stations for all of the small parts.

In the foundry, which is a building 453 feet by 74 feet, there are two cupolas, the newest one being of 30 tons per hour capacity, and the older of 12 tons per hour capacity. Here the castings for their own, as well as other makes of Diesel-engines, are molded and poured. However, some of the parts are made in a special air-furnace at their De Lavergne plant, where it is necessary to hold the mixture to close limits.

Naturally there have been a few minor refinements to the Danish design made by Cramps to conform better with American practices and conditions, but in the main the Burmeister and Wain plans have been faithfully followed.

The four main engines are similar to the two installed in the M/S "William Penn," which have been working so excellently for the past two months. Each engine is of the direct-reversible single-acting crosshead type and operates on the four-stroke cycle, and has six cylinders 29⅛ in. bore by 45¼ in. stroke, developing 2,250 i.h.p. at 115 r.p.m. This corresponds to 375 i.h.p. per cylinder and a piston speed of 870 ft. per minute with a mean indicated pressure of 85.5 lbs. The weight of each engine complete is about 271 tons (2,240 lbs.) and the overall length 43 ft. 6 in.

The auxiliary engines are similar to those installed on the M/S "William Penn," there being four per ship, however, instead of three, due to the larger number of winches employed on the later vessels. As the general design has frequently been discussed in "Motorship," we do not propose to redescribe the same at this time.



Ballast-pumps, fresh-water coolers and auxiliary air-compressors, all Diehl electrically-driven for the motorships "Californian" and "Missourian"

NORTH GERMAN LLOYD MOTORSHIP WITH VULCAN ENGINE

A single-screw Diesel-driven motorship now building at the Vulcan yard at Stettin for the Nord Deutsche Lloyd is of 6,250 to 6,300 tons d.w.c. The Diesel-engine for this vessel is of the four-cycle crosshead type, and is being constructed at the Hamburg plant of the Vulcan company. It develops 1,800 shaft h.p. at 100 R.H.P. from six cylinders, 28.740-in. bore by 49.212-in. stroke. The auxiliaries will be of Vulcan design and construction. The air compressor is driven-off the engine by rocking levers. Forced lubrication is adopted for the engine, and the crankshaft is from forged steel in two sections.

THE OCEAN-HARVESTER "LYBECK"

In our November issue it is stated that the Dodge oil-engines of the ocean-harvester "Lybeck" were to be removed and replaced with a Diesel-engine of a much higher power. We have been advised by the Dodge Manufacturing Co., that no immediate plans are under way for the replacement of the present Dodge engines.

GROWTH OF MOTORSHIPPING

In view of the interest attaching to the great development which has taken place in the use of internal-combustion engines in recent years, it is thought that the following Lloyd's statistics upon the subject will not be inappropriate.

Recorded in Register Book—	Motor vessels		Gross tons
July, 1914	297	of	234,287
July, 1919	912	of	752,606
July, 1920	1,178	of	955,810
July, 1921	1,473	of	1,248,800

The list below does not include the motorships registered with the American Bureau, British Corporation, Italian Register Navale and the Bureau Veritas, but, only includes vessels registered with Lloyds. It is interesting to note nevertheless that while the number of new steamers dropped in 1920-1921, new motorships increased, denoting the growing faith and interest in this class of vessel.

Of the 1,473 motor vessels mentioned in the above table as being recorded in the Society's Register Book for the current year, 287 are of 1,000 tons and upwards. Of these, 125 have tonnages ranging from 1,000 to 2,000 tons, 97 are from 2,000 to 5,000 tons, 44 are from 5,000 to 7,000 tons, and 21 above 7,000 tons. Nearly one-half of the smaller vessels depend solely on their motors for their motive power. Amongst the 287 vessels of 1,000 tons and above, 95 are provided with considerable sail power, and are recorded in the Register Book as "auxiliaries."

It looks as if the slump in steamer building will be the finest thing possible for motorship construction.

Period	Total Steam and Motor Tonnage Classed	Type of engines. Steam Reciprocating	Steam Turbines	Motors	Motive power Coal	Oil
	Gross tons	Gross tons	Gross tons	Gross tons	Gross tons	Gross tons
1918–1919	3,760,806	2,633,570	1,051,302	75,934	2,491,213	1,269,593
1919–1920	4,186,882	2,821,031	1,286,046 (all geared)	79,805	2,111,289	2,075,593
1920–1921	3,229,188	2,373,067	754,513 (all geared)	101,608	1,260,465	1,968,723

H. M. Robinson, President, Merchant Shipbuilding Company

A PROMINENT SHIP CONSTRUCTOR

In view of the great interest now being displayed in motorship construction by the Merchants Shipyard of Chester, who are building two motorships for the American-Hawaiian Steamship Company, doubtless some information concerning one of the prominent officials of this Company will be of interest to readers of "Motorship."

We refer to Mr. H. M. Robinson, who holds the offices of president of the Merchants Shipbuilding Corp., president of the American Ship & Commerce Corp., president of the American Ship & Commerce Navigation Corp., chairman of the executive committee and acting president of the United American Lines. He is a director of the Cramp Shipyards at Philadelphia and of the W. A. Harriman Company, a banking house specializing in marine securities.

Mr. Robinson graduated from the U. S. Naval Academy in 1896. He was then sent by the Navy to the University of Glasgow, where he remained until 1898, studying naval-architecture, marine and civil engineering. Returning to the United States, he was assigned to the Cramp Ship Company's yard as superintendent of naval construction and occupied this position up to 1902.

From 1902 to 1905, he was assigned to the New York Navy Yard in charge of the construction of the U. S. S. Connecticut. During this time he organized a construction force at that yard. From 1905 to 1913, he was in charge of the design and construction of all naval ships. In 1913, he resigned from the Navy and became managing director of the Lake Torpedo Boat Company at Bridgeport, which position he occupied until he became connected with the Harriman marine interests on the 1st of July, 1917.

Mr. Robinson was president of the Chester Shipbuilding Company, Ltd., and of the Merchant Shipbuilding Corporation (Harriman, Pa.). These companies were eventually amalgamated under the name of Merchant Shipbuilding Corporation, Mr. Robinson remaining president. He was president of the Independent Steamship Corporation.

"MOTORSHIP" ASSISTS SALESMAN SECURE ORDER FOR OIL

In conversing recently with a salesman for one of the leading oil-companies a representative of "Motorship" was pleased to listen to a story of how a copy of the magazine helped this salesman sell oil. It seems that one day an Italian motorship came into a port in Texas at which the salesman was stationed and needed a supply of fuel-oil. When this salesman went aboard he carried a copy of "Motorship" and as soon as the chief-engineer saw it he looked through it eagerly. The leading article was about his own ship—namely, the "Ansaldo San Giorgio I"—illustrating the vessel and also the machinery, himself and engine-room crew. The oil-salesman spent considerable time collecting from his friends all the copies of this issue of 'Motorship" he could lay his hands on and the chief-engineer felt that a man who represented a company which at that time advertised its products in "Motorship" was better posted on Diesel-fuel than some others and gave the order to him. The oil-company has received the business from this motorship ever since. The owners of this ship thought so much of this article that they had 500 reprints made for distribution to their shipowner friends.

A Diesel Engine That Burns Tar-Oils

The Steinbecker Engine Now Being Developed by Krupps

Our readers are undoubtedly well aware of the fact that since the war German manufacturers are taking up with renewed interest the manufacture of Diesel-engines; Germany gave up her steamships to the Allies and is now building Diesel-engines and motorships with such enthusiasm that Americans would do well to keep informed as to developments there. Germany is bending every effort to realize a future on the sea with her merchant-marine. That future for any nation must hinge on a realization that steam-vessels are not fitted to survive this competition which has already begun in good earnest, and that the ship which will survive is the motorship driven by oil-engines, those operating on heavy-grade oils having great advantages over others.

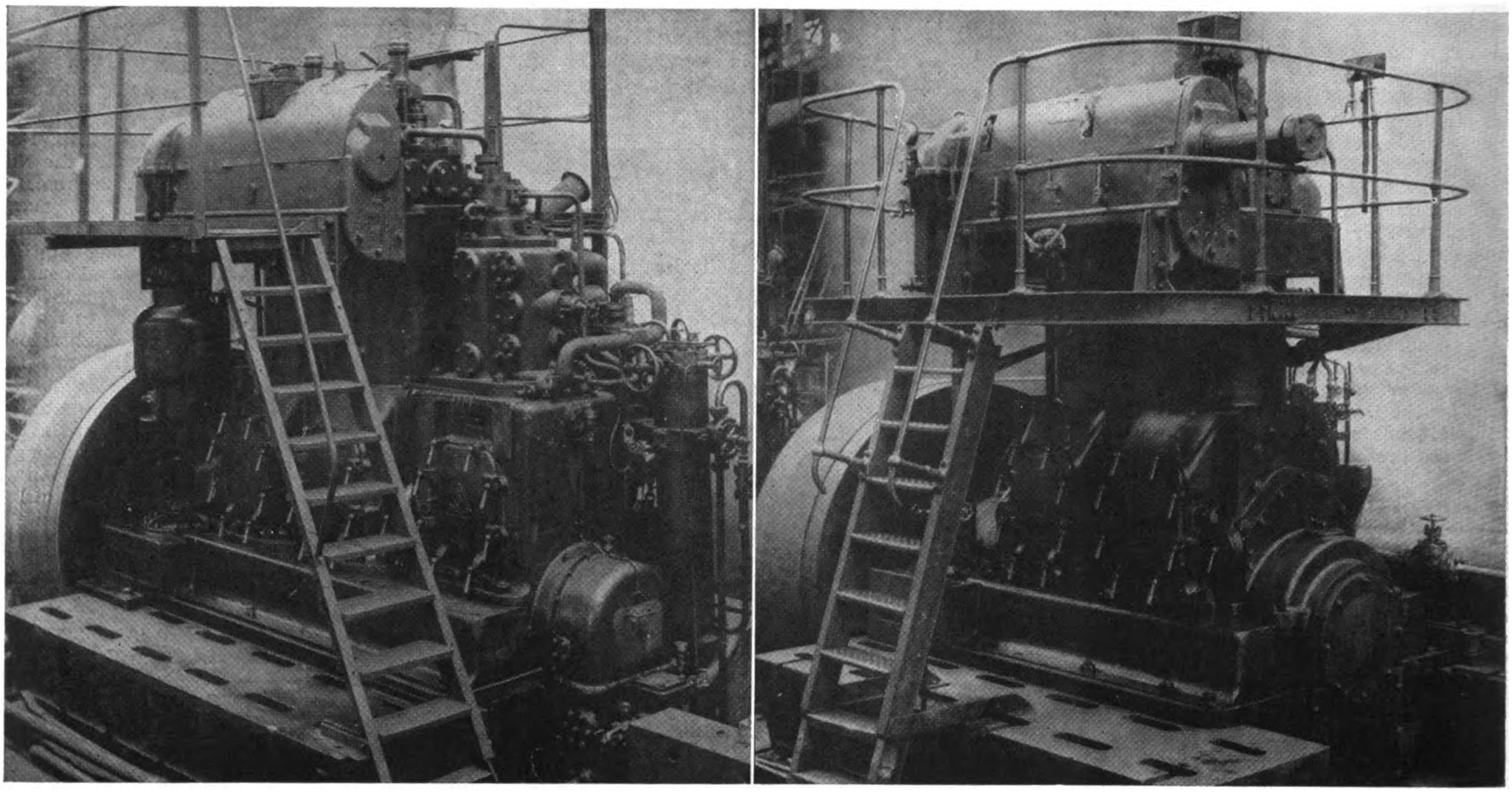
The engine of the future probably must be able to operate continuously on coal tar-oils as well as asphaltic- oils. While the problems to be solved in the design, manufacture and operation of such engines are now greater than those connected with engines utilizing lighter fuel oils, experience will solve them; the world's supply of the more volatile oil-fuels is not inexhaustible and sooner or later the heavier fuels must be quite commonly used.

One of the German firms devoting much attention to the development of engines burning very heavy-oils, such as tar-oils, is Fried Krupp, Germaniawerft, Kiel-Garden, Germany, who in addition to building their own crosshead and trunk-piston types of Diesel-engines, have a license for the manufacture of the Steinbecker engine, as previously announced in "Motorship." The first 100 h.p. two-cylinder engine has been developed under the personal supervision of the inventor, Mr. Steinbecker.

The Steinbecker engine our readers will remember has no compressor and might be called a combination of the surface-ignition and full-Diesel principle. The principle of operation is as follows: Toward the end of the compression-stroke the fuel-pump forces a small quantity of oil through the horizontal-channel into the vertical-channel, the top-end of which is fitted with a bulb with a number of spray-holes, the bottom-end being open to the cylinder. As the air rushes from the cylinder into the bulb it atomizes the oil in the same manner as water is atomized in a flower-spray as used by florists, and the mixture of air and oil is carried into the bulb. When the piston reaches the top of the stroke this mixture of oil and air is ignited by the heat produced by compression, resulting in great increase of pressure and a back-rush of the burnt gases which carry into the cylinder the oil-fuel which the pump has meanwhile pumped into the vertical-channel. In the cylinder the mixture burns and expands in the same manner as in other Diesel-engines.

It will thus be seen that this Steinbecker engine is a Diesel-engine without a compressor, which atomizes the fuel-oil by blowing it with great velocity into the combustion-chamber by means of gases which are formed by exploding a small amount of fuel-oil in a hot retort. The engine is claimed to be less complicated and therefore cheaper to build than the usual full-Diesel type; the fuel needle-valve, injection air-bottle, air-compressor, and high-pressure air-piping are eliminated. For starting the engine from cold a small auxiliary-sprayer is provided, which may be put out of action when the engine is running.

Our illustration shows Krupps' first-engine on the Steinbecker principle. On page 729 of our September issue of "Motorship" we published reference to the visit of Mr. R. Hildebrand, engineer of the oil-engine division of the Fulton Iron Works of St. Louis, Mo., through the Krupp works, where he saw Steinbecker motors under test. Complete articles and illustrations on the Steinbecker engine were also published in 'Motorship" for July and August, 1920.



On the left, Krupp twin-cylinder air-injection Diesel engine of 160 b.h.p. On the right, Krupp-built Steinbecker engine of exactly same dimensions and power. This shows the larger space occupied by the air-injection engine due to its compressor

"MOTORSHIP" MESSAGE READ AT THE MARINE SHOW

Thro' the courtesy of the Westinghouse Electric & Manufacturing Co. the following message was read at the New York Marine Show through the wireless telephone at their plant in Newark.

"The oil-engined motorship has arrived! It is such a pronounced economy that it was bound to come. Nothing could stop it! And all obstacles have been removed as fast as they arose. The law of progress has seen to that. Very strong prejudices stood in the way of steam. But one after another they were swept aside and steam reigned triumphant for a century. Steam now has had its day! Its zenith has passed, and gradually but surely it is being superseded by economical internal-combustion power. America, the most important oil-producing country, should be the greatest motorship owning nation. Let us all co-operate and assist to make that day come soon."

"Under pressure of war conditions and the abnormal period following the war, our Shipping Board has presented us with several thousand uneconomical steamships. Half of these vessels are laid-up and many will never go to sea again in their present condition. Too many billions of dollars have been spent to let our merchant-marine drop out of sight. We must formulate a plan whereby the investment of a little additional money will leave us with a fleet that is economically sound and which can compete with vessels of any other nation. In order to do this several hundred of these ships must be converted to Diesel-drive or to Diesel-electric power. The work should be in the hands of ship-owners under guarantee from the Government, and under the supervision of the Shipping Board. This, at the same time, will give much needed employment to our shipyards."

A HANDSOME SOUVENIR

We are in receipt of copy of a very handsome book entitled "Record of Ships Built" from the New York Shipbuilding Corp., at Camden, N. J. The book is printed on cameo paper somewhat similar to the paper used in the Special Schneider Supplement published in 1919, so that readers will have an idea of the excellency of the New York Shipbuilding Corp's book. It is profusely illustrated with the principal vessels built at this yard, and also contains a picture of their new 200-tons hammerhead crane. These vessels illustrated vary from steel car floats and freighters to the largest battle-ships. Only a limited edition of this volume has been published for distribution to a selected list of steamship owners, so early application should be made for the few copies that remain at their New York office.

The Sperry Compound Marine-Oil Engine

An Engine of Unusual Design and Operation

ON another page in this issue is a criticism of the turbine-electric drive by Elmer Sperry, the well-known electrical scientist. Consequently the present is an excellent opportunity to give some information respecting the new compound type of marine oil-engine now being developed by the Sperry Gyroscope company at their Brooklyn plant. Several of these engines have been ordered, including a set for a fishing-vessel in southern waters. The principle on which this engine operates differs vastly from any motor now on the market. It is very ingenious in design, and experiences with the first engines in coastwise service will demonstrate whether or not it is suitable for regular commercial adoption, particularly in the hands of unskilled operators like fishermen, and on heavy boiler-oils such as will have to be used by most work-boats in the near future.

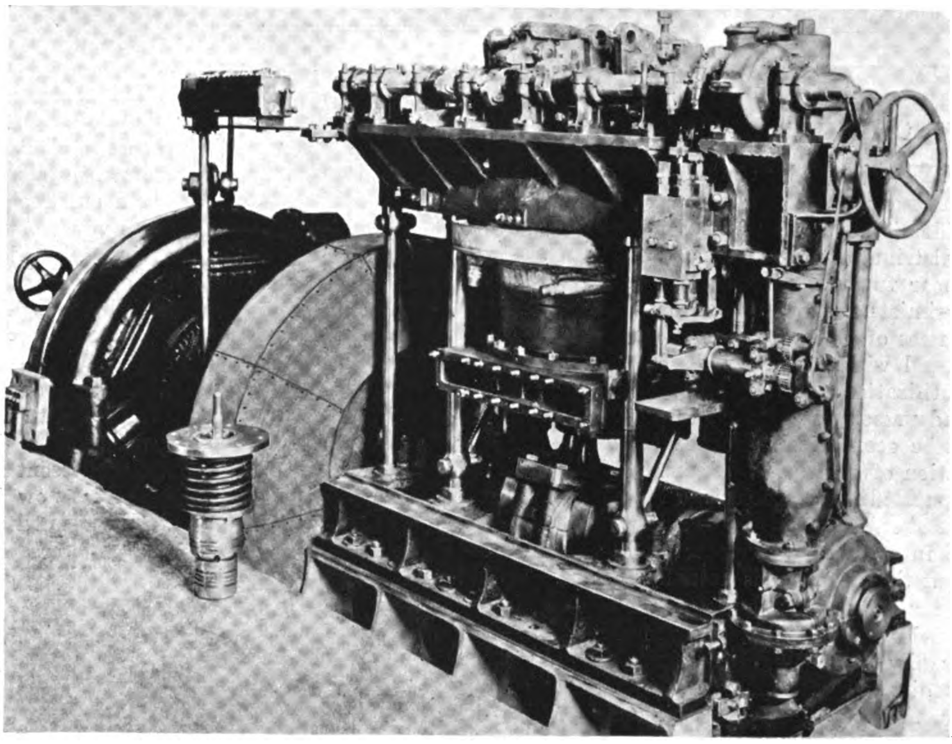
The smallness and lightness of this compound-engine is due to the following. In the four-cycle Diesel we have the tonnage of metal due to the presence of high pressures, operating at a comparatively low material efficiency because these high-pressures persist only about 2½% of the total time. The Diesel card rises abruptly and quickly falls. All the rest of the time, over 95%, either low pressures or no pressures at all are present, whereas in the compound the pressures persist and we are dealing with great blocks of power. Although the pressures are not materially higher than in Diesel practice, they are made to persist practically clear across the card, producing very large gross mean effectives. This is instantly followed by another line clear across the card, again producing another large gross mean effective in the low-pressure cylinder when referred to the high pressure area, all from a single fuel injection.

Instead of 60 lbs. to 80 lbs. net mean-effective to the crank, delivering its power through a few degrees only of one stroke in four, in the compound we have two net mean-effectives, each of 300 to 400 lbs. per sq. in., succeeding each other and covering two strokes out of the four from a single fuel-injection, giving very much better crank effort distribution for power purposes. The point of paramount interest is that these two large blocks of power are secured not by any material increase of pressures, but by large quantities of power gases, simply by "hanging on" to the pressures we have in those gases throughout practically two complete strokes, clear across the card twice, thus abstracting much more of the power they contain before exhausting. Suppose these to be 330 lbs. per sq. in. each. Added they make 660, which is nearly ten times the net mean-effective frequently met with in ordinary Diesels. In an engine of simple construction giving ten times the net mean-effective to its crank-shaft and well distributed, there would appear to be no good reason why it should weigh more than one-tenth the weight of a Diesel of the same speed.

The power-gases work in the Diesel about 120° of arc and in the compound 315°, or 2.6 times as long, or, considering the points of "cut-off" in each, the true expansion-curve is 3¼ times as long, which accounts for its large mean-effectives and higher economies.

Regarding the construction of the Sperry engine: on either side of the low-pressure cylinder are the two high-pressure cylinders and their pistons. The sturdy construction for an engine of its speed is indicated by the size of the crank-shaft, the same being considerably larger in diameter than in any other combustion engine, approaching, as it does, the bore of the combustion-cylinders themselves. The combustion-chamber of the compound has a large dome, which stands out in marked contrast to standard Diesel practice. This dome forms an upward extension of the combustion-cylinder, extending also in a large sweep surrounding the transfer valve, which seals the transfer port.

Seated on top of the transfer valve is a sleeve-like induction-valve and which is controlled by a cam-operated fork. The transfer-valve and sleeves are lifted by a fork located in a thimble near the top of the stem. The first-stage annual compression-pump surrounding the trunk-piston below the low-pressure piston proper, delivers its air to a small receiver, which in turn discharges to a cored port surrounding the induction sleeve, the cooling action of which has been described. A little balancing-cylinder sustains a permanent connection with the low-pressure cylinder. The solid fuel-injection valve and nozzle are placed approximately over the center of gravity of the large masses of air in the clearance dome.



New Sperry heavy-duty, light-weight Diesel-cycle engine operating on bunker-oil. For heavy-duty characteristics see crank-end of rod, center in foreground. Crank-shaft measurably same diameter as the combustion cylinders. The standard generator constituting full load in background, is heavier than the engine, which weighs about 30 lbs. per B.H.P.

Operation of Tug "Foss No. 16"

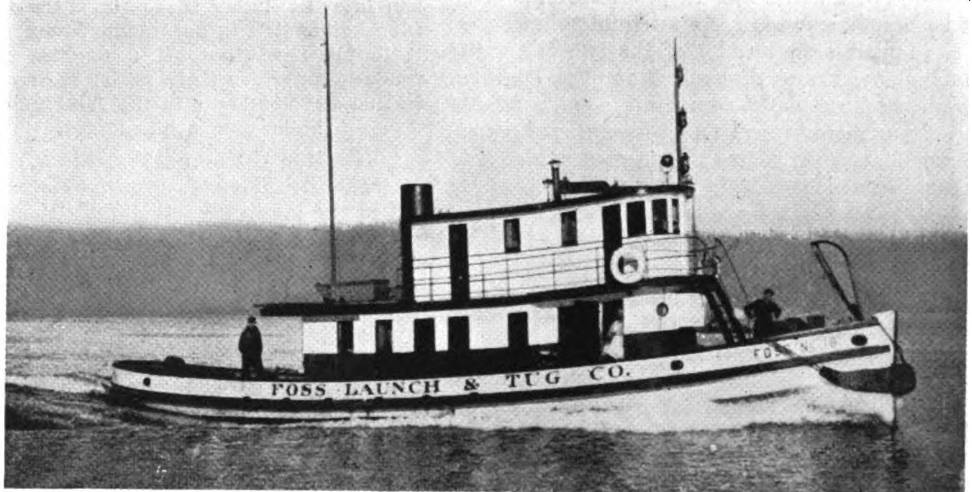
Steam Driven for 11 Year—Now Has Oil-Engines—Details Resultant Economy

The Foss Launch Company, of Tacoma, Washington, owners of "Foss No. 16," did not take out the steam-plant and install in its place a surface-ignition oil-engine because of sentiment. From 1909 till 1920 her 8x16x14 compound steam-engine had driven this tug in her work, but her owners, who also operate twenty-two other tugs, felt that oil-engines would give them every bit as good service with great reduction in operating costs. Out came the steam-plant, and in its place was installed a 200 h.p. Fairbanks, Morse oil-engine.

What happened? She now costs for fuel about one dollar per hour to run as against about $2.50 per hour with the former steam-plant; two men less are needed in the engine-room; she handles larger tows with quicker action than previously, and is so reliable and efficient that they arefiguring on other similar boats in the near future. With the old steam-plant she towed 300,000 to 400,000 feet of logs from Shelton to Tacoma in 24 hours and couldn't handle any more; she now tows one million feet without trouble.

"Foss No. 16" is 60 ft. long, 16 ft. breadth and has a regular steam tow-boat hull of heavy construction. She has towed the "Griffson," a 2,200-ton vessel from Seattle to Tacoma, a distance of 32 miles, in 4½ hours and has also towed the sailing-vessel "Henry Villard," of 1,553 tons, from Eagle Harbor to Tacoma in 5 hours, which is a speed of better than 6 knots.

Her record is convincing evidence that the oil-engine is bound to take its place very prominently in the tow-boat fleet of the country. The Carey-Davis Towboat Company, of Seattle, Washington, which owns a fleet of nine steam-tugs, has decided to convert the whole fleet to oil-engine power and the work has started, the first tug to be changed being the "Equator," which now has a steam-engine. The Puget Sound Tug Boat Co., have sold most of their steam-tugs and have had plans drawn up for a 245 foot 2,600 ton 2,400 h.p. Diesel-tug upon which construction will shortly commence as previously mentioned.



"Foss No. 16," Fairbanks-Morse oil-engined tug

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MOTORSHIP

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DIESEL ENGINES AND HEAVY BOILER-OILS—THE PRESENT FUEL-OIL SITUATION—NEED OF CO-OPERATION OF OIL-COMPANIES AND ENGINE-BUILDERS

LATELY we have given much thought to the fuel-oil question, and have been in consultation with authorities on the subject with the result that we consider it advisable to offer a timely suggestion to oil-engine builders and oil-distributers, which if followed will avoid a grave situation arising in the near future. All our readers are aware that at no time have we been pessimists, although we know there is real necessity for conservation of all classes of oil and that the waste of heavy-oil under boilers should be made illegal within a few years in all cases where means for more economical utilization for the same power purposes can be made, such as in cargo and passenger ships up to 20,000 tons and 8,000 horse-power. This oil must be economically burned in Diesel-engines. Oil experts differ on the question of oil supply. A few weeks ago H. G. James of the Western Petroleum Refiners Associations stated that the oil-industry are worrying over a market, not a supply and that there are over 150,000,000 barrels of crude-oil in storage and greater production in prospect. But the situation is actually serious.

The late Dr. Rudolf Diesel, inventor of the Diesel-oil engine, to perpetuate whose name it is proposed that oil companies grant funds to American Universities to carry out further developments in the combustion of boiler-oils in oil-engines.

During recent months, however, the price of Solar-oil—termed Diesel-oil in the marine field—has been steadily increasing, and in all cases where oil-companies have adequate refineries and cracking processes, the cost of this fuel-oil undoubtedly will increase in a few months hence to a figure way beyond the highest yet touched during the abnormal period that followed the war. In fact, at least one big oil-company would like to withdraw Diesel-oil from the market to-day. Several important foreign motorship owners have foreseen this situation and have built moderate-sized Diesel-driven tankers that can economically cruise to oil-fields in the Mesopotamia or Java districts, where such fuel is cheaper owing to local conditions preventing facilities for close refining. Thus they will be able to bunker their motorships at moderate prices. Boiler-oil, however, will not increase in cost to any appreciable extent until the supply runs low because of the competition it must face from coal.

Hitherto the "proportionate-difference" in prices between Diesel-oil and boiler-fuel, i.e. residual-oils, has not been sufficient to necessitate motorship owners always burning the heavier of the two oils with its attendant work and discomfort for the engine-room crews, because of the comparative small quantity used by a motor-vessel on an overseas voyage. Also, because on some routes the surplus bunker-oil was easily disposed of as cargo at a profit, as outlined on page 728 of our issue of September last, since when a change has occurred in the oil situation. When boiler-oil and Diesel-oil were $6.00 and $7.00 per barrel respectively, the "proportionate benefit" derived by using boiler-oil with Diesels was not as great as it is to-day with oils at much lower prices, and with the variation between the two rapidly widening.

For instance, on a transatlantic round-voyage, a 10,000 tons dead-weight 12½ knot oil-fired steamer burned 1,100 tons at sea (42 gals.=1 bbl.; 7 bbls.=1 ton), and a Diesel-motorship of similar tonnage and speed only burned 375 tons; or, with oil at the above prices fuel-bills of $46,200 and $17,775 respectively. Whereas, if the motorship had been using the boiler-oil as fuel, her bill would have amounted to $15,750 giving her an additional saving of but $2,005, which in those days of full cargoes and high freight-rates was but a small item, especially as it was more than offset by the earning power of her larger capacity. The motorship's fuel economy in port we have not taken into consideration.

It will be readily realized that the more expensive oils become, the greater the economy shown by the motorship compared with an oil-fired, or coal-burning steamer—provided coal, boiler-oils and Diesel-oils rise on an equal scale, or provided the motorship bunkers boiler-oil. Unfortunately, these prices will not rise on an equal scale. But if the cost of boiler-oil mounts too high, steamers will have to be converted back to coal-burners to the detriment of the oil-companies. Alternatively if coal drops below $6.00 per ton it means that boiler-oil will have to be sold to *steamers* at a loss if oil is to remain a competitor of coal, of which fact the oil-companies are well aware. On the other hand, motorships using boiler-oil could compete with coal-burning steamers using coal at $1.50 per ton if the price ever dropped so low. This fact should cause oil-companies to do their utmost to encourage the construction of Diesel-driven vessels.

Towards the end of October, we obtained prices on boiler-oil and Diesel-oil from four leading oil-companies, the same for delivery in New York harbor, as follows:

	Boiler-oil (Prices per bbl.)	Diesel-oil (Prices per bbl.)
A	$1.70	$3.04
B	1.77	2.61
C	1.70	220 to 2.31
D	1.68	2.20

This gives an average of $1.71 per barrel for boiler-oil and $2.52 for Diesel-oil. On this basis the fuel-bills of the steamer and motorship referred to above will be $13,167 and $6,625 on the same voyage. But, if the motorship burned boiler-oil, her fuel-bill would be reduced to $4,421, making a possible saving (compared with the steamer's bill) of $8,746 on the same voyage, which is more important to-day than was the much greater saving effected two years ago. Because, with ships running half loaded to-day the motorship only occasionally takes advantage of her larger cargo-carrying capacity, hence operating economy is paramount. Thus here is an excellent reason that at the present time motorships should burn the heaviest oils unless on a route where surplus Diesel-oil can be remuneratively sold abroad to gas and dye companies. This, of course, does not coincide with the theory proffered by Director Blache on page 892 of our last issue. While we would like to agree with his argument, loss of twenty-five percent bunker-capacity due to the tanks becoming coated with residue just now is of minor count, because there will be no cargo to take its place until the normal overseas trade is with us all once more.

In some ports abroad such as Italy, the price of boiler-oil is $18.00 per ton compared with $36.00 for Diesel-oil, due to expensive storage-tanks being required and oil kept on hand for long periods, as motorships utilize their great cruising radius to bunker where it is cheapest and only buy in Europe when forced. But, when the Standard Oil opens-up its new Polish concessions Diesel-oil may be offered at moderate prices in some nearby European ports for several years to come.

There is another factor to be considered. Lately, owing to so many oil-fired steamers being laid-up for lack of cargoes large quantities of the heavy-oils have accumulated, which fuel the oil-companies have an abundance and naturally are desirous of disposing prior to the cleaner fuel. Because, for the latter they have other markets, especially as several companies can use Diesel-oil in pressure-stills (Burton or similar processes) and obtain gasoline, kerosene, and refined products to meet the steadily increasing demand. Incidentally, if the town-gas standard is changed in the near future, the demand on land for Solar-oil will slightly decrease, but the greater demand for gasolene will more than offset this.

Consequently, it is very advisable for all oil-engine builders immediately to give further attention to the design and construction of fuel-injection systems, providing heating-coils in day-tanks and bunkers, and furnishing ample sized lines for the free flow of sluggish liquid, in order that reliable operation may be ensured with heavy Mexican and Texas residual-oils when in the hands of engine-room crews that might be more skilled and experienced than they sometimes are.

The latter matter we mention because some American motorships have gone to sea with engineers who certainly are hardly entitled to licenses, if their knowledge of Diesel-engines counts. On all sides we have evidence that a Diesel-engined motorship when in the hands of good engine-room staff can operate without any trouble on the heaviest of oils. For instance, one U. S. coastwise motor-tanker has been running with splendid success on Mexican boiler-oil of 14.5 degrees Beaume, 0.9685 gravity and with 4.365% sulphur content, no trouble with her exhaust and inlet valves resulting. She has American-built four-cycle Diesel engines. To enable this very heavy-oil to be used, a fuel-heating system has been installed, consisting of heating-coils in the silencers in which fresh-water is heated by the exhaust-gases. This hot-water is then passed through coils in the fuel-service tanks. In the silencer a coil also has been installed for the auxiliary oil-engines. When the main-engines are cold they are started and run on 0.92 gravity oil for about ten minutes, then the heavy-oil is turned on. It has a viscosity of 1,000 sec. Saybolt at 150 Fahr. The main engines have run for over 450 hours at sea on this fuel, and the fuel-consumption of these twin 500 brake horse-power engines have been reduced by over three barrels a day. The sulphur had no effect on the exhaust-valves. Ever since she was placed in service the motor-freighter "Kennecott" has been burning boiler-oil of 16.7 degrees gravity with most consistent reliability. She also has American-built four-cycle Diesel engines. Many other cases can be quoted. The Doxford engine, for instance, has been using Mexican low gravity oil exclusively.

However, in indifferent hands the use of such thick and sulphuric fuels on board motorships is not altogether desirable, but it can be made so by deeper investigation into oil-fuels, their atomization, and their combustion by domestic engine-builders in conjunction with the leading oil-companies. Also lectures on its use should be given before members of the M.E.B.A. In fact, it would be a good business investment for the principal oil-concerns to stand their share of the cost and this we urge them to do in their own interests. This could be done by making a substantial grant for this purpose to several of the leading American Universities, such as the Massachusetts Institute of Technology at Cambridge, Columbia University in New York, the University of California, Ohio State University, etc., with the understanding that they co-operate with the leading oil-engine builders of this country in carrying-out a series of thorough tests and exhaustive experiments on the lines of those carried-out in England by Lieut.-Engineer Commander Hawkes, which have proven highly valuable to British engineers. Also the Shipping Board and the Navy Department could lend financial and engineering assistance.

A good Diesel-engine could burn and operate on anything from garbage to coal-oil, if it could be reliably and consistently injected and pulverized. Consequently, there is no reason why this wonderful engine cannot be made to run with every reliability on the regular grades of boiler-oil when in the hands of the average set of marine-engineers that go to sea in American ships. "Motorship" has secured for its readers a valuable series of articles dealing with the use and methods of combusting coal tar-oil with Diesel-engines in Germany, where exhaustive experiments have been carried-out over a number of years. American coal companies should study this treatise.

Let us remember that the inventor, Rudolf Diesel, figured upon only burning coal-dust when he produced his original engine. Using oil was an after-thought. His first motor gave its initial "kick" on pulverized-coal fuel. This proposed grant to the Universities could be given to perpetuate the memory of this great German genius and scientist who died unhonored and unsung, but whose legacy to the world is so wonderful that his name will always be identified with the engine, regardless of the country in which it is made. Even an agitation in England during the height of the war to expunge his name in connection with the design was happily quashed by broadminded engineers and business men. But, it was a very bitter pill to Dr. Diesel that the ex-Kaiser never honored him or recognized his work—altho the Diesel-driven submarine afterwards nearly won the war for Germany—and he went to his watery grave a pauper and heart-broken man, just as his engine had attained success in the merchant-marine. As America will ultimately derive the greatest commercial benefit from the Diesel-engine there now is an excellent opportunity to perpetuate Dr. Diesel's name, and at the same time assist American engineers to attain an objective greatly desired by the inventor himself, also to provide a very steady market for residual-oils regardless of competition from coal, and meet competition from possible production of large quantities of coal tar-oil for bunker purposes.

DIESEL-ELECTRIC DRIVE IN THE NAVY

HITHERTO the electrical power of submarines has only been used when running submerged, the current being derived from batteries charged by Diesel-driven generators prior to submerging. Quite a radical departure is being carried-out with the three new V-class submarines building by the U. S. Navy Department. These boats are of 2,025 tons displacement, 21 knots speed, and of 300 ft. length, and the Diesel-electric system of propulsion will now be used for surface-operation, and electric power when under the water.

Altogether there will be four Busch-Sulzer Diesel-engines, two of 2,250 b.h.p. aft and two of 1,000 b.h.p. forward. Each will be coupled to an electric generator, the current from the entire set being available for the motors on the twin propeller-shafts, giving a maximum of 6,500 shaft h.p. less the loss in transmission, which we presume will be about 500 horsepower. Under normal cruising conditions, only the forward pair of Diesel-electric generator sets will be run, or sufficient to give a speed of 11 knots, and a radius of about 10,000 miles. A five-inch gun, machine-guns, and six torpedo-tubes will form the armament.

It is, of course, very interesting to note this development, but we would also like to see the Navy Department turn more attention to Diesel and Diesel-electric driven surface-craft of high power. Submarines have proven to be very effective weapons of both defense and attack, but adequate counter-weapons must be developed, and we believe that fast Diesel or Diesel-electric destroyers of moderate size and 20 to 30 knots speed would be the ideal craft for this purpose, as we strongly advocated during the war.

ANOTHER SUGGESTION FOR THE SHIPPING BOARD

IF a business man had manufactured a large quantity of articles, had offered them for sale at a low price, and had found few or no buyers, he would be facing the unpleasant choice between carrying them on his shelves as a fictitious asset, incurring continual expense for their care and insurance; or selling them for junk, and writing off his loss. And if, under such circumstances, he ascertained that, by making certain changes and additions to the articles, he would be able to sell many of them at the price he had originally asked plus the cost of such changes and additions, is there any doubt as to the course he would pursue?

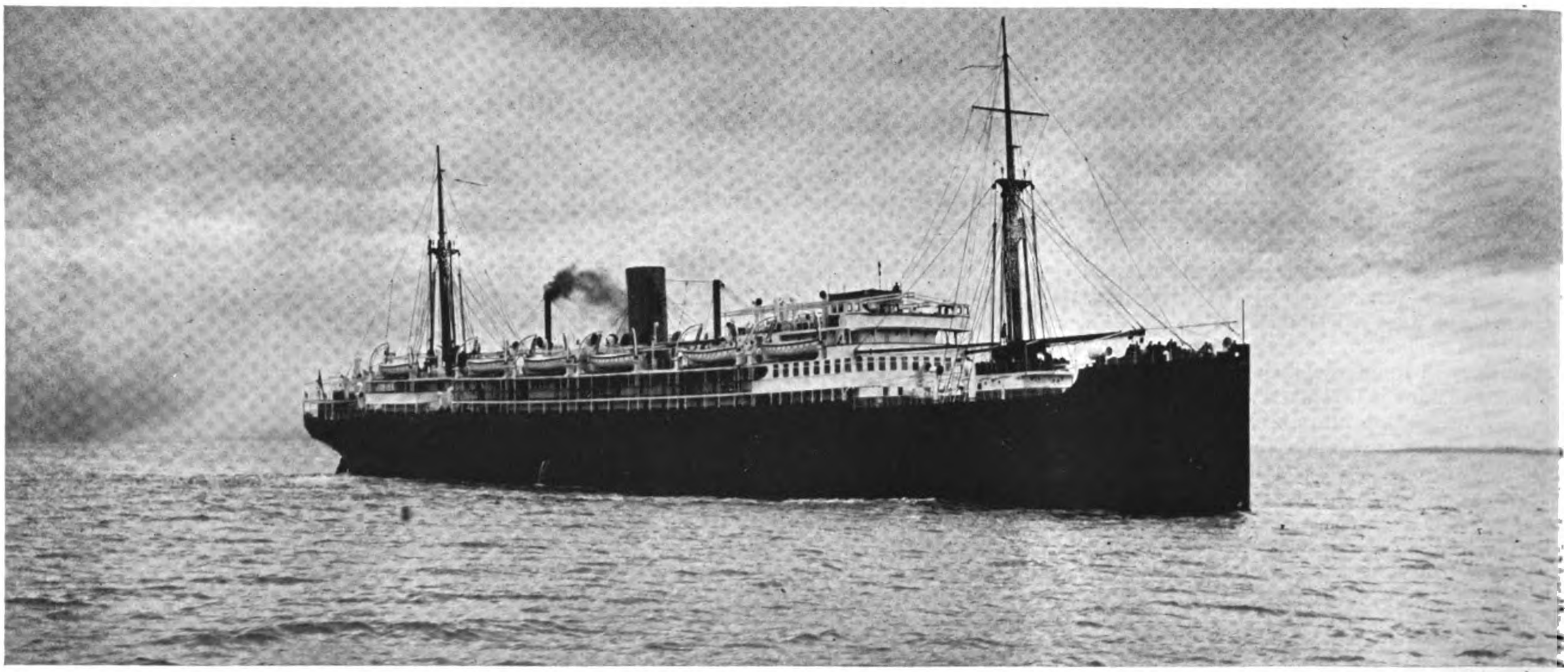
Isn't this exactly the position in which the Shipping Board finds itself today? It built hundreds of steamships, which it is offering for sale at prices far below their current replacement cost and on almost unbelievably easy terms of payment—yet, instead of anxious purchasers fighting for them, there are practically no buyers in sight.—Why?—There are more or less obvious explanations in the case of the wooden ships; but even the best steel ships are faring no better. The plain answer is that, in their ability to compete with modern motorships, of which Europe is putting so many on the seas, these Shipping Board vessels, equipped as they are with reciprocating steam-engines or steam turbines, are rapidly becoming as obsolete as side-wheelers.

The Shipping Board can continue to offer the ships in their present condition, at progressively lower prices and with continued lack of success, meanwhile spending large sums for their maintenance, and writing off yearly a heavy depreciation, with the scrap heap (or, as "Importer and Exporter" recently blithely suggested—Davy Jones's locker as the ultimate goal); or it can transform many of them into attractive bargains, by substituting modern machinery equipment, to take the place of their present moribund outfitting. There is the alternative of "allocating" them to private operators; but it appears doubtful that this course has proved attractively profitable to the "allocatees," while it has been hugely unprofitable to the "allocators"; in any event, there are no evidences of keen competition for such allocations, even on terms which appear to relieve the operator from direct losses in operation, by transferring them to the long-suffering taxpayer.

We are not presuming to assert that the steamer is entirely a "dead issue." There are certain classes of service in which the steamer may be operated more economically than the motorship so long as the first cost of oil-engine machinery is greater. We do contend, however, that the service which would favor the steamer is not such as the majority of the Shipping Board's best ships would be likely to be used in,—namely, general trans-oceanic cargo carrying. Even in the latter service, steamers will still be operated, more or less profitably, during periods when the cargoes offering are in excess of the available motorship capacity—a more and more remote condition. The day has passed, however, when, in the service referred to, the superior profit-earning ability of the motorship could be questioned. This fact has been forcibly demonstrated during this year's dull business period, when cargoes were very sparse. This is logical, under the existing circumstances, because of the ability of the motorship to be operated profitably with cargoes much below the minimum essential for the equivalent steamer to pay actual expenses.

Last month we made one suggestion for profitable disposal and conversion of some of these ships, but it is just as well to have an alternative plan, especially as the operation of even the best of the Shipping Board's ships—with their present equipment, is not a sufficiently attractive proposition to induce operators to invest their money in them, even at bargain prices and on long terms; whereas the same ships, modernized into motorships, would hold out the assurance of a sufficient return on the price at which the steamers are now being offered plus the cost of the reconditioning, to stimulate the purchase of such modernized ships. We are not overlooking the fact that this reconditioning will require money, and that, at the moment, the public is not greatly in favor of increasing its investment in ships; but, after recovering from the shock induced by the figures recently given out by Mr. Lasher, the public will come to the conclusion that an additional business-like investment, which opens up a reasonable prospect for some return or, shall we call it "salvage"?, is much to be preferred to a continuous drain, with little else in sight than the final engulfment of the original investment and all of the subsequent assessments. Nor is it necessary that such additional investment be made on a large scale at once.

The question which naturally presents itself is—if the ships, as they exist, may be purchased at attractive figures, and the money required for their reconditioning can be shown to offer promise of yielding satisfactory returns, why do not the ship-operators buy the ships and do their own reconditioning? The answer is found in the business conditions of the past twelve months. Money is tight; surpluses have been small or entirely absent; so that ship-operators cannot pay machinery-builders quickly and in full, and machinery-builders cannot carry the operators for long periods. The Shipping Board is the natural bridge across this chasm.



At last, a real trans-ocean motor passenger-liner. She makes 13 knots on a fuel consumption of 29 tons per day compared with 60 to 70 tons for a similar American oil-fired ship. The vessel illustrated above is the Elder-Dempster Co.'s twin-screw Diesel-driven ship "Aba." Originally the transport and freighter "Glenapp," she has just been re-conditioned and converted to a passenger-liner by Harland & Wolff

"ABA," A TRANS-OCEAN MOTOR PASSENGER-LINER

Enormous interest is being taken in the motorship "Aba," as hitherto it had not been thought feasible to equip large passenger-vessels with Diesel oil engines. But Harland & Wolff, Ltd. claim that they have solved the problem, the engines installed by them in this and other motor-vessels having proved eminently successful and capable of long non-stop runs, little short of a revolution being thus effected in marine propulsion.

The "Aba," a twin-screw motor-vessel belonging to the British & African Steam Navigation Company, Limited (Managers—Elder Dempster & Co., Limited, Liverpool), left Belfast on the 3rd instant after reconditioning from a transport and freighter by Harland & Wolff, and is to take her sailing on the Liverpool-Continental-African route during the month. She is the first motorship to be engaged in a regular first-class passenger service. Although she carried passengers in addition to cargo during her war service, it is to fufill her design as a high-class passenger-vessel that the "Aba" now commences her proper career.

The "Aba" is 450 ft. long by 55 ft. 6 in. broad and 33 ft. deep. Her propelling machinery consists of two 8-cylinder 4-cycle Diesel oil-engines of Harland & Wolff type on the well known Burmeister & Wain system, designed to develop 6,600 I.H.P. The engine-room auxiliaries, also the deck machinery and steering-gear, are electrically driven. She carries 225 first and 140 second and third-class passengers.

THE NEW YORK WERKSPOOR DIESEL ENGINE

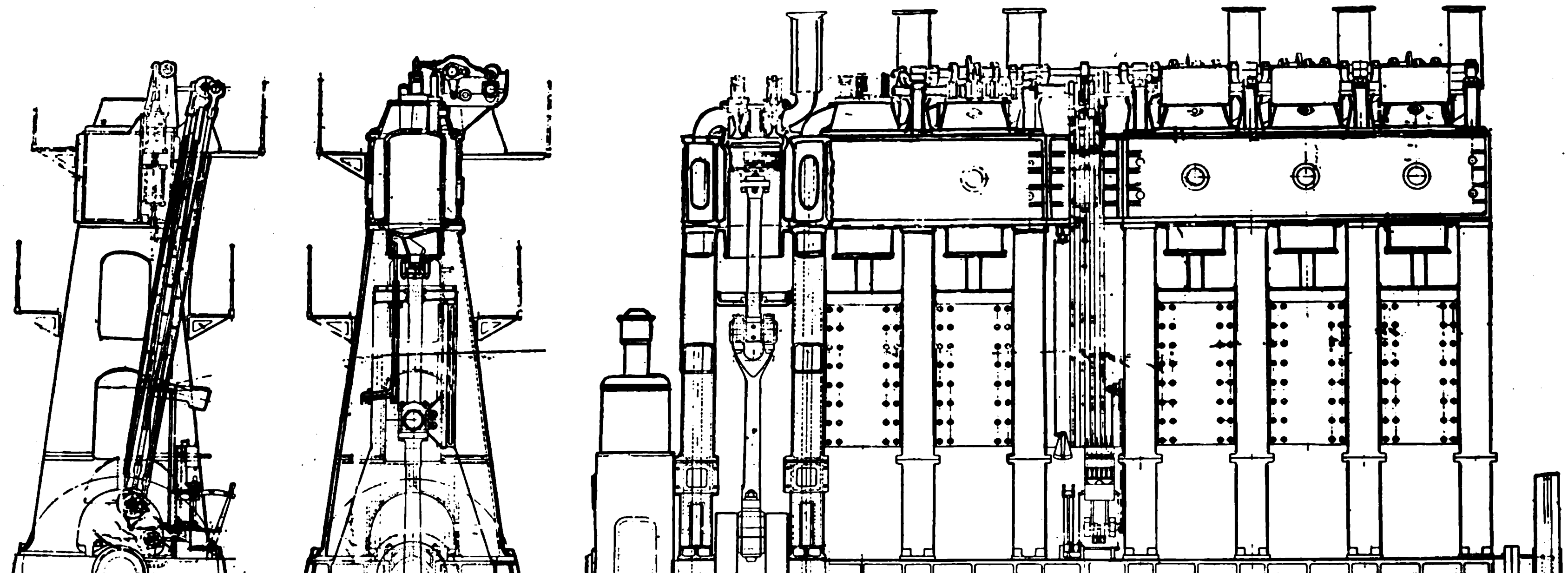
Constructional work on the 2,000 i.h.p. Werkspoor-Diesel marine-engine is being pushed forward by the New York Shipbuilding Corporation at their Camden plant, many of the parts such as piston-rods, connecting-rods, piston-bearings, etc. being already machined, while the big castings such as cylinder-box, cylinders, bed-plate are in the machine shop and will shortly be on the machine-tools.

The upper part of the engine will follow Werkspoor design, which includes the cylinder-box, mushroom-cylinders with integral head; diagonal eccentric valve reversing mechanism, with the long strutted-rods for operating the single camshaft, offset-fuel-valves, and detachable cylinder extensions. The bed-plate will be of similar but heavier construction.

However, the long steel columns and diagonal tie-rods so familiar to Werkspoor practice have been replaced by cast-iron frames which run from steel tie-rods running from the top of the cylinder-box to the bed-plate. There are also steel tie-rods running from the top of the cylinder-box down to the underside of the bed-plate. As forced lubrication is being used, the spaces between the frames will be enclosed by removable metal-plates allowing easy access. The New York designers favor the cast-iron frame and the steel column construction equally well from an engineering standpoint but consider the frames perhaps better conform to American merchant-marine practice.

NAMES OF MOTORSHIPS FOR TANKERS LTD.

The names of the four Diesel-driven 10,050 tons d.w.c. tankers now building by Vickers, Ltd., for Tankers, Ltd., are "Scottish Standard," "Scottish Maiden," "Scottish Minstrel" and "Scottish Musician."



General arrangements of the New York-Werkspoor Diesel marine-engine now under construction at the New York Shipbuilding Corporation's plant at Camden, N. J. Some minor modifications not shown on the drawing are being made

New Nobel 2,000 i.h.p. Diesel Marine Engine

First Details of Slow-speed Two-cycle Single-acting Crosshead Engine Which Shows Considerable Saving in Weight and Space Over Other Designs, with Fuel-consumption as Low as Leading Four-cycle Diesel Engines

By* EDVIN LUNDGREN, M.E.

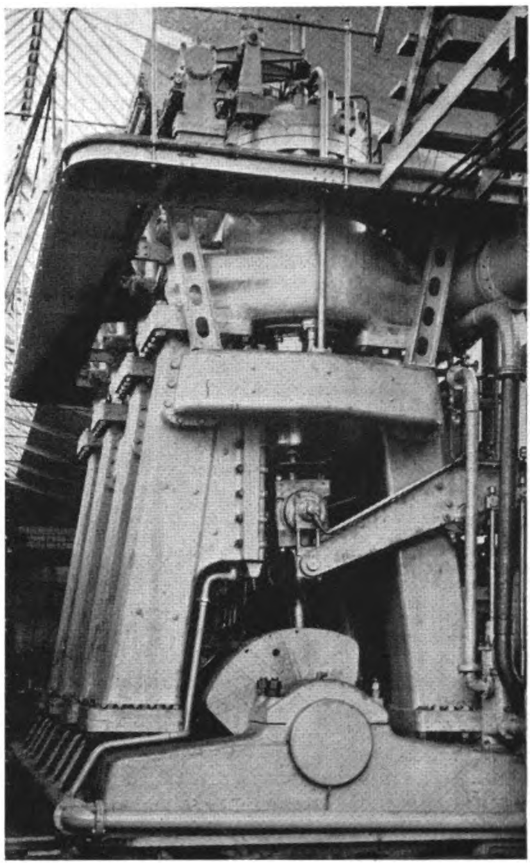
IN these days, when engineering and technical science have reached such a high degree of perfection, the opinion is often expressed that a stage has now been reached where further development along many lines is hardly possible or that further advances are comparatively unimportant. Indeed it must be admitted that progress in most branches really is of less magnitude than formerly, and it is also recognized that each step forward now requires considerably more headwork and study than in former times. And yet, every day we witness some advances in nearly every line, sometimes very striking advances, embodying new ideas, often of an almost freaky nature, sometimes the improvements are hardly perceivable to the superficial observer.

Also the Diesel-engine has during the last few years shown some remarkable progress and development. Some of this progress involved more radical changes and daring features, like for instance the English opposed-piston engines and the various airless-injection engines. Others have worked along more conservative lines, concentrating their efforts to improve the efficiency of existing elements and principles.

Among this latter group the new Nobel-Diesel engine may be classed, although it also shows a number of distinctly original and ingenious new features, the majority of which are covered by patents. The designers of this engine desired in the first place to produce a perfectly reliable and mechanically simple engine which should attain the highest degree of economy. Besides their aim was an engine which occupied a minimum of space for its power and the weight of which was to be kept within very reasonable limits.

Now, the first question which has to be decided upon by any designer who is to construct a new engine concerns the fundamental working principle. Is the engine to work according to the 2-stroke or the 4-stroke cycle? The issue is an old one and has been discussed over and over again, so it sometimes may seem tiresome to treat the subject once more, and yet every Diesel-engine builder must from time to time reconsider the question, face it squarely and decide for the one or the other.

Theoretically, no doubt, the 2-cycle is superior, as will be admitted by all who have studied the matter. In practice the inherent advantages of the 2-cycle are not always attained. As often pointed out, the difficulties to be overcome in designing a 2-cycle engine are far greater and require more experience and engineering skill than the comparatively simple 4-cycle problem. The Nobel-Diesel Company had the advantage of an extensive experience with both the 4-cycle as the 2-cycle, but has come to the firm conviction that the latter is decidedly superior and that it offers the greatest possibilities for the future, especially for the larger sizes.



End view of Nobel engine showing heavy cast-iron A-type columns and balance weight on crank-shaft

The new Nobel-Diesel engine is therefore a 2-cycle engine, and without enumerating all the well-known theoretical advantages of the 2-cycle and discussing their value, it shall here merely be referred to the actual performance of the engine which plainly proves that all these theoretical advantages can fully be obtained by a rational and scientific design.

The most outstanding feats and features of the engine may be summed up as follows:

Rating, Speed and Weight: With a rated capacity of 1,600 brake horse-power or 2,000 indicated horse-power at a speed of 106 revolutions per minute this Nobel-Diesel engine weighs, including a 13-ton flywheel, scavenging pumps, air-compressors, etc., but *170 tons or 236 lbs.* per B.H.P.

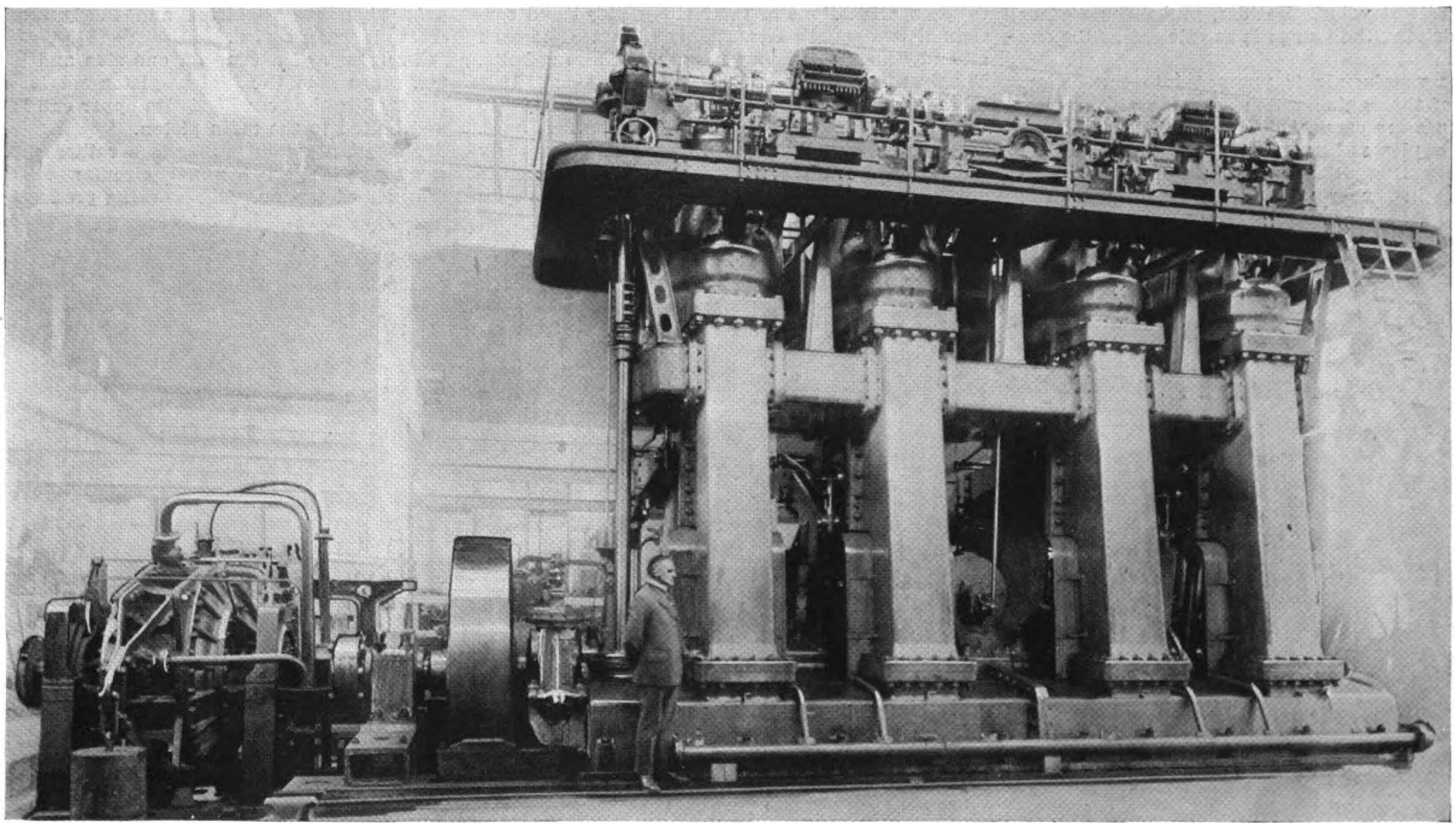
Overall Dimensions: The total length of the engine is 7.8 meters or 25 ft. 7 in.; its height above the center of the shaft to the top of the fuel value is 5.9 m. or 19 ft. 4 in. The meaning of these figures will be fully realized by a glance at the illustration, showing in shaded lines the contours of the Nobel-Diesel engine in comparison to a 4-cycle engine of a very prominent make, which is developing approximately the same power at the same speed.

Fuel Consumption: At full-load the fuel-consumption of the engine is *0.395* lb. of oil per B.H.P. hour with a heating value of 9,960 calories per kg. or *17,900 B.T.U.* per lb. That is exactly as favorable as the fuel-consumption of a good 4-cycle engine. At lighter loads the fuel consumption of this engine is considerably less than that of any 4-cycle engine.

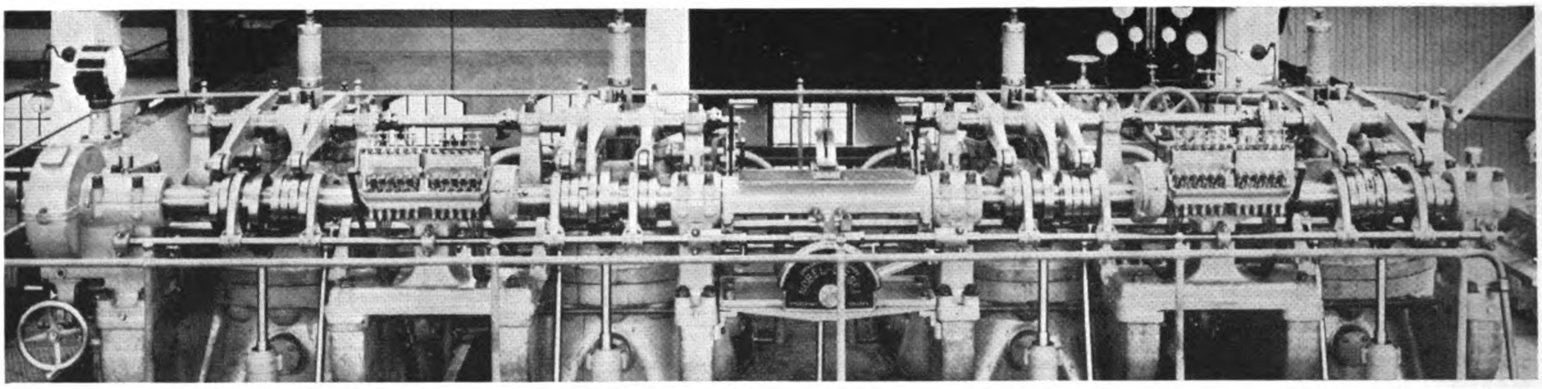
Mean-Indicated Pressure: At the rated load the M.I.P. is 6.48 at or 92 lbs.

Mechanical Efficiency: At full load the mechanical efficiency is *81%*. At 10% overload the mechanical efficiency is *82.3%*.

Overload Capacity: The heaviest overload so



General view of 2,000 i.h.p. Nobel two-cycle type Diesel marine engine on test bed showing Froude dynamometers used for recording power tests



View of valve gear and operating platform of Nobel marine engine

far carried is 22%, the engine developing 1,958 B.H.P. at 108 r.p.m. continuously during a period of ¾ of an hour without any trouble whatever.

The accompanying test chart of the official tests reveal further data of general interest to be referred to later.

The *fundamental working principle* of the engine is that of the ordinary 2-cycle engine with scavenging-ports in the cylinder walls and with scavenging-pumps, except that the scavenging-air is controlled by valves. Moreover, the scavenging-ports possess a greater height than the exhaust-ports in order to make supercharging possible.

As will be seen from the various illustrations, the mechanical construction is principally following conservative standard marine practice. The open A-frames with the one-sided cross-head slipper, the manner in which the frames are bolted to the bedplate as well as to the cylinders, the links and rocker-arms which serve to actuate the scavenging-pumps, the air-compressors and circulating-pumps, all these details and, in general, the convenient accessibility, so valued by marine engineers, remind one of standard marine steam-engine construction.

General Arrangement: The engine has four working-cylinders, each resting upon the two cast-iron columns composing one A-frame. Rocker-arms, connected to the crossheads, drive in the following order, the combined low and high pressure stages of the injection-air compressor, the two scavenging-pumps and the intermediate stage of the air-compressor. All this machinery is supported by brackets fastened to the bedplate directly opposite to the frames. This arrangement was chosen, as it, in the first place, utilizes the available space in the best manner, particularly in the longitudinal direction of the ship which is of the greatest value. Besides, probably no other way of driving the pumps is as efficient as the one used.

The scavenging-air is pumped into the hollow frames of the engine which serve as air-receiver. The frames are connected to each other by means of distance pieces of sufficiently large cross section.

The operating platform is arranged near the top of the engine, where all vital parts for operating and maneuvering are within easy reach of the engineer. If it should be preferred to have the operators stand on the main floor, no doubt this could be accomplished, but would require some additional and more or less complicated gearing.

Main Dimensions:

Working Cylinders:
- Diameter .... 675 m.m. (26.574 in.)
- Stroke .... 920 m.m. (36.200 in.)

Scavenging-Air Pumps, double-acting:
- Diameter .... 920 m.m. (36¼ in.)
- Stroke .... 680 m.m. (26¾ in.)
- Diameter of plunger guide .... 200 m.m. (7⅞ in.)

Air-Compressor:
- Diameters of the three stages 540, 250 and 110 m.m. (22¼ in., 9⅞in. and 4 $\frac{5}{16}$in.)
- Stroke for all three stages .... 570 m.m. (22½ in.)

Water Pumps, single-acting:
2 pumps for cooling cylinders, etc:
- Diameter x Stroke .... 125 x 360 m.m (5 in. x 14 in.)

2 pumps for general service, bilge, etc.:
- Diameter x Stroke .... 125 x 360 m.m. (5 in. x 14 in.)

Circulating pump for pistons
- Diameter x Stroke .... 125 x 160 m.m. (5 in. x 6¼ in.)

Crank-Pin:
- Diameter x Length .... 400 x 480 m.m. (15¾ in. x 19 in.)

Main-Bearing:
- Diameter x Length of Journal 400 x 690 m.m. (15¾ in. x 27¼ in.)

Turning now to the mechanical details of the construction, we find the engine resting on a solid *cast-iron bedplate* composed of two sections, firmly bolted to each other. The bedplate is completely closed-in at the bottom, in order to collect the used lubricating-oil which is to be filtered and used over again. The main-bearings are of the customary type for Diesel-engines and provided with babbitted bearing-shells, which may be removed from their seat by turning them around the crankshaft. The lubrication of the bearings is accomplished by gravity feed, instead of by forced lubrication, as is the standard practice in America.

The crank-shaft, weighing approximately 13 ton, is like all the other details made to conform to the specifications of the British Lloyd and consists of two equal parts, rigidly connected to each other by means of heavy flanges and strong bolts. The first two cranks are placed at an angle of 180° to each other, the following two also at 180° to each other but at an angle of 90° to the first ones. The engine is well balanced by means of properly dimensioned counterweights, bolted to some of the crank-arms. Any free forces or rocking couples are thereby reduced to a minimum. The lubrication of the crank-pin is effected by centrifugal rings. On account of the arrangement of the cranks the ignition in the cylinders takes place in the following order, 1, 3, 2, 4, and the turning effort is quite uniform, but a fly-wheel, weighing 13 tons and having a diameter of 2,500 MM. (8 ft. 3 in.)., serves to make the rotating speed still more uniform. The fly-wheel is figured for a speed fluctuation coefficient of 1/30.

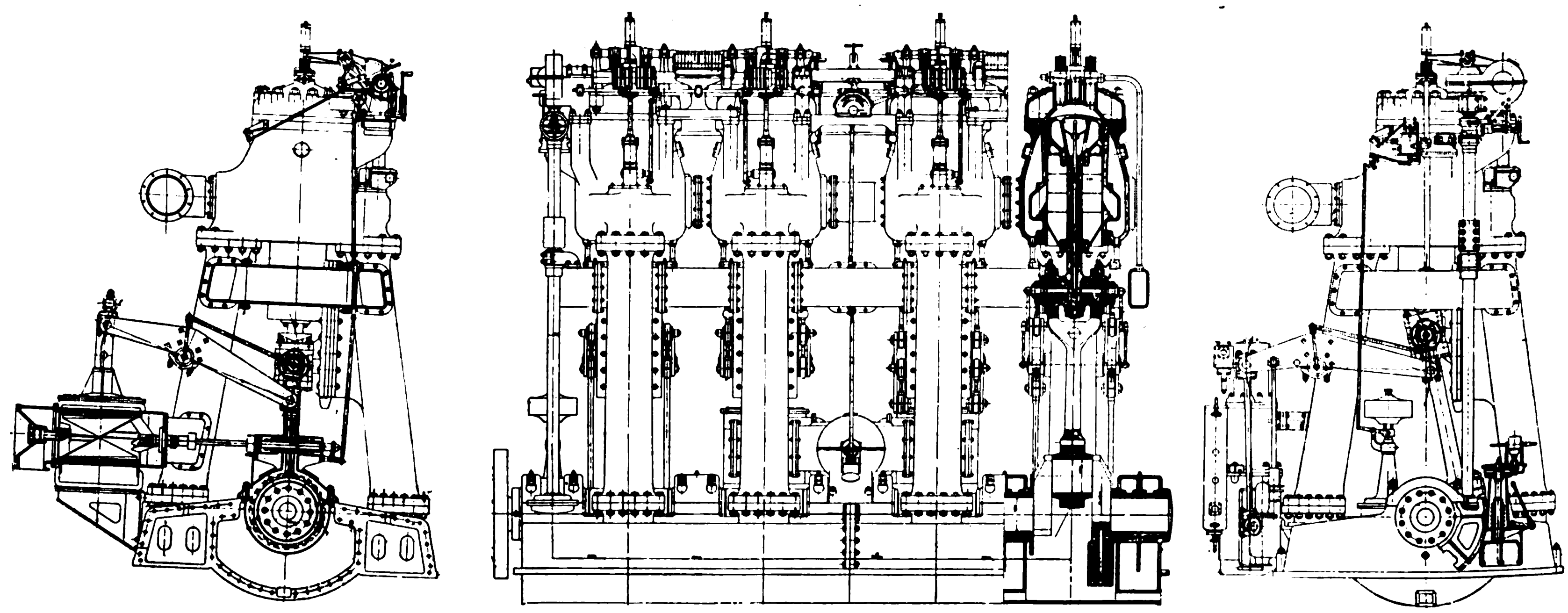
On the rear end of the crank-shaft, between the fly-wheel and the end main-bearing of the engine, a fairly large worm-gear is mounted for the purpose of slowly turning or "barring" the engine. The worm meshing with the gear is supported on a slide which by means of a handle can be moved easily, thus throwing in or disengaging the worm at will. The wormshaft is driven by a pair of spur-gears from an ordinary small pneumatic motor as commonly used for drill tools.

The connecting-rods are of standard design and made of open-hearth steel with a tensile strength of 70,000 lbs. per sq. inch and an elongation of 33%. The lower heads consist of two symmetrical steel castings with babbit lining and are held together by a solid-steel strap and two bolts. The upper ends are of the forked type but otherwise of similar design as the lower head. The forked type was chosen as with the same the piston can be brought closer to the crosshead, which contributes to reduce the height of the engine.

The cross-head consists of two separate main parts, the central piece, the two ends of which form the crosshead-pin, and the cast-steel shoe, which is bolted to the central piece. The crosshead shoe is guided between the main sliding-surface fastened to the A-frame and the guide-bars on either side. The wearing surfaces of the crosshead shoe are babbitted and the guide on the frame is water-cooled.

By means of a cone on one side and a nut on the other side the hollow piston-rod is securely fastened to the crosshead. Its upper end is flanged and bolted to the main piston.

The main piston proper is a rather short iron-casting with an internal circular rib to the crowned piston-top. The working pressure is thus



Sectional view showing arrangement of operating scavenging pumps and rotary valve; longitudinal elevation and section through cylinder; end view showing vertical shaft operating camshaft drawings of the Nobel 2,000 i.h.p. Diesel marine-engine

transferred in the most direct way to the piston-rod. Below the proper piston a light cast-iron sleeve is attached to another flange on the piston-rod. The only object of this piston sleeve is to keep the ports in the cylinder walls covered during the upward stroke of the piston. On its downward stroke this sleeve extrudes almost entirely out of the cylinder so that its surfaces may conveniently be inspected with regard to lubrication.

Through swinging-pipes the cooling-water is admitted to the central hole in the crosshead, whence it travels through the piston-rod to the piston and returns through a pipe in the interior of the piston-rod, to be carried away by swinging-pipes from the opposite end of the crosshead pin. The arrangement is as simple as it can be and perfectly reliable; not a drop of water can leak out, and consequently salt-water can be used without any risk of spoiling the lubricating-oil.

The most vital part of the engine is the cylinder, as it "embodies the lungs of the engine," namely the arrangements for exhausting and scavenging. The inner liner is made of special close-grained cast-iron and with a mild shrink-fit inserted into the outer jacket. The parts of the liner surrounding the exhaust-ports are provided with drilled vertical holes in order to secure a most effective water cooling. The exhaust-pipe, connecting all four cylinders, is of course also water cooled. An extension to the cylinder on the opposite side carries the piston-valve which prevents the exhaust-gases entering here and which controls the scavenging-air. This valve is actuated by a pushrod from a cam on the layshaft above. The scavenging-air enters from below, leaving the hollow *frame casting* which as already mentioned serves as air-receiver. The frame castings are otherwise very simple castings which transfer the stresses from the bedplate to the cylinder in the most direct and straightest way. There are a number of patented features about the cylinder, one of the mcovering a remarkably simple, but very efficient, method of cooling the upper joint between liner and water jacket. This joint is exposed to the very high internal-combustion heat and its cooling is therefore in all Diesel-engines of great importance, but possibly particularly so in 2-cycle engines where the amount of heat to be carried away is larger than in a 4-cycle of the same dimensions.

The cylinder head is an extremely simple and perfectly symmetrical steel casting, provided with ample water spaces. The reliability and safety of simple castings are too well known to builders and users of Diesel-engines to be discussed further. In its center the cover carries a *fuel-valve* of standard design, on one side the *air starting-valve* is arranged; on the other side is the compression relief-valve, which is combined with the safety-valve, and which relieves the compression in order to facilitate starting. The air which during starting is compressed in the working cylinders is not permitted to go to waste, but escapes into the air receiver and intermingles with the scavenging-air. This addition to the scavenging-air is very valuable, especially since it takes place in the beginning of the operation, before the scavenging pumps have been able to fill the receiver with air of the required pressure. On this account there is absolutely no trouble met in starting the engine. Even if the engine is perfectly cold, it can at any time be started within a few seconds, although the air pressure may be as low as 100 lbs. sq. inch. In order to prove this and also to determine the amount of air consumed for starting, a series of tests was conducted, the results of two of which are as follows:

Volume of air tank................2 cbmeter. (70.6 cubic feet)

	Test n:r 1	Test n:r 2
Barometric pressure	753 m.m. Hg.	770 m.m. Hg.
Condition of engine	cold	cold
Temperature in engine-room	19°C. (66°F.)	13°C. (55°F.)
Air-pressure in tank before starting	21.3 at 304 lbs.	7 at 99.6 lbs.
Air-pressure in tank after starting	18.7 at 267 lbs.	5 at 71.2 lbs.
Pressure-drop during starting	2.6 at 37 lbs.	2 at 28.4 lbs.
Air consumption reduced to atmospheric pressure	5.2 cbm. (183 cub. ft.)	4 cbm. (141 cub. ft.)
Time used for starting	2½ seconds	6 seconds
Number of cylinders, to which starting air was admitted	2	4

As indicated above, easy starting is made possible by relieving the compression and thereby decreasing the initial resistance, and also because, as soon as the relief-valve is kept closed, the cylinder is filled with sufficient air to insure a high compression and with it a regular ignition. This point has been dwelt upon explicitly, as it often has been stated that some 2-cycle engines have to be heated before starting. A similar statement has for instance been made by J. Anderson in the transactions of the American Society of Mechanical Engineers with regard to the U.S.S. "Maumee."

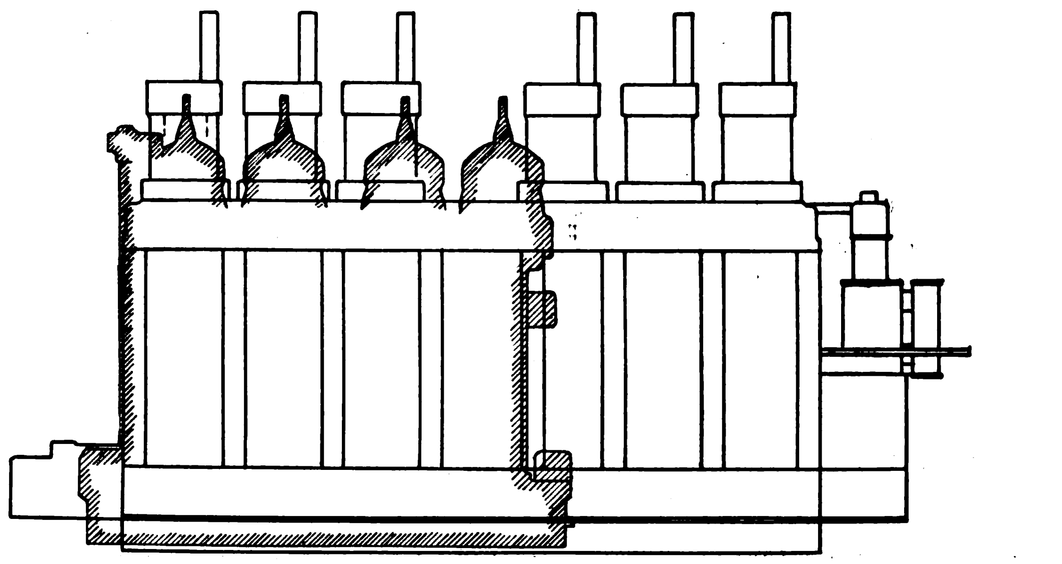
Valve-gear.—All valves are actuated by means of cast-steel rocker-arms, the fulcrum of which is formed by eccentric shafts, one for each cylinder supported in bearings fastened on the cylinder-heads. These eccentric shafts are flexibly connected in pairs, each pair can be turned by means of a lever, conveniently arranged near the center of the engine and provided with a latch which locks the lever in one of the three positions determined by notches on a segment. Thus by turning the lever either the rollers of the starting and the relief-valves or the roller of the fuel valve are brought into contact with their corresponding cams or both are brought into a neutral position entirely out of reach of these cams. For each valve there are two cams, one for ahead, the other one for astern. All cams are keyed to sleeves which by means of a rod with fingers or forks can be shifted on the cam-shaft. At the first glance the whole arrangement may look somewhat complicated, but it is to be remembered that normally during actual service only one cam and one valve, namely, the fuel valve, is active.

It will be observed that the camshaft is driven by means of an intermediate vertical-shaft and two sets of spiral gears. From this vertical shaft also the fuel-pump or rather the four fuel-pumps which are united in one casting are driven by one single eccentric. If desired, however, this drive can be disengaged and the fuel-pumps may be driven by hand as for instance in order to fill the piping with oil before starting. The amount of fuel delivered to each cylinder is as usual in Diesel engines controlled by lifting the suction-valves of the pumps. This is either accomplished by hand, by means of a system of levers and rods, or automatically by the action of a Jahns centrifugal governor. which cuts off the fuel supply entirely as soon as the engine obtains a speed of 130 r.p.m. and thus prevents racing. This governor is located just opposite to the vertical shaft and is driven by a set of spiral gears from the crankshaft.

The rocker-arms which drive the scavenging-pumps and the air-compressor have been designed with the view of facilitating easy and exact adjustment and assembling. Any undesirable play that continuous wear may be liable to produce can easily be taken up.

The proper arrangement and design of the scavenging-pumps are of the highest importance for the efficiency of the whole engine. Also this construction is guarded by a number of patents. The pumps are double-acting. The valve-gearing is of a remarkable simplicity, as there is only one single rotary-valve for both suction and pressure of both ends of both scavenge pumps. This valve is located in the center of the engine length transversely to the crank-shaft from which it receives its motion by means of a pair of spiral gears. It runs with only one-third of the engine speed and is therefore consuming but a slight amount of power.

Besides the pressure of the scavenging-air is kept exceedingly low; at full load and full speed it only amounts to 1.6 lbs. sq. inch. All these factors contribute to reduce the work expended for



Comparison of the Nobel 2,000 i.h.p. (1,600 shaft h.p.) at 106 r.p.m. with standardized four-cycle Diesel marine engine of the same power and speed

Nr of Test		1	2	3	4	*)5	7	8	9	10	11	12	12a	12b	12c	13	14
Date		23/8. 10.30–3.45 continual run					24/8. 3.10–5.30			19/9. 3.00 a.m. ... 4/9. 3.04 a.m. continual run 24 hours.							19/9
Revs pr min.	n	87.3	84.7	85.0	87.6	64.3	65.2	65.9	45.2	106.6	106.0	107.0	105.3	105.8	105.6	105.1	108.4
Brake load kg.	P	1669	2060	2612	2999	2600	2062	1578	1492	1600	2100	2750	2750	2750	2750	3000	3250
Brake-horsepower	N_e	810	970	1232	1456	930	746	578	375	948	1237	1635	1610	1615	1612	1752	1958
Eff. meanpressure kg/cm²	p_e	3.18	3.92	4.98	5.72	4.98	3.92	3.01	2.84	3.05	4.00	5.23	5.23	5.23	5.23	5.72	6.20
Working cylinders: Ind. meanpressure kg/cm²	p_i	4.45	5.20	6.38	6.98	6.07	5.09	4.00	3.85	4.30	5.24	6.47	—	—	6.48	6.94	7.58
Working cylinders: Ind. horsepower	N_i	1137	1290	1582	1797	1142	970	770	496	1342	1623	2022	—	—	2000	2128	2401
No load	$N_i - N_e$	327	320	350	341	212	224	192	121	394	386	387	—	—	388	376	443
Mechanical efficiency $\frac{N_e}{N_i}$	η_m%	71.3	75.2	77.8	81.2	81.4	76.9	75.0	75.4	70.6	76.2	81.0	—	—	80.5	82.3	81.7
" " $\frac{N_e}{N_i-(N_{isp}+N_{ik})}$	η_m%	81.4	84.1	85.8	89.5	89.9	86.4	85.5	86.4	81.1	85.5	89.8	—	—	—	90.2	89.6
Thermic "	η_i%	48.4	46.0	44.6	42.2	42.0	45.9	46.3	44.5	47.6	45.4	42.7	—	—	43.0	42.1	40.6
Thermodyn. " $\eta_e = \eta_m \cdot \eta_i$	η_e%	34.4	34.5	34.7	34.2	34.9	35.3	34.6	33.7	33.7	34.7	34.6	35.2	35.5	35.4	34.8	33.1
Fuel consumption pr hour kg	G	149	178	225	270	169	134	105.6	70.8	179	226.6	300	290	288.6	289	320	375
Fuel pr ind. HP-hour gr.	g_i	131.1	138.0	142.2	150.2	148.2	138.2	136.9	142.4	133.2	139.6	148.5	—	—	144.6	150.5	156
Fuel pr BHP-hour gr.	g_e	184	183.6	182.6	185.5	182.0	179.6	182.8	188.0	188.0	183.0	183.7	180.0	178.5	179.0	182.5	191.4
Scav. pumps: Ind. meanpressure	p_{isp}	0.155	0.150	0.156	0.160	0.100	0.110	0.100	0.066	0.180	0.180	0.180	—	—	—	0.175	0.190
Scav. pumps: Ind. horsepower	N_{isp}	52.8	49.6	52.4	55.6	25.3	27.6	25.3	11.7	75.3	74.9	76.0	—	—	—	72.3	81.5
Air-compressor: Pressure	E	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Air-compressor: Meanpressure	p_{ik}	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	—	—	[illegible]	—
Air-compressor: Horsepower	N_{ik}	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	—	—	[illegible]	—
Air-compressor: Total Horsepower	ΣN_{ik}	80.6	85.7	94.4	100.2	74.6	79.7	69.1	50.9	98.8	104.3	111.9	—	—	—	114.8	133.7
Scav air-pressure mm water	sp	830	825	850	950	510	500	540	320	1100	1100	1145	1120	1180	1110	1115	1280
Temperature of exhaustgases C°	T°	188	224	275	318	260	195	163	136	201	244	315	309	307	306	334	352
" " inlet air	t_0	21	23	24	22.5	22	22	21	21	19	18.5	18	17	17	17.5	18.5	14
" in airreceiver	t_{sp}	30	32	33	32	27	26	26	25	32	31	31	30	30	30	31	27
" of water inlet		18	18	18	18	18	18.5	19	—	14.5	14.5	14	14	14	14	14	—
" " " outlet fr. pistons		30	33	39	41.5	34	30	27	28.5	26	28	32	32	32	32	32	—
" " " " " cylinders		26	28	31	33	34	30	28	29	24	25	28	28	28	28	28	—
" " " " " common		—	—	—	—	—	30	29	30	25	27	30	30	30	30	30	—

*) Test Nr 5 was intended to be made with P=3000 kg and n=55, but the brake-load could on account of the brake be only 2600 kgs at this speed. Test Nr 5 thus being eliminated.

General remarks.

Length of Brake-arm [illegible]

Brake horsepower $N_e = \frac{P n}{[illegible]}$ HP

Test Nr	1-13	14
Fuel:	Solarol	Texaco
Sp. gravity	0.86	0.855
Lower cal. value cal. pr kg	9960	9990
Flash-point	+74°C	+78°C

Official test of Nobel engine made under supervision of A. Rosborg of Stockholm

the scavenging pumps to a minimum. At full load and normal speed it amounts to only 3.5% of the total indicated horse-power of the engine. Such a low figure can hardly be obtained with an independent drive of the scavenging-pumps, so appealing and simple this manner of driving at the first glance may appear.

Another advantage of the low-pressure is that artificial cooling of the air can be dispensed with, the rise of temperature at full load only amounting to 10-12° C. or 18-21° F.

The necessary air for the fuel-injection is furnished by the three-stage compressor of which the low and high pressure stages are combined in one casting, while the intermediate-stage cylinder is located separately at the other end of the engine. The valves are of the standard Nobel design with simple steel disks which have shown their reliability since a large number of years. All compressor cylinders are provided with safety-valves of sufficient sizes.

Lubrication of the compressors as well of the working cylinders, crosshead-guides and crosshead pins is effected by the two lubricating-pumps with sight feed.

Cooling water is furnished by several pumps driven from the rocker arms: Two circulating pumps deliver water to the cylinders, one separate pump supplies the pistons with cooling-water and besides there are two pumps for general purposes, *i. e.*, bilge-pump, etc.

After all important mechanical details have been touched upon, a few remarks about the operation and maneuvering of the engine may be of interest. Following the natural order, the first operation to be described is:

Starting.—After having made sure that the fuel piping is filled with oil and that there is sufficient compressed-air in the air-tank, the operator turns the above mentioned eccentric-fulcrum shafts by means of the turning levers into the starting position. As explained before, thereby the rollers of the starting valve and of the relief valve are brought into contact with their corresponding cams and at least one of the starting-valves will immediately open and admit air to its cylinder. The air pressure sets the engine into motion, and after one or two revolutions, as soon as the engine has received sufficient momentum, the engineer throws the turning levers into the normal running position which sets the starting and the relief-valves idle and puts the fuel valve into service. Regular ignitions occur immediately. The starting is normally accomplished within two or three seconds.

As a minor detail although causing considerable convenience a separate air-valve may be mentioned which is placed near the turning lever and controls the air supply, opening only when the operating lever is shifted into starting position, and automatically and reliably shutting-off the air as soon as this lever is moved over into the neutral or the normal running position. This arrangement prevents air losses in case the starting-valve may leak, which easily may occur during continuous or frequent maneuvering.

Speed Control.—During service the engine speed is controlled by the little lever in front of the operator. This lever moves in a slot, the edges of which are graduated and influences the fuel supply by acting upon the suction-valves of the fuel-pumps. In this way the engine can be slowed down as far as you please. On the test-bed the engine has been running for hours at a speed of 28 revolutions per minute, without showing the slightest irregularity or missing a single ignition in any of the four cylinders. The compression in the cylinder is at this speed 27 atmos (38.5 lbs) and the pressure in the scavenging-air receiver but 0.21 lb. The pressure of the injection-air at this speed is 30 atmos (430 lbs.), that is only slightly higher than the compression in the cylinder. It may be added that at normal speed the compression is 430 lbs., the scavenging pressure 1.6 lbs. and the injection-air pressure 60 atmos (860 lbs.).

It is even possible to stop the engine entirely by the small speed regulating lever, but it is preferred to move the turning levers of the eccentric valve shafts into neutral position whereby the fuel-pumps are cut out automatically.

Reversing.—Suppose now, the engine is running full-speed ahead, suddenly the signal is given: Full speed astern! The engineer then throws the two turning levers into their neutral position, turns thereafter the reversing lever from the ahead position at the right to the astern position to the left. He then starts the engine again as described above, and the engine will run in the opposite direction. The reversing is easily accomplished within eight seconds without any considerable effort by the engineer.

The most remarkable and appealing feature is that it is accomplished merely manually, without any servomotor or outside source of power.

It requires more than eight seconds to explain what is occurring when the engineer acts as ust described: First, by bringing the eccentric-shafts into neutral position, the fuel-valves are put out of motion and the fuel-pumps are cut-out; thereby the engine is brought to a standstill after a few revolutions. By turning the reversing lever, in the first place, by means of a gear segment and a rack, the camshifting rod is moved which in its turn brings the cams for the reverse rotation into their proper position. Simultaneously, by a system of levers and rods, the scavenging-air controlling valves are brought into their correct position for the reverse, whereupon the starting can be effected in the usual way.

The various levers are mechanically interlocked, so that it is impossible to move the reversinglever and shifting-rod, unless both eccentric turning levers are in their neutral position and on the other hand none of these levers can be moved, unless the reversing-levers and with it the other parts, cams and valves are in their proper position either for forward or for astern running.

Official Tests.—Under the supervision and control of Professor A. Rosborg of the Technical University of Stockholm a series of very thorough tests were conducted during August and September of this year. The principal results of these tests are compiled in the accompanying test chart, which gives some very valuable information and data. Information of this kind is seldom to be had, as most manufacturers prefer to keep it for themselves, and I wish at this occasion to thank the Nobel-Diesel Company for allowing me to use this material for publicity. I am convinced that it will be appreciated by all who are interested in the progress and development of the Diesel-engine.

During the tests the brake-load was furnished by a Heenan & Froude hydraulic brake n:r LS 11. The brake-lever was 3,987 mm. long and if P is the weight at the end of this lever and N the number of revolutions per minute, the brake horse-power in metric horsepower is $Ne = \frac{Pn}{180}$. Brake and weights were of course carefully checked.

Engine-speed was measured by tachometers as well as by ordinary revolution counters, from the readings of which the exact number of revolutions per minute during each test were computed. Indicator cards were taken of all working-cylinders and also of the scavenging air-pumps and the air-compressors. Pressure on space prevents "Motorship" publishing a set of indicator-cards in this issue. All indicator-springs were carefully checked.

The fuel oil consumption was measured by placing the oil tank on a sensitive balance scale. The time during which a certain quantity, say 500, 100 or 200 kg., at a certain constant load was consumed, was exactly determined with a chronograph. The oil was sampled and its heating-value determined by the Government's testing station. Its effective heating-value was found to be 9,960 calories per kilogram of 17,900 B.T.U. Its flash point was 74° C. or 165° F. and its specific gravity 0.86.

The lubricating-oil consumption amounted during the tests only to 4.6 lbs. per 1,000 B.H.P. hour. It must be remembered, however, that the engine, like all new engines on the test bed, was freely oiled.

Further the temperatures of the incoming and the discharged scavenging air were measured, as also the temperatures of the cooling-water and of the exhaust gases. The latter were analyzed by an Orsat apparatus and their composition at full-load was found to be the following:

CO_2	4.75%
O	14.4 %
CO	0.1 %
N	80.75%
	100

The analysis thus indicated a good combustion which was confirmed by the appearance of the exhaust gases, the same being practically colorless at normal load and barely perceptible at overload.

To subject the engine to a thorough trial, at first a number of tests were made at various loads and speeds, thereafter a series of manoeuvering trials were carried out and finally the engine was run for 24 hours at full load and full speed. At the end of this run all parts were in excellent condition, the warmest bearing having a temperature of 45° C. or 113° F.

In the next issue "Motorship" will give some results of the tests in graphical form which, as usual, gives a clearer conception than tables.

Furthermore, some very interesting relations between power, fuel consumption, mechanical efficiency and the temperatures of the exhaust gases are shown. Special attention is called to the curves for the fuel consumption and the mechanical efficiency, not only on account of the absolute values but also as they strikingly demonstrate the extraordinarily high mechanical efficiency and the remarkably low fuel consumption of the engine at light loads. At half-load for instance the mechanical efficiency is above 70% and the fuel-consumption but 188 gram. B.H.P. or 0.42 lb. B.H.P. In this respect the engine is far superior to any 4-cycle engine. This condition makes also the engine very apt for certain stationary purposes where the engines often have to run under light loads. This superiority of the 2-cycle is ultimately founded in the fact that the working parts are utilized better than in a 4-cycle engine with its practically idle second revolution.

In conclusion the writer wishes to compliment the Nobel-Diesel Company upon its success and also upon its readiness to show and demonstrate the engine to all who are interested, even to competitors, which shows a high degree of quiet self-confidence. Finally the writer wishes to express his thanks and indebtedness to Director Ludwig Nobel and the company's chief-engineer, Mr. A. Lagersten, for their courtesy of placing all the above information and material at his disposal.

Nobel-Diesel High-Speed Engine of 1,320 Shaft H.P.

Details of the Motor Installed in Nine Russian Submarines

THE August number of "Motorship" contained an illustration of a big submarine engine built by the Nobel Works in Petrograd for the Russian Navy. This engine is remarkable for its size, as well as for a number of constructional details. As up to this time nothing has been published about this machine, a short description of the same might prove to be of general interest.

General Arrangement and Main Dimensions

Each submarine was provided with two engines with a capacity of 1,320 B.H.P. apiece at 350 r.p.m. Each engine consisted of eight working cylinders, two cylinder bushings or liners always being connected and inserted in a common water-jacket. The cylinders had a diameter of 390 mm. and the stroke was 430 mm. The engine worked on the two-cycle principle and the scavenging-air was admitted to the cylinder through ports in the cylinder walls and was controlled by a common piston-valve for each pair of cylinders.

Scavenging air was furnished by two double-acting scavenging-air pumps arranged ahead of the main cylinders and driven by cranks from the main shaft. The diameter of the pumps was 760 mm. and the stroke 430 mm. The upper parts of the scavenging-pumps formed the low pressure cylinder for the injection-air compressor, while the cylinders for the intermediate and the high-pressure stage were combined in one separate casting placed at the extreme end of the engine. Fuel-pumps, one for each cylinder, were arranged between the scavenging-pumps and the working-cylinders.

Constructional Details

The base plate was made of cast-iron, composed of three parts, entirely closed in the bottom, while the frame was of a comparatively light box-section, light because the working pressure was transferred from the main-bearings to the cylinders directly by means of heavy bolts, six bolts for each pair of cylinders, the bolts in the joint between two adjacent cylinder pairs serving both pairs. As a rule this type of frame makes a light engine, but from a manufacturing standpoint it is usually less desirable, as it necessitates thin-walls and complicated castings. The material was cast-iron.

Also the cylinders were made of cast-iron, and in the beginning the cylinder covers likewise. As, however, during the war it was difficult to obtain good pig-iron and coke in Russia, the raw materials for cast iron, some trouble was experienced with the covers of which a good many cracked: they were then made of cast-steel which proved satisfactory. The cover carried the fuel valve, the starting valve and the safety valve.

Water cooling of the pistons was at first effected by a system of telescopic-pipes, but later replaced by swinging-pipes. In order to obtain light reciprocating weights, the connecting-rods were made of nickel steel, heat-treated and of I-section. The crank-shaft was also made of nickel steel; it consisted of three parts and had altogether 11 crank-throws. While the first two were furnished before the war by an Austrian concern, the remaining ones were furnished by Vickers Ltd. of England and delivered via Archangelsk.

The camshaft was arranged at about middle height of the engine and driven by means of two pairs of spiral-gears and an intermediate vertical shaft. The valves were actuated by pushrods.

Engine Control

Originally it was intended to make the engine reversible, but later this was not considered necessary for the submarine. The operating platform, not shown in the picture, was arranged slightly above the top of the frame. Starting and speed regulating was effected from the rear end of the engine, by means of a hand-wheel, levers and rods which in the customary way acted upon the eccentric-fulcrum shaft of the rocker-arms for the air and the fuel valves and upon the fuel-pumps.

Fuel Consumption

When the engine was running at 350 revs. per min., the fuel consumption was 228 grams per brake horse-power, at 250 R.P.M. it decreased to 210 grams. While the engine was not as economical as other Nobel engines and some of the details possibly not quite as fortunately worked-out as on other machines, the engine represented a remarkable piece of work and the highest class of workmanship. Material as well as the work was conforming to the exceedingly rigid specifications of the Russian Naval Authorities, who also exercised a very strict inspection.

Eighteen such engines were delivered, but their fate is unknown: some of them may rest peacefully on the bottom of the Baltic Sea; other engines may have been destroyed in some different way, like so many other fine pieces of human work during the war. This is of course a regrettable loss, but the experience gained while carrying out the work is not wasted but is now utilized by the Nobel-Diesel Company in Sweden for peaceful purposes.

List of German Motorships (Fishing and Pleasure Craft not Included) Building or Completed Since January 1, 1919

I Motorships Completed

No.	Name	Yard	Owner	Dimensions (m) Reg. Tons Gross D. W. Cargo Capacity	Number and Power of Engines Speed	Number and Dimensions (m-m) of Cylinders	Type of Engines	Maker of Engines	Remarks
1.	Zoppot	Germania Werft, Fr. Krupp, Kiel	Balt. Amerik. Petrol. Imp. Ges., Danzig	160. 24 x 20. 27 x 12. 57 9930 R. T. 15,700 tons	2 x1750 B.H.P. 10.75 knots	6 x 575/1000	Diesel, 2-cycle	Germaniawerft, Fr. Krupp, Kiel	Oil tanker.
2. 3.	Ostpreussen Oberschlesien	Germania Werft, Fr. Krupp, Kiel	Hugo Stinnes, Hamburg	84. 12 x 12. 35 x 7. 15 2083 R. T. 3000 tons	2 x 700 B. H. P. 10 knots	6 x 450/420	Diesel 4-cycle	Maschinenfabrik, Augsburg Nürnberg	Oil tankers. Each ship made out of two submarine hulls. Engines formerly destined for submarines.
4.	Adolf Sommerfeld (ex-Gefion)	F. Schichau, Danzig	Danziger Hochund Tiefban Ges., Danzig	105. 25 x 13. 14 x 8. 87 2146 R. T. 3200 tons	2 x 900 B.H.P. 9.5 knots	6 x 450/420	Diesel 4-cycle	Maschinenfabrik, Augsburg Nürnberg	Engines formerly destined for submarines.
5.	Havelland	Blohm & Voss, Hamburg	Hamburg Amerika Linie	136.70 x 17.68 x 9.00 6500 R. T. 10,200 tons	2 x 1950 B.H.P. 12 knots	10 x 530/530	Diesel 4-cycle	Maschinenfabrik, Augsburg Nürnberg	Engines formerly destined for submarines.
6.	Götaelf	Störwerft, Wewelsfleth	Baltische Reederei, Hamburg	56.0 x 8.64 x 4.60 .... 800 tons	2 x 410 B.H.P. 9.5 knots	4 x 340/560	Diesel 2-cycle	Gebr. Sulzer, Mannheim	Ferro concrete hull.
7.	Erna David	Fleusburger Schiffsbau Gesellschaft	Leopold David, Berlin	56.59 x 7.33 x 5.59 588 R. T. 850 tons	2 x 300 B.H.P. 12 knots	6 x 350/350	Diesel 4-cycle	Vulkan Werke, Hamburg	Hulls built for torpedo-boats, shortened and reconstructed. Engines built for submarines. (Nos. 7–10)
8.	Kosmos, I	Hansa, A. G., Töuning	Kruels & Mais, Hamburg	56.55 x 7.70 x 5.49 623 R. T. 900 tons	2 x 300 B.H.P. 12 knots	6 x 350/350	Diesel 4-cycle	Vulkan Werke, Hamburg	
9.	Leopold David	H. C. Stülken, Hamburg	Leopold David Berlin	56.10 x 7.70 x 5.49 620 R. T. 900 tons	2 x 300 B.H.P. 12 knots	6 x 350/350	Diesel 4-cycle	Vulkan Werke, Hamburg	
10.	Wilbo	Hansa, A. G. Töuning	Wilhelm Boelster, Hamburg	56.10 x 7.70 x 5.49 623 R. T. 900 tons	2 x 300 B.H.P. 12 knots	6 x 350/350	Diesel 4-cycle	Vulkan Werke, Hamburg	
11. 12.	Hausdorf Hoisdorf	Howaldswerke A. G. Kiel	Baltische Reederei Hamburg	71.79 x 9.13 x 5.40 980 R. T. 1400 tons	1 x 410 B.H.P. 8.5 knots	4 x 340/540	Diesel 2-cycle	Gebr. Sulzer Ludwigshaven	Hulls built for mine-sweepers, heightened and reconstructed.
13.	Seewolf (ex Hyäne)	Reconstructed Ver. Elbe u. Norderwerft, Hamburg	Cuxhaven, Bruisbüttel Dampfer, A. G. Cuxhaven	43.54 x 7.65 x 4.10 352 R. T. 450 tons	1 x 225 B.H.P.	6 x 300/300	Diesel 4-cycle	Benz u. Co. Mannheim	Ship formerly naval vessel.
14.	Odin	Reconstructed Deutsche Werke Wilhelmshaven	Arnold Bernstein, Hamburg	79.10 x 15.45 x 6.00 1590 R. T. 2100 tons	2 x 260 B.H.P. 9 knots	6 x 350/350	Diesel 4 cycle	Maschinenfabrik, Augsburg Nürnberg	Ship formerly coastwise battleship. Engines built for submarines.

II Motorships Building

No.	Name	Yard	Owner	Dimensions (m) Reg. Tons Gross D. W. Cargo Capacity	Number and Power of Engines Speed	Number and Dimensions (m-m) of Cylinders	Type of Engines	Maker of Engines	Remarks
15. 16.	Rheinland	Blohm & Voss, Hamburg	Hamburg Amerika Linie	136.70 x 17.68 x 9.00 6500 B. R. T. 10,000 tons	2 x 1750 B.H.P. 12 knots	6 x 720/1300	Diesel 2-cycle	Blohm & Voss Hamburg	Tankers. (Nos. 15–33)
17.	....	Reiherstieg Schiffswerfte, Hamburg	Hamburg Südamerikan, D. G., Hamburg	....	2 x 2600 B.H.P.	....	Diesel 2-cycle	Gebr. Sulzer, Luwigshaven	
18. 19. 20.	....	Deutsche Werft Hamburg	Hamburg Amerika Linie, Hamburg	121.4 x 16.45 x 11.67 4500 R. T. 8000 tons	2 x 1160 B.H.P. 11 knots	6 x 630/960	Diesel 4-cycle	....	
21. 22.	....	Deutsche Werft Hamburg	....	114.3 x 15.70 x 8.63 3500 R. T. 6500 tons	2 x 1160 B.H.P. 11.5 knots	6 x 630/960	Diesel 4-cycle	....	
23. 24. 25.	....	Deutsche Werft Hamburg Deutsche Werft	....	.... 2800 R. T. 5500 tons	2 x 1160 B.H.P. 12 knots	6 x 630/960	Diesel 4-cycle	....	
26. 27.	....	Deutsche Werft Hamburg	Schindler Mineral Oil Works Hamburg	94 x 13.0 x 8.0 2300 R. T. 4000 tons	2 x 1160 B.H.P. 12 knots	6 x 630/960	Diesel 4-cycle	....	
28. 29.	....	Deutsche Werft Hamburg	D. D. S. G. Kosmos, Hamburg	121.4 x 16.45 x 11.67 4500 R. T. 8000 tons	2 x 1700 B.H.P.	......	Diesel 4-cycle	Deutsche Oil Maschrinen Ges.	
30.	Behrentels	T. C. Tecklenborg, Geestemunde	D. D. S. G. Hansa, Bremen	.... 6200 R. T. 9000 tons	2 x 1600 B.H.P. 12 knots	......	......	....	
31.	....	Howaldtwerke, Kiel	D. D. S. G. Hansa, Bremen	.... 6200 R. T. 9000 tons	2 x 1600 B.H.P. 12 knots	......	Diesel 2-cycle	Sulzer Freres Luwigshaven	
32.	....	A. G. Weser, Bremen	....	131.0 x 17.15 x 10.01 6200 R. T. 9000 tons	2 x 1600 B.H.P. 12 knots	6 x 700/1200	Diesel 4-cycle	Maschinenfabrik, Augsburg, Nürnberg and A. G. Weser	
33.	....	Vulcan Co. Stettin	Norddeutsche Lloyd Bremen	6,300 D. W. T.	1 x 1,800 B. H. P. 12 knots	......	Diesel 4-cycle	Vulcan Co. Hamburg	

III Motor Sailing Vessels Completed

1. Magdalene Vinnen	Germaniawerft, Fr. Krupp, Kiel	F. A. Vinnen, Bremen	97.90 x 14.60 x 8.72 3200 R. T. 5200 tons	1 x 500 e.H.P. 6 knots	4 x 575/1000	Diesel 4-cycle	Germaniawerft, Fr. Krupp, Kiel	Four masted full rigged vessel.
2. Annen	Germaniawerft, Fr. Krupp, Kiel.	Fr. Krupp, Essen						
3. Buckau	" "	"						
4. Datteln	" "	"						
5. Gaarden	" "	"	47.48 x 9.03 x 4.10 456 R. T. 635 tons	1 x 160 e.H.P. 6.5 knots	6 x 260/360	Diesel 4-cycle	Maschinenfabrik, Augsburg, Nürnberg	Engines built for submarines. 3 masted schooners.
6. Hannun	" "	"						
7. Kallisto	" "	"						
8. Christa	Germaniawerft, Fr. Krupp, Kiel	Marine Reederei, Lübeck		1 x 35 e.H.P. 6 knots	2 x 210/250	Crude-oil 2-cycle	Apenrader Motorenfabrik, Apenrade	
9. Baldur	" "	Fr. Krupp, Essen		1 x 35 e.H.P. 6 knots	2 x 210/250	" " "	Apenrader Motorenfabrik, Apenrade	
10. Wiking	" "	" "	27.92 x 6.29 x 3.09 125 R. T. 175 tons	1 x 35 e.H.P. 6 knots	2 x 210/250	" " "	Hanseat. Motorenfabrik, Bergedorf	Schooners.
11. Gustav Adolf	" "	A. H. Schwedersky, Meusel		1 x 50 e.H.P. 7 knots	2 x 250/290	" " "	Allgem. Elektr. Ges., Berlin	
12. Mary	" "	Atlantic Reederei, Hamburg		1 x 35 e.H.P. 6 knots	2 x 210/250	" " "	Apenrader Motorenfabrik, Apenrade	
13. Elisabeth Seumenicht	Germaniawerft, Fr. Krupp, Kiel	F. Seumenicht Itzehoe					Apenrader Motorenfabrik, Apenrade	
14. Hans Ulrich	" "	Tänicke u. Dietrich Prerow	30.26 x 6.78 x 2.40 139 R. T. 195 tons	1 x 35 e.H.P. 5 knots	2 x 210/25	" " "	Hanseatische Motoren Ges. Bergedorf	
15. Christine Jensen	" "	J. H. Jensen Hamburg					"	Galleasses.
16. Gertrud Stein	" "	J. H. Jensen Hamburg					"	
17. Tröndelse	" "	Fr. Krupp, Essen					"	
18. Beta								
19.								
20. Alpha								
21.								
22.								
23.	Germaniawerft, Kiel	W. Treitschke u. Co. Kiel Fr. Krupp, Essen	23.79 x 5.63 x 2.30 78 R. T. 110 tons	1 x 25 e.H.P. 5 knots	1 x 240/280	Crude-oil 2-cycle	Hanseat. Motoren Ges., Bergedorf	Galiots
24.								
25.								
26.								
27.								
28.								
29. Emmi Stein	Smit u. Sohn, Westerbrock	J. H. Jensen, Fleusburg	33.95 x 7.29 x 3.20 211 R. T.	1 x 50 e.H.P. 6 knots	2 x 310/320	Hotbulb 4-cycle	Smit u. Sohn, Westerbrock	Schooner
30. Gerhard Barg	Neptun, A. G., Rostock	Otto Zelk, Rostock	37.55 x 8.54 x 3.83 359 R. T.	1 x 150 e.H.P.	4 x 260/370	Diesel 4-cycle	Benz. u. Co., Mannheim	3 masted schooner.
31. Heimat	Heinr. Brandt, Oldenburg	F. H. Bertling, Lübeck	29.20 x 7.23 x 3.10 152 R. T.	1 x 90 e.H.P.	2 x 335/350	Crude-oil	Deutsche Kromhout Motorenfabrik Brake	3 masted schooner.

IV Motor Vessels Completed

32. Helene Jensen 33. Anna Jensen	Schiffswerft Janssen u. Schmilinski, A. G., Hamburg	J. H. Jensen, Hamburg	32.76 x 7.00 x 3.25 232 R. T.	1 x 70 B.H.P.	2 x 300/360	Crude-oil 2-cycle	Fahrzengfabrik, Ensenach	Schooner.
34. Rebecca	D. W. Kremer, Elmshorn	D. W. Kremer, Elmshorn	34.30 x 7.10 x 3.00 203 R. T.	1 x 120 B.H.P.	4 x 215/320	Diesel 2-cycle	Benz u. Co., Mannheim	3 masted schooner.
35. Violet	Schiffswerft, Janssen und Schmilinski, A. G. Hamburg	Paul Puls, Hamburg	31.50 x	1 x 70 B.H.P.	2 x 300/300	Crude-oil 2-cycle	Fahrzengfabrik, Eisenach	Schooner.
36. Georg Kimme 37. Franziska Kimme	Reconstructed A. G. Weser, Bremen	Friedr. Kimme Bremerhaven	61.40 x 9.09 x 5.40 786 R. T.	2 x 100 B.H.P.	....	....	....	
38. Elsbeth 39. Charlotte	H. Pauksch Landsberg	Skandinavia Schiffahrts Ges., Hamburg	42.03 x 9.02 x 3.09 425 R. T.	......	......	......	....	

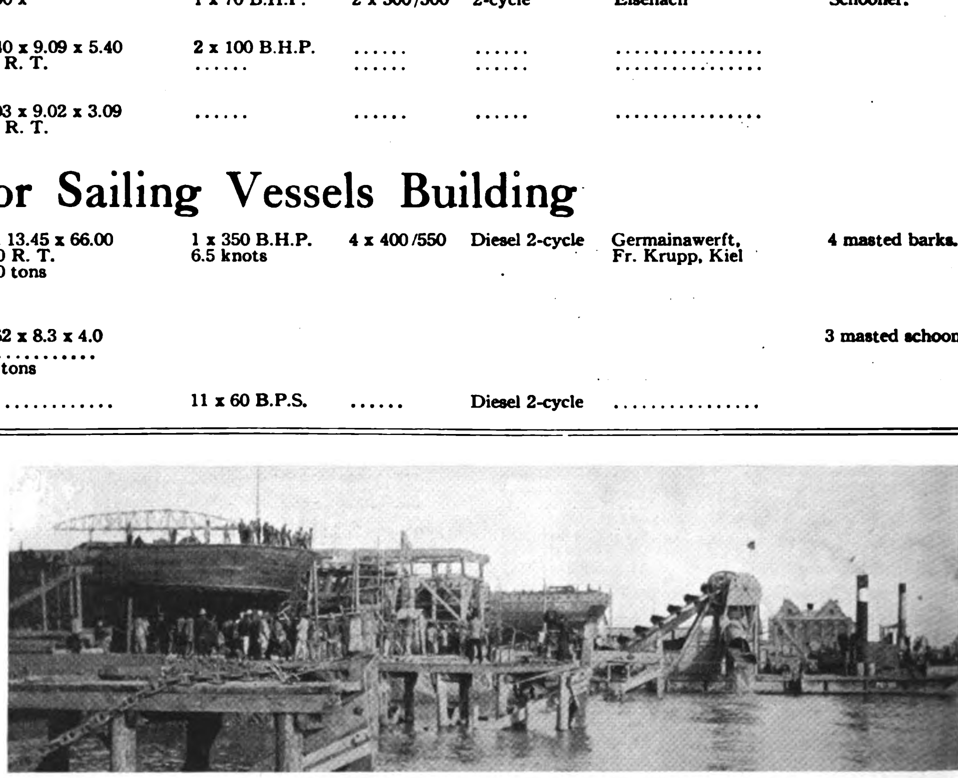
V Motor Sailing Vessels Building

40. .... 41. .... 42. .... 43. .... 44.	Germaniawerft Fr. Krupp, Kiel	....	77.x 13.45 x 66.00 1850 R. T. 2400 tons	1 x 350 B.H.P. 6.5 knots	4 x 400/550	Diesel 2-cycle	Germainawerft, Fr. Krupp, Kiel	4 masted barks.
45. 46. 47.	D. W. Kremer Elmshorn	Rhederei Rheinland, Duisburg	50.62 x 8.3 x 4.0 .... 500 tons					3 masted schooners.
48. Greif	....	Stettiner Reederei	....	11 x 60 B.P.S.	......	Diesel 2-cycle	....	

MOTORSHIPS BUILT IN CHINA

A short time ago, at Hsin-Ho, near Tientsin, on the banks of the river Pai-Ho, the first ship-building yard in Northern China was opened. It is true that the work carried out is, for the moment at least, rather of a primitive character, and as can be seen from the illustration, only wooden ships are constructed.

Five sailing-ships can be seen in the illustration. They are all of the same dimensions and were built to the order of the "Société Maritime et Commerciale du Pacifique" of Paris. Each has 2000 tons dead-weight carrying-capacity. For the present it is intended to equip two of these sailing-ships with Sulzer two-cycle reversible Diesel marine-engines of 420 h.p.



Five 2,000 tons d.w.c. wooden sailing-ships building in China, two of which are having Sulzer 420 b.h.p. Diesel-engines installed as auxiliary power.

Oil Engined Work Boats

DOWN-EAST FISH-CANNERS USE MANY OIL-ENGINES

On the Maine, New Brunswick and Canadian shores are located a great number of fish canning and packing establishments, gathering the sardines and herring in great quantities. Formerly a great many steamers and gasoline craft were used, but these are becoming more scarce each year, oil-engines being almost solely the power used. To mention fully the extent of the use of oil-engines in these vessels would require pages and at this time we will simply mention a few which have come to our notice, all installations by Fairbanks, Morse & Co.

Lawrence Brothers, of North Lubec, Maine operate the "Muriel" of 55 hogsheads capacity, 71 ft. long, 14 ft. breadth, 8 ft. depth, built by Hodgdon Bros., East Boothbay, Me. A 60 h.p. Fairbanks, Morse oil-engine drives her at 10 knots speed.

The Booth Fisheries Co., Eastport, Me., operate among other craft two-sister-ships, "Patriot" and "Black Diamond," each 64 ft., 5 in. long, 15 ft. 9 in. breadth, 5 ft., 8 in. depth, 60 hogsheads capacity, built 1918-19. Sixty h.p. surface-ignition oil-engines drive these vessels on a fuel-consumption of 5 gallons per hour.

Globe Canning Co., North Lubec, Me., have a 45 h.p. engine in the "Irma" of 60 hogsheads capacity, 63 ft. long, 13 ft., 5 in. breadth, and 6 ft., 2 in. deep, built by George Greenlaw of Eastport in 1918. A speed of 10 knots is obtained.

The E. A. Holmes Packing Co. own the "Eva H," which has a 45 h.p. oil-engine, driving this 65 ft. by 14 ft. by 5 ft., 6 in. vessel. She has a capacity of 60 hogsheads and was built by Walker at Ellsworth, Me., in 1919.

Connors Bros., Black Harbor, Charlotte County, New Brunswick, 12 miles from Eastport, own a large fleet, among which is the "Brunswick Maid," built in 1920, 78 ft. by 17 ft. by 6 ft. deep, powered with a 45 h.p. oil-engine which drives her at 9 knots speed, capacity 60 hogsheads. The "Page" operated by this company is a 65 footer of 55 hogsheads capacity and has a 60 h.p. oil-engine.

The "Kingfisher," owned by the Underwood Packing Co., of Jonesport, Me., has two 75 h.p. oil-engines. This vessel was built in 1908 and has been operated ever since with another type of internal-combustion engine until recently when an oil-engine installation was made. She is 74 ft., 5 in. by 17 ft., 4 in. by 7 ft., 2 in., with a capacity of 100 hogsheads. She makes 10 knots.

"Kingfisher," owned by Underwood Packing Co. Powered with two 75 h.p. Fairbanks, Morse engines

SAN FRANCISCO HARBOR COMMISSIONERS ORDER NEW DIESEL-BOAT

The Board of State Harbor Commissioners for the Harbor of San Francisco have placed the contract for an oil-engine for the new inspection and tow-boat with the Enterprise Engine Company, of that city. This new boat has been designed by D. W. & R. Z. Dickie and is to be of the following dimensions:

Length over-all	57 ft.
Breadth over-planking	15 ft.
Depth of hold	6 ft., 2 in.
Draft	6 ft., 3 in.

The Enterprise Diesel-engine selected is their 100 h.p. four-cylinder 9¼ in. by 14 in. engine turning at 318 r.p.m. which will develop well over 100 h.p. on a consumption of 0.405 lb. per h.p. hour, using 18.37 deg. Baumé oil. As compared with a distillate-engine a little figuring developed that the latter would only have to operate 1 hour and 12 minutes per day for 300 days a year for it to cancel-out the advantage in first-cost, as the fuel cost of the distillate-engine is 349 times that of the Diesel-engine.

ANOTHER FISHING BOAT WITH OIL-ENGINE

Following the trend of the time caused by the general realization among fishermen that although higher in first cost the oil-burning, heavy-duty engine is the cheapest in the end. Captain John Sater, principal owner of the auxiliary schooner "Viking" of New Bedford, Mass., recently has equipped his vessel with a 40-50 B.H.P. two-cylinder Bolinder engine of the direct reversible type.

"Viking," auxiliary fisherman with Bolinders engines

The schooner "Viking" was built at Noank, Conn. in 1897 and has since twice been equipped with 25 H.P. gasoline engines. She is 48 ft. in length, 16.1 ft. breath and 7.6 ft. depth, being registered at 27 gross tons and 19 net tons. While her gasoline engine equipment hardly gave her a speed of more than 3 miles an hour, the Bolinder oil-engine when taking the vessel over a measured course in New Bedford Harbor on October 27th last, increased this to 7 miles with a Columbian bronze propeller 34 in. diameter by 28 in. pitch, turning at about 440 r.p.m.

At full-load the engine consumed just 3 1/3 gallons of fuel an hour at 7 cents a gallon at which price this oil is now obtainable, this therefore means an outlay of 3 1/3 cents a mile. Add to this the cost of lubricating oil, approximately 1/7 of a gallon an hour at about 58 cents a gallon, that is 1 1/5 cents a mile, and a total outlay of 4½ cents a mile for operating this engine at full load is arrived at.

During the course of a year these vessels log in the neighborhood of 20,000 miles averaging two trips in three weeks, while working and running the engine about 100 hours a trip. Fuel and lubricating oils consumed during a year's activities therefore amount to about $900 with which there must be compared the expense of fully three times this amount to operate the gasoline-engined vessel.

ECONOMY IN RIVER-FREIGHTER OPERATION

90 Per Cent Saving in Fuel Cost; 15 Per Cent Less Power; 15 Per Cent More Speed

Trial-trips of the little river-freighter "Suisun City" owned by Hunt-Hatch Company, of Oakland, Cal., have recently been held, after two 65 h.p. twin-cylinder 12 in. by 12 in. Atlas distillate-engines had been removed and two 55 h.p. three-cylinder 8 in. by 10½ in. Atlas-Imperial Diesel-engines had been installed in their place. The change was made simply in the interests of economy. This freighter is:

Length over-all	84 ft. 5 in.
Breadth	23 ft. 5 in.
Depth	6 ft. 5 in.
Tons, gross	142 tons
Tons, net	73 tons

The following data on the performance of the boat before and after having this change of machinery made is exceedingly interesting as showing in black and white why the Diesel-engine, even in small units, must furnish the power in our harbor and coastwise fleets.

Propeller with distillate engines, 48 in. d., 44 in. p., 232 r.p.m.

Propeller with Diesel engines, 44 in. d., 38 in. p., 340 r.p.m.

Speed of boat with distillate engines, 8 miles per hour.

Speed of boat with Diesel engines, 9.2 miles per hour.

Fuel cost with distillate engines per hour .$3.22

Fuel cost with Diesel engines per hour . . 0.30

Actual fuel-consumption with Diesel-engines is 4¼ gals. per hour with 2 engines and 2⅛ gals. with 1 engine. Fuel used costs 6 cents per gal.

This is but one of many conversions from distillate to Diesel-engines which the non-availability of distillate fuel and the added economy of the latter type engine has made necessary on the Pacific coast.

NEW DESIGN OF OIL ENGINE FOR PASSENGER MOTOR-VESSEL

Now under construction at a Puget Sound yard is a twin screw passenger motorship in which two of the newly designed 125 b.h.p. surface-ignition oil-engines built by the Clift Motor Co. of Bellingham, Wash., will be installed. The vessel will operate between Bellingham and the San Juan Islands.

ANOTHER SUB-CHASER SOLD

We are advised that Henry A. Hitner's Sons Co. of Philadelphia, who purchased a great many ex-Navy submarine chasers from the government, have sold Submarine Chaser No. 71 to Mr. C. A. Cromwell, who will convert her into a yacht.

HALIBUT SCHOONER "ATLAS" TO HAVE DIESEL-ENGINES

Peter Wold's 65 ft. halibut schooner "Atlas" is having a 55 b.h.p. Atlas Imperial airless injection Diesel-engine installed. This boat is a Puget Sound craft.

"Patriot," owned by Booth Fisheries Co. Has 60 h.p. surface-ignition oil-engine

ANOTHER ECONOMICAL ATLAS-IMPERIAL INSTALLATION

According to a sworn statement issued by Capt. P. W. McAllister of San Pedro, Calif., the motor workboat G. W. powered with an 80 b.h.p. Atlas-Imperial Diesel-engine showed a fuel-consumption of under 18 cents per hour on a 48 hours' run from Long Beach, Calif. to San Pedro, and return.

"MOTORSHIP'S YEAR BOOK FOR 1922

If you have not already done so, we suggest that you delay no longer in ordering your copy of the Motorship Year Book for 1922. Its price is only one dollar.

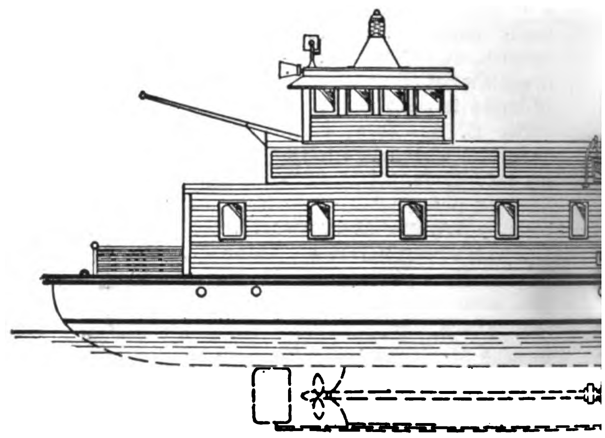
Win

OIL DIESEL TYPE

WINTON OIL ENGINES FOR DIRECT DRIVE	
Model W-54 6-cylinder	125 H.P.
Model W-58 4-cylinder	150 H.P.
Model W-35 6-cylinder	225 H.P.
Model W-24 6-cylinder	300 H.P.
Model W-40 8-cylinder	450 H.P.

WINTON AIR COMPRESSORS

Model AC-3 90 cu. ft. free air
Model W-18 38 cu. ft. free air



A DIESEL-ELECTR

The Ferry-Vessel "Poughkeepsie" no
Pacific Company's Yard, Brooklyn, N
Ferry Company is 140 ft. over guard
guards. Designs by C. V. S. Wyckoff

Power plant consists of a pair of six
rect connected to 90 K. W. Westingh
H.P. Westinghouse electric motors o
for 32 automobiles, in addition to th

WINTON DIESEL-ELECTRIC
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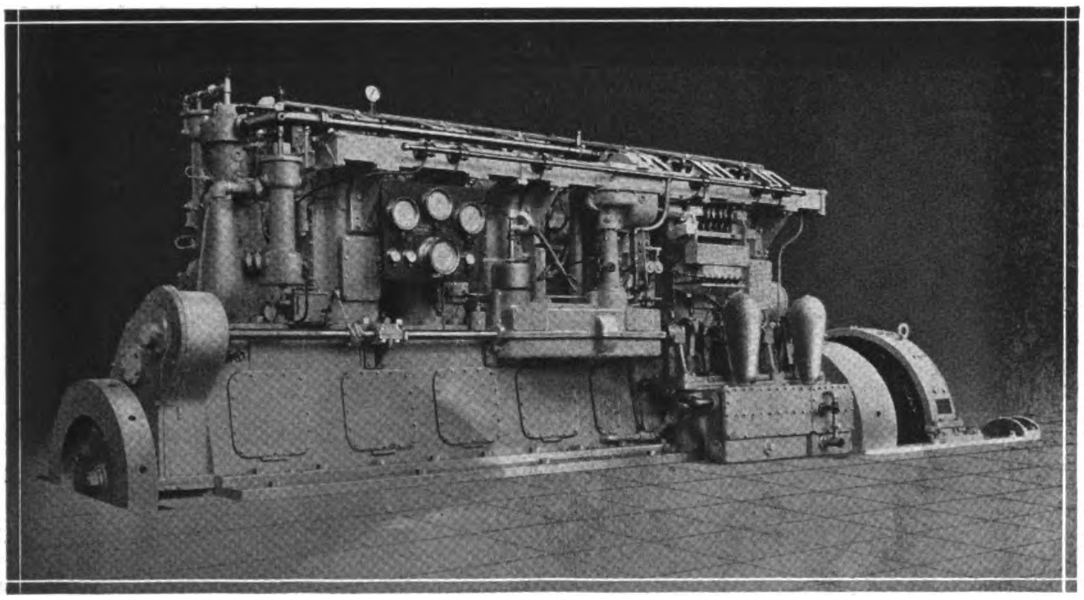

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WINTON ENGINE WORKS,

New York—A. G. Griese, Inc., 30 Church Street
Washington, D. C.—R. L. Fryer, 817 Albee Bldg. *Seattle*—H. W. Starrett,

Remarkable Economies Effected by Diesel-Driven Tugs

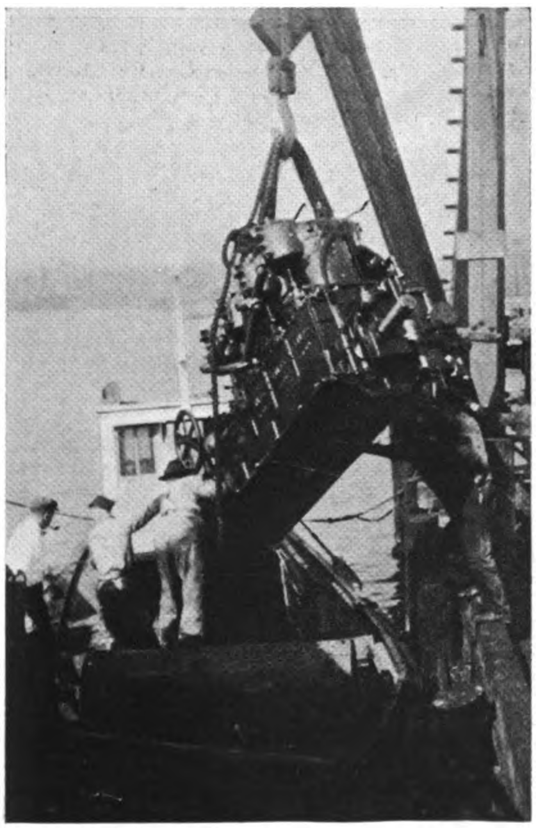
Actual Results Which Have Been Obtained in Operation of Two Boats

On page 727 of our September issue we illustrated the "Colon," a harbor-tug owned and operated by the Oakland Launch and Tugboat Co. at Oakland, California. This tug has been in operation for more than six months in continuous-service and during this time has never been laid-up on-account of engine-trouble. In fact, we are told by the Atlas-Imperial Engine Co., of Oakland, builders of the 55 h.p. Diesel-engine installed in the "Colon," that the engine has never been dismantled, never had a hot-bearing, no mechanical-troubles, heads have never been removed or fuel-valves touched, the only work done on the engine being to clean fuel-strainers and nozzles. Six to eight weeks elapse between nozzle cleanings.

Crude-oil of 24 deg. specific gravity costing 6 cents per gallon is used, so that the fuel-cost per hour is only about 17 cents. One gallon of lubricating-oil is sufficient for about 20 hours steady-running.

Small steam harbor-tugs of the approximate size of the "Colon" are coal-burners in the true sense of the word, for they burn enough coal to bring their fuel-bill to a figure of 2½ lbs. per brake-horse-power hour under the most economical condition, more often 3 lbs. per b.h.p. hour as against 0.405 lb. per brake-horse-power hour for the "Colon." On the Pacific coast of the United States oil-fuel is so near at hand, consequently more reasonable in price than coal, that for many years previous to the active development of the small Diesel and surface-ignition oil-engine the distillate engine enjoyed a very large degree of popularity being installed not only in commercial craft but in pleasure boats as well. Probably in San Francisco Bay more distillate-tugs have been put into operation than on any other body of water on the whole United States coast. But, distillate fuel is gradually being removed from the market and Diesel-engines are being installed in the place of distillate engines, although the former are operating with perfect satisfaction so far as everything but economy is concerned.

Motor-tug "HALCYON" now powered with a 125 b.h.p. Atlas Diesel engine, the old Atlas distillate engine having been removed for economy purposes.



Lifting out the Atlas distillate engine from the tug "HALCYON."

Quite likely the performance of the Diesel-engine in the "Colon" for the past six months or more has influenced the change in the case of the tug-boat "Panama" owned by the same company that owns the "Colon," the two being somewhat similar craft. An 85 h.p. 3-cylinder Atlas distillate-engine is being removed from the "Panama" and a 125 h.p. Atlas-Imperial Diesel-engine is being installed, the increase in power being made not because the Diesel-engine is not as powerful as the other, for it is even more effective, horse-power for horse-power, but because by reason of the extreme-economy of fuel-consumption of the Diesel-type engine it is possible to have more power for less fuel-cost and a little extra power is valuable in a tug. So with the Diesel-engine the owners buy power without eventually paying for it.

We also illustrate the harbor-tug "Halcyon," owned by A. V. Rideout Company, San Francisco, coming up to the Atlas-Imperial dock at Oakland to have her 150 h.p. 4 cyl. 12 in. by 12 in. Atlas distillate-engine removed and a 125 h.p. 3 cyl. 10½ in. by 14 in. Atlas-Imperial Diesel-engine installed in its place. She will save $745 per month with the Diesel-engine. Her distillate bill has been $825 per month; her fuel-oil bill with the new engine will be only $80 per month.

The "Halcyon" is of the following dimensions: Length over-all, 48 ft., 2 in., breadth 14 ft., 5 in., depth 5 ft., 8 in. Trial trips of this boat with the Diesel-engine installed were run on Nov. 9th, with the following results:

Propeller used....3-blade 53 in. diam. 48 in. pitch
Revolutions tied to dock...............270 r.p.m.
Revolutions running...................330 r.p.m.

The 150 h.p. distillate-engine formerly turned the same propeller as follows:

Revolutions tied to dock..............240 r.p.m.
Revolutions running....................285 r.p.m.

In view of the above proven, economy and desirability of the oil-engine for tow-boat use in actual hard-service day-in and day-out it is a mystery why tow-boat firms, especially on the Eastern-coast of the United States, continue to use the un-economical steam-tug. Not only is the fuel-cost so much higher, but stand-by expense, larger crew, greater heat and dirt, greater time required to get under-way and high smoke-stack are added to the unfavorable steam-tug side of the story. If the internal-combustion engined tow-boat could not do the work that the steam-tug does economy would amount to nothing. But, she can do and is doing exactly that work. When will the rest of the steam tow-boat companies see the light?

INTEREST IN BARGE CANAL TRANSPORTATION

None need worry about lack of interest in our inland waterways and barge transportation on the part of the general public. At the Marine Show just held in New York City there was a booth devoted to these subjects and at any hour of the day or evening more people crowded around in that booth than in any other single exhibit. The representative of "Motorship" was pleased to hear our recent series of articles on the Barge Canal spoken of with appreciation. There is no doubt that the public wants to see our inland waterways transportation developed.

TO BUILD BIG MOTOR FISHING-BOAT

The Arthur D. Storey Shipyard at Essex, Mass., has resumed work on a 400-ton three-masted schooner on which work was suspended last March. The plant is also making preparation to build a fishing schooner this fall.

DELIVERY OF TRAWLER "MUNKTELL"

A 66-ft. motor trawler named "Munktell" has recently been delivered to M. Lefournier, of Port-en-Bessin. She was built at Caen and is propelled by a Munktell surface-ignition oil-engine of 60 b.h.p. at 375 R.P.M.

CAREY DAVIS CO. CONVERT TUG "EQUATOR"

In our August issue we stated that the Carey Davis Tow Boat Co. of Seattle, Wash., would gradually convert their steam-tugs to oil-engine power, commencing with the "Equator." They have placed an order for a 200 b.h.p. Fairbanks-Morse surface-ignition oil-engine and the order for converting the boat has been awarded to J. C. Johnson, boat-builder, Port Blakely Wash.

OFF TO EUROPE

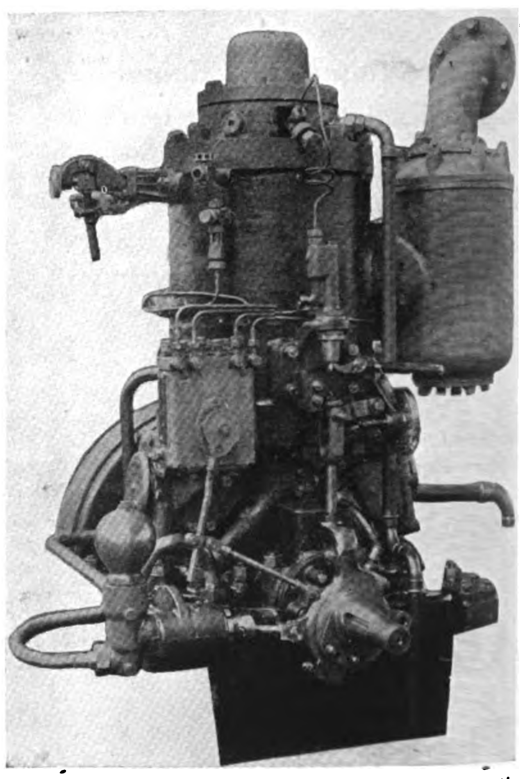
With a view to spending the winter studying the latest development in European Diesel engine construction, Mr. T. M. Holme of the Ingersoll-Rand Co. is leaving for England and Scandinavia.

NEW MOTOR-BARGE IN IRELAND

The new 72 ft. by 15 ft. motor-barge "Cambrais," owned by a large firm of flour millers, has just been put into operation. She was built by Messrs. W. J. Yarwood and Sons, Ltd., of Norwich, England, and is driven by a 40 h.p. surface ignition Robey oil-engine. The carrying capacity is about 60 tons on a draft of 4 ft. 6 in.

"NEPPO," A NEW STEEL AUXILIARY SCHOONER.

Van de Kuy and Van de Ree, ship-builders of Rotterdam recently launched a 300 tons d.w.c. steel auxiliary named "Neppo" for Van Oppen & Co. She has a four-cylinder 150 b.h.p. Kromhout oil-engine.



A surface-ignition marine oil-engine built by the Societe des Moteurs Chaleassiere.

Interesting Notes and News from Everywhere

ACTION STARTED ON "MOTORSHIPS" NEW PLAN

Twenty Shipping Board vessels of various types and tonnage are to be offered to operators who will agree to install in them Diesel propelling-machinery to be purchased from the government, Admiral Benson, commissioner in charge of construction and machinery efficiency of the Board, announced on December 1st. "The Board has long recognized the prime necessity of developing Diesel-engine driven tonnage if this country is to take its rightful place as a maritime nation," said Admiral Benson.

MOTORSHIP "LEIGHTON" RUNS TRIALS

Trials of Lamport & Holt's new 11,000 tons d.w.c. Diesel-driven motorship were run on October 13th last. She was built by A. McMillan & Son, of Dumbarton, Scotland, and B. & W. Diesel-engined by Harland & Wolff.

TRIALS OF MOTORSHIP "LINNELL"

Trials of the Diesel-driven freighter "Linnell" have just been run. She is a sister to the "Layton," and was also built and powered by Harland & Wolff, Ltd. She will be operated by the Liverpool, Brazil and River Plate Steam Navigation Company of Liverpool, which is one of the Lamport & Holt Companies.

LAUNCH MOTORSHIP "HALLFRIED"

The 7,200 tons deadweight Werkspoor Diesel-engined motorship "Hallfried" has just been launched at the Rijke yard, Rotterdam, Holland. Two 1,400 i.h.p. engines are being installed.

ANOTHER VICKERS' DIESEL-TANKER LAUNCHED

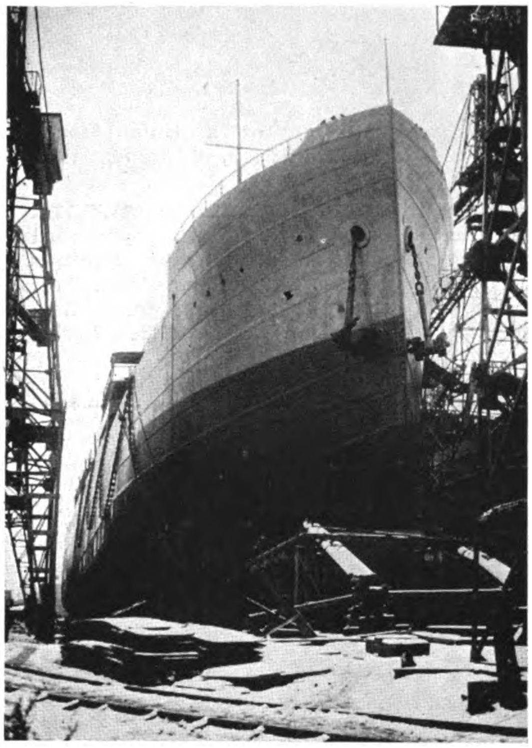
Vickers Ltd., Barrow-in-Furness, England, launched the twin-screw Diesel-driven motor tanker "Scottish Minstrel" on November 15th to the order of Tankers Ltd. of London. This ship is the third of four sister motorships built and building by Vickers for these owners.

REVIEWS

"Lubrication." A Technical Publication Devoted to the Selection and Use of Lubricants. Published monthly by The Texas Company, New York. We have had the pleasure of reading the September and October issues of this attractive little house-organ and feel that every engineer of a motorship would do well to read this interesting booklet each month. These September and October issues contain a general analysis of the Diesel-engine, the four-cycle air-injection type being discussed in the former and the two-cycle solid-injection type being discussed in the latter issue, together with articles on acidity in oils, lubrication of engines, etc. Both issues are well illustrated. We congratulate the Texas Company on publishing such a series of semi-technical booklets in which the subject is handled in such a non-partisan spirit and in which Texas products are effectively yet not obtrusively advertised.

ENGINE TESTS OF STANDARD OIL CO.'S MOTORSHIP

For testing the two 1140 I.H.P. (850 shaft h.p.) Werkspoor-Diesel engines of the Standard Oil tanker "H. T. Harper," the Pacific Diesel Engine Co. of Oakland used 14 degs. Baume oil-fuel. The two engines each developed 1,006 shaft h.p. at 135 R.P.M., and together used 54 barrels per 24 hour day. Sea trials of this ship are given elsewhere in this issue.



Motorship "Laponia," second of the Diesel-driven ore-carriers for the Oxelosund-Grangesburg and sister to the m.s. "Strassa" just prior to her launch at the Gotaverken Goteborg, Sweden, on November 5, 1921

GEO. ARMES HEADS RE-ORGANIZED SHIPYARD

Re-organization has taken place of Mooney & Young of San Francisco, with George A. Armes as president and John Mooney as vice-president, under the name of the General Engineering Company. M. Armes until recently was president of the Moore Shipbuilding Company at San Francisco, and Mr. Mooney was superintendent of construction at the Skinner & Eddy yard at San Francisco during the war. The main work of the plant at the present time will be ship and engine repairs, but later on they expect to undertake ship construction.

DO YOU WANT TO SELL US YOUR YEAR BOOK FOR TWO DOLLARS?

"Motorship" has received so many urgent requests for a copy of the 1921 Motorship Year Book that in order to meet this situation we will gladly buy back at an increase in price of one dollar a limited number of copies in good condition which any owner will part with. Before sending in the "Year Book," mail us a post-card.

AMERICAN MOTORSHIP OPERATES ON 14 BAUME BOILER-OIL

In our Editorial this month we have referred to an American coastwise Diesel-driven tanker that has been successfully using Mexican boiler-fuel of 14 degrees Baumé, which is as heavy and as near crude-oil as any steamship could use with safety.

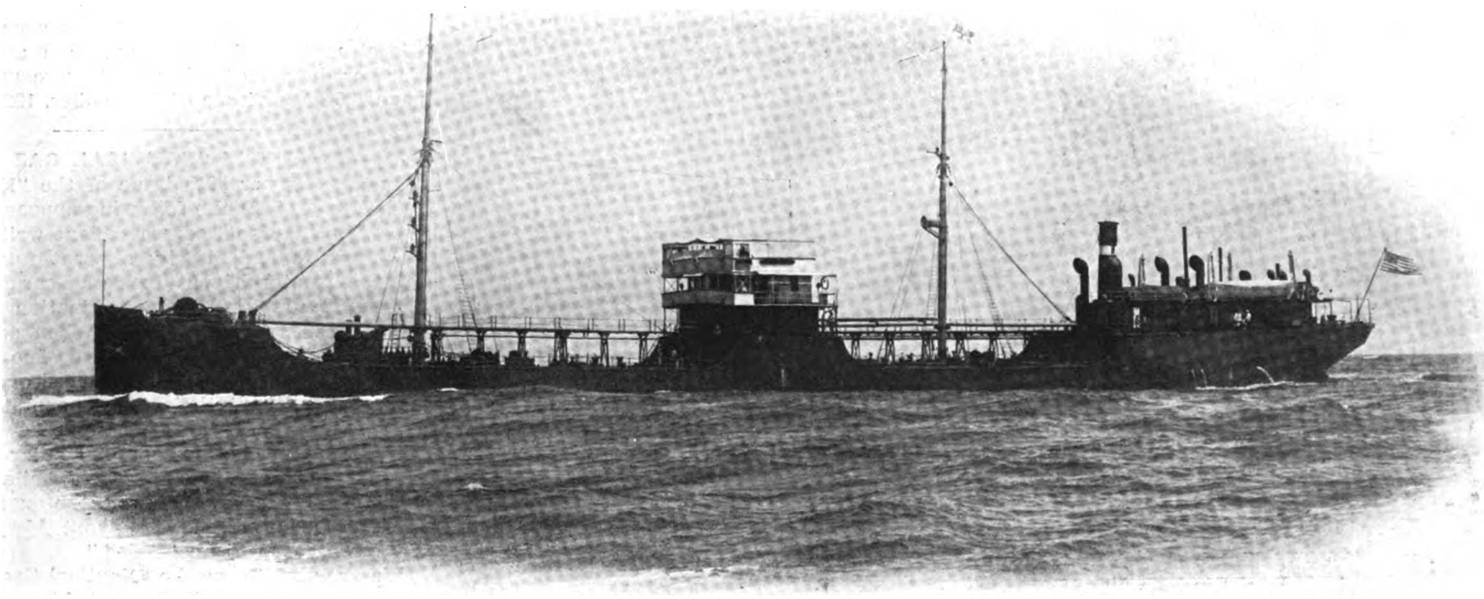
This is the motorship "Solitaire," which was built in the Texas Steamship Company's shipyard at Bath, Maine, went into commission April 20, 1920, propelled by twin 500 shaft h.p. McIntosh & Seymour Diesel engines. Her performance has been very satisfactory, as indicated by following averages for first sixteen months in service.

Average speed (loaded)	8.89 knots
Average fuel-consumption	38½ bbls. per day
Average cargo	4,252 tons
Total distance travelled	59,670 nautical miles

During above period the time lost due to machinery overhauls and adjustments amounted to but 15 days, 10 hrs. and 35 mins., less than one day per month. Lloyds annual machinery survey was held in August. At that time a fuel-heating system was installed in which the exhaust-gases were used for heating water, which in turn was employed to heat the fuel. After completion of the installation and survey the "Solitaire" again went into commission using 14 deg. B. to 16 deg. B. gravity fuel-oil, and has since been operating satisfactorily on this grade of oil.

This fuel-heating arrangement consisted of a set of heating-coils in the silencers in which fresh-water was heated by the exhaust-gases. This hot-water is then passed through coils in the fuel-service tanks. In the silencer a coil also has been installed for the auxiliary oil-engines.

When the main-engines are cold they are started and run on 0.92 gravity oil for about ten minutes, then the heavy-oil is turned on. It has a viscosity of 1,000 sec. at Seybolt at 150 Fahr. The main engines have run for over 450 hours at sea on this fuel, and the fuel consumption of the twin 500 brake horse-power engines have been reduced by over three barrels per day. The sulphur had no effect on the exhaust valves.



Texas Company's motorship "SOLITAIRE," whose twin 500 McIntosh & Seymour Diesel engines have been running with considerable success on Mexican boiler-oil on 14 degrees Baumé with 4.365 sulphur content

SINGLE-SCREW MOTORSHIP "SEGOVIA" RUNS TRIALS

The North Eastern-Werkspoor Diesel-engined 3,000 tons motorship "Segovia" recently ran trials.

NEW MOTORSHIPS EXCEED NEW COAL BURNERS

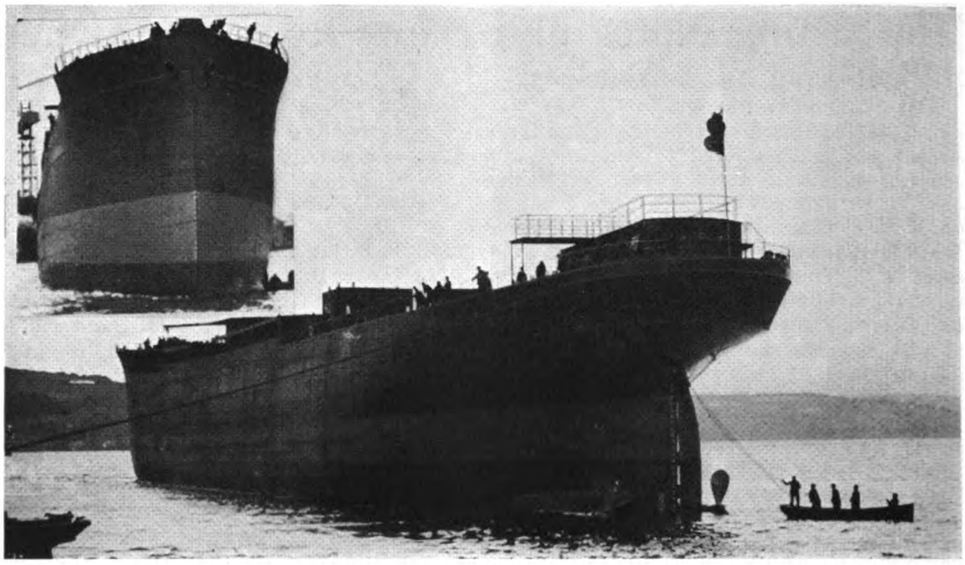
For the first time in history, new Diesel-engine motorship construction in 1920-1 exceeded in tonnage vessels fitted with coal-burning steam-boilers, according to Lloyd's recent report.

MAIDEN VOYAGE OF CONVERTED WARSHIP

The German Diesel-engined motorship "Odin," converted from a cruiser, recently arrived at Petrograd with a cargo of locomotives. She is owned by Arnold Bernstein and has been described in "Motorship."

TRIALS OF MOTORSHIP "VIRGINIA"

On the 5th of November the motorship "Virginia" ran her trials. She attained a speed of 9.2 knots at 200 R.P.M. on a displacement of 550 tons reversing in 13 seconds. The consumption was 146 grams per i.h.p. hour



After the launch of the Union Steamship Co.'s motor-freighter "Hauraki" at the Denny Shipyard, Dumbarton, Scotland. Plans were given in our last issue on pages 880 and 883

TRIALS OF MOTORSHIPS "LOSADA" AND "LOBOS"

The third Diesel-driven motorship constructed by Harland & Wolff for the Pacific Steam Navigation Company has run her trials. This is the "Losada," sister to the "La Paz" and "Lobos." It will be remembered that the "La Paz" visited New York last year and was full described and illustrated in our issue of November, 1920. All three vessels are of 9,190 tons d.w.c. and of 3.200 I.H.P. Harland & Wolff B. & W. Diesel engines are installed. Three larger motorships for the same owners are now under construction. The "Lobos" ran trials during October last.

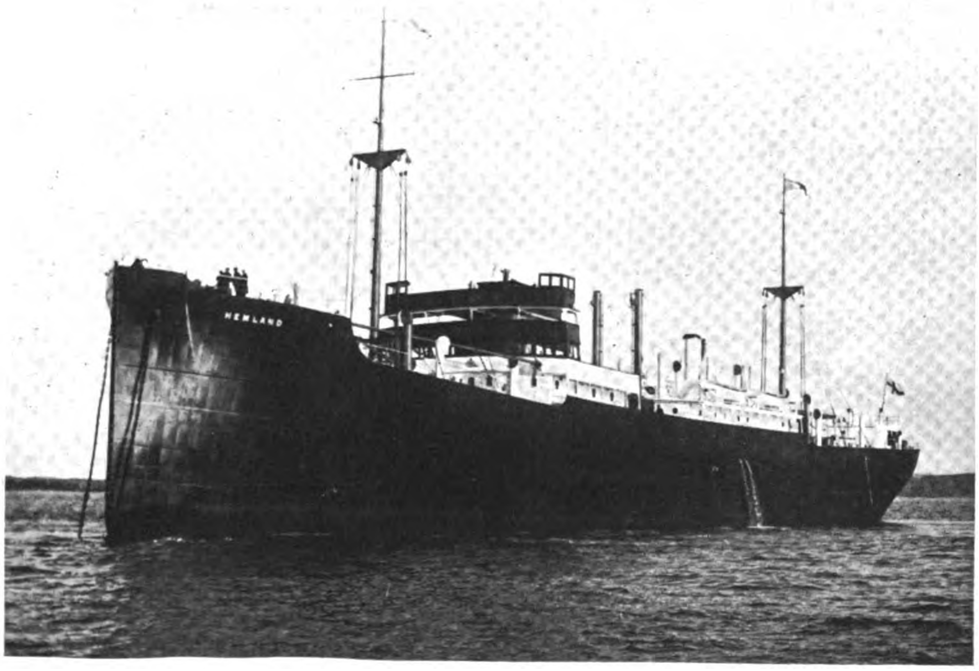
"FURUSTRAND" SOLD TO SWEDEN

The 700 tons deadweight auxiliary "Furustrand" has been sold to Swedish owners. She was built by the Santa Rosa Shipbuilding Corp., Florida, in 1920, and fitted with Fairbanks-Morse oil-engines, to the order of C. B. Nielsen of Skien, Norway.

Launch of the United Steamship Co.'s new Burmeister & Wain Diesel motorship "Louisiana" at the Ardrossan Shipyard

SLOW-SPEED GERMAN DIESEL ENGINES

Blohm and Voss of Hamburg are building a pair of two-cycle Diesel marine-engines of 1,750 shaft h.p. each at 95 r.p.m., which will be installed in a third sister motorship to the "Havelland." These are the engines shown in the drawing on page 871 of our November issue.



Swedish Lloyd's new motorship "Hemland," launched under the name of "Adria" at the Gotaverken, Goteborg. For details see page 735, September, 1921. Trials were run on November 10th

NEW MOTORSHIPS "PINTHIS" AND "PIZARRO"

In our issue of September, 1920, we described two motorships that had been ordered from Wm. Beardmore & Co., Ltd., of Dalmuir, Scotland, by MacAndrews Ltd. of London, for fruit carrying. The first of these vessels, the "Pinzon," was launched on November 15th. She carries about 2,000 tons d.w. and is propelled by Beardmore-Tosi marine Diesel engines developing 1,290 shaft h.p. at 125 R.P.M., or 1,000 shaft h.p. at 105 R.P.M. The name of the sister motorship is the "Pizarro" and she is now on the stocks.

GAS ENGINES FOR SUBMARINES

It is not generally known that a number of twin and triple screw submarines were built for the German Navy during the war, in which gas engines were installed. These vessels were of 100 ft. length, 500 b.h.p. and 14-knots and were fitted with Benz engines. Further details are before us but we are prevented from publishing same on account of pressure on space.

TRIALS OF THE SWEDISH LLOYD MOTORSHIP "HEMLAND"

Built to the order of the Rederiaktiebolaget Svenska Lloyd of Göteborg, Sweden, and launched under the name of "Adria," the new motorship "Hemland," now owned by the Rederiaktiebolaget Tirfing, which is another Dan Brostrom Company, and one of the largest steamship lines in Sweden, ran her sea trials on November 10th. These were carried out without any hitch whatever and the vessel averaged a speed of 12.02 knots, developing 2,812 i.h.p. on a consumption of 0.135 kg. of fuel-oil per i.h.p. hour, the vessel being lightly loaded.

This vessel has a carrying capacity of 8,400 tons on 25-ft. draft and has a bunker space for 1,150 tons of fuel. Accommodation is arranged for twelve passengers. Two Götaverken B. & W. Diesel motors of 1,400 i.h.p. each are installed. Further details of this vessel were published on page 735 of our issue of September, 1921.

—SAYS THE "NAUTICAL GAZETTE"

In the October 29th issue of the "Nautical Gazette" (page 562) the following appears—

> "Our Liverpool correspondent writes that there is undoubtedly a great future for the motor-driven express cargo boat and for motor-driven combination passenger-and-cargo vessels. When equipped with internal-combustion engine power such vessels can attain a speed of sixteen knots without their fuel-consumption exceeding that of an eleven or twelve knots geared turbine steamer of similar dimensions, whilst the absence of boiler-water and the great reduction in the quantity of fuel required enables about 15 percent more cargo to be carried."

We are glad to see the "Nautical Gazette's" correspondent endorse the type of ship recommended to Congress by "Motorship" in February and published in the "Congressional Record," also in "Motorship" for March, 1920.

DEUTSCHE WERFT MOTORSHIP READY IN JANUARY

The motorship "Julius Schindler," 3,700 tons d.w.c., now under construction at the Deutsche Werft, Hamburg, is expected to be placed in service during January next. She is being equipped with a Burmeister & Wain type Diesel-engine of 1,260 shaft h.p. by the A.E.G. of Berlin.

WOODEN MOTORSHIP "OREGON" SOLD

In view of the almost worthlessness of the U. S. Shipping Board's fleet of wooden steamers it is interesting to note that the American wooden motorship "Oregon," of but 1,616 gross tons, has just been sold at a price of $10,000 by U. S. Marshal to the bank of California. She is powered with twin Southwark-Harris Diesel engines.

LAUNCH OF MOTORSHIP "DUMRA"

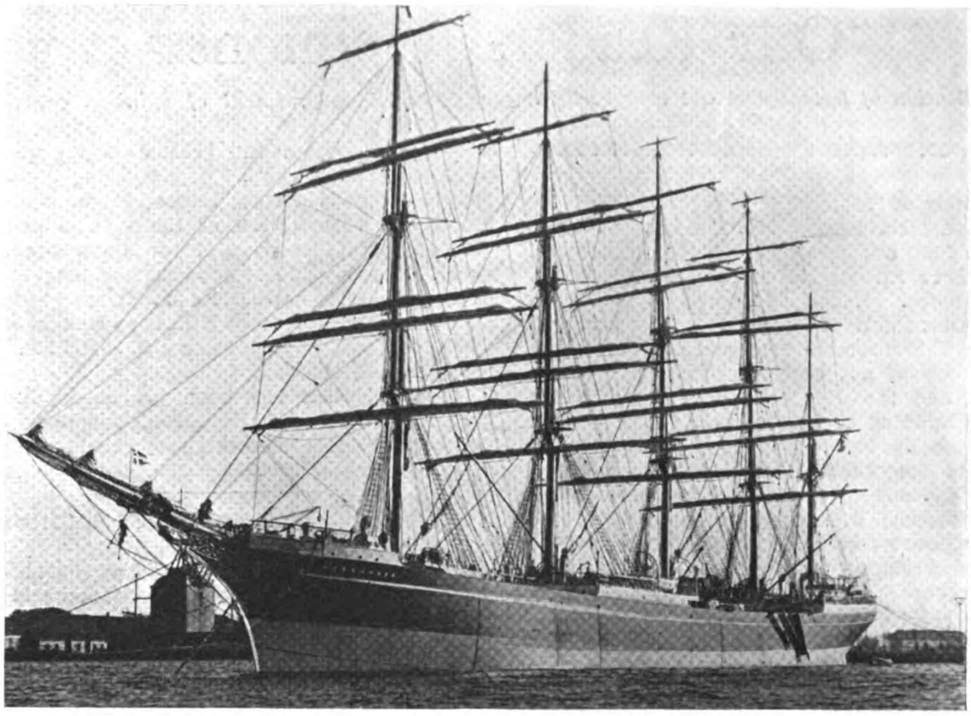
The twin-screw Diesel-driven combination passenger and cargo ship "Dumra" was launched on November 16th by Charles Hill & Son, Bristol, England, to the order of the British India Steam Navigation Company. This vessel was specially designed for a new service on the African coast and has accommodation for 24 first and 24 second-class passengers, in addition to accommodation for native passengers between decks. She is propelled by a pair of 600 shaft h.p. North British four-cycle type Diesel engines. Length is 280 ft. over-all, 48 ft. 6 in. breadth, and 24 ft. to upper deck. She will have a cruiser-type stern.

INSURANCE OF MOTORSHIPS

Owing to the higher rates asked by Norwegian insurance companies for motorships, owners of oil-engined vessels in that country formed a pool as they consider that the risks involved are not greater than for steamers and so do not warrant higher premiums. In this connection should be pointed out that first-class Danish motorships are covered at the same rates as prevail for steamers. In fact, ship chandlers abroad do not welcome motorships in port as they know from experience that they stand few chances of selling packings or spare parts, as it is only very occasionally that a motorship needs repair.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS' MEETING

During the week of the Marine Show held in New York November 14-19 the general meeting of the Society of Naval Architects and Marine Engineers was held on November 17th and 18th. The attendance was very good, many members taking advantage of the opportunity to inspect the exhibits at the show while in the city for the society meeting. Among the many interesting papers presented were the following in which Diesel-engines featured:



"Kobenhavn," the big Diesel-driven training-ship of East Asiatic Company

"Electric Propulsion of Ships," by W. E. Thau, general engineer, Westinghouse Electric & Manufacturing Co.

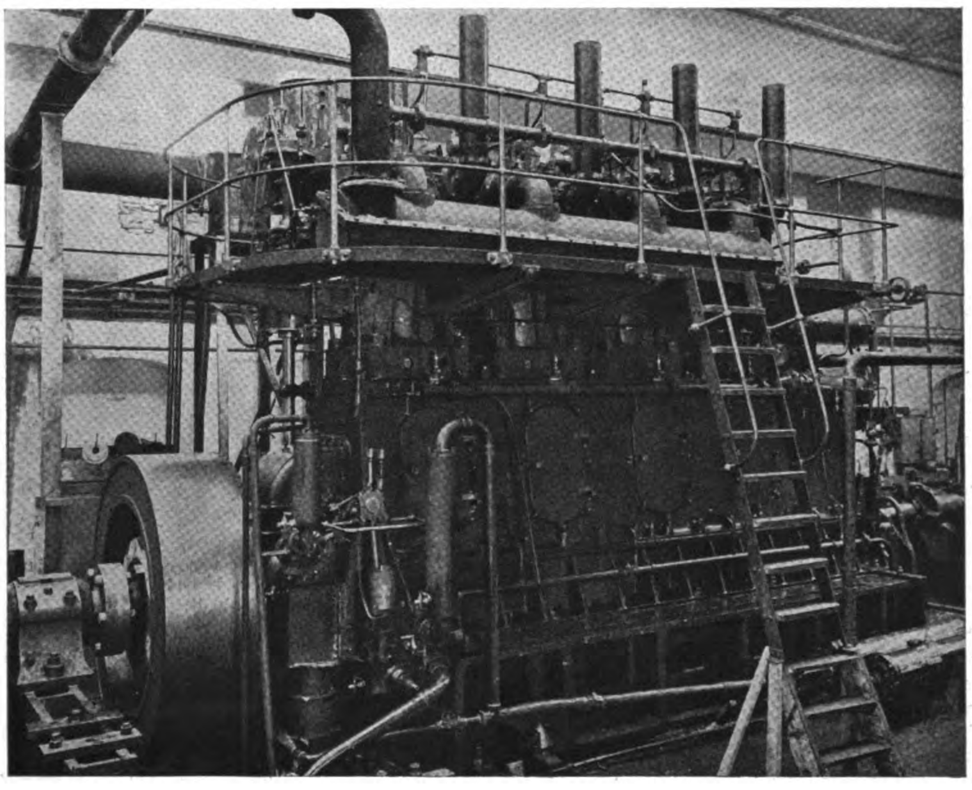
"Electric Auxiliaries on Merchant Ships," by E. D. Dickinson, mechanical engineer, marine department, General Electric Co.

In the former paper the principal types of electric propulsive equipments were analyzed on the score of reliability, maneuvering ability, economy, weight, space, maintenance, cost and operation, with the result that the Diesel-electric drive was found to provide an electric-drive "as reliable as any economical drive, weighing less than any other drive, as economical as the best, in most cases costs less than any other drive, provides more reserve power in case of casualty to prime movers, and affords simplest and most flexible control." Mr. Thau said among other things: "The Diesel-electric has the greatest range of application of any of the economical drives, geared turbine electric not excepted.

Because of the inherent merits of this drive, it is very suitably applied to merchant-ships, barges, river-boats, lake-boats, ferry-boats, small coastwise-vessels, yachts, fishing-boats, coastguard cutters, cable-laying ships, and any ship within its capacity requiring refined control and economical operation over a wide range of speed. As compared with any type of steam drive, the principal advantages of the Diesel-electric are: Fuel-consumption; weight; control; considerably more reserve power."

An animated discussion followed the reading of this paper, going into the question of the suitability of induction and synchronous motors, comparisons of steam and Diesel-electric drive, etc., and it was noted that only one speaker talked in favor of steam as against the Diesel-drive. The concensus of opinion among engineers agrees with the conclusions reached by Mr. Thau quoted above.

Following the reading of Mr. Thau's paper Mr. Dickinson presented the paper on "Electric Auxiliaries on Merchant Ships." The advantages and saving in cost of operation of electric-winches over steam-winches were covered in this paper. Referring to the motorship Mr. Dickinson said: "Because electricity makes possible many reductions in the cost of operation and at the same time enhances the earning power of a ship, it is being used to a never-increasing extent for driving the machinery on ships. On highly efficient new ships, especially motorships, practically all the auxiliaries are driven by electric motors. In the motorship the steam-boiler becomes an auxiliary, and it is apparent that much of the gain in economy secured by the oil-engine would be sacrificed if steam auxiliary machinery were retained. In the steamship, the losses incident to the steam auxiliaries are not so apparent; nevertheless, they are there, a constant drain on the boilers and a continual handicap to any operator or engineer endeavoring to attain efficiency in operation. It is recognized that a somewhat greater gain in fuel-economy is generally secured on a motorship by the adoption of electricity for the reason that Diesel-engines are employed to drive the generators."



The 600 b.h.p. non-reversible Burmeister & Wain Diesel engine of the "Kobenhavn"

COMING TECHNICAL PAPERS

The North East Coast Institution of Engineers and Shipbuilders, at their meetings of the current session will have many papers, the following among them being of interest to those having to do with Diesel engines:

"The Use of Compressed Air in Diesel-Engine Ships," by Mr. William Reavell. To be read on Jan. 13, 1922.

"Marine Diesel and Marine Oil Engines," by Mr. K. O. Keller, to be read on Jan. 27, 1922.

"Running Costs of Diesel-Engined Ships," by Mr. F. Madsen, to be read on Feb. 24, 1922.

"Diesel Engine Design," by Mr. Paul Belyavin, to be read on March 20, 1922.

VARIATIONS IN DIESEL-ENGINE DESIGN

A paper on variations in Diesel-engine design, illustrated by lantern slides of over 20 leading makes, was given before the Pennsylvania section of the Society of Automotive Engineers on November 22nd at the Engineers' Club, Philadelphia, by the Editor of "Motorship."

Our Readers' Opinions

(The publication of letters does not necessarily imply Editorial endorsement of opinions expressed)

—SAYS A SHIPYARD ENGINEER BACK FROM EUROPE!

To the Editor of "Motorship":

I returned from Europe last Sunday, but while over there I did not have as much time as I would have liked to investigate marine Diesel-engines and motorships. I, however, have no hesitation in saying that the next few years will see a great advance in this direction. Shipowners who a few years ago would not listen are now very much interested and the shipyards and engine shops are either building or getting ready to build this class of vessel.

One large shipyard I visited is building a standard 3,000 h.p. engine to fit their standard 12,000 tons d.w. vessels, and are confident that in the very near future they will receive orders for the Diesel-type of engine to replace the steam power plants at present installed in existing standard vessels.

There are several types of engines and it is a difficult matter to decide which is the best as the general opinion of engineers is divided. But, I am confident that within a year or possibly two years we will have motorships with machinery perfectly reliable and operating at a very much lower cost than at present.

From what I saw and heard, I find that we have got to push ahead faster than we are at present if we want to stay in the race and keep the American flag on the sea.

J. S. MILNE,
Chief Engineer,
Todd Shipyards Corp.,

25 Broadway, N. Y. C.
August 18, 1921.

MOTORSHIP "CHARLIE WATSON" IS RELIABLE SAYS HER ENGINEER

Aug. 29, 1921

To the Editor of "Motorship,"

I have read with much interest your great effort in bringing-out through the columns of the "Motorship" absolute facts and true statements as regards the "future propelling-power for ships."

My experiences with steam, gas and producer-gas engines mostly marine installations, dates back to 1900, and it surely was a "He-Man's" job to keep some of those "installations" in operation at that date.

At the present time I am in charge of my first Diesel installation, and what I can say of this is as follows—reliable, economical and very interesting, and a "power" that must have a wonderful future.

FRANK COULTER

M/S "Charlie Watson,"
At Sea, Off Pacific Coast.

[The "Charlie Watson" is a twin-screw tanker propelled by two 640 I.H.P. Werkspoor Diesel-engines built by the Pacific Diesel-Engine Co. of Oakland, Cal.—*Editor.*]

"SOLID INJECTION," "MECHANICAL INJECTION" AIRLESS-INJECTION, PUMP-INJECTION OR "UNMIXED VAPORIZATION"?

To the Editor of "Motorship":

For everything that is apt to grow in importance it is advisable to have it well named, that is to say, to avoid any denomination that may give rise to error as regards its character. Many of your readers will agree with me that the name of "Solid-injection," which is widely used for the system of vaporizing fuel without the aid of air under pressure, is not wholly justified by the character of the system. Far from being "solid," the fuel spray has, on the contrary, to be as finely spread as possible, and so the name "solid-injection" cannot satisfy.

In another sense the same is the case with the denomination "Mechanical-injection." With air-vaporization the process has to be regarded as a mechanical one too (the air is compressed mechanically); so the term is not justified and gives no exact indication as to the character of the system.

It has to be recognized that it is not very easy to give a word that will satisfy all, but I have endeavored to seek a denomination that rightly indicates the system and present it to the wide circle of your readers. In my view, "*Unmixed Vaporization*" is a right indication for a system, where the vaporization of the fuel is acquired without mixing it with air or another gaseous agent. Possibly one of your readers may present us a still better word. No doubt many of your readers would be pleased with it as well as

S. SNUYFF,

Bloemendaal, Holland.

[Pump-injection has been proposed. Another good suggestion made is "Airless-injection." Further correspondence on this subject will find space in our pages.—*Editor.*]

INSPECTION OF MOTORSHIP MACHINERY

To the Editor of "Motorship,"

If we are to keep on building larger and better motorships, why doesn't someone start a campaign for the establishment of separate inspectors for the machinery of motorships. I imagine the inspectors of boilers have their hands full attending to the steamships and examining candidates for steam engineer's licenses. We all know that small American motor vessels are often sent to sea in a condition that dooms them to failure from the start.

I have the most profound respect for the work that has been done and is being done, for the steamships, by the inspectors of boilers. And also I greatly admire the type of men usually found occupying the positions of inspectors of boilers and in charge of the machinery of our big steamers. I wish the "motorship game" had more engineers of the type of old school steam-men. However, is it well for motorships to be inspected and motor engineers examined and licensed by men who, in many cases, have never seen an oil-engine and, in most cases, have never operated one?

JOSE E. MERRILL

M. E. B. A. No. 49,
San Francisco, Cal.

SIXTY-ONE DAYS' NON-STOP RUN

To the Editor of "Motorship":

I've never read an article or notice about the auxiliary "La Merced." Tho very badly under-powered, I believe this little vessel is one of the most reliable auxiliaries under the American Flag, as far as her power-plant is concerned. She is about 1,650 tons net register and is equipped with two 160 H.P. Bolinder oil-engines. She is about five years old and, tho she broke a crankshaft on her first trip, she hasn't had a bit of important repair work since except the usual overhauling for cleaning purposes. We have just finished a voyage from Australia during which the port engine ran continuously from Newcastle to Frisco without a stop for 61 days. The starboard engine was stopped 24 hours by captain's orders, due to good wind. The Bolinder agents here tell us that the 61 day continuous run of the port engine established a new record. Incidentally, after a voyage to four different ports in New Zealand and two in Australia, nine months altogether, we have cleaned out the cylinders, made the few minor repairs necessary, with only the ship's three engineers and are at sea again 11 days after coming in from Australia.

We laid nearly three months in Newcastle for cargo, during which time we never touched the engines except to run them about an hour once a week to keep them limbered-up. I think the success of this ship has been largely due to the fact that the engines are installed on long, heavy iron beds.

There have been two or three cylinder-heads cracked. But a cracked-head doesn't necessarily mean a shut-down on a Bolinder job. We ran 30 days with a cracked-head and could have just as easily run 30 days longer. We repair them by shrinking a steel band around the circumference of the head.

Referring to the letter from Mr. Haggett of M. E. B. A. No. 52, published in your July, 1921, issue, I want to say "More power to you, Brother Haggett, you've got the right idea." There has seemed to be a general impression heretofore that the main requisite for a good oil-engineer was a well-defined foreign accent. Wishing all success to you and your excellent magazine—

JOSE E. MERRILL

M. E. B. A. No. 49,
San Francisco, Cal.

REVERSING RUDDERS FOR CANAL BARGES

To the Editor of "Motorship":

In view of our Kitchen patent reversing-rudder, I am greatly interested in the article appearing on page 720 of the September issue of "Motorship" under the heading of "Economical Transportation on the New York State Canal" in which it gives a very good reason why it is thought that twin-screw installation should be employed as a propelling unit on the type of barges shown in Figure 1, page 720. The article also states that "In Canal operation long non-stop runs at full power do not occur. The difference between the essentially intermittent service required on the Canal and the long, hard grind, say, of a transatlantic voyage, etc., etc."

You will readily realize the importance of the part which the reversing rudder will play in Canal transportation. For example, the same long non-stop run as the large ocean-type of vessel makes can be attained by a single internal-combustion engine on a canal barge for the reason that at the beginning of the run the engine can be started and kept continually in motion until the barge reaches her destination. Further, with the Kitchen rudder the engine is always under a constant load and rotating in one direction only, i.e., ahead, and a single screw barge can be operated in such a manner as to outmanoeuvre any twin screw barge afloat without interfering with the continued ahead operation of the engine and propeller. Again, regardless of the block co-efficient of the barge and as long as there is a stream line to the single propeller, a barge will handle as efficiently as a fine-lined craft.

No doubt you are aware that any vessel equipped with this rudder is under perfect control without being under steerage way. For example, a barge can be rotated on its own axis, as if on a pivot, to either port or starboard without progression. This, I do not think, can be attained even by a twin-screw installation. As the Kitchen rudder is solely a one man control the navigator can handle and manoeuvre his craft through the various locks and canal bends without having to slow down or reverse his engine or propeller and can negotiate a turn even at right angles, from the steering position. This was demonstrated by our motor-cruiser "Violet" on her way from Washington, D. C., to Bridgeport. The boat entered the Raritan Canal and from the time she entered until she left, in passing through locks and in slowing down and negotiating bends, the engine and propeller on this boat were kept running in one direction only and at a steady speed, the engine being at all times under a constant load.

A single-screw engined boat fitted with the Kitchen rudder for canal work would give better steering and manoeuvring ability in the bends and locks of the canal than the twin screw barge with reverse gear. Further the attention necessary for a boat equipped with one engine is much less than would be necessary if two engines were installed. Take for example the canal barge installation as described and illustrated on pages 22 and 23 of the enclosed booklet. This is a reprint from "Canals and Waterways Journal" of May, 1920, as per pamphlet enclosed. This canal barge prior to installation of a comparatively small engine, 25/30 b.h.p., was towed in the usual manner by horses along the canal bank. You can see that since the installation the barge is under one man control and can negotiate bridges and locks in a manner as never before known. Further it helps to prove that no special type of craft need be built to accommodate these rudders as the block co-efficient of this barge is 0.86 which is fully recognized as being more of a box than anything else.

In regard to the diagrams as shown on 720 of the September issue of "Motorship" a single-screw barge of this type equipped with Kitchen reversing-rudders would be much more efficient than the twin-screw barge as described.

THE McNAB COMPANY,
Per, Alexander McNab, President.

Bridgeport, Conn.

OUR NOVEMBER EDITORIAL

To the Editor of "Motorship,"

The editorial in "Motorship" entitled "Wanted a Man of Resolute Purpose, Financially Backed by "Congress" I read with interest and am glad to see that "Motorship" is doing its bit to help along our merchant-marine. There is a big task ahead of us, and I trust you will continue to rouse public interest through your paper.

JOS. E. RANSDELL

U. S. Senate
Committee on Commerce,
Washington, D. C. November 12, 1921.

BUILD MOTORSHIPS—SAYS REPRESENTATIVE EDMONDS

To the Editor of "Motorship"

It was with pleasure that I listened to the speech of Mr. Frank Munson, made during the voyage of the "Southern Cross" from Philadelphia to New York. Mr. Munson is one of our most able shipping operators, and when he praised so highly the "motorship" as the coming vehicle of trade, he only confirmed my convictions made in 1916, and urged by me upon the various chairmen of the Shipping Board, I regret to say without any action on their part. Perhaps it was not possible to carefully develop or study the various motors during the war, with positive assurance of the results desired, but it is now becoming more evident every day that the motor for economy and efficiency is far in advance of any other type of propulsion for shipping. It will be absolutely necessary for us whenever opportunity occurs, or changes can be made reasonably, to endeavor to install and place in operation ships of this type.

In my opinion the future control of commerce will be attained by the nations using this method of propulsion for their ships.

G. W. EDMONDS.

House of Representatives,
Comm. on Merchant Marine & Fisheries,
Washington, D. C. October 11, 1921.

SULPHUR IN LUBRICATING-OIL

To the Editor of "Motorship":

For the past six months I have been in charge of the Diesel-engine end of an ice plant, due to no Diesel motorships calling here for operating-engineers, before I took this place. Records show that we produce more ice that ever before. This plant has two single-cylinder Snow Diesel oil-engines 22½" x 38" and 16¾" x 24" bore and

I am pleased to see something on lubricating-oil in June issue and would like more on lubricating-oil, also on fuel-oils, and if there is a way that an engineer can find out an unreasonable amount of sulphur content without sending a sample away for an analysis. I have a list of 57 grades of different brands of lubricating-oil showing the Baumé, flash, burn, chill and viscosity seconds at 100 F., 150 F., and 212 F. While part of list is old, the last was received a short time ago. I believe more study of oils and fuel will save much trouble on Diesel-engines. Also, another thing that I use here on drains of air-compressor, is a steam-trap to take off a large amount of water that leaks past a new cylinder liner.

Yours very truly,
G. A. PINNEO.

R1, Box 57, Tampa, Fla.

[A comprehensive article on fuel-oils is in our Year Book, now on sale, price $1.00.—*Editor.*]

"MOTORSHIP" APPRECIATED IN FRANCE

(Translated)

To the Editor of "Motorship"

Allow me to convey to you the pleasure that I experience in reading my copies of "Motorship." I am convinced that the merchant-fleet in the future will be composed of a great number of ships with Diesel-engines, and I am pleased to see publications like "Motorship" make efforts to interest shipowning companies to a comprehension of their true interests.

Y. LE GALLON.

Etablissements Delaunay-Belleville,
Saint-Denis-sur-Seine, France.

THE ENGINEER QUESTION

To the Editor of "Motorship,"
Sir—

I have received a copy of "Motorship," and find it to be a most wonderful magazine. I wish to ask a few questions and make a few comments on different articles in the June number.

In the article on the M.S. "William Penn" on page 471, it is stated that shipowners, upon ordering ships motor-propelled, should give their best steam-engineers the chance. All well and good. On page 481, regarding the article on the M.S. "California," let me tell Captain Pedersen that Americans are just as smart, if not smarter, than any Scandinavians. Also it is stated that if more Americans would go to sea, conditions would improve. This is all good dope. But, why don't more Americans go out? Because there are certain rules under which a man must work.

Take the case of the engineer, officers and men of lower grades. If a man would be a marine-engineer, he must swing a shovel for 36 months' sailing time. How many will do that? Very few!

Oil-burning steam plants made that situation a whole lot better. Then when a man goes up for his license, no matter how hard he studied and all that, he is liable to get a flat turn down unless he has some pull or stands in. I have known of cases on the Great Lakes where one man made a round trip from Buffalo to Duluth and return, went up and got papers for 1,800 tons as 1st Assistant Engineer. Another one fired four years and was turned down flat. He was an arduous student, too. There are lots of stationary steam-men who can handle marine plants, but very few marine men can handle stationary plants.

I was with a tug engineer one summer on the Hudson, who could not pass the New York City License Bureau, yet has a thousand-tons ocean license. I do not pretend to be a marine engineer, even if I do hold more than one license. But how are you going to get men who know their business for motorship engineers when you can't get enough steam men. If a man must (according to law) have at least one year's experience as a licensed steam man to be eligible for an oil-engine license, and he should be at least a year with the makers of such engines in all work from making to testing, I fail to see how you are going to man these ships with men who must necessarily have more brains than steam men. I would go as an oiler or helper on a motorship if I got the chance, but as they appear to want all A No. 1 men, I don't see any such chance.

Yours very truly,
R. G. SUMMERS.

Rochester, N. Y.

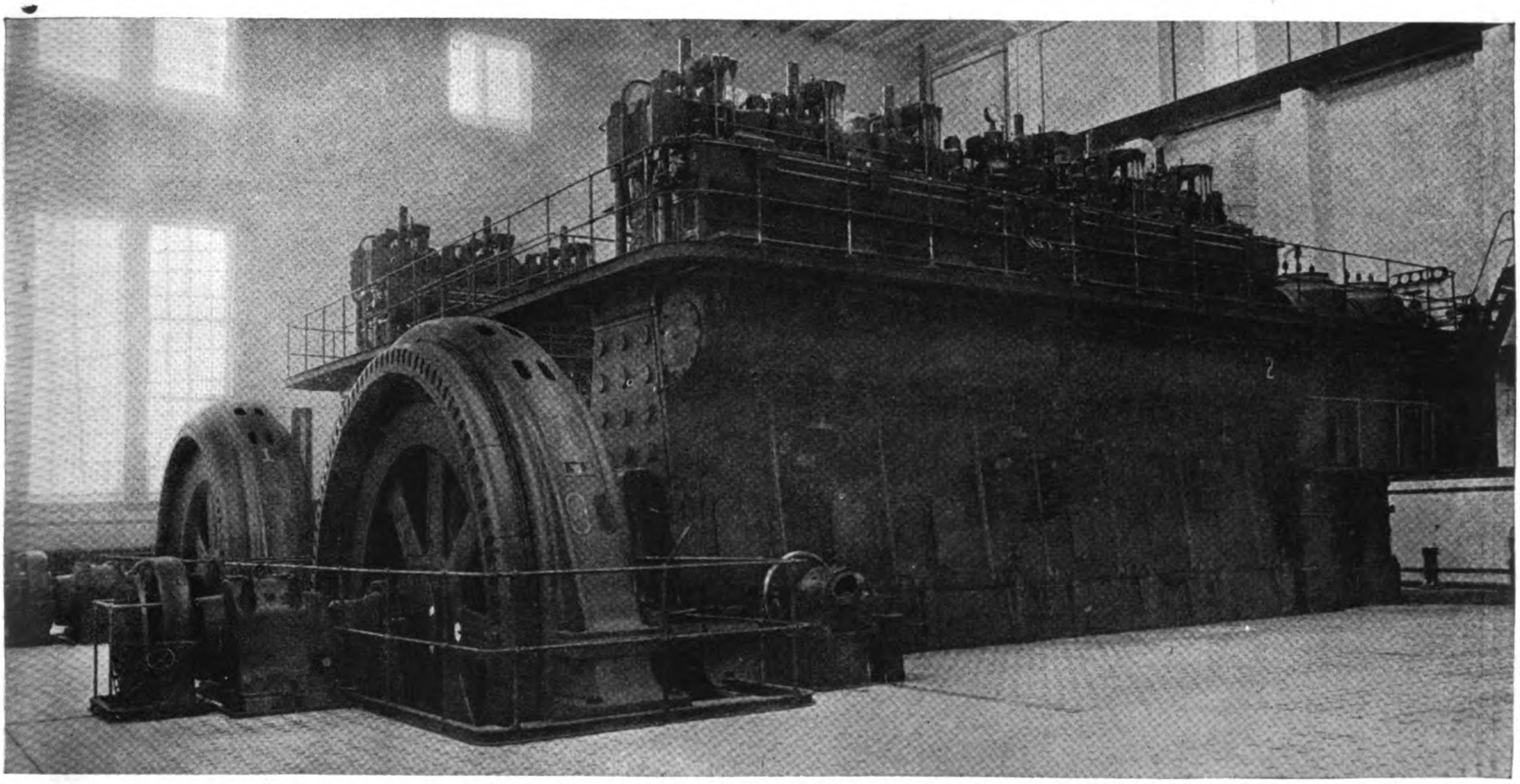
FROM A SWEDISH READER

To the Editor of "Motorship."

Since I first saw your magazine at the beginning of this year, when together with Mr. Hugo Moren I was an engineer on board the 9,400 tons motorship "Elmaren" during the marine-engineer strike, I have been a very interested reader. I want to express my thanks for several valuable articles. I think, largely due to your efforts, the opinions of American shipowners and shipbuilders are turning to the favor of motorships.

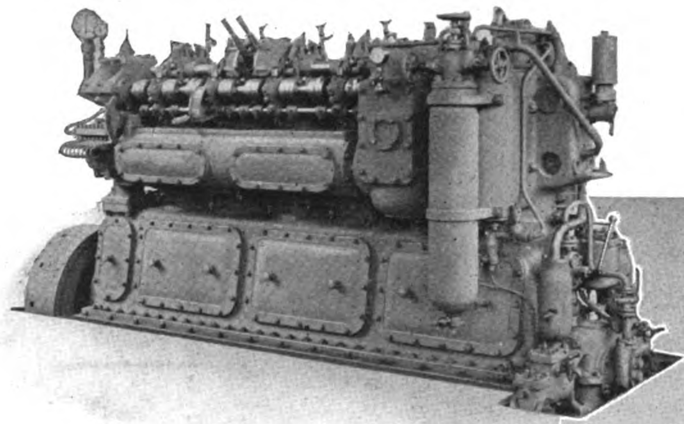
BERT H. BROWALL.

Civil Engineer,
Gothenburg, Sweden.

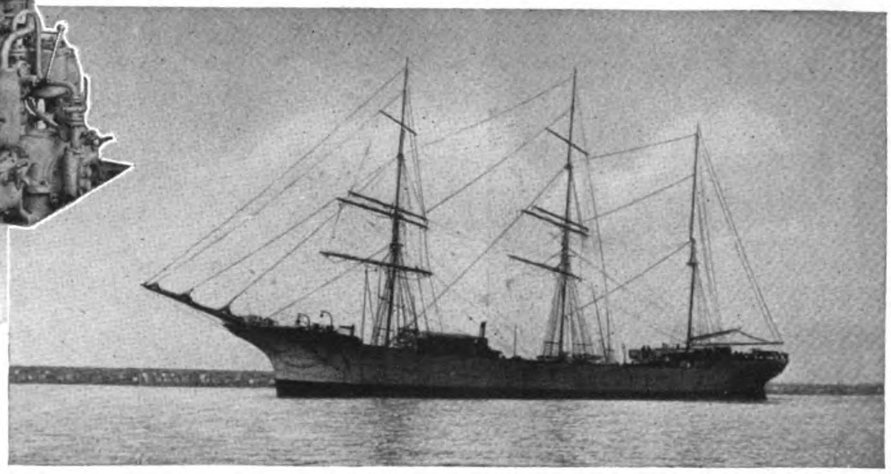


In view of the present interest in Diesel-electric drive, we are reproducing a photograph of two 6-cylinder 3,000 b.h.p. Sulzer, 2-cycle type Diesel-engines connected to generators at a power station at Bremen. In England and France there are two 4,500 b.h.p. Sulzer Diesel-engines driving electric-generators. Future development with the Diesel-electric drive aboard ships will probably show as many as 6 units of 1,000 to 2,000 b.h.p. each, in conjunction with single or twin screws

TWO-CYCLE DIESEL MARINE ENGINES



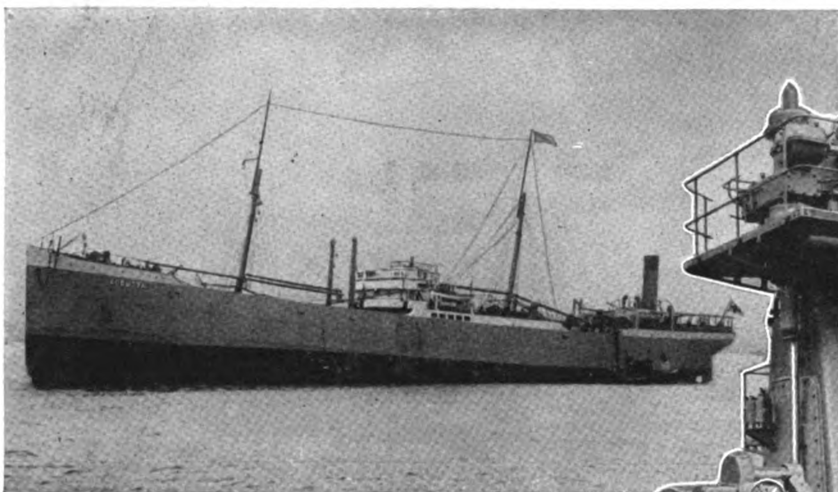
Smaller and medium-sized low-speed types
from 100—1000 HP for sailing ships, coasting and river service, medium-sized cargo-boats and passenger-ships, tugs, gun-boats, and yachts.

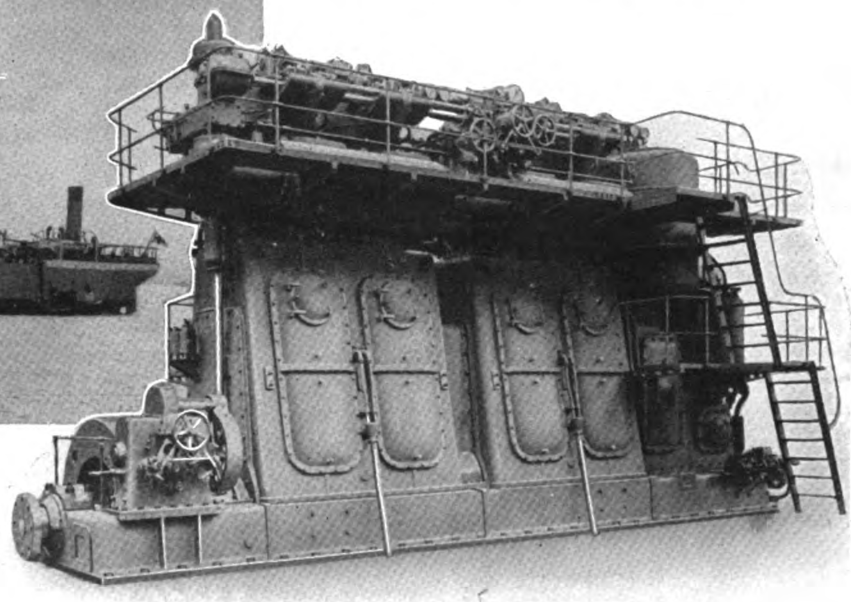


Sailing ship "Po"

SULZER

Cargoboat "Augusta"





Large low-speed types
from 1000 to over 6000 HP per unit for ships with one, two or more propellers, for ocean going vessels such as cargo boats, tankers, liners, etc.

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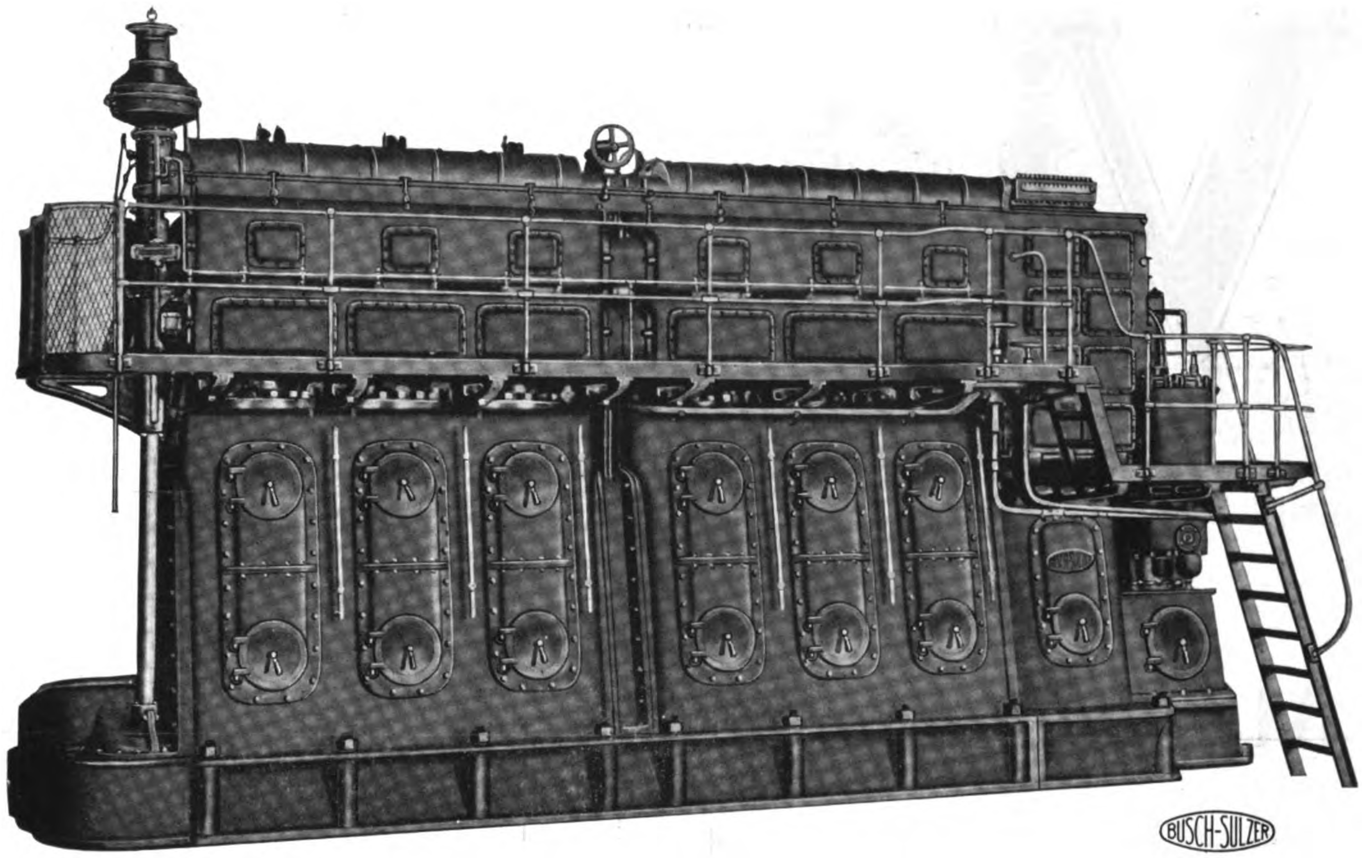

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Per Pair
1000 B.H.P. to 8000 B.H.P.

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For
Single & Twin Screw
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650 S.H.P. to 3750 S.H.P.

TWO CYCLE DIESEL MARINE ENGINES

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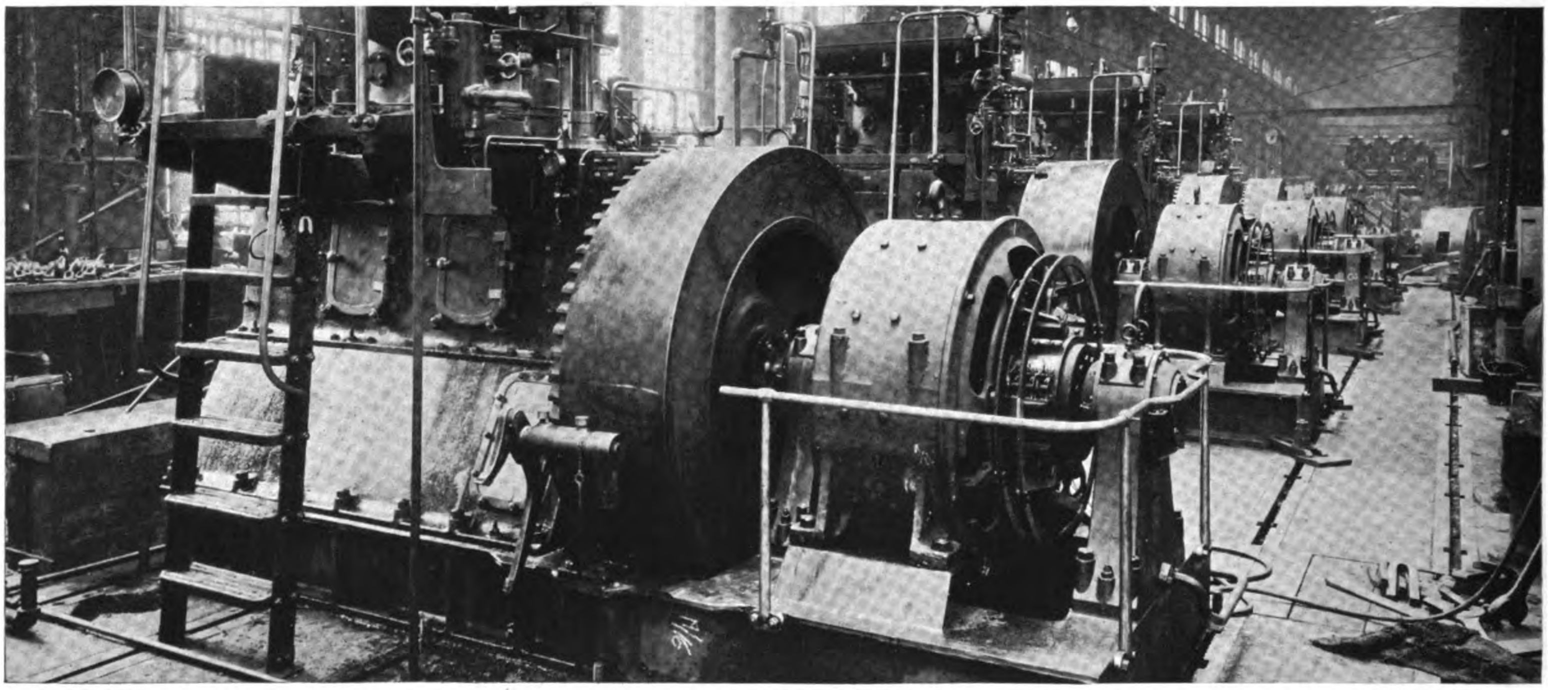

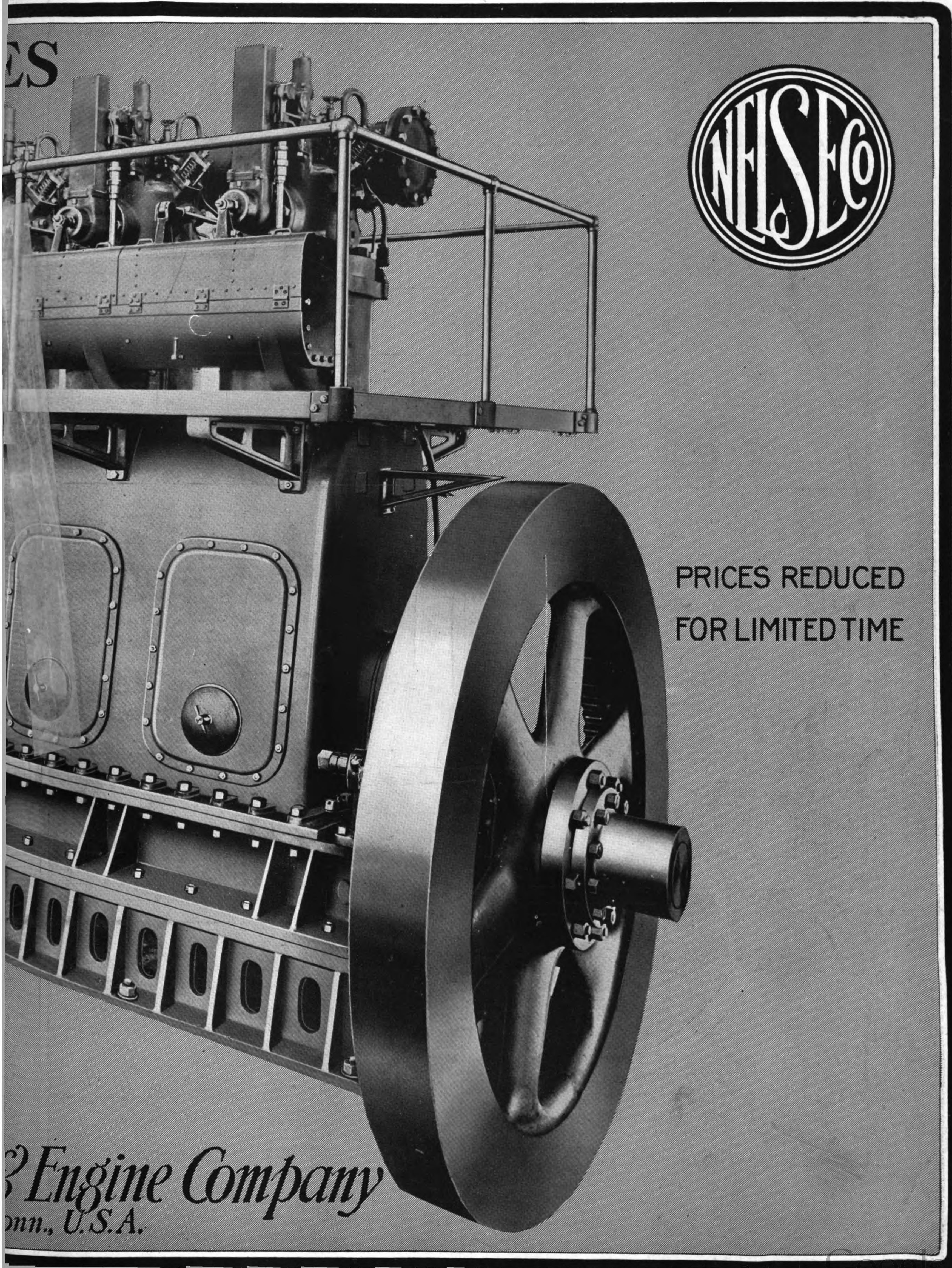
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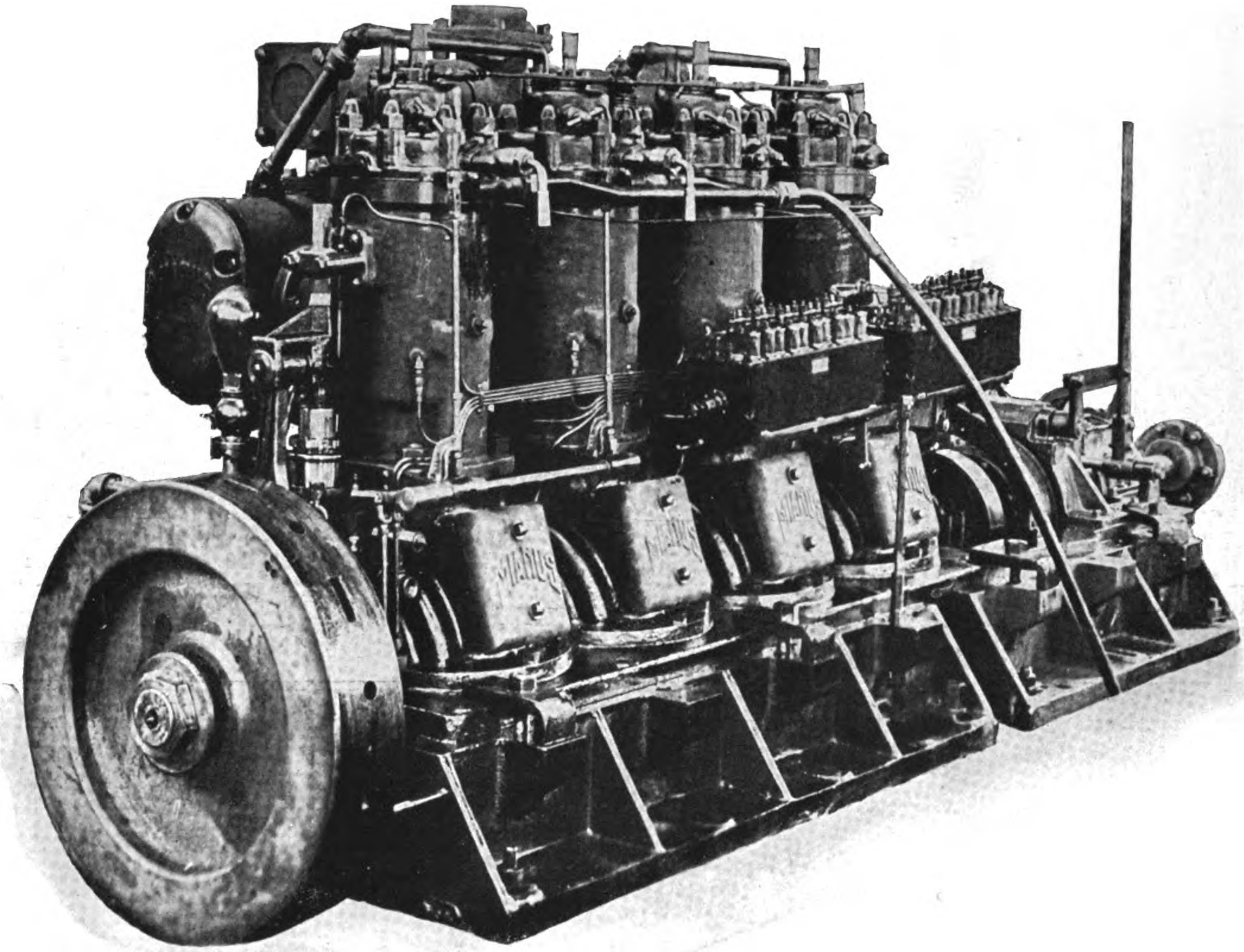

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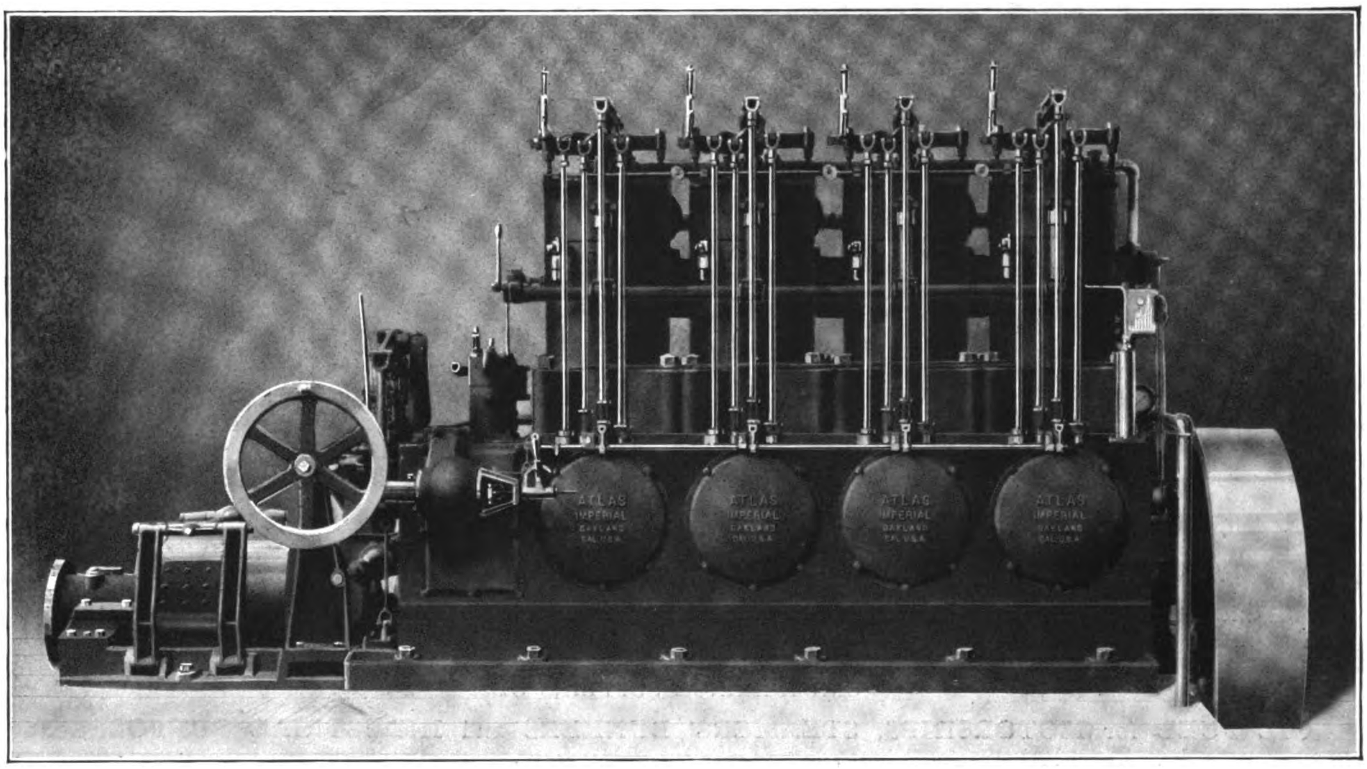

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BUILT IN 3, 4 AND 6 CYLINDER TYPES 55 TO 350 HORSE-POWER

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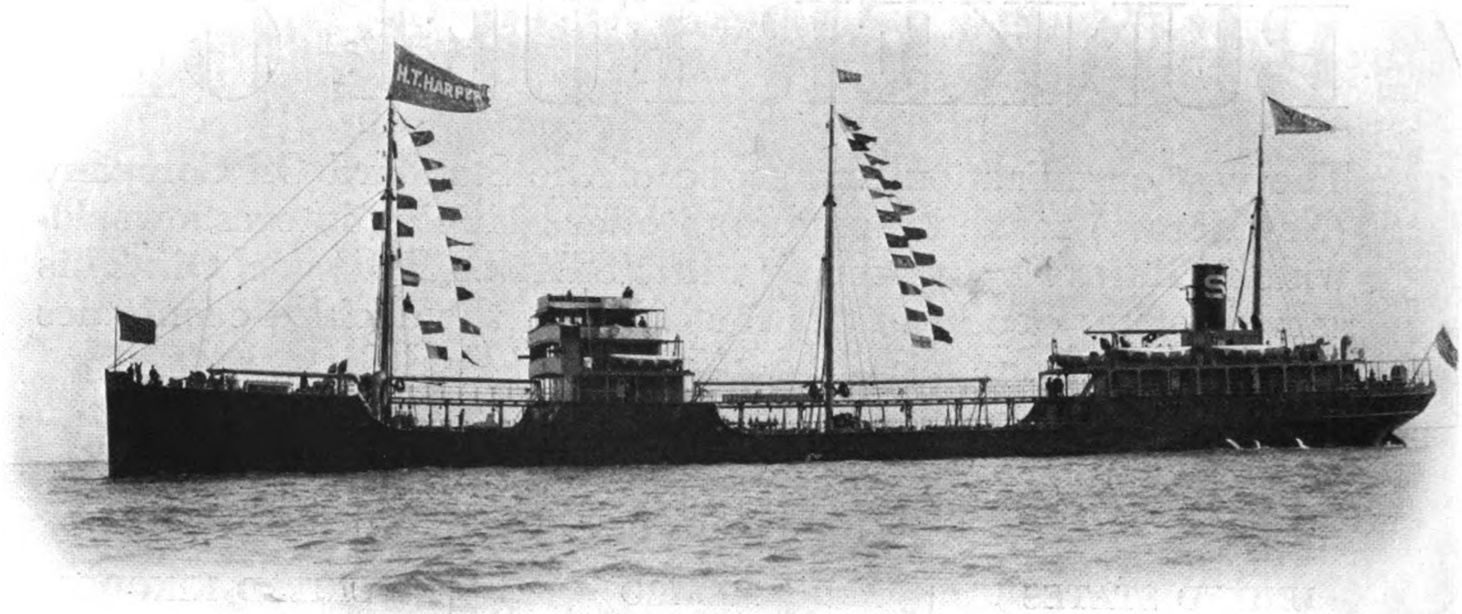

STANDARD Oil Company's New Pacific-Werkspoor Diesel-Driven Oil-Tanker "H. T. Harper" Surpassed All Expectations on Trials and on Her Maiden Voyage.

THE Results Demonstrate the Value of Experienced Assistance in Preference to Unguided Experimenting. She Is the Second Sucessful Werkspoor Diesel-Engined Motorship Built in America, the First Being the "Charlie Watson."

HER Twin 850 Shaft Horsepower Propelling-Engines Were Built by the Pacific Diesel Engine Co. of Oakland Under Werkspoor License and Under Supervision of Experts from the Werkspoor Works, Amsterdam.

Performance Average of the "Harper's" Diesel Engines

Shop Tests	1,694 Shaft Horsepower
Sea Trials	2,203 Shaft Horsepower
Maiden Voyage	1,783 Shaft Horsepower
Ship's Average Speed on Trials . . .	11.8 Knots
Ship's Average Speed on Maiden Round-Voyage	11.305 Knots
Fuel Used on Shop Tests . .	14 degs Baume Boiler Oil

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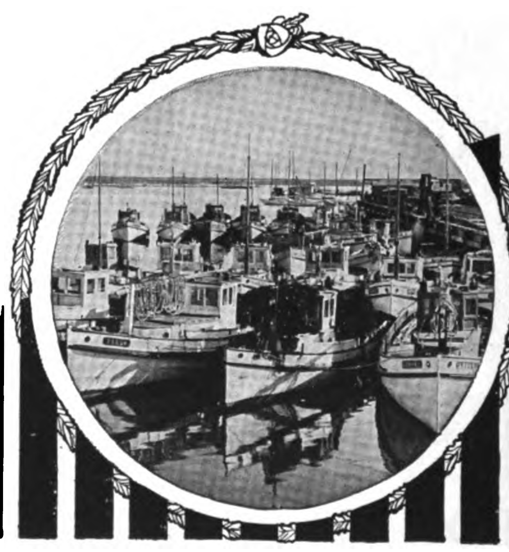

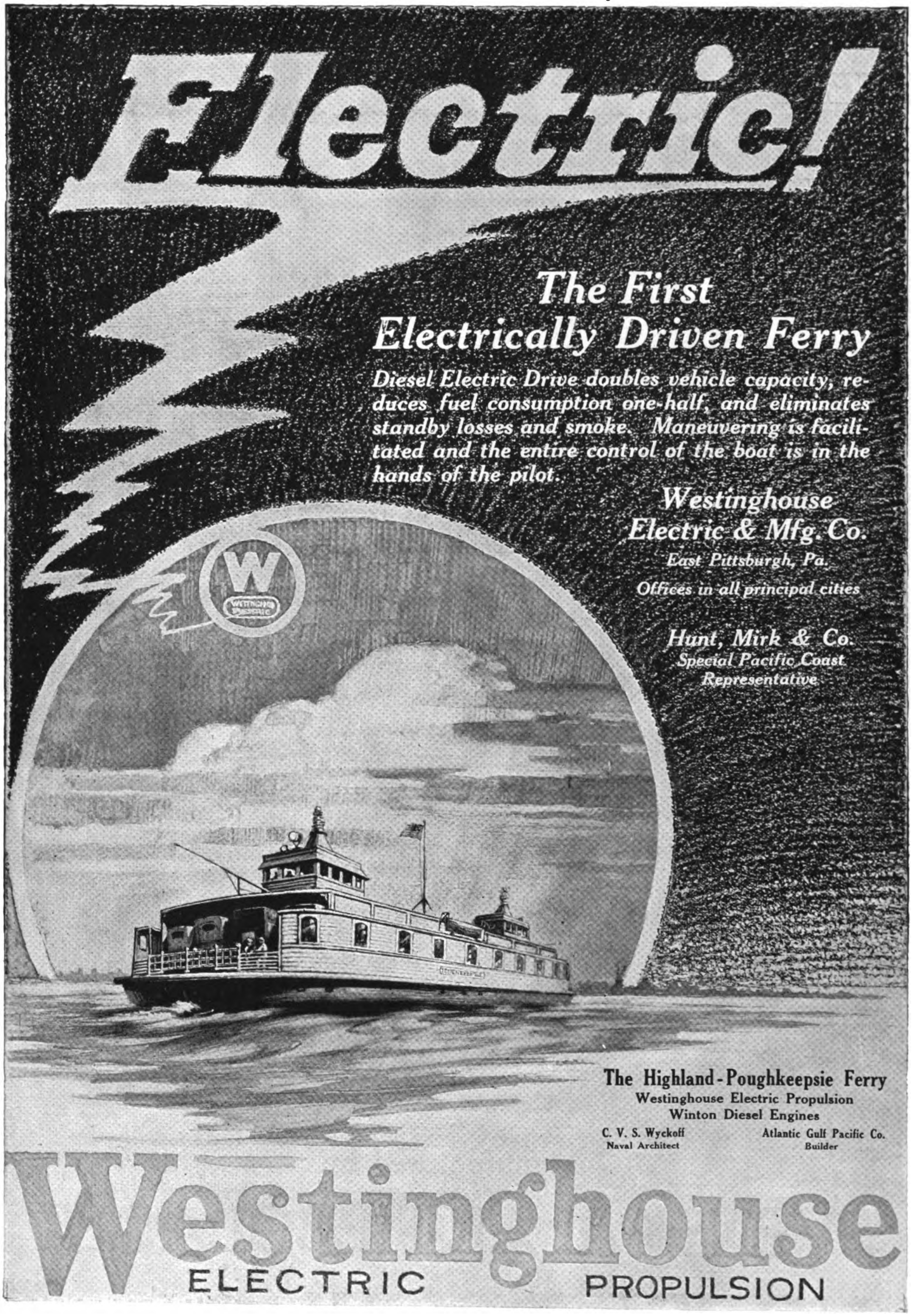
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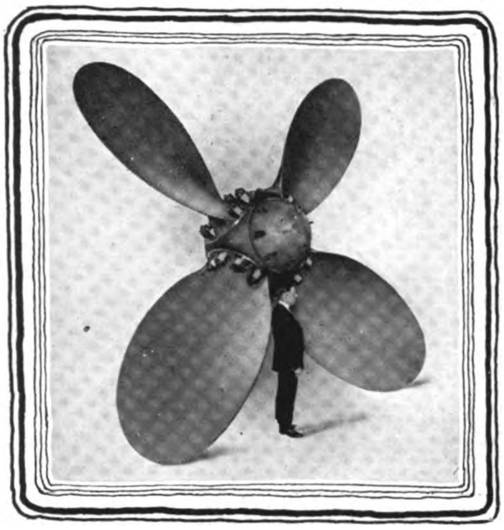
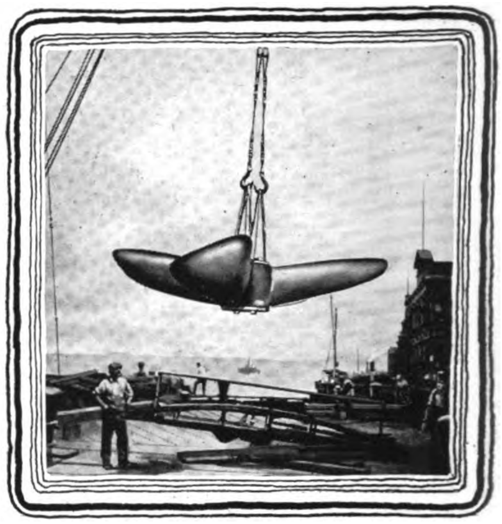
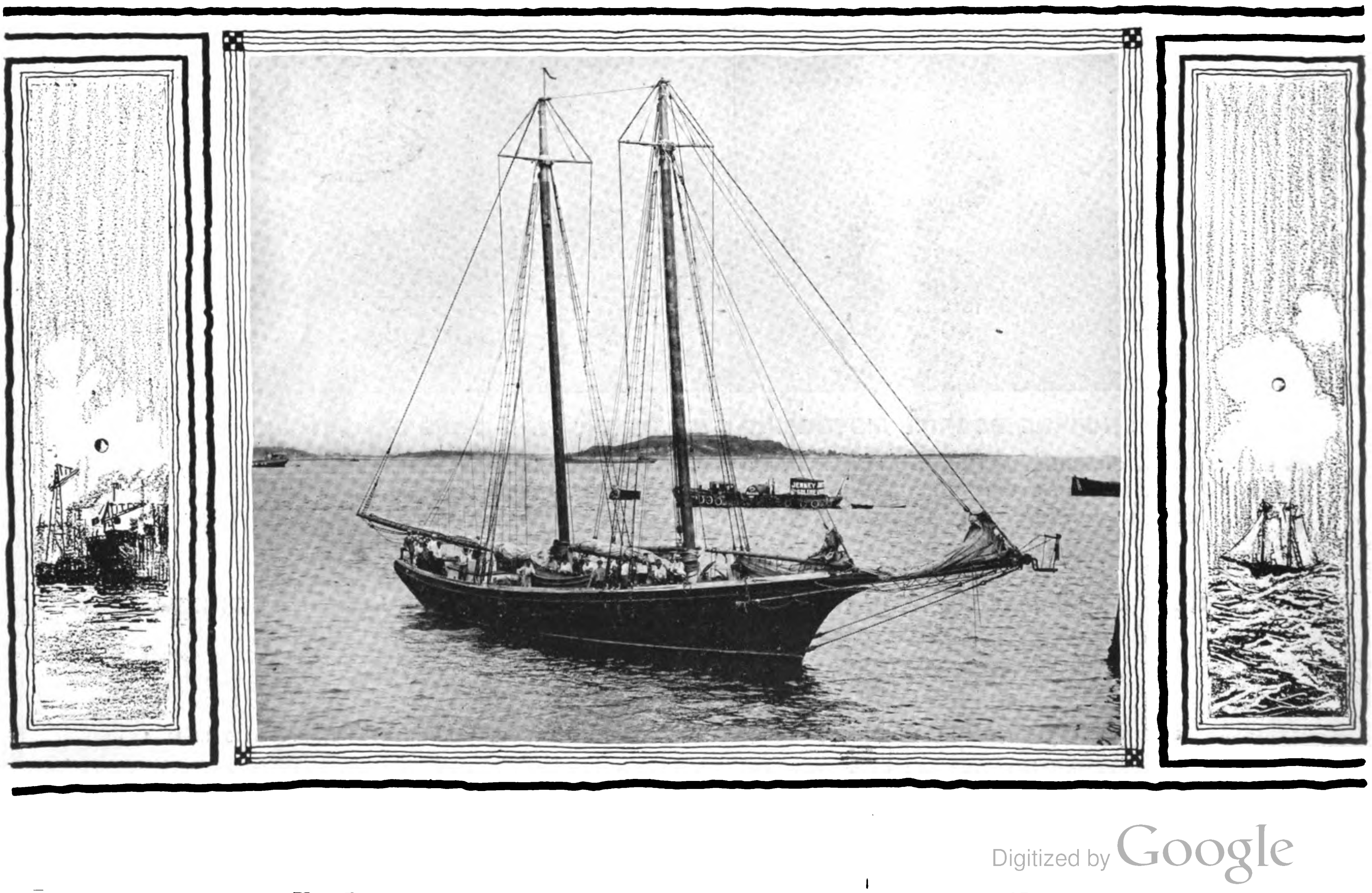
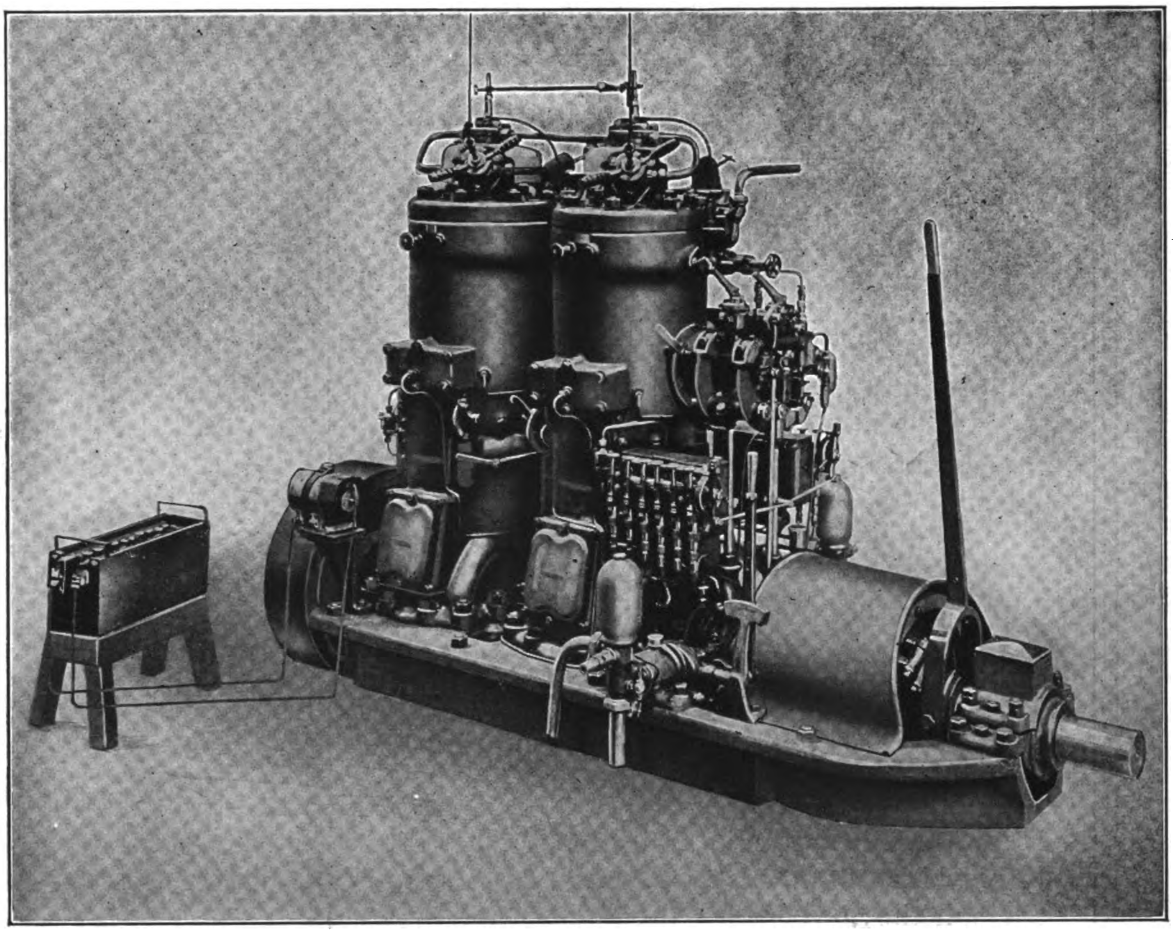






BOLINDERS



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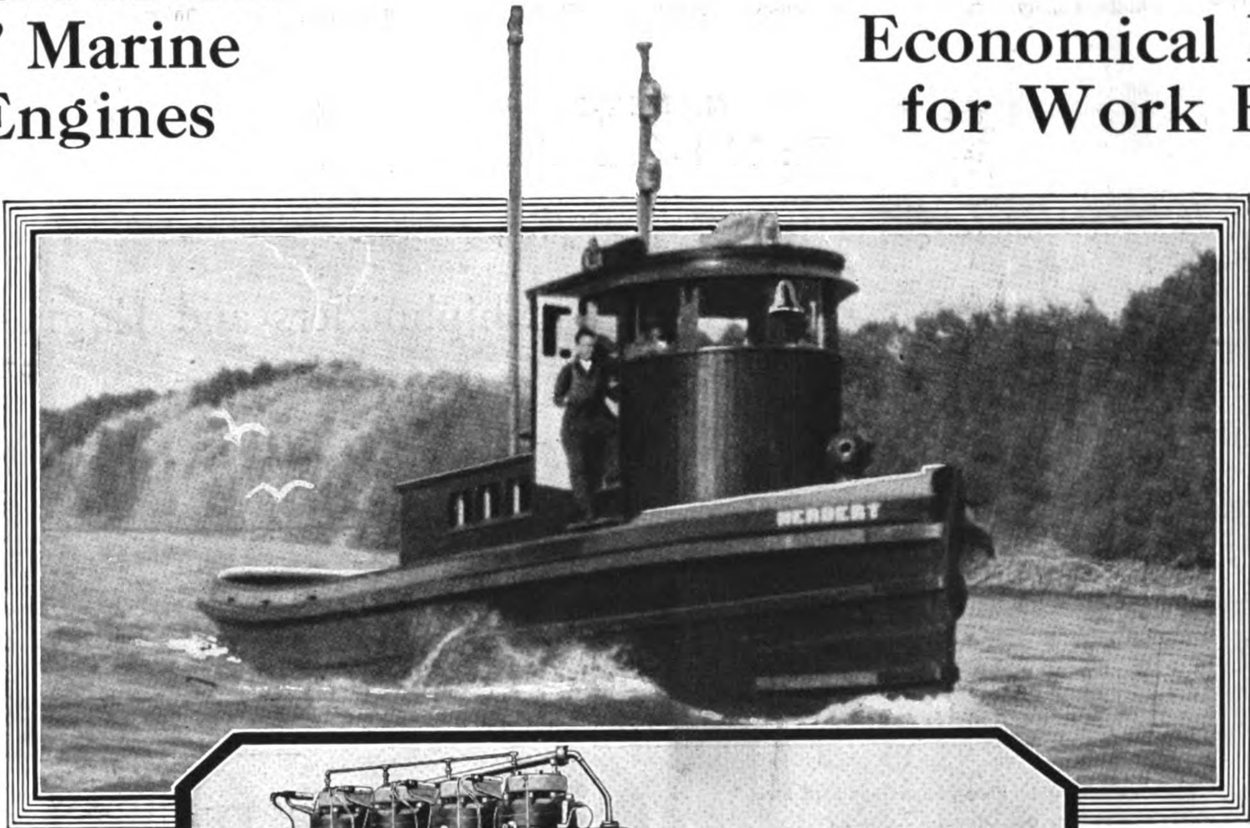
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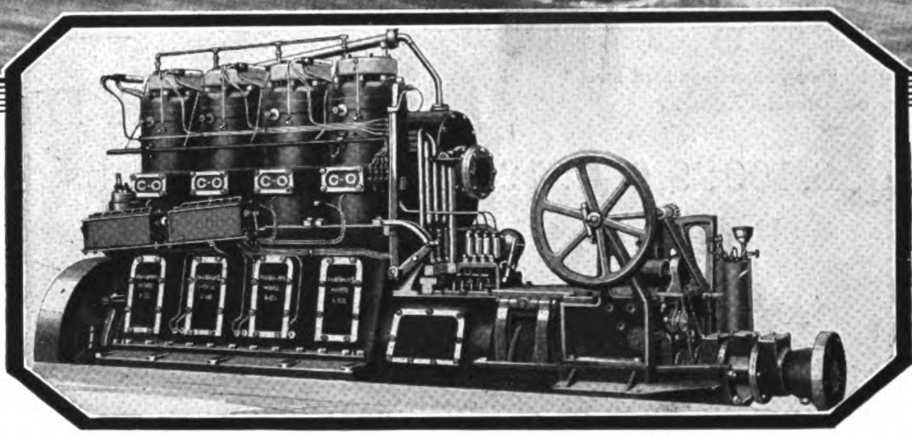

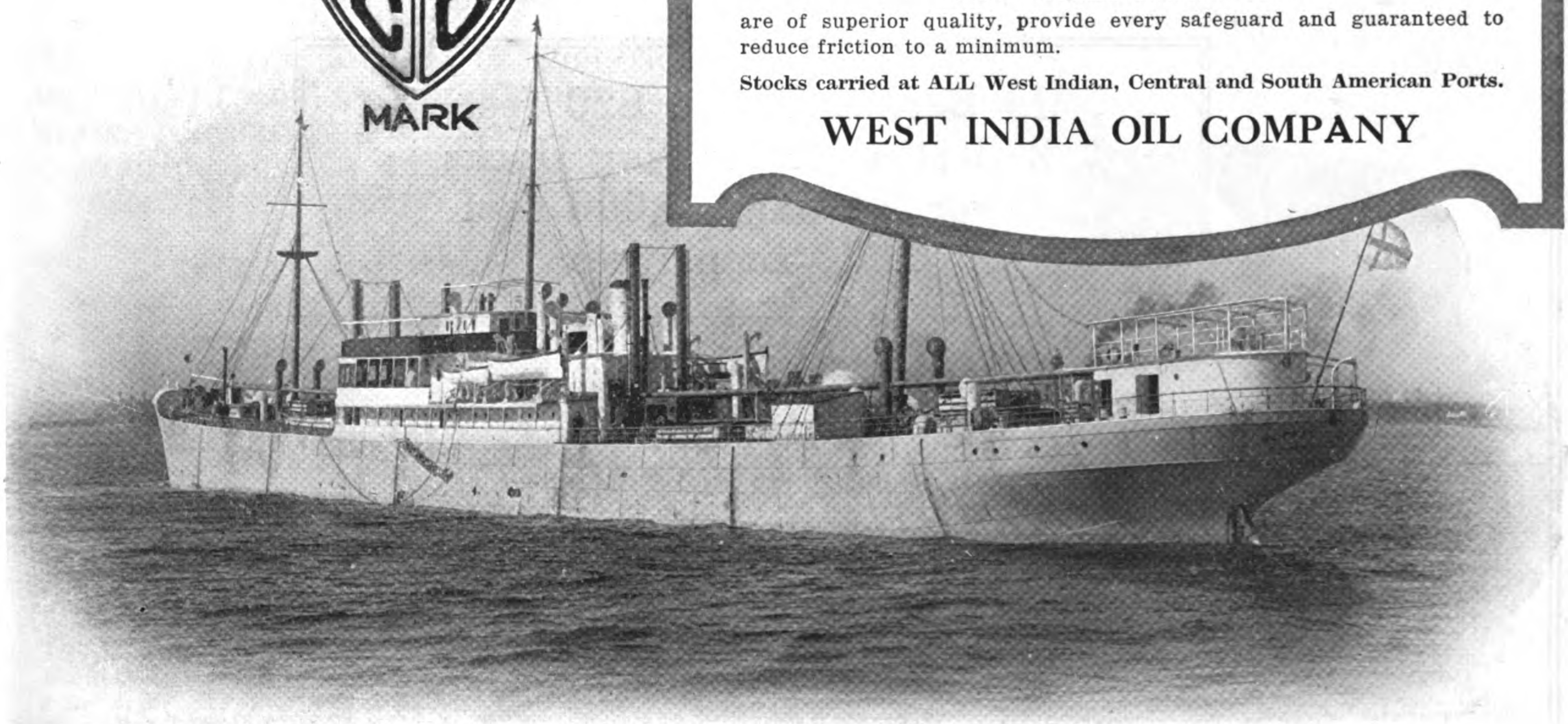

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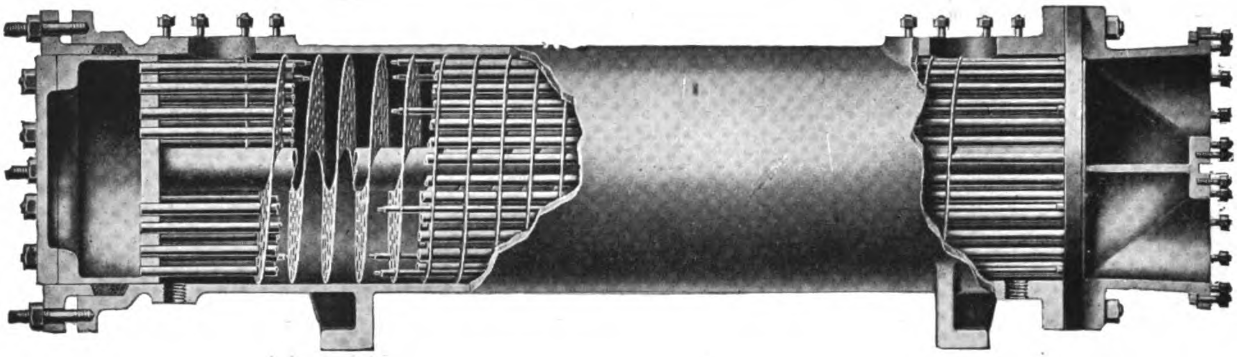

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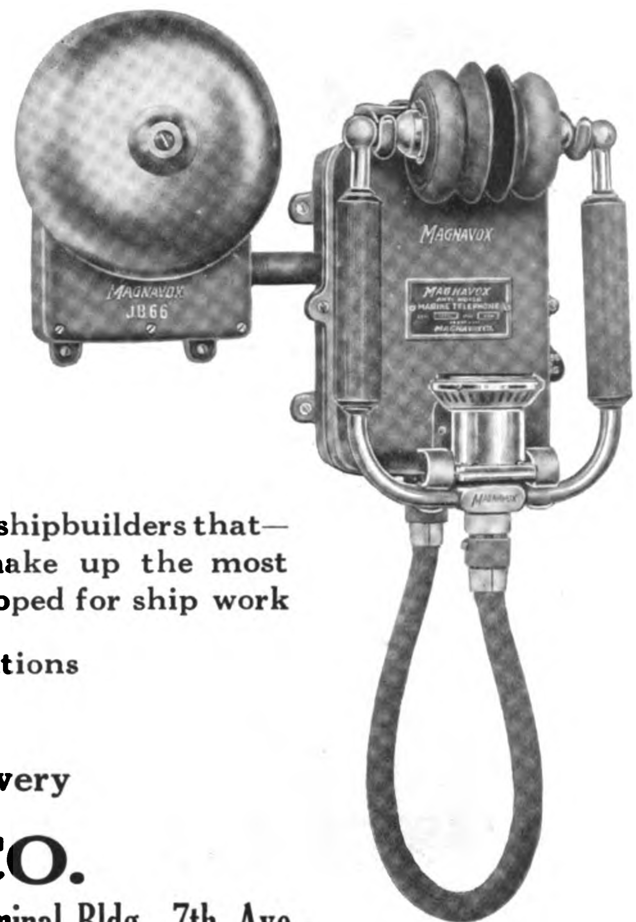

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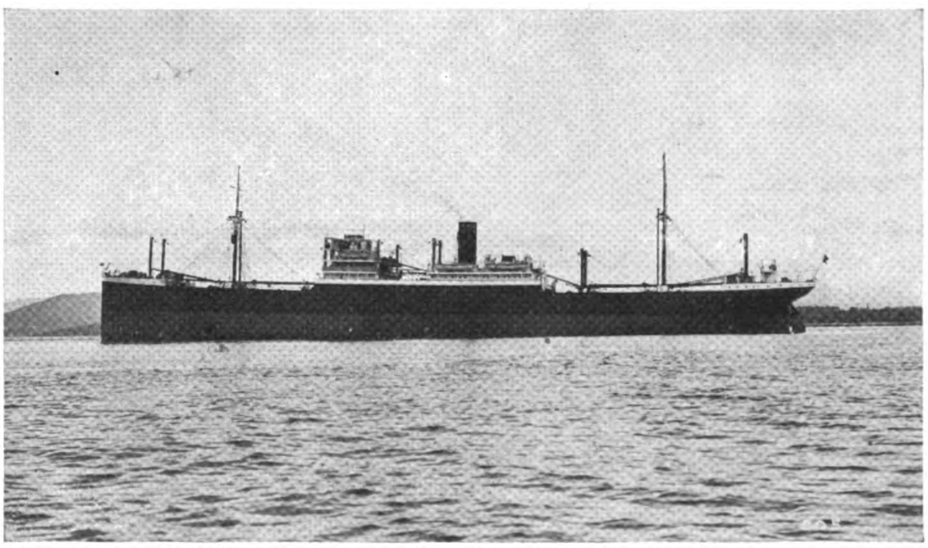

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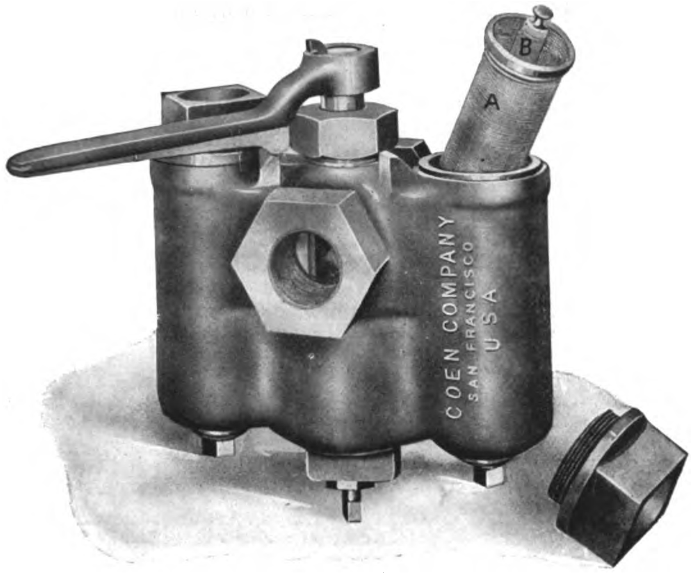

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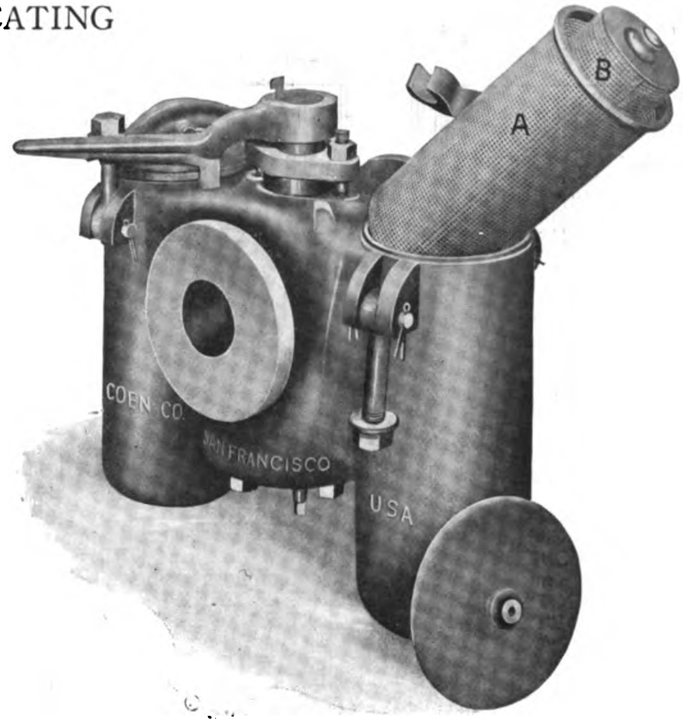

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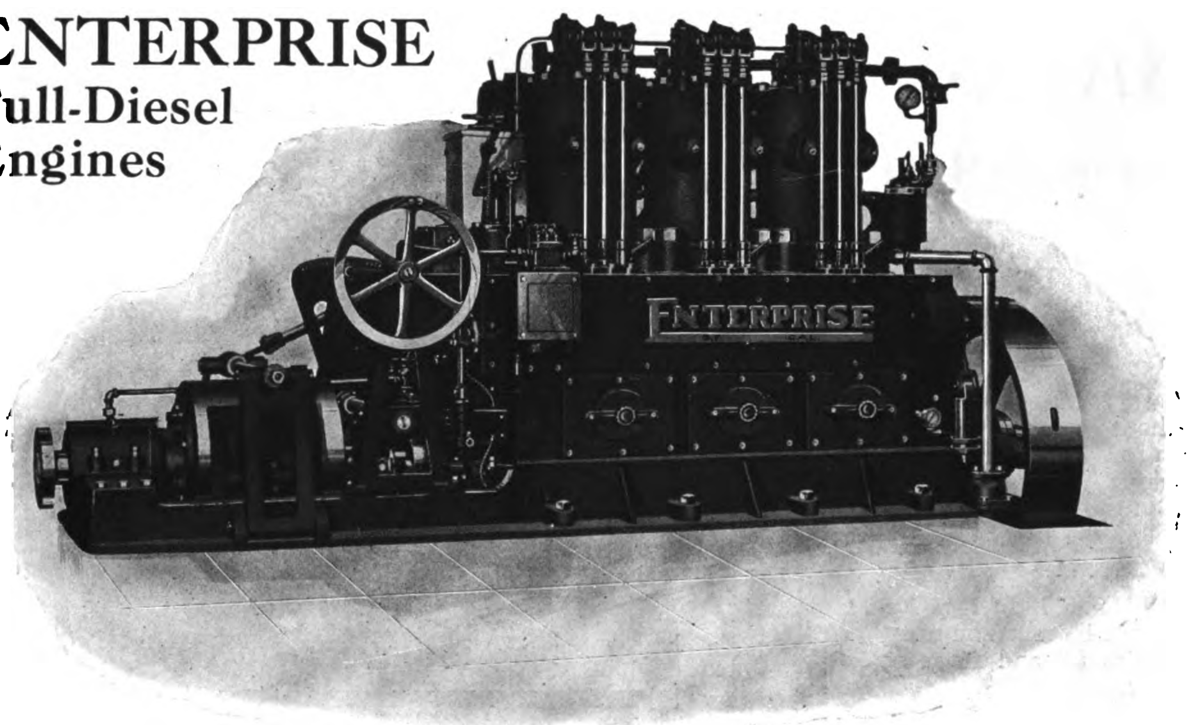

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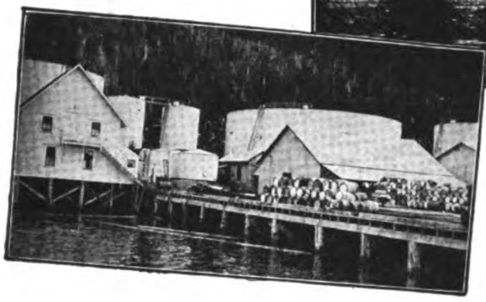




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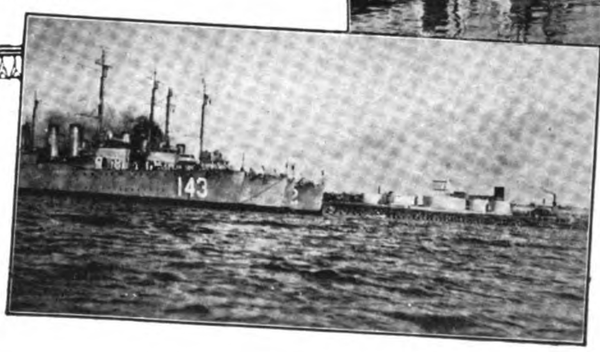
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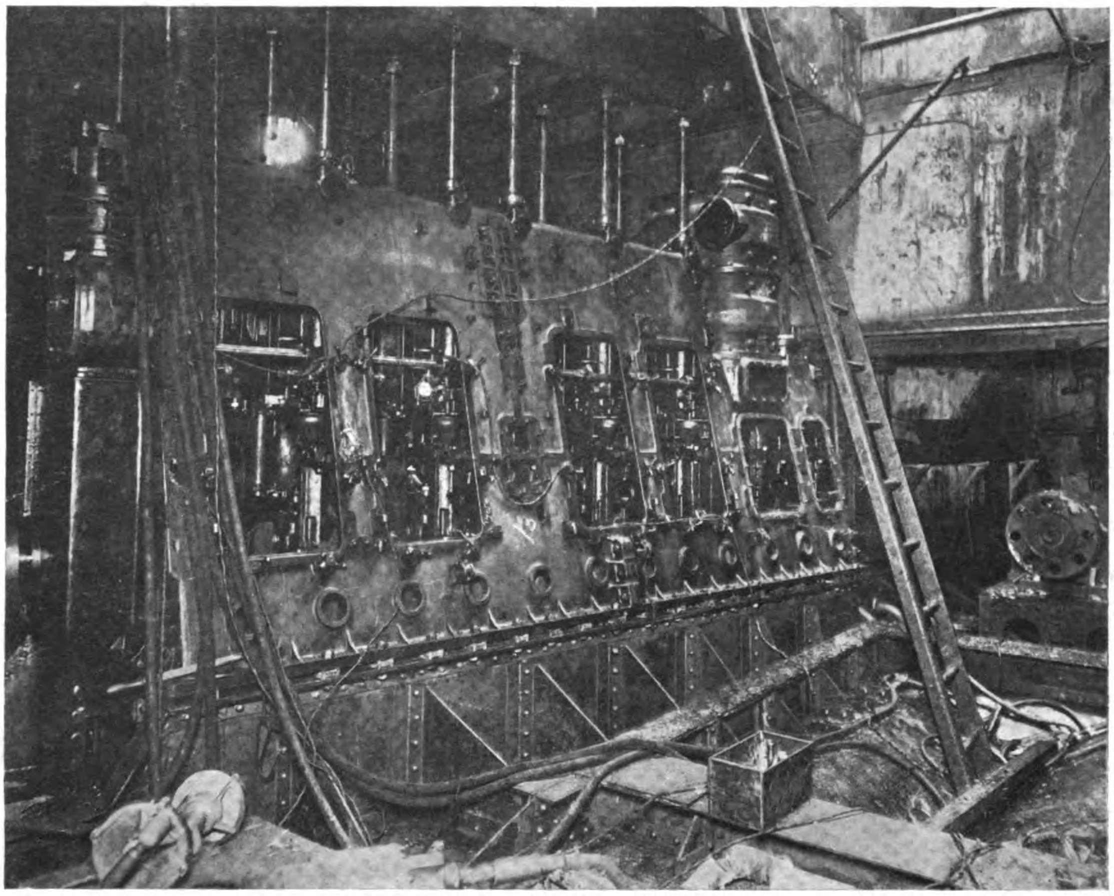
DIESEL-ELECTRIC DRIVE

For Economical Conversion of Steamers



One of the two Ansaldo-San Giorgio two-cycle type, four-cylinder Diesel engines now being installed in the freighter "FORDONIAN" in conjunction with General Electric drive. Photograph taken in engine-room during installation. This ship is being converted into a Diesel-Electric vessel at the plant of the Tebo Yacht Basin Co., Brooklyn, N. Y.

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