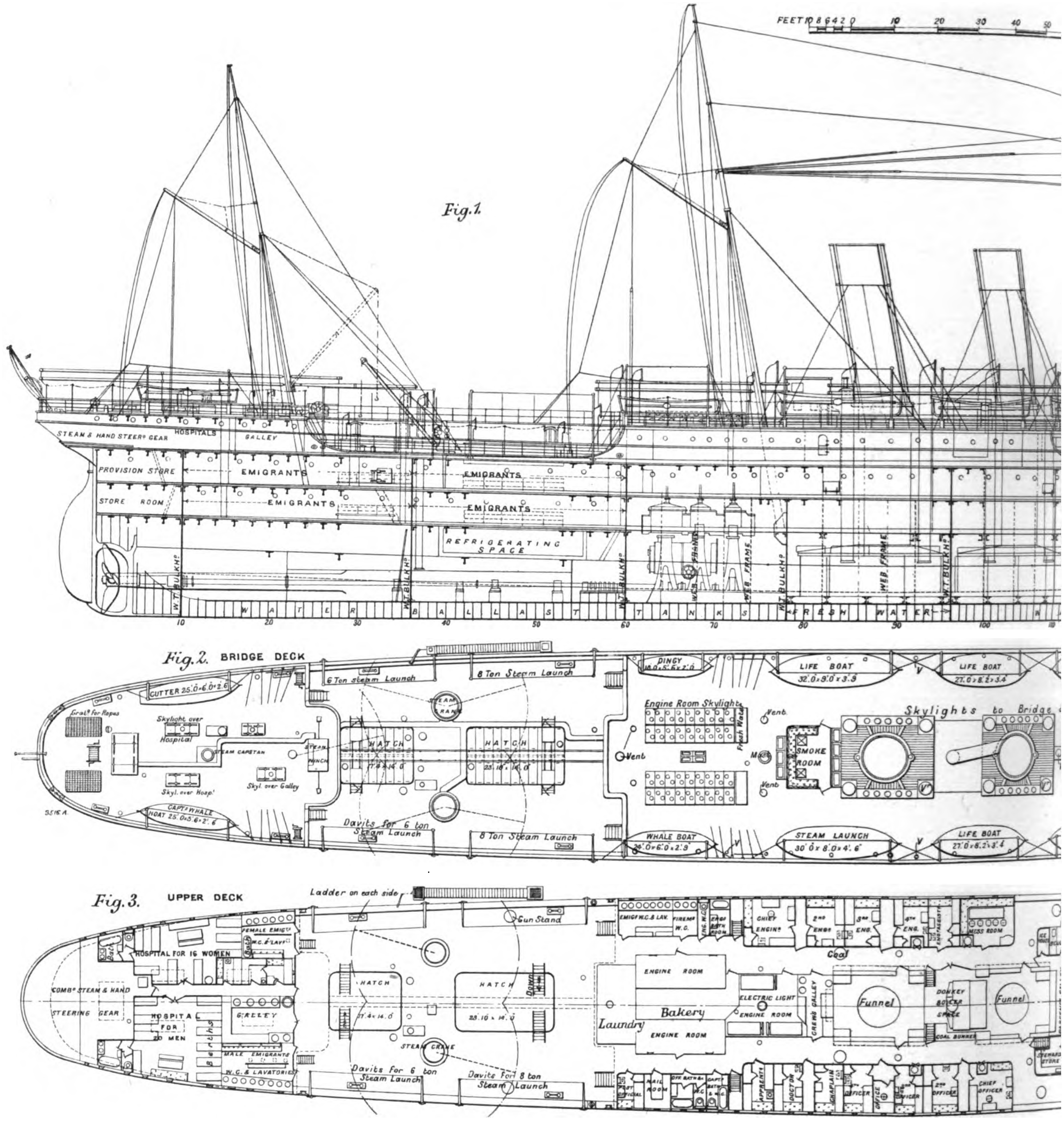
THE RUSSIAN VOLUNTEER TW

CONSTRUCTED BY MESSRS R. AND W. HAWT

(For Noti



N-SCREW STEAMER "KHERSON."

N, LESLIE, AND CO., LIMITED, HEBBURN-ON-TYNE.

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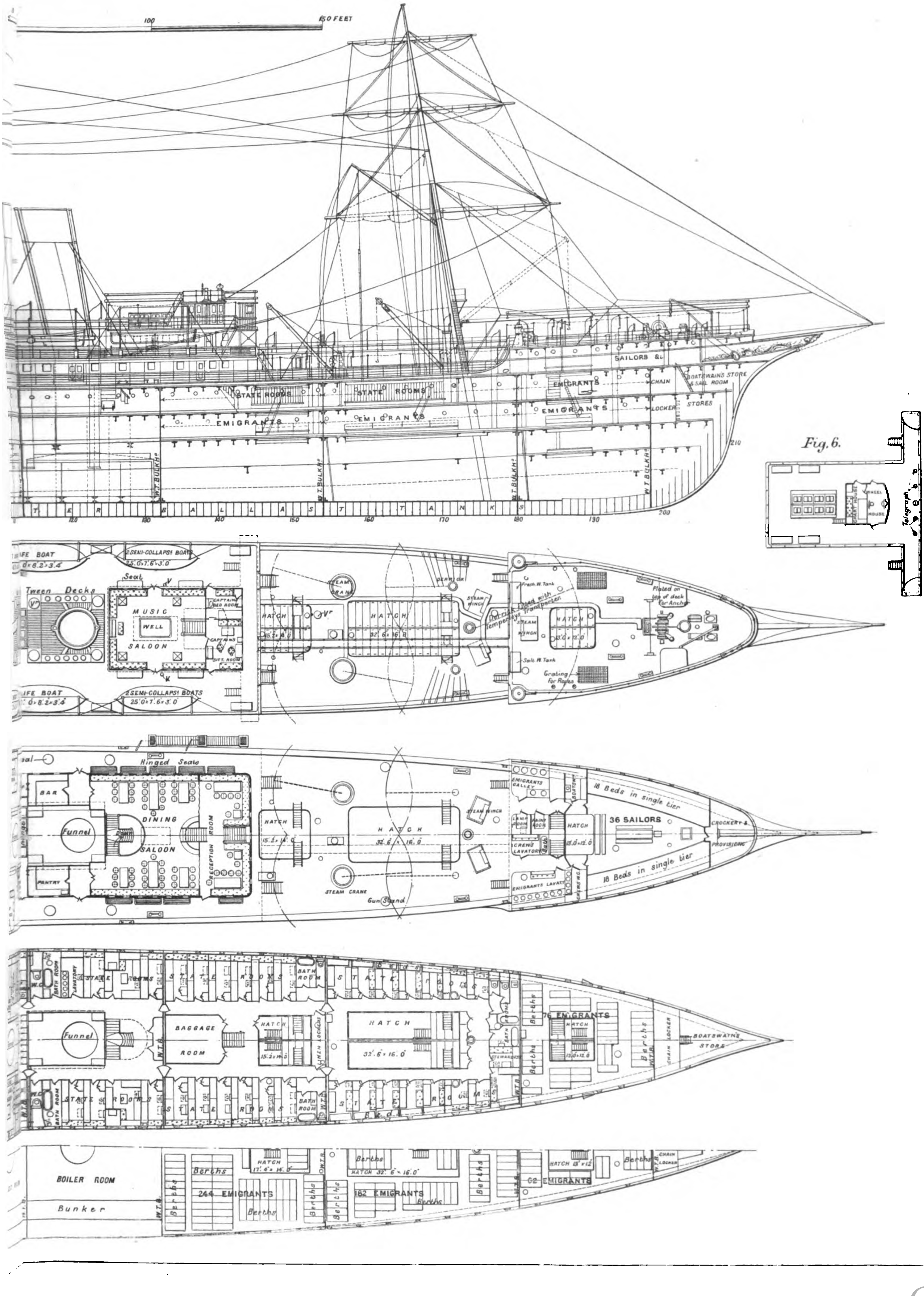


following officers were then chosen for the ensuing year:

President, Clement A. Griscom; vice-presidents, Charles H. Cramp, Philip Hichborn, Charles H. Loring, Richard W. Meade, William H. Webb, George W. Melville, George W. Quintard, Irving M. Scott, Francis A. Walker, and Frank S. Fernald. Francis T. Bowles was elected chairman. He was also elected secretary and treasurer.

(*To be continued*)

THE RUSSIAN VOLUNTEER S.S. "KHERSON."

On our two-page plate of November 27, we gave longitudinal section and deck plans of the steamer Kherson, the latest vessel which has been added to the Russian Volunteer Fleet. In the plate referred to Fig. 1 is a longitudinal section showing the general arrangement and apportionment of the space on the bridge deck. Fig. 2 is an exterior plan or deck view in which the positions of the boats, chimneys, deck-houses, &c., are given. Fig. 3 is a plan of the upper deck, Fig. 4 a plan of the main deck, and Fig. 5 a half-plan of the lower deck. Fig. 6 is a plan of the bridge. The two page plate given in our current issue shows the general arrangement of the machinery space. Fig. 7 is a longitudinal section through the engine-room, showing one set of engines in elevation. Fig. 8 is a plan of the same engines, with the other set of engines partially shown. Fig. 9 is a sectional elevation of the stokeholds, with the Belleville boilers shown in front elevation. Fig. 10 is a plan. Fig. 11, on the opposite page, is a cross-section on two planes of the engine-rooms, whilst on the same page, Fig. 12 gives a cross-section of the boiler compartment. In a succeeding issue we shall publish illustrations and a description of the machinery.

The Kherson is a twin-screw, square topsail, three-masted, schooner rigged steamship of the three-deck class, and is 493 ft. long over all, or 455 ft. between perpendiculars. Her maximum width is 54 ft. 3 in., and her moulded depth 37 ft. 3 in. She has three funnels, a clipper stem, and an elliptical stern. She has been designed as an auxiliary warship under the superintendence of Colonel Linden, Inspector of the Russian Volunteer Fleet, and has been built for that association by Messrs. R. and W. Hawthorn, Leslie, and Co., Limited, at their shipbuilding yard at Hebburn-on-Tyne. The engines have also been designed and constructed by the same firm at their St. Peter's Engine Works on the Tyne, near Newcastle. She has a displacement when at normal load draught of 10,225 tons, and has accommodation for 74 first-class passengers, 59 third-class passengers, and 1444 emigrants.

The main saloon, as shown in Fig. 3, is placed forward of the machinery space on the upper deck. It is 48 ft. long, and extends nearly the whole width of the ship. Above it, on the bridge deck, is a house which contains the music saloon, 28 ft. long, and bed and sitting room for the captain's use. These are shown in Fig. 2. The decoration of the saloon and music-room is in excellent taste, being light and yet not cold. The most notable features are the poker-work panels, which are very artistically done. The upholstery is in green leather. The forward end of the saloon is half screened from the main part, as shown in Fig. 3, and may be used as a sitting-room or for taking meals in as desired. The arrangement affords a very pleasing feature, as the usual rigid and formal lines of a ship's saloon are broken up, and a pleasant vista beyond is afforded; indeed, the saloon of the Kherson is one of the most attractive we know. The music-room is upholstered in antique plush. There is a handsome smoking-room fitted in marble on the bridge deck abaft the funnels.

The first-class passengers' sleeping cabins are on the main deck in the forward part of the ship, the modern plan of putting the best accommodation forward, so as to be away from the noise and rattle of the machinery, being followed. Each cabin contains only two berths, with the exception of one or two family cabins specially fitted. The beds are single, Colonel Linden being strongly of opinion that passengers paying first-class fares should not be stacked one above another, a view which might be more widely held with advantage to the travelling public. The beds are made to hinge back during the day, and when they are stowed the cabins, which are supplied with sofas, &c., are formed into quite comfortable sitting-rooms, and have certainly far more claim to the pretentious name of "state-room" than those of other well-known lines on which the expression is in vogue. Another modern concession to the comfort of passengers is a luggage-room which is accessible; an immense convenience. Bath-rooms, lavatories, and sanitary appliances are fitted.

The third-class passengers—there are none of the second class so called—are berthed aft on the same deck. They are really emigrants of a somewhat superior kind in regard to the accommodation they receive. They are placed about 12 to 20 in a cabin, and their necessities are well supplied by bath-rooms, &c., to an extent which would seem almost superfluous. The officers' quarters are on the upper deck in the usual position beside the machinery space, there being a mess-room on the port side forward. On this deck also, abreast the forward funnel and just aft of the saloon, the pantry is placed, whilst on the other side is a bar. The steward's room, scullery, &c., are adjacent. The stokers are berthed on the main deck at the side of the engine-room casing. The quarters are good, sanitary arrangements being well attended to. The rest of the crew are berthed on the upper deck under the forecastle forward. Here again the quarters are good, there being 36 berths in two rows, port and starboard. The beds are in single tier, and there is a large space between. On the main deck a certain number of emigrants are placed, the majority being on the lower deck. The accommodation is good; in regard to fittings and sanitary accommodation excellent. No doubt the men would be somewhat closely packed, but far less so than in many ships; in fact, to judge by a casual inspection, we should say that the name of "sardines," by which sailors often designate emigrants, is far less appropriate to those of the Volunteer Fleet than to those of some other lines making the Atlantic voyage. There are two hospitals on the upper deck in the poop aft. They are big rooms, one for men having 20 beds, and the other, for women, having 16 beds.

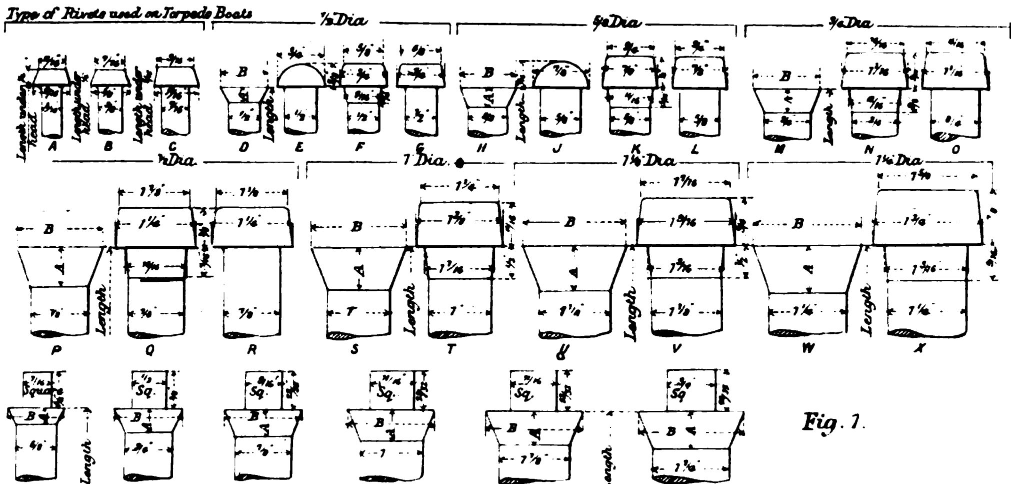
The ship is built of ordinary mild steel on the longitudinal cellular bottom principle, and will take about 900 tons of water ballast in the double bottom. She has 10 water-tight bulkheads extending to the upper deck. The machinery space occupies 156 ft. in the length of the ship, of which 39 ft. is engine room. There are three boiler-rooms, each 39 ft. long, or 117 ft. in all. The bunkers are at the sides of the boiler-rooms, as shown in the half-plan, Fig. 5. They have a capacity of 1500 tons of coal. The boilers are placed in two tiers fore and aft and back to back on the centre line of the ship. There are three boiler-rooms, each containing eight boilers. The stoking floors thus run fore and aft. There is a bulkhead between each boiler-room, McElroy's quick-closing doors being fitted. The width of the boiler-rooms between bunkers is 32 ft., and there is a space at each end between boilers to give access from the port to starboard stoking platforms. There is also access through water-tight doors to the engine-room. The doors are raised a few feet above the stoking level, so that one boiler-room might be flooded to a considerable height without the water escaping to another compartment, even were the doors open.

With regard to the general structure of the hull there is not much that need be said. The frames are of the ordinary Z-section with T-bulb beams. There is special strengthening for the gun positions, but this is not outside usual practice. The screw frame is a steel casting, and though there is a steel aperture in the deadwood as shown, the twin screws do not overlap, there being a foot between the tips of the blades of the two screws respectively when in their nearest position. The aperture is provided to keep the screw blades from revolving in too close proximity to the plating, and thus disturbing the race. The propeller shafts do not extend beyond the skin of the ship, as the frames aft are bent out to inclose the shafting by the plating, which thus forms two projections, one for each shaft, in the run. No shaft brackets are therefore required, the spectacle frame, or cruciform sternpost, being used. All decks are steel laid, with 3½-in. teak on the parts exposed to weather, and 3½-in. pitch pine on other parts. The rudder is single plate 1¼ in. thick. There is a steam bakery, with the usual machinery, of sufficient capacity to supply bread for all on board. There is also a steam laundry. There are five cargo hatches, well fitted with hoisting machinery for quick discharge. One hatch is large enough to take a locomotive.

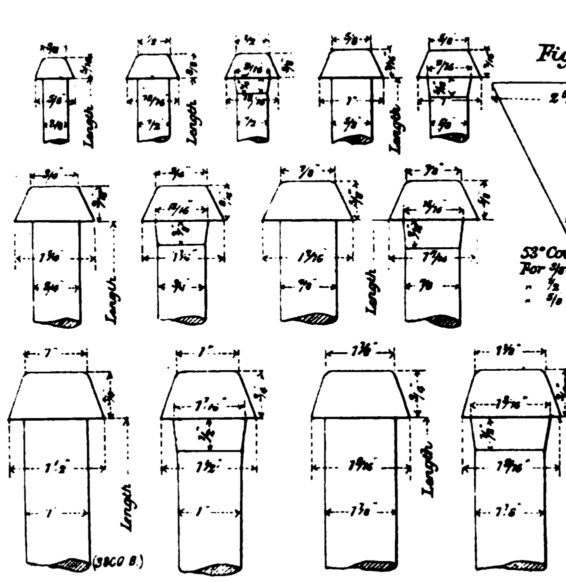
There are three funnels as stated, the height from the bottom of the keel being 95 ft., or 72 ft. from the water line. The ship is illuminated throughout by electric light, supplied by Messrs. Holmes and Co., of

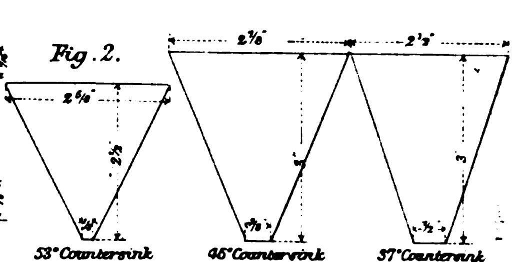
SHIP RIVETS AND RIVETING.

(*For Description, see Page 728.*)



For all countersunk head and tap Rivets make dimension A equal thickness of Plate plus 1/16 inch. Dimension B as per angle of countersink for given depth of head.
Tap rivets will be 1/16" larger than the corresponding Rivets for the same thickness of Pl., except those in stem and stern post, which will be one quarter inch larger.





TYPE OF POINTS	DIAMETER OF RIVETS									
	5/16"	3/8"	7/16"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"	1 1/4"
	Allowance for length of Rt over thicknesses connected									
COUNTERSUNK	3/8"	3/8"	7/16"	7/16"	1/2"	5/8"	3/4"	7/8"	1"	1 1/16"
MASHED	5/16"	7/16"	1/2"	1/2"	5/8"	3/4"	7/8"	7/8"	1	1 1/16
BUTTON				1/2"	5/8"	3/4"	7/8"	7/8"	[illegible]	1 1/16

NOTE. The allowances for length of Rt over thicknesses connected, as given are for two thicknesses only. An additional allowance of 1/16" is added to this length for each additional thickness of Pls connected. The exception to this rule is only where the Pls connected are very thin (less than 5/16") then the allowance will be 1/32 for each additional thickness.

MACHINERY OF THE RUSSIAN VOLUNTEER TWIN-SCREW STEAMER "KHERSON."

CONSTRUCTED BY MESSRS. R. AND W. HAWTHORN, LESLIE, AND CO., LIMITED, HEBBURN-ON-TYNE.

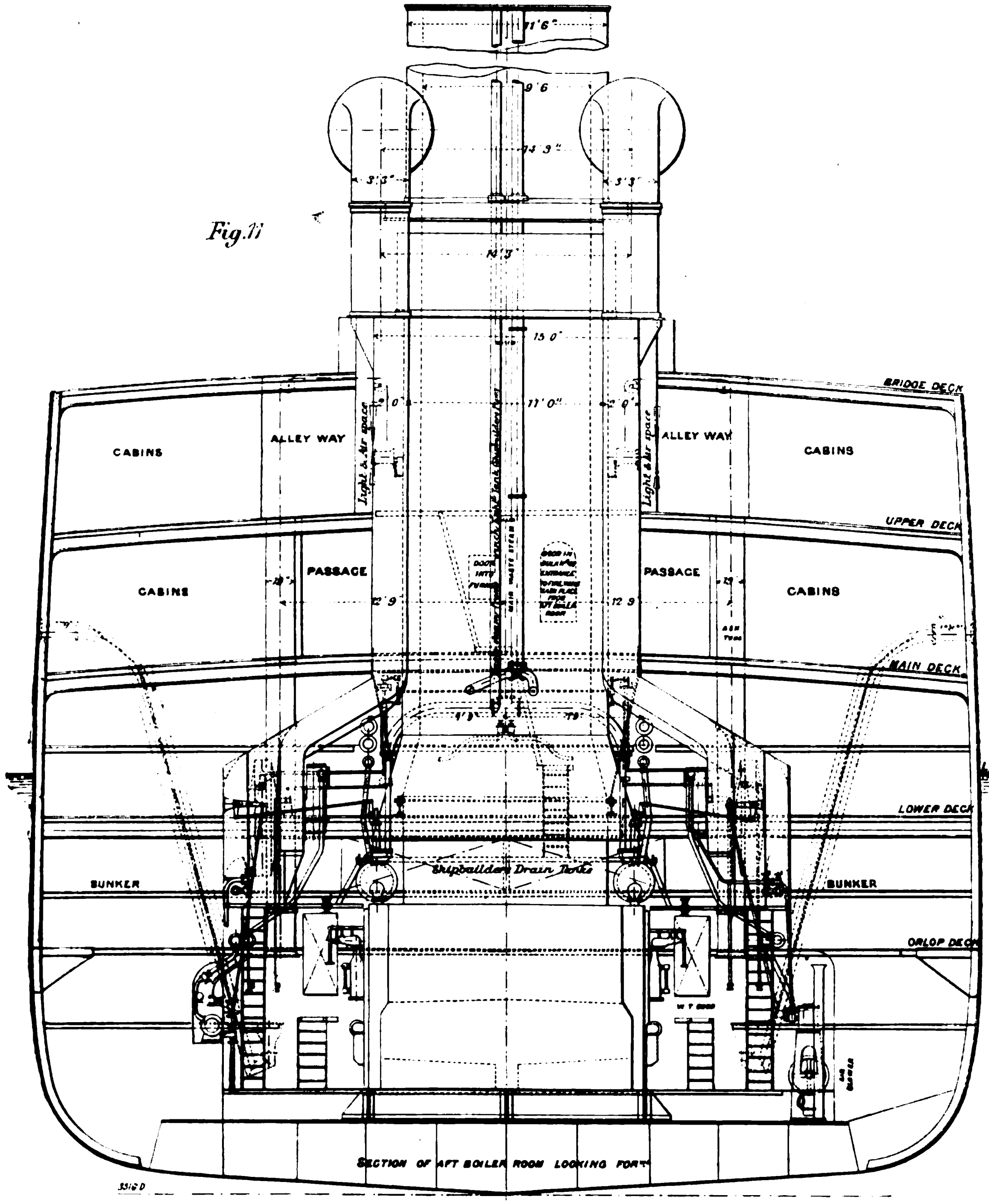


Fig. 11.

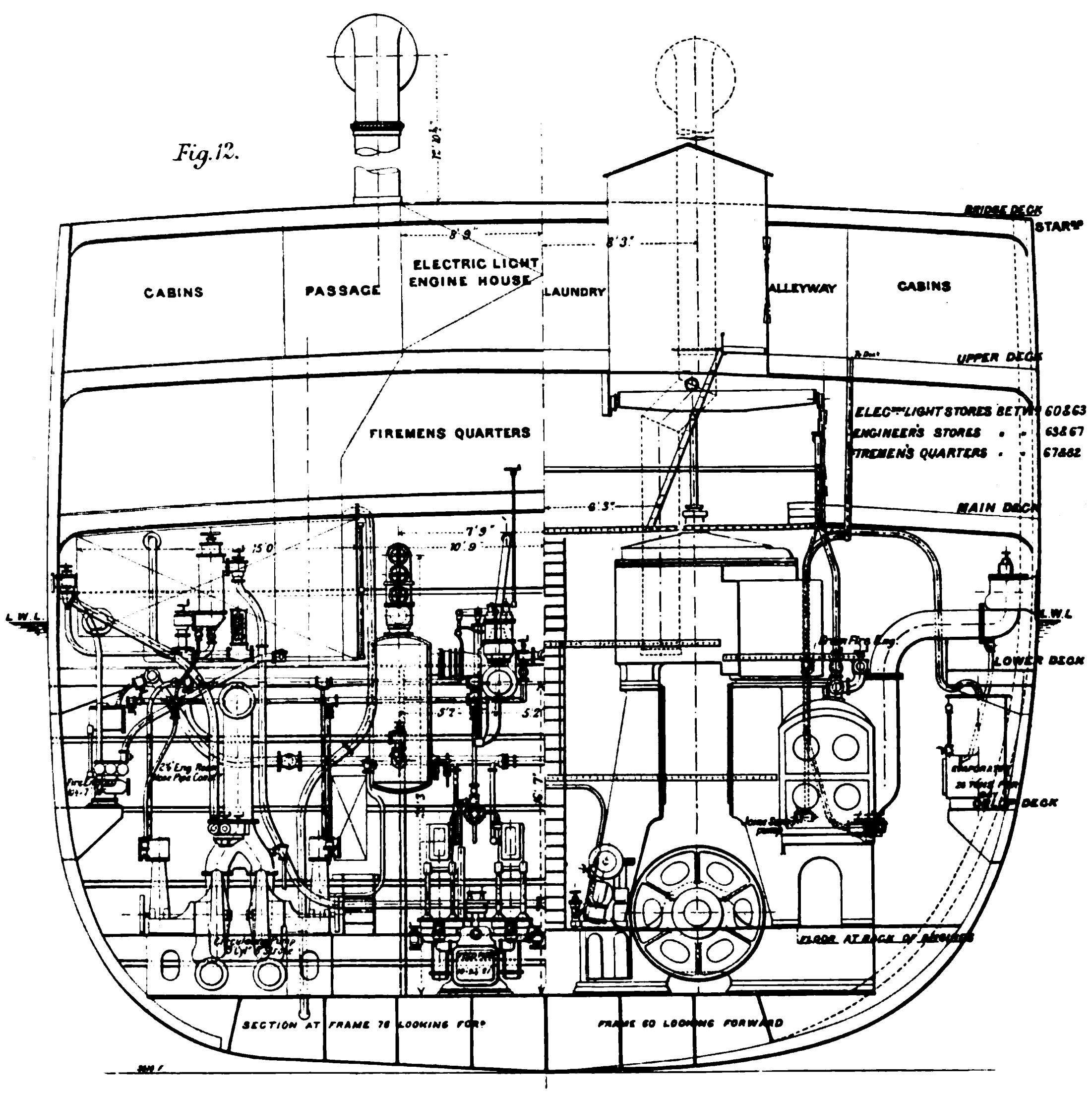


Fig. 12.

Newcastle. There are nearly 400 sixteen candle-power lamps, current being supplied by three dynamos on the upper deck. The ventilating fans, of which there are six, are run by electricity from these dynamos. Very complete provision has been made for the ventilation of the ship, air trunks in communication with the ventilating fans being run throughout the inhabited part of the vessel, including that occupied by passengers, emigrants, and crew. The system adopted is that of extracting the foul air by the fans, and allowing the fresh air to find its way in by gravity. There are, of course, the usual cowls. Refrigerating machinery supplied by the Linde Company is fitted with a chamber to contain 10 tons of frozen meat.

The boat equipment comprises 14 boats and one steam launch. Five of these boats have been supplied by the Seamless Steel Boat Company from their works at Wakefield. They are pressed from steel plates, which are then galvanised by electric deposition. The two sides are riveted together with a bulb iron to form the keel and the stem and stern-posts. They are doubtless very strong craft, but are, we should think, somewhat heavier than ordinary wooden boats. Their power of resisting the deteriorating effect of heat and cold, damp and dryness, so that they would be always tight whenever launched, would, however, amply compensate for a little additional weight. We are informed that it has been found almost impossible to make a hole in these steel boats by any probable accident, the plate bulging in when severely struck. We hear that these boats are growing in favour, being used on an increasing number of lines of large steamships. In war time four large steam launches would be carried for the purpose of landing troops. The navigating lights are electric. Special provision has been made for freeing the ship of water. The ballast tanks can be pumped out at the rate of 600 tons per hour, and the holds could be emptied by means of the circulating and water-ballast pumps at the rate of 800 tons per hour. The main bilge suction pipe is 12 in. in diameter, and the ballast suction 8 in. in diameter. There are steam fire-extinguishing pipes to each hold.

The windlass and capstan are by Harfield and Co., and the winches and cranes by Clarke, Chapman, and Co. There are four steam winches, each of 5 tons capacity, and four steam cranes to serve the holds. Temperley's transporters are placed forward and aft for purposes of quick loading and discharging.

The water-tight doors which are fitted are of the McElory type, and were made by Mr. T. Nicol, of Hope-street, Glasgow. They are raised and lowered in a frame by means of a screw, which can be worked from any position above the door as arranged. We illustrated the device in our fifty-ninth volume, page 635, when we referred to the advantages secured by the invention. We are informed that a door 4 ft. by 2 ft. clear opening can be opened by one man in 40 seconds, and can be lowered by the same means in 20 seconds. This is when using the screw, but there is an instantaneous lowering motion which was described in our former notice.

Special strengthening is provided for the main armament, which will consist of three 120-millimetre (4.7-in.) quick-firing guns. Two of these will be placed in the forecastle, one on each side, and the third will be mounted aft on the centre line. There are also to be twelve 75-millimetre (3.3-in.) guns, for the mounting of which special provision has been made. Six of these are to be mounted on the upper deck forward and six aft; that is to say, one-half will be in the forward well, formed by the space between the forecastle and bridge deck, and the remaining six in the after well formed by the space between the bridge deck and the poop. On the bridge deck there will be eight 47-millimetre (1.9-in.) guns, four a-side. These guns will not be mounted so long as the vessel is engaged in its peaceful avocations, but are kept in store, together with ammunition, &c, at Odessa, ready to be shipped in case of war or imminent danger of war. The special strengthening of the hull structure consists of extra pillars, teak chocks, &c. Space is apportioned for magazines, the arrangement here being that portable magazines should be kept in store at Odessa, ready to be fitted in case of need. Their position would be in the after hold.

AMERICAN CYCLE-MAKING MACHINERY.

In our last issue we gave perspective views of four of the machine tools designed and manufactured specially for cycle-making by the Pratt and Whitney Company, of Hartford, Connecticut, and exhibited by Messrs. Buck and Hickman, of Whitechapel, E., at the National Cycle Show now being held at the Crystal Palace, and which closes to-morrow.

The stand of Messrs. Buck and Hickman, which we believe is operated jointly by the two firms named, is in reality a small and, of course, temporary works, for the manufacture of certain bicycle parts, and in this aspect is certainly a most instructive mechanical feature, extending beyond the limits of the cycle-making industry. It should, moreover, afford serious food for reflection to the British machine tool maker far outside the mechanical aspect of his craft.

It will be of interest, no doubt, if, before proceeding to describe the machine tools in question, we say a few words about the company by which they were manufactured. The Pratt and Whitney Company was established at Hartford early in the sixties by Mr. Francis A. Pratt and Mr. Amos Whitney, the works being laid out for the manufacture of machine tools. From the first, attention was turned to the special tools required for the production of reduplicated parts to be interchangeable among a large number of exactly similar articles, of which sewing machines and small arms may be taken as leading examples. To carry this system of interchangeability to perfection, especially in delicate mechanism such as that of sewing machines and guns, the first thing requiring attention is extreme accuracy of measurement, and this led to the firm perfecting some of those beautiful gauges and measuring appliances for which it has since obtained a high reputation. An inquiry into this branch of mechanics by the Austrian military authorities resulted in the firm sending to Austria in 1866 a complete equipment of rifling machinery for the Government of that country; a speedy reward for the exercise of the primary engineering virtue of accuracy. The works of a firm amongst the pioneers of the modern interchangeable system naturally extended with great rapidity, for then there were not so many rivals in the field of special machine tool design. The company found ample scope, chiefly in the production of screwing machine and gun plant, although other labour-saving tools were devised and manufactured, those for the making of agricultural implements taking a somewhat prominent place. Electrical work came later, and soon grew into an important branch of the business, special machine tools being designed for the manufacture of dynamos or motors, together with lighter machines for the production of electrical instruments.

Another notable step in the history of the firm was due to the extension of the type-writing machine, for the manufacture of which several machine tools were devised for producing interchangeable component parts. In addition to machine tools for use in general manufacturing, they have designed and made during the past eight or nine years a large number of special machines and appliances for finishing brasswork with exceeding accuracy and economy. The rapid increase of the bicycle industry brings us down to the present day and the machines now under consideration. The event was early taken advantage of by this company, a number of special machines being devised and put upon the market. For some time previously, however, the firm had been doing business with cycle manufacturers, but in earlier days makers were content with the more general description of machine tools, with perhaps a few special additions of a more elementary nature.

As we are giving detailed descriptions of the machines shown at the Crystal Palace, it is perhaps right to say that most of the devices are patented both in the United States, in Great Britain, and on the Continent, many of the patents being in the name of Mr. W. W. Tucker, who has long been associated with the Pratt and Whitney Company.

In accordance with the statement made in our last issue, we will now proceed to give a fuller description of the machines exhibited, and which we then illustrated. Referring to the first operation hub-making machine (Fig. 1, page 699 *ante*), Fig. 5, on page 734, gives a view of the part as produced by this machine. There are two principal operations, namely, the forming of the outside contour of the hub, and boring the latter. The hub is made from a rod of low carbon steel, which may be fed up through the hollow spindle automatically or by hand as required. The whole of the outside contour is formed from the rod by a pair of circular cutters operating simultaneously, the drilling operation to form the hole in the hub being also carried on at the same time; the latter will be treated of presently. The rod or wire having been fed up into position through the hollow spindle, the exact length required being obtained by a stop, the first thing necessary is to chuck the piece firmly. This is accomplished by means of a collet, or split cone chuck. This fits into the spindle, the end of which is bored out to the same taper as the collet. The inner end of the collet joins a hollow plunger, which takes the form of a sleeve inside the spindle of the machine. The spindle is bored out from end to end, the steel rod, or stock, from which the hubs are made being inside the plunger, so that the spindle, plunger, and rod are concentric. If the plunger be thrust forward, the taper hole in the end of the spindle causes the spring collet to close round the rod. The latter is then held firmly by the wedge-like action, and is thus made to revolve with the machine spindle. The plunger is pushed forward to close the collet by means of the spider wheel shown to the left of the machine. This actuates a rack, which in turn moves a collar or annular wedge that encircles the lathe spindle. When the wedge is carried towards the end of the machine it acts on the ends of two dogs or bent levers which are pivoted in a collar fixed on the end of the spindle. The levers are so formed that when they are pushed apart by the sliding wedge they press the plunger forward, and that in turn chucks the work by means of the collet, as already described. When the sliding wedge is moved in the reverse direction it allows the dogs to close, when the collet forces the plunger back by its own elasticity, and thus releases the stock. The arrangement gives a ready means of holding the stock, and permits of adjustment to any position. It has also the further great advantage of bringing the part operated upon close to the front spindle bearing, and thus insures freedom from springing or chattering of the work. It should be stated that the spindle bearings are large, and are of Babbitt metal. The spindle is driven through either one part of a double set of back gears. The change of power and speed can be instantaneously made by the movement of a handle in front of the head, which is keyed to a shaft passing through the head of the machine, and actuating a friction clutch of simple design with adjustment for taking up possible wear.

The forming fixture of this machine carries the forming cutters. As will be seen by Fig. 6, on page 732, it consists of a saddle carrying two slide rests, a steady rest, and other allied parts. The front and back slide rests, which carry the forming cutters, are fed up to the work simultaneously by a right and left-threaded screw which is driven by worm gear taking its motion from the head. There is an adjustable knock-off device.

The forming cutters are of what is known as the circular type, that is to say, they are circular in cross-section, having a section milled out to form the cutting edge. The whole cut is taken at once, so that the cutters are formed with a corresponding (reverse) contour to that of the work, with two deep grooves which form the projecting flanges to which the wire spokes are attached (see Fig. 5). The forming cutters are ground radially, and as all radii of any given circle are equal, the shape of the cutting edge is preserved until the cutters are worn out. The circular fixed cutter gives a good opportunity of securing a very solid mounting. On the slide rests a segmental recess is formed in the casting, and in this the cutter is bedded. There are also necks at each end of the cutter by which it is held. The cutters are sharpened in an ingenious little machine, which secures true radial grinding. An example is shown on the stand at the exhibition.

It will be seen that provision is made to secure steady cutting, both by the chucking of the work and the firm abutment in which the very solid cutter rests, but still further means to this end are secured by a special steadying fixture which is shown in our illustration of last week (Fig. 1), but is partly obscured by the wire gauze which covers the oiling arrangement of the forming cutters. It is, however, well shown in Fig. 6. As will be seen, it consists of a long cylindrical piece, approximately horizontal, and attached to a web of the back slide, in fact, forming one with the slide. Within this cylinder there is a plunger, which is free to slide, and is propelled outwards by a coiled spring within it. The outer end of this plunger is bevelled off on the under side. At right angles to the plunger is a tool steel slide, the lower end of which presses on the piece being turned. The device acts not strictly as a rest—although it is described as a "steady rest"—but as a damper to vibration, for, as will be seen, it only presses on the work. The special feature in the arrangement is that the steadying slide follows up the work as it is reduced in diameter by being turned down, and forms to the end a firm abutment. This is secured by the flatness of the angle formed by the adjacent surfaces of the plunger and slide and the line of stress. As the hub is turned down and the slide descends, the plunger follows up, impelled by its spring, and thus forms a firm abutment for the slide; as the latter is unable to force the plunger back for the reason stated. A handle is provided for compressing the plunger spring and putting the plunger into the starting position. The slide then travels upwards, being moved by a less powerful spring provided for the purpose as shown.

The mechanism for drilling the hole in the hub is driven independently of the forming mechanism (which turns the outside of the hub), being actuated by a belt-driven pulley on the right side of the machine. It consists essentially of a twist drill carried in a spindle mounted in bearings in a slide which is fed up to the work longitudinally by rack and pinion operated by worm gear, and provided with adjustable automatic knock-off. The mounting of the drill spindle in a long slide in this way insures accuracy of work, so that the bore of the hub is truly concentric with the outer part, a matter of considerable importance to the easy running of the bicycle. The reciprocating slide takes the place here of the more usual turret head, but in case the machine should be wanted for work requiring a number of tools, a turret head can be easily placed in the place of the drill slide, the guides serving for both purposes.

One of the most interesting points about the drilling mechanism is the provision made for lubrication, and the double purpose the lubricant serves of removing the chips of metal formed. The arrangement is not altogether new, the Pratt and Whitney Company having had it in use for some time, but it is worth describing. The drill has two closed channels running from the shank end to the cutting point. The drill spindle is formed with a chamber at the back into which the oil channels lead, and as the lubricant used is pumped into the chamber at considerable pressure, it will be seen that there is a rapid stream of oil to wash the chips out of the hole, and thus keep the tool from getting clogged. The hubs being formed, so far as this machine is concerned, a cutting-off tool which pivots on the side of the front slide is swung into position, and the piece is parted from the stock. As stated in our last issue, this machine will turn out 80 rear hubs or 100 front hubs, formed and drilled, in a 10-hour day.

The second machine illustrated last week requires less description. As will be seen, it is essentially a turret lathe, with special features, which constitute it a second operation hub machine. The turret has holes for eight tool-holders, and the work is held by a draw-back collet worked by a lever, on the same general principle as in the first operation machine already described, but in the other machine the collet grasped the work by a forward in place of a backward movement, the term "forward" here meaning towards the work, and not to the front of the lathe. In place

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BELLEVILLE BOILER FOR THE RUSSIAN VOLUNTEER STEAMER "KHERSON."

CONSTRUCTED BY MESSRS. MAUDSLAY, SONS, AND FIELD, LIMITED, ENGINEERS, LONDON.

(*For Description, see Page* 800.)

Fig. 19.

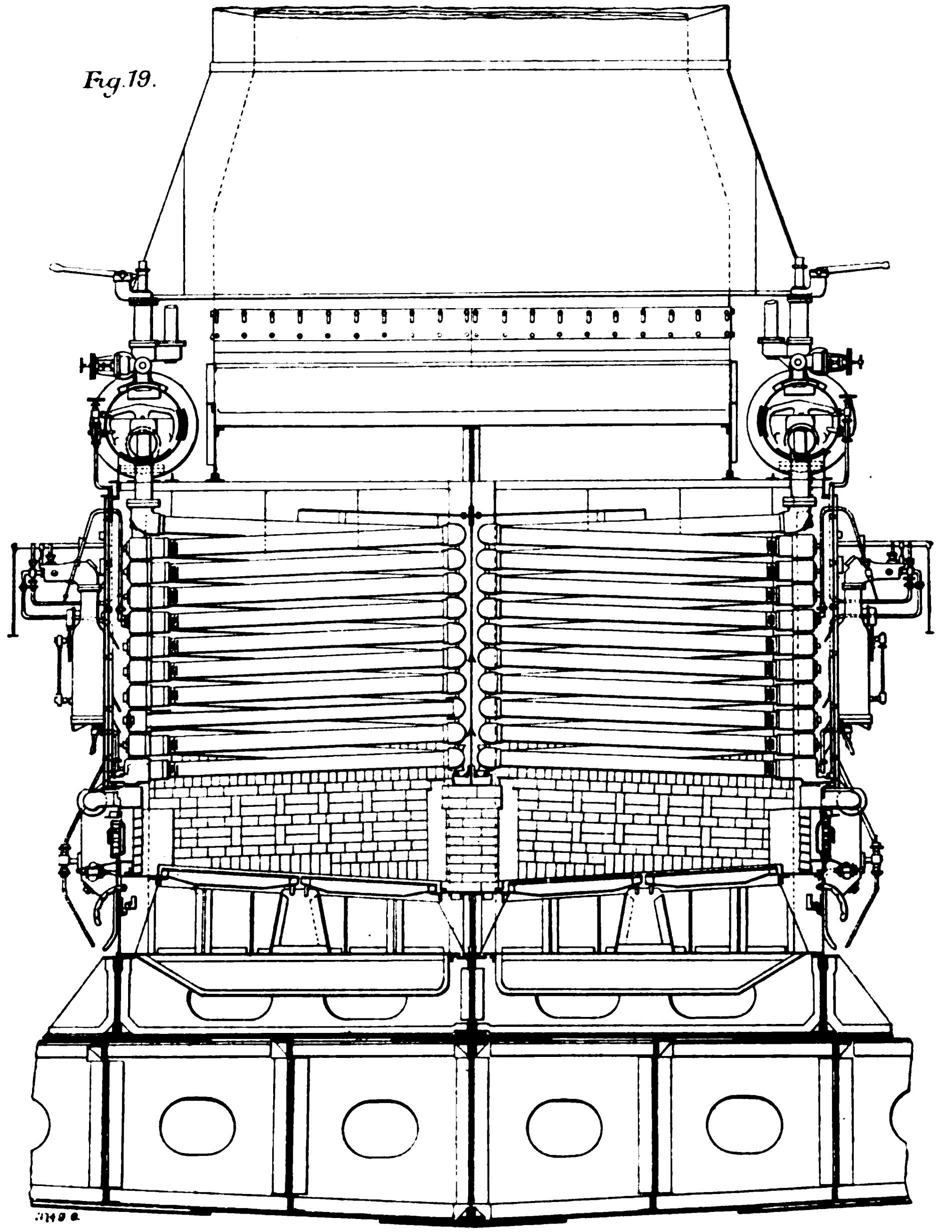
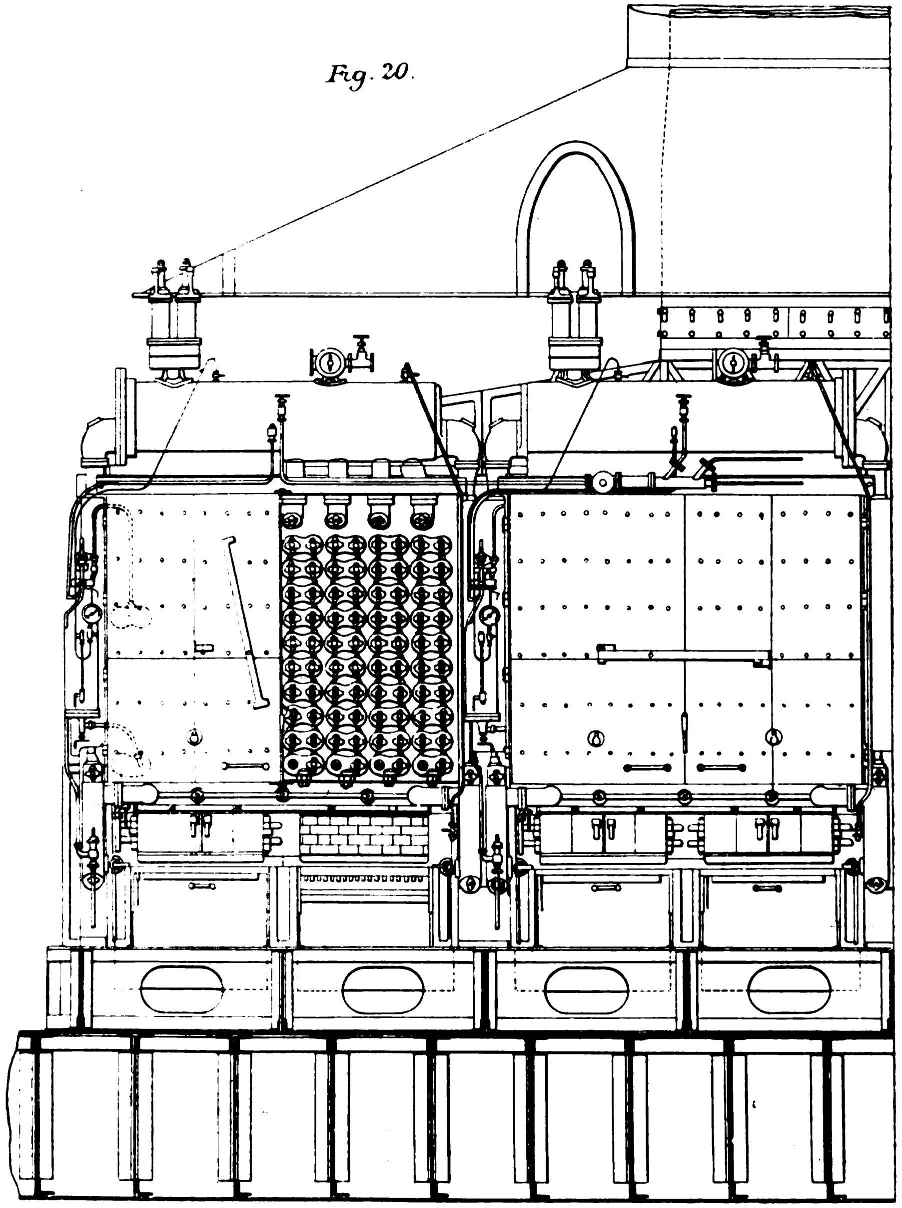


Fig. 20.



The indicated horse-power given is that developed by the main engines only, and does not include the air, circulating, or feed pumps. To determine the efficiency of the system, the screws were removed and the boat towed over the measured course, twice with and twice against the tide at three different speeds, and the tow-line strain measured by a dynamometer. The resistance observed is tabulated on page 800.

The author commented as follows:

It will be noticed that the ratio of the power put into the engine to the actual resistance of the boat at 9 miles per hour is 43 per cent. when two screws are in use, 60 per cent. when one screw is pushing, and 40 per cent. when one screw is pulling. The usual speed of this boat in ferry service is 11 miles per hour, and at this speed it requires 20 per cent. more power to propel the boat with two screws than with one screw pushing, and 69 per cent. more power to propel the boat with the screw at the bow than at the stern. If the same power could be put into one screw at the stern as is used by the two screws, the speed would be increased from 11 miles to 11.53 miles per hour. It is clear, therefore, that the bow screw is inefficient. When under way, it thrusts a column of water against the bow of the boat at a velocity equal to the slip ratio of the screw, and considerable power is absorbed through friction of the blade surface; but a ferryboat's bow becomes its stern at each succeeding trip, and it is, therefore, impossible to dispense with the forward screw. The screw at the bow, however, is useful, for one of the most desirable features in a ferryboat is the ability to start and stop promptly. Of the seven minutes required to go from landing to landing, two minutes are consumed in getting under way and stopping. Superiority in this respect is one of the reasons why a screw boat is preferable to a side-wheeler. A half-minute is more easily gained in manœuvring by using screws than by increasing the speed of the boat when under way, and it is in stopping and backing that the forward screw shows its usefulness; it is able to thrust a column of water directly ahead that will not impinge against the boat. Several means have been suggested to overcome the loss due to the use of this forward screw when under way, the most facinating of which seems to be to so design the screw that it will have

Trials of the Screw Ferry "Cincinnati."

Speed. Statute Miles per Hour.	One Screw Pushing.			Two Screws.			One Screw Pulling.		
	Indicated Horse-Power.	Revolutions per Minute.	Slip.	Indicated Horse-Power.	Revolutions per Minute.	Slip.	Indicated Horse-Power.	Revolutions per Minute.	Slip.
			p. ct.			p. ct.			p. ct.
9	250	91	19.5	332	87	20	443	103	35.6
10	364	103	24.5	461	97	20.5	638	118	36.0
11	520	115	27.5	624	107	19	880	135	35.0
12	720	128	28	816	116	19.5			

Resistance Trials of the Screw Ferryboat "Cincinnati."

Speed in Miles per Hour.	Resistance, both Screws Removed.	Indicated Thrust.		
		One Screw Pushing.	Two Screws.	One Screw Pulling.
	lb.	lb.	lb.	lb.
8	3850	6,700	9,050	9,380
9	4950	8,200	11,350	12,100
10	6400	10,250	14,120	15,440

very little backing power. If this could be done, the propelling effect of the forward screw would be small, and the power required to turn it would probably be only that due to the surface friction of the blades.

While the side-wheel boat is the more economical, the two-screw arrangement has such decided advantages that they more than compensate. The paper was illustrated by numerous diagrams showing the curves plotted in these experiments, the form of the hull, the screws, and the form of dynamometer employed, which latter was carefully described by the author, who was complimented on the completeness of his work, which was certainly well deserved.

ONE HUNDRED AND TWENTY-FIVE TON SHEERLEGS.

The next paper was entitled, "One Hundred and Twenty-five Ton Hydraulic Sheerlegs," by Mr. Frank B. King.

This was an elaborate account, accompanied by drawings, of the designing, erection, and operation of the machine at the shipyard of the Maryland Steel Company at Sparrow's Point, near Baltimore. Mr. King said:

The actual designing conditions were: a lifting capacity of 125 gross tons, a hoisting movement of 65 ft., and a lateral motion of the main blocks from 9 ft. 3 in. inboard to 49 ft. 6 in. outboard, measured from the heels of the front legs. These dimensions were adopted with a view to the use of the sheers in the shipment of ordnance and locomotives, as well as marine boilers, and especially with the idea of putting on board marine engines of considerable size without the expensive and tedious process of taking down and re-erecting; and it will be observed that the apparatus is quite capable of so handling a triple-expansion engine of the heavy merchant type, having a low-pressure cylinder of 66 in. by 42 in. stroke or equivalent capacity.

An examination of the problem led to the adoption of the three-legged sheers, in preference to a steam crane or floating derrick, as being, for its capabilities, much less expensive; and considerations of manageability and safety led to a scheme of hydraulic mechanism for effecting the several movements.

After describing at length the construction and erection, the author concluded as follows:

Some of my hearers will be curious to know the mechanical efficiency of the apparatus. It is difficult to say how much aid was given by the masting purchase, but I am satisfied that the weight was near the maximum lifting effort of the two purchases. If we deduct 10 gross tons, we shall have 276,000 lb. lifted by the main purchase alone. As the main block hangs from 12 parts of rope, and as each pair of 14 in. rams acts against 12 parts of rope, and the remaining rams simply go to increasing the height of hoist available, it will be convenient to consider one pair of rams as doing the work, rising, as they must, at precisely the same speed as the load. The hydraulic pressure on the two rams will be 508,000 lb.; from this we should deduct about 55,600 lb. as the combined weight of the rams, crossheads, sheaves, and bottom block, all of which are lifted at the same speed as the load, leaving 452,400 lb. to be applied to the load proper, and the friction of the packings, sheaves, &c., and the overcoming of the rigidity of the rope. If the load be taken at 276,000 lb, the loss in friction and rigidity will be about 39 per cent. This was with the apparatus entirely new; now, after several years of use, the figures would no doubt be greatly changed. A most interesting thing to determine would be what portion of this 39 per cent. margin is absorbed in the stiffness of the rope, and what part goes to the other friction of the machine. Our estimate of the friction of the rams was guided somewhat by the very practical experiments of Mr. J. E. Suit, which may be found recorded in ENGINEERING, vol. xlv., page 581. In such a machine, we are not aiming at a maximum of work done for power expended. As the employment is occasional and for brief periods, the percentage of mechanical efficiency is only important as it is reflected in the dimensions to which it is necessary to go to accomplish certain requirements, and as a guide to the designer of similar machinery. I hope the rough figures given may form a useful indication of what may be expected under the worst conditions; namely, rams fresh from the tools and rope new from the maker.

In conclusion, I desire to say that many of the most meritorious features in the working out of this design are due to Mr. Henry A. Magoun, a member of this Society, and formerly chief engine draughtsman of the shipyard at Sparrow's Point.

The machine itself is illustrated on page 798.

Following this came three papers which cannot be condensed, owing to various mathematical and tabular adjuncts, and those interested must obtain and read the papers entire to follow their calculations. The titles were, "A Method of Calculating the Stability of Ships, Adapted to the Use of Standard Curves of Stability," written by Naval Architect Hugo Hammar. "Stability of a Ship in Damaged Condition" was effectively treated by James Swan, of the Massachusetts Institute of Technology. The third paper was an exhaustive treatise on "Damaged Conditions as Affecting the Stability and Fighting Efficiency of Battleships," by Assistant Naval Constructor T. F. Ruhm, of the United States Navy. The last paper, which showed, if sailors are superstitious, engineers are not, bore the ominous number "13." It was called "Screw Propellers," and was by Professor George L. McDermott. Like the three preceding, it was mathematical and tabular, and is best described in the words of its author:

In submitting this paper, the writer has no new theories to advance, nor is any attempt made to discuss or justify any already existent, the main purpose being simply to place before the members of our Society formulæ for use in determining the dimensions and proportions of screw propellers, which he has derived from an analysis of the results of certain investigations that have been carried out by the eminent experimentalist Mr. R. E. Froude, and which have been described by him in a series of papers contributed to several technical societies.

This closed the meeting, and the session ended with a fine banquet at Delmonico's, at which the Secretary of the United States Navy made an interesting and patriotic speech. It is to be hoped that the Society will continue to grow in the future as in the past, for Americans can well be proud of such an organisation.

THE MACHINERY OF THE S.S. "KHERSON."

IN our former issues of November 27 and December 11, we published illustrations of the Russian Volunteer Fleet s.s. Kherson, built and engined by Messrs. R. and W. Hawthorn, Leslie, and Co., giving a general description of the vessel in the last-named issue (see page 730 *ante*). We now publish on our two-page plate and on page 799 the remainder of the engravings which illustrate this interesting vessel. Referring to the two-page plate, Figs. 13 and 14 are respectively a back and front elevation of one set of engines. Figs. 15 and 16 are end elevations, and Fig. 17 a plan. Fig. 18, on the opposite page, gives two sets of cards taken on trial. Fig. 19, on the preceding page, is a sectional side elevation of two of the Belleville boilers, and Fig. 20 is a front elevation, in one instance the front of the casing being removed and the door being open so as to show the "headers," or boxes which make junction between the lengths of generating tubes. We have recently illustrated the boilers of the Ohio (see page 640 *ante*), which are of the Belleville type; and were also constructed by Messrs. Maudslay, Sons, and Field, the makers of the Kherson's boilers, and we refer again to the boiler installation of the Kherson later on. We may repeat here, however, that they worked most satisfactorily on trial. Illustrations given in our two former issues (see two-page plate and page 730 of our issue of December 11) show the position of the machinery in the ship.

The machinery consists of two pairs of three-stage compound engines, and 24 Belleville boilers, supplied and manufactured by Messrs. Maudslay, Sons, and Field, who also supplied the feed pumps, air blowers, and automatic feed arrangements, and who had charge of the boilers during the trials, together with auxiliary machinery. The main engines have cylinders 36 in., 57 in., and 92 in. in diameter, the stroke being 54 in. Our illustrations give an excellent idea of the general design. The cylinders, it will be seen, are supported by A-frames back and front, which are of cast iron. The condensers are rectangular, with curved tops, and are also of cast iron, being incorporated with the back standards of the intermediate and low pressure engines. The total cooling surface of both condensers is 15,500 square feet. The valve gear is of the Marshall type, and by its position at the back of the engines gives an excellent open front, very accessible. The high-pressure cylinder has a piston valve, inside which an expansion valve works. This is a new feature, first adopted in the Petersburg, the ship of the Volunteer Fleet which preceded the Kherson in time of construction. The ratio of expansion due to cylinders is $8\frac{1}{2}$ with main cut-off only. The high-pressure main valve cuts off at 77 per cent. of the stroke, and the expansion valve gives a cut-off down to 18 per cent. of the stroke, so that a ratio of expansion of 36 can be attained. This wide range is required on account of the special conditions the ship has to fulfil. As a war vessel she was designed to have a high speed, $19\frac{1}{2}$ knots, but for the purposes of mercantile work, economy demanded she should not steam much above 12 to 13 knots. The power developed on trial, as will be presently stated, was 13,300 indicated horse-power about, so that the power required for the economical speed would probably be about 4000 indicated horse-power. This would approximate to that given by the earliest cut-off of the expansion valve. This valve is driven by a pin on the forward end of the crankshaft by means of a rocking lever. The main valve is worked from the main eccentric lever through two spindles on the valve. The expansion valve spindle is thus able to be placed between the main valve spindles. The expansion valve spindle is thus axial to the whole. The arrangement is well indicated in Fig. 15. The edges of the expansion valves are at an angle of 45 deg. to the vertical, and there are openings in the main valve at a corresponding angle. The expansion valve is free to turn on its driving spindle, and is actuated by means of a worm and quadrant on the top of the cylinder as shown. There is a handwheel and graduated index to show the point of cut-off. By turning the valve the openings are increased or reduced, the working length of the valve edges being increased or reduced proportionately.

In order to allow of the wide range of expansion with the early cut-off, the cylinders are jacketed both on the walls and top, but not on the bottoms. The high-pressure jacket takes steam at the initial pressure of 160 lb., and the jacket steam for the intermediate and low pressure cylinders is reduced to the required pressure by means of reducing valves, the steam being in this manner dried. There is a steam separator to each engine. These separators consist of boiler-plate cylinders containing a series of baffle plates, and each fitted with an automatic drain to draw off water. These separators are part of the Belleville system, and are drained by a float arrangement which opens and closes two valves leading respectively to steam and vacuum branches.

The air pumps possess no features of novelty. They are driven by levers from the high-pressure engine crossheads in the usual way. The bilge pumps and sanitary pumps are also actuated from the same levers. Coned steel pistons with ordinary piston rings having spiral springs behind are used. The intermediate and low pressure cylinders have ordinary double-ported flat valves with large relief rings at the back. The piston-rods have separate crossheads with double guides. The lower end of the rod passes through a block, the hole being coned and the end of the rod coned to fit. The whole is secured by a nut below. The crankshaft is of steel, and is built up in the ordinary form. The bedplate is of cast iron of box section. A two-cylinder reversing engine is used. For operating the engines all handles are brought together at the high-pressure end, so that both engines may be actuated at one spot, from whence the throttle valves, reversing engines, drains, starting valves, and main regulator valves can be worked. The front columns are made to form oil reservoirs, and these are in connection with the oil tank above. Pipes are led to all parts requiring lubrication, the supply being maintained by syphons.

Each cylinder may be linked up independently of the others within a range of about 10 per cent. of the stroke in the intermediate and low pressure cylinders. The linking up with this gear is effected by an adjustment in the reversing lever, which alters the point of suspension of the radius link, equal of course to the notching up of the ordinary link motion. The propellers have each four blades, and are 17 ft. 6 in. in diameter by 25 ft. pitch. The pitch, however, is adjustable, as the blades are bolted to the boss by oval holes in the flanges.

Among the auxiliary machinery may be noted two pairs of Horne's slow-speed direct-acting feed pumping engines, which are placed in the engine-room. These have been supplied by Messrs. Clarke, Chapman, and Co., of Gateshead, and are in addition to the regular feed pumps, which are of the Belleville type, and have been supplied by Messrs. Maudslay, Sons, and Field, of London, who are the sub-contractors for the boilers. The pumping engines in question have 10-in. steam cylinders, the pumps being $9\frac{1}{2}$ in. in diameter by 21 in. stroke. They are automatically controlled by a float gear, which is placed between them, and regulates the steam supply. The air pumps deliver to the hotwell, and water flows from thence by gravity to two float tanks, which are placed between each pair of pumps.

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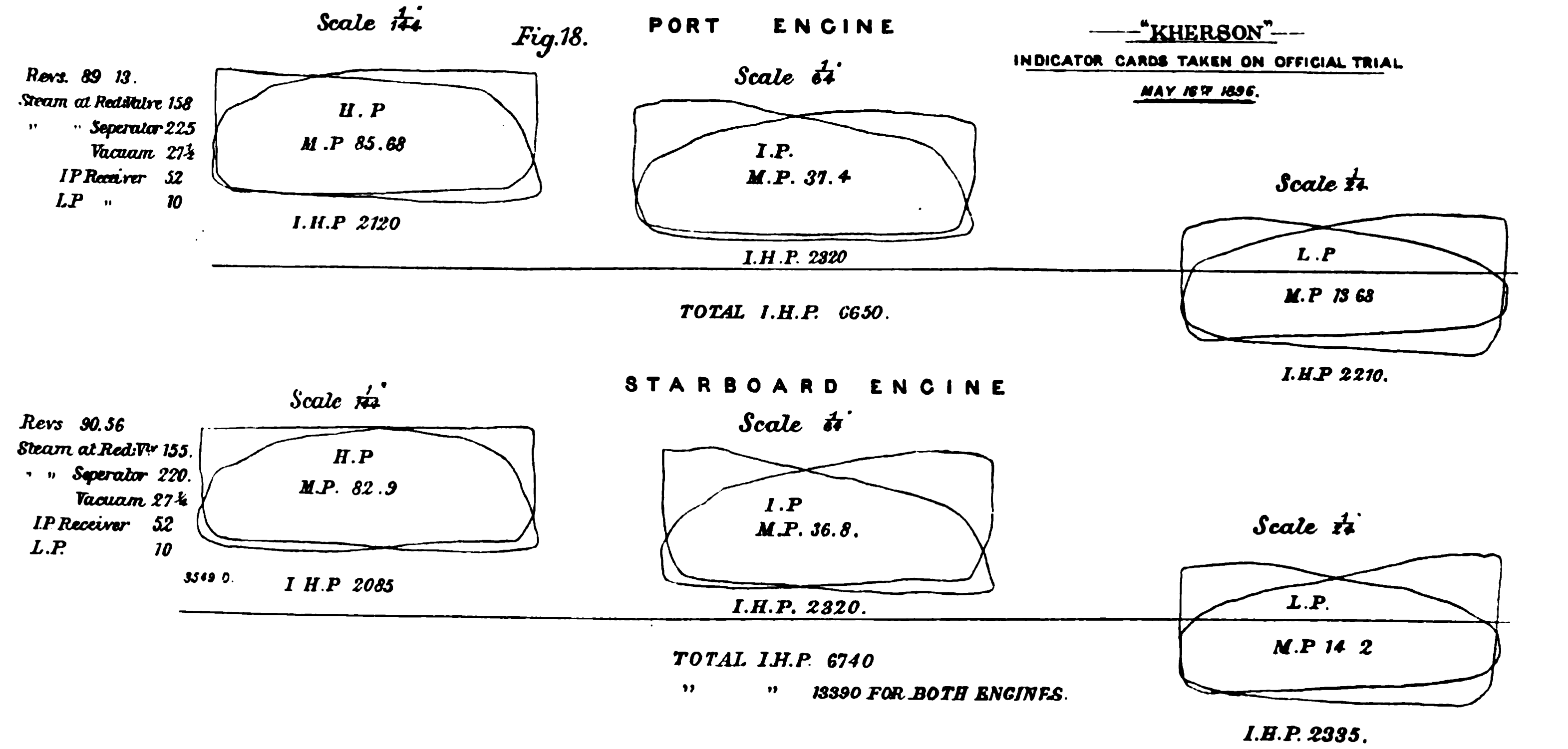
INDICATOR DIAGRAMS FROM THE ENGINES OF THE S.S. "KHERSON."



These tanks contain the float gear referred to. These pumps discharge into a series of tanks which are placed above the boilers, and thus a head is obtained for the feed pumps proper. These four pumps are capable of dealing with the feed water requisite for a development of 13,500 indicated horse-power when working at 10 strokes per minute. The long stroke is adopted in the design of these pumping engines so that they may be run at a slow speed, so as to avoid much of the slip, noise, and wear and tear generally which, more or less, is present with pumps driven off the main engines. The movement of the valve is entirely mechanical, and there being no dead point, the working can be started from any position. As will be gathered, the speed of the pump depends on the volume of feed water running into the tank.

The centrifugal pumps for refrigerating water are of the ordinary type. The ballast pumps in the engine-room will pump 600 tons of water per hour. They are Duplex pumps by Messrs. Watson and Son, of Newcastle.

The electric light machinery was referred to in our description of the hull. For discharging ashes there are two See's ejectors. Their position is shown in Fig. 12, on page 731 *ante*. They have a lift of 26 ft., and each is provided with a pumping engine by Messrs. Watson and Son, having a 10½-in. steam cylinder and 7½-in. pump, the stroke being 10 in. These pumps had to be specially designed, as it was found that the sudden shocks due to working the ejectors burst not only the pipe joints, but even the water end itself in the ordinary pumps. These pumps were, therefore, made very strong, the stud-holes round all covers being pitched very close. The valve gear and rods were also made additionally strong. There are ash hoist engines for working in port when ashes may not be ejected. There are six large ventilating fans in the boiler-rooms, there being one to each stokehold. They are 6 ft. 6 in. in diameter, and are driven each by a separate engine at about 300 revolutions per minute. The stokehold is open, so that there is no forced draught, but naturally these fans must materially assist the fires, especially with a stern breeze. The ventilating fans for the inhabited part of the ship, which are electrically driven, as stated in our previous article, are, of course, in addition to these stokehold steam fans.

The main boilers are, as stated, of the Belleville type, but there is an auxiliary return-tube boiler on the upper deck, placed between the after and centre chimneys, with a branch to the latter. It is 12 ft. 6 in. in diameter and 9 ft. long. The pressure is 160 lb. It supplies steam for the winches, cranes, and other auxiliaries on deck. It can be connected with the electric light engines if necessary, and also to the engine-room auxiliaries in case of need.

There are four steam winches by Messrs. Clarke, Chapman, and Co. of a recent design, the notable points being that the bearings and shafts are increased in dimensions, and the scantlings of the winch frames are exceptionally strong. The cylinders are 8 in. in diameter by 12 in. stroke, and are bolted on to the end of the frames, the cylinder having a spigot which fits into a recess in the frame. The cylinders and motion bars are bored out at one setting in position, in accordance with the best modern engine practice, accuracy of working thus being acquired. The connecting-rod is twice the length of stroke, and the gearing is of the helical type and exceptionally strong, the teeth of wheels and pinions being wide. There is also a steam warping capstan by the same firm, having cylinders 7¾ in. in diameter by 12 in. stroke. This also is a recent design, especially got out for large vessels where considerable strength is required. The gearing is of steel. The engine parts are inclosed in a cast-iron box, so that ropes may not get caught in it. The hatches are worked by means of four 3-ton deck steam cranes by the same firms. The crane posts are carried down to the 'tween-decks and there held by a strong foot-step.

The boilers are at the present juncture the most interesting features in the ship. As previously stated, they are of the Belleville type, and are 24 in number, having been supplied by Messrs. Maudslay, Sons, and Field, of London. In our issue of May 22 last* we gave somewhat full particulars of this feature of the Kherson's design, going into the question of weight and dimensions at some length. It is unnecessary, therefore, that we should go into all the figures again, and will content ourselves with repeating the leading details. There are three boiler-rooms, each containing eight boilers. Their design is well shown in Figs. 19 and 20, on page 799, whilst their position in ship is illustrated in the engravings Figs. 9 and 10 of the two-page illustration of our former issue of December 11, and the cross-section, Fig. 12, on page 731 *ante*. The boilers are all alike, each consisting of eight tube sections — or "elements," as they are sometimes termed. The tubes are of iron, and are 4½ in. in outside diameter. The makers would have preferred steel tubes, but the Board of Trade insisted they should be iron. The total grate area is 1132 square feet, and the total heating surface 30,350 square feet, the surface being calculated in accordance with the rule given in our issue of May 22 of this year. The height from grate bars to chimney top is 88 ft. 6 in., and each of the three funnels is 9 ft. 6 in. diameter. The total weight of boilers was 471 tons 8 cwt., allowing solid water to half glass. This includes boilers and fittings to the base of funnels, firebars, firebrick, feed regulators, safety valves, stop valves, lagging, feed pumps, air pumps for supplying air above the bars, steam separators, and reducing valves. The boiler pressure is 250 lb., but this is brought down by reducing valves to 160 lb. before going to the engines.

The Kherson made her official trial of 12 hours' duration on May 16 of this year off the mouth of the Tyne. On the present page we give a set of cards taken from the port and starboard main engines respectively. The details are given with the cards. It will be seen that the port engines developed 6650 indicated horse-power and the starboard engines 6740 indicated horse-power, or a total of 13,390 for both sets of cards. The mean revolutions were 89.8, the steam at the engines 157.3 lb., and at the separators 225.2 lb. The mean vacuum was 27.05 in. The mean horse-power for the whole run was 13,307 indicated. As stated in our previous issue, the run was perfectly successful, the boilers giving plenty of steam with poor Welsh coal. Fires were cleaned only in the forward stokehold, which was the first lighted. The engines were worked full open all through, and gave no trouble of any kind, and it may be said the ship is remarkably steady and free from vibration at all speeds of running. The speeds were taken on the long measured course off the mouth of the Tyne, along the Northumberland coast, and was returned at 19.5 knots. Colonel Linden and his staff watched the trial on behalf of the owners, whilst Mr. Herbert Rowell, director of the company and manager of Hebburn Shipyard, and Mr. F. Marshall, Jun., manager of St. Peter's Engine Works, represented the contractors, Mr. W. Maudslay, Mr. Milton, of Lloyd's, and other engineers being on board.

* See ENGINEERING, vol. lxi., page 683.

CANET NAVAL GUNS.

THE Forges et Chantiers de la Mediterranée built for the Greek Government, as long ago as 1889, three armoured vessels—the Hydra, the Spetzia, and the Psara. Each of these was armed with three Canet 27-centimetre guns (10 63 in.); at that time the quick firing class of the larger calibres had not been placed in service. Two years ago the Greek Minister of Marine announced the intention of increasing the armament of these ships, with the special view of obtaining greater power of defence against torpedo attack, by the addition of quick-firing guns of small calibre, but of high velocity and of very flat trajectory. It was decided that this supplementary armament should consist of Canet 10-centimetre and 65-millimetre quick-firing guns, 50 calibres in length. The order for these guns was given during the present year, and those for the Psara have been delivered and accepted after very satisfactory trials. The 10-centimetre guns fire a projectile of 13 kilogrammes (28.6 lb.), and the 65-millimetre one of 4 kilogrammes. The matériel possesses several features of interest; it is illustrated by the various figures on page 806, and the following is a description of the guns and mounting. The supplementary armament for each of the three ships consists of one 10-centimetre and eight 65-millimetre guns; they are all 50 calibres in length, and are composed of the following parts: (*a*) A tube that extends for the whole length of the gun, and in the end of which the screw seating for the block is formed; (*b*) a sleeve over the rear portion of the tube, and the ring carrying the shoulder-piece, and to which the piston-rod of the brake is attached; (*c*) a reinforcing sleeve over the forward part of the inner tube. The breech mechanism is on the Canet system, and is operated by a single movement of the breech lever. We recently (see ENGINEERING, page 663 *ante*) published illustrations of this class of mechanism; the breech block is of the ordinary type, with interrupted screw threads, and a central hole for firing the charge. Except when in place it is carried on a bracket, as is indicated in the illustrations. The various operations of turning the block so as to free it from its seat, of

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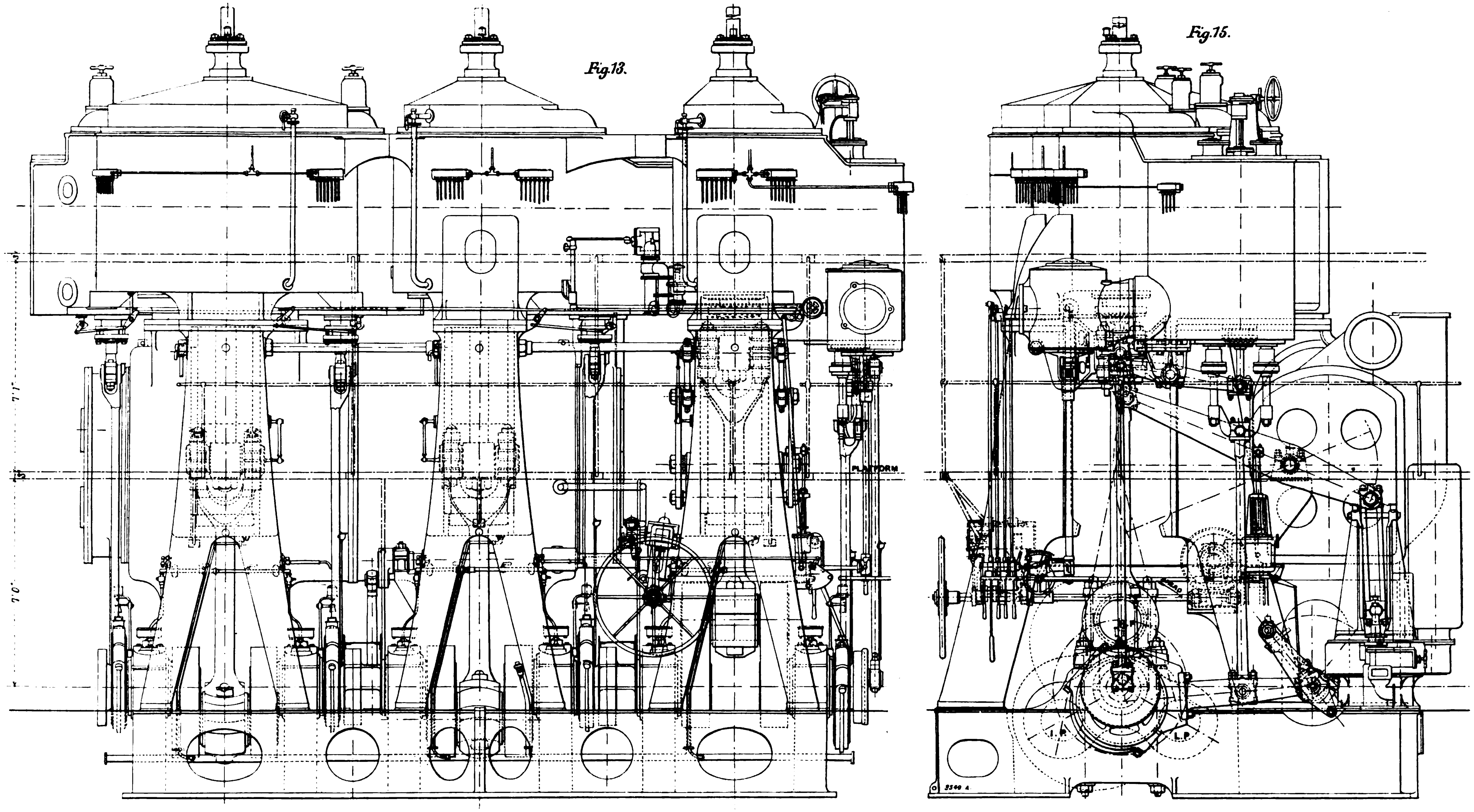
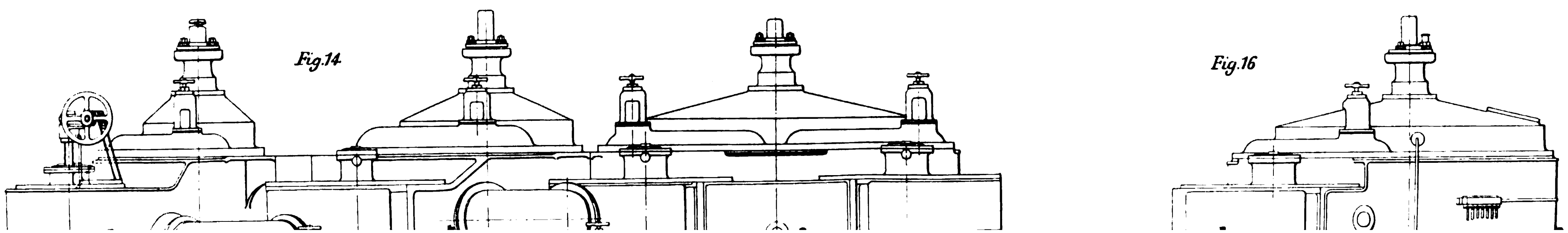
ENGINES OF THE RUSSIAN VOLUNTEER TWIN-SCREW STEAMER "KHERSON."

CONSTRUCTED BY MESSRS. R. AND W. HAWTHORN, LESLIE, AND CO., LIMITED, ST. PETER'S, NEWCASTLE-ON-TYNE.

(For Description, see Page 800)





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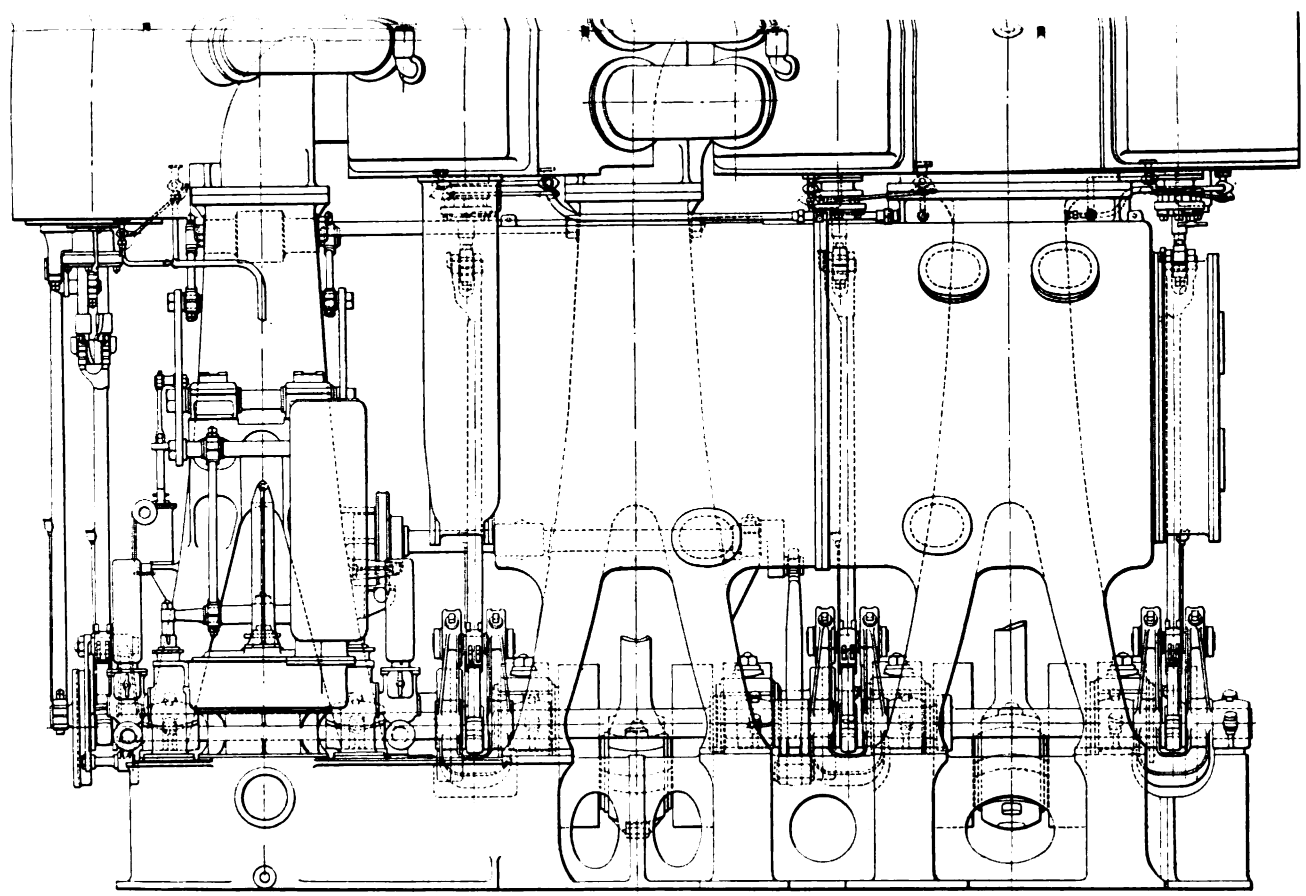


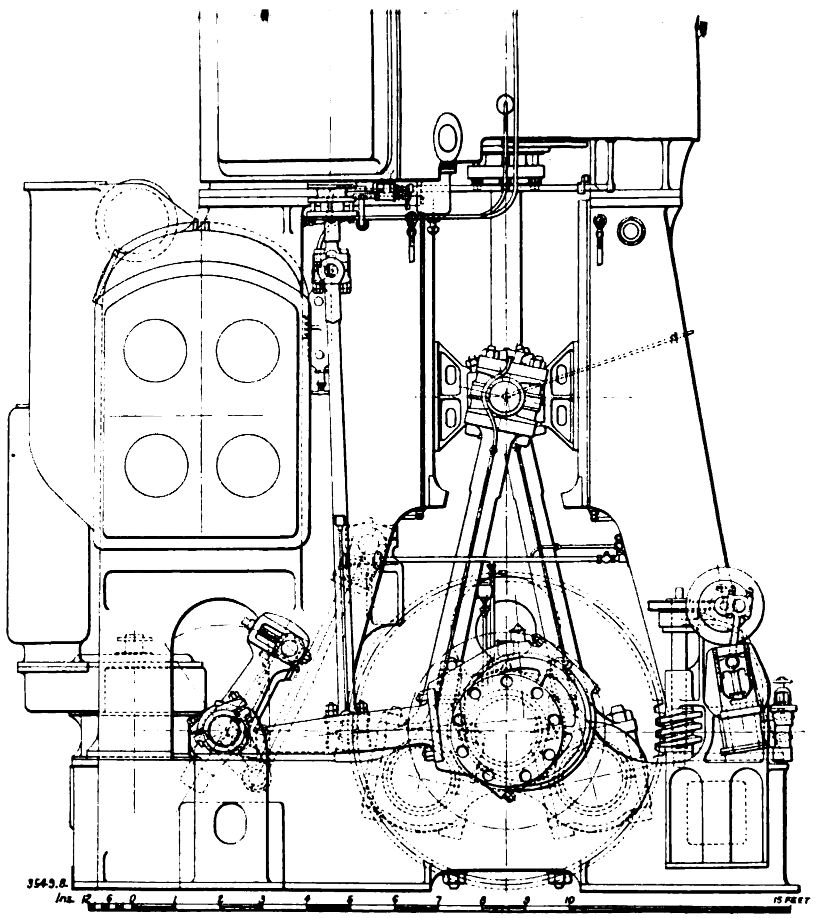
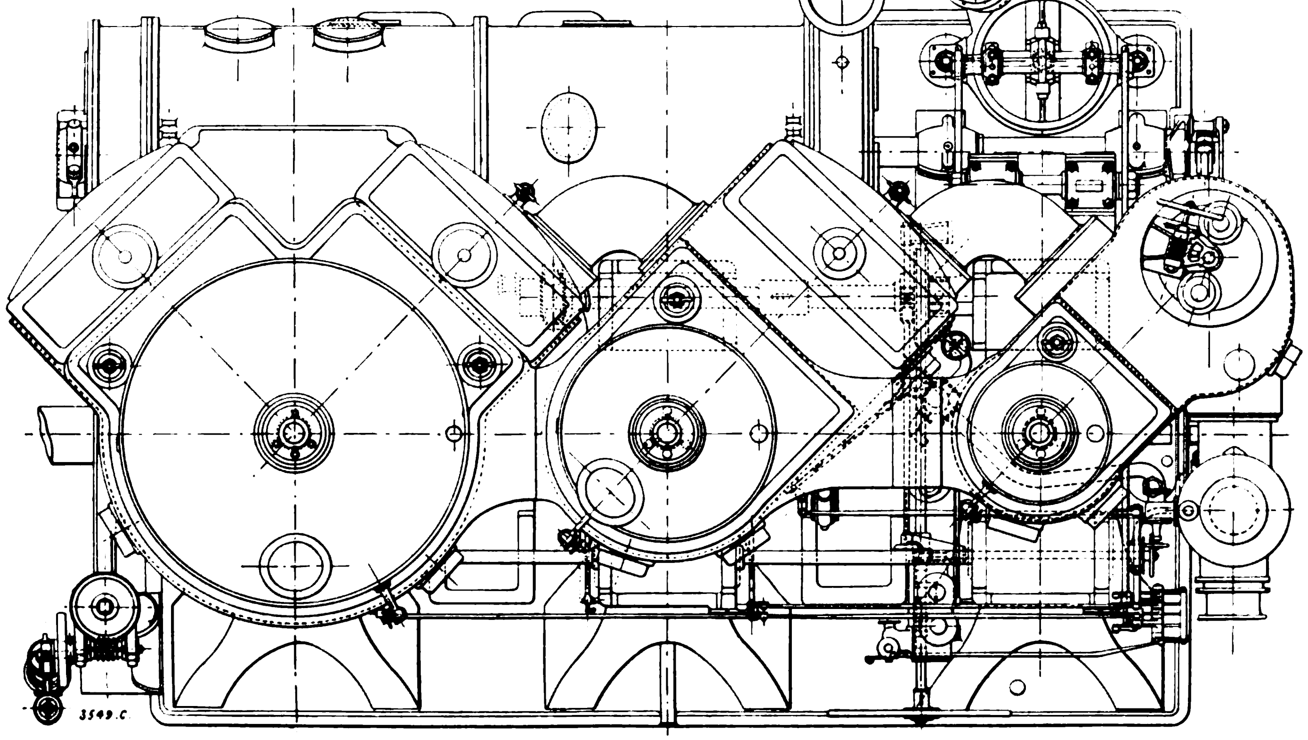


Fig. 17



DIMENSIONS.

High-Pressure Cylinder	36 In. in Diameter
Intermediate Pressure Cylinder...	57 ,, ,,
Low-Pressure Cylinder	92 ,, ,,
Stroke	54 In.
Indicated Horse-Power	13,300