110-FOOT U. S. SUBMARINE CHASER

Instructions, Care and Operation of Machinery Plant

L. C.

Bureau of Steam Engineering

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BUREAU OF STEAM ENGINEERING

These instructions are issued to the operating Personnel of each Submarine Chaser for their information, and as their issue is limited they should receive proper care and will remain with the Chaser to which they are issued. Attention is directed to "Safety Precautions," Page No. 98, which must be strictly obeyed.

(*Approved*) R. S. GRIFFIN,
Chief of Bureau.

FOREWORD

The idea in compiling this book is to give to those about to operate the STANDARD engines the written experience and information gained in years of operation and maintenance; to give it in a simple form using terms only which the average man is familiar with.

It is in sufficient detail for adjustment, repair, assembly, requisition of parts or supply, symptoms of trouble, necessary attendance, and cleaning or care of the entire propelling plant.

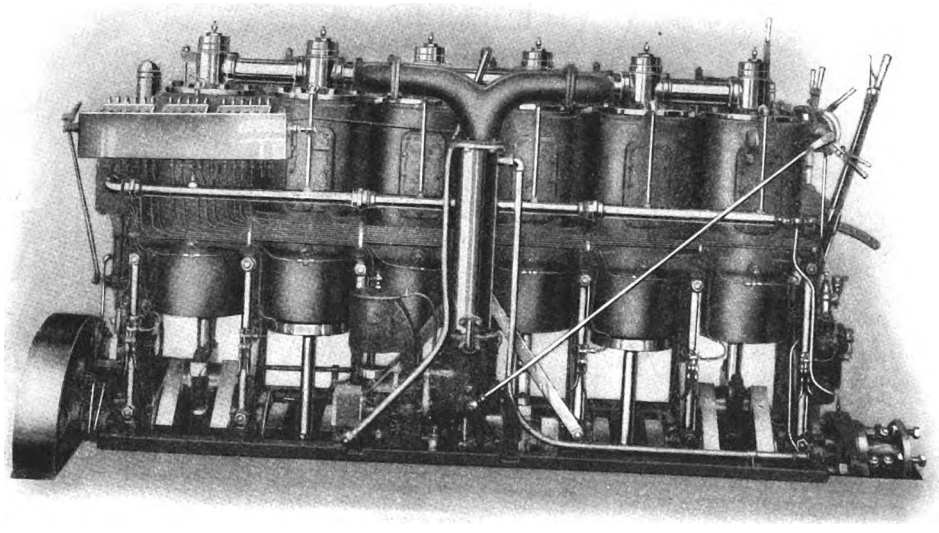
All of the above are more or less inter-dependent for perfect service. It is said any piece of machinery having been built a number of years has perfected itself as in its operation it has pointed the way to the development, which responded to each year, entails less attendance. The propelling plant described herein has passed through this stage of development, so the minimum of attendance is necessary but while attendance is the lesser factor in perfect operation, perfect attendance and care only will bring perfect operation. In other words "care and adjustment must be given in anticipation of engine demands" the engine can do its 90% only when you have contributed your 10% in advance. All failure can be attributed to accumulated neglect.

To those operating, many ideas of improvement will doubtless occur. The builders have a testing or experimenting plant working constantly trying everything but with the perspective of all past experiences and conditions constantly before them real progress is slow. Remember no two engineers would probably approve of the same thing or give the care to your device you will yourself.

The accessories man always stands ready to cure all your ills; don't pay any attention; he will fill your boat to the limit with useless, unsuitable trap, a continued source of care and annoyance. On any point which is not clearly understood a letter will bring prompt information.

In conclusion would say keep your outfit "Standardized" in the original "trial condition". If you find it altered bring it back to Standard as herein described. Then you will get perfect operation with the minimum amount of perfect attendance.

EUGENE A. RIOTTE, *President,*
Standard Motor Construction Company.



6 CYLINDER, 10" BORE x 11" STROKE
AIR-STARTING AND REVERSING STANDARD ENGINE

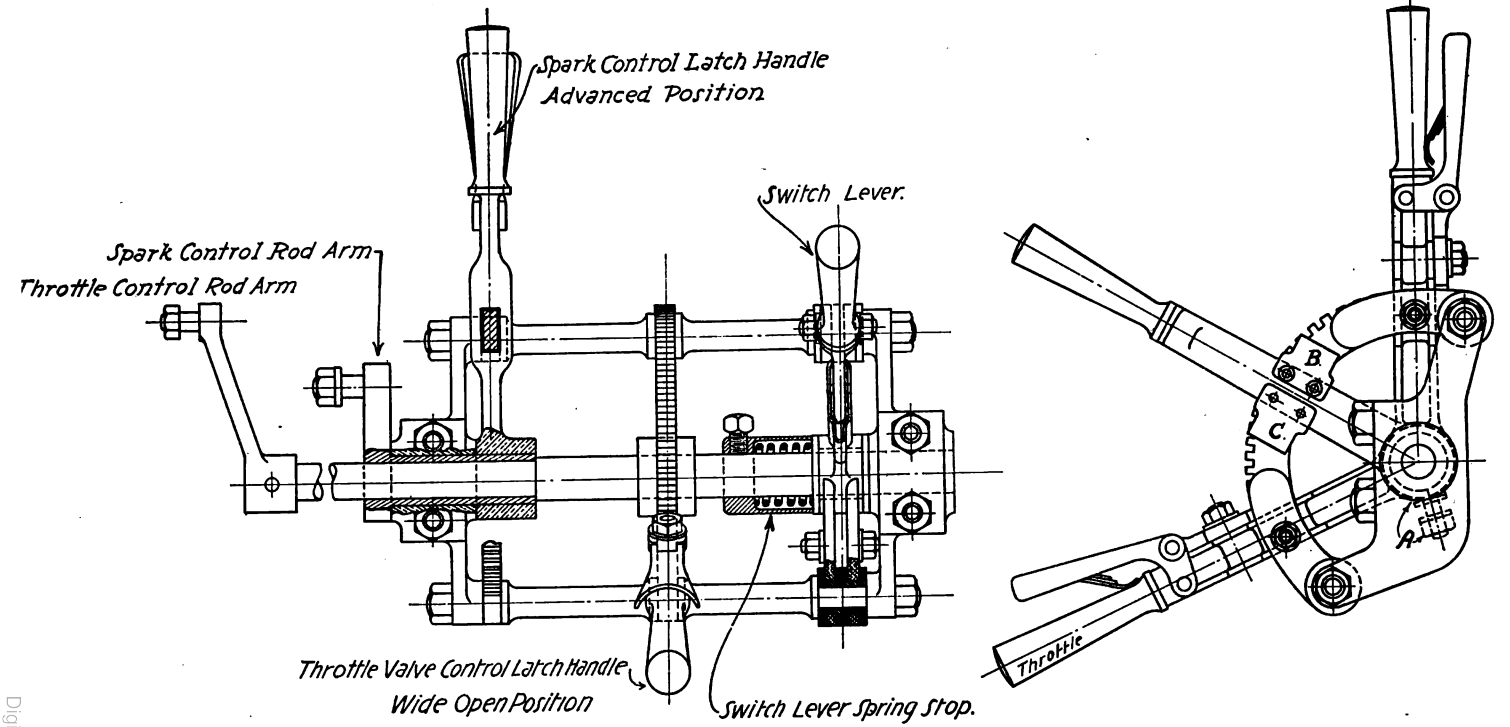
INSTRUCTIONS

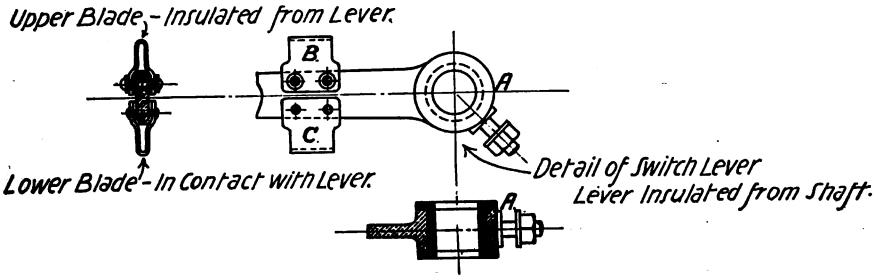
In the STANDARD air-starting and reversing engine the starting is accomplished by taking compressed air into the cylinder on the working stroke through a valve actuated by a cam.

The compressed air is fed into the cylinders four-cycle on explosion stroke as is the gasoline mixture on the suction stroke, and each system of operations is complete in itself and does not interfere with the other. The complete control of the engine on air alone, as on gasoline alone, is accomplished by means of a cam shaft carrying different complete sets of cams for running ahead and for running astern. These different cams synchronously and automatically work the air inlet valves, the exhaust valves and the ignitors, and are thrown into operation for reverse or ahead motion through a simple fore-and-aft movement of the cam shaft.

Main Engine

CONTROL ARRANGEMENT—

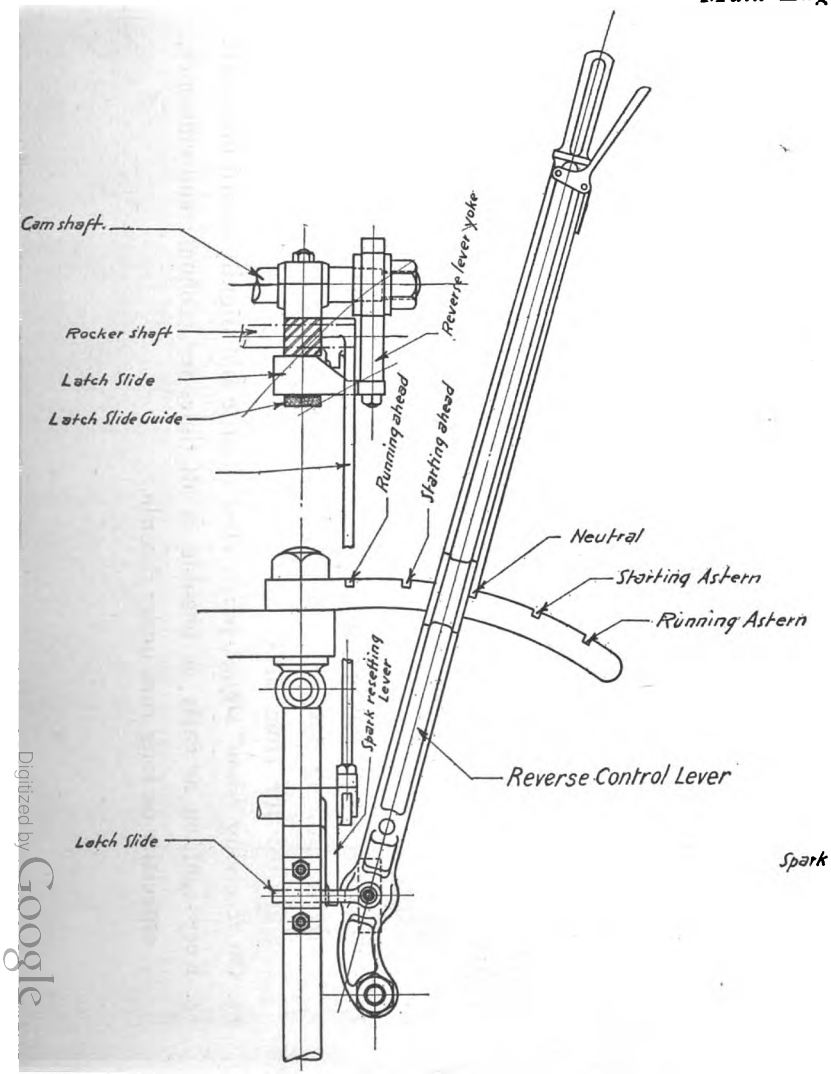


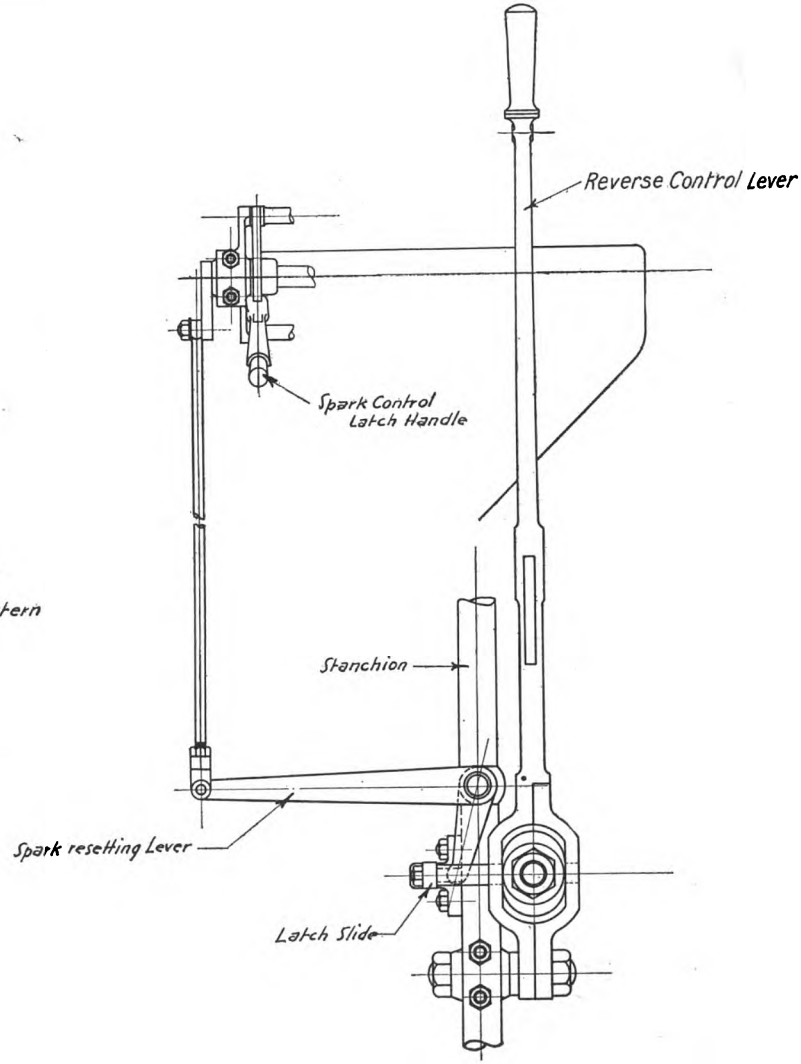


OPERATION OF ENGINE

STARTING

1. See that there is sufficient air in the air tanks,—250 lb.
2. See that sea cocks are open for circulating water.
3. Open the stop valve on the air tank which admits compressed air to the hand starting valve.
4. See that the lubricator is filled.
5. Turn on feed valve from gasoline tank and work the hand priming fuel pump until the vaporizer is filled to overflow level,—lifting side cover on vaporizer for inspection.
6. When engine is cold pour a small quantity of gasoline into the cylinders through the priming cups,—about a wineglassful.
7. See that the ground switch for the ignition is closed.
8. Partly open throttle valve by pulling down the throttle valve control latch handle to about half way on the throttle control sector.
9. Throw switch lever into top switch for battery and place reverse control lever in starting ahead position, first notch ahead.
10. Pull slightly on compressed air-starting valve lever.
11. When engine is firing let go of compressed air-starting lever and at the same time put reverse control lever into running ahead position, furthest ahead notch.
12. Advance spark by pulling up the spark control latch handle and open throttle by pulling down the throttle valve control latch handle, to give speed signalled for from deck.
13. On receiving "slow" signal, partly close throttle and slightly retard the spark.
14. Keep ignition as early as possible at all times for economy and efficiency, especially on long runs under throttle.



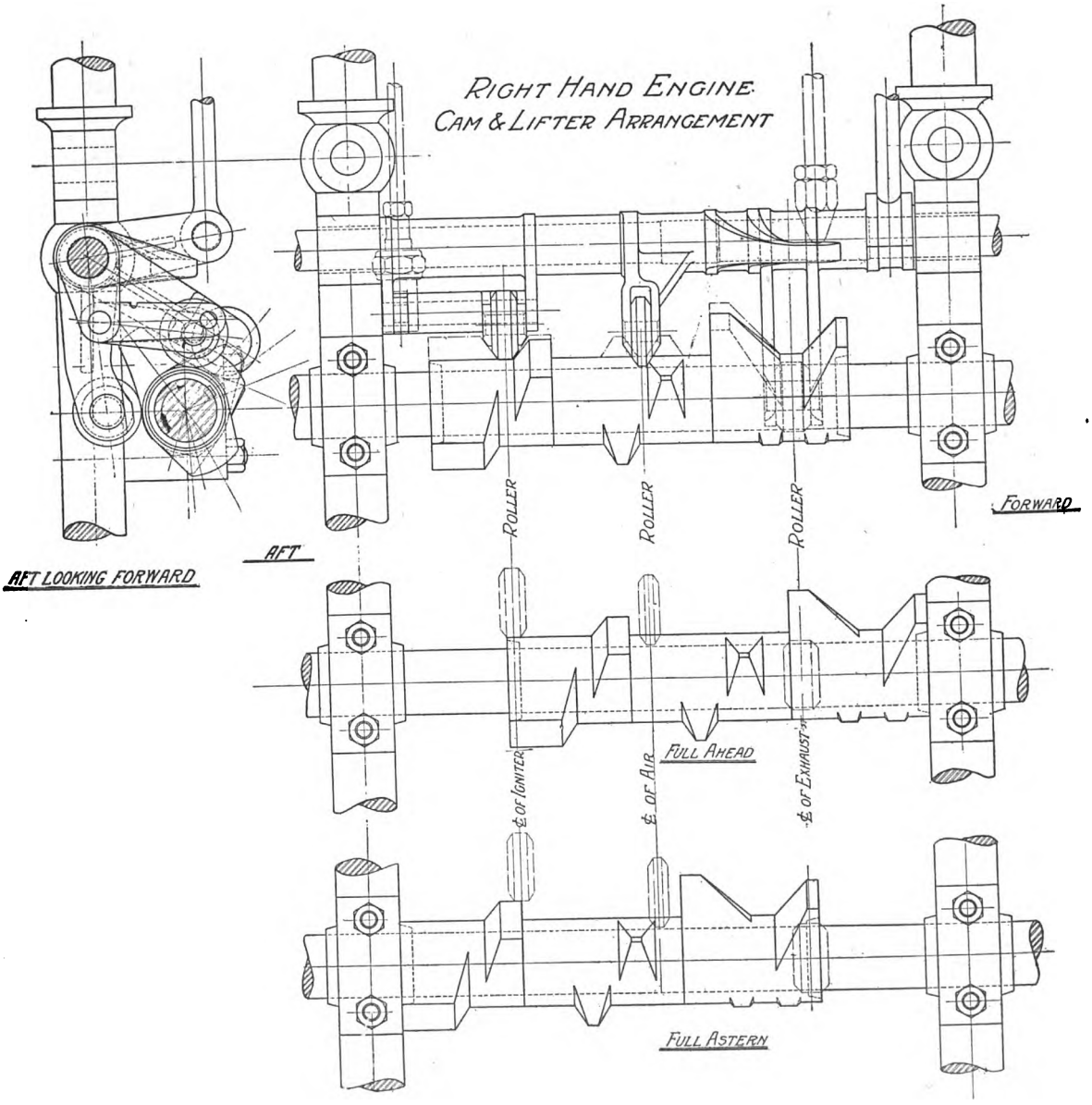


STOPPING

1. Place throttle valve control handle in position for starting and throw out spark control switch at same time.
2. Set reverse control lever in neutral position. By this method the engine stops quickly against compression with the last charge of gas in the cylinder unfired.
3. Slip in switch lever again when reverse control lever is in neutral position. Note that in bringing the reverse control lever to neutral position spark is automatically retarded so that engine is ready either for going ahead or astern.

REVERSING

1. Pull reverse control lever to astern starting position, first notch back from neutral.
2. Nine out of ten times an ignitor trips and fires in some one cylinder and the engine starts automatically without using compressed air.
3. Should the charge not fire, pull slightly on the compressed air-starting valve lever.
4. As soon as engine is firing throw the reverse control lever to running astern position, last notch back, and open throttle for desired speed signalled for from deck.



OPERATION PARTS

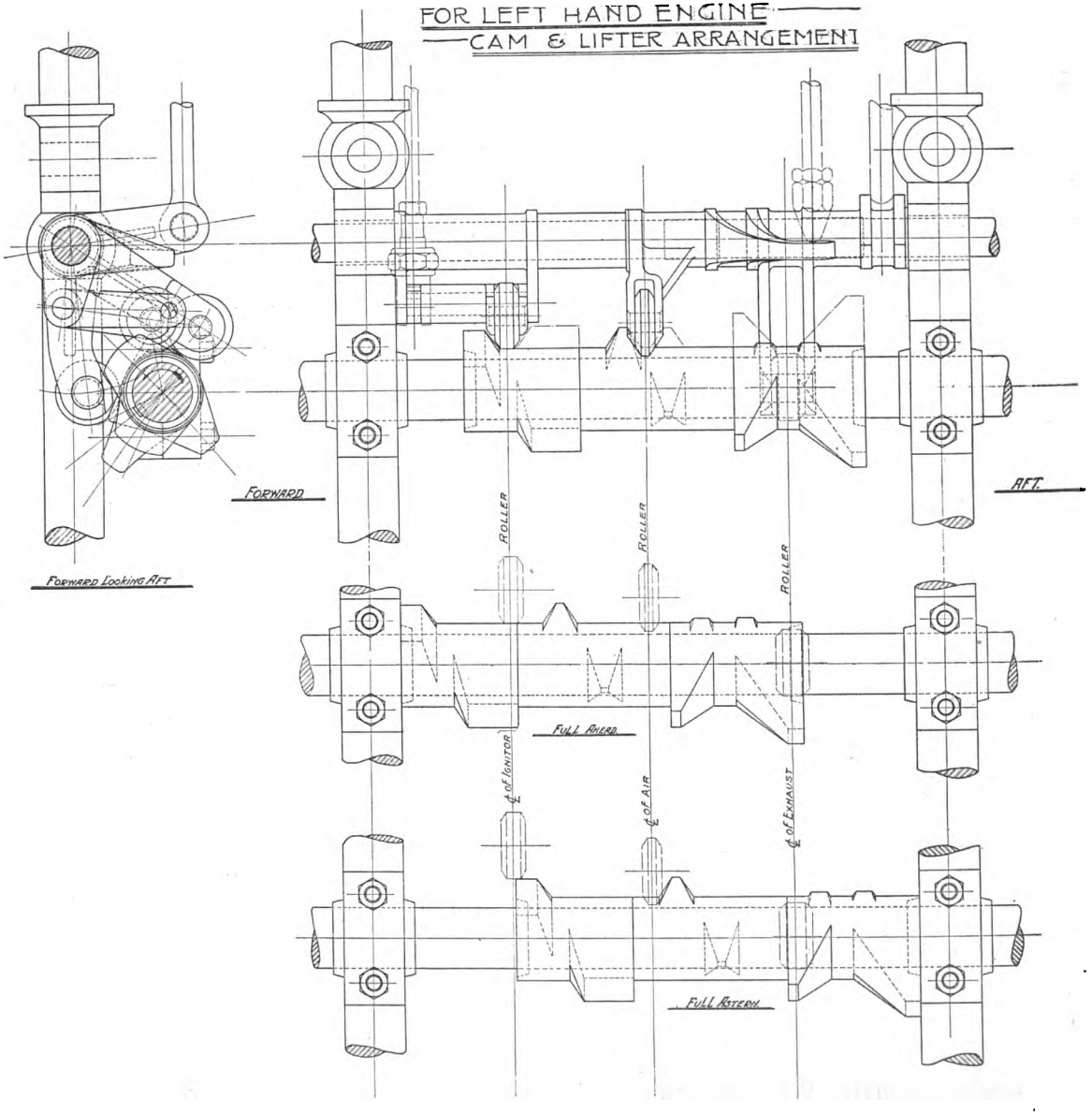
Reverse Control Lever

The fore-and-aft sliding of the cam shaft is accomplished by the shifting of the long reverse control lever. The fulcrum of this lever is the pin which supports it in the bronze bearing bolted to the aftermost upright engine stanchion a few inches below the cam shaft. The reverse control lever divides into a yoke at the cam shaft so that the end of the shaft extends through the lever, and is fastened to it by a collar with pin running through reverse lever yoke. The control lever swings on a sector which is bolted to the engine cylinder, and on which are notched the five positions of the cam shaft; neutral, starting ahead, running ahead, starting astern, running astern. A latch held down by a ribbon spring locks the lever into whichever notch of the reverse control lever sector it is set.

Cam Shaft

The cam shaft runs along the side of the engine below the cylinders and on the exhaust manifold side. It is supported in split bronze bearings bolted to the upright steel stanchions which support the engine cylinders. The cam shaft is operated through a vertical cam shaft drive with worm gears from the engine crank shaft to the vertical shaft, and pinion and plain bevel gears from the vertical shaft to the cam shaft. The gear on the cam shaft has a sliding key-way which allows cam shaft to slip in its fore-and-aft motion while the gears are always in mesh. The sliding gear key is filed to a perfect side fit and a fair fit top and bottom.

The cam shaft is a ground steel shaft, the keys are a perfect fit for the key-way of the shaft. When the cam shaft is properly timed at the factory a dumb-bell mark (o—o) is stamped on the top side of the shaft at the flywheel end.



The cam shaft is removed by taking off the outer half of the cam shaft bearings and the vertical drive shaft complete. In putting back the cam shaft it must be placed with the dumb-bell stamp at the flywheel end directly on top when No. 1 crank is on upper dead center so that the cams are in the right position for each cylinder.

CARE OF: Put a few drops of oil in the oil hole at the top of cam shaft bearings once an hour.

CAMS

All cams are ground to a perfect fit on the cam shaft, and are keyed to it so that it is impossible for any cam to get out of time one from the other and the whole shaft is timed from one cam. The cams are keyed on the cam shaft at the factory so each cam performs its proper function at the proper point of the piston travel for each cylinder. Cams are all interchangeable and all cams, cam rollers and pins are hardened and ground.

CARE OF: Wipe clean the cams and the cam shaft every day when engine is idle. They should never be removed from the cam shaft.

VERTICAL CAM SHAFT

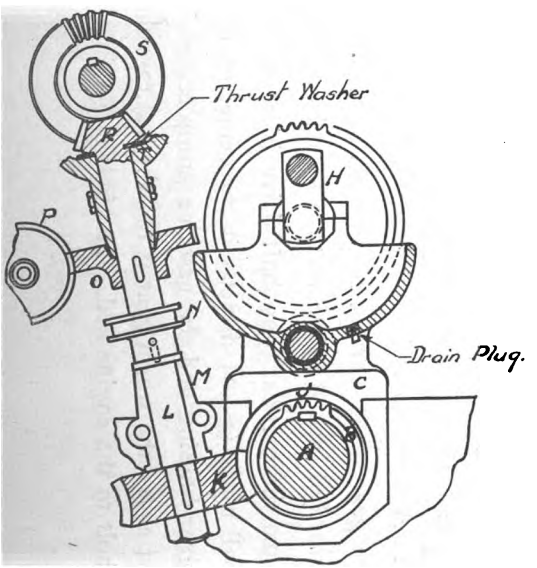
The cam shaft of the vertical drive is forged nickel steel case-hardened and ground. A worm gear is keyed to the shaft at the lower end where it meshes with the gear wheel shrunk on and keyed to the engine crank shaft. This worm gear is further locked to the vertical shaft by a nut.

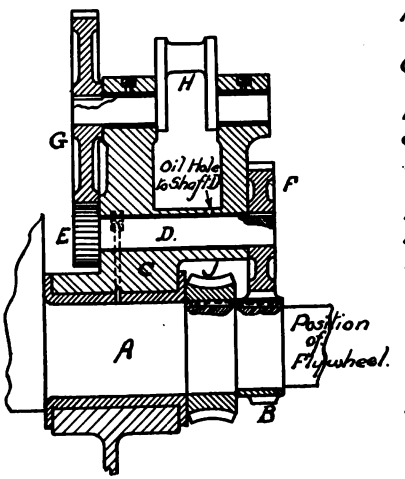
When the vertical cam shaft drive is set at the factory it is stamped with a dumb-bell mark (o—o) directly in the center of the front side, and between the upper gear housing and the gasoline pump eccentric drive.

Just above the worm gear is the vertical cam shaft bearing, the two halves of which bolt to the engine bed. The bolt holes in the bearing are elongated to

Main Engine

GEAR DRIVES OF CIRCULATING PUMP, VERTICAL SHAFT, CAM SHAFT, MAGNETO AND FUEL PUMP.





A = Main Crank Shaft
B = Gear Wheel (29 Teeth) for Circulating Pump Drive.
C = Bed of Circ. Pump forming Cap of No 1 M.B.
D = Circ. Pump Driving Shaft.
E = Pinion made solid with D. (14 Teeth)
F = Gear Wheel (32 Teeth) gearing with B to drive D.
G = Gear Wheel (52 Teeth) on Circ. Pump Crankshaft gearing with E
H = Circ. Pump Crankshaft.
J = 18 Thread Worm on Main Shaft.
K = 18 Tooth Worm Wheel gearing with J and Keyed to Vertical Shaft
L = Vertical Shaft.
M = Lower Bearing of Vertical Shaft
N = Eccentric Driving Fuel Pump
O = 36 Toothed Spiral Gear for Magneto Drive.
P = 24 Toothed Spiral Gear on Magneto, gearing with O.
R = Bevel Pinion (14 Teeth) made solid with L for Camshaft Drive.
S = Bevel Gear (28 Teeth) on Camshaft gearing with R.
T = Part of Gear Casing bolted to Engine Stanchion

allow of correct meshing of the gears. Above this the eccentric for the gasoline pump drive is keyed to the shaft and above this is keyed the magneto drive gear. The top end of the shaft is forged and machined into the pinion gear which meshes with the bevel gear on the end of the cam shaft. A gear housing for this bevel gear and pinion gear is bolted to the engine stanchion. The shoulder of the pinion is ground on its surface and a case-hardened and ground thrust washer sets on the vertical cam shaft and against the shoulder of the pinion. When the shaft is in place in the gear housing the lower surface of the bevel pinion thrust collar bears against the gear housing so that the down thrust of the vertical cam shaft is taken by the gear housing. The up thrust is taken by the bronze shaft bearing and the hardened steel gasoline pump eccentric. A copper oil pan is fastened below the gears of the vertical shaft drive and circulating pump drive.

CARE OF: The grease cup on the gear housing should be kept filled with grease which, as it is gradually melted, works around the gears.

See that oil is feeding properly to the vertical shaft bearing at lower end of shaft.

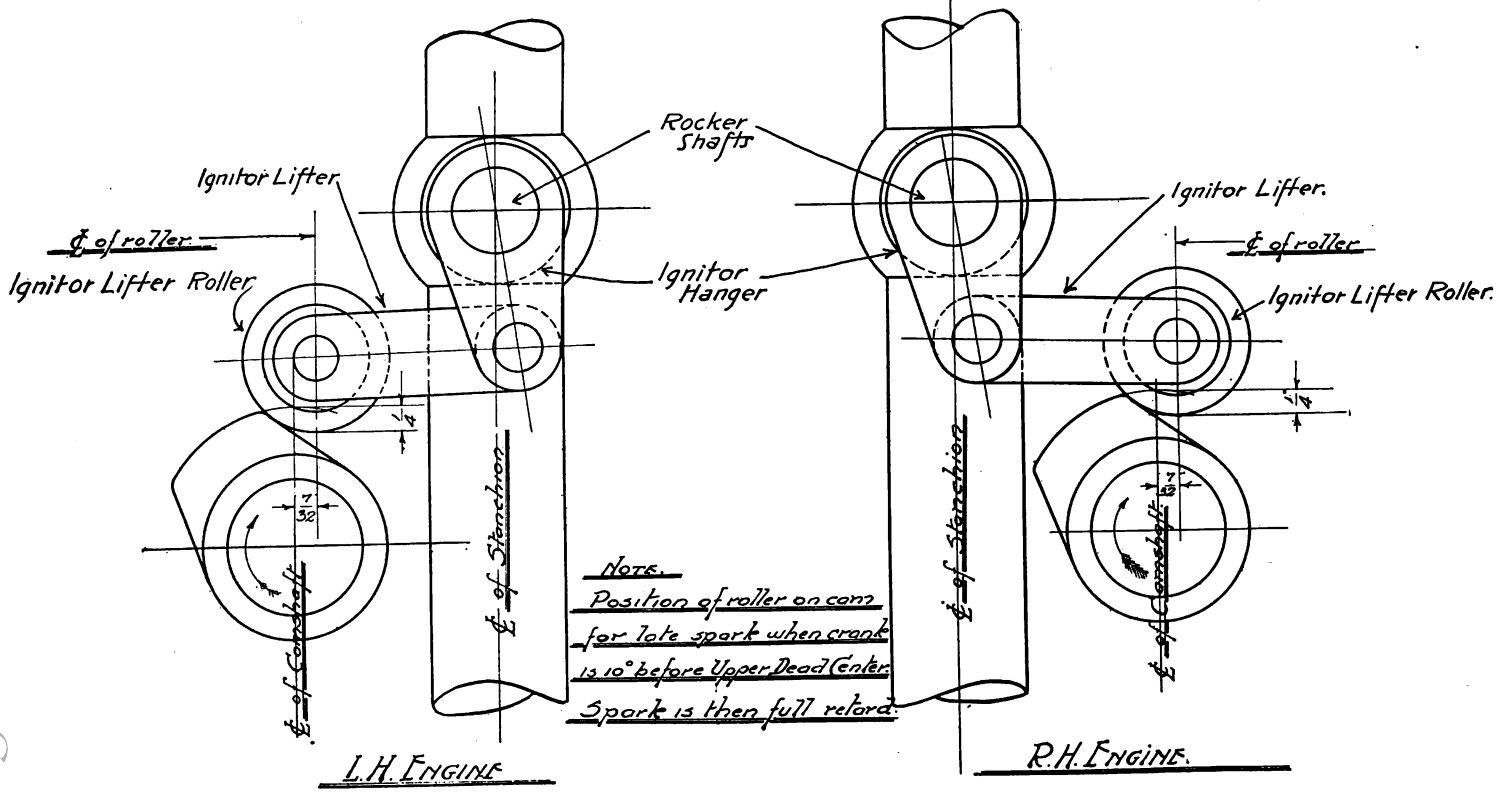
Keep oil pan clear of dirt or grit but let clean oil remain in it.

In replacing the vertical cam shaft at any time have the worm gear in the bevel pinion so mesh with the cam shaft bevel gear and the engine shaft gear wheel, that when the cam shaft dumb-bell marking is on top the dumb-bell marking on the vertical cam shaft is directly in front, facing the flywheel end of the engine.

ROCKER SHAFT

The motion of the different valve stems and ignitor rods is transmitted through lifters. The valve lifters are hung on the rocker shaft. The ignitor lifters are hung on hangers pinned to the rocker shaft. This shaft runs parallel to the cam shaft, a little above and nearer the cylinders, and through the engine stanchions which are enlarged at this point to receive the bronze bushings inserted.

SPARK ADVANCE ARRANGEMENT



NOTE.
Position of roller on cam for late spark when crank is 10° before Upper Dead Center. Spark is then full retard.

CARE OF: See that no lifters are sticking on the rocker shaft and that no rollers are sticking in the lifters. Wipe clean every day when engine is idle.

Put a few drops of oil on the pins and in the oil hole of the exhaust valve lifters, air valve lifters, ignitor hangers and rollers every day when engine is idle.

VALVE LIFTERS

In one end of each lifter is hung a roller which bears on the cam shaft and which is raised by its cams. The other end of the air inlet valve lifter bears against the end of the valve stem; the other end of the exhaust valve lifter is pinned to the end of the exhaust valve pull rod. The other end of the ignitor lifter is pinned to the end of the ignitor lifter rod. The ignitor lifter is in two parts, one part the ignitor lifter hanger pinned to the rocker shaft, the other part the ignitor lifter carrying the cam roller. The roller is held down on the cam shaft by a spiral spring fastened to the hanger and bearing on the lifter. This spring will hold its tension indefinitely. The air inlet valve lifter and the exhaust valve lifter float freely on the rocker shaft.

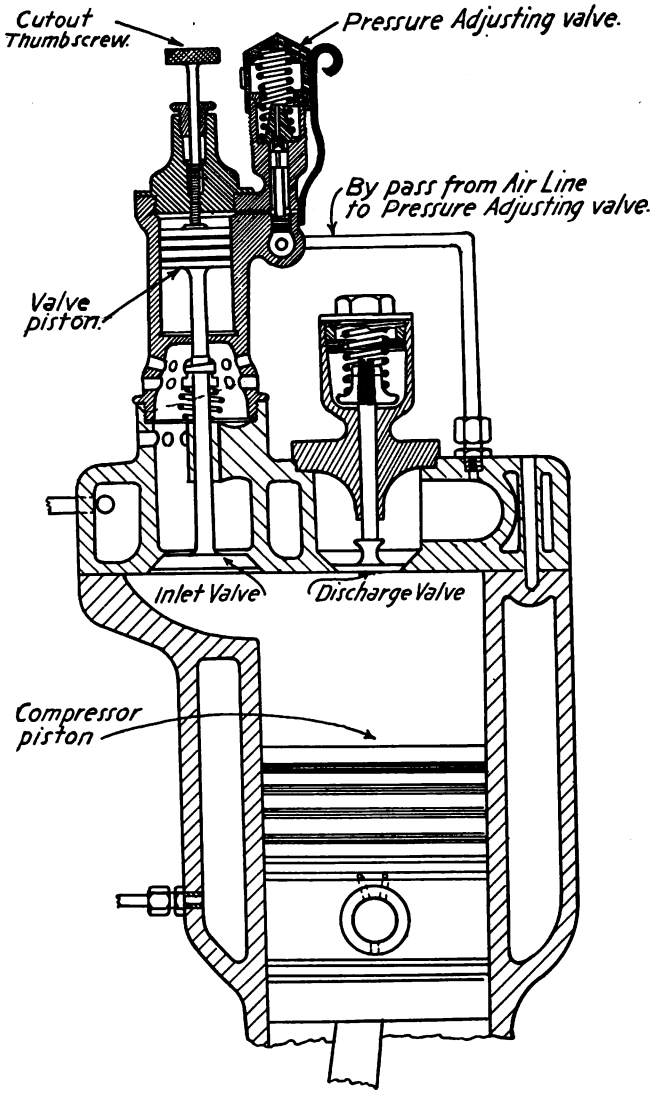
CARE OF: See that none of the lifters are sticking on the rocker shaft.

Lubricate these parts every day when engine is idle through the oil holes and on the pins.

See that all rollers are running freely on the cam shaft. Lubricate these parts once a day when engine is idle.

Main Engine

AIR COMPRESSOR



AIR

Air Compressor

Air compressor is mounted on the after end of the engine. The compressor piston is worked directly off the engine crank shaft by an eccentric so that it is running while the main engine is running.

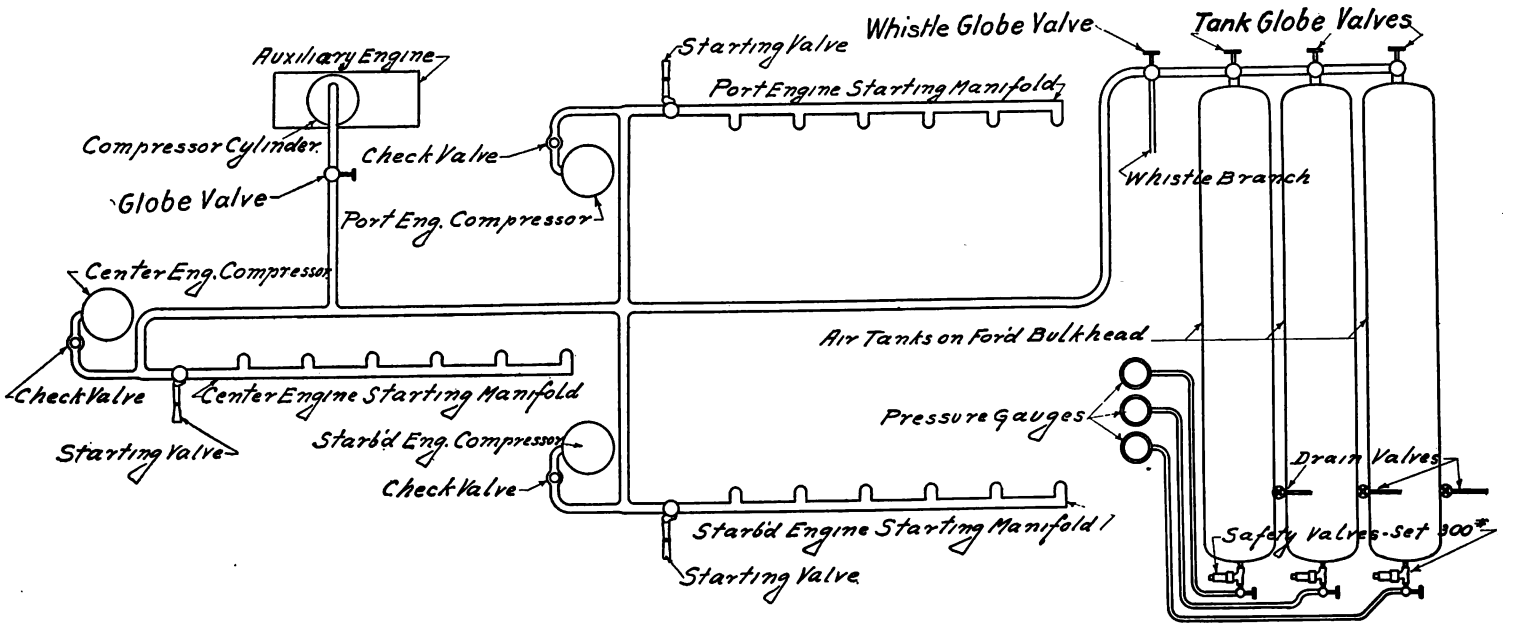
The inlet valve of the air compressor is normally held on its seat by a spring. This valve acts from vacuum created when the compressor is compressing up to the set maximum pressure, 250 lb for the tank. The air is taken in to the compressor cylinder, compressed on the up stroke of the piston, and discharged through the discharge valve which is lifted off its seat against a spiral spring on the valve stem.

Above the inlet valve stem there is a piston, the stem of which bears on the inlet valve stem when the cut-out thumb screw is screwed down upon the piston. This is done when it is wished to cut out the air compressor by hand. Just to the side of the thumb screw is a pressure adjusting valve, by means of which the air compressor is *automatically* cut out when the set maximum pressure for the tank is reached. This is a spring-loaded piston valve.

A small pipe taps the air supply line to the tank just beyond where the air is discharged from the compressor through the air compressor discharge valve. This small pipe leads from this point of the supply line to the spring-loaded pressure adjusting valve, so that the air tapped from the supply line tends to lift this valve off its seat.

The tension of the spring keeping the pressure adjusting valve seated can be varied sufficiently by screwing up or down the valve cap to hold the valve seated up to any pressure between 200 and 300 lb per square inch. With the spring set for 250 lb, when that pressure is reached in the supply line and tank, the spring-loaded pressure adjusting valve is lifted off its seat and air is admitted into the valve and through a port into the cylinder in which the piston over the

Compressed Air System
U.S. Standard 110 Ft 0" Submarine Chaser



inlet valve works. The pressure of this air bearing down upon the piston and so upon the inlet valve stem opens the inlet valve, just as the thumb screw does when screwed down upon the piston, but keeps it open only as long as the set pressure is maintained in the air supply line and air tank. In this way the air compressor automatically starts and stops compressing when the pressure in the tank drops below and again reaches the set 250 lb pressure.

A check valve is placed in the air supply line to the tank by the side of the air compressor. This is to relieve the pressure on the compressor. It also cuts the compressor out from the rest of the air system so that any one air compressor can be taken apart or taken off while the other compressors on the air systems are working. The air compressor is water jacketted. It is oiled from the main lubricator.

CARE OF: See that the lubricating oil is feeding freely to the air compressor cylinder.

Put a few drops of oil by hand every hour in the air compressor eccentric strap oil pad.

See that the circulating water is feeding freely to the compressor cylinder. Should the circulating water intake pipe to the air compressor become broken, the compressor could be run without circulating water if the engineer will watch it carefully and cut it out of action as soon as it commences to get overheated; or that particular pipe could be temporarily plugged up and the compressor cut out by hand when the air could be compressed in the tank by the air compressor on the other engines. If only the discharge pipe from the air compressor is broken the water could be fed in and allowed to drain into the bilge while pumping.

See that no dirt gets into the eccentric which operates the air compressor.

See that the pressure adjusting valve does not leak. This valve is ground to have a cylinder clearance of .0005".

See that the check valve at the side of the air compressor is working freely. The check-valve cap should be taken off and the valve inspected and cleaned once in a while.

See that the valve seats properly. Grind the valves at intervals if necessary.

Test compressed air joints and connections for slight leaks by putting a film of oil over the joints, seams, etc.

ADJUSTMENT OF: Adjust regulating pressure valve to cut compressor out at 250 lb pressure in the air supply line.

To remove the inlet valve, first slack up on the cross brace of the engine stanchion. Then take off the cylinder head stud nuts and disconnect the water by-pass channel and lift the compressor cylinder head off. Unscrew the inlet valve cage and take off the key in the valve stem, take off the valve spring and let the valve drop down. To remove the discharge valve take off the two valve cage flange nuts and lift the cage off the studs, unscrew the cap, take off the spring, then unscrew lock nut and collar on the valve stem. There is an asbestos packing between the cylinder and cylinder head, and in putting on the cylinder head be careful to have the packing placed evenly so that when the head is drawn home it makes a perfectly tight joint.

TANK

The air tank is of steel tested by water pressure to 500 lb per square inch. A relief valve on the forward end is set to blow at 300 lb pressure. A Globe valve is fitted at the after end of the tank on the delivery pipe. On the under side of the tank is a drain valve for drawing off oil and water. The same pipe is used for filling the tank and for delivering air to the engine. Pipe is of brass of 1¼" diameter. Time required to fill one tank from 0 to 250 lb, using two main air compressors and the engines running at 300 revolutions per minute, is about 15 minutes.

CARE OF: The air tank should be tested once a year with a cold water test of 500 lb per square inch.

Never allow all air tanks to be empty at the same time. When leaving the engine for any length of time be sure that all tanks are full and that the valves on them are closed. The valve at the after end of the tank should be closed when the tank is to be out of service for the night or a longer period. This will prevent leakage and keep air ready for immediate service when required.

Fill the tanks by the engine air compressors when the engines are running.

Tank should be drained monthly, or whenever there is an indication of condensed water in the air, through the drain valve on the under side of the tank.

Should one air tank be out of service it can be cut out by shutting off its valve on the delivery pipe while the engines can be operated from the remaining tanks.

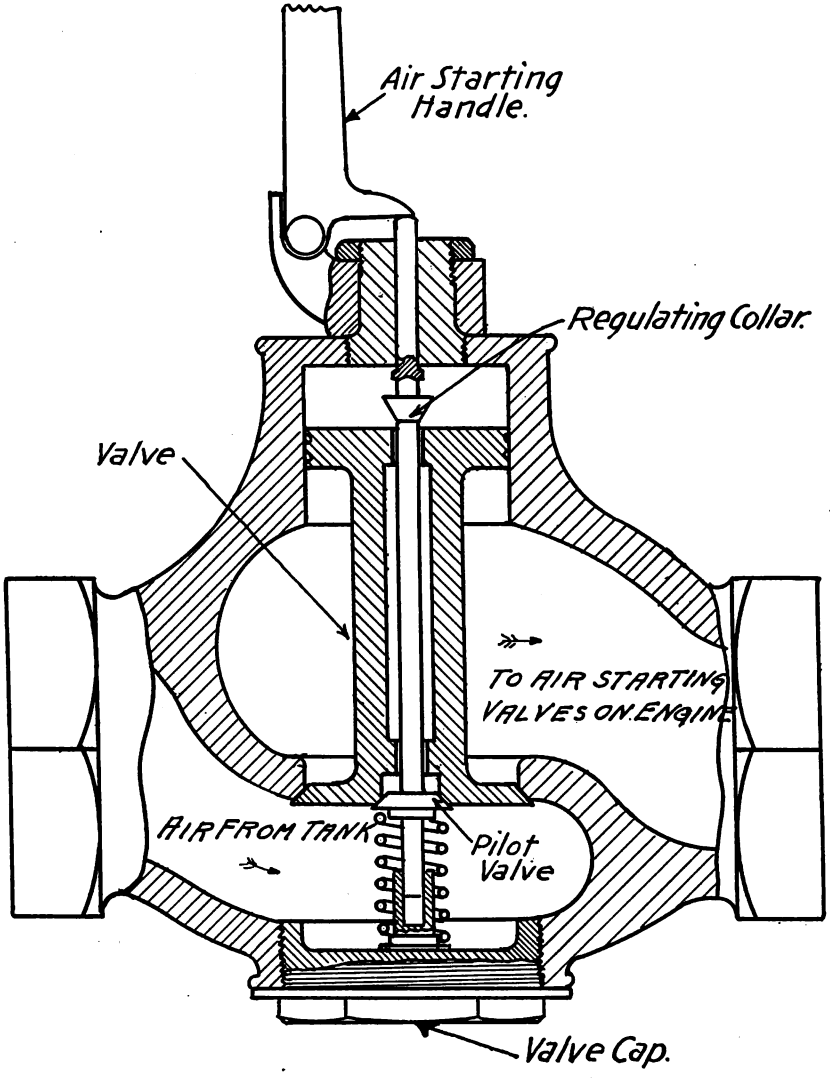
Compressed Air Starting Valve

There is a large valve operated by the air-starting handle at the after end of the air manifold pipe which carries the compressed air over the tops of the cylinders and to the inlet air valves. The upper part of this valve is a piston having a sliding fit in the valve cage above the air feed pipe to the cylinders. The valve stem extends free through the valve.

A regulating collar is pinned to the stem just above the top surface of the starting valve and a pilot valve is on the stem just below the bottom surface of the starting valve. A spiral spring on the valve stem holds the pilot valve seated in the bottom surface of the starting valve.

When the air-starting handle is pulled it bears the valve stem downwards carrying the pilot valve off its seat, so allowing a small amount of air from the supply tank to pass up through the center of the valve. By the time the air-starting handle has pushed the valve stem far enough to seat the regulating collar on the stem against the upper surface of the valve enough compressed air has passed through the valve to practically balance it, and the further down pull of the starting handle opens the air-starting valve.

HAND STARTING VALVE



Some such mechanism as this is necessary as it would otherwise be impossible to open a sufficiently large valve against the 250 lb pressure per square inch in the air supply line.

When the starting handle is released the spring automatically closes the valve. A valve cap is screwed into the bottom of the valve cage through which the valve can be removed.

CARE OF: See that the spiral spring has sufficient tension to hold the valve properly seated.

See that the valve seats tightly.

See that the pilot valve, valve stem regulating collar and valve are clean.

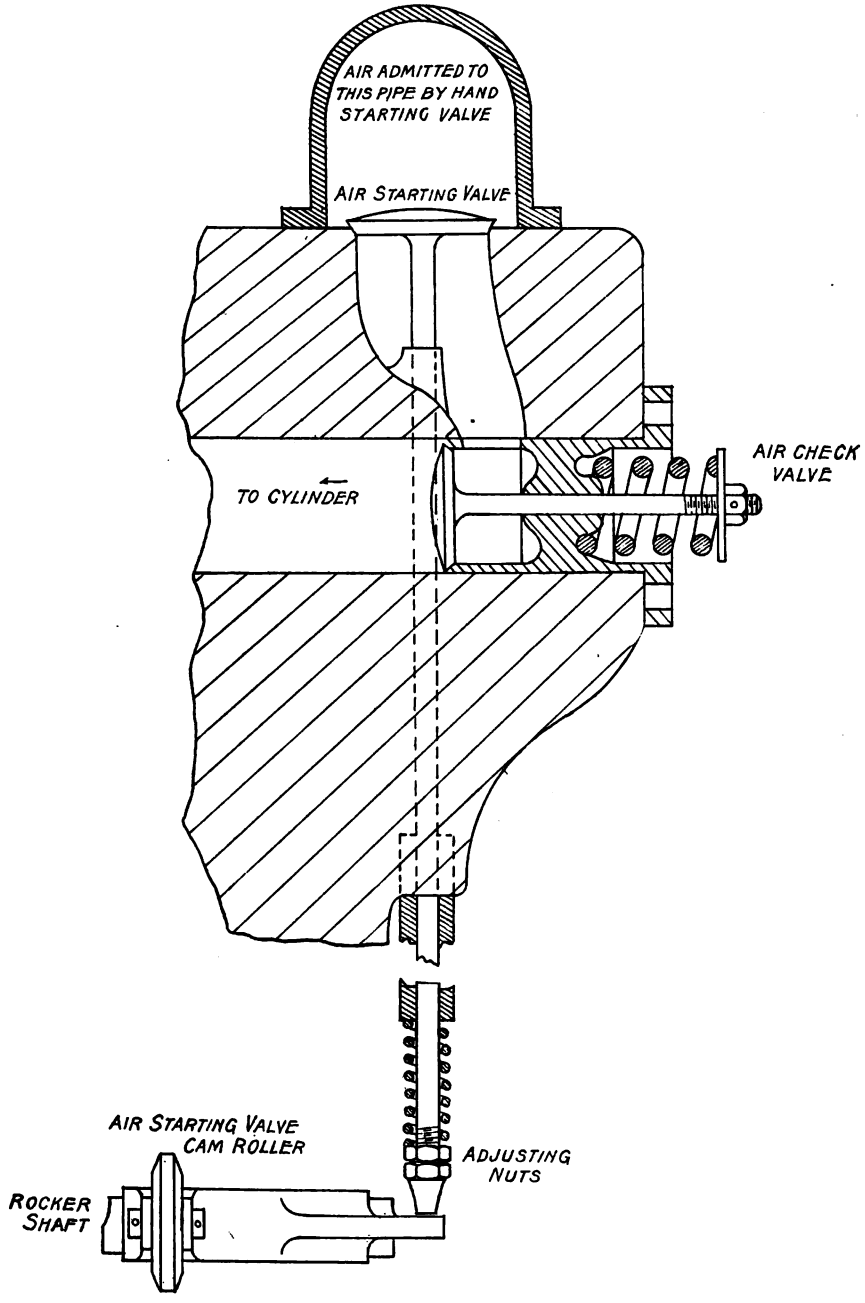
Compressed Air Inlet Valve

The air passing through the air-starting valve enters the air manifold pipe which has a series of holes distributing air to all six engine cylinders.

The air inlet valve in the engine is operated by the air cam on the cam shaft which is correctly timed so that the air in the distributing pipe over the valves enters each cylinder, when piston has just passed over its highest point for either direction on the firing stroke. The valve is lifted off its seat by the air cam working against the end of the valve stem. A spiral spring bearing against the adjusting nut at the bottom of the valve stem and against the valve stem guide re-seats the valve quickly.

CARE OF: Inspect frequently to see that the air valves do not stick,—if a valve stuck it would affect the starting of the engine. Test the air valve before starting the engine, and if necessary put a slight amount of oil on the valve stems. If the valves seem to be leaking so that the engine is not immediately responsive to the air the valves should be taken out and ground in.

AIR STARTING VALVE AND AIR CHECK VALVE MAIN ENGINE.



ADJUSTMENT OF: To take out the air inlet valve it is necessary to take out the exhaust valve and cage complete. Then disconnect from the air manifold pipe the air delivery pipe which is the air inlet valve bonnet. Then take off the two nuts at the bottom of the stem, the valve spring and the valve head sleeve and lift out the valve. To grind the valve use grinding paste on the bevelled valve seat and turn the valve back and forth on the seat with a screwdriver. The valves should be re-ground often enough to have them always seat tightly but they should not wear sufficiently to make necessary the scraping in of the valves.

Be careful to keep grinding paste out of cylinder.

Adjustment for wear to maintain correct lift of the valve is obtained through the nut and cone lock nut at the bottom of the valve stem. There should be a clearance of 1/32" between the bottom of the cone nut and the air cam.

Compressed Air Check Valve

The compressed air going to the engine cylinder through the compressed air inlet valve passes through a port in the cylinder casting where there is a check valve. This valve is set in the air check valve cage which is held to the engine cylinder by a flange and two studs and nuts.

There is an annular groove on the inside corner of the cage flange, and lead packing is placed in this groove so that there is a perfectly tight joint between the flange and the cylinder. The inner edge of the valve cage is ground on a bevel which seats tightly against a machine fit in the engine cylinder casting. It is very important that the inner end of the cage makes a tight joint with the engine cylinder, because if this joint leaked it would allow the hot gases of combustion to pass through and melt the soldered joints in the air inlet valve bonnet. The valve is on a bevel so that it seats tightly on the bevel ground seat of the cage. It is normally held seated by the valve spring on the valve stem which extends out beyond the engine cylinder and which is held to the valve by spring washer, stop collar and split pin.

The compressed air which has passed through the air inlet valve passes through openings in the side of the air check valve cage and lifts the air check valve off its seat against its valve spring when no explosion takes place in the engine cylinder. The pressure of explosion in the cylinder holds the air check valve on its seat when explosions are taking place in that cylinder, so that the compressed air then goes no further than the tightly closed air check valve.

CARE OF: Inspect frequently for any leak through the ground joint of the inner edge of the valve cage and the cylinder.

Inspect frequently for any leak of air between the valve cage flange and the cylinder.

Keep the valve cage clean.

Be careful in putting in the valve cage not to overpull on the stud nuts and to pull up evenly on them.

ADJUSTMENT OF: To grind the air check valve use grinding paste on the valve cage seat and turn valve back and forth on the seat with a screwdriver.

To grind the inner edge of the valve cage and its seat in the cylinder use grinding paste and turn the cage by hand.

Be careful to keep grinding paste out of cylinder.

Take out the old lead packing between the valve cage flange and the engine cylinder as often as necessary and replace with a new lead packing. The tension of the valve spring could be regulated by washer and nut on the valve stem but this should never be necessary.

GASOLINE

Float Box

The fuel tanks in the boat must be installed so as to give a gravity flow of gasoline to the float box installed below the engine vaporizer.

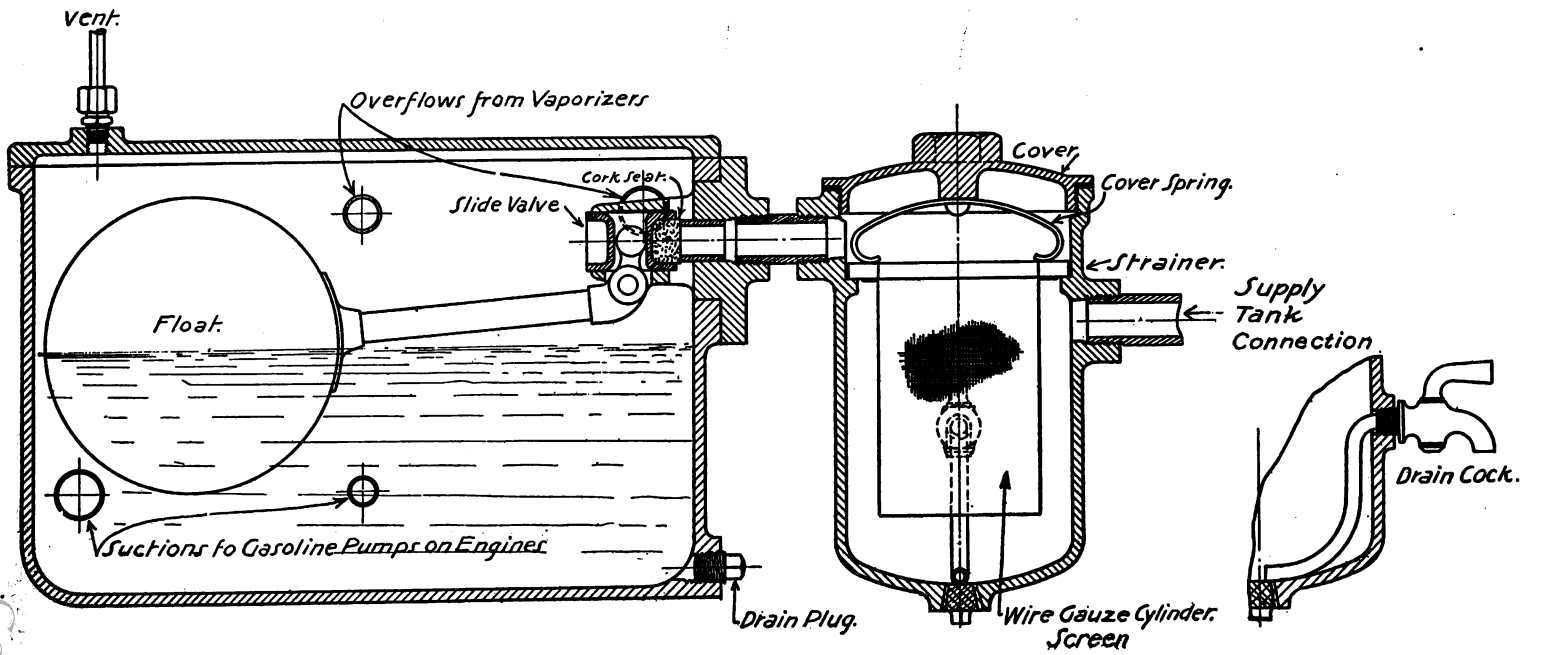
This is a small cast iron tank having a cast iron cover which bolts to it. The level of the gasoline in the box is kept constant by a float which opens and closes a valve as it drops or rises with the level of the gasoline. The valve which admits the gasoline from the strainer to the float box is at the top of one end of the box.

The valve guide is held to the float box by a flange and three studs and nuts. The guide extends into the float box and from this is hung the float lever tube. This is a hollow brass tube soldered on the lower end to the float level pad, which pad conforms to the shape of the float and is in turn soldered to that. The fulcrum of the lever tube is at the bend of a knuckle soldered to the other end of the tube and held to the gasoline valve guide by the knuckle pin. The lever knuckle extends up into the valve guide and into the gasoline valve, so sliding the valve forward and back with the lowering and raising of the float. A cork is placed in the end of the valve, and this seats against a brass guide bushing soldered in the valve guide, when the swing of the float lever tube closes the valve.

Screwed into the end of the float box at the bottom is a cast iron plug which, when unscrewed, allows the float box to be drained. The suction pipes leading to the gasoline pump on the engines are tapped into the bottom of the side of the box. The overflow connections tap into the upper side of the box. A vent pipe runs from the float box cover to just in front of the vaporizer screen.

CARE OF: To clean the gasoline valve in the float box remove the valve guide from the float box by unscrewing the valve guide flange from the float box,

FLOAT BOX & STRAINER



and by removing the knuckle pin which is simply held in place by a split pin, and which when removed allows the float lever knuckle to drop out of the gasoline valve and the valve guide. The gasoline valve can then be slid out and wiped clean, and the valve guide can be wiped clean inside and out and the valve cork can be replaced if necessary.

In putting connections back use shellac in all joints and be sure to make all connections perfectly tight. Inspect all joints frequently for the slightest leak.

If there is any suspicion of dirt or water in the gasoline drain the float box through the plug at the bottom of one end. Take out the float by disconnecting at the valve guide and thoroughly clean the box. When draining the float box or the vaporizer or any part of the installation always catch the gasoline in a cup or pail in the retainer so that it doesn't run into the bilges. Test the piping and gasoline pumps and vaporizer to see if clogged and clean if necessary.

To clean the gasoline valve in the float box remove the valve guide from the float box by unscrewing the valve guide flange from the float box, and by removing the knuckle pin which is simply held in place by a split pin, and which when removed allows the float lever knuckle to drop out of the gasoline valve and the valve guide. The gasoline valve can then be slid out and wiped clean, and the valve guide can be wiped clean inside and out and the valve cork can be replaced if necessary.

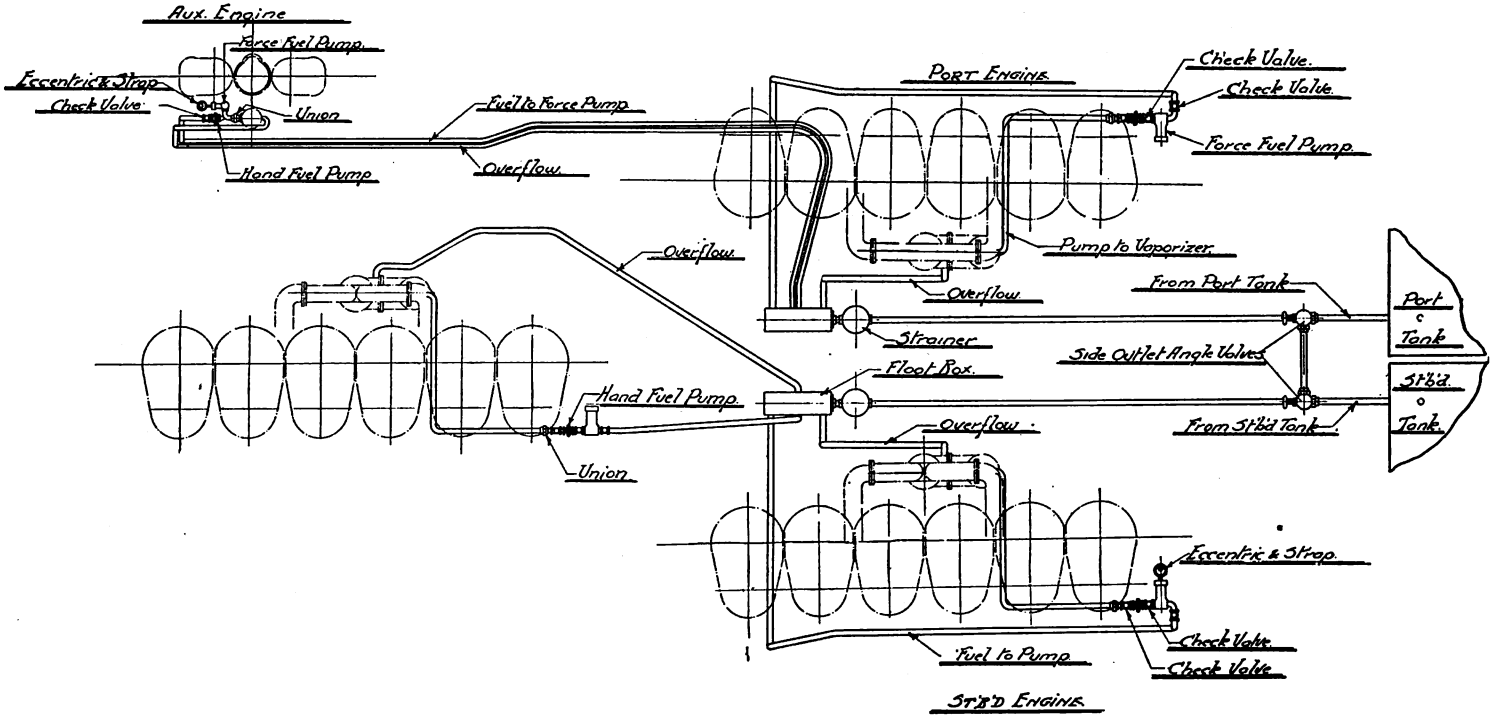
See that the float is air tight. This can be tested by putting in warm water.

STRAINER

The strainer tank installed in front of the float box on the pipe line from the main supply tank is a cylindrical bronze casting. A brass cap screws down onto this cylinder with a leather washer between. A spring fastened to this cover holds the brass collar of the wire gauze screen fast on the shoulder of the inside of the strainer. This brass wire gauze screen is made in the form of a cylinder hung from the brass collar just mentioned, and which cylinder is only open at the top. The diameter of the cylinder is smaller than that of the strainer tank.

Fuel Piping Arrangement.

U.S. "Standard" 110 ft. 0" Submarine Chaser.



The gasoline flows from the main supply tank into the strainer tank outside of the wire gauze screen and the gasoline seeps through the screen so that the gasoline taken off the top of the strainer tank to the float box is thoroughly strained.

A cock is set in the side of the strainer tank for testing the gasoline and for draining the strainer tank.

CARE OF: Frequently take off the strainer cap and remove the wire gauze screen and clean. If the screen is torn it must be repaired at once and replaced as soon as possible. Frequently open the cock in the side of the strainer and pour off just a little gasolene into a cup to test for water. If water is present in the gasoline it will pour out through the pet cock first. Look carefully for water after every fresh lot of gasoline is put into the main supply tank, allowing an hour for what water there may be in the gasoline to settle to the bottom of the main tank. Then, pour more gasoline out through the cock to test for clearness.

If water gets to the strainer it settles to the bottom but the strainer will not hold back water if it is passed through in any large quantity. Completely drain the strainer. Drain the float box.

Drain the vaporizer and test carefully for water. If a trace of water is found the vaporizer must be completely drained and all trace of water cleaned out of the gasoline tips and the tubes. If water has gotten to the engine the ignitor plug must be taken out and the contact tips wiped clean. Siphon the water from the bottom of the gasoline supply tank with a hose or drain off the bottom through drain cock.

After having thoroughly cleaned the entire gasoline line, fill the strainer and the float box again and test for water. After this has had time enough to settle test again for water and if present drain again and continue this until positive that the gasoline fed to the engine is free of water. Test the entire gasoline suction pipe line frequently for air leaks. The gasoline pump, hand primer, check valves and all joints must be very carefully watched for air leaks into suction pipe. All joints must be kept well shellaced and perfectly tight. All packings must be

maintained in good condition and all glands kept tight. The pump glands must be frequently packed. The gasoline system must be tight.

Gasoline Pump

While the engine is running the gasoline pump, mounted on the forward end of the engine base and driven by an eccentric on the vertical cam shaft, is constantly pumping gasoline from the float box to the vaporizer. The excess gasoline overflows from the vaporizer to the float box.

The pump consists of a cast bronze pump body which forms the cylinder and the base, a stuffing box gland, a gland nut, a plunger, eccentric strap and rod, eccentric, wrist pin and two eccentric strap bolts and nuts. All parts are of phosphor bronze excepting the wrist pin, the eccentric and the eccentric strap bolts and nuts which are of machined steel.

CARE OF: See that the pump does not leak, and to be tight the pump must always be well packed and the glands screwed tight. If, with the gland tight, the pump still leaks new packing is required. See that pump is not clogged, and clean if necessary.

ADJUSTMENT OF: To pack the pump, unscrew the gland nut from the cylinder. Lift the gland up on the plunger and pull the stuffing box gland down so that the packing can be taken out. Then re-pack with new flax packing.

Hand Primer Pump

A hand primer pump is located on the gasoline line between the gasoline pump and the vaporizer. This is a brass cylinder and plunger, with stuffing box and gland. By working the plunger by hand the gasoline is pumped from the float box to the vaporizer establishing the normal level of gasoline in the vaporizer for starting. Excess of gasoline through continued working of the hand

primer pump overflows back by pipe to the float box, just as it does with the gasoline pump when the engine is running.

Check Valves

One check valve is set in the gasoline line in front of the gasoline pump, one check valve behind the gasoline pump, between it and the hand primer pump, and one check valve behind the hand primer.

These are the ordinary check valves whereby the gasoline flowing towards the engine holds the little valve off its seat, and closes the valve on its seat with the first back flow.

CARE OF: All check valves must be kept perfectly clean so that the bevelled edge of the valve seats tightly against the machined bevel of the seat.

To clean the check valve unscrew the cap at the top and lift out the valve when the valve and seat can be wiped clean. If there is any indication of much dirt in the valve unscrew the valve from the nipple on each side so that the valve chambers can be gotten at and cleaned out.

Supply Tank

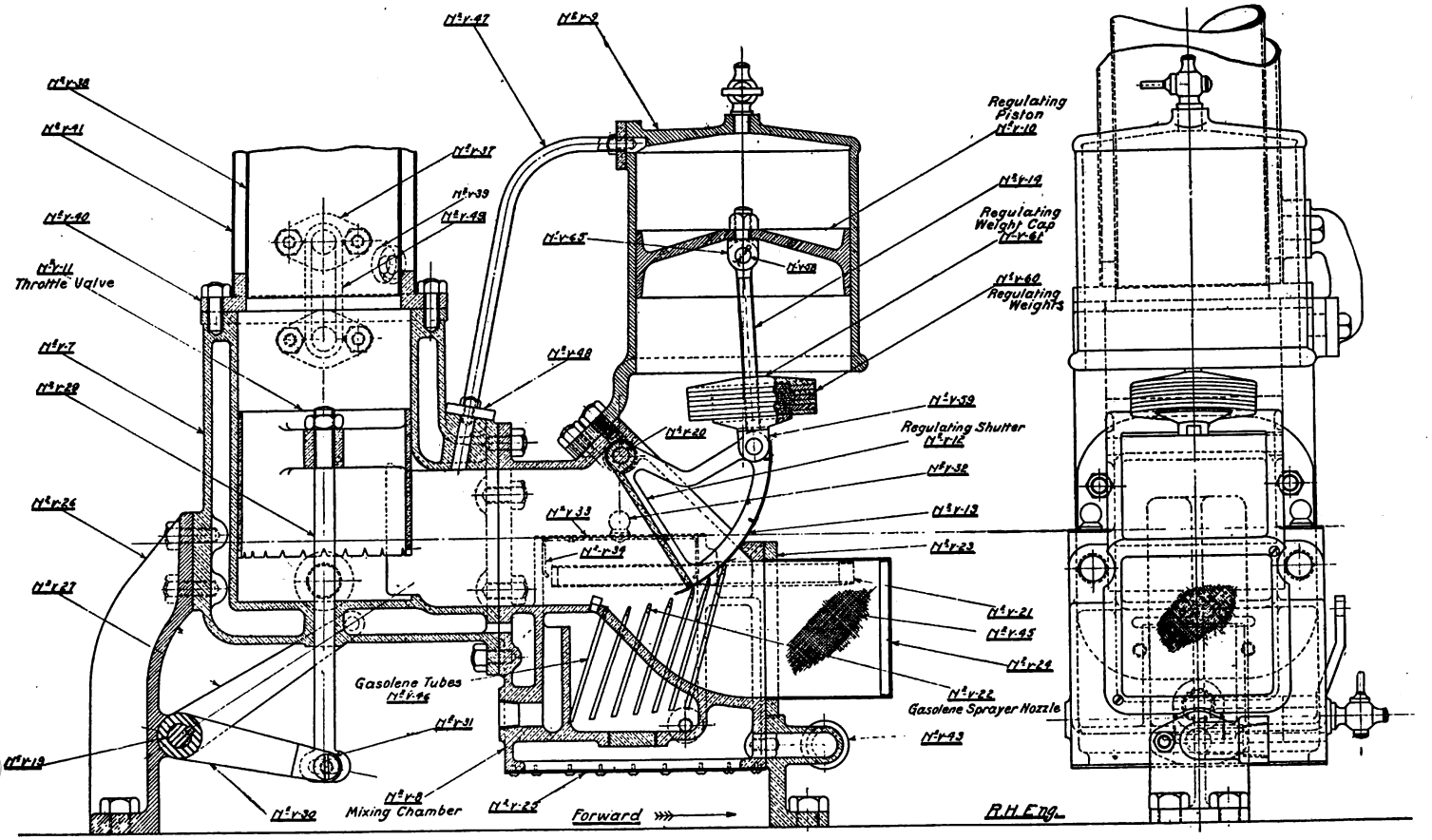
CARE OF: In filling the gasoline supply tank always thoroughly strain the gasoline. Do not drain the barrel or can into the tank but leave some of the gasoline in the bottom of the receptacle and pour into a separate can and strain particularly carefully and test for water.

Vaporizer

The vaporizer is of the Standard constant vacuum type which automatically regulates the mixture of gasoline and air at all engine speeds.

The vaporizer and the vertical intake pipe are water jacketted and warm water

Main Engine



Detail Arrangement of Vaporizer.

is circulated through them from the cylinder heads, exhaust valves and air compressor. Vaporizer is in three main castings; the regulating cylinder which is bolted to the top of the mixing chamber, which in turn is bolted to the front of the throttle valve chamber which in turn is bolted to the inlet pipe flange. A wire gauze screen fastened to the front of the mixing chamber screens the ingoing air.

In the mixing chamber there are fourteen thin brass sprayer tubes with the ends extending into the air inlet passage and together forming an arc just clearing the surface of a sprayer shutter. The upper end of the tube has a sprayer nozzle screwed into it, and the holes in these nozzles vary in diameter.

The sprayer shutter swings over the surface of the sprayer nozzles, the surface of the shutter being in the form of an arc so that when closed all of the fuel nozzles are closed by it. This sprayer shutter is worked automatically by the varying volume of air which enters the intake pipe. The back edge of the sprayer shutter is fastened by a connecting link to a regulating piston which works with a sliding fit in a cylinder so that the space above the piston is practically a vacuum chamber. A pipe leads from the top of this cylinder to the intake air passage in front of the throttle valve and in back of the sprayer shutter.

As the throttle valve is opened by the operator, and the volume of air decreased in the space tapped by the pipe from the regulating piston cylinder, an increased vacuum acts on the top of the regulating piston lifting it with sprayer shutter until a balance is established. In this way with the opening and shutting by hand of the throttle valve the sprayer shutter is automatically raised or lowered, and more or less sprayer nozzles covered or uncovered keeping gasoline in same proportion with air in the intake pipe. The connecting link is threaded its entire length, fastened at the upper end to the regulating piston by means of a pin through the eye of the link, and locked with cotter pins. The bottom of the link screws into the regulating weight base from the fork of which the sprayer shutter is hung.

Weights to vary the weight of the regulating piston slip over the connecting link and rest on the regulating weight base, and are fastened down by means of a brass weight cap threaded to the link and which screws up and down on it.

By making the regulating piston heavier through the addition of these weights a greater vacuum is necessary for the piston to be raised, and a greater suction from off the sprayer nozzles produced. The most efficient adjustment of weight for running is soon found and this adjustment should be maintained.

On top of the mixing chamber at each side is a small removable brass cover held in place by ribbon springs, and by taking off these covers the height of gasoline in the vaporizer can be seen. The cock in top of piston chamber is for a drop of oil once a day.

CARE OF: Keep sprayer nozzles cleaned out to their original diameter by means of wire and the drills furnished. These drills are the following sizes: Nos. 44, 50, 60, 64 and 71, No. 44 being the smallest and No. 71 being the largest.

If the nozzle opening has become enlarged a new nozzle of the correct size must be substituted; if the nozzles become enlarged the engine will consume an excessive amount of gasoline.

Always use special nozzle wrench furnished for removing a sprayer nozzle; don't attempt to take off a nozzle with a pair of pliers.

If the wire gauze screen attached to the vaporizer becomes torn repair it at once and replace as soon as possible. Clean it at times with kerosene.

See that the brass sprayer tubes are not clogged, and for testing these out use a small wire long enough to reach to the bottom of the tube. If the nozzles become clogged the engine will backfire from too weak a mixture. The engineer can temporarily remedy this by adding weights to the regulating piston.

See that the gasoline is kept at a constant level in the vaporizer by the gasoline pump. This pump should deliver gasoline in excess of amount required, the excess gasoline going back to the float box.

Drain the vaporizer frequently through the pet cock in the side of the mixing chamber to test for water or dirt.

If the gravity flow from the main supply tank maintains the constant level in the float feed box, and the constant level in the vaporizer is not maintained, so

that the engine is backfiring from too weak a mixture, the cause may be one of the following:

A leak in the gasoline pipe from the float box to the pump.

Leaking gasoline pump glands or valves.

Choked sprayer nozzles.

Sticking of the vaporizer piston.

The temperature of the vaporizer jacket too low.

See that the vaporizer regulating piston is kept properly lubricated and that the regulating cylinder is kept clean.

See that the air cock on top of the regulating cylinder is not leaking air.

See that the packing at the joints of the intake pipe are not leaking air, they must be kept properly packed and bolted tight.

See also that the fork which holds the connecting rod to the regulating piston does not turn so as to prevent free swing of the rod.

A little oil should be kept smeared over the steel throttle valve rod where it passes through the bottom of the valve box cover to prevent rusting.

See that hot water is circulating around vaporizer. Lack of this water affects horsepower economy, and in cold weather will cause missed ignition.

ADJUSTMENT OF: To change sprayer nozzles first take out the split pins in the shaft holding the sprayer shutter in the vaporizer. Then take out the sprayer shutter shaft holding the shutter to the connecting rod of the regulating piston. Then lift out the shutter and take off the old sprayer nozzle and put on the new one with the special wrench furnished. Spare nozzles are furnished with each engine, all drilled to smallest size. A set of special drills is furnished for the nozzles and the new ones must be drilled to proper size.

INLET PIPE

The inlet pipe extends from the vaporizer vertically up to where it divides to the right and left, into horizontal pipes one feeding the three forward cylinders and one feeding the three after cylinders.

The different lengths of vertical pipe are fastened together by flange joints having rubber gaskets between. The vertical length of inlet pipe is water jacketted, the circulating water from the vaporizer jacket being by-passed outside of the flange joint connecting the pipe to the vaporizer.

As the circulating water rises in the intake pipe jacket it is carried off at the top and lead into the exhaust pipe line. Through the by-passing of the cylinder water at the flange joint an unbroken gasket is maintained. This is most desirable because of the importance of having all gaskets perfectly tight at all joints and great care must be used, when connecting different lengths of the inlet pipe, to have the rubber gasket placed perfectly even in the joint and the flanges pulled up evenly and tightly.

Inlet Valve

This valve is operated automatically by the vacuum created in the engine cylinder from the intake stroke of the piston. It is a steel mushroom valve with a long hollow stem for lightness. The valve stem slides in the inlet valve guide. This guide is made up of a long hollow, cast iron stem of sufficiently larger diameter than the valve stem to permit of an inlet valve phosphor bronze bushing being set inside of the guide stem at its lower end and at its upper end. The bottom of this valve guide stem is cast into a ring which just fits under a shoulder in the cylinder head and prevents the guide from being pulled up out through the valve opening in the cylinder head.

Threaded onto the upper end of the guide stem is a bronze guide nut with a flange on the top outer edge which extends over the top of the inlet valve bonnet. This guide nut when screwed down on the guide stem holds the valve bonnet tight to the cylinder head. The guide nut is also a spring pot for the inlet valve bumper spring. The valve bonnet for cylinders No. 2, 3, 4 and 5 have flanges on two sides corresponding to the flanges on the intake pipe. The valve bonnet for cylinders No. 1 and 6 have flanges on only one side to correspond with the flanges

on the intake pipe. A brass cap is screwed to the top of the valve bonnet and this cap is the valve dashpot in which works the steel valve piston screwed and locked with lock nut and pin to the top of the valve stem. The valve piston has one groove containing three steel piston rings.

Small holes are drilled through the sides of the dashpot at the top of the valve piston travel, and larger holes at the bottom of the piston travel, small enough to have the air slowly drawn in and forced out through them so that the air has a cushioning effect on the valve. Immediately the valve and its piston is moved downward it commences to compress a large diameter light spiral steel spring which is inside of the cage, and when the valve has reached its wide open position it is stopped by a small strong spiral bumper spring. A cock set into the valve cap is for putting a drop of oil in once a day when engine is idle.

CARE OF: See that the spring is holding the valve up against the seat.

See that the valve piston on the valve stem has 1/16" clearance beneath the dashpot top when it is screwed on.

Put a drop of oil into the dashpot once a day when engine is idle.

Unscrew the dashpot frequently and inspect the piston rings, the spiral springs, the pin through the valve stem and piston, the plug in the valve stem and the distance the valve is above the original setting in the cylinder head due to grinding.

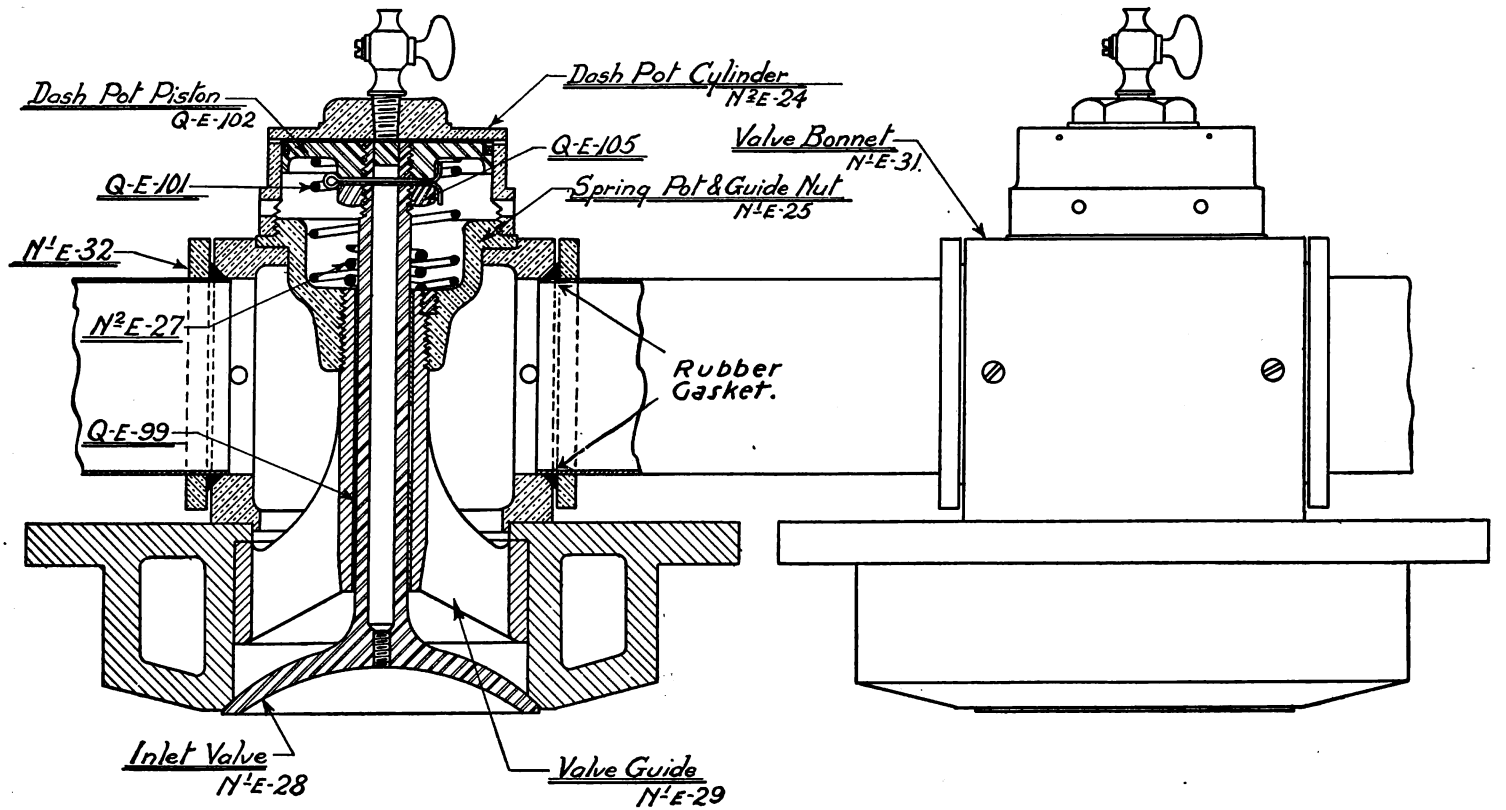
See that air holes through the valve bonnet at the bottom of the dashpot piston travel and the smaller air holes at the top of the piston travel are kept clear.

See that valve does not leak compression, by taking the valve cap off and feeling with the hand when engine is running. When engine is idle occasionally run compressed air into the cylinder and listen at the inlet valve for the hissing sound of air leaking past it.

ADJUSTMENT OF: To grind the inlet valve remove the cylinder head. Clean off the valve seat. Then put a little bluing underneath the valve. Seat the valve again and turn it back and forth on the seat by hand. This will show any

Main Engine

INLET VALVES.

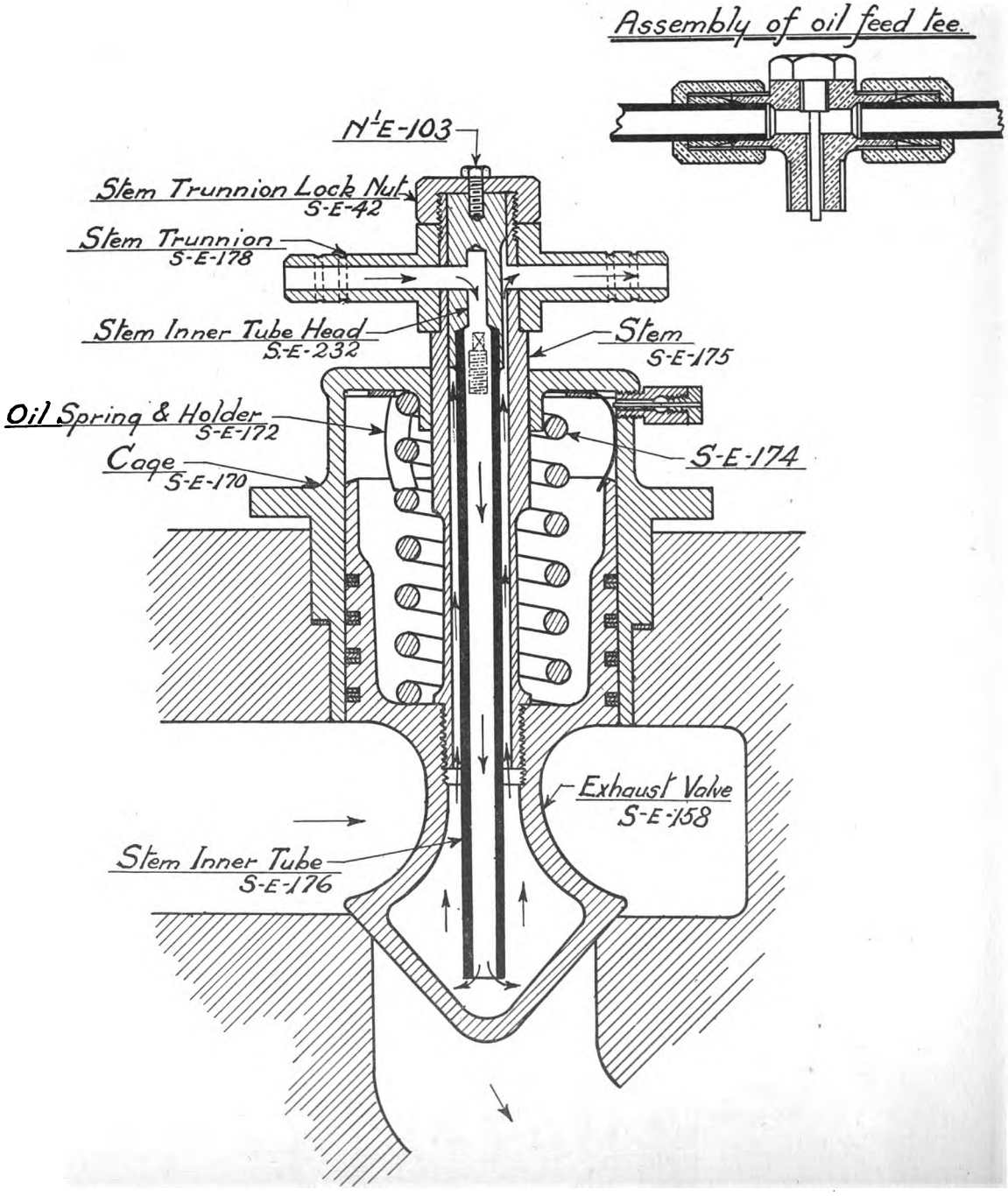


irregularities and if there are none of any amount simply use a fine grinding paste and turn the valve lightly on the seat until it shows a perfect bearing all around. If the bluing has shown considerable irregularities the valve seat should be scraped. A special tool is furnished for grinding the inlet valve seat, but if only a little scraping is needed this can be done with the end of an ordinary machinist's scraper.

Be careful to keep grinding paste out of cylinder.

Main Engine

EXHAUST VALVE



EXHAUST

Exhaust Valve

Exhaust valve is operated by the exhaust valve cam on the engine cam shaft which is correctly timed for proper opening of the valve on both running ahead and running astern.

Instead of the cam pushing the valve up off the valve seat it pulls the valve up by means of exhaust valve lifter at cam shaft and valve cage levers on top of valve cage. The valve is set in a cast iron cage which is recessed into the cylinder. One half inch from the bottom of the cage is a shoulder which seats into the cylinder head with a metal and asbestos gasket between. The cage is bolted to the cylinder head by four studs through the heavy flange of the cage extending out over the top of the cylinder head. A cast rib extending upward from the top and side of the cage is drilled out and bushed for the pivot pin of the valve cage lever.

The valve is of cast iron so designed that it is balanced against the cylinder pressures. It is cast hollow its entire length. The stem is of hollow monel metal and is screwed into the valve. A nickel steel valve stem trunnion is held to the end of the stem and locked down on a shoulder of the valve stem by a trunnion lock nut.

A cap screw threads down through the trunnion lock nut and screws into the brass exhaust valve tube head which head is screwed to the copper exhaust valve inner water tube so that it holds this tube in place in the valve stem and extending down through it. The valve tube head is hollow to above the center of the valve stem trunnion, and a hole is drilled through one side into the center of the hollow valve tube head, where it will exactly meet the hole of the valve stem trunnion when the key of the tube head is set in the key-way of the stem trunnion.

The trunnion lock nut is marked with an arrow and when this is screwed in place so that it is holding the valve stem trunnion against the shoulder of the valve

stem, and the valve correctly set in the valve cage, the arrow will point out to the side of the engine. The valve must be set so that the arrow points this way for the flow of the circulating water. Water from the cylinder jacket then passes through a rubber hose joining the cylinder head water connection, to one end of the valve stem trunnion, to the center of the exhaust valve tube head, and thence on down through the exhaust valve inner water tube to the bottom of the hollow valve, thence up through the valve stem around the outside of the inner water tube and out of the valve stem to the opposite end of the valve stem trunnion. The circulating water keeps the exhaust valve cool.

The upper part of the valve is a piston which operates in the valve cage. This piston has four grooves and twelve steel rings. Three small ribbon steel springs are riveted to the top of the dashpot chamber and these lubricate the cage walls. A large steel spiral spring which is compressed when the valve is open gives a quick re-seating of the valve.

CARE OF: When putting on the stem trunnion insert a piece of 5/16" rod through the trunnion into the valve tube head water hole, then lock the trunnion with trunnion lock nut. In replacing the exhaust valve, see that it is put in so that the cooling water flows through the valve by having arrow, that is stamped on the trunnion lock nut, point out to the side of the engine when nut is holding trunnion against valve stem shoulder. In putting on the valve cage be careful to put gasket level between cylinder and the shoulder of the cage, and turn down on opposite nuts evenly and only lightly as very little pressure is needed to hold the cage and if much force were used the cage might be distorted which would prevent the valve from seating properly. When engine has been run a short time again turn down lightly on nuts.

Keep joint between valve cage and cylinder tight by renewing gasket as often as old one shows leaks. Replace by taking out valve cage and fitting new gasket on shoulder of cylinder.

Put a few drops of oil by hand every hour in the oil hole of the exhaust valve link and on the pins. Wipe clean all parts every hour.

See that the valve is not sticking; if the valves stuck it would prevent starting on air. See that valve does not leak compression by taking the exhaust manifold hand hole plates off when engine is idle. Run compressed air into the cylinder and feel with the hand at the exhaust port. When starting engine see that all exhaust valves are down before admitting air.

See that there is a clearance of not more than 1/32" between exhaust valve cam lifter roller and body of exhaust valve cam, when exhaust valve is closed.

See that lubricating springs riveted to the top of the valve cage are all right; if they became broken the fragments would become wedged between the valve piston and the cage walls.

Occasionally put a little lubricating oil into the valve cage through plug when engine is idle. Do not fill the valve cage with oil as this would cause the cracking of the cage or of the valve or the breaking of the exhaust rocker arm.

Keep hose for circulating water well shellaced. When putting on a new hose soap well the stem trunnion and the cylinder head water connection and the inside of both ends of the hose, then slip the hose onto both water connections and screw tight the brass clamps on each end of the hose.

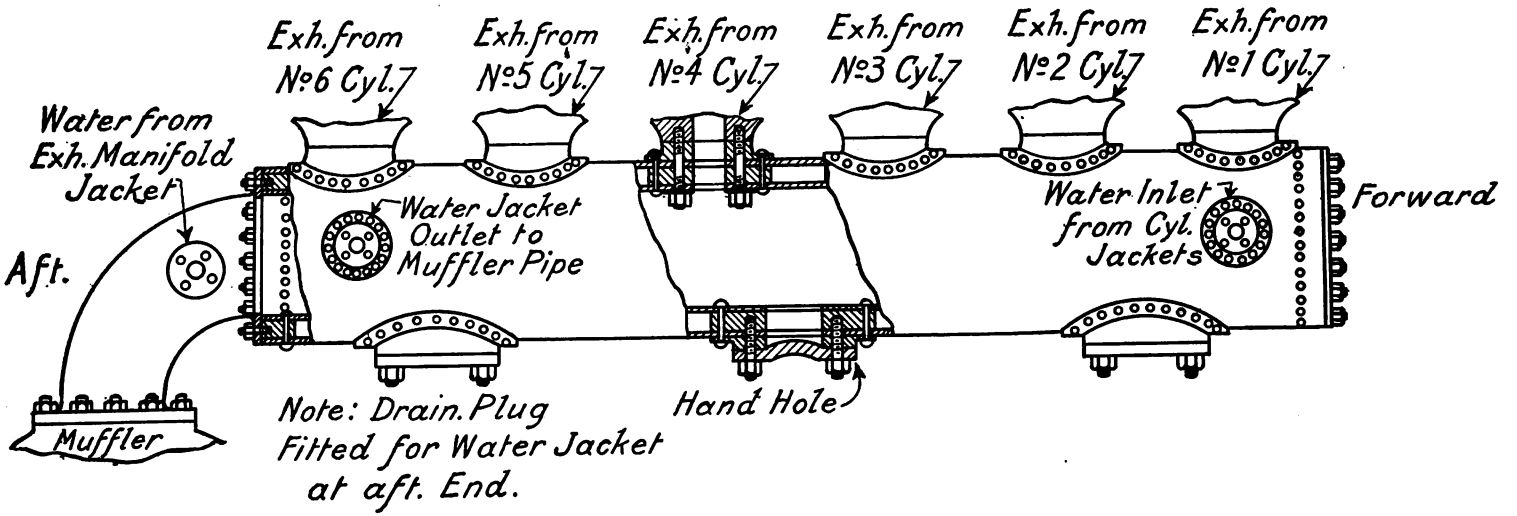
ADJUSTMENT OF: To grind the valve take out the valve cage and disconnect parts and take off the valve springs. Take out the valve and thoroughly clean. Clean off the valve seat. Then put a little bluing underneath the valve. Seat the valve again within cage and turn it back and forth on the seat by hand. This will show any irregularities, and if there are none of any amount simply use a fine grinding paste and turn the valve lightly on the seat until it shows a perfect bearing all around. If the bluing has shown considerable irregularities the valve seat should be scraped.

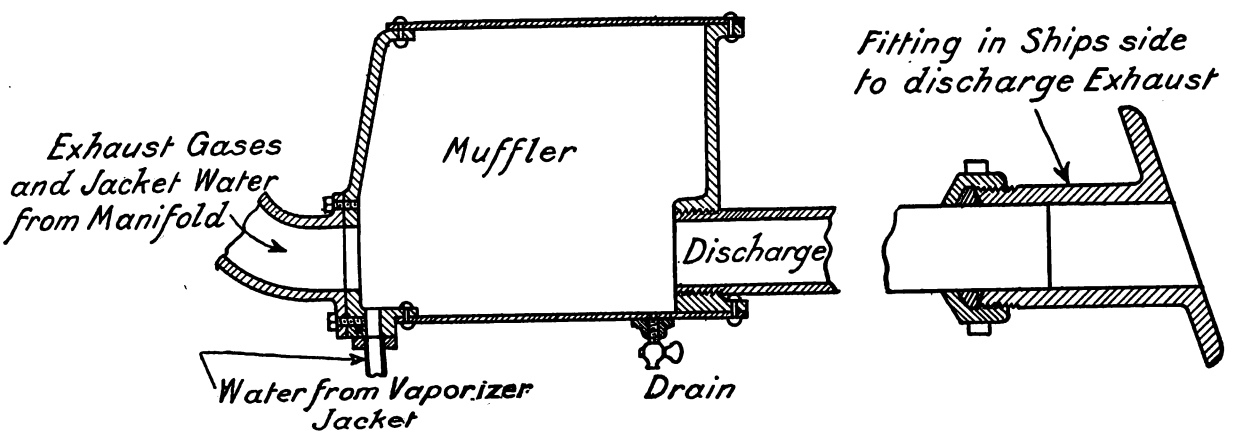
If very little scraping is needed this can be done with the end of an ordinary machinist's scraper. If the valve itself should have grooves worn in it, it should be put in a lathe and faced off so that its surface to be ground is perfectly true.

The lift of the exhaust valve is 3/4" on ahead motion and 1/2" on reverse.

Main Engine

Exhaust Manifold, Muffler and Outboard Fitting





After the exhaust valve is faced off a new adjustment must be made with nut and lock nut at top of valve pull rod to lengthen it.

EXHAUST MANIFOLD

The exhaust gases pass out through the exhaust valve to the exhaust manifold running along the side of the engine cylinders. The gases are expanded in this manifold. They are cooled by the circulating water in the jacket of the exhaust manifold. There is an exhaust connection to the manifold from each engine cylinder. Screwed to the manifold is one hand hole plate towards the forward end, one hand hole plate midway between ends and one hand hole plate towards the after end. When these plates are removed all of the nuts holding the manifold to the cylinder studs can be reached. Both ends of the manifold are easily taken off also.

After leaving the exhaust manifold jacket the main lead of cooling water is discharged into the exhaust gases at the cast iron elbow in pipe between exhaust manifold and the muffler. The cooling water from the exhaust valves after leaving the vaporizer and inlet pipe is discharged directly into the muffler.

CARE OF: See that all lock nuts on studs are tight by removing hand hole plates. When renewing joints between manifold and cylinders see that the thickness of the new joint or joints is the same as the original, otherwise the manifold might be distorted, causing the joints to leak.

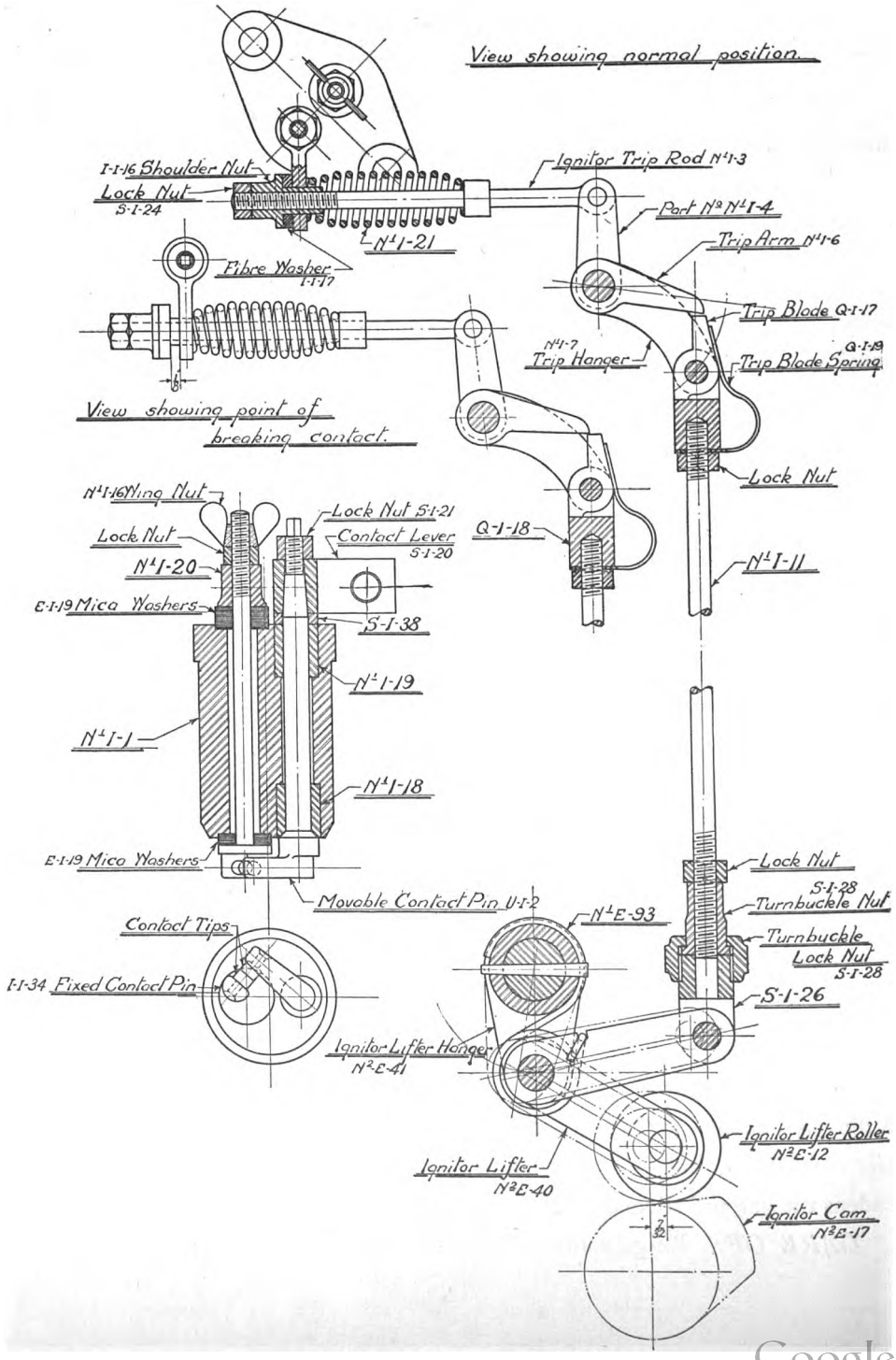
Use special spanner wrenches for removing manifold.

MUFFLER

The muffler is a chamber where the gases are allowed to further expand. As the gas and the water from the manifold and the water from the vaporizer jacket enter the muffler, and the gas expands, there is a spraying effect which thoroughly deadens the gas and silences the exhaust.

CARE OF: Re-galvanize if the muffler shows any leak.

Main Engine
— IGNITOR GEAR —



IGNITION

The ignition is of the low tension system. Both magneto and battery are used. The battery must be used for starting and for running astern, the magneto is simply used for straight running ahead. The ignition is of the make-and-break type, and the ignition parts are operated by the ignitor cam set to fire the engine at the proper point on both running ahead and running astern.

IGNITOR LIFTER ROD

Screwed to the top end of the ignitor lifter rod (the vertical ignition rod) is the tripper eye. Straddling the tripper eye and pinned to it is the trip blade. The trip blade spring is hung from the ignitor lifter rod just below the tripper eye and locked by a nut holding it against the trip blade.

The bottom surface of the trip blade is made square from the center to the edge opposite the trip blade spring, the other half of the bottom is rounded so that the trip blade can be pushed outward against the spring. This makes it impossible for the trip blade spring to push the blade further in than where the vertical surface of the blade is exactly perpendicular to the center line of the lifter rod,—and the trip blade spring is normally holding the trip blade in this position. Should for any reason the trip blade spring lose its tension the ignitor would be put out of operation and the old spring would have to be replaced immediately by a new spring. At the bottom of the ignitor lifter rod is screwed a turnbuckle fork, a turnbuckle nut and lock nut for varying the length of the rod.

IGNITOR TRIP ROD

The ignitor trip rod (the horizontal ignition rod) is pinned through its eye on one end to the trip shaft to which is pinned the trip arm. The trip shaft is

held in a bracket bolted to the top of the cylinder head, and floating freely on it at one end is the trip hanger which at its other end floats freely on the trip blade pin. A shoulder on the ignitor trip rod holds a spiral spring against the flipper fastened to the movable contact pin and which moves the contact pin. A washer, shoulder nut and lock nut are beyond the flipper on the end of the trip rod.

IGNITOR PLUG

The ignitor plug is of steel with a flange which holds it to the cylinder by means of two studs and nuts. The inner end of the plug is bevelled on the edge, and this bevel ground to make a tight fit with the cylinder head casting. The space drilled for the fixed contact pin is slightly countersunk on both ends of the plug into which set the mica washers on each end of the pin.

The fixed contact pin is insulated from the plug by these mica washers at both ends, and by an air gap inside of the plug around the pin. The fixed contact pin is threaded on the outer end to take a lock nut and wing nut. On the inner end it is made with a shoulder, and an extension beyond the shoulder off center drilled and countersunk on the front side and bevelled on the back side for the ignitor contact tip.

The space for the movable contact pin is countersunk on each end of the plug for ¾" into which is forced a tool steel bushing on each end. The bushing on the inner end of the plug is bevelled on the edge and ground. The movable contact pin has a shoulder bevelled on the edge and ground which beds into the bevelled edge of the bushing in the plug.

On the inner end the pin is made with an arm which is drilled and countersunk for the ignitor contact tip the same as is the fixed contact pin. The outer end of the movable contact pin is threaded to take a nut and then tapered to take the ignitor flipper. This movable contact pin is given .007" up and down movement which tends to keep the ignitor contact tips free from carbon deposit. The contact tips, for both the movable and fixed contact pins, are made with the head of larger diameter than the stem so that the stem is simply forced into the drilled

hole for the tip in each contact pin and then the pin riveted with the shoulder drawn tight up. The end of the riveted tip is then filed smooth.

CARE OF: Remove the ignitor plug frequently and clean off any carbon deposit. Renew the mica washers on the fixed terminal as often as necessary to always have perfect insulation. Watch for leaks in insulation by smoke or sputtering.

Grind shoulder of the movable terminal stem and its seat in the plug as often as necessary to always have it properly seated.

Renew contact tips as often as necessary. Extra tips should always be carried. In an emergency, however, a spark can be obtained from the terminals alone.

To drive out a movable contact pin bushing take a piece of 3/8" cold rolled rod and saw a slit down the center for about an inch from the end. Take a strip of about 1/16" thick by 5/16" wide sheet iron and file one end narrow enough to go into the contact pin hole of the ignitor plug with its end made sharp to form a wedge. Then take the ignitor plug and put it in a machine vise with the end which has the bushing to be driven out on the bottom. Take the piece of cold rolled rod and hammer into the movable contact pin hole to where it is inside of the bushing to be driven. Then take the piece of sheet iron wedge and drive it from the other end into the slit of the cold rolled rod tight enough so that when the rod is again hammered down it grips the bushing so tight that it carries the bushing with it.

To replace a bushing clean the hole and the plug of every bit of grit and dust and smear the new bushing with lubricating oil. Then lightly hammer the bushing into the ignitor plug hole till the eye shows it to be started perfectly straight. Then put the plug with the new bushing just started in it in a vise and work the bushing in slowly between the vise jaws, after each slight pull of the vise turning the ignitor plug so that the bushing is bound to be worked in perfectly evenly.

See that the ignitor return springs and the latch springs are in good condition and working properly.

Put a drop of oil every hour in the oil hole of the ignitor trip rod bracket, and

on the pins holding the trip hanger and on the trip rod where it slides through the flipper. Watch carefully to see if all of these parts are working freely.

ADJUSTMENT OF: The fixed contact pin should be set so that the head of the contact tip in this pin makes a flat bearing with the head of the tip in the movable contact pin when it is at the point of contact. Wear of the contact tips is taken up by loosening the wing nut and the lock nut on the fixed contact pin, and with pliers or wrench turning the pin slightly so that the tip is brought nearer to the contact tip in the movable contact pin.

Operation of Ignition

As the ignitor lifter rod is lifted by the ignitor cam the upper end with the trip blade is carried outward in its upward movement by the trip hanger so that, as the trip blade is forcing up the trip arm, it is sliding outwards on it. Before the trip arm and the trip blade slip apart through this movement the ignitor trip rod is moved forward a distance sufficient to close the contact tips and then a distance sufficient to compress the ignitor trip rod spring 1/8". When this travel of the ignitor lifter rod is reached and the trip blade slips past the trip arm the ignitor trip rod spring makes the contact tips fly apart and break the contact. This point is known as the ignition trip and is the point at which the cylinder fires on account of a spark jumping across the gap between the contact tips at the moment of breaking contact.

TO SET IGNITION: To set the ignition two adjustments are necessary. Turn the engine over until the ignitor to be set just trips. Then proceed as follows to adjust so that the flipper when locked on the movable contact pin has a rock of 1/16":—

First loosen the lock nut on the movable contact pin and tap the contact pin lightly to loosen the flipper on the taper of the pin. Then turn the contact pin in the flipper so that the ignitor contact tips are nearer together or further apart as the need may be to make the space between

them when in normal position 1/16". Then lock the flipper on the contact pin with the lock nut and test to see if the flipper has the 1/16" rock. Adjust in this way until correct.

Then to have the ignitor lifter rod move the ignitor trip rod ⅛" further than the 1/16" movement of the flipper adjust as follows:

Loosen the lock nut on the ignitor trip rod and turn the shoulder nut in whichever direction is necessary to give a travel of the trip rod of ⅛" through the hole in the flipper when trip rod has been pushed to furthest point. Lift the ignitor lifter rod with the hand to see that ignitor trip rod moves forward the correct distance and repeat until setting is correct.

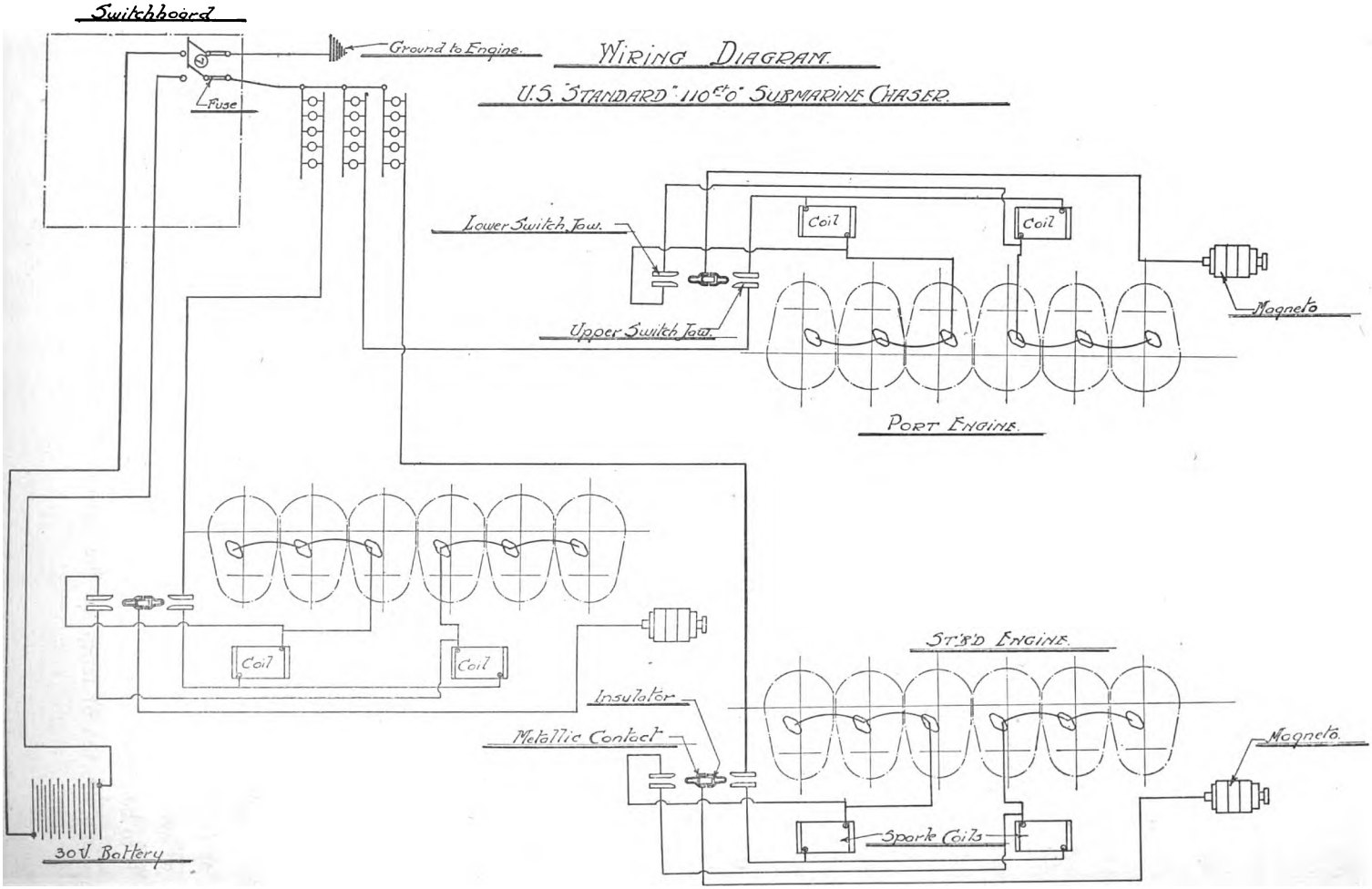
TO TIME IGNITION: To time the point of firing, or trip of ignition, throw the reverse control lever in ahead running position. Pull spark control latch handle down as far as it will go,—lowest notch on spark control sector. Bar the engine over until the engine crank shaft is 10° before upper dead center. Then shorten or lengthen the ignitor lifter rod by screwing the turnbuckle to the right or to the left until the trip blade slips off the trip arm.

Bar flywheel over again very slowly and if ignitor does not trip when crank is 10° before upper dead center shorten or lengthen ignitor lifter rod again as the case may require. Repeat this operation until timing is correct. The reverse motion will take care of itself.

The engines however have "ignitor trip" marks on the flywheel rim, a mark for *"ignitor trip" "retard"* for 1-6, 3-4 and 2-5 cylinders and a mark for *"ignitor" trip" "advance"* for 1-6, 3-4 and 2-5 cylinders.

To time the ignition by the *"ignitor trip" "retard"* marks throw the reverse control lever in ahead running position. Pull spark control latch handle down as far as it will go,—lowest notch on spark control sector. Bar the engine over to where the "ignitor trip" mark bearing the number of the cylinder which is to be timed, is directly under the pointer extending over the rim of the flywheel. Then shorten or lengthen the ignitor lifter rod of that cylinder for the trip at this

Main Engine



point. Bar engine over again and repeat this operation until timing is correct.

To time the ignition by the *"ignitor trip" "advance"* marks throw reverse control lever in ahead running position and pull the spark control latch handle up as far as it will go on the spark control sector. Then bar the engine over and adjust for trip as just described.

Spark Control Latch Handle

The spark control latch handle is hung on the control handle shaft supported in the control bracket attached to the after cylinder. The control handle slides on a notched sector, and a latch and spring on the handle lock it at any point on the sector. The hub of the control handle is insulated from the shaft and carries a short arm to one side of the handle, and the spark control reach rod is hung to this arm by means of a pin through the arm and through an eye in the rod. The bottom of the reach rod is attached to the long arm of the spark resetting lever by means of a rod-end threaded on the reach rod and which screws to the arm of the resetting lever. By means of this rod end the length of the spark control reach rod is made shorter or longer. A lock nut locks the reach rod.

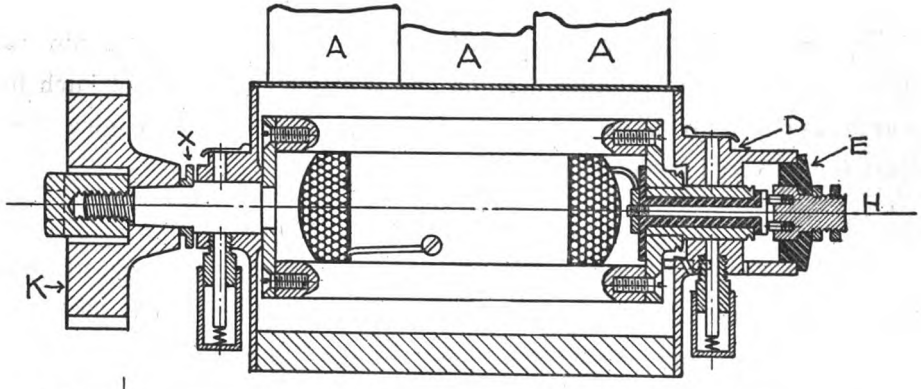
The long arm of the spark resetting lever extends horizontally across the back of the engine and the lever is keyed to the end of the rocker shaft on which are pinned the ignitor hangers. Through working this resetting lever, by means of the spark control latch handle, the rocker shaft is made to turn with the ignitor hanger causing the ignitor cam to lift the ignitor lifter rod earlier or later.

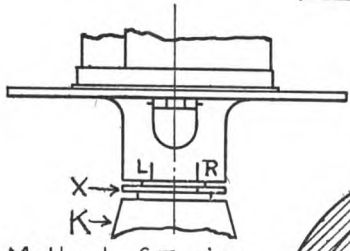
When the spark control latch handle is in a vertical position and in the top notch of the sector on which it works, the spark has been advanced to the farthest point. When the spark control handle is at the very bottom of the sector the spark has been retarded to the farthest point.

Automatic Retard Spark

The spark resetting lever has a short arm at an angle with its long arm which, when the reverse control lever is in starting ahead or back of starting ahead posi-

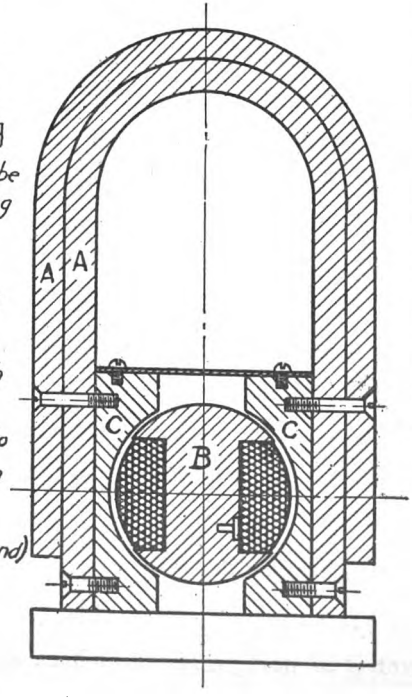
DETAILS OF LOW TENSION MAGNETO

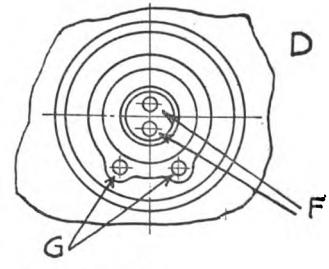




Method of Timing

Line on washer X to be opposite R on bearing when crank is 10% before top centre (compression stroke) Reversing lever in ahead running notch spark lever fully retarded, if magneto turns clockwise when geared to engine (viewed from geared end)





A = Magneto
B = Armature
C = Pole Pieces
D = End plate carrying brushes
E = Insulation
F = Brushes connected to firing circuit
G = Earth brushes
H = Terminal
K = Gear wheel
X = Washer coinciding with centre line of armature

tion, brings the short arm in the way of a latch that is fastened to the reverse control. So, in moving the reverse control lever back from starting ahead position, this small arm of the spark resetting lever is pried outward and the spark is automatically retarded. By means of this automatic spark retard the engine is always started either on ahead running or astern running with a late spark.

MAGNETO

This is a simple alternating current dynamo. One end of the wiring is led to the magneto shaft and from there to the ignitors. The other end is grounded through the frame of the magneto.

The magneto consists chiefly of magnets screwed to two pole-pieces, a base, and armature hung between the pole-pieces and operated by gearing from off the vertical cam shaft drive. The shaft of the armature is insulated and there are the usual brushes connected to the firing circuit and the earth brushes. A washer fixed on the armature shaft is marked for timing.

There is nothing inside the magneto that requires adjustment or attention. Do not take out the armature under any circumstances. If the armature needs repair it should be done by the manufacturer. Do not take off the magnets unless sure that they need to be sent to the factory to be re-magnetized. The various parts are accurately fitted together and locked in place. A precaution against magneto trouble is to not attempt to take it apart.

CARE OF: The magneto requires a drop of good light oil in each bearing at the beginning of each day's run. Use a light lubricating oil such as sewing machine oil, do not use a heavy cylinder oil. Do not flood the magneto, one drop of oil in each bearing is better than a quart on the terminal. Keep oil holes open and free from dirt. Keep covers closed.

The magneto has fine bearings and with proper care and attention will last for years. Keep the drain holes and grooves in the base for draining off the surplus oil clear. Open drain hole occasionally with a small wire. Do this

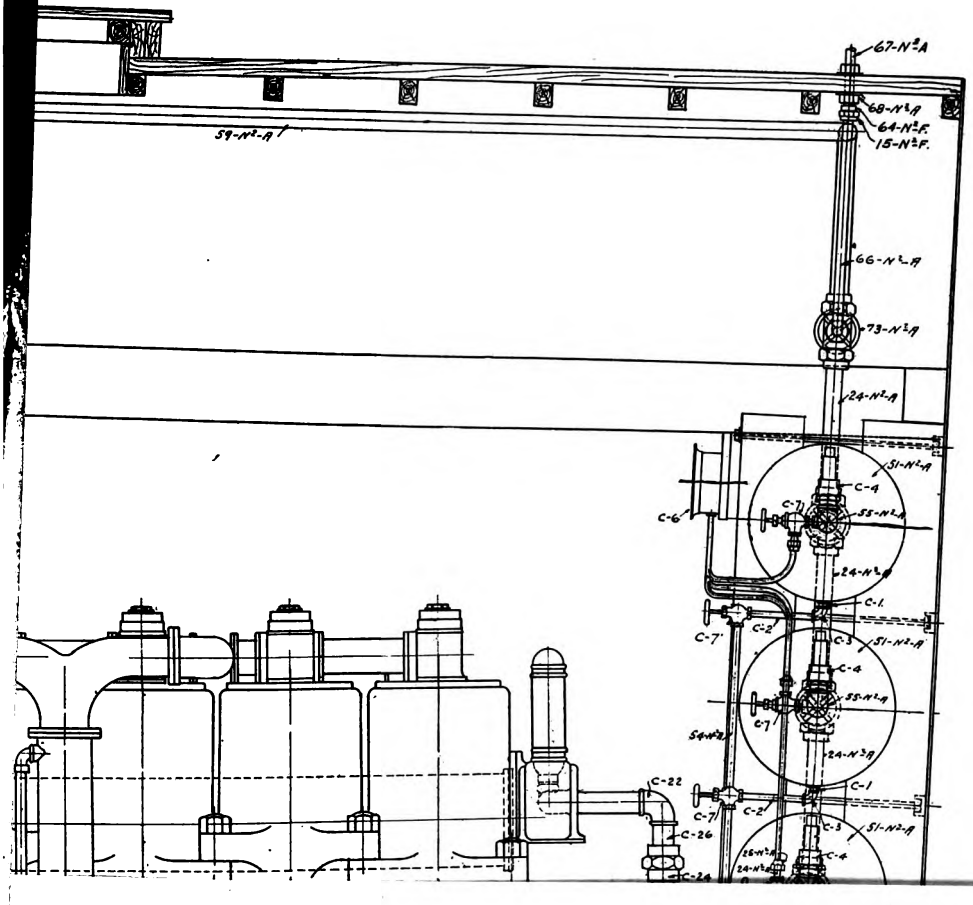
when the magneto is not running and be careful not to poke the wire into the armature. Keep the magneto in proper timing. See that the magneto gear is held tight with key and nut and that none of the gears can slip.

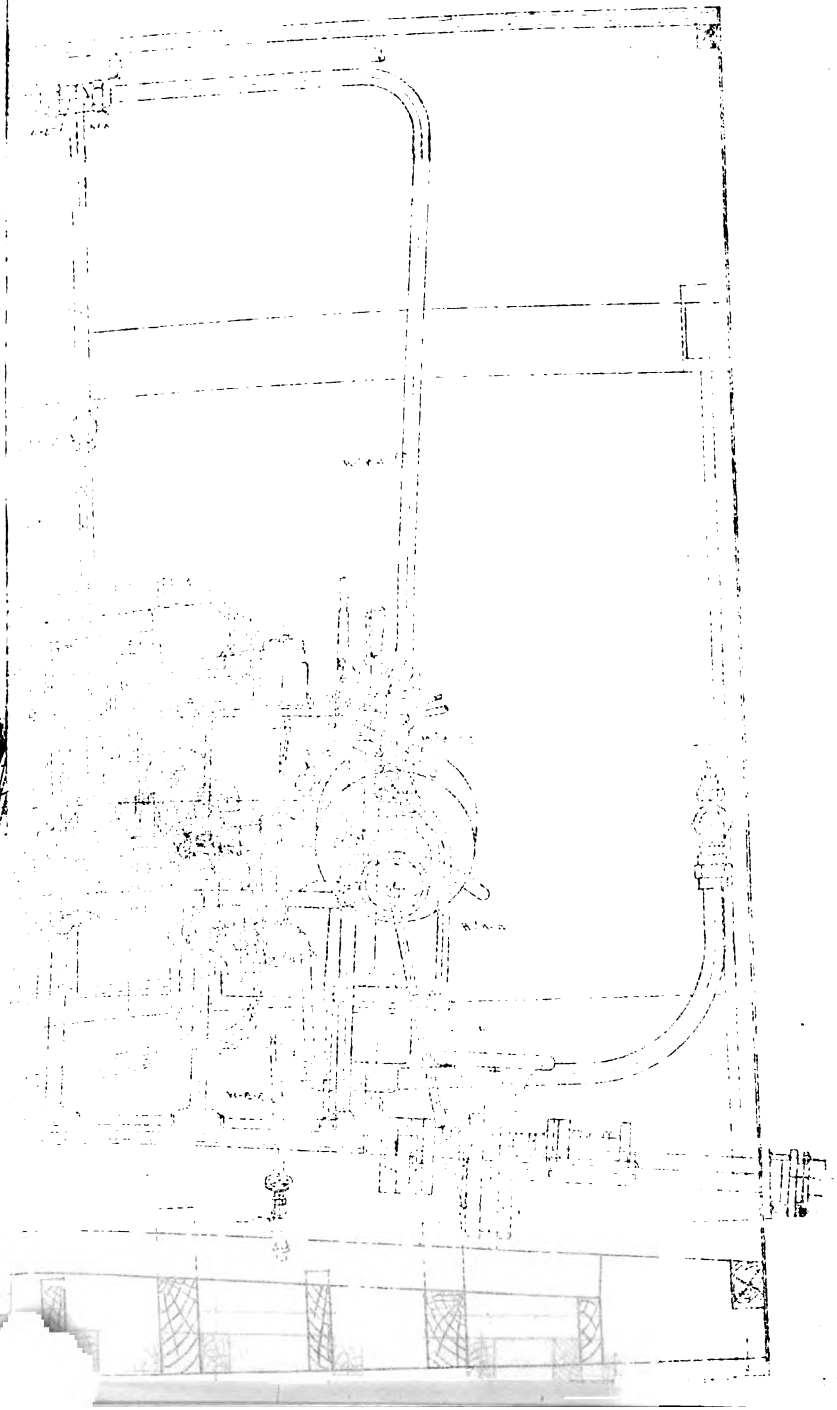
If the magneto has been oil soaked for some time it should be cleaned. To do this, loosen the screw in the split collar holding the porcelain bushing carrying the terminal and wash the brushes with gasoline. Wash also the end of the magneto shaft against which these brushes bear. At the same time see that the brushes move freely in their supports but do not pull them out, and be careful not to break the springs to which they are soldered. The brushes should last for years but if loose or damaged procure new ones from the factory. Pieces of copper wire, carbon brushes or other substitutes will not give satisfaction.

If the magneto has become gummed up by the use of cylinder oil clean by taking off the terminal and plate, by removing the screws in the corners of the plate, and wash out the earth brush and the end of the armature against which it bears. See that the earth brush makes a good contact and carefully fit back the end plate taking care that the bezel on the plate fits into the pole-piece opening before the corner screws are tightened. Punch surface of end plate into screw slots to keep screws from turning.

ADJUSTMENT OF: To time the magneto turn the engine in the direction in which it runs until the ignitor trips. Do not turn past this point. Observe the setting disc on the magneto shaft and so mesh the magneto driving gear with gear on vertical cam shaft of engine that either small notch N is exactly in line with the mark R on the end plate if rotation is righthand, or L, if rotation is lefthand, looking at magneto from gear end. When checking timing, note that the magneto marks line up when the piston is in proper firing position, as it is possible that the ignitor may have gotten out of time with the piston through wear. If so, the ignitor should be properly adjusted, so that it will break in time with the magneto.

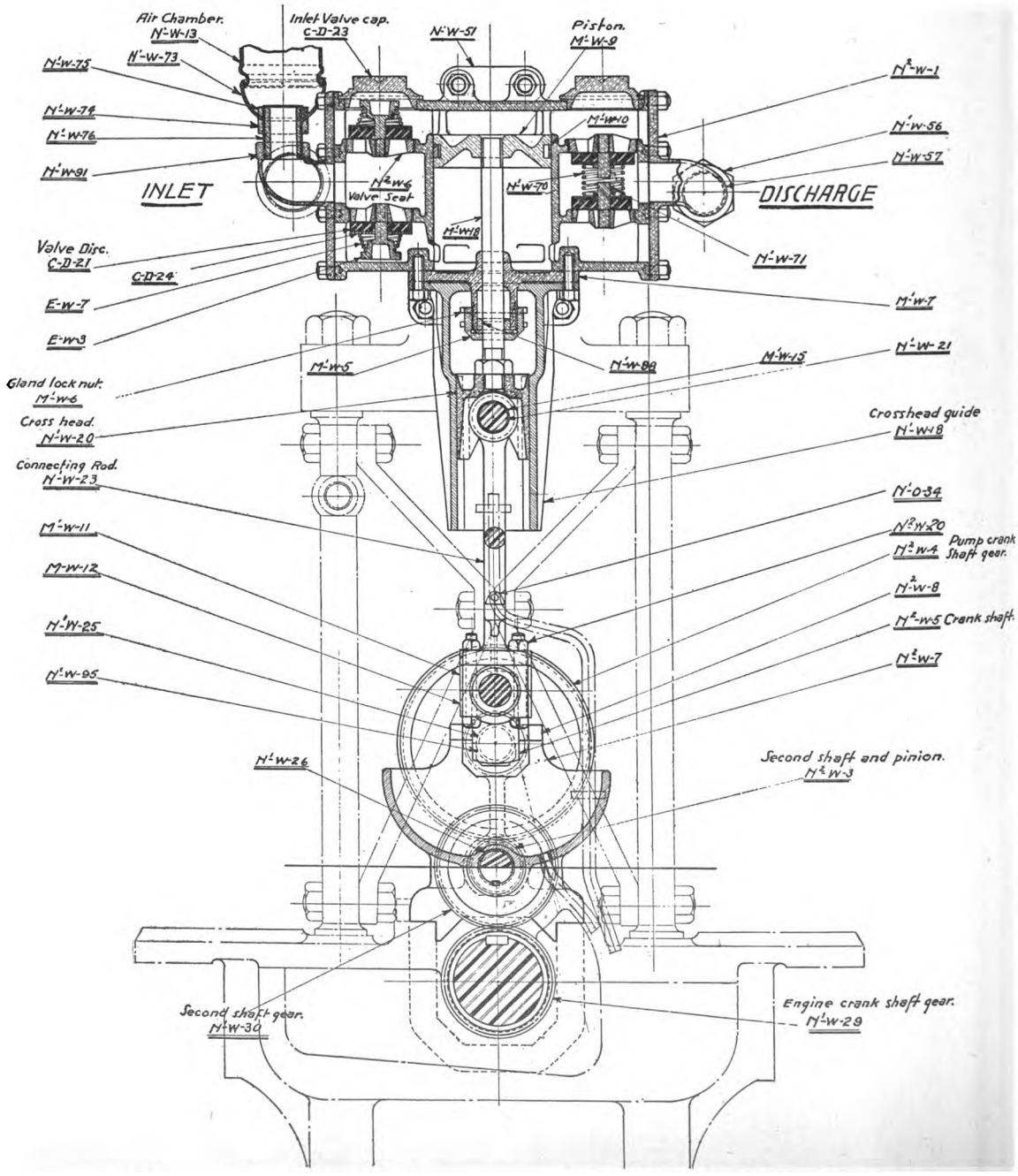
ASER





Main Engine

DETAIL ARRANGEMENT OF WATER CIRCULATING PUMP



WATER

Circulating Pump

The circulating pump is on the forward end of the engine and is driven by a crank through gearing from the engine crank shaft. The pump is operated at one fourth engine speed.

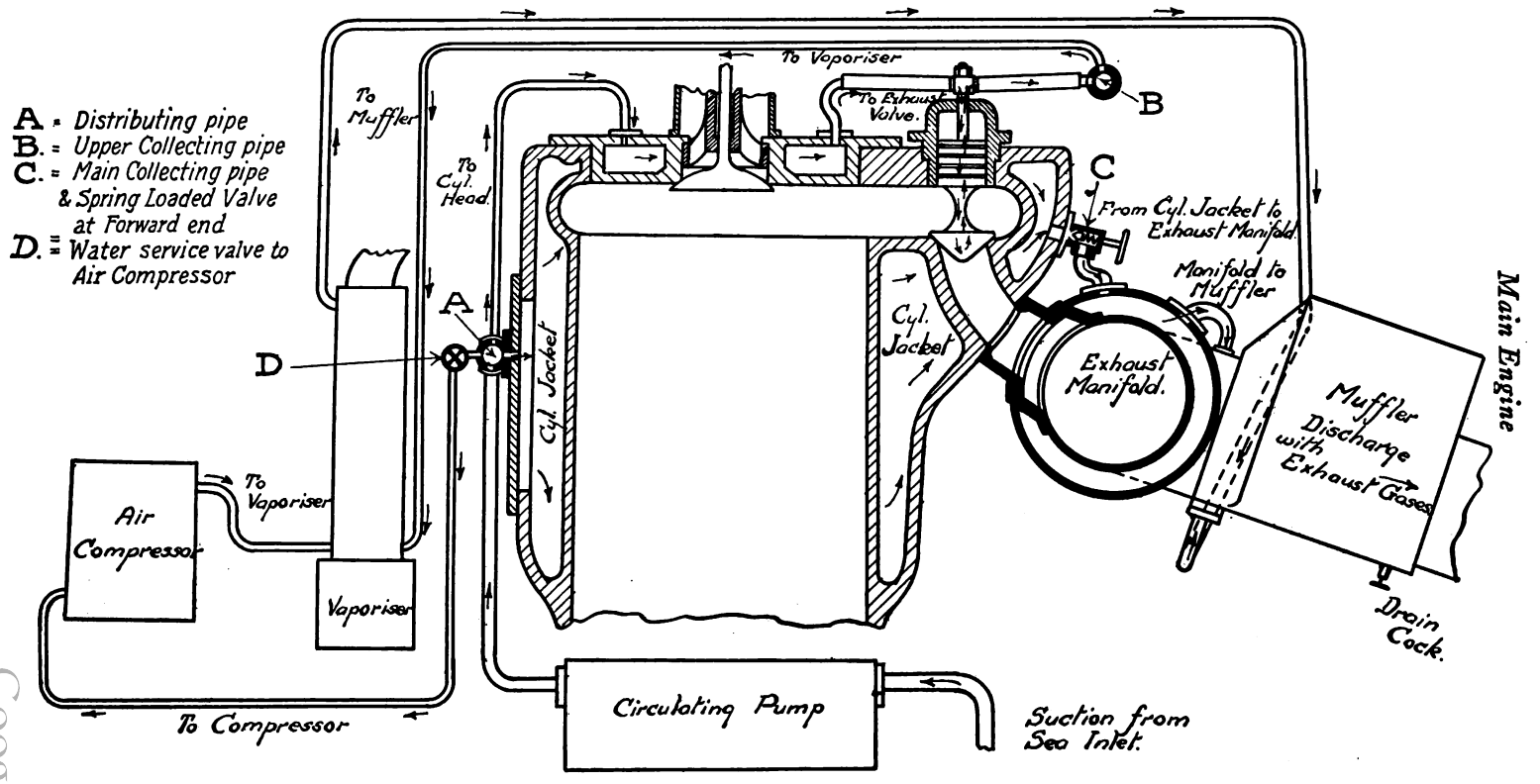
It is a double-acting piston pump. The plunger is of bronze with a bronze piston ring and all metal parts of the pump are either of bronze or monel metal. The valves are rubber discs which can be renewed after becoming worn. The seats are of bronze and these screw into the pump cover so that they can be renewed. Monel metal springs pressing on a brass disc hold the inlet valves to the end of the valve stem. A brass spring between the two discharge valves holds these seated. There is a brass valve cap screwed into the pump cover above each set of valves. By taking off these two caps all four valves can be lifted out.

The bronze piston rod is screwed into the bronze plunger, and this rod passes down through a brass stuffing box screwed to the bottom of the pump cover, and is attached to a bronze crosshead shoe which slides in the cast iron crosshead guide bolted to the bottom of the pump cover and to the engine cylinder.

The upper end of the steel connecting rod is forged into an eye for the wrist pin which works in a bronze bushing fitted into the rod eye. The lower rod bearing is of bronze bolted to the foot of the connecting rod. Wear can be taken up by scraping the bearing and filing the surfaces of the two bearing halves where they come together.

The main pump bearings are of bronze and adjustment can be made by scraping and removing the brass liners between the bearing halves. There is a pet cock screwed into the pump cover on a level with the upper inlet valve and the lower inlet valve for draining the pump. The pump should be drained through these cocks whenever the engine is stopped overnight in cold weather or is to be left any length of time.

Circulating Water System.



A copper cylindrical air chamber is screwed into an elbow on the suction end of the pump and this is, of course, for stabilizing the flow of water.

CARE OF: When replacing the rubber disc of the pump valves, be sure to set them so that they cannot work to one side and rub against the pump cover enough to interfere with the seating of the valve,

Drain the pump through both pet cocks in the pump cover when the engine is shut down in cold weather or laid up. See that the drain pipes from the pump crank case are clear. If not clear blow compressed air through them. These pipes are for draining what water may get past the pump stuffing box.

Keep the crank case free of dirt and water.

See that the pump stuffing box glands are always packed tight enough to prevent leakage.

Put a few drops of oil by hand every hour in the oil hole of the circulating pump connecting rod wrist pin, and in the oil hole of the connecting rod bearing and in the oil hole of the two pump shaft bearings.

ADJUSTMENT OF: To pack the stuffing box gland, unscrew the lock nut and unscrew the packing box. Then slip the gland up on the rod and take out the old packing and put in the new. Be sure to get the gland back tight with everything screwed fast so that there will be no leakage.

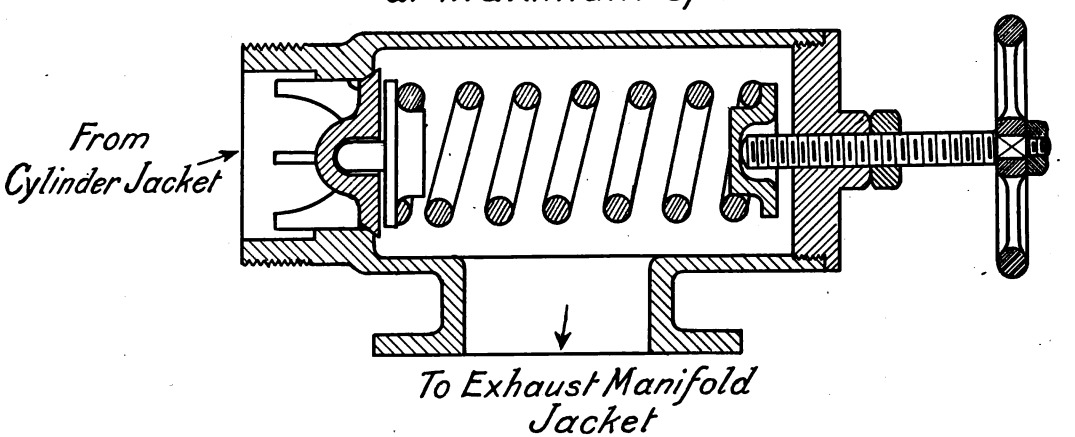
Water Piping System

The circulating pump is connected to the sea water by piping and outboard connection on the skin of the boat. The pump lifts the sea water through a bronze screen and strainer into the main water supply pipe which runs along the sides of the cylinders, bolted to the hand hole plates of the cylinders. A connection from the main supply pipe to each cylinder jacket furnishes cooling water for the cylinders direct from the supply pipe. By restriction of holes the same amount of water is fed to each cylinder.

Main Engine

Cylinder Jacket Water Pressure Regulating Valve

To be adjusted so as to keep a pressure not greater than 25 lbs. per sq. inch at maximum speed



The circulating water goes from the cylinder jacket directly into the main collecting pipe running along the engine cylinders above the exhaust manifold, with connections which carry the water into the exhaust manifold jacket where it then flows to the muffler.

A distributing pipe leads from the main supply pipe to each cylinder head, and by the restriction of holes the same amount of water is supplied to each cylinder head. From the cylinder head the water goes directly to the exhaust valves and from them to the vaporizer and intake pipe water jackets.

At the after end of the main supply pipe is a service valve through which water is supplied direct to the air compressor on the engine. This should be open while engine is running. The circulating water from the air compressor goes to the intake pipe water jacket.

Pressure Regulating Valve

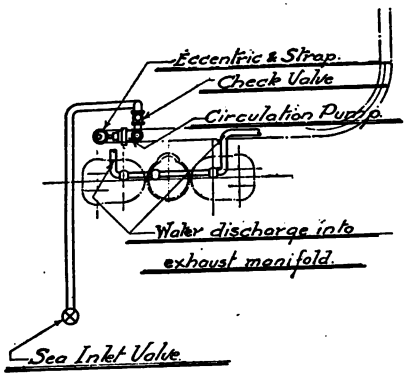
A spring-loaded pressure regulating valve is located at the forward end of the main supply pipe, by which a pressure is put on the circulating water in the engine cylinder jackets. The valve should be regulated to have not more than 25 lb pressure, approximately, at maximum speed,—a low pressure here increasing the heat of vaporizer circulating water and a high pressure the reverse.

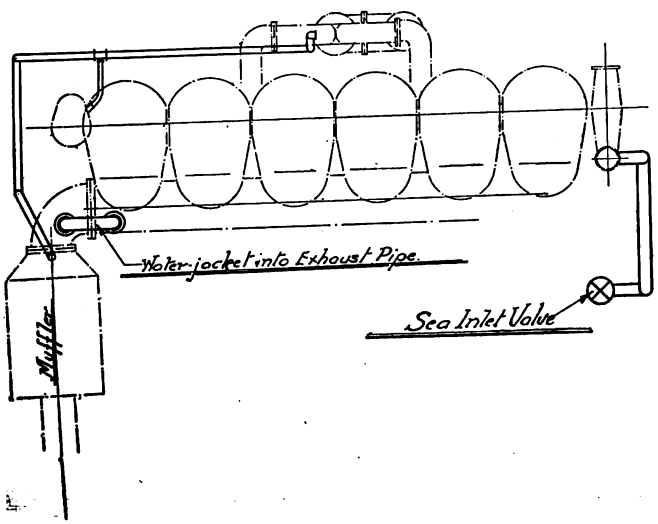
Pressure Gauge

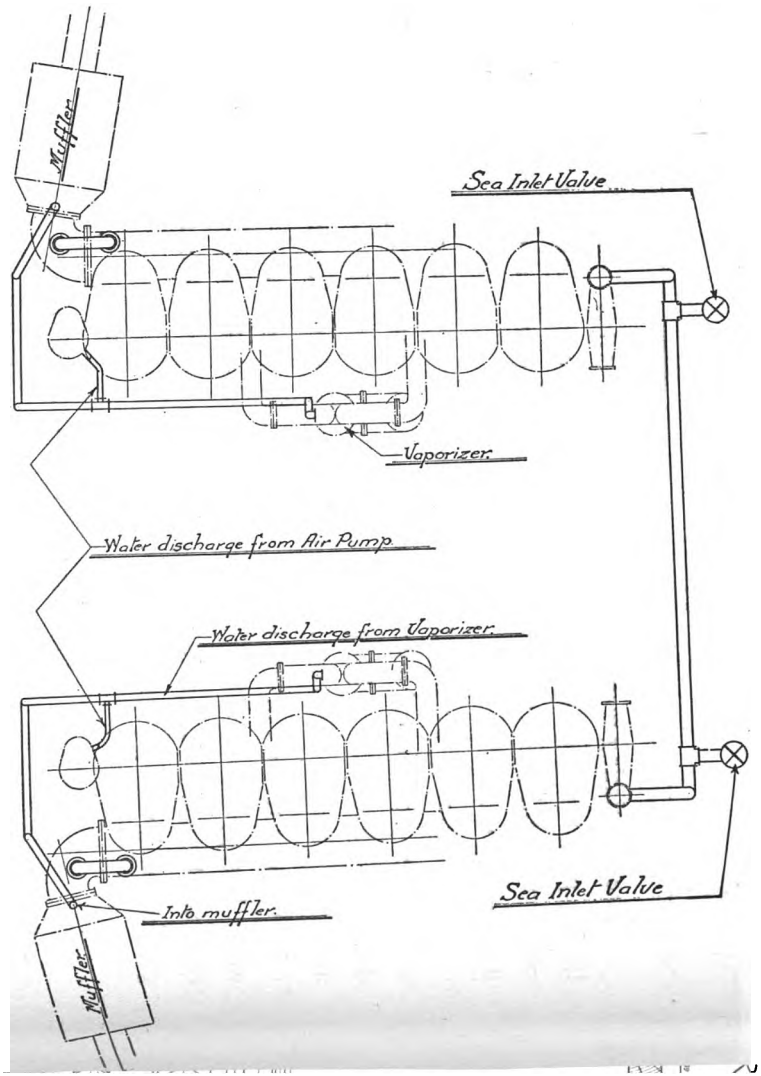
A gauge is connected to the after engine cylinder which indicates at all times the pressure in the circulating water system. A check valve between the cylinder and the gauge prevents the gauge from slamming, and this should be kept working properly by as frequent cleaning of the valve as might be necessary.

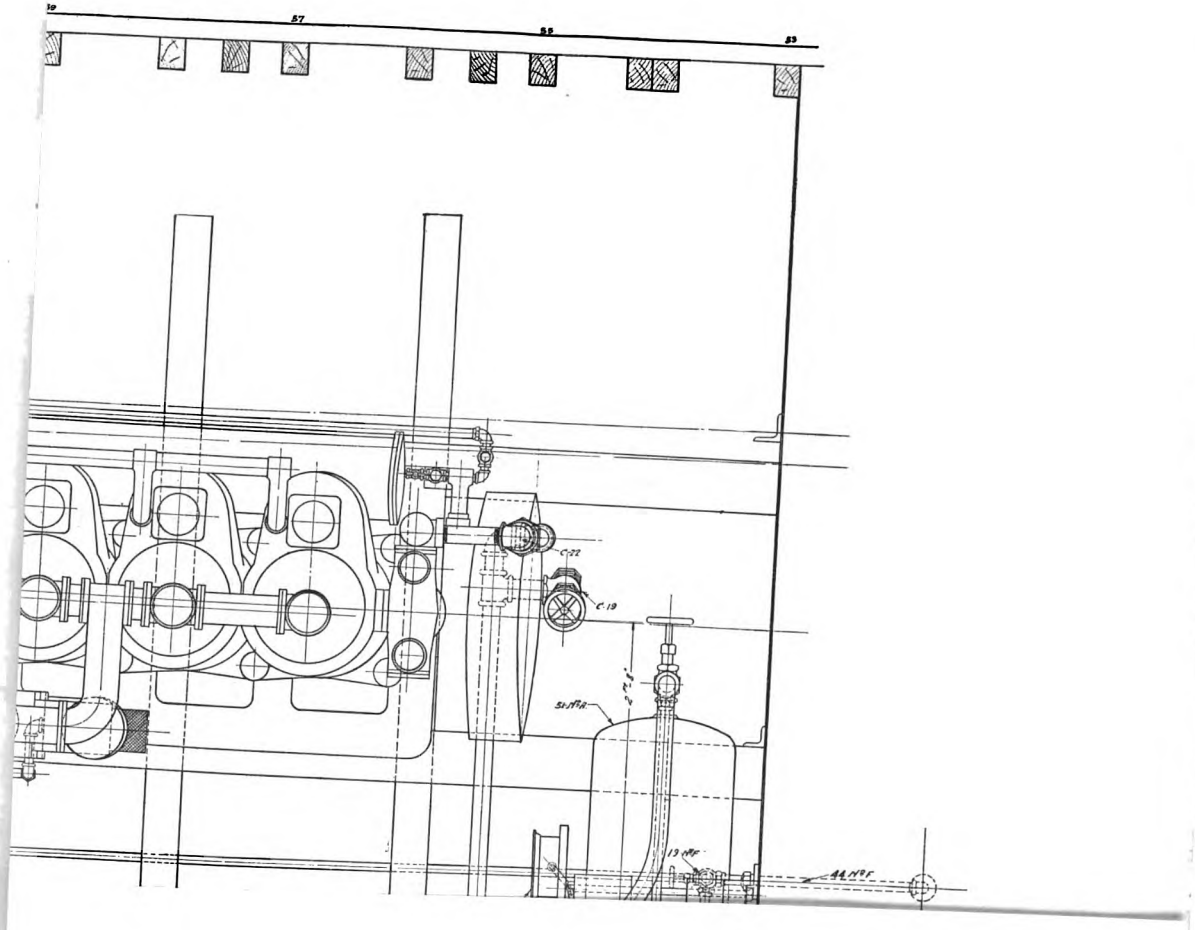
Cir. Water Piping Arrangement

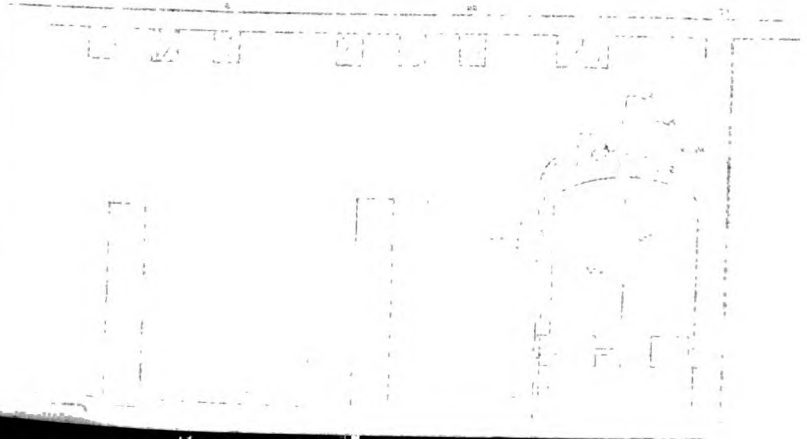
U.S. Standard 110 Ft. Submarine Chaser.





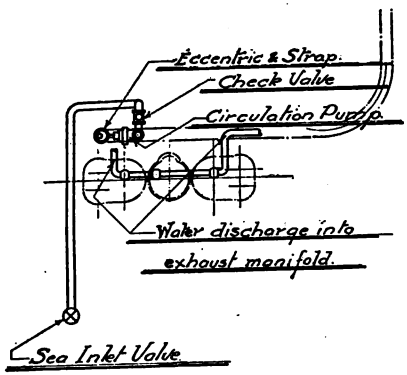


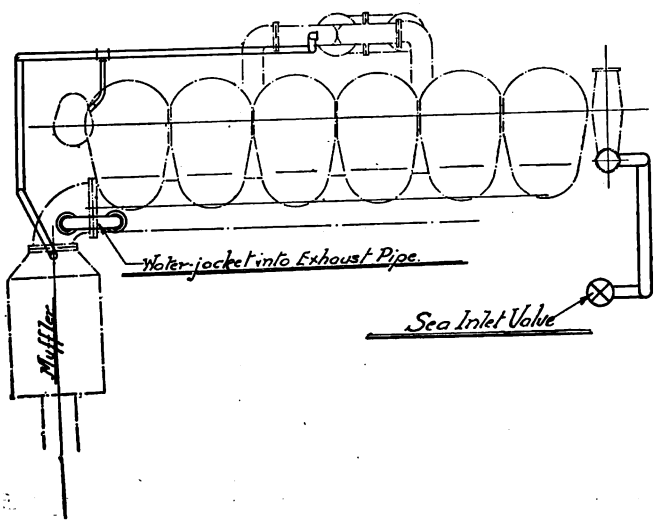


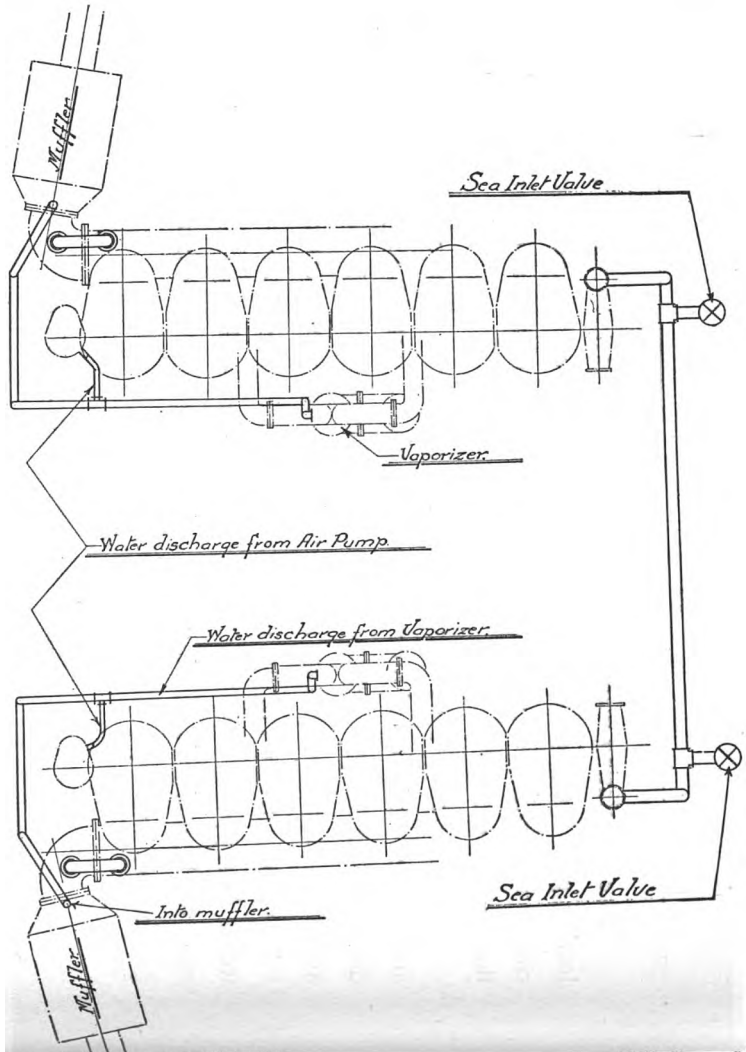


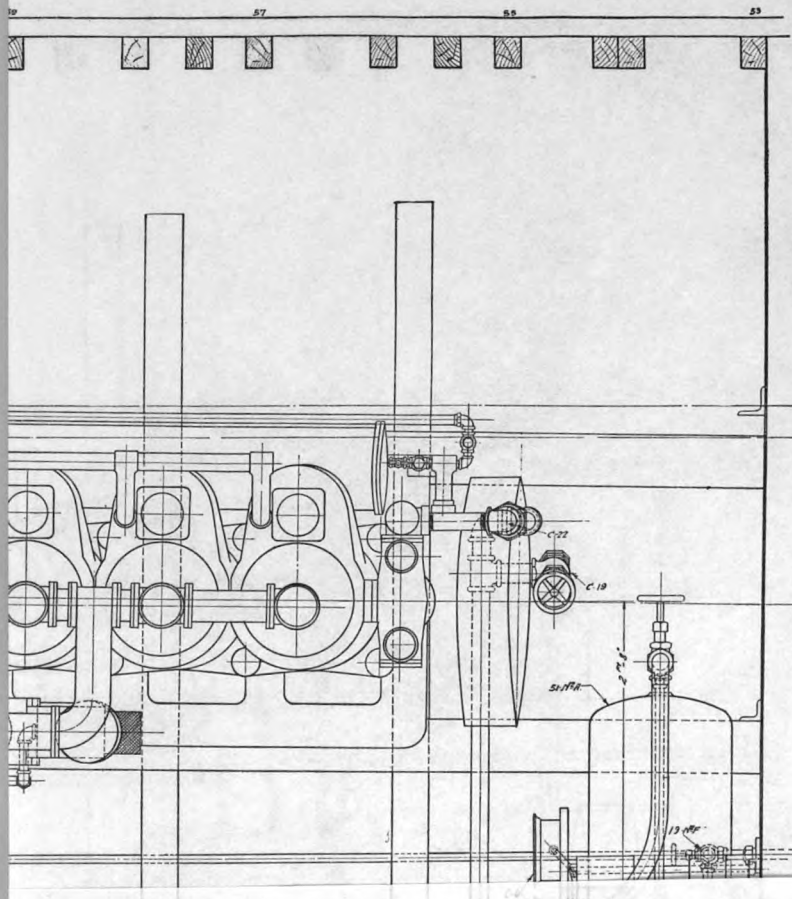
Cir. Water Piping Arrangement

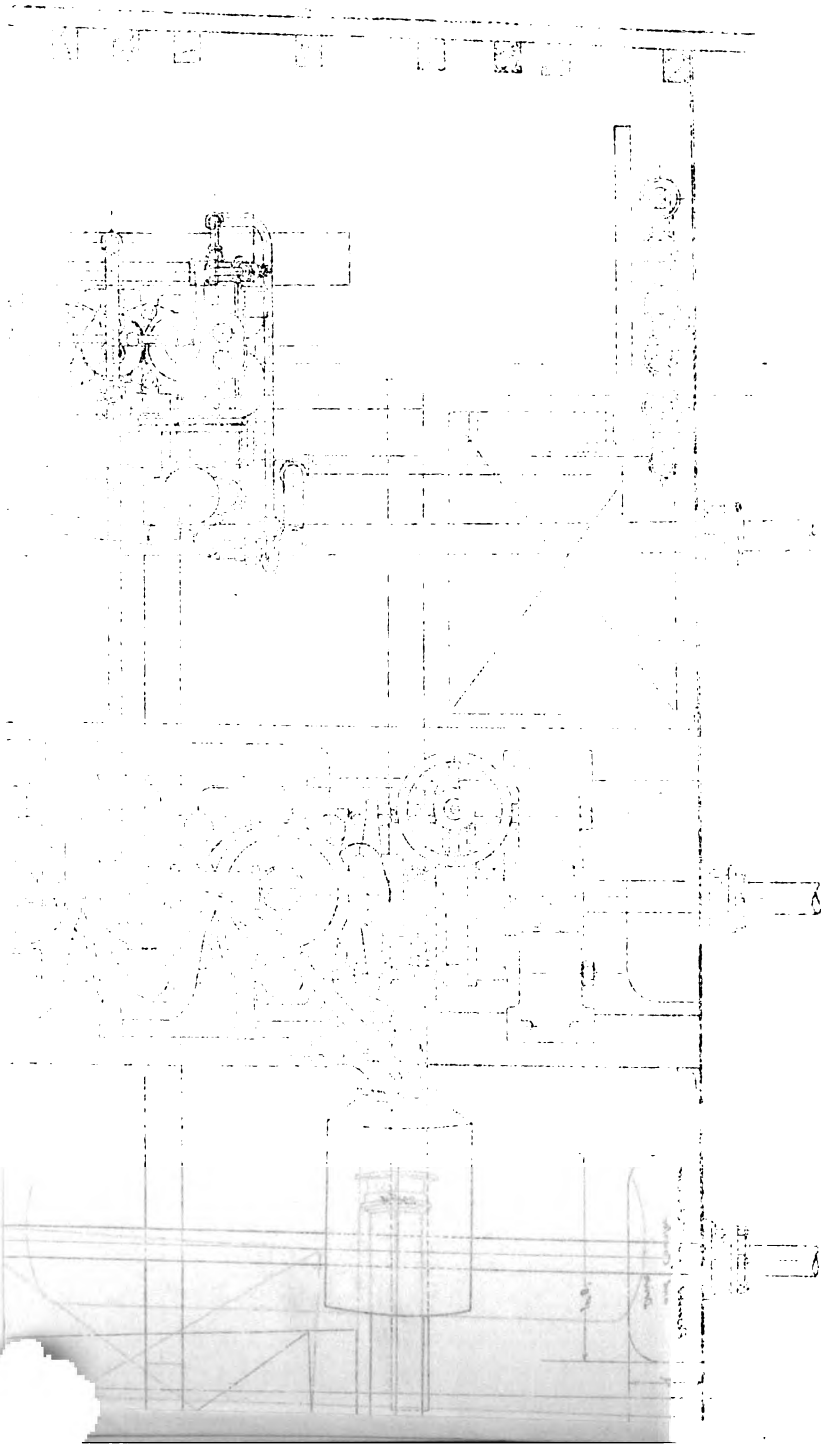
U.S. Standard 110 Ft. Submarine Chaser.











LUBRICATION PUMP DETAILS AND ONE CYCLE OF EVOLUTIONS. — STANDARD ENGINE.

FIG. I.

Plunger A scarcely moving bringing pipes 1 & 2 into conjunction Plunger B drawing oil first through port 3 and later through port 4 and filling spaces C & E. Space D filled from cup through pipes 5, 6 & 7 and being cut off by plunger B which is moving rapidly.

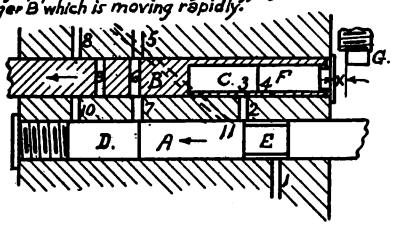
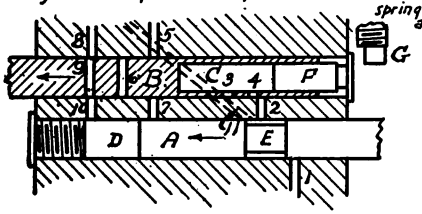


FIG. II.

Plunger B at end of stroke with pipes 8, 9 & 10 in conjunction. Plunger A moving rapidly forcing oil from D through pipes 10, 9 & 8 to bearings and bringing pipes 2 & 11 into conjunction. Spaces C & E filled.



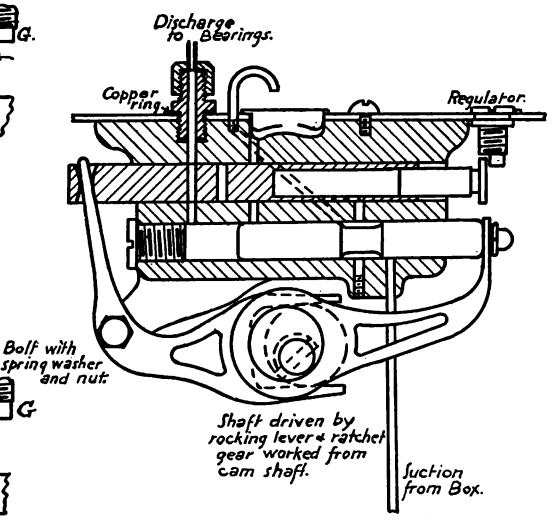


FIG. III.

Plunger A just beginning its outward stroke. Pipes 2 & 11 in conjunction. Plunger B moving rapidly has pushed plunger F against regulating stop G. Port 3 about to open for discharge from C & E through pipe 11 to oil cup at top of pipe 5

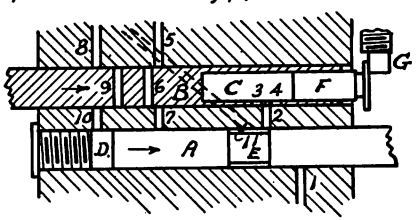
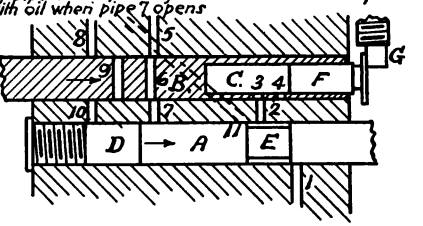


FIG. IV.

Operation of Fig. III practically finished Plunger B moving slowly near end of stroke bringing pipes 5, 6 & 7 into conjunction. Plunger A moving rapidly cutting off pipe 11 and forming vacuum in D which will fill with oil when pipe 7 opens



NOTE - The portion of the stroke of plunger B equal to the distance X Fig. I. when plungers B & F move together is ineffective both in the suction and the force stroke. By turning the stop G, which is eccentric on a spindle with a screw head, the distance X is shortened or lengthened as desired and in this way the supply is regulated.

LUBRICATION

OILER

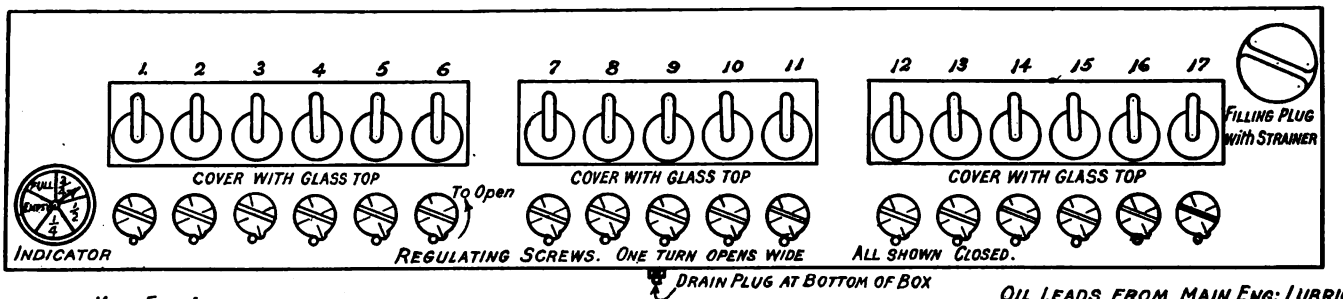
Lubrication is principally by forced feed through individual feed pipes to the different running parts. The force feed lubricator is attached to the side of the forward cylinder. The lubricator box is filled by hand through a funnel and strainer. There are seventeen pumping units in this with seventeen feed pipes running from it. Each pumping unit is a double-plunger valveless pump. One plunger pumps the oil from the reservoir through the sight feed nozzle from which it drops in full view, and the other plunger takes the oil from the sight feed chamber under the nozzle and forces it to the part to be lubricated.

All of the pumping units are actuated by a drive shaft which extends through the lubricator box and beyond each end. One end of this drive shaft has a handle for working the pumps before starting engine. The other end is connected to the engine cam shaft by a ratchet arm and a rod connected by a fork on one end to the ratchet arm and on the other end to a bell crank on the end of the engine cam shaft.

Changing the position of the fork on the ratchet arm changes the length of stroke so that any desired amount of oil beyond the range of the adjusting buttons can be obtained. The fork must never be placed on the ratchet arm so that the drive could touch a dead center position, or in other words, the drive must always be so adjusted that the lengths of the bell crank, the rod and the ratchet arm can never make a straight line connection between the engine cam shaft and the oiler.

There is one adjusting button on the oiler cover in front of each sight feed nozzle. These buttons have a slight projection on one side with a zero mark stamped on it. When this projection, or stop, is against and on the right side of the stop pin inserted in the oiler cover, no oil is being fed. To feed oil turn the

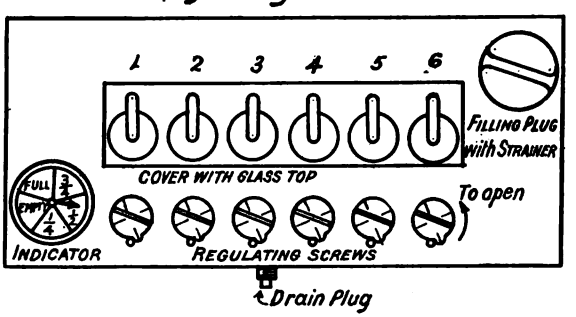
Main Engine Lubricator



OIL LEADS FROM MAIN ENG: LUBRICATOR.

1.(a) CIR. PUMP MAIN BEARINGS.
(b) VERTICAL CAM SHAFT BEARING.
(c) SPIRAL GEAR OF VERTICAL CAM SHAFT.
2.(a) Nº1. MAIN BEARING.
(b) Nº1. CRANK PIN OIL RING.
3. Nº1 CYLINDER AND WRIST PIN.
4.(a) Nº2 MAIN BEARING.
(b) Nº2 CRANK PIN OIL RING FOR Lº
5. Nº2 CYLINDER AND WRIST PIN.
6.(a) Nº3 MAIN BEARING.
(b) Nº3 CRANK PIN OIL RING.
7. Nº3 CYLINDER AND WRIST PIN.
8.(a) Nº4 MAIN BEARING.
(b) Nº4 CRANK PIN OIL RING.
9. Nº4 CYLINDER AND WRIST PIN.
10.(a) Nº5 MAIN BEARING.
(b) Nº5 CRANK PIN OIL RING.
11. Nº5 CYLINDER AND WRIST PIN.
12.(a) Nº6 MAIN BEARING.
(b) Nº6 CRANK PIN OIL RING.
13. Nº6. CYLINDER AND WRIST PIN.

Auxiliary Engine Lubricator



OIL LEADS FROM MAIN ENG: LUBRICATOR.

14(a) Nº7 MAIN BEARING.
(b) ECCENTRIC DRIVING AIR COMPRESSOR.
15(a) AIR CYLINDER AND WRIST PIN.
(b) THRUST YOKE.
16. Nºs 1.2 & 3 EXHAUST VALVES.
17. Nºs 4.5 & 6 EXHAUST VALVES.

LEADS FROM AUX: ENG: LUBRICATOR.

1. Nº1 CYLINDER AND WRIST PIN.
2. Nº2 CYLINDER AND WRIST PIN.
3. Nº3 CYLINDER AND WRIST PIN.
4.(a) Nº1. CAM SHAFT.
(b) Nº1. MAIN BEARING.
(c) Nº1. CRANK PIN OIL RING.
5(a) Nº2. CAM SHAFT.
(b) Nº3. MAIN BEARING.
(c) Nº4. MAIN BEARING.
(d) Nº3. CRANK PIN OIL RING.
6(a) Nº2 MAIN BEARING.
(b) Nº2 CRANK PIN OIL RING.

button to the left, or in a counter clockwise direction. One complete turn to the left opens the feed to full capacity. To decrease the feed the button is turned to the right, or in a clockwise direction.

The idea of the Standard lubricating system is to deliver a clean drop of oil to the different running parts fast or slow as needed, and the pump being worked from off the engine cam shaft the speed at which it pumps is proportionate to the speed of the engine. The individual oil feed pipes run from the oiler to the different engine parts. Each pipe has a check valve in it and a sight feed drip where the oil runs to a wire, dropping off it in plain sight into the continuation of the feed pipe. By unscrewing the cap to which the wire is attached and working the wire into the oil hole the pipe can be kept cleared at this point, and except by keeping the orifice of the oil pipe clear the cap with wire attached does no adjusting of the oil feed. Where the oil pipes leading from the sight feed subdivide into more than one pipe there are restricted openings so that with the pump delivering an excess each pipe gets it proper amount of oil.

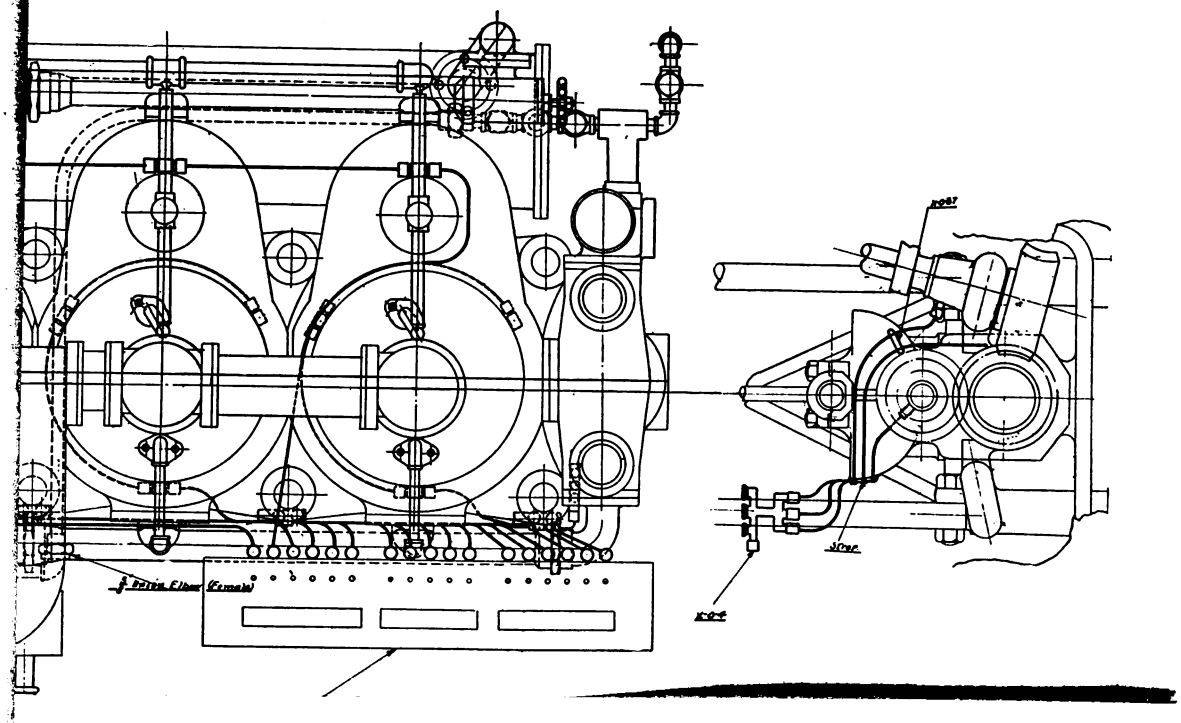
Small leather washers are placed in the sight feed connections when the engine is being shipped and the wires mentioned above are screwed down to hold the leather washers. The washers are put here to keep any dust or foreign matter from getting into the oil pipes. They must, of course, be removed when the engine is installed and ready to be started.

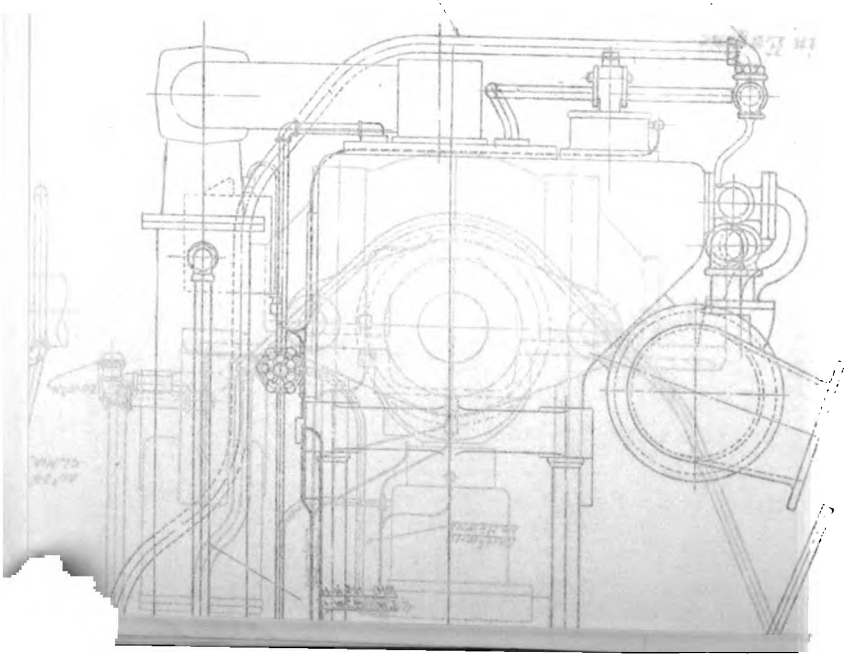
There are two oil pipes for the six exhaust valve balance pistons, one pipe for each crank pin centrifugal oiler and main bearing, one pipe for each cylinder, one pipe for the main air compressor, one for the thrust yoke and one pipe for the circulating pump gear. What few other parts need lubrication are taken care of by hand every hour.

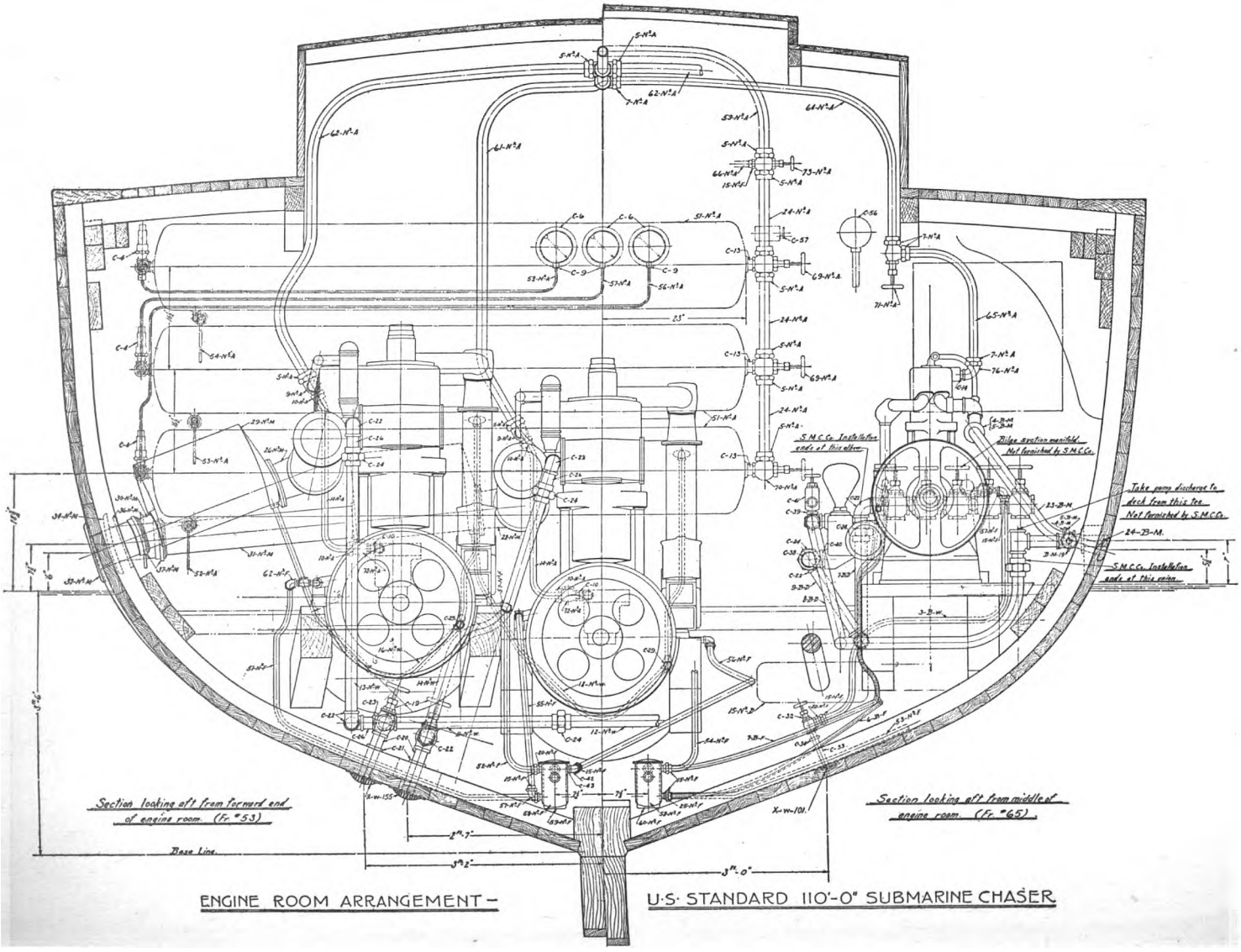
CARE OF: Watch the sight feed glasses on lubricator box to see that oil is feeding continuously while engines are running. Watch feed drips in every oil feed pipe to see that every part oiled from the force feed oiler is getting proper lubrication. Always strain the oil when filling the oiler tank. Remove the drain

plug and flush the tank out with kerosene when oil is dirty. Do not take the oiler apart. Take off the oiler cover and inspect the oiler parts frequently. If the plungers show a tendency to gum up clean carefully.

See that the fork on the ratchet arm and the buttons in front of each sight feed are regulated to give proper delivery of oil.







ENGINE PARTS

Bed Plate

The engine foundation is a cast iron planed bed plate. This casting has seven webs, each with a square sided slot cut into it to hold the main bearing boxes.

Main Bearings

Each main bearing has square sides conforming with the sides of the bed slot and also a heavy flange on each end so that it cannot be turned or gotten out of line by any side thrust or end thrust or handling.

The rigid support of the bearings and their large area make the explosions of the engine thoroughly absorbed through the connecting rod, bearings and base.

The bearings are of phosphor bronze. They are machine relieved on the sides and have oil grooves cut in both halves. The bearings are all scraped and fitted and lined up by hand in the factory so that the crank shaft is held in perfect alignment. The upper halves of the bearings are held in place by the bearing cap which fits into the engine bed slot and which is held down by two steel studs locked with lock nut and split pin.

The main bearings are lubricated from the force feed lubricator. An individual feed pipe delivers the oil through a drilled hole in the center of the bearing cap and through the upper bearing halve to the center of the bearing.

CARE OF: Prevent foreign substance such as sawdust or sand-dust from getting into the bearing.

Watch them to see that the force feed lubricator is feeding sufficient oil to keep the bearings from overheating.

Should for any reason a bearing become overheated douse it with oil or water and see that sufficient feed of lubricating oil is provided. Should the engine have

been run long enough to so overheat the bearing as to bind the crank, take off the bearing cap and the upper bearing halve and douse the bearing with water or oil until it has cooled off. Then put the bearing cap in place and with the proper feed of oil to the bearing the engine can be started and run as long as the bearing continues to get sufficient oil. At the end of the run, however, both halves of the bearing should be removed to see that there is no foreign matter in it which has scored the bearing; if such has occurred the bearing should be scraped in.

ADJUSTMENT OF: To get at the lower bearing halves for scraping take off all of the main bearing caps and the upper bearing halves, and also disconnect the crank pin bearings; disconnect the air compressor eccentric strap and take off the air compressor complete; disconnect the circulating pump connecting rod from the pump main shaft by taking off the pump crank pin bearing, and then take off the pump crank case; take off the vertical cam shaft complete; take off the stanchion cross braces, and the thrust yoke. Then the engine crank shaft can be raised high enough to get at the lower halves of the bearing boxes for scraping, and re-lining if necessary. Put bluing on both halves of the bearing, then put the halves back in place and turn the crank shaft by hand to show the high spots to be scraped down in the bearings. File the upper and lower edges of the halves to take up for wear. Re-line by inserting one or more metal liners between the bottom of the bearing and the engine bed slot.

CRANK SHAFT

The crank shaft is hammer forged from one solid billet of nickel steel. It is designed stiff enough so that with its rigid bearing support there can be no vibration or deflection of the shaft. The shaft is balanced through there being six throws 120° apart. It is heat-treated and ground on the bearing surfaces.

Cranks are in pairs 1-6, 3-4, 2-5.

Cylinders fire going ahead in the order 1-5-3-6-2-4 for left hand engine and 1-4-2-6-3-5 for right hand engine.

Crank Pin Bearing

This is a split phosphor bronze bearing, the male and female halves being held together by two steel bolts through lugs on each halve. These steel bolts are long enough to extend through the foot of the connecting rod and the foot is threaded to receive them so that the nut on the bolt above the foot is a lock nut.

This bearing is machine relieved on the sides with oil grooves cut in, and hand scraped and fitted to the crank pin. An oil ring is fitted to the side of each throw of the crank shaft and lubricating oil from the force feed lubricator is fed through an individual pipe to where it drops into the deep groove in the oil ring, from which it flows through a diagonally drilled hole in the crank throw to the center of the crank pin bearing.

CARE OF: See that no foreign substance gets into the bearing.

See that oil is feeding properly into the oil ring and that the bearing does not overheat.

ADJUSTMENT OF: Should the bearing become overheated douse with oil or water.

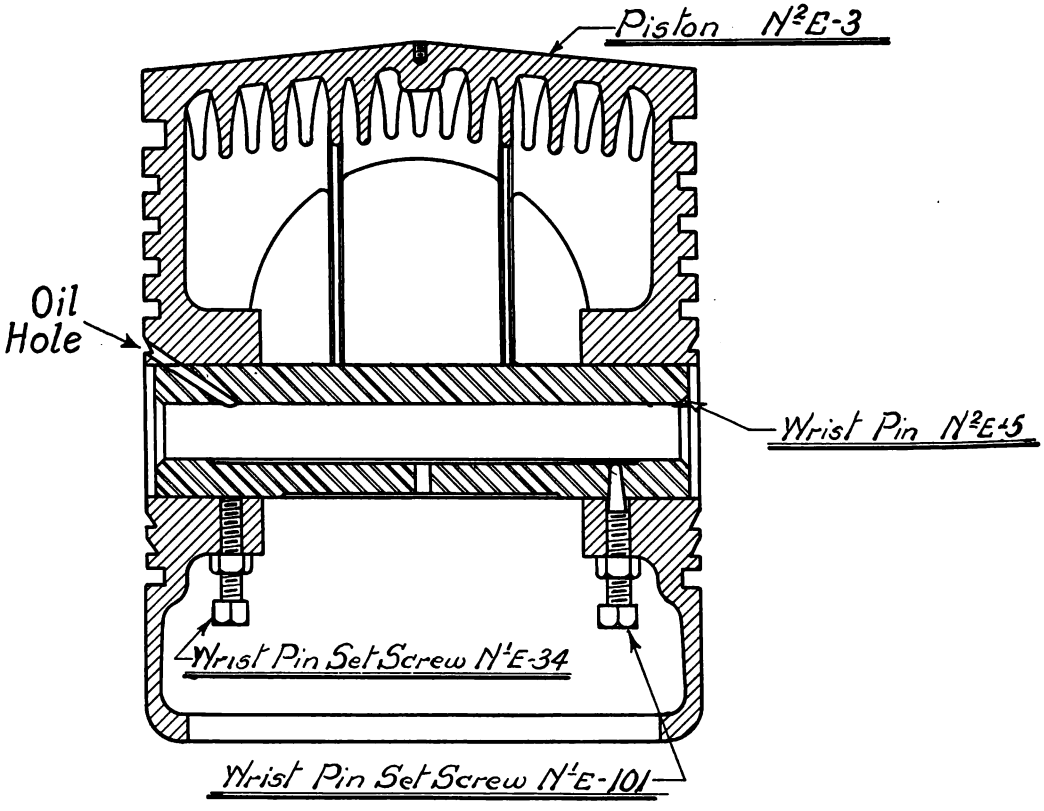
Should the engine be allowed to run without oil feeding to the bearing long enough so that it binds, take the bearing off as soon as possible and if necessary re-scrape and take up for wear by taking out one or more of the brass liners between the bearing halves.

Connecting Rod

This is hammer forged from one solid billet of steel. The foot is forged into a rectangular piece which is milled smooth and drilled and tapped for the connecting rod bearing bolts. The wrist pin end of the rod is forged into a cylindrical shape which is drilled and finished for the bronze wrist pin bushing. The rod is turned down with a tapering cut.

Main Engine

PISTON AND WRIST PIN



After the wrist pin bearing and connecting rod bearing are fitted and lined up in the connecting rod the complete rod with bearings is perfectly balanced and fitted to the wrist pin and the crank pin at the factory.

WRIST PIN

The wrist pin is a hollow steel pin case-hardened and ground. The wrist pin bearing is a phosphor bronze bushing fitted into the connecting rod. This bearing is lubricated through diagonally drilled holes from the upper oil groove of the piston through to the center as described under "Cylinder". The wrist pin bearing should go for a long period of time without perceptible wear. Should unusual wear occur the bushing can be forced out and a new one inserted.

PISTON

The piston is of cast iron. It has six piston ring grooves, five above the wrist pin and one below. There are also three oil grooves, one above and two below the wrist pin. The upper piston ring is of cast iron, ground concentrically. All other grooves have four split steel rings each. From the bottom of the piston to 7¾" up it is .015" in diameter smaller than the cylinder bore. From this point upwards it tapers to where at the head it is .030" smaller than the cylinder bore. The piston is ribbed and dished at the top for strength with radiation points on the under side of the head for cooling.

The wrist pin is held in place in the wrist pin hole of the piston by a round pointed set screw which screws against its surface at one end, and with a tapered set screw fitting into a hole in the wrist pin at the other end. The wrist pin set screws in turn are locked with a lock nut. The wrist pin is oiled by means of two diagonally drilled oil holes from the upper oil groove of the piston to the center of the wrist pin bearing, through which oil from the cylinder walls is fed into the center of the hollow pin and out to the surface through a drilled hole at the bottom of the pin.

Care must be given in putting in a piston to place it so that the side with the oil holes is towards the flywheel. A file mark is put into the bottom rim of the piston, underneath the drilled oil holes. This mark can be felt by putting the hand up underneath the cylinder. If the mark is towards the flywheel end of the engine it shows that the side of the piston which has the drilled oil holes is towards the flywheel as it should be.

CARE OF: Care should be taken to see that the pistons are running properly. Inspect frequently by feeling up in the wrist pins to make sure that the set screws are locked and the wrist pin tight. This is easy as they can be felt without removing any parts. A loose wrist pin would cause scoring of the cylinder walls.

See that the wrist pin bearing is not loose. A loose wrist pin bearing would make an excessive knocking noise.

See that the piston rings are in good condition.

Don't renew rings too often and never remove rings for more than two or three slots at a time so as to give the new rings time to wear in. To remove one of the split steel rings or to put one on, care must be taken not to break it. It cannot be sprung on as with an ordinary cast iron ring but instead it must be worked onto the piston spirally, turning it around on the piston in the way that a cap would be screwed or threaded on.

Poor lubrication of the cylinder walls, or too light and insufficient lubricating oil used, will cause piston rings to wear excessively and eventually leak.

While the piston is out inspect the wrist pin and insert a piece of wire in the oil holes that are drilled through it. See also that these holes are in line with the holes drilled in the piston when the wrist pin is in place. When replacing a piston be sure that the oil holes in it are at the forward end of the wrist pin.

ADJUSTMENT OF: To remove the piston take off the crank pin bearing and lower the piston to a point where the set screws can be easily unscrewed and the wrist pin taken out and the rod disconnected, when the piston can be dropped

to the bearing caps and slid out. The wrist pin bearing has a clearance of .002". Never force the round pointed set screw hard up on the wrist pin when the engine is cold so that when the pin expands, due to increase of temperature when the engine is running, the tapered set screw might be sheared off.

CYLINDER

The cast iron cylinder is cast individually and mounted on the braced and interbraced engine stanchions. The cylinder is cast with heavy lugs on the side which rest on the shoulder of the stanchion. These lugs vary in different cylinders, the cylinders being known as "high", "low", "pump" and "control" lug cylinders. Cylinders are numbered from the flywheel end 1-2-3-4-5-6.

The cylinder has large water jacketted spaces, and large hand hole openings for cleaning out any dirt or sediment which might accumulate. A drain cock is connected to each cylinder at the bottom of its water jacket so that all water can be drained off.

CARE OF: Drain water from the cylinder jackets through the drain cocks whenever leaving the engine for any length of time in cold weather.

Take off the hand hole covers once a year or as required and clean the water jackets of any sediment that may have collected.

Inspect the cylinder frequently for cracks or blow holes that might develop.

CYLINDER HEAD

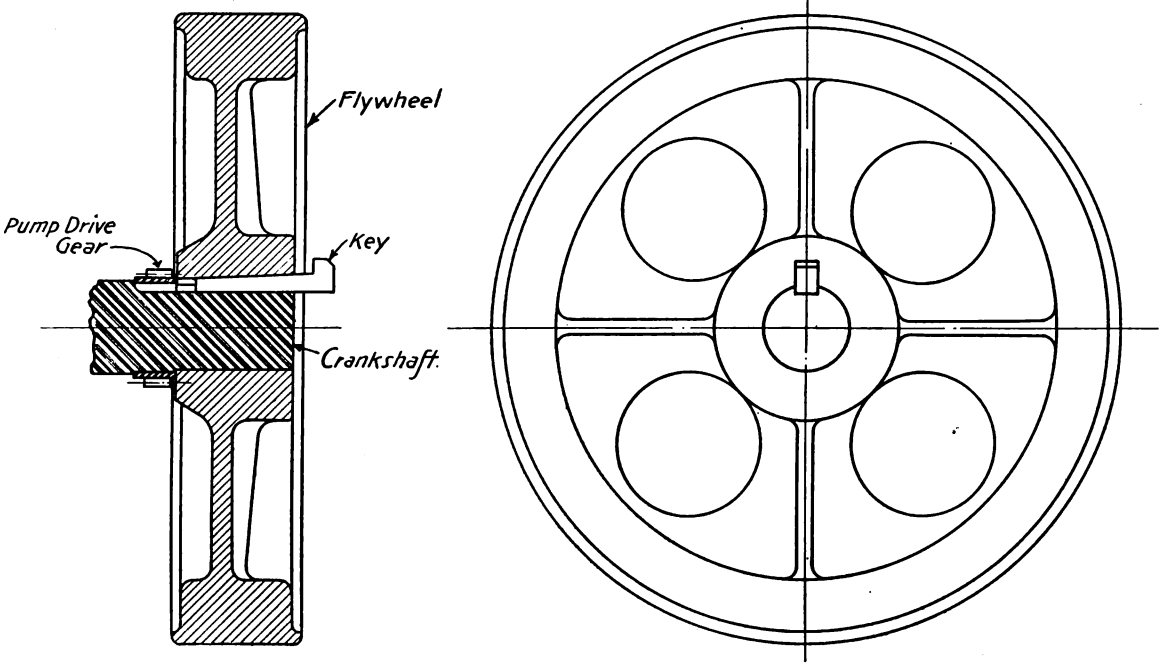
The cast iron cylinder head is a separate casting which has ample water jacket space. The head recesses into the cylinder and is bolted to it, with 1/32" thick asbestos millboard packing in the joint between the head and the cylinder.

The head is cast with the opening for the inlet valve in the center of the top and with the opening for the ignitor plug to one side.

CARE OF: To remove cylinder head uncouple the circulating water connection to the exhaust valve and the circulating water connection to the cylinder

Main Engine

METHOD OF KEYING FLYWHEEL TO CRANKSHAFT



jacket; unbolt the intake valve cage from the intake valve pipe flange and disconnect the ignitor.

If the cylinder head sticks so that it cannot be taken off readily bolt down all heads and turn engine over so that all valves are closed. Run compressed air into the cylinders, gradually slacking off nuts a half-thread at a time on the head that is sticking, and see that head is following up before slacking more. Also after head has come up ¼" let off all air.

In removing the head, if it be found that the cylinder head packing of 1/32" thick asbestos millboard is split it should be renewed. The old joint should be scraped off clean and the new packing cut from the cylinder head and laid over the studs, then sprinkled with salt water on under side and smeared with graphite on the upper side. In putting the cylinder head back in place put a little graphite and oil on each stud, and all the stud nuts should be turned down equally. As soon as the engine is running and up to heat turn down on the nuts again.

When the cylinder head is being replaced be careful also to set the rubber packing in the intake pipe joint perfectly true and bolt the pipe flange joint tight.

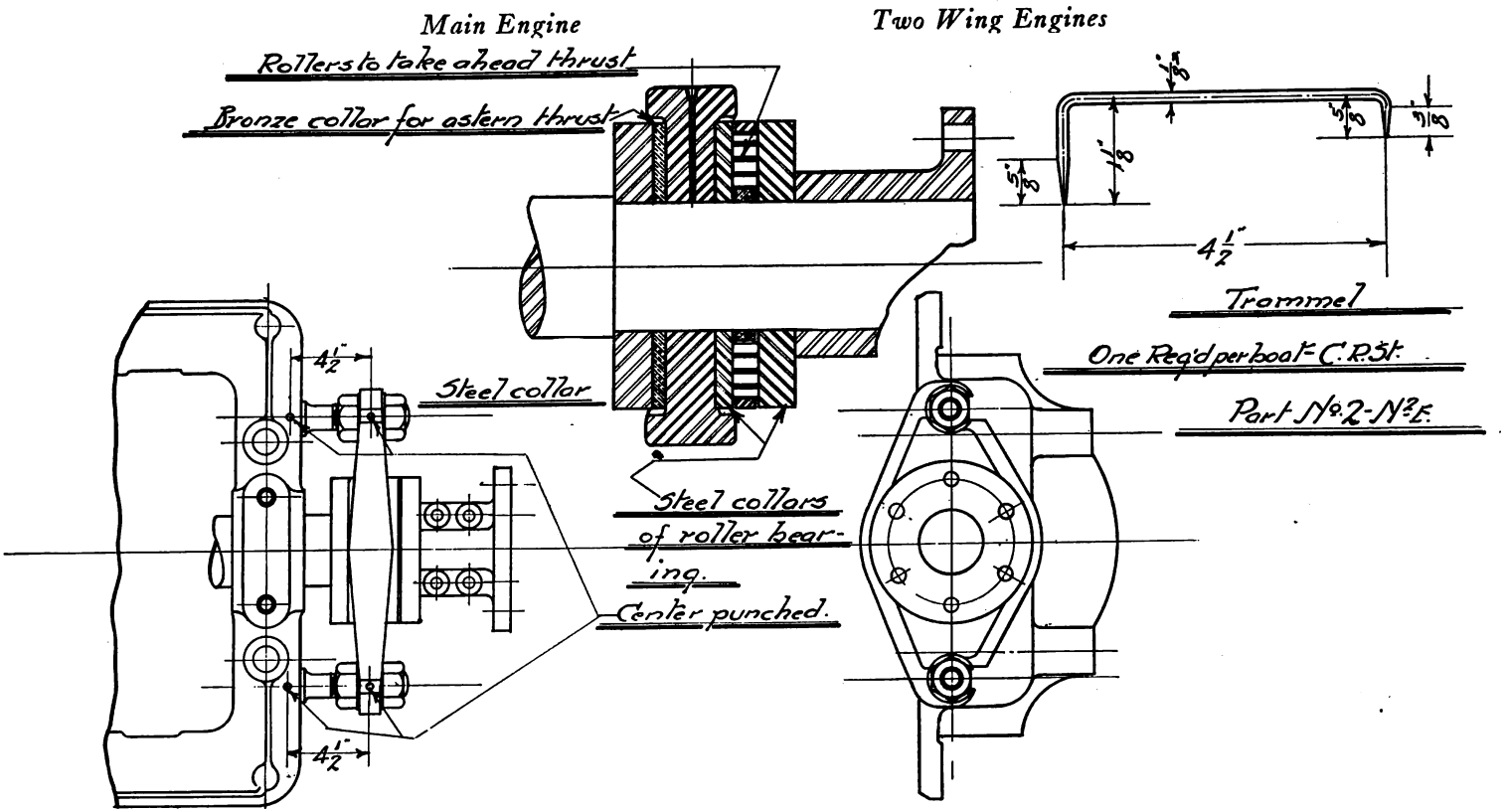
FLYWHEEL

Flywheel is bored for a tight fit on the forward end of the crank shaft and is locked to it with a taper key.

The key must be filed to give a good bearing on the sides of the key-way in the shaft and the sides of the key-way in the flywheel. It must be filed and scraped to give a perfect bearing on the bottom of the shaft key-way and the top of the flywheel key-way. This is most important. The key must be a perfect fit and must be kept driven in hard.

Always grease key before driving.

If flywheel key were broken off under head, chip a flat spot and put a center punch mark in center, then drill with a small drill, then with a larger and tap



Thrust

Note - When thrust bearing is set, Thrust yoke and base is to be heavily center-punched as shown on both sides to dimension as shown.

with a thread tap and insert a stud as large as possible. After this put over some washers large enough to clear the key and put on a nut, then draw up with a wrench. If it does not come readily tap on flywheel hub with a hammer. This will start it and by following up with a wrench the key can be pulled out.

THRUST

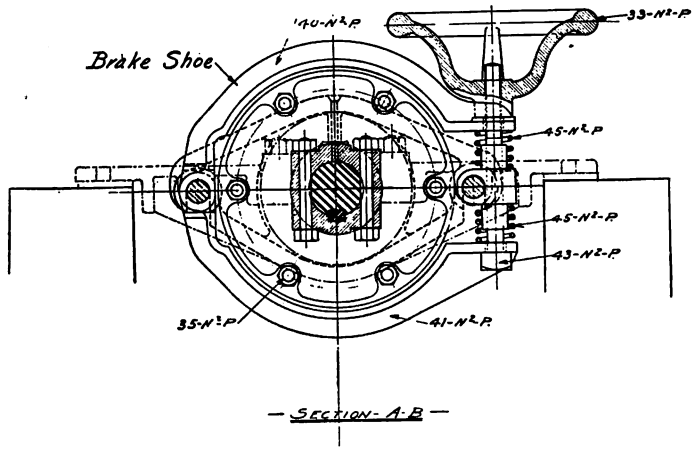
Aft of the aftermost main bearing and extending just beyond the eccentric which drives the air compressor is a shoulder on the crank shaft. A steel collar on the shaft sets up against this shoulder and a pin through the collar and into the air compressor eccentric keeps the collar from turning on the shaft. Just aft of the steel collar is a bronze collar.

On each side of the crank shaft a long bolt extends out from the engine bed parallel to the shaft and these bolts support the steel casting which is the thrust yoke. The yoke is slipped over the crank shaft next to the bronze collar. Just aft of the thrust yoke on the crank shaft are two case-hardened and ground steel collars with cage containing hardened and ground roller bearings between. Just aft of these is the propeller shaft coupling bolted to the shaft and which faces up against the after steel collar.

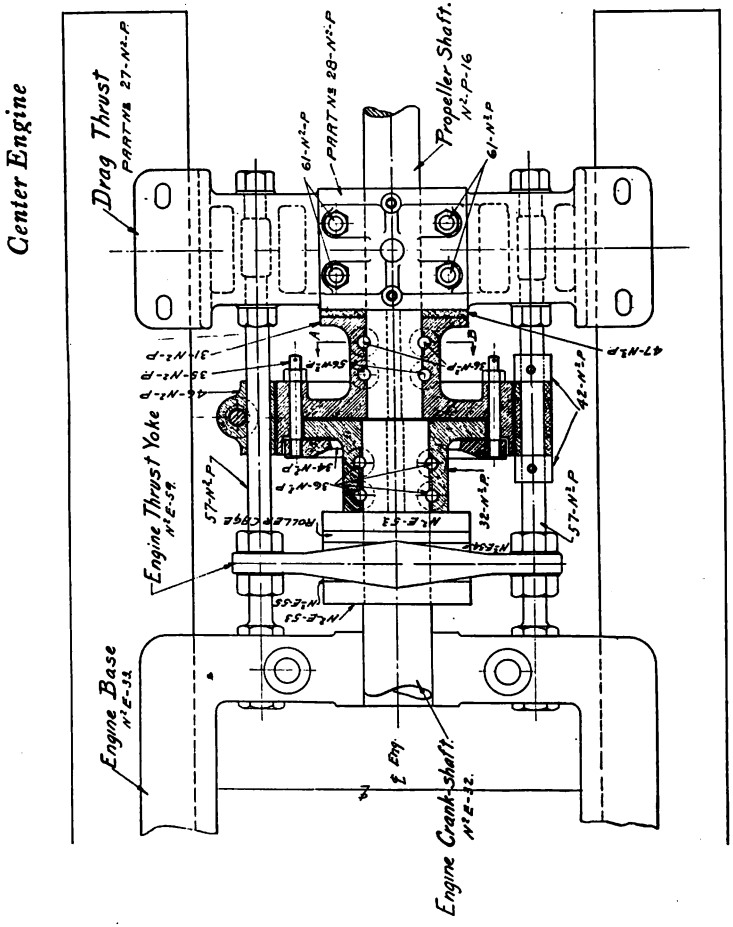
The ahead thrust of the propeller is taken up by the engine bed through the roller bearing and forward steel collar bearing against the after face of the yoke.

The astern thrust of the propeller is taken by the engine bed through the bronze collar bearing against the forward face of the yoke. It is important that neither the forward or the after thrust comes on the crank shaft bearings and this depends upon the fitting of the thrust yoke.

There are two nuts on each stud which support the thrust yoke. One nut on each stud is screwed against the after side of the yoke and one nut on each stud is screwed against the forward side of the yoke. By turning these nuts forward or aft the yoke is carried forward or aft on the crank shaft, and this is set in the proper position at the factory and shaft coupling locked on the shaft so that the



— SECTION-A-B —



forward face of the coupling holds the face of the roller bearing collar against the yoke. A trammel is used for this adjustment and each end of the yoke measured from a point on the engine bed to make sure that the yoke is set equally on both yoke studs.

CARE OF: See that the thrust is never being taken by the crank shaft bearings.

ADJUSTMENT OF: To adjust the thrust, first loosen up on all four nuts of the yoke studs.

Then move the crank shaft aft as far as it will go.

Then move the thrust yoke forward until it is pressing the bronze collar and the steel collar against the shoulder on the crank shaft.

Then lock the thrust yoke by means of the four nuts on the yoke studs using trammel as described above.

Then move the crank shaft forward 1/64".

Should unusual wear have occurred it might be necessary to move the shaft coupling further forward on the shaft so as to have the roller bearing collars tight up against the after face of the yoke, and if this is necessary the recesses in the shaft for the coupling bolts must be widened on the forward faces.

PROPELLER SHAFT COUPLING

The propeller shaft coupling of steel is in two halves and is a drive fit on the crank shaft and the propeller shaft and must run true. It is keyed on with a well fitted key, and the one halve bolted to the crank shaft with four bolts and the other halve bolted to the propeller shaft with four bolts, the bolts being scored through the side of the shafts. The two halves bolt together face to face with six bolts through the coupling flanges. This is the coupling on each wing engine.

Shaft Slip Coupling

There is a shaft slip coupling on the center shaft in the place of the shaft coupling just described so that the center engine can be cut out and its propeller made to spin freely with no drag when the boat is being propelled by only the two wing engines.

This coupling is made in two halves. The casting on the crank shaft is a drive fit and is keyed on with a well fitted key and bolted with four bolts which are scored through the sides of the shaft.

The propeller shaft halve of the coupling is driven on and keyed and bolted with the bolts scored through the shaft. Fastened loosely to this halve of the coupling by bolts through the flange is a heavy steel flattened ring or collar.

The flange of the crank shaft halve faces into the propeller shaft halve with a bronze bushing between. The bolts holding the steel ring to the propeller shaft halve extend over the crank shaft halve flange so that when the bolt nuts are tightened the ring, bearing on the forward face of the crank shaft halve flange, binds it against the bronze bushing in the propeller shaft halve so that a solid shaft is had. Then by the simple slacking off on the bolts the ring is loosened from the crank shaft halve so that the propeller shaft turns free of the crank shaft.

A break band, when tightened by a hand screw at the side of the slip coupling, holds the propeller shaft from turning so that the propeller shaft can be quickly locked to the crank shaft by means of the slip coupling bolts and steel ring. Then when the coupling bolts and steel ring are fast and the hand screw is slacked off the forward travel of the boat (if under way) turns the engine over.

Slip Coupling Thrust

This is in the form of a thrust bearing on the center engine shaft, aft of the slip coupling. When the slip coupling is slacked off the coupling works back to the slip coupling thrust which then takes the aft thrust of the propeller.

The slip coupling thrust is lubricated by oil piped from an oil cup on the engine room bulkhead. Keep oil cup well filled and see that oil is feeding to thrust properly. Keep foreign matter out of thrust.

ADJUSTMENT OF: The thrust is taken up by adjustment of nuts on studs which bolt the thrust bearing to the engine bed just as described under "Thrust".

PROPELLER SHAFT

Shaft is of steel covered with a copper sleeve with bronze bushings shrunk on where each bearing comes.

The shaft has a Standard three-quarter inch to the foot taper at the end for the propeller and, beyond, a thread to take lock nuts and pin.

PROPELLER

The propeller is of cast manganese bronze with three blades of 36″ diameter, 63″ pitch. The hub is bored out to Standard taper of three-quarter inch to the foot to fit the taper of the propeller shaft and is keyed to the shaft.

Aft of the propeller on the shaft and holding the propeller tight up on the taper of the shaft is a propeller nut and a propeller lock nut, in turn locked with a taper pin through the end of the shaft.

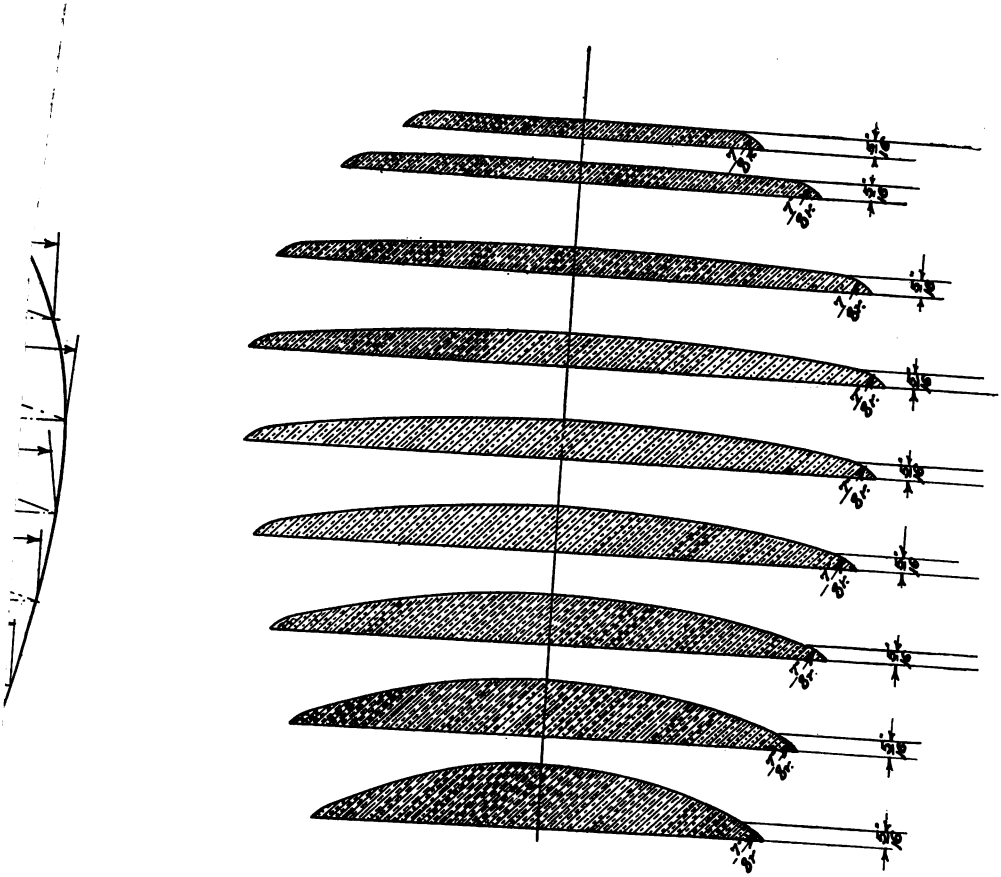
A bronze cone nut goes over the end of the shaft and propeller lock nut, propeller nut and taper pin and threads onto the propeller nut and faces tight up against the after side of the propeller hub. This cone nut is locked by a set screw through it into the propeller. In putting on the cone nut the threads and joint must be well filled with white lead to make an absolutely water-tight joint.

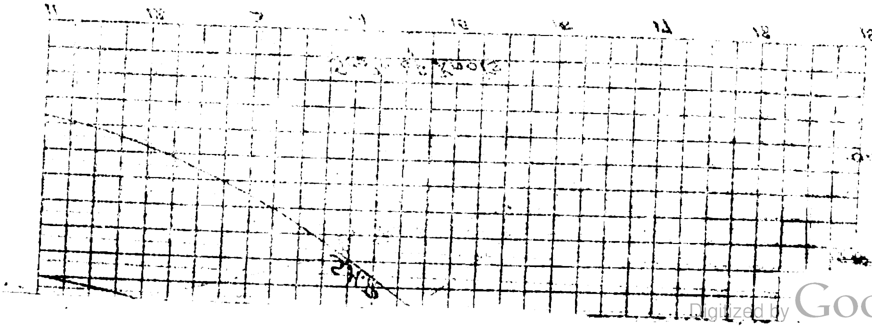
The forward face of the propeller hub is counterbored about 5/8″ so that when the propeller is forced into place the bushing on the propeller shaft fits into this counterbore.

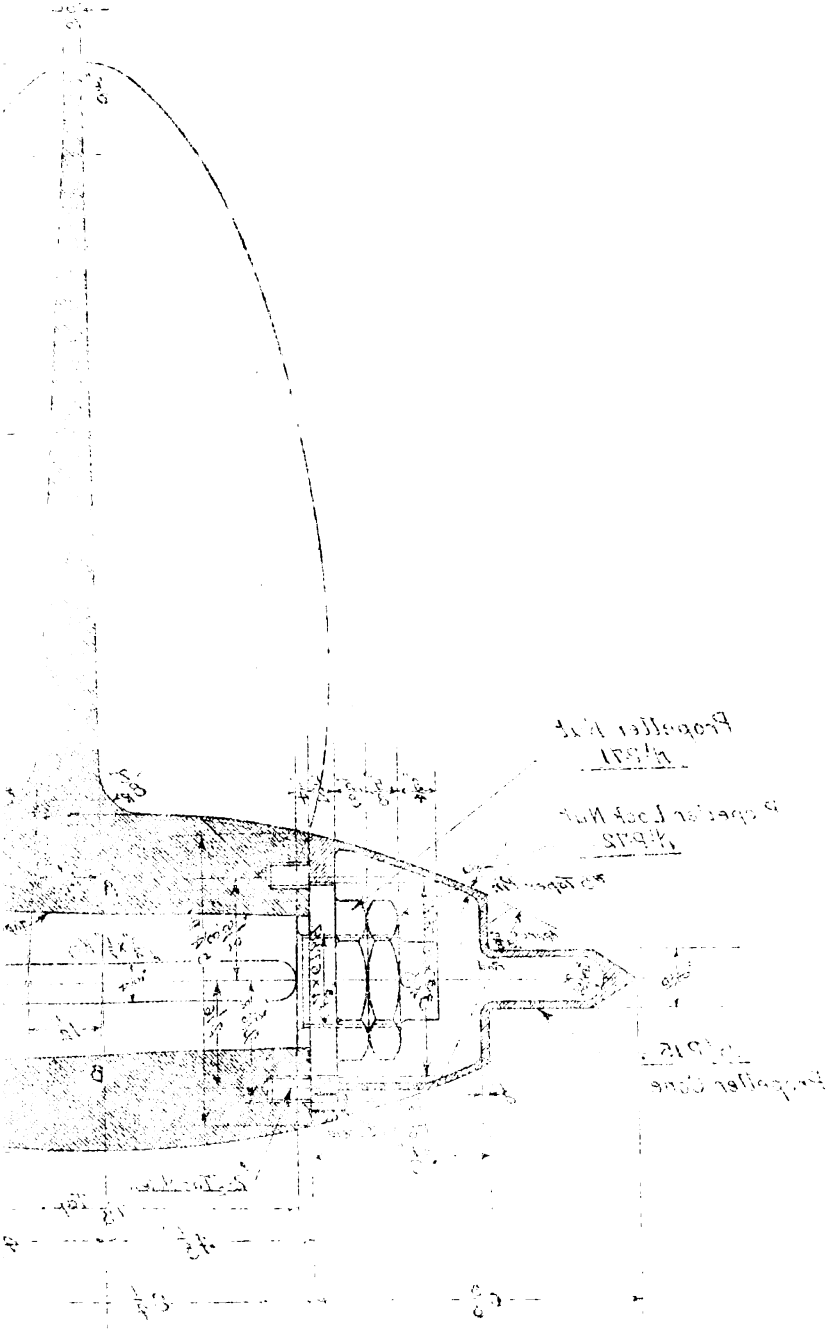
In putting the propeller on the counterbore must be well filled with white lead to make an absolutely water-tight joint.

CARE OF: Every time the boat is hauled out the propeller should be examined to insure perfectly water-tight joints all of the time so as to prevent salt water leaking in to the steel shaft.

ADJUSTMENT OF: In fitting a propeller drive it hard up on the shaft without the key in and mark on the shaft how far it goes up on the taper. Then take the propeller off and file the key to a tight fit in the propeller shaft key-way. Put bluing on the top of the key and try the propeller on the shaft with the key in, and if it does not go up on the taper to the original mark take the propeller off and file high spots on the key and continue until the key is a perfect fit. To take the propeller off, screw two studs into the two tap holes in the after end of the propeller hub. Put a strongback on the studs and screw this down across the end of the shaft as much as it will stand. Then give the end of the shaft a quick blow and the propeller will be loosened so that it is easily worked off. Should a propeller blade become bent it could be bent back.







SAFETY PRECAUTIONS

IMPORTANT

See that no gasoline leaks out of gasoline system anywhere.
" " no air leaks into gasoline suction system anywhere.
" " no salt water leaks through propeller hub joints.
" " no salt water leaks on to engine parts anywhere.
" " no salt water gets into batteries.
" " no ammonia or other alkali is kept near batteries.
" " no metal tools are left lying near batteries.
" " no water is in gasoline tanks.
" " no water or oil is in air tanks.
" " there is no foreign matter in lubricating oil.
" " there is no sulphur in lubricating oil; buy the best.
" " the inlet valve does not leak.
" " the exhaust valve does not leak.
" " all repairs and adjustments are immediately made.
" " there is no naked light used in engine room.
" " engine room is being properly ventilated.
" " ground spark switch is thrown out when not in use.
" " spare parts and tools are properly greased and cared for and ready for immediate use.
" " spare ignitors are re-tipped immediately, before putting away in reserve box.
" " all adjustments are made and engines are ready for full service before leaving engine room on shutting down engines.
" " water is drained off through pet cocks when leaving engine for the day in cold weather. Make sure that pet cocks are not clogged by running a piece of wire into each one.

DON'T

Do Not run with too rich a gasoline mixture.

Do Not feed too much lubricating oil to cylinders.

Do Not take the oiler apart.

Do Not run with a late spark.

Do Not take magneto apart.

Do Not start engine when water has been drained off without first filling up water jackets.

Do Not allow over 25 lb in water jackets.

Do Not forget to open ground switch when engine is stopped for the day.

Do Not change the timing of the cam shaft.

Do Not pull up too tightly or unevenly on nuts holding valve cages.

Do Not pull unevenly on flange studs.

Do Not overwrench a nut.

Do Not grind valves except in their cages.

Do Not let grinding paste get into cylinders.

Do Not pien on valve stems, valve guides or valves.

Do Not sweep dust from engine room floor into engine base.

Do Not fill exhaust valve dashpot with oil.

Do Not start engine with arrow on exhaust valve stem nut pointing towards center of engine.

Do Not start engine when first installed with the leather washers in the oil feed pipes or with the packing cord in oil rings. These washers and cord are put in the pipes and rings when engine is shipped to keep any dust or foreign matter from getting into them.

Do Not make changes in engine design, piping or installation. There are many reasons why the maker hasn't made them.

ADJUSTMENTS

Main bearings .007″ clearance.
Crank pin bearings .010″ clearance.
Wrist pin bearings .002″ clearance.
Top of inlet valve piston to valve cap 1/16″.
Exhaust valve travel; ahead ¾″ lift, reverse ½″ lift.
Exhaust valve roller clearance between body of cam and lifter roller 1/32″.
Ignitor tripper rod rocking motion 1/16″.
Ignitor tripper rod spring compression ⅛″.
Air pump on engine set at 250 lb pressure.
Air pump on engine; top of piston to cylinder head 1/64″ clearance.
Safety valve on air tank set at 300 lb pressure.

PACKINGS

Rubber gaskets between inlet pipe flanged joints.
Rubber gaskets between circulating pump and liner base.
Rubber packing in water pipe expansion union.
Flax packing in air line expansion unions.
Flax packing in gasoline pump glands.
Flax packing in gasoline hand pump glands.
Flax packing in circulating water pump glands.
Asbestos gaskets in all exhaust pipe line flanged joints.
Asbestos gaskets at exhaust pipe hand plate joints.
Asbestos gaskets at exhaust valve cage joints.
Asbestos gaskets at cylinder head joints.

INSPECTION HOURLY

For Hand Oiling

Exhaust valve links, pins and joints.
Ignitor trip gear pins and joints.
Air compressor eccentric strap.
Circulating pump wrist pin bearing.
Circulating pump connecting rod bearing.
Circulating pump shaft bearings.
Cam shaft bearings.
Cam roller pins.
All lifters on rocket shaft.
All bushings in stanchions.
Gasoline pump eccentric.
Inlet valve through cock in top of the valve cap when engine is idle.
Wherever there is an oil hole; it is there for oil.
Wherever there are rubbing surfaces; they need lubrication.
Inspect feed drips in every oil feed pipe to see that every pipe from the force feed oiler is giving proper lubrication.
Note: Use a grade of oil equivalent in body to "Mobiloil B" or Texaco "Pinacle" or "Regal".
Use an equivalent of Albany grease in the vertical cam shaft gear housing, shaft bearings and bulkhead stuffing boxes.

INSPECTION HOURLY

For Running

Become familiar with hum of perfect running.
Look for any symptoms of irregularities.

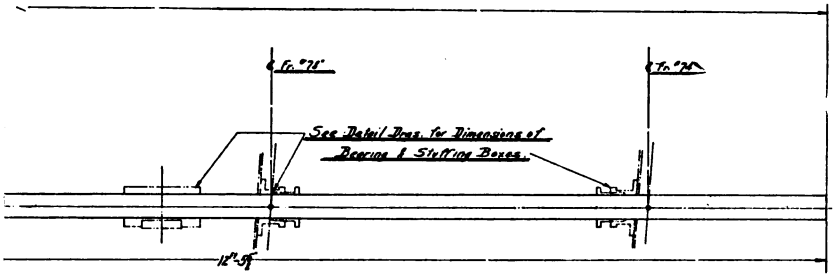
For Overheating

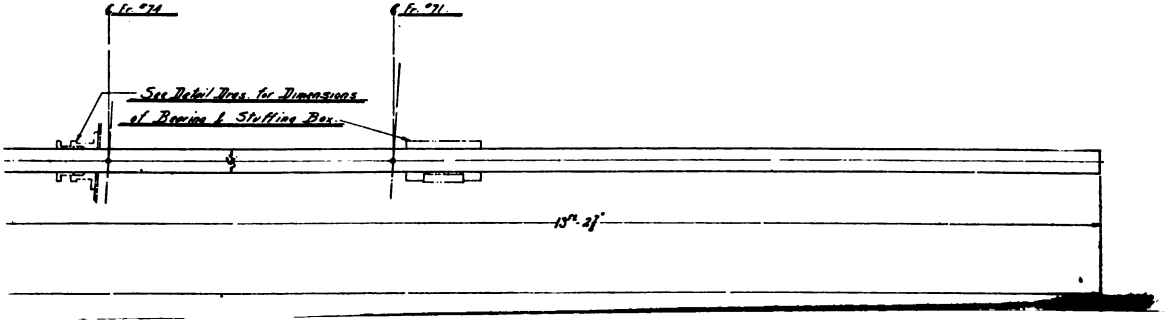
Exhaust valve cages.
Cylinder heads.
Cylinders.
Exhaust manifold.
All bearings wherever possible. Bearings may feel warm to the hand without danger.

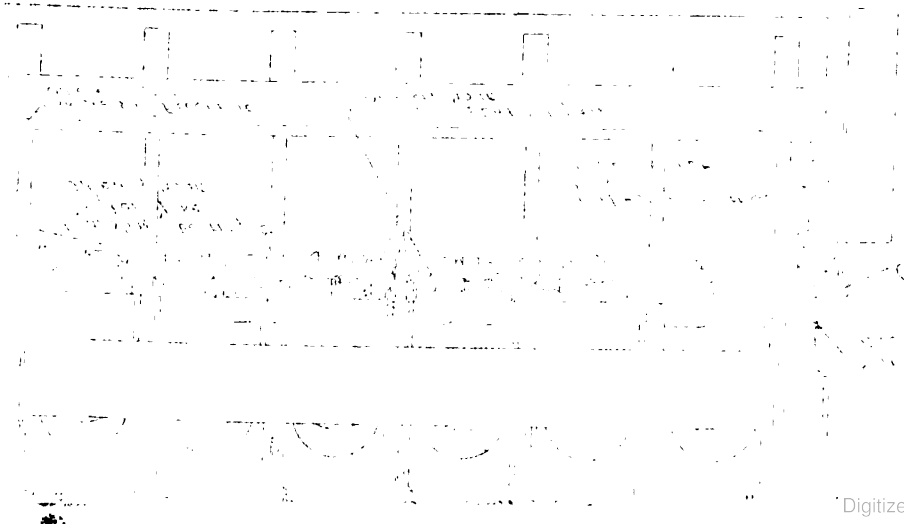
INSPECTION DAILY

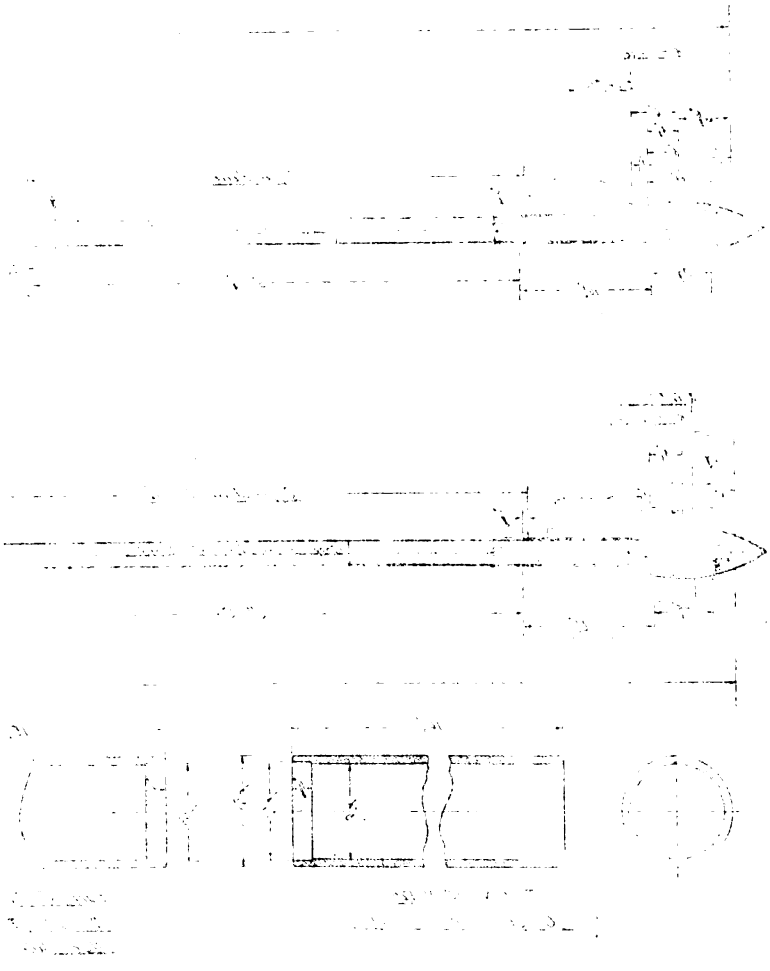
For Wiping

Ignition parts; clear oil holes.
Exhaust parts; clear oil holes.
Circulating pump parts including crank case; clear oil holes; clear drain holes.
Vertical cam shaft gear housing.
Gasoline pump eccentric.
Cam shaft bearings; clear oil holes.
All lifters and hangers on the rocker shaft; clear oil holes.
Air parts; clear oil holes.
Magneto parts; clear oil holes.
Engine should be idle when getting at these different parts.









INSPECTION DAILY

For Hand Oiling

Inlet valve dashpot, when engine is idle.
Exhaust valve through plug in valve cage; do not fill full.
Gasoline pump eccentric.
Thrust roller bearing.
Magneto shaft bearings.
All gears.
Wherever there is an oil hole; it is there for oil.
Wherever there are rubbing surfaces; they need lubrication.
Propeller shaft bearings.
Grease cup of shaft stuffing boxes on all bulkheads.
Grease cup of vertical cam shaft gear housing.

For Running

AIR SYSTEM:

Air compressor working properly.
Air valves working properly.

GASOLINE SYSTEM:

Float box working properly.
Pumps working properly.
Vaporizer working properly showing an excess feed of gasoline overflowing to the float box.
Vaporizer sprayer nozzles feeding properly.

INSPECTION DAILY FOR RUNNING
(Continued)

INLET SYSTEM:

Inlet valve working properly.
See that valve is not leaking compression.
See that the pet cock for oil is closed.
See that air holes in valve dashpot are clear.

EXHAUST SYSTEM:

Exhaust valve working properly. Make sure that valve is not sticking.
See that valve is not leaking compression.
Valve cage levers working properly.
Valve lifters working properly.
Water circulating through valve properly.

IGNITION SYSTEM:

Ignition gear working properly.
Examine ignition wires for breaks, poor connections, worn insulation.
Magneto working properly.
See that oil hole is clear.
See that drain holes and grooves in the base are clear.
Batteries working properly.

CIRCULATING WATER SYSTEM:

Circulating pump working properly.
Bearings cool and tight.
Water on piston rod draining off.
Crank case draining properly.
Spring-loaded valve working properly.
Water gauge working properly.

INSPECTION DAILY FOR RUNNING

(Continued)

LUBRICATING SYSTEM:

Lubricator pumps working properly.

Oil feed pipes delivering properly.

Oil feed pipe to connecting rod bearing trailing properly in crank shaft oil rings.

MAIN BEARINGS:

To see if they are not over-comfortably warm to the touch.

CRANK PIN BEARINGS:

To see if they are not over-comfortably warm to the touch.

WRIST PIN BEARINGS:

To see if they are not over-comfortably warm to the touch.

WRIST PIN SET SCREWS:

To see that they are tight and properly locked.

FLYWHEEL:

To see if key is tight.

INSPECTION DAILY

FOR LEAKS

AIR SYSTEM:

Air tanks.
Air piping and joints.
Air check valves.
Air compressors.

GASOLINE SYSTEM:

Gasoline tanks.
Gasoline piping and joints.
Gasoline check valves.
Gasoline pumps.

Leaks of air into the gasoline suction pipe system must be looked for just as carefully as leaks of gasoline from the system.

INLET SYSTEM:

Inlet piping.
Joints and piping.

Look very carefully for leaks in this system as a leak upsets the mixture of explosive charge delivered to the cylinder.

EXHAUST SYSTEM:

Piping and joints.
Manifold.
Muffler.

INSPECTION DAILY FOR LEAKS

(Continued)

BATTERY:

Jars, for excessive evaporation as well as leaks.

Excessive loss of voltage.

CIRCULATING WATER SYSTEM:

Piping and joints.

Packed glands.

Sea inlet valves.

Water strainer.

All flanged connections for leaky gaskets.

All connections that have gaskets between.

All threaded connections for leaky threads.

All glands for leaky packing.

All bulkhead glands on propeller shaft.

Stuffing box bearings.

Leaks of air into circulating water system, especially on pump suction line.

CYLINDERS:

Cylinder head gaskets for leaks.

INSPECTION WEEKLY

FOR ADJUSTMENT

AIR SYSTEM:

Air compressor inlet valve seating properly.
" " discharge valve seating properly.
" " pressure adjusting valve seating properly.
Air valve in pipe at tank.
Air relief valve on air tank.
See that lead packing makes a perfectly tight joint between air check valve cage flange and the cylinder.

GASOLINE SYSTEM:

Gasoline strainer for sediment.
Wire gauze for cleaning or renewing.
Float box.
Vaporize parts.

INLET SYSTEM:

Inlet valve working properly.
Inlet valve seating properly.

EXHAUST SYSTEM:

Exhaust valve working properly.
Exhaust valve seating properly.

INSPECTION WEEKLY FOR ADJUSTMENT

(Continued)

IGNITION SYSTEM:

Remove ignitor plugs and free ignitor contact tips from any trace of carbon.

See that movable contact pin makes proper contact with stationary contact pin.

" " the insulation of the fixed contact pin is good.

" " the wires are clean and properly connected to contact pins.

" " lock nuts on fixed contact pin locks properly.

" " the flipper on the taper of the movable contact pin is fast.

" " lock nuts on ignitor trip rod and ignitor lifter rod locks properly.

" " ignitor plug seats tightly in the engine cylinder on the ground seat.

" " ignitor trip rod is not bent.

" " the trip arm is well clear of the trip blade when ignitor lifter rod is in lowest position.

" " the trip blade spring is not weak and that it keeps the trip blade in place.

Test setting of ignition.

Test timing of ignition.

BATTERY:

Connections clean.

Connections perfect.

LUBRICATING SYSTEM:

Take off the cover of the force feed oiler and inspect for sediment.

Drain the tank through the drain plug and flush with kerosene.

Blow out the oil feed pipes.

MAGNETO:

Timing correct.

INSPECTION WEEKLY

FOR RUNNING

CIRCULATING WATER SYSTEM:

Valves working properly.

Valves seating properly.

Pump chamber clear of sediment. Inspect by removing valve caps in top of pump.

BATTERY:

Test with voltmeter.

Test with hydrometer for density.

Inspect battery plates for deterioration.

INSPECTION MONTHLY

FOR ADJUSTMENT

AIR SYSTEM:

Air compressor inlet valve for need of grinding.
" " inlet valve spring for tension.
" " discharge valve for need of grinding.
" " discharge valve spring for tension.
" " pressure regulating valve for need of grinding.

GASOLINE SYSTEM:

Cutoff valve in float box for proper seating.
Check valves at sides of pump for proper seating.

INLET SYSTEM:

Inlet valve for grinding.
Inlet valve springs for tension.
Inlet dashpot piston rings for wear.

EXHAUST SYSTEM:

Exhaust valve for grinding.
Exhaust valve spring for tension.
Exhaust lubricating springs for tension.
Exhaust valve piston rings for wear.
Exhaust manifold joint nuts.

IGNITION:

Ignition gear setting.
Ignition gear timing.
Ignitor tips for wear.

INSPECTION MONTHLY FOR ADJUSTMENT

(Continued)

CIRCULATING WATER SYSTEM:

Rubber pump valves for wear.

Valve springs for tension. Inspect these parts by taking off valve caps on top of pump.

LUBRICATING SYSTEM:

Force feed oiler parts for wear. Inspect by removing the oiler cover.

MAGNETO:

Check the timing by seeing if the magneto marks line up when the piston is in proper firing position. It is possible that the ignitor may have gotten out of time with the piston through wear. If so, the ignitor should be properly adjusted so that it breaks in time with the magneto. If the magneto were out of time proceed to time it as follows:

Turn the engine in the direction in which it runs until the ignitor just trips. Do not turn past this point. Observe setting disc on the magneto shaft and so mesh the magneto driving gear with gear on the vertical cam shaft of the engine that small notch N (see cut) is exactly in line with the mark R on the end plate if rotation is righthand, and in line with mark L if rotation is lefthand looking at magneto from magneto gear end.

SYMPTOMS OF IRREGULAR RUNNING

FAILURE OF ENGINE TO START ON COMPRESSED AIR:

Causes:

Reverse control lever not in starting position.

One or more exhaust valves holding open.

Air pressure too low in air tanks.

Leak in air pressure pipes or valves.

Remedy:

Place the reverse control lever in either ahead starting notch or astern starting notch.

Tap down on all exhaust valve stems.

Raise pressure in air tank with auxiliary air compressor.

Inspect air pipe system and air valves in system.

FAILURE TO FIRE WHEN ENGINE IS TURNED OVER BY AIR:

Causes:

Battery switch open.

Battery connections broken.

Poor batteries.

Ignitor timing wrong.

Vaporizer not filled with gasoline.

Sprayer nozzles choked.

Water in gasoline.

When cold not sufficiently primed.

Remedy:

Examine battery and connections.

Drain vaporizer and fill with hand pump.

Prime through cylinder head pet cocks.

(Continued on next page)

SYMPTOMS OF IRREGULAR RUNNING

FAILURE TO FIRE WHEN ENGINE IS TURNED OVER BY AIR

(Continued)

Examine ignition gearing.

Hold down vaporizer piston, or partially restrict inlet pipe opening until engine starts.

Test for water in vaporizer.

If one cylinder does not fire examine ignition gear.

Then examine ignitor plug and contact tips.

If cylinders 1-2-3 or cylinders 4-5-6 do not fire inspect battery connections and circuit for the three cylinders for broken wire or connection.

After engine fires on battery put in on magneto.

Examine magneto setting.

Test wiring.

Remove magneto if necessary and turn magneto shaft by hand. It should come up stiff when the marks line up and should produce a good spark when ignitor wire is held to it as the marks pass each other. Magneto current would not ignite a charge of gas if the battery circuit were connected to it and the battery would weaken the magneto magnets.

ENGINE STOPPING WHEN UNDER WAY:

Causes:

Water or dirt in vaporizer or stoppage somewhere in the gasoline system.

Break in ignition system.

Remedy:

If running on magneto test on battery or vice-versa. If no broken wires or connections examine magnets.

Oftentimes when a break occurs in ignition system it is inside of the insulation where it cannot be seen. Test for spark both sides of insulation. If it sparks sometimes and not others try inserting new wire.

SYMPTOMS OF IRREGULAR RUNNING

(Continued)

ENGINE COMING TO GRADUAL STOP WITH MIS-FIRES:

Stoppage in gasoline supply, tank empty, strainer clogged, float box clogged, pipes broken, joints broken, gasoline pump clogged, vaporizer sprayer nozzles clogged.

ENGINE NOT SLOWING DOWN UNDER CLOSED THROTTLE:

Throttle rod connections and throttle rod bent.

ENGINE NOT PICKING UP UNDER OPEN THROTTLE:

Incorrect timing of magneto and ignitors.
Vaporizer not filled with gasoline.
Sprayer nozzles choked.
Shutter or regulating piston sticking.
Water in gasoline.

BLACK SMOKE IN EXHAUST:

Almost always too rich a mixture caused by the following carburetor troubles:

Pet cock in vacuum chamber open.
Too many weights on regulating piston.
Enlarged sprayer nozzles or split tubes.
Wrong nozzles in tubes.
Gasoline overflow from vaporizer plugged making too high an average level of gasoline.
Leak of air into the intake pipe at some one or two cylinders.
Regulating shutter sticking.
Regulating piston sticking.

SYMPTOMS OF IRREGULAR RUNNING

(Continued)

BLUE SMOKE IN EXHAUST:

Almost invariably caused by over-feeding of lubricating oil.

STEAM IN EXHAUST:

Generally caused by lack of proper water circulation.

Note:—In first starting, of course, no attention should be paid to a little excess steam.

BACK-FIRE IN INLET PIPE:

Generally caused from too weak a mixture.

Sprayer nozzles clogged, if cannot clear at once add weights to regulating piston.

Vaporizer not filled with gasoline.

Shutter or regulating piston sticking so that shutter is held open.

Water in gasoline.

Leak of air into vertical inlet pipe.

A sticky inlet valve or sticky exhaust valve may cause back-fire in the inlet pipe.

POUNDING NOISES:

Causes:

Loose flywheel key.

Flywheel must be kept driven hard home.

Loose coupling keys. Coupling keys must be kept driven tight.

Premature ignition; setting timer lever too far ahead.

One or two cylinders firing too early due to uneven setting of ignitors.

Carbon or dirt on pistons, cylinder walls or valves causing premature ignition.

(Continued on next page)

SYMPTOMS OF IRREGULAR RUNNING

POUNDING NOISES

(Continued)

A pounding noise or knock every revolution is almost invariably due to overheating and gripping of the pistons from lack of proper water circulation or lack of proper lubrication. An overheated piston expands more rapidly than the cylinder and grips the wall of the cylinder, dragging heavily.

Lost motion between cams and cam rollers of valves.

Lost motion in bearings. Main bearings can easily be tested with a pinch bar and the Standard clearance maintained. Make sure that a knock or pounding noise is due to a loose bearing before taking the engine down to take up a bearing for wear.

SQUEAKS AND WHISTLING NOISES:

Usually mean leaky exhaust manifold packings or leaky intake packings.

Sometimes from lack of lubrication especially of levers, bell cranks, etc.

LOST POWER—IN ORDER OF IMPORTANCE:

Usually vaporizer out of adjustment giving too rich a mixture.

Too many weights on vaporizer regulating piston.

Open pet cock on vaporizer.

Enlarged sprayer nozzles or split tubes.

Sticky vaporizer regulating piston.

Lack of lubrication.

Missing ignition.

Lack of water circulation.

Water in gasoline.

Gasoline pump failing.

Leaky exhaust valves.

(Continued on next page)

SYMPTOMS OF IRREGULAR RUNNING

LOST POWER

(Continued)

Leak of water from the water jacket through a porous wall into the cylinder.
Leaky inlet valves.
Leaky inlet pipes.
Engine out of line with propeller shafts.
Bent propeller wheel.
Overloading the engine.
Engine thrust coming on crank shaft.
Incorrectly timed ignition.
Hot bearings.
Exhaust pipe line choked.
Incorrect valve timing, which could happen very seldom.

MISSED IGNITION:

Ignitor tips sticking together.
Ignitor tips covered with carbon.
Ignitor tips covered with oil or water.
Ignitor tips normally too close or too far apart.
Ignitor trip blade spring too weak or broken.
Travel of ignitor tripper rod too short.
Ignitor trip rod spring too weak or broken.
Ignitor trip rod nuts loose.
Ignitor contact pin mica washers bad.
Ignitor wires disconnected or broken, sometimes in insulation.
Lack of current from battery.
Loose flipper on movable contact pin.
Bent rods or lifters.

(Continued on next page)

SYMPTOMS OF IRREGULAR RUNNING

MISSED IGNITION

(Continued)

Vaporizer not filled with gasoline.
Sprayer nozzles choked.
Shutter or regulating piston sticky.
Water in gasoline.
Vaporizer not warm enough (in Winter).

HOT BEARINGS:

Carelessness in sweeping dirt from engine room floor into crank cases.
Getting of dirt into oiler rings.
Getting of dirt into bearing rings, thrust bearings and fillet of cranks.
Getting salt water into bearings.
Allowing stuffing boxes to leak and not stopping leaks of salt water immediately.
Lack of lubrication.
Thrust being taken by crank shaft.

EXCESSIVE WEAR:

Wear in circulating pump crank shaft bearing will be caused by dirt allowed to accumulate in the crank case, and lack of lubrication.

Wear in the air compressor eccentric will be caused by allowing salt water to leak from circulating pump gland when any water that may leak past the gland is not readily drained off through the drain pipes attached to the pump. Lack of lubrication of the eccentric will also cause wear.

ENGINE NUMBER

The engine number is stamped into the end of each engine crank shaft at flywheel end; on the forward face of the flywheel hub; on the flywheel key and on the name plate attached to the after cylinder.

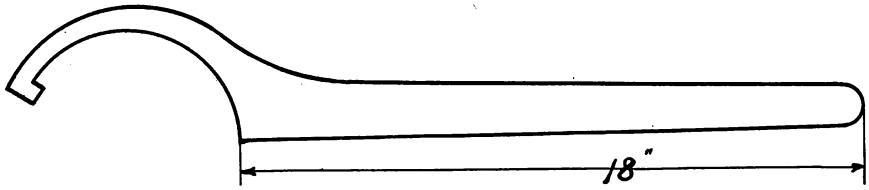
All *right hand* engines have an *odd* number. All *left hand* engines have an *even* number.

PIPE JOINTS

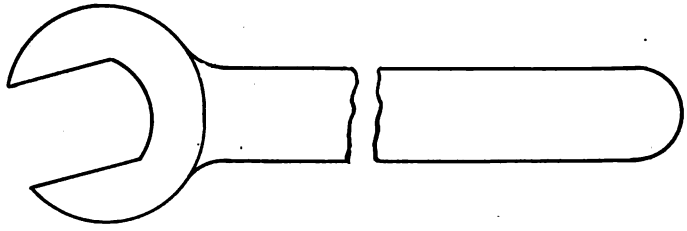
Pipes and tubing are flanged at joints to make them tight when the washers and nuts of pipe fitting are screwed tight. Flanging tools are supplied which make possible flanging sizes of copper tubing and copper pipe used on the engines.

To flange a copper tube or pipe put end into die for that size pipe then hammer tapered punch with pilot end into die until end of pipe is worked into desired flange.

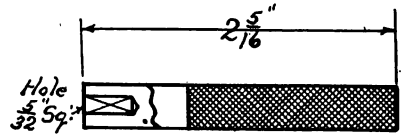
SPECIAL TOOLS—



Spanner Wrench for Under Water Exhaust Fitting.



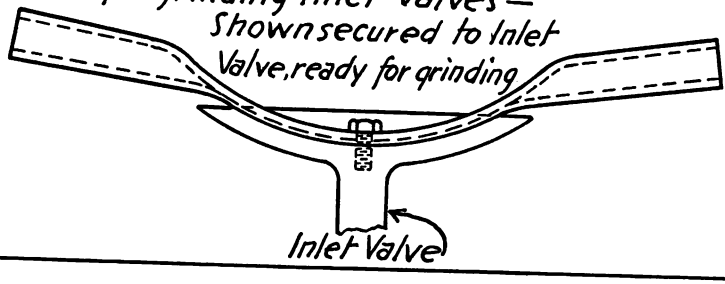
Wrench for Propeller Hub Cone Nut.

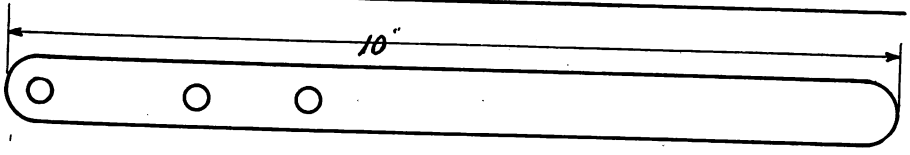


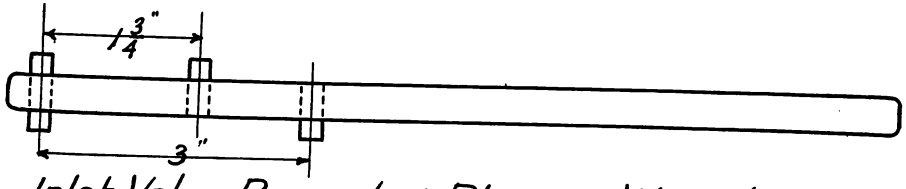
Vaporizer Nozzle Tip Socket Wrench.

SPECIAL TOOLS—

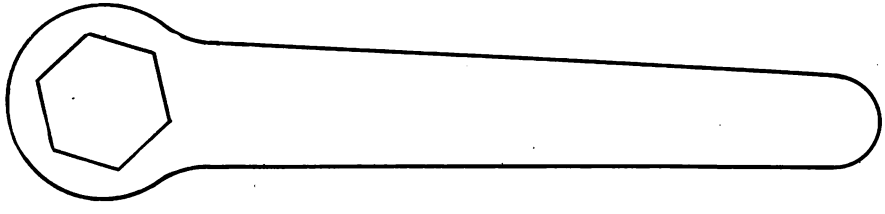
Tool for grinding Inlet Valves—
Shown secured to Inlet
Valve, ready for grinding



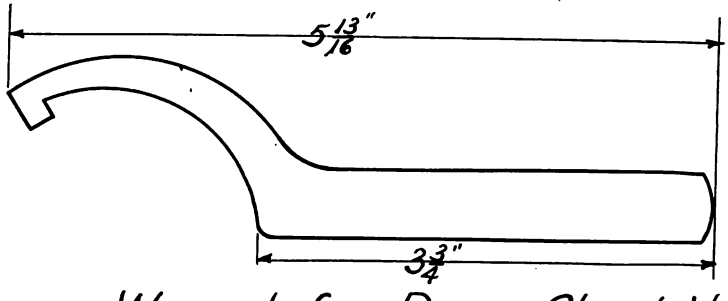




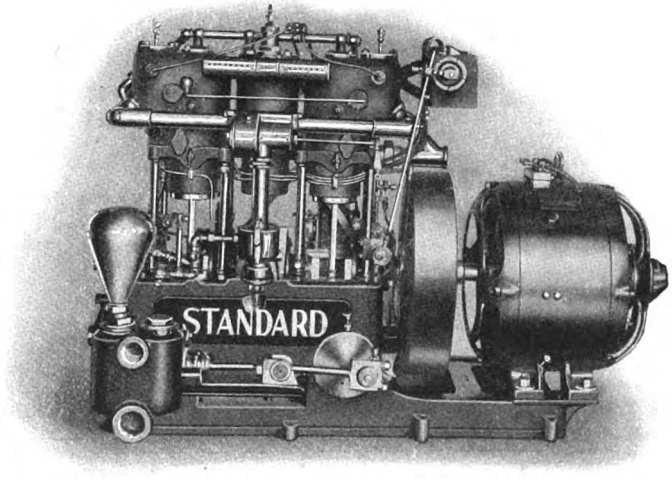
Inlet Valve Bonnet & Plunger Wrench



Stanchion Nut Wrench



Spanner Wrench for Pump Gland Nut.



2 CYLINDER, 4½" BORE x 5½" STROKE
STANDARD AUXILIARY ENGINE

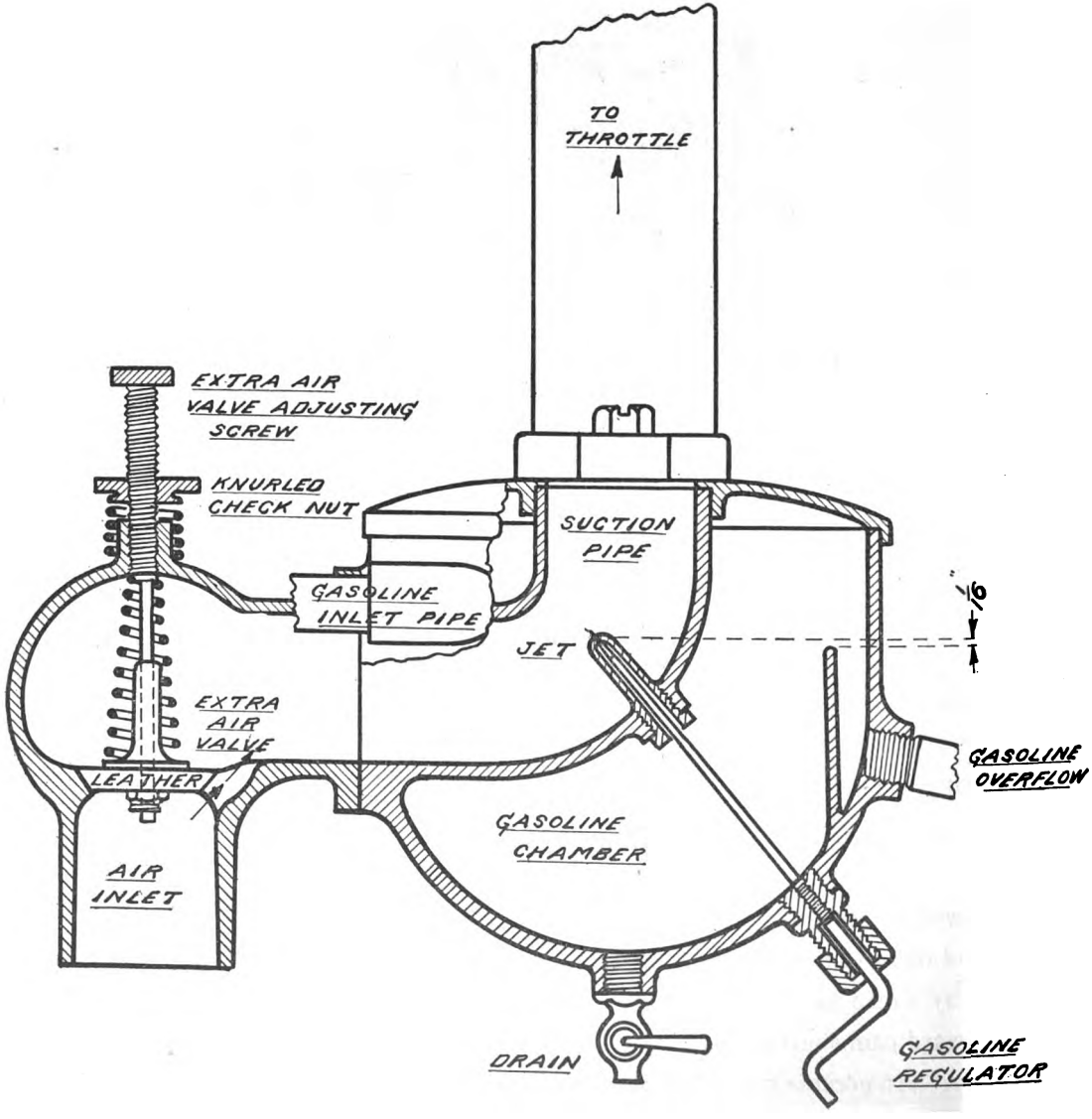
INSTRUCTIONS

This engine is provided for furnishing compressed air to the main engines in an emergency, for pumping out bilges, pumping for fire purposes, etc., and for furnishing electric current for general use throughout the boat.

CAM SHAFT

There are two cam shafts, one extending across the forward end of the engine and one extending across the after end of the engine. Both cam shafts are driven by worm gears, running in oil, from the engine crank shaft. Cams on the forward cam shaft actuate the exhaust valve and the inlet valve of the forward cylinder. An eccentric on one end of the cam shaft operates the circulating water pump and an eccentric on the other end operates the gasoline pump.

CARBURETTER AS FITTED TO AUXILIARY ENGINE



Cams on the after cam shaft actuate in the inlet and exhaust valve on the after cylinder, and an eccentric on one end of this cam shaft drives the lubricator and a bevel gear on the extreme end drives the magneto.

Cam shafts run in split bronze bearings bolted to the engine cylinder stanchions.

GASOLINE PUMP

The gasoline pump has a brass eccentric strap, brass plunger and brass pump chamber. This pump is operating all the time that the engine is operating pumping gasoline from the float box to the overflow carburetor.

A hand pump is located in the gasoline supply line for priming the carburetor for starting.

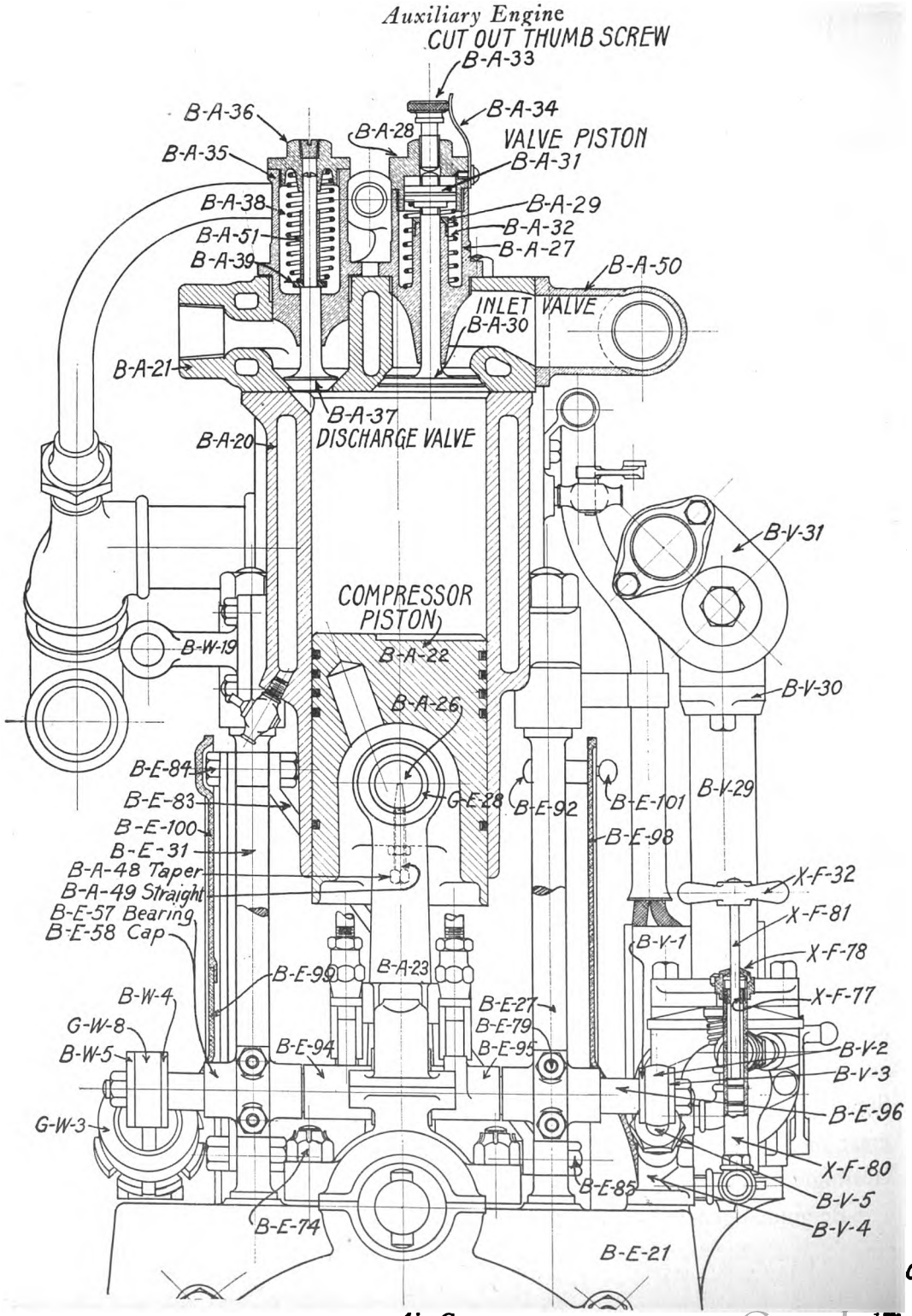
Be guided generally by instructions under main engine.

CARBURETOR

This is an overflow carburetor so that with the gasoline pump always supplying an excess amount of gasoline, while the engine is running, the level of gasoline in the carburetor is kept at the proper height of 1/16" below the gasoline jet which extends into the center of the air suction pipe.

A valve in the air pipe when seated closes the air inlet excepting for a small passage at the side of the valve seat. The valve is held to its seat by a spiral spring. The tension of the spring is varied by the thumb screw which has a lock nut and spring on its stem. By screwing the thumb screw down, the spring is given a greater tension so that a greater vacuum condition in the suction pipe is necessary to lift the valve off its seat. This valve should be regulated with as little tension on the spring as possible so as not to make vacuum condition too great, and so that on light loads the valve lifts very little if any and opens increasingly at increasing engine speeds.

Be guided generally by instructions under main engine.



Air Compressor

Circulating Pump

The circulating water pump has a steel connecting rod, brass plunger and brass pump chamber with stuffing box, gland and nuts.

The circulating water is pumped from a sea cock directly to the bottom of the cylinder jackets of both engine cylinders and compressor cylinder; then passes out through the top of the cylinders into a cooling pipe which carries it into the exhaust pipe line.

Be guided generally by instructions under main engine.

Air Compressor

The compressor cylinder head of cast iron is cast separate from the cast iron cylinder and the circulating water is by-passed from the cylinder jacket to the head outside of the cylinder head gasket.

The air compressor inlet valve is similar to that described under "Compressor" on the main driving engines. The auxiliary engine air compressor, however, can only be cut out by the cut-out thumbscrew. This is for the reason that the compressor is never used excepting at infrequent intervals as an auxiliary compressor to the main engine compressor.

The air intake is through a perforated brass suction muffler attached to the side of the compressor head and the air is discharged from the opposite side of the cylinder head. The air compressor discharge valve is similar to that described on compressor of main engine.

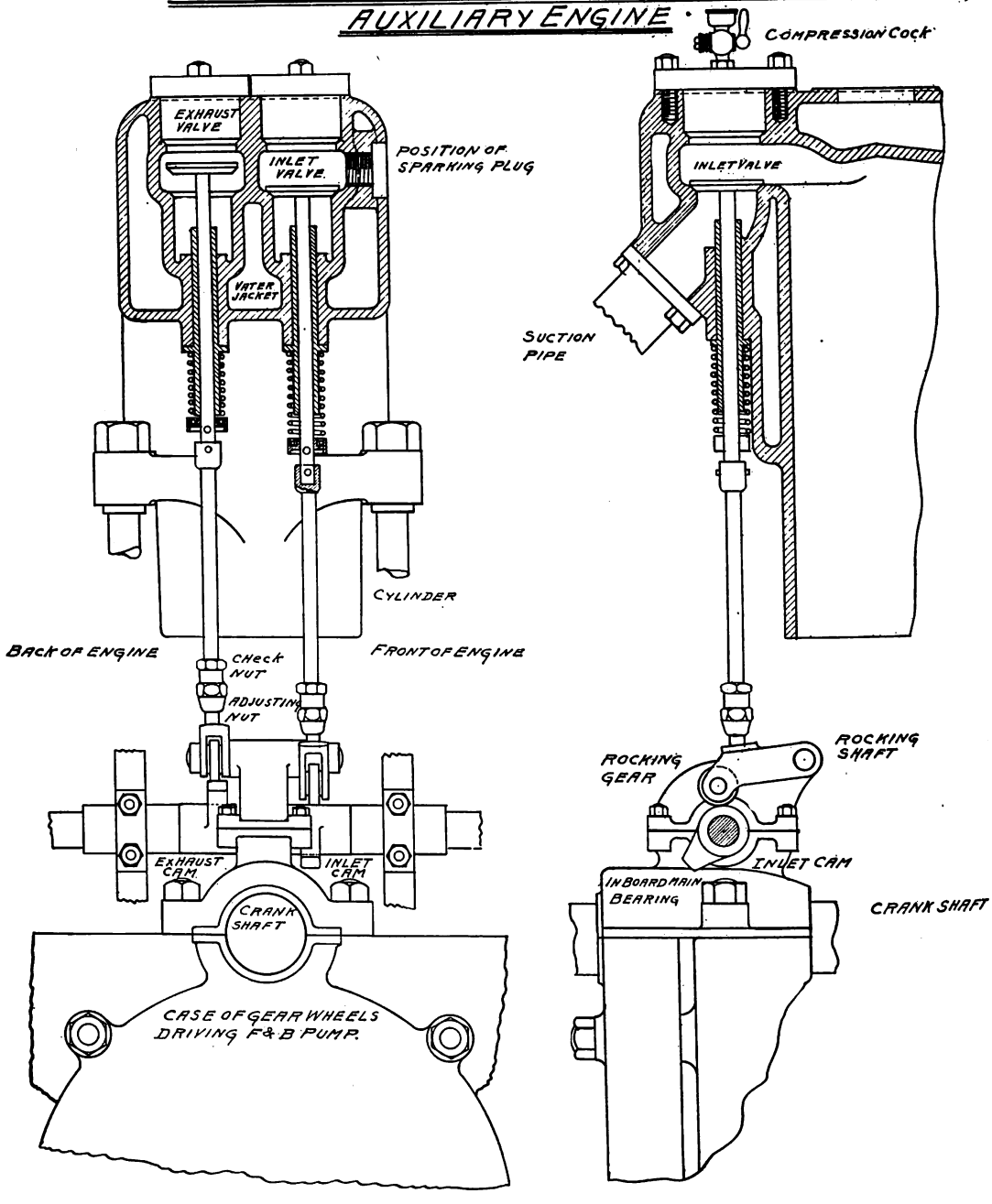
The auxiliary engine compressor cylinder head must be taken off to take out the valves or for re-grinding the valves.

Be guided generally by instructions under main engine.

Engine Cylinders

Each engine cylinder and cylinder head is of cast iron in one casting. Cylinders are cast separate.

INLET AND EXHAUST VALVES AND LIFTING CAMS OF AUXILIARY ENGINE



CLEARANCE UNDER ROLLERS IN LOWEST POSITION OF CAMS = $\frac{1}{32}$"

LIFT OF VALVES = $\frac{7}{16}$"

The auxiliary engine inlet and exhaust valves are set in cylinder so that by taking off the valve cover the valves canan be easily removed.

A drain cock is placed at the bottom of each cylinder water jacket for draining. There is a pet cock in each engine cylinder at the side operated by one common control for testing firing and compression of each cylinder. One jump spark ignitor plug is in the side of each engine cylinder head.

Be guided generally by instructions under main engine.

PISTON

Piston is of cast iron with four piston ring slots filled with split steel rings above the wrist pin and one slot with steel rings below the wrist pin. Piston can be taken out by disconnecting bearings, dropping the piston down and pulling it out from the side between the cylinder stanchions.

WRIST PIN

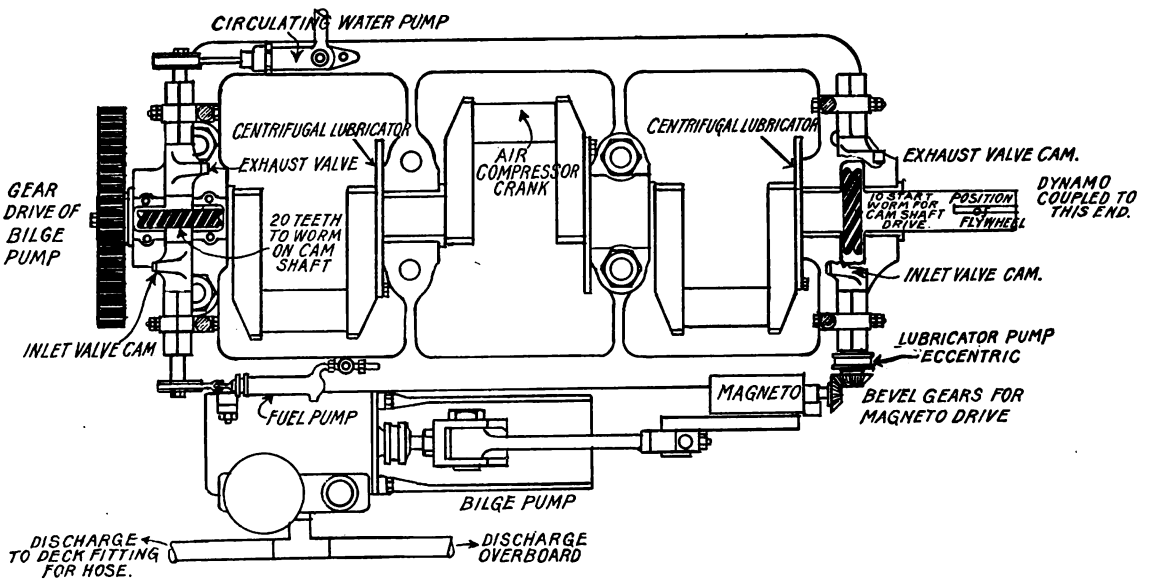
The wrist pin is hollow of nickel steel, case-hardened and ground. The wrist pin bearing is a phosphor bronze bushing driven into the eye of the connecting rod. It is lubricated by diagonally drilled holes from the one oil groove above the wrist pin and the wrist pin bearings and pin are made and locked as described under "Piston" main engine.

Be guided generally by instructions under main engine.

CONNECTING ROD

The auxiliary engine connecting rod is of forged steel designed for extreme strength and lightness, forged into an eye at the upper end and into a foot at the lower end.

AUXILIARY ENGINE BED PLAN



Crank Pin Bearing

The crank pin bearing is of bronze, the two halves of which are bolted to the foot of the connecting rod. This bearing is adjustable by scraping and filing where the sides come together.

Main Bearings

Crank shaft bearings are of phosphor bronze made in two halves and adjustable by scraping and taking out one or more liners.

Crank Shaft

Crank shaft is of forged steel with engine cranks and compressor crank set at 180 degrees. Crank shaft can be raised for adjusting the main bearings by taking off forward bearing cap and cam shaft gear housing, the after bearing cap and cam shaft drive gear housing and the two main bearing caps. The intermediate bed holds the crank shaft far enough above the base to allow clearance for the flywheel for a direct drive to the dynamo mounted on the same base.

The crank shaft extends beyond the intermediate bed at forward end and a pin is driven through the shaft. The starting crank hanging on the shaft is notched so that as it is held and turned by hand the engine is turned over.

Flywheel

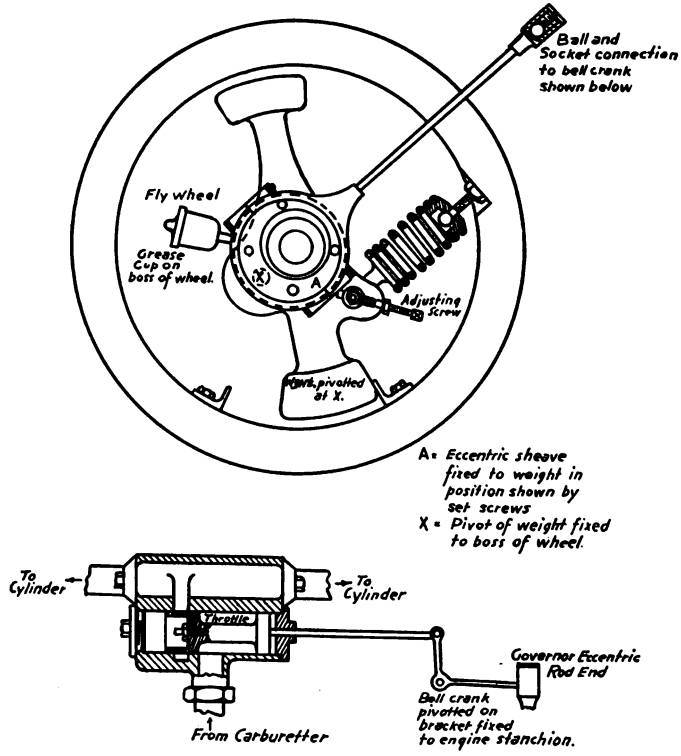
Flywheel is keyed to the shaft between the engine and the dynamo.

Throttle

Throttle is a piston valve operating in the throttle body connected to the intake pipe. The sliding of this valve varies the opening in the intake pipe for the ingoing charge and the valve is adjustable for the maximum opening. It can be removed by unscrewing the cap in the throttle valve body.

The throttle valve is actuated by the governor.

AUXILIARY ENGINE GOVERNOR AND THROTTLE.



ADJUSTMENT OF: The throttle piston rod must be $11^{7}/_{16}$" from cut-off point on throttle valve to center of hole in valve rod. Opening point on long stroke is when crank is 53° past upper dead center. Closing point on long stroke is when crank is 20° past lower dead center. Opening point on short stroke is when crank is 17° past upper dead center. Closing point on short stroke is when crank is 103° past upper dead center. The governor eccentric pin must be on top dead center when crank is on quarter, on downward stroke.

GOVERNOR

Governor is of the combined inertia and centrifugal type and acts directly on the throttle. The governor controls the speed variation to a point where the lights may if desired be run from the dynamo direct. This is done through the movement of a weight by centrifugal force actuating an eccentric and rod and bell cranks to the throttle valve. The proper adjustment of the governor is important.

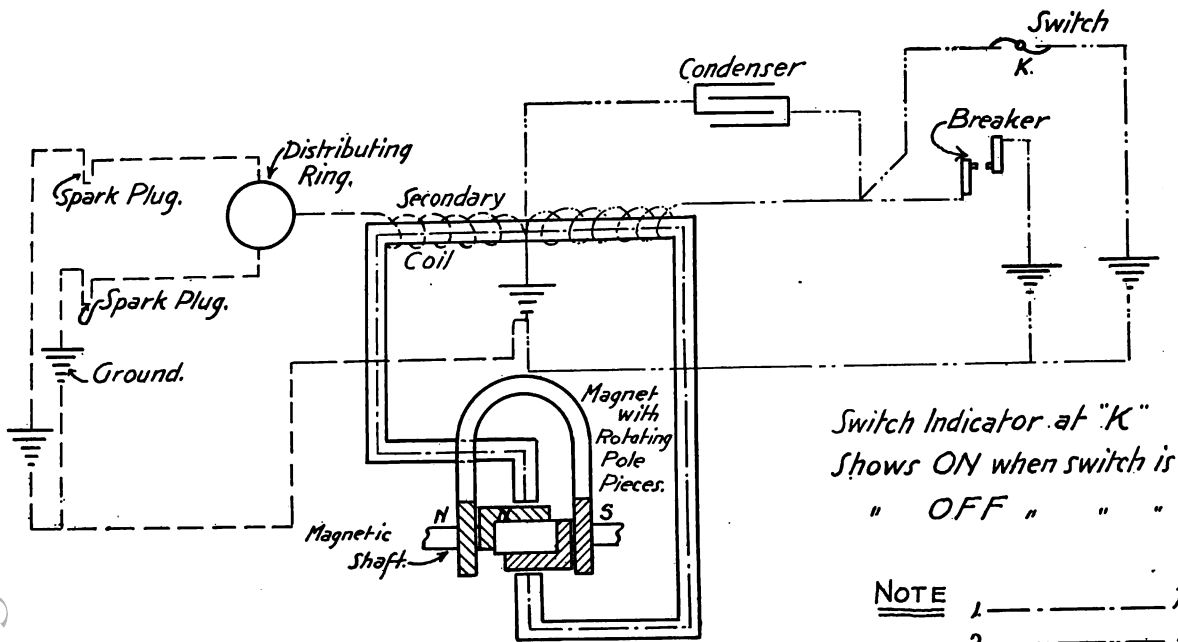
ADJUSTMENT OF: To adjust the governor, if engine is under speed at full load, screw in the adjusting screw which is marked "adjusting screw" in the governor and throttle diagram. If the engine does not respond to this screw in the bolt at the end of the weight spring shown in diagram; then adjust with the adjusting screw.

If, with the proper speed at full load, the engine runs too fast without load, shorten the point of cut-off by screwing in on bolt in head of throttle valve. Then adjust with adjusting screw as before.

Care must be taken when making any adjustment to the point of cut-off on the throttle valve as a slight altering makes a big difference in the speed of the engine.

Auxiliary Engine

WIRING DIAGRAM OF HIGH TENSION MAGNETO



Switch Indicator at "K"
Shows ON when switch is open.
" OFF " " " closed.

NOTE
1 — · — · — Magnetic Circuit.
2 — ·· — · — Primary Electric Circuit.
3 — — — — — Secondary " "

LUBRICATOR

The auxiliary engine lubricator is of the forced feed type as described under "Lubricator", main driving engines. There are six oil feeds as shown on auxiliary engine lubricator diagram.

Be guided generally by instructions under main engine.

SPARK PLUG

Ignition is of high tension jump spark type with high tension jump spark plugs.

CARE OF: Faulty ignition may be due to various causes, and a careful inspection should be made to ascertain whether the spark plugs or magneto require attention; or loose or broken connections in wiring, poor insulation, etc.

Continual misfiring in one cylinder is usually due to a defective or fouled spark plug, which should be replaced with a new one. A spark plug may be short-circuited by a piece of carbon between the electrodes and body of the plug or a carbon coating on the insulator. Removing the carbon particles will remedy this at once.

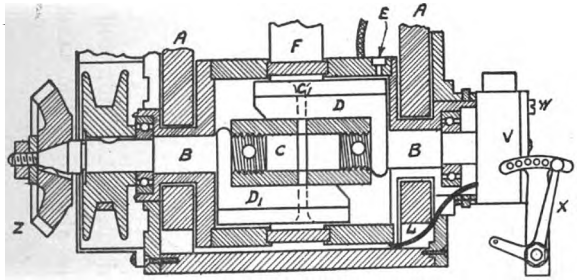
ADJUSTMENT OF: In order to obtain the most efficient results with the magneto the normal setting of the spark plug points should not exceed .025 of an inch and it is advisable to have the gap just right before a spark plug is inserted.

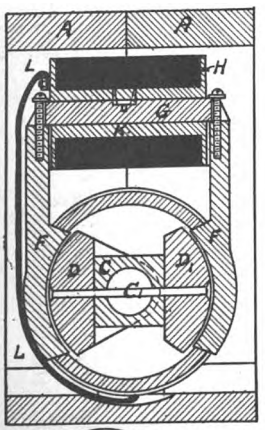
The spark plug electrodes may be easily set by means of the gauge attached to the wrench furnished with the magneto. The setting of the spark plug points is an important function which is usually overlooked, with the result that the magneto is blamed when it is not at fault.

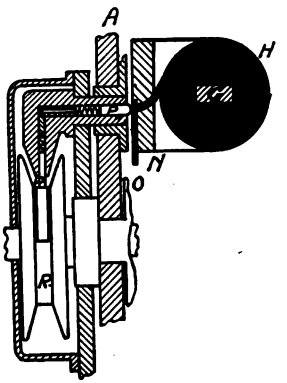
MAGNETO

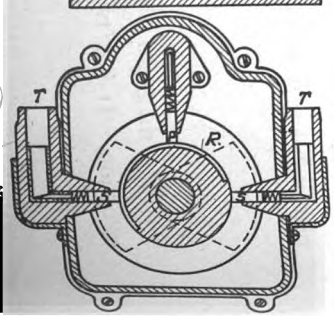
The magneto is of the high tension type of simple and understandable construction. It has two rotating polar extremities which are always of the same

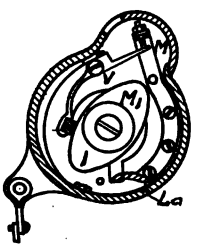
DETAILS OF HIGH TENSION MAGNETO.











REFERENCES TO SKETCH OF H.T. MAGNETO.

A.A. = *Magnets*
B.B. = *Magneto Shaft in two Parts.*
C. = *Brass Block Connecting two Parts of Shaft.*
C_1. = *Brass Pin through D.,D_1., and C., and riveted over at ends.*
D.D_1. = *Rotating Pole Pieces in Practical Contact with Poles of Magnets, A.A.*
E. = *Oil Holes.*
F.F. = *Laminated Iron uprights forming with G a Magnetic Circuit. F.F. are in practical Contact with D.D_1.*
G. = *Laminated Iron Core, on which the Frame of the windings is placed, fixed to F.F. by a Screw into each.*
H. = *Primary and Secondary windings Wound on same Frame.*
K. = *Earth Connection for the two coils on G.*
L. = *Wire Connecting the end L_1. of primary Winding to the Terminal L_2. of the Make-and-Break.*
M. = *Make-and-Break.*
M_1. = *Cam Causing Make-and-Break Action.*
N. = *Plate Forming Terminal of Secondary Winding and one Point of safety Gap.*
O. = *Safety Gap between Bottom Point of N., and Top of Framwork round the Rotating Poles.*
P.P. = *Brushes taking Current from N. to the Distributor Ring R.*
R. = *Distributor Ring.*
S. = *Distributing Brushes.*
T. = *Connections for leads to Sparkling Plugs.*
V. = *Condenser.*
W.W_1. = *Screws securing Condenser. W. also connects the Lead to the Engine Swith and thence to Earth.*
X = *Advance and Retard Lever.*
Y. = *Earth Screw in Make and Break.*
Z = *Bevel Wheel for Magneto Drive.*

polarity, never reversing. The poles are in practical contact with the inner cheeks of the permanent magnets, all air gaps being eliminated. Together with the U-shaped magnets they form a magnet with rotating ends.

All of the mechanism of the magneto breaker is stationary. This mechanism is readily adjusted while the magneto is running so that the intensity of the spark produced may be seen while the screws are being manipulated. The advanced position of the magneto is located by the manufacturer. The breaker mechanism is fixed to the coil carrying structure and moves with it.

The magneto is timed to the engine in full retard position and an advance of 30 degrees or more is obtained by rotating the coil carrying structure to which the breaker box is attached.

CARE OF: The bearings of the magneto are provided with oil cups and a drop of oil every week is sufficient. Use a special, light oil such as sewing machine oil.

The breaker should be lubricated every week with a drop of light oil applied with a tooth-pick. Use a special, light oil such as sewing machine oil.

The platinum contacts should be kept clean and properly adjusted. Should the contacts become pitted a fine file should be used to smooth them in order to permit them to come into perfet contact.

The distributor block should be removed occasionally and inspected for an accumulation of carbon dust. The inside of the distributor block should be cleaned with a cloth moistened with gasoline and then wiped dry with a clean cloth.

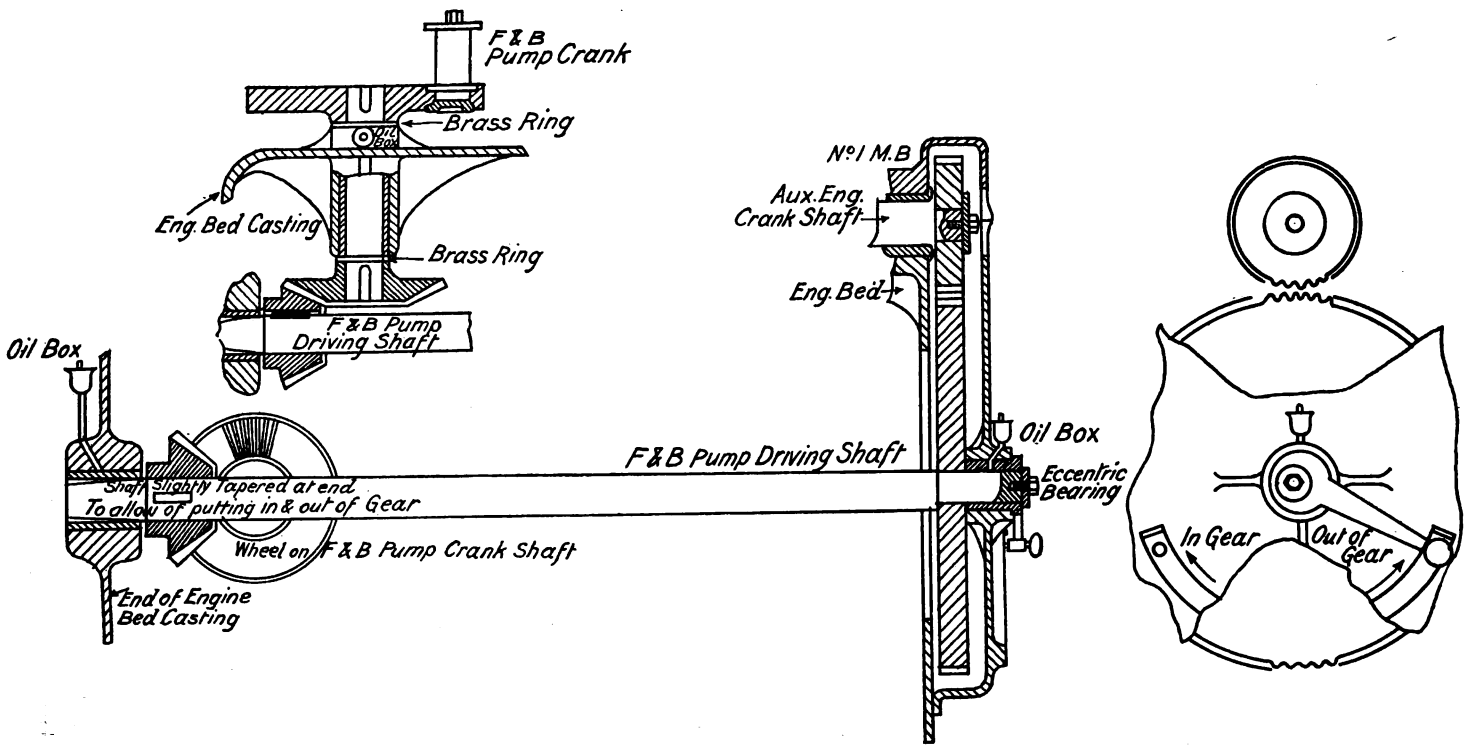
Whenever the wires leading from magneto to spark plugs are taken off, observe that they are correctly replaced.

Do not pull out the carbon brushes in the distributor because you think there is not enough tension on the small brass springs.

If magneto will not spark after everything else has been tried clean breaker tips by drawing a piece of emery cloth between them.

Do not try to start engine with switch closed. Watch for loose wires.

GEAR DRIVE OF FIRE & BILGE PUMP



ADJUSTMENT OF: The proper distance between the platinum points when separated should not exceed .020 or 1/50 of an inch. A gauge of the proper size is attached to the wrench furnished with the magneto.

Fire and Bilge Pump

This pump, which has a capacity of about a barrel a minute, is a bronze casting bolted to the side of the auxiliary-set base. The valve chest and cylinder are cast en-block. In the valve chest the two vertical suction valves are at the bottom and the two vertical discharge valves are at the top. The bronze valve seat screws into the valve chest body so that the seat can be renewed.

The rubber valves have a brass washer on top and a spiral spring bearing against it holds each valve seated. All valves can be taken out by unscrewing valve cap in valve chest over each set of valves. These caps are of brass and the top of the valve chest and the bottom of the cap flange are scraped to make a perfectly tight joint. One cap is drilled and tapped for the pump air chamber.

The bronze pump piston screws to the brass piston rod which is then riveted over it. The piston has one split bronze ring. The piston rod extends through the bronze cylinder head and the pump stuffing box fastened to the head. The piston rod is threaded into the bronze crosshead and locked with lock nut. The crosshead is held to its guide in the cast iron crosshead shoe by the cross "T" plate underneath.

The connecting rod is of steel with a steel wrist pin in a bronze bushing connecting it to the crosshead and a steel pin in split bronze crank pin bearings connecting it to the steel disc keyed to the crank disc shaft. A bevel gear on the end of this shaft which runs crosswise of the engine, meshes with a pinion gear on the end of the pump intermediate shaft.

The intermediate shaft is supported at the pinion gear end in a long bronze bushing in the after vertical end of the auxiliary-set base. A cast iron gear case is fastened to the forward vertical end of the auxiliary-set base. This end of the

intermediate shaft is supported by the gear case in a bronze eccentric bushing which is the hub of the gear shifting lever. The hole in the bushing for the shaft is off center so that by swinging the lever to the left or to the right this end of the intermediate shaft is lowered or raised.

A gear wheel is keyed to the end of the engine crank shaft and a gear wheel is keyed to the end of the pump intermediate shaft, and when the gear shifting lever is in "out" position the gears do not mesh, and when in "in" position the gears are meshed so that then, when the auxiliary engine is started the pump is being driven from off the engine crank shaft through the gears and pump shafts.

CARE OF: Do not try to put the pump in action with the engine running. When the pump is required mesh the gears by putting the gears shifting lever into "in" position with the engine idle. Then start up the engine with the pump in action. Shut the engine down to throw the pump out of action.

Be guided generally by instructions under main engine, "Circulating Pump."

ADJUSTMENT OF: Be guided generally by instructions under main engine, "Circulating Pump."

Relief Valve

A spring-loaded valve is set in the discharge pipe at the side of the fire and bilge pump which opens should the pressure in the discharge line go above the point at which the valve is set to blow off. This is an ordinary spring-loaded safety valve, the valve itself being of brass with a spiral brass spring normally holding it against its seat which screws into the valve body. The top of the spiral spring bears against a hollow stem which is worked up and down by the turning of the hand wheel at its top and it is by means of this hand wheel that the tension on the spring is varied to fix the point at which the valve will blow off.

CARE OF: No care or adjustment is necessary excepting to once in a while unscrew the valve from the discharge pipe and the valve seat from the valve

body to make sure that the valve has not become frozen to the seat through corrosion or that no sediment has lodged on the seat.

The valve is set to blow off at 15 lb per square inch pressure.

Hand Oil Parts

Cam shaft bearings.
Gasoline pump eccentric.
Gasoline pump connecting rod bearing.
Circulating pump eccentric.
Governor eccentric strap.

Generator

The Generator is of the Inter-Pole design, compound wound, rated at 4½ kilowatt, 120 volts, the shunt field being wound for 32 volts.

BEARINGS: The commutator end bearing is of the ring oiling type. Care should be taken to see that the oil well is properly filled with the best grade of thin lubricating oil and that the oil ring turns freely with the armature shaft.

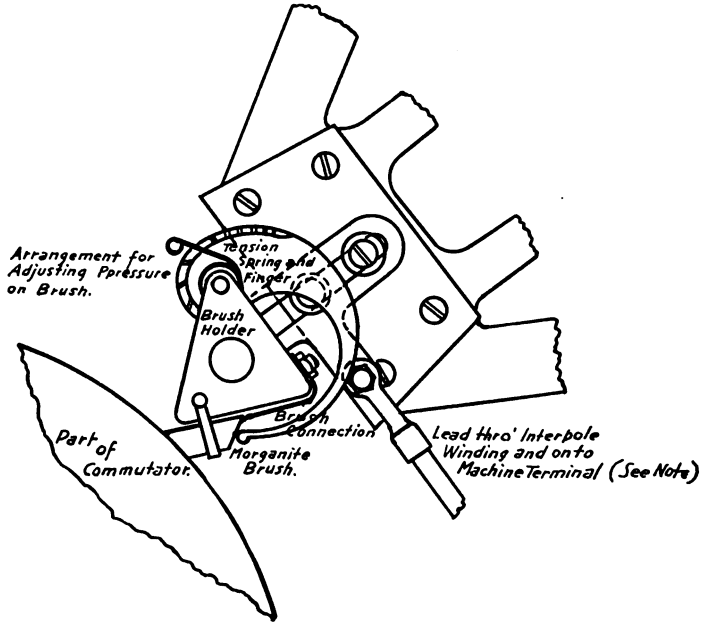
BRUSHES: The generator is provided with four carbon brushes. The position of the brushes on the commutator is determined when the machine is tested at the factory and is fixed by a set screw projecting through the upper right hand side of the yoke into the brush ring. It is important that the position of the brushes as set at the factory should not, under any condition, be changed.

The brush holders are provided with spiral springs through which the pressure on the brush can be adjusted. There should be about two pounds pressure and there is nothing gained by increasing the pressure as there is practically no change in the brush resistance and the friction is increased in direct proportion to the pressure.

When installing new carbon brushes they should be put in the holder and fitted to the commutator by placing No. 0 sandpaper between the brush and com-

Auxiliary Engine

GENERATOR BRUSH AND BRUSH HOLDER



NOTE: The Lead is named for a + Brush. In the Case of a – Brush two Leads will come to this point; a large one from the – terminal of the Machine and a small one from the – end of the shunt field.

mutator, the rough side against the brush and the smooth side held down closely to the surfaces of the commutator. If the brush requires considerable fitting No. 2 sandpaper may be used first but the final fitting should be with No. 0. Under no circumstances should emery cloth be used in place of sandpaper.

CARE OF: Examine all connections and see that they make good contact. All external connections should be well insulated with tape.

Lubricate the bearings. Ball Bearings are packed with grease at the factory and require no immediate attention, but Ring-Oiled Bearings must be filled with oil as the oil wells are drained before shipment.

See that the brushes bear properly on the commutator. Turn the armature over a few times by hand to see that it is free and does not rub or bind at any point.

Keep all parts clean and it is good practice to "blow out" the generator occasionally with compressed air.

It is very important that oil should not be allowed to get on any of the windings or the commutator as it has a tendency to rot the insulation.

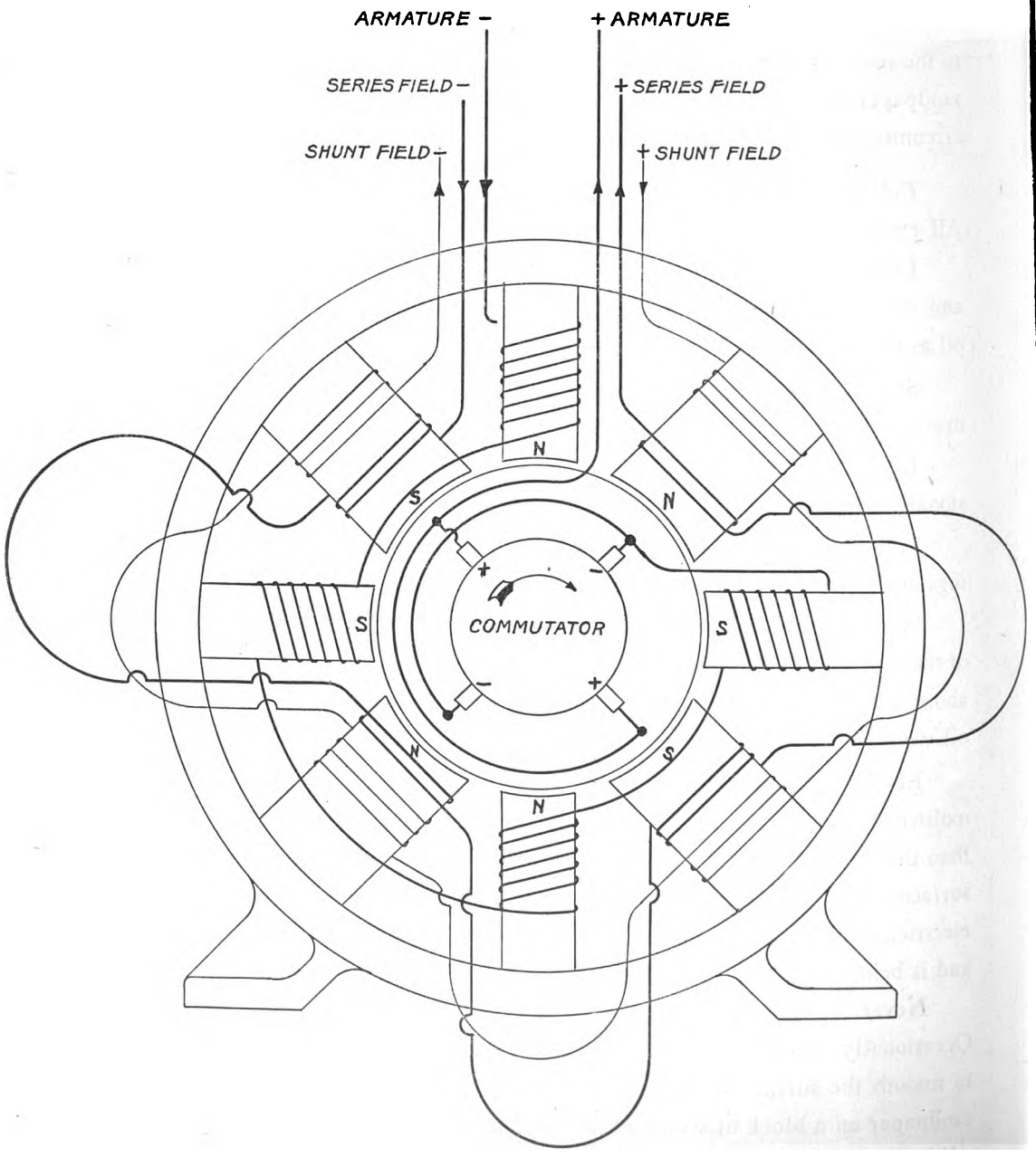
When a generator is installed it is advisable to empty the oil wells at the end of the first week and fill with fresh oil, afterwards it is only necessary to do this about once in every six months, depending upon the severity of the service. The oil wells may be emptied by removing the drain plug in the bottom.

Keep the commutator clean by wiping it off occasionally, first with a rag moistened with a few drops of oil and afterwards with a clean dry rag. Other than this, leave it alone. After being in operation for some time the commutator surface will have a dark brown glossy shine which should be the ambition of the electrician in charge to preserve, as it indicates the motor is in a healthy condition and is being properly cared for.

Never sandpaper a commutator unless it seems to be absolutely necessary. Occasionally a commutator will become rough and in such cases it is permissible to smooth the surface with sandpaper. The best way is to tack a strip of No. 0 sandpaper on a block of wood which has the same curvature and about the same

Auxiliary Engine

WIRING DIAGRAM



width of the commutator. Hold the sandpaper against the commutator with a light pressure moving it slightly back and forth while the generator is running at normal speed; a rag moistened with oil should be held against the commutator and in front of the block, so as to collect the sand and carbon dust. After the commutator is sufficiently smoothed up, the brushes should be sandpapered and all the rest of the motor should be thoroughly cleaned. Never use emery cloth or any commutator compound on Inter-Pole commutators.

As with other parts of a generator, the brushes and brush holders should be kept clean. Dirt may cause the brushes to stick in the holders, preventing them from making a good contact with the commutator. If a brush should stick, remove it from the holder and clean both thoroughly with a rag moistened with kerosene.

The brush holder arm should bear on the center of the brush; if it does not it will tend to make the brush wear uneven. The arms may be bent so that they will bear evenly.

The copper plating on the brushes should not be allowed to come in contact with the commutator. As the brush wears down the copper should be trimmed back with a knife to within 1/8" of the edges of the face.

NORMAL HEAT OF: If trouble of any kind should develop the first thing to do is to locate the cause, for if this is known the remedy is generally obvious.

The effect of most troubles is shown by abnormal heating but in using this as a guide do not depend on your sense of touch.

Assuming that the generator rating is based on a temperature rise of 40° Centigrade, which means that with a normal room temperature of 25° Centigrade the normal full load temperature would be 65° Centigrade or 149° Fahrenheit.

The average person cannot rest his hand on a metal surface having a temperature of more than 130° Fahrenheit, so before deciding that any part of a generator is abnormally hot it is advisable to take the temperature with a thermometer.

Symptoms of Irregular Running

ABNORMAL HEATING of the whole generator may be due to overload. Check the current with an ammeter and reduce the load if it is found to be excessive.

EXCESSIVE STARTING CURRENT may be caused by rapid starting under load, frequent starting without sufficient starting resistance or to defective starting resistance.

HEATING OF BEARING may be due to lack of oil, improper grade of lubricant, grit or dirt in lubricant, oil ring not revolving properly. If unable to locate cause, remove and examine. If the surface is in good condition, clean and reassemble with fresh lubricant.

HEATING OF COMMUTATOR AND BRUSHES AND SPARKING are usually closely related and may be caused by:

Heavy overloads.

Poor brush contact.

Wrong brush position.

Wrong brush spacing.

Brushes sticking in holders.

Dirty or rough commutator.

Commutator running out of true.

Improper grade or size of brush.

High mica or high bars on commutator.

Insufficient or excessive tension on brush holder springs.

Open circuit in armature winding.

HOT WINDINGS. Shunt field coils will overheat if the supply voltage is too high or if one or more of the coils are short circuited or grounded.

Short circuits can be located by measuring the potential of each coil with a voltmeter. It should be the same in each coil. *(Continued on next page)*

Grounds can be located with either a test lamp or a voltmeter.

If all the armature coils overheat the generator is probably overloaded but if one coil heats up more than the rest the indication is that this coil is short circuited either internally or between commutator bars. A short circuit of this kind can be located by stopping the generator and quickly feeling the back end of the coils with the hand.

GROUNDS may occur in any part of the installation. To locate test with voltmeter or test lamp—going over each part separately; that is, when disconnected from the other parts.

Switchboard Arrangement

A. Double Pole Double Throw Field Switch, for connecting the shunt field to either storage battery.

B. Double Pole Single Throw Starting Switch, to be closed only when starting the engine.

C. Underload Circuit Breaker, to be used to automatically open the starting circuit after the engine is operating under its own power and its voltage is equal to the battery voltage.

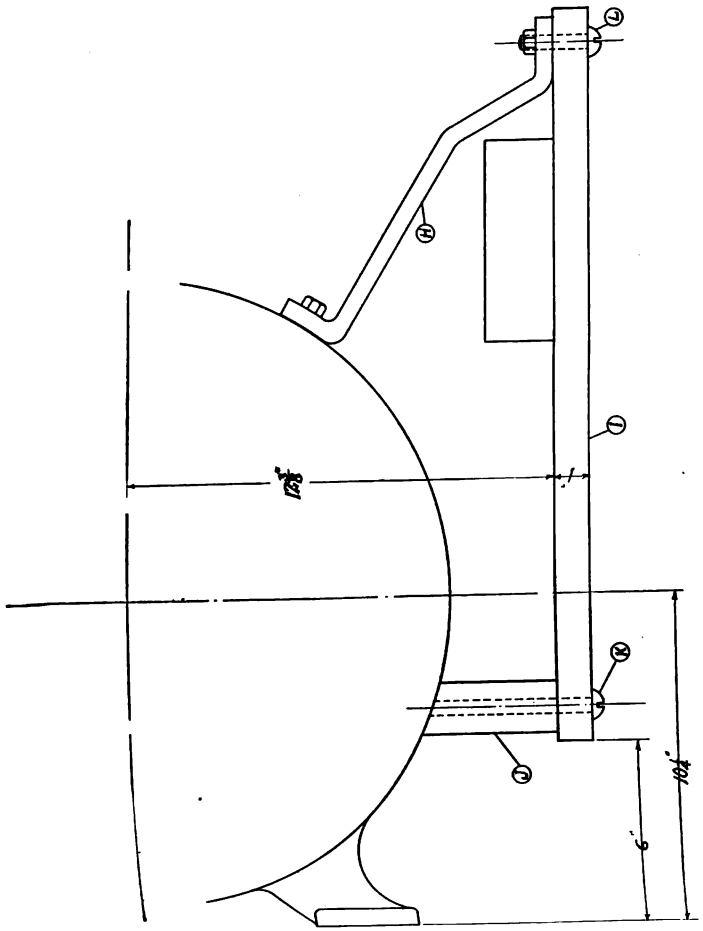
D. Field Rheostat, to be used for adjusting the voltage of the generator.

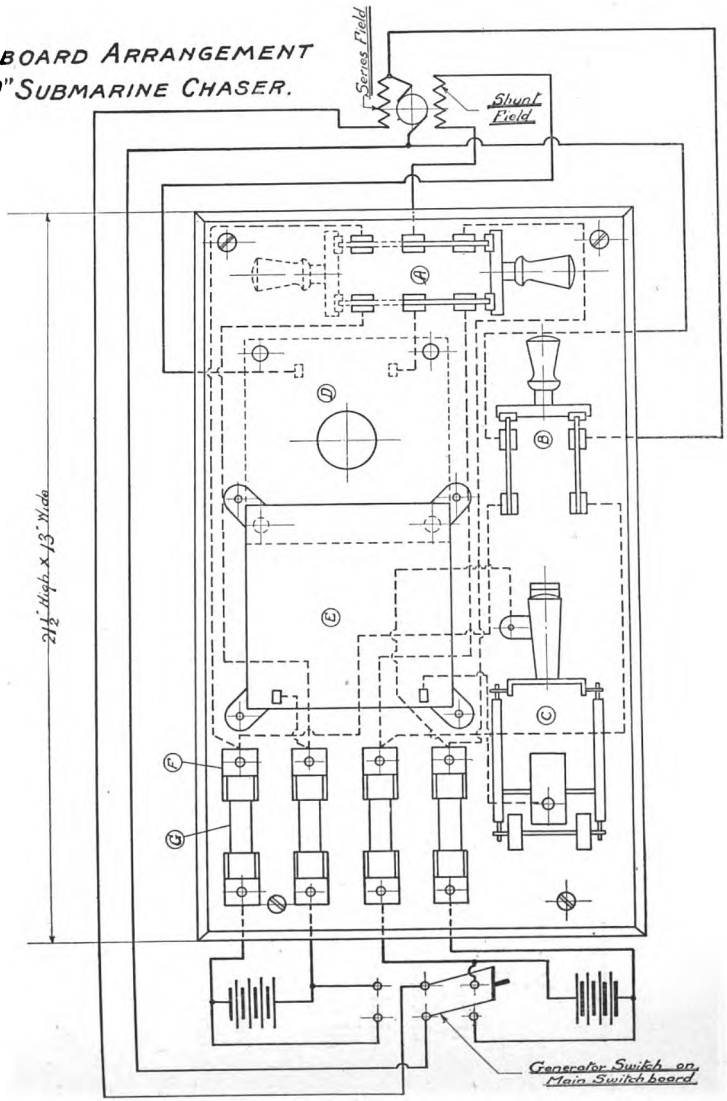
E. Starter for bringing the engine up to speed.

To Start Auxiliary Engine Using Generator as a Motor

Be sure that the generator charging switch on Main Switchboard is open and all of the field rheostat resistance is cut out (short circuited). Close field switch A to battery most highly charged; close starting switch B; close underload circuit breaker C; then as the engine starts to turn over, gradually move the starter handle cutting out the starting resistance. When the engine commences to operate under its own power the underload circuit breaker will automatically open the starting circuit and at the same time the starter handle will return to the "off" posi-

AUXILIARY SWITCHBOARD ARRANGEMENT
U.S. STANDARD 110'-0" SUBMARINE CHASER.





tion. The starting switch B must then be opened. If the starting switch is not opened before the generator switch on Main Switchboard is closed a short circuit will be made causing a fuse to burn.

After the generator is running under its own power its voltage can be adjusted by the field rheostat to the proper value.

When the generator is stopped the charging switch on Main Switchboard should be opened, also the field switch A. If the field switch is not opened the generator field will be connected across the battery thereby wasting current.

BATTERY

This is a lead accumulator or storage battery consisting of lead plates immersed in dilute sulphuric acid as electrolyte. The plates are arranged alternately terminating in lugs forming the + and — terminals of the battery. The type used is, 30 volts, 140 amp. hours capacity consisting of 16 cells assembled in four 4-cell boxes. The cells are connected in series for lighting the ship and starting the auxiliary engine.

OUTLINE OF ACTION IN STORAGE BATTERY:

When a cell is put on discharge the current is produced by the acid in the electrolyte going into and combining with the lead of the porous part of the plates called "active material". In the positive plate the active material is lead peroxide and in the negative, metallic lead in a spongy form.

When the sulphuric acid in the electrolyte combines with the lead in the active material a compound, lead sulphate, is formed and the amount of acid used from the electrolyte will cause the specific gravity to drop.

When the cell is put on charge direct current is passed through the cell in a direction opposite that of discharge and restores the active material to its original condition and returns the acid to the electrolyte. Thus during charge the electrolyte gradually becomes stronger as the sulphate in the plates decreases, until no more acid remains and all the acid has been returned to the electrolyte. It will

then be of the same strength as before the discharge and the same acid will be ready to be used again during the next discharge. Since there is no loss of acid none should ever be added to the electrolyte.

PUTTING INTO SERVICE:

If battery is shipped "dumped", i. e., not filled with electrolyte, it should be put in service as follows:

Not later than six months after the date stamped on the name plate, fill the cells with electrolyte of 1.200 specific gravity until level with bottom of filling tubes. Replace filling plugs and allow battery to stand 12 hours before starting the initial charge.

Start the charge at rate given on the name plate and continue until the specific gravity and voltage have been at a maximum for 5 hours. At least 36 hours will be required for this charge. If two charge rates are given on the name plate use the lower rate.

If temperature of electrolyte approaches 125° Fahrenheit reduce rate or stop charging until it lowers.

At end of charge adjust gravity so that it will be between 1.200 and 1.215.

CARE OF: Never allow the level of the electrolyte to fall below top of plates.

Before every charge and at regular intervals between charges remove filling plugs and add approved water until lever of electrolyte is even with bottom of filling tubes. Replace and tighten plugs after filling.

Use only approved water to replace evaporation, never use acid or electrolyte.

Take frequent gravity readings with the hydrometer syringe; these readings will indicate the state of charge or discharge of the battery.

Do not repeatedly discharge the battery below the limit given on the name plate.

Always remove tray covers when charging.

For charging use the rate given on the name plate and continue until the specific gravity and voltage have been at maximum for one hour. If two rates are given use the higher rate until gasing begins, then finish at the lower rate.

Keep filling plugs tightly in place while charging to avoid flooding. When taking readings be sure to turn the valve inside the filling tube so that it will be at right angles to its normal position. If the valve is not turned when filling plug is removed the electrolyte may flood out of the cell.

Do not allow temperature of electrolyte to exceed 125° Fahrenheit during charge. It is recommended that a maximum electrolyte temperature of 110° Fahrenheit during charge be made standard practice unless the temperature of the surrounding air prevents. If temperature of electrolyte tends to run high, reduce charging rate.

If the battery is to be out of service for any length of time give a charge to maximum gravity every two months, but under no circumstances allow the battery to stand more than 6 months without charging. Always give the battery a charge to a five hour specific gravity maximum before and after an "out of service" period.

Keep top and sides of battery dry and clean. Use waste moistened with dilute amomnia to remove traces of acid or electrolyte.

INDICATIONS OF FULL CHARGE:

A battery charge is complete when with charging current flowing at 10 amperes all cells are gasing (bubbling) freely and evenly and the specific gravity and voltage of all cells have reached a maximum, i. e., have shown no further rise during a period of one hour.

SYMPTOMS OF IRREGULARITY

The chief indications of trouble in a cell are,—

Falling off in gravity or voltage relative to the rest of the cells.

Lack of gasing on charge.

Color of plates markedly lighter or darker than in surrounding cells.

Use of Hydrometer

The specific gravity and density of the electrolyte is measured by an instrument called an " hydrometer". For convenience the hydrometer is usually placed inside a glass syringe.

To use the hydrometer lift the wooden cover over the cells; take out the rubber plug in the top of the cell to be tested. Squeeze the bulb of the syringe and insert the nozzle into the electrolyte. Slowly release the bulb and the electrolyte will be drawn up into the glass tube. Sufficient electrolyte should be drawn up to float the hydrometer clear of the rubber plug in the bottom. To prevent the hydrometer from sticking to the side of the tube it is necessary that the syringe be held in a vertical position. A reading is taken at the surface of the electrolyte and when there is no compression on the bulb.

In recording the gravity of the different cells it is customary to begin with the cell at the negative end. When readings have been taken be careful to put the electrolyte back into the same cell from which it was taken.

The gravity of the electrolyte is assumed to be correct when the readings are taken at a temperature of 70° Fahrenheit. The gravity will become one point heavier for each three degrees below 70°, also one point lighter for each three degrees above 70°.

For the convenience of the operator a thermometer has been designed with a special scale on which the amount of correction is indicated. The figure in red directly opposite the reading must be added to or subtracted from the hydrometer reading to correct for temperature.

Acid Stains

If electrolyte is spilled on clothing apply strong ammonia.

DON'T

Do Not bring flames of any kind (match, candle, lamp, cigar, etc.) near battery at any time.

Do Not charge cells at higher rate than 10 amperes after gasing commences.

Do Not allow battery voltage to drop below 28 volts for 16 cells in series.

Do Not leave metal tools near battery.

Do Not short circuit the battery.

Do Not allow metals or impurities to get into the cells. The chief impurities likely to get into the cells are salt water and iron. If any impurities get into a cell remove the electrolyte at once, flush the plates with water and replace with new electrolyte.

Do Not replace evaporation with acid.

GENERAL

If a jar develops a leak promptly replace it.

If a cell becomes "dead" from a leaky jar cut it out of circuit by opening up the connector and restore the circuit with a jumper.

GOVERNMENT REGULATIONS

Information for Ship's Officers

1. The allowance list should be an up-to-date and complete guide for the use of the ship, home yard, and Bureau of Steam Engineering. It is important that desirable changes be made the subject of a letter to the Navy Department (Bureau of Steam Engineering).

2. The allowance list will consist of the Spare Part list one boat and the tool list one boat as contained herein:

Preparation of Requisitions

3. The totals of Title "B" items on board must not exceed in kind or quantity those shown, unless drawn by means of an "in-excess" requisition, approved by the Bureau of Steam Engineering. If *quick action is desired, do not place on one requisition* a large number of items of a *great variety of materials. Keep Bureau of Steam Engineering items separate* from those under the bureaus of Supplies and Accounts, Construction and Repair, and Ordnance. Different offices and officials have to pass upon different classes of material, and this involves delays. More than 200 items shall not be requested on any one requisition.

If stock catalogue numbers are used, do not leave out information necessary for action when the S. & A. stock catalogue is not at hand.

4. *Stick to the allowance list* and avoid considerable correspondence and explanation. If items "in-excess" are desired, *give in footnotes on the requisition full reasons why* the items are *needed,* and state whether desired added to allowance or not, *otherwise approval will be delayed.*

5. Useful information will be found in the latest Confidential Bulletins, and in Contract Bulletins concerning annual contracts for "Packings," for "Lubricating oils," for "Boiler gaskets," etc., issued by the Bureau of Supplies and Accounts.

Information for Yard and Ship's Officers

6. The ship's quarterly money allotment *must not be exceeded.*

7. Title "B" articles on board *in-excess* of allowance can not be replaced by a survey, or otherwise, except by authority of the Bureau of Steam Engineering.

8. Ordinary consumable Title "X" supplies, under annual contract, may be obtained as "not-in-excess" in reasonable amounts, even if not shown in this allowance.

9. Requests for repairs or increases in the money allotment should be in the form of a letter to the Bureau of Steam Engineering. Requisitions alone must not cover repairs, but "in-excess" requisitions for the material desired may accompany such letters.

10. Requisitions marked "in-excess" may be exempted from charge against the money allotment by this Bureau, but the actual expenditure involved must be stated in dollars and cents.

11. The following are not under the Bureau of Steam Engineering and *will be disapproved if* upon a Steam Engineering requisition:

Air compressors of submarines, except for engines (Bureau of Construction and Repair).

Adjusting and ballast pumps of submarines (Bureau of Construction and Repair).

Air compressors and parts for torpedoes (Bureau of Ordnance).

(Machinery air compressors are under Bureau of Steam Engineering, and it should always be noted for which ones parts or supplies are desired.)

Text and reference books of ships (Bureau of Navigation).

Blank forms (send in a request to the Bureau of Steam Engineering on Form N. S. E. 52A or 52C).

Fuel, coal, fuel oil, gasoline, etc. (Bureau of Supplies and Accounts, fuel and transportation).

Fuel-oil filling hose (Bureau of Construction and Repair).

Gaskets for hatches, water-tight doors and manholes (Bureau of Construction and Repair).

Anchor and steering-engine parts, boat cranes, and deck winches (Bureau of Construction and Repair).

Fire main, fresh-water lines for ship's tanks, main and auxiliary drain lines and parts for same (Bureau of Construction and Repair).

Galley stoves and bake ovens (Bureau of Construction and Repair).

Paint for the hull, double bottoms, bulkheads, Construction and Repair piping and machinery (Bureau of Construction and Repair).

Typewriters for ships (Bureau of Supplies and Accounts).

Ventilating blowers, fixed, Title "A" (Bureau of Construction and Repair).

(Portable fans and ventilating blowers, including the canvas hose supplied with ventilating sets, are under Steam Engineering and in the electrical allowance.)

Window panes and deadlights (Bureau of Construction and Repair).

12. Sufficient information must accompany requisitions to enable the average officer or clerk to understand just why and what is needed.

13. Necessary items should be requested added to the allowance so they can be obtained by not-in-excess requisitions and quickly in the future. *No one knows the full requirements of a ship as well as her officers and crew.*

14. *Proprietary articles,* except standard stock items, are not allowed unless for test purposes or for *very good reasons,* which *must be stated.*

15. *Ships* are *not required to use bad or inferior materials.* They are returnable to the contractors generally. Report in full to the Bureau of Steam Engineering, giving date and source of supply, with all important information. If practicable, mail the Bureau samples of used and unused materials.

16. Request authority from the Bureau to turn into store at a navy yard all equipage or supplies which can not be used on board.

17. Large quantities of rubber packings, gaskets, hose, fiber pump valves, and such articles must not be carried on a ship, as they will, in a warm storeroom, be of no value in a year or two.

18. *Do not lose the allowance lists.* Keep them corrected to date, showing corrections on the proper page and under each item. Copies of letters are best kept in the back of the book in a large manila envelope.

NOTES CONCERNING REQUESTS FOR SPECIAL MONEY ALLOTMENTS FROM SHIPS

For intelligent action in considering requests for special allotments the following information is necessary:

(*a*) A statement that the items desired are in addition to those ordinarily required for maintenance, upkeep, and cruising.

(*b*) A detailed list of such unusual items.

(*c*) The purpose for which desired.

(*d*) The necessity for the unusual expenditures or the reasons why a special allotment is considered desirable.

(*e*) The exact amount in dollars and cents requested as a special allotment to cover the cost of the items listed.

Indefinite requests stating that the allotment is exhausted, as result of unusual repairs or unusual conditions, as a result of supplies found missing and expended, as a result of careless

bookkeeping, lack of funds for repairs at a navy yard, etc., without detailed information, should be discouraged. They generally cause unnecessary correspondence and delay, and if approved would tend to defeat the purpose of the money allotment, which it is believed should provide for proper centralized control of expenditures of appropriations and tend to promote economy and efficiency on board vessels under ordinary service conditions.

Lubricating Oils

Many oils contain impurities due to poor refining and some actually have harmful ingredients mixed in with them:

The following are *pure, straight mineral oils, properly refined,* and *can be used for most any kind of lubrication. None other should be used for forced-feed lubrication and internal-combustion engines.*

Heavy	Medium	Light	Company
Pinacle or Regal, Ursa or Algol	Alcaid	Cetus	Texas Co.
Atlantic No. 465 and Atlantic forced-feed engine	No. 204 turbine	Acme engine	Atlantic Refining Co.
Zerolene, heavy	Calol turbine, heavy	Zerolene, light	Standard Oil Co. of California.
Monogram, heavy	Monogram, medium	Monogram, light	New York Lubricating Oil Co.
Veedol, heavy	Heavy Rado A	Light Dyno C	Platt & Washburn Co.
Motorine, heavy	Union AX	Union AXX	Union Oil Co. (California).

Note.—In cold weather use light or medium oils; for light, rapidly moving machinery use medium or light oils; for heavy, slow-moving machinery and gears use heavy or extra heavy oils.

Nomenclature of Oils

Officers should not be deceived by the great variety of names given oils by various companies, and said to be intended for a particular machine or purpose, and superior to any other kind of oil. Often the same product is sold under various names in different localities and for various reasons.

Straight mineral oils are a mineral product refined from crude, just as silver or copper or zinc are refined from various ores. If not properly refined they contain impurities and many oils on the market are cheap, imperfectly refined products. It is foolish to insist that oils must come from a certain district or company. All such sources can produce both bad and good oils.

Instructions contained in both Bureau Supplies and Accounts contract bulletins and late Engineering bulletins must be read to understand about oils.

Oils of the same type can be mixed without doing any harm whatever.

Much misinformation can be obtained from those promoting the sales of certain oils, from manufacturers of machinery who are allied with or own stock in oil companies, and from others prejudiced and ignorant concerning late practice. If a good oil is being used and trouble is encountered, don't blame the oil; look for some other causes and report details to the Bureau of Steam Engineering.

It is estimated that some proprietary oils are sold for three times the current market price for such a product, due to extravagant claims and the ignorance of the consumer.

Valve stem packings are cheaply made in the form of woven or twisted rope and will stand high heat around globe valve stems, etc. *They last only a short time around moving rods or in steam line slip joints.* Such packings are designated as "Mogul," "Alabestos," "Heliobestos," "Vulcabeston," etc.

Flax packing and Tucks packing are largely used for water pump plungers, in stern tube stuffing boxes, etc. They are bought under standard leaflet specifications, but high-grade long-fiber flax is hard to obtain.

Round Tucks seems little used in the service. Alternate rings of square flax and round Tucks have been found by the engineering experiment station to give long service in feed-pump plungers.

Pressure Gauges, Steam, Etc.

Steam, vacuum, air, water and other pressure gauges are obtained under specifications 45-G-1d.

Acceptable gauges are supplied by American Steam Gauge & Valve Co., Boston, Mass.; Ashcroft Manufacturing Co., Bridgeport, Conn.; Ashton Valve Co., Boston, Mass.

Gauges from the following would probably be satisfactory, though tests are not complete: Crosby Steam Gauge & Valve Co., Boston, Mass.; Industrial Instrument Co., Foxboro, Mass.

Spark Plugs

Considerable trouble has been experienced with spark plugs and unwarranted criticisms of different brands. (See Confidential Engineering Bulletin No. 35, pp. 6-10.)

The following may be considered satisfactory and others are being tested: "Splitdorf," "Bosch," "Benton," "Rajah," and "A. C. (Champion)." Any purchased should be guaranteed the same as those tested and found acceptable to the Bureau of Steam Engineering.

PURCHASE AND INSPECTION OF MATERIALS FOR THE NAVY DEPARTMENT.

Requisitions

All material purchased is made the subject of a requisition by the bureau, navy yard, or office requiring it. These requisitions are required to give as complete specifications as practicable for the material wanted, in order that all responsible firms which handle the material in question may be in position to bid with the assurance that they understand exactly what is required. Owing to the special needs of the naval service, special material is frequently required, but it is the aim to buy material conforming as closely to recognized engineering or commercial standards and specifications as the special needs of the service will permit. For a very large number of more or less commonly used materials, printed leaflet specifications are issued by the Navy Department, Washington, D. C., and the specifications for such items will be the same no matter for what yard or office they are purchased. Bidders should always exercise great care in reading the specifications to note any special requirements.

Bids and Awards

In general, all material is purchased after competition by means of sealed bids which are received by the Bureau of Supplies and Accounts or the various purchasing pay offices. These bids are not opened until the time indicated in the proposal for bidding. The openings are public, and any interested party is privileged to be present at the time. Other things being equal, the contract is awarded to the lowest bidder on the advertised specifications. Occasionally factors, such as time of delivery or the suitability of certain material for the purpose intended, must necessarily be considered in making the awards.

Method of Purchasing

There are two general classes of requisitions—"open purchase" and "advertised." When the estimated cost of the materials required on a single requisition composed of a number of

items is less than $500, or when the material is so urgently needed as not to permit of advertisement, it is usually purchased on an open-purchase requisition. In this case, after the requisition is approved by the Navy Department, the supply officer in the city nearest the yard which originated the requisition is directed to make the purchase after competition. The supply officer sends out proposals without newspaper advertisement—written, if time permits; otherwise verbal or by telegraph—to all firms known by him to be able to furnish such material and requests them to bid. These bids must be received by him prior to the announced hour of opening, and at this hour they are publicly opened. There are comparatively few formalities attached to such purchases.

Advertisement

When the estimated cost is more than $500 and the case permits of advertisement the material is purchased, after two weeks' newspaper advertisement, by the Bureau of Supplies and Accounts. A printed post card, "Notices of proposed purchases," giving a classified list of all advertised material is sent out weekly by this bureau to all manufacturers on its mailing list. Such manufacturers are invited to examine the notice of proposed purchases and request the Bureau of Supplies and Accounts to forward detail schedules for the particular classes of material in which they may be interested. The schedule number, with the name of the material, will be found in many trade papers so that those interested may obtain copies of the schedule as above noted. These bids are opened at the Bureau of Supplies and Accounts and the contract, after bids are considered by the technical Bureau for recommendation as to award, is awarded by the Bureau of Supplies and Accounts. By addressing the Bureau of Supplies and Accounts and the various purchasing pay offices a prospective bidder's name will be entered on their mailing lists. Such a request should state the classes of material on which it is desired to bid.

Award of Contracts

The Bureau of Supplies and Accounts submits all bids to the bureau concerned, and supply officers forward all bids to the navy yard concerned, for recommendation as to award. Whenever award is recommended to any but the lowest bidder, detail reasons for rejection of lowest bid become a matter of record. When the total amount of all classes bid upon at one time to the Bureau of Supplies and Accounts exceeds $500, it is necessary to execute with the bid a guaranty for faithful performance of delivery; but this is simplified by executing an annual guaranty, which will cover all proposals which a contractor may submit during the fiscal

year for which the annual guaranty is executed. This annual guaranty may be executed by any well-known surety company, or by two individuals, if preferred. Contractors may also file an annual contract bond, with corporate surety only, to cover all contracts which may be awarded. Bidders and contractors also have the option of filing a certified check for 25 per cent of the amount of bid or contract in lieu of guaranty or bond if they prefer it. When bids or awards do not exceed $500 in the total amount, no guaranty, bond, or check is required.

Alternative Bids

While, generally, contracts will be awarded to the lowest bidder conforming to the advertised specifications, modified bids are also frequently invited and will be considered on material which differs from that specified, provided it will fulfill the purpose for which that specified is intended. Such bids must state, however, in detail the departure from the specifications of the schedule or order. It is therefore necessary for the bidder, in order that his bid may receive full consideration, to give a detailed description of the material offered in case it differs any from that called for in the specifications, especially noting those points wherein he believes his material is superior to that called for and wherein it differs from the requirements of the specifications.

Inspection

The bureaus of the Navy Department maintain inspection offices at convenient points. The duty of these offices is to inspect prior to shipment the material furnished in their respective districts for the use of the bureau they represent. Such inspection is made in order to avoid shipment of material which is not in accordance with the specifications, and, therefore, subject to rejection at destination. This not only saves time and expense for the Government but also for the contractor. Another function of these offices is to give information to prospective bidders as to interpretation of the specifications, and to interest manufacturers to handle Navy Department business. A general information pamphlet, with a list of the names of the various inspectors under the different bureaus and their locations, is published by the Navy Department, obtainable from the Bureau of Supplies and Accounts, Navy Department, Washington, D. C.

Payments

The material when delivered is consigned to the supply officer of the delivery yard. Deliveries are made f. o. b. navy yard, cars, or wharf, or infrequently at the mills of the contractor when so stated in the contract or order. If not inspected prior to shipment it is inspected as soon as received, and in any case it is tallied with the inspector's report. For such portion as passes inspection the supply officer prepares a voucher, which after approval by the bureau is used as the basis of payment. A system has been instituted by which payments are made promptly after the material has been accepted. Payments are made in full for each partial delivery of a class when the amount warrants it.

Steam Engineering and Steam Engineering Electrical Allowance Lists for Submarine Chaser (Scout Patrol) 110-Foot

STEAM ENGINEERING ALLOWANCE LIST
SUBMARINE CHASER (SCOUT PATROL)

EQUIPAGE, TITLE "B".

Items marked "x" to be supplied by Contractor.

Title and Class	Articles	Unit	Allowance	Remarks
41	Calipers, firm joint:			
	6 inch inside	No.	1	
	6 inch outside	No.	1	
12	Chests, tool, about 24 by 12 by 10 inches.	No.	1	
41	Dividers, machinist's spring, 6 inches .	No.	1	
41	Drills, twist, straight shank, steel-wire gage No. 1 to 60, mounted on block .	Set	1	Drill sets Title "B" but worn out drills may be replaced under Title "X"
41	Drills, twist, square taper shank to fit ratchets:			
	1/4 to 1/2 inch by 32ds.	Set	1	
	9/16 to 1 inch by 16ths.	Set	1	
41	Drill braces, breast, double-geared . .	No.	1	
40	Drills for vaporizer tips	Set	1x	
41	Drill, ratchet, with all collets and sockets for square and taper shank drills up to 1 1/4 inch drills	No.	1	
41	Flanging tools	Set	1x	
41	Gages, thickness (feelers), 22 leaves . .	No.	1	
41	Gages, wire, B.W.C.	No.	1	
41	Hack-saw frames, best quality adjustable	No.	1	
41	Oilstones, hard, mounted in wooden case.	No.	1	
13	Oil syringes, brass, with straight tube, each syringe to have an extra tube with curved end	No.	1	
41	Rules, boxwood, brass-bound, 2-foot 4-fold, best, graduated to 1/16 in. . .	No.	2	
41	Rules, steel-tempered, machine-divided to 64ths, metric divisions on one edge, one edge thin bevel:			
	6-inch	No.	1	
41	Scrapers, machinists', assorted for fitting brasses	No.	4	
41	Taps, dies, stocks and tap wrenches U. S. N. set No. 1: 1/4 to 1 in. . .	Set	1	
B41	Trammels, thrust bearing	No.	1x	
13	Valve grinding tool for inlet valves . .	No.	1x	
41	Vises, swivel base, adjustable taper jaws, brass finishing caps and adjustable pipe grips:			
	Width of jaws, 4 inches	No.	1	

EQUIPAGE, TITLE "B". (CONTINUED.)

Title and Class	Articles	Unit	Allowance	Remarks
41	Wrenches, adjustable, diagonal S, best quality: 8-inch	No.	1	
41	Wrenches, propeller-shaft nuts	No.	1x	
41	Taps, pipes, stocks and dies, U. S. N. set No. 1, ¼ to 1 inch	Set	1	
41	Wrenches, engineer's angle double head:			
	5/16 and ¼ inch	No.	2 (1x)	Dimensions of wrenches are sizes of bolts with U. S. standard hexagon nuts.
	7/16 and 3/8 inch	No.	2 (1x)	
	5/8 and ½ inch	No.	2 (1x)	
	7/8 and ¾ inch	No.	2 (1x)	
	No. 1, ¼ inch	No.	1x	
41	Wrenches, screw (monkey) best quality steel bar:			
	6-inch	No.	1	Leaflet specifications.
	10-inch	No.	1x	
	18-inch	No.	1	
41	Wrenches, pipe, Stillson, with steel handles:			
	8-inch	No.	1	Jaws for wrenches are as required Title "X"
	14-inch	No.	1x	
41	Special Wrenches:			
	Crank bar	No.	1x	
	Magneto	No.	1x	
	Socket wrench ½ inch	No.	1x	
	Socket wrench 5/8 inch	No.	1x	
41	Special Wrenches:			
	Socket wrench for wrist pin set screws	No.	1x	
	Spanner for circulating pump gland	No.	1x	
	Spanner for exhaust pipe gland	No.	1x	
	Spanner for propeller shaft stuffing box nuts	No.	1	
	Stanchion wrench	No.	1x	
	Wrench for inlet valve bonnet and inlet valve plunger	No.	1x	
	Wrench for vaporizer tips	No.	1x	

SPARE PARTS

Class 10, Unless Otherwise Specified.

MAIN ENGINE SPARES FOR EACH BOAT.

Title and Class	Articles	Unit	Allowance	Remarks
B	Exhaust valves, complete	No.	3	Spare parts to be supplied by Contractor unless otherwise specified.
B	Inlet valves, complete	No.	3	
X	Exhaust valve springs	No.	9	
B	Ignitor, complete	No.	1	
B	Ignition motion, complete	No.	1	
X	Mica insulation	Lb.	¼	
X	Standard ignitor tips	Doz.	2	
X	Ignitor return springs	No.	4	

MAIN ENGINE SPARES FOR EACH BOAT. (CONTINUED.)

Title and Class	Articles	Unit	Allowance	Remarks
X	Ignitor drop rods	No.	3	
X	Taper pins, assorted sizes	No.	12	
X	Rubber valves for circulating pump	No.	4	
X	Springs for circulating pump	No.	4	
X	Valve seats for circulating pump	No.	2	
B	Valve guide for circulating pump	No.	1	
X	Fibre washers for ignitor rod sleeve nuts	No.	12	
X33	Packing for inboard bearing	Ft.	3	
X33	Packing for circulating pump	Ft.	1	
X33	Packing for gasoline pump	Ft.	2	
X	Piston rings, air pump	No.	16	
X	Cone nuts for air starting valve	No.	2	
B41	Ignitor lifter	No.	1	
X	Inlet valve, air pump	No.	1	
X	Inlet valve springs, air pump	No.	3	
X	Discharge valve, air pump	No.	1	
X	Discharge valve springs, air pump	No.	3	
X	Regulating valve springs, air pump	No.	3	
X	Valve, air starting	No.	1	
X	Valve spring, air starting	No.	1	
B	Air check valve with cage complete	No.	1	
X33	Gaskets, copper, for exhaust manifold	No.	6	
X33	Rubber gaskets for inlet pipe	No.	6	
X33	Exhaust valve gaskets	No.	6	
B34	Hose, rubber, for exhaust valve water circulation	Ft.	6	
X34	Hose clamps	No.	6	
X	Vaporizer tips	No.	6	
B41	Exhaust valve lifter	No.	1	
B41	Air valve lifter	No.	1	
	Brushes, springs for magneto	Set	1	
X	Wrist pin bushing	No.	1	
B	Connecting rod bearing with bolts	No.	1	
B	Coupling bolts	No.	3	
X33	Cylinder head gaskets	No.	3	
X	Wrist pin screws	No.	2	
X33	Circulating pump valve chest packing	No.	1	
X33	Water connection packing	No.	6	

AUXILIARY ENGINE SPARES FOR EACH BOAT.

X	Spark plugs	No.	2
	Brushes for magneto	Set	1
	Contact point screws for magneto	Set	1
	Spring for contact for magneto	No.	1
B	Exhaust valve, complete	No.	1
B	Inlet valve, complete	No.	1
B	Air discharge valve with springs	No.	1
X	Air discharge valve springs	No.	2
B	Air inlet valve with spring	No.	1
X	Air inlet valve springs	No.	2

AUXILIARY ENGINE SPARES FOR EACH BOAT. (CONTINUED.)

Title and Class	Articles	Unit	Allowance	Remarks
X	Rubber valves for bilge pump	No.	2	
X	Spring for bilge pump	No.	1	
X	Brass washer for bilge pump	No.	1	
X	Valve seat for bilge pump	No.	1	
X	Piston rings for one power piston	Set	1	
X	Air pump piston ring	No.	1	
B	Valve guide for bilge pump	No.	1	
X	Set dynamo brushes (4)	Set	1	
X	Brush holder spring	No.	1	

MAIN ENGINE SPARES FOR EACH TEN BOATS.

B	Cylinders	No.	6	These spares for ten boats are to be stored at Navy Yard or Base.
B	Pistons	No.	12	
B	Cylinder heads	No.	12	
X	Piston rings, cast iron	No.	24	
X	Piston rings, steel	No.	240	
X	Wrist pin bushings	No.	10	
X	Wrist pins	No.	10	
B	Connecting rods	No.	10	
B	Crank pin bearings	Pair	10	
B	Crank shaft bearings, (7 pair)	Set	1	
X	Bearing caps	No.	2	
B	Air pump cylinder complete, with eccentric strap	No.	1	
B	Thrust complete with studs	No.	1	
B	Coupling complete	No.	1	
B	Propeller shaft	No.	1	
B	Propellers, right hand	No.	2	
B	Propellers, left hand	No.	2	
X	Gage pressure, each kind	No.	1	
B	Crank shaft	No.	1	
B	Ignitor cam, right hand	No.	1	
B	Ignitor cam, left hand	No.	1	
B	Exhaust cam, right hand	No.	1	
B	Exhaust cam, left hand	No.	1	
B	Air cam, right hand	No.	1	
B	Air cam, left hand	No.	1	
B	Valve shaft drive gears worm and bevel	Set	1	
X	Circulating pump piston rings	No.	12	
B	Intermediate valve shaft bearings	Set	1	
X	Flywheel keys	No.	6	
B	Exhaust valves with springs	No.	15	
B	Inlet valves with springs	No.	15	
X	Oiler rings, crank shaft	No.	10	
X	Spring for relief valve, each kind	No.	1	
X	Exhaust valve springs	No.	15	
B	Cam shaft	No.	1	
B	Air manifold	No.	1	
B	Water manifold	No.	1	

MAIN ENGINE SPARES FOR EACH TEN BOATS. (CONTINUED.)

Title and Class	Articles	Unit	Allowance	Remarks
B	Circulating pump with drive, complete	No.	1	
B	Valve shaft gear housing	No.	1	
B	Rear cam shaft bearing	No.	1	
	Magneto with gear	No.	1	
B	Vaporizer, complete	No.	1	
B	Float box	No.	1	
B	Exhaust manifold	No.	1	
B	Exhaust manifold elbows	No.	2	
B	Force feed lubricator, RH drive, Detroit oiler	No.	1	
B	Force feed lubricator, LH drive, Detroit oiler	No.	1	
B	Hoisting shackle (to be made from casting) one for every 50 boats	No.	1	

AUXILIARY ENGINE SPARES FOR EACH TEN BOATS.

B	Bed plate	No.	1	
B	Crank shaft	No.	1	
	Main bearings	Set	1	
B	Engine crank pin bearings with bolts	Pair	2	
B	Engine connecting rods with bushings	No.	2	
B	Air compressor connecting rod with bushing	No.	1	
B	Air compressor crank pin bearings with bolt	Pair	1	
B41	Valve lifters	No.	4	
B	Cover for spur gears for bilge pump drive	No.	1	
B	Circulating pump	No.	1	
B	Worm gears for cam shaft drive	Pair	1	
B	Gasoline pump	No.	1	
B	Spur gears for bilge pump drive	Pair	1	
B	Bevel gears for bilge pump drive	Pair	1	
B	Engine pistons	No.	2	
X	Piston rings (American)	No.	16	
B	Engine piston wrist pins	No.	2	
B	Air compressor piston	No.	1	
X	Air compressor piston rings	No.	8	
B	Air compressor piston wrist pin	No.	1	
B	Air compressor cylinder	No.	1	
B	Air compressor cylinder head	No.	1	
B	Valve guides	No.	6	
B	Valve box covers	No.	6	
X	Spring for each relief valve	No.	1	
B	Engine cylinders	No.	2	

SUPPLIES, TITLE "X".

14	Albany grease, in tin cans	Lb.	10	As required.
41	Bars, pinch, steel, hexagon:			Not furnished by contractor except items marked x.
	18 inches long, ¾ inch diam.	No.	1	
	36 inches long, 1 inch diam.	No.	1	

SUPPLIES, TITLE "X". (CONTINUED.)

Title and Class	Articles	Unit	Allowance	Remarks
43	Bolts, brass, machine screw (lengths from ¾ to 1½ inches by quarter inches): Assorted, Gross	No.	1	
43	Bolts, iron or steel, machine screw (lengths from ¾ to 1½ inches by quarter inches): Assorted, Gross	No.	1	
43	Bolts, steel, hexagon heads, with wrought-iron hexagonal nuts, U. S. standard threads: Assorted	No.	72	
43	Studs, mild steel, U. S. standard threads: Assorted	No.	1x	Each size ⅝ inch and over.
		No.	3x	Each size under ⅝ inch.
43	Nuts, mild steel: Assorted	No.	1x	Each size ⅝ inch and over.
		No.	3x	Each size under ⅝ inch.
47	Brass and bronze, sheet, soft and spring, in sheets, 24 by 48 inches: Assorted, Sheet	No.	2	
38	Brooms, corn, best quality	No.	1	
55	Brooms, wisp, medium size	No.	1	
38	Brushes, paint and varnish: Assorted	No.	3	
55	Brushes, scrub, hand	No.	2	
12	Buckets, water, 2½ gallon, iron, galvanized	No.	2	
13	Cans, oil, filler: coppered, pint	No.	1x	See also "Measures oil."
13	Cans, oil, squirt, straight spout: Coppered, ½ pint	No.	1x	
	Brass, 1 pint	No.	1	
41	Center punches, best cast steel, machinist's	No.	1x	
41	Chisels, machinist's cape: ¼ inch	No.	1	
41	Chisels, machinist's flat: ½-inch	No.	1	
	⅝-inch	No.	1x	
	¾-inch	No.	1	
41	Chisels, machinist's diamond point: ¼-inch	No.	1	
41	Clamps, screw, drop-forges steel, C: No. 2 with 2¼-inch opening	No.	1	
	No. 3 with 3¼-inch opening	No.	1	
41	Drifts, for driving keys, assorted sizes	No.	1	
42	Emery, in 1-lb. tins, assorted	Lb.	2	As required.
42	Emery and crocus cloth, assorted	Sheets	48	As required.
43	Eyebolts, wrought steel, assorted lengths, U. S. standard threads:	No.	4	
	⅝-inch	No.	1x	
41	Files, all kinds and cuts: Files, flat, bastard, 8-inch	No.	1x	
	Files, flat, rough, 10-inch	No.	1	
	Files, flat, smooth, 8-inch	No.	1x	
	Files, half-round, bastard, 12-inch	No.	1	

SUPPLIES, TITLE "X". (CONTINUED.)

Title and Class	Articles	Unit	Allowance	Remarks
41	Files, all kinds and cuts—(Continued.)			
	Files, half-round, second cut, 8-inch	No.	1x	
	Files, half-round, smooth, 10-inch	No.	1	
	Files, knife-edge, second cut, 6-inch	No.	1	
	Files, rat-tail, smooth, 6-inch . .	No.	1	
	Files, round, bastard, 12-inch . .	No.	1x	
	Files, round, smooth, 8-inch . .	No.	1	
	Files, square, second cut, 8-inch .	No.	1	
	Files, triangular, second cut, 6-inch	No.	1	
42	Funnels, oil, copper, with fine gauze strainer:			
	Quart	No.	1	
14	Grinding paste	Tube	1x	
13	Glass tubes:			
	For lubricators	No.	3	
	For oil tanks	No.	3	
33	Grommets, gage glass, assorted . . .	No.	6	
41	Hack-saw blades, best quality	Doz.	3	As required.
41	Hammers, copper, handled, 4-lb	No.	1	
41	Hammers, machinist's solid steel, handled:			
	1-pound, ball peen	No.	1x	
	1½-pound, ball peen	No.	1	
	1½-pound, straight peen	No.	1	
41	Hammers, scaling, handled	No.	1	
41	Handles, file, assorted	No.	6	
41	Handles, hammer, machinist's best hickory: assorted	No.	2	
14	Kerosene	Gal.	5	As required. Keep on deck.
42	Locks, brass, pad, 1½ inch, with chain .	No.	2	Two keys each
42	Measures, oil, copper:			
	1 pint	No.	1	
	½ gallon	No.	1	
43	Nuts, iron, hexagonal, standard tapped: assorted	No.	72	
33	Packing, sheet, H.P., woven asbestos, for rough-joint surfaces	Sq. yd.	1	All packings are as required. Excessive amounts of rubber composition packings which deteriorate easily in hot storerooms, must not be carried. Consult Bu. S. & A. annual contract memo. for information about packings.
33	Packing, sheet, H.P., for internal-combustion engines	Sq. yd.	3	
33	Packing, sheet, rubber, cloth insertion, low grade, commercial	Sq. yd.	2	
33	Packing, sheet fiber, for oil and gasoline lines	Sq. yd.	1	
33	Packing, asbestos, rope	Lb.	2	
33	Packing, flax, square, water packing, machine laid	Lb.	5	
33	Packing, spiral gland, rod, H.P., square .	Lb.	10	
33	Packing, Tucks, round or square . . .	Lb.	5	
41	Packing hooks, steel, assorted lengths: ⅛-inch, ¼-inch, ⅜-inch, ½-inch.	No.	4	
41	Packing screws, steel, assorted lengths: ⅛-inch, ¼-inch, ⅜-inch, ½-inch.	No.	4	

Title and Class	Articles	Unit	Allowance	Remarks
	SUPPLIES, TITLE "X." (CONTINUED.)			
41	Packing sticks, hardwood, assorted lengths: ¼-inch, ⅜-inch, ½-inch, ¾-inch, 1-inch	No.	5	
51	Paste, polishing, in ½-pound tins	Lb.	10	As required.
14	Petrolatum, in tins	Lb.	20	As required.
42	Pins, split, brass, assorted lengths: assorted	Doz.	2	
42	Pins, split, steel assorted lengths: assorted	Doz.	2	(1x)
45	Pipe fittings:			
	Nipples, brass shoulder, assorted lengths of each size: assorted	No.	12	
	Plugs, brass, assorted	No.	24	
	Unions, ground joint, brass, assorted	No.	6	
41	Pliers, best steel, round nose: 6-inch	No.	1	
41	Pliers, combination, gas, wire-cutting, etc.: 10-inch	No.	1	
41	Pliers, side cutting, 6-inch	No.	1x	
41	Screw drivers, machinist's best steel:			
	7-inch blades	No.	1x	
	12-inch blades	No.	1	
	16-inch blades	No.	1	
52	Smooth-on compound, in 5-pound cans	Lb.	5	
54	Fileboards	No.	1	
53	Pads, memorandum, 5 by 8 inches	No.	2	
53	Pencils, lead, black, assorted	Doz.	2	
43	Washers, iron, assorted	Lb.	2	
13	Waste, cotton, best white, in 100-pound bales	Lb.	100	As required.
41	Wedges, steel, for breaking joints:			
	2 by ¾-inch	No.	1	
	3 by 1-inch	No.	1	
22	Wire, brass annealed, assorted	Lb.	2	
22	Wire, copper, soft, assorted	Lb.	2	
22	Wire, lead, soft, assorted	Lb.	2	
22	Wire, phosphor bronze, spring, assorted.	Lb.	2	

STEAM ENGINEERING ELECTRICAL ALLOWANCE LIST
SUBMARINE CHASER (SCOUT PATROL) 110-FOOT

EQUIPAGE, TITLE "B", AND SUPPLIES, TITLE "X", AND SPARE PARTS, TITLES "B" AND "X".

Class 17.

Title	Articles	No.	Remarks
			Spare parts to be supplied by Electrical Contractor unless otherwise specified.
	Blinker signal set:		
A	Controller (complete)	1	Drawing B-2250-L.
X	Controller contact points	2	

EQUIPAGE, TITLE "B", AND SUPPLIES, TITLE "X", AND SPARE PARTS, TITLES "B" AND "X". (CONTINUED.)

Title	Articles	No.	Remarks
A	Lantern (complete)	1	Drawing 2178-L (modified to take a medium screw base lamp).
	Lamps:		See lamps.
B	Blinker-Portable tube (complete)	1	Drawing 9-S-2743.
X	Batteries (spare)	4	
	Lamps		See lamps.
A	Ceiling fixtures (complete)	12	
	Lamps		See lamps
	Lamp sockets		See sockets.
X	Globes (spare)	2	
A	Condulets (complete)	25	
X	Condulet covers	6	
X	Condulet gaskets	6	
	Deck fixtures (complete)	18	
	Lamps		See lamps.
	Lamp sockets		See sockets.
X	Globes (spare)	3	
A	Fans—ventilation	2	
B	Armature (spare)	1	
X	Carbon brushes (spare)	12	
X	Bearing linings (spare)	4 sets	
B	Heaters	3	
	Lamps:		
X	For fixtures and running lights—15-watt tungsten, 30-volt G-18½, frosted, medium screw base	100	
X	For searchlight and blinker signal set 150-watt tungsten, 30-volt G-25 clear, concentrated filament, medium screw base	10	
	Lamps:		
X	For portable tube blinker FE 3¾ opal back 2.7 volts miniature base	5	
B	Magneto with gear	1	
	Spare parts:		
X	Set of brushes	1	
X	Set of brush springs	1	
X	Set of contact point screws	1	
X	Spring for contact	1	
B	Magneto wrench	1	
B	Plugs (complete)	24	Drawing 9072-D
X	Tips for plugs	1	
B	Portables (complete)	6	
	Lamp sockets		See sockets.
X	Steel enameled reflector (spare)	1	
A	Rheostat—battery charging	1	
	Running lights:		
B	Masthead	1	
B	Starboard side	1	

EQUIPAGE, TITLE "B", AND SUPPLIES, TITLE "X", AND SPARE PARTS, TITLES "B" AND "X". (CONTINUED.)

Title	Articles	No.	Remarks
B	Port side	1	
B	Range or stern	1	
A	Searchlight—Incandescent	1	
	Lamp socket		See sockets.
	Lamps		See lamps.
	Sockets:		
X	Type—for ceiling, deck and bulkhead fixtures	5	
X	Type—for portable	1	
X	Type—for searchlight	1	
A	Storage batteries (30 volt 140 A.H. capacity) (complete)	2	
B	Testing set	1	
A	Switches (complete)	2	Drawing No.
	Spare parts:		
X	Cams	1	
X	Handles and Spindles	1	
X	Blades	1	
X	Bases	1	
A	Switchboard—Containing the following:— 1 voltmeter, 0-130 1 voltmeter, switch—4 point 2 ammeter 50-0-35 2 switches, 50 Amp. (fused) double pole double throw. 10 switches, 25 Amp. (fused) double pole single throw. 8-40 Amp. fuses N.E.C. std. 16-10 Amp. fuses N.E.C. std. 4-30 Amp. fuses N.E.C. std.		
	Spare parts:		
X	40 Amp. fuses N.E.C. std.	16	
X	10 Amp. fuses N.E.C. std.	60	
X	30 Amp. fuses N.E.C. std.	2	
	Wire (spare):		
X	Reinforced cord N.E.C. std. (No. 16 B. & S. gauge)	100 ft.	
X	Single conductor, double braid N.E.C. std. stranded for ignition circuits	50 ft.	

RADIO SPARE PARTS.

Class 16.

X	Telephone cord	1	
X	Detector renewal	1	
X	Audion bulb	1	Spare audion bulbs will be carried only on boats fitted with audions
X	Key contacts	2	

RADIO SPARE PARTS. (CONTINUED.)

Class 16.

Title	Articles	No.	Remarks
B	Telephone	1	
B	Quenched gap units, complete	3	To be carried only on ships which have quenched gap sets.
X	Complete set quenched gap gaskets	2	To be carried only on ships which have quenched gap sets.
X	Spark plugs	2	

In addition to the spares listed above, which should be carried on each boat, spares for the different types of sets will be carried at Navy Yards as specified below.

One of the following spare parts will be carried in stock for every ten sets that have been purchased:

Radiation meter	1	
Speedometer with flexible shaft	1	For sets having gasoline engine.
Starter box, complete	1	For sets having gasoline engine.
Gasoline engine, complete	1	For sets having gasoline engine.
Receiver	1	

One of the following spare parts will be carried in stock for each five sets that have been purchased:

Complete rotating element	1	
One of each type field coil	—	
Set of brushes	1	
Set of bearings	1	
Set coupling washers between engine and generator	2	For sets having gasoline engines.
Set spares for gasoline engine	1	For sets having gasoline engines.
Transmitting condenser	1	
Transformer	1	For sets containing transformers.
Complete spark gap with mountings	1	
Key	1	
Telephone cord	1	
Telephone	1	
Detector renewals	5	
Audion bulbs	5	For sets having audion bulbs.
Spark plugs for engines	4	For sets having gasoline engine drive.
Key contacts	10	
Protective devices	2	½ K. W. size.

Spares kept at the Navy Yards, will be distributed as follows:

Spares for Cutting & Washington sets, Boston Navy Yard.
Spares for Sperry sets, New York Navy Yard.
Spares for Nat'l Electric Sig. sets, Washington Navy Yard.
Spares for De Forest sets, Washington Navy Yard.
Spares for Nat'l Elec. Supply sets, Washington Navy Yard.
Spares for Western Electric sets, Washington Navy Yard.
Spares for Am. Radio & Research sets, Washington Navy Yard.
Spares for Marconi sets, New York Navy Yard.

NOTES: FOR ORDERING BY TELEGRAM

The five letter code word, found after each engine part in the parts list, when telegraphed to the Company, is an order for immediate shipment of that part.

IMPORTANT: The number of the engine (found on the engine name plate and flywheel) for which the part is wanted must be given in the telegram with the five letter code word for the engine part. The five letter code words for numerals are found in the A B C Fifth Edition Improved Code Book, which is the book from which the five letter code words for the engine parts have been taken. The code words for any numerals can also be found in the Western Union, Liebers, A B C 4th and 5th Edition.

NOTE—It will be found in the code book that there are five letter code words for every numeral up to 500. As the engine numbers run in the thousands, it will be necessary to combine two of the five letter code words to get the engine number in code.

Only when the five letter code word for the *engine part* and the five letter code word for the *engine number* are given together, can this Company know the right part to ship. This is because sizes of some parts are different for some engines and the pattern is different for right-hand and left-hand engines.

NOTE—All engine numbers are odd numbers for right-hand engines and even numbers for left-hand engines.

EXAMPLE CODE TELEGRAM FOR ORDERING PARTS

Standard Motor Construction Co., Jersey City, N. J. Utgim Usnupuregl

Translation: Ship immediately Hand Hole and Name Plate Cover, for engine No. 2321.

You must, of course, make plain in the telegram to what point shipment is to be made, and to whom, and any other information, such as special shipping directions that you might want. All of these things can be made up in the five letter code from A B C 5th Edition Improved Code Book or in other code from Western Union, Liebers, A B C 4th Edition or old 5th Edition.

NOTES: FOR CONDENSING ORDER

The following parts are shipped assembled, in pairs, or as noted:

Complete inlet valve consists of inlet valve N[1]-e-28, inlet valve spring Q-e-101, inlet valve dash pot piston Q-e-102, piston ring for dash pot piston and piston nut Q-e-105.

Complete exhaust valve consists of exhaust valve body S-e-158, exhaust valve piston ring, exhaust valve stem S-e-175, exhaust valve stem inner tube S-e-176, exhaust valve stem inner tube head S-e-232, exhaust valve plug S-e-169, exhaust valve stem trunnion S-e-178, exhaust valve stem trunnion lock nut S-e-42, exhaust valve spring S-e-174.

Complete Ignitor consists of ignitor plug N^1-i-1, movable contact pin U-i-2, fixed contact pin I-i-34, movable contact lever S-i-20, movable contact lever lock nut S-i-21, movable contact lever filling washer S-i-38, wing nut N^1-i-16, fixed contact pin collar N^1-i-20, outside insulation washer E-i-19, ignitor tips X-i-5.

Complete ignition motion consists of ignitor trip rod N^1-i-3, ignitor tripper shaft and lever N^1-i-4, ignitor tripper arm N^1-i-6, ignitor tripper hanger countersunk N^1-i-7, ignitor tripper hanger plain N^1-i-8, ignitor tripper hanger bolt N^1-i-9, ignitor tripper shaft bracket N^1-i-10, ignitor lifter rod N^1-i-11, ignitor tripper eye Q-i-18, ignitor tripper eye spring Q-i-19, turn buckle fork S-i-26, turn buckle fork bolt S-i-27, turn buckle nut S-i-28, turn buckle lock nut S-i-29, trip blade Q-i-17, shoulder nut I-i-16, shoulder lock nut S-i-24, shoulder nut washer I-i-17, ignitor trip rod spring N^1-i-21.

Complete ignitor trip rod consists of trip rod N^1-i-3, ignitor spring N^1-i-21, shoulder nut I-i-16, shoulder lock nut S-i-24, shoulder nut fibre washer I-i-17.

Air chamber for circulating pump consists of shell N^1-w-13, upper head N^1-w-72, lower head N^1-w-73, concave nut N^1-w-74, convex nut N^1-w-75, nipple N^1-w-76.

Expansion union for circulating water rail consists of joint base N^1-w-59, joint liner N^1-w-60, and joint gland nut N^1-w-61.

Water pressure adjusting valve consists of adjustable angle check valve body N^1-w-81, cap N^1-w-84, hand wheel N^1-w-85, spring N^1-w-86, screw and lock nut N^1-w-87, screw end spring header N^1-w-88, valve end spring header N^1-w-89, poppet N^1-w-90, gland nut N^1-w-77.

Expansion union for water pipe near circulating pump consists of gland N^1-w-56, and liner N^1-w-57.

Exhaust manifold consists of inner shell N^2-m-21, outer shell N^2-m-22, flange N^1-m-26, cylinder connection and hand hole flange N^1-m-3, packing flange N^1-m-4, drain flange S-m-11, water connection flange N^2-m-19.

Crankshaft oil ring consists of bolted halve N^2-o-15, fly wheel halve N^2-o-16, cap studs and nuts I-o-9 and oil ring stud I-o-10.

Air compressor eccentric strap consists of strap N^2-a-7, strap cap N^2-a-8, eccentric rod N^2-a-9, stud N^2-a-11.

Cylinder air check valve and cage complete consists of cage N¹-a-38, valve N¹-a-40, collar N¹-a-43, spring N¹-a-41, washer N¹-a-42.

Expansion union for compressed air line consists of base X-w-7 and gland nut X-w-117.

Crank pin bearing includes crank pin brasses N²-e-50 and caps N²-e-51.

Exhaust valve body S-e-158, exhaust valve stem S-e-175, and exhaust valve plug S-e-169 are not shipped separately.

Exhaust valve cage S-e-170 is shipped with cage bushing S-e-111.

Exhaust valve lifter N²-e-37 shipped with roller N²-e-11 and pin.

Ignitor lifter N²-e-40 (R.H.) N²-e-44 (L. H) shipped with roller N²-e-12 and pin.

Compressed air valve lifter N²-e-38 (R. H.) N²-e-46 (L. H.) shipped with roller N²-e-8 and pin N²-e-64.

Cam shaft bearings include bearing N¹-e-53 and cap N¹-e-54.

Cam shaft drive bevel gear case includes cam shaft drive bevel gear bearing N¹-e-92, case studs N¹-e-94, case and cover S-e-85, case and cover S-e-86.

Vertical shaft bearing includes bearing S-e-107, and cap S-e-108.

Reverse lever bearing includes bearing N¹-e-71 and cap N¹-e-72.

Crank shaft bearing includes (forward) N²-e-48, (intermediate) N²-e-47 and (after) N²-e-49.

Cylinders N²-e-2 and N²-e-1 shipped with hand hole plates N²-e-23 and hand hole plates N¹-e-88. Cylinders are studded and the number of cylinder, counted from fly wheel end, should be given.

Circulating pump crank pin bearing includes bearing M¹-w-11 and cap M¹-w-12.

Circulating pump crank shaft bearing includes circulating pump split bushing N¹-w-25 and circulating pump split bushing N¹-w-95.

For forward main bearing cap see circulating pump gear housing N²-w-7.

For aft main bearing cap see air compressor cylinder N²-a-5.

Complete float box consists of 65-N²-F (Starboard), 66-N²-F (Port), 67-N²-F, X-f-15, X-f-16, X-f-17, X-f-18, X-f-19, X-f-20 and X-f-72.

Complete strainer consists of X-f-85, X-f-86, X-f-87, X-f-88, X-f-89 and X-f-90.

Propeller shaft bulkhead stuffing box consists of stuffing box 51-N²-P (Starboard), 50-N²-P (Port) 53-N²-P (Center) after bulkhead, gland 52-N²-P and studs and nuts 54-N²-P.

AUXILIARY ENGINE

The following parts are shipped assembled, in pairs or as noted:

Base B-e-21 shipped with bearing caps B-e-32, B-e-33, and B-e-51 and nut B-e-74.

Bushing B-e-53 shipped as long crank shaft bearing. Two halves shipped as one pair.

Bushing B-e-54 shipped as short crank shaft bearing. Two pieces shipped as one pair.

Bushing B-e-52 shipped as intermediate crank shaft bearing. Two pieces shipped as one pair.

Crank pin brass G-e-30 and cap G-e-31 shipped as crank pin bearings.

Complete inlet valve consists of inlet valve C-e-36, spring collar C-e-40, springs C-e-39 and key C-e-78.

Complete Exhaust valve consists of exhaust valve C-e-36, spring collar C-e-40, spring C-e-38 and key C-e-78.

Valve lifter B-e-42 shipped with roller G-e-37 and pin G-e-38.

Cam shaft bearings B-e-57 and cap B-e-58 shipped as cam shaft bearings.

Governor eccentric strap B-g-19 and cap B-g-20 shipped as governor eccentric strap.

Connecting rod for circulating pump consists of strap B-w-22, rod and nut B-w-3, wrist pin brass B-w-23.

Air suction muffler consists of muffler tee B-a-50, inner shell B-a-43, outer shell B-a-44, muffler head B-a-45.

Starting crank consists of crank arm B-s-3, crank pin G-s-7, crank handle X-c-113, crank handle cap G-s-6.

Crank pin brass G-e-30 and cap G-e-31 shipped as bilge pump crank pin bearing.

MAIN ENGINE

Name of Part	Part No.	Code
Hand Hole and Name Plate Cover	N^1 e 88	utgim
Hand Hole Plate	N^2 e 23	utgko
After Starboard Stanchions	N^1 e 6	utgos
After Port Stanchions	N^1 e 7	utgpt
Stanchion Bushings	N^1 e 87	utgqu
Inter Starboard Stanchions	N^1 e 8	utgsw
Inter Port Stanchions	N^1 e 9	utguy
Forward Starboard Stanchions	N^1 e 10	utgwa
Forward Port Stanchions	N^1 e 85	utgyc
Stanchion Nuts	N^1 e 89	uthar
After Stanchion Cross Brace	N^1 e 11	uthbs
Inter Stanchion Cross Brace	N^2 e 21	uthdu
Inter Stanchion Cross Brace Washer	N^2 e 22	uthev
Forward Stanchion Cross Brace	N^1 e 27	uthhy
Fore and Aft Stay	N^2 e 61	uthiz
Fore and Aft Stay Washer	N^2 e 62	uwcba
Engine Base	N^2 e 33	uthja
Forward Main Bearing Cap (see Circ. Pump Gear Housing)		
Aft Main Bearing Cap (Air Pump Cyl.)		
Intermediate Main Bearing Cap	N^2 e 35	uthmd
Crankshaft	N^2 e 32	uthne
Flywheel	N^1 e 15	uthof
Crank Pin Brasses	N^2 e 50	uthri
Crank Pin Brasses Caps	N^2 e 51	uthsj
Crank Brass Bolts	N^2 b 1	uwced
Cylinder Head	N^1 e 3	uthxo
Cylinder Head $\frac{1}{8}$" Pet Cocks		uwcfe
Wrist Pin Set Screw	N^1 e 34	uwcih
Wrist Pin Set Screw	N^1 e 101	utibg
Inlet Valve Bonnets for Forward and Aft Cyls	N^1 e 30	utich
Inlet Valve Bonnets for 2 and 5 Cyls Inlet Valve Bonnets for 3 and 4 Cyls	N^1 e 31	utidi
Upper Piston Ring		uwcji
Lower Piston Ring		uwcon
Inlet Valve Bonnet Joint Ring	N^1 e 32	utiej
Comp. inlet valve		uwbdo
Piston	N^2 e 3	utifk
Connecting Rod	N^2 e 36	utigl
Wrist Pin	N^2 e 5	utihm
Wrist Pin Bushing	N^2 e 6	utjin
Inlet Valve Guide	N^1 e 29	utijo
Inlet Valve	N^1 e 28	utikp
Inlet Valve Bushing in Guide	Q e 99	utilq
Inlet Valve Spring Pot and Guide Nut	N^2 e 25	utimr
Inlet Valve Spring	Q e 101	utins
Inlet Valve Bumper Spring	N^2 e 27	utiot
Inlet Valve Dash Pot Piston	Q e 102	utipu
Inlet Valve Dash Pot Piston Ring		utiqv
Inlet Valve Dash Pot Cyl	N^2 e 24	utirw

MAIN ENGINE. (CONTINUED.)

Name of Part	Part No.	Code
Inlet Valve Dash Pot Piston Nut	Q e 105	utisx
Exhaust Valves	S e 158	utity
Exhaust Valve Ring		utiuz
Exhaust Valve Stem	S e 175	utiva
Exhaust Valve Stem Inner Tube	S e 176	utiwb
Exhaust Valve Stem Inner Tube Head	S e 232	utixc
Exhaust Valve Plug	S e 169	utiyd
Exhaust Valve Stem Trunnion	S e 178	utize
Exhaust Valve Stem Trunnion Lock Nut	S e 42	utjas
Exhaust Valve Spring	S e 174	utjcu
Exhaust Valve Cages (with Lugs)	S e 170	utjdv
Exhaust Valve Cages Lever	S e 35	utjew
Exhaust Valve Cages Lever Pivot Pin	S e 34	utjgy
Exhaust Valve Lifter Pin	S e 211	utjia
Exhaust Valve Cage Lever Pivot Pin Washer	S e 233	uwcpo
Exhaust Valve Pull Rod	N² e 52	utjme
Exhaust Valve Pull Rod Swivel	S e 113	utjog
Oil Spring and Holder	S e 172	utjph
Exhaust Valve Cage Bushing	S e 111	utjqi
Exhaust Valve Lifter	N² e 37	utjsk
Exhaust Valve Lifter Roller	N² e 11	utjtl
Exhaust Valve Lifter Roller Pin		uwcts
Com. Ex. Valve		uwbep
Cap Screw	N¹ e 103	uwcut
Ignitor Lifter (R. H. Eng.)	N² e 40	utjyq
Ignitor Lifter (L. H. Eng.)	N² e 44	uwcvw
Complete Ignitor Trip Rod		uwbgr
Complete Ignitor		uwbit
Ignitor Lifter Hanger (R. H. Eng.)	N² e 41	utjzr
Ignitor Lifter Hanger (L. H. Eng.)	N² e 45	uwcyx
Ignitor Lifter Hanger Pin	N² e 42	uwczy
Ignitor Lifter Roller	N² e 12	utkbh
Ignitor Lifter Roller Pin		uxpul
Complete Ignition Motion		uwbju
Ignitor Lifter Return Spring	N¹ e 93	utkdj
Spacing Collar (R. H. Eng.)	N² e 39	utkek
Spacing Collar (L. H. Eng.)	N² e 43	uwdam
Air Valve Lifter (R. H. Eng.)	N² e 38	utkfl
Air Valve Lifter (L. H. Eng.)	N² e 46	uwdco
Air Valve Lifter Roller	N² e 8	utkgm
Air Valve Lifter Roller Pin 7/16"Dx1 1/16"	N² e 64	uwdeq
Air Valve Cams	N² e 16	utkou
Ignitor Cams	N² e 17	uwdfr
Exhaust Valve Cams	N² e 60	utktz
Rockershaft	N¹ e 51	utksy
Camshaft (R. H. Eng.)	N² e 26	utkua
Camshaft (L. H. Eng.)	N² e 63	uwdiu
Camshaft Nut		uxqva
Camshaft Washer 1" Hole	N¹ e 105	utlat
Camshaft Washer 1 1/8" Hole	N¹ e 106	utlbu
Camshaft Bearing	N¹ e 53	utldw

MAIN ENGINE. (CONTINUED.)

Name of Part	Part No.	Code
Camshaft Bearing Cap	N¹ e 54	utlex
Camshaft Drive Bevel Gear Brg. (For L. H. Eng.)	N¹ e 92	utlfy
Camshaft Drive Bevel Gear Case Stud	N¹ e 94	utlha
Camshaft Drive Bevel Gear Case and Cover	S e 85	utlib
Camshaft Drive Bevel Gear Case and Cover	S e 86	utlle
Camshaft Drive Bevel Gear	N¹ e 57	utlng
Camshaft Drive Bevel Gear Pinion and Vertical Shaft	N¹ e 58	utloh
Camshaft Drive Bevel Gear Thrust Washer	N¹ e 99	utlpi
Vertical Shaft Bearing	S e 107	utlsl
Vertical Shaft Bearing Cap	S e 108	utltm
Vertical Shaft Hindley Wheel	S e 78	utlun
Crank Shaft Hindley Worm	N¹ e 62	utlvo
Flange Coupling Prop. Shaft End	N² e 58	uwdkw
Flange Coupling Crankshaft	N² e 56	utlzs
Camshaft Drive Bevel Gear Bearing (For R. H. Eng.)	N¹ e 104	uxpxo
Reverse Lever Bearing	N¹ e 71	utmah
Reverse Lever Bearing Cap	N¹ e 72	utmbi
Thrust Bearing Yoke	N² e 59	utmel
Thrust Bearing End Rings	N² e 53	utmgn
Thrust Bearing Roller Plate	N² e 54	utmho
Thrust Bearing Floating Collar	N² e 55	utmip
Thrust Bearing Yoke Columns	N² e 57	utmkr
Thrust Bearing Roller Cage		utmnu
Shoulder Nut	N² e 66	uwdmy
Forward Main Bearing Br	N² e 48	utmov
Intermediate Main Bearing Br.	N² e 47	uwdnz
After Main Bearing Br.	N² e 49	uwdoa
Forward Cylinder Low Stanchion Lugs and Circular Pump Lugs	N² e 2	utmub
Aft Cylinder High Stanchion Lugs and Cont. Brk't Lugs	N² e 1	utmxe
Inter Cylinder High Stanchion Lugs Plain	N² e 1	utmyf
Inter Cylinder Low Stanchion Lugs Plain	N² e 2	utnzu
Cyl. air check valve (repair bushings)	N² e 34	utnic
Cyl. drain ⅛" pet cocks		uwdse
Flywheel key	N¹ e 108	uwdug
Throttle valve body	N² v 7	utnke
Vertical inlet pipe (inner shell)	N² v 38	uwdvh
Vertical inlet pipe (outer shell)	N² v 41	uwdwi
Vertical inlet pipe flange	N² v 40	uwdyk
Throttle valve	N² v 11	utntn
Throttle valve rod and nut	N² v 29	utnus
Horizontal inlet pipe set 1 and 2, 3 and 4, 5 and 6	N¹ v 6	utobj
Horizontal inlet pipe set 2 and 3, 4 and 5	N² v 6	utock
Sprayer tubes	N² v 46	utodl
Sprayer tubes nozzle	N² v 22	utoem
⅛" drain cock		uwdzl
½" short nipple (gas or overflow)		uwebb
½" Ell (gas or overflow)		uwecc
½"x3½" Nipple (gas or overflow)		uwedd
Screen frame	N² v 23	utojr
Screen frame screws No. 12-24		uweff
Screen brace	N² v 24	utolt

MAIN ENGINE. (CONTINUED.)

Name of Part	Part No.	Code
Screen	N² v 45	utomu
Sprayer shutter shaft	N² v 20	uwegg
Sprayer shutter	N² v 12	utoow
Sprayer shutter connecting pin	N¹ v 58	uwehh
Regular weight base	N¹ v 59	utoqy
Regular weight	N¹ v 60	utorz
Regular weight cap	N¹ v 61	utosa
Regular piston connecting rod	N² v 14	utotb
Regular piston jaw and nut	N¹ v 65	utouc
Regular cylinder	N² v 9	utovd
Regular piston	N² v 10	utowe
Regular cyl. pet cock ⅛"		uwejj
Regular cyl. suction tube	N² v 47	utoyg
Regular cyl. suction tube flange	N² v 48	utozh
Inlet pipe water jacket flange—inlet	N² v 37	uwekk
Inlet pipe water jacket drain flange	N² v 39	uwemm
Inlet pipe water jacket flange—outlet	N² v 42	uwenn
Gasoline pocket cover plate	N² v 33	utpav
Gasoline pocket cover clip	N² v 34	utpbw
Gasoline pocket cover knob	N² v 32	utpdy
Vaporizer foot elbow (R. H. Eng.)	N² v 43	uwepp
Vaporizer foot elbow (L. H. Eng.)	N² v 44	uwerr
Mixing chamber water jacket plate	N² v 25	utpfa
Vaporizer foot	N² v 26	uwess
Throttle shaft lever	N² v 27	uwett
Throttle stem lever	N² v 30	uwexx
Throttle stem lever pin	N² v 31	uwezz
Gasoline inlet pipe ⅜" pipe	N² v 21	uwfan
Gasoline pump body (for R. H. Eng.)	N² v 50	utpsn
Gasoline pump body (for L. H. Eng.)	N² v 51	uwfbo
Gasoline pump plunger	S v 8	utpto
Gasoline pump plunger gland nut	S v 13	utpup
Gasoline pump plunger wrist pin	S v 15	utpwr
Gasoline pump stuffing box gland liner	S v 12	utpyt
Gasoline pump ecc. strap	N¹ v 97	utpzu
Gasoline pump ecc. strap stud		uwfer
Gasoline pump eccentric	N¹ v 79	utqcl
Gasoline pump eccentric rod	N¹ v 80	utqdm
Gasoline pump pipe bracket	N¹ v 96	utqen
Vaporizer mixing chamber	N² v 8	utqfo
Sprayer shutter plate	N² v 13	utqir
Bushing in mixing chamber	N² v 52	uwfhu
Gasoline hand pump barrel	X f 27	utqkt
Gasoline hand pump plunger rod	X f 28	utqlu
Gasoline hand pump plunger rod handle	X f 32	utqox
Gasoline hand pump gland	X f 30	utqpy
Gasoline hand pump cap	X f 31	utqra
Mixing chamber support cover	N² v 50	uwfiv
Gasoline hand pump collar	X f 29	utqsb
Inlet Pipe Elbow	N² v 35	utrie
Inlet Pipe "Y" Fitting	N² v 36	utrlh

MAIN ENGINE. (CONTINUED.)

Name of Part	Part No.	Code
Throttle valve body water by-pass	N^2 v 49	uwfly
Control lever shaft	N^2 v 19	uwfoc
Gasolene pump valves ⅜″ horizontal checks		uwfqe
Gasolene feed pipe ⅜″ br. pipe	N^2 v 53	uwfsg
⅜″ close nipple		uwfth
⅜″ unions		uwfui
⅜″ union elbow—female ends		uwfym
½″ cone union nipple	20 N^2 f	uwgab
Igniter plug	N^1 I 1	uttby
Movable contact pin	U I 2	uttcz
Ignitor spring rod (trip rod)	N^1 i 3	utteb
Ignitor tripper shaft and lever	N^1 i 4	utthe
Ignitor tripper arm	N^1 i 6	uttif
Ignitor tripper hanger (countersunk)	N^1 i 7	uttkh
Ignitor tripper hanger (plain)	N^1 i 8	uttli
Ignitor tripper hanger bolt	N^1 i 9	uttol
Ignitor tripper shaft bracket	N^1 i 10	uttro
Ignitor lifter rod	N^1 i 11	uttsp
Ignitor tripper eye	Q i 18	uttur
Ignitor tripper eye spring	Q i 19	uttxu
Turnbuckle fork	S i 26	uttyv
Turnbuckle fork bolt	S i 27	uttzw
Turnbuckle nut	S i 28	utual
Turnbuckle lock nut	S i 29	utubm
Trip blade	Q i 17	utucn
Movable contact lever	S i 20	utudo
Movable contact lever lock nut	S i 21	uwgde
Movable contact lever filling washer	S i 38	utufq
Shoulder nut	I i 16	utugr
Shoulder nut lock nut	S i 24	uwgef
Shoulder nut washer	I i 17	utuit
Ignitor spring	N^1 i 21	utuju
Wing nuts	N^1 i 16	utukv
Fixed contact pin collar	N^1 i 20	utulw
Outside insulation washer	E i 19	utuny
Inside insulation washer	E i 19	uwggh
Ignitor plug bushing with seat	N^1 i 18	utuoz
Ignitor tips	X i 5	uwghi
Ignitor plug bushing (straight)	N^1 i 19	utuqb
Cyl. wires		uwgij
Terminal tubes		uwgkl
Fixed contact pin	I i 34	uwgmn
Tripper shaft pin	N^1 i 22	uwgno
Circ. pump cyl.	N^1 w 51	utute
⅛″ pet cocks		uwgop
Circ. pump cyl. head	M^1 w 7	utuvg
Circ. pump cyl. head gland liner	N^1 w 98	utuwh
Circ. pump cyl. head gland nut	M^1 w 5	utuxi
Circ. pump cyl. head gland lock nut	M^1 w 6	utuyi
Circ. pump piston	M^1 w 9	utuzk
Circ. pump piston ring	M^1 w 10	utvay

MAIN ENGINE. (CONTINUED.)

Name of Part	Part No.	Code
Circ. pump piston rod and nut	M^1 w 18	utvca
Circ. pump crosshead guide	N^1 w 18	utvec
Circ. pump crosshead	N^1 w 20	utvge
Circ. pump crosshead pin	N^1 w 21	utvig
Circ. pump crosshead pin bushing	M^1 w 15	utvki
Circ. pump conn. rod	N^1 w 23	utvom
Circ. pump crank pin brass	M^1 w 11	utvpn
Circ. pump crank pin brass cap	M^1 w 12	utvqo
Circ. pump crankshaft in gear housing	N^2 w 5	utvtr
Circ. pump split bushing upper half	N^1 w 25	utvus
Circ. pump solid bushing in gear housing	N^1 w 26	utvwu
Circ. pump gear housing	N^2 w 7	utvyw
Circ. pump gear housing caps	N^2 w 8	utwam
Eng. cr'sh'ft gear	N^1 w 29	utwco
Second shaft gear	N^1 w 30	utweq
Second shaft and pinion (1 piece)	N^2 w 3	utwfr
Pump cra'sh'ft gear in gear housing	N^2 w 4	utwiu
Circ. pump bush. split bottom halves	N^1 w 95	utwkw
Spanner wrench for pump gland nut	N^1 w 100	utwmy
Circ. pump valve springs (inlet)	E w 7	utwnz
Circ. pump valve springs (disch.)	N^1 w 70	utwoa
Circ. pump valve seats	N^2 w 6	utwse
Circ. pump valve studs (inlet)	E w 3	utwug
Circ. pump valve studs (disch.)	N^1 w 71	utwvh
Circ. pump valve discs	C d 21	utwwi
Circ. pump conn. rod bolt	N^2 w 20	uwgst
Circ. pump valve disc washer	C d 24	utwyk
Circ. pump valve caps	C d 23	utwzl
Air chamber shell	N^1 w 13	utxaz
Complete Air Chamber		uwbkv
Air chamber upper head	N^1 w 72	utxba
Air chamber lower head	N^1 w 73	utxed
Air chamber concave nut	N^1 w 74	utxfe
Air chamber convex nut	N^1 w 75	utxih
Air chamber nipple	N^1 w 76	utxji
Water inlet flange on cyl. head	N^1 w 35	utxon
Water br'k't inlet nozzle	N^1 w 101	utxpo
Water outlet conn. on cyl. head	N^1 w 44	utxsr
Cyl. water inlet bracket	N^1 w 43	utxts
Cyl. water inlet rail (for'd length)	N^1 w 62	utxut
Cyl. water inlet rail (inter length)	N^1 w 63	utxvu
Cyl. water inlet rail (aft length)	N^1 w 64	utxyx
Outlet water rail (for'd length)	N^1 w 66	utxzy
Outlet water rail (inter length)	N^1 w 67	utyan
Outlet water rail (aft length)	N^1 w 68	utybo
Water rail caps	N^1 w 69	utycp
Exp. Un. for circ. water rail		uwbwh
Cyl. water rail expansion joint base	N^1 w 59	utydq
Cyl. water rail expansion joint liner	N^1 w 60	utyer
Cyl. water rail expansion joint gland nut	N^1 w 61	utyfs
Cyl. water drain bracket	N^1 w 41	utygt

MAIN ENGINE. (CONTINUED.)

Name of Part		Part No.	Code
Cyl. water drain flange		N¹ w 42	utyhu
Water pressure adjusting valve			uwbny
Adj. angle check valve body		N¹ w 81	utyiv
Exh. pipe water inlet channel (R. H. Eng.)		N¹ w 82	utyjw
Exh. pipe water inlet channel (L. H. Eng.)		N¹ w 83	uwgtu
Exh. pipe water inlet channel tapered flange		N¹ w 107	uwguv
Adj. check valve body cap		N¹ w 84	utykx
Hand wheel		N¹ w 85	utyly
Spring—Set for 15 lbs. maximum operating press		N¹ w 86	utymz
Adj. screw and lock nut		N¹ w 87	utynb
Screw end spring header		N¹ w 88	utyoc
Valve end spring header		N¹ w 89	utypd
Valve poppet		N¹ w 90	utyqe
Angle check valve body gland nut		N¹ w 77	utyrf
Exh. pipe water outlet tapped flange		N¹ w 38	utysg
Bracket for ¾″ pipe drain rail (valves)		N¹ w 49	utyth
¾″ water drain rail—Assembly valves		N² w 27	uwgxy
¾″ pipe hose conn. threaded br'k't ell (R. H. Eng.)		X w 37	utyvj
¾″ pipe hose conn. threaded br'k't ell (L. H. Eng.)		X w 38	utywk
¾″ pipe hose conn. soldered tee		X w 36	utyxl
¾″ pipe hose conn. soldered br'k't tee		X w 35	utyym
¾″x¾″x½″ tee—commercial			uwgyz
⅛″ ell	For circ. pump Crosshead drain		uwgza
⅛″ close nipple			uwhao
3/16 O. D. Br. tube soldered into ⅛″ Br. pipe plug		N² w 12	uwhdr
⅛″ Br. pipe length bent to form		N² w 21	uwhes
Br. clamp for ⅛″ pipe		X w 141	uwhgu
Pump gear housing drain pipe		N² w 26	uwhiw
¼″ check valve	Water press gauge conn. to aft cyl.		uwhky
¼″ close nipple			uwhma
¼″x½″ elbow			uwhob
⅛″ close nipple			uwhre
30 lbs. press. gauge 3″ D.			uwhsf
½″x2½″ nipple	Water feed to vaporizer		uwhuh
½″ union elbow—female			uwhvi
½″ elbow			uwhyl
⅛″ pet cock			uwhzm
½″ pipe—62½″ long	Overflow from vaporizer	N² w 16	uwiac
½″x½″x⅛″ Tee		N² w 17	uwibd
½″ pipe bracket		N² w 11	uwidf
⅛″ pipe—18½″ long (R. H. Eng.)	Overflow from compressor	N² w 18	uwieg
⅛″ pipe—18½″ long (L. H. Eng.)		N² w 19	uwifh
⅛″ union			uwigi
⅛″ close nipple			uwihj
½″ union elbow—male			uwiik
½″ pipe 5′ 8″ lg. bent (R. H. Eng.)		N² w 24	uwijl
½″ pipe 5′ 8″ lg. bent (L. H. Eng.)		N² w 25	uwikm
¼″ pipe lengths—11⅛″ long	Water feed to cyl. head		uwiln
¼″ ells			uwimo
¼″ unions			uwinp
¼″ close nipples			uwioq
¼″ nipples—1¾″ long			uwipr

MAIN ENGINE. (CONTINUED.)

Name of Part	Part No.	Code
Cyl. head feed horiz. nipple	N^1 w 96	uwiqs
Cyl. head feed vert. nipple	N^1 w 97	uwirt
Circ. pump valve chest cover (inlet R. H. Eng.)	N^1 w 91	uuber
Circ. pump valve chest cover (inlet L. H. Eng.)	N^1 w 92	uwisu
Circ. pump valve chest cover (Disch. R. H. Fng.)	N^2 w 1	uubhu
Circ. pump valve chest cover (Disch. L. H. Eng.)	N^2 w 2	uwitv
Expansion gland	N^1 w 56	uuboc
Expansion joint liner	N^1 w 57	uubqe
Exhaust manifold		uwboz
1/8" angle valve		uwiuw
1/8" union		uwivx
1/8" close nipple		uwiwy
1/8" pipe 24 3/4" lg. bent (R. H. Eng.)	N^2 w 22	uwixz
1/8" pipe 24 3/4" lg. bent (L. H. Eng.)	N^2 w 23	uwiya
1/2"x1/8" bushing		uwizb
Valve water circ. conn. hose (inlet)		uwjap
Valve water circ. conn. hose (outlet)		uwjcr
Valve water circ. conn. hose clamp		uwjet
Valve water circ. conn. hose clamp screws and nuts		uwjfu
Exh. manifold inner shell	N^2 m 21	uubsg
Exh. manifold outer shell	N^2 m 22	uubth
Exh. manifold end flange	N^1 m 26	uubui
Exh. manifold end flange cover	N^1 m 27	uubym
Exh. manifold cyl. conn. and hand hole saddle flange	N^1 m 3	uucab
Exh. manifold cyl. conn. and hand hole saddle packing flange	N^1 m 4	uucde
Exh. manifold hand hole cover	N^1 m 5	uucef
Exh. manifold drain pipe flange	S m 11	uucgh
Exh. manifold water conn. saddle flange	N^2 m 19	uuchi
Soft washer for exhaust pipe	N^1 m 50	uucij
Oiler drive rod universal joint	X o 83	uudky
Oiler drive rod universal joint	X o 97	uudma
Oil Ring		uwbuf
Crankshaft oil ring (bolted half)	N^2 o 15	uudob
Crankshaft oil ring (flying half)	N^2 o 16	uudre
Crankshaft oil ring cap studs	I o 9	uwjix
Crankshaft oil ring stud	I o 10	uuduh
Aft. inlet side splash guard plate	N^2 o 19	uudzm
For'd inlet side splash guard plate	N^2 o 20	uufap
Aft. exh. side splash guard plate	N^2 o 3	uufcr
For'd exh. side splash guard plate	N^2 o 4	uufds
Splash guard stanch. clip	N^2 o 7	uufet
Splash guard stanch. clip stud, exh. side 4 1/2" O. A.	N^2 o 6	uuffu
Splash guard stanch. clip stud, inlet side 2 1/4" O. A.	N^2 o 8	uufix
Splash guard plate base clip	N^2 o 21	uufjy
Splash guard plate base clip (long)	N^2 o 22	uwjjy
Double sight feed oiler	X o 3	uufla
Triple sight feed oiler	X o 4	uufod
Sight feed oiler straps	X o^1 43	uufpe
Sight feed oiler pins	X o 2	uufsh
Oil pipe gland nuts	X o^2 24	uufti
1/4" copp. oil tubing		uxpyp

MAIN ENGINE. (CONTINUED.)

Name of Part	Part No.	Code
Oil pipe clamp		uxqaf
Oil pipe clamp— 3 pipes	X o 38	uufzo
Oil pipe clamp— 2 pipes	X o 37	uuhaq
Oil pipe clamp— 4 pipes	X o 39	uuhbr
Oil pipe clamp—11 pipes	X o 98	uuhcs
Oil pipe ends	X o 54	uwjla
⅛″ oil cups on gear housing		uwjod
Cyl. oiler tee	X o 45	uuhgw
Cyl. oiler elbows	X o 103	uuhiy
Oiler feed needle	X o 46	uuhka
Close nipple		uwjpe
⅛″ elbow		uwjsh
⅛″ union conn. and nuts		uwjti
Detroit oiler, 17 feeds, C. I. body (L. H. Drive for R. H. Eng. and vice versa)		uwjuj
Detroit oiler drive crank and nut	N¹ o 32	uuhmc
Circ. pump conn. rod oil cup	N¹ o 34	uuhnd
Oiler drive rod	N¹ o 21	uuhoe
Oil pan for camshaft drive gear (R. H. Eng.)	N² o 17	uuvaz
Oil pan for camshaft drive gear (L. H. Eng.)	N² o 18	uvaba
Exh. valve feed tee	X o 45	uwjyn
Aft oiler bracket (R. H. Eng.)	N² o 5	uvadc
Aft oiler bracket (L. H. Eng.)	N² o 9	uwjzo
For'd oiler bracket (R. H. Eng.)	N² o 10	uvaed
For'd oiler bracket (L. H. Eng.)	N² o 11	uwkad
Oil pipe clamp 6 pipe	X o 41	uwkbe
Oil pipe clamp 10 pipe	X o 101	uwkeh
Oil pipe clamp 8 pipe	X o 102	uwkfi
Crankshaft oil ring stud nut	I o 15	uwkil
Exh. valve feed ell	X o 103	uvakj
Air pump feed tee	X o 45	uwkkn
Air pump feed ell	X o 103	uvaml
Magneto cover (side) (R. H. Eng.)	1 N² o	uvanm
Magneto cover (side) (L. H. Eng.)	3 N² o	uwklo
Magneto cover (end) (L. H. Eng.)	2 N² o	uvaon
Magneto cover (end) (R. H. Eng.)	4 N² o	uwkor
Drip pan	N² o 13	uwkps
Drip pan flange	N² o 14	uwkru
½″ pipe plug		uwksv
Aft. oil dash plate exh. side	N² o 23	uwktw
For'd oil dash plate exh. side	N² o 24	uwkux
Aft. inlet side splash guard plate	N² o 25	uwkvy
For'd inlet side splash guard plate	N² o 26	uwkxa
Crankshaft oil ring feed tube	N² o 27	uwkyb
Strap for one ¼″ tube	X o 106	uwlaq
Strap for three ¼″ tube	X o 107	uwlbr
Strap for one ¼″ tube and one ⅛″ pipe	X o 108	uwlcs
Strap for one ¼″ tube to 5/16″ bolt	X o 109	uwleu
Strap for compr. oil feed tee	X w 142	uwlgw
Magneto side cover (R. H. Eng.)	6 N² o	uwliy
Magneto side cover (L. H. Eng.)	7 N² o	uwlka

MAIN ENGINE. (CONTINUED.)

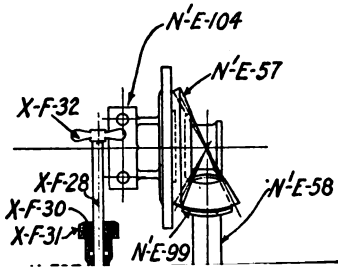
Name of Part	Part No.	Code
Water cooled air comp. cyl.	N^2 a 5	uvapo
Water cooled air comp. eccentric	N^2 a 6	uvarq
Water cooled air comp. eccentric strap	N^2 a 7	uwbpa
Water cooled air comp. eccentric strap cap	N^2 a 8	uvats
Water cooled air comp. eccentric rod	N^2 a 9	uvaut
Water cooled air comp. cyl. head	N^1 a 55	uvavu
Water cooled air comp. piston	N^1 a 52	uvawv
Water cooled air comp. piston rings		uvaxw
Water cooled air comp. wrist pin	N^1 a 54	uvayx
Water cooled air comp. wrist pin set screw		uwloe
Water cooled air comp. press. reg. cyl.	N^1 a 60	uvbam
Water cooled air comp. press. adj. nut	N^1 a 62	uvbco
Water cooled air comp. press. adj. valve plug	N^1 a 61	uvbeq
Water cooled air comp. press. adj. valve plug stop	N^1 a 63	uvbfr
Water cooled air comp. press. adj. valve plug spring	N^1 a 71	uvbiu
Water cooled air comp. press. reg. cyl. cap	N^1 a 64	uvbkw
Water cooled air comp. press. reg. cyl. cutout screw	N^1 a 66	uvbmy
Water cooled air comp. press. reg. cyl. cutout gland	N^1 a 65	uvbnz
Water cooled air comp. press. reg. cyl. piston	N^1 a 69	uvboa
Water cooled air comp. press. reg. cyl. piston return spring	N^1 a 80	uvbse
Water cooled air comp. inlet valve	N^1 a 56	uvbug
Water cooled air comp. inlet valve spring	N^1 a 72	uvbvh
Water cooled air comp. inlet valve spring collar	N^1 a 67	uvwbi
Water cooled air comp. inlet valve spring collar key	N^1 a 68	uwlpf
Water cooled air comp. disch. valve guide	O a 55	uvbzl
Water cooled air comp. disch. valve guide cap	O a 56	uvdan
Water cooled air comp. disch. valve spring collar	O a 59	uvdbo
Water cooled air comp. disch. valve spring	N^1 a 73	uvder
Water cooled air comp. disch. valve and nut	N^1 a 58	uvdhu
Water cooled air comp. cyl. water channel	N^1 a 59	uvdiv
Press. adj. nut spring	N^1 a 75	uvdly
W. C. air comp. cyl. water channel stud	N^1 a 77	uwlrh
Air comp. steady bracket (short)	N^1 a 82	uwlsi
Air comp. steady bracket (long)	N^1 a 83	uwltj
Comp. air start. valve stem cone nut	N^1 a 15	uvdqe
Comp. air start. valve stem sleeve	N^1 a 17	uvdsg
Comp. air start. valve spring	N^1 a 84	uwluk
Comp. air start. valve body	N^1 a 44	uvdui
Comp. air start. valve pipe rail, 1¼" pipe		uwlvl
Comp. air start. valve	N^2 a 1	uveab
Comp. air start. valve lock nut		uwlyo
Comp. air pipe exp. joint base, 1¼" pipe	X w 7	uvecd
Comp. air pipe exp. joint gland nut	X w 117	uvede
Complete cyl. air check valve		uwbte
Cyl. air check valve cage	N^1 a 38	uveef
Cyl. air check valve	N^1 a 40	uvefg
Cyl. air check valve stop collar	N^1 a 43	uvegh
Cyl. air check valve spring	N^1 a 41	uvehi
Cyl. air check valve spring washer	N^1 a 42	uveij
Eccentric rod stud	N^2 a 11	uwmae
Eccentric rod strap stud	N^2 a 10	uwmdh

MAIN ENGINE. (CONTINUED.)

Name of Part	Part No.	Code
Comp. air throttle valve		uwmei
Air pipe end cap		uveno
Air comp. cyl. pet cock 1/8"	N² a 3	uwmfj
Reverse control lever		uvgmo
Reverse control lever clamp	N¹ c 54	uvgoq
Reverse control lever latch	N¹ c 55	uvgpr
Reverse control lever latch stud	N¹ c 3	uwmim
Reverse control lever latch stud washer	N¹ c 4	uwmko
Reverse control lever latch handle	N¹ c 5	uvguw
Reverse control lever fulcrum pin	N¹ c 6	uvgwy
Reverse control lever sector	N¹ c 7	uvgya
Air starting handle	N¹ c 8	uvhap
Air starting handle pin	N² c 1	uwmos
Control bracket—port (R. H. Eng.)	N² c 3	uvhds
Control bracket—port (L. H. Eng.)	N¹ c 12	uwmpt
Control bracket cap	N¹ c 46	uvhet
Control bracket starb'd (R. H. Eng.)	N¹ c 13	uvhfu
Control bracket starb'd (L. H. Eng.)	N¹ c 14	uwmqu
Control handle shaft	N¹ c 47	uvhix
Throttle control sector	N¹ c 15	uvhjy
Throttle control latch	Q c 14	uvhla
Throttle control latch stud and nut	S c 7	uwmsw
Throttle control rod arm	S c 9	uvhpe
Throttle control rod	N² c 15	uwmuy
Throttle control rod pin	N² c 16	uwmwa
Throttle control yoke end	N² c 18	uwmyc
Throttle control rod end	N² c 17	uwnar
Throttle control rod arm stud	N² c 19	uwnbs
Spark control latch stud and nut	N² c 20	uwndu
Spark control sector	S c 9	uvicf
Spark control rod arm	N¹ c 25	uvidg
Spark control rod	N¹ c 34	uwnev
Spark control rod pin	N¹ c 27	uwnhy
Switch lever handle	N¹ c 29	uvigj
Switch jaw sleeve	Q c 21	uvihk
Switch jaw washer	Q c 7	uviil
Switch lever spring stop	Q c 8	uvijm
Switch lever spring	Q c 16	uvikn
Spool (long)	Q c 17	uvilo
Spool (short)	Q c 18	uvimp
Spool bolt	Q c 19	uwniz
Spark resetting latch slide	N¹ c 58	uvior
Spark resetting latch slide guide (Same for R. H. and L. H. Eng.)	N¹ c 38	uvips
Rev. lever yoke (R. H. Eng.)	N¹ c 39	uviru
Rev. lever yoke (L. H. Eng.)	N¹ c 40	uwnja
Univer'l joint on spark resett. lever (L. H. Eng. only)	N¹ c 44	uwnmd
Spark resetting lever (R. H. Eng.)	X c 8	uvisv
Spark resetting lever (L. H. Eng.)	N¹ c 49	uwnne
Spark control rod jaw (for both R. H. and L. H. Engs.)	N¹ c 50	uvitw
Control lever latch eye	X c 127	uviux
Rev. lever latch pin	N¹ c 51	uvivy
	N¹ c 52	

MAIN ENGINE. (CONTINUED.)

Name of Part	Part No.	Code
Rev. lever fulcrum pin	N^1 c 53	uviwz
Spark control latch handle	N^1 c 56	uvixa
Throttle valve control latch handle	N^1 c 57	uviyb
Spark control rod jaw pin	X c 15	uwnof
Spark advance hand lever latch	Q c 49	uvjeu
Spark and throttle control latch grip	N^2 c 4	uvjgw
Latch grip pin	N^2 c 5	uvjiy
Latch grip spring	N^2 c 6	uvjka
Air starting valve bracket	N^2 c 7	uvjoe
Spark control rod arm washer	N^1 c 63	uvjpf
Switch lever	N^2 c 9	uvjrh
Switch lever insulator bushing	N^2 c 10	uvjsi
Switch lever insulator washers	N^2 c 11	uvjtj
Switch jaws (R. H.)	N^2 c 12	uvjuk
Switch jaws (L. H.)	N^2 c 13	uvjvl
Switch jaws spacer	N^2 c 14	uvjyo
Contact	1 N^2 I	uwnri
Insulator	2 N^2 I	uwnsj
Filler	3 N^2 I	uwnul
Connection stud and washer	5 N^2 I	uwnxo
Insulating bushing	6 N^2 I	uwnyp
Insulating washer	7 N^2 I	uwoaf
Magneto gear—large	1 N^1 N	uvest
Magneto gear—small	1 N^2 N	uvetu
Magneto gear nut	3 N^1 N	uveuv
Magneto bracket (R. H. Eng.)	4 N^1 N	uvevw
Magneto bracket (L. H. Eng.)	8 N^1 N	uwoch
Magneto bracket cap	5 N^1 N	uvewx
Magneto bracket liner	6 N^1 N	uvexy
Cranking bar	N^2 T 4	uwodi
Stanchion nut wrench	N^2 T 5	uwoej
Inlet valve grinding tool	N^2 T 7	uwofk
Vaporizer nozzle tip socket wrench		uveqr
Packing box for tools	N^2 T 8	uwogl
Inlet valve bonnet and plunger wrench	N^2 T 9	uwohm
Reseating tool	N^2 T 10	uwoin
Cutter	N^2 T 11	uwojo
Reseating tool stem	N^2 T 12	uwokp
Cutter	N^2 T 13	uwolq
Valve reseating tool guide	N^2 T 14	uwomr



AUXILIARY ENGINE

Name of Part	Part No.	Code
Base	B e 21	uvlja
Engine cylinder—R.H.	B e 22	uvlmd
Engine cylinder—L.H.	B e 23	uvlne
Stanchions:		
No. 1 exh. side	B e 26	uvlri
No. 1 inlet side	B e 27	uvlsj
No. 4 inlet side—Flywheel end	B e 28	uvlul
No. 4 exh. side	B e 29	uvlxo
No. 2 inlet side	B e 30	uvlyp
No. 3 exh. side	B e 30	uvmaf
No. 3 inlet side	B e 31	uvmch
No. 2 exh. side	B e 31	uvmdi
Longitudinal brace—11 9/16″ long	B e 93	uwpcu
Longitudinal brace—11 1/8″ long	B e 82	uvmej
Cross brace	B e 83	uvmgl
Brace bolt—long	B e 84	uwpdv
Brace bolt—short	B e 85	uwpew
Long. brace washer	B e 88	uvmjo
Main bearing cap—Flywheel end	B e 32	uvmot
Main bearing cap—Pump drive end	B e 33	uvmpu
Camshaft gear cover	B e 34	uvmty
Main bearing cap—Intermediate	B e 51	uvmuz
Nut for end bearing cap stud	B e 74	uvmva
Intermediate bearing bush—Half	B e 52	uvmze
Long end bearing bush—Half	B e 53	uvnas
Short end bearing bush—Half	B e 54	uvncu
Crank shaft	B e 20	uvnew
Crank shaft nut—castellated	B e 76	uvngy
Flywheel	B e 55	uvnia
Dynamo shaft coupling	B e 87	uvnme
Wrist pin bushing	G e 28	uvnog
Connecting rod	G e 29	uvnph
Connecting rod bolts	G e 77	uwpgy
Crank pin brass	G e 30	uvnsk
Crank pin brass cap	G e 31	uvntl
Piston	B e 24	uvnum
Piston ring		uvnwo
Wrist pin	B e 35	uvnyq
Wrist pin set screw	B e 80	uwpia
Wrist pin taper screw	B e 81	uvoag
Inlet and exh. valves	C e 36	uvobh
Inlet and exh. spring collar	C e 40	uvoci
Valve key	C e 78	uvodj
Valve guide	C e 35	uvoek
Valve covers	C e 46	uvofl
Exh. valve spring	C e 38	uvogm
Inlet valve spring	C e 39	uvohn
Exhaust cam	B e 94	uvojp

AUXILIARY ENGINE. (CONTINUED.)

Name of Part	Part No.	Code
Inlet cam	B e 95	uvlkq
Valve lifter	B e 42	uvolr
Rocker shaft and collars	B e 41	uvoms
Valve lifter roller	G e 37	uvont
Valve lifter pin	G e 38	uvopv
Cam shaft—Pump drive end	B e 96	uvorx
Cam shaft—Flywheel end	B e 97	uvosy
Valve push rod	B e 43	uvotz
Valve push rod cone nut	B e 44	uvovb
Valve push rod lock nut	B e 45	uwpme
Cam shaft bearing	B e 57	uvoxd
Cam shaft bearing cap	B e 58	uvoye
Cam shaft bearing bolts	B e 79	uwpog
Hindley worm	C e 76	uvpat
Hindley wheel	C e 77	uvpbu
Priming cock—Long shank 1/8"		uxqch
Test cock—Lunkenheimer 1/8"		uxqdi
Test cock lever	X e 1	uvpfy
Test cock rod	X e 2	uvpha
Test cock handle	X c 116	uvpib
Test cock handle pin	X c 117	uvple
Magneto base plate	B e 86	uvpng
Side door—Inlet side	B e 98	uvpoh
Side door—Exh. side, lower	B e 99	uvppi
Side door—Exh. side, upper	B e 100	uvpsl
Side door clip	B e 92	uvptm
Side door thumb screw	B e 101	uvpun
Base hand hole cover—Exh. side	B e 102	uwpph
Base hand hole cover—Inlet side	B e 103	uwpqi
Gasoline pump eccentric	B v 1	uvpvo
Gasoline pump eccentric strap	B v 2	uvpyr
Gasoline pump eccentric plate	B v 3	uvpzs
Gasoline pump body	B v 4	uvqah
Gasoline pump plunger	B v 5	uvqbi
Gasoline pump valve cap	B v 6	uvqel
Gasoline pump plunger pin	C g 49	uvqgn
Gasoline pump gland nut	B v 27	uvqho
Gasoline pump ball valve—large 1/2"		uwpsk
Gasoline pump ball valve—small 5/16"		uwptl
Gasoline hand pump		uvqip
Handle—Tapped 1/4"/20	X f 32	uvqkr
Pump bushing	X f 77	uvqnu
Pump barrel	X f 80	uvqov
Pump plunger	X f 81	uvqry
Pump gland nut	X f 78	uvqsz
Reg. 1/4" brass tee		uxqej
Reg. 1/4" brass el.		uxqgl
Reg. 1/4" angle check valve		uxqhm
Inlet pipe elbow—R. H.	B v 14	uvqyf
Inlet pipe elbow—L. H.	B v 15	uvrau
Cut-off valve body, with flanged connection for inlet pipe	B v 31	uvrey

AUXILIARY ENGINE. (CONTINUED.)

Name of Part	Part No.	Code
Cut-off valve body flange	B v 17	uvrga
Cut-off valve caps	B v 18	uvric
Cut-off valve piston	B v 19	uvrke
Horizontal inlet tube	B v 28	uvroi
Vertical inlet tube	B v 29	uvrsm
Vertical inlet tube flange	B v 30	uvrtn
Carburetor—Schebler "D"—special		uvruo
Governor eccentric	B g 18	uvrys
Governor eccentric strap	B g 19	uvsai
Governor eccentric strap cap	B g 20	uvsbj
Governor eccentric rod	B g 21	uwpum
Governor eccentric ball socket	C g 43	uvsem
Governor eccentric ball socket cap	C g 44	uvsfn
Governor eccentric ball socket lock nut	C g 45	uvsgo
Governor eccentric ball socket lock washer	X o1 19	uvsiq
Governor bell crank	C g 46	uvsks
Governor bell crank washer	C g 48	uvsmu
Governor valve rod pin	C g 49	uvsow
Governor valve rod	C g 50	uvsqy
Governor bell crank bracket	B g 22	uvssa
Governor weight	B g 30	uvsuc
Governor spring socket header	B g 31	uvswe
Governor spring eye header	B g 33	uvsyg
Governor spring	B g 32	uvszh
Governor spring tension bolt	B g 34	uvtav
Governor spring pin and nut	B g 35	uvtbw
Governor spring pin washers	B g 36	uvtdy
Governor eccentric shaft bushing	B g 38	uvtez
Governor eccentric shaft collar	B g 39	uvtfa
Governor stop	B g 40	uvtid
Governor spring pin adjusting screw		uxqin
Governor eccentric strap bolt	B g 41	uwpwo
Circulating pump body	B w 2	uvtni
Circulating pump conn. rod and nut	B w 3	uvtoj
Circulating pump eccentric	B w 4	uvtsn
Circulating pump eccentric plate	B w 5	uvtto
Circulating pump eccentric strap	B w 22	uvtup
Circulating pump plunger	G w 2	uvtwr
Circulating pump gland nut	G w 3	uvtyt
Circulating pump wrist pin	G w 4	uvtzu
Circulating pump wrist pin brass	B w 23	uvuaj
Circulating pump outlet valve—Reg. ½" vert. check		uwpyq
Circulating pump inlet valve—Reg. ½" horiz. check		uwpzr
Circulating pump body dowel		uwqag
Air comp'r. water channel	B w 11	uvuen
Cyl. water outlet fitting	B w 15	uvufo
Air comp'r. outlet fitting	B w 16	uvugp
Water outlet pipe—Reg. ½" br. pipe 16¼" long	B w 21	uwqbh
Water outlet elbow—Reg. ½" br. elbow		uwqci
Cyl. water inlet fitting—end	B w 18	uvukt
Cyl. water inlet fitting—intermediate	B w 19	uvulu

AUXILIARY ENGINE. (CONTINUED.)

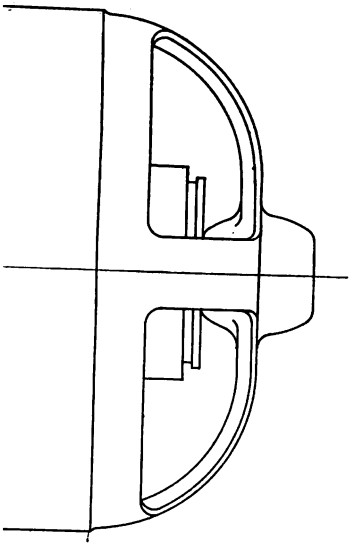
Name of Part	Part No.	Code
Cyl. water inlet tee—Reg. ½″ tee drilled out	B w 17	uvumv
Cyl. water inlet pipe—Reg. ½″ pipe 12½″ lg.	B w 20	uwqdj
Vertical water inlet pipe—½″x5½″ nip. and close nip.		uwqek
Pump suction pipe—Three ½″ close nip. and el.		uwqfl
½″ brass unions		uwqgm
Cylinder drain cock—Reg. ⅛″ pet cock		uxqjo
Exhaust elbow	B m 1	uvuox
Exhaust manifold—Galv. pipe and fittings		uwqio
1½″ galv. pipe about 21″ long		uwqou
1½″ galv. nipple 3½″ long		uwqsy
1½″ galv. nipple 3¼″ long		uwqtz
1½″ galv. nipple close		uwqua
1½″ galv. elbow with ½″ heel outlet		uwqye
1½″ galv. 45° elbow		uwrat
1½″ galv. Y branch		uwrbu
1½″ galv. union		uwrcv
1½″x2½″ galv. nipple		uwrdw
Crank pin oil ring—For cranks No. 1 and No. 2	B o 1	uvuve
Crank pin oil ring—For crank No. 3 (next flywheel)	B o 10	uvuwf
Crank pin oil ring stud and nut	B o 2	uvuxg
Crank pin oil ring stud (for after crank)	B o 16	uwrex
Oiler drive rod	B o 13	uxqot
Oiler drive eccentric	B o 14	uvuzi
Oiler drive eccentric plate	B o 15	uvvaw
Oiler drive eccentric strap	B o 12	uvvcy
Oiler support—For Detroit oiler	B o 9	uvvdz
Single sight feed oiler—Tapped both sides	X o 1	uvvea
Double sight feed oiler—Tapped one side	X o 3	uvvie
Pins for sight feed oiler	X o 2	uvvlh
Oil pipe ends	X o 54	uvvmi
Oil pipe union nut	X o² 24	uvvok
Oil pipe connection—For No. 1 main br'g cap		uxqpu
Oil pipe connection—For No. 2, 3, and 4 main br'g cap		uxqty
Oil pipe clamp, single	X o 36	uvvpl
Oil pipe clamp, double	X o 37	uvvuq
Oil pipe clamp, triple	X o 38	uvvvr
6-feed oiler—Detroit		uvvyu
Drip pan	B o 17	uvwak
Air compressor cylinder	B a 20	uvwbl
Air compressor cyl. head	B a 21	uvwdn
Air compressor piston	B a 22	uvweo
Air compressor piston ring		uvwis
Air compressor conn. rod	B a 23	uvwku
Air compressor conn. rod brass	B a 24	uvwoy
Air compressor conn. rod cap	B a 25	uvwqa
Air compressor wrist pin	B a 26	uvwsc
Air compressor wrist pin bushing	G e 28	uvwue
Air compressor inlet valve case	B a 27	uvwyi
Air compressor inlet valve cover	B a 28	uvxax
Air compressor inlet valve guide cap	B a 29	uvxby
Air compressor inlet valve	B a 30	uvxcz

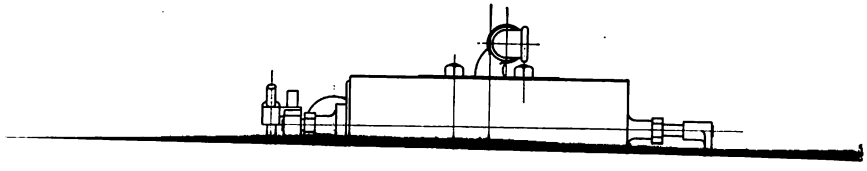
AUXILIARY ENGINE. (CONTINUED.)

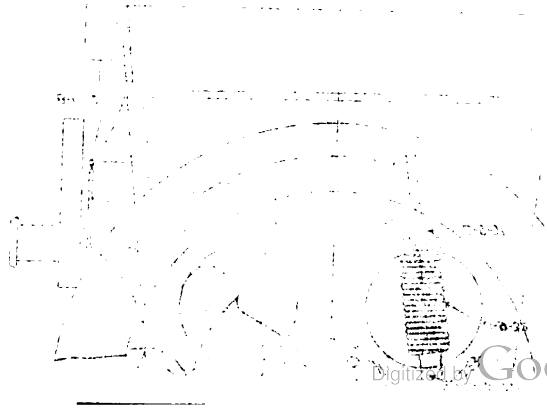
Name of Part	Part No.	Code
Air compressor inlet valve stop collar	B a 31	uvxda
Air compressor inlet valve spring	B a 32	uvxeb
Air compressor inlet valve release screw	B a 33	uvxhe
Air compressor inlet valve release screw spring	B a 34	uvxif
Air compressor inlet valve release screw spring screw		uvxkh
Air compressor outlet valve case	B a 35	uvxli
Air compressor outlet valve cover	B a 36	uvxol
Air compressor outlet valve cover plug		uvxro
Air compressor outlet valve	B a 37	uvxsp
Air compressor outlet valve spring	B a 38	uvxur
Air compressor outlet valve spring washer	B a 39	uvxxu
Air compressor outlet valve sleeve 7/16" o. d. x No. 17–1 5/8" long	B a 51	uwrfy
Air suction muffler, inner shell	B a 43	uvxyv
Air suction muffler, outer shell	B a 44	uvxzw
Air suction muffler head	B a 45	uvyal
Air suction muffler tee	B a 50	uvybm
Compressor cyl. head studs	B a 46	uwrha
Compressor conn. rod bolts	B a 47	uwrib
Compressor wrist pin taper screw	B a 48	uvyep
Compressor wrist pin set screw	B a 49	uwrle
Starting pin	B s 2	uwrng
Starting crank arm	B s 3	uvyuf
Starting crank handle	X c 113	uvyvg
Starting crank handle pin	G s 7	uvywh
Starting crank handle cap	G s 6	uvyxi
Bilge pump drive gear case	B d 2	uvyyj
Bilge pump drive pinion	B d 3	uvyzk
Bilge pump drive gear	C d 14	uvzay
Gear shifting lever	B d 4	uvzca
Gear shifting lever latch pin and washers	B d 5	uvzec
Gear shifting lever latch spring	B d 6	uvzge
Gear shifting lever latch handle	X c 115	uvzig
Intermediate shaft	B d 8	uvzki
Intermediate shaft collar	B d 7	uvzom
Intermediate shaft screw	B d 15	uwroh
Intermediate shaft bushing	B d 9	uvzqo
Pump drive bevel gear	B d 10	uvztr
Pump drive bevel pinion	C d 4	uvzus
Pump crank disc shaft	B d 11	uvzwu
Pump crank disc shaft bushing	B d 12	uvzyw
Pump crank disc	C d 13	uwaay
Pump crank pin and washer	C d 7	uwabz
Pump crank pin brass	M¹ w 11	uwaca
Pump crank pin brass cap	M¹ w 12	uwadb
Pump connecting rod	M¹ w 14	uwaec
Pump connecting rod bolts		uxquz
Pump wrist pin bushing	M¹ w 15	uwage
Pump cross head	M¹ w 2	uwahf
Pump cross head tee plate	M¹ w 3	uwaig
Pump cross head pin and nut	B d 16	uwajh
Bilge pump piston	M¹ w 9	uwaki

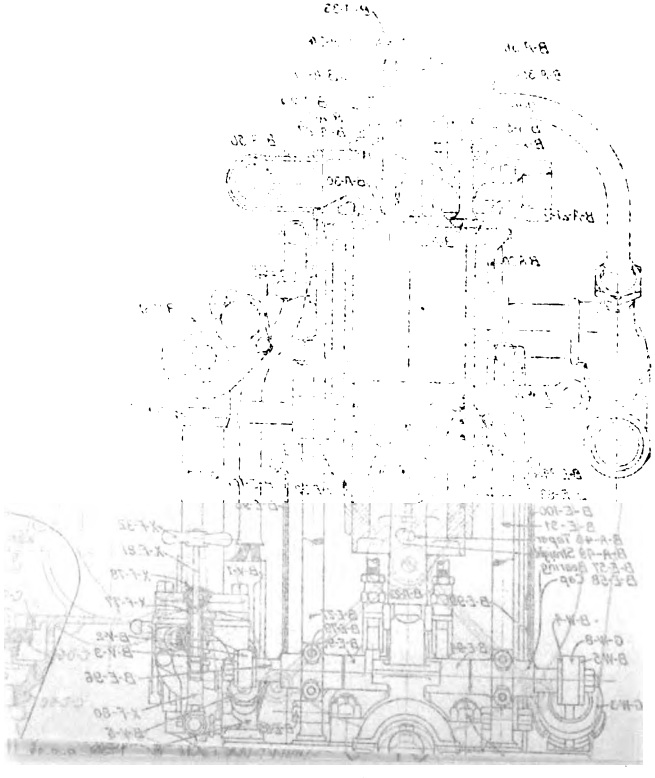
AUXILIARY ENGINE. (CONTINUED.)

Name of Part	Part No.	Code
Bilge pump piston ring	M^1 w 10	uwalj
Bilge pump piston rod and nuts	M^1 w 18	uwamk
Bilge pump bracket	C d 12	uwanl
Bilge pump cylinder	C d 20	uwaom
Bilge pump cylinder head	M^1 w 7	uwapn
Bilge pump stuff box gland	M^1 w 4	uwaqo
Bilge pump stuff box nut	M^1 w 5	uwarp
Bilge pump stuff box lock nut	M^1 w 6	uwasq
Bilge pump valve seats	C d 22	uwatr
Bilge pump valve stud	E w 3	uwaus
Bilge pump valve spring	E w 7	uwavt
Bilge pump valve washer	C d 24	uwawu
Bilge pump valve disc	C d 21	uwaxv
Bilge pump valve cap—solid	C d 23	uwayw
Bilge pump valve cap tapped for air chamber	C d 26	uwazx
Bilge pump air chamber. No. 1 air chamber		uwbal
Bilge pump drain cock. Reg. ¼" pet cock		uwbcn
Magneto gear	B n 1	uvygr
Cross shaft gear	B n 2	uvyhs
Spark control bell crank	B n 17	uvyit
Spark control bracket	B n 4	uvyju
Fulcrum pin	B n 8	uvykv
Spark control link pin	B n 9	uvylw
Pawl and spring	B n 11	uvymx
Spark control link	B n 12	uvyny
Wire duct—¾" o. d. x No. 22 B.W.G. br. tube	B n 20	uvyoz
Wire duct upper support—for'd cylinder	B n 18	uvypa
Wire duct upper support—after cylinder	B n 21	uwrpi
Magneto—Dixie–2–M–counter-clockwise–timing lever, left hand		uvysd









INSTALLATION PARTS

Name of Part	Part No.	Code
Compressed Air Tanks 14″ dia x 96″	51 N² a	uwrsl
Tank Drain Close Nipple		uwrtm
Tank Drain Elbow		uwrun
Tank Drain Angle Valve (Extra Heavy)		uwrvo
Tank Drain Pipe (Lower Tank) Long	52 N² a	uwryr
Tank Drain Pipe (Upper Tank)	54 N² a	uwrzs
Tank Drain Pipe (Middle Tank)	53 N² a	uwsah
Safety Valve		uwsbi
Safety Valve Elbow ¾″ x 1″ x ¼″	55 N² a	uwsel
Safety Valve Nipple Close (1″ Galv. Pipe)		uwsgn
Gage Scale 0 lb. to 500 lb.		uwsho
Gage Pipe (Upper Tank) 6′ 4 7/16″ long	58 N² a	uwsip
Gage Pipe (Middle Tank) 7′ 6 1/16″ long	57 N² a	uwskr
Gage Pipe (Lower Tank) 9′ 4 7/8″ long	56 N² a	uwsnu
Gage Pipe Union Male End	24 N² f	uwsov
Gage Pipe Union Nut	25 N² f	uwsry
Gage Pipe Union Washer	26 N² f	uwssz
Gage Pipe ¼″ Angle Valve		uwsta
Gage Pipe ¼″ Angle Valve Close Nipple		uwsub
Tank Drain Nipple	C 2	uwsxe
Supply Pipe Angle Valve	70 N² a	uwsyf
Supply Pipe Cross Valves	69 N² a	uwtau
Whistle Pipe Cross Valves	73 N² a	uwtey
Valve Gland Nuts	5 N² a	uwtga
Valve Gland Washers	6 N² a	uwtic
Valve 1¼″ Close Nipples		uwtke
Tank Cross Over Pipes	24 N² a	uwtoi
Whistle Valve ½″ Nut	15 N² f	uwtsm
Whistle Valve to Cross (Tube)	59 N² a	uwttn
Whistle Valve Nut Washer	16 N² f	uwtuo
Air Pipe Cross Fitting	74 N² a	uwtys
Air Pipe Cross Fitting Nuts	5 N² a	uwubj
Air Pipe Cross Fitting Washers	6 N² a	uwuck
Comp. Air Pipe (Cross to Wing Engs.)	62 N² a	uwudl
Starting Valve Fitting	9 N² a	uwuem
Starting Valve Fitting 15/16″ Nut	5 N² a	uwufn
Starting Valve Fitting 15/16″ Washer	6 N² a	uwugo
Starting Valve Fitting 1″ Washer	11 N² a	uwuhp
Starting Valve Fitting 1″ Nut	10 N² a	uwuiq
Air Pipe (Starting Valve Fitting to Check Valve)	14 N² a	uwujr
Air Pipe (Starting Valve Fitting to Check Valve)	15 N² a	uwuks
Main Engine Air Comp. ¾″ Check Valve	72 N² a	uwult
Main Engine Air Comp. ¾″ Union Elbow		uwumu
Main Engine Air Comp. ¾″ Close Nipple		uwunv
Pipe Comp. Air (Cross to Tee)	60 N² a	uwuow
Comp. Air Tee	75 N² a	uwupx

Name of Part	Part No.	Code
Pipe, Comp. Air (Tee to Aux. Eng. Angle Valve)	64 N² a	uwuqy
Comp. Air Tee 1⅝" Nuts	5 N² a	uwurz
Comp. Air Tee 1⅝" Washers	6 N² a	uwusa
Comp. Air Tee 1¼" Nuts	7 N² a	uwutb
Comp. Air Tee 1¼" Washers	8 N² a	uwuuc
Comp. Air Angle Valve (At Aux. Eng.)	71 N² a	uwuvd
Comp. Air Angle Valve Nuts	7 N² a	uwuwe
Comp. Air Angle Valve Washers	8 N² a	uwuxf
Comp. Air Pipe (Angle Valve to Elbow)	65 N² a	uwuyg
Comp. Air Pipe Elbow	76 N² a	uwuzh
Comp. Air (Galv. 1" Close Nipple)		uwvav
Comp. Air Pipe (Tee to Air Starting Valve Center Eng.)	61 N² a	uwvbw
Comp. Air Pipe (Whistle Supply Valve to Running Nipple)	66 N² a	uwvdy
Comp. Air Whistle Running Nipple, in Deck	67 N² a	uwvez
Comp. Air Whistle Running Nipple Lock Nuts	68 N² a	uwvfa
Comp. Air Whistle Running Union Female End	64 N² f	uwvid
Comp. Air Whistle Running Union Nuts	15 N² f	uwvje
Comp. Air Whistle Running Union Washers	16 N² f	uwvmh
Comp. Air Pipe (Running Nipple to Whistle)	77 N² a	uwvni
Comp. Air Whistle ½" Female End		uwvoj
Comp. Air Whistle Pipe Straps	N² a	uwvsn
Comp. Air 1⅝" Tube Straps	N² a	uwvto
Comp. Air 1¼" Tube Straps	N² a	uwvup
Comp. Air Strap Screws		uwvwr
Comp. Air Running Nipple	78 N² a	uwvyt

WATER PIPING

Suction to Main Engine

Port and Starboard

Sea Valve Strainer	Xw 155	uwvzu
Sea Valve Strainer Screws		uwwaj
Sea Valve Nipple 1½" x 8½" long	C 20	uwwen
Sea Valve Lock Nuts (1½")	Xw 111	uwwfo
Sea Valve	C 19	uwwir
Sea Valve Drain Cock	C 31	uwwlu
1½" Nipple 3" long	C 26	uwwox
1½" Tee	C 23	uwwpy
1½" 90° Elbow	C 22	uwwra
1½" Union	C 24	uwwud
St'b'd & Port Cross Conn. 2' 2½" long	11 N² w	uwwve
St'b'd & Port Cross Conn. 3' 3¼" long	12 N² w	uwwyh
St'b'd & Port Vertical Suction Pipe	13 N² w	uwwzi
1½" Nipple 7" long	C 68	uwxaw

Suction to Center Engine

Sea Valve Strainer	Xw 155	uwxcy
Sea Valve Strainer Screws		uwxdz
Sea Valve Nipple 1½" x 8½" long	C 20	uwxea

Water Piping. (Continued.)

Name of Part	Part No.	Code
Sea Valve Lock Nut (1½″)	X w 111	uwxie
Sea Valve	C 19	uwxlh
Sea Valve Drain Cock	C 31	uwxmi
1½″ Nipple 4″ long	C 69	uwxok
1½″ 90° Elbow	C 22	uwxpl
Vertical Suction Pipe	14 N² w	uwxso
1½″ Union	C 24	uwxuq
1½″ Nipple 3″ long	C 26	uwxvr
1½″ Close Nipple	C 25	uwxyu

Discharge Main Engines

Port and Starboard

1¼″ Nipple 2″ long	C 35	uwyak
1¼″ 90° Elbow	C 27	uwybl
1¼″ Nipple 3″ long	C 30	uwycm
1¼″ Nipple 6″ long	C 28	uwydn
½″ Union Elbow Female ends	C 29	uwyeo
Water Discharge Pipe (Port Eng.)	17 N² w	uwyfp
Water Discharge Pipe (St'b'd Eng.)	16 N² w	uwygq
⅛″ Water Discharge Pipe Drain Cock	C 31	uwyhr
Water Discharge Pipe Flange	N¹ v 82	uwyis
½″ Pipe 8″ long	15 N² w	uwyjt

Discharge Center Engine

1¼″ Nipple 2″ long	C 35	uwyku
1¼″ 90° Elbow	C 27	uwylv
1¼″ Nipple 3″ long	C 30	uwymw
1¼″ Nipple 6″ long	C 28	uwynx
½″ Union Elbow Female ends	C 29	uwyoy
Water Disch. Pipe (Center Eng.)	18 N² w	uwypz
Water Disch. Pipe Drain Cock	C 31	uwyqa
Water Disch. Pipe Flange	N¹ v 82	uwyrb
½″ Pipe 8″ long	15 N² w	uwysc

Auxiliary Engine (Suction)

Sea Valve Strainer	X w 101	uwytd
Sea Valve Strainer Screws		uwyue
Sea Valve Nipple 6¾″ long	C 33	uwyvf
Sea Valve Lock Nuts	X w 107	uwywg
Sea Valve	C 32	uwyxh
½″ Special Union (Male End)	20 N² f	uwyyi
½″ Special Union Washer	16 N² f	uwyzj
½″ Special Union Nut	15 N² f	uwzax
Water Suction Tube	B w 3	uwzby
½″ Special Union Elbow	57 N² f	uwzcz
½″ Special Union Elbow Washer	16 N² f	uwzda

Auxiliary Engine (Suction). (Continued.)

Name of Part	Part No.	Code
½″ Special Union Elbow Nut	15 N² f	uwzeb
Sea Valve Drain Cock ⅛″ Pet Cock	C 31	uwzhe

Bilge Pump (Suction)

2″ Close Nipple	C 40	uwzif
2″ x 1½″ Elbow	C 38	uwzkh
1½″ Nipple 2½″ long	C 61	uwzli
1½″ Union	C 24	uwzol
1½″ Elbow	C 22	uwzro
1½″ Nipple 14″ long	9 B d	uwzsp
1½″ Suction Pipe	7 B d	uwzur
Drain Cock—Solder into Part No. 7BD	C 31	uwzxu

Discharge

1½″ Close Nipple	C 25	uwzyv
1½″ x 1¼″ Side Outlet Elbow	C 39	uwzzw
1½″ Union	C 24	uxaax
1½″ Discharge Pipe	8 B d	uxaby
1¼″ Relief Valve—Angle outlet Male inlet	C 41	uxacz
Drain cock—solder into Part No. 8 BD	C 31	uxada

FUEL PIPE AND FITTINGS

Gasoline Tanks to Valves	44 N² f	uxaeb
Bulkhead Stuffing-box	X w 202	uxafc
Bulkhead Stuffing-box Gland	X w 203	uxagd
Bulkhead Stuffing-box Bolts and Nuts	X w	uxahe
Special ½″ Angle Valves with side outlet	19 N² f	uxaif
½″ Union Washers	16 N² f	uxajg
½″ Union Nut	15 N² f	uxakh
Tank Connecting Pipe	46 N² f	uxali
Gasoline Pipe (Valve to Strainer)	48 N² f	uxamj
½″ Union (Female End)	64 N² f	uxank
½″ Union Washer	16 N² f	uxaol
½″ Union Nut	15 N² f	uxapm
Gasoline Pipe Connecting Nipple	49 N² f	uxaqn
Bulkhead Stuffing-box Gasket	1 N² w	uxaro
Bulkhead Stuffing-box Packing		uxasp
Strainer Body	X f 85	uxatq
Strainer Cap	X f 86	uxaur
Strainer Screen	X f 87	uxavs
Strainer Screen Ring	X f 88	uxawt
Strainer Screen Spring	X f 89	uxaxu
Strainer Cap Gasket	X f 90	uxayv
Strainer Drain Cock		uxazw
Strainer Drain Cock Tube		uxbak
Nipple between Strainer and Float Box	50 N² f	uxbbl
Float Box (St'b'd)	65 N² f	uxbdn

FUEL PIPE AND FITTINGS. (CONTINUED.)

Name of Part	Part No.	Code
Float Box (Port)	66 N² f	uxbeo
Float Box Cover	67 N² f	uxbis
Float Box Valve Guide	X f 15	uxbku
Float Box Valve	X f 16	uxboy
Float Lever Knuckle	X f 17	uxbqa
Float Lever Knuckle Pin	X f 20	uxbsc
Float Lever Tube	X f 18	uxbue
Float	X f 72	uxbyi
Float Lever Pad	X f 19	uxcay
Float Valve Guide Bushing	X f 68	uxcca
Float Box Cap Screws		uxcec
Float Box Drain Plug		uxcge
½" Union (Male End)	20 N² f	uxcig
½" Union Washer	16 N² f	uxcom
½" Union Nut	15 N² f	uxcpn
½" 45° Elbow	C 42	uxcqo
½" Special Union Elbow	57 N² f	uxctr
½" Union Washer	16 N² f	uxcus
½" Union Nut	15 N² f	uxcwu
½" Close Nipple	C 43	uxcyw
⅜" Union (Male End)	21 N² f	uxdal
⅜" Union Washer	23 N² f	uxdcn
⅜" Union Nut	22 N² f	uxddo
¼" Union (Male End)	24 N² f	uxdep
¼" Union Washer	26 N² f	uxdgr
¼" Union Nut	25 N² f	uxdit
Gasoline Suction (Port Eng.)	53 N² f	uxdju
½" x ⅜" Union Elbow	62 N² f	uxdkv
½" Union Washer	16 N² f	uxdny
½" Union Nut	15 N² f	uxdoz
Gasoline Suction (St'b'd Eng.)	51 N² f	uxdpa
½" x ⅜" Union Elbow	62 N² f	uxdsd
½" Union Washer	16 N² f	uxdte
½" Union Nut	15 N² f	uxduf
Gasoline Suction (Center Eng.)	55 N² f	uxdwh
½" x ⅜" Union (Male End)	63 N² f	uxdxi
½" Union Washer	16 N² f	uxdyj
½" Union Nut	15 N² f	uxeaz
Gasoline Overflow (Port Eng.)	54 N² f	uxeba
½" Union Elbow	57 N² f	uxecb
½" Union Washer	16 N² f	uxedc
½" Union Nut	15 N² f	uxeed
Gasoline Overflow (St'b'd Engine)	52 N² f	uxefe
½" Union Elbow	57 N² f	uxegf
½" Union Washer	16 N² f	uxehg
½" Union Nut	15 N² f	uxeih
Gasoline Overflow (Center Eng.)	56 N² f	uxeji
½" Union Elbow	57 N² f	uxekj
½" Union Washer	16 N² f	uxelk
½" Union Nut	15 N² f	uxeml

Auxiliary Engine

Suction

Name of Part	Part No.	Code
¼″ Close Nipple		uxenm
¼″ 90° Elbow Comm.		uxeon
¼″ Horizontal Check Valve Comm.		uxepo
¼″ Nipple 3 3/16″ long		uxerq
¼″ Union (Male End)	24 N² f	uxesr
¼″ Union Washer	26 N² f	uxets
¼″ Union Nut	25 N² f	uxeut
Gasoline Suction Pipe 540″ O. D. x No. 16 Ga. (B. W. G.)	6 B f	uxevu

Overflow

Gasoline Overflow Pipe 675″ O. D. x No. 16 B. W. G.	7 B f	uxewv
⅜″ Union Washer	23 N² f	uxexw
⅜″ Union Nut	22 N² f	uxeyx
⅜″ Union (Male End)	21 N² f	uxezy
⅜″ 90° Elbow Comm.		uxfam
⅜″ Nipple 4″ long		uxfco
⅜″ Close Nipple		uxfeq

Float Box Vent

Float Box Vent Tube ¼″ O. D. x 4′ 0″ long		uxffr
Tube Union Fitting	X o² 45	uxfiu
Tube Union Nut	X o² 46	uxfkw
Tube End	X o 54	uxfmy

Exhaust Fittings

Exhaust Elbow (Starboard Eng.)	26 N² m	uxfnz
Exhaust Elbow (Center Eng.)	28 N² m	uxfoa
Exhaust Elbow (Port Eng.)	27 N² m	uxfse
Exhaust Elbow (Connection Studs)		uxfug
Exhaust Elbow (Connection Studs Nuts)		uxfvh
Muffler Assembly	29 N² m	uxfwi
Muffler Studs		uxfyk
Muffler Studs Nuts		uxfzl
Muffler Vaporizor Water Conn. Studs		uxhan
Muffler Vaporizor Water Conn. Stud Nuts		uxhbo
Exhaust Outboard Fitting (Wing Eng.)	32 N² m	uxher
Exhaust Outboard Fitting (Center Eng.)	34 N² m	uxhhu
Exhaust Outboard Fitting Ring (Center Eng)	35 N² m	uxhiv
Exhaust Outboard Fitting Ring (Wing Eng.)	36 N² m	uxhly
Exhaust Outboard Fitting Bolts	40 N² m	uxhoc
Exhaust Outboard Fitting Bolt Nuts		uxhqe
Exhaust Pipe (Wing Eng.)	30 N² m	uxhsg
Exhuast Pipe (Center Eng.)	31 N² m	uxhth

Exhaust Fittings. (Continued.)

Name of Part	Part No.	Code
Exhaust Outboard Fitting Gland Nut	N^2 m 5	uxhui
Aux. Eng. Outboard Exh. Fitting	24 B m	uxhym
Aux. Eng. Outboard Exh. Fitting Nut	B m 19	uxiab
Aux. Eng. Outboard Exh. Fitting Screws		uxibc
Aux. Eng. Outboard Exh. Flange Connection	25 B m	uxicd
Aux. Eng. Outboard Exh. Clamp Flanges	4 B m	uxide
Aux. Eng. Exhaust Pipe	26 B m	uxief
Aux. Eng. Exhust Pipe Screw Flange	5 B m	uxifg
Aux. Eng. Exhaust Pipe Clamp Bolts		uxigh
Aux. Eng. Exhaust Pipe Clamp Bolt Nuts		uxihi
Aux. Eng. Exhaust Pipe Clamp Cap Screws		uxiij

Propellers, Shafts, Bearings, Etc.

Propellers Right Hand		uxijk
Propellers Left Hand		uxikl
Propeller Keys ¾″ x ½″ Cold Rolled		uxilm
Propeller Cone	N^2 p 15	uximn
Propeller Cone Nut	N^1 p 71	uxino
Propeller Lock Nut	N^1 p 72	uxiop
Propeller Cone Lock Set Screw	N^2 p 24	uxiqr
Propeller Taper Pin No. 5 Taper Pin		uxirs
Propeller Shafts (Wing Engines) 3″ dia.	N^2 p 20	uxist
Propeller Shafts (Center Engine) 3″ dia.	N^2 p 16	uxitu
After Strut Bushing (Center and Wing Eng.)	N^1 p 125	uxiuv
Intermediate Bearing Bushing (Center Eng.)	N^2 p 17	uxivw
Stuffing-box Bearing Bushing (Wing Eng.)	N^2 p 21	uxiwx
Stuffing-box Bushing (Center and Wing Eng.)	N^1 p 125	uxixy
After length Shaft Covering (Center Eng.)	N^2 p 18	uxiyz
After length Shaft Covering (Wing Eng.)	N^2 p 22	uxiza
Forward length Shaft Covering (Center Eng.)	N^2 p 19	uxjao
Forward length Shaft Covering (Wing Eng.)	N^2 p 23	uxjdr
Pillow Block (Flint and Chester) Plain Patt.	C 60	uxjes
Pillow Block Bolts		uxjgu
Pillow Block Bolt Washers		uxjiw
Bulkhead Stuffing-box (St'b'd Eng.)	51 N^2 p	uxjky
Bulkhead Stuffing-box Gland	52 N^2 p	uxjma
Bulkhead Stuffing-box Gland Studs	54 N^2 p	uxjob
Bulkhead Stuffing-box Gland Stud Nuts		uxjre
Bulkhead Stuffing-box Canvas Gasket	55 N^2 p	uxjsf
Bulkhead Stuffing-box Fastening Bolts and Nuts	58 N^2 p	uxjuh
Bulkhead Stuffing-box Grease Cups	C 58	uxjvi
Bulkhead Stuffing-box (Port Eng.)	50 N^2 p	uxjyl
Bulkhead Stuffing-box (Center Eng.)	53 N^2 p	uxjzm
Bulkhead Packing	C 59	uxkac
Bulkhead Stuffing-box (Center Eng.) Aft. Bulkhead	60 N^2 p	uxkbd
Flange Coupling (Wing Eng.)	5 N^2 p	uxkce
Flange Coupling (Wing Eng.) Crankshaft End	N^2 e 56	uxkeg
Flange Coupling Shaft Bolts Crankshaft End		uxkgi
Flange Coupling Shaft Bolts Prop. Shaft End		uxkik
Flange Coupling Shaft Bolt Nuts		uxkkm

PROPELLERS, SHAFTS, BEARINGS, ETC. (CONTINUED.)

Name of Part	Part No.	Code
Flange Coupling Bolts		uxkmo
Flange Coupling Bolt Nuts		uxkoq
Slip Coupling Thrust Bearing	27 N² p	uxkpr
Slip Coupling Thrust Bearing Cap	28 N² p	uxksu
Slip Coupling Thrust Bearing Cap Studs	61 N² p	uxktv
Slip Coupling Thrust Bearing Fastening Bolts and Nuts		uxkuw
Slip Coupling Thrust Bearing Fastening Bolts and Washers		uxkwy
Slip Coupling Thrust Bearing Oil Pipe ⅛" Pipe		uxkya
Slip Coupling Thrust Bearing Oil Pipe Union ⅛" Pipe		uxlap
Slip Coupling Thrust Bearing Oil Cup (⅜" Pipe Size)		uxlcr
Slip Coupling Thrust Bearing Oil Cup Bracket	59 N² p	uxlds
Thrust Columns for Center Engine	57 N² p	uxlet
Slip Coupling Crankshaft Half	32 N² p	uxlfu
Slip Coupling Propeller Shaft Half	31 N² p	uxlix
Slip Coupling Shell liner	37 N² p	uxljy
Slip Coupling Ring liner	38 N² p	uxlla
Slip Coupling Flange liner	39 N² p	uxlod
Slip Coupling Shaft Bolts ⅝" dia. x 4⅝" long	36 N² p	uxlpe
Slip Coupling Shaft Studs (th'ds both ends 1⅛")	56 N² p	uxlsh
Slip Coupling Shaft Stud Nuts ⅝" standard		uxlti
Slip Coupling Flange Studs	35 N² p	uxluj
Slip Coupling Flange Stud Nuts		uxlyn
Slip Coupling Ring	34 N² p	uxlzo
Slip Coupling Thrust Washer	47 N² p	uxmad
Slip Coupling Brake (Upper Shoe)	40 N² p	uxmbe
Slip Coupling Brake (Lower Shoe)	41 N² p	uxmeh
Slip Coupling Brake Lining	44 N² p	uxmfi
Slip Coupling Brake Lining Rivets		uxmil
Slip Coupling Brake Lug	46 N² p	uxmkn
Slip Coupling Brake Springs	45 N² p	uxmlo
Slip Coupling Brake Collar	42 N² p	uxmor
Slip Coupling Brake Collar Set Screw		uxmps
Slip Coupling Brake Clamp Bolt	43 N² p	uxmru
Slip Coupling Brake Hand Wheel	33 N² p	uxmsv

MAIN ENGINE SUNDRIES

Spark Coils, Edison		uxmtw
Ignition Wire L. T. single conductor		uxmux
Flexible Conduit No. 1 Loom		uxmvy
Terminals Tubular Type		uxmxa
Wire cleats—single		uxmyb
Wire cleats—double		uxnaq
Wire cleats—triple		uxnbr
Clamp for Loom to Stanchion	10 N² i	uxncs
Straps for Loom ¼" Comm. Pipe Straps		uxneu
Resistance Units		uxnhx
Resistance Receptacles		uxniy
Wood screws No. 10x Rd. hd.		uxnka
Wood screws No. 8x Rd. hd.		uxnmc

MAIN ENGINE SUNDRIES. (CONTINUED.)

Name of Part	Part No.	Code
Wood screws No. 8x Rd. hd.		uxnnd
Oil Pan for Center Engine	8 N² o	uxnoe
Oil Guards	5 N² o	uxnrh
Oil Guard Screws No. 10 x ½" Rd. hd. Wood screws		uxnsi
Foundation Bolts for Main Engs. & Drag Thrust		uxnuk
Foundation Lag-Screws for Main Engs.		uxnyo
Tachometer—Johns-Manville Scale O		uxnzp
Tachometer Drive Case Upper Half Stbd. and Center	16 N² d	uxobf
Tachometer Drive Case Lower Half Stbd. and Center	17 N² d	uxocg
Tachometer Drive Case Upper Half Port	33 N² d	uxodh
Tachometer Drive Case Lower Half Port	34 N² d	uxofj
Tachometer Drive Gear	18 N² d	uxogk
Tachometer Drive Gear Bolt	19 N² d	uxohl
Tachometer Drive Gear Dowel	20 N² d	uxoim
Tachometer Drive Spindle	21 N² d	uxojn
Tachometer Drive Spindle Gear	22 N² d	uxoko
Tachometer Drive Spindle Bearing—Comm. Ball Bearing		uxolp
Tachometer Drive Case Bolts		uxomq
Tachometer Drive Shaft	23 N² d	uxonr
Tachometer Drive Shaft Coupling—Upper	24 N² d	uxoos
Tachometer Drive Shaft Coupling—Lower	25 N² d	uxopt
Tachometer Drive Shaft Casing	26 N² d	uxoqu
Tachometer Drive Shaft Casing Nut	27 N² d	uxorv
Tachometer Drive Shaft Casing Cap	28 N² d	uxosw
Tachometer Drive Hanger Bolt 2 5/16" nuts and locknuts with each	29 N² d	uxotx
Tachometer Drive Hanger Stud 2 3/8" nuts with each	30 N² d	uxouy
Tacohmeter Drive Spindle Washer	31 N² d	uxovz
Tachometer Drive Spindle Adjusting Washer	32 N² d	uxowa
Tachometer Drive Shaft Bearings—Comm. Ball Bearing		uxoxb
Revolution Counters		uxoyc
Revolution Counters Impulse Tube —" O. D.		uxozd
Union Fittings —" Tube x —" Pipe-Male		uxpar
⅛" Tee		uxpbs
⅛" Close Nipple		uxpdu

AUXILIARY ENGINE SUNDRIES

Foundation Bolts		uxpev
Ignition Switch Porcelain Base		uxphy

TOOLS

Spanner Wrench for Outboard Exh.	N² t 1	uxpiz
Cranking Bar	N² t 4	uxpja
Expander Die for Small Tubes	30 N² t	uxpmd
	33 N² t	uxpne
Expander Die for Large Tubes	31 N² t	uxpof
	32 N² t	uxpri
Expander Punch	4 N² t	uxpsj

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MEMORANDUM

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