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T. O. NO. 19-85AC-1

SEP 12 1945
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HANDBOOK OF INSTRUCTIONS

FOR

63-FOOT AAF RESCUE BOATS

PROPELLERS - 23 3/4 x 23 3/4

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TABLE OF CONTENTS

Section		Page
I	DESCRIPTION	1
	1. Introduction	1
	2. General Description	1
	a. Type	1
	b. Arrangement Below Decks	2
	3. Leading Particulars	2
	a. Dimensions	2
	b. Displacement	2
	c. Tank Capacities	2
	d. Performance	2
II	BOAT OPERATION	4
	1. General	4
	2. Engine Operation	4
	a. General	4
	b. Steps Preliminary to Starting	4
	c. Starting the Engines	8
	d. Warm-up	9
	e. Stopping the Engines	9
III	HULL AND DECK	10
	1. Description	10
	a. Hull Framing	10
	b. Planking	11
	c. Deck Covering	11
	d. Pilot House	11
	e. Bridge	11
	f. Dispensary Cabin Trunk	11
	g. Lazaret	11
	h. Interior Floors	11
	i. Windows	11
	j. Doors	15
	k. Companionways and Ladders	15
	l. Masts	15
	m. Railings	15
	n. Deck Gear and Fittings	15
	2. Care, Maintenance, and Stowage	15
	a. General	15
	b. Maintenance Periods	15
	c. At Docks	15
	d. At Sea	16
	e. After Mooring	16
	3. Quarterly Reconditioning	16
	a. General	16
	b. Drydocking	16
	c. Inspection	16
	d. Painting	19
	4. Major Repairs	21
	a. Planking	21
	b. Frame Members	22
	c. Propellers	22
	d. Shafts	25
	e. Shaft Bearings	26
	f. Metal Tanks	26
	g. Plumbing	27
IV	MISCELLANEOUS EQUIPMENT	29
	1. Armament	29
	a. Description	29
	b. Installation	29
	c. Loading	29
	d. Service, Inspection, Maintenance, and Lubrication	29
	2. Rescue Gear	29
	a. Rescue Nets	29
	b. Rescue Crane	29
	c. Dinghy	29
	d. Ring Life Buoys	33
	e. Rubber Boats	33
	f. Life Jackets	33
	3. Navigation Equipment	33
	4. Anchor and Winch	34
	a. Anchors	34
	b. Winch	34
	5. Warps, Lines, and Hawsers	34
	6. Stove	34
	a. Description	34
	b. Operation	34
	c. Service and Maintenance	35
	d. Removal	36
	7. Refrigeration	36
	a. General	36
	b. Refrigerator	36
V	STEERING SYSTEM	37
	1. Description	37
	a. Bridge Steering Assembly	37
	b. Stub Shaft Assembly	37
	c. Worm Shaft and Starboard Rudder Assembly	37
	2. Emergency Tiller	37
	3. Service, Inspection, Maintenance, and Lubrication	37
	a. General	37
	b. Bridge Steering Assembly	37

Section *Page*

c. Intermediate and Stub Shafts..... 37
d. Sprocket Wheels 37
e. Chains 37
f. Torque Tube Assembly..... 37
g. Rudder Bearing 40
h. Stuffing Boxes 40

VI CLUTCH CONTROLS 41
1. General 41
2. Engine Telegraph 41
3. Electric-Hydraulic System 41
a. Description 41
b. Operation 43
c. Operation Instructions 44
d. Service, Inspection, and Maintenance 44
4. Adjustment of Clutch Control Limit Switch Box 45
a. General 45
b. How To Adjust Cam Controlling Action From "Neutral" to "Forward" 45
c. How To Adjust Cam Controlling Action From "Neutral" to "Reverse" 47
d. How To Adjust Cam Controlling Action From "Forward" to "Neutral" 47
e. How To Adjust Cam Controlling Action From "Reverse" to "Neutral" 47
f. How To Adjust All Cams at Time of New Installation 47
5. Trouble Shooting (Electric-Hydraulic System) 47

VII THROTTLE CONTROLS 49
1. Description 49
a. Hydraulic Units 49
b. Tubing 49
c. Closed System 49
2. Operation 49
3. Servicing and Maintenance 49
a. Synchronizing 49
b. Replenishing Fluid 49
c. Filling the System 50
d. Filling the System by Pressure Filler 51
e. Replacing Piston Packing 52
4. Major Repairs 52
a. Disassembly 52
b. Assembly 53
c. Installing Throttle Controls..... 53
d. Replacing Tubing 53
5. Trouble Shooting 53

Section *Page*

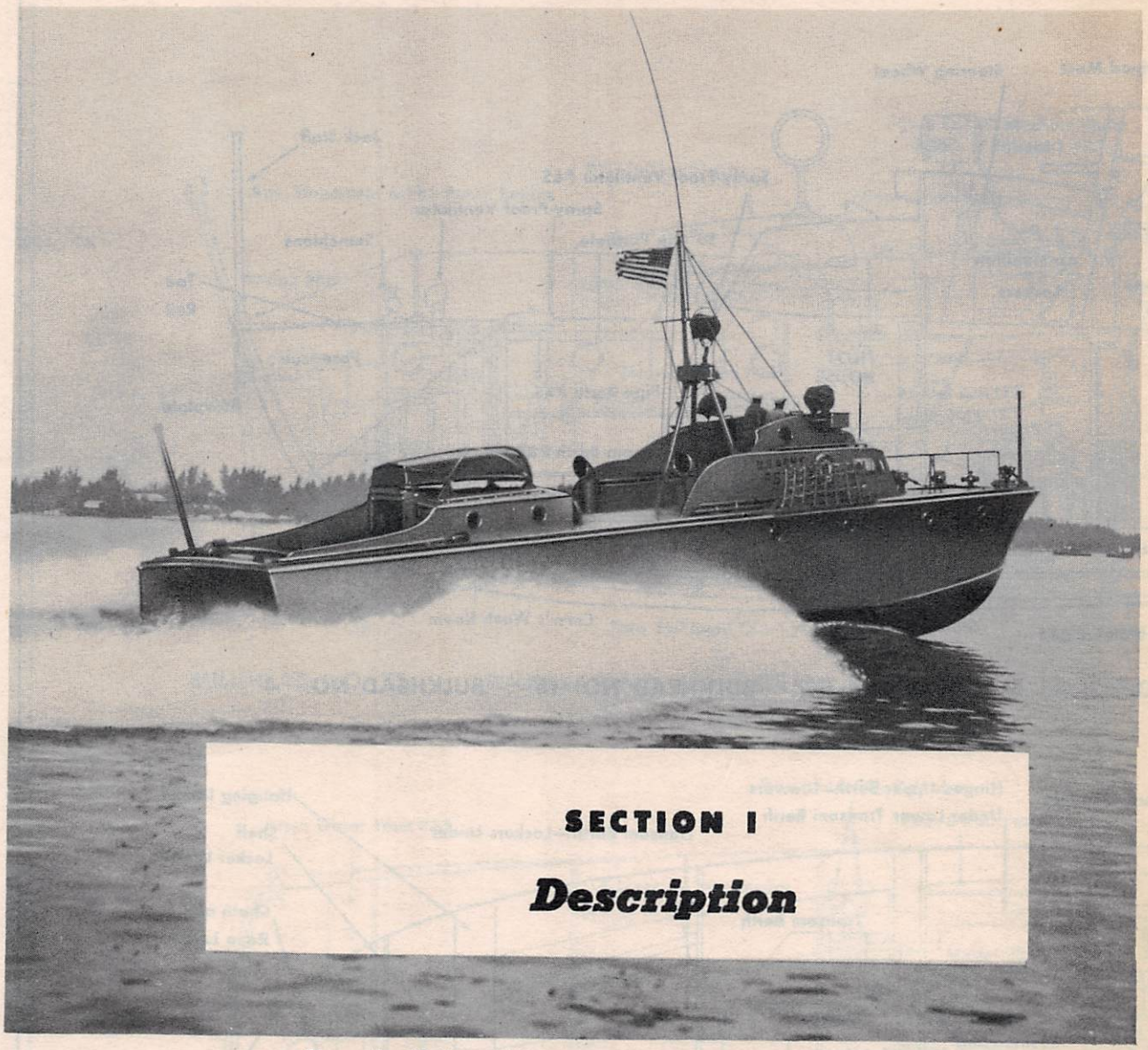
VIII ENGINE SYSTEMS 55
1. Fuel System 55
a. Description 55
b. Operation 55
c. Servicing and Maintenance 55
d. Emergency Repairs 57
e. Removing Tanks From Boat..... 57
f. Trouble Shooting 57
2. Lubricating Oil System 58
a. Description 58
b. Servicing and Maintenance 58
3. Salt Water Cooling System 58
a. Description 58
b. Operation 58
c. Servicing and Maintenance 59
4. Trouble Shooting 59
5. Engine Removal 60
a. Steps Preliminary to Removing Engine 60
b. Removal of Engine 61
c. Lifting Engine In 61
d. Lining-up the Engine 61
e. Replacing Hatch 62

IX AUXILIARY GENERATOR AND FIRE PUMP ENGINE 63
1. Description 63
a. General 63
b. Specifications 63
c. Installation 63
2. Operation 64
a. Before Starting 64
b. Starting 64
c. Running 65
d. Stopping 65
3. Service, Inspection, Maintenance, and Lubrication 65
a. Oil Filter 65
b. Engine Generator (100-Hour Inspection) 65
c. Starting Motor (100-Hour Inspection) 65
d. Carburetor Adjustment 66
4. Removal 66
5. Trouble Shooting 66

X ELECTRICAL SYSTEM 69
1. Description 69
a. General 69
b. Batteries 69
c. Switchboard 69

Section		Page
	d. Forward Distribution Box	69
	e. Engine Generators	69
	f. Auxiliary Generator	69
	g. Shore Connection	69
	h. Voltage and Current Regulators	69
	2. Operation Instructions	69
	a. Normal Operation	69
	b. Charging Batteries with Auxiliary Generator	70
	c. Charging Batteries From Shore Connection	71
	3. Service, Inspection, and Maintenance	72
	a. Batteries	72
	b. Engine Generators	73
	c. Auxiliary Generator	74
	d. Battery Charger	74
	e. Reverse Current Relays	74
	4. Removal	75
	a. Auxiliary Generator	75
	b. Battery Charger	75
	5. Trouble Shooting	75
XI	LIGHTING AND SIGNALING SYSTEMS	76
	1. General	76
	2. Interior Lighting	76
	a. Description	76
	b. Service and Maintenance	77
	3. Exterior Lighting	77
	a. Description	77
	b. Operation	78
	c. Servicing and Maintenance	78
	4. Searchlights	78
	a. Description	78
	b. Operation	79
	c. Service, Maintenance, and Lubrication	80
	5. Horn	80
	a. Description	80
	b. Service and Maintenance	80
XII	RADIO EQUIPMENT	81
	1. Transmitter	81
	2. Receiver	81
	3. Antenna	81
	4. Radio Direction Finder	81
	a. General	81
	b. Operation Instructions	84
	c. Service, Inspection, and Maintenance	84
	d. Calibration Procedure	84
	5. Trouble Shooting	88
XIII	FRESH WATER SYSTEM	91
	1. Description	91
	a. Tanks	91
	b. Pipe Lines	91
	c. Fixtures	91
	2. Operation Instructions	91
	3. Service and Maintenance	92
	a. Filling the Tanks	92
	b. Pump Repair	92
	c. Cleaning the System	92
	d. Pipes, Valves, and Fittings	94
	e. Tanks	94
	4. Removal of Tanks	94
	5. Trouble Shooting	94
XIV	SANITATION SYSTEM	95
	1. Description	95
	a. Officers' Toilet	95
	b. Crew's Toilet	95
	c. Officers' Lavatory Drain	95
	d. Galley Sink Drain	95
	e. Crew's Lavatory Drain	95
	f. Ice Box Drain	95
	2. Principles of Operation	95
	a. Drains	95
	b. Toilet Connections	96
	c. Toilets	96
	3. Operation Instructions	96
	4. Service and Maintenance	96
	a. Toilets	96
	b. Drains	97
	5. Trouble Shooting	97
XV	BILGE PUMPING SYSTEM	99
	1. Description	99
	a. General	99
	b. Piping, Strainers, and Valves	99
	c. Engine-driven Bilge Pump	99
	d. Electric Bilge Pump	99
	e. Limber Chains	100
	2. Operation Instructions	100
	3. Servicing, Lubrication, and Maintenance	102
	a. Pipe Lines and Valves	102
	b. Engine-driven Pump	103
	c. Electric Pump	103
	4. Removal of Electric Pump	104
	5. Trouble Shooting	104

Section		Page
XVI	FIRE FIGHTING SYSTEM—WATER-FOAM	105
	1. Description	105
	a. General	105
	b. Pump	105
	c. Foam Generator	105
	d. Pipe Lines and Valves	105
	e. Hose and Fittings	105
	f. Monitors	107
	2. Operation Instructions	107
	a. Valves	107
	b. Pump	107
	c. Foam Generator	108
	d. Monitors	109
	e. Hose	109
	3. Service, Inspection, and Maintenance	109
	a. General Inspection Test	109
	b. Pump	109
	c. Pipe Lines	110
	d. Monitors	110
	4. Removal of Pump	110
	5. Trouble Shooting	110
XVII	FIRE EXTINGUISHING (CO_2) SYSTEM AND PORTABLE EXTINGUISHERS	111
	1. CO_2 System	111
	a. Description	111
	b. Principles of Operation	111
	c. Operation Instructions	111
	d. Service, Inspection, and Maintenance	113
	e. Trouble Shooting	117
	2. Portable Fire Extinguishers	117
	a. Description	117
	b. Operation	117
	c. Service and Maintenance	118
	3. Trouble Shooting	118
XVIII	HEATING SYSTEM	119
	1. Description	119
	a. General	119
	b. Location of Heaters	119
	c. Heater Construction and Operation	119
	d. Electrical System	120
	e. Fuel System	121
	f. Exhausts	122
	2. Operating Instructions	122
	a. To Start Heater	122
	b. To Shut Heater Off	122
	3. Service and Maintenance	122
	a. General	122
	b. Fuel Pump	122
	c. Fan Motor	123
	d. Blower Motor	123
	e. Carburetor	123
	4. Removal	123
	a. General	123
	b. Removal of Heater	123
	c. Removal of Fuel Pump	123
	5. Trouble Shooting	123
XIX	VENTILATION SYSTEM	125
	1. Description	125
	a. Location of Blowers and Cowls	125
	b. Blowers	126
	c. Electrical System	126
	d. Cowls	127
	2. Operation Instructions	127
	3. Servicing and Maintenance	128
	a. Lubrication	128
	b. Spare Parts	128
	4. Removal	128
	5. Trouble Shooting	128
XX	PERIODIC INSPECTION	129



SECTION I

Description

Figure 1—63-Foot AAF Rescue Boat, Design No. 416

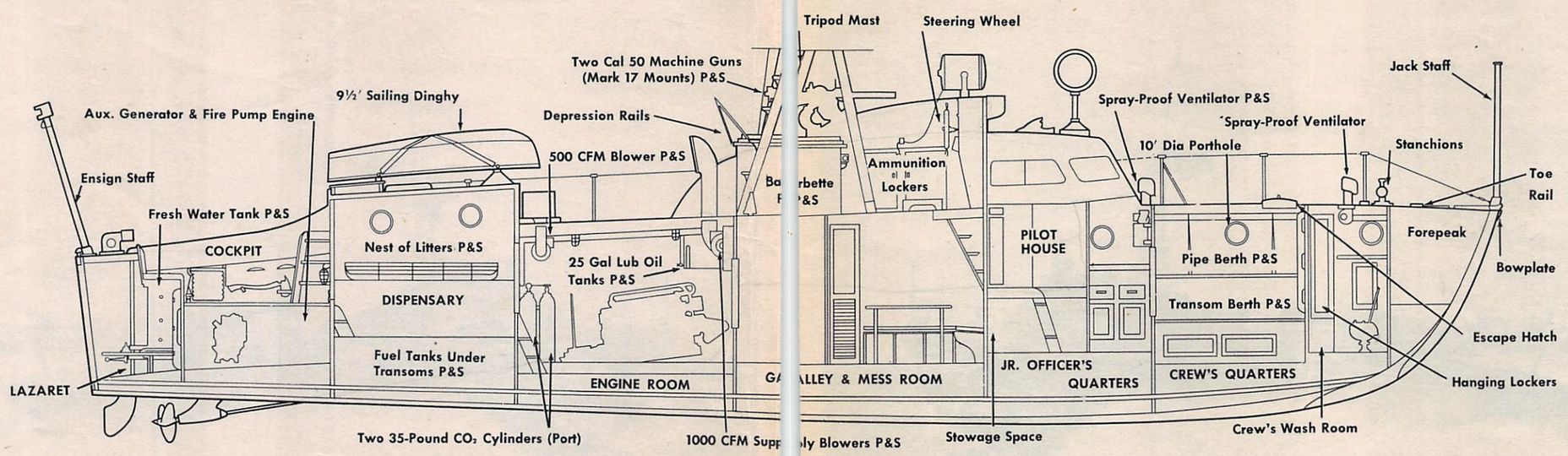
1. INTRODUCTION.

This Handbook covers the Operation, Service, and Maintenance of the 63-foot AAF Rescue Boat, Design 416. *(See figure 1.)* The text and illustrations were prepared from approved plans made by the design agent and from data obtained on boat No. P-662 built by Truscott Boat Works, St. Joseph, Michigan.

Because of successive alteration of plans, changes made at various yards for local reasons, and authorized modifications after the boats have been in operation, not all the data in this Handbook will apply to every 63-foot boat of this design. For this reason, it is important that operating personnel become familiar with wiring, piping, and equipment installed on individual boats, and compare the actual installations with the text and diagrams.

2. GENERAL DESCRIPTION.

a. TYPE.—The 63-foot AAF Rescue Boat, Design 416, is a twin screw "V" bottom stepless hydroplane intended for offshore, long-range operations. It can be driven at high speeds under severe weather conditions without excessive pounding and yet remain dry. The construction is of ample strength to withstand the severe operation anticipated. It is powered by two 12-cylinder Hall-Scott "Defender" marine engines, rated at 630 bhp at 2100 rpm. A model 2268 engine is installed to starboard turning a right-hand wheel and a model 2269 to port, turning a left-hand wheel, that is, the engines rotate in opposite directions, with the propellers turning outboard. These engines have a 24-volt starting, ignition, and generating system. Both engines are fully radio-shielded.



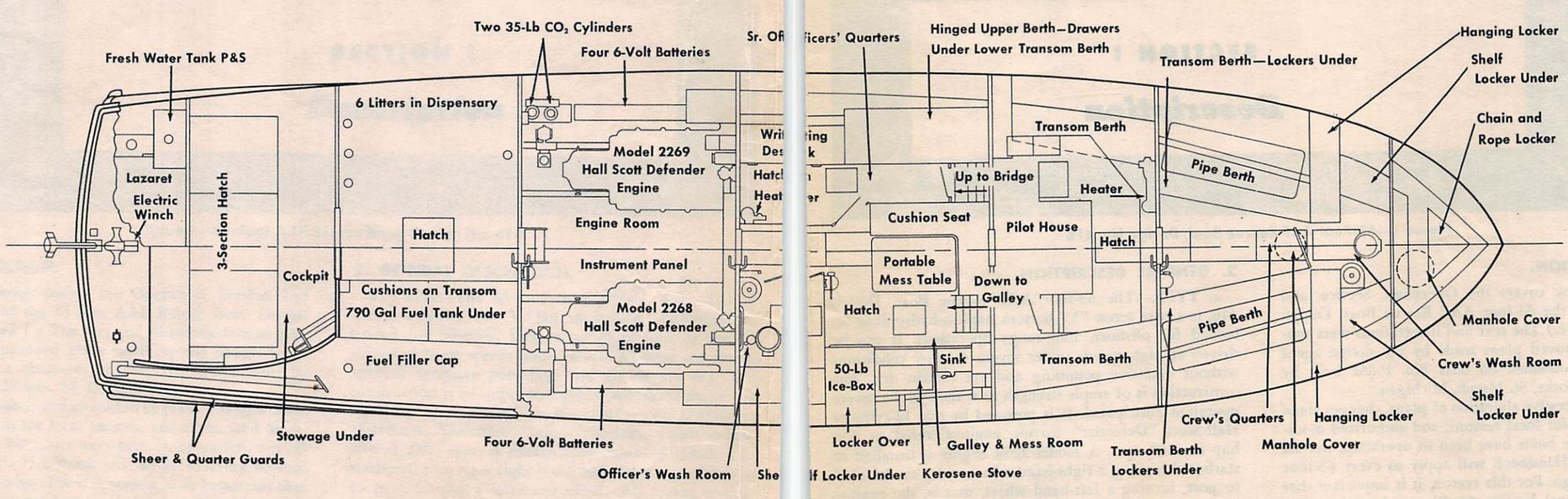


Figure 2—Inboard Plan and Profile

b. ARRANGEMENT BELOW DECKS.
(See figure 2.)

(1) FOREPEAK.—The space forward of the collision bulkhead at frame 4 provides a forepeak to be used for an anchor and chain locker. There is a watertight manhole flush with the deck for access to this compartment.

(2) CREW'S QUARTERS.—Immediately aft of the forepeak is a crew's quarters in which there are two transom berths and two pipe berths. Hanging lockers are provided in the washroom at the forward end of the crew's quarters.

(3) PETTY OFFICERS' QUARTERS AND PILOT HOUSE.—Between watertight bulkheads at frames 18 and 28, there are two transom berths with lockers under. Companionways, both port and starboard lead to the pilot house from these quarters. A passage to starboard leads aft from the pilot house down to the galley, radio room, and officers' quarters. A companionway to port leads to the flying bridge and deck. The bulkhead at frame 28 forms the after end of the pilot house and forward end of the flying bridge.

(4) GALLEY.—The galley, on the starboard side abaft bulkhead 28, is fitted with a 50-pound ice box, three-burner kerosene stove, sink, fresh water pump, dishracks, lockers, and a suction blower for elimination of cooking fumes.

(5) OFFICERS' QUARTERS.—On the port side abaft bulkhead at frame 28, is an officers' stateroom which is fitted with a transom berth and folding Pullman upper berth, as well as a writing desk, chair, and clothes locker. The officers are provided with a washroom abaft the galley.

(6) ENGINE ROOM.—The engine room is located between the watertight bulkheads at frames 42 and 55.

(7) DISPENSARY AND FUEL TANK COMPARTMENT.—Beneath the transom berths in the dispensary are two bullet-sealing integral fuel cells. The construction is such that the tanks may be removed and replaced in case they are damaged. The bulkhead at frame 66 is provided with a wide plywood door to facilitate carrying litters in and out of the dispensary.

(8) COCKPIT.—Aft of the dispensary is the open cockpit for rescue operations. A hatch is provided in the cockpit deck for access to the storage space below.

(9) LAZARET.—The fresh water tanks and tiller arms are located in the lazaret which is between bulkhead 75 and transom. A hatch in the cockpit seat is provided for access to this compartment.

3. LEADING PARTICULARS.

a. DIMENSIONS. *(See figure 2.)*

Length, overall	63 ft 0 in.
Length, designed water line	58 ft 10 in.
Maximum beam (moulded)	15 ft 0 in.
Beam, designed water line	13 ft 10 in.
Maximum draft (propeller tips)	3 ft 10 in.
Depth, amidships at center line to main deck	8 ft 9 in.
Freeboard forward	6 ft 8 in.
Freeboard aft to center of deck	4 ft 7 in.

b. DISPLACEMENT.

Light load displacement (less armament)	39,000 lb
Full load displacement (with armament)	52,000 lb

c. TANK CAPACITIES.

Fuel gasoline capacity (two tanks) total	1,580 U.S. gal
Lubricating oil capacity (two tanks) total	50 U.S. gal
Fresh water capacity (two tanks) total	150 U.S. gal

d. PERFORMANCE.

Maximum speed (with full load and complement)	33½ nautical mph
Fuel consumption (full power)	110 gal per hr
(25 knots)	70 gal per hr
Cruising range:	
At full speed	475 nautical miles
At 25 knots	530 nautical miles
At 15 knots	600 nautical miles
Tactical diameter (full speed)	75 yd

SECTION II

Boat Operation

1. GENERAL.

a. To maintain proper efficiency in a comparatively light weight high speed boat of this type, it must be serviced and operated with the same alert attention that would be given an aircraft. The vessel weighs less than 28 pounds per horsepower (light) and THE USUAL PROCEDURE OF LOADNG A BOAT DOWN WITH TONS OF USELESS GEAR MUST BE AVOIDED. The bottom must be kept clean and free from marine growth or fouling of any kind, the propellers in good condition, the engines in proper adjustment, the BILGES DRY AND CLEAN, the controls and instruments in good working order. Experience, alertness and good judgment are the best guides to proper operation.

b. As shipped for export, shipping cradle, hoisting sling, and boat (light) weigh approximately 54,000 pounds. To avoid strain in unloading, the boat should be lifted with the cradle in place. In the event that the boat must be lifted by slings, be sure that keel and chines are well protected to avoid damage. Personnel acquainted with the procedure must be on hand if this method must be used. Refer to section III, paragraph 3.*b.*(2). The shipping cradle is useful for future hauling and dry-docking.

c. After the boat is in the water, the tripod mast, jack, and ensign staffs may be erected. The electric connections for the mast should be run through the stuffing tubes provided at the foot of the after leg and be connected to the proper terminals in the port fuse box in the engine room. The deck plate should be removed from all ventilating blower intakes and outlets and the ventilating cowls screwed in place.

d. Proper maintenance is important to retain the high efficiency of the vessel. The performance of high speed boats is reduced considerably by factors having little or no effect on slower boats. Overloading will reduce the speed, turning ability and dryness of the boat and increase the fuel consumption. It is advisable to limit the amount of personal belongings each member of the crew may keep aboard. Only sufficient galley stores required for the operation should be carried and spare lines, paint, tools, spare parts, and unnecessary gear should be left ashore. The fuel tanks will hold five tons of gasoline but there is no necessity for carrying this load for short range operation. If it is necessary to add considerable load to the boat, this weight should be distributed so that the hull trims parallel to the designed waterline.

2. ENGINE OPERATION.

a. GENERAL. — Continuous cruising speeds below 1000 rpm may foul the spark plugs. Speed the engine up at intervals of 30 minutes so that the plugs will clean themselves. Maximum oil temperature should not exceed 200°F at full power and speed. The maximum oil pressure is usually around 80 pounds when the engine is hot. If it drops below 40 pounds at 2100 rpm, adjust the pressure regulating valve. Fuel pressure should read between 3 and 5 psi at all speeds and loads with the autopulses switched "OFF." The engine should not be run over 1800 rpm with the fuel pressure less than 3 psi as the resulting lean mixture will cause damage. 1800 rpm is regarded as the maximum cruising speed; however, 2100 rpm is regarded as the maximum safe crankshaft speed as the propeller will hold the engine down to these revolutions with the throttle wide open. *The engine should be run at 2100 rpm only in an emergency.*

Control the speed when in neutral. Do not open the throttle until forward (or reverse) is engaged. If the engine is inclined to stall when the gear is engaged, increase the idling speed or adjust the carburetor.

b. STEPS PRELIMINARY TO STARTING.

WARNING

Fire precautions must be observed. Engines should never be started while a strong odor of gasoline is present. If fumes are in the engine room, open the hatches and ventilate the room. Do not operate the blowers. DETERMINE THE SOURCE OF THE FUMES.

(1) Sound the fuel tanks to determine that the supply is adequate. *(See figure 3.)*

(2) Check the oil level in the storage tanks. *(See figure 4.)*

(3) Fill each engine oil sump to "FULL" mark on the gage. *(See figure 5.)*

Note

Do not fill the sump or attempt to check oil level within 1 hour after stopping an engine. Oil gage will give a false reading until adequate time has passed for oil to flow back to the sump.

(4) Check condition of storage batteries. If below 1.200 specific gravity, recharge them before using.

(5) Close main battery disconnect switch on instrument panel. *(See figure 6.)*

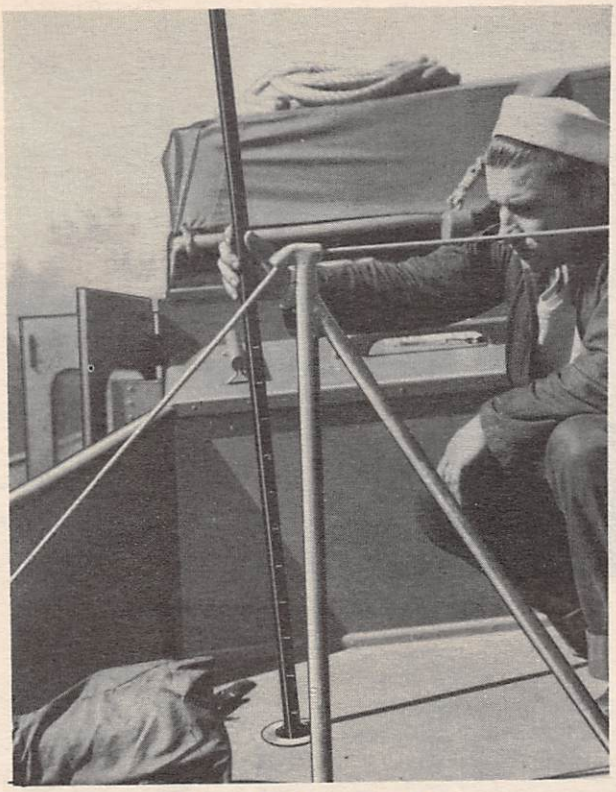


Figure 3—Measuring Fuel

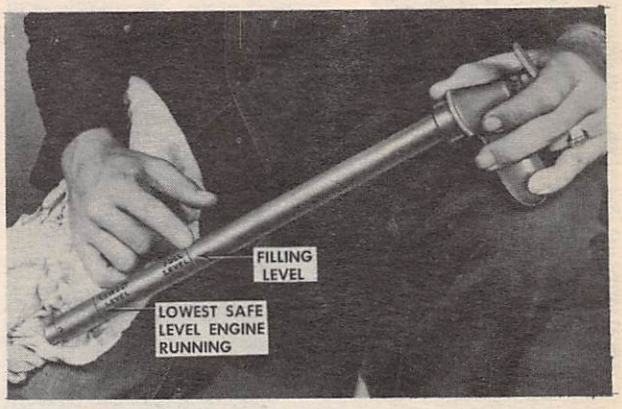


Figure 5—Checking Oil in Sump

(6) Turn the engine room blowers on for 5 minutes before starting the engines. *(See figure 7.)*

(7) Open fuel tank supply valves in the dispensary. *(See figure 8.)*

(8) Open fuel tank selector valves in the engine room. *(See figure 9.)*

(9) Open engine supply valves in lines from manifold to the engines. *(See figure 10.)*

(10) Open the two water intake seacocks for each engine.

Note

The position of the seacock valve lever when the valve is open is not the same on all boats. If there is any doubt regarding the position of the lever, the operator should determine the proper position for this lever. Refer to section VIII, paragraph 3.*c.*(1).

(11) Make sure that the water intake strainers are clean.

(12) See that the water bypass valves at forward end of each engine are closed. *(See figure 11.)*

(13) See that the engine-driven bilge pump clutch (on the starboard side of the starboard engine) is not engaged. *(See figure 12.)*



Figure 4—Checking Oil Level in Storage Tanks

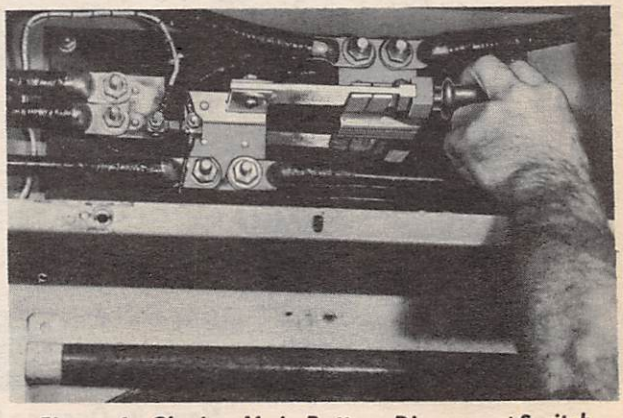


Figure 6—Closing Main Battery Disconnect Switch

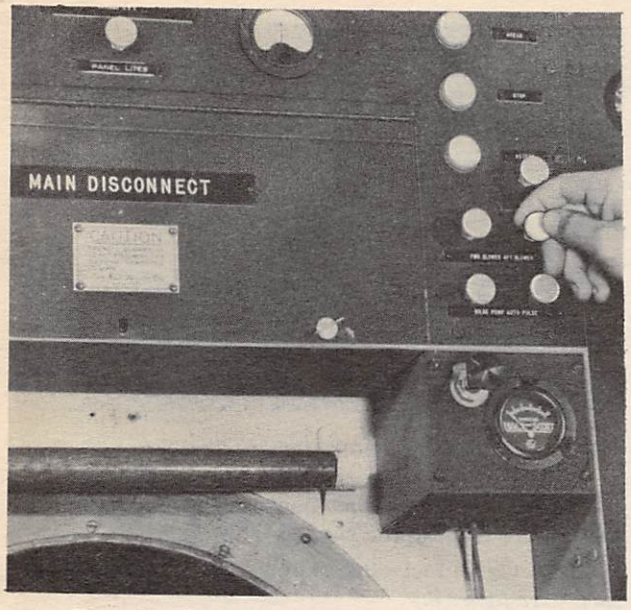


Figure 7—Turning on Engine Room Blowers

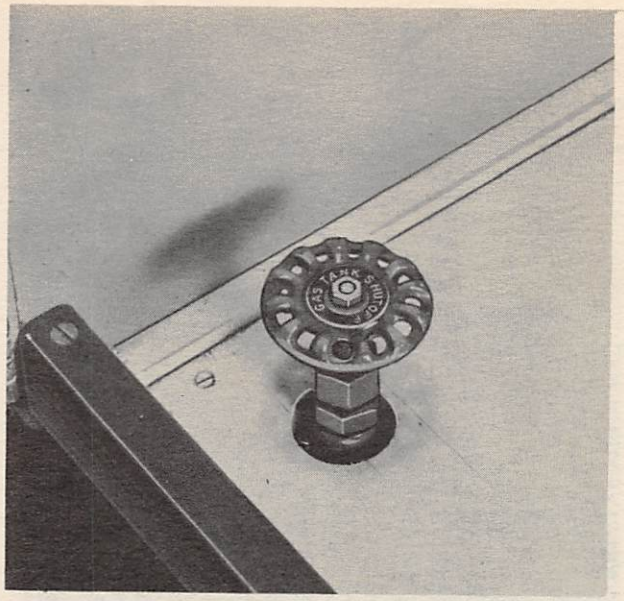


Figure 8—Fuel Tank Supply Valve

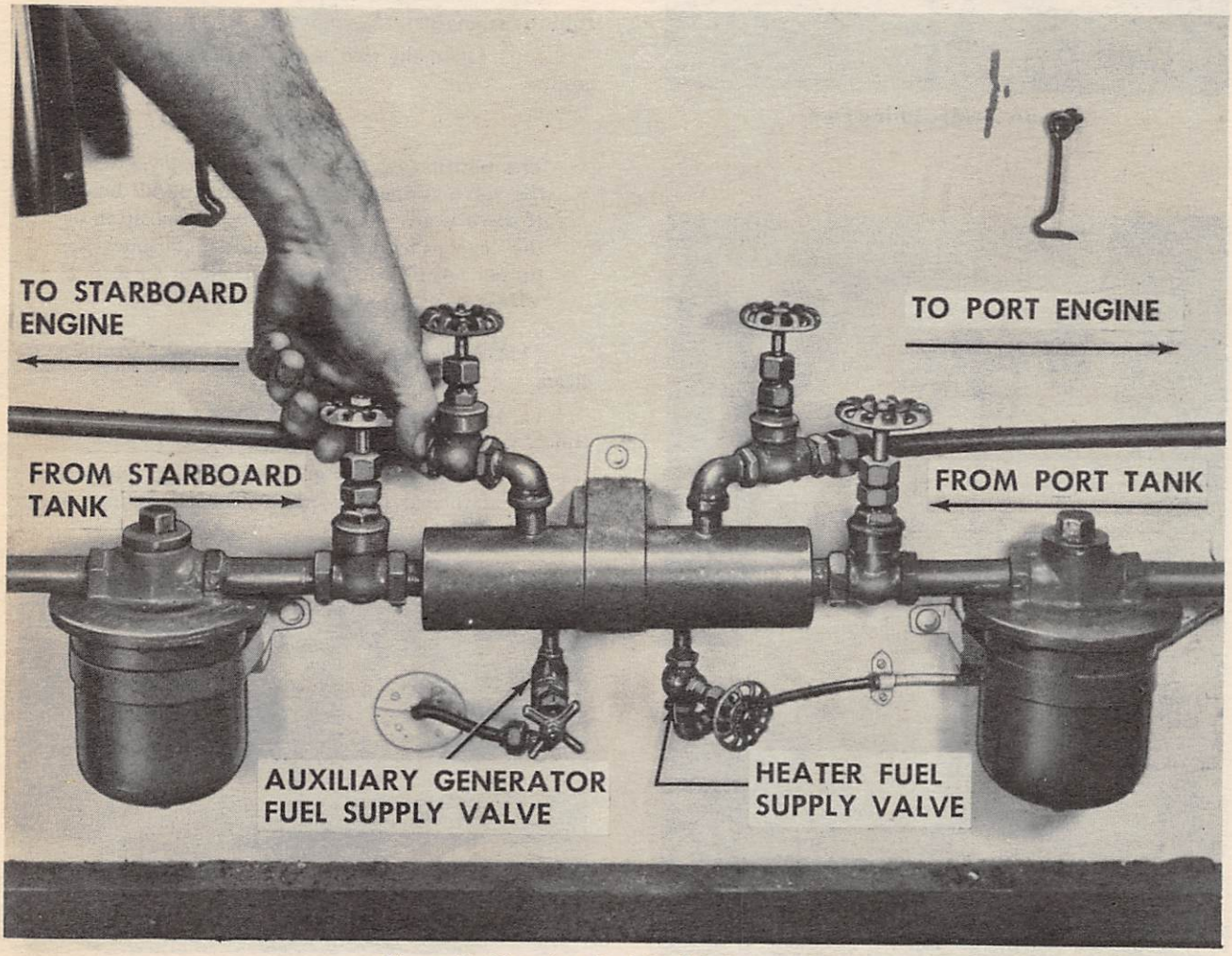


Figure 9—Opening Fuel Tank Selector Valve

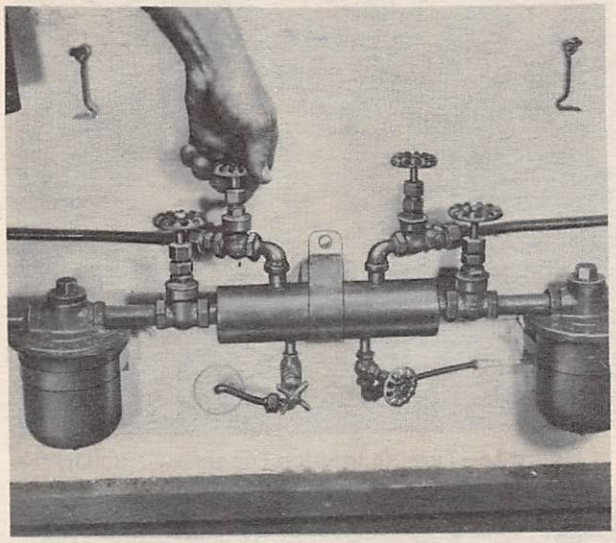


Figure 10—Opening Engine Supply Valves

Note

On boats equipped with the throttle controls both on the bridge and in the pilot house, the throttle levers at one or the other station should be moved to full forward and locked. Normally the pilot house throttle controls will be locked to permit operation from the bridge.

(14) Turn the water pump grease cup. *(See figure 13.)*

(15) Make sure the oil cup on the gear box which connects the water pump shaft to the distributor shaft is adequately filled. *(See figure 13.)*

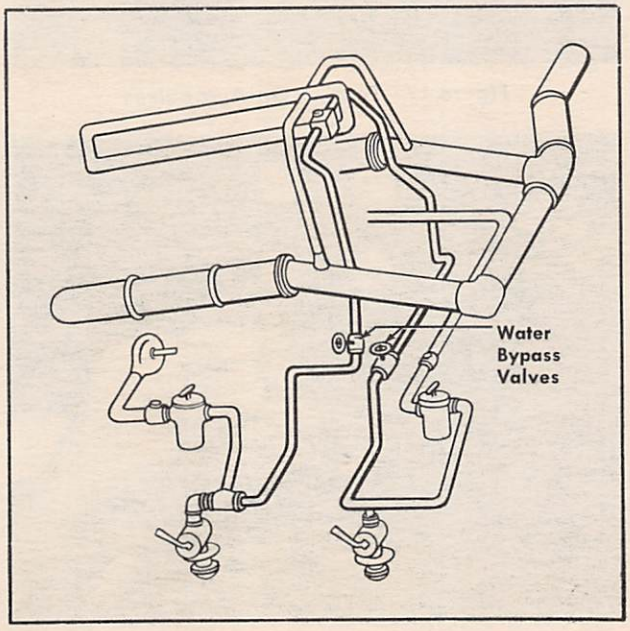


Figure 11—Water Bypass Valves

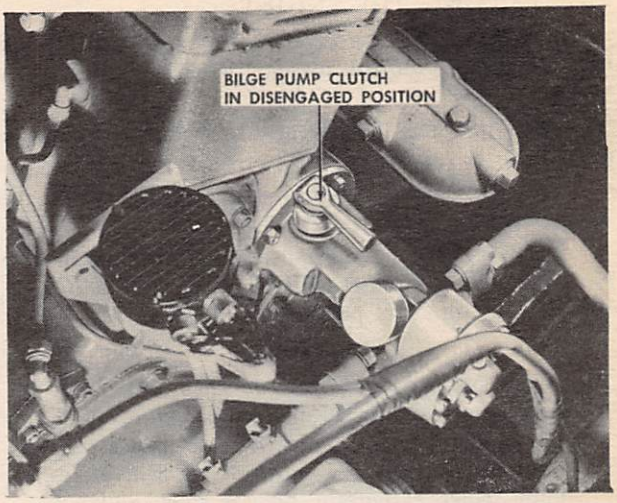


Figure 12—Engine-driven Bilge Pump

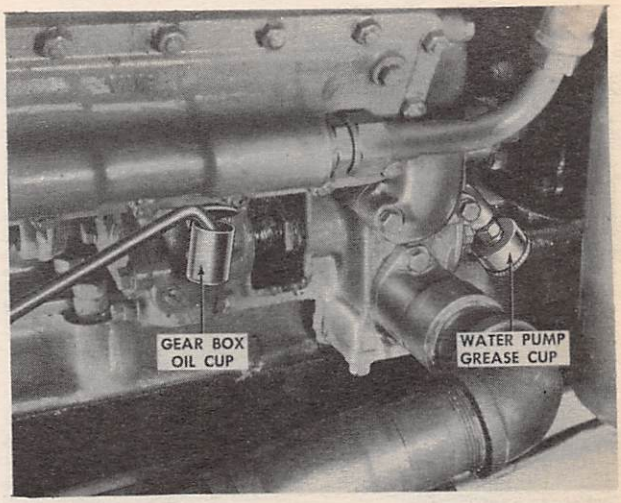


Figure 13—Filling Gear Box Oil Cup



Figure 14—Clutch Control Switch

c. STARTING THE ENGINES.

(1) Make sure the reverse lever is in neutral and that the clutch control master switch *(figure 14)* is "OFF."

(2) Close the throttle all the way, then crack it open 1/8 inch. *(See figure 15.)*

(3) Turn on the ignition toggle switch (with the wing switches "OFF"). *(See figure 16.)*

(4) Turn on the autopulse units. *(See figure 17.)* Normally the autopulses will click for half a minute. When they stop, fuel pressure is adequate.

CAUTION

If the autopulses continue to click, either the fuel supply to the autopulses has stopped or the carburetor float valve has stuck and gasoline will overflow. Should this happen, determine which carburetor float is stuck and tap the carburetor gently to see if this will remedy the trouble. DO NOT start the engines until this trouble is corrected.

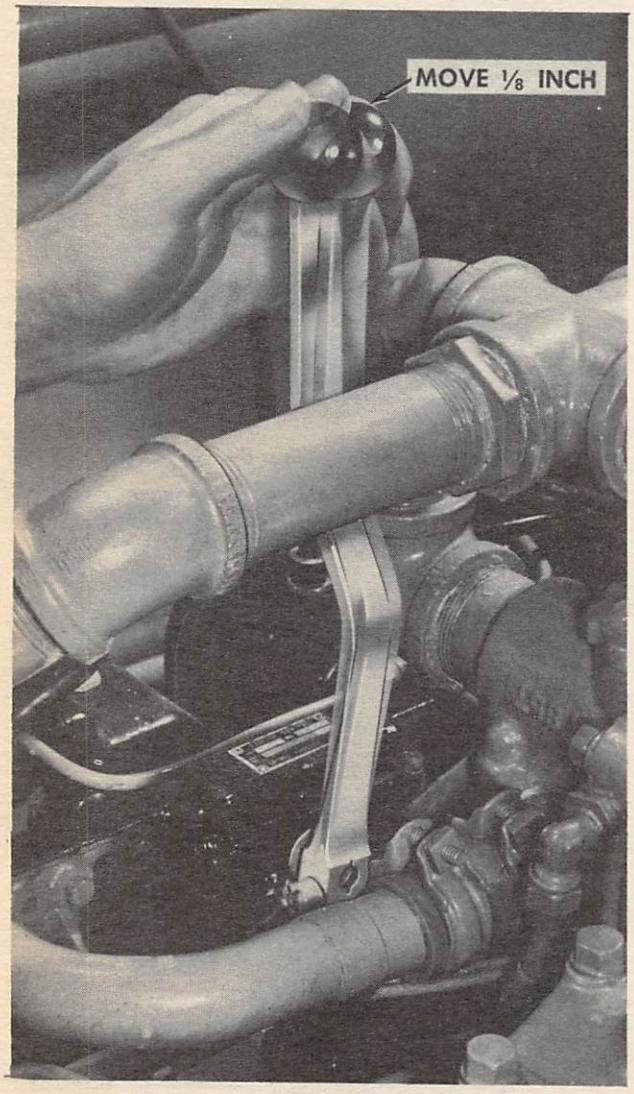


Figure 15—Cracking the Throttle

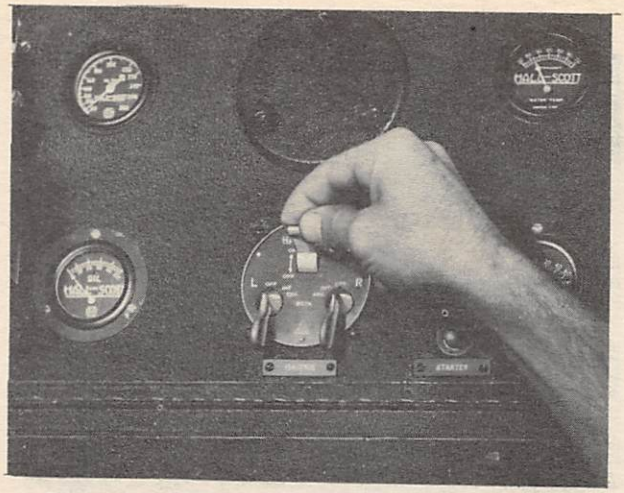


Figure 16—Turning Ignition Toggle Switch "ON"

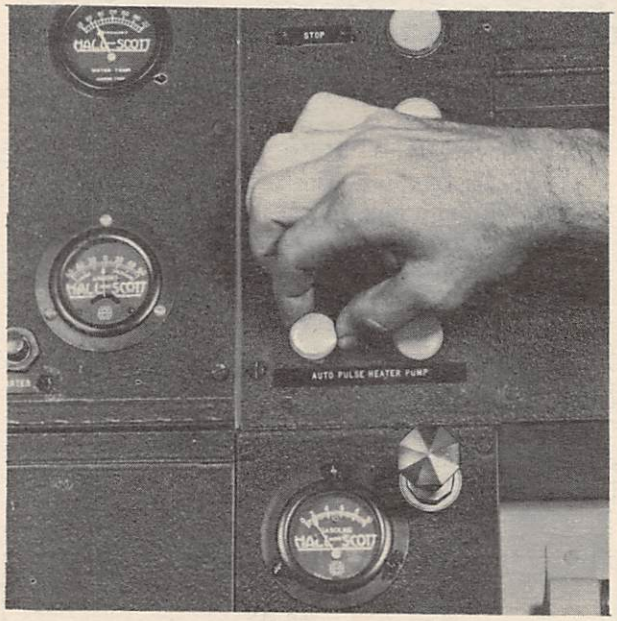


Figure 17—Turning On Autopulses

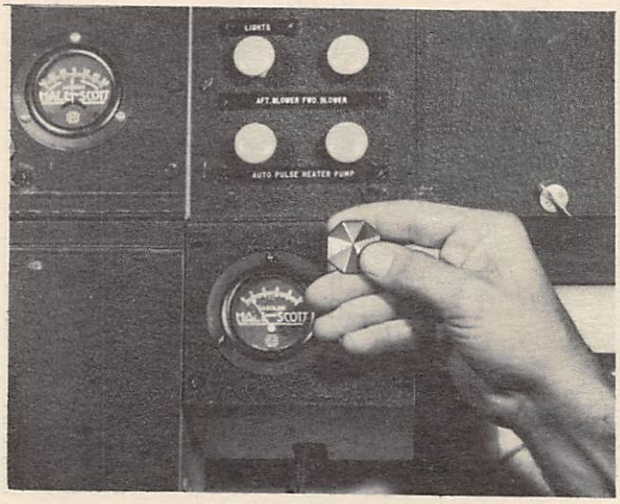


Figure 18—Working Fuel Primer Pump

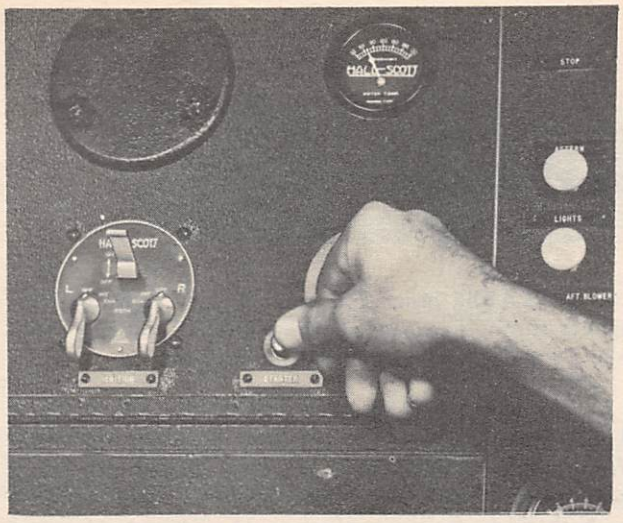


Figure 19—Pressing Starter Button



Figure 20—Turning Ignition Wing Switches to "BOTH ON"

(5) Work the fuel primer pump handle slightly to obtain suction, then move it approximately 2½ to 3 strokes. *(See figure 18.)*

(6) With the wing switches "OFF," press the starter button and let the engine turn over three or four times. *(See figure 19.)*

(7) Turn the ignition wing switches to "BOTH ON" position. *(See figure 20.)*

(8) Press the starter button and release it immediately when the engine starts. (If the engine does not start in 10 seconds, release the button, prime again with three strokes, and try again.)

Note

When the engine starts, it should not be necessary to "jab" the throttle to keep it running. If this is necessary, either the idling speed is too slow or the carburetors are out of adjustment.

d. WARM-UP.

(1) Check that the oil pressure gage is registering pressure immediately after the engine starts.

(2) See that the cooling water is discharging normally.

(3) Check that the two exhaust manifolds feel about the same temperature.

Note

Since the water temperature bulb is located in the intake manifold, it does not indicate the temperature of the individual exhaust manifolds. The only way to determine that BOTH exhaust manifolds are being properly cooled is to feel them. If either overheats, stop the engines and determine the cause. Most often the water strainer needs cleaning, but occasionally the engine water pump is worn and must be repaired or replaced.

(4) Leave autopulse units in operation as long as the boat is maneuvering around the dock or until operating in open water at 700 to 800 rpm.

(5) Check that the fuel pressure is normal (3 to 5 psi).

(6) Check to see that all plugs are firing as follows: Set the throttle so that the engine is idling steadily at about 600 rpm. Then, watching the tachometer, turn the ignition wing switches to cut out each of the four rows of plugs, one at a time. (If all the plugs are firing, cutting out one row when idling will hardly affect the rpm. If one or more plugs are "OUT," however, the speed will be noticeably reduced.)

Note

The water bypass valves *(figure 11)* may be opened to warm the engine up more quickly in cold weather. *Never* attempt to warm the engine quickly by partially closing the seacocks.

e. STOPPING THE ENGINES.

(1) Run the engines at idling speed (600 rpm) for 2 or 3 minutes before switching "OFF."

(2) Close throttle completely which should reduce rpm to 450 to 500.

(3) Turn wing switches to "EXHAUST" and let engine run on exhaust plugs for 30 seconds.

(4) Turn "OFF" the ignition toggle switch.

(5) Turn both wing switches to "OFF" position.

(6) Close fuel supply valves to each engine.

(7) Close the fuel tank selector valves.

(8) Close the fuel tank valves in the dispensary.

(9) Close both water bypass valves for each engine.

Note

It is wise to wipe the engines down while they are still hot.

SECTION III

Hull and Deck

1. DESCRIPTION.

(See figure 21.)

a. HULL FRAMING.

(1) KEEL, KNEES, AND STEM.—The keel, forefoot knee, stem knee, and stem are made of mahogany in five sections. These sections are carefully scarfed, glued, and bolted together. The keel is double rabbeted to take the inner and outer planking.

(2) KEELSON.—The keelson is spruce or Douglas fir with its sections scarfed. This beam is laid on the middle of the floor timbers over the keel of the boat to strengthen it. It is fastened to the keel by the keel bolts.

(3) CHINES.—The chines are mahogany made up of three sections, scarfed and double rabbeted in the same manner as the keel. The chine scarfs are located between the keel scarfs. The breast hook is mahogany also, fastened to the stem and to the chines with carriage bolts. The keel and chines are bolted to the frame with galvanized carriage bolts.

(4) BULKHEADS. — The structural watertight bulkheads are hollow, being built of two layers of 3-ply fir plywood separated by spruce stiffeners. The boundary frames are of fir, Oregon pine or cypress assembled with glue and galvanized wood screws. The bulkheads are attached to the keel and chines by means of steel angles fastened with carriage bolts.

(5) FRAMING.—After the keel and bulkheads are set up, spruce or cypress longitudinal stringers spaced 1 foot apart are fastened into notches provided in the bottom and sides of the bulkheads and to temporary steel molds. These longitudinals then become the building form and transverse double white oak frames are steam bent and fitted throughout: the outer frame next to the planking and the inner frame inside the longitudinal stringers.

(6) FILLER BLOCKS.

(a) Between the inner and outer frames at the keel there are fitted oak floor timbers. Outboard of these timbers from keel to chine, fir or cypress fillers are fitted between the inner and outer frames, intercostal between longitudinal stringers, except under the engine stringers where the fillers are sided fir or cypress.

(b) Between the inner and outer frames, from chine to sheer, there are fitted spruce or cypress fillers, intercostal between the longitudinal stringers.

(c) All filler blocks are fastened through the frames with galvanized screws on the bottom and top.

(d) The inner and outer frames are bolted together through each of the longitudinal stringers from keel to sheer with galvanized flathead bolts.

(7) KNEES AND GUSSETS.—There are plywood knees fitted on both sides of each frame at the chine from bulkhead 18 to the stern. They are not fitted forward of frame 18. At the sheer, plywood knees are fitted to both sides of alternate frames. The knees are screwed to the frames with galvanized screws at sheer and chine.

(8) ENGINE BED STRINGERS. — The engines are mounted on four longitudinal bed stringers. Before the boat is planked, these prefabricated engine bed stringers are put in through the transom and bolted down through each frame. The outboard stringer extends from frame 76 forward to the bulkhead at frame 18. This construction allows distribution of weight of the engines and gasoline. The engine bed stringers are made up of oak, or long leaf yellow pine, rabbeted both top and bottom to take the plywood facings. Spruce, fir or cypress stiffeners are fitted, using a truss type construction with vertical spruce, fir or cypress stiffeners, at every frame. Both sides of the built-up stringers are faced with 3-ply fir plywood glued and screwed to the stiffeners and the stringers. Solid fir or cypress fillers are fitted between oak or yellow pine stringers in the engine compartment. The stringers rest on every frame and are bolted through the frames with flathead galvanized bolts. Together with the keel and chines they form the main strength members of the bottom of the boat.

(9) ENGINE BEDS.—The engine beds are made of oak and are bolted to the engine bed stringers at an angle in line with the propeller shaft. The forward ends of the engine beds are provided with an engine antitripping bracket to keep the engines and beds from rocking back and forth when the boat is at sea.

(10) DECK BEAMS.—The deck beams are spruce or cypress on 9-inch centers at each frame. They are sided and moulded at center line and at shelf, and have a camber of 6 inches in 15 feet.

(11) HEADERS AND SHEER CLAMP.—Headers of spruce or cypress intersect with the sheer clamp at about frame 2. The after end of the header is fastened to the cockpit header with a suitable knee at the bulkhead at frame 66. The sheer clamp is spruce or cypress. The headers and shelves are bolted to the deck beams with flathead galvanized bolts.

(12) FENDER GUARDS. — The sheer fender guards are of white oak, fastened into the clamp with wood screws faced with galvanized iron half oval. The quarter guards are bolted with galvanized bolts through every frame.

(13) SPRAY STRIPS.—Spray strips are shaped from mahogany and fastened with bronze screws and are faced with brass half oval.

b. PLANKING.—The boat is double planked and has 8-ounce cotton duck laid in marine glue between the two layers of planking.

(1) INNER PLANKING.—The inner planking is cedar run diagonally at approximately a 45-degree angle. This planking is screwed to the keel, chine, and clamp and is fastened to the frames by means of copper nails.

(2) OUTER PLANKING.—The outer planking is mahogany run longitudinally. The butts are staggered and made on butt blocks between frames. Butt blocks are made of the same thickness as the outer planking and the outer planking is flush fastened with screw heads let in only enough to allow planing and sanding of the hull. Fastenings are surfaced with a hard surfacing putty. Fastening holes are not counterbored and plugged. The planking is made up as tightly as possible with no caulking seam except the garboard seam. This seam is caulked lightly with cotton and filled with surfacing putty. Plank ends are bolted through butt blocks with three bronze flathead bolts. The inner and outer planking are fastened together between the frames with wood screws from the inside.

(3) MAIN DECK PLANKING.—The main deck planking is ¾-inch, 5-ply fir plywood in long lengths with butts bolted on butt blocks between beams. It is fastened to the deck beams with nails and into the edge of the topside planking and clamp with screws. Removable sections are provided over the engine room for removing the main engines. Either engine may be removed without interfering with the other engine. The top of the trunk cabin can be removed to allow replacement of the bullet sealing gasoline tanks under the dispensary seats.

(4) BRIDGE AND COCKPIT PLANKING.—The bridge and cockpit deck planking is ¾-inch, 5-ply fir plywood fastened with screws. A weather-tight removable hatch for access to storage space is provided in the cockpit.

c. DECK COVERING.—The main deck and cockpit are covered with 12-ounce canvas laid in marine glue. The removable sections of the deck are made watertight by gluing and painting down a 3 inch wide duck strip over the seams. The flying bridge deck is covered with a nonslip, light weight plastic deck covering.

d. PILOT HOUSE.—The prefabricated pilot house is constructed of 1-inch plywood for sides and front and ⅜-inch plywood top. It is dropped into place and securely fastened to the deck and bulkhead at frame 28.

e. BRIDGE.—The forward bridge panel is an extension of bulkhead 28, forming the afterside of the pilot house. The bridge sidings are constructed of 1-inch plywood. The steering wheel, radio, and navigation equipment, manual clutch control, hydraulic clutch control, throttle controls, and topside light switch panel are installed in the forward bridge panel. Machine gun foundations and suitable lockers for stowage of signal flags and ammunition are built into the bridge.

Note

On some boats used in noncombat areas the machine gun turrets have been removed and plywood lockers installed to provide storage space for life rafts, life jackets, and other equipment.

f. DISPENSARY CABIN TRUNK.—The dispensary cabin trunk has ¾-inch, 5-ply fir plywood sides with spruce or cypress stiffeners at every third deck beam. Cabin trunk deck carlings are of spruce or cypress, fastened with plywood knees to the stiffeners at every third frame. The cabin trunk top is of plywood covered with 12-ounce canvas laid in paste paint, stretched tightly and free from wrinkles. The trunk top is removable to facilitate the removal of the gasoline tanks.

g. LAZARET.—The lazaret deck planking is of ¾-inch, 5-ply fir plywood fastened with screws. A square weather-tight hatch is fitted in the center of the cockpit seat with a wood ladder providing access to the lazaret.

h. INTERIOR FLOORS.—Interior floors throughout the boat are ½-inch plywood supported on spruce floor timbers on 12-inch centers. Removable sections with flush lifting handles are provided for access to piping, valves, tank, limber chains, etc.

i. WINDOWS.

(1) The chart and radio room windows are glazed with Plexiglas, a clear plastic material. They are let in flush into rabbets cut in 1-inch plywood and are laid in seam composition "Durite," or equal, and are held in place by a brass finishing strip fastened through the brass and Plexiglas with brass screws every 2 inches. The after half of the side windows are movable.

(2) Four 10-inch round portlights are fitted into the trunk cabin, two of which are fitted with wind scoops. In addition, ten 10-inch round portlights are fitted in the following locations:

(a) Two in the crew's toilet.

(b) Four in the crew's quarters, two with windscoops.

(c) Two in the officer's quarters, both with windscoops.

(d) One in the galley.

(e) One in the officer's toilet.

All portlights are fitted with portable screens in metal frames with blackout covers. Windscoops have screens and are stowed in racks with the blackout covers.

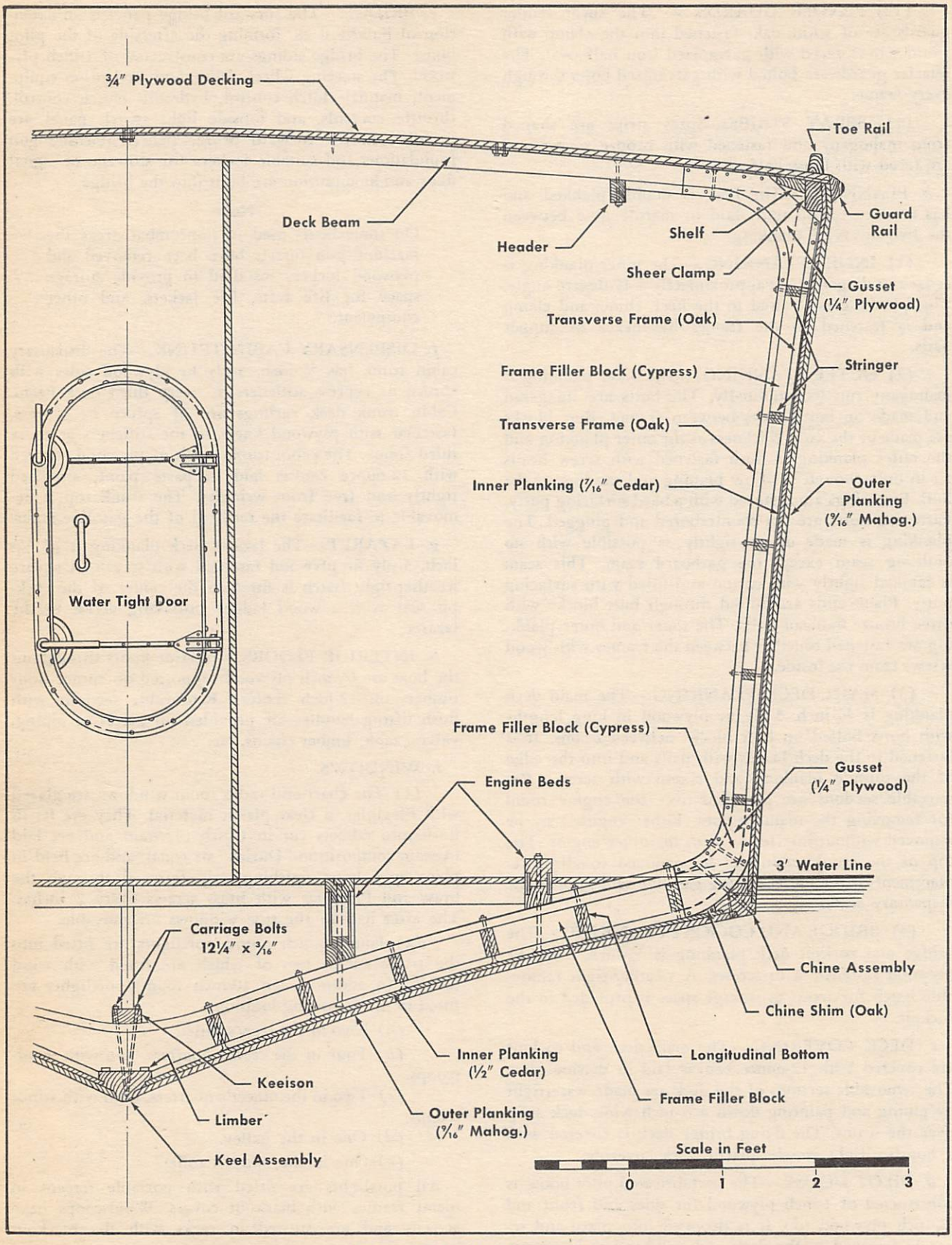


Figure 21A—Midship Section

(3) Four deadlights are provided in the removable decking over the engine room. They are complete with blackout covers and are waterproof.

j. DOORS.

(1) ESCAPE SCUTTLE.—The escape scuttle at the forward end of the crew's compartment is a standard Navy type, or equal, with galvanized steel cover and quick-acting arrangement. The hatch has a clear opening of 18 inches in diameter and a ladder of wood is fitted on the afterside of the door to the crew's toilet.

(2) WATERTIGHT DOORS. — Plywood doors, provided on bulkheads at frames 18, 42, and 55, have a clear opening of 18 x 36 inches with wedges and locking dogs of galvanized steel. These doors can be opened from either side of the bulkhead. The watertight bulkhead at frame 66 is fitted with a wide plywood door and a single step into the dispensary for easy access when carrying litters in and out of the dispensary.

k. COMPANIONWAYS AND LADDERS. — Companionways and ladders throughout the boat are made of mahogany with antiskid treads mortised into the side stringers. The steps are portable. Safety treads are provided at the top and bottom landings of all ladders and on both sides of all doors.

l. MASTS.

(1) The tripod type radio mast is made of cypress or spruce. Each of the legs have welded steel fittings at their lower ends for fastening to the deck. The legs of the mast support a lookout platform on which the searchlight is mounted and out of which the top mast is extended. The top mast is fitted with a yardarm with blocks for signal halyards and lugs for carrying the radio antenna. The guard rails at the lookout position on the mast are securely bolted with galvanized steel bolts.

(2) The bow plate casting is provided with a socket for a tapered wooden jack staff.

(3) The ensign staff is identical to the jack staff, except that it is fitted into an angle casting bolted through the deck on the center line at the stern.

m. RAILINGS.—The life line consists of $\frac{5}{16}$-inch galvanized steel rigging wire with turnbuckles and other gear. It runs through steel tubing stanchions bolted to the deck. The fittings are the welded type, not threaded. At the forward end of the pilot house the removable section of the life line, a galvanized steel chain fitted with a pelican hook for closing, is installed.

n. DECK GEAR AND FITTINGS.

(1) Deck cleats are galvanized malleable iron, 10 inches long. They are bolted through the deck to braces below.

(2) Four galvanized malleable iron chocks are mounted on blocks and fitted inside the toe rail.

(3) The stem is fitted with a galvanized steel bow plate having integral towing chock, lugs for attachment of life lines and socket for jack staff.

(4) Two wooden towing bitts are installed in the stern, one port and one starboard.

(5) Eyes, ringbolts, pads, straps, etc, which may be necessary for securing and stowing the various gear and equipment, are installed on the deck and elsewhere as required.

2. CARE, MAINTENANCE, AND STOWAGE.

a. GENERAL.—Proper stowage of equipment on board a boat is important not only for the sake of appearance, but because it increases the efficiency of the boat and crew. "The right thing at the right place at the right time" should be the guiding principle behind any stowage plan. Gear and equipment lying haphazardly around throughout a boat gets lost, gets damaged, damages other equipment at sea, interferes with the free movement of the crew about the boat, and decreases the boat's speed. Preparation of a stowage plan and the discipline of the crew in observing it is the responsibility of the master of the boat.

b. MAINTENANCE PERIODS.—The maintenance periods given in this section may vary with climate, operational conditions, and general care. The periods may be changed to fit local conditions at the discretion of the Commanding Officer.

c. AT DOCKS.

(1) Keep fiber mats or strips of canvas laid down on the principal walking surfaces of the deck and below decks to catch dirt and save the paint work.

(2) Wash down the deck daily with fresh water and a hose, if available. Swab the decks clean and dry.

(3) Surround deck filler connections with rags when filling oil or fuel tanks, to catch any spills or drips which would stain the paint.

(4) Keep canvas covers installed and lashed on armament, searchlights, bridge wheel, and fire hoses.

(5) Keep lines and fenders stowed neatly when not in use. Make sure they are dry before stowing them in the forepeak or closed lockers. Air and dry stowed lines once a week.

(6) Air life jackets in the sun once a week.

(7) Sweep interior floors daily. Mop them with fresh water twice a week.

(8) Wash interior surfaces and fittings as required. Use soap or cleaning powder for interior walls. Use a piece of chamois for windows and glass surfaces. NEVER USE CLEANING POWDERS. A liquid cleaner which will not scratch the Plexiglas window coating should be used.

(9) Polish brass daily.

(10) To preserve bright work wipe with a cloth slightly moistened with a light oil.

(11) Keep living quarters clean and orderly. Bunks should be made up and clothes, toilet articles, and personal belongings should be stowed away when not in use. Clean toilets and lavatories as often as necessary.

(12) Air bedding above decks once a week. Every 3 months, or as necessary, close up the sleeping quarters and spray, gas, or fumigate the compartments with a suitable insecticide.

(13) Keep the galley scrupulously clean. Do not leave food exposed without reason. Remove all food from the ice box when it is not operating. Clean the ice box with hot water and soda every week. Wash all mess gear and silver after use. Operate the galley blower while cooking to keep the other compartments free of cooking odors.

d. AT SEA.

(1) All loose deck gear should be stowed away or lashed in place. This includes such things as the anchor, lines and fenders not in use, hoses, lift rings, and pennants or flags.

(2) Keep the canvas covers installed on such items as the searchlight and the armament when the use of such equipment is not anticipated during the trip.

(3) Stow away below deck gear and equipment—galley equipment, tools, charts and papers, navigation equipment, clothes and bedding, etc—when not in actual use.

(4) Fasten bulkhead doors to prevent swinging and close manhole covers to exclude salt spray while underway.

e. AFTER MOORING.

(1) Wash down the decks and all exterior surfaces with fresh water, if available, to remove salt water deposits. Use a hose, if possible, and swab the decks dry and clean.

(2) Wash interior surfaces which have been wet by salt water. Use a piece of chamois and fresh water.

(3) Wash windows with fresh water and a chamois.

(4) Dry all lines and fenders thoroughly before stowing them.

(5) Polish all brass.

(6) Wash oilskins with fresh water and dry them before stowing them away.

3. QUARTERLY RECONDITIONING.

a. GENERAL.—This type boat must be reconditioned every 3 months, except when it is used in fresh water, in which case a longer period of operation is possible as conditions may permit. The following procedure is adequate for accomplishing the necessary repairs.

b. DRYDOCKING.—Three methods of dry-docking the boat are described following. The marine railway method is preferable, if available. Whatever means of support is used for the boat, it should be checked with the docking plan. *(See figure 22.)*

(1) MARINE RAILWAY.—Where a marine railway is used and the boat manufacturers boat cradle is available, *(figure 23)*, the cradle should be used to place the boat on the ways for hauling. *(See figure 24.)* If a manufacturers cradle is not available, then docking plan should be checked very closely and suitable keel chocks set up on the runway at the bulkheads to guarantee an even distribution of weight on the entire keel section. Suitable chine chocks or shores should be cut and arranged on the railway in direct line with the keel chocks to accommodate a portion of the weight of the ship. The boat should be run onto the cradle far enough so that the forward cradle riser lines up with the brass plate on the after end of the port spray strip. *(See figures 25 and 26.)* Great care should be taken to make sure that the weight is equally distributed at all bearing points. It is imperative that the propellers, struts, rudders, scoops, and any other underwater projections carry no weight while the boat rests on the marine railway. If wedges are used to adjust the cradle to the lines of the boat, they should be nailed in place on the chock.

(2) LIFT.—If a lift is the only means available to take the boat from the water, it is preferable to sling the cradle on the lift and then lower the cradle into the water deep enough so that the boat may be placed on it without damaging propellers or rudders. Braces should be used to prevent the sling from damaging the hull. When the boat is in proper position on the cradle, lift cradle and boat clear of the water and place in a suitable location to accomplish quarterly reconditioning.

CAUTION

If the lift method is used, it is very important that personnel acquainted with this procedure directly supervise the work.

(3) BEACHING.—If neither a crane or a marine railway is available, the boat may be beached in a locality with sufficient rise and fall of tide. Place the cradle in shallow water at high tide so that just enough water is over it to float the boat onto the cradle. When the tide recedes, the necessary underwater repairs may be made and the bottom painted. The boat can then be floated off the cradle at the next high tide.

CAUTION

Support the cradle firmly.

c. INSPECTION.

(1) After the boat has been drydocked, the underwater surfaces should be thoroughly cleaned with suitable brushes, scrapers, and fresh water hose. *(See figures 27, 28, and 29.)* This cleaning should be accomplished before the marine growth dries and hardens on the bottom. Upon completion of this task the following inspection should be made:

(a) Inspect and clean all the under water through hull fittings and sea chest strainers. *(See figures 30 through 36.)*

(b) Check propellers, strut bearings, and rudders to insure proper mechanical operation.

(c) Check zinc plates for electrolytic decomposition.

(2) The completion of the above inspection will determine the amount of under water repairs necessary

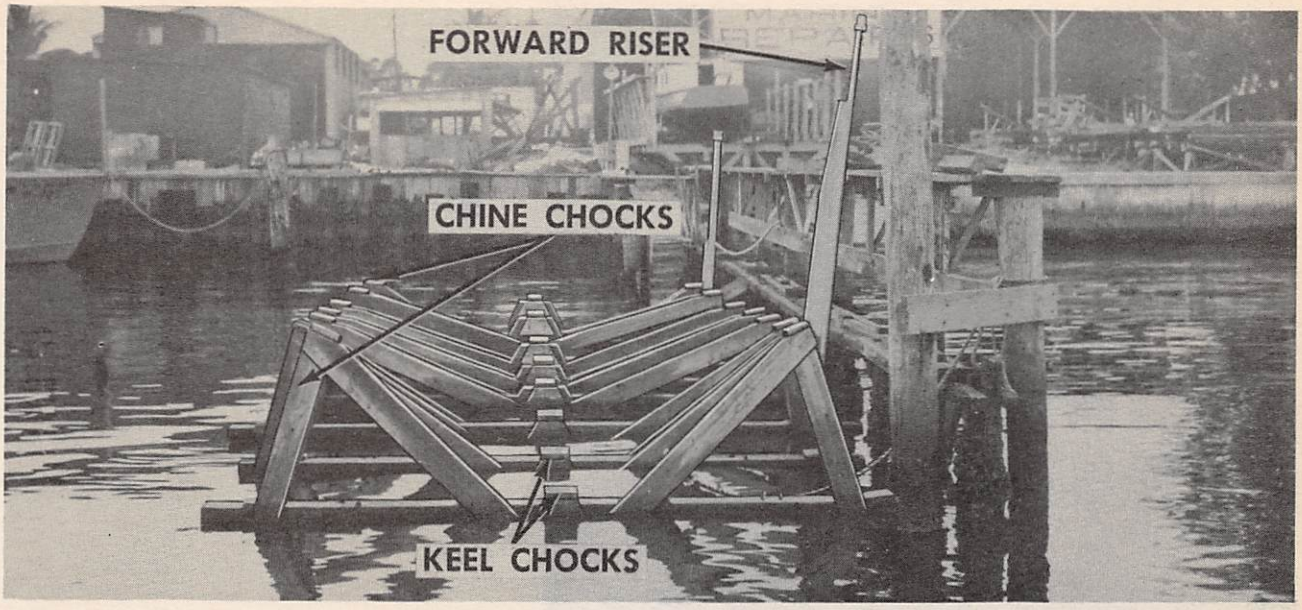


Figure 23—Boat Manufacturer's Shipping Cradle

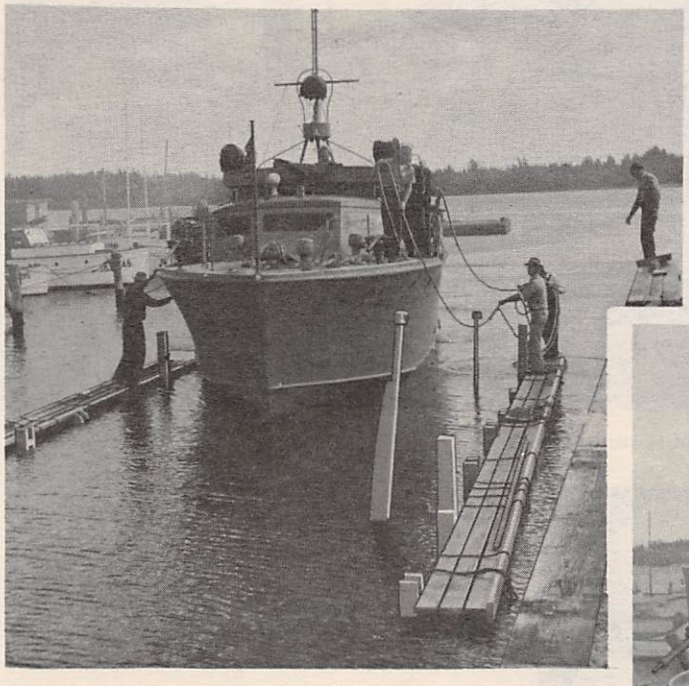


Figure 24—Boat Being Moved into Place Over Cradle

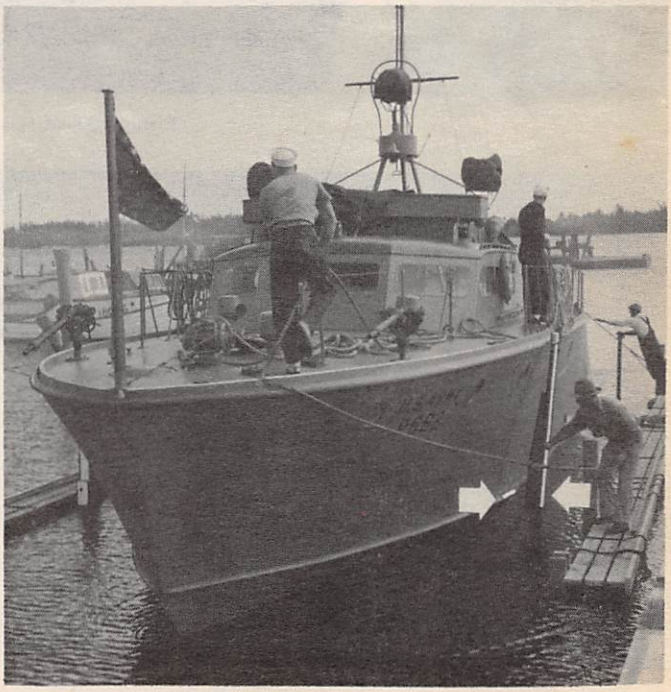


Figure 25—Locating Boat So That Forward Riser Aligns with Cradle Location Plate on After End of Spray Strip

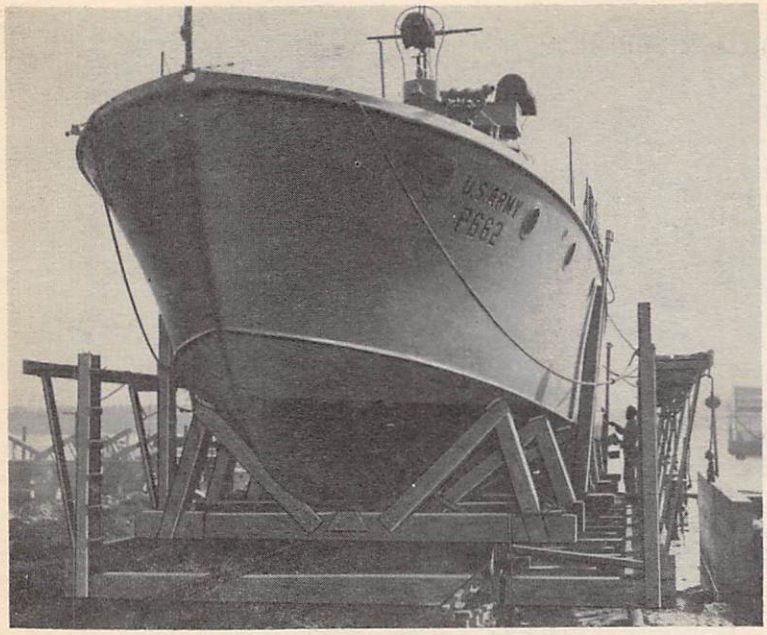


Figure 26—Boat Properly Hauled on Manufacturer's Cradle

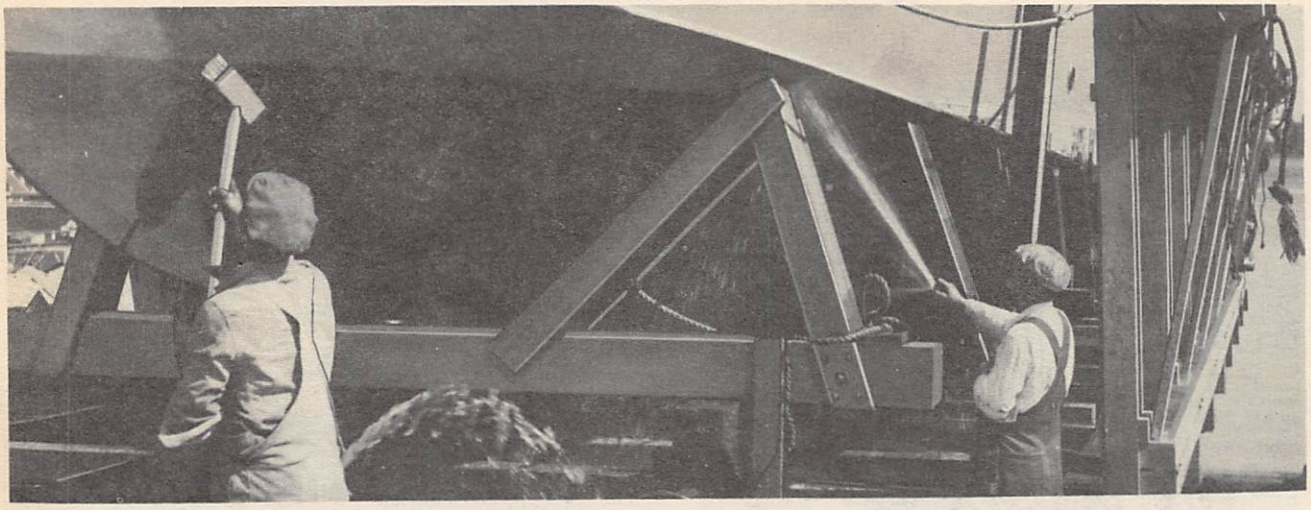


Figure 27—Cleaning Bottom



Figure 28—Brushing Bottom

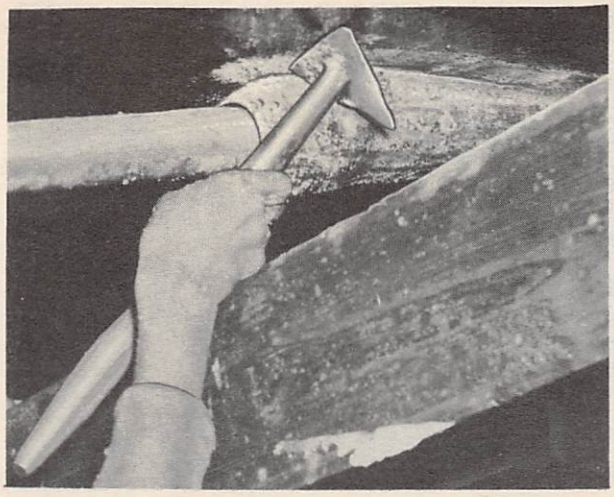


Figure 29—Scraping Propeller Shaft Log



Figure 30—Rudder, Propeller, and Strut Before Cleaning

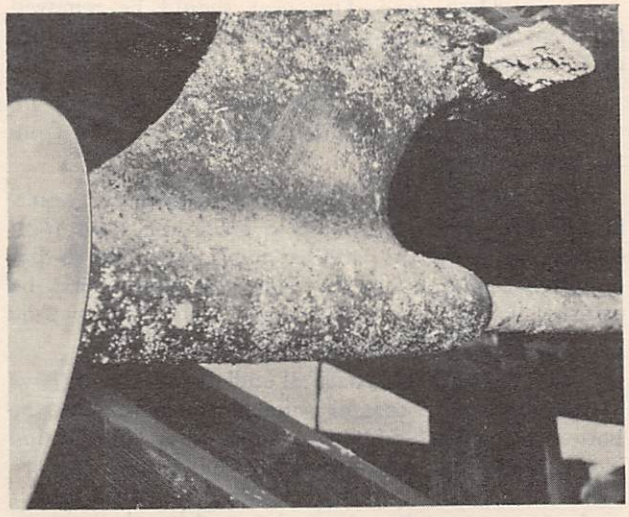


Figure 31—Strut and Zinc Plate Before Cleaning

to place the boat in first class operating condition. These repairs, if any, should be accomplished before painting is started on the under water surfaces. For the necessary instructions to accomplish these needed repairs or maintenance, refer to paragraph 4., this section.

d. PAINTING.

(1) PROCEDURES AND PRACTICES.—The following customary procedures and practices should be observed in painting:

(a) Never paint over a wet, dirty, or greasy surface. Make sure the sections to be painted have been sanded, cleaned, and are dry.

(b) If possible, do not paint in wet weather or in bright sunlight. Too much heat may blister the paint.

(c) Thoroughly brush the paint on the surface. Thick, uneven coats will crack, blister, and peel.

(d) Do not let dirt or water fall on fresh paint until it is thoroughly dry.

(e) Paint all exterior vertical surfaces above the top line of the bottom paint with sea blue paint conforming to Formula No. 5S, Marine Design Construction and Procurement Specification No. 1-MDCP-2. This includes hull topsides, pilot house and bridge sides, cabin trunk, cockpit sides, mast, radio mast, life ring buoys, and similar surfaces or items fastened to vertical surfaces. The direction finder loop is similarly painted with the exception of the black ring at the top of the loop which is covered with clear lacquer only.

(f) Paint all horizontal exterior surfaces above the water line with deck blue paint conforming to Formula No. 20B, Marine Design Construction and Procurement Specification No. 1-MDCP-1. This includes the main deck, bridge deck, cockpit deck, all steps, and deck gear and fittings such as the anchor and anchor winch, handrail, bitts and cleats, and deck plates.

(g) When successive coats of paint become too thick, burn and scrape off all the old paint down to the bare wood for repainting. Fill any cracks or exposed seams with plastic wood or seam compound; apply a first coat of hull or deck paint thinned down with 1½ quarts of linseed oil to 1 gallon of paint; apply a regular coat of the proper paint.

CAUTION

If the old paint is to be scraped off, be careful not to scrape through or tear the canvas deck covering.

(h) Whenever metal surfaces such as through-hull connections and deck fittings are cleaned down to the bare metal, prime the surface with red lead, Federal Specification No. TT-R-191a, grade B or C, before repainting.

(2) ORDER OF PAINTING.—The boat is most conveniently painted in the following order:

(a) Sides above waterline.

(b) Underwater surfaces.

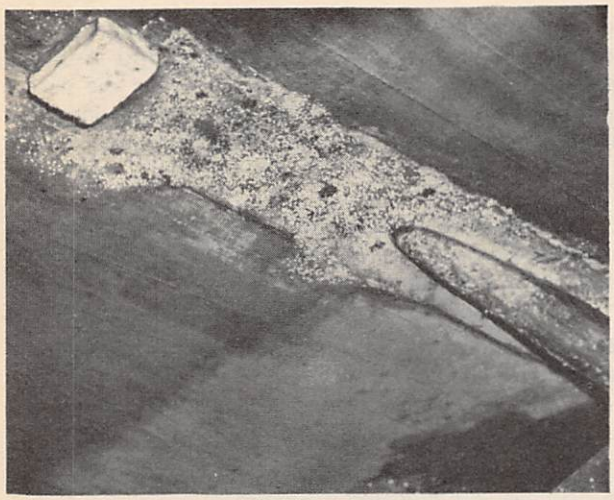


Figure 32—Shaft Log and Zinc Plate Before Cleaning

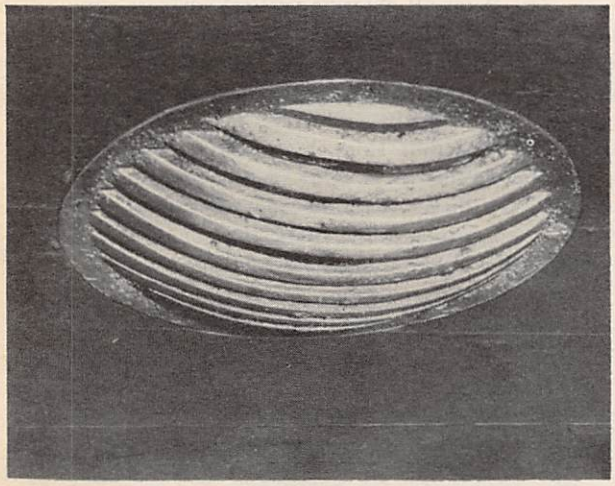


Figure 33—Fire Pump Intake Strainer Before Cleaning

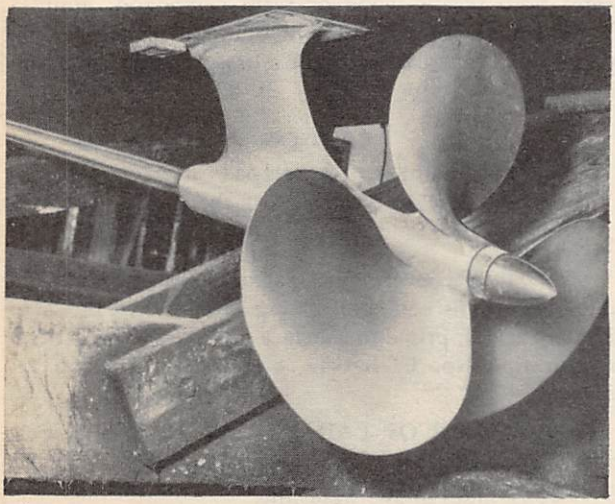


Figure 34—Propeller, Shaft, and Strut After Cleaning

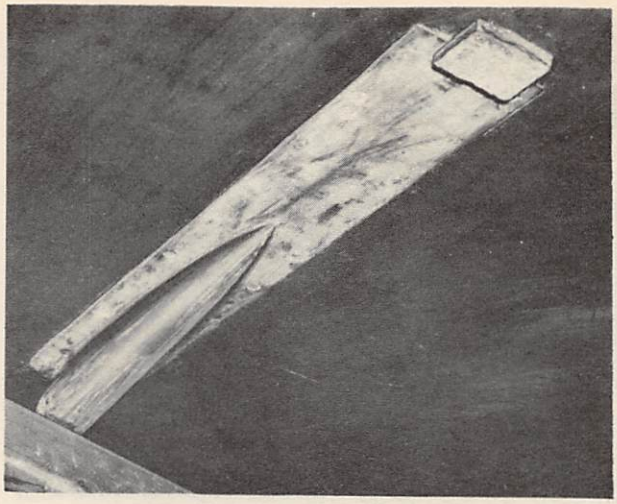


Figure 35—Shaft Log and Zinc Plate After Cleaning

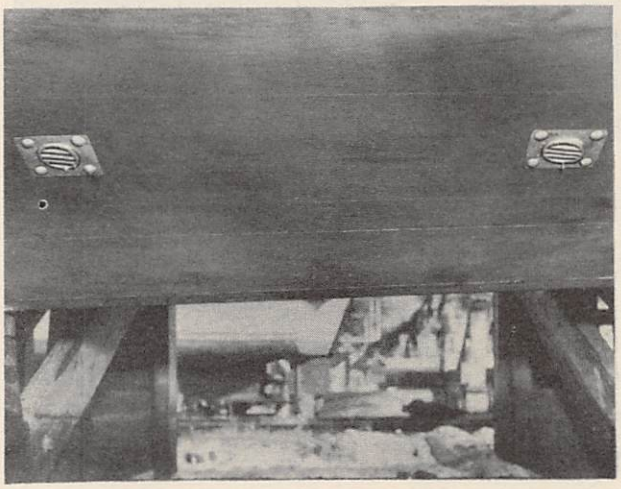


Figure 36—Engine Cooling Water Intake and Discharge Strainers After Cleaning

(c) Deck gear. This gear should be removed from the boat, painted, and replaced after the entire deck has been painted and is dry.

(d) Vertical surfaces in deck structure.

(e) All horizontal deck surfaces, working from the bow to the stern.

(3) SIDES.—Paint the hull sides from the waterline to the gunwale according to paragraph 3.*d.*(1)*(e)*, this section. After this paint has sufficiently dried so that it will not scuff off at the dock, the bottom may be painted. If it is desired, the sides of the boat may be painted while the boat is at the dock.

(4) BOTTOM.—After all under water repairs have been completed, a coat of suitable antifouling marine bottom paint, preferably copperoyd, Navy Specification No. 52-P-20, should be applied to the bottom. If more than one coat is necessary, this first coat should be left to dry before applying a second coat. After the last coat

of antifouling paint has been applied, the boat should be put overboard within an hour or as soon after as is possible. If antifouling paint is allowed to dry, it will crack and peel, leaving the bottom unprotected.

CAUTION

In launching the boat care should be taken to be sure that all loose shores or chocks or other blocking used in hauling the boat be free from the bottom before the engines are started, otherwise when the boat is put in motion under power, loose wood may be sucked into the wheels and consequent damage result.

(5) DECK AND SUPERSTRUCTURES. — The deck and superstructures of the boat should now be cleaned, prepared for painting, and painted according to the same practices and procedures outlined in paragraph 3.*d.*(1), this section. All existing lettering and numerals should be refinished with black exterior paint.

(6) INTERIOR (EXCEPT BILGES). — If it is necessary to refinish interior surfaces of the boat, the practices and procedures outlined in paragraph 3.*d.*(1), this section, should be followed.

(a) Paint all interior walls and ceilings with suitable paint and varnish, following the same color scheme already used.

(b) Paint interior walking surfaces with light grey deck paint, Navy Formula 20L.

(c) When the interior has been painted, mark exposed tanks, doorways and lockers, and units of machinery as necessary for quick identification. Use stencils and black paint.

(7) BILGES.

(a) If the bilges are not painted when the boat is received, it is recommended that they be thoroughly cleaned and dried and painted with some suitable deck paint to make their upkeep easier.

(b) The painting period of the bilges varies with their condition, care, and the amount of water seepage. It is usually not necessary to repaint them as often as exterior surfaces, but often their condition requires painting more frequently than interior walls and floors.

(c) Before painting is started the bilges must be thoroughly cleaned. Oil, grease, and dirt can be removed by dumping 5 pounds (10 pounds if bilge condition requires) of trisodium-phosphate, AN Specification No. O-T-671a., into the bilge water before a short trip. During the trip this bilge wash will be sloshed over the entire bilge, cleaning off any undesirable material. At dock start the bilge pump and pump the bilge dry. Sponge out the entire bilge with clean kerosene and then wash down with clean water, if available. Pump the bilges dry and paint if their condition requires. Refer to section XV.

4. MAJOR REPAIRS.

a. PLANKING.

(1) Repair small gouges in the hull, if they are not through the outer planking, with several thin layers of plastic wood and sand it off flush with the planking.

(2) Repair more serious cuts or cracks by replacing the damaged planks. Usually it is necessary to replace only the outer layer.

(3) It is generally advisable to replace entire planks, but when the damage is slight, the affected sections of planks can be cut out and replaced. Replaced planks should be at least twice as long as the distance between two main frames. When only sections of planks are installed, stagger the seams where the new patches butt against the old planks so they are not in a straight line. *(See figure 37.)*

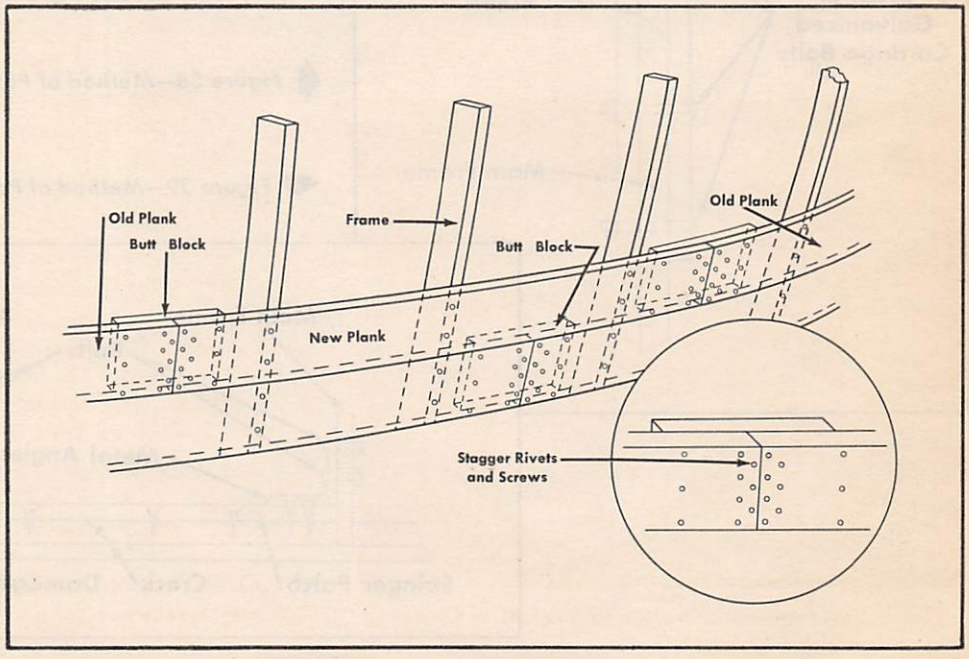


Figure 37—Method of Replacing Planking

(4) Be careful when removing planks from the hull to damage as little as possible of the airplane fabric between the two layers of planking. If the fabric is not seriously damaged, apply a coat of marine glue and install the new plank over the old fabric. If it is badly damaged, replace the fabric with a new section. Coat the inside plank with marine glue, lay the new section of fabric in place smoothly, coat the outside of the fabric with glue, and install the new outside plank.

(5) When a new plank is installed, plug the old screw holes with wooden pegs and duplicate the fastenings of the old plank as closely as possible.

(6) New planks should fit as snug as possible. Where a slightly open seam is unavoidable, fill the crack with plastic wood.

(7) When a new plank is installed, sand it down to a very smooth finish matching the surrounding planks. Prime and paint it as described in paragraph 3.*d.*(1)*(e)*, this section.

b. FRAME MEMBERS.

(1) Broken main frames are almost impossible to remove and must be repaired in the boat. Cut two "sister frames" out of heavy plywood to fit both sides of the broken frame and extend as far as possible above and below the break. Place the plywood pieces on both sides of the frame and through-bolt them with brass or galvanized bolts. Use fairly large bolts and as few of them as practical, since many holes in the frame will weaken it. *(See figure 38.)*

(2) Cracked longitudinal stringers do not weaken the structure of the boat materially unless several of them in the same area are cracked. Cut new stringers to fit between the frames over the damaged one. Fasten the new piece to the frames at either end with metal angles, and to the cracked stringer with screws. *(See figure 39.)*

(3) The rub strake and chine cap are designed to prevent damage to more vital parts of the boat when it comes in contact with the dock or floating objects and as such they must be replaced fairly often. Remove the damaged pieces in entire sections as they were built on the boat. Plug the old screw holes, and install new sections. When a new chine cap is shaped and installed, do not let it overlap or come flush with the bottom of the chine; the bottom of the chine should extend at least 1/8 inch below the bottom of the cap so the force of the water will not rip the cap off.

c. PROPELLERS.

(1) REMOVAL OF PROPELLER. *(See figure 40.)*

(a) Place a wooden block between the propeller blade and the hull. *(See figure 45.)*

(b) Remove the propeller fairwater screw. *(See figure 41.)*

(c) Remove the propeller fairwater *(figure 42)* with propeller fairwater wrench *(figure 43)*.

(d) Remove the cotter pin from the propeller nut. *(See figure 44.)*

(e) Remove the propeller nut *(figure 45)* with propeller nut wrench *(figure 43)*.

(f) Bolt a propeller puller *(figure 43)* to the propeller, and tighten it until it puts a strain on the propeller, but not tight enough to damage it.

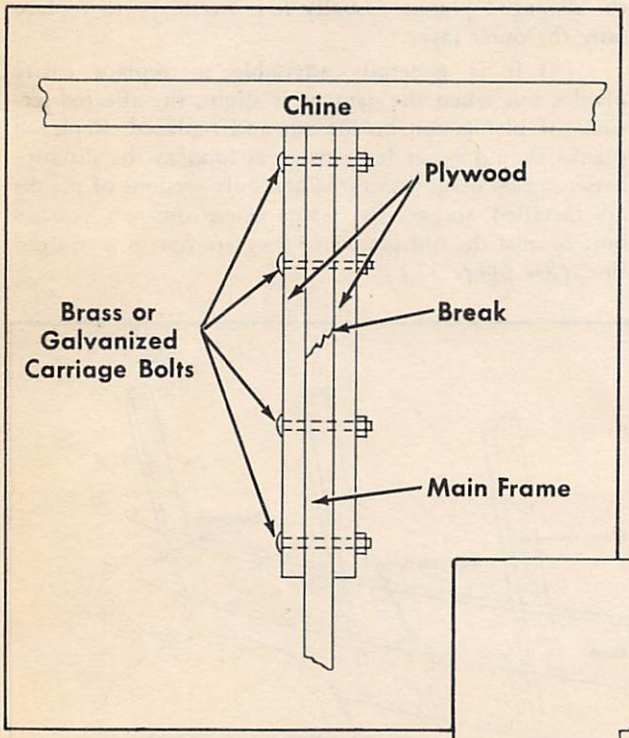


Figure 38—Method of Patching Broken Main Frame

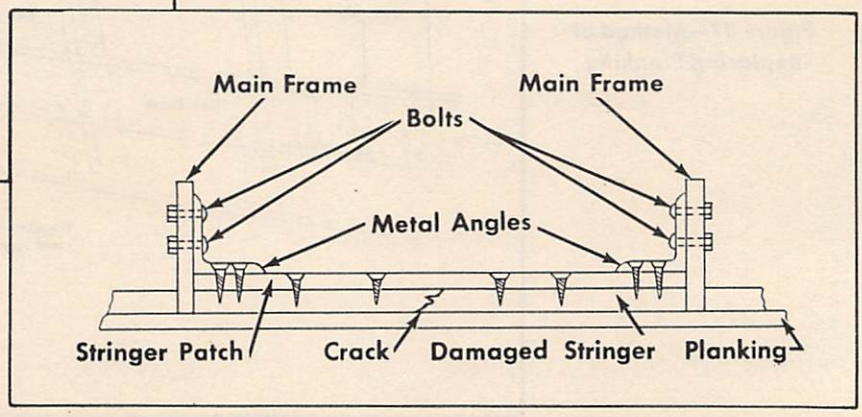


Figure 39—Method of Patching Longitudinal Stringer

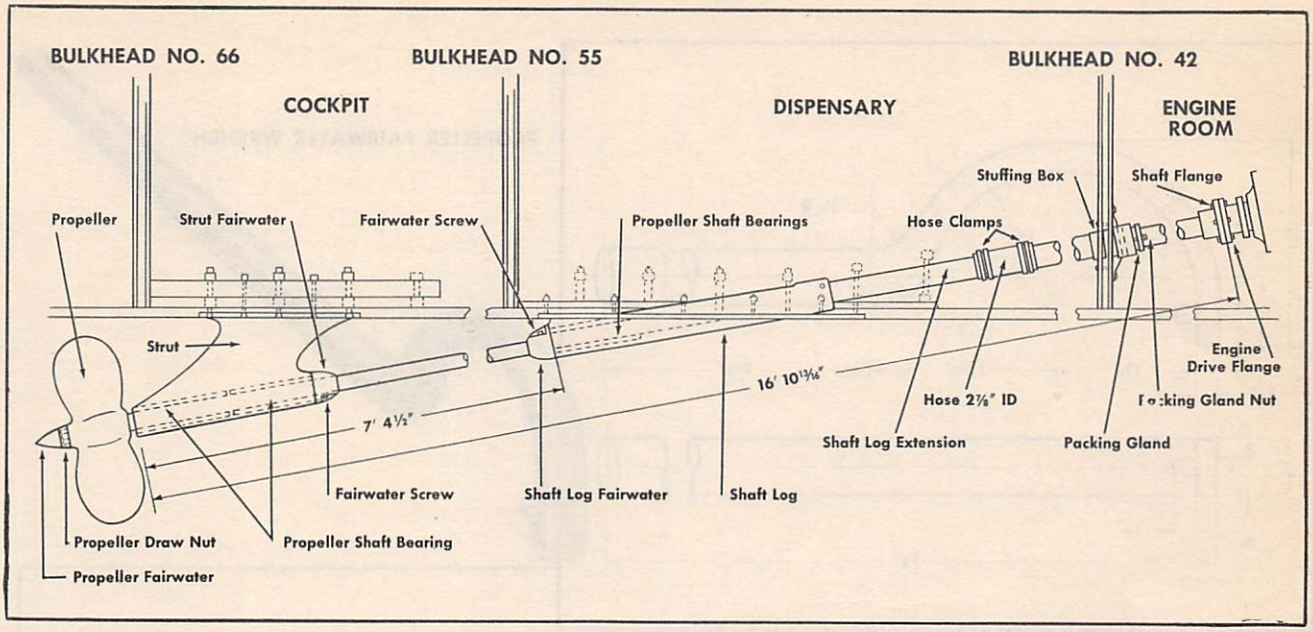


Figure 40—Propeller and Shaft Assembly

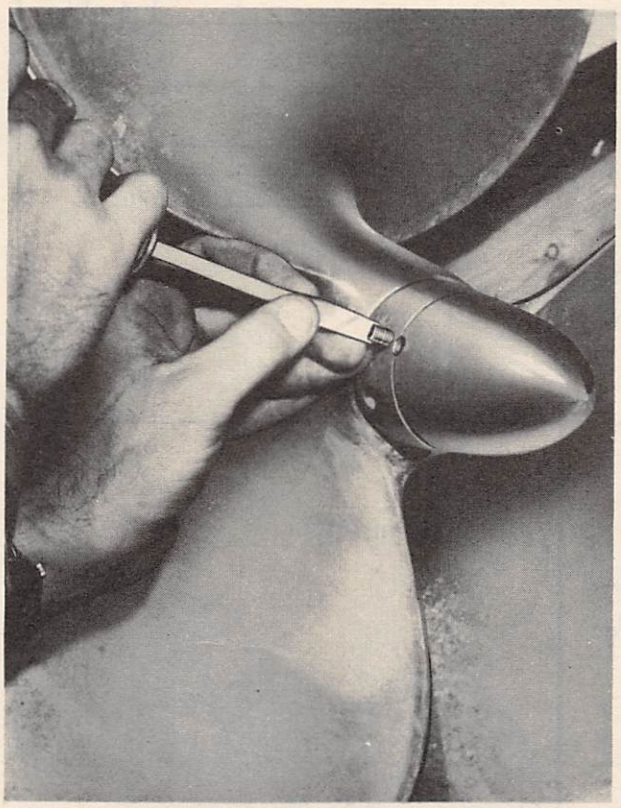


Figure 41—Removing Propeller Fairwater Screw

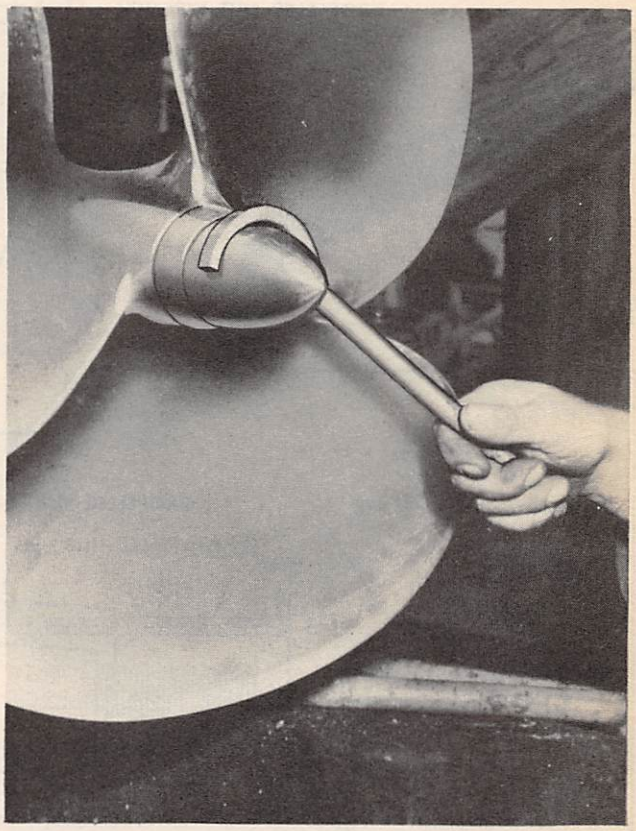


Figure 42—Removing Propeller Fairwater

PROPS. — 23 3/4 x 23 3/4

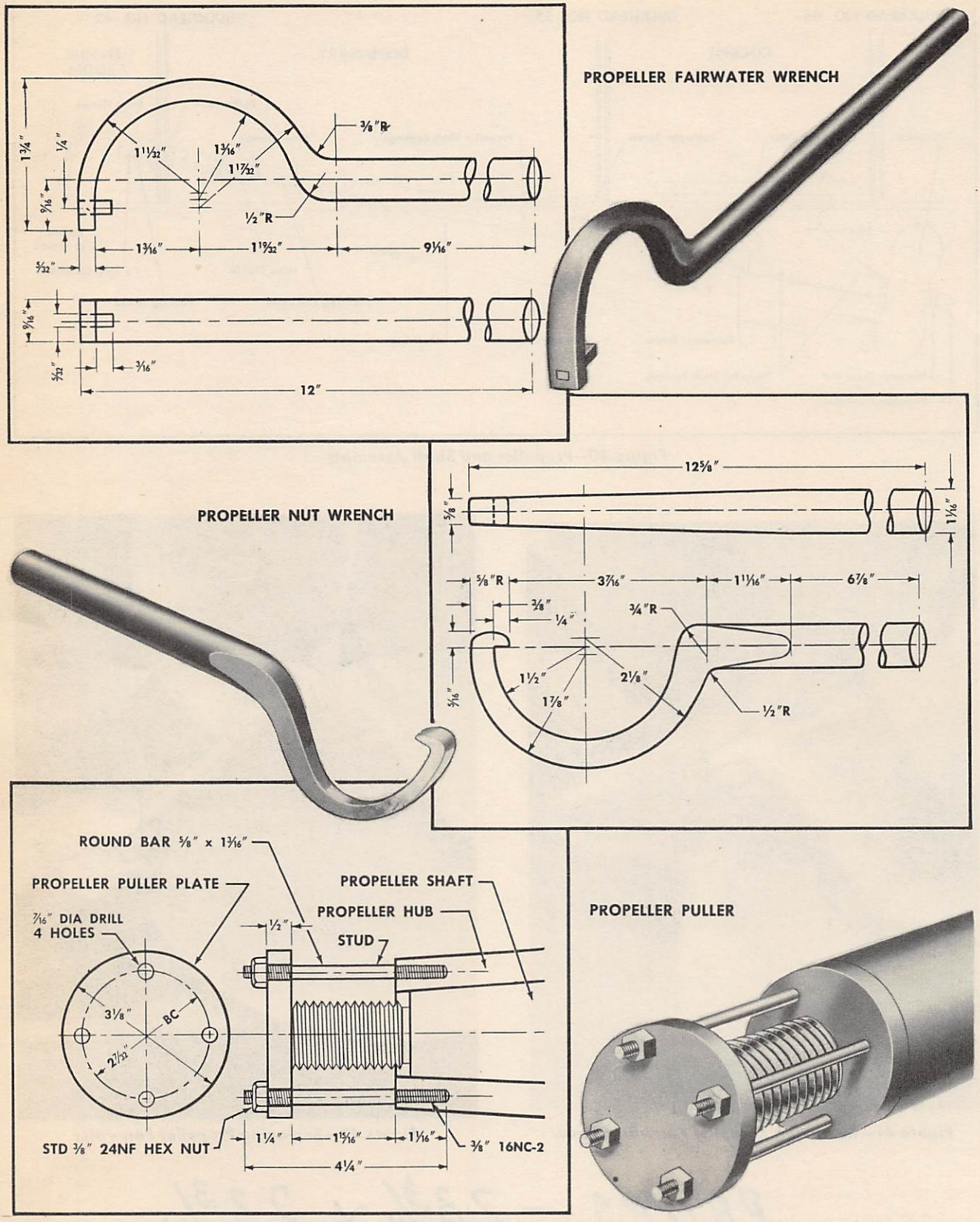


Figure 43—Special Tools for Removing Propeller

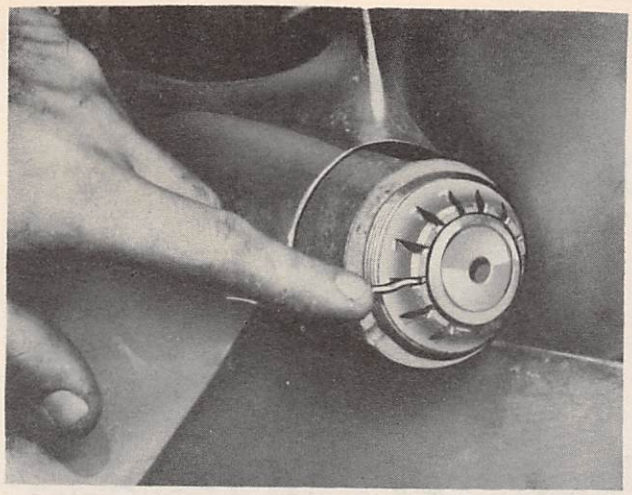


Figure 44—Removing Propeller Nut Cotter Pin

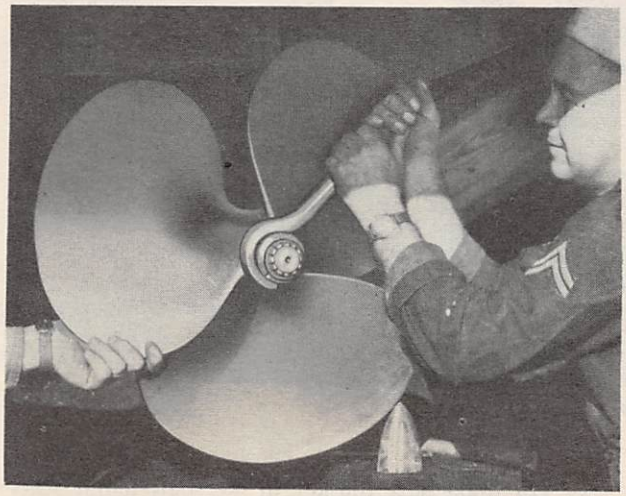


Figure 45—Removing Propeller Nut

(g) Strike the propeller hub sharply with a hammer to break it loose from the shaft.

(h) Remove the propeller, and the propeller key.

(2) INSTALLATION OF PROPELLER.

(a) Make sure the shaft and the inside of the propeller hub are clean and free of dirt and grit.

(b) With the propeller key removed from the shaft, push the propeller over the tapered end of the shaft as far as it will go.

(c) Mark the position of the forward end of the propeller hub on the shaft and remove the propeller.

(d) Insert the key in the shaft and push the propeller back on the shaft, lining up the key with the keyway in the propeller hub.

(e) The propeller hub should come up to its previous position on the shaft. If it does not, the propeller is riding on the key which will unbalance it or shear off the key. Trim down the key enough to fit.

(f) Install the propeller nut, the cotter pin, the propeller fairwater, and the propeller fairwater nut.

d. SHAFTS. *(See figure 40.)*

(1) CHECK FOR STRAIGHTNESS.—After removal of the propeller, the straightness of the shaft can be checked visually by turning the engine over (without ignition) a few times and observing the outboard end of the shaft. If the end of the shaft moves definitely out of line during rotation, (more than $\frac{1}{16}$ of an inch), the shaft must be replaced.

CAUTION

If the engine is turned over with the boat in dry dock, water must be sprayed at the after end of the shaft log and the forward end of the strut to lubricate the shaft bearings.

(2) REMOVAL OF SHAFT.

(a) Remove the nuts and bolts from the propeller shaft flange and engine drive flange. *(See figure 46.)*

(b) Place drifts in flange bolt holes and work back and forth to separate the flanges. *(See figure 47.)*

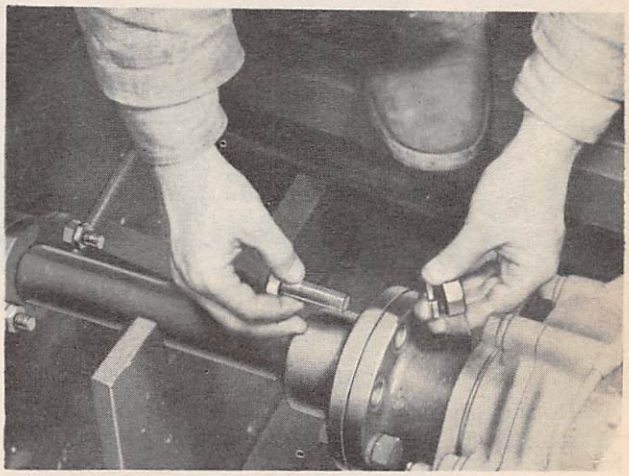


Figure 46—Removing Bolts from Engine Drive Flange and Propeller Shaft Flange

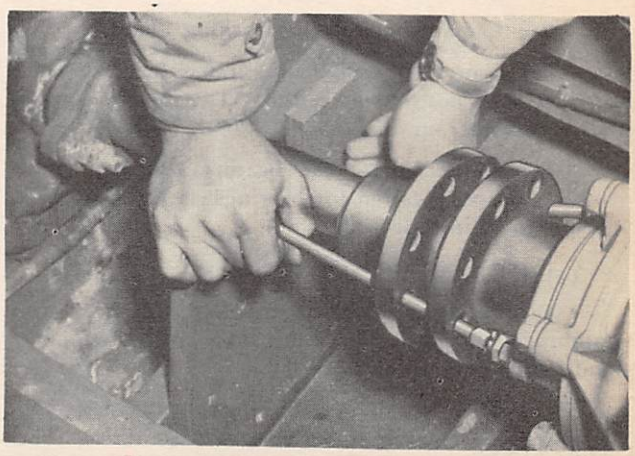


Figure 47—Use of Drifts to Loosen Propeller Shaft Flange from Engine Drive Shaft Flange

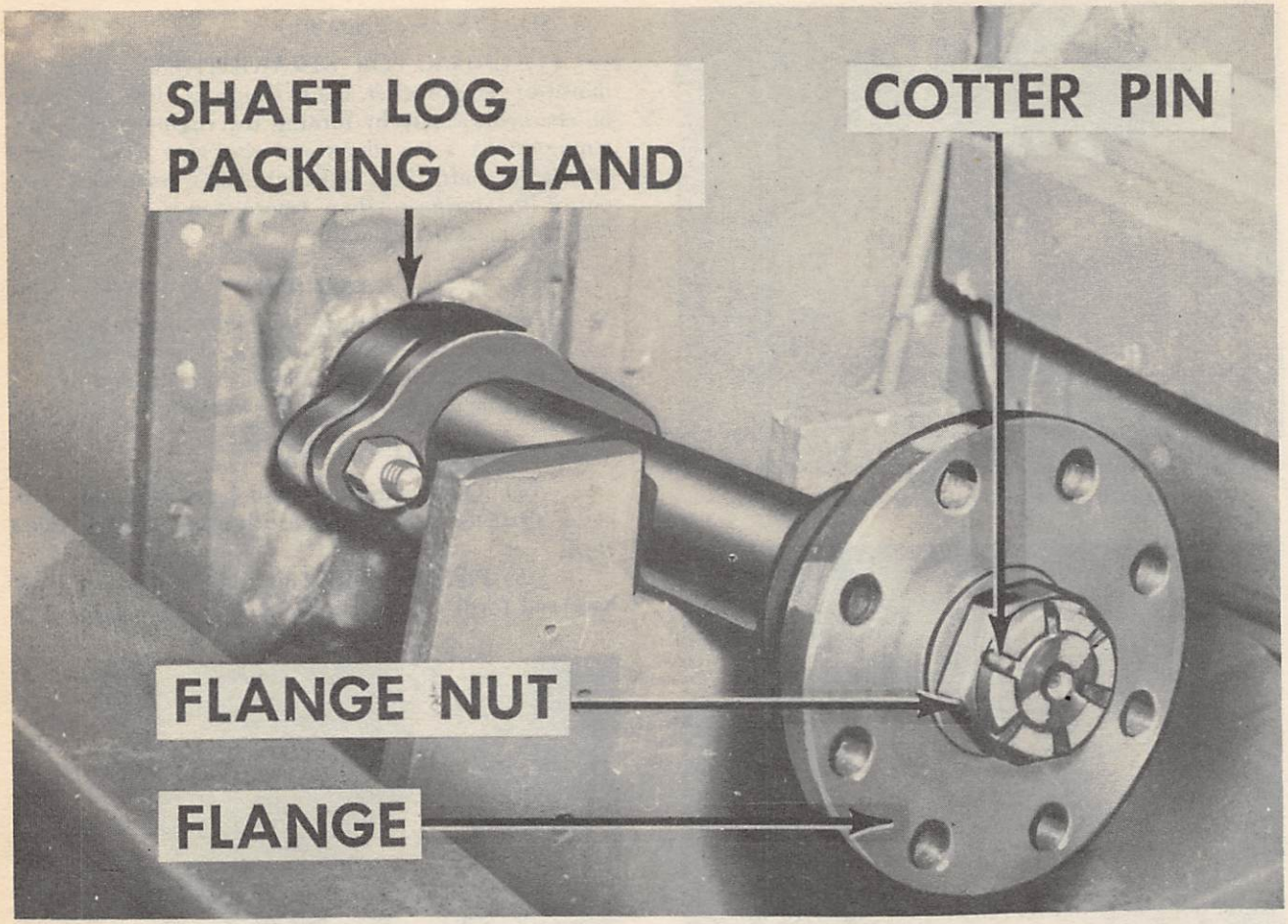


Figure 48—Propeller Shaft Flange Assembly

CAUTION

Do not pry flanges apart with a sharp edged tool, as this will damage the machined faces.

(c) Remove the cotter from the flange nut, unscrew and remove the flange nut, then remove the flange. *(See figure 48.)*

(d) Loosen the shaft log packing gland.

(e) Remove the shaft log fairwater and strut fairwater, so as not to damage the Akerite bearings when shaft is pulled from the boat. *(See figure 40.)*

(f) Before taking the bearings off the shaft, mark the proper location for bearings on the new shaft which is to be installed.

(3) INSTALLATION OF SHAFT.

(a) Before a shaft is installed, check it for straightness with a dial indicator on a lathe or suitable stand if this equipment is available.

(b) Then install new bearings on the shaft and install bearing sleeves in the strut and shaft log. The new bearings and bearing sleeves must be installed in the same position as they were on the old shaft assembly.

(c) Make sure the key in the shaft flange seats properly and permits the flange to fit tight on the shaft.

(d) Install the shaft flange, tighten the nut, and insert a cotter pin.

(e) Push the shaft into the boat until the shaft flange is flush with the engine drive flange. The flange faces should meet so that a .005-inch feeler gage cannot be inserted between them at any point.

e. SHAFT BEARINGS.—When the propeller shafts are removed, the shaft bearings should be examined. When the bearings are new, the lengthwise grooves are about 1/4 inch deep. When the bearings are worn so the grooves are less than 1/8 inch deep, replace the bearings.

Note

Make sure the shaft, struts, and bearings are free of oil when the shaft is passed through the strut and shaft log, as oil will deteriorate the rubber bearings. If a lubricant is needed for easy installation, use only water or glycerine.

f. METAL TANKS.

(1) TEMPORARY PATCH.

SECTION IV

Miscellaneous Equipment

1. ARMAMENT.

a. DESCRIPTION.—Two twin-mount machine guns, caliber .50, M-2, are installed on mark 17 model 1 (Navy) mounts, port and starboard. *(See figures 49, 50, and 51.)* Suitable depression rails are provided to limit the movement of the guns within safe limits. For data on operation, servicing, maintenance, and overhaul of the guns, refer to T. O. No. 11-1-8.

b. INSTALLATION.

(1) Clamp the mount in a convenient position. *(See figure 52.)* Place the gun in position to insert a bolt through the front mount adapter and the forward bracket on the mount *(figures 53 and 54)* and tighten the nut *(figure 55)*.

(2) Tighten the nut on the rear mount adapter bolt. *(See figure 56.)* Washers may be used on this bolt to adjust the gun in relation to the mount when the guns are synchronized.

c. LOADING.

(1) Lift up the cover, feed the ammunition belt through both the fixed and movable guides *(figure 57)* and insert the double end loop in place. *(See figure 58.)*

(2) Replace the cover.

(3) Pull the retracting lever twice. *(See figure 59.)* The ammunition belt is pulled into the gun by the belt feed pawl which is attached to the belt slide. The first movement of the retracting lever pulls a cartridge directly over the chamber and the second movement draws the cartridge into the chamber.

d. SERVICE, INSPECTION, MAINTENANCE, AND LUBRICATION.

(1) GENERAL.—The corrosive action of salt water makes the most careful attention to cleanliness and anti-corrosion measures an absolute necessity. Tarpaulins should be kept over the guns when not in use. Remove the tarpaulins daily to dry them out. If left on, they get damp inside from condensation.

(2) GUNS.—During periods when the guns are not being used, they should be kept covered with light rust-preventive compound, Specification No. 2-84A. Before the guns are put in use, clean them thoroughly with dry cleaning solvent, Specification No. RIA-ES12 and dry thoroughly. Then apply a thin protective coating of special preservative lubricating oil, Specification No. AXS-777.

(3) MOUNT.

(a) The working parts of the mounts should be kept lightly coated with water pump grease. *(See figure 60.)* To clean them, use dry cleaning solvent Specification No. RIA-ES12.

(b) All painted metal surfaces of the mounts should be inspected daily for signs of corrosion. Wherever paint has come off, exposing metal, scrape the surface carefully with steel wool and apply zinc chromate metal primer, Specification No. 14080 (stock No. 7300-788000). *(See figure 61.)* When the primer is dry, apply a finish coat of engine grey paint, code No. 2311, U. S. Navy Specification No. 52-P-43.

2. RESCUE GEAR.

a. RESCUE NETS.—Two 8-foot rescue nets, one port and one starboard of the bridge, are fastened with snap hooks to eye bolts along the edge of the deck. *(See figure 62).* On a rescue mission, secure the nets on the outside of the rail rolled up and lashed with the straps which are provided. The straps can be quickly released and the net will fall down over the side. Lead weights on the bottom batten make it sink and form a ladder which is easy to climb.

b. RESCUE CRANE.—At the stern there is provided a retractable 1-ton shear leg crane with 1-hp electric winch for operation. The crane is rigged with ¾-inch Manila line through two sheave blocks. The electric winch *(figure 63)* is operated through a relay by a foot switch in the cockpit deck. To operate the crane the ensign staff is first removed. The rigged crane *(figure 64)* is then swung over the transom and operated from the cockpit. *(See figure 65.)*

CAUTION

To prevent excessive drain on the batteries, the auxiliary generator is always kept running while the crane is in use.

When not in use, the crane is kept securely fastened in its chocks. Oil the winch motor weekly with SAE 20 oil. Check the gear case to make certain that it is kept filled to the level of the filler plug with SAE 80 oil.

c. DINGHY.—One standard 9½-foot, wooden sailing dinghy, complete with oars, oarlocks, weather cloth and sails, is provided. The necessary fittings are installed for lashing this dinghy securely along the center line of the boat atop the engine room hatch or trunk cabin. *(See figure 66.)*



Figure 50—Port Barbette and Gun Mount

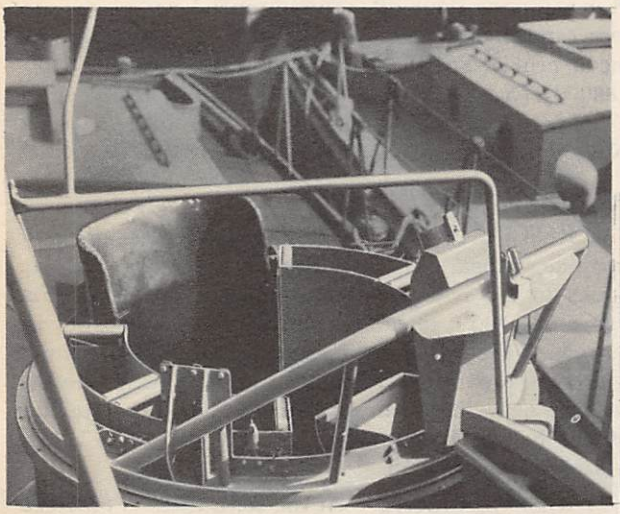


Figure 51—Port Gun Mount Showing Guard Rails Which Limit Movement of Guns

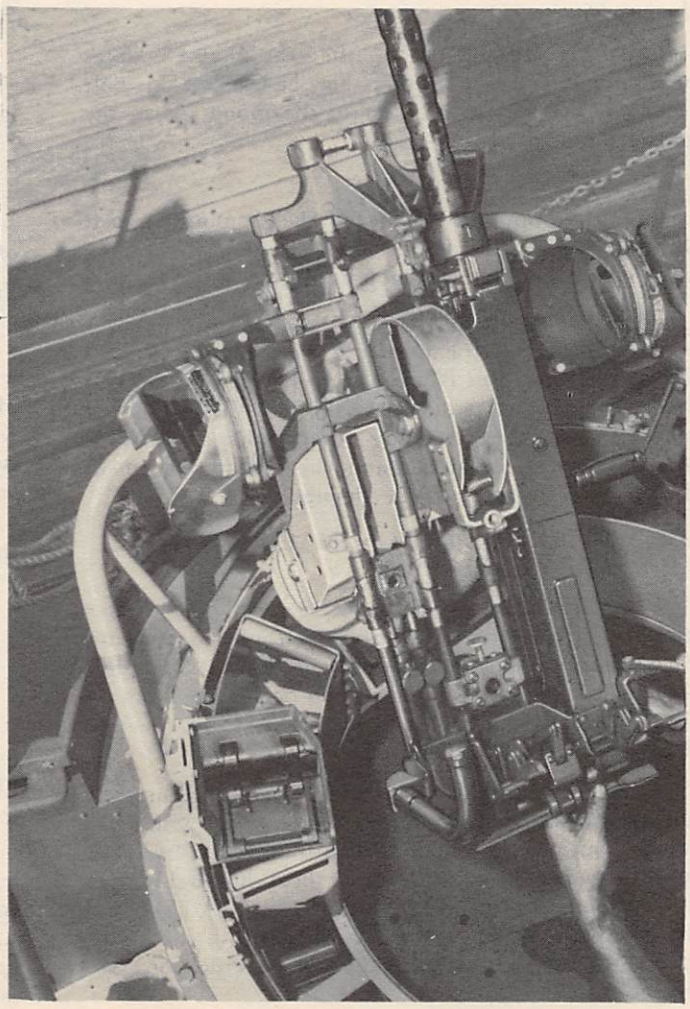


Figure 52—Port Gun Mount with One M-2 Caliber .50 Gun Installed

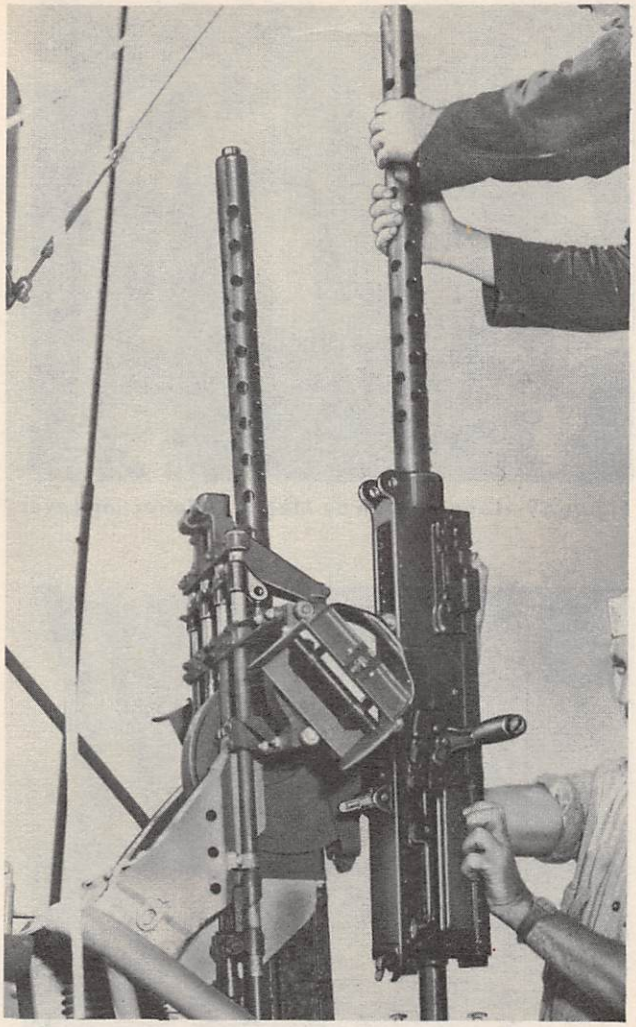


Figure 53—Gun in Position Prior to Installation

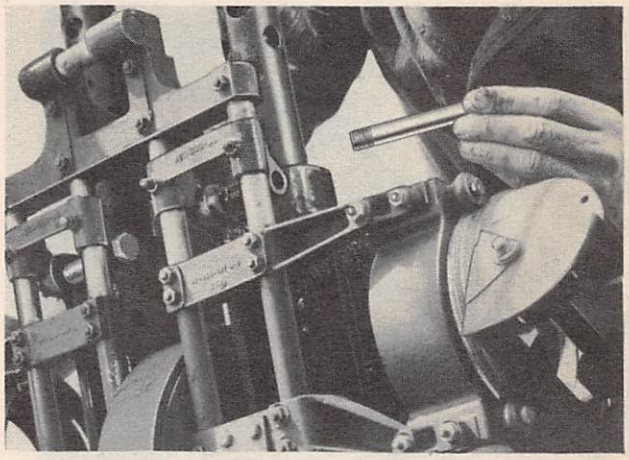


Figure 54—Inserting Bolt in Front Mount Adapter

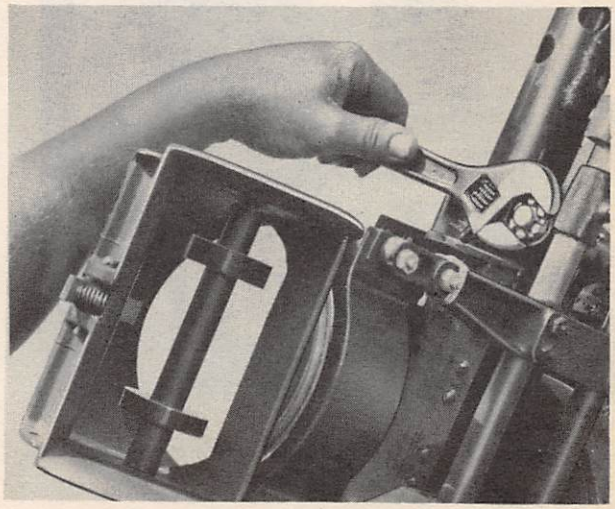


Figure 55—Tightening Nut on Front Mount Adapter Bolt

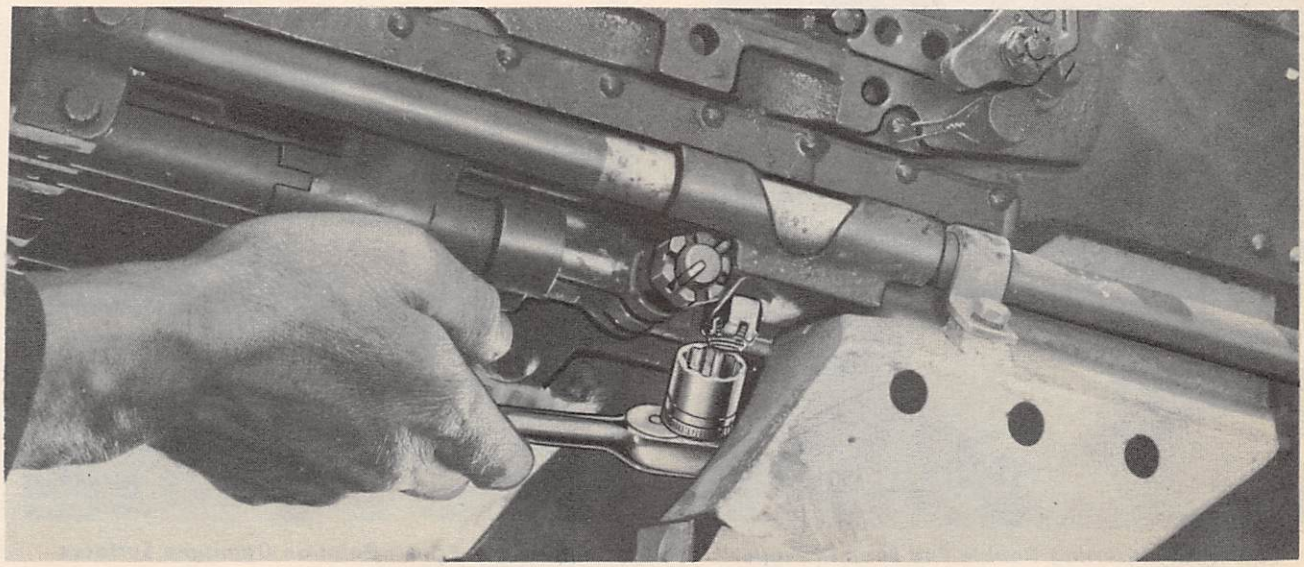


Figure 56—Tightening Nut on Rear Mount Adapter Bolt

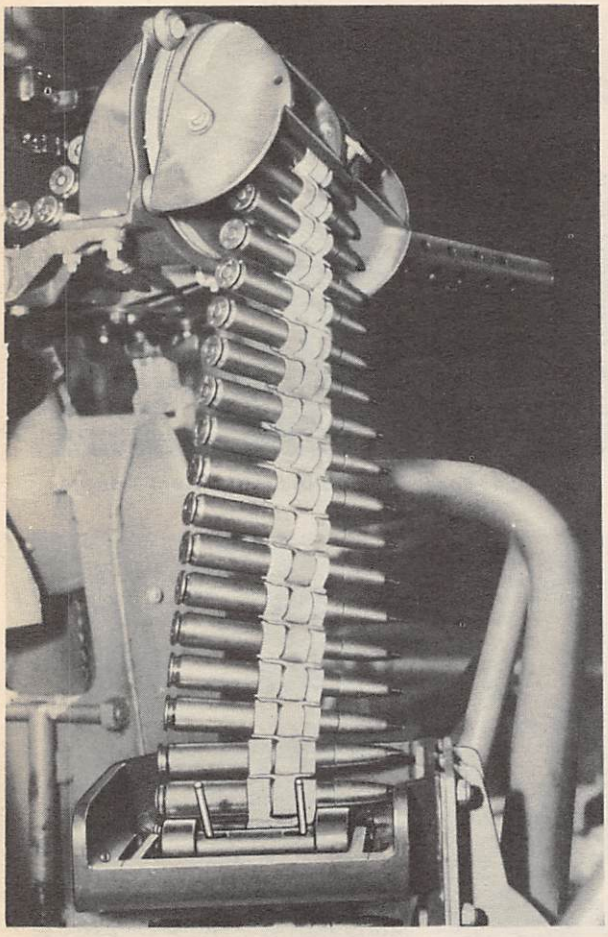


Figure 57—Proper Position of Ammunition Belt in Guides

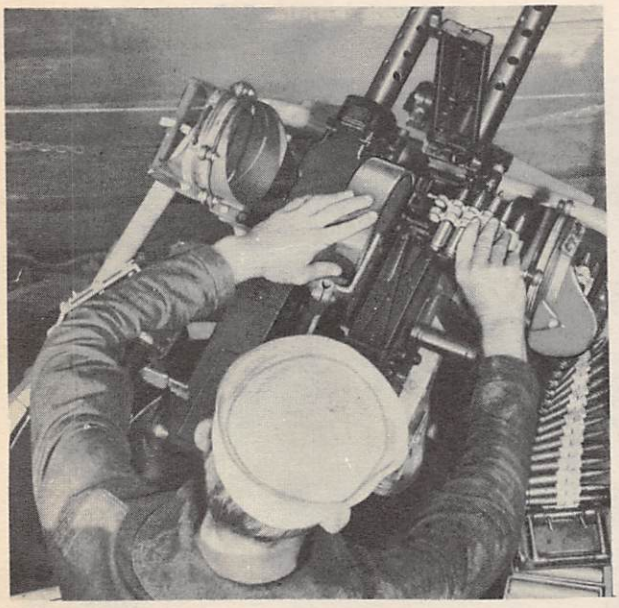


Figure 58—Inserting Double End Loop in Proper Position for Loading

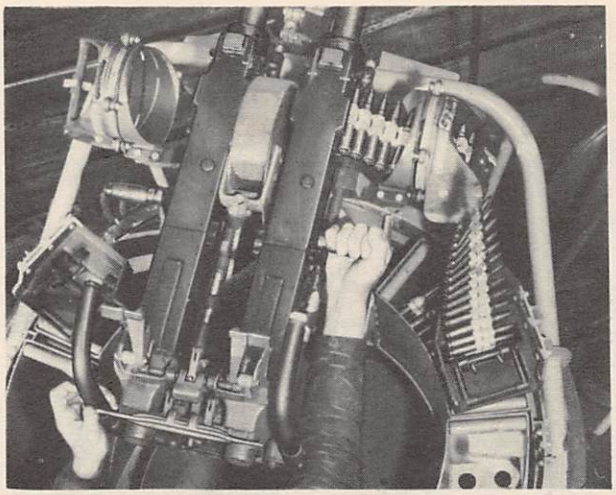


Figure 59—Loading Gun by Means of Retracting Lever

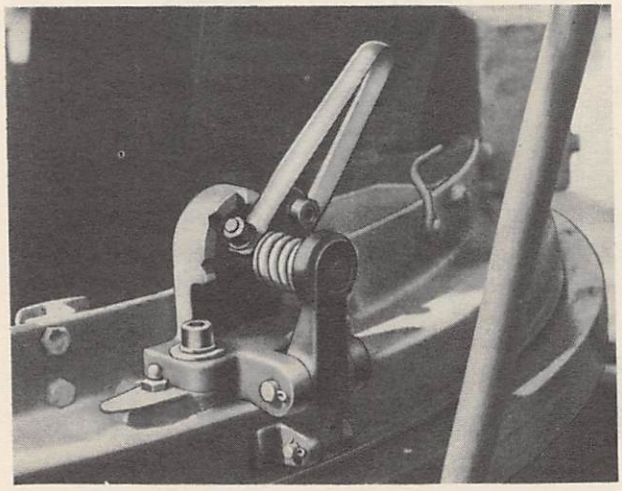


Figure 60—Gun Mount Clamp

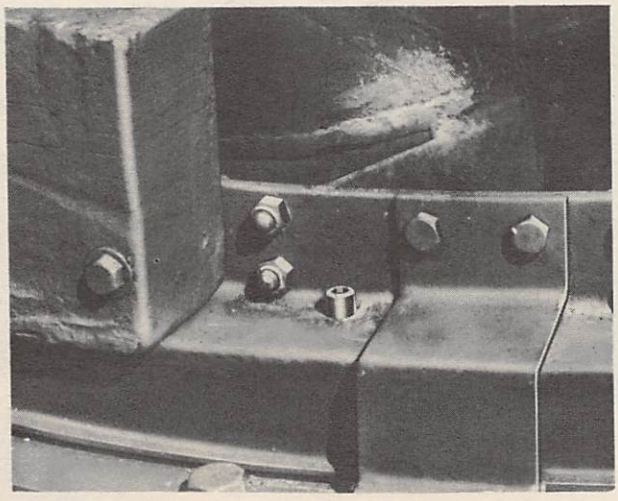


Figure 61—Primer Paint on Damaged Surfaces Prior to Application of Boat Paint

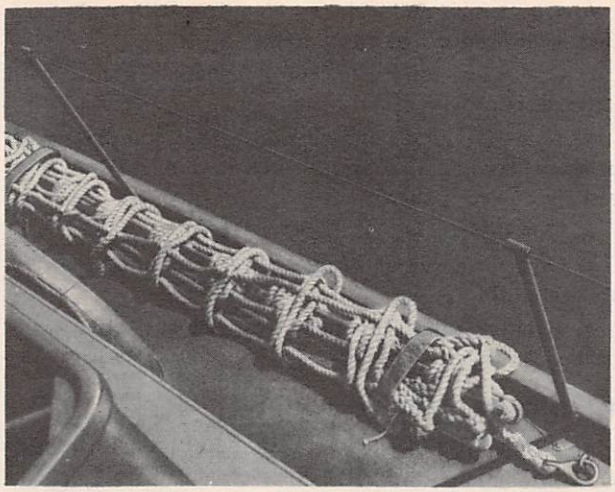


Figure 62—Rescue Net

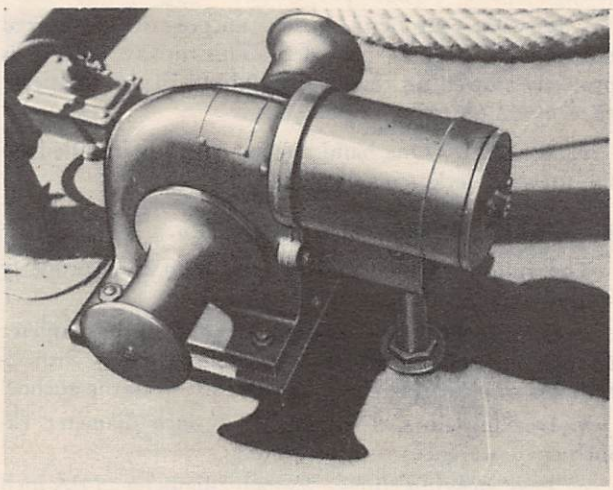


Figure 63—Electric Winch for Rescue Crane

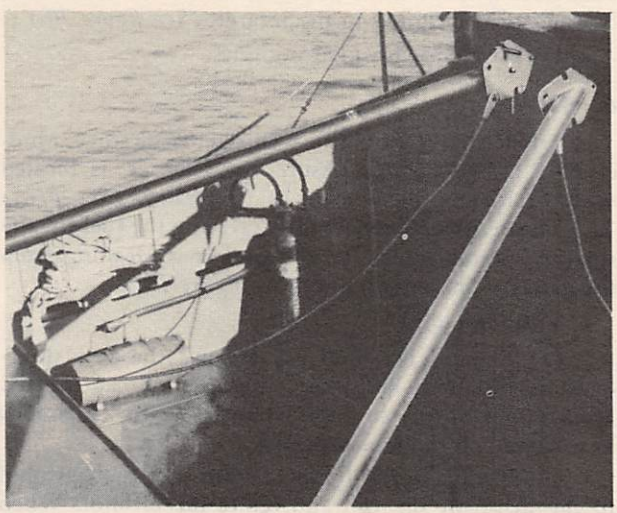


Figure 64—Rescue Crane Before Rigging

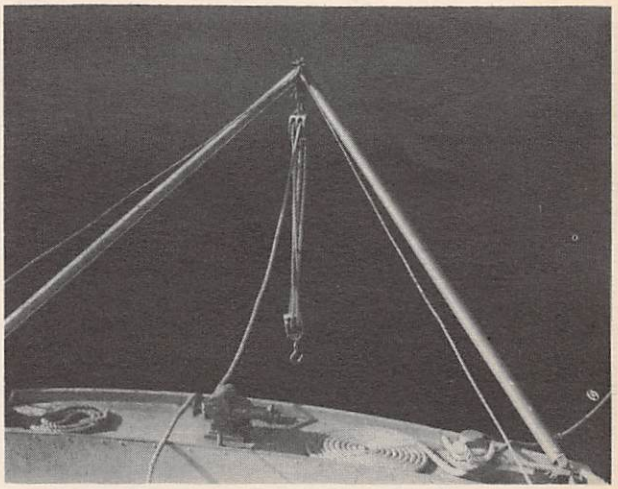


Figure 65—Rescue Crane Ready for Use

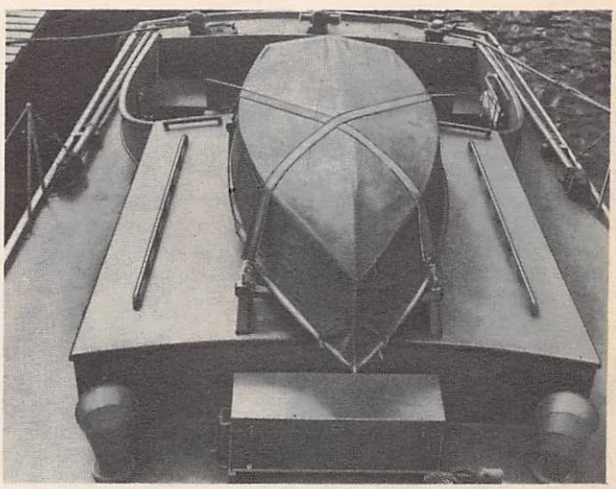


Figure 66—Rescue Dinghy Lashed Over Dispensary Cabin

Note

If dinghy is lashed atop the trunk cabin, the bridge deck is left clear. This arrangement is recommended on boats carrying armament.

d. RING LIFE BUOYS.—Two standard 24-inch circular ring life buoys are installed, one on each side of the pilot house. With each buoy there is a 50-foot, 1⅛-inch circumference, rope of Manila or equivalent strength sisal.

e. RUBBER BOATS.—Two rubber boats, seven man, inflatable, complete with carbon dioxide filling bottles and collapsible oars and carrying cases, are provided.

f. LIFE JACKETS.—Fifteen adult size, vest type, reversible canvas covered life jackets are provided.

3. NAVIGATION EQUIPMENT.

a. A compass and binnacle, complete with indirect lighting and waterproof canvas cover, is installed on a shock mount on the flying bridge.

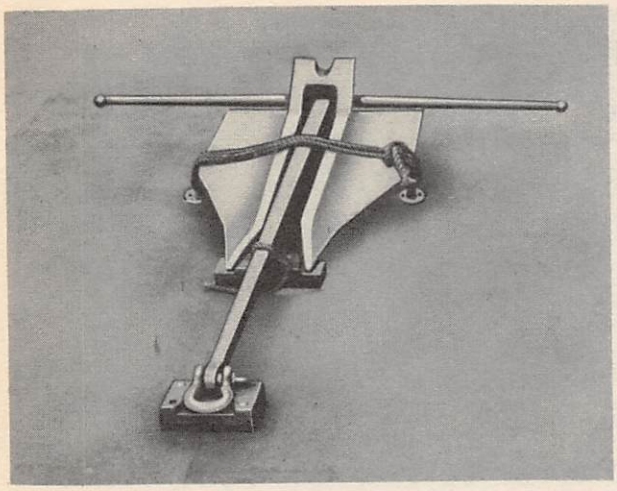


Figure 67—Forward Anchor Stowed on Deck

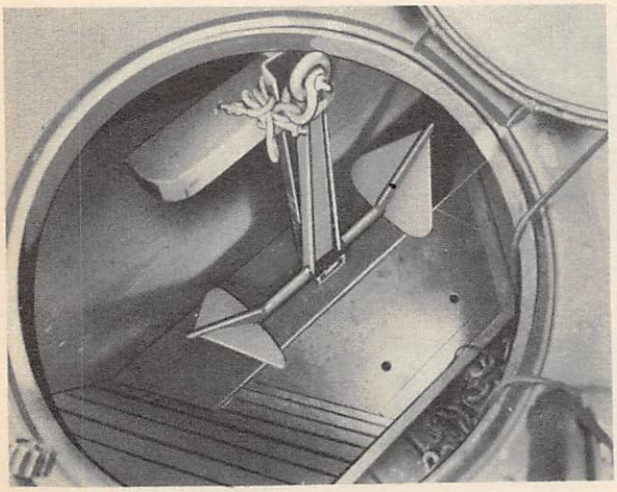


Figure 68—Utility Anchor Stowed in Forepeak

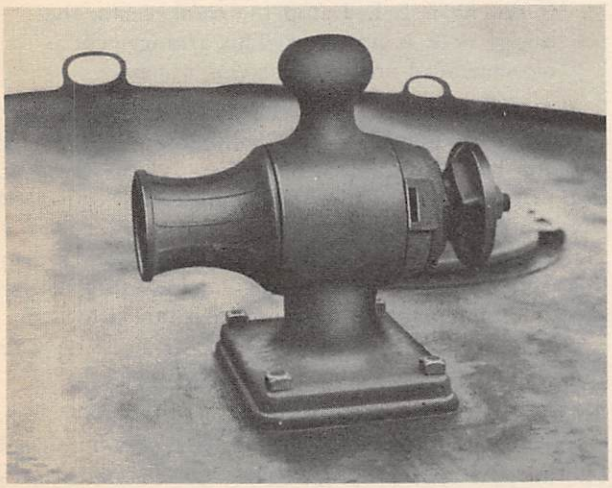


Figure 69—Hand Anchor Winch

b. One 5-inch dial pelorus, complete with mahogany case, is stowed in the chart room.

c. One 8-inch diameter case steel bell, complete with lanyard, is provided.

d. One 10-pound hand sounding lead equipped with properly marked line and packed in a wood box with case, is stowed in the chart room.

e. One distress signal kit is provided.

f. One chronometer (8-day clock) mounted on suitable mounting is provided.

g. Parallel rules, dividers, stop watch, and a comparing watch are provided.

4. ANCHOR AND WINCH.

a. ANCHORS.—The forepeak bulkhead is arranged to accommodate the anchor lines.

(1) One 75-pound anchor of galvanized heat-treated steel, complete with balance lifting shackles on stock, shackle, etc, is provided. Deck pads and lashings for this anchor are also provided. *(See figure 67.)*

(2) One 47-pound utility anchor of galvanized heat-treated steel is provided. This utility anchor is properly stowed on the after bulkhead in the forepeak. *(See figure 68.)*

b. WINCH.—One hand anchor winch is installed on the forward deck. *(See figure 69.)*

5. WARPS, LINES, AND HAWSERS.

The following lines and hawsers with ends properly spliced and seized are provided:

a. One anchor line, 50-fathoms of 1-inch diameter (3-inch circumference) sisal or Manila fitted with 2-fathoms of close link chain for attachment to the anchor.

b. Docking lines, 8-fathoms of $\frac{5}{8}$-inch diameter (2-inch circumference) sisal or Manila.

c. Two heaving lines, $\frac{3}{8}$-inch diameter ($1\frac{1}{2}$-inch circumference), 60-feet long made of sisal.

d. Six rope fenders, 8 x 24 inches, for protection of boat sides while moored at the dock. These fenders may be conveniently stored in the lazaret. *(See figure 70.)*

e. Six rat guards for mooring lines.

6. STOVE.

a. DESCRIPTION.—The Willis kerosene stove, Model No. 227-3-3, with pressure type burner, is located at the center outboard side of the galley. *(See figure 71.)* The kerosene pressure tank carrying the fuel for the stove is located under the companionway leading from the galley to the pilot house. *(See figure 72.)*

b. OPERATION.

(1) Remove the filler cap and fill the tank three-quarters full with kerosene, replacing the cap tightly. Then pump up pressure with pump—15 to 25 pounds as indicated on the pressure gage.

(2) To preheat fill the preheat tray with alcohol to the mark on the rim and ignite the alcohol. When the alcohol has burned out, light the burner immediately.

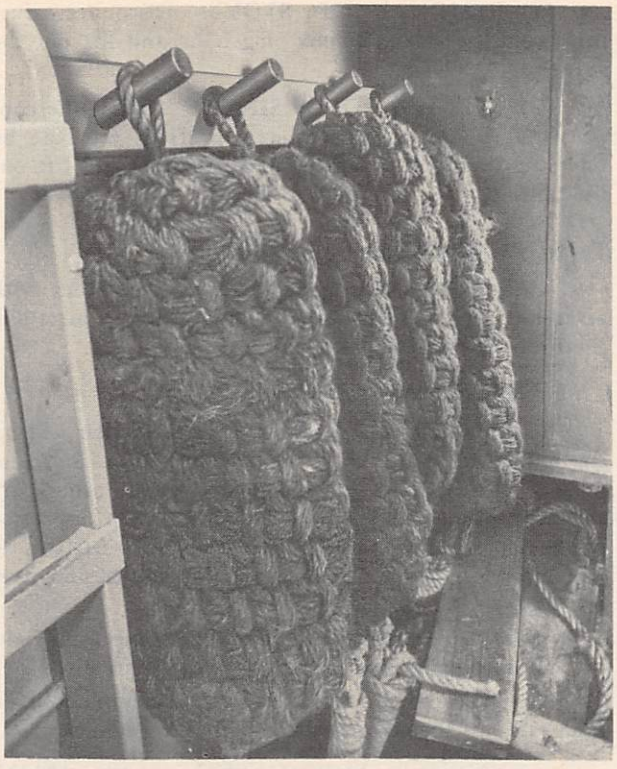


Figure 70—Fenders Stowed in Lazaret

(3) To light the burner turn the control handle slowly counterclockwise, as indicated on the knob. Allow the burner to operate for a minute or two at about one-eighth turn. Then change the knob to one-third turn for maximum efficiency. The flame should burn blue.

(4) If at the start of operation the flame burns yellow, the preheat operation should be repeated. Turn the valve off before repeating. If the flame burns too low at one-third open, soot or dirt has blocked the jet opening.

(5) To extinguish the flame turn the knob clockwise as far as possible.

c. SERVICE AND MAINTENANCE.

(1) Keep the units and burners clean by removing and washing thoroughly with clean kerosene.

(2) Keep the fuel tank and pipe clean. Disconnect the pipe from the stove and tank and blow it out with compressed air. Empty the tank and wash it out with clean kerosene.

(3) Check the valve stem packing nuts to be sure they are tight and do not leak.

(4) Fill the tank three-quarters full with kerosene and replace cap tightly.

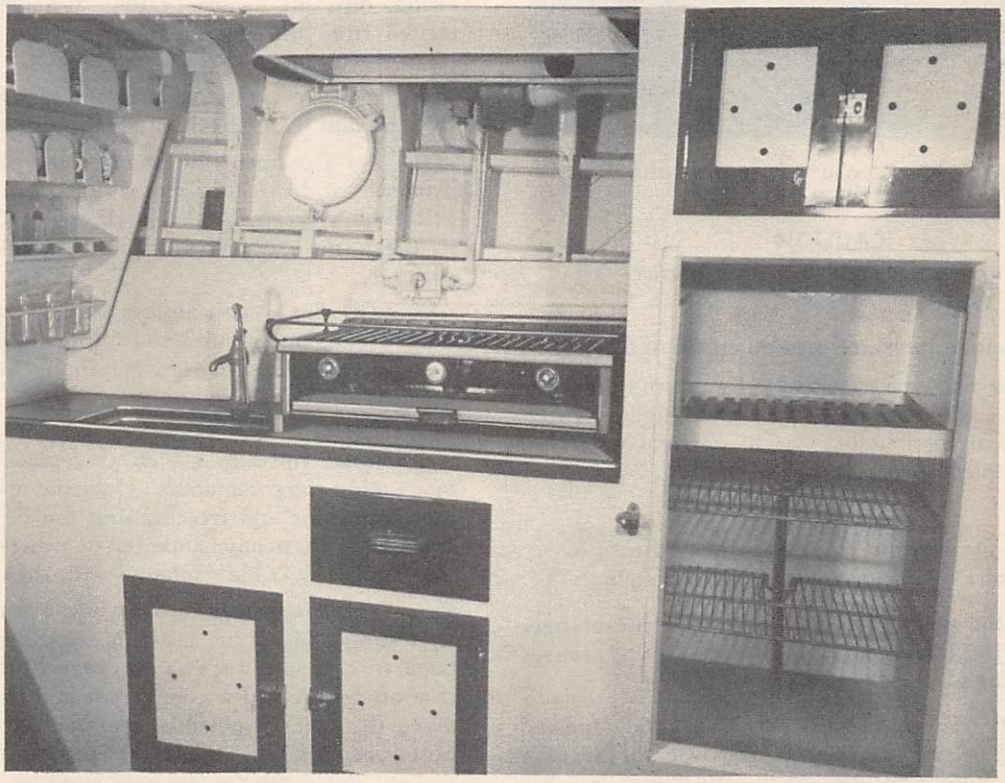


Figure 71—Outboard Side of Galley

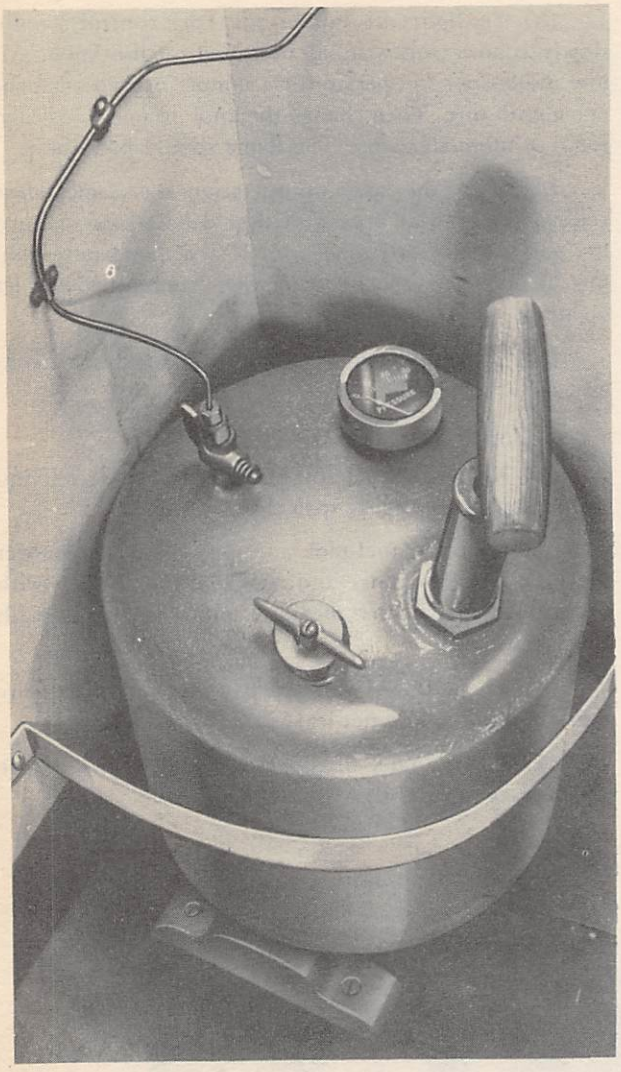


Figure 72—Kerosene Pressure Tank

CAUTION

Before refueling tank, be sure burners are turned "OFF."

(5) Pump up pressure with pump, 50 to 60 strokes.

(6) Clean out the jet opening by turning the valve stem on fully, when burner is hot but not lighted, rotating valve stem counterclockwise to one-half open and back to one-third open.

CAUTION

Do not use force in cleaning—one-half turn is sufficient. Do not operate burner on this range.

(7) If the pump does not work, take the plunger out, spread the leather and oil it. Replace the plunger carefully being sure not to damage the leather.

d. REMOVAL.—The entire stove may be removed for servicing or one unit may be removed for cleaning or replacing. Before making any disconnections, remove the cap from the fuel tank to release pressure.

(1) REMOVAL OF STOVE.—Disconnect fuel line from the stove. Remove leg bolts and lift out the stove.

(2) REMOVAL OF A SINGLE UNIT.—Disconnect unit fuel line. Disconnect unit from the base by releasing lock nut. Remove control handle and lift out the unit.

7. REFRIGERATION.

a. GENERAL.—The galley is equipped either with an icebox or a refrigerator. If a refrigerator is installed, the following instructions will apply.

b. REFRIGERATOR.

(1) DESCRIPTION.—Refrigerator models and installation vary. Some models have the motor and compressor unit located in the engine room; others are standard cabinet models with the motor and compressor in the same cabinet with the freezing unit. All the refrigerators, however, can be roughly divided into two classes:

(a) Open unit models have the compressor belt-driven by the motor, which is mounted separately.

(b) Sealed unit models have the motor mounted integral with the compressor and freezing unit.

(2) SERVICE, LUBRICATION, AND MAINTENANCE.

(a) Defrost the refrigerator once a week. On models with a "DEFROST" position on the switch, turn the switch to that position. On models with no such provision, turn the switch "OFF." When all the ice has melted from the freezing unit, remove the water and clean the cabinet.

(b) Clean the inside of the refrigerator and the freezing unit with a baking soda solution.

(c) On open unit models, oil the motor every 3 months with SAE 20 motor oil. Clean the condenser grill with a brush to remove all dust and dirt clogging it. Clean the compressor drive belt and tighten it if necessary.

(d) Sealed unit motors are usually grease packed at the factory and require no additional lubrication. Consult the service instructions pertaining to the particular refrigerator model.

(e) Open unit motors can be removed for maintenance operations such as replacing the brushes or cleaning the commutator. On some open unit models the compressor and freezing unit can be removed from the cabinet for maintenance, but on others, and on sealed unit models, it is built integral with the cabinet.

(f) No further repair work, other than continuity testing and motor repair, is recommended, since refrigeration is such a specialized branch of mechanics. In case of trouble in the compressor and freezing unit, remove the unit, if possible, and replace it. If the unit cannot be removed, replace the entire refrigerator. Have the old refrigerator or unit repaired by a refrigeration specialist.

SECTION V

Steering System

1. DESCRIPTION.

(See figure 73.)

The steering system is of the roller chain and torque tube type and consists of the following assemblies:

a. BRIDGE STEERING ASSEMBLY.—The bridge steering wheel, shaft, flanged cartridge bearings, rudder angle indicator, and sprockets. *(See figure 74.)* The sprocket is chain-connected over a pair of idler sprockets *(figure 75)* to an intermediate shaft which extends through the pilot house after bulkhead. *(See figure 76.)* This intermediate shaft has a 15-tooth sprocket, chain connected to a stub shaft mounted on the starboard side of the pilot house after bulkhead.

b. STUB SHAFT ASSEMBLY.—The stub shaft *(figure 77)* drives the torque tube assembly, which consists of flanged cartridge bearings, universal joints, and a splined expansion joint *(figure 78)*. This expansion joint located on the forward side of the engine room after bulkhead, provides for end play of the torque tube while the boat is working in a sea.

c. WORM SHAFT AND STARBOARD RUDDER ASSEMBLY.—The after end of the torque tube assembly, in the lazaret, is a worm shaft, with a double acme thread, which moves a worm nut *(figure 79)* attached to a yoke on the end of the starboard rudder bell crank. *(See figure 80.)* An adjustable tierod joins the starboard rudder bell crank to the port rudder tiller arm. An oak stop on the rudder support shelf limits the rudder angle to a movement of 35 degrees each way, which corresponds to 6½ turns of the steering wheel from hard over to hard over.

2. EMERGENCY TILLER.

An emergency tiller is provided, *(figure 81)* consisting of a tiller post and arm. The female square end of the tiller post fits over the starboard rudder shaft. To use the emergency tiller the mechanical steering system must be disconnected. This is done by loosening the setscrews and removing the machine screws holding the worm nut in the bell crank yoke. By swinging the worm shaft free of the bell crank and securing it, the rudders are free to be operated by the emergency tiller, which is installed through the deck plate on the starboard side of the after deck and operated from the cockpit.

3. SERVICE, INSPECTION, MAINTENANCE, AND LUBRICATION.

a. GENERAL. — Any evidence of slipping, undue slack, or binding in the system should be investigated and corrected immediately.

b. BRIDGE STEERING ASSEMBLY.—The bronze bearings for the steering wheel shaft and the idler sprockets beneath the station on the bridge have Zerk-type grease fittings. These bearings should be filled with medium cup grease every 50 hours of operation. The sprockets, roller chain, and rudder angle indicator gears should be lubricated with a light cup grease every 50 hours of operation.

c. INTERMEDIATE AND STUB SHAFTS.—Bearings for the intermediate and stub shafts *(figures 76 and 77)* have Zerk-type grease fittings. They should be lubricated with heavy engine oil after every 100 hours of operation. The intermediate shaft is serviced through the storage space beneath the pilot house deck. The stub shaft is serviced from the locker in the after end of the petty officer's quarters berth.

d. SPROCKET WHEELS.—In normal service the set screws which hold the sprocket wheel keys in place can easily become loosened by vibration, permitting the key to fall out. To prevent this, use one of the following procedures:

(1) Replace the original setscrew with a square-head screw, the head of which has been drilled to permit safety-wiring.

(2) Drill a ¼-inch hole through the shaft and both sides of the sprocket wheel. Insert a bolt through the sprocket wheel and shaft, tighten the nut, and peen the bolt end to prevent its becoming loose.

e. CHAINS.—All chains should be kept sufficiently tight to eliminate undue slack in the wheel and to prevent their jumping the sprockets. The bridge chain may be adjusted by moving the idler sprocket mounting and securing it. The transverse steel chain from the intermediate shaft to the stub shaft can be adjusted by loosening the stub shaft bearing mounting and moving the entire unit temporarily. When in proper adjustment, the chains should have a slight amount of slack, sufficient to prevent binding and unnecessary wear.

f. TORQUE TUBE ASSEMBLY.

(1) The torque tube bearings (located as shown in figure 73) are packed with medium cup grease. They should be flushed out and repacked after 500 hours of operation. They should require no service between these periods unless loss of grease is evident, in which case the leak should be repaired and grease replaced.

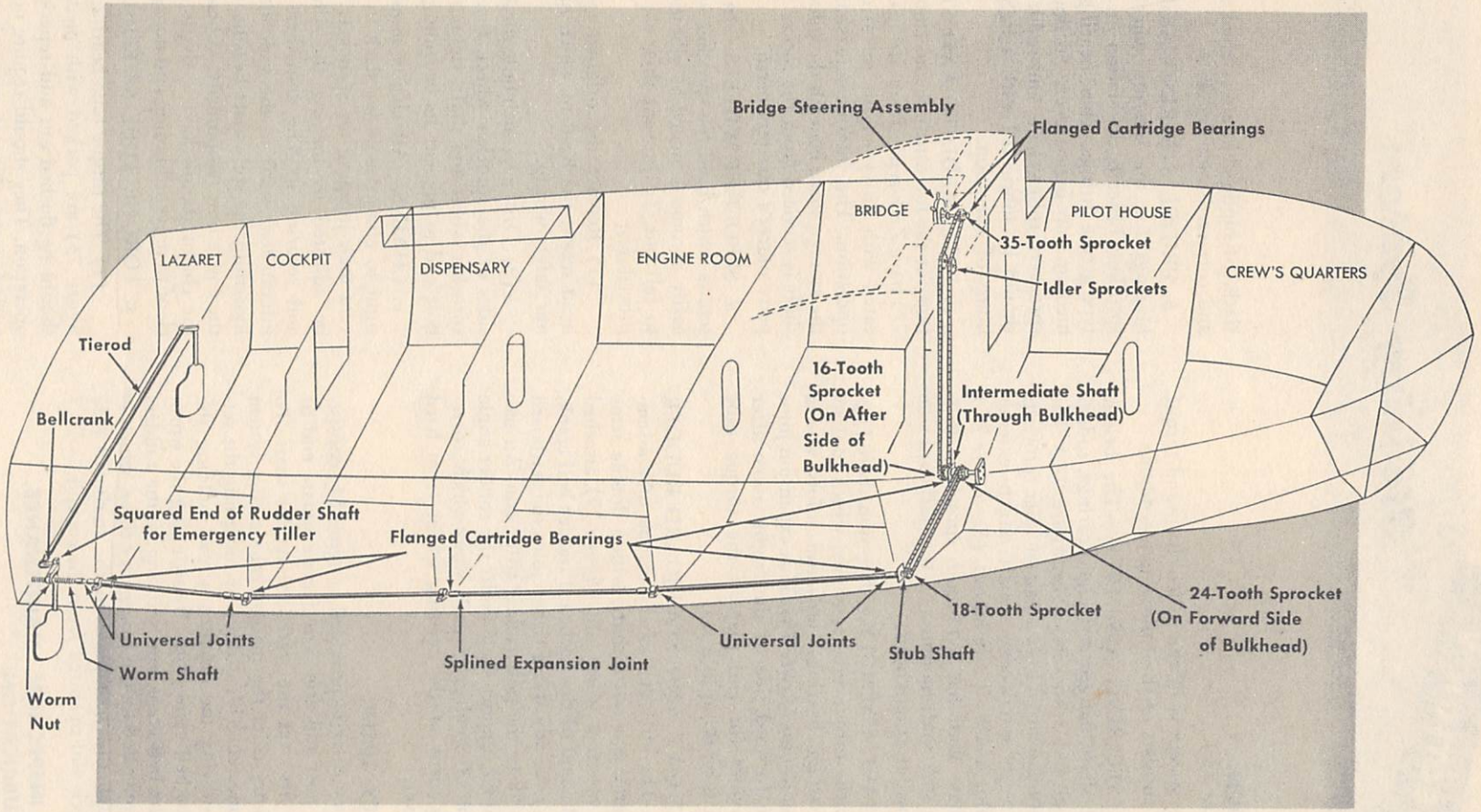


Figure 73—Steering System

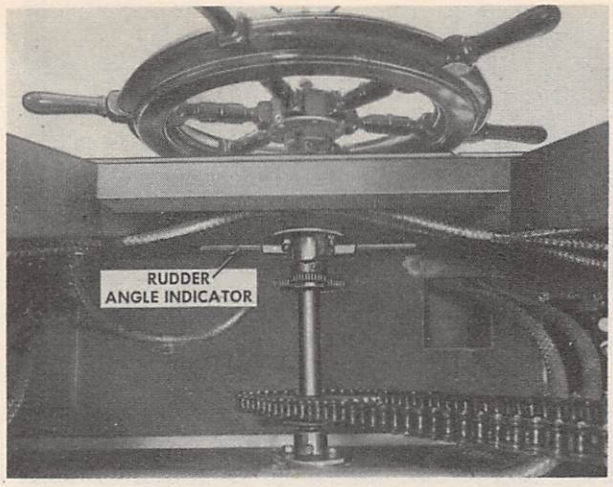


Figure 74—Bridge Steering Assembly

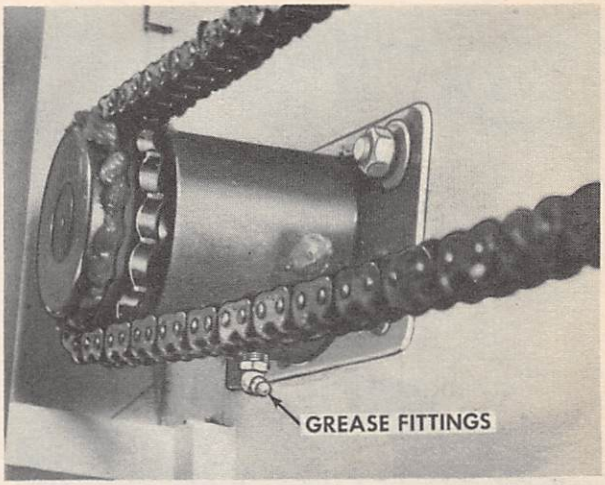


Figure 77—Stub Shaft at Forward End of Torque Tube Assembly

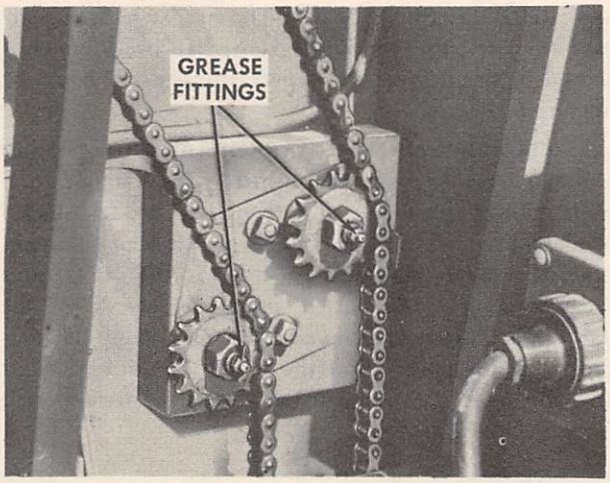


Figure 75—Idler Sprockets in Bridge Steering Assembly

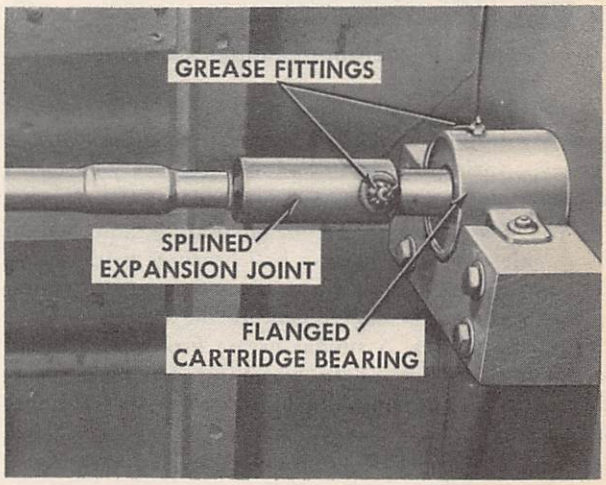


Figure 78—Splined Expansion Joint and Cartridge Bearing on Forward Starboard Side of Engine Room After Bulkhead

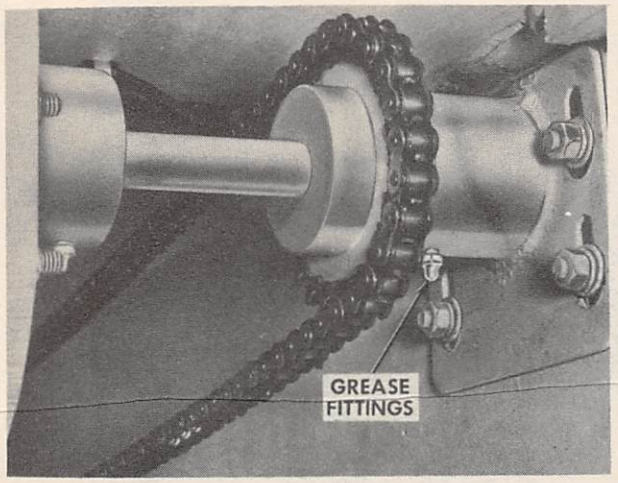


Figure 76—Intermediate Shaft Through the Pilot House After Bulkhead

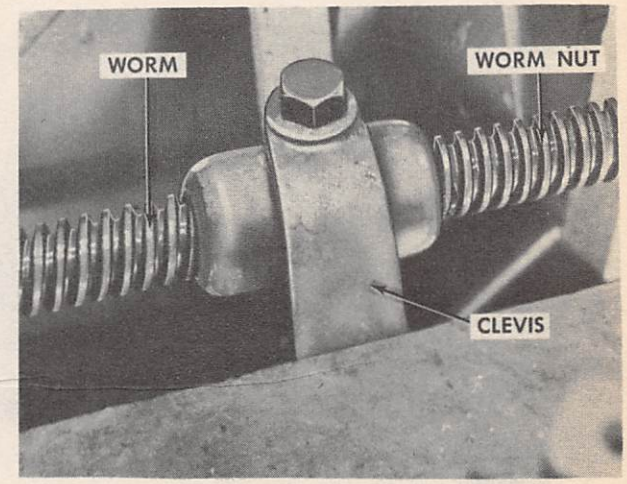


Figure 79—Worm Shaft and Worm Nut at After End of Torque Tube Assembly, Connected to Starboard Rudder Bell Crank

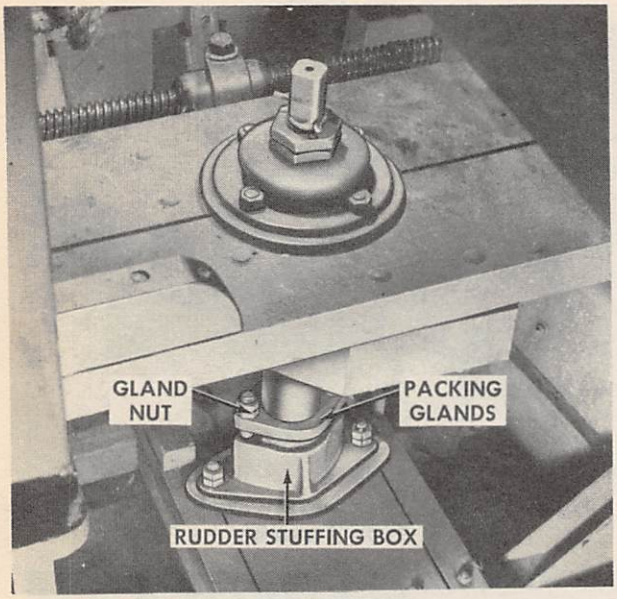


Figure 80—Starboard Rudder Assembly

(2) The splined expansion joint on the forward starboard side of the engine room after bulkhead has a Zerk-type fitting. It should be lubricated every 50 hours of operation.

(3) The thrust of the worm shaft is absorbed in the double row self aligning ball bearings mounted on the cockpit after bulkhead. A Zerk-type grease fitting on this bearing is accessible beneath the starboard water tank in the lazaret. A similar grease fitting is provided on the outboard side of the worm nut. The thrust bearing and worm nut should be lubricated every 100 hours of operation.

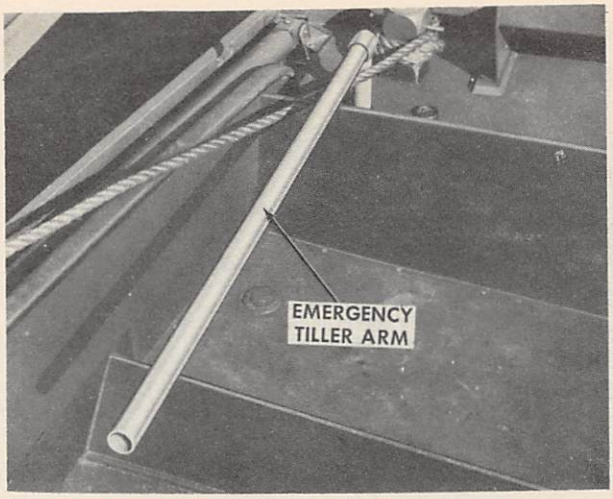
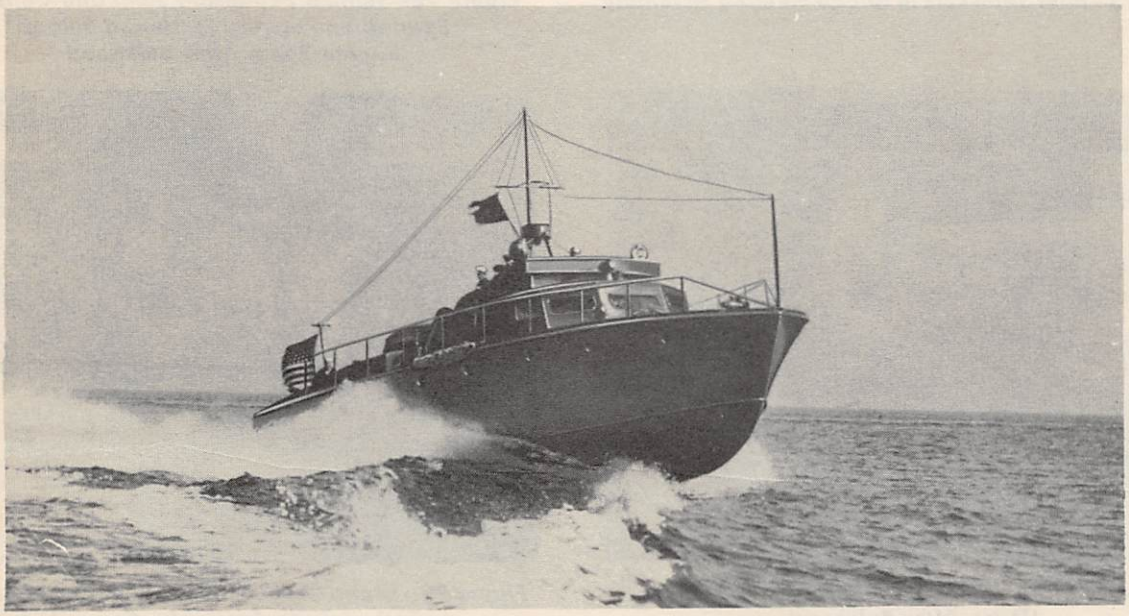


Figure 81—Emergency Tiller Arm

g. RUDDER BEARINGS.—The rudder hanger bearings are deep-grooved, single-groove ball bearings. They should be flushed out and repacked every 500 hours of operation.

h. STUFFING BOXES.—Adjustment of the packing glands *(figure 80)* is accomplished by tightening up the bolts located forward and aft of the rudder stocks. Moderate wrench pressure should be sufficient to obtain operating water tightness in the packing. If greater wrench pressure is required, need for renewal of the packing is indicated. In no case should packing be compressed to the point where the rudder cannot be rotated freely by hand, by means of the tiller arm, disconnected from the tie rods.



SECTION VI

Clutch Controls

1. GENERAL.

Two systems of clutch control are provided: the engine telegraph, and an electric-hydraulic (Columbian Bronze) system.

2. ENGINE TELEGRAPH.

The engine telegraph system, operated manually, consists of a control pedestal mounted on the bridge *(figure 82)* with two control levers and one set of indicator lights, and one set of indicator lights mounted on the engine room instrument panel *(figure 83)* and a warning bell on the starboard side of the engine room forward bulkhead *(figure 84)*. The engine room indicator lights respond to lever operation from the bridge. A three-way switch on the reverse gear shaft controls the indicator lights on the bridge. When using the engine telegraph system, the electric-hydraulic system should be made inoperative by turning "OFF" the master switch and disconnecting the actuating cylinder piston rod from the clutch lever.

3. ELECTRIC-HYDRAULIC SYSTEM.

a. DESCRIPTION. *(See figure 85.)*—The electric-hydraulic clutch control system consists of the following equipment:

(1) A control pedestal, located on the bridge, *(figure 86)* containing two triple-throw rotary switches and four indicator lights to show clutch operation.

(2) A limit switch box for each engine, containing four cams on a shaft which is linked by a lever and tie rod to the clutch lever.

(3) A solenoid-operated four-way valve for each engine *(figure 87)*. These valves direct the flow of oil to the actuating cylinders.

(4) A master switch on the port side of the engine room after bulkhead, *(figure 88)* which supplies 12-volt current to the solenoids.

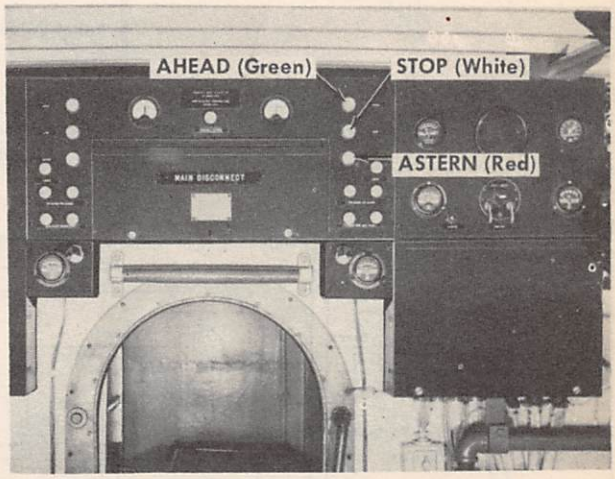


Figure 83—Engine Telegraph Indicator Lights

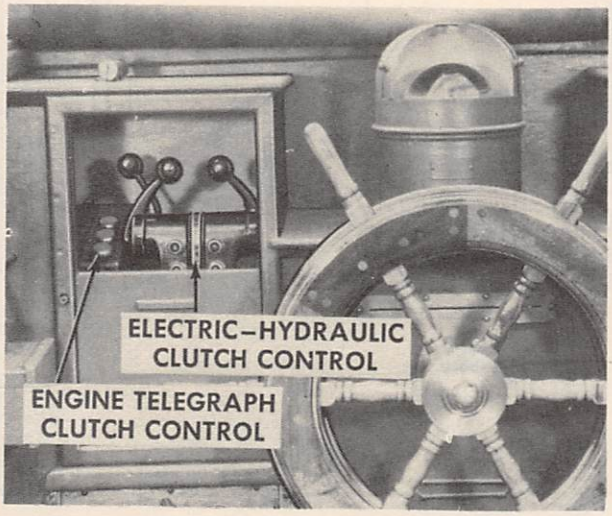


Figure 82—Bridge Clutch Controls

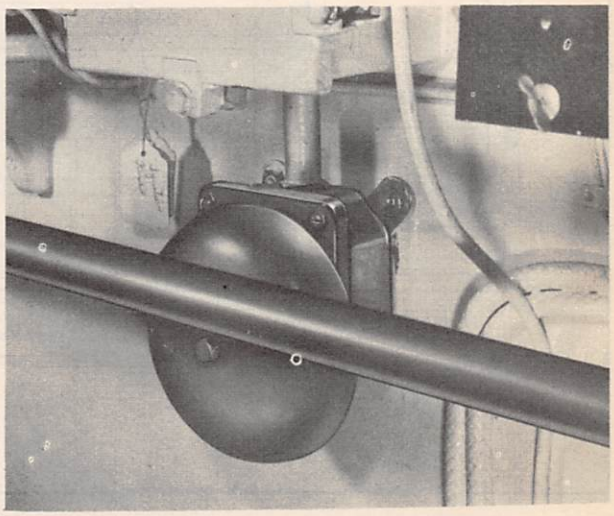


Figure 84—Engine Telegraph Warning Bell

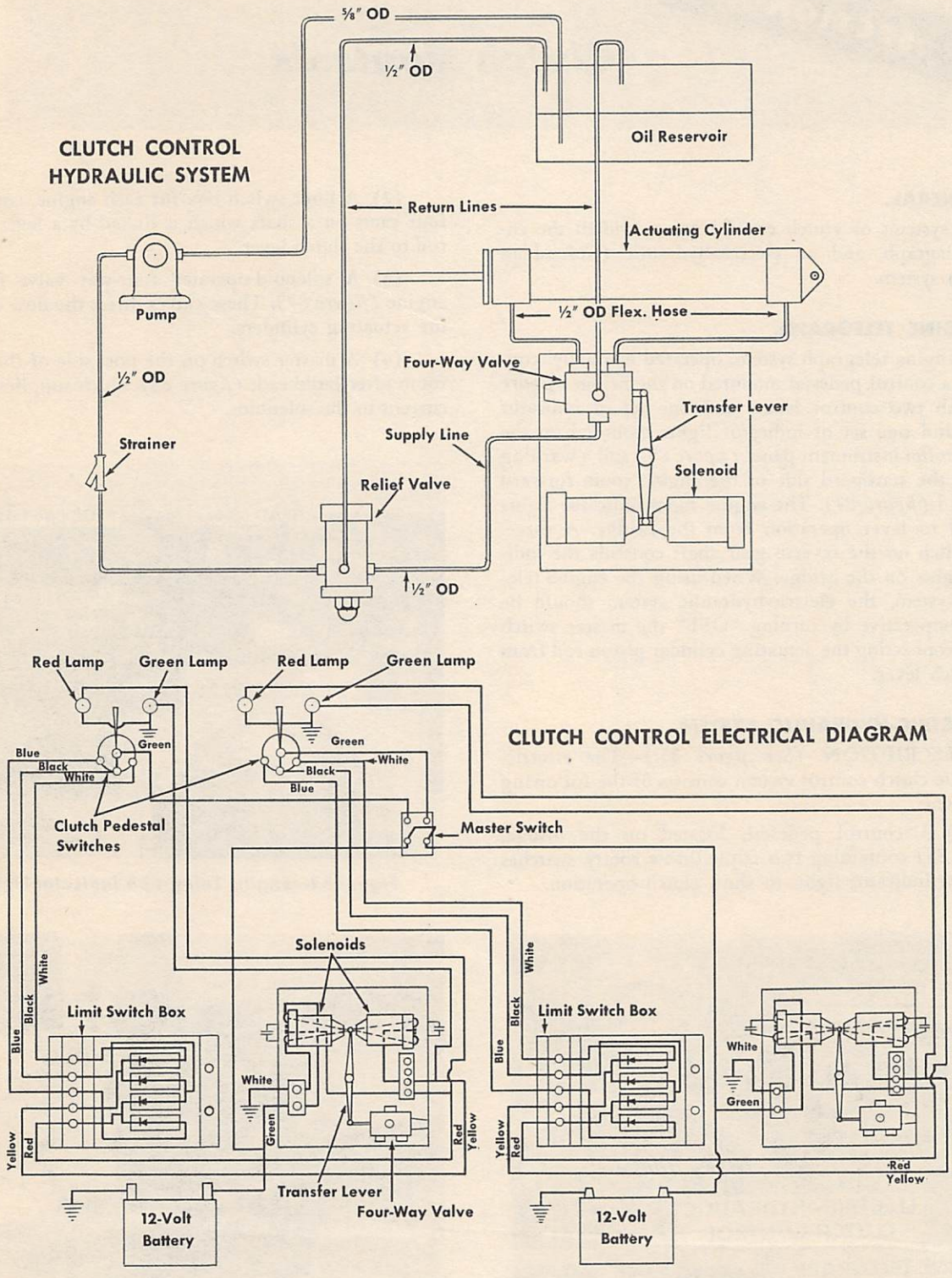


Figure 85—Electric-Hydraulic Clutch Control System

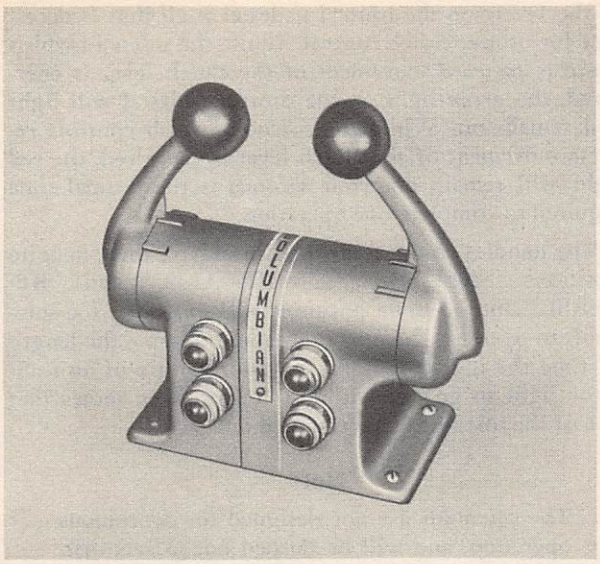


Figure 86—Electric-Hydraulic Clutch Control Pedestal

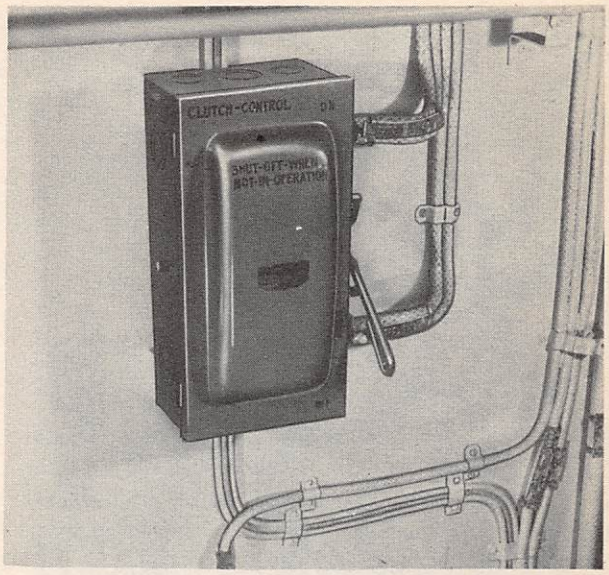


Figure 88—Clutch Control Master Switch

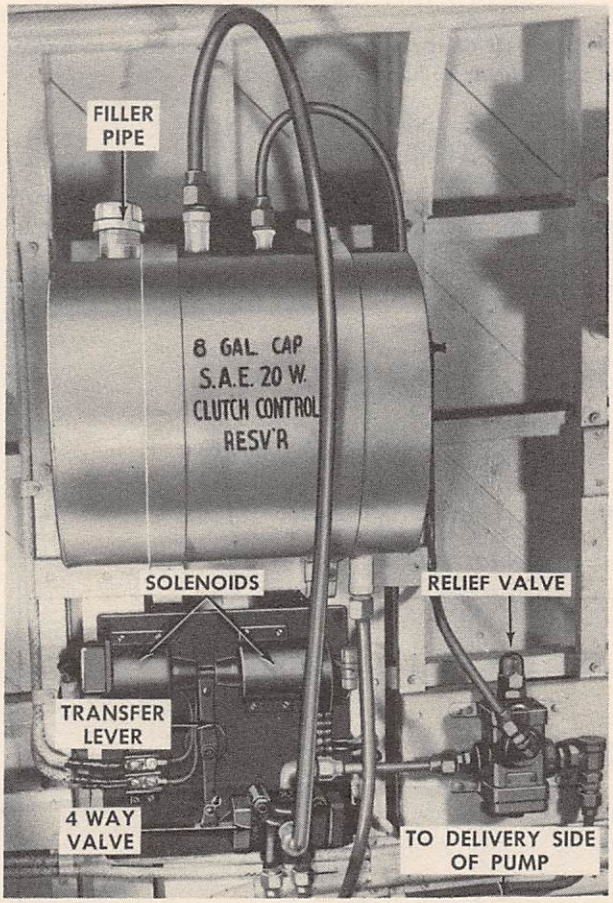


Figure 87—Storage Tank and Solenoid Operating Valve Assembly

(5) A spur-geared high-pressure oil pump for each engine, direct driven from the engine camshaft.

(6) A strainer on the delivery side of each pump.

(7) A ball check type relief valve for each engine, *(figure 89)* set to open at a pressure approximately 20 percent greater than that required for clutch operation.

(8) A double-acting hydraulic actuating cylinder for each engine to operate the clutch levers. *(See figure 90.)*

b. OPERATION.

(1) While the main engines are running, the gear pump delivers oil under pressure to the relief valve. While the clutch controls are not in use, the relief valve returns the oil to the reservoir. While the clutch is in use, oil is delivered through the relief valve to a four-way valve which has three positions.

(2) In the extreme left and right positions of the valve stem, the valve is open and oil flows into one or the other end of the actuating cylinder. In the center position the four-way valve is closed, and oil returns to the reservoir.

(3) The valve stem is actuated by a transfer lever connected to a pair of solenoids. One solenoid controls forward action of the clutch lever and the other controls reverse action.

(4) Each of the solenoids is connected to a 12-volt d-c source through switches in the control pedestal. When a control handle is moved from neutral to *forward,* for example, the solenoid which causes *forward* movement is energized, the valve stem is pulled to one of its extreme positions, oil flows into one end of the actuating cylinder and causes the clutch lever to move toward its *forward* position. This movement continues until the solenoid circuit is broken.

(5) It is the function of the limit switch box to break the circuit at the point where the clutch lever has

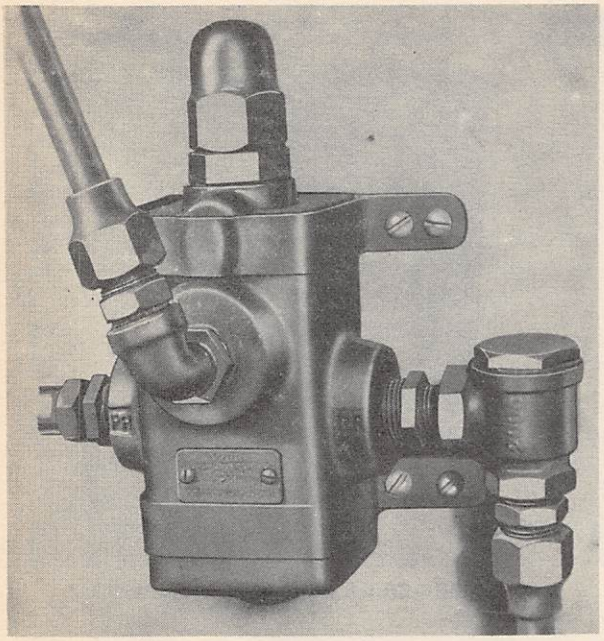


Figure 89—Clutch Control Hydraulic System Relief Valve

moved to the desired position. The limit switch box contains four switches operated by cams on a shaft linked to the clutch lever itself. Two switches control forward movement and two control reverse movement. The setting of the cams determines the position to which the clutch lever will move before the limit switches open.

c. OPERATION INSTRUCTIONS.

(1) NORMAL.—In normal operation, movement of the levers on the control pedestal is all that is necessary for proper clutch control. While the solenoid which controls *forward* movement of the clutch lever is energized, the *green* light on the control pedestal will light and remain on. While the solenoid which controls *reverse* movement of the clutch lever is energized, the *red* light will remain on. Four seconds is the normal time required to complete one operation.

The handles on the control pedestal have three definite positions: "NEUTRAL," "FORWARD," and "REVERSE." Intermediate positions will *not* cause the solenoids to operate. The operator should observe the length of time the indicator lights stay on. Failure of an indicator light to go out within a few seconds shows that one of the solenoids has remained on.

Note

The solenoids are not designed for continuous operation, and will be burned out in less than 10 minutes if the control circuit is not opened. This can be done either by moving the control lever to a new position, or opening the master switch on the engine control pedestal. Before resuming normal operation, stop the main engines and make any necessary adjustments of the cams in the limit switch box.

If any part of the system fails, it is necessary to move the clutch lever by hand.

d. SERVICE, INSPECTION, AND MAINTENANCE.

(1) CONTROL PEDESTAL.—If the indicator lights on the control pedestal do not light during clutch

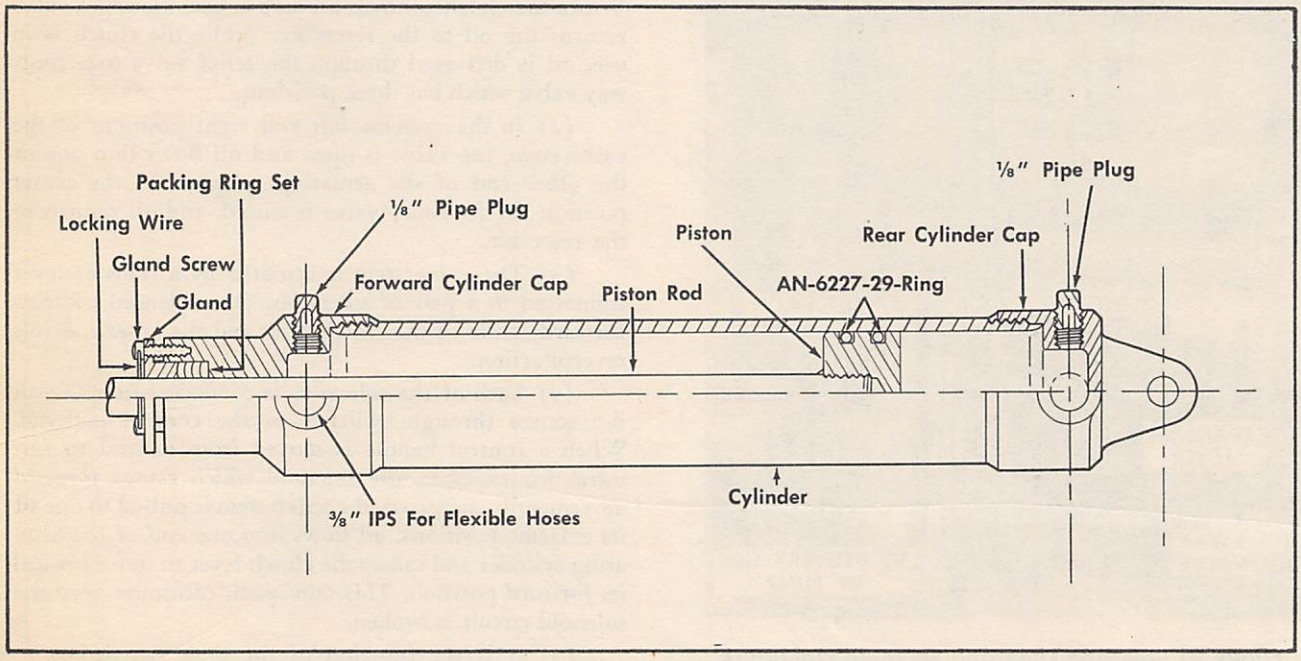


Figure 90—Hydraulic Actuating Cylinder

operation, or if they remain on continuously, it is possible that the control handles are loose on the shaft, or are not adjusted properly in relation to the rotary switch shaft. To readjust a handle, proceed as follows:

(a) Loosen the Allen setscrew and take off the handle.

(b) Turn the rotary switch shaft by hand to determine its neutral position (intermediate position between forward and reverse position).

(c) Locate the shaft in this position, then replace the handle in the exact "NEUTRAL," position, and tighten the setscrew.

(d) Move the handle to the forward and reverse positions to check the adjustments.

(2) LIMIT SWITCH BOX.—Normally the limit switch box requires no attention unless improper operation of the system reveals that one or more of the cams are out of adjustment. Procedures for adjusting cams are given in paragraph 4. of this section. It is important that the tie rod which connects the limit switch box lever to the clutch lever be free of any play. Personnel in the engine room should never step on the limit switch box, so doing may bend or damage the tie rod.

(3) RELIEF VALVE.—Slow operation of the clutch indicates that there is inadequate oil pressure at the actuating cylinder. If this is not caused by restrictions in the lines, dirty filter, or failure of the pump, the relief valve may require adjustment to raise the pressure at which oil is bypassed. To readjust the relief valve, remove the nut, loosen the lock nut on the adjusting screw, and turn the adjusting screw clockwise. When the valve is set properly, about $\frac{3}{4}$ to $\frac{3}{16}$ inch of thread is left exposed, and oil will be bypassed at about 300 psi. *(See figure 91.)*

4. ADJUSTMENT OF CLUTCH CONTROL LIMIT SWITCH BOX.

Note

Personnel not familiar with cam adjustments should not attempt to change them.

a. GENERAL. *(See figures 92 A and B.)*—The arrangement of the limit switches in relation to the cams is not the same on all boats. The following text applies to boats in which the standard arrangement recommended by the manufacturer is used. As you look at the cam box with the terminal strip away from you, the cams function as follows:

(1) The left-hand cam controls motion from neutral to reverse.

(2) The second cam from the left controls motion from forward to neutral.

(3) The third cam from the left controls motion from reverse to neutral.

(4) The right-hand cam controls motion from neutral to forward.

It will be noted that clutch return to neutral from forward or reverse positions depend on the two center cams; proper action from neutral to reverse depends on the left-hand cam, and proper action from neutral to forward depends on the right-hand cam.

b. HOW TO ADJUST CAM CONTROLLING ACTION FROM "NEUTRAL" TO "FORWARD."

(1) Stop the engines, turn the master switch "OFF," and remove limit switch box cover.

(2) Loosen setscrew in the cam which controls action from "NEUTRAL" to "FORWARD" position.

(3) Move clutch lever into "FULL FORWARD" position, determine the amount of play of the lever in this position, then hold lever at midpoint of this play.

(4) Adjust the cam so that its switch has just opened, and so that further movement of the clutch lever will result in the switch remaining "OPEN."

(5) Secure the cam on the shaft very tightly.

(6) Start engine.

(7) Turn "ON" master switch.

(8) Move handle on control pedestal from "NEUTRAL" to "FORWARD" and observe clutch action in engine room. Green indicator light should be on while clutch lever is in motion, and go off when the lever has reached the "FORWARD" position. The action should not take more than 4 seconds.

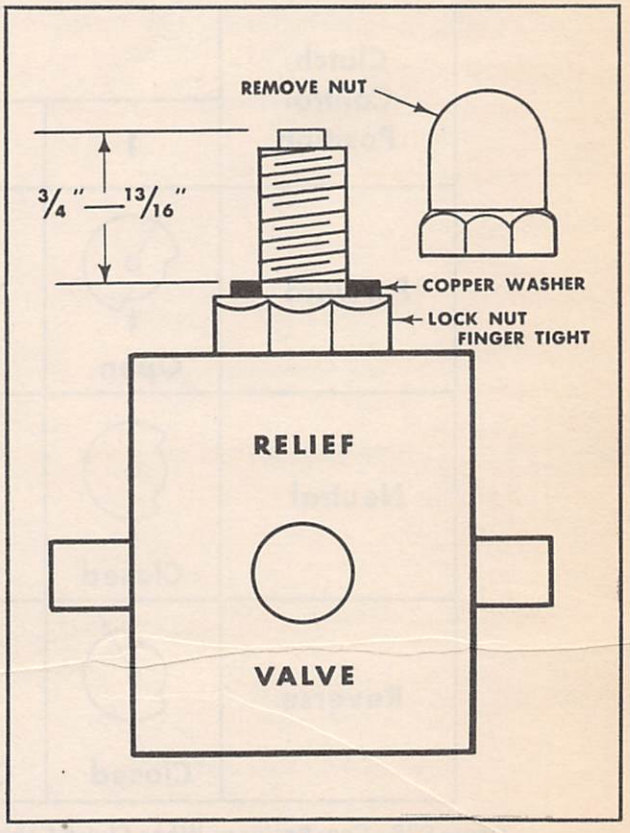


Figure 91—Relief Valve Adjustments

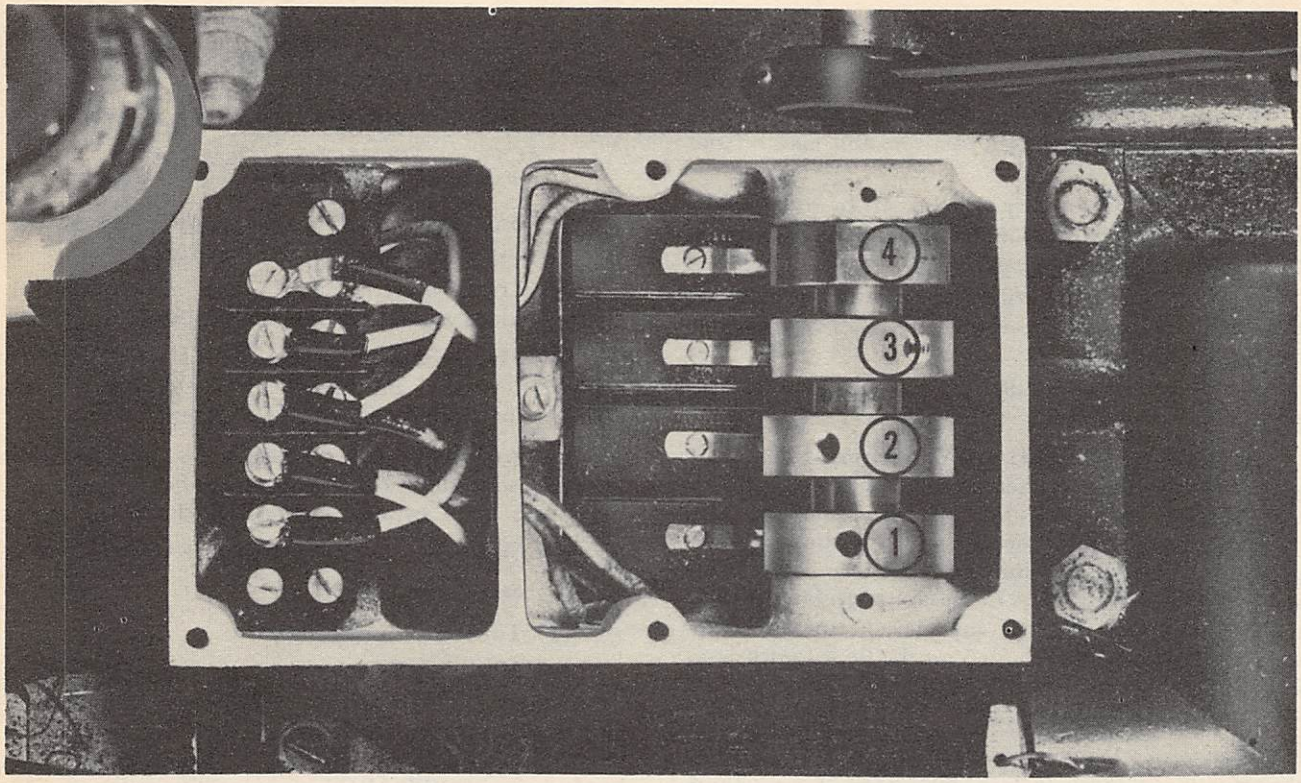


Figure 92A—Limit Switch Box

Clutch Control Position	Cam No.			
	1	2	3	4
Forward	Open	Open	Closed	Closed
Neutral	Closed	Open	Open	Closed
Reverse	Closed	Closed	Open	Open

Figure 92B—Cam Positions When Clutch Controls are in "Forward," "Neutral," and "Reverse"

c. HOW TO ADJUST CAM CONTROLLING ACTION FROM "NEUTRAL" TO "REVERSE."—Procedure is the same as that for adjusting cam controlling forward action except that clutch lever should be moved to "REVERSE."

d. HOW TO ADJUST CAM CONTROLLING ACTION FROM "FORWARD" TO "NEUTRAL."

(1) Stop the engines, turn the master switch "OFF," and remove limit switch box cover.

(2) Loosen setscrew in cam controlling action from "FORWARD" to "NEUTRAL."

(3) Move clutch lever to its definite "NEUTRAL" position, then move it forward to position "1."

(4) Adjust the cam so that its switch has just opened and that any movement of the clutch lever toward neutral will result in the switch remaining open.

(5) Secure the cam on the shaft very tightly.

(6) Locate the clutch lever in its definite "NEUTRAL."

(7) Locate the handles on the control pedestal in "NEUTRAL."

(8) Turn "ON" the master switch.

(9) Move the clutch lever forward until the red indicator light goes on, then move it back toward neutral, and note the position of the lever when the red light goes out.

e. HOW TO ADJUST CAM CONTROLLING ACTION FROM "REVERSE" TO "NEUTRAL."—Procedure is the same as that for adjusting cam controlling action from forward to neutral except that the clutch lever should be moved toward reverse.

f. HOW TO ADJUST ALL CAMS AT TIME OF NEW INSTALLATION.

(1) Remove limit switch box cover.

(2) Loosen setscrews and rotate all cams so that switches are in released ("OFF") position.

(3) Put handles on control pedestal in "NEUTRAL" and turn the master switch "ON."

(4) Depress the spring leaf on one of the center switches and note which solenoid operates. Determine whether this solenoid controls forward, or reverse movement of the clutch lever. To do this, note which end of the actuating cylinder oil is directed into when the solenoid is energized. If the valve stem is moved into the valve, the flow is into the actuating cylinder from the stem end of the valve. If the valve stem is moved out of the valve, the flow is from the valve outlet opposite the stem end.

(5) Turn the master switch "OFF."

(6) If the switch tested in paragraph 4.*f.*(4), this section controls action from "REVERSE" to "NEUTRAL," the remaining *center* switch will control action from "FORWARD" to "NEUTRAL."

(7) Move the clutch lever forward.

(8) Adjust the center cam which controls action from forward to neutral so that its switch has just opened and that further movement of the clutch lever toward neutral will result in the switch *remaining* open.

(9) Move the clutch lever to position "2."

(10) Adjust the center cam controlling action from reverse to neutral, so that its switch has just opened, and so that further motion of the clutch lever toward neutral will result in the switch *remaining* open.

(11) Set the clutch lever in "FORWARD" locating it in the center of the slack, if any.

(12) Locate the outside cam furthest away from the center cam which controls action from reverse to neutral. It will be this cam which controls the "FORWARD" position of the clutch lever. Adjust this cam so that its switch has just opened, and so that further movement of the clutch lever toward *forward* will result in the switch *remaining open.*

(13) The remaining outside cam controls the "REVERSE" position of the clutch lever. Move the clutch lever to "REVERSE" and locate it in the middle of the slack, if any.

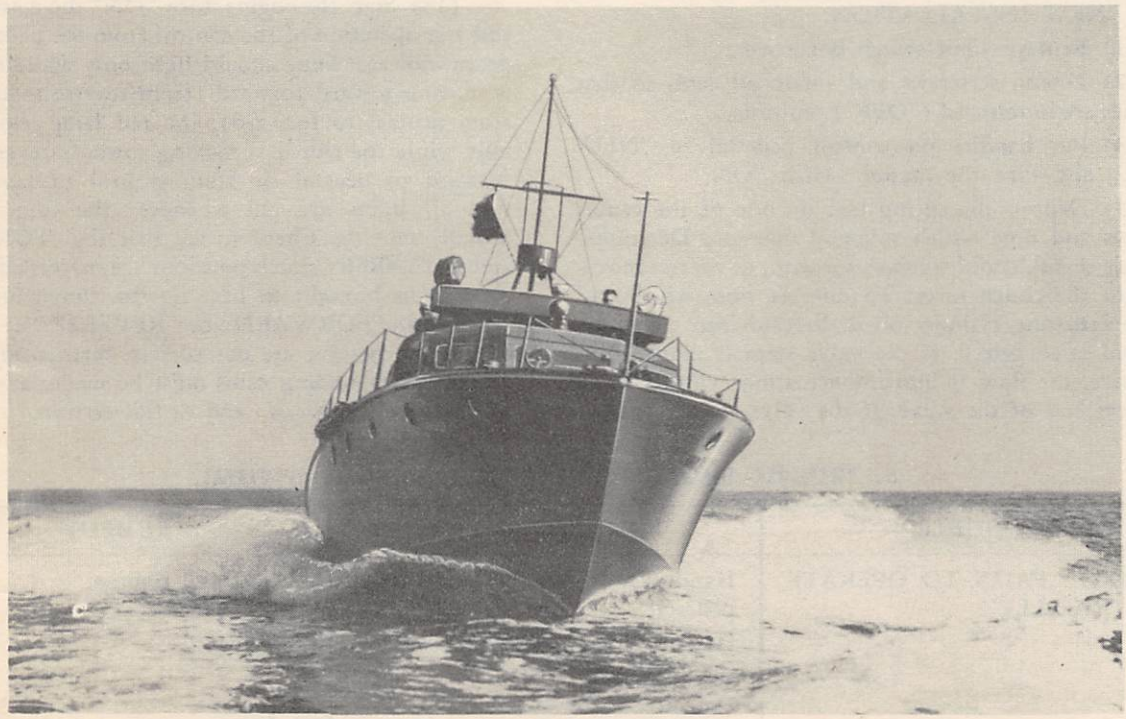
(14) Adjust this cam so that its switch has just opened, and that further movement of the clutch lever towards *reverse* will result in the switch *remaining open.*

(15) Start the engine, turn "ON" the master switch and test operation of the control from the pedestal. The green indicator lamp should light only while the clutch is moving toward forward (from reverse to neutral or from neutral to forward); the red lamp should light only while the clutch is moving towards reverse (from forward to neutral or from neutral to reverse). Be sure all lights are out whenever the control is not actually moving. Check to see that the "FORWARD" and "REVERSE" clutch positions are correct and that no pressure is brought to bear on the clutch lever when engaged in "FORWARD" or "REVERSE." If positions of the clutch lever are not correct, further adjustments of the corresponding cams must be made, as described in paragraphs 4.*b.*,*c.*,*d.*, and *e.*, this section.

5. TROUBLE SHOOTING (ELECTRIC-HYDRAULIC SYSTEM).

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
CONTROL FAILS TO OPERATE ELECTRICALLY	Handles loose on shaft at control pedestal.	Adjust and tighten.
	Handles not properly adjusted on shaft at control pedestal.	Readjust.
	Defective rotary switch.	Replace.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
	Defective solenoid.	Replace.
	Low batteries.	Recharge.
	Inaccurate adjustment of cams in limit switch box.	Readjust cams.
	Loose or broken connections at master switch, in control pedestal, on four-way valve assembly, in limit switch box, or in terminal block.	Repair.
	Failure or improper operation of transfer lever.	Check and Repair.
SLUGGISH OPERATION "SNAP-ACTION" OF CONTROLS, OR FAILURE OF HYDRAULIC PART OF SYSTEM.	Pump not operating.	Repair or replace.
	Pump air-bound.	Put oil in pump inlet.
	Air trapped in actuating cylinder.	Loosen 1/8-inch pipe plug and let air escape (while pump is operating).
	Incorrect setting of relief valve.	Check setting; adjust to open at 300 psi.
	Dirty strainer.	Clean.
	Block or leak in suction line, or pressure line.	Locate and repair.
	Four-way valve fails to operate.	Repair.
OSCILLATION AROUND "NEUTRAL," "FORWARD," OR "REVERSE," OR FAILURE TO REACH "FORWARD" OR "REVERSE"	Cams in limit switch box out of adjustment.	Readjust.



SECTION VII

Throttle Controls

1. DESCRIPTION.

Throttle controls for the two engines are of the single-tube hydraulic type known as the Sperry Exactor control. *(See figure 93.)*

a. HYDRAULIC UNITS.—For each of the two engines there is a transmitter on the bridge *(figure 94)* and a receiver mounted on the forward end of the engine bracket between banks of cylinders. *(See figure 95.)* The receiver delivers through its lever whatever motion is imparted to the handle of the transmitter. The receiver shaft is connected to the carburetor throttle shaft by a lever, so that the range of travel of the receiver lever will move the throttle lever to the "FULLY CLOSED" and "FULLY OPEN" positions, as well as to all intermediate positions desired.

b. TUBING.—A single 1/4-inch copper tube is the only connection between the transmitter and the receiver, and is connected to each unit with flared tube fittings.

c. CLOSED SYSTEM.—The cylinders of the transmitter and receiver are fitted with trunk-type pistons and packing glands to prevent fluid leakage. The cylinders and tubing form a closed system which is filled with a liquid of low freezing point. Refer to paragraph 3. *b.*, this section, for data on proper fluid to be used.

2. OPERATION.

The controls for the throttles of the two engines are identical. Operation of one of the throttle control systems is described following:

a. Moving the handle of the transmitter toward the "OPEN" position causes a downward movement of the transmitting piston and forces a definite quantity of hydraulic fluid to pass through the copper tubing to the receiver, forcing the piston of the receiver upward.

b. Opposing springs of equal force in the transmitter and receiver "balance" the control and eliminate lost motion and backlash. The receiver is installed so that, if the hydraulic line breaks and the transmitter no longer has control of the throttle, the spring in the receiver automatically will close the throttle. This spring also operates to close the throttle when the handle of the transmitter is moved toward the "CLOSED" position.

c. When the throttle controls are properly synchronized, movement of either the handle on the bridge or the handle on the receiver will cause the other handle to move to the corresponding position.

3. SERVICING AND MAINTENANCE.

a. SYNCHRONIZING.—Temperature changes will result in changes in the volume of hydraulic fluid between the pistons of the transmitter and the receiver. This will cause loss of synchronization; that is, the handles of the transmitter and the receiver will not stand in the same relative position. Moving the transmitter handle through the 7 degrees of overtravel past the "CLOSED" position will open a synchronizing valve, releasing fluid from the reservoir into the system or permitting the release of excess fluid from the copper tubing into the reservoir. *(See figure 96.)*

Note

Always synchronize the controls before any period of operation. If necessary, controls can be synchronized during the operation.

(1) If fluid pressure in the system cannot be established after synchronizing, or if the receiver fails to move through its full stroke, there probably is not enough fluid in the reservoir. Refill the reservoir and push the transmitter back and forth several times to expel air that has been sucked into the system and to replace it with hydraulic fluid.

(2) Frequent need for synchronizing indicates that the system probably is leaking fluid. Check the line for leaks.

Note

Dirt in the hydraulic fluid may hold the synchronizing valve open, requiring frequent synchronizing or resulting in failure of the controls.

b. REPLENISHING FLUID.—Fluid may be added to the supply in the transmitter reservoir by removing the filler cap shown in figure 94. The reservoir should be kept filled to the level of the cylinder packing nut locking screw, which may be removed for checking. *(See figure 96.)* The following fluids are recommended: Specification No. AN-VV-O-366, stock No. 7500-140800; Specification No. 3500, stock No. 7500-140500; Specification No. 3586, Stock No. 7500-138000. In an emergency, a suitable fluid may be made by blending 20-percent SAE 20 motor oil and 80-percent clean kerosene, measured by volume.

(1) Under no circumstances should fluids be mixed. If an alternate fluid is to be used, the entire control system should be flushed and then filled with the alternate.

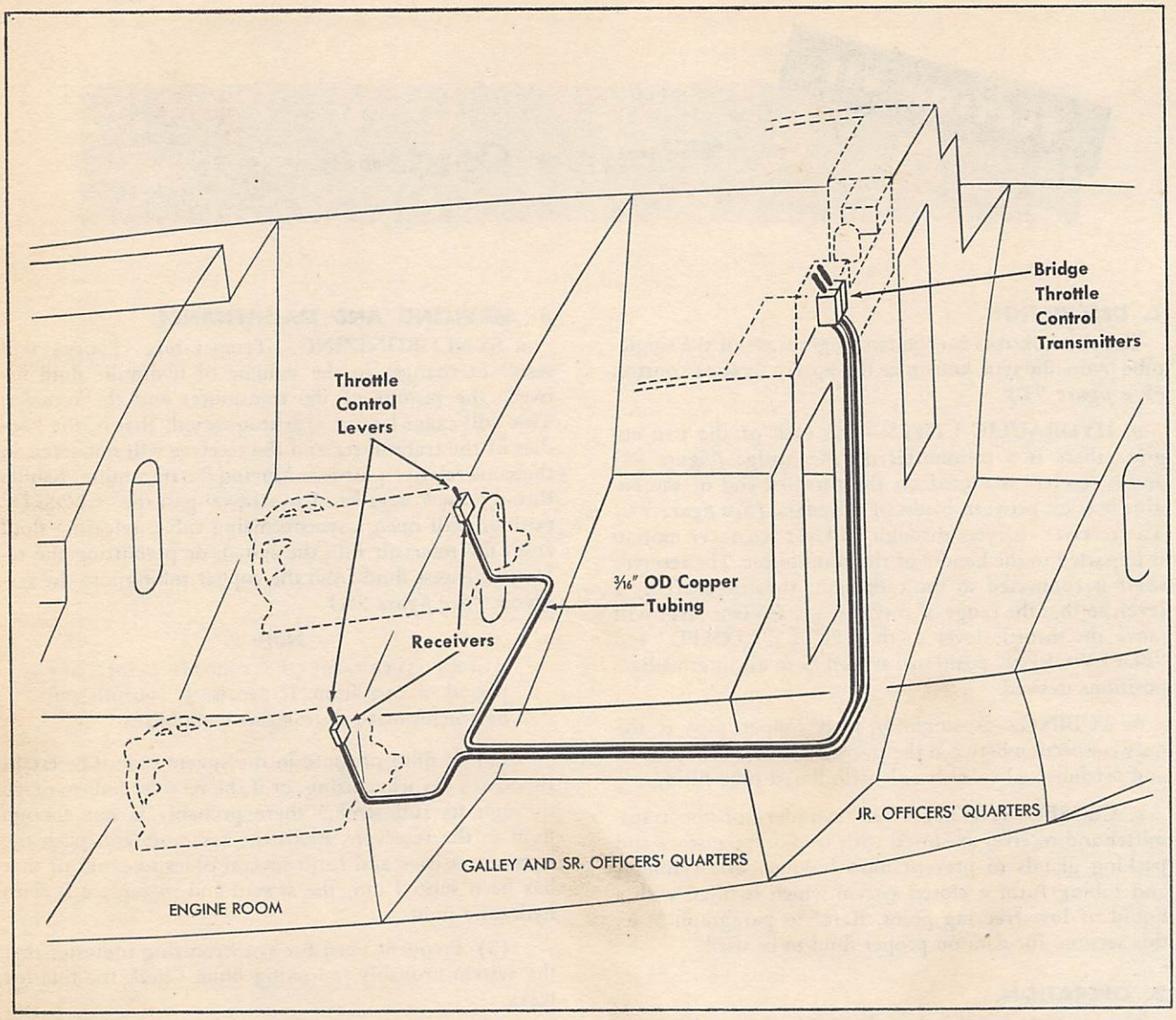


Figure 93—Throttle Control System

To flush the system, disconnect the lines at both the transmitter and receiver and blow them out with compressed air. Pump the handle of the transmitter until all fluid is ejected from the cylinder and reservoir. Before each stroke, pull the handle of the transmitter to the synchronizing position *(figure 96)* to allow the fluid to flow from the reservoir.

(2) The level of the hydraulic fluid should be maintained up to the required height, level with the packing nut lock screw, at all times. If the fluid reservoirs should become empty, it may be necessary to refill the entire system before satisfactory operation is again obtained.

c. FILLING THE SYSTEM.—Station one person at the transmitter and another at the receiver.

(1) Remove the filler cap of the transmitter.

(2) Fill the transmitter reservoir.

(3) Disconnect the tubing at the receiver and put your finger over the tube end.

(4) Pull the transmitter handle slowly past the closed position. This will create a partial vacuum in the system, and when the synchronizing valve opens, fluid will be sucked into the tubing from the reservoir.

CAUTION

Take care not to allow the reservoir to become empty while filling the system.

(5) While the person in the engine room keeps a finger over the end of the tubing, the person on the bridge pumps the transmitter handle, pulling it to the synchronizing position before each stroke.

(6) Refill the reservoir after each three strokes to avoid sucking air into the system.

(7) Repeat steps (3) through (6) preceding about six to eight times.

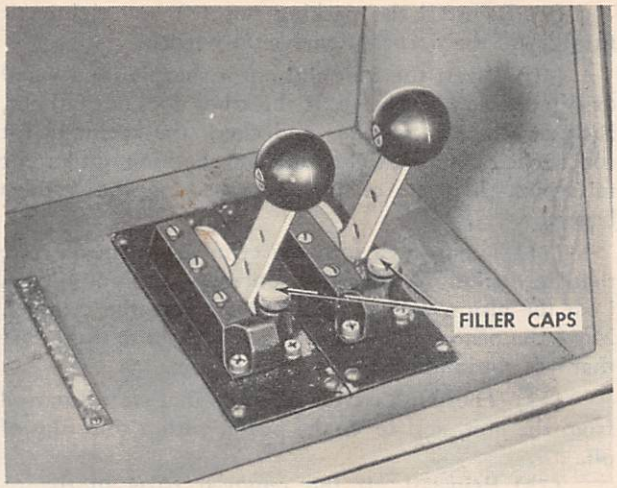


Figure 94—Throttle Control Transmitters on Bridge

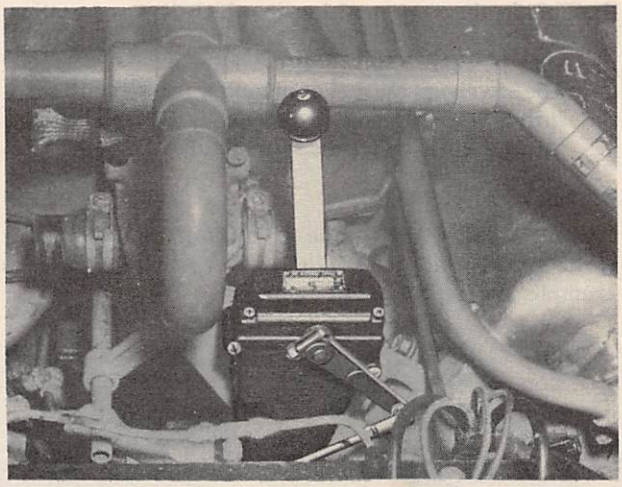


Figure 95—Throttle Control Receiver Mounted on Engine

(8) Tighten the tubing to the receiver.

(9) Operate the handle several times with short, rapid strokes. Then move the handle to the synchronizing position to open the synchronizing valve. Repeat until the receiver lever moves through its full stroke in response to the movement of the handle of the transmitter. Any trapped air will be expelled, as the piston packings will retain fluid but will allow air to pass.

Note

If the handle continues to go to the end of its stroke without building up pressure, there is still a considerable amount of air in the system. The cause may be either incorrect filling procedure or allowing the reservoir to run dry, thereby sucking air into the system. In either case, the preceding filling procedure must be repeated until all air has been pumped out of the tubing. If the system fills with fluid but the transmitter unit fails to hold its full stroke after a short time, carefully examine all tube fittings for leaks. If any fluid leakage is found, wipe off and tighten the joint.

(10) Fill the reservoir of the transmitter to the level of the connecting rod lock screw. *(See figure 96.)* This screw may be removed for checking the level of the fluid.

d. FILLING THE SYSTEM BY PRESSURE FILLER.—When a pressure filler is available, the hydraulic throttle control system may be filled with fluid as follows:

(1) Fill the pressure filler four-fifths full of fluid.

(2) Close the valve and pump up the air pressure in the filler.

(3) Loosen the tubing connection to the receiver.

(4) Connect the flexible tube of the pressure filler to the receiver end of the tubing.

(5) Open the pressure filler valve and allow the fluid to be forced into the tubing until it is full. Allow a small amount of fluid to flow out of the tubing to insure that all air pockets are forced from the line.

(6) Close the pressure filler valve.

(7) Connect the tubing to the receiver.

(8) Open the pressure filler valve.

(9) Pull the handle of the transmitter back to the synchronizing position and allow a small amount of fluid to go into the reservoir. Then allow the handle to go forward.

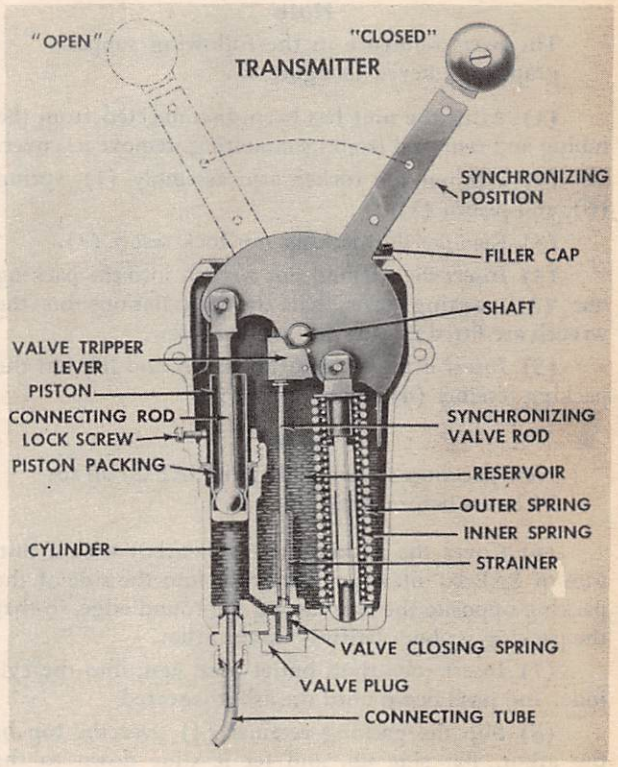


Figure 96—Throttle Control Transmitter

(10) Shut off the filler valve.

(11) Remove the pressure filler from the tubing, and reconnect the tubing to the receiver.

(12) Test the system to make sure that the receiver lever moves through its full stroke in response to the transmitter. If it does not, repeat the fluid replenishing operation until the reservoir is properly filled, the tubing is completely free of air pockets, and the handle of the receiver responds properly to the control handle.

e. REPLACING PISTON PACKING.—Piston packings in the transmitter and receiver should last a minimum of 6 months under normal operation. The packings are interchangeable. The following directions for replacing the packing in the receiver may be used for replacements in the transmitter, as the procedure for disassembly of the springs, pistons, and rocker arm assemblies, and removal of the piston packings is the same. Special tools required are the packing assembly arbor, and the packing nut wrench. *(See figure 97.)*

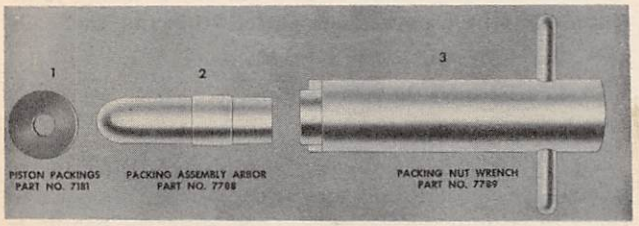


Figure 97—Tools for Replacing Piston Packings

Note

The parts reference in the following subparagraphs are keyed to figure 98.

(1) After the unit has been disconnected from the tubing and removed from its mounting, remove its cover.

(2) Lift out the rocker arm assembly (1), spring (6), and piston (7).

(3) Remove the packing nut lock screw (2).

(4) Insert the packing nut wrench into the packing nut (3), making sure that the castellations on the wrench are fitted into the nut, and unscrew.

(5) Insert a finger into the piston and lift out the packing retainer (4) and packing (5).

Note

New packings should be kept in SAE 20 oil for 24 hours before installing.

(6) Cover the packing assembly arbor with a thin film of SAE 20 oil. Insert the arbor into the side of the packing opposite the side having the round edge, so that the packing is about halfway up the arbor.

(7) Insert the arbor, bullet nose first, into the cylinder and push down until the arbor is seated.

(8) Slip the packing retainer (4) over the top of the arbor, flat side up, and let it slide down to the packing.

(9) Reinstall the packing nut (3) and tighten it firmly with the wrench. Remove the wrench.

(10) Invert the unit and tap it sharply on a wood or composition bench top. If the arbor does not fall out, back off the packing nut and check the assembly for concentricity. Repeat tightening and checking until arbor falls out when the casting is tapped on the wooden bench.

(11) Look down into the cylinder and make sure that the packing is relatively concentric and not kinked. Coat the piston with oil and insert it into the cylinder. Move the piston up and down a few times to make sure that it is not binding. Remove the piston.

(12) Thoroughly clean all parts that were removed from the unit, and cover the piston with a thin film of oil.

(13) Reinstall all the removed parts in the reverse order of their removal.

(14) Replace the cover of the unit, and remount the unit in the same position in which it was installed.

CAUTION

The receiver must be mounted so that the spring assembly will automatically CLOSE the throttle if the hydraulic system fails.

4. MAJOR REPAIRS.

a. DISASSEMBLY.—The procedure for disassembly is the same for all units. The receiver is here used as an example. References are to figure 98.

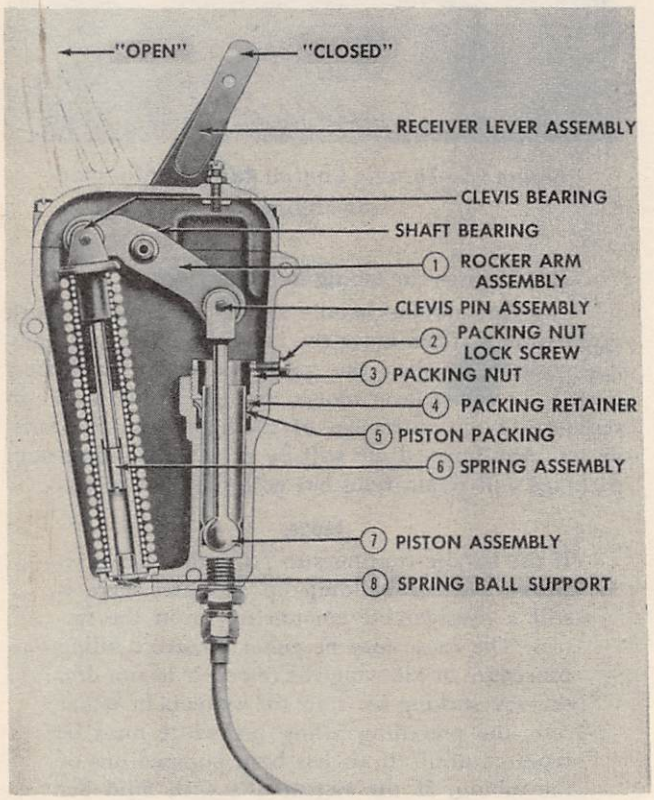


Figure 98—Throttle Control Receiver

(1) Remove the receiver cover.

(2) Lift out the spring assembly (6), piston (7), and rocker arm assembly (1).

(3) Drive out the clevis pin.

(4) Remove the packing nut lock screw (2) and the packing nut (3) only if the packing is to be renewed. Otherwise do not adjust.

(5) Remove the spring ball support (8) which fits loosely at the lower end of the spring assembly.

(6) To disassemble the spring assembly further, first force the springs back over the spring guide until the spring guide pin (6) is exposed. Clamp the assembly in a vise to keep the springs under compression, and drive out the 1/16-inch pin from the spring guide clevis. Then unscrew the spring guide pin (6) which is screwed into the clevis.

b. ASSEMBLY.—The throttle control units are reassembled by installing the parts in the reverse order of their disassembly. Take care to keep all parts clean.

c. INSTALLING THROTTLE CONTROLS.—Whenever it is necessary to remove any part of the system for repairs or replacement, observe the following precautions during reinstallation:

(1) INSTALLING TRANSMITTERS. — The transmitter must be mounted on the bridge in such a position that the handle may be pushed away from the operator to cause the receiver to move the throttle lever to the "OPEN" position. Therefore, the piston side of the transmitter must be mounted away from the operator.

(2) INSTALLING RECEIVER. — The receiver must be mounted securely to its bracket in such a position that its spring will automatically CLOSE the throttle if the hydraulic system fails.

CAUTION

It is possible to mount the receiver in such a position that the spring will automatically OPEN the throttle if the hydraulic system fails. Take care to avoid this position.

(3) ADJUSTING CONNECTION TO THROTTLE LEVER.—After the entire throttle control system has been installed and filled with fluid, install and adjust the connecting rod between the receiver lever and the throttle arm of the carburetor as follows:

(a) Synchronize the units. (Refer to paragraph 3.*a.*, this section.)

(b) Move the transmitter handle to the midpoint of its travel.

(c) Install the receiver lever at right angle to the connecting rod.

(d) Synchronize the units again, leaving the transmitter handle and receiver lever in the "CLOSED" position.

(e) Move the carburetor throttle arm to its "CLOSED" position.

(f) Adjust the connecting rod to the proper length to connect the receiver lever and the throttle arm, carefully leaving both in the "CLOSED" position.

(g) Install the connecting rod.

(h) Move the transmitter handle from the "CLOSED" to the "OPEN" position, and check to see that the throttle arm travels through its complete stroke.

CAUTION

Do not adjust the stop on the receiver, which has been adjusted in the factory to give 55 degrees of rotation to the receiver shaft. All adjustment of stops is to be made with the stops on the carburetor.

d. REPLACING TUBING.

(1) Annealed copper tubing, 1/2-inch outside diameter by .035 inch, must be used to replace any of the hydraulic lines that may become clogged.

(2) The hydraulic units are tapped for standard 1/8-inch male pipe fittings.

Note

A small amount of gasket paste applied to the thread of male fittings will assure a tight joint. Take care to prevent a surplus of this material from entering the oil chamber.

(3) All joints in the tubing must be tight, for the normal system pressure is 200 psi and the fluid is of low viscosity. Tube ends must be carefully flared to avoid possible fracture under vibration.

(4) Support tubing adequately to prevent vibration.

5. TROUBLE SHOOTING.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
THROTTLE HANDLE WILL NOT REMAIN IN "FULLY CLOSED" POSITION	Units not synchronized.	Synchronize units. Refer to paragraph 3.*a.*, this section.
PUSHING HANDLE FORWARD AT BRIDGE CONTROL DOES NOT OPEN THROTTLE OF CARBURETOR	Air in line. Leak in line. Broken tubing. Dirt in fluid.	Prime the line. Tighten connections. Repair and refill. Refer to paragraph 3.*c.*, this section. Flush system and refill with clean fluid.

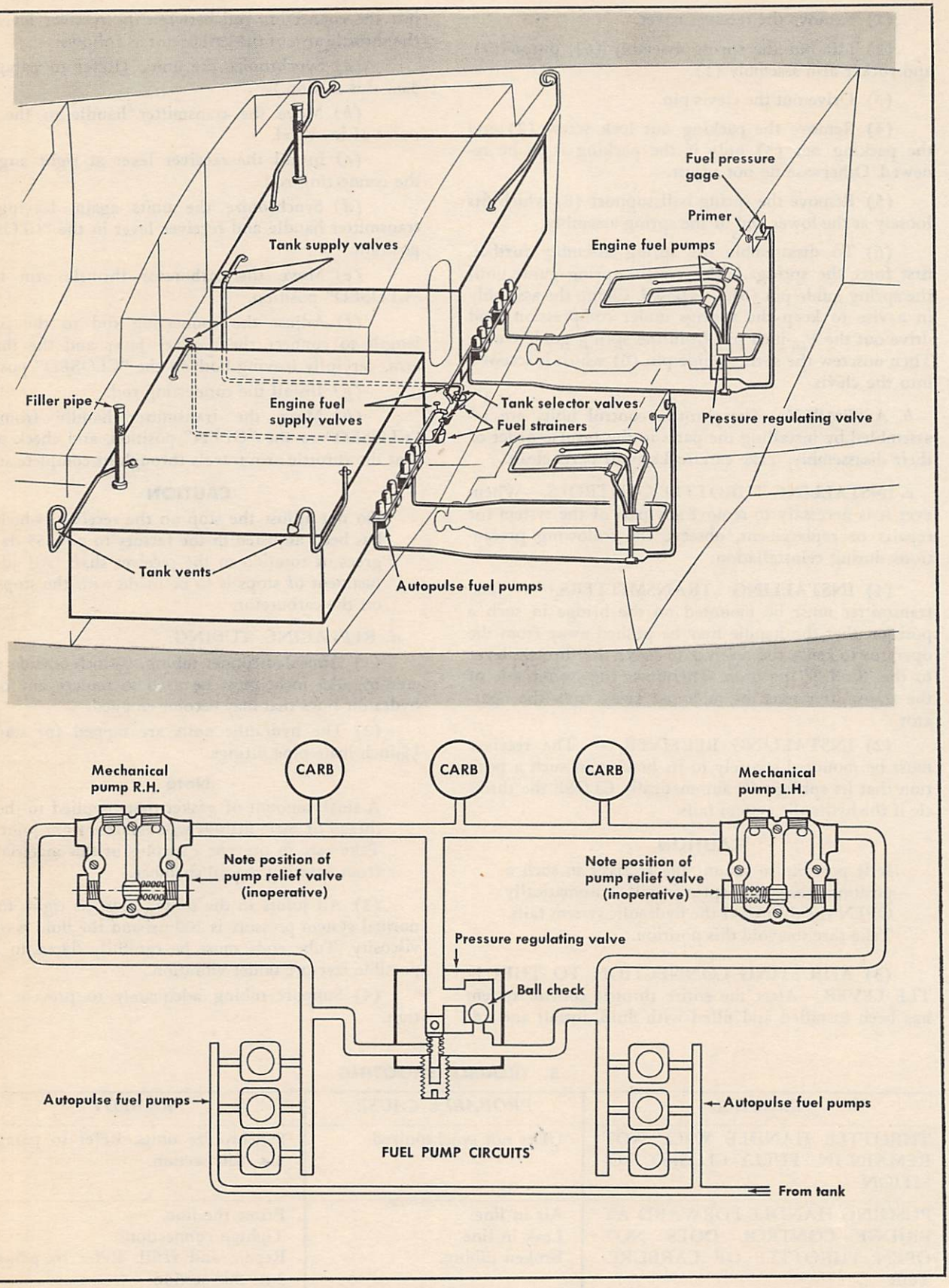


Figure 99—Fuel System Diagram

SECTION VIII

Engine Systems

1. FUEL SYSTEM.

a. DESCRIPTION. *(See figure 99.)*

(1) FUEL TANKS AND LINES.—Two rubber, self-sealing integral type tanks are located beneath the dispensary berths. The tanks are identical and each has a capacity of 790 gallons. *(See figure 100.)*

(2) FUEL STRAINERS.—On each side of the fuel manifold is a bucket type fuel strainer. Each strainer has a filtering element of closely spaced spiral-wound wire to strain out dust and water. *(See figure 101.)*

(3) FUEL MANIFOLD.—Fuel passes from the strainer into a manifold which supplies both engines, the auxiliary generator engine, and the heaters. *(See figure 101.)*

(4) AUTOPULSES.—Six autopulses to each engine are connected in series with the engine fuel pumps. *(See figure 102.)* They build up pressure in the fuel lines before starting and prime the fuel pump. Sometimes it is necessary to operate the autopulses while the engines are turning less than 1000 rpm, but not beyond this speed.

Note

It is wise to operate the autopulses while maneuvering, as the engine fuel pump may momentarily lose its prime at low speeds.

(5) ENGINE PRIMER AND GAGES.—A hand-priming pump is furnished for injecting gasoline into the main intake manifold. The supply side of the pump is connected to the same line as the fuel pressure gage. *(See figure 99.)*

(6) FUEL PUMPS.—Two engine-driven vane-type fuel pumps, one located on the forward end of each cylinder bank, supply the carburetors with gasoline. A fuel line leading from the autopulses to the pressure regulating valve supplies fuel to the fuel pumps, which are connected in parallel. Either pump alone is capable of supplying enough fuel to operate the engine at approximately 75 percent of maximum power output.

b. OPERATION.

(1) FILLING TANKS. *(See figure 103.)*—High octane gasoline is extremely volatile and may cause an explosion at considerable distance from the fuel location. Observe the following precautions when refueling:

(a) Pull the main disconnect switch located in the engine room instrument panel.

(b) Stove, heaters, and electric apparatus should not be in operation during filling.

(c) Permit no smoking within the immediate vicinity of the boat. Only personnel engaged in refueling should remain aboard boat.

(d) Have a fire extinguisher near the fuel filler when refueling.

(e) Clean deck area around filler caps.

(f) Ground the nozzle of the hose securely before uncovering the tank.

(g) Do not remove the tank cap until filling is about to start and replace it immediately thereafter.

(2) SELECTING FUEL TANKS. — If the tank valves and selector valves for both tanks are open, fuel will be withdrawn from only one tank. Over a period of time, the resulting unbalance of weight will cause the boat to list. To avoid this, open the tank valve and tank selector valve for each tank alternately every 2 hours.

(3) MEASURING FUEL.—Measuring sticks are provided for checking the fuel supply in the storage tanks. Some sticks are made to measure the fuel by gallons while some are made to measure by inches. On sticks that measure by inches, 1 inch equals approximately 20½ gallons of fuel.

c. SERVICING AND MAINTENANCE.

(1) FUEL TANKS AND LINES.

(a) Check tank filler caps to see that they fit properly and are securely fastened.

(b) See that the fuel tanks vents are open. The vents are of ample size; however, in cold climates they sometimes freeze shut when spray and vapor hit them.

(c) Check the lines and connections if a strong odor of gasoline exists.

(d) Fuel tanks will not have to be cleaned if the fuel is properly strained when the tanks are filled. If a supply of dirty fuel, through error, is placed in the tanks, remove the manhole covers and pump the tanks dry. Air them out for 24 hours. DO NOT use steam—it would ruin the rubber tanks. Then, clean the tanks out with a long-handled clean swab or clean rags. When reinstalling the manhole covers, torque the screws and safety wire them.

Note

Wear a gas mask on entering a tank to prevent being overcome by fumes.

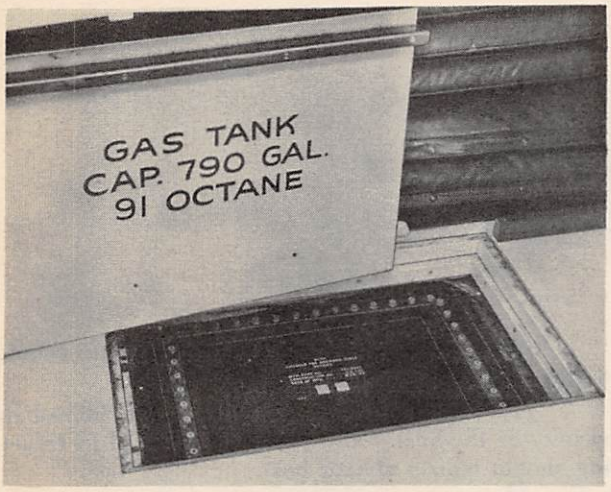


Figure 100—Access to Fuel Tank Manhole

(2) FUEL STRAINERS.

(a) Drain and clean fuel strainers after every 50 hours of operation.

Note

If the gas pressure drops to 1½ or 2 pounds, turn on the autopulses to build up pressure to normal 3 to 5 pounds. If pressure drops with the autopulses on, it indicates that the strainers need cleaning. Continue to use the autopulses long enough to allow the strainers to fill up before cleaning them.

(b) Remove the drain plug from the bottom of the case with a socket wrench to drain water from the sediment pot. *(See figure 104.)*

(c) To clean the screen, remove the nut in the center of the top of the strainer element and remove the screen. *(See figure 105.)*

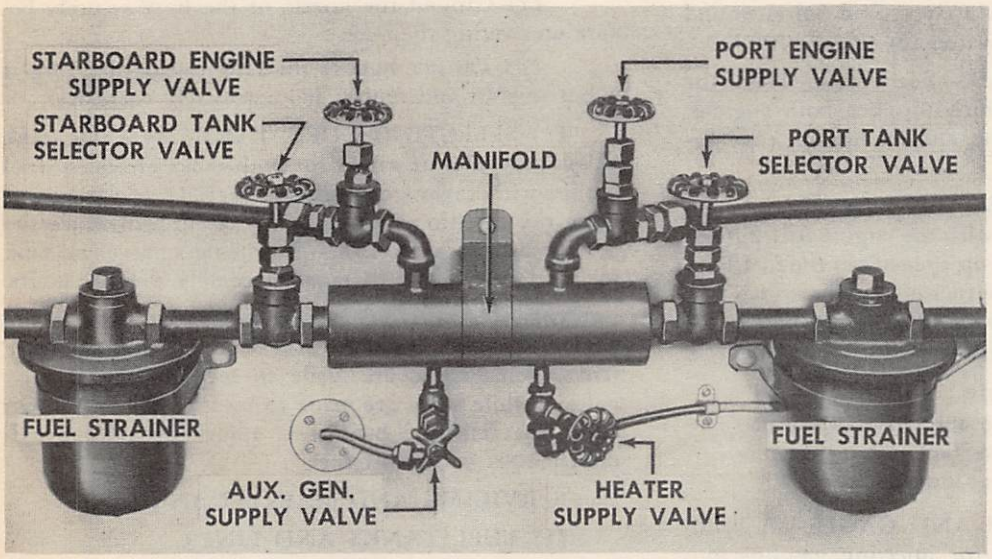


Figure 101—Fuel Strainers and Manifold

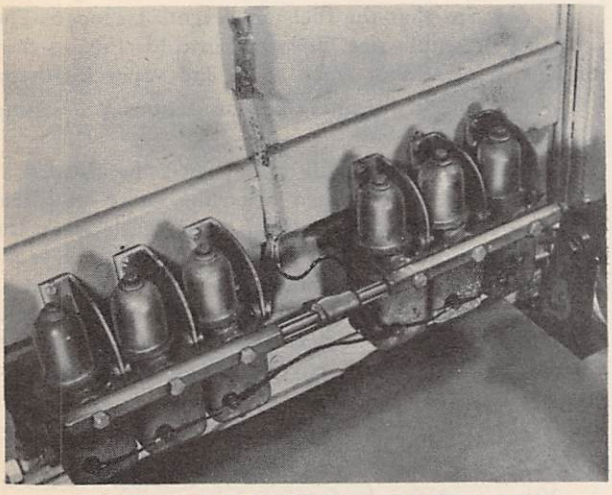


Figure 102—One Bank of Autopulses

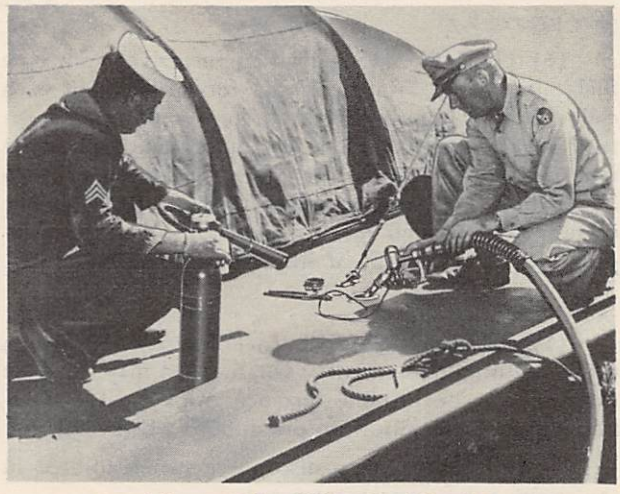


Figure 103—Filling Fuel Tanks

(d) Use an old toothbrush and cleaning fluid to wash the inside of the screen. Never use a wire brush or scraper as either will damage the fine element or screen.

(3) PRIMER PUMP.

(a) Operate the primer pump sufficiently to force fuel through the primer lines.

(b) Inspect all the primer lines and connections for leaks, particularly the connection from the primer line to the carburetor manifold.

(4) AUTOPULSES. — To remove strainer screen for cleaning, remove nut, bolt, and cap at top of pump. *(See figure 106.)* If additional servicing is required, replace pump as faulty assembly may cause a leak and consequent fire hazard.

d. EMERGENCY REPAIRS.

(1) REPAIRING TANKS.—Repair of the self-sealing fuel tanks may be made with the repair kit included in the equipment of the boat. A manual giving detailed instructions is in the kit.

(2) If a tank is damaged or leaking, plug it up if possible. If the leak cannot be plugged, continue to use it. (Close the bulkhead door leading into the engine room.)

(3) REPAIRING PIPES.—Emergency repair of a break in the fuel mains may be made by slipping a length of neoprene hose over the ends of the pipe and installing clamps. If the break occurs between a fuel tank and the fuel manifold, close the supply valve of the tank affected by the broken main. Close the corresponding selector valve at the manifold.

e. REMOVING TANKS FROM BOAT.

(1) Disconnect the wires to the dispensary dome light.

(2) Remove the bolts from the trunk cabin top gussets.

(3) Remove the molding from around the trunk cabin so as to raise the top.

(4) Remove the upper plywood sheet of the seat, and the fixtures on the face of the dispensary after bulkhead.

(5) Break tube connections and remove nuts from the hangers on top of the tank.

(6) Remove bolts holding the dispensary deck.

(7) Remove bolts through the bulkhead holding the end vertical stiffeners of the inboard tank wall to tilt it away from the tank.

(8) Remove the watertight door handles before attempting to lift the tank from the compartment.

(9) Lift the tank from the compartment.

CAUTION

Care should be taken not to puncture the tank while handling it. Complete collapse of the tank will tear the fiber carcass.

f. TROUBLE SHOOTING.—Refer to paragraph 4. this section.

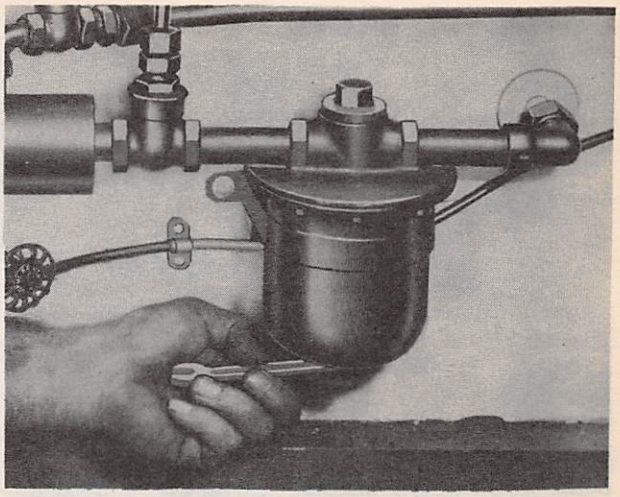


Figure 104—Removing Drain Plug from Fuel Strainer

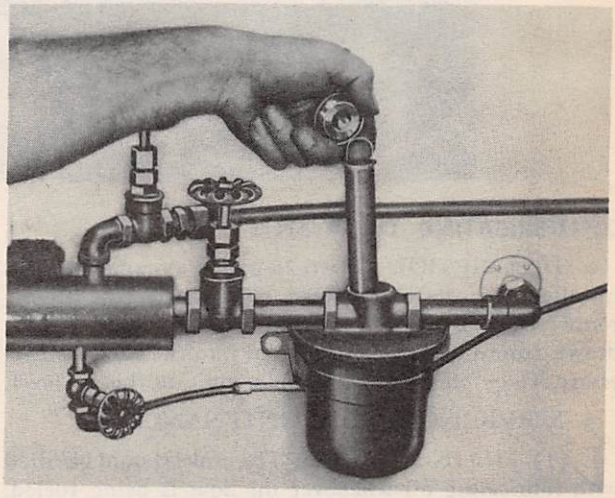


Figure 105—Removing Fuel Strainer Screen

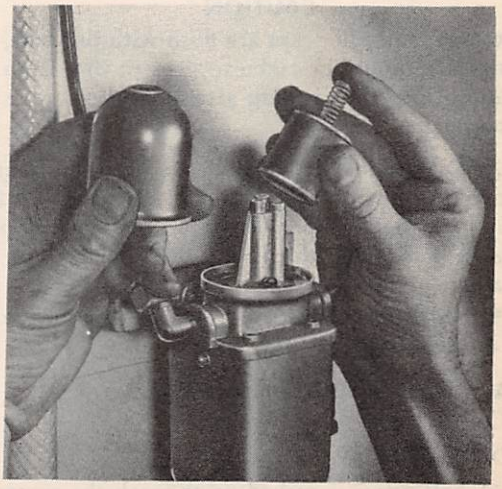


Figure 106—Removing Autopulse Strainer

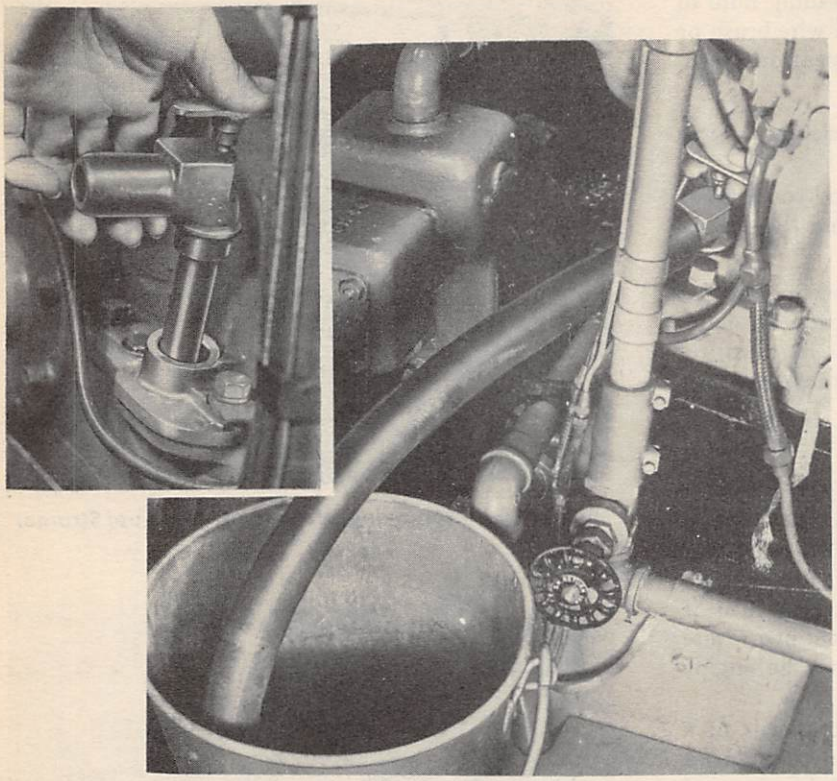


Figure 107—Scavenging Oil Pump and Draining Oil

2. LUBRICATING OIL SYSTEM.

a. DESCRIPTION.—Two 25-gallon storage tanks are installed against the forward bulkhead in the engine room. They are not connected to the engine. Oil is drawn from the tanks and poured into the sump as necessary. Gage glasses on the tanks indicate the oil level.

b. SERVICING AND MAINTENANCE.

(1) FILLING TANKS.—The tanks should be filled with lubricating oil whenever the boat is being fueled. Oil remaining in the storage tanks should be used to fill the sumps to the proper level before the storage tanks are filled.

CAUTION

Storage tank filler caps are flush with the deck, and care should be taken to prevent dirt from falling into the opening after the filler cap is removed.

(2) Oil should be changed after every 50 hours of operation, or more often if it is dirty. To drain oil from the sump, manually operate the scavenging oil pump *(figure 107)* to pump the oil out through the hose into a container.

(3) Oil filters should be replaced after every 100 hours of operation.

3. SALT WATER COOLING SYSTEM.

(See figure 108.)

a. DESCRIPTION.

(1) Salt water is picked up through the seacock in the hull and passes through a bucket type strainer to the engine water pump. Each engine is equipped with two water pumps, one attached to each side of the upper case.

(2) The water on leaving the pump passes through the oil cooler, from which part of it enters the exhaust manifold and the remainder goes into the cylinder blocks. Water passes up into the cylinder heads through indexing holes drilled in the head and manifold and head and block. It crosses through the head into the intake manifold elbows, then into the intake manifold. Water is discharged overboard from the intake manifold through the exhaust stacks.

(3) A thermostat is mounted on the forward end of the intake manifold. It is in the "OPEN" position when the engine is cold, allowing the water to return to the suction side of the engine water pumps and recirculate, permitting quicker warm-up. A water bypass valve is provided in each return line.

b. OPERATION.

(1) Prior to starting the engines, the water bypass valves *(figure 108)* should be closed. If they are left open, air is liable to enter the system. When this occurs, the engine water pumps may not receive an adequate supply of water and be damaged by running dry.

(2) After the engines are started, the bypass valves may be opened to permit the engines to warm-up more quickly.

Note

The seacocks should be kept open at all times. Attempts to reduce the flow of cooling water

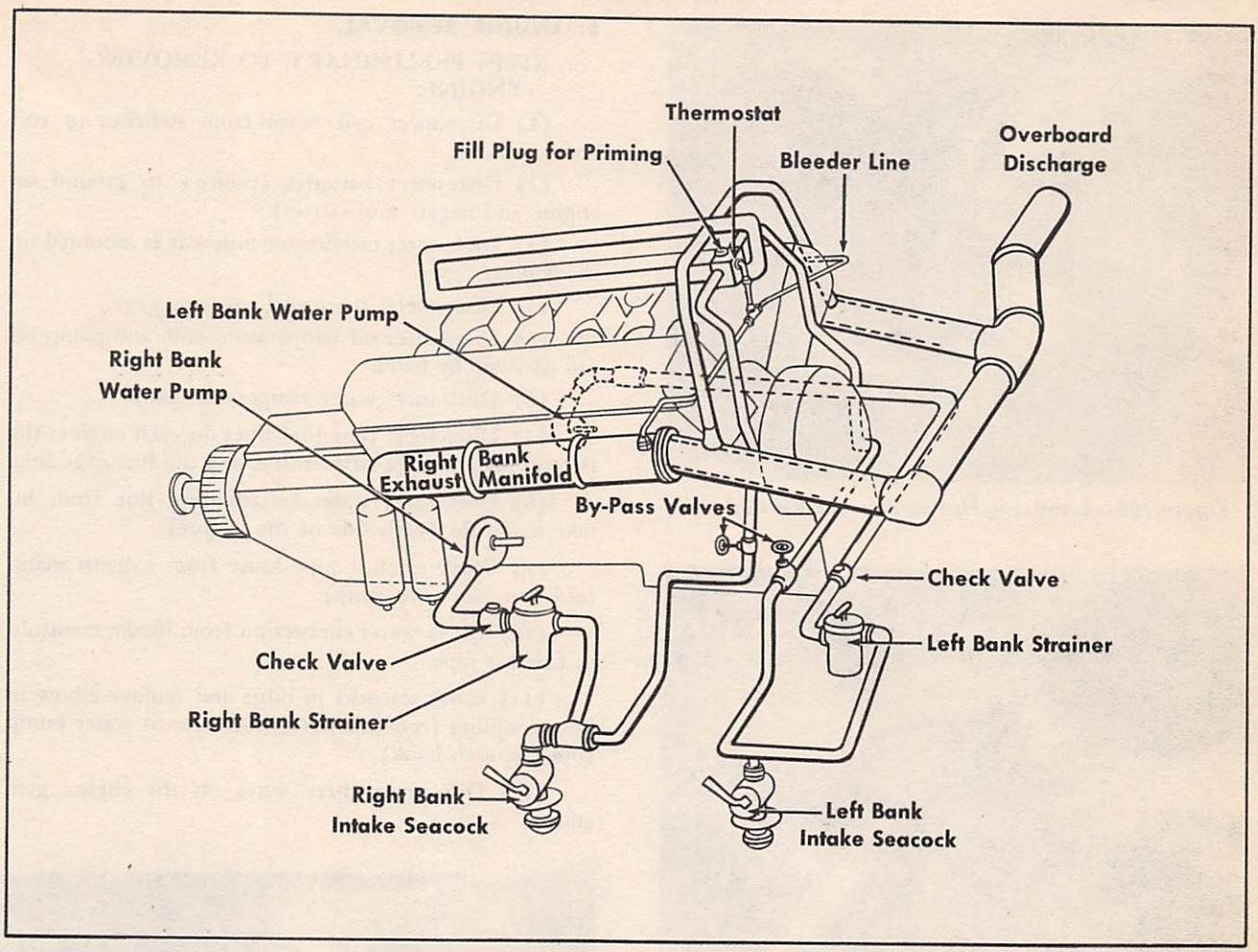


Figure 108—Cooling System for Port Engine

by partly closing the seacock may damage the water pumps, proper operation of which depends on an adequate supply of water.

c. SERVICING AND MAINTENANCE.

(1) SEACOCKS.—The seacock valve lever position may not indicate when the valve is open. To determine if the valve is open, disassemble the valve barrel as follows: Remove the nut on the valve barrel assembly *(figure 109)* and tap the valve barrel out far enough to observe the position of the opening. *(See figure 110.)* Replace the valve barrel and tighten nut, while keeping valve in "OPEN" position. Then mark the valve barrel with a chisel or punch to indicate the position of the barrel when the valve is fully opened. *(See figure 111.)*

(2) STRAINERS.—Inspect the sea water strainers and clean when necessary, before each trip or every week while the boat is docked. *(See figure 112.)*

(3) WATER PUMPS.—Turn grease cups on water pumps before starting and every 2 hours of engine operation.

4. TROUBLE SHOOTING.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
DIRT IN FUEL	Damaged screen in fuel strainer.	Replace.
VENTS OBSTRUCTED	Frozen spray or vapor.	Thaw out.
STRONG ODOR OF GASOLINE IN BOAT	Leak in fuel tank. Leak in fuel lines.	Locate and repair. Locate and repair.
EXHAUST MANIFOLD OVERHEATS	Seacock not open. Clogged screen. Water pump worn.	Open seacock. Refer to paragraph 3.,*c.*,(1), this section. Clean. Replace.

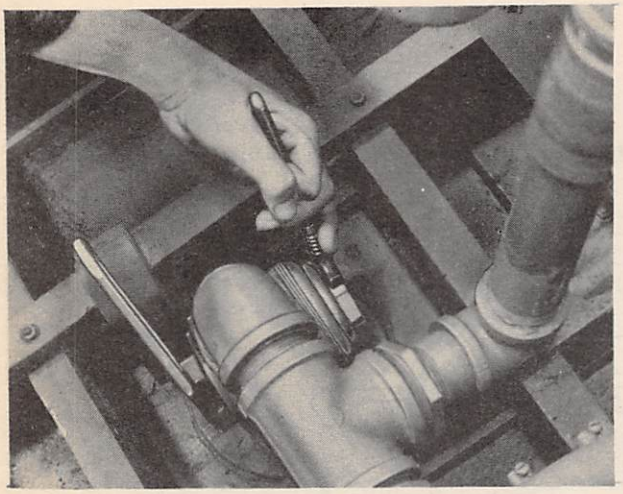


Figure 109—Removing Nut on Seacock Valve Barrel

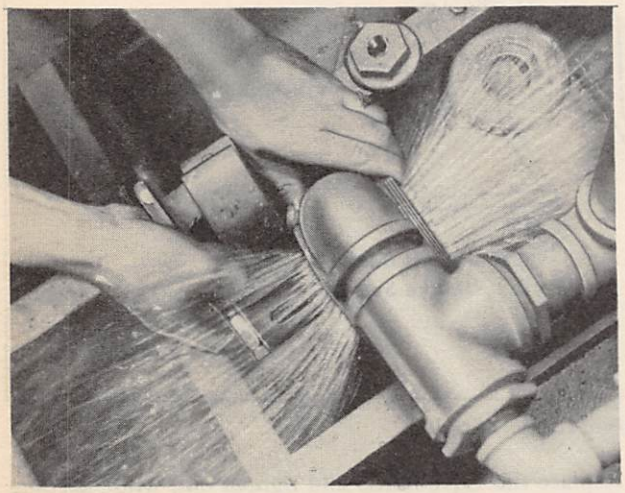


Figure 110—Pulling Out Valve Barrel Assembly to Observe Position of Opening

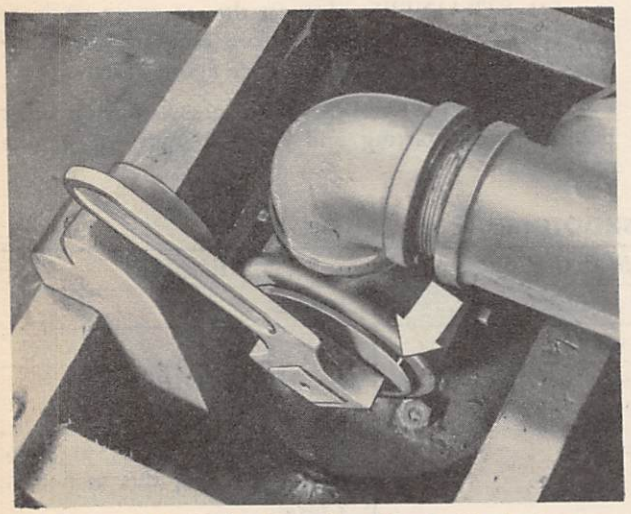


Figure 111—Valve Barrel and Body Marked to Indicate "OPEN" Position

5. ENGINE REMOVAL.

a. STEPS PRELIMINARY TO REMOVING ENGINE.

(1) Disconnect coil wires from switches to coil boxes.

(2) Disconnect batteries (positive to ground on engine and negative to starter).

(3) Disconnect tachometer unless it is mounted on the engine.

(4) Disconnect line to oil pressure gage.

(5) Disconnect oil temperature bulb and pump oil out of sump by hand.

(6) Disconnect water temperature bulb.

(7) Disconnect four fuel lines on each engine: the two supply lines, the primer line, and the fuel gage line.

(8) Disconnect water recirculating line from intake manifold (each side of the engine).

(9) Break exhaust pipe loose from exhaust manifold (one for each bank).

(10) Break water connection from intake manifold to exhaust pipe.

(11) Close seacocks in bilge and remove elbow in hose coupling from sea water inlet line to water pump (one for each bank).

(12) Disconnect three wires on the engine generator.

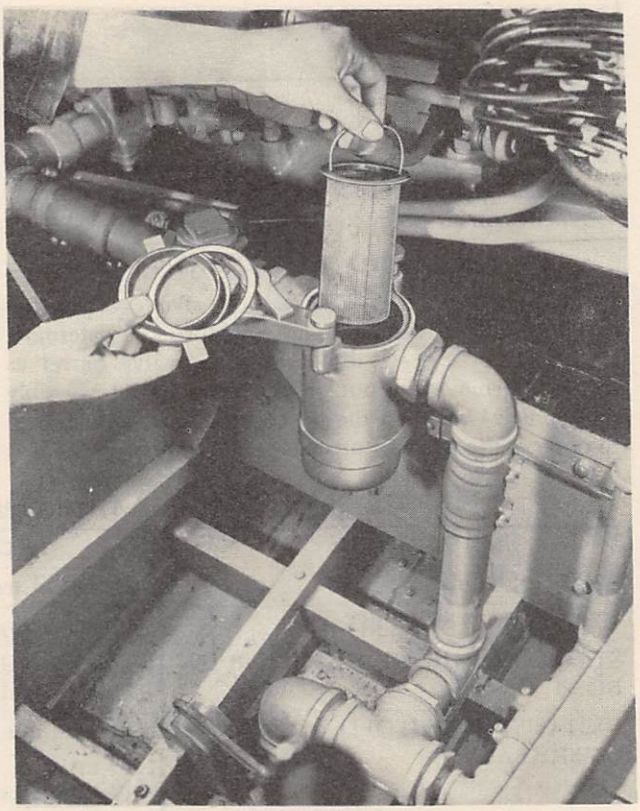


Figure 112—Sea Water Strainers

(13) Take engine telegraph switch off reverse gear shaft.

(14) Disconnect hydraulic throttle line at receiver and plug it.

(15) Disconnect pressure and suction line from engine-driven bilge pump on starboard engine.

(16) Remove both manual and automatic gear shift levers.

(17) Remove bolts from shaft coupling.

(18) Separate the engine flange from the propeller shaft flange by using drifts. *(See figure 113.)*

Note

The faces of the flanges are machined for an accurate fit. Hence under no circumstances should a wedge be used to separate them.

(19) Disconnect overspeed cut-out.

(20) Remove engine bed bolts.

(21) Remove speaking tube brackets and speaking tube.

(22) Remove 1¼-inch batten strip over edges of hatch *(figure 114)* and take out the hatch bolts.

(23) Remove the two forward engine room blowers.

(24) Remove hatch over the engine room.

(25) Make a final check to see that all lines and connections have been disconnected.

b. REMOVAL OF ENGINE.

(1) Loop the sling around the reverse gear drive shaft. *(See figure 115.)*

(2) Place wooden block between sling and reverse gear housing.

CAUTION

Be sure to block the sling away from any pipes or delicate parts to prevent breaking or damaging them.

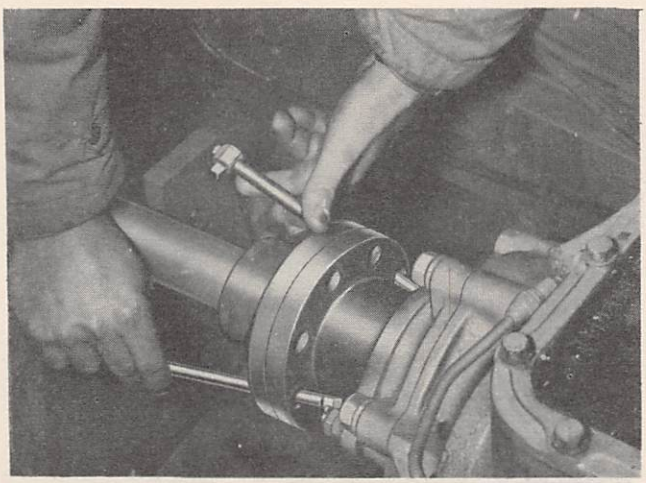


Figure 113—Loosening Shaft Flange from Engine Drive Flange

(3) Attach a sling to the two lifting eyes at the forward end of the cylinder head. *(See figure 116.)*

(4) Lift engine out. *(See figure 117.)*

c. LIFTING ENGINE IN.—The engine should be lifted-in in the same manner as it is removed. Attach the sling to the two lifting eyes at the forward end of the cylinder head and loop it around the reverse gear drive shaft at the rear.

d. LINING-UP THE ENGINE.—Lining-up the en-

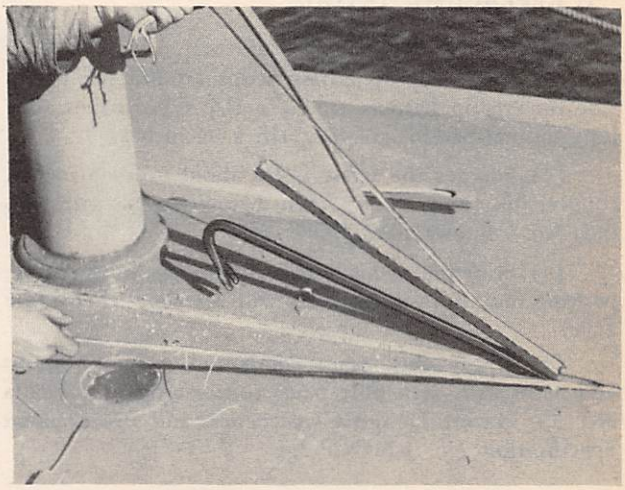


Figure 114—Removing Hatch Batten Strip

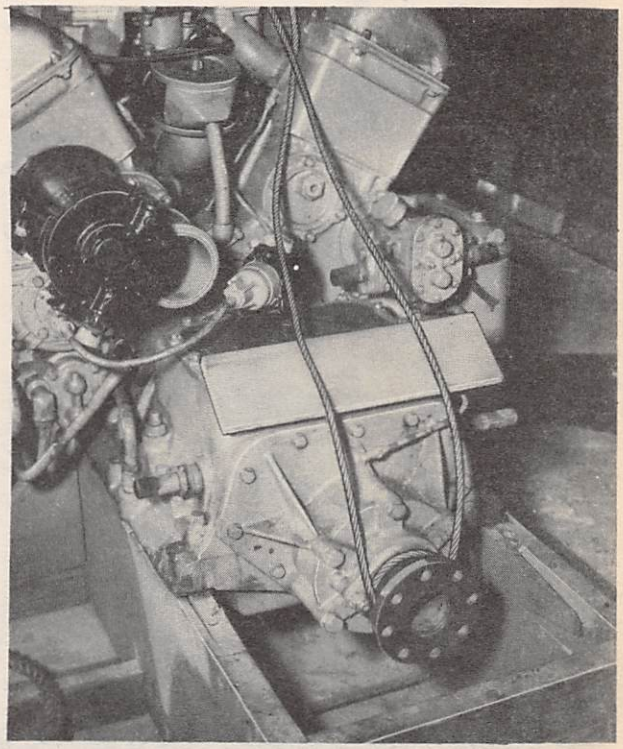


Figure 115—Looping Sling Around Reverse Gear Drive Shaft

gine with the propeller shaft must be done while the vessel is afloat. The adjustment should be checked when the vessel is fully loaded and again after the shake-down cruise at which time the alignment should be:

(1) The pilot ring which centers the flanges can be manipulated into engagement manually without using force.

(2) When the flanges are lightly touching each other, it should be impossible to insert a .005-inch feeler between them.

e. REPLACING HATCH.

(1) Put the hatch in place.

(2) Insert cypress batten strips around the hatch. The thwartship battens are ¾ x 1¼ x 92 inches. The longitudinal battens are ¾ x 1¼ x 94 inches.

(3) Stagger the screw holes about every 3 inches, countersink, and screw down batten strips with 1½ inch No. 9 screws. *(See figure 118.)*

(4) Stuff the seams with strips of caulking cotton, packing the cotton in carefully with a wedge. *(See figure 119.)*

(5) Apply deck seam compound over the seams and paint with deck blue paint conforming to Formula No. 5S, Marine Design Construction and Procurement Specification No. 1-MDCP-2.

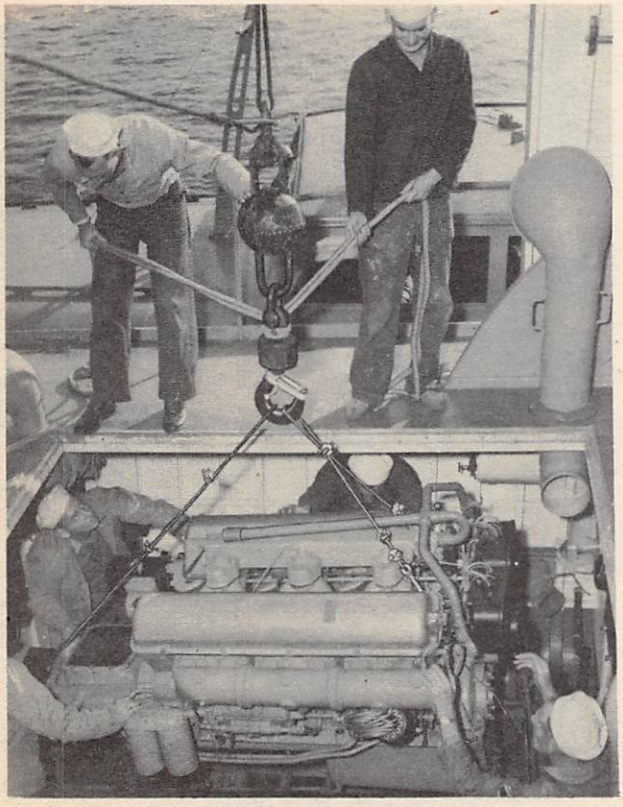


Figure 116—Sling Attached to Lifting Eyes

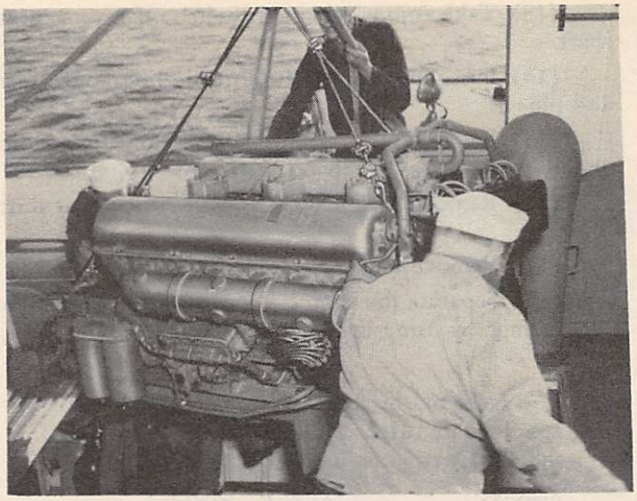


Figure 117—Hoisting Engine

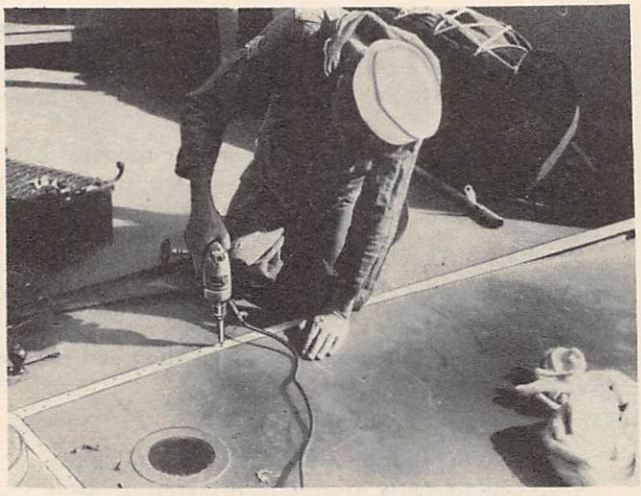


Figure 118—Replacing Batten Strips Around Hatch



Figure 119—Filling Batten Strip Seams

SECTION IX

Auxiliary Generator and Fire Pump Engine

1. DESCRIPTION.

a. GENERAL.—The engine which operates the auxiliary generator and the fire pump is a Kermath Sea Chief, located under the cockpit deck. Access to the engine is made by removing the cockpit deck hatches. *(See figure 120.)* The control panel is mounted either on the starboard side of the cockpit or on the starboard side of the engine room after bulkhead. *(See figure 121.)* The generator is mounted on one end of the engine and the fire pump is mounted on the other.

b. SPECIFICATIONS.

Type	L-Head
Number of cylinders	4
Bore	3 1/8 inches
Stroke	4 3/8 inches
Piston displacement	134.2 cu inches
Compression ratio	6.48 to 1
Horsepower max brake	38 at 2600 rpm
Compression	111 psi at 185 rpm
Maximum torque	82 ft-lbs at 1500 rpm
Firing order	1-3-4-2

c. INSTALLATION.

(1) Fuel for the engine is supplied by a fuel line which taps off the main fuel manifold in the engine room. This line is controlled by a valve near the manifold.

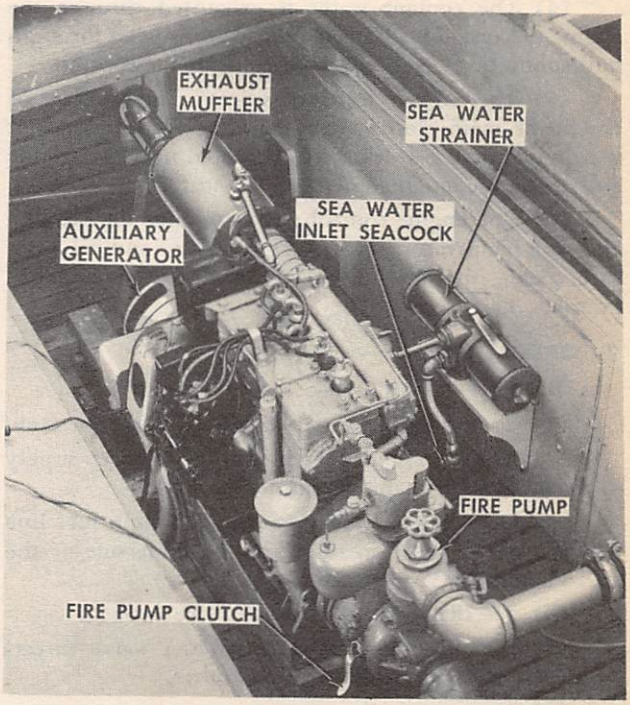


Figure 120—Auxiliary Generator and Fire Pump Installation

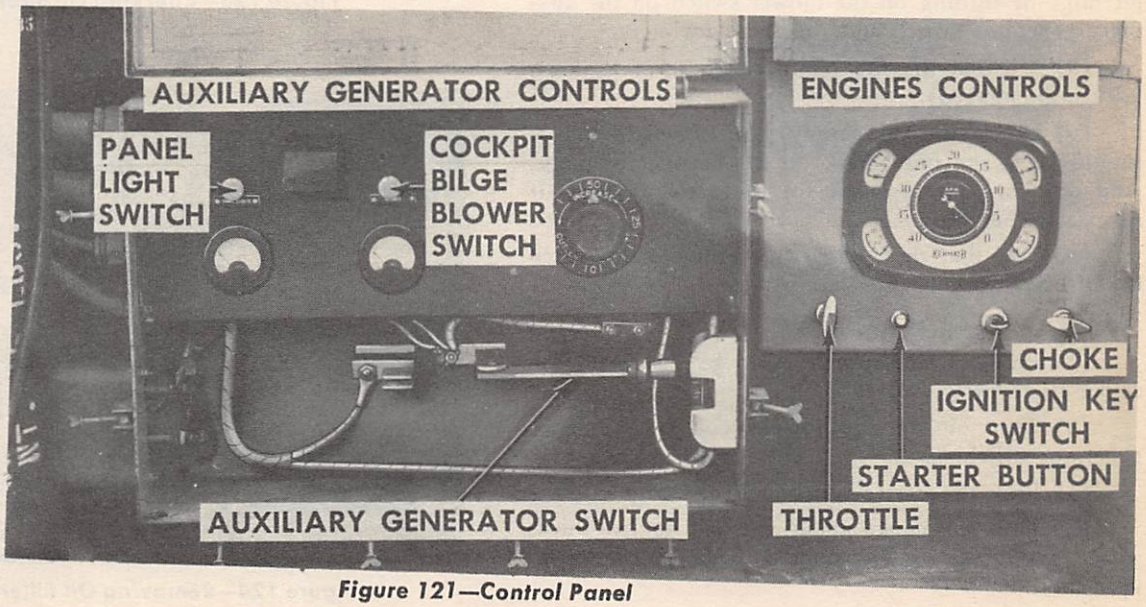


Figure 121—Control Panel

(2) The engine uses the same oil as the main engines. The engine has a filler cap and a bayonet type oil gage.

(3) The cooling salt water is pumped through the engine by a water pump mounted on the engine. The water is drawn up through a strainer and seacock below the engine. A dual strainer assembly allows water to be strained through either of two strainers. A valve controls the flow of water through the strainers so that one can be removed and cleaned while the other is being used.

(4) The coolant water is exhausted through the engine exhaust. This leads overboard through a through-hull connection on the starboard side of the cockpit.

(5) The engine electrical system is independent of the boat's main electrical system. The electrical power is supplied by a 6-volt battery mounted near the engine and an engine-mounted 6-volt generator.

(6) The engine control panel contains the tachometer, oil temperature, water temperature, and oil pressure gages, the ignition key switch, and the starter button.

2. OPERATION.

a. BEFORE STARTING.

(1) Turn on a fuel tank valve for at least one tank.

(2) Turn on the corresponding selector supply valve on the fuel tank manifold.

(3) Open the auxiliary generator engine fuel line supply valve located on the starboard underside of the fuel manifold. *(See figure 122.)*

(4) See that the water intake valve is open.

(5) See that the sea water strainer valve directs water through one strainer or the other.

(6) Turn down the grease cups on the sea water pump one full turn.

(7) If any gas fumes are present, air out the cockpit bilge by turning on the blower switch on the auxiliary generator switch and rheostat panel.

(8) See that the fire pump clutch lever is down (clutch disengaged).

(9) Check the oil supply. *(See figure 123.)* It should be at the high mark on the bayonet oil gage. Add oil—the same as used for the main engines—if necessary. *(See figure 124.)*

(10) See that the auxiliary generator main switch is "OPEN."

b. STARTING.

(1) Pull out the throttle 3/8 to 1/2 inch. Pull the choke all the way out.

(2) Turn on the ignition key on the auxiliary generator switchboard.

(3) Press the starter button until the engine starts.

(4) Push the choke about one-half to two-thirds of the way in for a few seconds until the engine warms up.

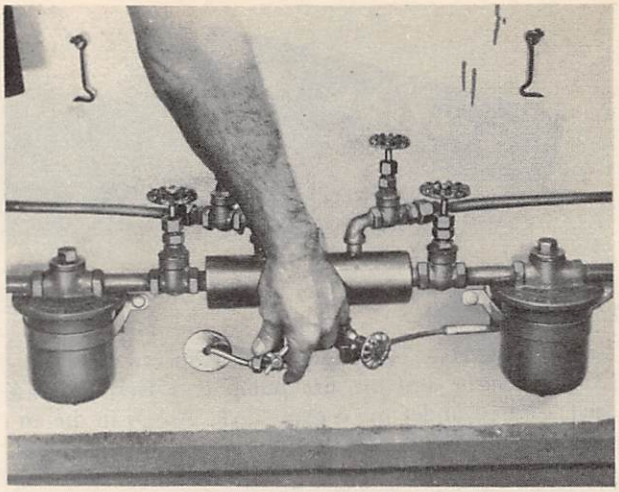


Figure 122—Opening Auxiliary Generator Engine Fuel Supply Valve

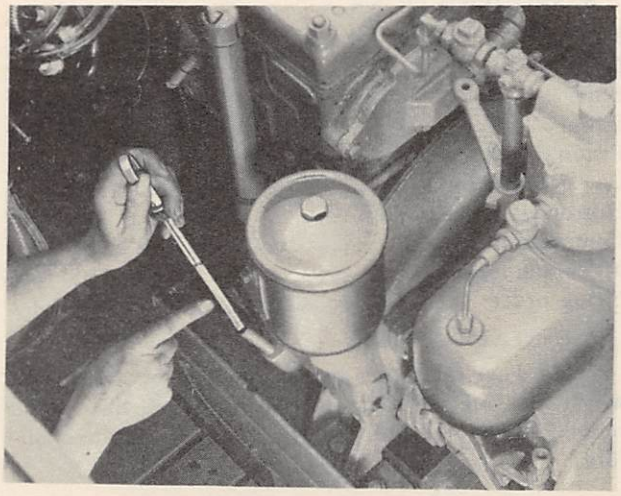


Figure 123—Checking Oil Supply

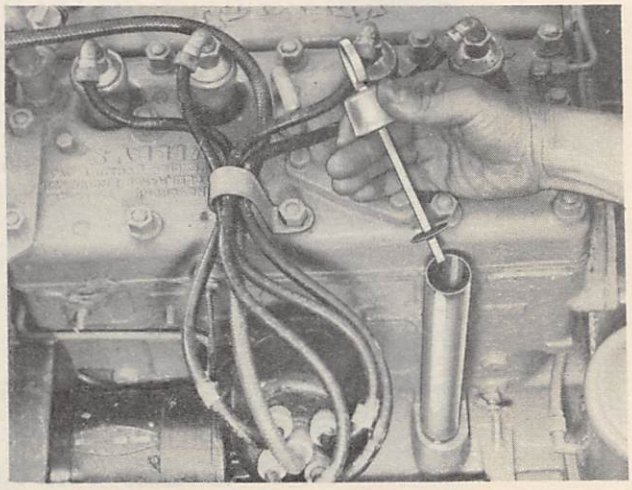


Figure 124—Removing Oil Filler Cap

(5) Immediately after the engine starts, check that oil pressure registers on the gage.

(6) See that the water pump has primed and that water is coming out the exhaust.

c. RUNNING.

(1) When engine is warm and running smoothly, push the choke all the way in.

(2) When the engine is operating normally, the panel instruments will read as follows:

(a) Oil temperature: 150°F.

(b) Charging current: 15 amperes.

(c) Oil pressure: 20 psi, minimum.

(d) Water temperature: 150° to 170°F.

(3) Regulate the rpm with the throttle all the way out. The governor will hold the engine at 2250 rpm.

(4) Watch the water strainer while the engine is running. If it becomes clogged so that the water cannot flow through freely, turn the valve to the other strainer. The dirty strainer can be cleaned while the engine is running, as long as the water is flowing through the other strainer. Remove the wing nut on the end of the strainer and pull off the strainer cover and the strainer to clean it. *(See figure 125.)*

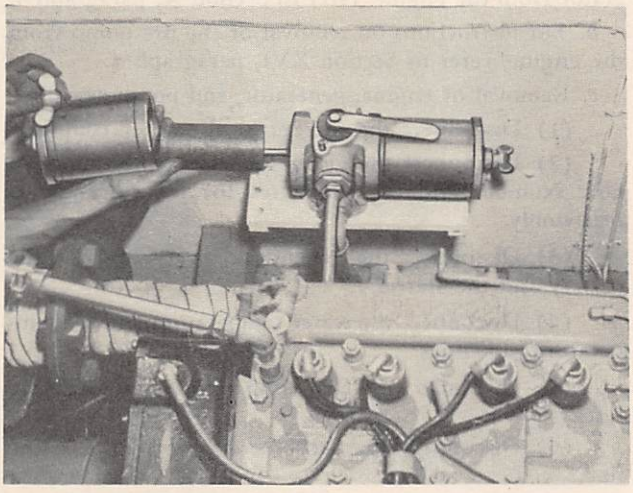


Figure 125—Removing Water Strainer

d. STOPPING.

(1) Slow down the engine to 800 to 900 rpm.

(2) Turn "OFF" the ignition key.

(3) Turn "OFF" the fuel supply valves.

(4) Cover the engine with a tarpaulin when it is not in use.

3. SERVICE, INSPECTION, MAINTENANCE AND LUBRICATION.

a. OIL FILTER.

(1) The inlet line to the filter is connected to the oil distribution line by a tee on the port side of the engine. The outlet or oil return line to the engine is through a hole in the center stud of the oil filter discharging into the timing chain cover.

(2) When the oil on the level indicator becomes dark, remove the oil filter cover; remove the drain plug and drain out the sludge. Replace the drain plug. Replace the element. Install a new cover gasket; reinstall cover, start the engine and check for leaks; then check the oil level and add to the oil supply if necessary.

b. ENGINE GENERATOR (100-HOUR INSPECTION).

(1) Remove the cover band.

(2) Inspect the commutator. If the commutator is dirty or discolored it can be cleaned by holding a piece of 00 sandpaper against it while turning the armature slowly. Blow the sand out of the generator after cleaning the commutator. If the commutator is rough or worn, the generator should be removed from the engine and completely overhauled.

(3) Inspect the brushes and brush holders. The brushes should slide freely in their holders. If the brushes are oil-soaked or if they are worn to less than one-half of their original length, replace the brushes.

(4) Add three to five drops of medium engine oil to the oiler in the drive end head and fill the commutator end oil pocket to the combination oiler and overflow hole in the commutator end cover.

(5) Inspect all wiring from the generator to the cut-out relay, from the cut-out to the battery and from the battery to the ground for worn or frayed insulation, broken wires, and for loose or corroded connections. Repair or replace any defective wiring.

(6) Run the generator at about 50 percent of its maximum output and measure the voltage drop from the cut-out relay terminal to the battery terminal. This drop should not be more than a .1 volt at a 10-ampere charging rate or .05 volt at a 5-ampere charging rate. There should be no voltmeter reading when the drop is measured from the generator frame to the battery ground post. If larger readings are obtained, the high resistance should be eliminated.

(7) Run the generator at near maximum output and note the commutator action. If there is excessive arcing between the brushes and commutator, remove the generator for overhaul.

(8) Replace the generator cover band.

c. STARTING MOTOR (100-HOUR INSPECTION).

(1) Remove the cover band.

(2) If the commutator is dirty it can be cleaned by holding a piece of 00 sandpaper against it while turning the armature slowly. Blow the sand out of the motor after cleaning. If the commutator is rough or worn the motor should be removed for a complete overhaul.

(3) The brushes should slide freely in their holders and should not be oil soaked. If the brushes are oil soaked or are worn to less than one-half of their original length they should be replaced.

(4) The oiler in the commutator end cap should

be given three to five drops of medium engine oil every 100 hours.

(5) Check the wiring for broken wires, frayed insulation, and corroded connections. Particular attention should be paid to the ground connections.

(6) Check the voltage drop across the starting switch to see that it does not exceed .4 volt per 100 amperes. Close the switch electrically without pressing the emergency button under the dust cap.

(7) Replace the cover band.

d. CARBURETOR ADJUSTMENT.

(1) GENERAL.—If the engine, after running satisfactorily, suddenly ceases to perform properly, look over the intake manifold and carburetor flange gaskets, throttle, choke, and fuel connections. Make sure that throttle and choke valves open and close correctly and that fuel enters the carburetor in a free and steady stream. Do not change carburetor adjustments until other causes of trouble have been investigated. Changes in adjustment should be necessary only with changes in fuel or climate. Before making any adjustments, warm up the engine thoroughly so that the intake manifold feels warm to the hand.

(2) STANDARD SETTING.

(a) Throttle stop screw 1½ turns (to right) from fully closed position of throttle plate.

(b) Idling needle valve one turn open (to left) from seat.

(c) Main jet adjustment 2½ turns open (to left) from seat.

(3) IDLE AND LOW SPEED ADJUSTMENT.

(a) Close the throttle slowly until desired idling speed is reached.

(b) Turn idling needle valve gradually to right and left until the engine runs steady and as fast as this throttle position will permit. Turning the idling needle to right (in) makes the mixture richer, to left (out) leaner.

(c) If a satisfactory adjustment cannot be obtained, examine the idling jet and the idle discharge plug to make sure that dirt or water does not obstruct the free flow of the mixture through these parts.

(d) After completing the adjustments set throttle stop screw for desired idling speed.

(4) INTERMEDIATE AND HIGH SPEED ADJUSTMENT.—The mixture at intermediate and high speed is controlled by the main jet and the well vent. The main jet may be either of fixed size or adjustable. Whether fixed or adjustable, remove main jet and blow out with compressed air or rinse in clean gasoline to remove water or dirt which may obstruct the metering orifice. If adjustable, adjustment should be made as follows:

(a) Open throttle about one-third.

(b) Loosen packing nut on main jet adjustment.

(c) Turn main jet adjustment to right (in) until the engine speed is noticeably reduced.

(d) Turn main jet adjustment slowly to left (out) until the engine runs smoothly and as fast as this throttle position will permit.

(e) Hold the needle valve in position and tighten packing nut after completing the adjustment. Compensation is controlled by the well vent. A richer mixture, at high speeds, is obtained with a smaller well vent and a leaner mixture with a larger well vent. If the mixture suddenly becomes too rich at high speeds, examine the well vent and make sure that it is not obstructed. Inspect these jets for water and dirt.

4. REMOVAL.

a. For instructions on removal of the auxiliary generator from the engine, refer to Section X, paragraph 4.

b. For instructions on removal of the fire pump from the engine, refer to Section XVI, paragraph 4.

c. Removal of engine, generator, and pump assembly.

(1) Disconnect the muffler at the outer coupling.

(2) Disconnect the generator wires at the junction box. Number and tag the wires for identification at reassembly.

(3) Disconnect the generator battery leads at the battery and the starter.

(4) Disconnect the water temperature and oil temperature gage lines.

(5) Disconnect the fire pump suction and discharge lines.

(6) Disconnect the tachometer line and gasoline line.

(7) Disconnect the throttle and choke links.

(8) Disconnect the sea water suction line.

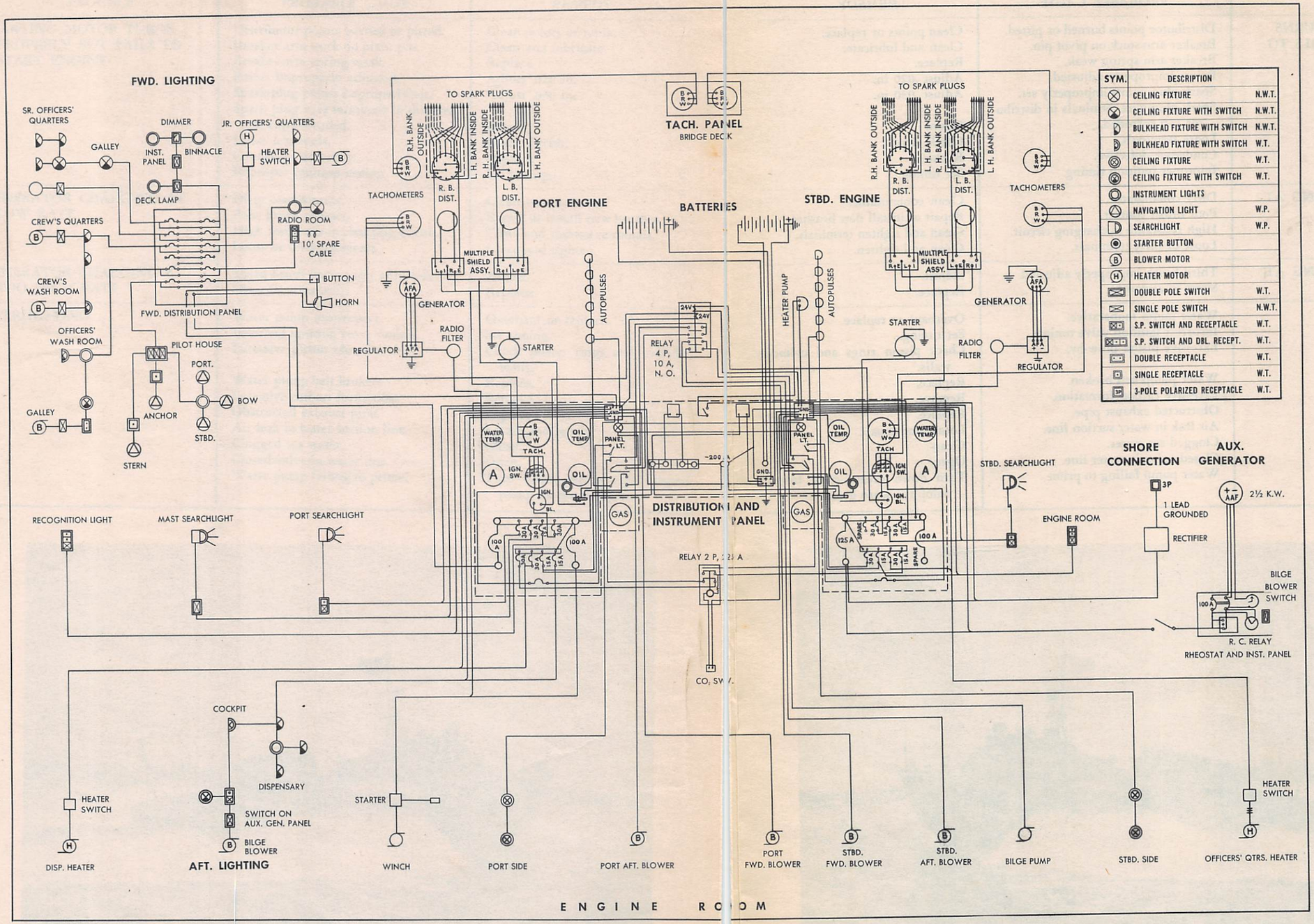
(9) Disconnect the oil pressure gage line.

(10) Remove the four bolts on either side of the engine holding the frame to the engine bed.

(11) Fasten a hoist to the lifting ring in the cylinder head and lift the engine from the boat.

5. TROUBLE SHOOTING.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
STARTING MOTOR TURNS TOO SLOWLY	Discharged battery or shorted cell.	Recharge or repair.
	Loose or dirty terminals.	Clean and tighten.
	Dirty commutator.	Clean with No. 00 sandpaper.
	Poor brush contact.	Repair or install new brushes.
	Worn bearings.	Replace.
	Burned starter switch contacts.	Replace switch.



SYM.	DESCRIPTION	
⊗	CEILING FIXTURE	N.W.T.
⊗	CEILING FIXTURE WITH SWITCH	N.W.T.
◗	BULKHEAD FIXTURE WITH SWITCH	N.W.T.
◗	BULKHEAD FIXTURE WITH SWITCH	W.T.
⊗	CEILING FIXTURE	W.T.
⊗	CEILING FIXTURE WITH SWITCH	W.T.
◯	INSTRUMENT LIGHTS	
△	NAVIGATION LIGHT	W.P.
◗	SEARCHLIGHT	W.P.
◉	STARTER BUTTON	
B	BLOWER MOTOR	
H	HEATER MOTOR	
⊠	DOUBLE POLE SWITCH	W.T.
⊠	SINGLE POLE SWITCH	N.W.T.
⊠	S.P. SWITCH AND RECEPTACLE	W.T.
⊠	S.P. SWITCH AND DBL. RECEPT.	W.T.
⊡	DOUBLE RECEPTACLE	W.T.
⊡	SINGLE RECEPTACLE	W.T.
⊡	3-POLE POLARIZED RECEPTACLE	W.T.

Figure 126—Electrical System Schematic Wiring Diagram

SECTION X

Electrical System

1. DESCRIPTION.

a. GENERAL.

(1) The electrical system of the 63-foot boat is 24-volt dc. It is a two-wire system employing a grounded positive; i.e., the positive side of each circuit is connected to a ground.

(2) There are four sources of electrical power: two 750-watt engine generators, an auxiliary generator, and a rectifying shore connection.

(3) The batteries and generators are parallel so that any of the generators or the rectifier can be used in connection with the batteries at any time without changing or operating any transfer switches.

(4) The system is wired according to the wiring diagram. *(See figure 126.)*

b. BATTERIES.—Two banks of batteries are located in the engine room, outboard of the engines. Each bank is composed of either two 12-volt, 200 ampere-hour batteries connected in series, or four 6-volt, 175 ampere-hour batteries connected in series. The 24-volt terminal of each bank is connected to the main disconnect switch at the switchboard.

c. SWITCHBOARD.—The main switchboard, mounted on the engine room forward bulkhead, *(figure 127)* contains the following:

(1) The main disconnect (single-pole single-throw) switch in the bottom center of the switchboard which energizes all electrical circuits.

(2) Two fuse panels which contain the master fuse in the battery line (150 amperes), the fuses for the engine room, after compartments, and exterior lighting circuits, and the main fuse for the forward distribution box. *(See figure 128.)*

(3) The battery voltmeter and ammeter, and switches for engine room and after compartment circuits such as blowers and lights.

(4) The engine switches and instruments, engine telegraph lights, and clutch control signal lights.

d. FORWARD DISTRIBUTION BOX. — The forward distribution box, located forward on the galley inboard bulkhead, contains the fuses for the electrical circuits of the forward compartments. *(See figure 129.)*

e. ENGINE GENERATORS.—A generator is mounted on and belt-driven by each main engine. These generators run at 1.7 times engine speed, cut in at 750 rpm, and have a maximum output of 24 amperes at 25 volts.

f. AUXILIARY GENERATOR.—A Kurz-Root 2½-kilowatt generator supplies auxiliary power through the switchboard to the batteries. This generator is 28 volts, 90 amperes, 2600 rpm, compound wound. It carries 100 percent of the load continuously with a 40°C temperature rise. The generator is driven by a Kermath Sea Chief engine, located under the cockpit deck. *(See figure 130.)* The auxiliary generator line is protected by fuses and is controlled by a knife switch. A rheostat regulates the generator output. The switch, fuses, and rheostat are located in a panel either on the engine room after bulkhead or on the starboard side of the cockpit. *(See figure 131.)* Operation and service instructions for the auxiliary generator engine are given in section IX.

g. SHORE CONNECTION.

(1) The shore connection receptacle for 110-volt ac is located on the port side of the bridge.

(2) A battery-charging rectifier for converting the 110-volt ac shore current to 24-volt dc is installed between the connection and the batteries. This is a General Electric Tungar 12-battery charger and is located in the pilot house. *(See figure 132.)*

(3) The battery charger has two charging circuits, each with a separate ammeter, rectifying tube, and 15-ampere fuse. Each circuit also has two separate control boards. One control board on each circuit is for coarse adjustment and one is for fine adjustment of the charging rate. One switch closes both circuits. The transformer is of the insulated type (double winding) with primary taps to compensate for differences in shore line voltages.

h. VOLTAGE AND CURRENT REGULATORS.

(1) A voltage and current regulator is installed in the line between each engine generator and the batteries. The regulator unit consists of a cut-out relay, a current regulator unit, and a voltage regulator unit mounted in the same housing.

(2) A Hartman Electric reverse current relay is mounted in the line between the auxiliary generator and the batteries.

2. OPERATION INSTRUCTIONS.

a. NORMAL OPERATION.

(1) Close the main disconnect switch to energize all electrical circuits. *(See figure 133.)*

(2) Close the switches to desired circuits.

(3) When the engines are running, the engine generators will be charging the batteries. DO NOT open

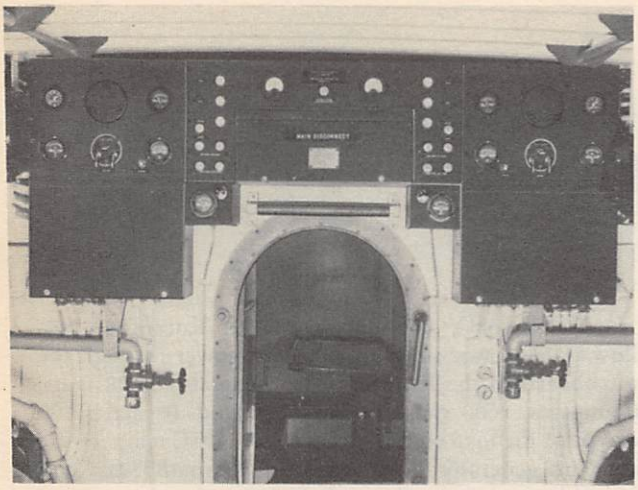


Figure 127—Main Switchboard

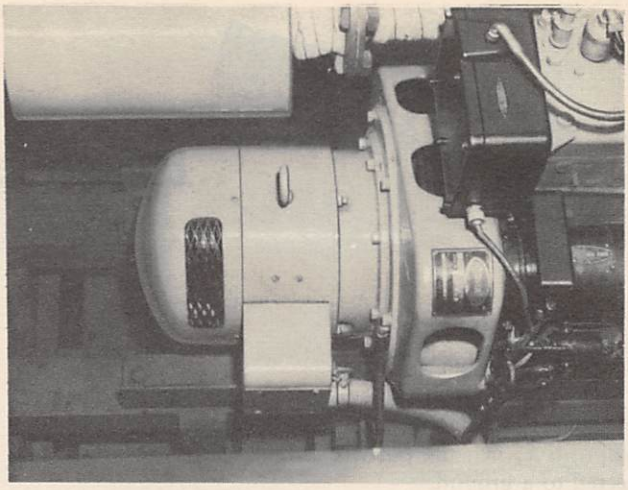


Figure 130—Auxiliary Generator

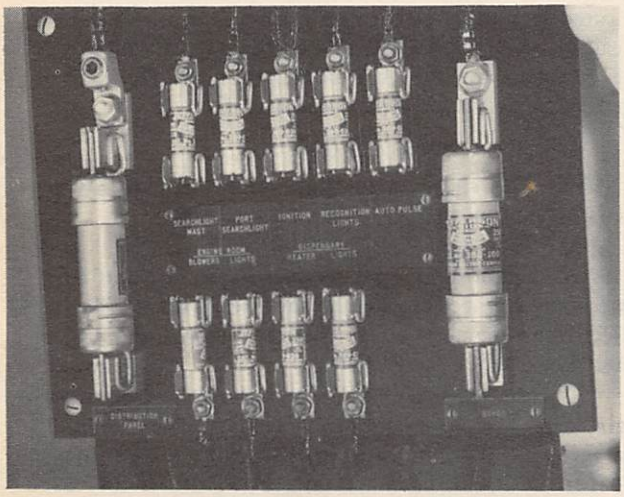


Figure 128—Switchboard Fuse Panel, Port

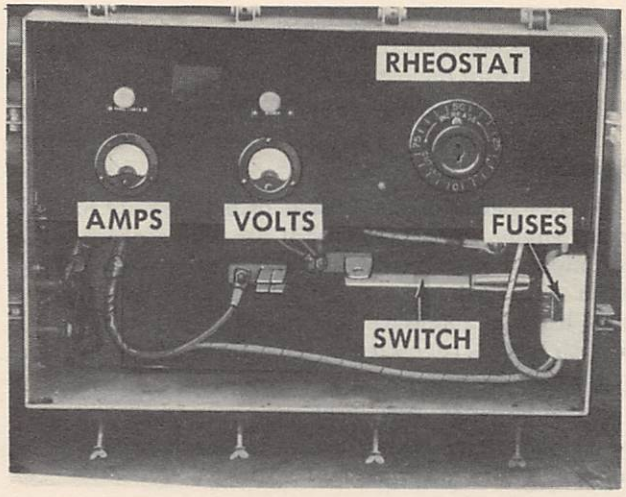


Figure 131—Auxiliary Generator Control Panel

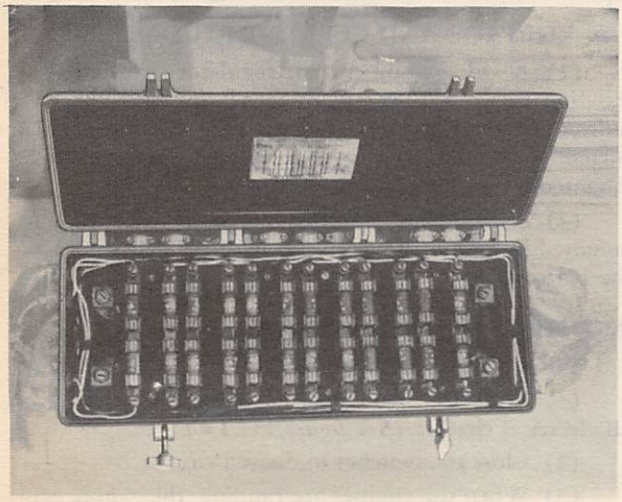


Figure 129—Forward Distribution Box

the main disconnect switch while the engines are running. While the electrical system will continue to operate from the generators, it will burn out the voltage regulators, distributor points, and condensers, and cause serious damage to the entire engine electrical system.

b. CHARGING BATTERIES WITH AUXILIARY GENERATOR.

Note

Since the gas driven off toward the end of a charge is an explosive mixture of hydrogen and oxygen, care must be exercised to have the engine room well ventilated during, and for some time after, the charging period.

(1) Start the auxiliary generator engine and run it at 2300 to 2600 rpm. (See Section IX.)

(2) With the main disconnect switch "OPEN," check the main switchboard battery voltmeter to see that it reads "ZERO." If it does not read zero, adjust it

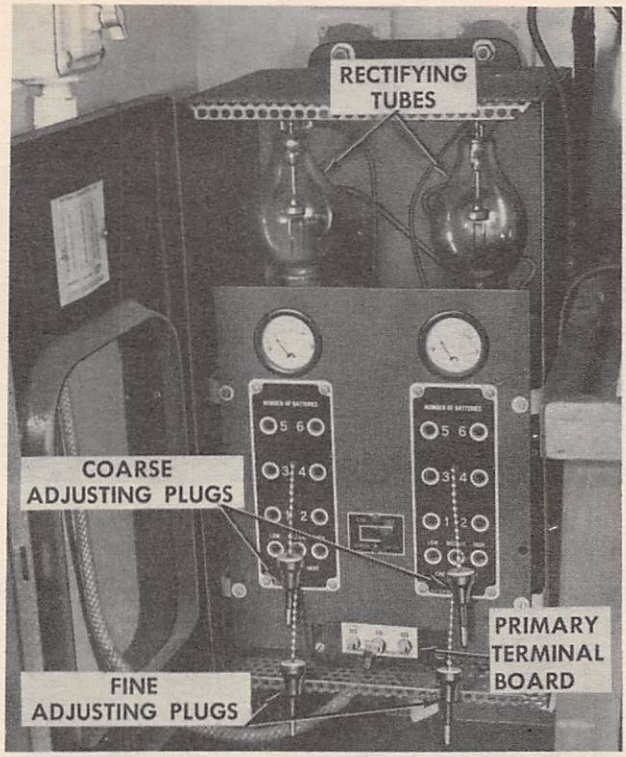


Figure 132—Battery-Charging Rectifier

with the regulating screw until it does give a zero reading. *(See figure 134.)*

(3) Close the main disconnect switch. Read the battery voltage on the battery voltmeter.

(4) Adjust the auxiliary generator output voltage by means of the rheostat and the auxiliary generator engine rpm until the auxiliary generator output voltmeter reads 2 or 3 volts higher than the battery voltmeter.

(5) "CLOSE" the generator switch.

(6) While charging the batteries, keep the generator output voltage 2 or 3 volts higher than the battery voltage.

Note

On boats not equipped with reverse current relays, generator voltage should not be allowed to drop below the battery voltage during charging. Should this occur, the batteries will motorize the generator and the generator polarity will be reversed. For data on how to correct reversed polarity refer to paragraph 3.*e.*(2), this section.

(7) The main switchboard ammeter should read from 30 to 50 amperes. The amperage will drop as the battery voltage increases.

(8) As battery voltage comes up, increase the generator output voltage so it is always 2 or 3 volts above the battery voltage until the batteries are charged. Charging rate should not exceed 50 amperes. During charging keep checking the specific gravity of the batteries with a hydrometer.

(9) When the batteries are fully charged "OPEN" the generator switch. On systems equipped with an auxiliary generator reverse current relay, slow down or stop the generator engine before opening the auxiliary genrator switch. If a reverse current relay is not provided, DO NOT slow down the engine until after opening the auxiliary generator switch.

c. CHARGING BATTERIES FROM SHORE CONNECTION.

(1) Close the main disconnect switch. Keep this switch closed all the time the shore connection is connected.

(2) Make sure the battery charger switch is in the "OFF" position.

(3) Connect a supply line to the shore connection. This line should be protected by 30-ampere fuses.

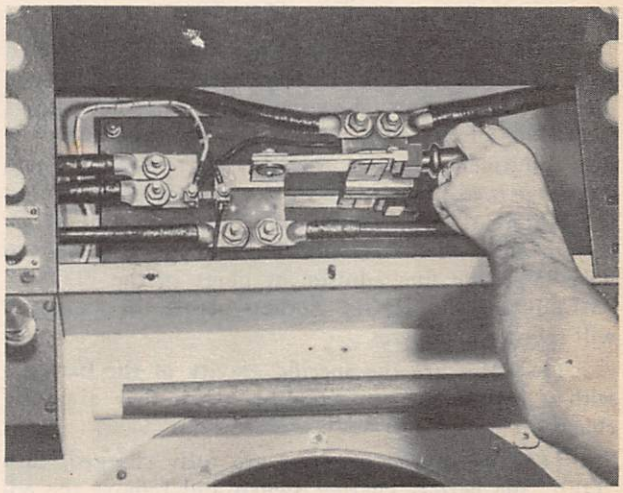


Figure 133—Closing Main Disconnect Switch

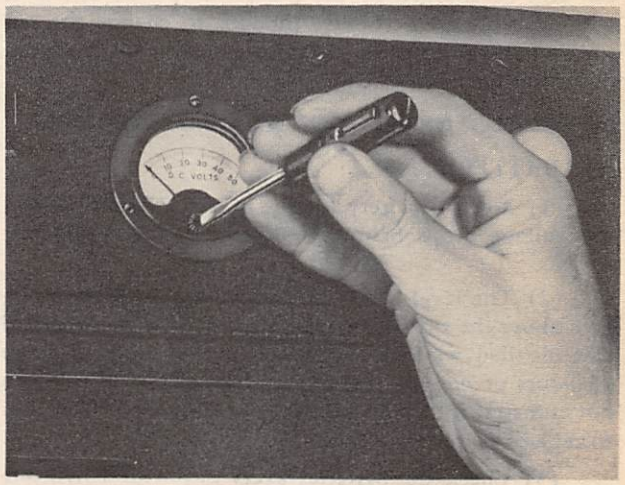


Figure 134—Adjusting Voltmeter

(4) The primary terminal board is used to adjust the battery charger to suit the voltage of the shore line. It is normally set for 115 volts. If the shore line is greater or less than 115 volts, change the primary terminal connection. Open the battery charger door and disconnect the wire from the primary terminal board at the bottom of the charger. The terminals are marked 105, 115, and 125 volts. Connect the wire to the terminal nearest the actual voltage of the shore line.

(5) Connect the shore line to the receptacle on the bridge. This is a push connection with a screw lock. *(See figure 135.)*

(6) Insert the coarse adjustment plugs in the No. 4 holes.

(7) Turn the battery charger switch "ON."

(8) Insert the fine adjustment plugs in the "LOW" sockets. The ammeters will register the charging rates. *(See figure 136.)*

(9) The battery charger should charge at 6 amperes. If the ammeters read less than 6 amperes, move the fine adjustment plugs to "MEDIUM." If the readings are still low, move them to "HIGH."

(10) If the ammeter readings are still less than 6 amperes, turn "OFF" the battery charger switch, remove the adjustment plugs, move the coarse adjustment plugs to the No. 5 holes, turn "ON" the switch, and insert the fine adjustment plugs in the "LOW" sockets. If more amperage is still needed, move the fine adjustment plugs to "MEDIUM" or "HIGH" as before. It may be necessary to move the coarse adjustment plugs to the No. 6 holes with the fine adjustment plugs in the "LOW," "MEDIUM," or "HIGH" sockets before the ammeters will register 6 amperes.

(11) Measure the specific gravity of the batteries with a hydrometer to determine when they are fully charged.

(12) When the batteries are fully charged, turn "OFF" the battery charger switch and remove the adjustment plugs. Disconnect the shore line connection.

(13) If one rectifying tube burns out, the batteries can still be charged by the other side of the board. It will probably be necessary, though, to change the settings of the adjustment plugs to maintain the charging current at 6 amperes.

3. SERVICE, INSPECTION, AND MAINTENANCE.

a. BATTERIES.

(1) Normal battery voltage is 26 to 28 volts. When the voltage drops below 23.5 volts, recharge the batteries.

(2) The level of the electrolyte should be $\frac{3}{8}$ to $\frac{5}{8}$ inch above the top of the separators. Check the level and add distilled water as necessary twice a week or every 10 hours of engine operation, whichever is oftener. In hot climates, it may be necessary to add water every day to replace evaporation loss.

(3) Check the batteries every day with a hydrometer. When fully charged, the specific gravity of the electrolyte should be between 1.225 and 1.250 at 80°F. The reading will be lower at higher temperatures, and higher at lower temperatures. In normal operation it is sufficient to check one or two pilot cells and use these to determine the state of charge of the entire battery.

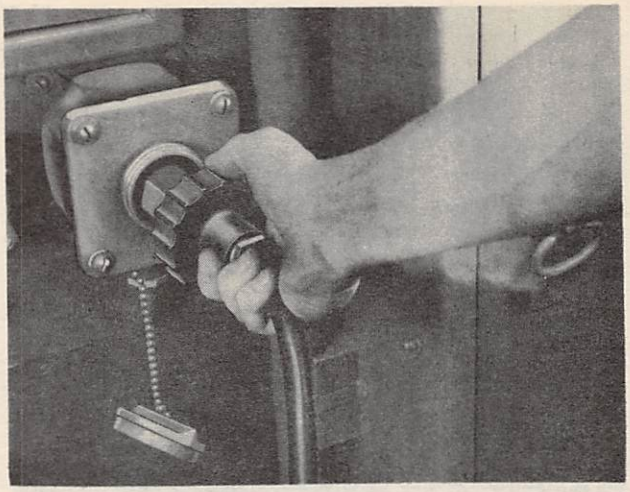


Figure 135—Connecting Shore Line

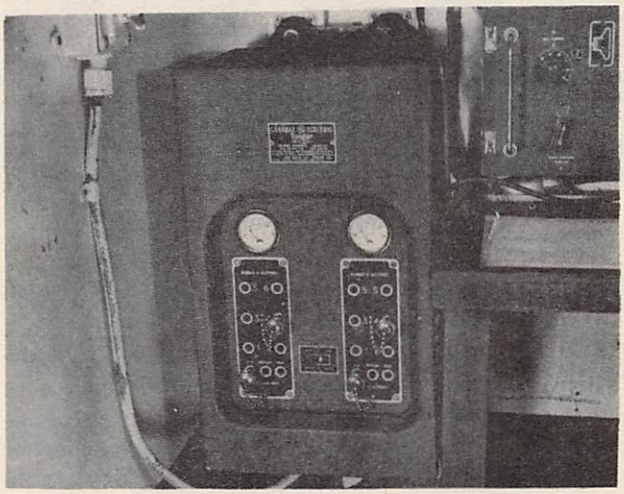


Figure 136—Battery Charger Set for Charging

Note

As a battery gets older, the "top gravity" point will gradually drop because of acid loss. When a battery is charged, the specific gravity will rise to a point beyond which it will not go. Though this point may not be up to the specific gravity of a new battery, if it holds steady for 3 hours of charging, it can be taken as the battery's "top gravity." Record it so that at the next charging the battery can be brought up to that point without trying to raise it beyond its "top gravity."

(4) HIGH-RATE DISCHARGE VOLTMETER TEST.—If the batteries are not maintaining their charge properly under ordinary conditions, charge them com-

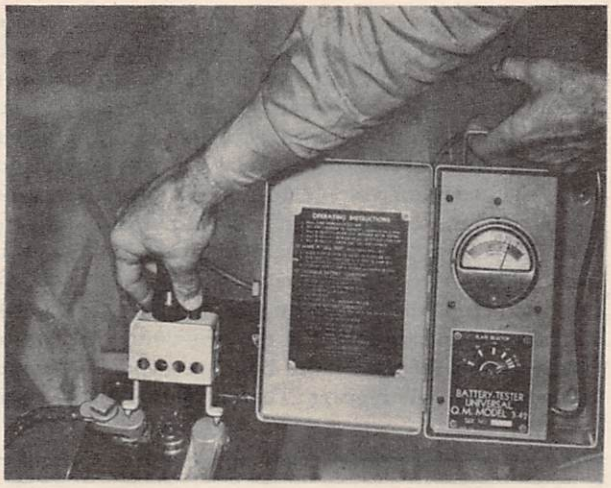


Figure 137—High Rate Discharge Voltmeter Test

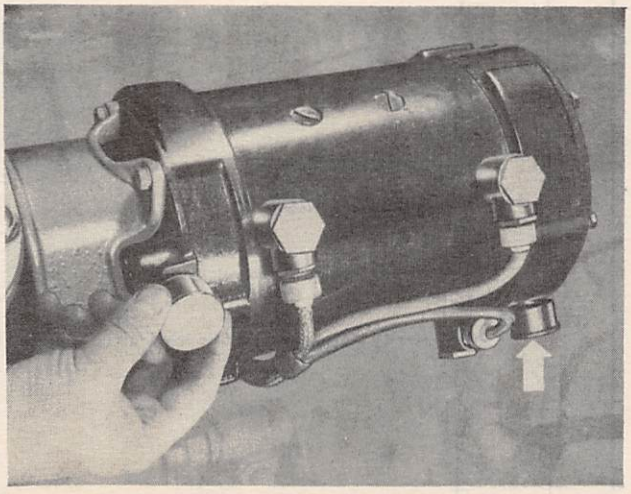


Figure 138—Turning Down Engine Generator Grease Cups

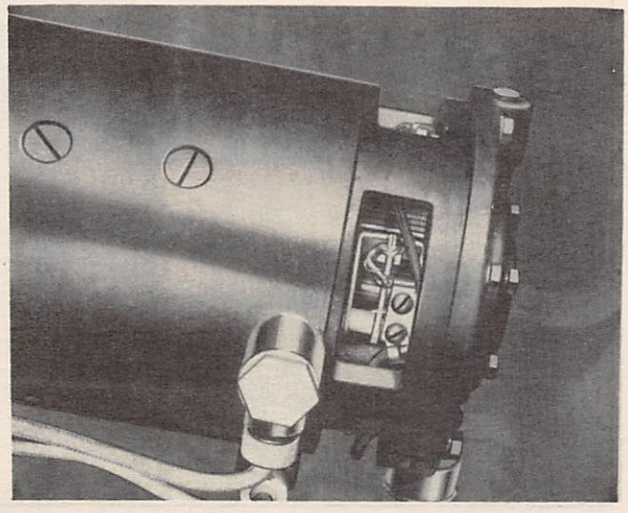


Figure 139—Access to Engine Generator Brushes and Commutator

pletely and make a high rate discharge voltmeter test. Connect a high rate discharge voltmeter across the terminals of each cell, one at a time, for 15 seconds each. *(See figure 137.)* If the voltage of any cell falls below 1.5 volts at 80°F or if there is a difference of more than 0.2 volt between cells the cell is in bad condition and the battery must be replaced. At temperatures below 80°F, the cell voltages will drop lower. If a high rate discharge voltmeter is not available, this test can be made with an ordinary low rate voltmeter while the starter motor supplies the load by cranking the engine with the ignition switch "OFF."

CAUTION

Do not operate the starter for more than 30 seconds at any one time.

(5) The only mechanical maintenance that should be necessary to the batteries is to keep the terminals and cable connections clean and tight. If for any reason electrolyte should be spilled, chemically pure sulphuric acid (oil of vitriol) should be diluted with distilled water and added until the specific gravity of the cell is the same value as before the acid was lost or until it is the same as adjoining cells.

b. ENGINE GENERATORS.

(1) LUBRICATION.—Turn down the grease cups at either end of the generator shaft one-half turn every 10 hours of running. *(See figure 138.)* When the cups have been turned all the way down, refill them with alemite grease, Federal Specification No. VV-G-681, grade, medium. Avoid overlubrication. Be careful not to get oil or grease on the commutator or brushes.

(2) COMMUTATOR.—Remove the generator end band and inspect the condition of the commutator every 50 hours. *(See figure 139.)* Keep it free from dirt or grease. It can be cleaned with canvas or lint-free cloth. If it is very dirty, use No. 00 sandpaper. Never use emery or carborundum cloth on the commutator. If it is worn rough or eccentric, have it turned down on a lathe and have the insulating mica undercut.

(3) BRUSHES.

(a) Inspect the brushes every 50 hours. Replace brushes which are oil-soaked or worn to one-half their original length. Seat new brushes with No. 00 sandpaper, never emery cloth. Wrap the sandpaper around the commutator, sanded side out. Press the brushes against the sandpaper and rotate the armature a few times. Blow out the generator thoroughly to remove all particles.

(b) Check the brush spring tension (22 to 24 ounces on a pull scale for engine generators). The spring should hold the brush against the commutator firmly but not too tightly. Excessive spring tension will cause rapid wear; lack of tension will cause arcing and loss of generator output.

(4) BELTS.

(a) The generator drive belts should be kept tight, clean, and free from oil or grease.

(b) To tighten the belts, loosen the clamp bolt holding the generator bracket ring. *(See figure 140.)* Insert a lever between the generator bracket and the bracket ring post on the engine, and move the generator over until the belts are taut but not too tight. Tighten the clamp bolt.

(c) Replace worn or frayed belts.

c. AUXILIARY GENERATOR.

(1) Lubricate the generator ball bearings every 100 hours of operation. Use ball-bearing grease, Specification No. AN-G-5. Avoid overlubrication, as too much grease will cause friction and may leak into the windings.

(2) Inspect and service the commutator and brushes in the same way as the engine generators. Refer to paragraphs 4.*a.*(2) and (3), this section.

d. BATTERY CHARGER.

(1) Keep the rectifying tubes tightened in the sockets. Remove the tubes and inspect the sockets every week. Clean the center contacts if necessary. If the sockets are corroded, replace them.

(2) Carry a spare rectifying tube on board. Test the spare for at least one complete charge before placing it in reserve.

(3) A worn rectifying tube may have trouble "picking up" when the charging rate starts at a high value. If the current cannot be kept down to 6 or 7 amperes, replace the tube.

(4) Replace fuses in the battery charger as necessary. Use 15-ampere fuses only.

e. REVERSE CURRENT RELAYS.

(1) The reverse current relays in the engine generator lines and the auxiliary generator line are adjusted and set at the factory. Do not make any further adjustments of these items. In case a relay is damaged or gets out of adjustment, replace it and send the old one to the proper repair station.

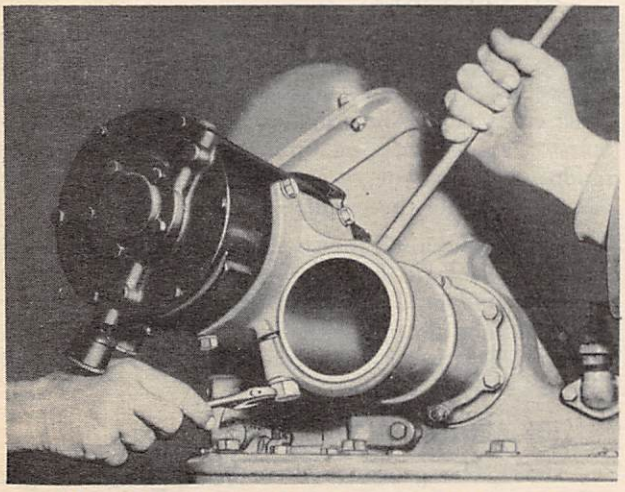


Figure 140—Tightening Generator Drive Belts

(2) Sometimes a damaged auxiliary generator reverse current relay will short itself out. In other cases a damaged relay can be shorted out of the circuit if it is desirable to charge the batteries before a new relay can be installed. When charging with the auxiliary generator without a reverse current relay, be very careful not to let the generator voltage drop below the battery voltage. If it does, the generator will be motorized and reverse its polarity, and the main line fuse will blow. In such a case, open the generator switch and renew the fuse. Although the generator will operate satisfactorily with the polarity reversed, if the generator leads are reversed at the generator fuse box, the generator output voltmeter will not register. Therefore, turn off the gen-

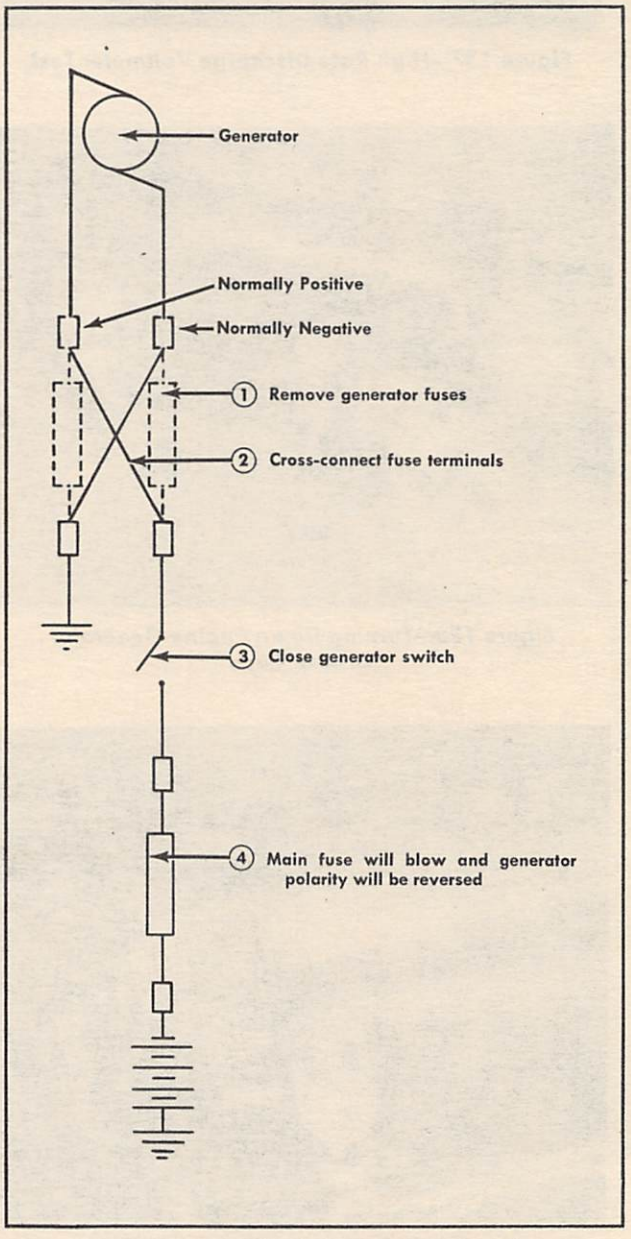


Figure 141—Method of Reversing Auxiliary Generator Polarity

erator and "flash" the generator to re-reverse the polarity. This is most easily done by removing the two generator fuses and cross-connecting the fuse terminals on the generator side to the opposite terminals on the switchboard side. *(See figure 141.)* Close the generator switch. This will blow the main fuse again and restore the generator's original polarity. Open the generator switch, replace the main fuse, remove the cross wires, and reinstall the generator fuses.

4. REMOVAL.

a. AUXILIARY GENERATOR.

(1) Disconnect the wires at the generator junction box. Number and tag the wires for identification at reinstallation.

(2) Remove the cap screw holding the generator to the engine frame, under the generator.

(3) Remove the six outside bolts holding the generator flange to the flywheel housing.

(4) Remove the three bolts holding the engine flywheel to the generator coupling. These bolts are on the engine side of the flywheel.

(5) Slide the generator back, fasten a hoist to the lifting ring, and lift it out.

b. BATTERY CHARGER.

(1) Open the battery charger door and remove the two rectifying tubes.

(2) Remove the four screws holding the battery charger unit to the case.

(3) Disconnect, number, and tag the electric leads from the two conduits, and remove the unit.

(4) Disconnect the conduits from the case.

(5) Remove the three bolts holding the case to the shockproof mountings and remove the case.

5. TROUBLE SHOOTING.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
BATTERIES DO NOT MAINTAIN CHARGE	Short circuit.	Locate short by continuity test and repair.
	Bad battery cell.	Make high-rate voltmeter discharge test. (Refer to paragraph 3.*a.*(4), this section.
GENERATOR CHARGING AT LOW RATE	Dirty commutator.	Clean commutator.
	Poor brush contact.	Repair or install new brushes.
	High resistance in charging circuit.	Clean and tighten terminals.
	Loose or dirty terminals.	Clean and tighten.
GENERATOR CHARGING AT TOO HIGH RATE	Third brush improperly adjusted.	Adjust.
	Short in armature.	Replace armature.
GENERATOR OVERHEATS	Too great a load.	Reduce load.
	Sparking at brushes.	Clean commutator and check it for roughness.
	Short in armature.	Replace.
BATTERY CHARGER RECTIFYING TUBE DOES NOT LIGHT	Supply line fuse blown.	Replace fuse (30 amp).
	Loose tube.	Tighten tube.
	Dirty socket.	Clean socket.
	Defective tube.	Replace tube.
BATTERY CHARGER TUBE LIGHTS BUT NO CURRENT SHOWS ON AMMETER	Break in battery charger wiring.	Trace and repair wiring.
	Fuse blown.	Replace fuse (15 amp).
	Loose clip on wire to tube.	Fasten clip.
	Slow leak in tube.	Replace tube.
	Loose adjustment plug.	Insert plug firmly.
BATTERY CHARGER CURRENT HIGH AND CANNOT BE REDUCED	Defective ammeter.	Repair ammeter.
	High shore line voltage.	Adjust primary terminal board connection. (Refer to paragraph 2.*c.* (4), this section.)
	Worn rectifying tube.	Replace tube.

SECTION XI
Lighting and Signaling Systems

1. GENERAL.

Current is supplied to lighting fixtures throughout the boat from the ship's batteries through two fuse boxes in the engine room and a distributor box in the galley. Refer to wiring diagram in Section X *(figure 126)*.

2. INTERIOR LIGHTING.

a. DESCRIPTION.

(1) The interior light fixtures are standard marine fixtures with the lamp bulb and socket enclosed by a watertight glass globe. These lights are of the following types:

(a) BULKHEAD LIGHTS.—The globe is secured in the bulb housing by three screws. *(See figure 142.)*

(b) CEILING LIGHTS.—There are two types of ceiling fixtures with globes secured to the socket and switch housing by screwed-on retainer rings. One metal and two rubber gaskets make the fittings shockproof and watertight. The ceiling fixtures in the engine room are enclosed in a wire cage to protect the globe. *(See figures 143 and 144.)*

(2) The interior lights are installed in the following locations:

(a) Three in the dispensary.
(b) Four in the engine room.
(c) One in the officers' toilet.
(d) Three in the senior officers' quarters.
(e) Two in the galley.
(f) One in the pilot house.
(g) Two in the junior officers' quarters.
(h) One in the crew's quarters.
(i) One in the crew's toilet.

(3) These light fixtures are controlled individually by switches on their bases, except the engine room lights which are controlled by switches labelled "LIGHTS" mounted on the main switch board in the engine room.

(4) Four hand lanterns, type J-1, complete with mounting brackets, one in a convenient place in the engine room, one in the officers' quarters, one in the crew's quarters, and one in the pilot house, are provided. *(See figure 145.)*

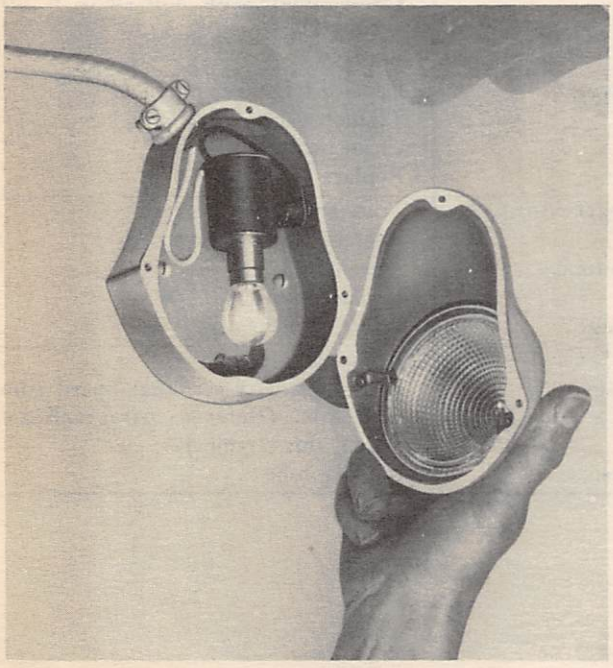


Figure 142—Bulkhead Light



Figure 143—Ceiling Light

(5) Two portable emergency lights, complete with portable cable, lamps, and plugs for use with receptacle installed in the galley and engine room are stored in the cockpit storage space. These portable lights are equipped with double contact bayonet base lamp sockets with 30 feet of cable.

b. SERVICE AND MAINTENANCE.

(1) Replace burned out light bulbs as necessary.

(2) To reach the bulb in the watertight fixture, unscrew the retainer ring and remove the ring, the metal gasket, the flanged rubber gasket, and the glass bowl.

(3) Replace the rubber gaskets when they show signs of excessive wear or deterioration.

(4) The following spare parts should be carried on the boat:

(a) Five percent of the light bulbs installed.

(b) Five percent of the glass globes installed.

(c) Five percent of the fixture parts installed, such as gaskets, retainer rings, and sockets.

(d) Five percent of the fuses installed.

3. EXTERIOR LIGHTING.

a. DESCRIPTION.

(1) Exterior lights are located and wired as shown in figure 126.

(2) The cockpit light fixture is of the same watertight type used in the engine room, with globe guard fastened to the retainer ring and an individual switch at the base for operation.

(3) A clear glass globe range light is mounted on the top of the mast. This is a standard marine fixture, giving a white light signal in all directions.

(4) A colored glass lens running light is mounted on both outboard sides of the bridge, red on the port side, green on the starboard, and a clear glass lens running light is mounted on the top of the pilot house on the center line. The colored side running lights have a 112.5-degree (10-point) angle of vision. The bow light has a 225-degree (20-point) angle of vision. *(See figure 146.)*

(5) A blue glass running light is mounted on the top of the ensign staff at the stern. This stern light has a 135-degree (12-point) angle of vision. *(See figure 147.)*

(6) A panel with switches for controlling the navigation lights is installed to port side on the bridge. *(See figure 148.)*

(a) The switch labelled "NAVIGATION" controls the three running lights.

(b) The switch labelled "MAST" controls the range light mounted on top of the mast.

(c) The switch labelled "ENSIGN" controls the stern light mounted on the ensign staff.

(d) The switch labelled "TELEGRAPH" controls the telegraph lights mounted on the bridge.

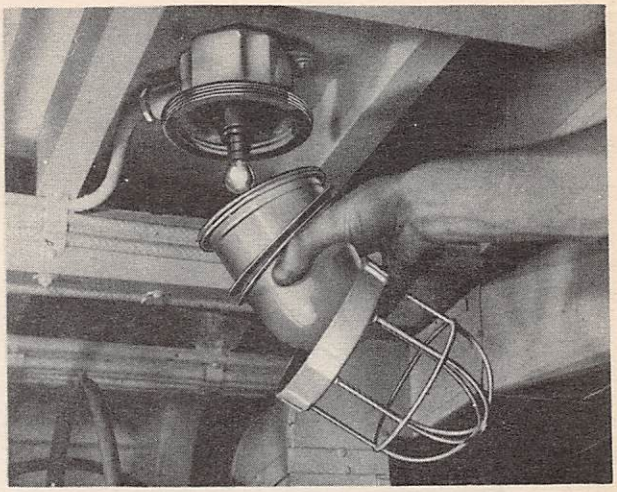


Figure 144—Engine Room Light with Wire Cage

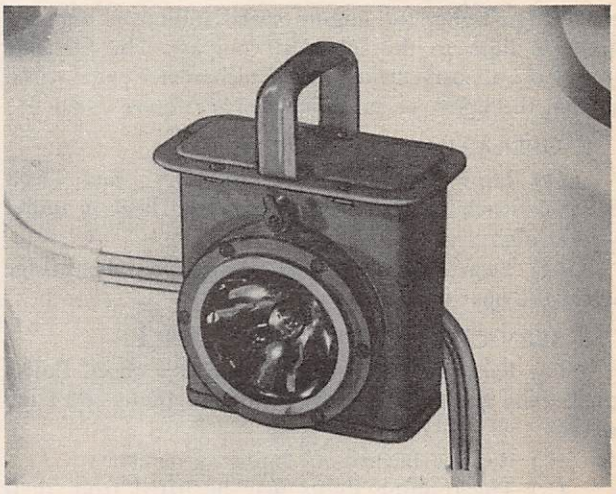


Figure 145—Type J-1 Lantern

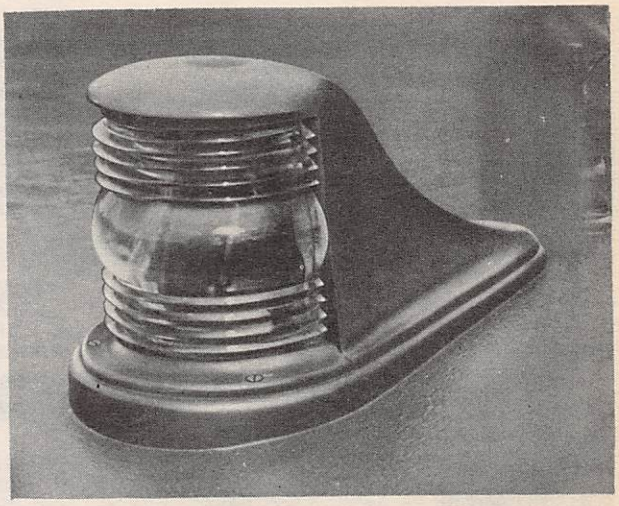


Figure 146—Bow Light Mounted on Top of the Pilot House

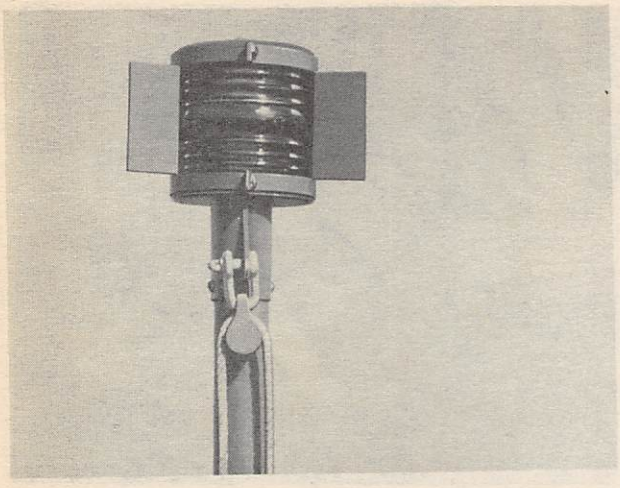


Figure 147—Stern Light

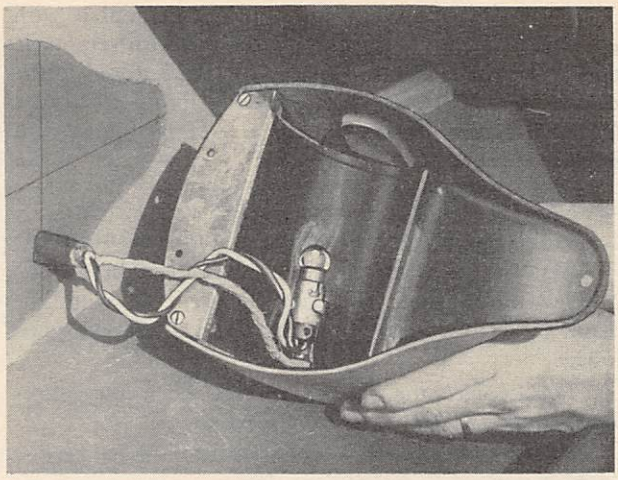


Figure 149—Removal of Port Running Light

(7) A separate switch on the tachometer panel on the bridge lights the engine speed indicators and the binnacle light in the spherical compass. The binnacle light has a rheostat switch on the tachometer panel wired so that the light can be dimmed. *(See figure 148.)*

b. OPERATION.

(1) Turn on the "NAVIGATION" and "ENSIGN" switch on the bridge when the boat is under way at night.

(2) Turn on the "MAST" switch on the bridge when the boat is at anchor at night.

c. SERVICING AND MAINTENANCE.

(1) Keep the glass lenses clear and clean. Polish them daily and after each trip with a chamois and fresh water.

(2) Replace burned-out bulbs as necessary.

(3) The running lights may be lifted from their mountings for servicing. *(See figure 149.)*

(4) Spare fuses should be carried in the senior officers' desk.

4. SEARCHLIGHTS.

a. DESCRIPTION.—Three searchlights are mounted on the bridge, one to port, one to starboard, and one on the tripod mast. The port and starboard searchlights are connected to the 24-volt switchboard via a plug and receptacle on either side of the bridge. The mast searchlight *(figure 150)* is directly connected with the 24-volt switchboard by wires running through the after leg of the tripod mast, and is controlled by a manually operated switch on the under side of the crow's nest. *(See figure 151.)* The searchlight consists of a housing, spherical reflector, lamp, and parabolic mirror. The assembly is adjusted prior to installation to suit the lamps specified on the name plate.

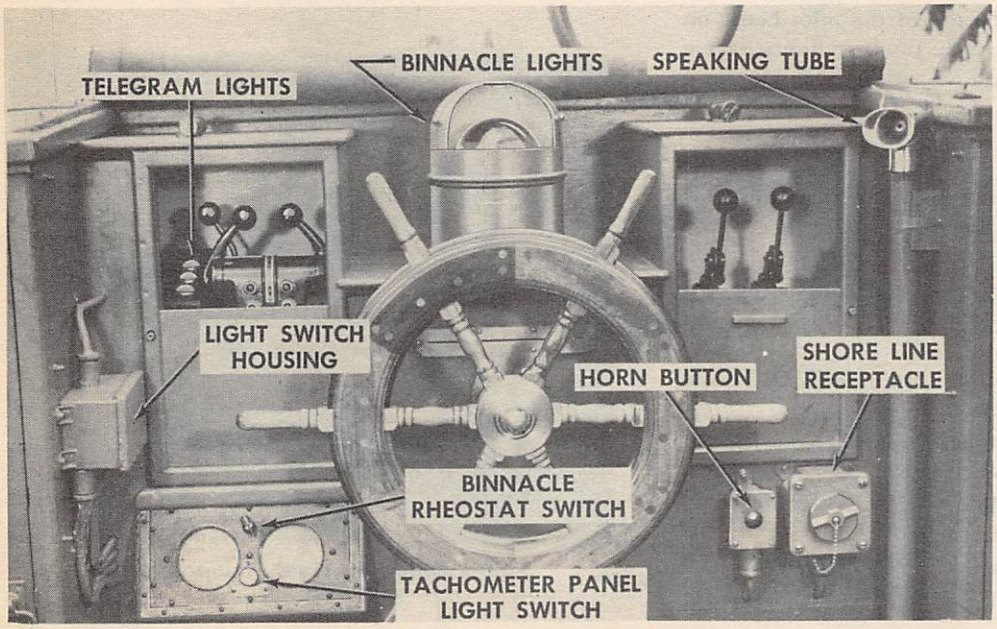


Figure 148—Location of Lighting Switches on Bridge

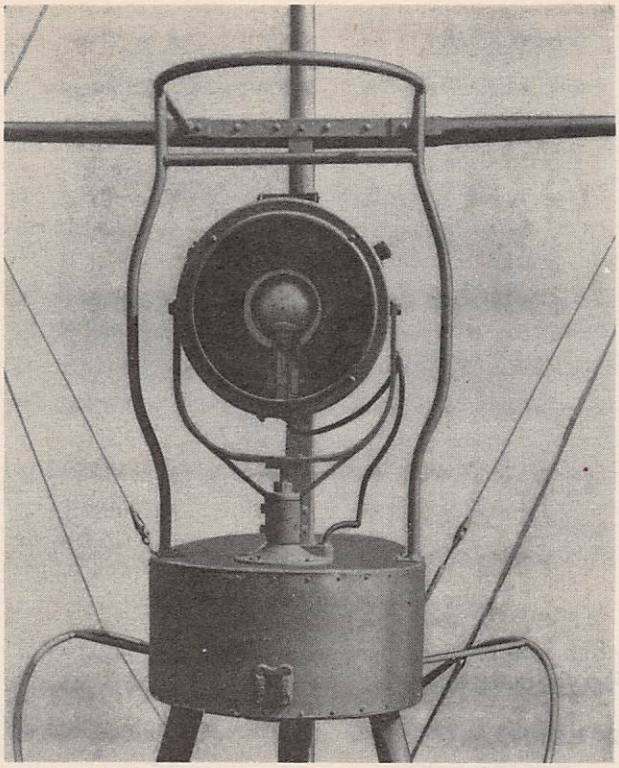


Figure 150—Mast Searchlight

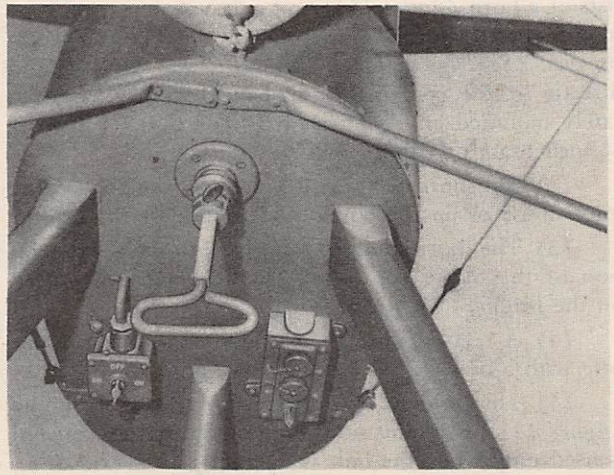


Figure 151—Mast Searchlight Control Handle and Switch

b. OPERATION.—The mast searchlight is aimed by moving the control handle at the end of the shaft. *(See figure 151.)* The bridge searchlights are aimed with the handle at the rear of the lamp housing. The light may be locked in any position by means of the vise handles. *(See figure 152.)* The searchlights should be clamped securely when not in use.

Note

Do not operate the searchlights in positions for which the lamps are unsuited. For example, T-bulbs and C-13 type of filament construction should be burned only within 25 degrees to base down. The voltage rating of the lamp should be the same as the circuit voltage; burning lamps at higher than rated voltage will increase the candle power values and decrease lamp life.

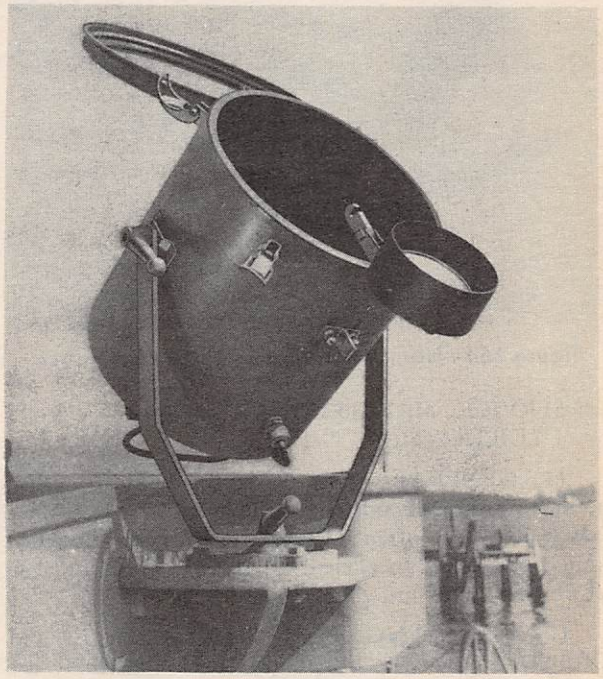


Figure 152—Port Searchlight Assembly

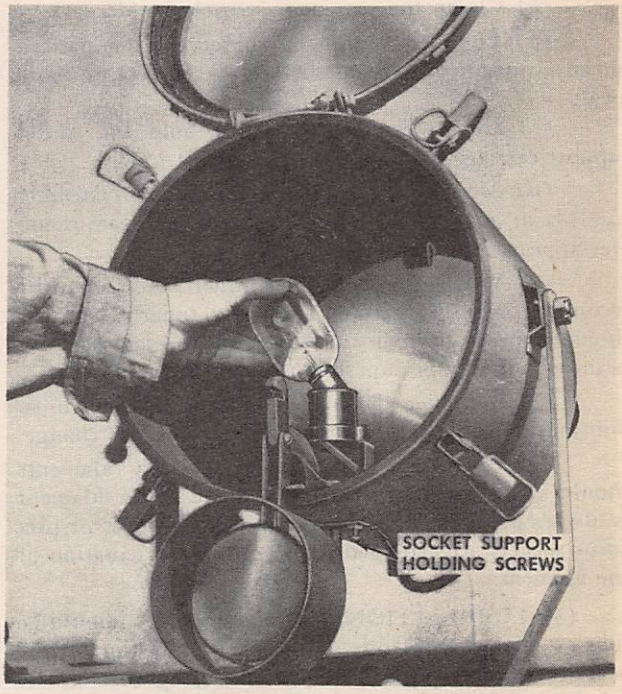


Figure 153—Replacing Searchlight Bulb

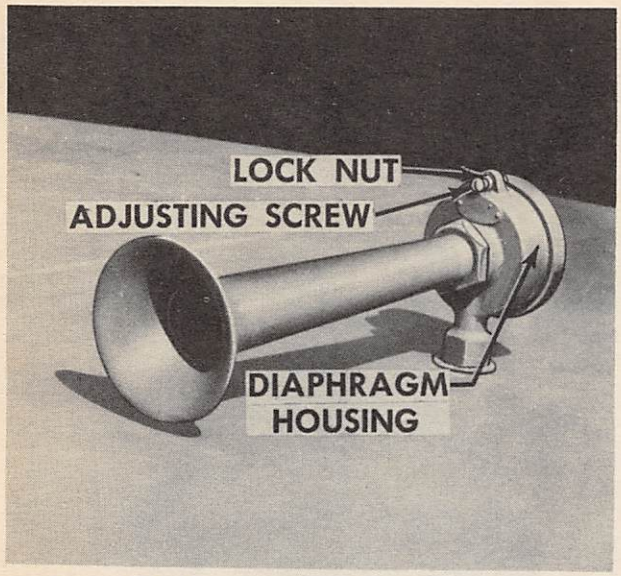


Figure 154—Horn Mounted on Top of Pilot House

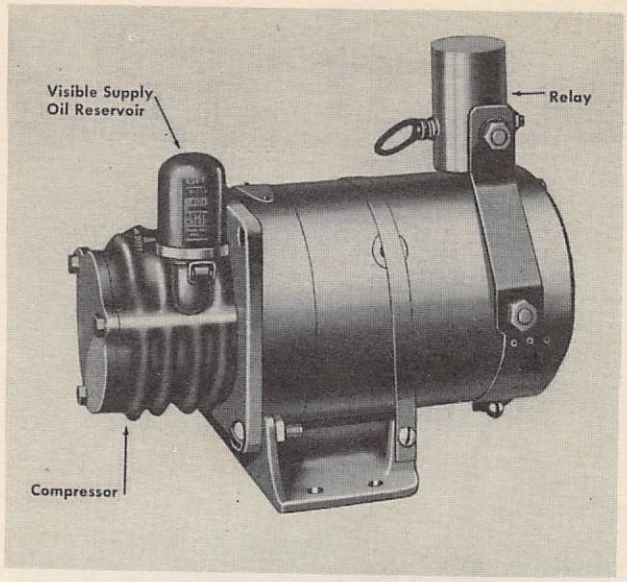


Figure 155—Horn Compressor Unit

c. SERVICE, MAINTENANCE, AND LUBRICATION.

(1) GENERAL.—Keep searchlights clean. Clean the mirror and both sides of the door glass at least once a week and more often if necessary. Keep the electrical connections tight. Blackened lamps should be replaced before they burn out. *(See figure 153.)*

(2) FOCUSING FOR MINIMUM BEAM SPREAD.—When the lamp and reflector assembly are properly adjusted in relation to the parabolic mirror, the beam spread is at minimum. To make this adjustment, proceed as follows:

(a) Clamp the rear door securely in place.

(b) Light the lamp and observe beam pattern on any convenient vertical surface at 100 feet or more away.

(c) Loosen the screws which hold the socket support carriage to the drum. *(See figure 153.)*

(d) Move the entire lamp and reflector assembly towards or away from the mirror until the beam diameter appears at the minimum.

(e) When the beam is properly focused, the secondary beam formation from the spherical mirror should appear approximately the same size as the main beam and should be superimposed on the main beam.

(f) Retighten the four holding screws and in so doing make sure that the beam pattern does not change.

(g) Monoplane or biplane type of filaments should all be oriented so that the plane of the filament is always parallel to the mirror opening. Bipost or prefocus sockets are arranged for the proper orientation of the filament.

(3) LUBRICATION.—All moving parts should be lubricated once a month or oftener depending on the severity of service. All of the mountings are grease lubricated. Fittings are provided where required. Use a light cup grease or any grease which will meet Navy Specification No. 14G1.

5. HORN.

a. DESCRIPTION.

(1) The horn assembly (Doran Model EA-1) consists of a horn *(figure 154)* and a 24-volt universal type motor directly driving a rotary vane-type air compressor. *(See figure 155.)* The horn may be mounted directly at the compressor discharge or may be separately mounted and connected by not over 15 feet of $\frac{3}{8}$-inch brass or copper tubing.

(2) The horn is located either on the top of the pilot house or on the port outboard side of the bridge.

(3) The horn blast promptly follows the operation of the motor controlled by the "HORN" button on the bridge. *(See figure 148.)*

(4) A relay *(figure 155)* is mounted on the motor case with a bracket.

(5) The constant level oiler with visible oil supply *(figure 155)* maintains saturation of the felt feeder. Oil is used only when the unit is operating.

Note

Always carry a mouth horn in the bridge locker for use in case of a failure in the horn.

b. SERVICE AND MAINTENANCE.

(1) Keep the visible oil reservoir on the compressor unit filled with engine oil, SAE 20.

(2) Adjust the tone of the horn when necessary. Loosen the lock nut and adjusting screw at the back of the horn *(figure 154)* and turning the diaphragm housing inwards or outwards until the desired tone is achieved. Lock the diaphragm housing in position with the adjusting screw and lock nut. If the horn fails to work, the adjustment screw is too tight or too loose.

SECTION XII

Radio Equipment

1. TRANSMITTER.

A Collins Model 32-RA transmitter may be located in either the pilot house *(figure 156)* or in the galley *(figure 157)*. This transmitter sends on four channels and covers a frequency range of 1.5 to 15 mc. The 110-volt power supply is furnished by a dynamotor *(figure 158)* which runs off the 24-volt system and is connected to the forward distribution box. This transmitter is covered in T. O. No. 08-10-116.

2. RECEIVER.

A receiver, BC-348, eight-tube, six-band, superheterodyne is installed in either the pilot house or in the galley. For operation and service instructions, refer to Technical Order Handbook AN 08-10-112. The receiver is connected to the forward distribution box. Since this receiver is designed for a negative ground and the ship's batteries use a positive ground, a .5 mfd condenser must be used between the receiver's ground connection and the ground connection at the forward distribution box. An antenna switching relay is provided.

3. ANTENNA.

a. Two types of whip antennas are used on 63-foot boats. On some boats the whip antenna is bracketed to the mast *(figure 159);* on others the whip is mounted on the port side of the pilot house. *(See figure 160.)*

b. On some boats an antenna grounding switch *(figure 161)* is installed on the bulkhead between the galley and the senior officers' quarters. By means of this switch the antenna may be grounded during electrical storms.

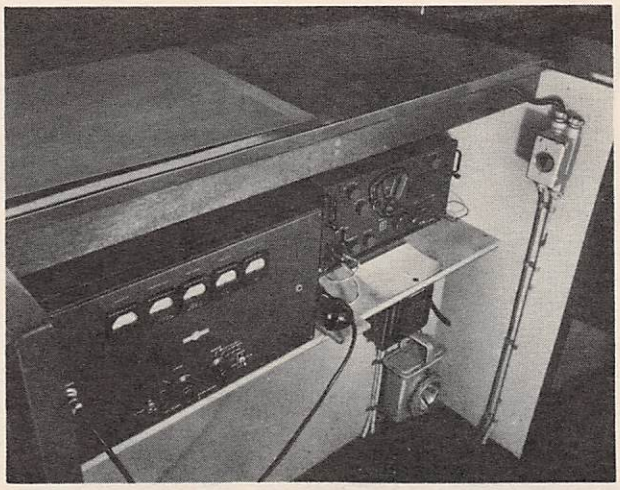


Figure 156—Collins Transmitter, Model 32-RA and Receiver BC-348, Mounted on Shelf Under Pilot House Table

4. RADIO DIRECTION FINDER.

a. GENERAL.

(1) The direction finder, Bludworth Model DF-1016, furnished as standard equipment, comprises the following items:

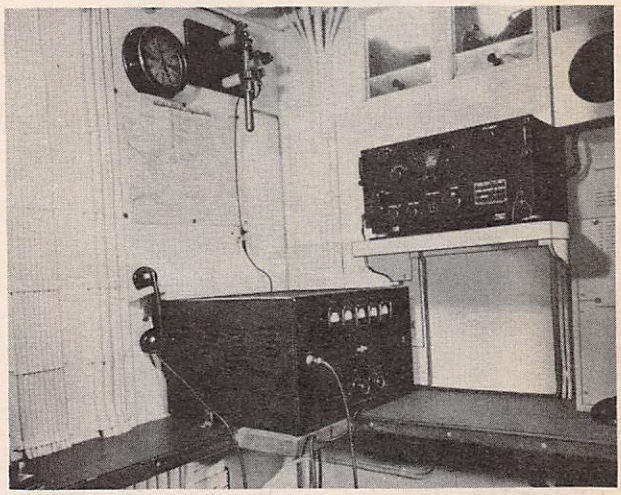


Figure 157—Alternate Radio Installation, with Transmitter and Receiver Shelf Mounted in the Galley

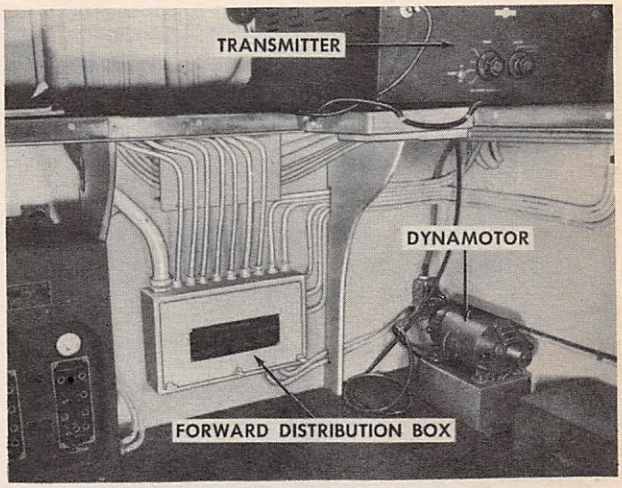


Figure 158—Dynamotor Power Supply for Collins Transmitter



Figure 159—Whip Antenna Mounted on Mast

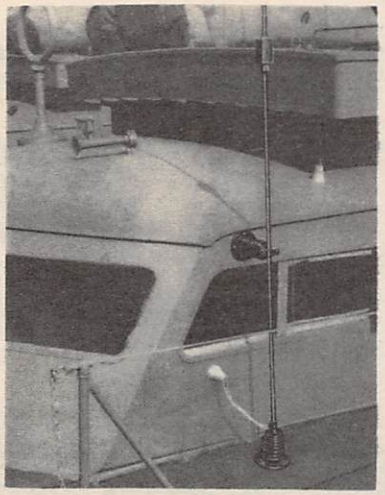


Figure 160—Whip Antenna Mounted on Port Side of Pilot House

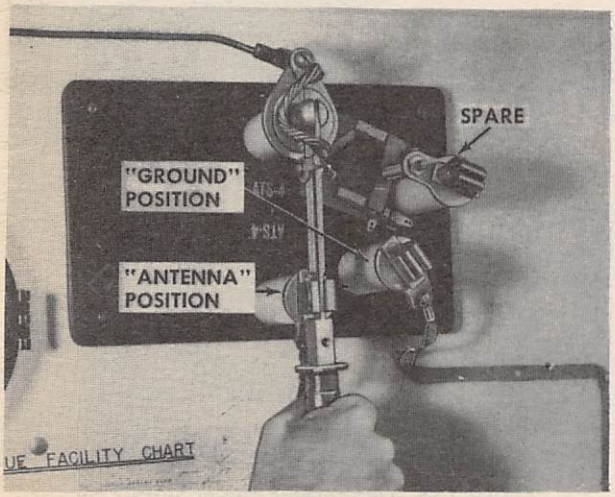


Figure 161—Antenna Grounding Switch

(a) A directional loop, mounted on the starboard side of the pilot house. *(See figure 162.)*

(b) A sense antenna, of the conventional cable type, connected to the instrument through a deck insulator.

(c) A sensitive radio receiver or tuner which operates in the 1000-meter or 300-kilocycle radio beacon brand. *(See figures 163, 164, and 165.)*

(d) An index or pointer coupled to the loop.

(e) A mechanical compensator.

(f) A dummy compass card.

(g) A pair of sensitive telephone receivers for identifying signals and determining the null position of loop rotation.

(h) A separate 6-volt storage battery for current supply.

(2) DIRECTIONAL LOOP.—The directional loop *(figure 162)* is circular and enclosed in a seamless copper shield of 18-inch outside diameter and 2-inch cross section. The loop rests on a bronze deck flange and is supported by a roller bearing. The loop is continuously rotatable about its vertical axis by means of a hand-wheel. A locking clamp or brake on the hand-wheel provides a smooth even drag and locks the loop shaft at any desired position with no backlash. Loop leads, completely shielded, terminate directly at the receiver, and are connected to the receiver through silver collector rings and contact brushes.

(3) CONSTANT POINTER AND DUMMY COMPASS CARD.—A constant pointer is attached to the loop shaft at right angles to the plane of the loop. The loop is so mounted that the pointer swings over an etched dummy compass card. The compass card is rotated within a ring on which the lubber's lines are marked, directly providing a magnetic or gyro meridian and course reference.

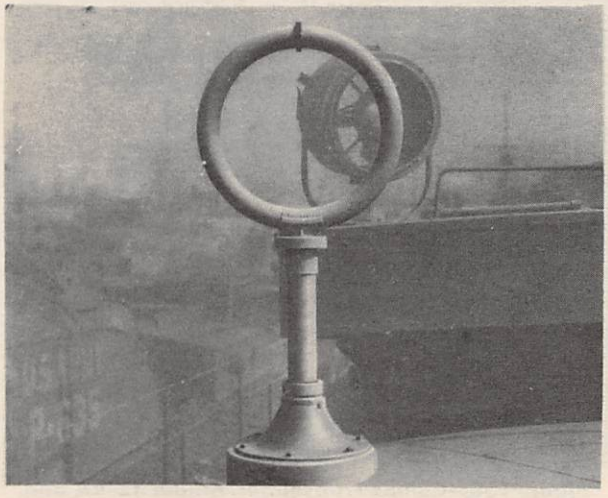


Figure 162—Radio Direction Finder Loop, on the Starboard Side of the Pilot House

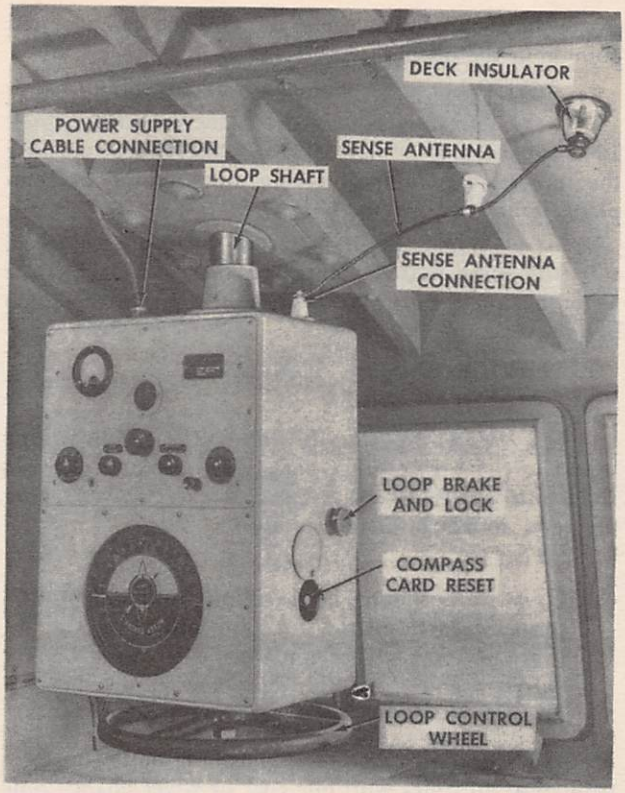


Figure 163—Radio Direction Finder Tuner Case and Connections

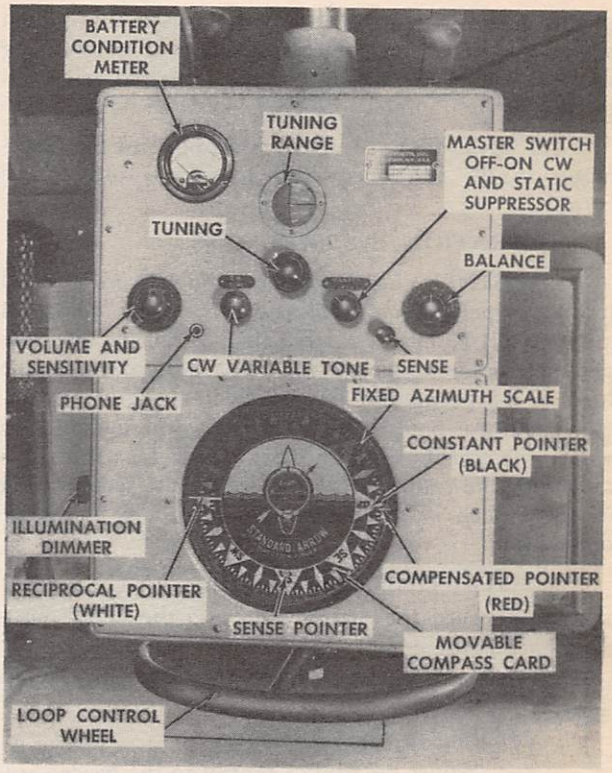


Figure 164—Front View of Tuner Case

(4) COMPENSATED POINTER. — A compensated pointer is linked to the constant pointer by means of a mechanical compensator consisting of levers, a roller, and a circular band which can be distorted by means of adjusting screws. The linkage is such that as the loop rotates, the compensator automatically adds or subtracts predetermined corrections. When the band is properly adjusted, the compensated pointer exactly follows the correction curve pattern throughout 360-degree rotation and indicates the true bearing at every fractional degree of rotation.

(5) RADIO RECEIVER OR TUNER.—The tuner is enclosed in a case which excludes the electric component of the radio waves and allows the instrument to respond only to the magnetic component. The tuner is a superheterodyne, balanced type, with constant alignment, and has a range from 280 to 520 kilocycles. The tuning dial is directly calibrated in kilocycles accurate to plus or minus 1 kilocycle. The beacon sector of the band is etched on the red background of the tuning dial. The tuner also contains a "CW" oscillator with variable beat frequency or tone control, a built-in static suppressor eliminating interference above and below the modulation frequency of the beacons, a battery voltmeter, and nine tubes; one VR-105-30, four 6SK7, one 6SJ7, one 6SA7, and two 6C5. The null is within plus, minus 1 degree 80 miles from a 200-watt beacon.

(6) SENSE.—A cable-type sense antenna is connected to the tuner through a deck insulator. By means

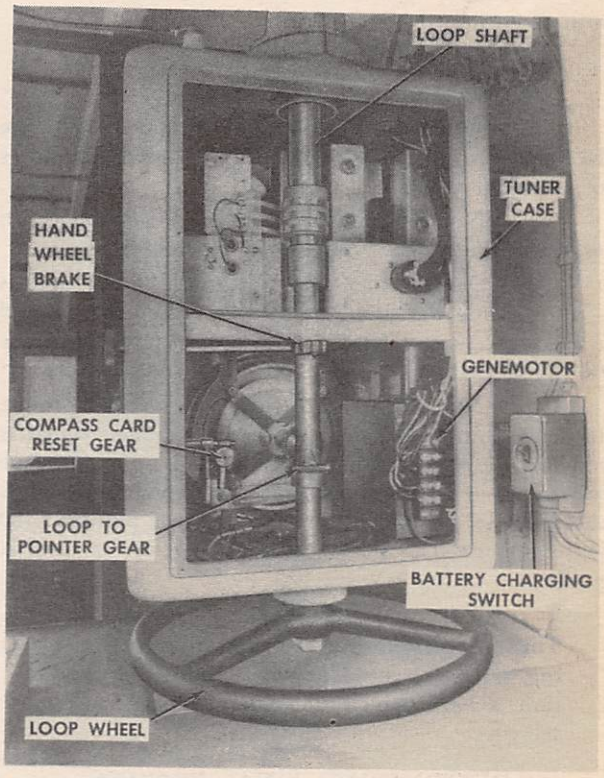


Figure 165—Rear View of Direction Finder Tuner Case

of this antenna, the operator can balance out unwanted signals and determine the true direction of transmitting stations. The sense indicator is the large red arrow on the dial at right angles to the compensated pointer.

(7) BATTERY.—Current is supplied to the Genemotor in the instrument case from a 6-volt storage battery.

b. OPERATION INSTRUCTIONS.

(1) GENERAL.—Once the radio beacon is tuned in and proper volume established, rotate the loop until a sharp null is obtained. Note the position of the compensated pointer, depress the sense button, rotate the loop to the position at which signal strength is greatest. The sense pointer will then show the quadrant in which the true bearing will be found. Then obtain a null with the compensated pointer on the true bearing of the beacon in the quadrant indicated by the sense observation.

(2) STARTING PROCEDURE.

(a) Turn the master switch to the "ON" position. *(See figure 155.)*

(b) Note the meter indicating the battery voltage.

(c) Plug in the headphones.

(d) Adjust the tuning control to the beacon signal desired. If the signals are weak, turn the master switch to "CW" position and adjust "CW TONE" control to a moderately high pitch. If static interferes, turn the master switch to static suppressor ("SUP") position to improve reception.

(e) Set the balance control to "zero."

(3) USE OF SENSE POINTER.

(a) When the beacon signal is tuned in, rotate the loop control wheel slowly until the signal diminishes to minimum volume.

(b) Note position of the indicating pointer with respect to the compass card or fixed azimuth ring.

(c) Depress the sense button and hold in this position while the loop control wheel is being rotated to place the sense pointer in the former position of the indicating pointer.

(d) Note the beacon signal strength and rotate the sense pointer 180 degrees. If the strongest signal is noted in the first position of the sense pointer, the true bearing is in that quadrant. If the strongest signal is noted in the second position of the sense pointer (180 degrees from the first), the true bearing is in that quadrant.

CAUTION

This observation does not indicate a true bearing, but is essential to determining the direction toward which the final bearing is observed.

(4) DETERMINING FINAL BEARING.

(a) When the sense observation has been made, rotate the loop control wheel to place the compensated pointer in the quadrant indicated.

(b) Observe the minimum signal volume.

(c) Carefully adjust the balance control *(figure 164)* to the right or left of zero while finely adjusting the indicating pointer to obtain a sharp null or complete diminishing of the signal.

(d) When the sharpest null has been observed, read the compensated pointer on the compass card or azimuth ring for true or relative bearing to the radio beacon used.

c. SERVICE, INSPECTION, AND MAINTENANCE.

(1) BATTERY MAINTENANCE. — Check the liquid level of the storage battery at least once a week. Replenish as necessary with distilled water only, keeping the level above the battery plates.

CAUTION

Great care should be exercised to maintain proper polarity of the direction finder connections. A reversal of polarity will ruin the batteries and the Genemotor and render the direction finder inoperative.

(2) CARE OF LOOP.—The loop should be kept painted at all times with one coat of silver enamel, one coat of clear lacquer, and a coat of sea blue paint. Clear lacquer only should be applied to the black ring at the top of the loop.

d. CALIBRATION PROCEDURE.

(1) PREPARATION.

(a) For the calibration of the direction finder, place a sight pelorus on top of the pilot house or on the bridge with its lubber's lines lined up exactly with the keel of the boat. The distance between the boat and the beacon should be as great as possible to reduce the parallax introduced by the separation of the direction finder loop from the pelorus. Keep all persons, including the sight pelorus observer, well away (6 feet or more) from the loop while calibrating. Do not attempt calibration in rough weather. The vessel must be held steady on some headings for ½ minute or more to permit an accurate check between the direction finder and the sight bearings.

(b) Two experienced observers and a checker are required to do a good job with the least delay. The sight pelorus observer directs the helmsman as the ship is swung and signals with a whistle or by singing out "mark" the instant the beacon bears true, on each consecutively, 0, 10, 20, 30 degrees, etc. At the same instant the direction finder observer reads and calls out his bearings to the checker, as 12, 24, 36 degrees, or whatever they may be. The checker records both in two or four parallel columns of the calibration sheet, and in the third column makes entry of the difference between the pelorus and the direction finder bearings. Values of the fourth column cannot be determined until

the curve is plotted on cross section paper. A sample work sheet is shown in figure 161.

(2) LINE UP LUBBER'S LINE.—When in a position to maneuver the vessel, the helmsman should be directed to head for the beacon at idling speed and change his course slightly to the right or left as directed by the observer at the sight pelorus until the beacon bears dead ahead. At the same time the direction finder observer should take a simultaneous radio bearing. Sight pelorus and direction finder bearings must be made to agree on dead ahead or zero degrees heading. This may require adjusting the direction finder constant pointer, or the mechanical compensator, or both.

(3) FIX SENSE.—The next operation is to orient or fix the sense of the direction finder. The large red pointer, at right angles to the constant pointer, is the sense indicator. To test the sense, reduce the volume, press the sense button down, and turn the loop so that the sense arrow points to the beacon. Now observe the volume in the headphones, then quickly rotate the loop exactly 180 degrees. The volume should be louder when the sense pointer points toward the beacon. If it is not, set the constant pointer on zero (dead ahead), lock the loop, loosen the pointer head, and rotate the pointer 180 degrees. Recheck the sense and then proceed with the calibration.

(4) SWING THE SHIP.

(a) Set the dummy compass dead on "ZERO." Then start the vessel swinging very slowly. The beacon will bear consecutively, 10, 20, 30, 40 degrees, etc., through 360 degrees. Check the radio bearing simultaneously on each 10-degree change of heading and note the deviation, if any. Be sure to establish a good, clean null every 10-degree swing of the ship.

(b) Extreme caution is required in noting and setting down the observed bearings and differences. It is the best practice to use a ruled sheet of four columns. *(See figure 166.)* In the first column are set down the

Col 1	Col 2	Col 3	Col 4
True Bearing	DF Bearing	Deviation	Correction
0	0	0	0
10	12	– 2	– 1.7
20	24	– 4	– 3.3
30	35.5	– 5.5	– 4.8
40	46	– 6	– 5.8

Figure 166—Sample Work Sheet for Posting Data During Swinging the Direction Finder

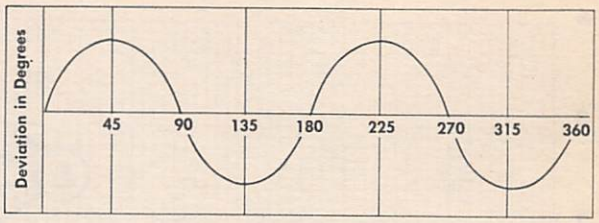


Figure 167—Typical Direction Finder Deviation Curve

true bearings in degrees as 0, 10, 20, 30, 40, etc., through 350. The true bearings may be written in before starting the calibration, and as the work progresses the radio direction finder observer, or checker, simply writes his bearings in the second column, headed "Direction Finder Reading." The third column is marked "Deviation" and when the work of swinging the ship is completed, the difference between the direction finder bearing and the sight pelorus bearing is set down in this column as +5, –4, etc. For example, on the 40-degree heading, if the radio direction finder bearing is 35 degrees, the deviation is plus 5. If on the 130-degree heading the direction finder bearing is 137 degrees, the deviation is –7. The value in the "Deviation" column must always be that number which, added to or subtracted from the direction finder bearing, increases or reduces it to the true bearing.

(5) PLOT CORRECTION CURVE.—In general, the bearing indicated by the direction finder is less than the true (sight bearing) in the starboard bow quadrant, and greater than the true bearing in the starboard quarter quadrant. When plotted on the cross-section paper, the plotting points will follow the general form of sine curve shown in figure 167. The correction curve should be plotted on cross-section paper, similar to that shown in figure 168, with 10 lines to the inch, every tenth being a heavy line. The sheet should not be smaller than 15 x 20 inches. Prepare the curve as follows:

(a) Name the center, horizontal line "zero." *(See A, figure 168.)*

(b) Name seven heavy horizontal lines above the zero line "plus 1," "plus 2," "plus 3," "plus 4," "plus 5," "plus 6," and "plus 7." *(See B, figure 168.)*

(c) Name seven horizontal lines below the "zero" line "minus 1" through "minus 7." *(See C, figure 168.)* Vertically, above and below the zero line, each small square will be one-tenth of 1 degree of deviation.

Note

If deviation is greater than plus or minus 7 degrees, adjust the scale to bring the curve within desired limits.

(d) Name 36 vertical lines (left to right) "0," "10," "20," "30," "40" degrees, etc, through 350 degrees so that each small square across the sheet represents a 1-degree angle of departure from the line of the ship's keel (20 degrees to the inch).

(e) Plot the points for the correction curve

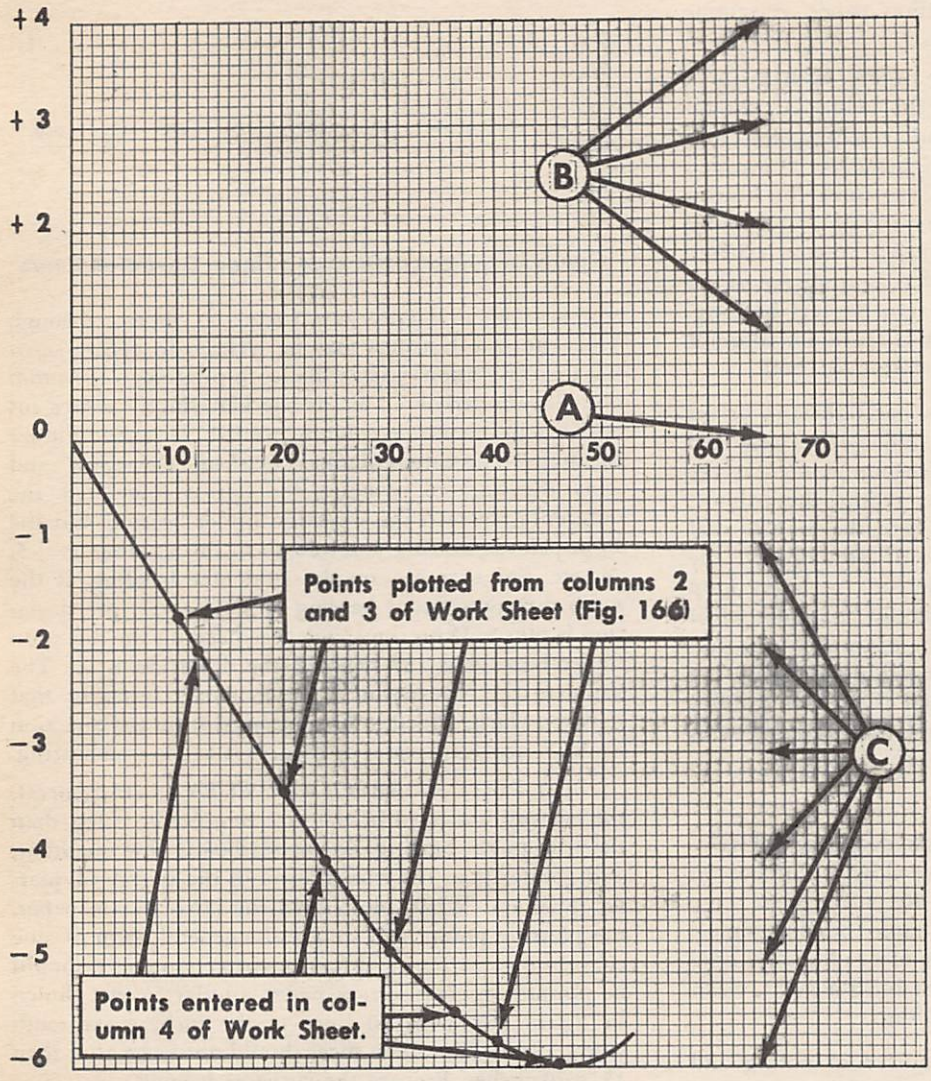


Figure 168—Direction Finder Correction Curve Chart

(figure 168) from the figures in columns 2 (Direction Finder Reading) and 3 (Deviation) of the work sheet. *(See figure 166.)* Place the point on the vertical line which corresponds to the direction finder reading and on the horizontal line which corresponds to the deviation. The sample correction chart *(figure 168)* shows three points plotted from the work sheet.

(f) Draw a smooth curve through all the spotted points. The shape of the curve should rise until 45-degree keel angle, or broad on the starboard bow, is reached and then should fall gradually to zero at or near 90 degrees, or the starboard beam, etc.

(6) DETERMINE CORRECTIONS FROM CURVE.—Follow each vertical keel angle line (10, 20, 30, 40 degrees, etc.) upward or downward until it crosses the curve. The name of the intersecting horizontal deviation line will be the value of the correction for each 10-degree heading, or keel angle. Values for these corrections should be entered in the fourth column of the work sheet.

(7) ADJUST THE MECHANICAL COMPENSATOR. *(See figure 169.)*—The compensating mechanism consists of a system of levers and a roller in contact with one face of an unbroken adjustable soft brass band. Distortion of the band (by means of 36 adjusting screws at 10-degree intervals around its circumference) causes the roller to move in such a way that the compensated pointer leads or lags behind the constant pointer. The adjusting screws are accessible from the front face of the compass card after the compass glass and holder have been removed. Prior to calibration as described in paragraphs 4.*d.*, this section, the "ZERO" position of the constant pointer is established by locking the loop in dead-ahead position and setting the constant pointer on "zero." The compensated pointer should also read "ZERO." Proceed as follows:

(a) Turn the loop so that the constant pointer is on 10 degrees and lock it.

(b) Turn the adjusting screw so that the compensated pointer indicates the corrected bearing. Turn-

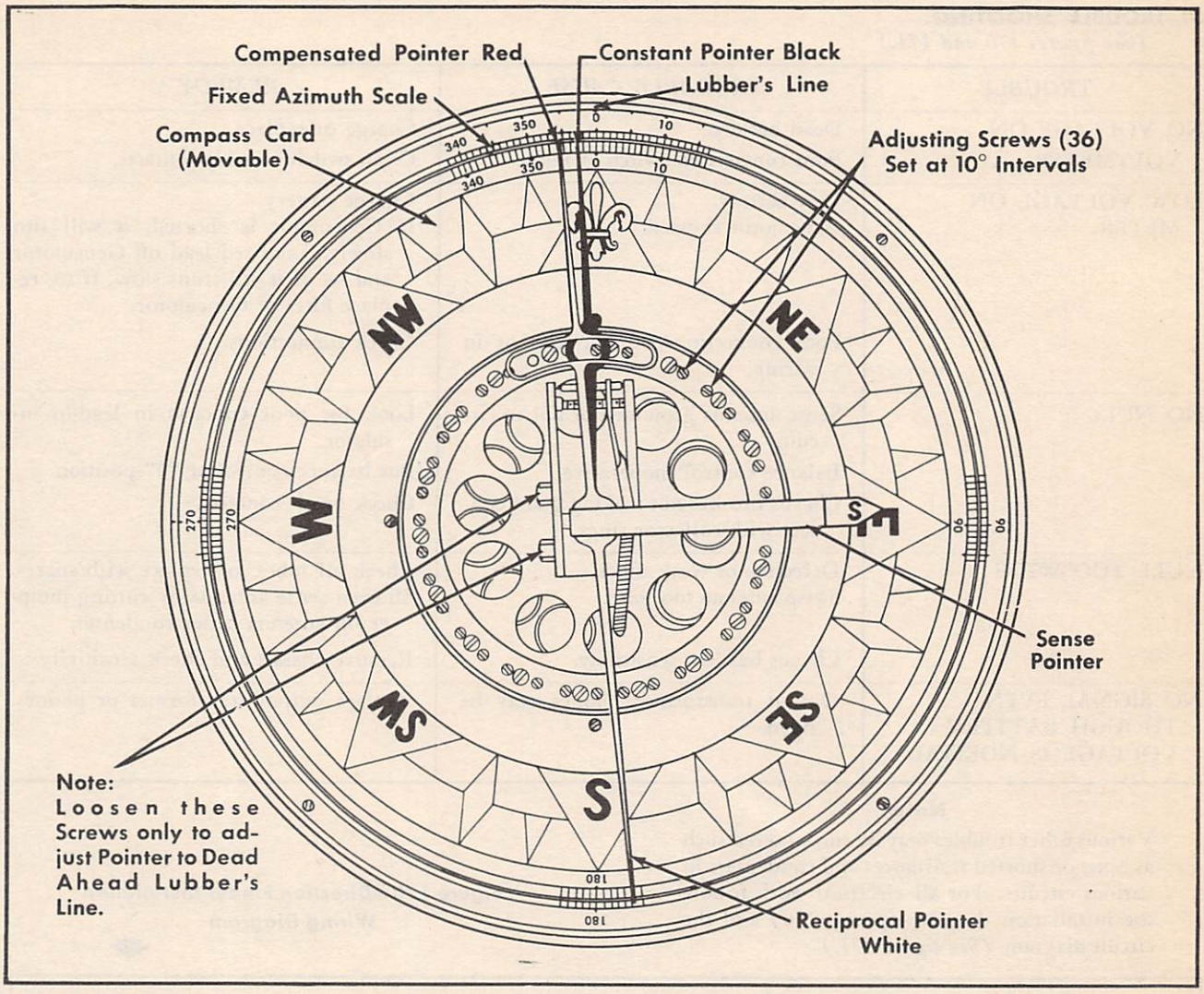


Figure 169—Mechanical Compensator

ing the screw clockwise causes the compensated pointer to lead (add the correction) the constant pointer; counterclockwise turning causes it to lag (subtract the correction).

CAUTION

Do not turn any adjusting screw more than two-fifths of a turn at any one time. If this is insufficient, proceed with partial adjustments at 10-degree intervals completely around the compass card; then, start again at the 10-degree position and make another series of adjustments. Use only the special screw driver provided and do not move the constant pointer while the screw driver is in position.

(c) Having made partial or complete adjustment at the 10-degree position, proceed with adjustments at the other positions and make as many complete circuits as necessary. Be positive that the black pointer is exactly on the radian of the screw through which you are applying correction, and that it does not drift while the screw is being adjusted. Do not allow yourself to become confused by the compensated pointer. *Nonobservance of this precaution will result in kinking the band, and will be evident in a jumpy, uneven motion of the compensated pointer when the loop is revolved.* Replace the glass cover and cover band when calibration is completed.

(d) The corrections will be greatest at or near 45 degrees (plus correction); 135 degrees (minus correction); 225 degrees (plus correction); and 315 degrees (minus correction). The minimum corrections will occur at or near 90, 180, and 270 degrees. Ordinarily, no correction should be made at zero. Thus, the corrections applied should taper off gradually toward these points. A smoother curve will be developed by working from dead astern or 180 degrees, toward the bow or zero, alternating port and starboard, particularly toward the finish of the operation. *Do not hurry.*

5. TROUBLE SHOOTING.

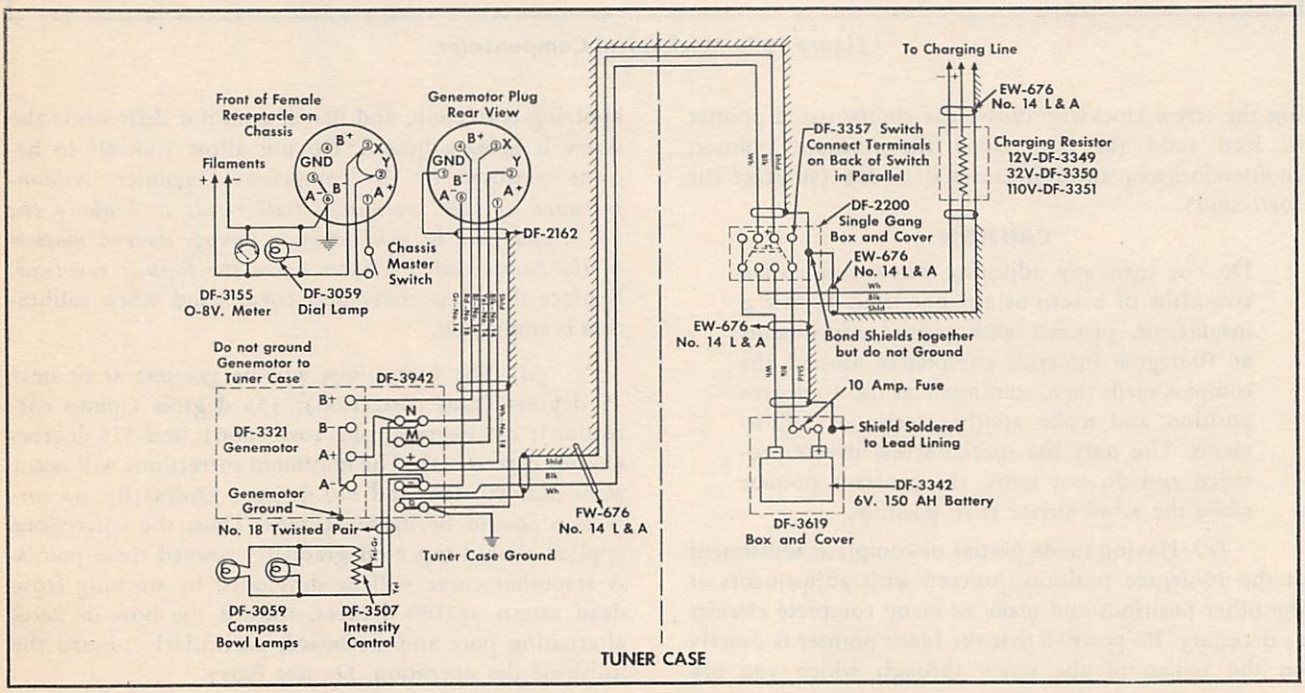
(See figures 170 and 171.)

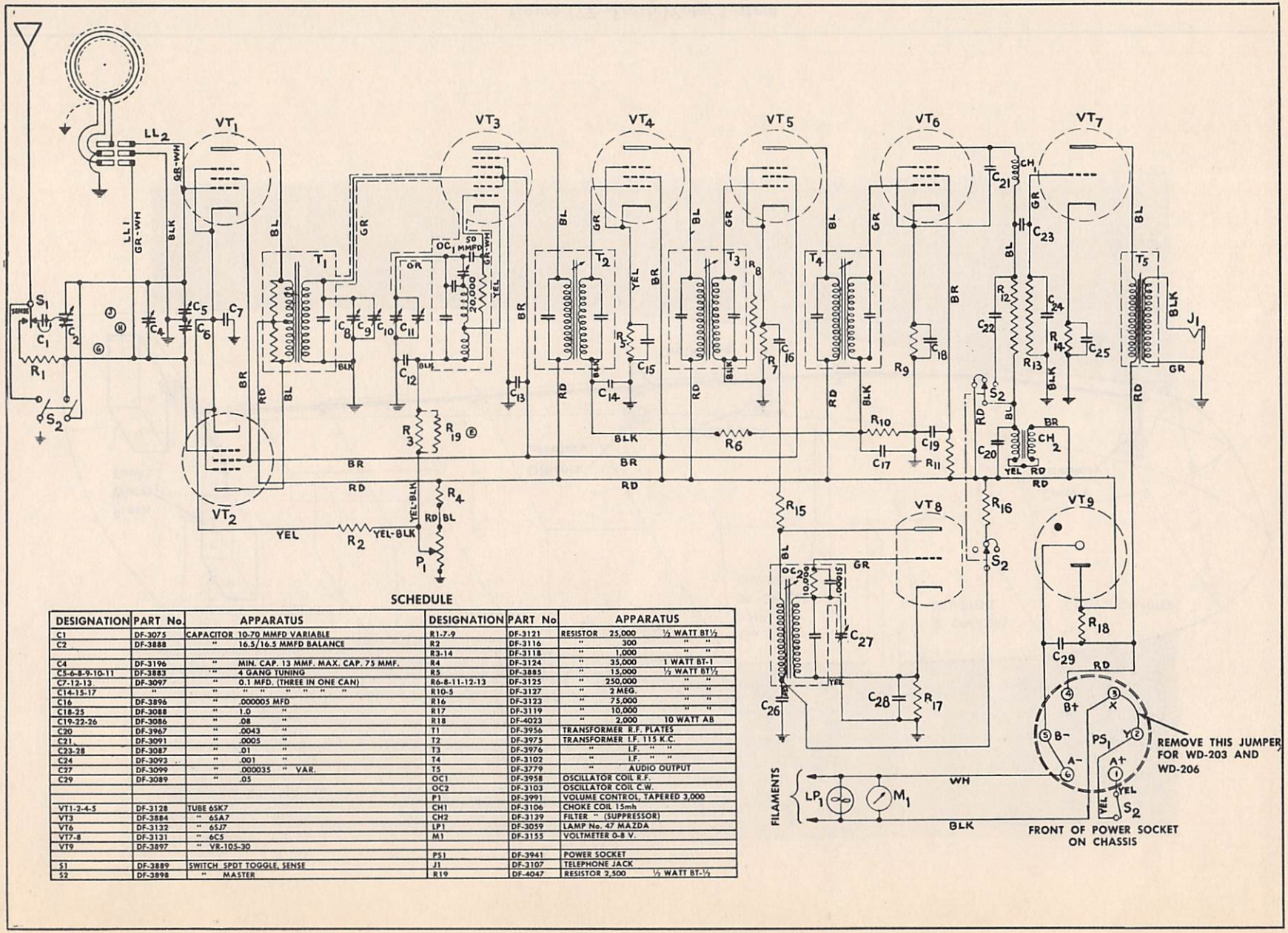
TROUBLE	*PROBABLE CAUSE*	*REMEDY*
NO VOLTAGE ON VOLTMETER	Dead battery. Poor contacts on switch or relay.	Charge or replace. Clean switch or relay contacts.
LOW VOLTAGE ON METER	Low battery. Genemotor shorted. Poor connections on batteries or in wiring.	Charge battery. If Genemotor is shorted, it will run slowly. Take red lead off Genemotor and see if it still runs slow. If so, replace filter or Genemotor. Check connections.
NO NULL	Sense antenna grounded or not in circuit. Balance control inoperative. Chassis brushes not making good contact with collector rings.	Look for poor contacts in lead-in insulator. Put balance control at "0" position. Check brush contacts.
NULL TOO WIDE	Defective or weak tubes. Sense antenna too long. Chassis has low sensitivity.	Check all tubes, or replace with spares. Shorten sense antenna by cutting jumper on antenna series condenser. Remove chassis and check sensitivity.
NO SIGNAL EVEN THOUGH BATTERY VOLTAGE IS NORMAL	Output transformer phones may be open.	Replace output transformer or phones.

Note

Various other troubles may be encountered such as open or shorted resistances and condensers in various circuits. For all electrical work follow the installation diagram *(figure 170)* and the circuit diagram. *(See figure 171.)*

Figure 170—Direction Finder Installation Wiring Diagram





SCHEDULE

DESIGNATION	PART No.	APPARATUS	DESIGNATION	PART No	APPARATUS
C1	DF-3075	CAPACITOR 10-70 MMFD VARIABLE	R1-7-9	DF-3121	RESISTOR 25,000 ½ WATT BT½
C2	DF-3888	" 16.5/16.5 MMFD BALANCE	R2	DF-3116	" 300 " "
			R3-14	DF-3118	" 1,000 " "
C4	DF-3196	" MIN. CAP. 13 MMF. MAX. CAP. 75 MMF.	R4	DF-3124	" 35,000 1 WATT BT-1
C5-6-8-9-10-11	DF-3883	" 4 GANG TUNING	R5	DF-3885	" 15,000 ½ WATT BT½
C7-12-13	DF-3097	" 0.1 MFD. (THREE IN ONE CAN)	R6-8-11-12-13	DF-3125	" 250,000 " "
C14-15-17	"	" " " " " " "	R10-5	DF-3127	" 2 MEG. " "
C16	DF-3896	" .000005 MFD	R16	DF-3123	" 75,000 " "
C18-25	DF-3088	" 1.0 "	R17	DF-3119	" 10,000 " "
C19-22-26	DF-3086	" .08 "	R18	DF-4023	" 2,000 10 WATT AB
C20	DF-3967	" .0043 "	T1	DF-3956	TRANSFORMER R.F. PLATES
C21	DF-3091	" .0005 "	T2	DF-3975	TRANSFORMER I.F. 115 K.C.
C23-28	DF-3087	" .01 "	T3	DF-3976	" I.F. " "
C24	DF-3093	" .001 "	T4	DF-3102	" I.F. " "
C27	DF-3099	" .000035 " VAR.	T5	DF-3779	" AUDIO OUTPUT
C29	DF-3089	" .05	OC1	DF-3958	OSCILLATOR COIL R.F.
			OC2	DF-3103	OSCILLATOR COIL C.W.
			P1	DF-3991	VOLUME CONTROL, TAPERED 3,000
VT1-2-4-5	DF-3128	TUBE 6SK7	CH1	DF-3106	CHOKE COIL 15mh
VT3	DF-3884	" 6SA7	CH2	DF-3139	FILTER " (SUPPRESSOR)
VT6	DF-3132	" 6SJ7	LP1	DF-3059	LAMP No. 47 MAZDA
VT7-8	DF-3131	" 6C5	M1	DF-3155	VOLTMETER 0-8 V.
VT9	DF-3897	" VR-105-30			
			PS1	DF-3941	POWER SOCKET
S1	DF-3889	SWITCH SPDT TOGGLE, SENSE	J1	DF-3107	TELEPHONE JACK
S2	DF-3898	" MASTER	R19	DF-4047	RESISTOR 2,500 ½ WATT BT-½

Figure 171—Direction Finder Circuit Wiring Diagram

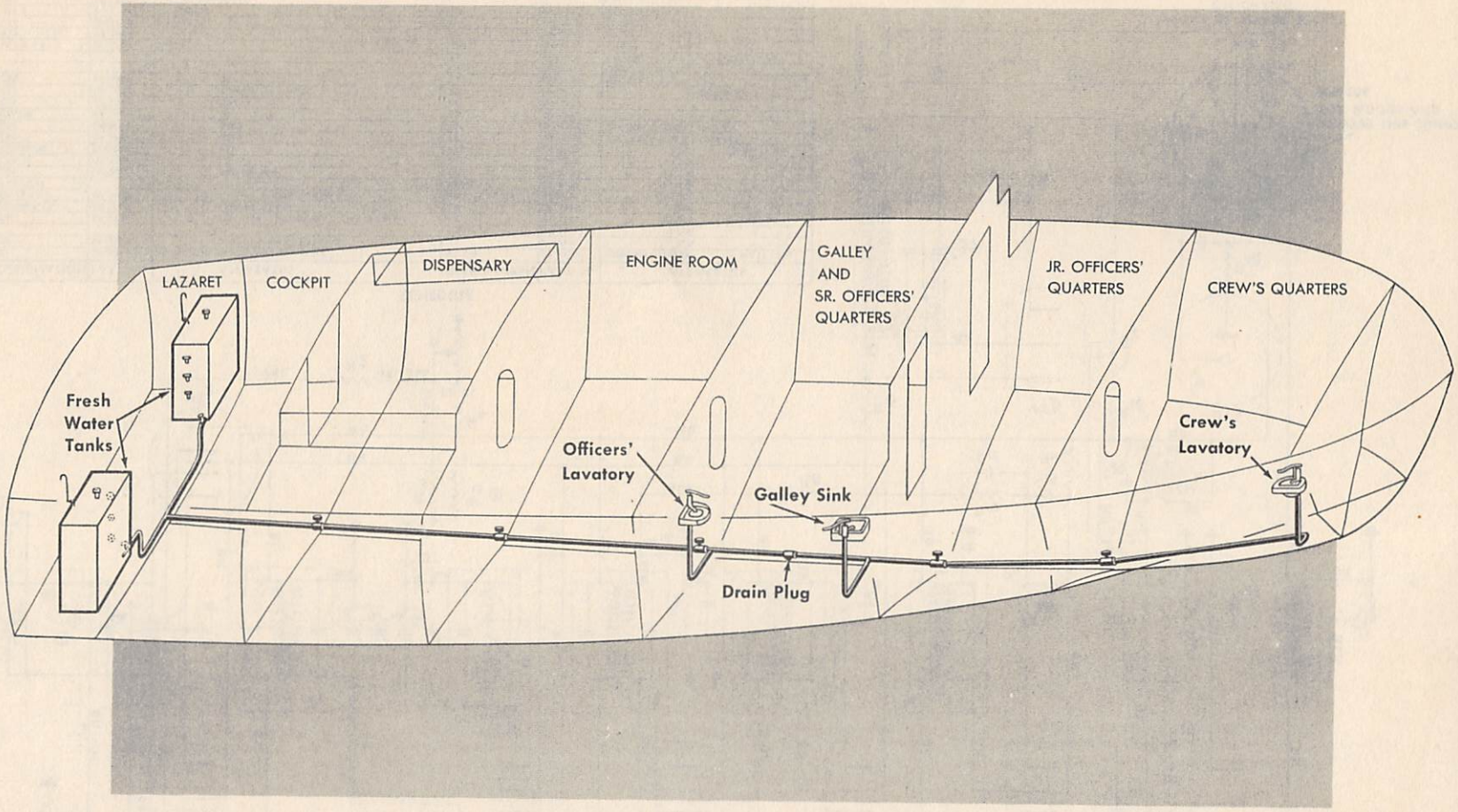


Figure 172—Fresh Water System

SECTION XIII

Fresh Water System

1. DESCRIPTION.

(See figure 172.)

a. TANKS.

(1) Two galvanized steel fresh water storage tanks are located against the lazaret forward bulkhead, one on each side, port and starboard. Each tank holds 75 gallons. *(See figure 173.)*

(2) Each tank is fitted with two transverse baffles to prevent undue motion of the water, a filler pipe connection on the top side, a vent pipe connection on the top of the after side, an inspection plate in the after side, an outlet pipe connection near the bottom on the inboard side, a drain plug in the bottom, and three petcocks for measuring along the inboard side.

(3) The filler pipe for each tank connects to a deck filler cap in the cockpit seat. The vent pipe for each tank goes up behind the cockpit seat to a point higher than the filler cap.

b. PIPE LINES.—Five-eighths inch copper tubing leads from the tank outlet connections to the fresh water connections in the boat. The lines from the two tanks join in a tee in the lay-out and run forward above the keel. A drain plug is fitted in a tee in the line in the galley compartment. Each tank line is regulated by a gate valve near the tank.

c. FIXTURES.

(1) The fresh water lines connect to the following fixtures in the boat:

(a) The lavatory in the officers' wash room.

(b) The sink in the galley.

(c) The lavatory in the crew's wash room.

(2) Each of these fresh water fixtures is equipped with a hand pump to pump water from the lines and tanks to the fixture. The pumps are of standard design, employing a flap valve and ball check valve mechanism. Some boats are equipped with pumps having a shut-off valve in the spout.

2. OPERATION INSTRUCTIONS.

a. The 63-foot rescue boat can carry only 150 gallons of fresh water for drinking, cooking, and washing purposes of the entire crew. On long trips and in territory where drinking water is a problem, water discipline is of utmost importance and is the responsibility of the boat's master.

b. Unless the use of water is being restricted, both tank valves are usually left open. If water is being rationed, one tank may be shut off to save that water for emergencies.

c. Operate the hand pumps to draw water at either lavatory or the galley sink.

Note

When one pump is being operated, water may leak at one or both of the others because of the pressure in the lines. If this happens, insert plugs in the pump spouts at all times when they are not being used. *(See figure 174.)*

d. Fill the tanks before leaving on a trip and at any stop where fresh water is available.

e. To check the level of water in the tanks, open the

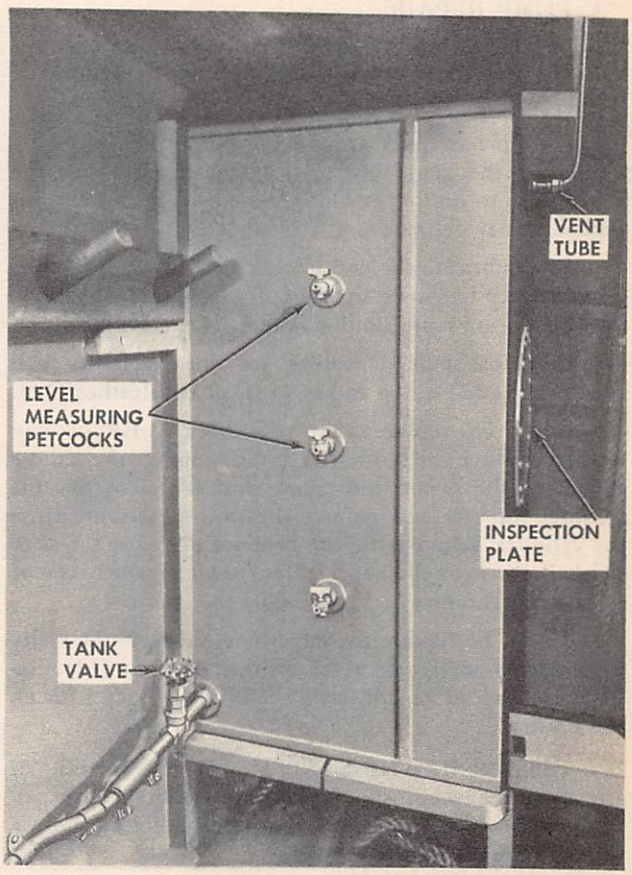


Figure 173—Starboard Fresh Water Tank

petcocks in the side of the tanks one at a time and observe at which one water flows. The water level can also be measured with a dip stick. Make sure the stick is clean, dry, and unpainted. If both tank valves are kept open it is necessary to measure only one tank since both tanks will maintain the same level.

3. SERVICE AND MAINTENANCE.

a. FILLING THE TANKS.

(1) Make sure the water supply is pure and fit for drinking.

(2) Wash the cockpit seat clean around the filler connections so that dirt will not fall into the tank when the filler cap is removed.

(3) Remove the filler cap. Use the special key.

(4) Run a hose from the shore connection to the tank. Do not turn on the water until the end of the hose is in the filler pipe. *(See figure 175.)* Turning it on sooner and spilling water on the deck or cockpit seat may wash dirt into the tank.

Note

A hose is the most convenient method of filling the tanks. If a hose is not available, carry the water in a suitable clean vessel and pour it through a funnel.

(5) When the tank is filled, reinstall the filler cap immediately.

b. PUMP REPAIR.

Note

The references in this paragraph are to figure 176.

(1) Correct leaks around the pump piston rod by tightening the gland nut (20) finger tight. When the gland nut can no longer be tightened, remove it and install some new felt packing (21) under it.

(2) Lubricate the cup leather (22) every 6 months or whenever it shows signs of drying out. Use tallow, mineral oil, or some similar sanitary, tasteless lubricant.

(3) Most pump troubles are due to faulty ball check valves (24), flap valves (14), or cup leather (22).

(a) To replace the ball check valve or cup leather, remove the screw (6) and disconnect the handle (1) from the piston rod connection (8). Unscrew the cylinder top (4) and remove the piston assembly from the cylinder. Remove the cup retainer (23) for access to the ball check or the cup leather. Replace whichever of these items is faulty and reassemble the pump.

(b) To replace the flap valve, unscrew the cylinder body assembly from the cylinder bottom (13). Replace the flap valve and screw the cylinder body back on the bottom.

c. CLEANING THE SYSTEM.—Once a month, or any time the water should become polluted with salt water or otherwise rendered unfit to drink, clean the system as follows:

(1) Turn off the gate valve by each tank.



Figure 174—Plug Installed in Lavatory Pump

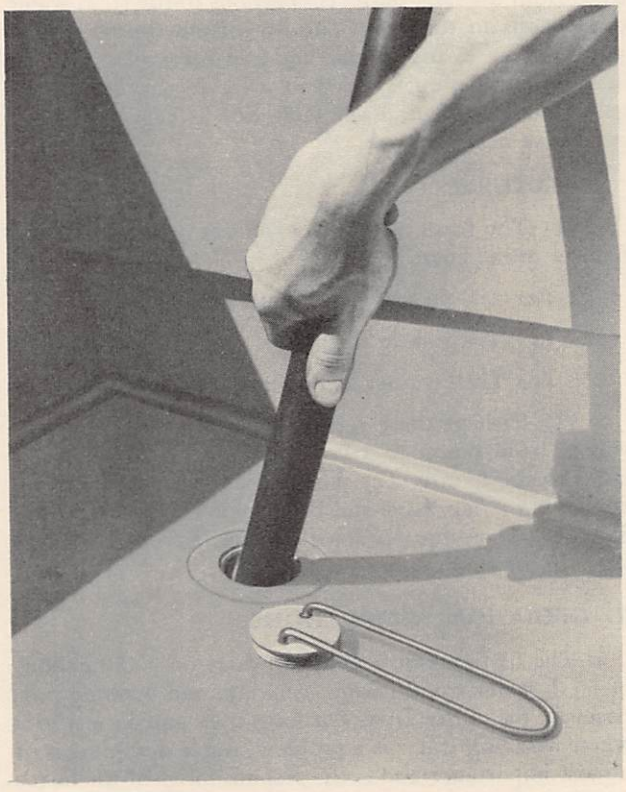


Figure 175—Filling Fresh Water Tanks

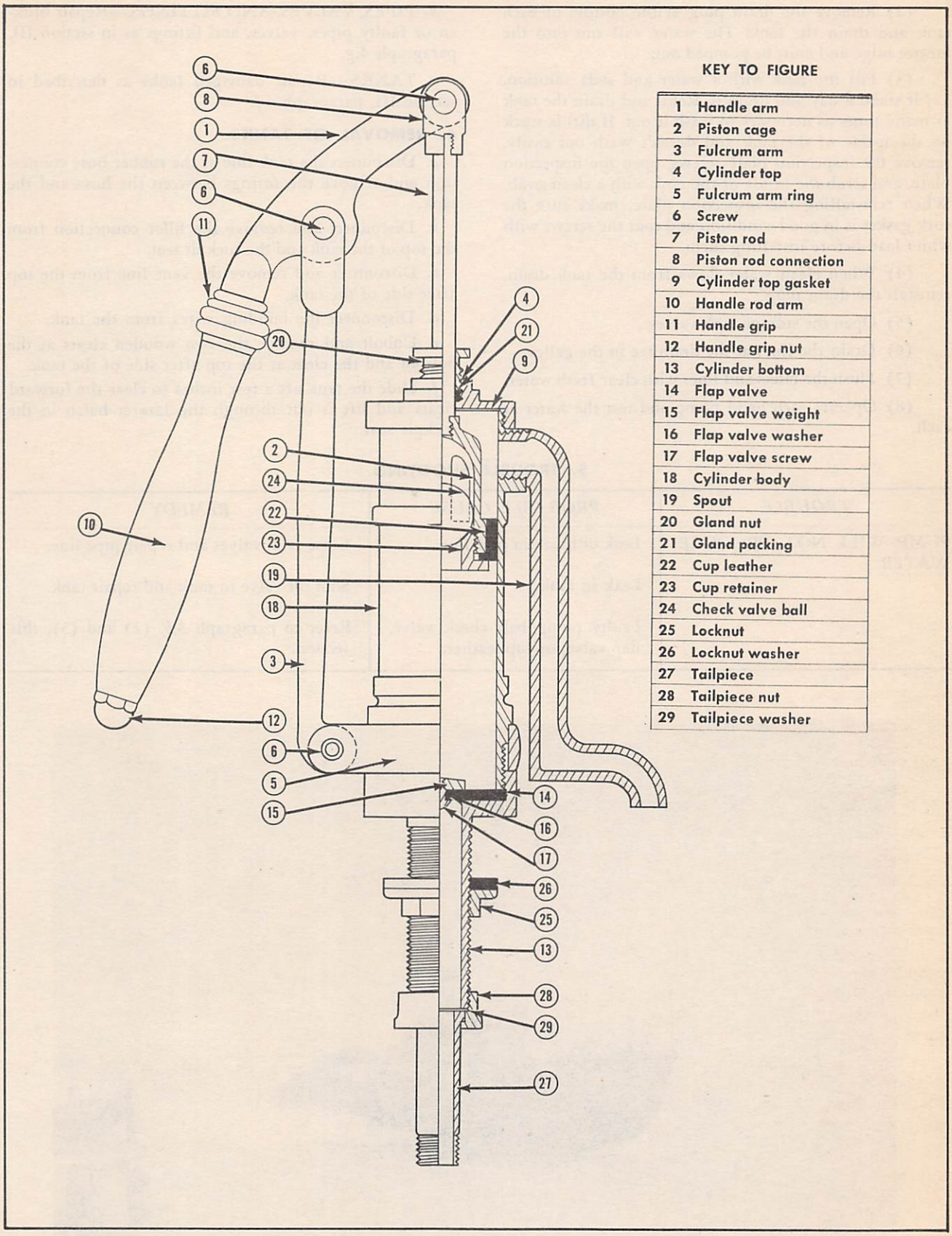


Figure 176—Cutaway View of Hand Pump

(2) Remove the drain plug at the bottom of each tank and drain the tank. The water will run into the lazaret bilge and must be pumped out.

(3) Fill the tank with a water and soda solution. Let it stand a day and drain it. Refill and drain the tank as many times as necessary to wash it out. If dirt is stuck on the inside of the tank and doesn't wash out easily, remove the inspection plate screws, open the inspection plate, and scrub the inside of the tank with a clean swab. When reinstalling the inspection plate, make sure the cork gasket is in good condition and coat the screws with white lead before installing them.

(4) When clean water flows from the tank drain, reinstall the drain plug.

(5) Open the storage tank valves.

(6) Drain the lines at the drain tee in the galley.

(7) Flush the tanks and lines with clear fresh water.

(8) Operate each hand pump and test the water at each.

d. PIPES, VALVES, AND FITTINGS.—Repair broken or faulty pipes, valves, and fittings as in section III, paragraph 4.*g.*

e. TANKS.—Repair damaged tanks as described in section III, paragraph 4.*f.*

4. REMOVAL OF TANKS.

a. Disconnect the tank line at the rubber hose connection and remove the fittings between the hose and the tank.

b. Disconnect and remove the filler connection from the top of the tank and the cockpit seat.

c. Disconnect and remove the vent line from the top after side of the tank.

d. Disconnect the bonding wires from the tank.

e. Unbolt and remove the two wooden cleats at the bottom and the cleat at the top after side of the tank.

f. Slide the tank aft a few inches to clear the forward cleats and lift it out through the lazaret hatch in the cockpit seat.

5. TROUBLE SHOOTING.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
PUMP WILL NOT PRODUCE WATER	Leak or break in pipe line.	Close tank valves and repair pipe line.
	Leak in tank.	Shut off valve to tank and repair tank.
	Faulty pump ball check valve, flap valve, or cup leather.	Refer to paragraph 3.*b.* (2) and (3), this section.



SECTION XIV

Sanitation System

1. DESCRIPTION.

(See figure 177.)

The sanitation system consists of the following components:

a. OFFICERS' TOILET.—The officers' toilet is located in the after outboard corner of the officers' wash room. Intake is made through a line of 3/4-inch copper tubing connecting with a seacock inboard of the toilet near the galley and officers' quarters compartment after bulkhead. Discharge is made through a line of 1 5/8-inch copper tubing to a seacock directly behind the toilet. A check valve in the intake line helps keep the toilet pump primed.

b. CREW'S TOILET.—The crew's toilet is installed in the crew's washroom forward. Intake is made through 3/4-inch copper tubing connecting with a seacock aft of the toilet on the port side of the keel. Discharge is made through 1 5/8-inch copper tubing to a seacock behind the toilet on the starboard side. There is a check valve in the intake line. *(See figure 178.)*

c. OFFICERS' LAVATORY DRAIN.—This line of 3/4-inch copper tubing drains from the officers' lavatory in the after inboard side of the officers' wash room to a seacock in the hull on the outboard side of the room.

d. GALLEY SINK DRAIN.—This line of 1 1/8-inch copper tubing leads from the galley sink to a through-hull fitting outboard of the sink.

e. CREW'S LAVATORY DRAIN.—This line of 3/4-inch copper tubing leads from the crew's lavatory in the after port corner of the crew's wash room to a seacock directly below the lavatory.

f. ICE BOX DRAIN.—The ice box in the galley drains through a line of 1-inch copper tubing to an open through-hull fitting directly behind it in the starboard hull.

2. PRINCIPLES OF OPERATION.

a. DRAINS.—The lavatory, galley sink, and ice box drains operate by gravity. A length of rubber hose in the drain line takes up vibration.

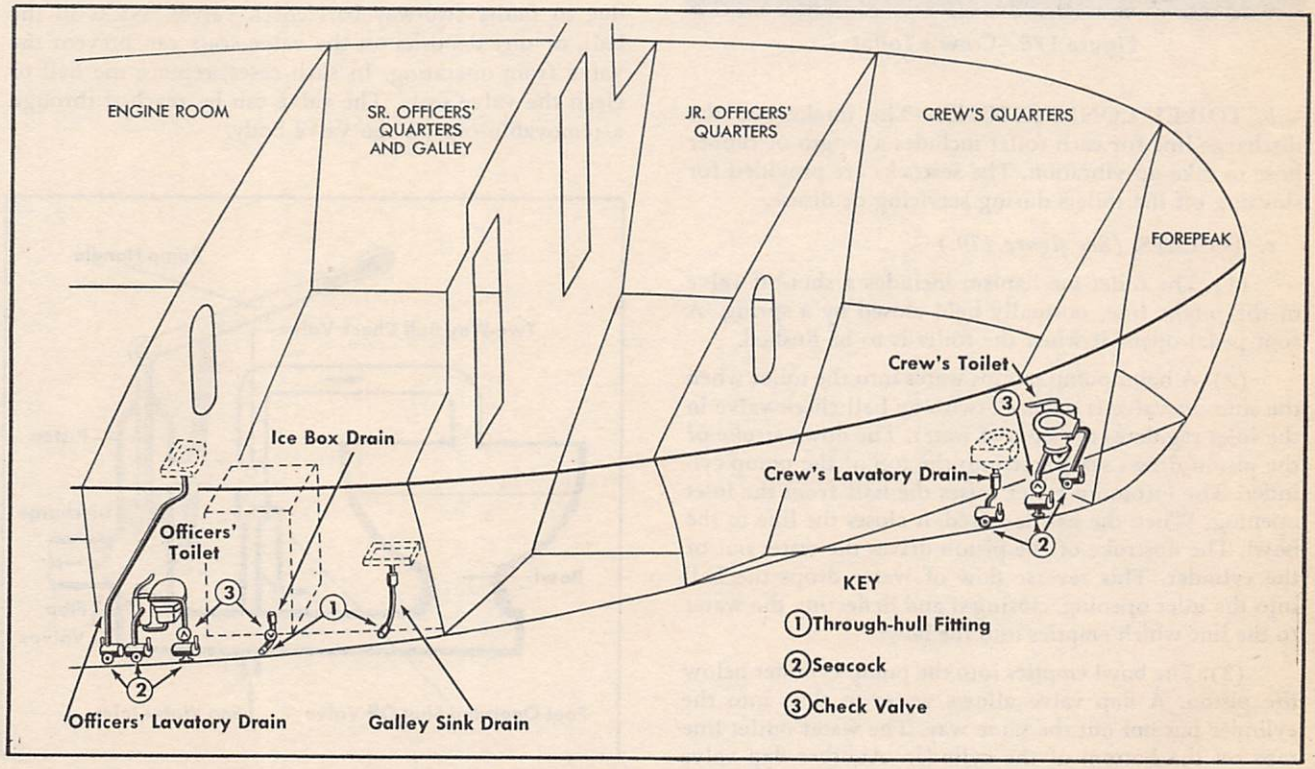


Figure 177—Sanitation System

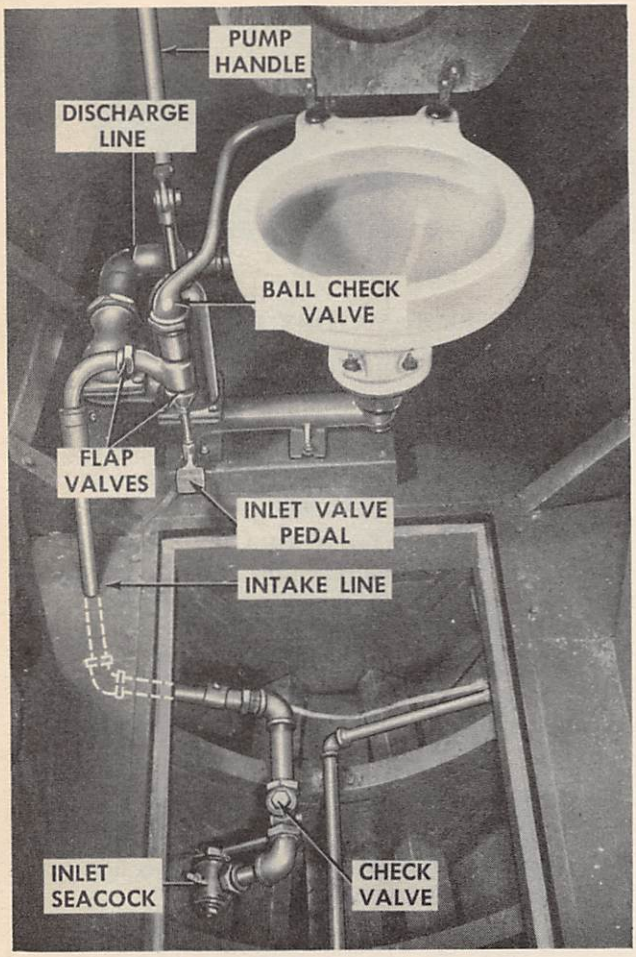


Figure 178—Crew's Toilet

b. TOILET CONNECTIONS.—The intake and the discharge line for each toilet includes a length of rubber hose to take up vibration. The seacocks are provided for shutting off the toilets during servicing or disuse.

c. TOILETS. *(See figure 179.)*

(1) The toilet mechanism includes a shut-off valve in the intake line, normally held closed by a spring. A foot pedal opens it when the toilet is to be flushed.

(2) A hand pump pumps water into the toilet when the shut-off valve is open. A two-way ball check valve in the inlet regulates the flow of water. The down stroke of the piston draws sea water into the top of the pump cylinder. The incoming water raises the ball from the inlet opening. When the ball is raised, it closes the line to the bowl. The upstroke of the piston drives the water out of the cylinder. This reverse flow of water drops the ball into the inlet opening, closing it and deflecting the water to the line which empties into the bowl.

(3) The bowl empties into the pump cylinder below the piston. A flap valve allows water to flow into the cylinder but not out the same way. The water outlet line taps off the bottom of the cylinder. Another flap valve in the outlet allows water to flow outward only.

(4) The up stroke of the piston closes the water outlet valve, opens the bowl valve, and draws the water from the bowl into the cylinder. The down stroke of the piston closes the bowl valve, opens the outlet valve, and drives the water into the discharge line.

3. OPERATION INSTRUCTIONS.

a. The seacocks in the toilet intake and drain lines should be left open normally. The seacock is open when the handle is parallel to the flow. *(See figure 180.)*

b. Step on the foot pedal to open the inlet valve while the toilet is being flushed.

c. Operate the pump until the toilet bowl is flushed. Pump a few more strokes after the toilet is flushed in order to clear the pump and discharge lines.

d. If the discharge line becomes plugged up, release the foot pedal and continue pumping. In this way all the pump pressure will be on the discharge line and it will not suck more water into the bowl.

e. Do not throw matches, wads of paper, or other foreign matter into the toilet bowl; they will plug up the discharge line. Matches especially often catch in the flap valves and prevent them from closing fully.

f. Leave the seacocks in the sink and lavatory drain lines open normally.

g. Do not flush down grease, paint, or other material which will coat or clog the pipes.

4. SERVICE AND MAINTENANCE.

a. TOILETS.

(1) The most frequent trouble with the toilets is due to faulty two-way ball check valves. Nicks in the ball, or dirt deposits on the valve seats can prevent the valve from operating. In such cases, replace the ball or clean the valve seats. The valve can be reached through a removable cap on the valve body.

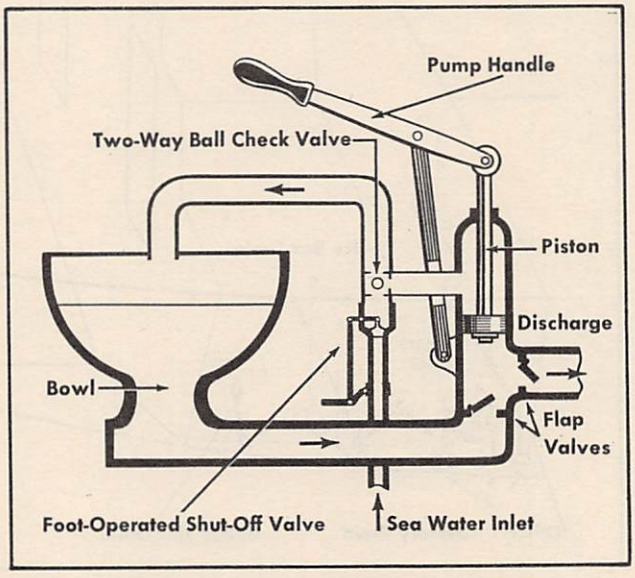


Figure 179—Schematic Diagram of Toilet

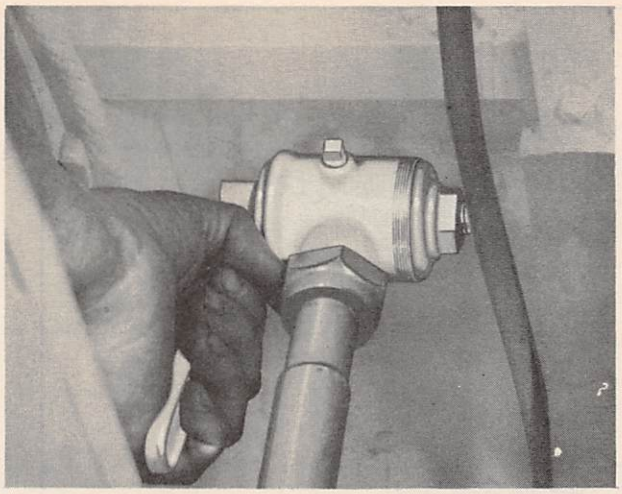


Figure 180—Opening a Seacock

(2) Leaking pump pistons should be removed and the cup leather replaced.

(3) Keep the packing nut around the piston rod tightened so it does not leak. When necessary, renew the packing under the nut. Ordinary cotton string is suitable for packing.

(4) Faulty flap valves in the discharge connections should be cleaned or replaced. If the toilet is allowed to dry and the flap valves dry and harden, they must be replaced.

(5) If the toilet is not used for a long period, it may lose its prime and will not pump. In such cases, pour a pail of water into the bowl and flush it down.

(6) In case of a break in the inlet line between the sea chest and the toilet, close the inlet line gate valve to prevent leakage into the boat until the break is repaired.

(7) If the boat lies idle for a long time and the toilets are not used, the inlet seacock opening may become clogged with marine growth and must be cleaned out.

(8) Each boat should carry at least one kit of spare parts for each toilet. These kits contain proper two-way ball check valves, piston gaskets, flap valves, and other parts which are replaced frequently.

b. DRAINS.

(1) In case of a leak or break in the pipe line between a toilet, sink, or lavatory and the seacock, turn off the seacock to prevent water from splashing up through the drain and out the break in the pipe.

(2) If the flow of water through a sink or lavatory drain line is sluggish, remove and clean the strainer.

(3) If the drain is still sluggish, flush it out with a lye solution.

(4) Flush all the drains with a lye solution at the time of every overhaul.

(5) Make repairs in pipes, valves, and fittings as in section III, paragraph 4.*g*.

5. TROUBLE SHOOTING.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
TOILET PUMP WILL NOT PRIME	Inlet seacock closed.	Open seacock.
	Toilet dry.	Refer to paragraph 4.*a.*(5), this section.
	Faulty check valve.	Refer to paragraph 4.*a.*(1), this section.
	Faulty piston cup leather.	Replace cup leather.
	Plugged inlet line seacock.	Clean seacock.
	Broken inlet line.	Close inlet line seacock and repair line.
	Faulty inlet line check valve.	Replace check valve.
TOILET PRIMES BUT DOES NOT SEND WATER TO BOWL	Faulty check valve.	Refer to paragraph 4.*a.*(1), this section.
	Faulty piston cup leather.	Replace cup leather.
TOILET BOWL FILLS WITH WATER FASTER THAN IT IS PUMPED OUT	Outlet seacock closed.	Open seacock.
	Faulty flap valves.	Clean or replace flap valves.
	Clogged drain line.	Close inlet shut off valve and operate pump.
SINK OR LAVATORY DOES NOT DRAIN OR DRAINS SLOWLY	Seacock closed.	Open seacock.
	Sink strainer clogged.	Clean strainer.
	Line clogged.	Flush line with lye solution.
BREAK IN DRAIN LINE		Close seacock. Do not use until break is repaired.

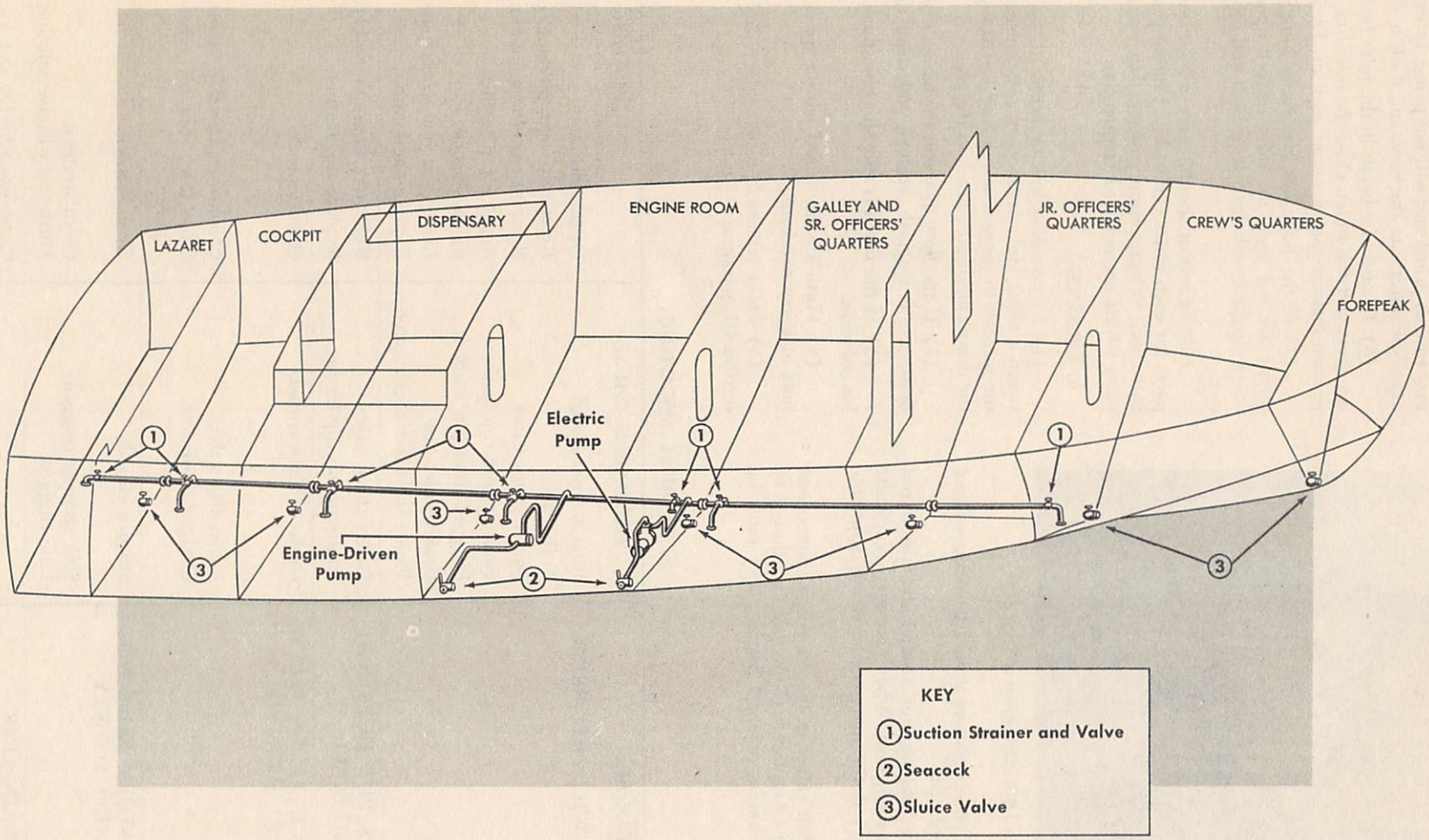


Figure 181—Bilge Pumping System

SECTION XV

Bilge Pumping System

1. DESCRIPTION.

(See figure 181.)

a. GENERAL.—The bilges can be pumped by either a pump mounted on the starboard engine or an electric centrifugal pump. Each pump discharges overboard through its own seacock. The bilge pipes run fore and aft with suction strainers in all compartments except the forepeak and crew's quarters. Sluice valves are also provided through all the watertight bulkheads. Each compartment except the forepeak and the lazaret is provided with a limber chain.

b. PIPING, STRAINERS, AND VALVES.

(1) The bilge line of 1⅜-inch hard copper tubing runs along the keel from the lazaret to the junior officers' quarters compartment. Watertight through-bulkhead fittings are provided where the bilge piping passes through the bulkheads.

(2) A bilge strainer line with a gate valve *(figure 182)* taps off the main bilge line at the after end of the transom, the cockpit compartment, and the galley and senior officers' quarters compartment, the forward and the after end of the engine room compartment, and the center of the junior officers' quarters compartment.

(3) A sluice valve is fitted through the bottom of each watertight bulkhead near the center. The sluice valve consists of a gate valve attached to a ¾-inch nipple in a through-bulkhead fitting.

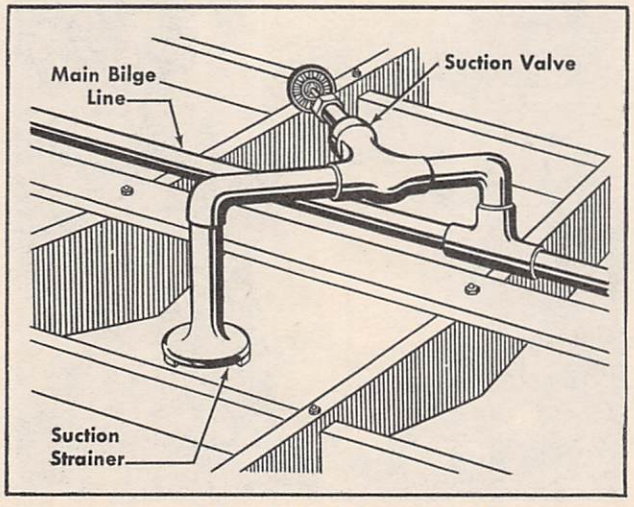


Figure 182—Typical Suction Strainer and Valve Assembly

(4) The line from the main bilge line to the engine-driven pump is of 1⅛-inch hard copper tubing. It is fitted with a rubber hose connection to take up vibration, and a check valve to help maintain the pump prime. *(See figure 183.)* The pump discharges through another line of 1⅛-inch tubing to a seacock in the starboard side of the hull above the waterline near the pump. It is also fitted with a rubber hose connection.

(5) The line from the main bilge line to the electric pump is similar to the one for the engine-driven pump except that it is of 1⅜-inch hard copper tubing. The intake line includes a check valve, the discharge line connects to a seacock near the pump *(figure 184)* and both lines are fitted with rubber hose connections.

c. ENGINE-DRIVEN BILGE PUMP.—The engine-driven bilge pump *(figure 185)* is mounted on the after end of the starboard engine. It is a vane-type pump operated through a clutch by the engine.

d. ELECTRIC BILGE PUMP. *(See figure 186.)* The electric pump is a Deming self-priming centrifugal type, model 3302. It is operated by a ¼-hp, 1750 rpm, 24-volt motor. The pump body is bolted to the motor

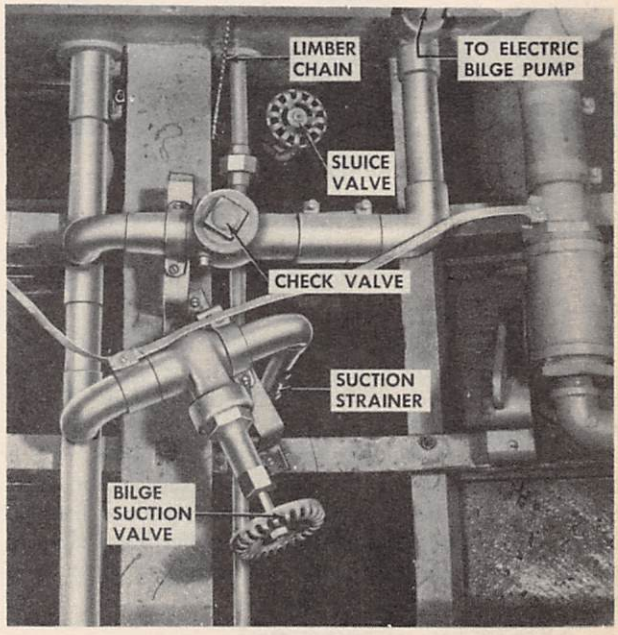


Figure 183—Bilge Pumping System Fittings in Forward Part of Engine Room

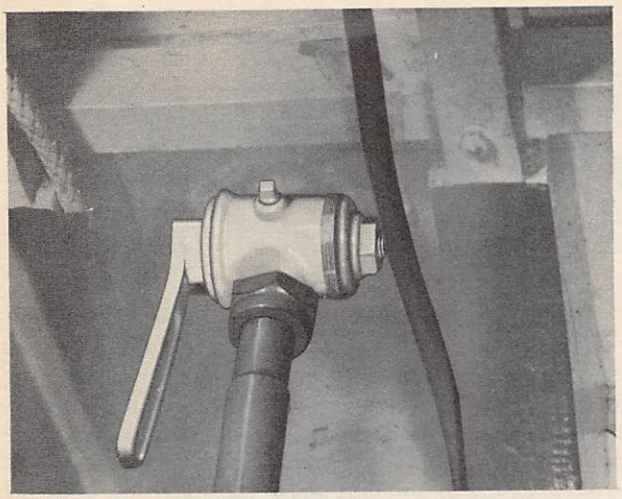


Figure 184—Electric Bilge Pump Discharge Seacock

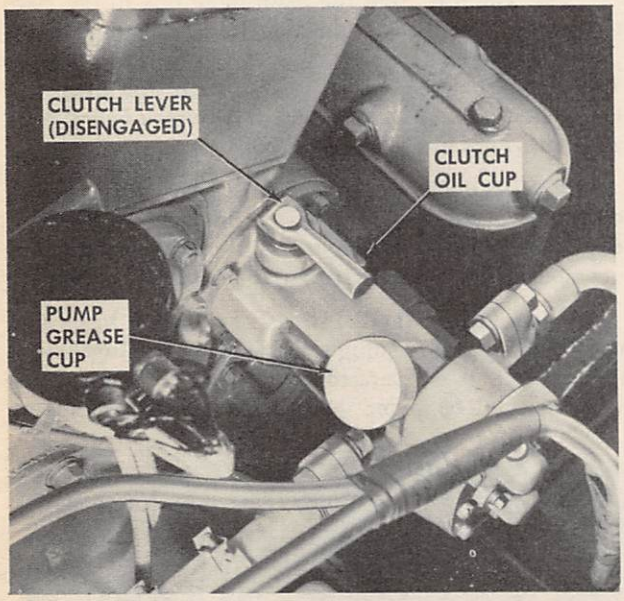


Figure 185—Engine-Driven Bilge Pump

frame and the impeller is mounted directly on the motor shaft with a lock nut. An intake chamber with a check valve and a discharge chamber maintain the pump prime when it is not operating.

e. LIMBER CHAINS. *(See figure 187.)*—In each compartment except the forepeak and the lazaret a limber chain passes through holes in the bottom of each frame just above the keel. Each chain is fastened by a spring at one watertight bulkhead. The other end is brought up through a block along the face of the other bulkhead to a point where it can be operated conveniently. The limber chains keep the limber holes clear so the water can drain through the frames to the suction strainer.

2. OPERATION INSTRUCTIONS.

a. Keep all the suction strainer valves and all the sluice valves closed tightly when the bilges are not being pumped. The discharge seacocks may be left open when not in use, and *must* be opened before starting to pump the bilges.

b. If the starboard main engine is running, engage the engine-driven bilge pump. Turn the clutch handle counterclockwise, so that it is at right angles to its disengaged position. *(See figure 188.)* The pump will prime automatically.

c. If the starboard main engine is not operating, use the electric bilge pump. Turn on the bilge pump switch on the main switchboard.

d. As soon as either bilge pump is operating, open the suction strainer valve or valves in the bilges to be pumped. Access to the valves is made as follows:

(1) Lazaret—In the after end of the lazaret.

(2) Cockpit compartment—Through the cockpit deck hatch. The valve is in the center of the after cockpit floor.

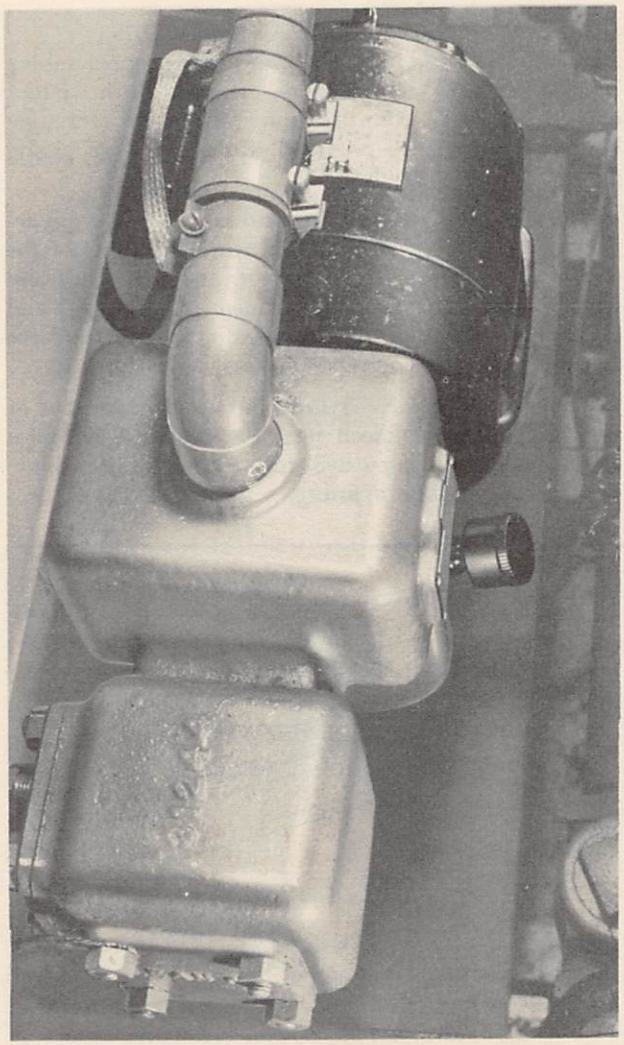


Figure 186—Electric Bilge Pump Installation

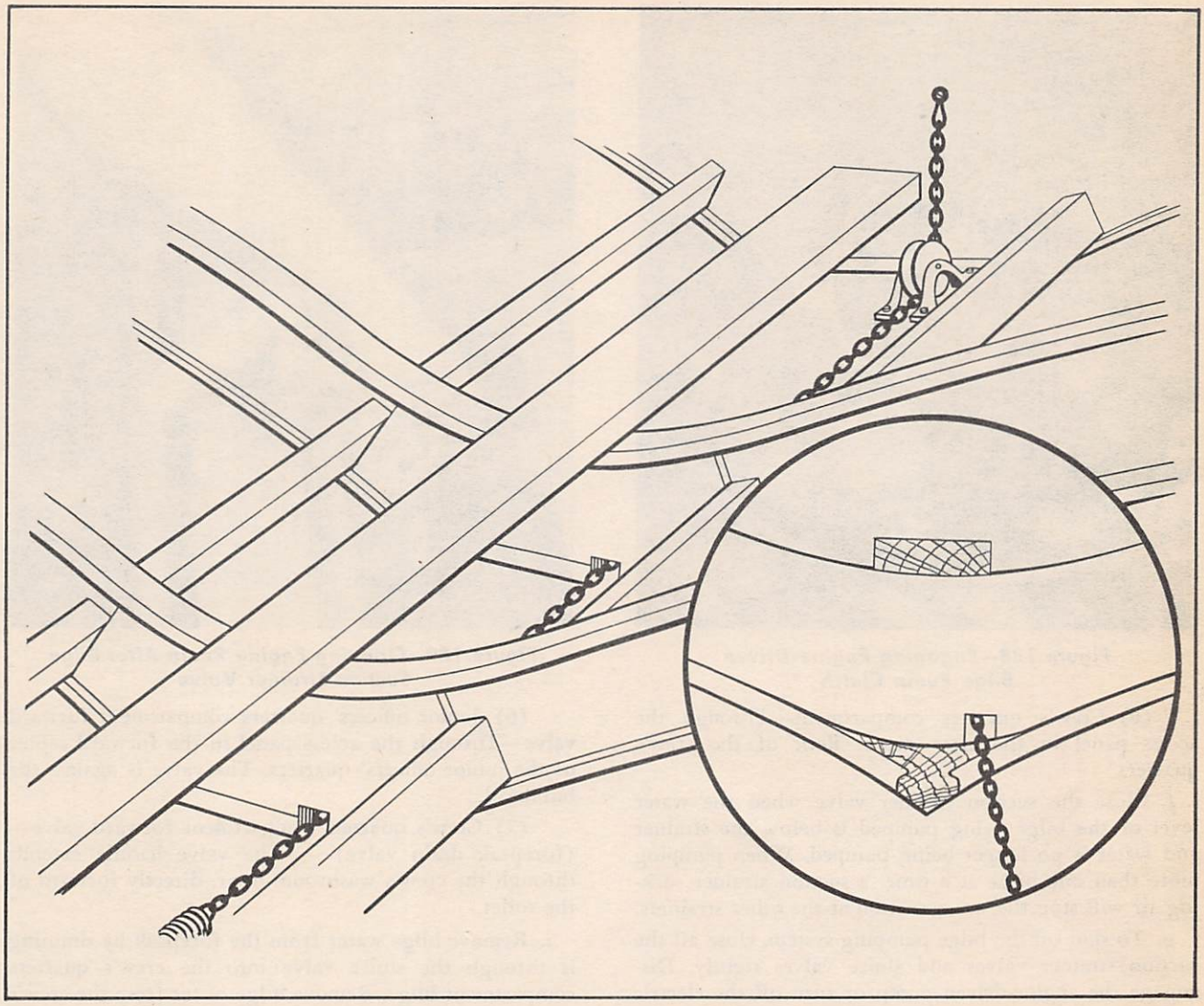


Figure 187—Typical Limber Chain Installation

(3) Dispensary compartment—Through the access panel in the center of the dispensary floor. The valve is aft of the access opening.

(4) Engine room compartment after valve—Through the access panel in the after center floor in the engine room. *(See figure 189.)*

(5) Engine room compartment forward valve—Through the access panel in the forward center floor of the engine room.

(6) Galley and senior officers' quarters compartment—Through the access panel in the after floor of the galley passage just forward of the galley to engine room door.

(7) Junior officers' quarters compartment—Through the access panel in the center forward floor of the junior officers' quarters. The valve is about 4 feet aft of the bulkhead.

e. While a bilge is being pumped, agitate the limber chain in the compartment to clear the holes and allow the water to flow through the holes to the suction strainer. Access to the limber chains is made as follows:

(1) Cockpit compartment—Under the cockpit deck. The chain is brought up against the forward bulkhead.

(2) Dispensary compartment—Through the access panel in the center of the dispensary floor. The chain is brought up against the after bulkhead.

(3) Engine room compartment—Against the engine room forward bulkhead, below the engine room to the galley door.

(4) Galley and senior officers' quarters compartment—Through the access panel in the after floor of the galley passage, just forward of the galley to engine room door.

(5) Junior officers' quarters compartment—Through the access panel in the forward center floor of the junior officers' quarters. The chain is against the forward bulkhead.

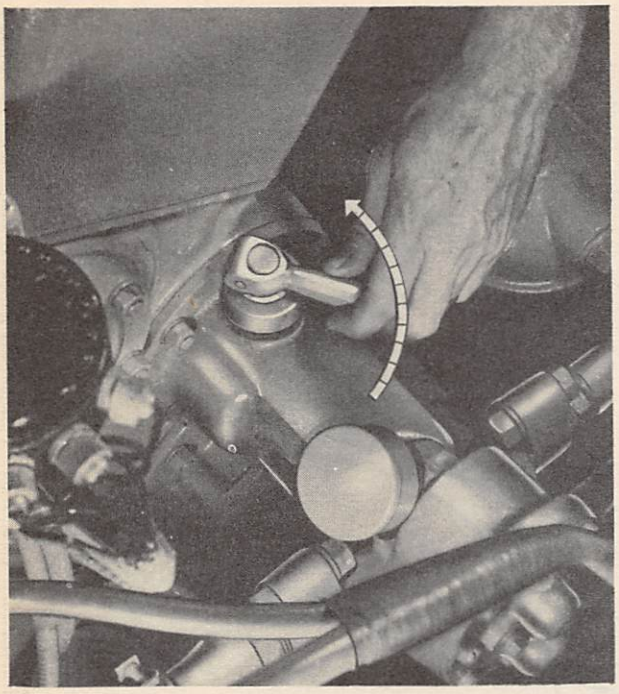


Figure 188—Engaging Engine-Driven Bilge Pump Clutch

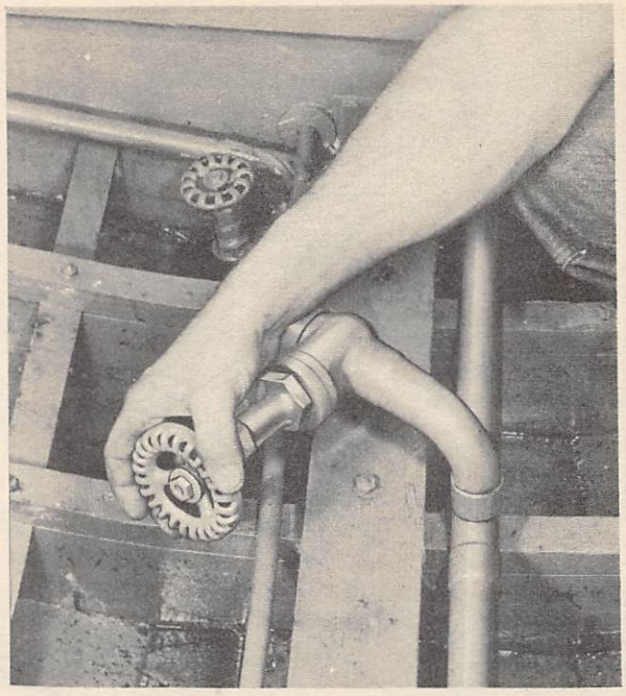


Figure 189—Opening Engine Room After Bilge Suction Strainer Valve

(6) Crew's quarters compartment—Through the access panel in the after center floor of the crew's quarters.

f. Close the suction strainer valve when the water level of the bilge being pumped is below the strainer and water is no longer being pumped. When pumping more than one bilge at a time, a suction strainer sucking air will stop the water suction at the other strainers.

g. To shut off the bilge pumping system, close all the suction strainer valves and sluice valves tightly. Disengage the engine-driven pump or turn off the electric pump switch.

h. The through-bulkhead sluice valves are provided so that water from one compartment can be drained into another and pumped out in case of failure or plugging of part of the system. These valves should be closed tightly when not in use. Access to the sluice valves is as follows:

(1) Lazaret drain valve—In the lazaret, under the ladder.

(2) Cockpit compartment forward valve—Under the cockpit deck. The valve is in the forward bulkhead.

(3) Dispensary compartment forward valve—Through the access panel in the after center floor of the engine room. *(See figure 190.)*

(4) Engine room compartment forward valve—Through the access panel in the forward center floor of the engine room.

(5) Galley and senior officers' quarters compartment forward valve—Through the access panel in the forward center floor of the compartment, under the galley forward seat.

(6) Junior officers' quarters compartment forward valve—Through the access panel in the forward center of the junior officers' quarters. The valve is against the bulkhead.

(7) Crew's quarters compartment forward valve—(forepeak drain valve) — The valve handle extends through the crew's washroom floor, directly forward of the toilet.

i. Remove bilge water from the forepeak by draining it through the sluice valve into the crew's quarters compartment bilge. Remove bilge water from the crew's quarters bilge by draining it through the sluice valve into the junior officers' quarters compartment bilge and pumping it out from there.

3. SERVICING, LUBRICATION, AND MAINTENANCE.

a. PIPE LINES AND VALVES.

(1) Refer to Section III, paragraph 4.*g.* for repairs of pipes, valves, and fittings.

(2) Clean the bilge strainers whenever they appear to be clogged.

(a) Reach under the strainer and wipe it clean with the hand, a rag, or a stick.

(b) Access to the strainers is made at the same places as access to the valves.

(3) A break or large leak any place in the main bilge line will cause the entire system to stop operating, as the pump will suck air rather than water. In case of such a break, turn off the pump immediately and make the necessary repairs.

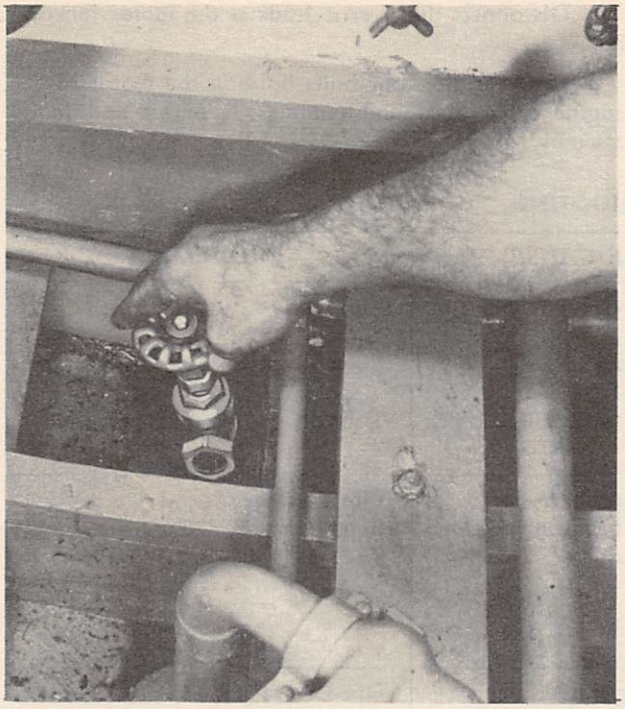


Figure 190—Opening Dispensary Compartment Forward Sluice Valve

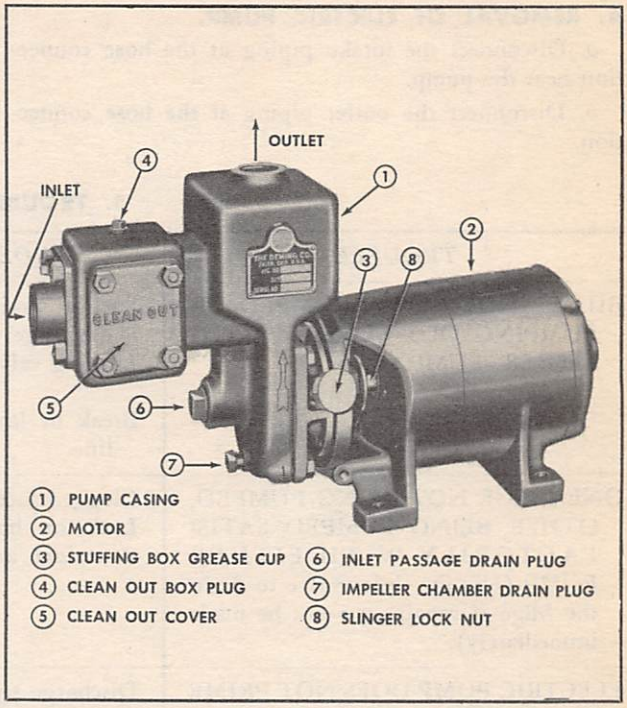


Figure 191—Electric Bilge Pump

(4) A leaking suction strainer valve will affect the system in the same way after the bilge in that compartment is sucked dry. In an emergency, when other bilges must be pumped and there is no time to repair the valve, close the strainer with tape or rags to keep it from sucking air.

(5) In case of a leak or a break between a suction strainer and its valve, close the valve. The rest of the system can continue to operate.

(6) In case of a leak between a pump line check valve and the overboard discharge, turn off the pump and use the other one until repairs are made.

b. ENGINE-DRIVEN PUMP.

(1) LUBRICATION.—Turn down the grease cup one turn before starting and every 3 hours of running. When the cup is turned all the way down, refill it with water pump grease, U. S. Army Specification No. 2-109, Amendment 2.

(2) Keep the clutch box filled with the same oil as is used in the main engines. Fill the clutch box through the oil cup at the top of the pump.

c. ELECTRIC PUMP.

The references in the following subparagraphs are to figure 191.

(1) LUBRICATION.

(a) Keep the stuffing box filled with water pump grease, U. S. Army Specification No. 2-109, Amendment 2. Turn down the grease cup (3) one turn every hour of running.

(b) Turn down the grease cups of the motor one turn every 3 hours of running. Fill the cups when necessary with alemite grease.

(2) If the pump and suction lines are emptied of water, the pump may have to be primed before it will operate. To do this, remove the pipe plug in the clean-out box (4), and fill the pump with water. Replace the plug and start the pump.

(3) Foreign matter fouling the impeller will reduce the action of the pump. Clean the impeller by removing the drain plug in the front of the inlet passage (6) and removing the foreign matter with a wire or hook. If this is not satisfactory, remove the casing (1) to reach the impeller.

(4) If the check valve in the inlet chamber is fouled so it will not close tightly, the water in the pump may drain back out and lose the pump's prime. To clean and check this valve, remove the clean-out cover (5).

(5) To check the priming action of the pump and locate air leaks, remove the suction line connection of the pump and plug the pump opening. Fill the pump with water and attach a vacuum gage to the clean-out box plug (4). Turn on the pump. If the gage registers 13 to 14 inches Hg vacuum, the pump is tight and free of air leaks.

(6) If the stuffing box is not properly lubricated, the rotary seal may wear too much and cause air leaks. In such a case, the pump must be removed and disassembled to refinish or replace the sealing surfaces.

(7) The clearance between the impeller and the pump casing can be adjusted by loosening the slinger lock nut (8) and turning the shaft sleeve in or out.

4. REMOVAL OF ELECTRIC PUMP.

a. Disconnect the intake piping at the hose connection near the pump.

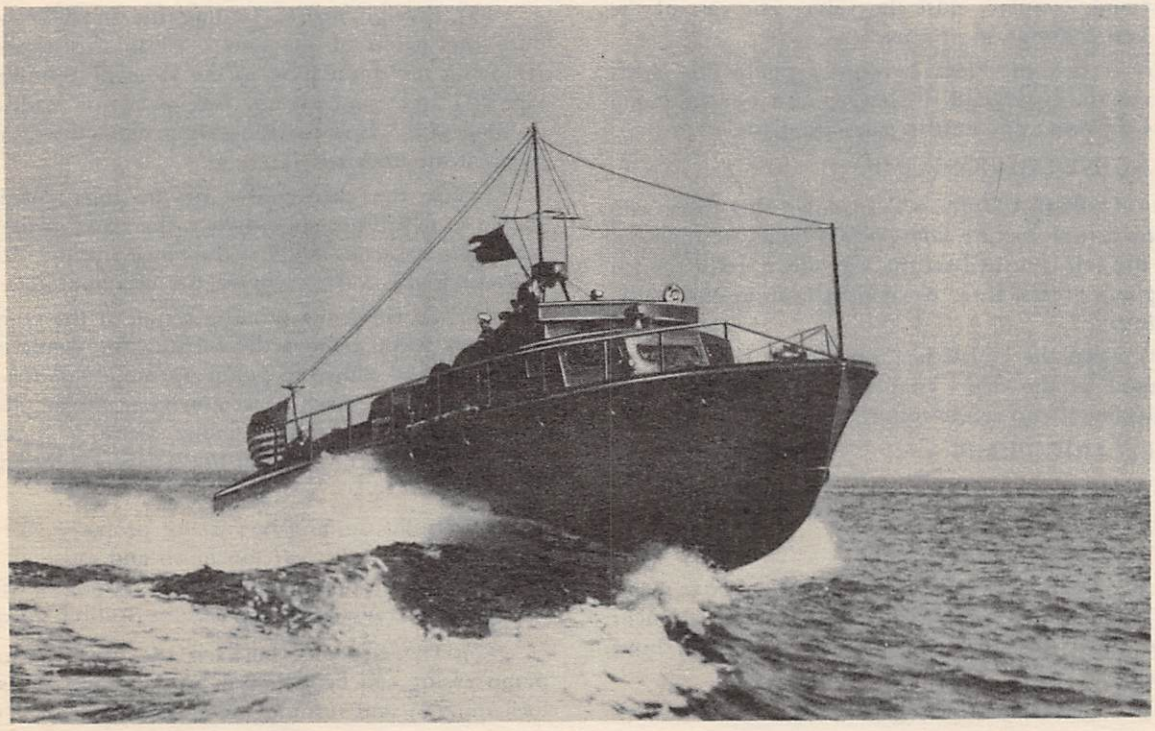
b. Disconnect the outlet piping at the hose connection.

c. Disconnect the electric leads at the motor junction box.

d. Unfasten the four bolts holding the motor to the engine room floor and remove the motor and pump assembly.

5. TROUBLE SHOOTING.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
BILGES NOT BEING PUMPED OR PUMPING OUT SLOWLY WITH EITHER PUMP.	Suction strainer valve left open to dry bilge. Leaking valve to dry bilge. Break or leak in main bilge pipe line.	Close valve. Refer to paragraph 3.*a.*(4), this section. Turn off pump and repair pipe.
ONE BILGE NOT BEING PUMPED, OTHER BEING PUMPED SATISFACTORILY WITH EITHER PUMP (Use the sluice valve to drain the bilge if repairs can not be made immediately).	Clogged suction strainer. Leak or break between suction strainer and valve.	Clean strainer. Repair line.
ELECTRIC PUMP DOES NOT PRIME OR PRIMES AND PUMPS SLOWLY (Use engine-driven pump until repairs are made).	Discharge seacock closed. Leak or break between pump and main bilge line. Impeller clogged. Faulty pump inlet check valve. Faulty pump line check valve. Air leak.	Open seacock. Repair line. Refer to paragraph 3.*c.*(3), this section. Refer to paragraph 3.*c.*(4), this section. Repair check valve. Refer to paragraphs 3.*c.* (5) and (6), this section.



SECTION XVI
Fire Fighting System—Water-Foam

1. DESCRIPTION.

(See figure 192.)

a. GENERAL.—The water-foam fire fighting system supplies water, foam, or fog to two monitors mounted on the forward deck and a hose mounted in the cockpit. The system consists of a pump, a foam generator, and the necessary valves and piping. The pump, foam generator, and valves are installed under the cockpit deck.

b. PUMP.

(1) The pump is a Barton-American Marsh Type GF-250 single stage centrifugal pump. It is mounted on a Kermath engine, by which it is driven through a clutch.

(2) Water passes into the pump through a 3-inch inlet with a screen strainer and is pumped out through a 2½-inch discharge outlet.

(3) The discharge is regulated by a stop check valve (2, *figure 192*). This is a self-closing, rubber faced valve which is opened by the discharge pressure and drops closed when the pump stops, aiding quick priming. The valve handle regulates the amount the valve can open and controls the volume of water the pump discharges.

(4) A vacuum primer primes the pump by the vacuum created in the intake manifold of the engine. When the primer line valves are opened, the vacuum sucks the air out of the primer chamber, which in turn is connected to the pump near the inlet opening. When the air is sucked out of the pump inlet, the water will enter the primer chamber and raise a float. This closes a valve and shuts off the vacuum line. A smaller chamber above the primer chamber operates in the same way for additional protection against letting water be sucked into the engine manifold. When the primer operating lever is released, the valves are opened and the primer chamber drains.

(5) A pressure and vacuum gage mounted on the pump registers from 30 inches Hg vacuum to 150 pounds pressure.

(6) The pump is equipped with the necessary oil fittings, vents, and drain cocks.

c. FOAM GENERATOR.

(1) The foam generator mixes foam powder with water to produce a chemical foam capable of extinguishing oil and gasoline fires.

(2) Foam powder poured into the generator hopper is drawn into the water by the force of the water flow through the bottom part of the generator. The creation of foam takes place as soon as the powder and water mix.

(3) On some models a quick acting valve in the water inlet side controls the flow of water through the generator.

(4) A dial gage registers the inlet pressure of the water flowing through the generator.

(5) The generator hopper is removable.

(6) Four 50-pound cans of foam powder are stored in the forward port corner of the cockpit, under the deck.

d. PIPE LINES AND VALVES.

Note

The key references in the following subparagraphs are to figure 192.

(1) An inlet line of 3-inch pipe leads from a through-hull connection below the pump to the intake connection on the pump. The line has a strainer at the through-hull connection, a flexible rubber hose connection near the pump, and a sea suction valve (1).

(2) A 2½-inch pipe manifold, from which the other pipes in the system branch off, is connected to the pump discharge outlet. This line is also equipped with a flexible rubber hose connection.

(3) Two lines of 1½-inch pipe tap off the upper part of the manifold and lead to the monitors. These lines run along the starboard side of the boat, under the deck, until they reach the location of the monitors, just forward of the crew's quarters after bulkhead. Here the outboard line goes up through the deck and connects to the port monitor. The inboard line crosses the boat and then goes up through the deck to connect with the starboard monitor. These two lines are controlled by gate valves (3 and 4) near the manifold.

(4) A third line of 1½-inch pipe from the manifold runs along the floor of the cockpit to the port after corner. Here it goes up through the cockpit deck to a hose connection. This line is controlled by a gate valve (6) near the manifold.

(5) A fourth line of 1½-inch pipe taps off the manifold and connects with the foam generator. From the foam generator it divides into three lines which connect with the two lines to the monitors and the line to the hose connection respectively. This line is controlled by a gate valve (5) near the manifold and a gate valve in each of the three branch lines from the foam generator (7, 8, and 9).

e. HOSE AND FITTINGS.—Twenty-five feet of 1½-inch rubber lined fire hose is stowed on a folding type hose rack on the port side of the cockpit. The hose is

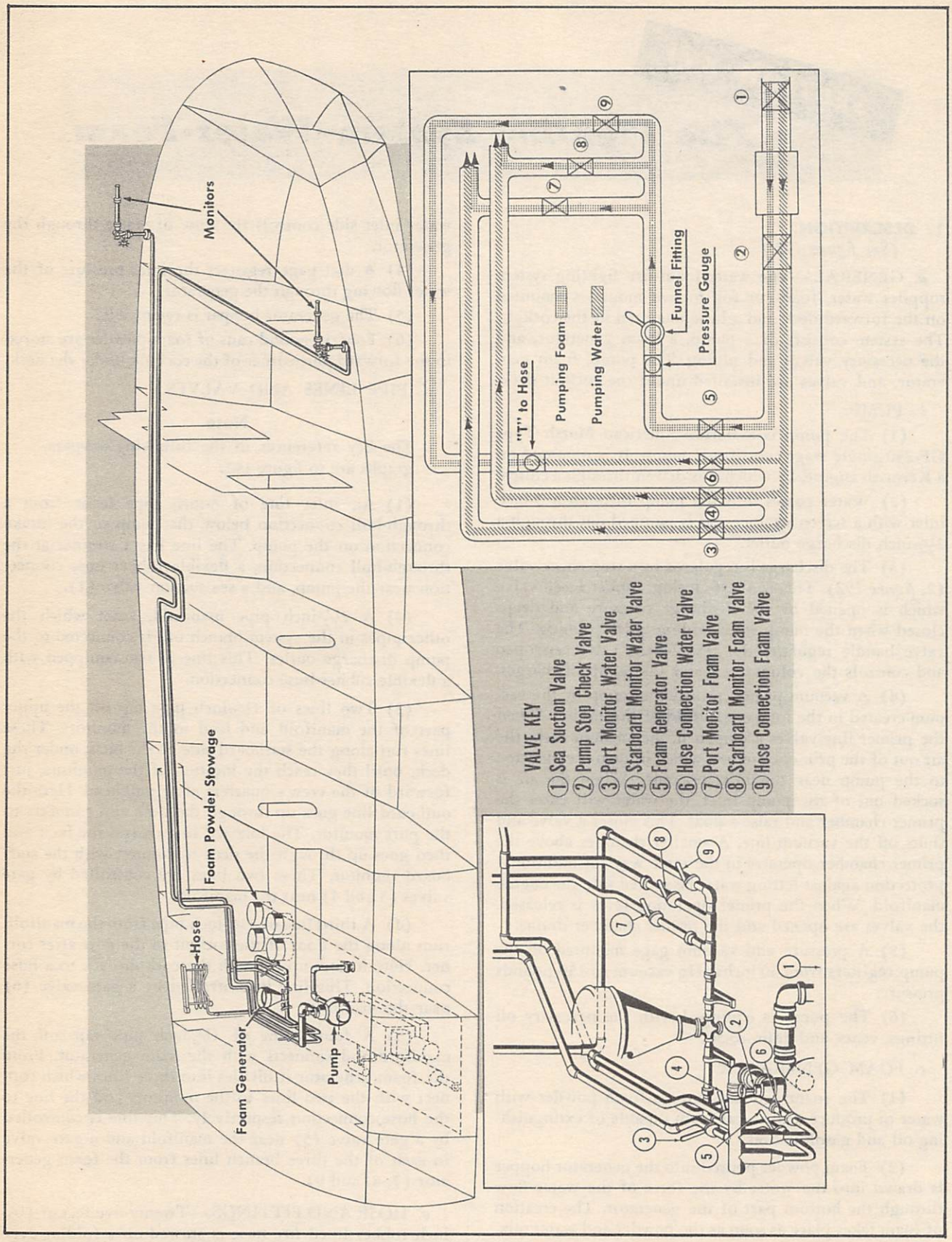


Figure 192—Fire Fighting System—Water-Foam

equipped with a brass lug coupling and a coupling spanner is chained near the hose connection. Two nozzles are provided: a smooth bore nozzle for foam, and a fog nozzle. The fog nozzle has a three position valve for fog, water, or off.

f. MONITORS.—A monitor is mounted on each side of the forward deck. The monitor is free to swing in a complete circle horizontally. A control wheel operating a worm gear raises or lowers the monitor nozzle. *(See figure 193.)*

2. OPERATION INSTRUCTIONS.

a. VALVES. *(See figure 194.)*

(1) When the system is not being used, leave the sea suction valve (1), the stop check valve (2), and either of the monitor water valves (3) and (4) open. This will take care of any emergencies, such as starting the engine with the pump clutch engaged.

(2) Set the valves in the correct positions to supply water or foam to the desired locations before starting the pump.

(3) After the pump is operating, the position of the valves may be changed to supply water to a different location—such as from the monitors to the hose—without turning off the pump, provided there is always an outlet for the water. Open the valves to the second location before closing the valves to the first. Never operate the pump with all the valves in the discharge line closed.

(4) Make sure the sea suction valve (1) and the pump stop check valve (2) are open before operating the pump and keep them open all the time the pump is operating.

(5) TO PUMP WATER.

(a) Open the port or starboard monitor water valve (3 or 4) or the hose connection water valve (6).

(b) Close the foam generator valve (5) and all the foam valves (7, 8, and 9).

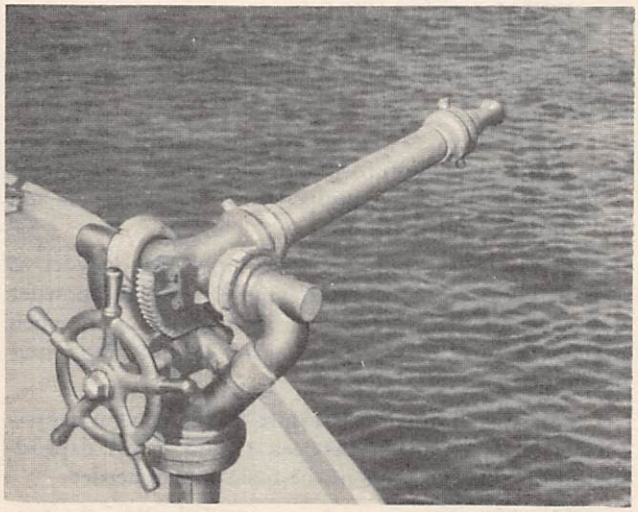
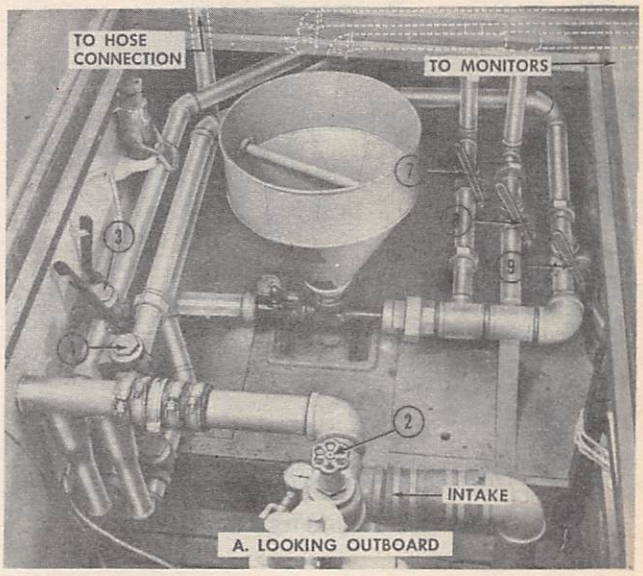


Figure 193—Starboard Monitor



Key to Figure 194

1. Sea Suction Valve
2. Pump Stop Check Valve
3. Port Monitor Water Valve
4. Starboard Monitor Water Valve
5. Foam Generator Valve
6. Hose Connection Water Valve
7. Port Monitor Foam Valve
8. Starboard Monitor Foam Valve
9. Hose Connection Foam Valve

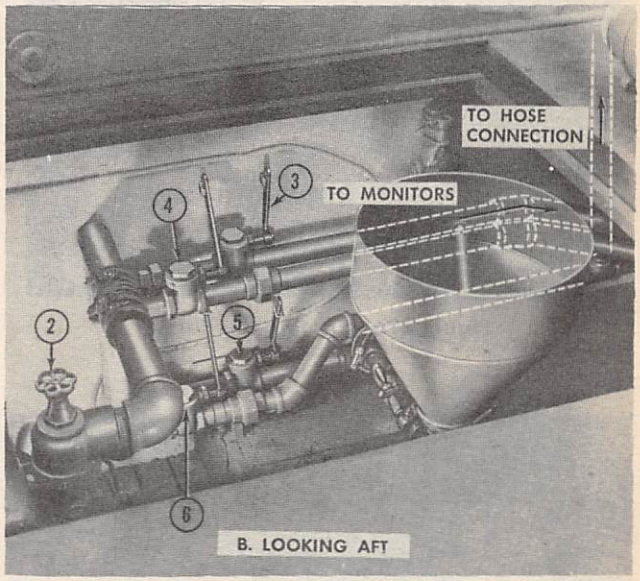


Figure 194—View of Water-Foam System Valves

(6) TO PUMP FOAM.

(a) Open the foam generator valve (5) and the port or starboard monitor or hose connection foam valve (7, 8, or 9).

(b) Close the port and starboard monitor water valves (3 and 4) and the hose connection water valve (5).

b. PUMP.

(1) Start the engine. *(Refer to section IX.)* Run the engine at idling speed, not over 1000 rpm.

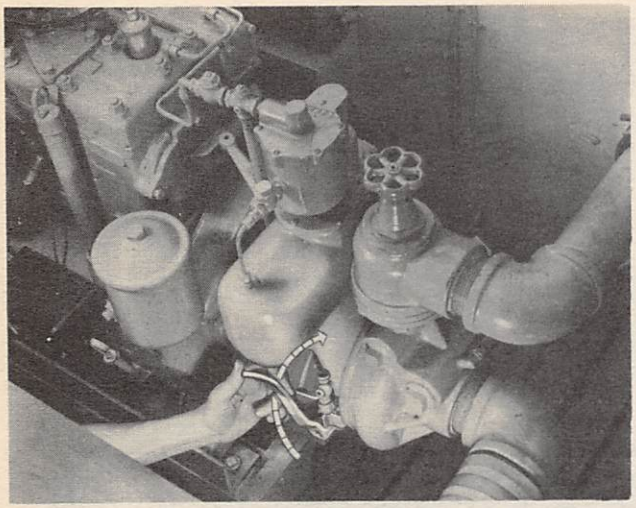


Figure 195—Engaging Pump Clutch

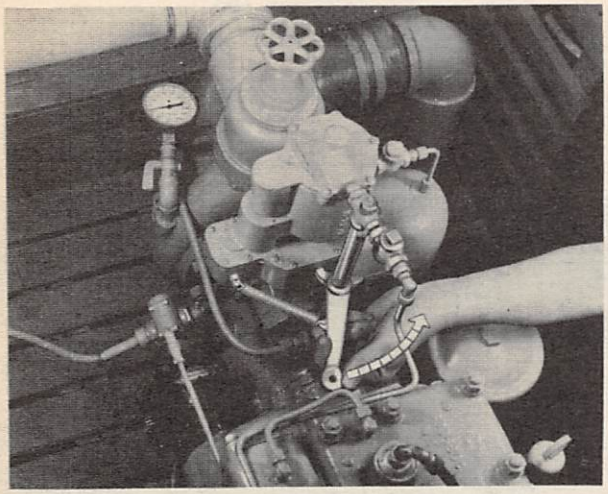


Figure 196—Priming the Pump

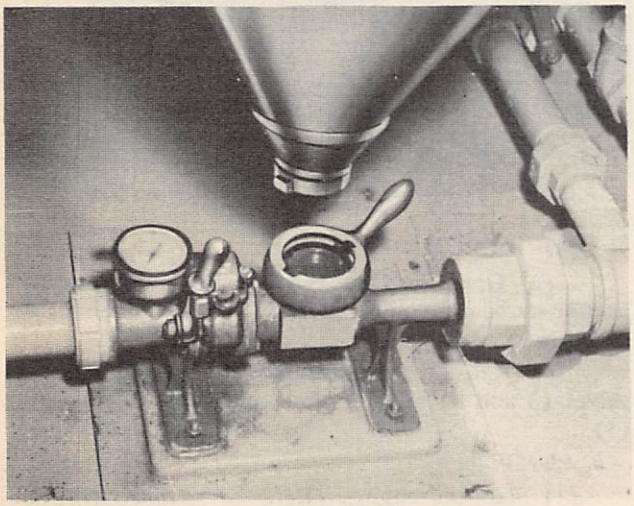


Figure 197—Removing Foam Generator Hopper

(2) Close the pump drain cocks, if open.

(3) Raise the clutch lever slowly to the horizontal position. This engages the friction clutch. If the pump turns when the friction clutch is engaged, raise the clutch handle further to the vertical position. *(See figure 195.)* This engages a set of interlocking jaw clutches in addition to the friction clutch. If the clutch lever cannot be raised past the horizontal position, the interlocking clutches are in such a position that they cannot be engaged; drop the lever back to the downward position and repeat the operation.

(4) Pull the primer lever over against the spring pressure as far as it can go. *(See figure 196.)* Watch the pump pressure gage. Pressure should be registered within 1 minute. If pressure is not shown in this time, disengage the clutch and check for air leaks.

WARNING

Do not operate the pump without water for longer than 1 or 2 minutes.

(5) When the pump is primed (steady pressure shown on gage), release the priming lever.

Note

The pump will normally prime with the stop check valve open. If it does not prime readily, close the stop check valve for priming.

(6) Regulate the pressure and capacity by the engine rpm. For most pumping operations, 75 psi is the best operating pressure.

(7) After operation, throttle the engine down to less than 1000 rpm before disengaging the clutch.

(8) Drain the pump by opening the two oil cocks to provide vent and opening the drain cock in the bottom of the pump.

(9) When the pump and lines have drained, engage the clutch and run the pump at idling speed for 30 seconds. While the pump is running dry, close the drain cock and fill both oil cocks with medium engine oil. This will keep the seal rings lubricated. Close the oil cocks.

c. FOAM GENERATOR.

(1) Pump water through the foam generator to the monitors or hose as described in paragraph 2.*a.*(6), this section.

(2) As soon as water is flowing through the generator, empty a pail of foam powder into the generator hopper. The pails are equipped with "strip" covers and pull rings for quick opening.

(3) Keep the hopper filled with foam powder as long as necessary. Do not attempt to force the powder down into the hopper except at the end of the run when the powder may be pushed from the edges to the center of the hopper.

(4) Watch the inlet pressure on the generator pressure gage. It should be between 35 and 75 psi, depending on the size and force of the foam stream needed.

(5) After foam is no longer needed, allow the gen-

erator to empty itself of powder. Continue to pump water through the foam or water line until clear water runs from the hose or monitors.

(6) After the pump is stopped, remove the hopper by turning it counterclockwise and lifting it off. *(See figure 197.)*

(7) Clean the hopper and generator thoroughly with clean water. Make sure all passageways are clear.

(8) Reinstall the hopper.

(9) Replenish the powder supply as soon as possible.

d. MONITORS.

(1) Swivel the monitor on its base and turn the wheel to raise or lower the nozzle, to aim the water or foam stream.

(2) Use the spanner wrench to fasten the foam or the fog nozzles to the monitors. The foam nozzles are normally left on the monitors.

e. HOSE.

(1) Remove the hose from its mounting, fasten it to the deck connection, install the proper nozzle if it is not already on, straighten out any sharp bends or kinks, and aim in the desired direction before opening the valve to let water or foam through the hose.

(2) Use the spanner wrench to fasten the pin lug hose coupling to the deck connection and to fasten the nozzle to the hose. *(See figure 198.)* When not in use, keep the spanner wrench chained or installed in a bracket near the deck connection.

(3) Use the fog nozzle for water or fog. *(See figure 199.)* Use the smooth bore hose for foam or water.

(4) Avoid kinks and sharp bends in the hose while it is being used.

(5) After use, disconnect the hose from the deck fitting. Lay the hose out straight on an inclined surface to drain and dry. When it is perfectly dry, reinstall it on its mounting.

3. SERVICE, INSPECTION, AND MAINTENANCE.

a. GENERAL INSPECTION TEST.

(1) Once a week operate the pump and test all the operations of the system at normal operating pressure (about 75 psi). This test should include running water through both the monitors and the hose. Run water through the foam generator also, but do not use foam powder for routine testing.

(2) Inspect all the lines, valves, and fittings for leaks, clogs, or excessive looseness.

b. PUMP.

(1) During the weekly inspection test run, examine the pump for any signs of leaking. Examine the packing gland behind the pump impeller case for leaks. Watch the pressure gage to see if the pump produces sufficient pressure steadily without overspeeding the engine.

(2) CLEANING PUMP STRAINER.

(a) Remove the two hose clamps from the sea suction pipe hose connection.

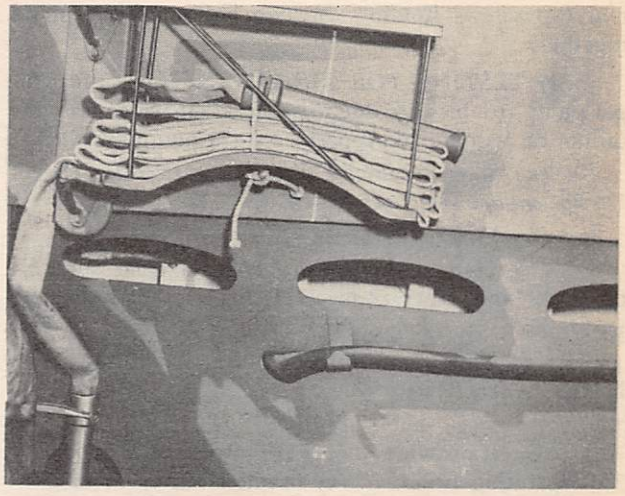


Figure 198—Fastening Hose to Connection

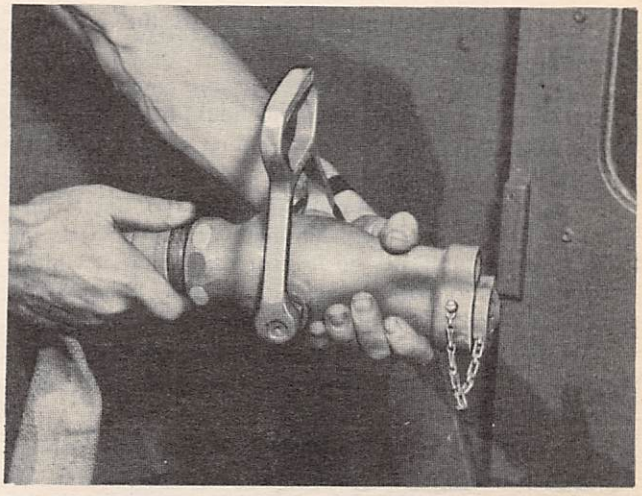


Figure 199—Installing Fog Nozzle on Hose

(b) Slide the hose back along the sea suction pipe. Unfasten the pipe elbow from the pump inlet opening.

(c) Remove the strainer from the pump inlet opening.

(d) Clean and reinstall the strainer.

(e) Reinstall the pipe elbow and the hose and hose clamps.

(3) CARE OF PACKING GLAND.

(a) If the packing gland leaks, tighten the two adjusting nuts evenly. Tighten the gland enough to stop the leak but not enough to make it run hot.

(b) When the gland has been tightened to the point where it nearly touches the case, back the gland off on the shaft and insert a new piece of braided graphited asbestos packing in the stuffing box.

(c) After new packing has been added twice, remove all the old packing and repack the stuffing box. Remove the gland for this operation by removing the

two cap screws holding the two halves of the gland together.

(4) TESTING FOR AIR LEAKS.—Most centrifugal pump troubles are due to air leaks. If water pressure cannot be maintained properly, test the pump as follows:

(a) Start the engine and run it at idling speed. *Do not engage the pump clutch.*

(b) Drain the pump.

(c) Tighten the drain valve and make sure the oil cocks and other connections are closed. Leave the pump discharge valve open.

(d) Close the sea suction valve, and all the valves in the discharge line.

Note

This test presumes that these valves are in good operating order. If any of these valves or the pipe connections between them and the pump leak, this test cannot be made.

(e) Move the primer handle to the priming position.

(f) Watch the pressure vacuum gage until it reaches a stationary position. This should be at about 15 inches Hg vacuum or over, depending on the vacuum producing capacity of the engine.

(g) Release the primer handle and watch the gage. If the hand stands stationary or moves back to zero slowly, it indicates no leak or a minor leak which will not interfere with the operation of the pump. If it falls back rapidly, it indicates an air leak in the pump.

(h) If this test indicates a leak in the pump, the stuffing box may need repacking. (Refer to paragraph 3.*b.*(3), this section.)

(i) Open either the water or suction valve while the gage still registers vacuum. If the hand returns to zero faster than it did before the valve was open, it indicates improper seating of the self-closing pump discharge valve.

(5) CARE OF PUMP DISCHARGE VALVE.

(a) If the self-closing pump discharge valve is suspected of leaking, remove the discharge connection and enough of the piping to allow access to the discharge outlet.

(b) Reach into the discharge outlet with a screwdriver and lift the valve from its seat. Inspect the valve and seat and remove any foreign matter from the valve chamber.

(c) Lift the valve and let it fall back on its seat several times to check its freedom of motion.

(d) If the rubber valve face is torn or badly worn, remove the six nuts holding the valve body to the pump and lift off the valve body. Remove and replace the valve face and reinstall the valve body.

(e) After replacing or cleaning the valve but before reattaching the discharge piping to the pump, test the operation of the valve in this manner: Start the engine and run it at idling speed, but do not engage the pump clutch. Close the pump drain valve and the sea suction valve. Move the primer handle to the priming position. Hold the palm of the hand squarely over the discharge outlet. If the hand is drawn tightly against the opening by the vacuum in the pump, it indicates a leak around the rubber discharge valve. If no vacuum is felt, the valve is in good condition.

c. PIPE LINES.—For repairs of pipes, fittings, and valves, refer to section III, paragraph 4.*g.*

d. MONITORS.—Keep the worm gear parts coated with a heavy graphite grease, Federal Specification No. VV-G-671a, grade, hard. Do not paint these moving parts.

4. REMOVAL OF PUMP.

a. Unfasten the hose clamps and slide back the rubber hose connection in the sea suction pipe. Remove the sea suction pipe elbow from the pump inlet opening.

b. Unfasten the discharge line connection at the pump discharge opening.

c. Remove as much of the piping around the pump as is necessary for accessibility.

d. Unfasten at the pump the primer vacuum line, the governor link, the tachometer drive connection, and any other lines between the pump and the engine.

e. Unfasten the cap screws holding the pump gear case to the engine and remove the pump.

5. TROUBLE SHOOTING.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
PUMP DOES NOT PRIME	Priming line broken.	Repair priming line.
	Air leak in pump.	Refer to paragraph 3.*b.*(4), this section.
	Pump discharge valve not seated.	Refer to paragraphs 3.*b.*(4) and (5), this section.
	Leak in sea suction line.	Repair line.
	Sea suction strainer clogged.	Clean strainer.
	Pump inlet strainer clogged.	Refer to paragraph 3.*b.*(2), this section.
PUMP NOT MAINTAINING PROPER PRESSURE AT A GIVEN RPM	Pump stuffing box leaks.	Refer to paragraph 3.*b.*(3), this section.
	Air leaks in pump.	Refer to paragraph 3.*b.*(4), this section.
	Sea suction strainer clogged.	Clean strainer.
	Pump inlet strainer clogged.	Refer to paragraph 3.*b.*(2), this section.
	Leak in sea suction line.	Repair line.

SECTION XVII

Fire Extinguishing (CO_2) System and Portable Extinguishers

1. CO_2 SYSTEM.

a. DESCRIPTION. *(See figure 200.)*—The CO_2 fire extinguishing system is designed to flood the engine room and fuel tank compartments with carbon dioxide in case of fire. It consists of the following components:

(1) Two carbon dioxide cylinders, rated at 35 pounds, are bracketed against the hull in the after port side of the engine room. *(See figure 201.)* The forward cylinder has a remote control enclosed cutter valve screwed directly on a disc type cylinder valve. When the forward cylinder is manually released, the after cylinder is automatically opened by back pressure in the line.

(2) Two pull release boxes: one on the bridge and one on the forward port side of the cockpit. These pull boxes may be either the type shown in figure 202 or figure 203.

(3) Woven wire cable run through ½-inch conduits incorporating suitable corner pulleys connecting bridge remote control and cockpit remote control with the forward cylinder.

(4) One-half-inch pipe leading from the cylinders to the fuel tank compartment and around the engine room, to carry the carbon dioxide gas.

(5) A pressure-operated switch connected to the pipe line. *(See figure 204.)* This electric switch, when opened by pressure in the line, shuts off the engine room blowers.

(6) Six baffle-type nozzles in the pipe lines to distribute the carbon dioxide. *(See figure 200.)*

b. PRINCIPLES OF OPERATION.

(1) Carbon dioxide extinguishes fires by excluding oxygen. When the compressed carbon dioxide is released from the cylinders, it expands, blankets the fire, and smothers it.

(2) Pulling the release box handle pulls the release cable and rotates the pulley on the discharge head clockwise. This drives a hollow cutter down through the metal sealing disc in the cylinder valve, releasing carbon dioxide. Back pressure in the pipe line will also drive the cutter through the valve seal in the after cylinder and release it.

(3) The pneumatic switch *(figure 205)* is tapped off the engine room CO_2 pipe. When the cylinders are discharged, the pressure in the line pushes the plunger up, trips a toggle switch, and shuts off the engine room blowers. The plunger on top of the switch may be pushed in to reset the switch and close the electric circuit.

c. OPERATION INSTRUCTIONS.

(1) IN CASE OF FIRE.

(a) Clear all personnel from the compartment being flooded.

WARNING

Carbon dioxide is not poisonous but will not support human life and is extremely cold. The rate of expansion of the discharged gas is so great that a person in the same compartment will be overcome by it and become unconscious in a very short time. Therefore, immediately evacuate all below deck compartments and close all doors below decks.

(b) Break the glass at either remote control release box to flood the engine room and the fuel tank compartments. Use the small hammer chained to the box. Pull the release handle hard as far as it will go (approximately 18 inches). *(See figure 206.)*

(c) The gas will make a loud hissing noise when escaping, similar to escaping steam. The system is not equipped with an automatic warning signal, but the sound of the gas being discharged should serve as a signal to evacuate all personnel.

(d) Anyone overcome by carbon dioxide should be removed to fresh air immediately and given artificial respiration and first-aid treatment as in cases of drowning.

(e) If it is necessary to enter a compartment flooded with CO_2, it may be done for a short period by taking a deep breath of fresh air and holding it while in the compartment. For longer periods, use a hose-type gas mask or portable oxygen breathing apparatus. Do not use a canister-type gas mask.

(2) AFTER THE FIRE.

(a) Operate the blowers in flooded compartments until all the carbon dioxide is removed. This can be tested, if necessary, by inserting a lighted Davy-type safety lamp into the compartment. If the lamp continues to burn, there is enough oxygen present to be safe.

WARNING

Do not make this test with an open flame because gasoline vapors may be present and cause an explosion.

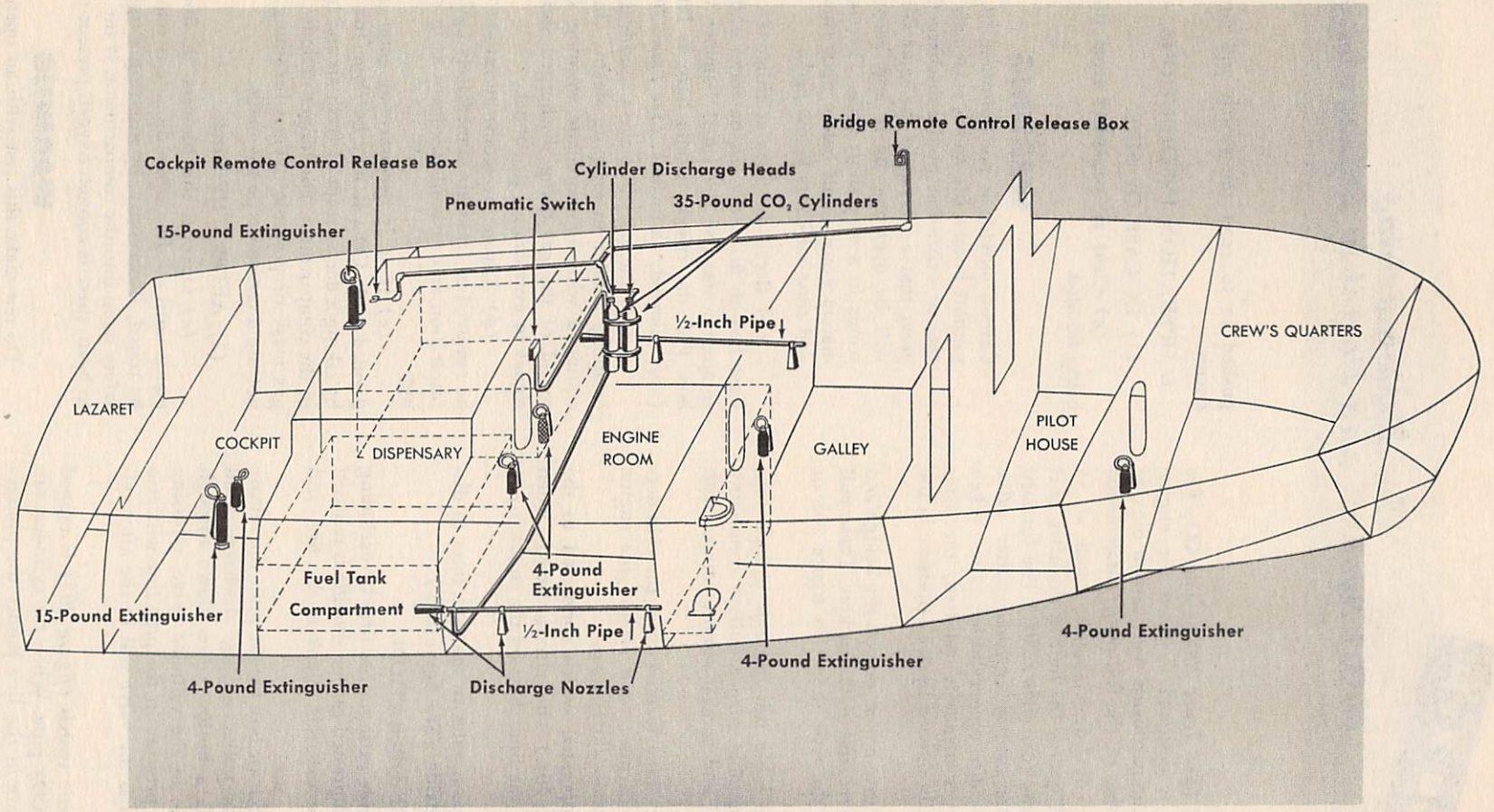


Figure 200—Fire Extinguishing System—CO_2 and Portable



Figure 201—CO_2 Cylinders

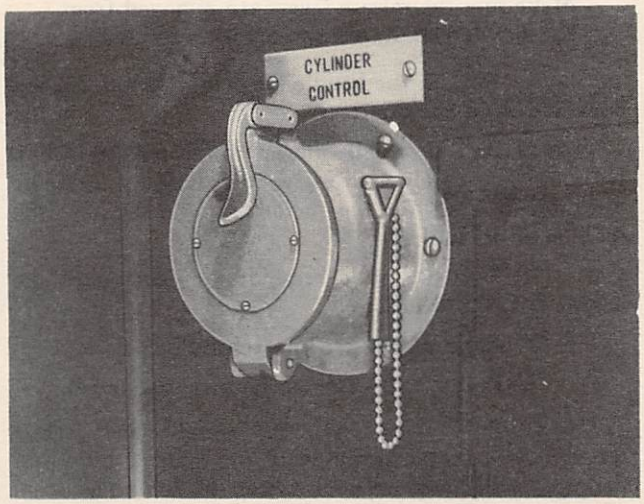


Figure 202—Bridge Release Box

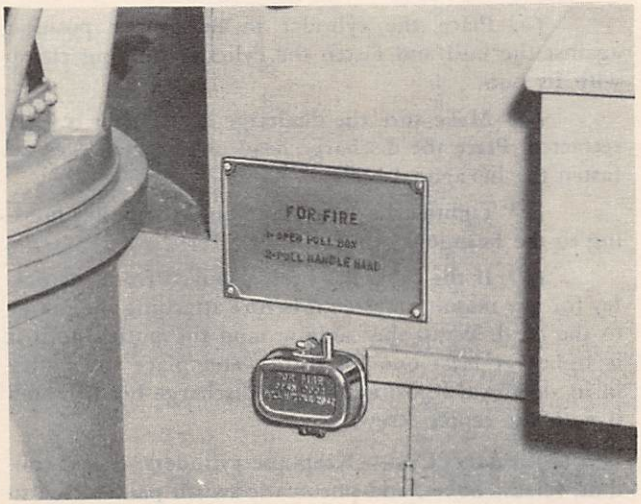


Figure 203—Bridge Release Box, Alternate Installation

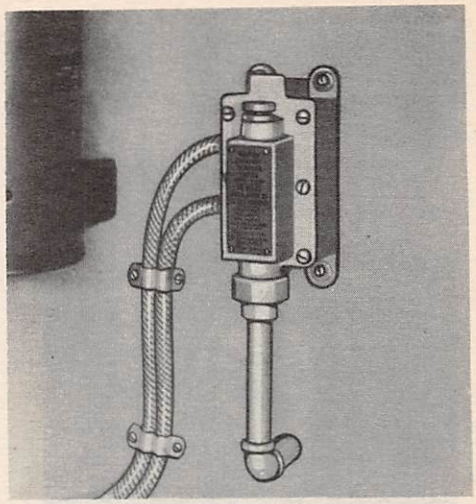


Figure 204—Pneumatic Switch

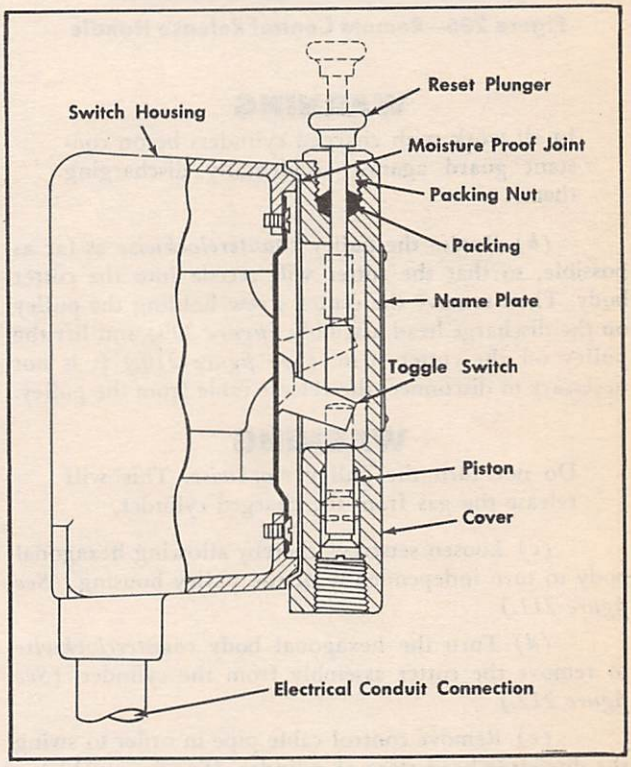


Figure 205—Cutaway View of Pneumatic Switch

(b) Remove the discharged CO_2 cylinders and install filled cylinders as soon as possible. Refer to paragraph 1.*d.*(1), this section.

(c) Push in the plunger of the pneumatic switch to reset it after cylinders have been reinstalled.

(d) Replace the broken glass in the release box.

d. SERVICE, INSPECTION, AND MAINTENANCE. *(See figure 207.)*

(1) REMOVAL OF CYLINDERS.

(a) Remove the three cover screws and lift off cover. *(See figure 208.)*



Figure 206—Remote Control Release Handle

WARNING

In all work with charged cylinders be on constant guard against accidentally discharging them.

(b) Rotate the pulley *counterclockwise* as far as possible, so that the cutter will recede into the cutter body. Then remove the center screw holding the pulley on the discharge head assembly *(figure 209)* and lift the pulley off the cutter stem. *(See figure 210.)* It is not necessary to disconnect the release cable from the pulley.

WARNING

Do not turn the pulley *clockwise*. This will release the gas from the charged cylinder.

(c) Loosen setscrew, thereby allowing hexagonal body to turn independently of the pulley housing. *(See figure 211.)*

(d) Turn the hexagonal body *counterclockwise* to remove the cutter assembly from the cylinder. *(See figure 212.)*

(e) Remove control cable pipe in order to swing the discharge head clear of cylinder. *(See figure 213.)*

(f) Lift out discharge head. *(See figure 214.)*

(g) Inspect the head. Make sure that the cutter is in its full upward position and the blade is in good condition. *(See figure 215.)*

(h) Unscrew and remove the cylinder holding clamp *(figure 216)* and lift the cylinder out.

(2) WEIGHT CHECK.—Make the cylinder weight check once a month. Remove the cylinders and weigh them one at a time.

(a) The forward cylinder weighs 80 pounds empty, is charged with 35 pounds of CO_2 — a total weight of 115 pounds.

(b) The after cylinder with head weighs 82 pounds empty (head alone weighs 5 pounds), is charged with 35 pounds of CO_2—a total weight of 117 pounds. *(See figure 217.)*

(c) The "Cylinder Record" in the envelope fastened to the neck of the cylinder gives the full weight of the cylinder. If the measured weight is more than 3.5 pounds below the full weight, replace the cylinders or have them recharged by an authorized recharge service station listed on the "Cylinder Record."

(d) Enter the inspection date (or recharging date if the cylinder has been recharged) on the "Cylinder Record." Tie the record, in its envelope, back on the cylinder.

(3) RELEASE BOX AND CABLE TEST.

(a) Test the release box and cable operation at the same time the weight check is made.

WARNING

Make sure the release levers are removed from the discharged heads when making this test.

(b) Pull up the handle fastening the release box door and open the door.

(c) Pull the handle out approximately 18 inches. It should pull freely and easily. If it does not, examine the cable conduit for obstructions and make sure the cable is on its pulley.

(d) Pull the pulley end of the cable until the handle is again in its box.

(e) Close and fasten the release box door.

(f) Perform this test on both release boxes.

(4) PLUMBING.—At every weight check while the cylinders are removed from the system, blow out the pipes with compressed air. Check the flow of air from all nozzles. Make repairs in the pipes and conduit as in other plumbing. Refer to Section III, paragraph 4.*g*.

(5) REINSTALLING CYLINDER.

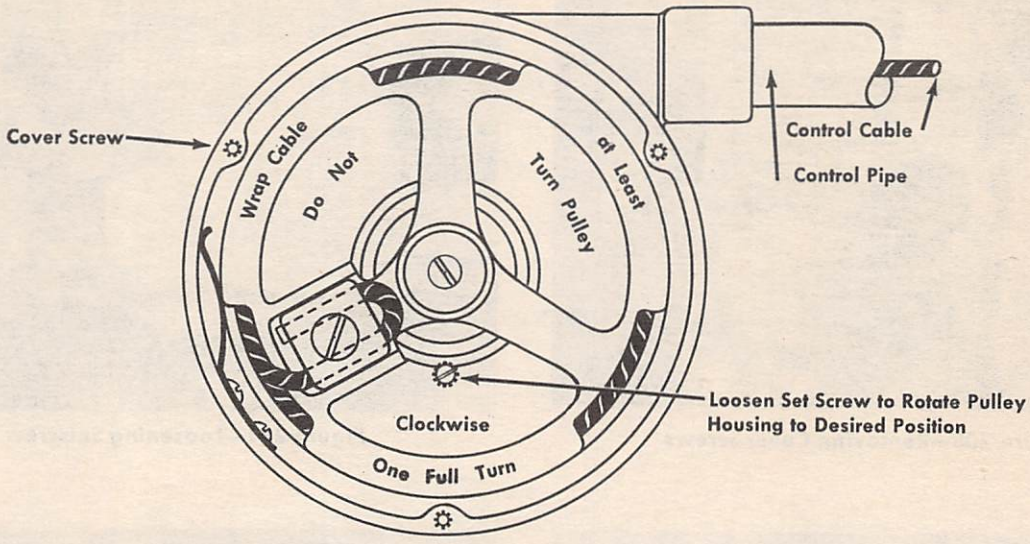
(a) Place the cylinder in its proper position against the hull and fasten the cylinder holding clamp with its nut.

(b) Make sure the discharge head cutter is fully retracted. Place the discharge head on the cylinder and fasten the hexagonal body.

(c) Tighten the setscrew to hold the pulley housing to the hexagonal body.

(d) If the cable has been removed from the pulley for any reason, refasten it before attaching the pulley to the head. Wrap the cable around the pulley until it is tight (at least one full turn) and place the pulley in its downward position on the discharge head. Fasten it with the center screw.

(6) PAINTING.—Keep the cylinders, pipes, conduit, release boxes, and pneumatic switch painted red to aid in identification.



PLAN VIEW
(Cover Removed)

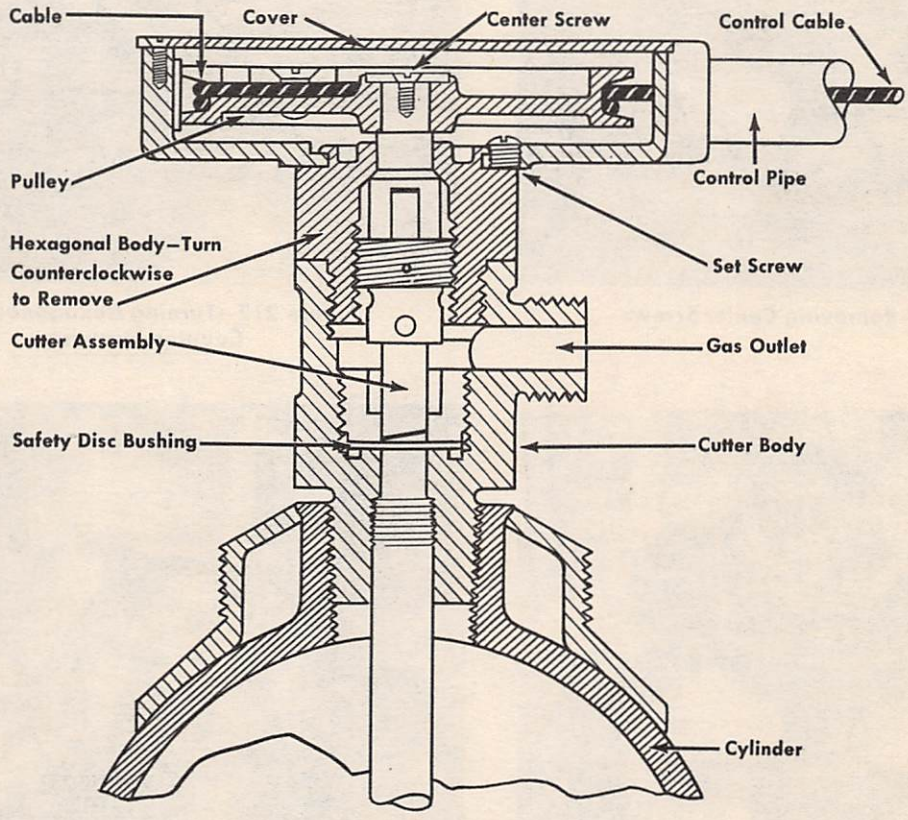


Figure 207—Cutaway View of CO_2 Cylinder Discharge Head

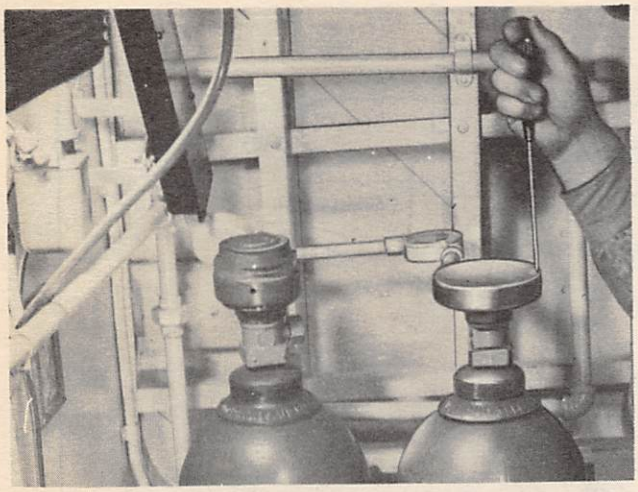


Figure 208—Removing Cover Screws

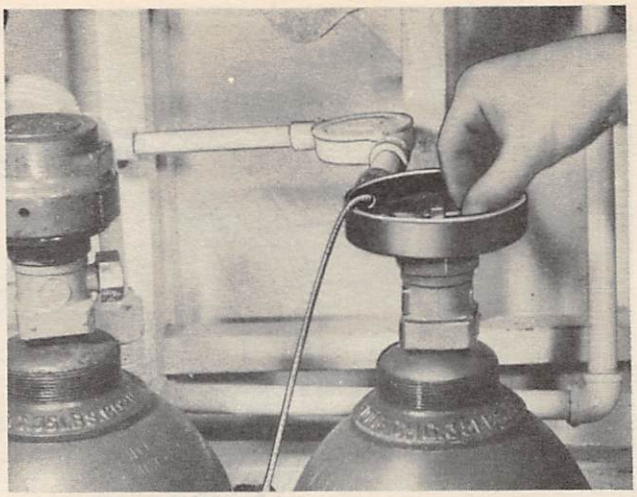


Figure 211—Loosening Setscrew

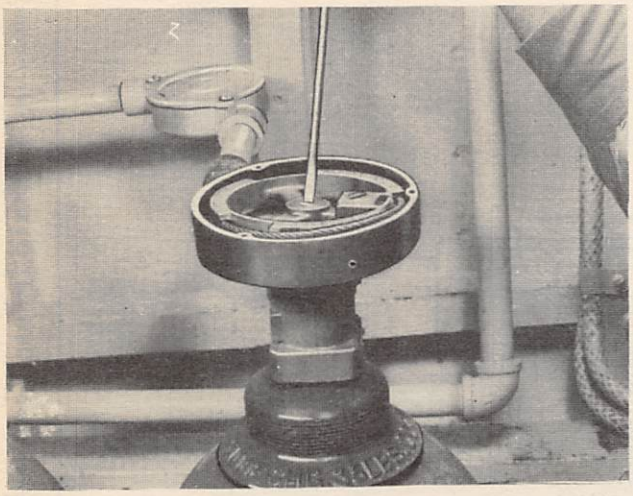


Figure 209—Removing Center Screws

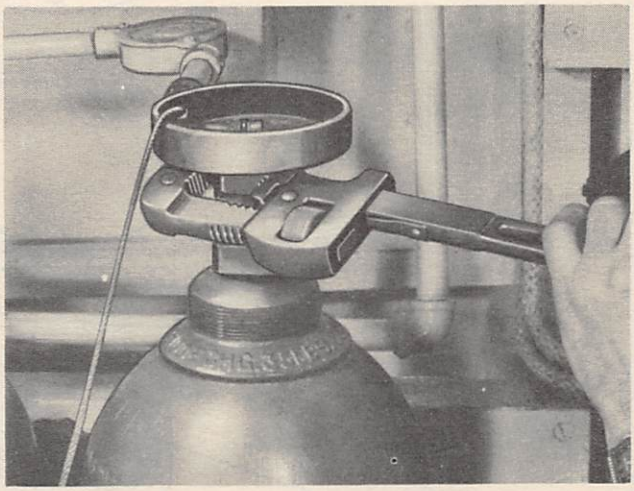


Figure 212—Turning Hexagonal Body Counterclockwise

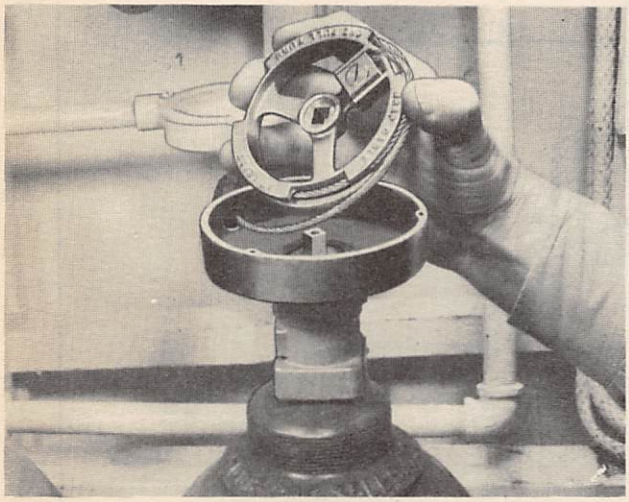


Figure 210—Lifting Pulley from Pulley Housing

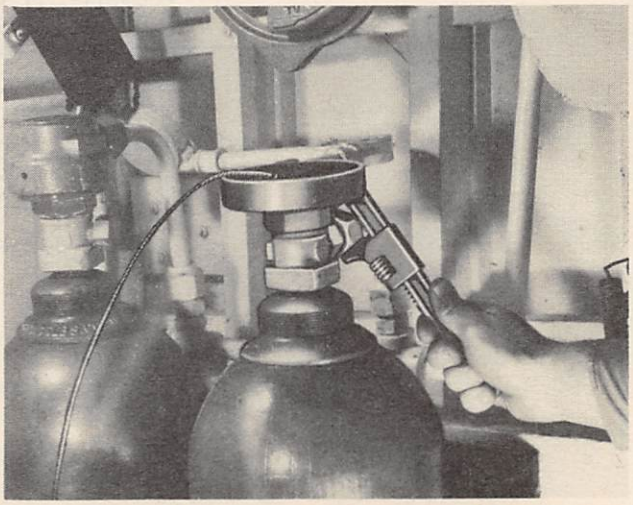


Figure 213—Removing Control Cable Pipe

CAUTION

Be careful not to paint over the openings of the nozzles.

e. TROUBLE SHOOTING.—Refer to paragraph 3., this section.

2. PORTABLE FIRE EXTINGUISHERS.

a. DESCRIPTION. *(See figure 200.)*

(1) Five 4-pound hand-operated portable fire extinguishers containing carbon dioxide are placed on the boat in the following positions: one on the starboard side of the cockpit *(figure 218)*, one in the dispensary, one in the engine room, one in the galley, and one in the crew's quarters.

(2) Two 15-pound hand-operated extinguishers are located in the cockpit, one to port and one to starboard. *(See figure 218.)*

b. OPERATION.

(1) Lift the fire extinguisher from its bracket and carry it to the fire.



Figure 214—Lifting Out Discharge Head

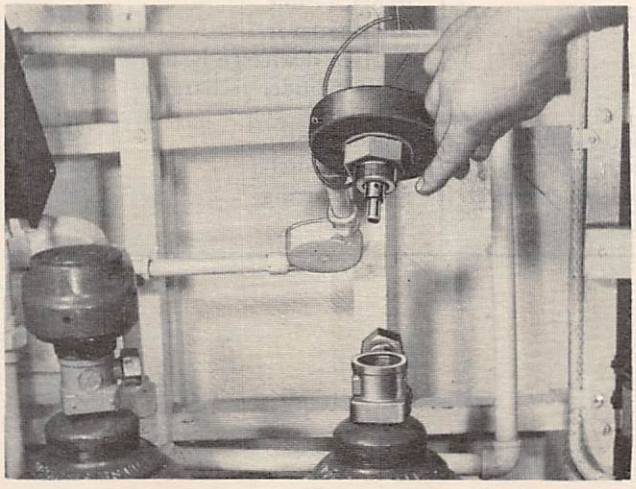


Figure 215—Inspecting Discharge Head

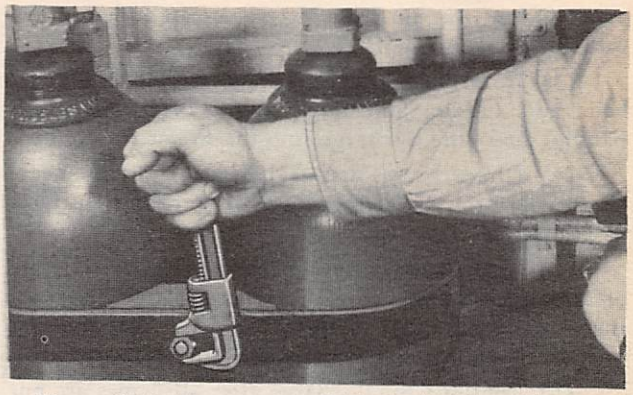


Figure 216—Unscrewing Cylinder Holding Clamp



Figure 217—Weighing Cylinders

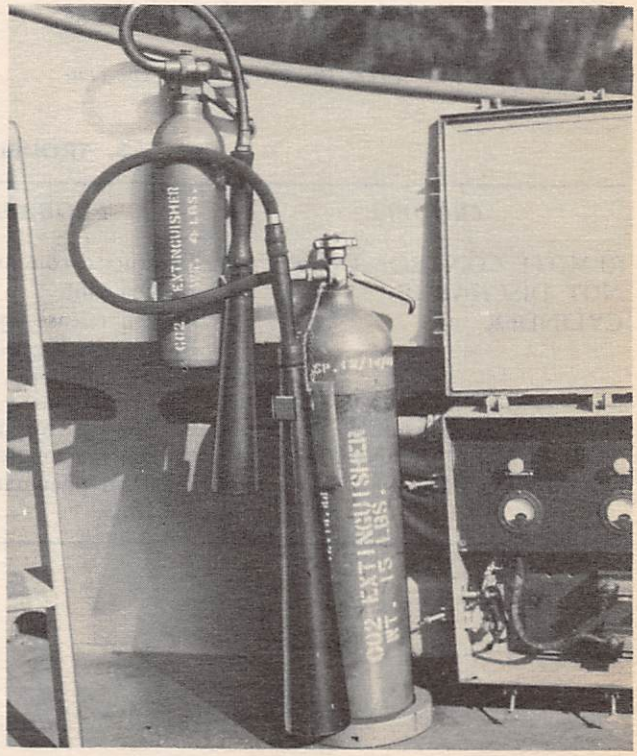


Figure 218—Four-and Fifteen-Pound Portable Fire Extinguishers

(2) Pull the pin from the valve cap and turn the valve to open it completely.

(3) Hold the extinguisher by its handle in the left hand and, holding the nozzle at the hose end of the handle, direct the discharge into the fire at close range.

(4) Direct the gas first at the edge of the fire nearest the operator, or, if the fire is on a vertical surface, at the bottom of the fire.

(5) As the flame is extinguished on the nearer edge or bottom of the fire, slowly advance the discharge further toward the center of the fire. Be sure that the first portion of the fire is out before advancing farther.

(6) Continue the discharge after all flames are out in order to coat the hot material with the snowlike precipitation from the gas.

(7) Close the valve and insert the pin, which is attached to the neck of the extinguisher by a chain, to safety the valve cap.

(8) Have the cylinder recharged at the earliest opportunity by an authorized recharge service station listed on the "Cylinder Record" in the envelope chained to the neck of each cylinder.

CAUTION

Observe the following precautions in operating the portable extinguishers:

Do not open the valve until in position to direct the discharge onto the fire.

Do not stand the extinguisher on the deck. Always hold it by the carrying handle.

Do not hold the nozzle near the discharge end.

Do not first direct the discharge at the center of the fire and then attempt to work to the edge.

Do not direct the discharge haphazardly over various sections of the fire.

Do not shut off the extinguisher just as soon as the fire is out, but wait until the heated material is thoroughly coated with the precipitate.

Do not forget to have used extinguishers recharged at the earliest opportunity.

c. SERVICE AND MAINTENANCE.

(1) When not in use, the portable fire extinguishers should be installed upright in their mountings. Inspect the mountings for security at every overhaul.

CAUTION

Do not let the cylinders lie on their sides or remain in any position but upright.

(2) To make sure that every portable fire extinguisher will be ready for emergencies, they should be weighed once a month and the weight recorded on the tag attached to each extinguisher.

(a) The 4-pound portable fire extinguisher weighs 10 pounds, 10 ounces when empty, has a 1-pound, 10-ounce horn and hose assembly, is charged with 4 pounds, 2 ounces of CO_2 — a total weight of 16 pounds, 6 ounces. If this weight drops 6 ounces, the cylinder should be recharged.

(b) The 15-pound extinguisher weighs 31 pounds, 8 ounces when empty, has a 2-pound horn and hose assembly, is charged with 15 pounds of CO_2 — a total weight of 48 pounds, 8 ounces. If this weight drops 1 pound, the cylinder should be recharged.

3. TROUBLE SHOOTING.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
REMOTE CONTROL DOES NOT DISCHARGE CYLINDER	Obstructed conduit. Broken cable. Broken release lever. Broken discharge head. Empty cylinder.	Clean out conduit. Replace cable. Replace lever. Replace discharge head. Have cylinder recharged.
PNEUMATIC SWITCH DOES NOT TURN OFF ENGINE ROOM BLOWERS	Broken pipe to pneumatic switch. Broken pneumatic switch. Break in pneumatic switch electrical wiring.	Repair pipe. Repair switch. Repair wiring.

SECTION XVIII

Heating System

1. DESCRIPTION.
(See figure 219.)

a. GENERAL.—The boat's quarters are heated by three Stewart-Warner Model 792-E internal combustion gasoline heaters, each with a rated output of 20,000 Btu's per hour. They are supplied with engine fuel from the main fuel manifold by an autopulse electric pump. The 24-volt current which operates the heaters is tapped off the main switchboard in the engine room. Exhaust from the heaters is carried outboard by individual pipes.

b. LOCATION OF HEATERS.

(1) One heater is located against the junior officers' quarters forward bulkhead. A duct carries part of the heat through the bulkhead to the crew's quarters. *(See figure 220.)*

(2) One heater is located in the inboard after corner of the senior officers' quarters. A duct carries part of the heat through the longitudinal bulkhead to the galley. *(See figure 221.)*

(3) One heater is located against the dispensary compartment forward bulkhead on the port side of the engine room door. This heater has no duct. *(See figure 219.)*

c. HEATER CONSTRUCTION AND OPERATION. *(See figure 222.)*

(1) The heater burns a fuel-air mixture in a hermetically sealed chamber. It consists of the following main assemblies.

(a) Electric-motor-driven blower.

(b) Carburetor and check valve.

(c) Heater, ventilating air fan, and housing.

(2) When the main switchboard disconnect switch and the tap switch are turned "ON" the fuel-air blower sends air through the elbow assembly to the carburetor. The air mixes with fuel in the carburetor and the resulting mixture passes through the check valve assembly and into the combustion chamber of the heater.

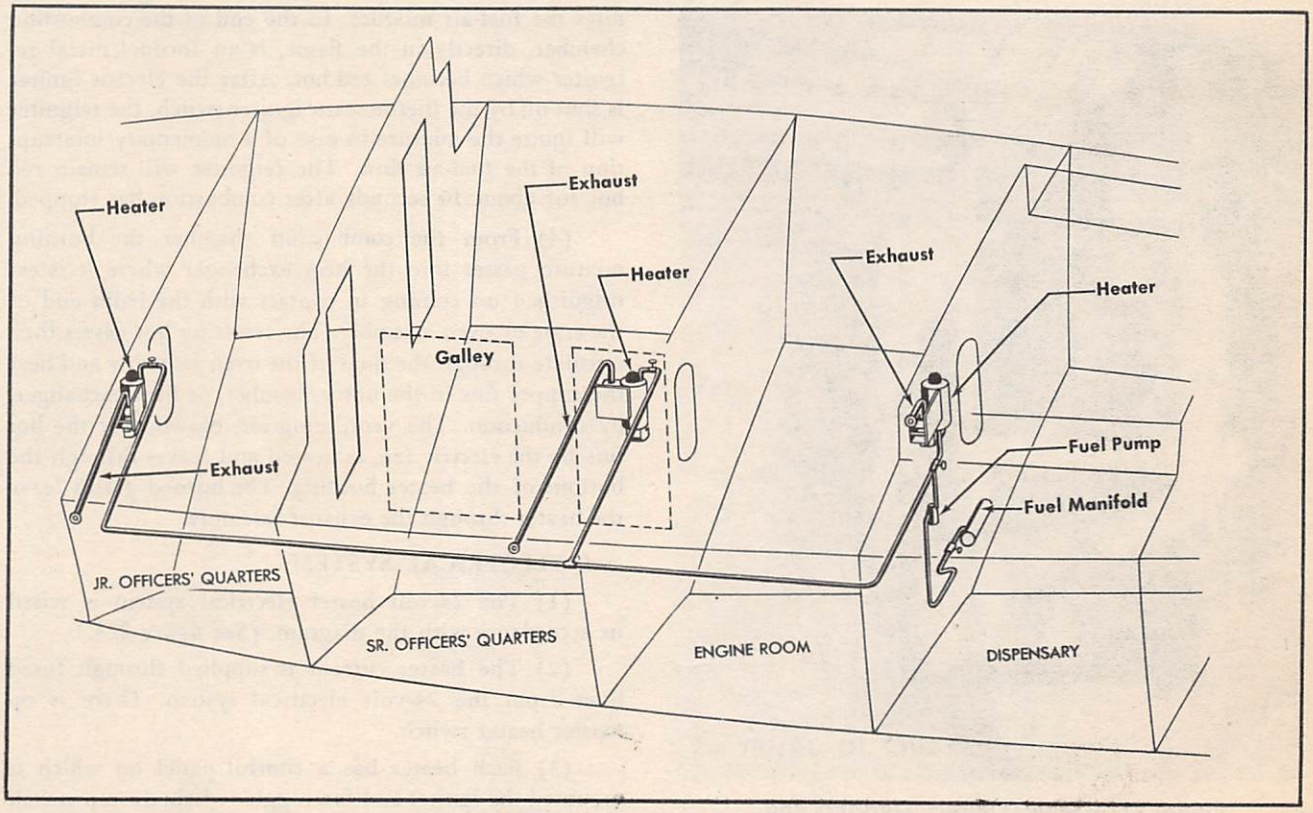


Figure 219—Heating System

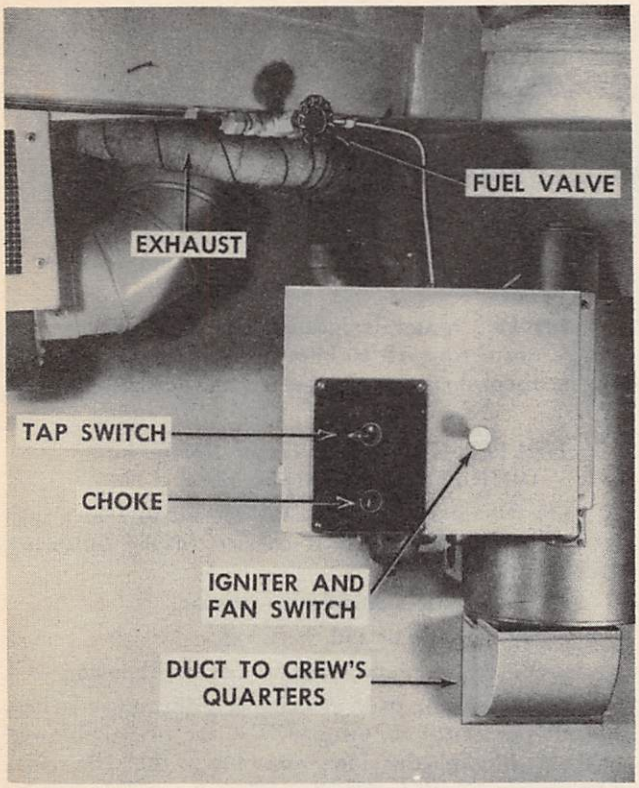


Figure 220—Junior Officers' Quarters Heater

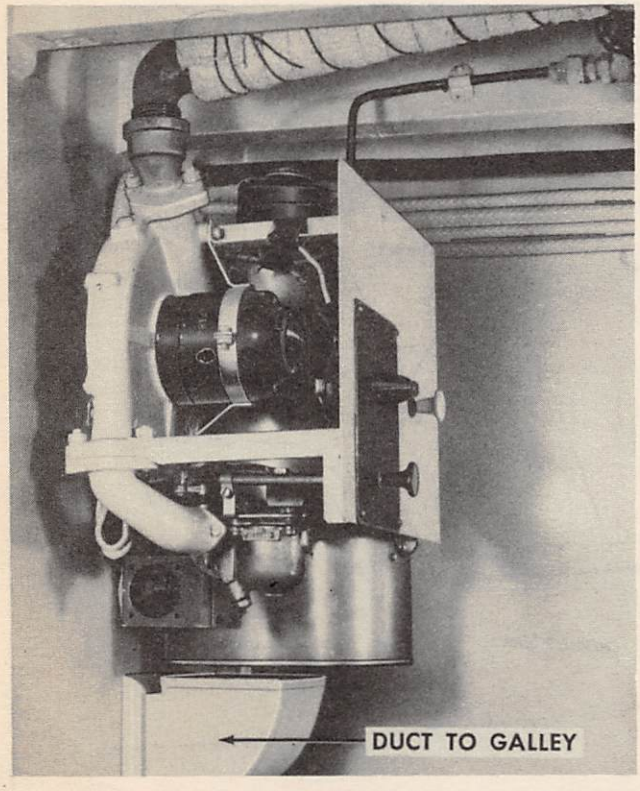


Figure 221—Senior Officers' Quarters and Galley Heater

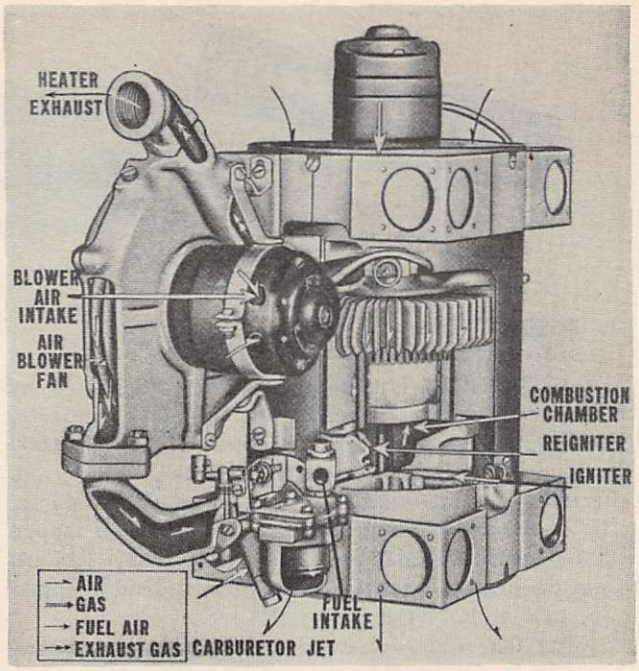


Figure 222—Cutaway View of Heater

(3) The fuel-air mixture enters the combustion chamber through the burner tube which breaks up and distributes the mixture for more efficient combustion. The electric igniter on the side of the combustion chamber has a resistance coil which comes to a glow and ignites the fuel-air mixture. In the end of the combustion chamber, directly in the flame, is an Inconel metal reigniter which becomes red hot. After the electric igniter is shut off by the thermostatic igniter switch, the reigniter will ignite the mixture in case of a momentary interruption of the fuel-air flow. The reigniter will remain red hot for about 10 seconds after combustion has stopped.

(4) From the combustion chamber the burning mixture passes into the heat exchanger where it is extinguished on coming in contact with the baffle-end of the crate or oven assembly. The resulting hot gasses then circulate through the flues of the oven assembly and heat the copper fins in the outer chamber, or heat exchanger, by conduction. The ventilating air, blown over the hot fins by the electric fan, is heated and leaves through the bottom of the heater housing. The burned gasses leave the heater through the exhaust assembly.

d. ELECTRICAL SYSTEM.

(1) The 24-volt heater electrical system is wired in accordance with the diagram. *(See figure 223.)*

(2) The heater current is supplied through fused lines from the 24-volt electrical system. There is no master heater switch.

(3) Each heater has a control panel on which is mounted the igniter and fan toggle switch, the tap switch which regulates the heater output, and the choke button.

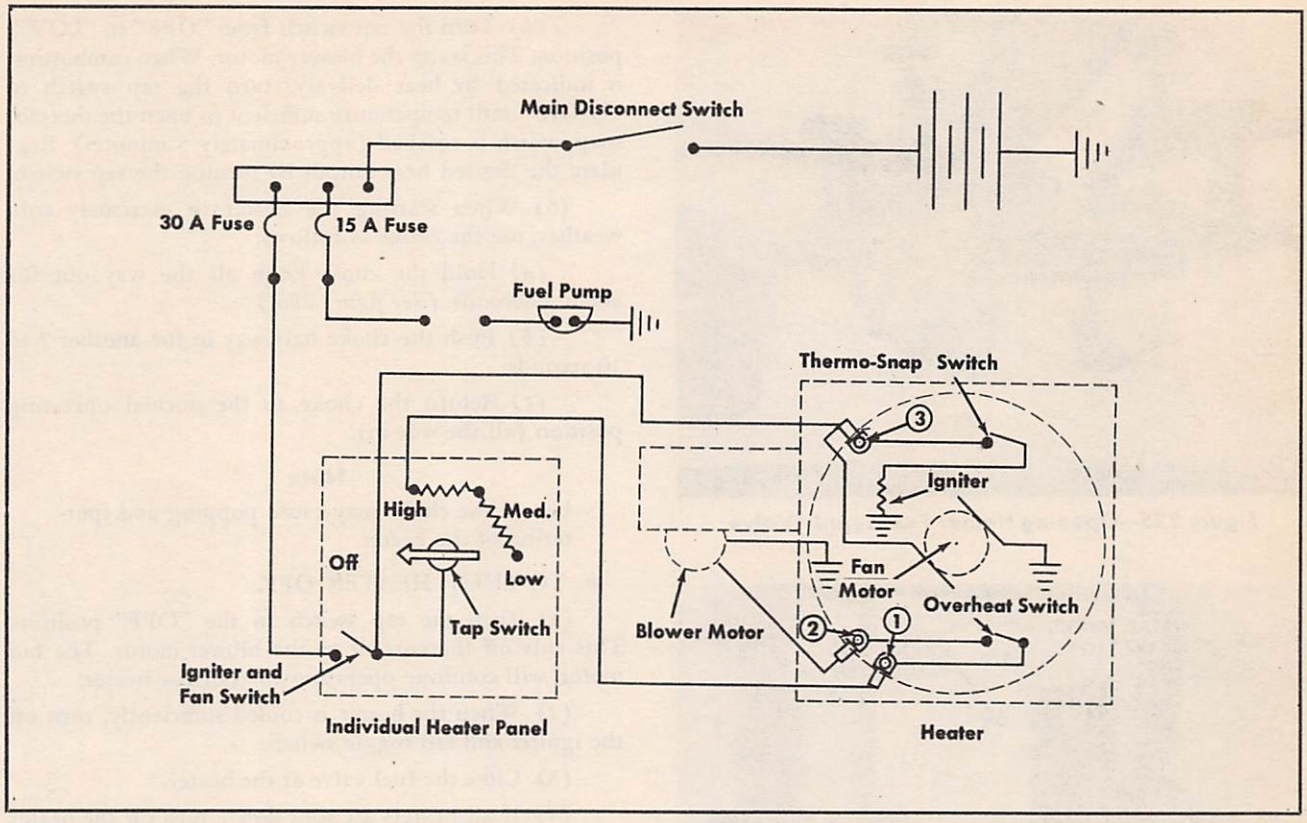


Figure 223—Heater Schematic Wiring Diagram

(4) In operation, current from heater terminal 3 also flows to the fan motor. Current from terminal 1 flows to the top blade of the overheat switch which (at normal operating temperatures) is in contact with the center blade. One lead from the igniter switch is connected to terminal 3 of the heater; the other is connected to the terminal on the igniter. From the center blade current flows through terminal 2 to the blower motor.

(5) After the heater has warmed up, the electrical circuit to the igniter is broken by the action of a bi-metal disc within the igniter switch.

(6) If, for any reason, the heater should become hotter than normal, the lower blade of the over-heat switch will bend toward the heater until the contact between the center and top blade is broken. This will cause the blower motor to stop, shutting off the fuel-air mixture to the combustion chamber. The fan motor, however, will continue to operate and cool the heater.

(7) When the heater cools sufficiently, the over-heat switch will again close the circuit to the blower motor, supplying fuel-air mixture to the combustion chamber. The igniter switch circuit will also close, starting the electric igniter. This is called recycling.

e. FUEL SYSTEM.

(1) Fuel for the heaters is taken from the engine fuel manifold by 1/4-inch copper tubing. A valve in the line at the manifold controls the flow of fuel.

(2) Pressure in the line to the heater is maintained by an autopulse electric pump, located on the port side of the engine room after bulkhead. *(See figure 224.)* The pump is controlled by a switch on the main switchboard. The pump is factory set to maintain a specified pressure in the fuel line. The pump cuts in and out automatically to maintain that pressure.

(3) A shut-off valve is located in the fuel line by each heater.

(4) The carburetor of each heater has a fixed jet which is permanently set at the factory. Do not attempt to change the jet setting. A choke knob on the control panel is connected to the heater carburetor by a control wire.

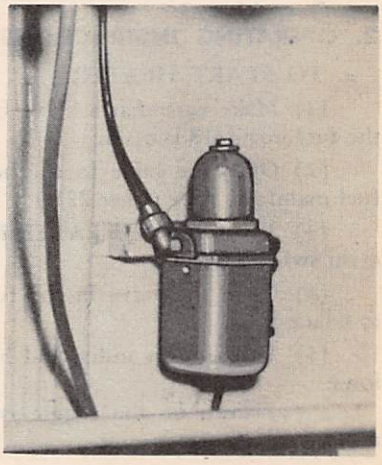


Figure 224—Heater Fuel Pump

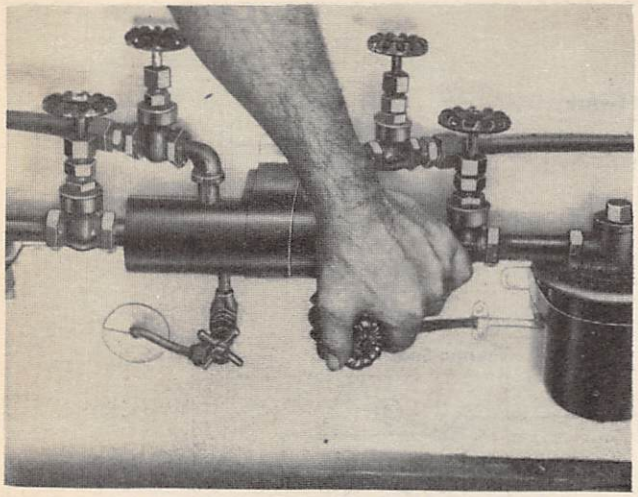


Figure 225—Opening Heater Fuel Supply Valve

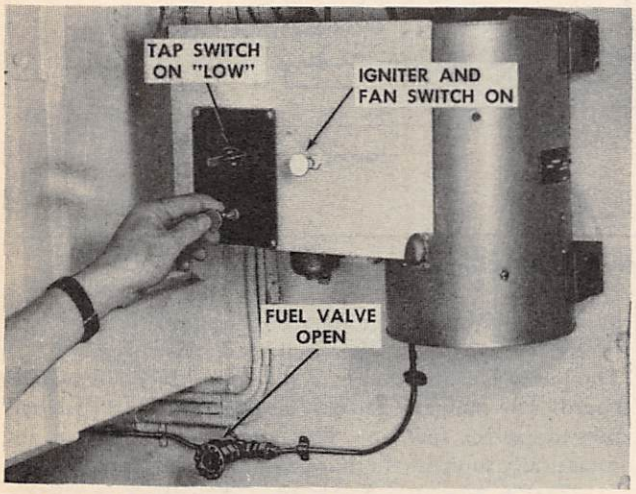


Figure 226—Operating Dispensary Heater Choke

f. EXHAUSTS.—The exhaust gases of each heater are carried to a through-hull exhaust fitting just below the deck line at the point closest to the heater. The exhaust lines are 1⅛-inch copper tubing and 1⅛-inch flex tubing wrapped with asbestos wicking, wire, and tape.

2. OPERATING INSTRUCTIONS.

a. TO START HEATER.

(1) Make sure that a valve from the fuel tanks to the fuel manifold is open.

(2) Open the valve in the heater fuel line at the fuel manifold. *(See figure 225.)*

(3) Turn on the "HEATER PUMP" switch on the main switchboard.

(4) Open the valve in the fuel line by the heater to be used.

(5) Turn on the individual heater switches as follows:

(a) Turn on the toggle switch to start the fan motor and electric igniter.

(b) Turn the tap switch from "OFF" to "LOW" position. This starts the blower motor. When combustion is indicated by heat delivery, turn the tap switch to "HIGH" until temperature sufficient to open the thermo-snap switch is reached (approximately 5 minutes). Regulate the desired heat output by turning the tap switch.

(6) When starting the heater in extremely cold weather, use the choke as follows:

(a) Hold the choke knob all the way out for about 2 seconds. *(See figure 226.)*

(b) Push the choke half way in for another 7 to 10 seconds.

(c) Return the choke to the normal operating position (all the way in).

Note

Use of the choke may cause popping and sputtering of the heater.

b. TO SHUT HEATER OFF.

(1) Turn the tap switch to the "OFF" position. This cuts off the current to the blower motor. The fan motor will continue operating to cool the heater.

(2) When the heater is cooled sufficiently, turn off the igniter and fan toggle switch.

(3) Close the fuel valve at the heater.

(4) If all heaters are shut down, turn off the heater pump switch and close the fuel valve at the fuel manifold.

c. When the heaters are used for any length of time while the boat is not under way, maintain the battery voltage with the auxiliary generator or shore current.

3. SERVICE AND MAINTENANCE.

a. GENERAL.—Check the heaters and all fuel, electric, and exhaust lines each day of operation and remedy any signs of looseness or chafing.

WARNING

DON'T operate the heater system if any fuel line is loose or leaking. Repair such leaks immediately as they are a grave fire hazard.

DON'T operate any heater if the exhaust tubing is loose, leaking, or burned through. The exhaust gases are highly poisonous carbon monoxide.

b. FUEL PUMP.

(1) Remove and clean the pump strainer every 2 days of operation. Remove the nut and bolt from the pump cap and remove the cap. The strainer can then be lifted out and cleaned with a brush and clear gasoline. Refer to section VIII, paragraph 1.*c.*(4).

(2) If additional servicing is required, it is advisable to replace the entire pump, as a faulty assembly, especially a leak between the fuel chamber and the electric motor, can be a fire hazard.

c. FAN MOTOR.—If the fan motor does not operate, make certain that all connections are tight and that there are no short circuits. If the motor still does not operate, it must be replaced.

d. BLOWER MOTOR.

(1) If the blower motor fails to operate, inspect the wiring to make certain all connections are tight and that there are no short circuits.

(2) If after examining the wiring the blower motor still does not operate, disconnect the blower motor lead from heater terminal 2 and connect it directly to heater terminal 1. If the blower then operates, the overheat switch is out of adjustment. If the blower motor does not operate when connected to heater terminal 1, the motor is defective and must be replaced.

e. CARBURETOR.—The carburetor is not adjustable. It is a fixed-orifice type, calibrated for the heater to which it is attached. Do not attempt to change this adjustment. If the carburetor does not function properly, however, it should be removed for the following possible adjustments:

(1) Checking of float level.

(2) Cleaning of float bowl and screen.

(3) Adjustment of opening between fiber disc and seat in check valve.

4. REMOVAL.

a. GENERAL.

(1) Before removing any item from the heater fuel system, drain heater fuel lines at the lowest point. This is best done at the fuel manifold heater valve connection. When reinstalling the heaters, bleed the air from the fuel lines at each heater.

(2) Before adjusting or removing any item from the heater electrical system, make sure the main switchboard disconnect switch is "OFF."

b. REMOVAL OF HEATER.

(1) Disconnect the electrical lead at the heater panel.

(2) Disconnect the fuel line at the carburetor.

(3) Remove the two nuts on the exhaust elbow flange and disconnect the exhaust piping.

(4) Remove the four nuts and bolts which fasten the heater brackets to the bulkhead and remove the heater.

c. REMOVAL OF FUEL PUMP.

(1) Disconnect the electrical lead from the back of the pump body.

(2) Unscrew the coupling nuts to disconnect the fuel inlet line and the fuel outlet line.

(3) Unscrew the screws holding the pump bracket to the bulkhead and remove the pump.

5. TROUBLE SHOOTING.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
HEATER OPERATING, NO HEAT DELIVERY	No fuel. Break or leak in fuel line. Carburetor clogged. Fuel-air blower not operating. Blower operating, igniter not operating. Fan motor not operating. Fuel pump strainer clogged.	Check fuel supply. Check lines and valves. Clean carburetor. Check electrical connections and switches. Check ignition. Check fan motor. Clean strainer.
HEATER CONTINUALLY RECYCLING (STARTING AND STOPPING)	Fan motor not operating properly. Overheat switch defective or out of adjustment.	Check fan motor. Check overheat switch.
HEATER SPUTTERS IN OPERATION	Choke partly out. Carburetor check valve not correctly spaced.	Close choke. Adjust valve.
FUEL PUMP KEEPS OPERATING	Break in fuel line.	Turn off heater, locate and repair break.
FUEL PUMP NOT OPERATING	Clogged screen. Hole in diaphragm.	Remove and clean. Replace pump.

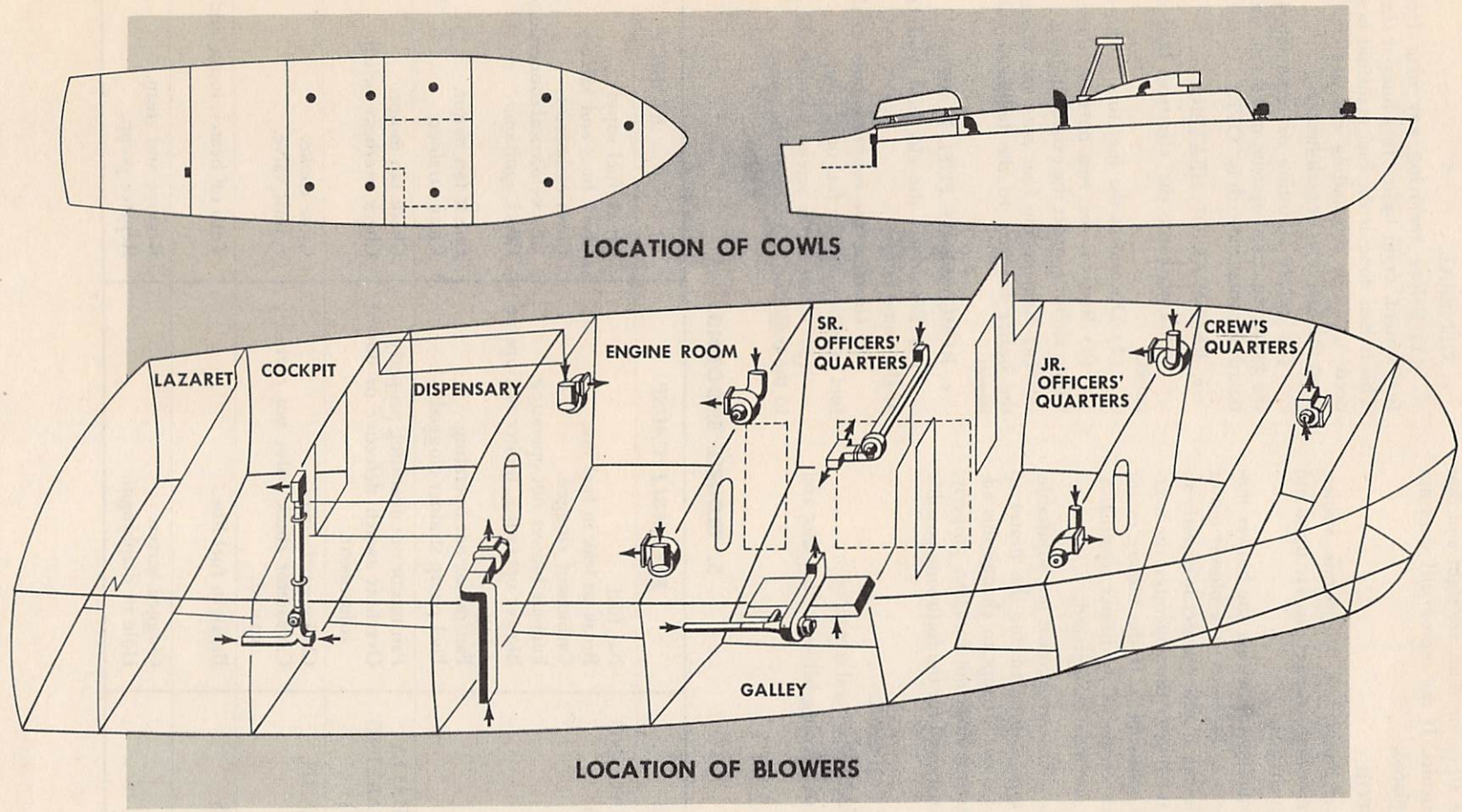


Figure 227—Ventilation System

SECTION XIX

Ventilation System

1. DESCRIPTION.

(See figure 227.)

a. LOCATION OF BLOWERS AND COWLS.

(1) One 180 cfm, 4-inch blower is located on the after port side of the crew's wash room. This blower exhausts air to a sprayproof cowl on deck.

(2) Two 180 cfm, 4-inch blowers are located in the junior officers' quarters, against the forward bulkhead, port and starboard. These blowers provide an intake of air through sprayproof deck cowls. The starboard blower supplies air to the crew's quarters through a duct through the bulkhead. The port blower has no duct and supplies air to the junior officers' quarters.

(3) One 180 cfm, 4-inch blower is located on the center outboard side of the galley. *(See figure 228.)* This blower exhausts air to a deck cowl on the starboard side of the bridge. The intake opening of the blower is connected to a hood over the stove and to a duct which leads to the officers' wash room. Another duct connects the exhaust opening of the blower to the deck cowl. This duct has a spray trap in it which drains to the deck.

(4) One 180 cfm, 4-inch blower is fastened to the longitudinal bulkhead between the galley and senior officers' quarters, on the galley side. This blower takes air in from a deck cowl mounted on the port side of the bridge, through a duct with a spray trap similar to that of the galley blower. A duct on the exhaust opening of the blower divides the supply of air between the galley and the senior officers' quarters. *(See figure 229.)*

(5) Two 1000 cfm, 8-inch blowers are fastened under the deck against the engine room forward bulkhead, port and starboard. *(See figure 230.)* These blowers provide an intake of air from deck cowls immediately above them, just aft of the bridge. A tube drains the rotor chamber of each blower into the bilge.

(6) One 500 cfm, 6-inch blower is mounted in the after port side of the engine room. This blower provides an intake of air from a deck cowl immediately above it. A tube drains the blower rotor chamber into the bilge.

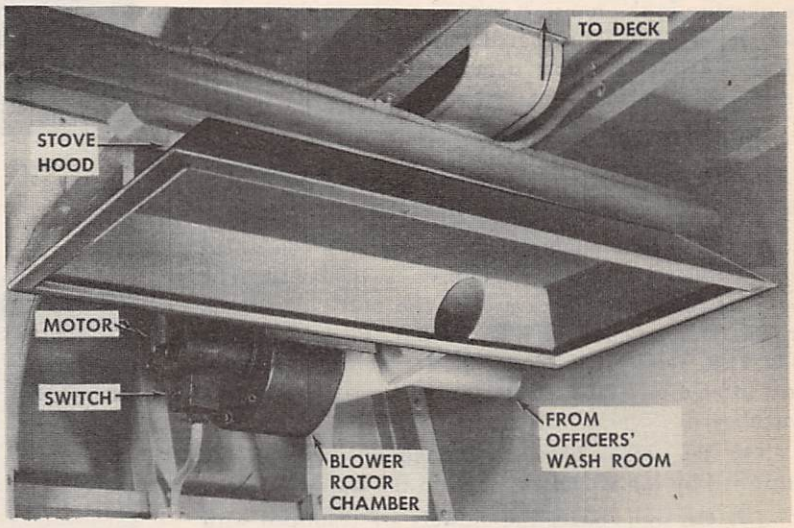


Figure 228—Galley Outboard Blower

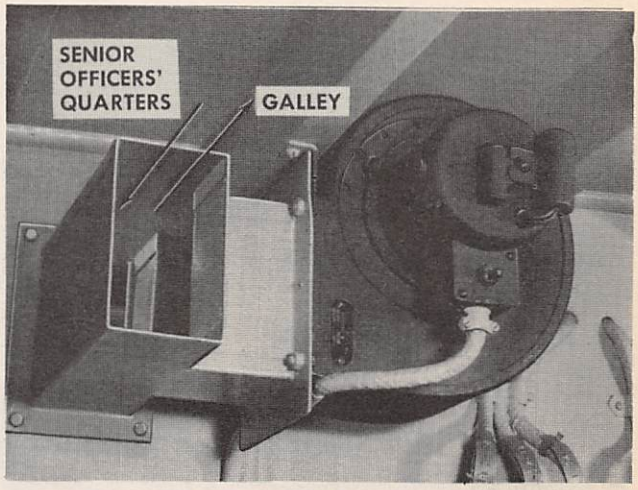


Figure 229—Senior Officers' Quarters and Galley Inboard Blower

(7) One 500 cfm, 6-inch blower is mounted in the after starboard side of the engine room. A duct from this blower leads through the engine room floor. The blower exhausts air from the engine room bilge through a deck cowl immediately above it. A tube drains the blower rotor chamber into the bilge. *(See figure 231.)*

(8) One 180 cfm, 4-inch blower is mounted under the cockpit deck against the cockpit forward bulkhead on the starboard side. A duct from the blower leads to the cockpit bilge. This blower exhausts air from the cockpit bilge to a louvred exhaust stack in the starboard forward corner of the cockpit. *(See figure 232.)*

b. BLOWERS.

(1) The ductless blowers (the crew's wash room blower, the junior officers' quarters port blower, the two forward and the port after blowers in the engine room) are equipped with screen guards over the openings. These guards prevent foreign objects from entering the rotor chambers and damaging the rotors.

(2) Each blower takes air in through the side opening in line with the rotor shaft and exhausts it through the opening in the housing at right angles to the intake. *(See figure 233.)* Whether a blower blows air in or exhausts it out of a boat depends on the mounting of the individual blower.

c. ELECTRICAL SYSTEM.

(1) The blowers take their current from the 24-volt electrical system through fused lines.

(2) The four engine room blowers are controlled by individual switches on the main switchboard. The two port blower switches are on the port side of the switchboard, labelled "FWD. BLOWER" and "AFT. BLOWER," and the starboard blower switches are similarly located and labelled on the starboard side of the switchboard.

(3) The other blowers throughout the boat are controlled by individual switches on the blower motors.

(4) On some boats, the blowers are equipped with

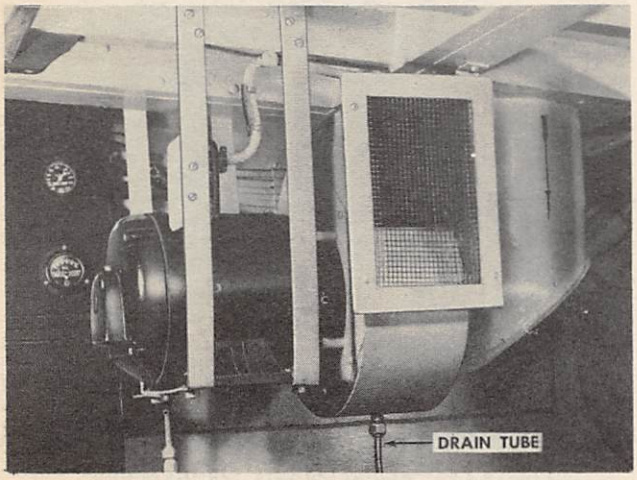


Figure 230—Engine Room Forward Blower, Starboard

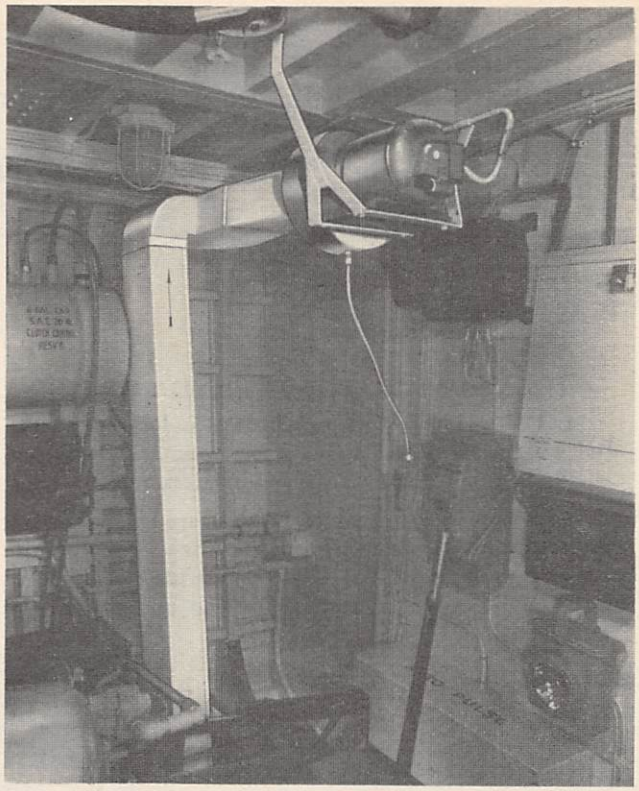


Figure 231—Engine Room Starboard Blower, After (Bilge)

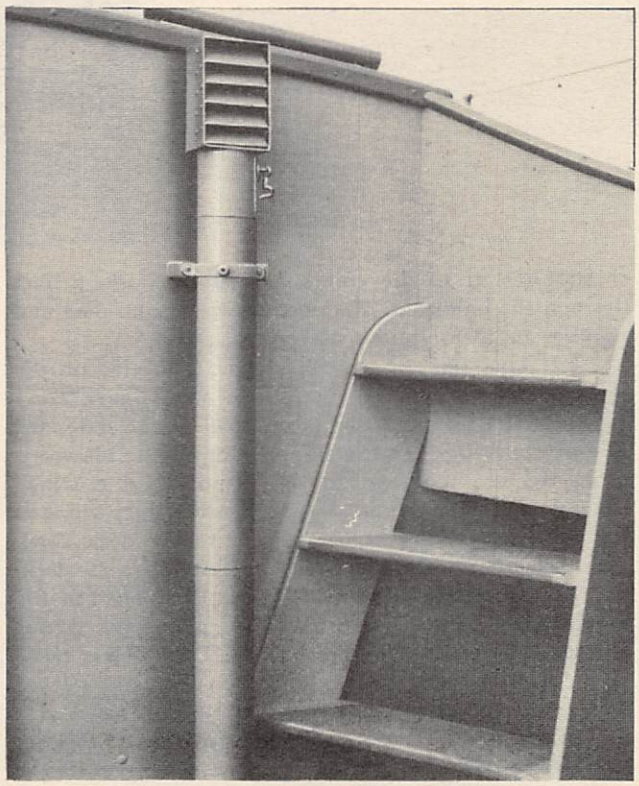


Figure 232—Cockpit Bilge Blower Exhaust Stack

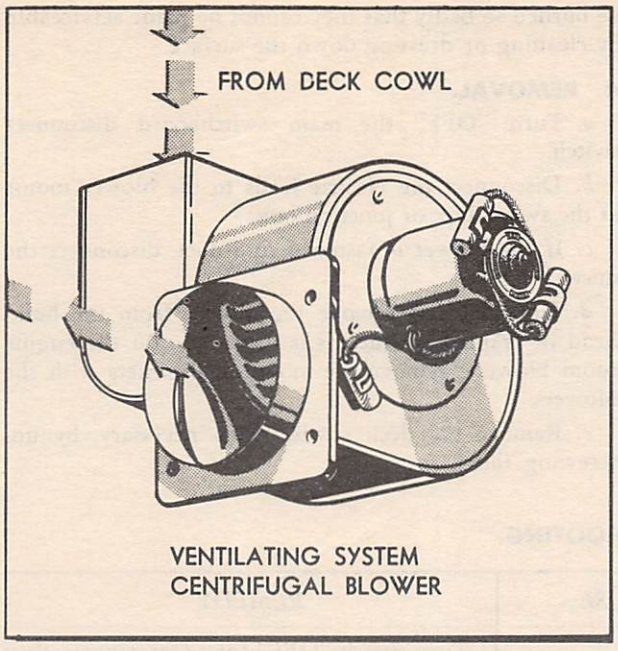


Figure 233—Blower Mounted for Taking Air into the Boat

thermal overload switches for motor protection. If the motor develops too much heat in operation, the switch will automatically open the circuit instead of blowing a fuse. It must be reset by hand.

(5) The four engine room blowers are wired through the CO_2 pressure switch. Refer to Section XVII, Fire Extinguishing System. When the CO_2 system is discharged, it will open the blower circuit and stop the blowers from ventilating the engine room. The pressure switch must be reset by pushing down the plunger at the top before the blower circuit is again operative.

d. COWLS.

(1) The three forward cowls are of the sprayproof type. *(See figure 234.)* The heads of the cowls can be swivelled around so the openings can be faced in any direction.

(2) The other cowls are of the conventional marine type with openings facing aft at all times.

2. OPERATION INSTRUCTIONS.

a. With the main battery disconnect switch closed, close the blower switch on the blower to be used. In the engine room, close the blower switches on the main switchboard. *(See figure 235.)*

b. On boats with thermal overload switches, the thermal switches for the engine room blowers are normally left "ON" and the blowers are controlled by the switchboard switches.

c. If a blower with a thermal overload switch should stop, turn the thermal switch "OFF" and allow the motor to cool before turning it "ON" again. If it again trips off, do not turn it on again until the source of trouble is located and corrected.

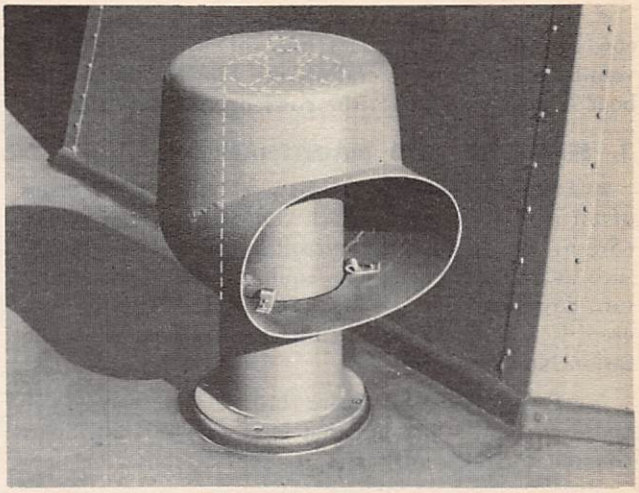


Figure 234—Sprayproof Ventilator Cowl

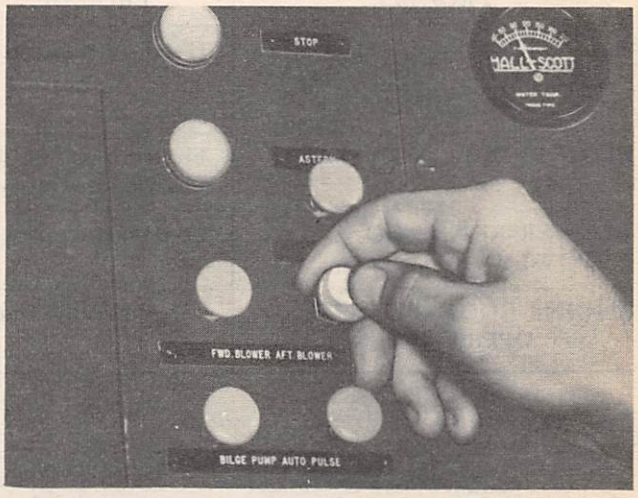


Figure 235—Closing Engine Room Blower Switch

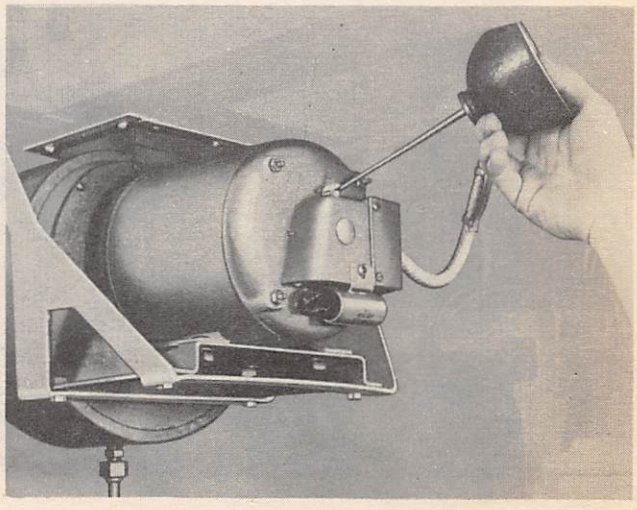


Figure 236—Lubricating Blower Motor

d. When the boat is at dock, turn the sprayproof cowls so the openings face into the wind, to provide ventilation without operating the blowers. When the boat is under way, turn the cowl openings to face aft.

3. SERVICING AND MAINTENANCE.

a. LUBRICATION.—Once a week, place a few drops of oil in the oil cups at each end of the motor shafts. *(See figure 236.)* Do not overoil. Use a light engine oil such as SAE 20. On motors equipped with grease cups, turn down the cups one turn each week. When the cups are dry, refill them with alemite grease, Federal Specification No. VV-G-681.

b. SPARE PARTS.—Spare brushes are carried on board to replace brushes that burn or wear out. Spare commutators also are carried to replace those that may be burned so badly that they cannot be made serviceable by cleaning or dressing down the surface.

4. REMOVAL.

a. Turn "OFF" the main switchboard disconnect switch.

b. Disconnect the electric leads to the blower motor at the switch box or junction box.

c. If the blower is fastened to a duct, disconnect the duct.

d. Unfasten and remove the blower from the bulkhead or frame on which it is mounted. On the engine room blowers, remove the mounting brackets with the blowers.

e. Remove the deck cowls, when necessary, by unscrewing them.

5. TROUBLE SHOOTING.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
BLOWER WITH OVERLOAD SWITCH AUTOMATICALLY STOPS RUNNING	Overloaded circuit.	Turn switch "OFF" for a few minutes, then turn it "ON."
BLOWER WILL NOT START.	Electric motor brushes worn out. Electric lines broken.	Replace brushes. Repair lines.
BLOWER RUNS TOO SLOWLY	Commutator surface burned.	Remove blower motor and have commutator dressed down or replaced.
ENGINE ROOM BLOWER NOT OPERATING	CO_2 pressure switch open.	Press switch plunger in to reset.



SECTION XX

Periodic Inspection

The following material is presented as a guide to the inspection, servicing, and maintenance operations to be performed at specified periods on the 63-foot AAF Rescue Boat.

The column headings "25 hours," "50 hours," "100 hours," and "1200 hours," refer to hours of engine operation and not to hours of "trip" time.

	Pre-Trip and Enroute	*25 Hours*	*50 Hours*	*100 Hours*	*1200 Hours*	*Daily*	*Weekly*	*Monthly*	*Haulout*
ENGINE CONTROLS									
Throttle			L	A	O	I	L	A	A
Reverse Gear			I	A	O		I	A	A
Spark			L	A		I	L	A	
Primer		I					I		
Seawater Valve	I		I				I		
Mixture	I		I				I		
Telegraph			L	A	O	I	L	A	A
ENGINE INSTRUMENTS	I								
IGNITION AND WIRING									
Spark Plugs		I		R				I	
Wiring Primary				I				I	
Wiring Secondary			I				I		
Distributer Points			I				I		
Distributer Rotor			I				I		
Distributer Cap			I				I		
Distributer Timing				A				A	
Ignition Switch				I				I	
Condensers				I				I	
Distributers			L		O		L		A
Coils			I					I	
Shielding		I			O			I	
FUEL SYSTEM									
Fuel Pumps		I	C	L	O				O
Autopulses			I		O				O

Key to Symbols: I—Inspect. L—Lubricate. C—Clean. A—Adjust. O—Overhaul. R—Replace.

	Pre-Trip and Enroute	*25 Hours*	*50 Hours*	*100 Hours*	*1200 Hours*	*Daily*	*Weekly*	*Monthly*	*Haulout*
FUEL SYSTEM (Cont)									
Sediment Pots		I							
Fuel Strainer			I						
Fuel Lines	I				O	I			O
Fuel Gages	I					I			
Fuel Tanks						I			
Fuel Valves	I				O	I			O
OIL SYSTEM									
Oil Tanks	I					I			
Pressure Oil Gages	I								
Sumps	I								
Oil Lines		I					I		
Sump Pump					I				I
Pressure Pump					I				I
Strainer Cartridge			drain sediment pots	R					
COOLING SYSTEM									
Seawater Pump					O	L			O
Seawater Lines						I		I	
Scoops					I				I
Temperature Gage	I								
VALVES AND LINES									
Suction Lines			I				I		
Suction Valves			I				I		
Pressure Lines			I				I		
Pressure Valves			I				I		
MANIFOLDS									
Intake Manifolds		I						I	
Exhaust Manifolds		I						I	
Manifold Gaskets			I	I				I	
STUFFING BOXES AND SHAFTS									
Stuffing Boxes	I		A		O	I	A		O
Shaft Log			I				I		
Main Shafts					I				

Key to Symbols: I—Inspect. L—Lubricate. C—Clean. A—Adjust. O—Overhaul. R—Replace.

	Pre-Trip and Enroute	*25 Hours*	*50 Hours*	*100 Hours*	*1200 Hours*	*Daily*	*Weekly*	*Monthly*	*Haulout*
GENERAL AND MISCELLANEOUS									
Starter									
Commutator			I				C	C	
Brushes			I						R
Bearings				L					
Generator									
Mount		I					I		
Terminals and Connections		I					I		
Commutator			I					I	
Voltage Regulator									
Contact Points			C					C	
Open Circuit Voltage				I				I	
Engine Mount Bolts		I					I		
BILGE SYSTEM									
Bilge Pumps			I	L			I L		
Bilge Strainers	I					I C			
Bilge Compartments	I					I			
Bilge Suction Valve Glands			A				A		
STEERING MECHANISM									
Chains and Sprockets			L	A		I	L	A	
Shafts and Bearings			I L				I L		
Worm Gear			I	L			I	L	
Packing Glands				A		I		A	
Tierod and Joints				A		I		A	
HULL AND DECK									
Hull Underwater									I C O
Hull Above Water			I		O				O
Deck General					O	I C			O
Superstructure			I		O		I		O
Ships Framing					I				I
Ships Bulkheads				I				I	
Paint Hull				I	O			I	O
Paint Decks			I		O		I		O

Key to Symbols: I—Inspect. L—Lubricate. C—Clean. A—Adjust. O—Overhaul. R—Replace.

	Pre-Trip and Enroute	*25 Hours*	*50 Hours*	*100 Hours*	*1200 Hours*	*Daily*	*Weekly*	*Monthly*	*Haulout*
SHIP'S GEAR									
Lines, Fenders						I C A			
Life Preservers						I C A			
Slickers, Life						I C A			
Rafts, etc.						I C A			
QUARTERS									
Quarters, Crew						I C A			
Quarters, Officers						I C A			
Heads (All)						I C A			
Lockers						I C A			
Blowers			I	L	O		I	L	O
GALLEY									
Stove						I C			
Refrigerator			Defrost			I C	Defrost		
Galley Equipment						I C			
Stowage Lockers						I C			
Blowers			I	L	O		I	L	O
FRESH WATER SYSTEM									
Motor				I L	L			I L	L
Belt				I A				I A	
Pump				I A				I A	
Spigots					O	I			O
REFRIGERATOR									
Motor				I	L			I	
Belt				I A				I A	
Pump					I				I
Insulation				I	O				O
RESCUE EQUIPMENT									
Lifeboat					O	I			O
Liferaft				I			I		
Crash Kit				I	O		I		O
A-Frame				I	O		I		O
Hoisting Tackle				I	O		I		O
Flares				I	O		I		O

Key to Symbols: I—Inspect. L—Lubricate. C—Clean. A—Adjust. O—Overhaul. R—Replace.

	Pre-Trip and Enroute	*25 Hours*	*50 Hours*	*100 Hours*	*1200 Hours*	*Daily*	*Weekly*	*Monthly*	*Haulout*
FIRE EQUIPMENT									
CO_2 Cylinders				I				I	
Nozzles			I C				I C		
Piping and Control				I				I	
Foamite Pump			I L				I L		
Foamite Valves and Piping			I				I		
Hand Extinguisher			I				I		
ARMAMENT									
Rapid Fire Barrel			C L		O	I	C L		O
Rapid Fire Mechanism			C L		O	I	C L		O
Rapid Fire Mounts			C I L		O		C I L		O
Small Arms			C L		O	I	C L		O
NAVIGATION									
Direction Finder	I				swing O	I			swing O
Charts, etc	I		I		O		I		O
Compass	I				swing O	I			swing O
Chronometer	I								
Sextant	I								
COMMUNICATION									
Transmitter					O	I			O
Receivers					O	I			O
Dynamotor					I O				I O
Interphone					O	I			O
Speaking Tubes					O	I			O
Miscellaneous					O	I			O
VENTILATION SYSTEM									
Motors				I	L O			I	L O
Screens			I		O		I		O
Ventilators			I		O		I		O
Ducts				I	O			I	O
Switches					I O				I O
HEATING SYSTEM									
Fuel Line			I				I		
Igniters						I			

Key to Symbols: I—Inspect. L—Lubricate. C—Clean. A—Adjust. O—Overhaul. R—Replace.

	Pre-Trip and Enroute	*25 Hours*	*50 Hours*	*100 Hours*	*1200 Hours*	*Daily*	*Weekly*	*Monthly*	*Haulout*
HEATING SYSTEM (Cont)									
Exhaust Lines				I				I	
Motor					L I			L I	L I
UNDERWATER MECHANISM									
Struts					I O				I O
Propellers					I O				I O
Rudders					I				I
Zinc Plates					I R				I R
Scoops					I O				I O
Ground Plate					I				I
MEDICAL EQUIPMENT									
Splints			I				I		
Surgical Instruments			I				I		
Drugs			I				I		
Accessories			I				I		
EXHAUST STACKS									
Flange Joints			I		I O				I O
Hose Connections			I		I O				I O
Thru Hull Rings			I		I O				I O
LAZARET									
Stowage						I			
Paint Supply						I			
Rag Supply						I			
AUXILIARY GENERATOR									
Cooling			I		O				O
Lubrication	I				O	I			O
Fuel System			I		O		I		O
Ignition System			I		O		I		O
Generation Brush	I		R			I	R		
Oil Supply					I O				I O
Grounds					I O				I O
BATTERIES									
Electrolyte						I			
Terminals						I			

Key to Symbols: I—Inspect. L—Lubricate. C—Clean. A—Adjust. O—Overhaul. R—Replace.