TECHNICAL MANUAL

OPERATOR AND OROANIZATIONAL MAINTENANCE MANUAL
LANDING CRAFT, MECHANI7F,D; STEEL; DED; OVERAIT, LENGTH 74FEET; MOD 1, MARK VIII, NAVY DESIGN LCM-8
HULL NUMBERS 8500 THRU 8560 AND 8580 THRU 8618
(GUNDERSON BROS. ENGINEERING CORP., MARINETTE MARINE CORP., AND ROHR CORP.)
FSN 1905-935.6057

This copy is a reprint which includes current pages from Changes 1 through 3.

HEADQUARTERS, DEPARTMENT OF THE ARMY
AUGUST 1974

WARNING
DANGEROUS CHEMICALS
are used in this equipment.
SERIOUS INJURY OR DEATH
may result if personnel fail to observe these safety precautions.
Avoid contact with the battery electrolyte.
If the solution comes in contact with the skin, rinse the area immediately with clear water to avoid skin burns.
Be sure all cargo is secure, especially during rough seas.

WARNING
FIRE OR EXPLOSION HAZARD
SERIOUS INJURY OR DEATH
may result if personnel fail to observe these safety precautions.
Hatches must be open before energizing any electrical circuits or starting engines.
Do not smoke or use an open flame in the vicinity when servicing batteries as hydrogen gas, an explosive is generated. Use only distilled water to maintain battery electrolyte level.
Do not fill fuel tank while engine is running.
Provide me'allic contact between the fuel container and fuel tank to prevent a static spark from igniting fuel.
Wipe or flush any spillage.
Volatile materials will not be brought aboard;
electrical circuits will not be energized;
fuel tanks will not be topped off;
and engines will not he started
before C02 fire fighting
equipment is available
and operative.
Observe NO SMTOKING rules when refueling.
Do not work on live circuits. Tag circuit and warn other personnel not an energize the circuit.
Never use a b)low torch or other similar means for heating fuel or oil lines.

WARNING
ASPHYXIATION DANGER
Be sure engine room ventilators are open when operating the engine (s).
The engine exhaust gases contain carbon monoxide, which is a colorless, odorless, and poisonous gas.

CHANGE

NO. 7

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WASHINGTON, D.C., 4 April 1994

Operator and Organizational
Maintenance Manual

LANDING CRAFT, MECHZED;
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MOD 1, MARK VIII, NAVY DES GN LCM-8
HULL NUMBERS 8500 THRU 8560 AN :m:8o THRU 8618
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Operator and Organizational Maintenance Manual

**LANDING CRAFT, MECHANIZED, STEEL, DED, OVERALL LENGTH 74-FEET,
MOD 1, MARK VIII, NAVY DESIGN LCM-8
HULL NUMBERS 8500 THRU 8560 AND 8580 THRU 8618
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Operator and Organizational Maintenance Manual

LANDING CRAFT, MECHANIZED; STEEL; DED; OVERALL LENGTH 74-FEET;
MOD 1, MARK VIII, NAVY DESIGN LCM-8
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Operator and Organizational Maintenance Manual
LANDING CRAFT, MECHANIZED;
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MOD 1, MARK VIII, NAVY DESIGN LCM-8
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C3

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NO. 3 }

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Operator and Organizational Maintenance Manual

LANDING CRAFT, MECHANIZED;
STEEL; DED; OVERALL LENGTH 74-FEET;
MOD 1, MARK VIII, NAVY DESIGN LCM-8
HULL NUMBERS 8500 THRU 8560 AND 8580 THRU 8618
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Operator and Organizational Maintenance Manual

LANDING CRAFT, MECHANIZED;
STEEL; DED; OVERALL LENGTH 74 FEET;
MOD 1, MARK VIII, NAVY DESIGN LCM-8
HULL NUMBERS 8500 THRU 8560 AND 8580 THRU 8618
(GUNDERSON BROS. ENGINEERING CORP.,
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	Remove pages	Insert pages
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	3-7 and 3-8	3-7 and 3-8

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Operator and Organizational Maintenance Manual

LANDING CRAFT, MECHANIZED;
STEEL; DED; OVERALL LENGTH 74 FEET;
MOD 1, MARK VIII, NAVY DESIGN LCM-8
HULL NUMBERS 8500 THRU 8560 AND 8580 THRU 8618
(GUNDERSON BROS. ENGINEERING CORP.,
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2-1 thru 2-4	2-1 thru 2-4
2-13 and 2-14	2-13, 2-14, and 2-14.1
2-37	2-37
4-79 and 4-80	4-79 and 4-80
A-1	A-1
B-1 thru B-6	B-1 thru B-6

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SERIOUS INJURY OR DEATH

may result if personnel fail to observe these safety precautions.
Avoid contact with the battery electrolyte.
If the solution comes in contact with the skin, rinse the area immediately with clear water to avoid skin burns.

Acids can cause serious burns or blindness. Avoid contact with eyes, skin, or clothing. Do not breathe vapors. Wear rubber gloves, goggles, and a rubber apron when handling them. When diluting acids, do not add water to acid; the acid must be added to the mixture slowly and with constant mixing. In case of contact with acid, flush the affected area with plenty of water and obtain medical aid immediately.

Before working on any electrical equipment, make sure the circuits has been deenergized and the cables have been disconnected from the battery.

When cutting with a torch, or when welding, always station fire watches, ready with fire extinguishers, in the vicinity on both sides of the plate that is being cut or welded.

Ramp hinge pins must be replaces one at a time, allowing three remaining pins to support ramp. Removal of two or more hinge pins may result in the weight of the ramp misaligning the remaining hinges, resulting in damage to ramp and possible injury or death to maintenance personnel.

When refueling, shut down the electrical system of the LARC. Observe the no smoking rule. Do not permit anyone to operate tools or equipment which may produce sparks near the refueling operation. Sparks or fire may ignite the diesel fuel and produce an explosion.

Before attempting to remove any compressed air system lines or components, relieve air pressure from system. Failure to do so may result in injury or possible death to maintenance personnel.

Before disconnecting a line in the hydraulic system, bleed the pressure from that portion of the line. Failure to do so may result in injury or possible death to maintenance personnel.

Be sure all cargo is secure, especially during rough seas.

WARNING
FIRE OR EXPLOSION HAZARD
SERIOUS INJURY OR DEATH

may result if personnel fail to observe these safety precautions.

Hatches must be open before energizing any electrical circuits or starting engines. Do not smoke or use an open flame in the vicinity when servicing batteries as hydrogen gas, an explosive is generated. Use distilled water to maintain battery electrolyte level. Do not fill fuel tank while engine is running. Provide metallic contact between the fuel tank to prevent a static spark from igniting fuel.

Fuel oil and other petroleum products are highly volatile in extreme heat. To minimize the possibility of explosion, wipe up all spills at once, see that fuel lines and valves are not leaking and pump bilges regularly.

Volatile materials will not be brought aboard; electrical circuits will not be energized: fuel tanks will not be topped off; and engines will not be started before C02 fire fighting equipment is available and operative.
Observe NO SMOKING rules when refueling. Do not work on live circuits. Tag circuit and warn other personnel not to energize the circuit. Never use a blow torch or other similar means for heating fuel or oil lines.

Prior to cutting or welding on the ramp, remove drain plugs on both sides of the ramp and check if ramp interior is primer coated. If primer coated, flush thoroughly with steam, carbon dioxide, or water. Do not reinstall drain plugs until the cutting and/or welding operation is completed. Failure to take this precaution may result in explosion of accumulated primer vapors.

WARNING
ASPHYXIATION DANGER

Be sure engine room ventilators are open when operating the engine(s). The engine exhaust gases contain carbon monoxide, which is a colorless, odorless, and poisonous gas.

When working inside the hydraulic oil supply tank, a portable-type circulating blower should be used to prevent vapor accumulation. For extended work periods inside the tank, an air line tube respirator should be worn. Station an observer outside tank in case worker is overcome by fumes.

TECHNICAL MANUAL
No. 556-1917-12

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., 15 August 1974

OPERATOR AND ORGAIZATIONAL MAINTENANCE MANLUAL
LANDING CRAFT, MECHANIZED; STEEL; DED; OVERALL
LENGTH 74-fEET; MOD I, MARK VII, NAVY OESIGN LCM-8
HULL NUMBERS 8500 THRU 8560 AND 8580 THRU 8618
(GUNDERSON BROS. ENGINEERING CORP.,
MARINETTE MARINE CORP., AND ROHR CORP.)
FSN 190' 9356057

LIST OF ILLUSTRATIONS

CHAPTER 1

INTRODUCTON

SECTION I. GENERAL

1-1. Scope
This manual is for your use in operating and maintaining the landing craft, design LCM-8, MOD 1. The manual provides information on the operation, lubrication, and organizational maintenance of the equipment. Also included are descriptions of main units and their functions in relationship to other components.

1-2. Maintenance forms and Records
Maintenance forms and records that you are required to use are explained in DA Pam 738-750.

1-3. Reporting of Errors
You can improve this manual by calling attention to errors and by recommending improvements, using DA Form 2028 (Recommended Changes to Publications), or by a letter, and mail direct to the Commander, U.S Army Troop Support Command, ATTN: AMSTR-MCTS, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798. A Reply will be furnished directly to you.

1-4. Equipment Serviceability Criteria (ESC)
This. equipment is not covered by an ESC.

1-5. Destruction of Army Material to Prevent Enemy Use .
Procedures to be followed when capture or abandonment of the landing craft to an enemy is eminent are covered in TM 750-244-3.

1-6. Administrative -Storage
Procedures to be followed will be found in T'M 740-90-1 Administrative Storage.

SECTION II. Description and Data

1-7. Description

a. General. The LCM-8, MOD 1, Landing Craft (fig. 1-1 and 1-2) is a welded steel, twinscrew type craft. It is used to transport cargo, troops, and vehicles from ship shore, shore-to shore, or in retrograde movements. It may be utilized for lighterage and utility work in harbors. It is intended for use in rough or exposed waters and is capable of operating through breakers and grounding on a beach, remaining upright and tight, and retracting from the beach under its own power. The craft is propelled by two twin-engine propulsion units, and is capable of a speed of nine knots when fully equipped. The maintenance paragraphs of this manual contain detailed descriptions of the components of the LCM's.

b. Main Deck. The main deck is aft, with the pilot house centrally located on the deck. The engine room hatch is located in the deck from the pilot house and the Lazarette hatch is located in the deck aft from the pilot house. The deck contains a bolted cover plate over each-engine to facilitate engine removal and installation.

c. Cargo Well and Ramp. The cargo well is forward. Dimensions are 42 ft. long and 15 ft. wide. The ramp is lowered and raised, by a winch located forward in the hull. The winch is powered by a hydraulic motor and is normally controlled from the pilot house.

d. Engine Room. The engine room is below the main deck between the cargo well and the Lazarette. Hydraulic system tanks are located in the engine room. Craft manufactured by the Marinette Marine Corporation also have a steering system expansion tank in the pilot house. Bilge pumps and bilge system. valves are located in the engine room.

e. Lazarette. The lazaette is aft below. the main deck. It contains the two diesel fuel tanks,

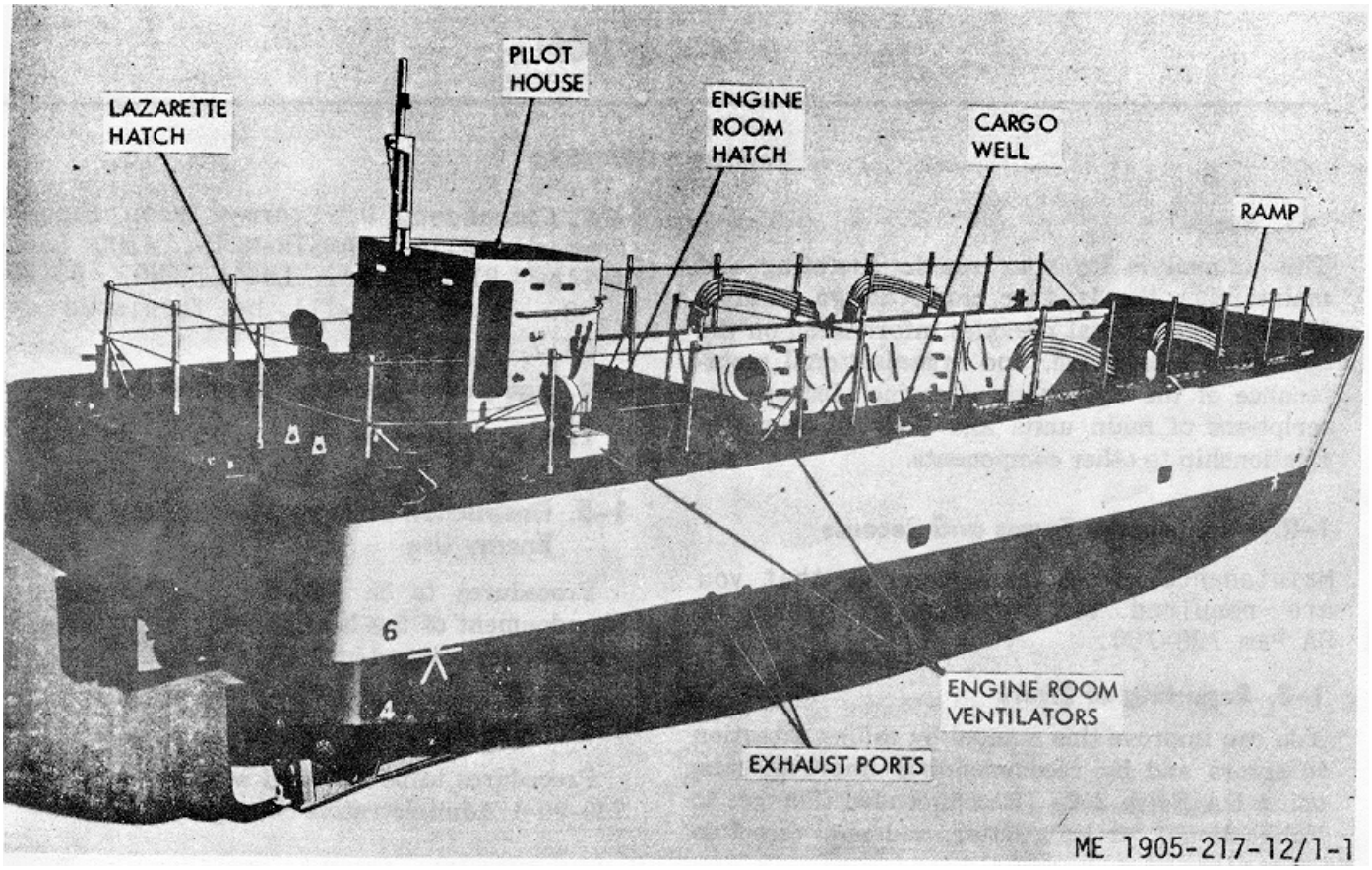


Figure 1-1. Landing craft, mechanized, diesel, design, LCM-8, MOD-1. (Marinette and Gunderson Models)

fuel shutoff and steering cylinders, steering linkage, and ball valves and counterbalance valves. Space for ammunition stowage is provided in the Lazarette

f. Starting and Control Systems. Two starting systems are provided for the diesel engines. Each outboard engine has an electric starter and each inboard engine has a hydraulic starter. If either stating system should fail, the other systems can be used to start both engines. Separate hydraulic systems can be used to start both engines. Separate hydraulic systems are provided for steering and for the ramp hoist.

g. Pilot House. The pilot house on the Marionette and Gunderson Models are of the same type construction. The pilot house on the Rohr Model is somewhat different in that it has an overhead.

1-8. Difference in Models

a. General. Landing craft, LCM-8, MOD 1, have been produced by three different manufacturers as follows:

Maufacturer Registry Numbers

Marinette Marine Corp.	LCM-8500 thru LCM-8519
Gunderson Bros Engineering Corp.	LCM-8450 thru LCM-8539
Rohr Corporation	LCM-8540 thru LCM-8560 and LCM-8580 thru LCM8a18

b. Components. The propulsion engine units and many other components are common to all craft. There are some differences in the ramp hoist system and the steering system. Refer to paragraph 1-9c for a list of major accessories used in these craft.

c. Operation. Controls and operation are generally the same for all craft. Minor differences are explained in paragraphs 2-1 thru 2-6.

d. Maintenance. Differences in maintenance procedures may be required where different accessories have been used. Maintenance procedures for all accessories are provided and identified in appropriate sections in this manual.

e. Schematic and Functional Diagrams. Plan views and functional diagrams of the systems are shown in figures 13 through 1-18.

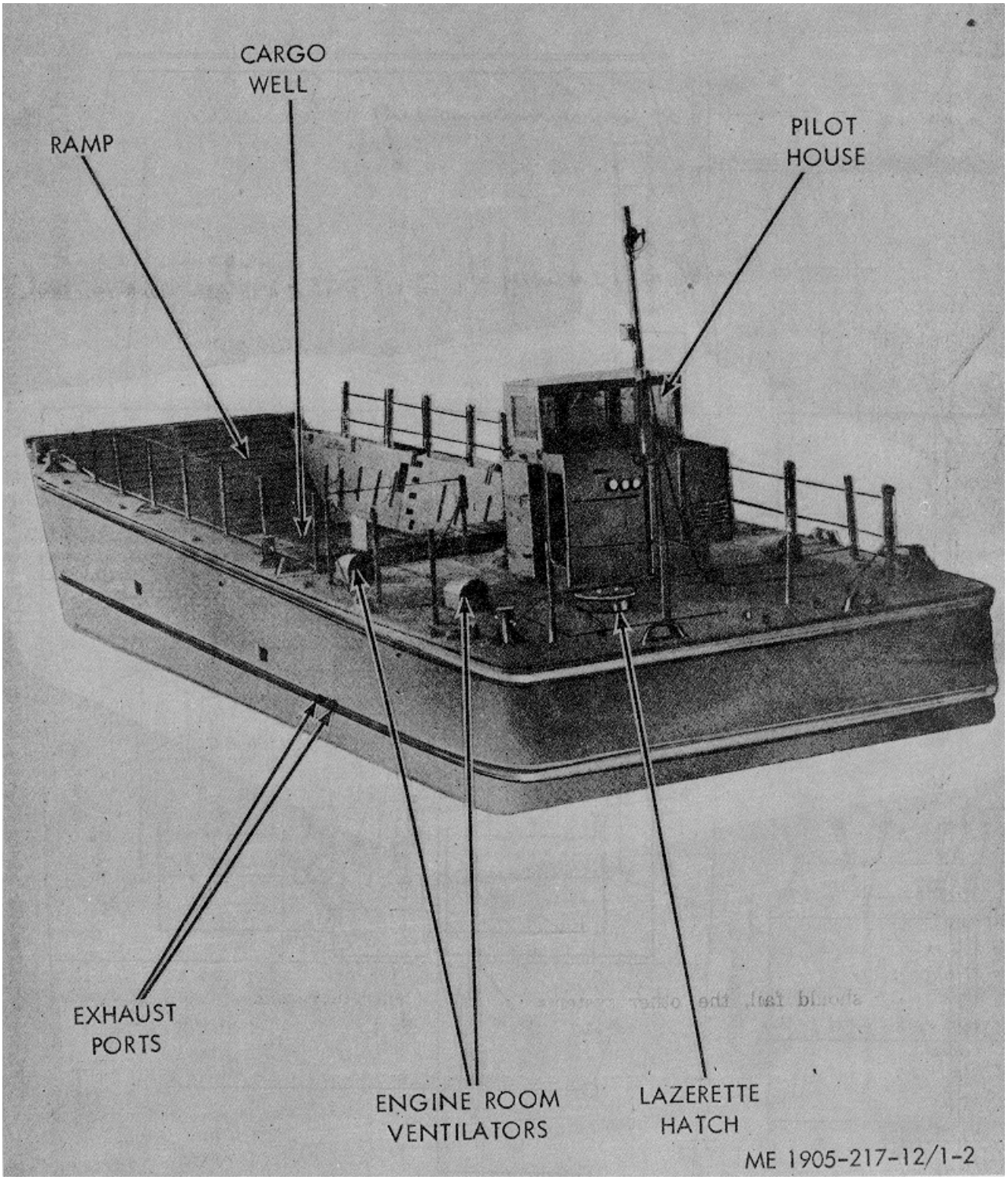


Figure 1-2. Landing craft, mechanized, diesel, design, LCM-8, MOD I (Rohr Model).

1-9. Tabulated Data

a. Major Identification Plates.

(1) Landing Craft identification plate. Located in the engine room, specifies the nomenclature, registry number, manufacturer, and Buships plan number.

(2) Engine identification plate. Located on the engine rocker arm cover, includes the model number, unit number, rated H.P., continuous

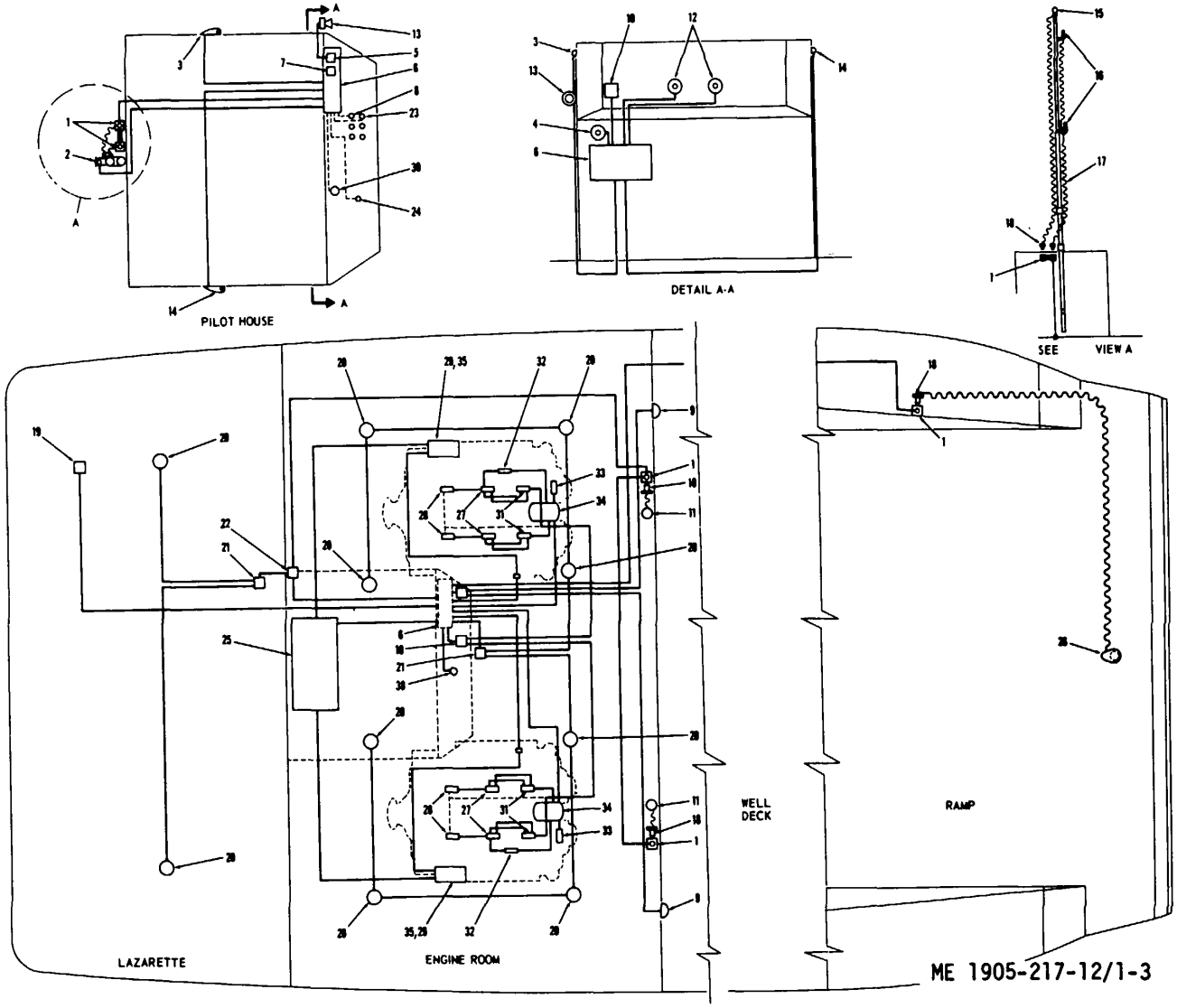


Figure 1-3. Plan view wiring diagram, hull numbers LCM 8500 thru 8519 (Marinette Marine

1.Receptacle
2 Stern Light
3 Port aide light (red)
4. Radio receptacle
5. Horn button
6. control and distribution panel
7. Cargo well light switch
8. Battery charge ammeter
9. Cargo well light (red)
10. Engine alarm panel
11. Fan
12 Binnacle light and receptacle
13.Horn
14. Standard side light (green)
15.Masthead light
16"Not under command" light
17. Mast light cable
18. Plug
19.Rudder angle indicator XMTR
20.White light
21Toggle switch
22.Reeptade
23. Port alternator -ammeter
24. Starboard alternator ammeter
25 .Battery
26. Anchor light
27 Oil pressure switch
28.Fuel pressure switch
29 Starter motor
30 Rudder angle indicator
31.Water temperature witch (close at 2060 F)
32 Resistor
33 Regulator
34 Alternator
35 Magnetic switch (starter contractor)

Figure 1-3- Continued

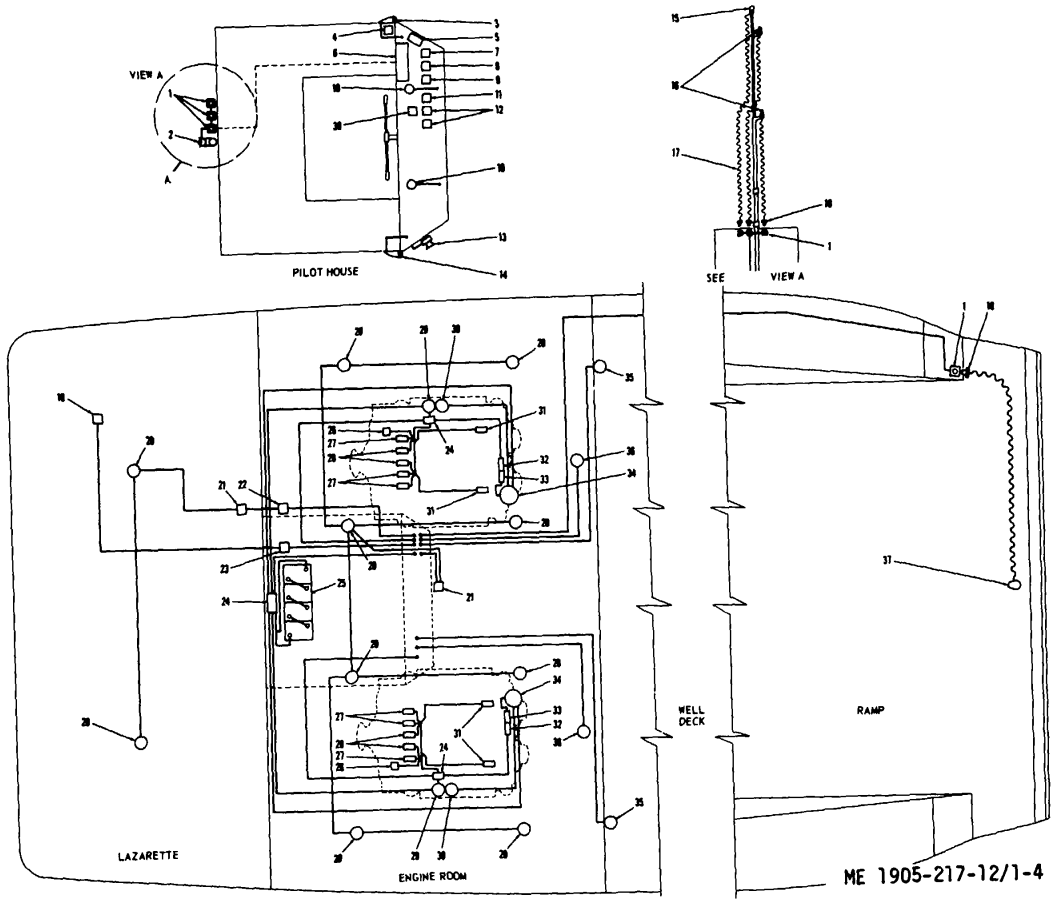


Figure 1-4. Plan view wiring diagram, hull numbers LCM- 8539 (Gunderson Brothers)

1. Receptacle
2 Stern light
3 Port side light (red)
4. Radio receptacle
5 Water tight enclosure
6. Control and distribution panel
7. Rotary snap switch, navigational lights
8 Toggle switch, navig tional lights
9. Rotary snap switch binnacle instrument light
10. Light panel
11. Cargo well light switch
12 Binnacle light and receptacle
13. Horn
14. Starboard side light (green)
15 Masthead light
16. "Not under command light
17. Mast light cable
18 Plug
19. Rudder angle indicator
20. White light
21. White lights toggle Retort
22 Receptacle
23. Rudder angle indicator power supply
24. Rain tight enclosure
25. Battery
26. Push-button start switch
27 Fuel pressure switch
28. Oil pressure switch
29. Starting motor
30. Magnetic switch (starter contactor)
31 Temperature switch (closes at 205* F)
32 Resistor
33 Regulator(alternative)
34. Alternator
35. Cargo well light (red)
36 Fan
37. Anchor light
38. Rudder angle in
27. Fuel pressure switch

F1-4 - Continued

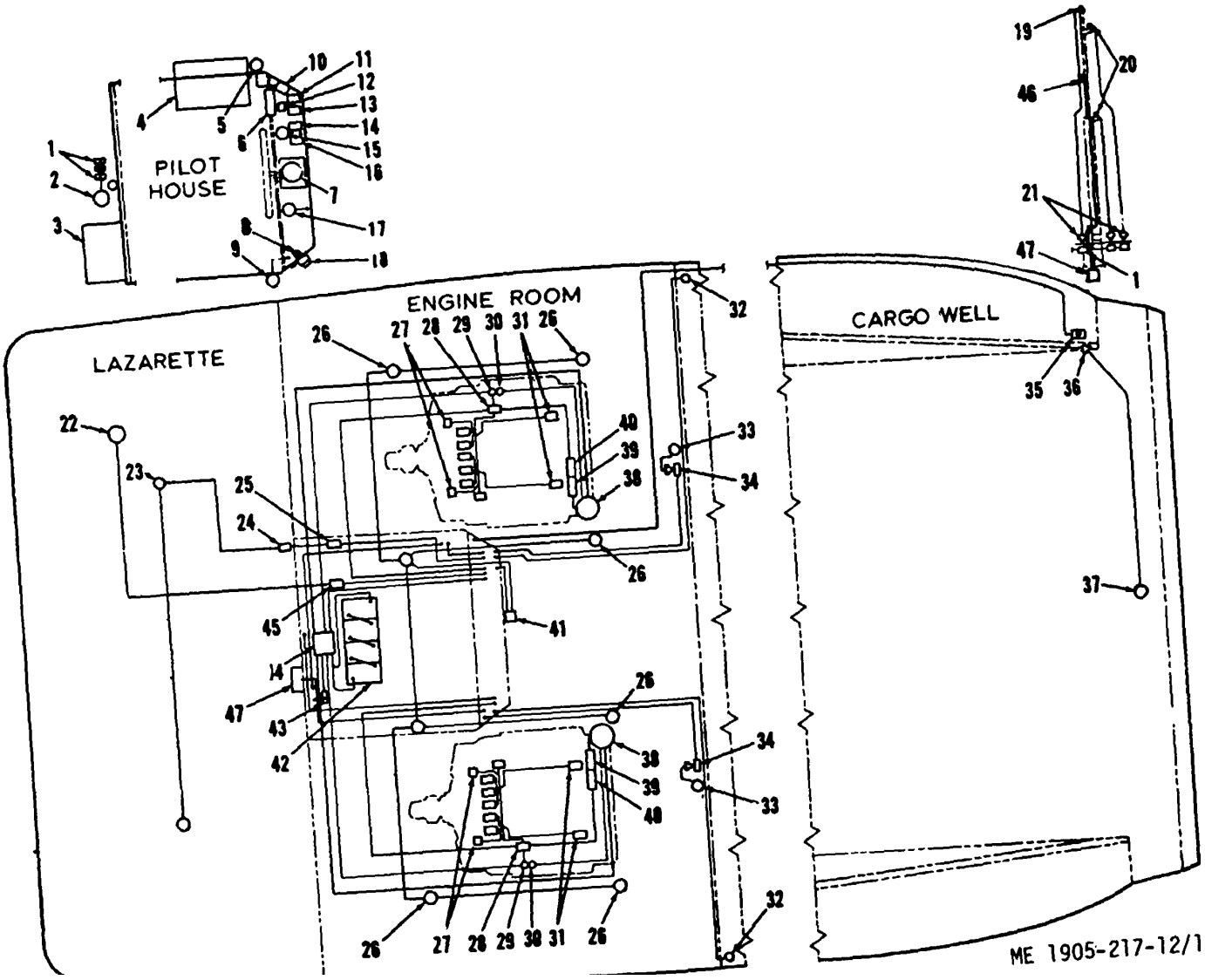


Figure 1-5. Electrical system schematic, hull numbers LCM 8540 thru 8560 and 8580 thru 8618 (Rohr Corp).

1. Receptacles (3) main mast lights
2. Stern light (white)
3 Static isolator (MX8171)
4. Communications cabinet
5. Port side light (red)
6. Control and distribution panel
7. Heading indicator
8 Terminal board and watertight enclosure
9. Starboard side light (green)
10. Engine alarm panel
11 Toggle switch, naviga lights
12. Horn button
13 Rotary switch, navig tion lights
14 Toggle switch, pal lights
15.Panel light
16.Toggle switch, cargo lights
17.Panel light
18 Horn
19. Masthead light (white)
20. Not-under command lights (2) red
21 Connectors, masthead and "not-under com-mand" lights (3)
22 Rudder angle indicator transmitter
23. Interior lights, lazarette (2)
24. Toggle switch, lazarette
39. Voltage regulator
25 Engine room receptacle
26.Interior lights, engine room (8)
27.Engine start switches (on each engine) (4)
28.Terminal board and enclose
29. Starting motors ()
30. Engine start contactor
31. Temperature switch
32. Cargo well lights (red)
33.Engine room fan
34. Receptacle, fan
35. Receptacle, anchor light
36. Connector, anchor light
37. Anchor light (white)
38. Alternator with voltage protector
40.Resistor, voltage regulator
41.Toggle switch, engine room lights
42 Battery
43. Circuit breaker, stable isolator
44. Terminal board and water tight enclosure
45. Power supply, rudder angle indicator
46.Induction compass transmitter
47.Terminal board and watertight enclosure

Fig 1-5--Continued

H.P., maximum r.p.m. no-load, and a list of optional equipment.

(3) Power transfer gear plate. Located on the power transfer gear housing at rear of propulsion unit, includes power transfer gear part number and serial number.

b. Instruction Plates.

(1) Engine starting instructions plate. In landing craft with hull number 8500 thru 8539, this plate is located in the pilot house.

(2) Ramp hoist operating instructions. This plate is located in the pilot house.

(3) Emergency steering instruction plate. In hull number 8500 thru 8539, this plate is located in the pilot house. In hull numbers 840 thru 8560 and 8580 thru 8618, this plate is located in the lazarette of the landing craft.

c. Tabulated Data. Descriptive data of the LCM is listed in table 1-1, Tabulated Data

Table 1-1. Tabulated Data

a. Landing Craft

Length, overall	74 ft. (ft)
Length, overall, hull, molded	71 ft 6 3/4 in.
Length, designed, waterline, molded	63 ft. 3 1/2 in.
Beam, extreme	21 ft. 0 5/8 in.
Beam, molded	20ft. 11 3/4 in.
Depth, molded amidships	9 ft 4 In.
Draft (full load)	4 ft 6 in
Speed, maximum loaded	9 knots

b. Propulsion Units

Manufacturer	Detroit Diesel
Type	Twin engine units
Models	12005A 12006A port
Cylinders	6 (per engine)
Bore	4.25in
Stroke	5 in.
Displacement	425cu in. (per engine)
Fuel _	Diesel
Rating (100° F 29 in. Hg)	300 HP at 1800 RPM continuous
Fuel consumption	21.5 GPH (each engine)
Fuel tank capacity (2)	432 gal each tank
Firing order	
R. H. rotation (stbd)	1-5-3-6-2-4
L. H. rotation (port)	1-4-2-6-3-5
Fresh water capacity (4 engines)	9 gallons (each engine)
Propeller shaft rotation	Starboard-clockwise Port-counterclockwise
Transmission	Allison hydraulic

c. Electric Starting and Alternator System (24 vdc), Outboard Engines.

Starting motor (clockwise rotation)	Delco 1108850
Starting motor (counter-clockwise rotation)	Delco 1108890
Alternator	Motorola 24A107G (hull numbers 8500 thru 8539)
Alternato	Motorola 8SA-3006 (hull number- 8540 thru 8560 and 80 thru 8618)

d. Hydraulic Starting System, Inboard Engines.

Pumps (2)	General Motors 6256
Cranking motor (clockwise rotation)	Bosch CMD2A1IU
Cranking motor (counter clock wise rotation)	Bosch CMD2A221
Accumulators (2)	Bosch ACB30A7109
Hand pump	Bosch HPAS00118
Filter	Bosch FRH3001.16
Filter, inlet _	Bosch FRK300282-3 (hull numbers8540 thru 8560 and 8580 thru 8618)

e. Hydraulic Steering System

	Marinette Marine Hull registry numbers LCM-8500 thru LCM-8519	Gunderson Brothers Hull registry numbers LCM-8520 thru LCM-8539	Rohr Corporation Hull registry numbers and LCM-8580 thru LCM-8618
(1) Helm unit	Char Lynn UE-01 with SCA Column	Char Lynn WK-11-SCC Char Lynn WK-11-SCC	
(2) Pump Vickers	V200-5-1C-S85 Vickers V110-35-1C-S214 (2)	Vickers V110-25-1C-10	
(3 Pump Vickers	V200-5-1CLH-S85 Vickers V200-5-1CLH S85 Vickers	V110-25-1C-10-LH	
(4) Cylinder (2)	Ortman Miller 2TH-Style G Ortman Miller 2TH-Style G	Ortman Miller 2kTH-Style G	
(5) Filter (return line)	Gresen FB101	Gresen FB101	Gresen FB101

f. Ramp Hoist System. (Hydraulic).

	Marinette Marine Hull registry numbers LCM-8500 thru LCM-8519	Gunderson Brothers Hull registry numbers LCM-8520 thru LCM-8539	Rohr Corporation Hull registry numbers and LCM-8580 thru LCM-8618
(1) Winch	Marco No. W-0951	Gearmatic 22-SCL10	Gearmatic 22-SCL10
(2) Winch	Denison M1D-117-21N	Gearmatic (winch component)	Gearmatic (winch component)
(3) Pump right	Vickers 25V17A-1C10-002	Vickers 35V25A-1C-10-132	Vickers 35V25A-1C-10-002
(4) Pump (left))	Vickers 25 V17A-1C10-L-002	Vickers 35V25A-1C-10-L-132	Vickers 35V25A-1C-10-L-002
(5) Control valve	Vickers CM2-NO2-R20B-L-30	Vickers CM3No2R20-BL-30	Vickers CM3N02R20-BL-30
(6) Tank	75 gal. Marco H-0131	75 gallons	75 gallons
(7) Suction strainer	Michigan Dynamics MP-75	Jelliff J75-600-100-2-1/2NPTF	Jelliff J75-600-100-2-1/2NPTF
(8) Return line filter	Gresen NFB-401	Gresen FB-408	Gresen RF 3-415

g. Bilge Drainage System (hull numbers LCM-8560 and LCM-8580 thru LCM-8618)

Pumps, port engine driven	MP Pump Co. Model 3800 M-LH MP Pump Co. Model 3600 M-LH
Pump, starboard engine driven	MP Pump Co. Model 3600 M-RH
Pump, manual (2)	Wilcox Crittenden 542
Strainers (8)	MP Pump Co. Model 2225 A

h. Engine Cooling System (fresh water) (hull numbers LCM-8540 thru LCM-8560 and LCM-8580 thru LCM-8618). Capacity, each propulsion system 9 gallons each.

Pumps (2)	Detroit Diesel
Tanks (2)	Copper, 10-inch O. D. x 15, 25 inches long
Heat exchangers (2)	BUSHIPS Drawing C-3166915

i. Sea (raw) Water System (hull numbers LCM-8540 thru LCM-8560 and LCM-8580 thru LCM-8618.

Pumps (4)	Detroit Diesel
Strainers, dual (2)	Groco HD 2000A

j. Fuel System (hull numbers LCM-8540 thru LCM-8560 and LCM-8580 thru LCM-8618).

Fuel tanks, capacity (2)	432 gallons each
Governors (2)	Limiting speed type, setting 108 percent rated speed
Primary strainers (2)	Purolator 63108-3

Engine fuel strainers (2)	**Purolator 63108-3**
Engine fuel filters (2)	**Detroit Diesel**
Fuel pumps (4)	**Detroit Diesel**
Cooler, fuel oil (4)	**Detroit Diesel Part No. S136348**

k. Navigational and Communication Equipment (hull numbers LCM-8540 thru LCM-8560 and LCM-8580 thru LCM-8613).

Remote magnetic heading system (RMHS)	**Sperry**
Static isolation equipment	**MX-8171/URC**

Radio Set AN/GRC-106
Radio Set AN/SRC-32
Radio Set AN/VRC-46
Radio Set AN/VRC-47

Note

The AN/GRC-106 or AN/SRC-32 and AN/VRC-47 may be installed in the LCM-8 landing craft.

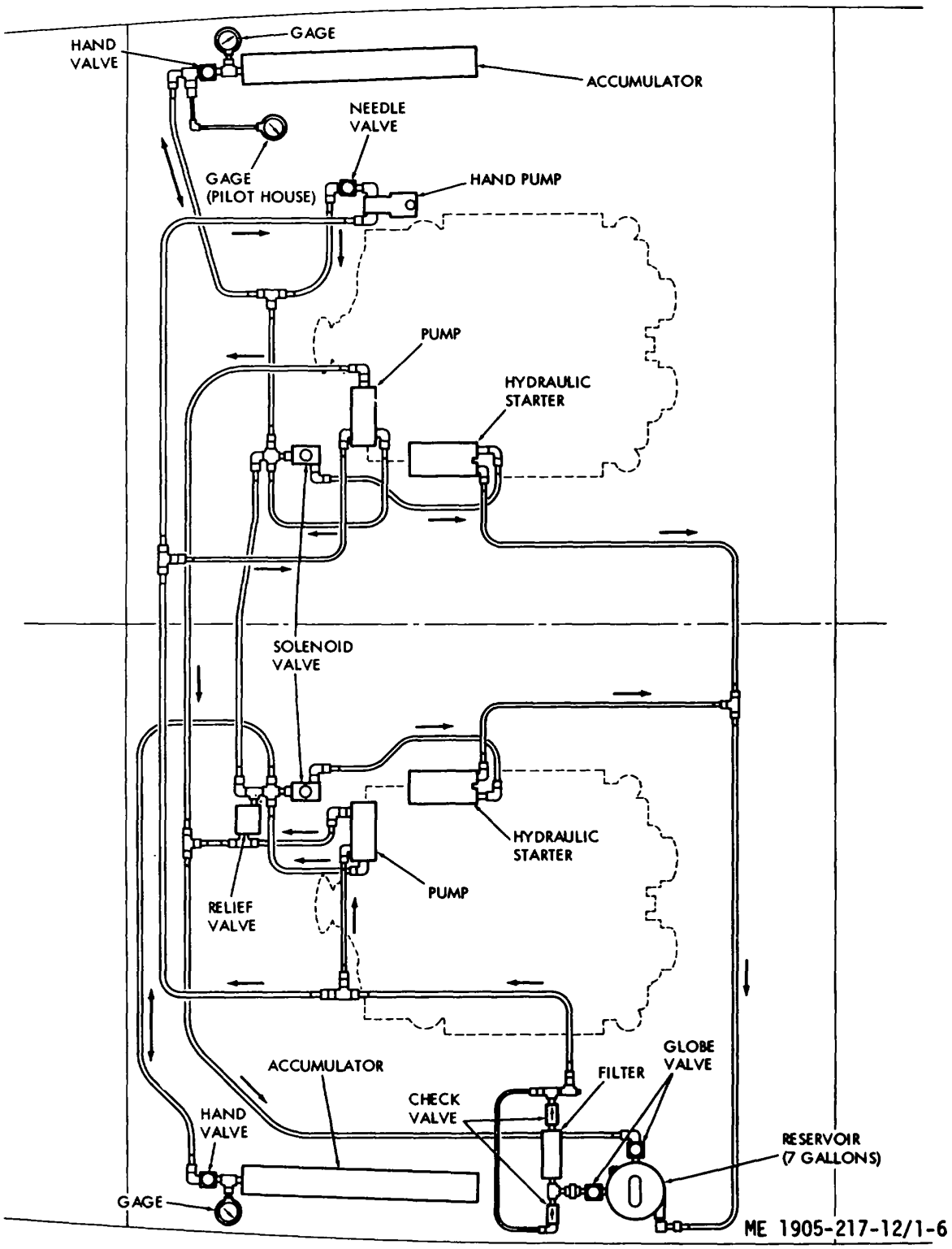


Figure 1-6. Hydraulic starting system diagram, hull numbers LCM 8500 thru 8519 (Marinette Marine).

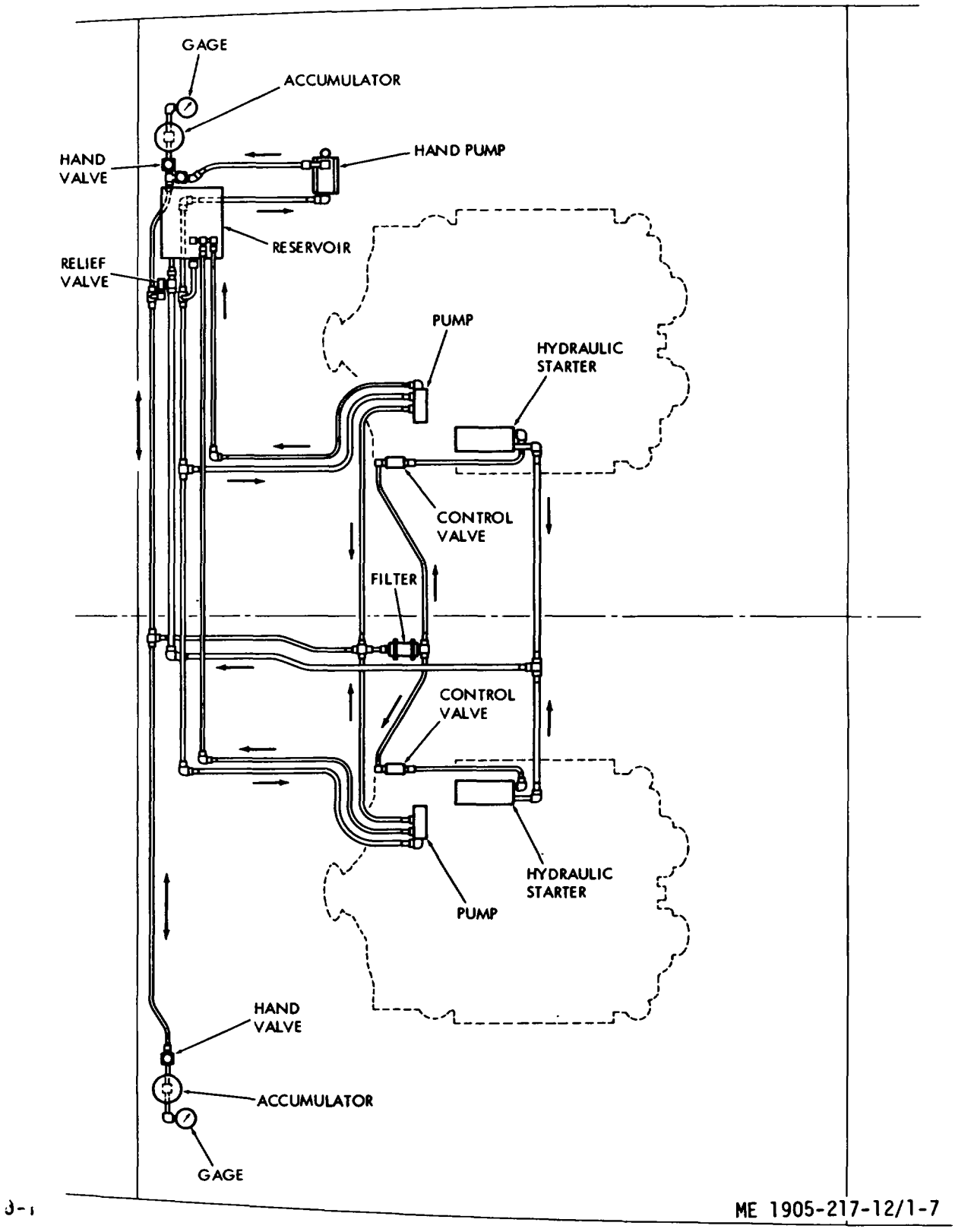


Figure 1-7. Hydraulic starting system diagram, hull number LCM 8520 thru 8539 (Gunderson Brothers).

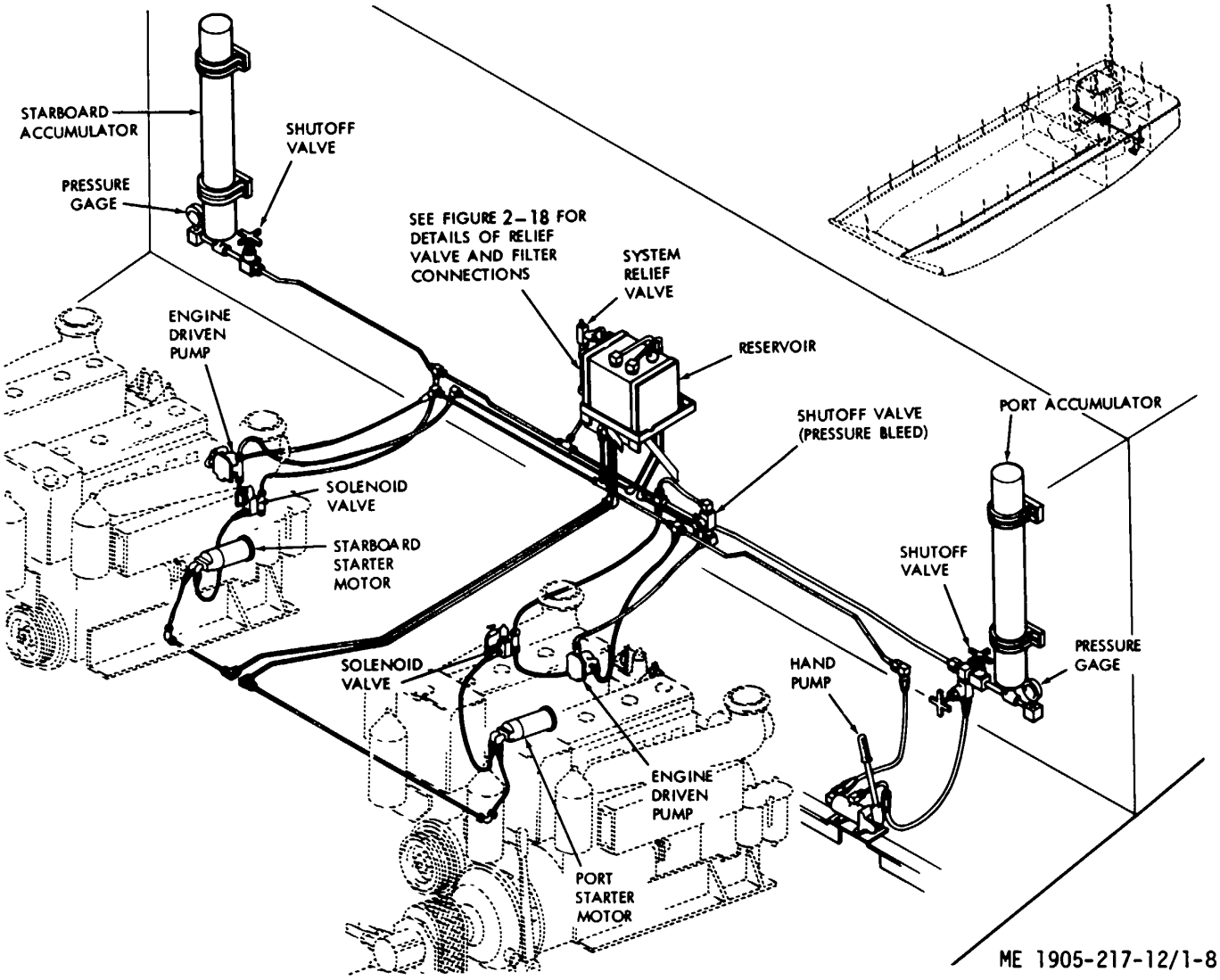


Figure 1-8. Hydraulic starting system functioning diagram, hull numbers LCM 8540 thru 8560 and 8580 thru 8618 (Rohr Corp).

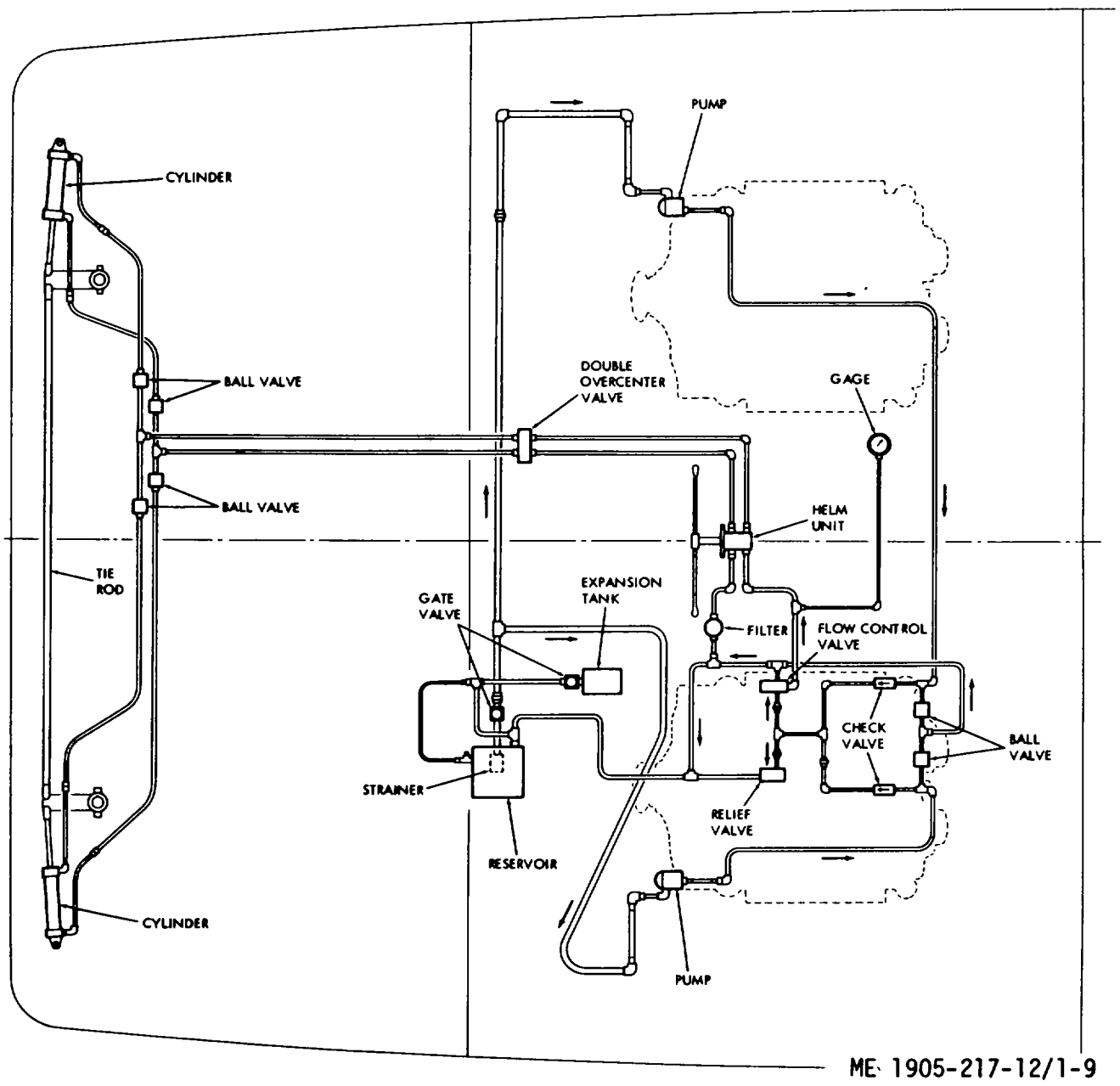


Figure 1-9. Hydraulic steering system diagram, numbers LCM 8500 thru 8519 (Marinette Marine).

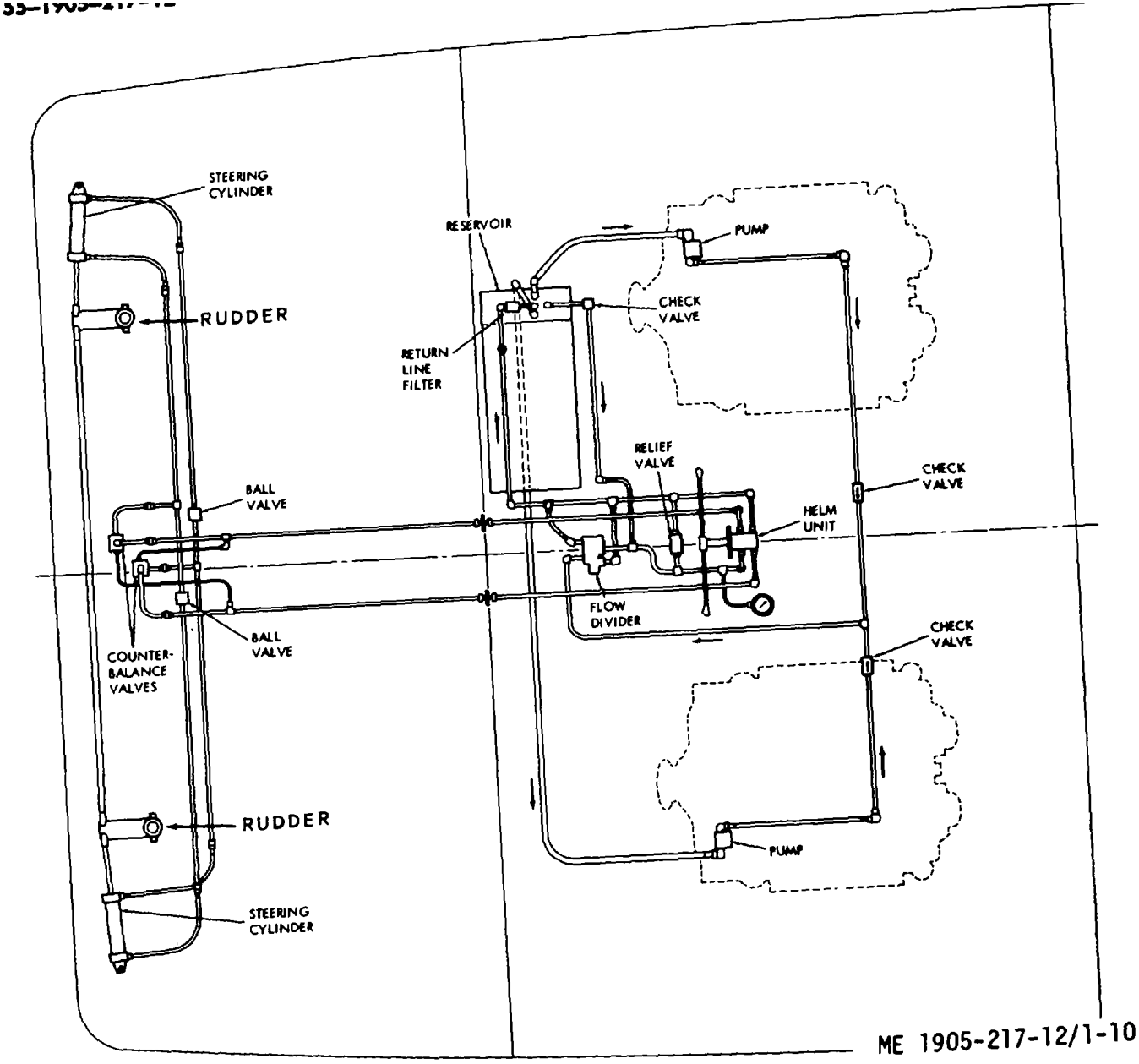


Figure 1-10. Hydraulic steering system diagram, hull numbers LCM 8520 thru 8539 (Gunderson Brothers).

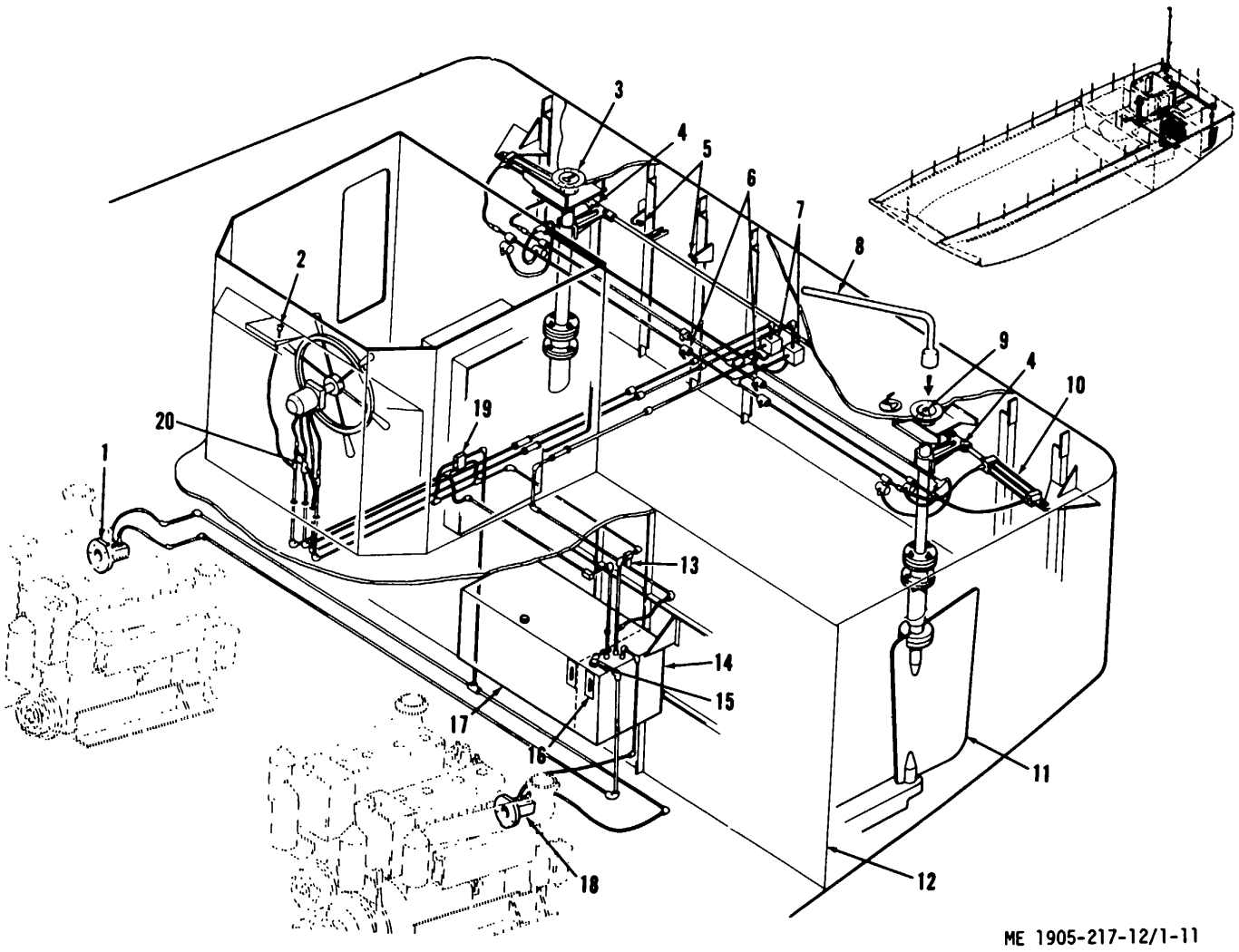


Figure 1-11. Hydraulic steering system functional diagram, hull numbers LCM 8540 thru 8560 and LCM 8580 thru 8618 (Rohr Corporation).

1. Starboard engine driven pump
2 Steering system hydraulic pressure gage
3 Starboard emergency tiller access plate
4 Clevis pin (2). Remove when using emergency tiller
5. Rudder angle stop bracket
6. Ball valves (8)
7. Counterbalance valves (2)
8. Emergency tiller
9. Port emergency tiller access plate
10. Port actuating cylinder
11. Port rudder
12 Engine room aft bulkhead
13. Return line filter and ondition indicator
14. Steering system reservoir
15. Steering system fill cap
16. Steering system reservoir level indicator and fluid temperature indicator
17. Ramp hoist hydraulic system reservoir (ref.)
18. Port engine
19. Steering syst divider valve
20. Check valve (2)
21. Relief valve

Fig. 1-11 - Continued

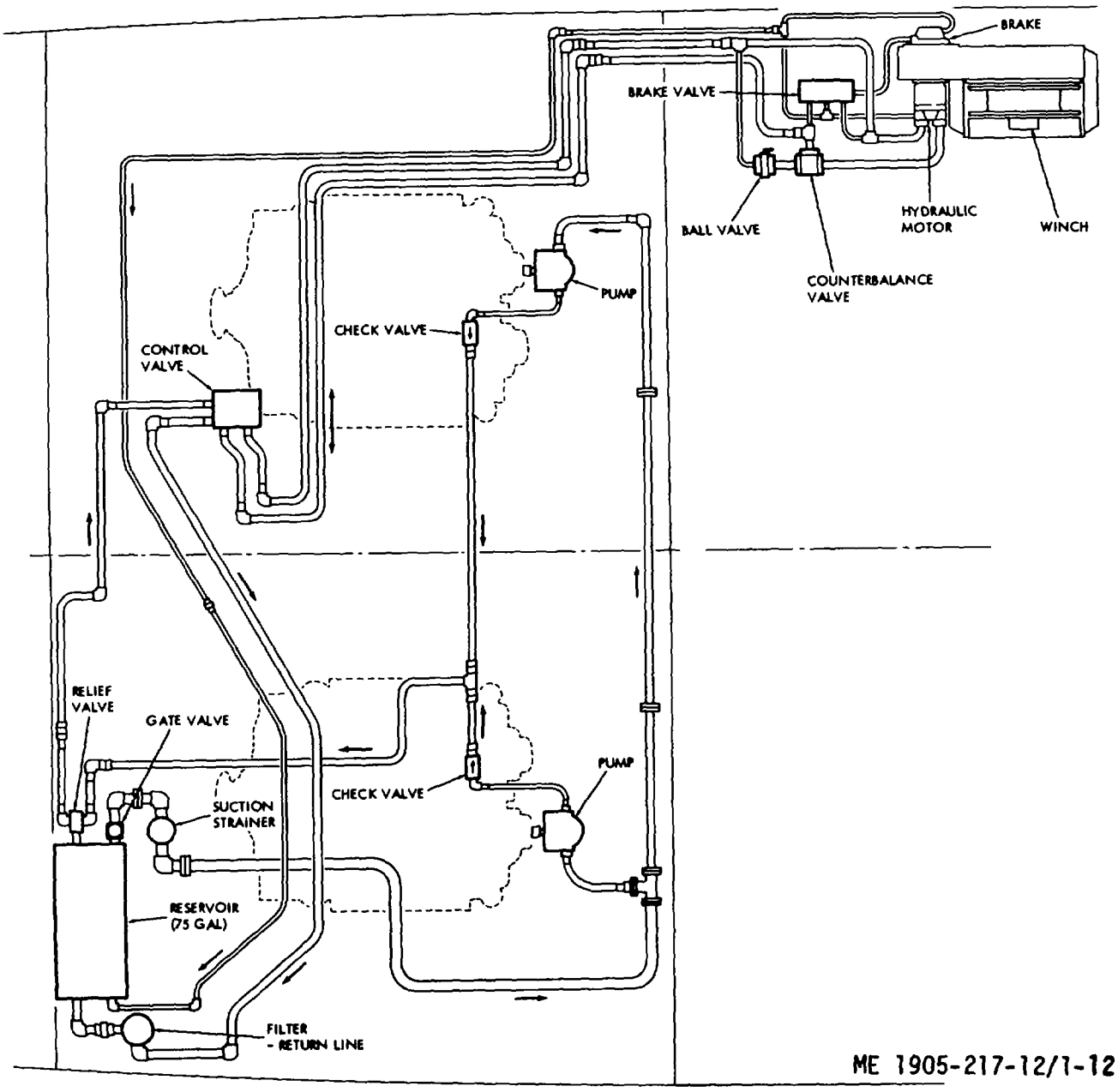


Figure 1-12. Ramp hoist hydraulic system diagram, hull number LCM 8500 thru LCM 8519 (Marinette Marine).

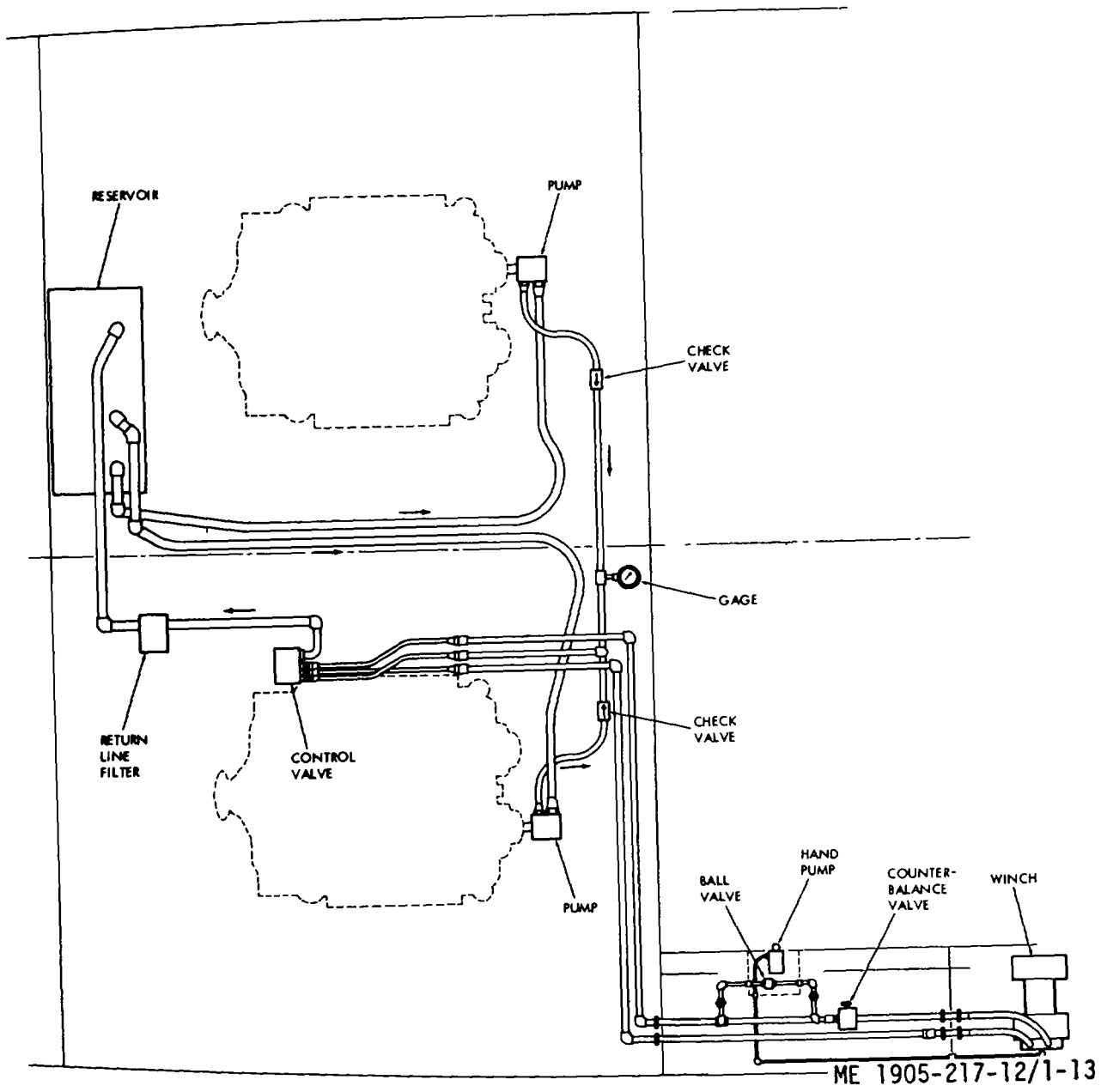


Figure 1-13. Ramp hoist hydraulic system diagram, hull numbers LCM 8520 thru LCM 8539-Gunderson Brothers).

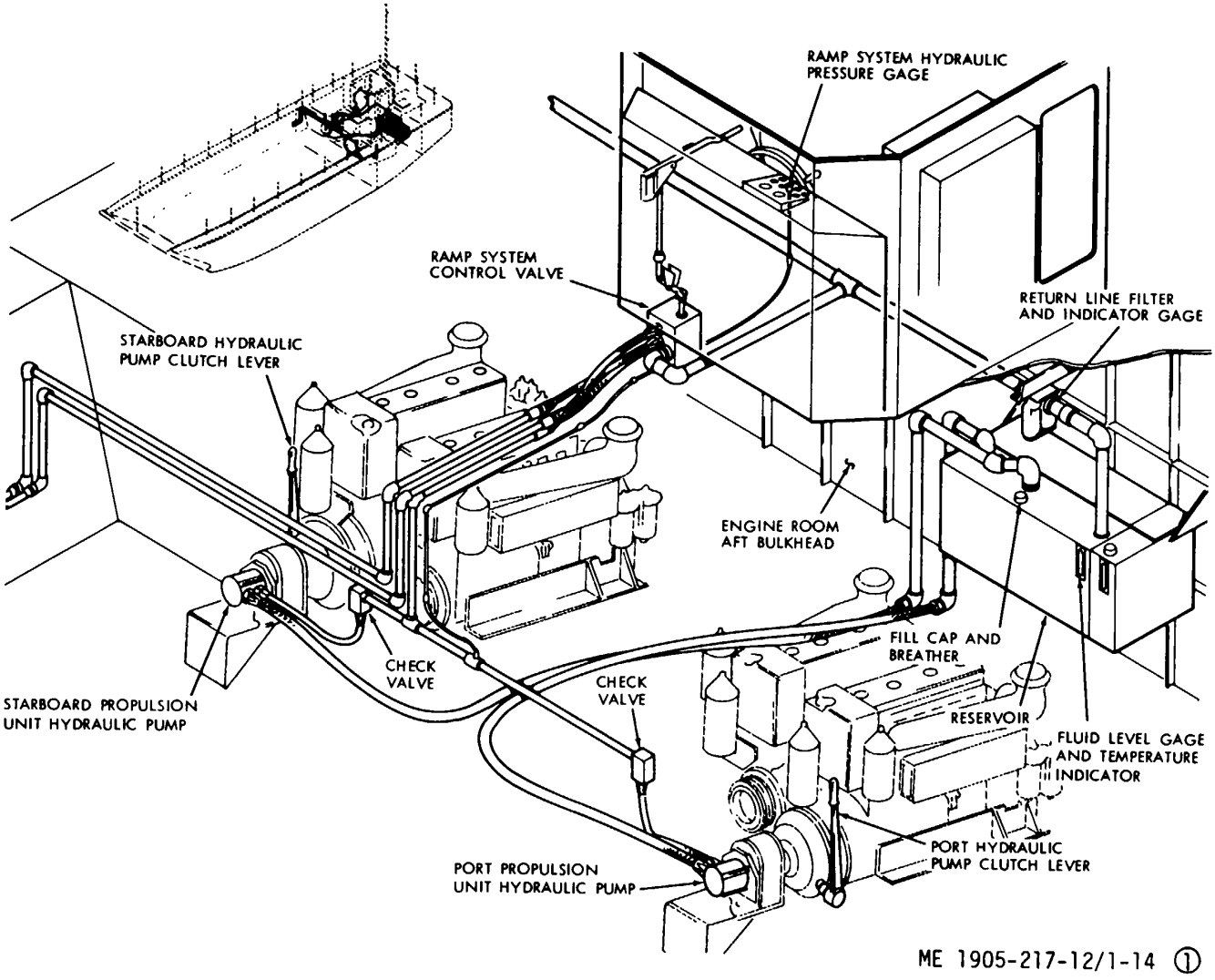


Figure 1-14.1. Ramp hoist system hydraulic functional diagram. (Sheet 1 of 2).

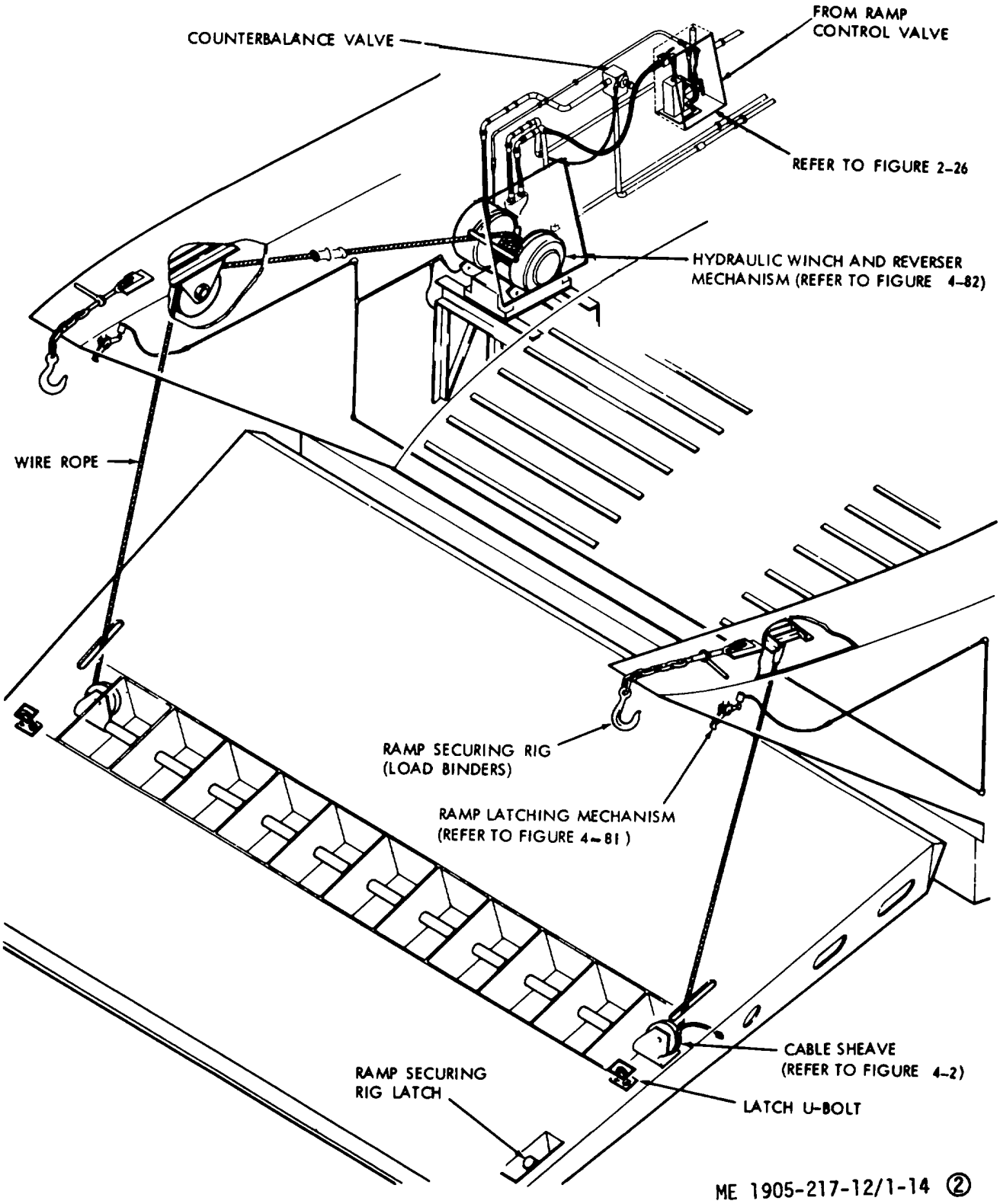


Figure 1-14.2. Ramp hoist system hydraulic functional diagram. (Sheet 2of 2).

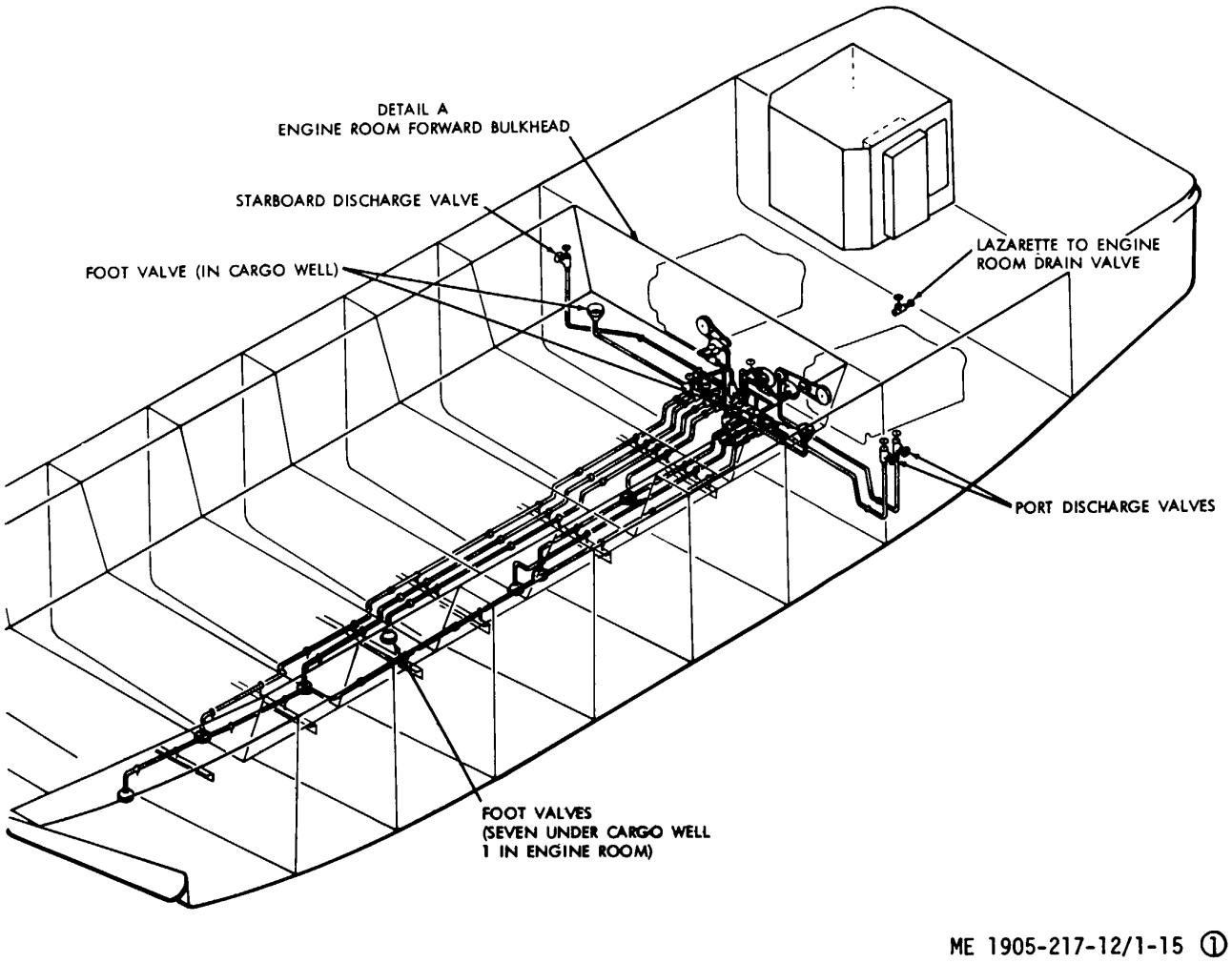


Figure 1-15.1. Bilge drainage system functional diagram. (Sheet 1 of 2)

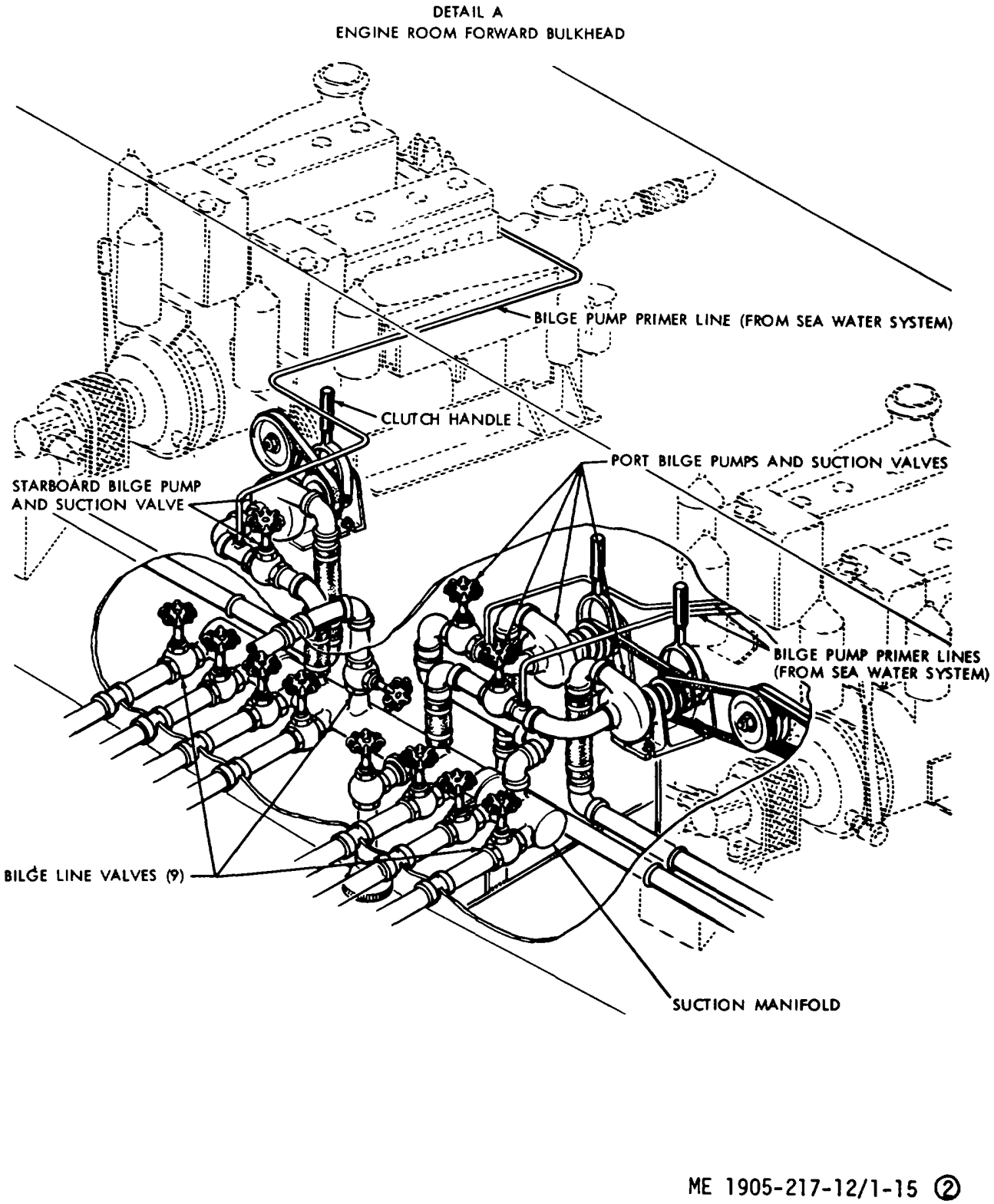


Figure 1-15.2. Bilge drainage system functional diagram. (Sheet 2 of 2).

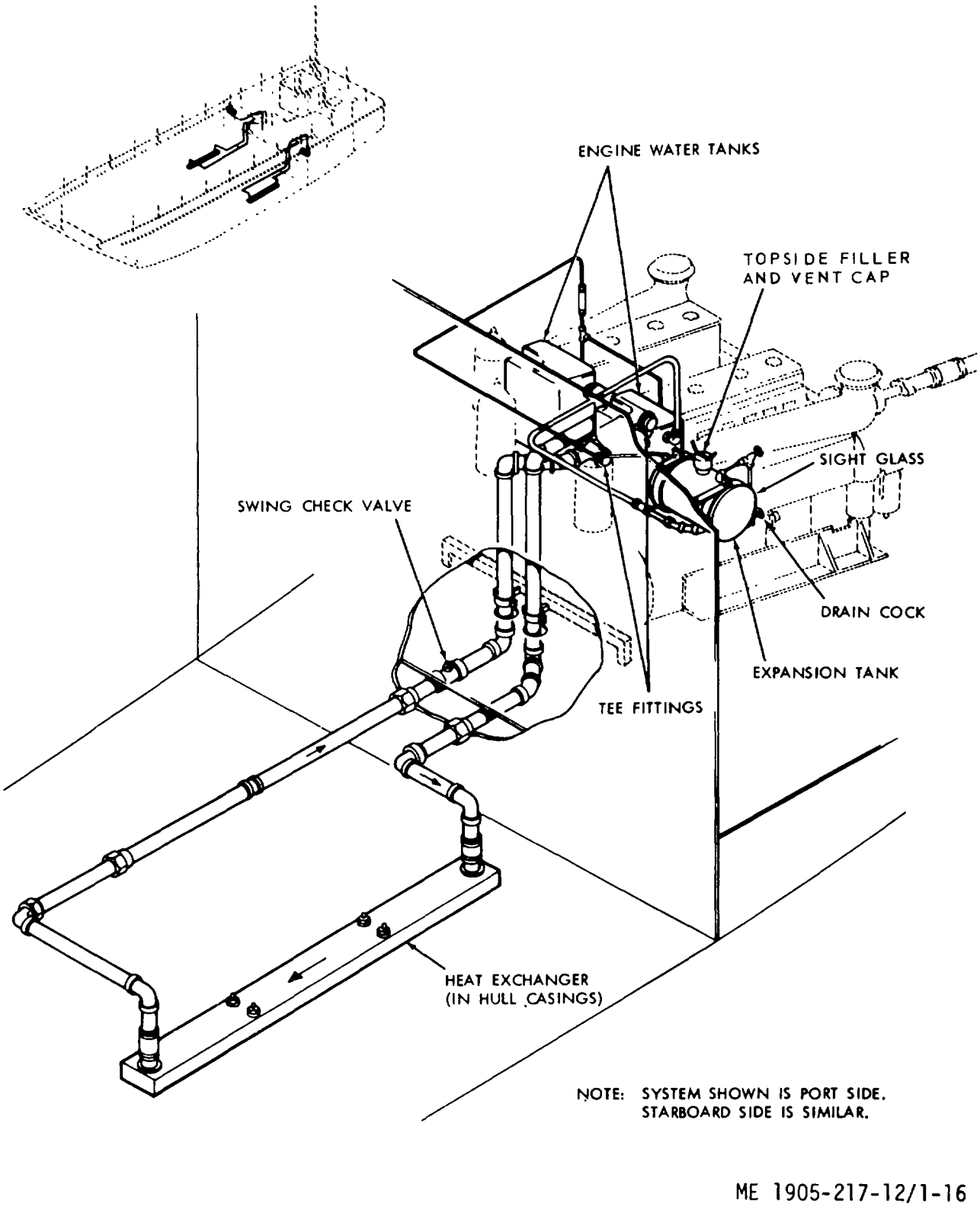


Figure 1-16. Engine fresh water system functional diagram.

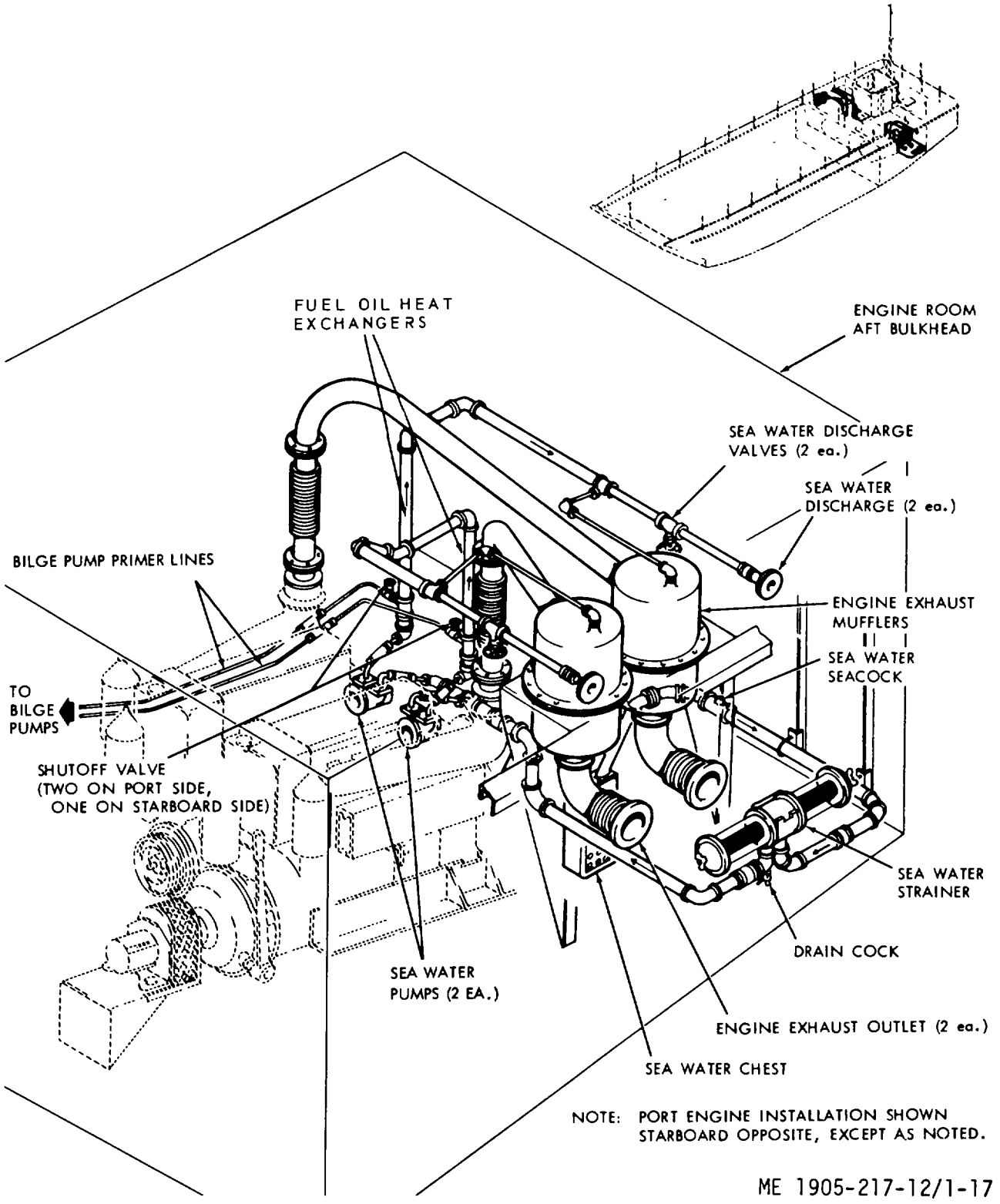


Figure 1-17. Engine raw sea water system functional diagram.

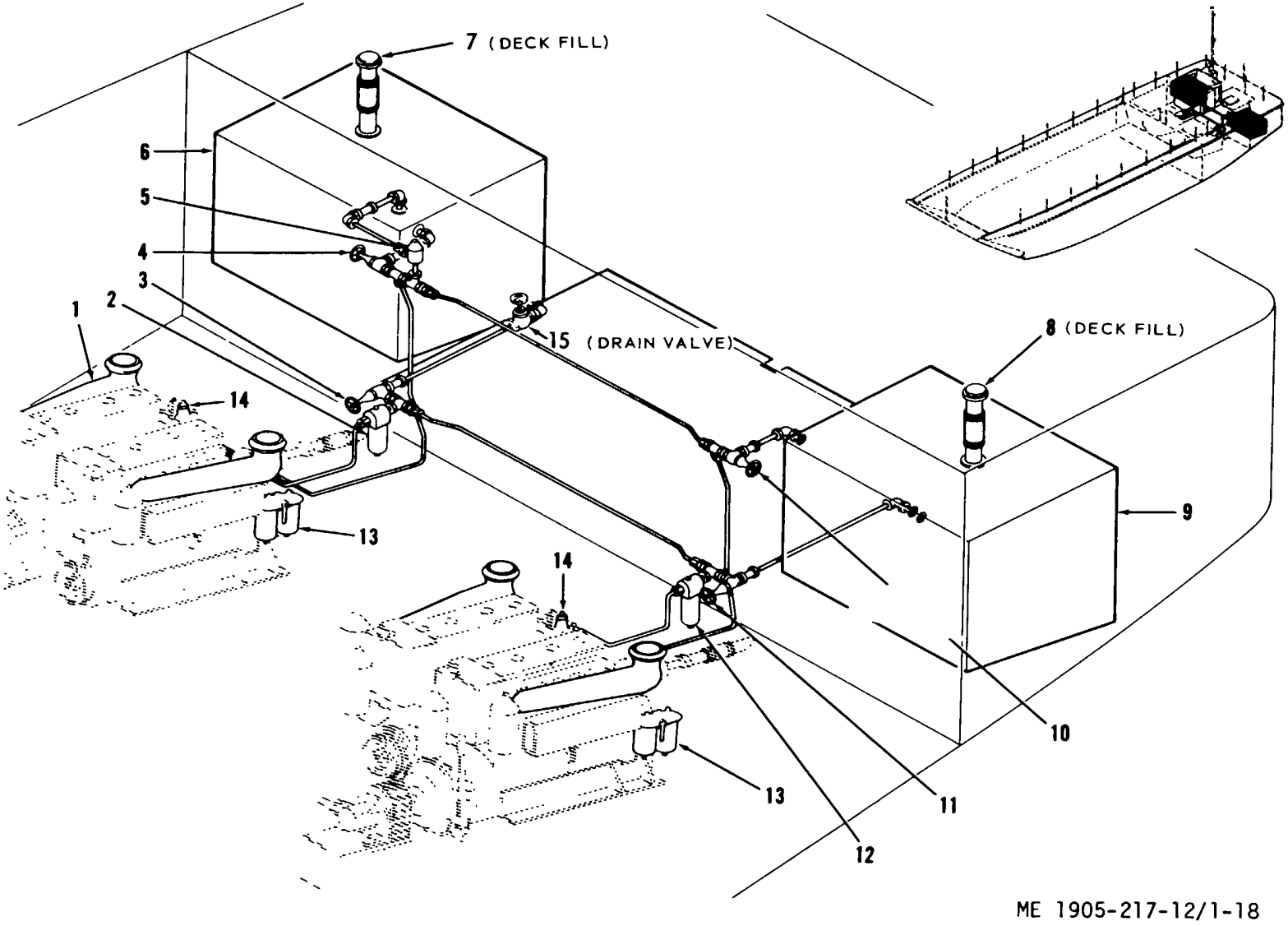


Figure 1-18. Engine Fuel system functional diagram.

1 Starboard propulsion unit
2. Starboard system primary fuel filter
3. Starboard system supply shutoff valve
4. Starboard system return shutoff valve
5. Relief valve
6. Starboard reservoir
7. Starboard reservoir fill and vent port
8. Port reservoir fill and vent
9. Port reservoir
10. Port system return shutoff valve
11. Port system supply shutoff valve
12 Port system primary fuel filter
13. Engine fuel filters
14. Engine fuel strainers
15 Drain Valve

Figure 1-18 - Continued

CHAPTER 2

OPERATING INSTRUCTIONS

SECTION I. OPERATING PROCEDURES

WARNING
If equipment fails to operate refer to troubleshooting procedure in Chapter 3.

2-1. General

This section describes, locates, illustrates, and furnishes the operator and/or crew with sufficient information for the proper operation of the vessel. Throughout the vessel the control valves and electrical circuits and switches are located and identified by the appropriate nomenclature plates.

2-2. Controls and Instruments

a. Pilot House Controls.

(1) A separate stop for each engine is located on the pilot house control panel. To stop the engines, pull the handles the full length of their travel and hold them at full length until the engine stops. The engine stop control (2, fig. 2-1) is for hull numbers 8500 through 8529. The engine stop control (12, fig. 2-2) is for hull numbers 8520 through 8539. The engine stop control (13, fig. 2-3) is for hull numbers 8540 through 8560 and 8580 through 8618.

(2) A separate neutral throttle control for each engine or each propulsion unit is located on the pilot house control panel. These controls are provided for regulation of the idle speed or for controlling engine speed when the ramp is to be lowered or raised. The neutral throttle control (3, fig. 2-1) is for hull numbers 8500 through 8529. The neutral throttle control (13 , fig. 2-2) is for hull numbers 8520 through 8539. The neutral throttle controls (15 and 16 fig. 2-3) are used for hull numbers 8540 through 8560 and 8580 through 8618.

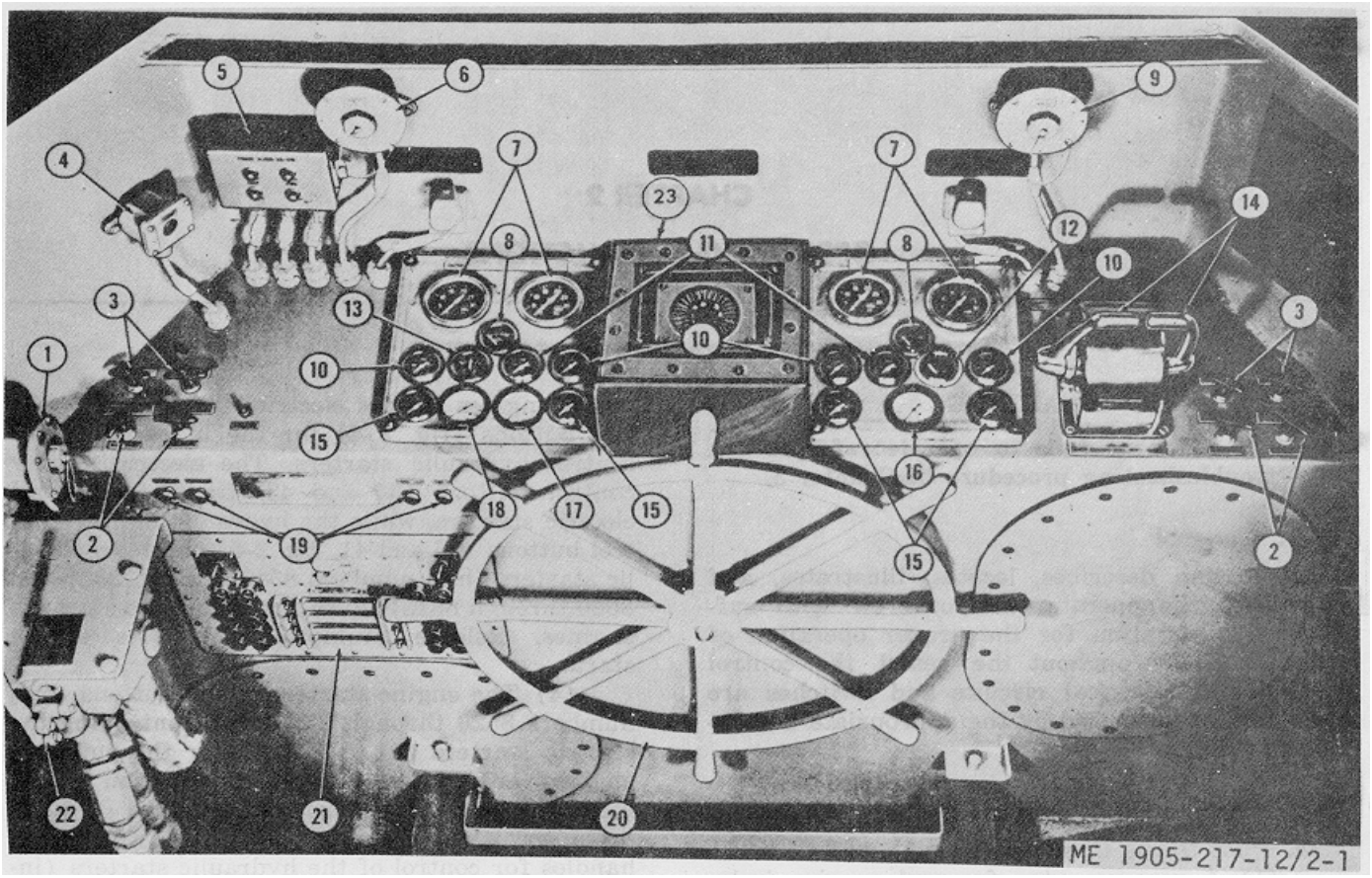
(3) Separate starter control buttons (hull numbers 8500 through 8519) for each engine are located on the distribution panel in the pilot house. The starter buttons (fig. 2-4) for the out-
board engines control electric starters, while the two buttons (fig. 2-4) for the inboard engines control hydraulic starters. The electric starter control buttons (34 and 43, fig. 2-5) control electric starters, while the hydraulic starter control buttons (36 and 41, fig. 2-5) control hydraulic starters (hull numbers 8540 through 8560 and 8580 through 8618). Push the buttons to start the engines. Release promptly when the engine starts.

(4) The engine starter control buttons (hull numbers 8520 through 8539) for controlling the electric starters (21, fig. 2-2) for the outboard engines are located on the distribution panel. Push the buttons to start the engines. Release promptly when the engines start. Two control handles for control of the hydraulic starters (inboard engines) are mounted on top of the control panel. Pull the handles out to start the engines. Release promptly when the engines start.

(5) The starting aid controls used on hull numbers 8500 through 8519 have a separate primer control mounted on each engine, and are to be used for cold weather starting. Hull numbers 8520 through 8560 and 8580 through 8618 do not have such controls. On these craft the primer fuel cylinders are stored in the engine room and must -be individually applied to the injectors on each engine.

(6) The engine control levers (14, fig. 2-1) on hull numbers 8500 through 8539, have single levers (fig. 2-7) for each propulsion unit. These levers control both the clutches and throttle in proper sequence. Hull numbers 8540 through 8560 and 8580 through 8618 have separate reverse gear levers (21, fig. 2-8.1) for each propulsion unit. The reverse gear levers are interlocked with the throttle controls to prevent clutch engagement or disengagement except at idle rpm.

(7) The horn buttons (4, fig. 2-1), hull numbers 8500 through 8519; (23, fig. 2-2) hull numbers 8520 through 8539; or (8, fig. 23) hull



1. Radio receptacle
2. Engine atop control
3. Neutral throttle control
4. Horn button
5. Engine alarm panel
6. Receptacle
7. Engine tachometer
8. Alternator ammeter
9. Receptacle
10 Engine water temperature gage
11. transmission oil pressure
12. Rudder angle indicator
13. Battery charge ammeter
14. Engine control levers
15. Engine oil pressure
16. Steering hydraulic pressure
17. Ramp hoist hydraulic pressure
18. Starting hydraulic pressure
19. Overspeed shutoff
20. Steering wheel
21. Distribution pane (includes starter buttons)
22. Ramp hoist control valve lever
23. RHMS heeding indicator

Figure 2-1. Pilot house controls and instrument, hull numbers 8500 thru 8519.

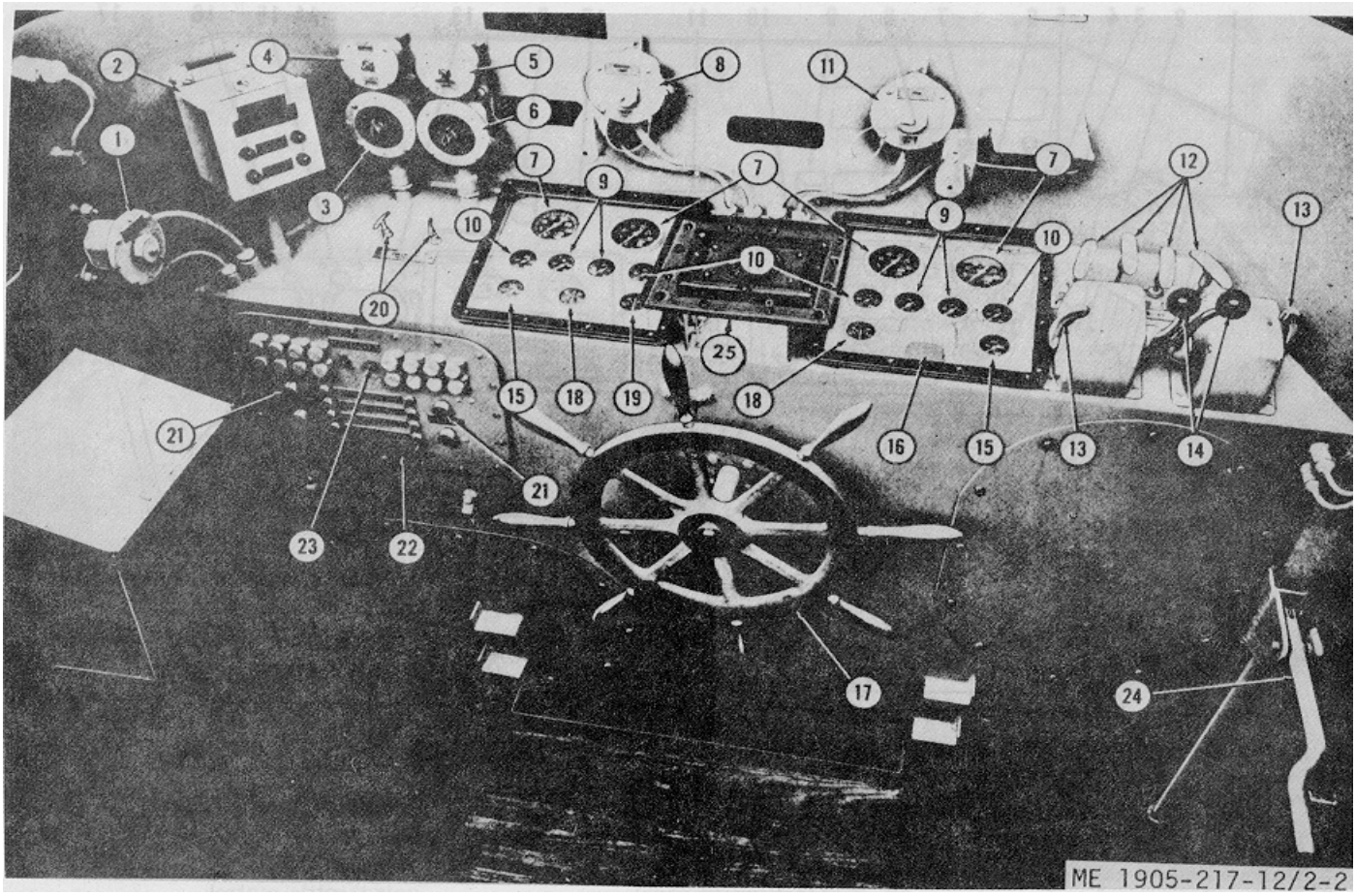
number 8540 through 8560 and 8580 through 8618 ’are used to sound the horns.

(8) The steering wheel (20, fig. 2-1), (17, fig. 2-2) , or (20, fig. 2-3) is used to change the course of the craft. The steering is hydraulic powered. If the steering pumps should fail, the helm unit acts as a hand -pump when the wheel is turned.

(9) The ramp hoist control valve lever (22, fig. 2-1), hull numbers 8500 through 8519; (11,fig. 2-2), hull numbers 8520 through 8539; or (18, fig. 2-3), hull numbers 8540 through 8560 and 8580 through 8618 is used to control operation of the hydraulic powered ramp winch.

(10) The navigation lights switches (fig. 2-4), (3 and 4, fig. 2-2), or (4 and 5, fig. 2-3) are used to control the navigation lights. They are to be set in the position as instructed on the switch information plate which is mounted above the switches.

(11) The light switches are used to control various lights and receptacles on the landing craft. On hull numbers 8500 through 8519, switches are located on the distribution panel, in the engine room, and in the lazarette. Hull numbers 8520 through 8560 and 8580 through 8618, have switches in similar locations and additional switches above the control panel.



1. Radio receptacle
2. Engine alarm panel
3. Rotary switch, navigational lights
4. Toggle switch, navigational lights
5. Switch, cargo well lights
6. Rotary switch, panel lights
7. Tachometer
8. Compass outlet
9. Engine oil pressure
10. Engine water tempe ture
11. Receptacle
12. Engine stop control
13. Neutral throttle control levers
14. Engine control levers
16. Transmission oil pressure
16. Rudder angle indicator
17. steering wheel
18. Alternator ammeter
19. Battery charge ammeter
20. Hydraulic Barter controls
21. Electric starter controls
22. Distribution panel
23. Horn button
24. Ramp hoist control valve lever
25. RHMS heading indicator

Figure 2-2. Pilot house control and instruments, hull numbers 8510 thru 8509.

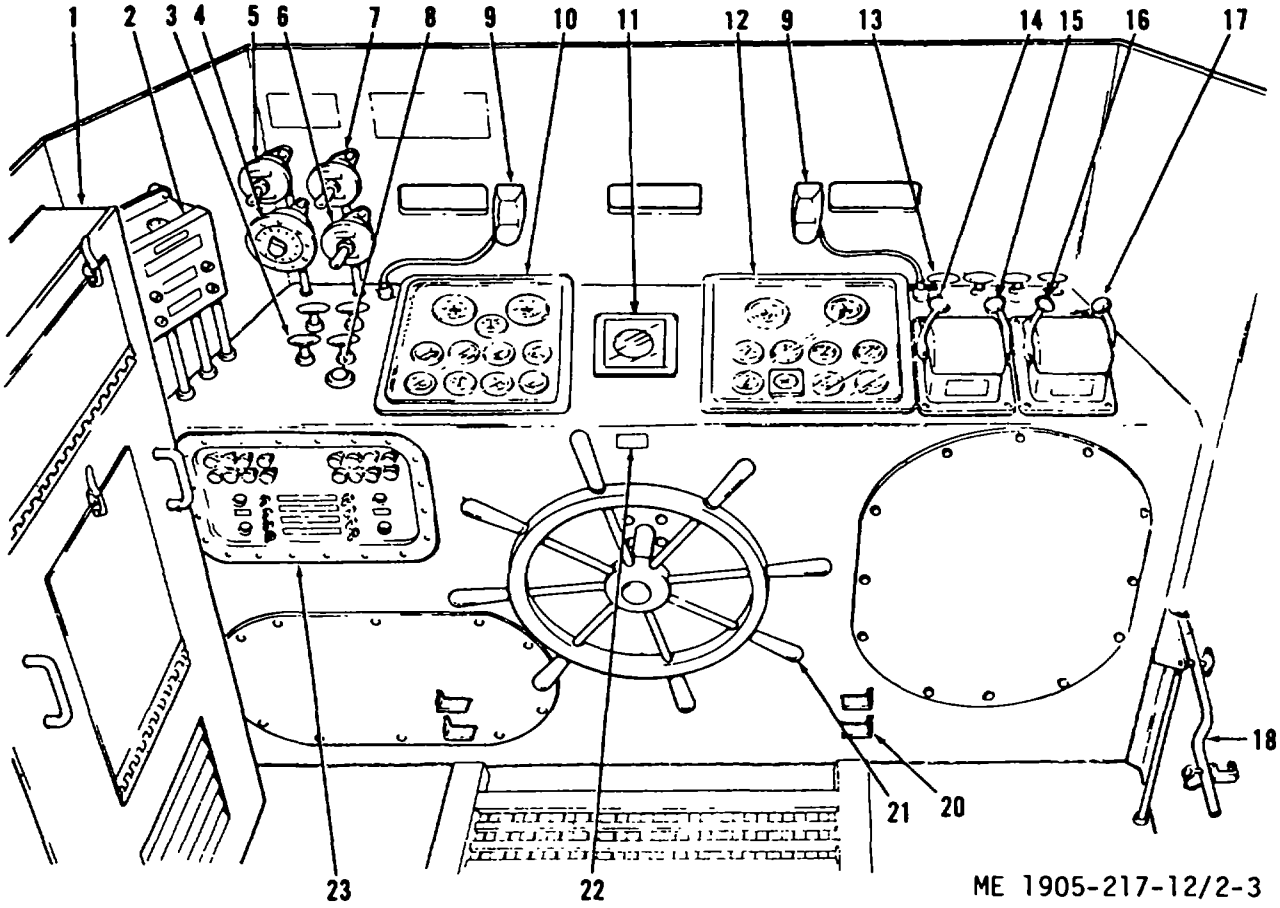
b. Engine Room Controls

(1) The engine throttle controls (fig. 2-7.1) are separate throttle controls for each engine and are mounted at the rear of the propulsion unit.

(2) The throttle control of the propulsion unlit on hull numbers 8540 through 8560 and 8580 through 8618 (fig. 2-6) is accomplished by pulling, out and rotating the pin (16, fig. 2-8.1) on the control 90 degrees. Throttle control of each individual engine is accomplished by pulling up on the individual throttle lever mounted on the rear of each unit. When the lever is pulled up (pin disengaged), the lever can be moved independently to control the individual engine.

(3) The shift control for hull numbers 8500 through 8518 has a master shift and throttle control (fig. 2-7) which provides the same control as the levers in the pilot house.

(4) The shift control (fig. 2-6.1) is used to shift the transmission. To shift the transmission in the engine room the cable from the pilot house



1. Communications cabinet
2. Engine alarm panel
3. Engine emergency stop controls (1 for each engine)
4. Rotary switch, running lights
5. Toggle switch, masthead or anchor lights
6. Toggle switch, panel lights
7. Toggle switch cargo well lights
8. Horn button
9. Instrument lights
10. Port instrument panel (ref. fig.2-5)
11. RMMS heading indicator
12. Starboard instrument panel (ref. fig. 2-5)
13. Engine stop control (1 for each engine)
14. Port propulsion unit reverse gear control
15. Port propulsion unit throttle control
16. Starboard propulsion unit throttle control
17. Starboard propulsion unit reverse gear control
18. Ramp hoist control valve lever
19. Pilot control stand grating cups
20. Landing craft hoist data
21. Steering wheel
22. Control panel

Figure 2-3. Pilot house controls and instruments, hull numbers 8540 thru 8560 and 8580 thru 8618.

must be disconnected. A quick disconnect is provided for this purpose. The throttle controls are separate.

(5) The reverse gear control (21, fig. 2-8.1) of the propulsion unit for hull numbers 8540 through 8560 and 8580 through 8618 is in the engine room. Operation is accomplished by pulling out and rotating the pin (16, fig. 2-8.1) on the control 90 degrees. Control of an individual engine transmission is accomplished by the shutoff control valves on the propulsion unit transmission.

(6) The neutral shift levers (fig. 2-7.1) are used if it is necessary to shut down one engine of a propulsion unit. If shut down is necessary ,push the neutral shift lever forward.

(7) The engine electric start button control (fig. 2-9) is mounted on a vertical support near each outboard engine on hull numbers 8500 through 8519. On hull numbers 8520 through 8560 and 8580 through 8618, this control is mounted on the upper engine block of each out board engine. This control is used to start outboard engines from the engine room.

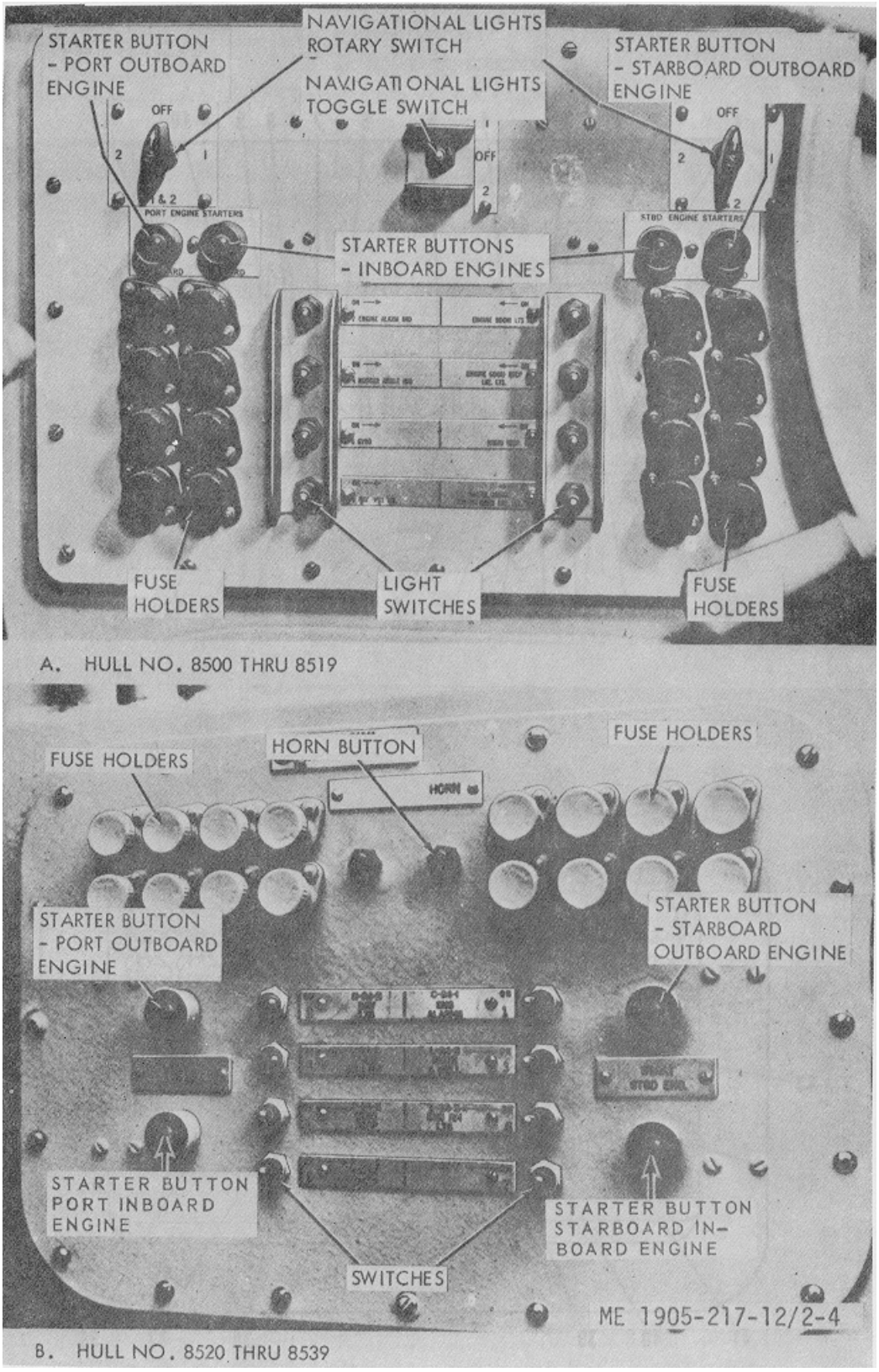


Figure 2-4. Distribution panel

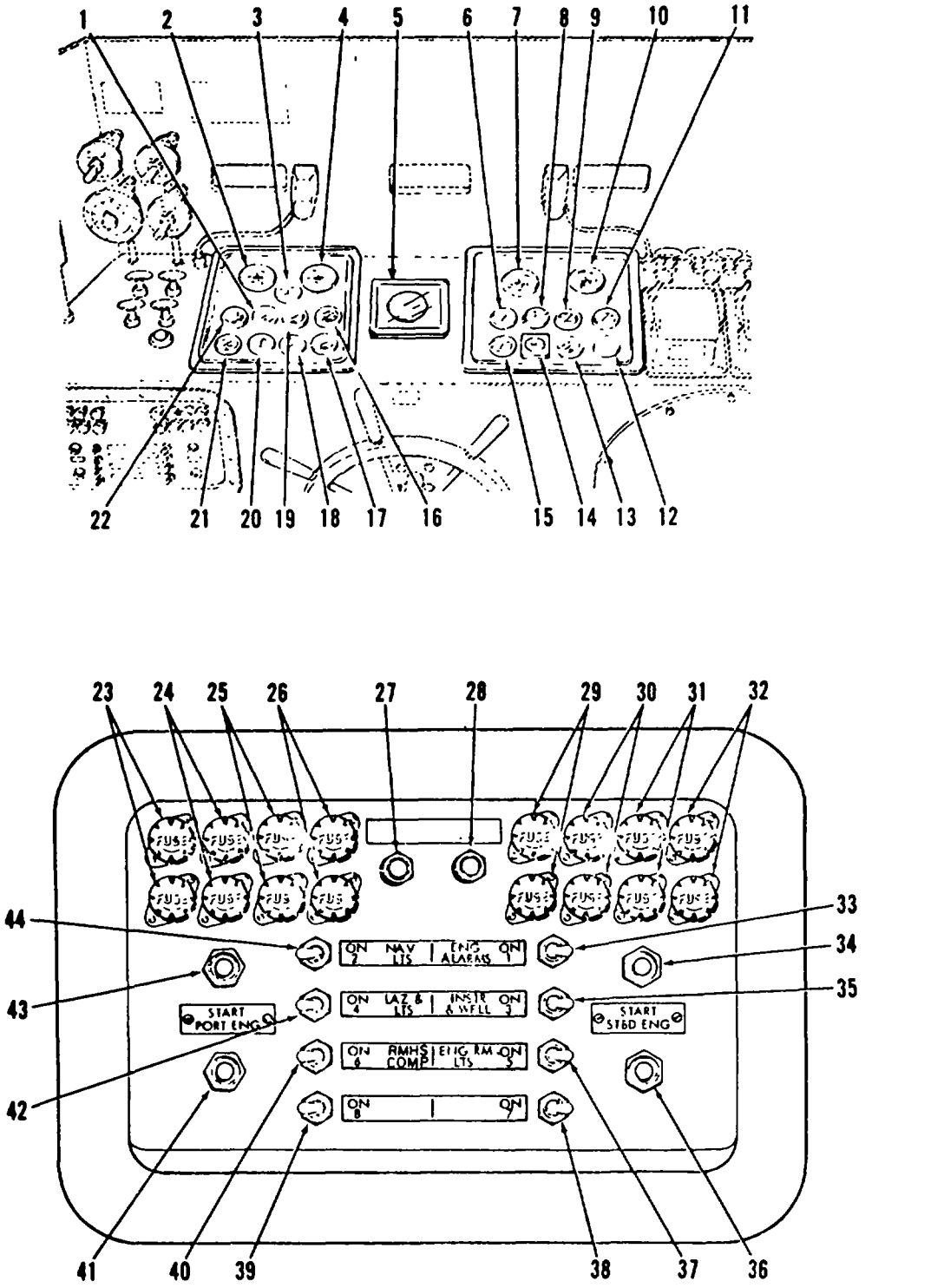


Figure 2-5. Distribution panel

1. Alternator ammeter (port) propulsion unit
2. Port outboard engine tachometer
3. Battery ammeter
4. Port inboard engine tachometer
6. RMHS Heading Indicator
6. Starboard inboard engine coolant temperature
7. Starboard inboard engine tachometer
8. Alternator ammeter (starboard propulsion unit)
9. Transmission oil pressure (starboard propulsion unit)
10. Starboard outboard engine tachometer
11. Starboard outboard engine coolant temperature
12. Starboard outboard engine oil pressure
13. Steering system hydraulic pressure
14. Rudder angle indicator
15. Starboard inboard engine oil pressure
16. Port inboard engine coolant temperature
17. Port inboard engine oil pressure
18. Ramp hydraulic system pressure
19. Transmission oil pressure port propulsion unit
20. Starting system hydraulic pressure
21. Port outboard engine oil pressure
22. Port outboard engine coolant temperature
23. Fuse, 10 amp, navigation lights
24. Fuse, 10 amp, lazarette light, engine room fan, and engine room receptacle
25. Fuse, 5 amp RMHS
26. Fuse, 10 amp spare
27. Not used
28. Not used
29. Fuse, 10 amp, engine alarm lights
30. Fuse, 10 amp, cargo well lights and instrument panel light
31. Fuse, 15 amp, engii room lights
32. Fuse, 10 amp, spare
33. Switch, engine alarm circuit test
34. Electric starter button, starboard outboard engine
35. Switch, cargo well
36. Hydraulic starter button, starboard inboard engine
37. Switch, engine room lights
38. Switch, spare
39. Switch, spare
40. Switch, RMHS
41. Hydraulic starter button, port inboard engine
42. Switch, lazarette lights
43. Electric starter button, port outboard engine
44. Switch, navigation Lights

Figure 2-5 - Continued

(8) The hydraulic starter control valve (fig. 2-10) can be manually actuated to start the inboard engines that are started by the hydraulic starting motors.

(9) The hydraulic starting control valves and the solenoid valve on hull numbers 8540 through 8560 and 8580 through 8618 are located on each inboard engine (fig. 2-11). Engine room starting capability is provided by a pushbutton located on each engine instrument panel. The solenoid control valve contains a manual override which allows opening of the valve if electrical circuits fail. The override shutoff valve is normally open. In the event of electrical failure, the shutoff valve is manually closed allowing accumulator hydraulic pressure to open the control valve and port pressure to the applicable hydraulic cranking motor. A fuel pressure switch is interlocked with the hydraulic starter control valves to prevent the accidental engagement of the hydrostarters when the engine is running.

WARNING

In the event of fire in the engine room, close the fuel supply valve from the tank immediately.

(10) Each fuel tank has a supply valve and a return valve (,fig. 2-12). Both valves must be open when using fuel from a tank.

(11) On hull numbers 8540 through 8560 and 8580 through 8618, there is one supply valve from each fuel reservoir. When open allows fuel to flow from reservoir to propulsion unit. Both reservoir valves should be open prior to starting engines. A cross-over system allows one reservoir to supply fuel to either or both propulsion units. To operate ,all engines from one reservoir, open only one supply valve. There is one return valve to each fuel reservoir. When open, they allow fuel to flow in the return lines from propulsion units to the reservoirs. Both shutoff vale should be open prior to starting engines. A cross-over system allows returning fuel from both propulsion units to flow into one reservoir.

(12) The sea water seacocks are located in the compartment below the aft end of the cargo well. Access to this compartment is through the scuttle in the starboard side of the cargo well. One seacock is on the port side and one starboard. Both seacocks must be open before the engines are started.

(13) The sea water seacocks on hull numbers 8540 through 8560 and 8580 through 8618 are located on the engine room aft bulkhead (fig. 1-16).

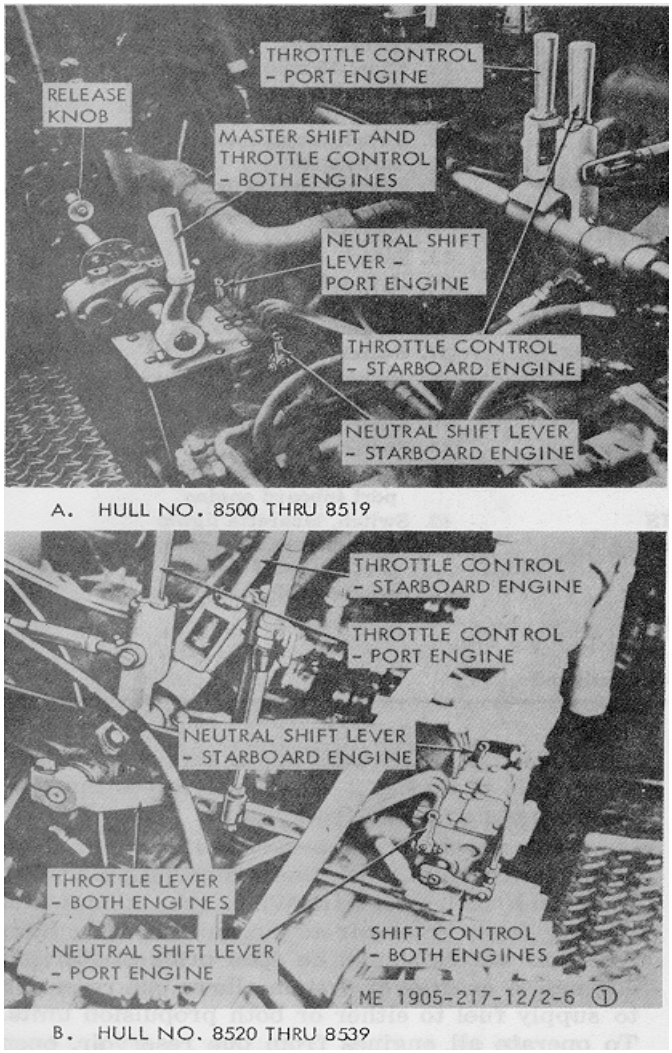


Figure 2-6.1. Engine control in engine room (Sheet 1 of 2)

When open they allow inlet flow of sea water through the sea chests for engine muffler cooling. Both 6eacocks must be opened prior to starting the engines.

(14) Two sea water discharge valves (fig. 2-13) are located on each side of the engine room. These valves must be opened (1/2 open) before engines are started.

(15) The bilge pump prime valves are located in prime lines between the sea water system and the three bilge pumps. The valves must be opened before engines are started.

(16) The bilge pump suction valves (fig. 2-14) are located in the suction line to each of the three bilge pumps. Open valves as needed to pump water out of the bilge compartments.

(17) On hull numbers 8540 through 8560 and 8580 through 8618 incorporate clutch drive bilge pumps. As shown in fig. 1-14.2 , two pumps are driven by the port inboard engine and one pump is driven by the starboard inboard engine. Each pump incorporates a friction drive clutch plate and manual clutch lever. The belt driven pulley on each pump is engaged or disengaged with the pump shaft and impeller by movement of the clutch lever. The clutch normally is disengaged and would be engaged only when needed to drain a compartment. The clutch can be engaged or disengaged at any engine rpm.

(18) The bilge pump overboard discharge valves (fig. 2-15) are located on the port side of the engine room and one valve is located on the starboard side. All three valves must be open when engines are running. In hull numbers 8500 thru 8539, all three valves must be open when engines are running.

(19) The nine bilge line valves (fig. 2-14) are located forward in the engine room. These valves are opened as needed to pump out the various bilge compartments.

(20) The hydraulic steering suction valve, hull numbers 8500 through 8519 (fig. 2-16), is located at bottom of steering system tank in the engine room. The valve must be open before engines are started. The Gunderson and Rohr crafts do not have a valve for this purpose because the hydraulic fluid is pumped out through the top of the tank.

(21) The ramp hoist hydraulic system supply valve, hull numbers 8500 thru 8519 (fig. 2-16), is located at bottom of ramp hoist system tank in the engine room. This valve must be open when the ramp hoist system pump is operating. Close this valve only for periods of maintenance or prolonged shutdown. Hull numbers 8520 thru 8560 and 8580 thru 8618 do not have a valve for this purpose because the suction line enters the tank through the top.

(22) The hydraulic starting system tank valves, hull numbers 8500 thru 8519 (fig. 2-17) and 8540 thru 8560 and 8580 thru 861-8 (fig. 2-18), are located at bottom of tank on starboard side of engine room. Valves must be open when engines are running. Hull numbers 8520 thru8539 do not have similar valves.

(23) The starting system accumulators and valves (fig. 2-19 and fig. 2-20 for hull numbers 8540 through 8560 and 8580 thru 8618). Two accumulators with shutoff valves are located in

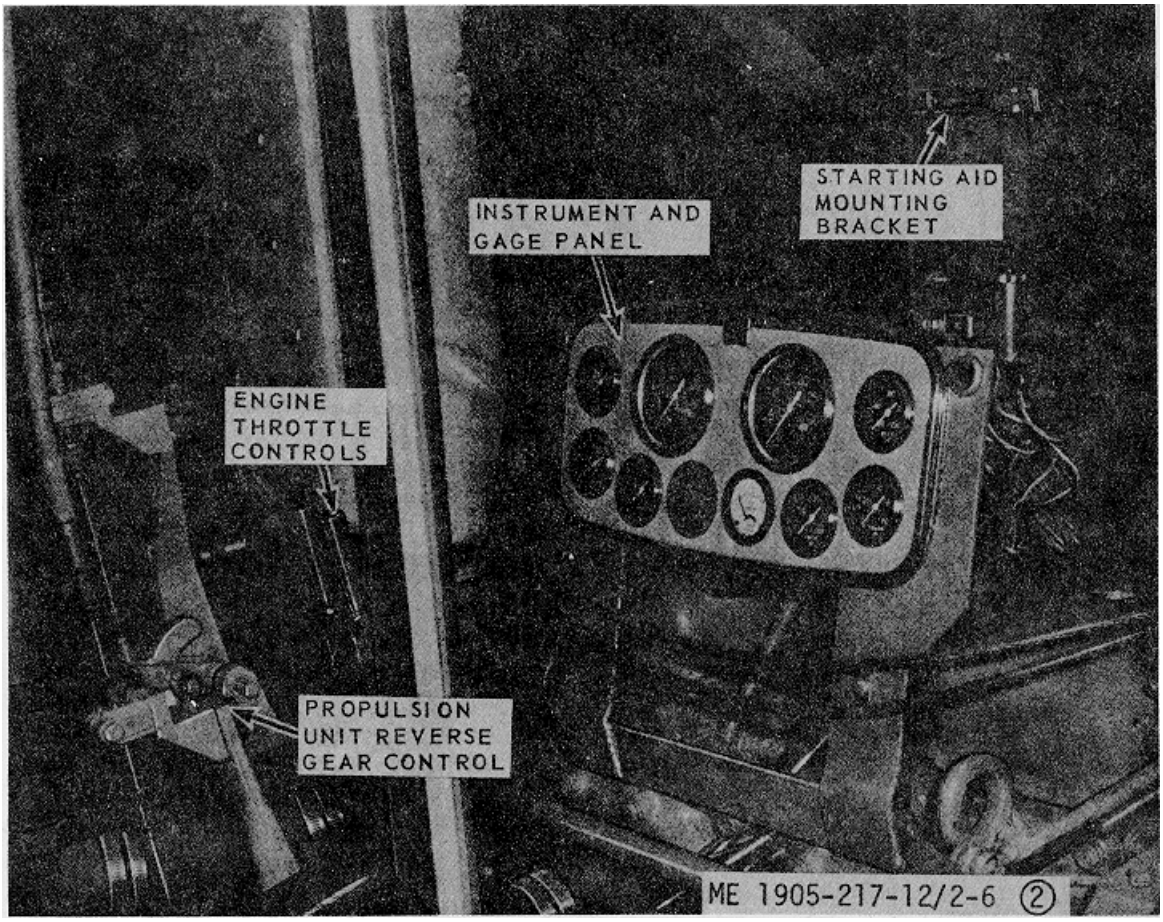


Figure 2-6.2. Engine controls in engine room. (Sheet 2 of 2)

the engine room. Prior to starting an inboard engine, the valve controlling the accumulator for the engine to be started must be opened. A crossover system allows starting of an engine from either accumulator.

(24) The hydraulic starting system hand pump and valve (fig. 2-21, hull numbers 8500 thru 8539 and fig. 2-22, hull numbers 8540 thru 8560 and 8580 thru 8618) are located on the port side of the port propulsion unit. The hand pump is used to restore pressure in the accumulators if engines are not running. The hand pump shutoff valve on hull numbers 8520 thru 8560 and 8580 thru 8618 is located near the port accumulator.

(25) The steering system valves, pump discharge (fig. 2-23), are not used on hull numbers 8520 thru 8560 and 8580 thru 8618. This paragraph applies to hull numbers 8500 thru 8519. Only one steering pump is needed to supply the steering system, so one is closed at all times. Valves are located aft in engine room.

(26) The steering system valves, cylinders (fig. 2-24), are in the lazarette and are used only if it is necessary to isolate a cylinder because of failure.

(27) The clutch lever, ramp hoist system pumps (fig. 2-25), includes two pumps. The winch may be operated by using one or both pumps.

c. Emergency Winch Controls (fig. 2-26.1).

(1) Emergency controls are provided to lower the ramp if the ramp hydraulic system should fail. These controls are located at or near the winch. The winch on hull number 8500 thru 8519 is located forward on the port side and hull number 8520 thru 8560 and 8580 thru 8618 the winch is located forward on the starboard side.

(2) Refer to fig. 2-26.1 for emergency lowering of the winch.

d. Pilot House Instruments and Gages. See figure 2-1 for hull numbers 8500 thru &519 instruments; figure 2-2 for hull numbers 8520 thru 8539 instruments; and figure 2-3 for hull numbers 8540 thru 8560 and 8580 thru 8618 instruments.

(1) *Engine tachometers.* Four tachometers are included in the panel, one tachometer for

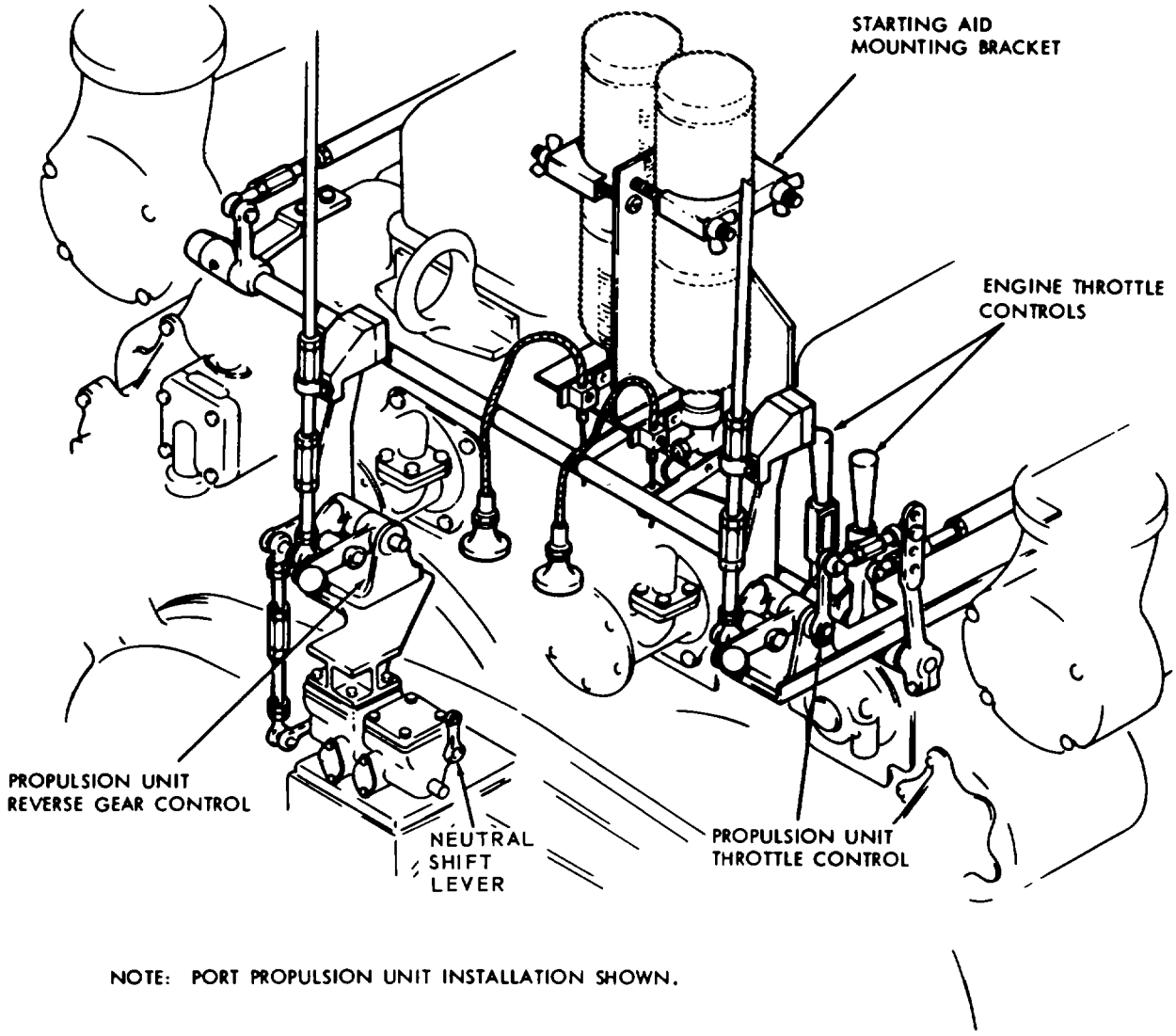


Figure 2-7.1. Engine room controls and indicator hull numbers 8540 thru 8560 and 8580 thru 8618. (Sheet 1 of 2)

each of the four engines. Engine speeds are indicated in revolutions per minute.

(2) *Alternator ammeters*. A separate ammeter is provided for each of the two alternators. The ammeters indicate the alternator output. The scale reads from 0 to 100-amperes.

(3) *Battery charge ammeter*. This meter indicates battery charge rate and discharge rate in amperes. The scale reads from 0-to 200-charge and 0-to 200-discharge.

(4) *Engine water temperature gages.* A separate temperature gage for each of the four en-

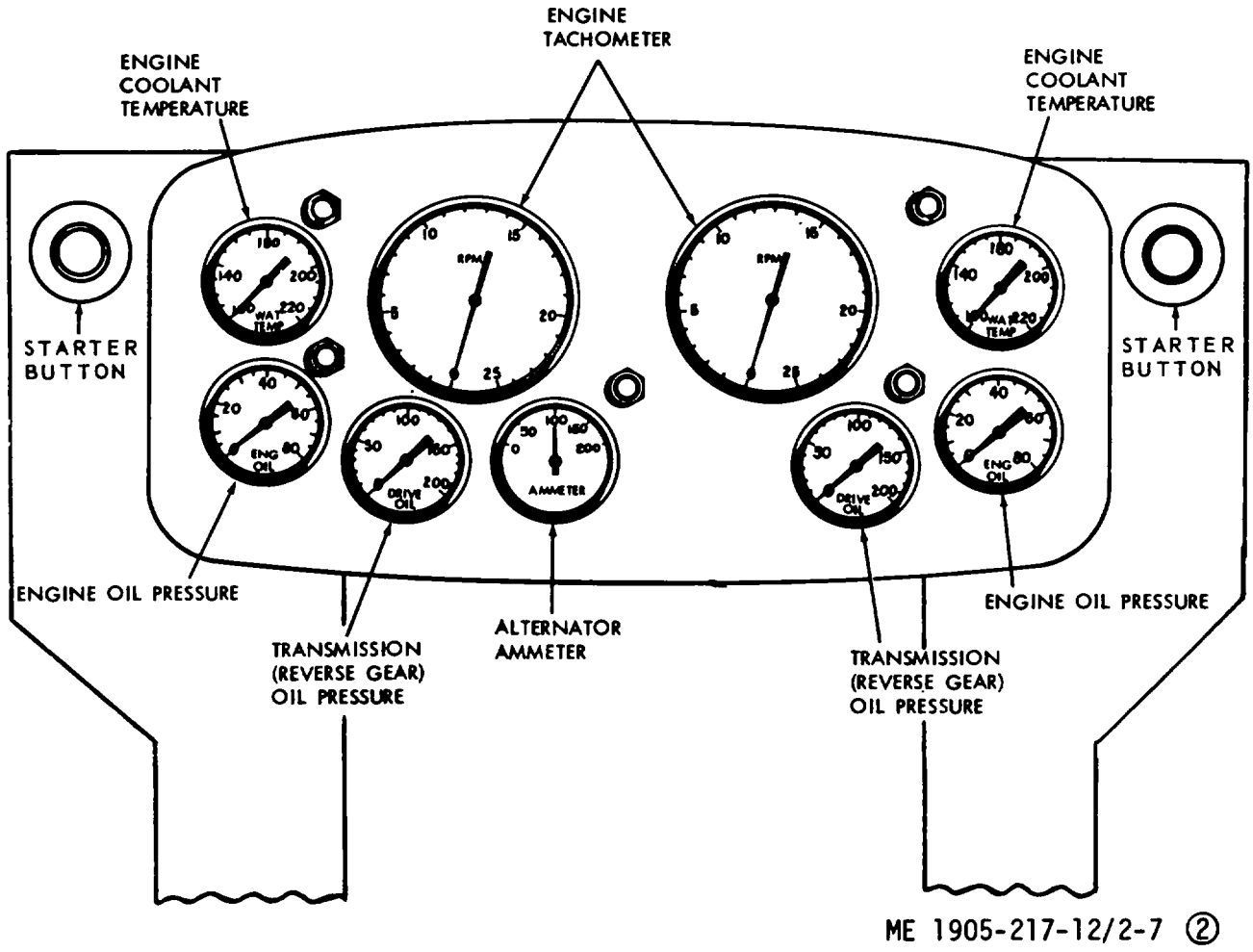


Figure 2-7.2. Engine room controls and indicators, hull numbers 8540 thru 8560 and 8580 thru 8618. (Sheet 2 of 2)

gines is mounted on the panel. The gages indicate the temperature of the coolant being circulated through the engine.

(5) *Transmission oil pressure gage*. The control panel contains a separate gage for each of the two propulsion units.

(6) *Engine oil pressure gages*. There are four oil pressure gages, one for each of the four engines.

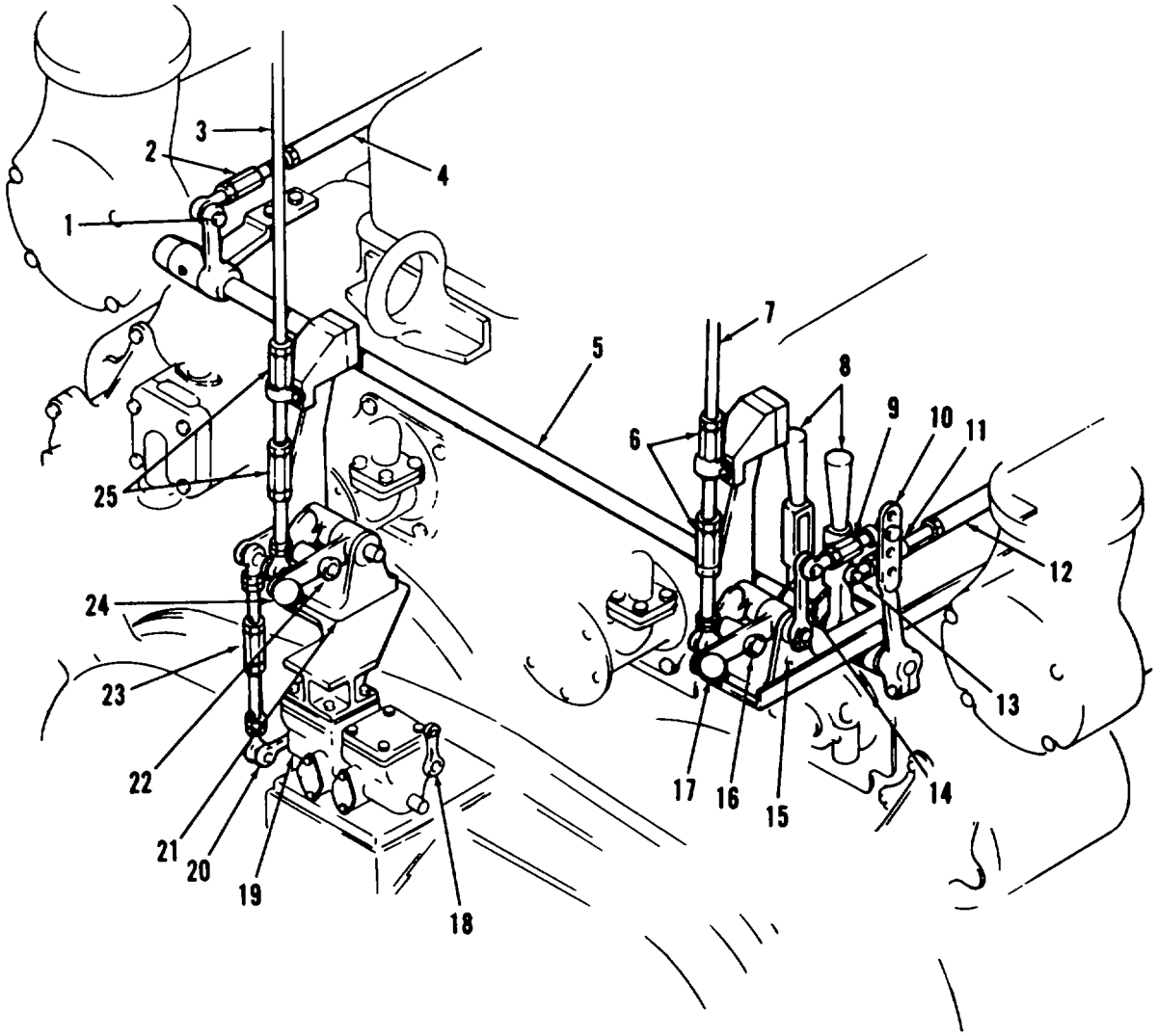
(7) *Starting system hydraulic pressure gage.* The gage (18, fig. 2-1) hull numbers 8500 thru 8519 and (20, fig. 2-5) hull numbers 8540 thru 8560 and 8580 thru 8618, only on hull numbers listed, indicate the pressure available for starting inboard engines.

(8) *Ramp hoist hydraulic System pressure gage (17, fig. 2-1).* Furnished on hull numbers 8500 thru 8619 and (18, fig. 2-5) on hull numbers 8540 thru 8560 and 8’580 thru 8618. When a ramp hoist pump is operating, the gage indicates the pressure in the system.

(9) *Steering hydraulic pressure gage (16, fig. 2-1)* Furnished on hull numbers 8500 thru 8519. This gage indicates the pressure available in the steering hydraulic system to operate the rudders.

(10) *Rudder angle indicator*. The indicator will show the position of the rudders. It is connected to a sender located in the lazarette at the port side rudder post

(11) *Sight glass, steering system 8 gallon expansion tank, hull numbers 8500 thru 8519 (fig. 2-27).* Tank is mounted aft in the pilot house. Oil level in the tank should ,be within one inch of the red center line of the sight glass.



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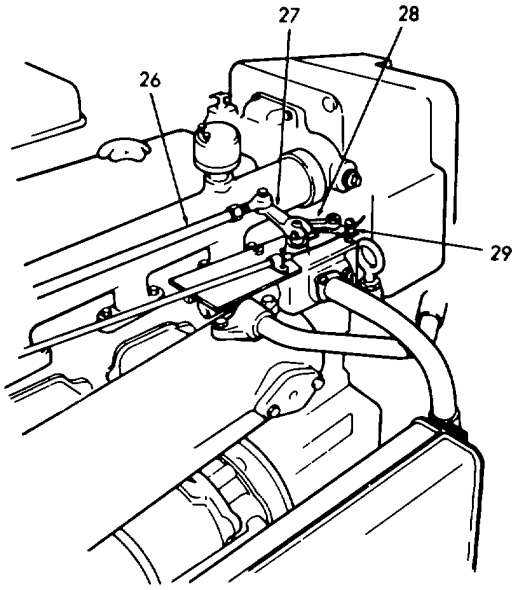
1. Bolt
2. Turnbuckle
3. Plot house to engine room reverse gear control rod
4. Governor speed control rod
5. Throttle control cross shaft
6. Turnbuckle
7. Pilot house to engine room throttle control rod
8. Engine throttle levers
9. Rod
10. Lever
11. Turnbuckle
12. Governor speed control rod
13. Bolt
14. Lever
15. Engine room propulsion unit throttle control
16. Manual disconnect pin
17. Throttle control knob (black)
18. Engine marine gear oil shutoff valve
19. Marine gear selector control valve
20. Rod
21. Propulsion unit reverses gear control
22. Manual disconnect pin
23. Rod and turnbuckle
24. Reverse gear control knob (red)
25. Turnbuckle

Figure 2-8.1. Propulsion unit control diagram, hull numbers 8540 thru 8560 and 8580 thru 8618. (Sheet 1 of 2)



26. Governor speed control rod
27. Speed control lever
28. Throttle shaft lever
29. Engine stop control cable

Figure 2-8.2. Propulsion unit controls diagram, hull numbers 8540 thru 8560 and 8580 thru 8618. (Sheet 2 of 2)

e. Engine Room Instruments and Gages.

(1) *Sight glasses, ramp hoist hydraulic system tank and steering tank.* These tanks are equipped with sight glasses on all craft. Oil temperatures are also indicated on the gages on hull numbers 8520 thru 8560 and 8580 thru 8618.

(2) *Sight glass, fresh water cooling system expansion tanks (fig. 2-28).* There are two expansion tanks, one on each side of the engine room. The coolant level should be visible in the sight glass at all times.

(3) *Ramp hoist hydraulic filter gage (fig. 1-13 or fig. 2-29*). The gage is located adjacent to the return line filter on the engine room aft bulkhead. The gage indicates element condition.

(4) Steering system filter gage (fig. 2-30). The gage is located adjacent to the reburn line filter on engine room aft bulkhead. The gage indicates filter condition. (Hull numbers 8540 thru 8560 and 8580 thru 8618).

f. Ramp-Slack Cable System (Hull numbers 8500 thru 8519). When the ramp is lowered and comes to rest on some surface; the cable will continue to pay out from the winch unless it is immediately shut off. This causes the cable to bind and kink when attempting to raise the ramp

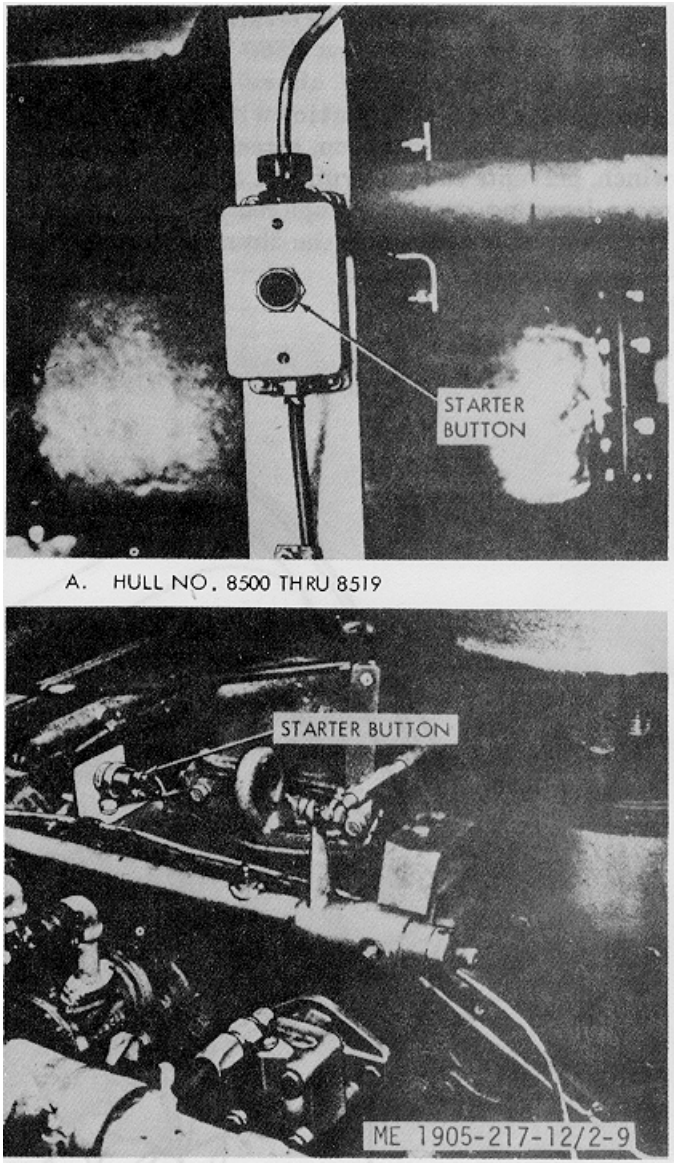


Figure 2-9. Engine electric start button in engine room.

to the closed position. A system of limit switches, a cable shield, and a directional control valve have been added to remedy this operational problem. Briefly, the system works in the following way:

(1) The limit switch, located in the pilot house aft of the ramp control lever energizes the system when the ramp control lever is pulled.
(2) The limit switch at the ramp is activated as soon -as slack exists in the cable.
(3) The solenoid valve shuts off the hydraulic fluid to the cable winch and returns it to the reservoir thereby not allowing any more cable to pay out.

g. Winch Automatic Reversing Mechanism (Hull Numbers 8540 thru 8560 and 8580 thru 8618 (fig. 2-9.1).
The above hull numbers incorporate an automatic winch reversing mechanism. The mechanism, attached to the ramp winch, prevents cable overrun and coiling when the ramp lowering cycle is completed or interrupted. When the cable goes slack, the direction of rotation is automatically reversed.

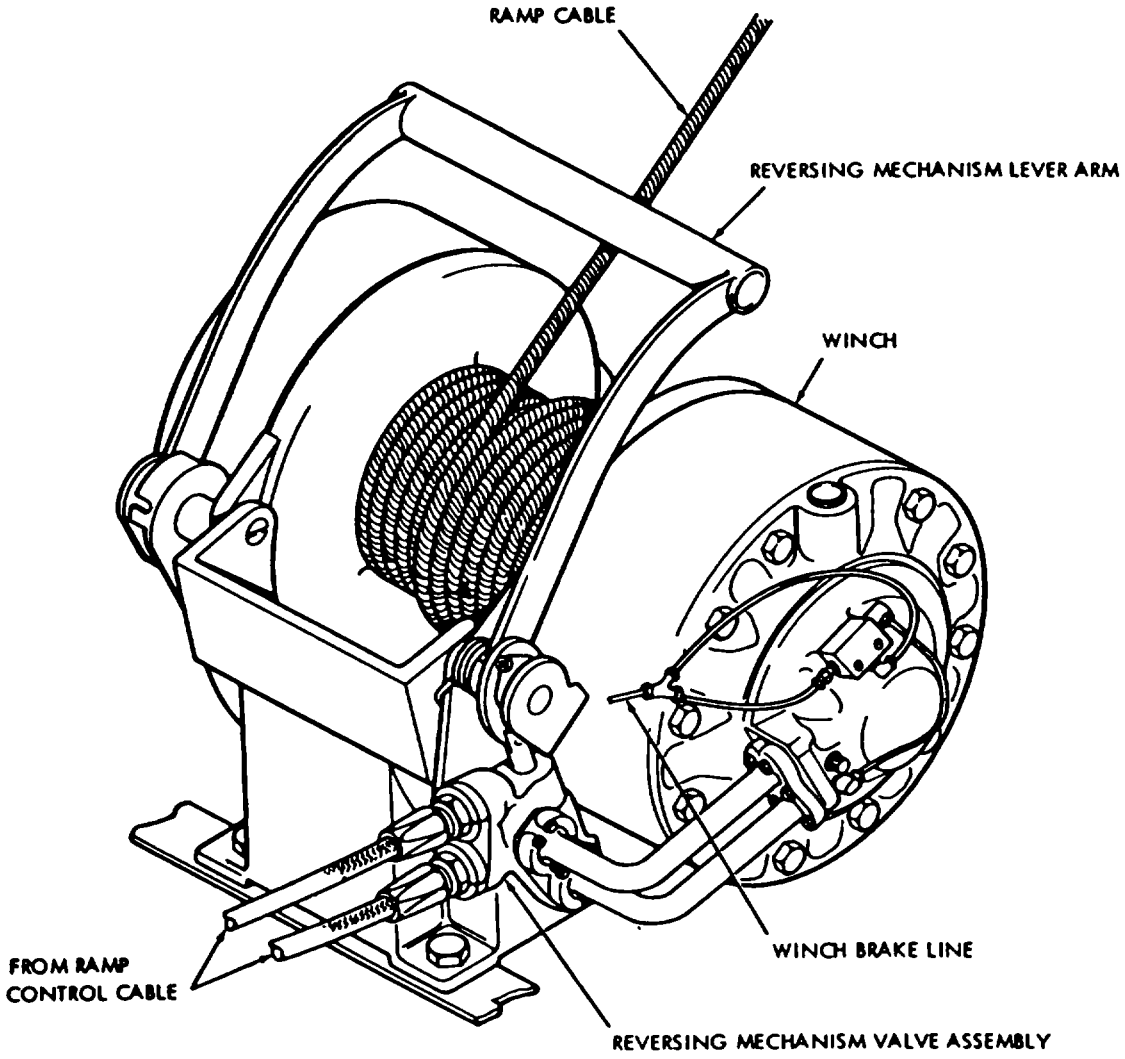
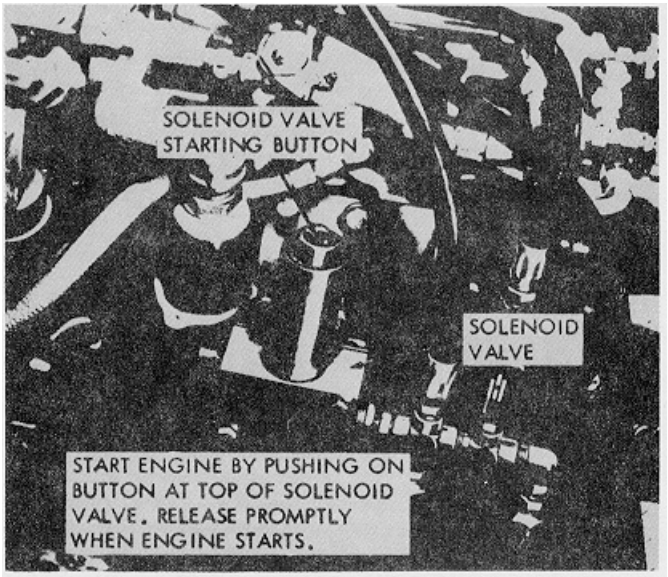
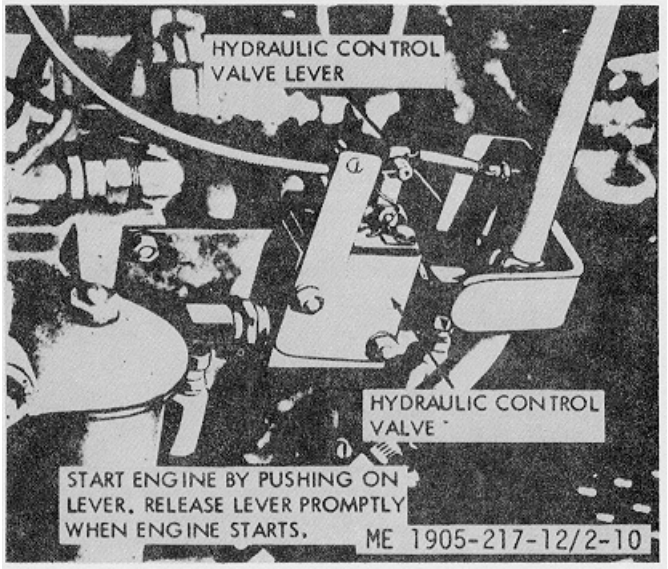


Figure 2-9.1. Winch automatic reversing mechanism (hull numbers 8540 thru 8560 and 8580 thru 8618).



A. HULL NO. 8500 THRU 8519



B. HULL NO. 8520 THRU 8539

Figure 2-10. Hydraulic starting control valves in engine room.

2-3. Starting

a. Preparation for starting.

(1) Perform the before-operation services (para. 3-4).

(2) Lubricate the landing craft as specified in the current lubrication order.

(3) Open the two sea water seacocks (para 2-1b(13)).

(4) Open the four sea water discharge valves 1/2 open (fig. 2-13).

(5) Disengage the three bilge pump clutches on hull numbers 8540 thru 8560 and 8580 thru 8618 (fig. 1-14.1).

(6) Open fuel supply and return valves at each tank (fig. 2-13).

(7) Disengage the two ramp hoist pump clutches (fig. 2-25).

(8) Open the hydraulic steering suction valve (fig. 2-16).

(9) Open one of the two hydraulic starting. system accumulator valves (fig. 2-19 and fig. 2-20) and the two starting system tank valves (fig. 2-17) or suction valves (fig. 2-18).

b. Starting the Engines.

(1) Figure 2-1 provides engine starting instructions for hull numbers 8500 thru 8519 and 8520 thru 8539. Figure 2-32 provides engine starting instructions for hull numbers 8540 thru 8560 and 8580 thru 8618.

(2) As engines warm up, check operating temperatures and pressures.

(3) *Hydraulic dead start.* If there is insufficient pressure in accumulators, the hand pump may be used to -provide initial starting pressure as follows:

(a) Open accumulator valves (fig. 2-19 or 2-20) and (on hull numbers 8500 thru 8519) open the starting tank valve (fig. 2-17).

(b) Open hand pump discharge valve (fig. 2-20 or 2-21).

(c) Pump accumulators with hand pump, to 2000 psi minimum.

(d) Close hand pump discharge valve.

(e) Start engine by pushing button (hull numbers 8500 thru 8519 and 8540 thru 8560 and 8580 thru 8618) or pulling handle (hull numbers 8520 thru 8539) in pilot house or by actuating the valve (fig. 2-10) in the engine room.

(4) *Emergency starting.* The outboard engine of each propulsion unit has an electric starter and each inboard engine has a hydraulic starter. If either the electric system or the hydraulic system should fail, one engine of a propulsion unit can be used to start the other by actuating the clutches.

c. Starting Engine with Engine Room Controls. Engines can be started and operated by using controls in the engine room. See figures 2-6, 2-7.1, 2-9.1, 2-10, and 2-11.

2-4. Stopping the Engines

Figure 2-33 provides engine stopping instructions for hull numbers 8500 thru 8519 and 8520 thru 8539. Figure 2-34 provides engine stopping instructions for hull numbers 8540 thru 8560 and 8580 thru 8618.

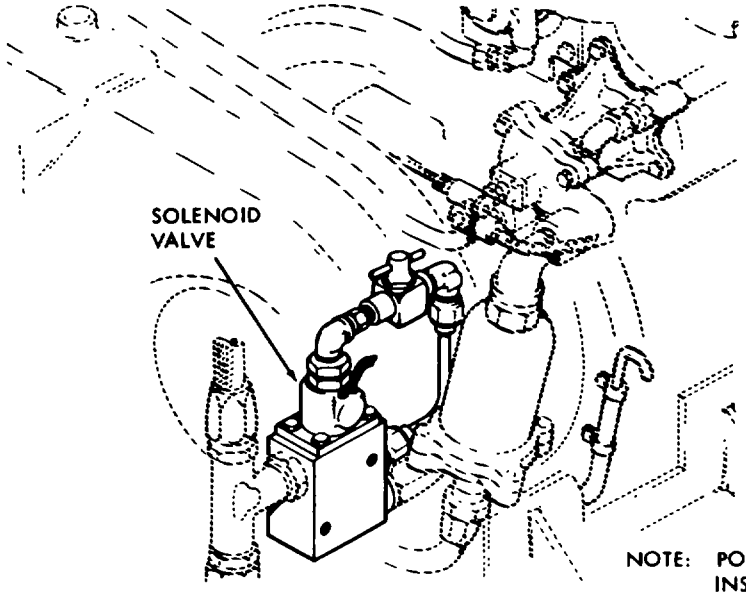


Figure 2-11. Hydraulic starting system solenoid control valve, hull numbers 8540 thru 8560 and 8580 thru 8618.

2-5. Operation of Landing Craft

a. Normal Operation. Refer to figure 2-35 or 2-36, as applicable.

b. Emergency Engine Controls. Auxiliary controls for emergency shifting and throttle control are located in the engine room. See figure 2-6.1 or 2-7.1 for hull numbers 8540 thru 8560 and 8580 thru 8618.

NOTE

If it is necessary to shut down one engine of a propulsion unit, push the neutral shift lever forward.

c. Emergency Steering.

(1) If one steering pump or one engine should fail, the steering system will continue to operate. On hull numbers 8500 thru 8519, close the shut-off valve (fig. 2-23) for the pump that is not operating.

(2) If both steering pumps or the engines should fail, steering can be accomplished by turning the steering wheel so the helm unit will act as a pump to actuate the steering cylinders.

NOTE

Hull numbers 8500 thru 8519. Close both shutoff valves (fig. 2-33) if both pumps or both engines fail.

(3) In case of failure of all hydraulic steering, use the emergency tiller as follows:

(a) Pull out access plate in deck over one rudder stock.

(b) Insert emergency tiller (fig. 2-37) at open rudder stock.

(c) Enter the lazarette and pull out eye pins to disconnect the hydraulic cylinders and tie rod.

2-6. Operation of Ramp Hoist

a. General.

(1) On hull numbers 8500 thru 8518 the ramp hoist system supply valve, located at the bottom of the ramp hoist system tank, must be open at all times when equipment is operating. Close valve only for periods of maintenance or prolonged shut down.

(2) Check filter (fig. 2-29) and strainer indicators (fig. 2-38) when in operation. Shut down system and clean filter or strainer when indicator shows that oil is bypassing the element (red indicator).

(3) Operate only one ramp hoist pump at a time. On hull numbers 8540 thru 8560 and 8580 thru 8618, the system will operate with one engine-driven pump in operation; however, if maximum ramp hoist rate is required, both pumps must .be in operation.

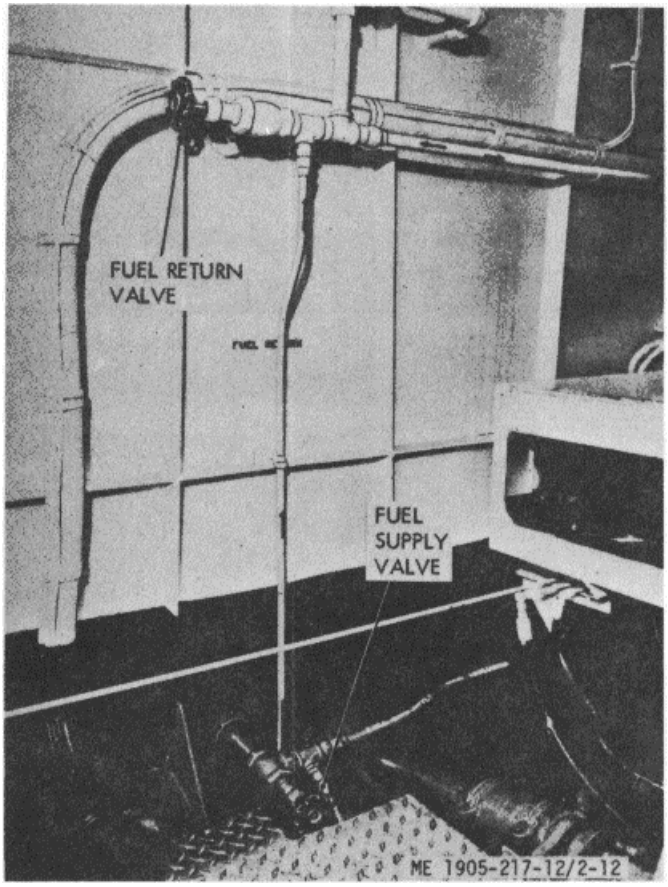


Figure 2-12. Fuel system valves.

b. Normal Operation to Lower Ramp.

(1) Ramp hoist valve (fig. 2-3 for hull numbers 8540 thru 8560 and 8580 thru 8618) must be in neutral position.

(2) On hull numbers 8500 thru 8519 be sure the supply valve, located at the bottom of the ramp hoist system tank, is open.

(3) With engine running, start hydraulic ramp hoist pump (one only) by engaging clutch (fig. 2-25).

(4) Disconnect load binders (fig. 2-39) at ramp (both sides).

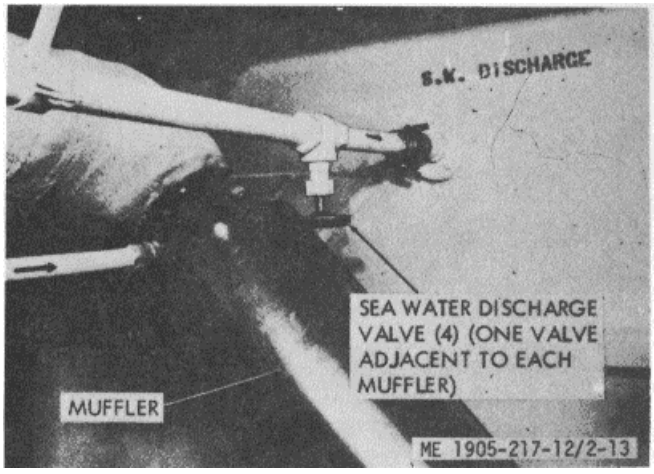


Figure 2-13. Sea water discharge valve.

(5) Move hoist valve lever (fig. 2-35) to RAMP DOWN.

((6) Neutral throttle (fig. 2-31 or 2-32 for hull numbers 8540 thru 8560 and 8580 thru 8618) may be used to accelerate raising or lowering ramp.

(7) Move hoist valve lever to NEUTRAL position when ramp is lowered and cable is slack.

c. Normal Operation to Raise Ramp.

(1) Move ramp control valve lever (fig. 2-36 for hull numbers 8540 thru 8560 and 8580 thru 8618 and fig. 2-35) to RAMP UP.

(2) When ramp is raised, return lever to NEUTRAL position and secure load binders (fig. 2-39).

(3) Disengage pump clutch (fig. 2-25).

d. Emergency Operation to Lower Ramp.

(1) Disconnect load binders (fig. 2-39).

(2) Refer to figure 2-26.1 and lower ramp.

e. Emergency Operation to Raise Ramp.

(1) Use chain hoists (2) as shown in figure 2-39. Hoists are stored in the lazarette.

(2) Secure load binders.

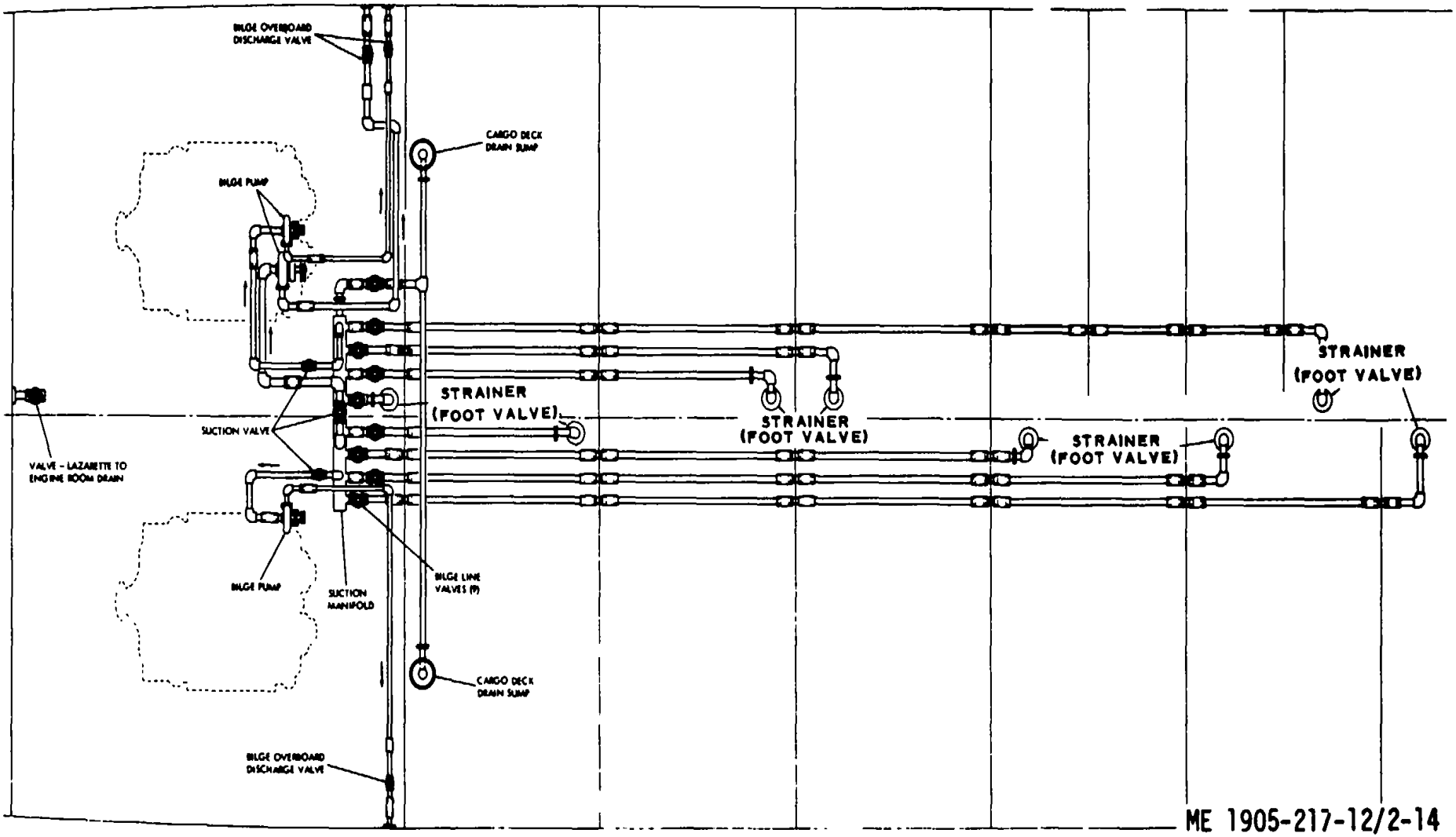


Figure 2-14. Bilge pumps, lines and valves.

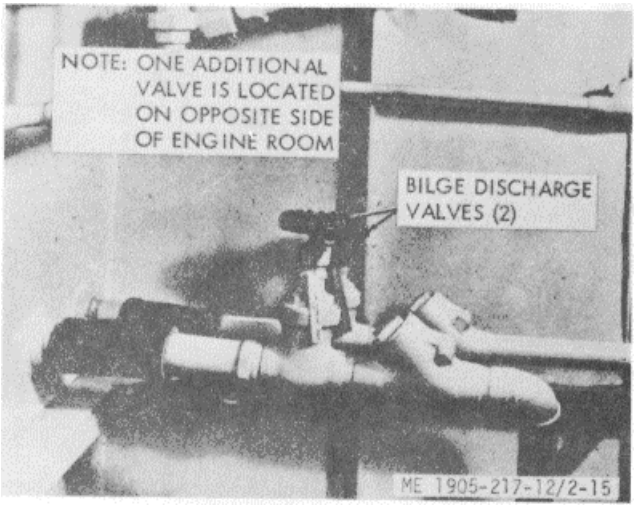


Figure 2-15. Bilge overboard discharge valves.

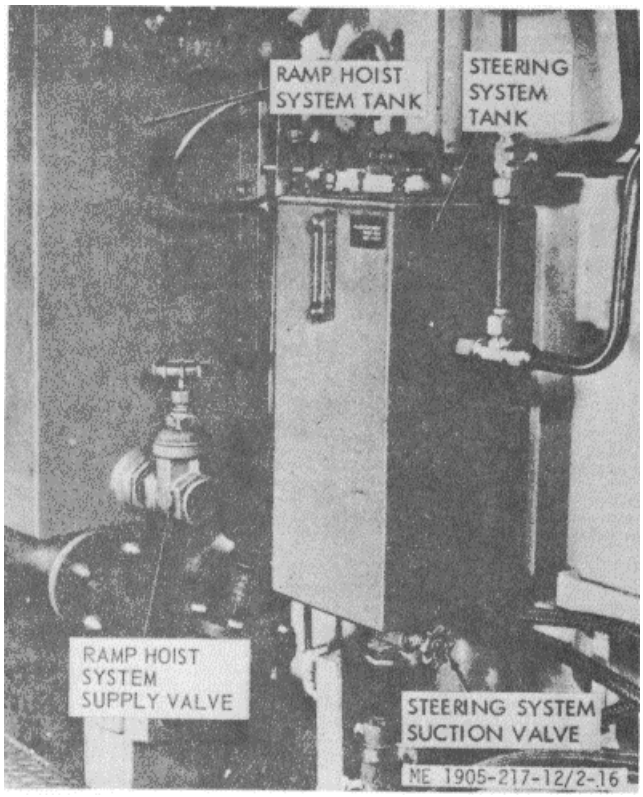


Figure 2-16. Steering system and ramp hoist system suction valves, hull numbers 8500 thru 8519.

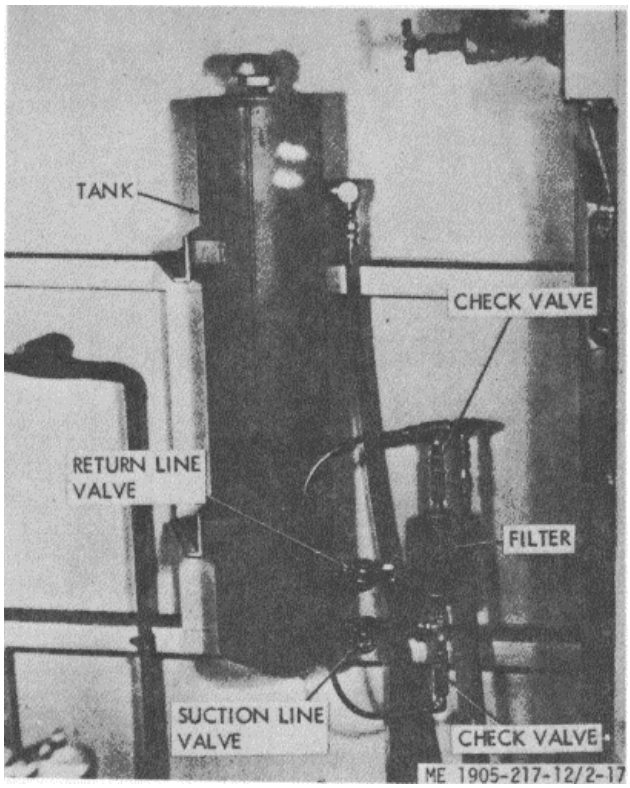


Figure 2-17. Hydraulic starting system tank and valves, hull numbers 8500 thru 8519.

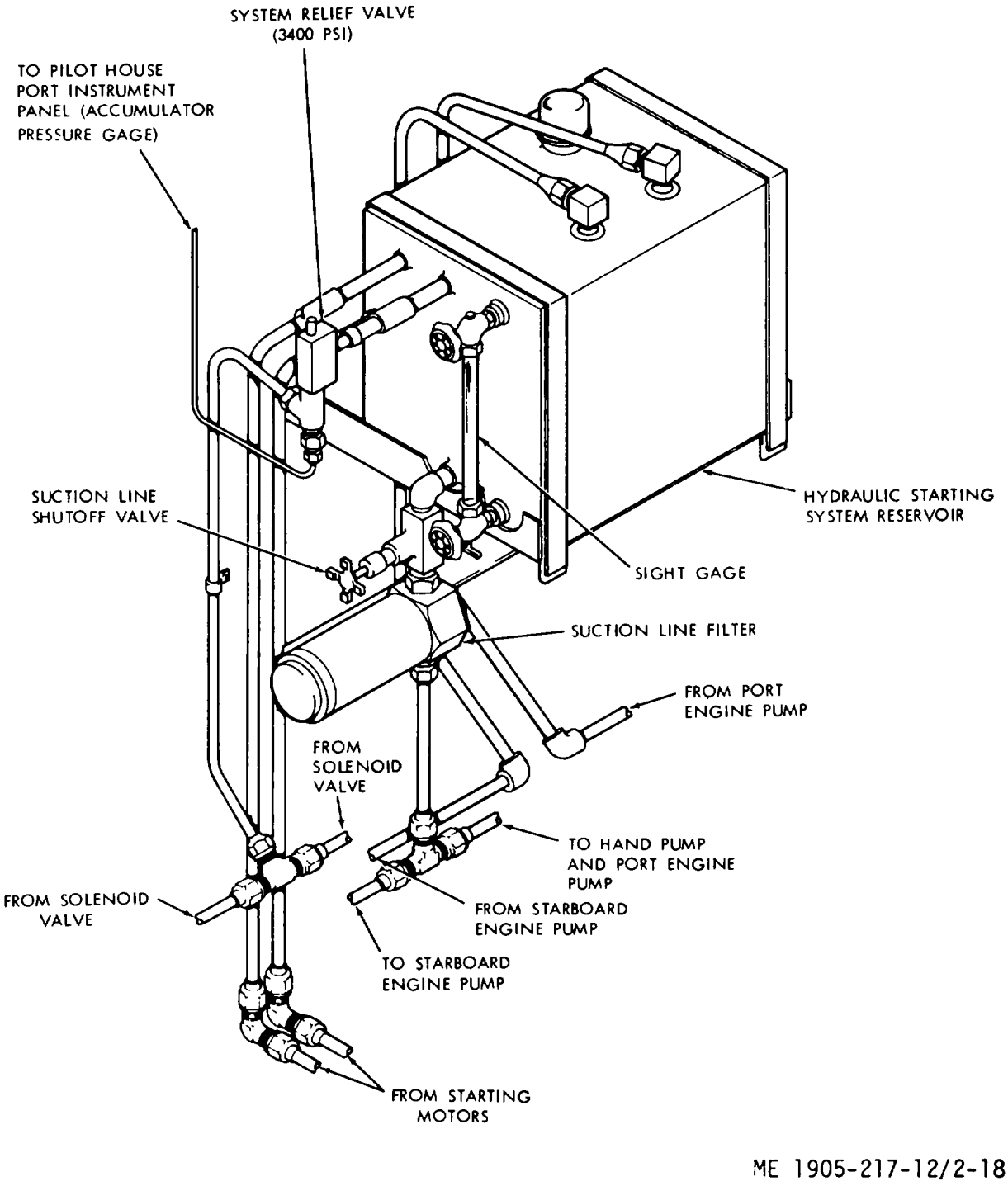


Figure 2-18. Hydraulic starting system reservoir, hull numbers 8540 thru 8560 and 8580 thru 8618.

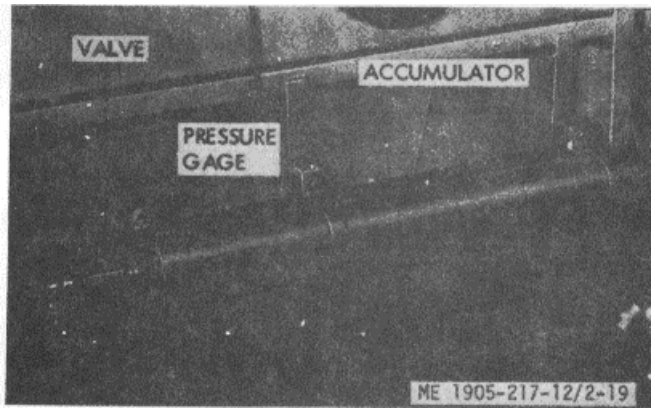


Figure 2-19. Hydraulic starting system accumulator and valve.

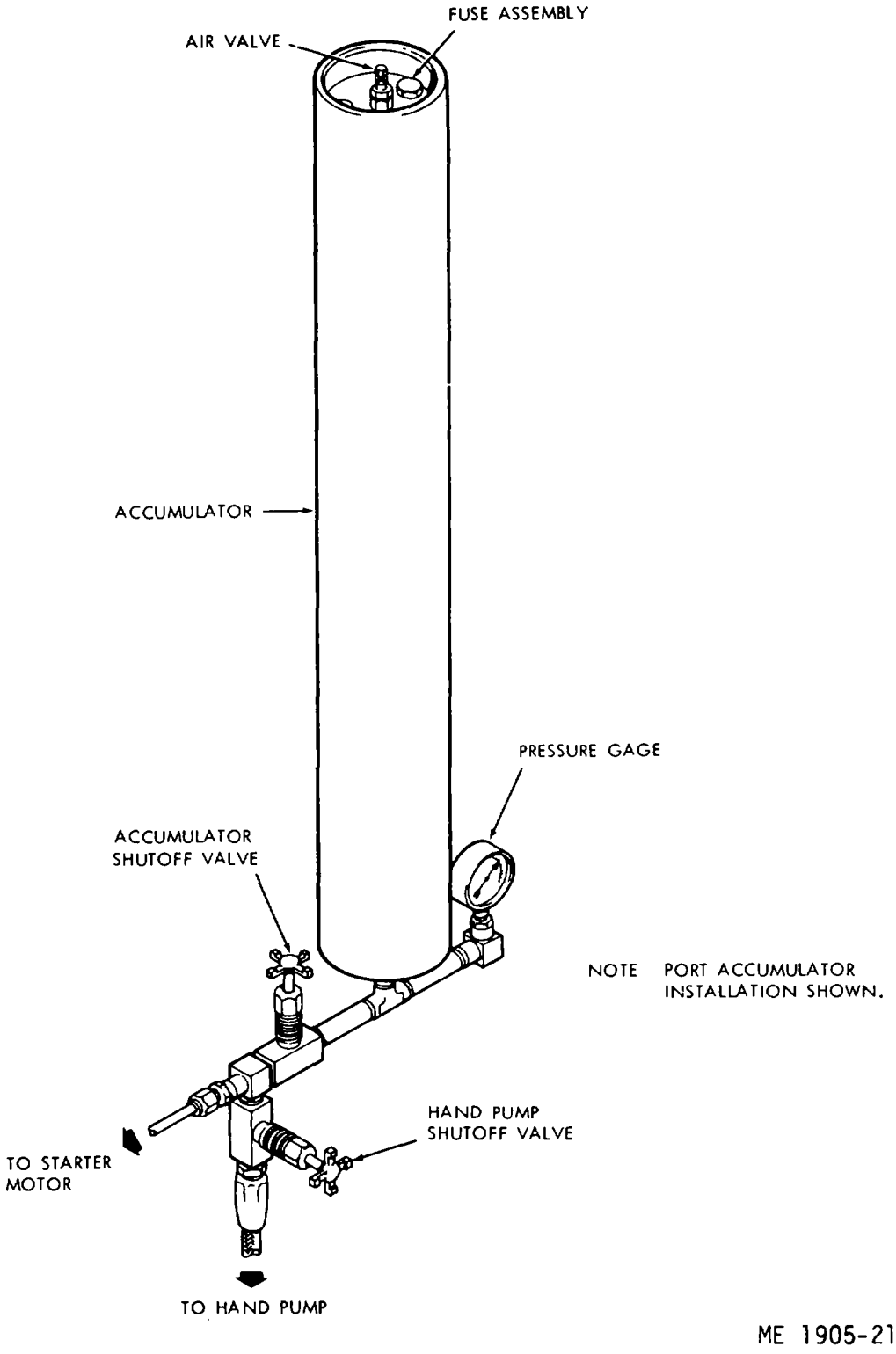


Figure 2-20. Hydraulic starting system accumulator and valve, hull numbers 8540 thru 8560 and 8580 thru 8618.

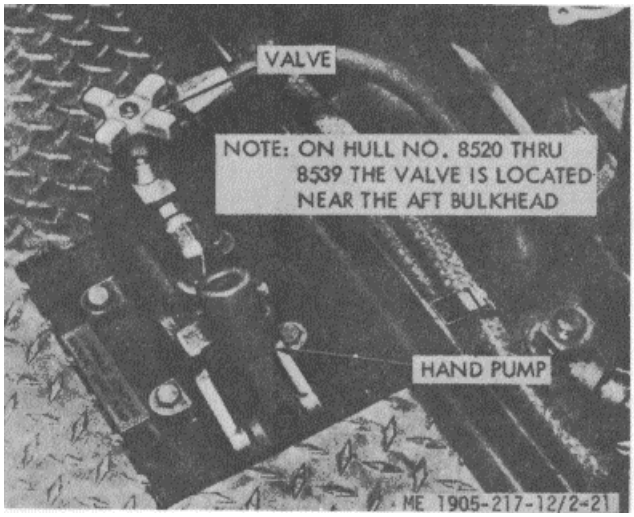


Figure 2-21. Hydraulic starting system hand pump, hull numbers 8500 thru 8539.

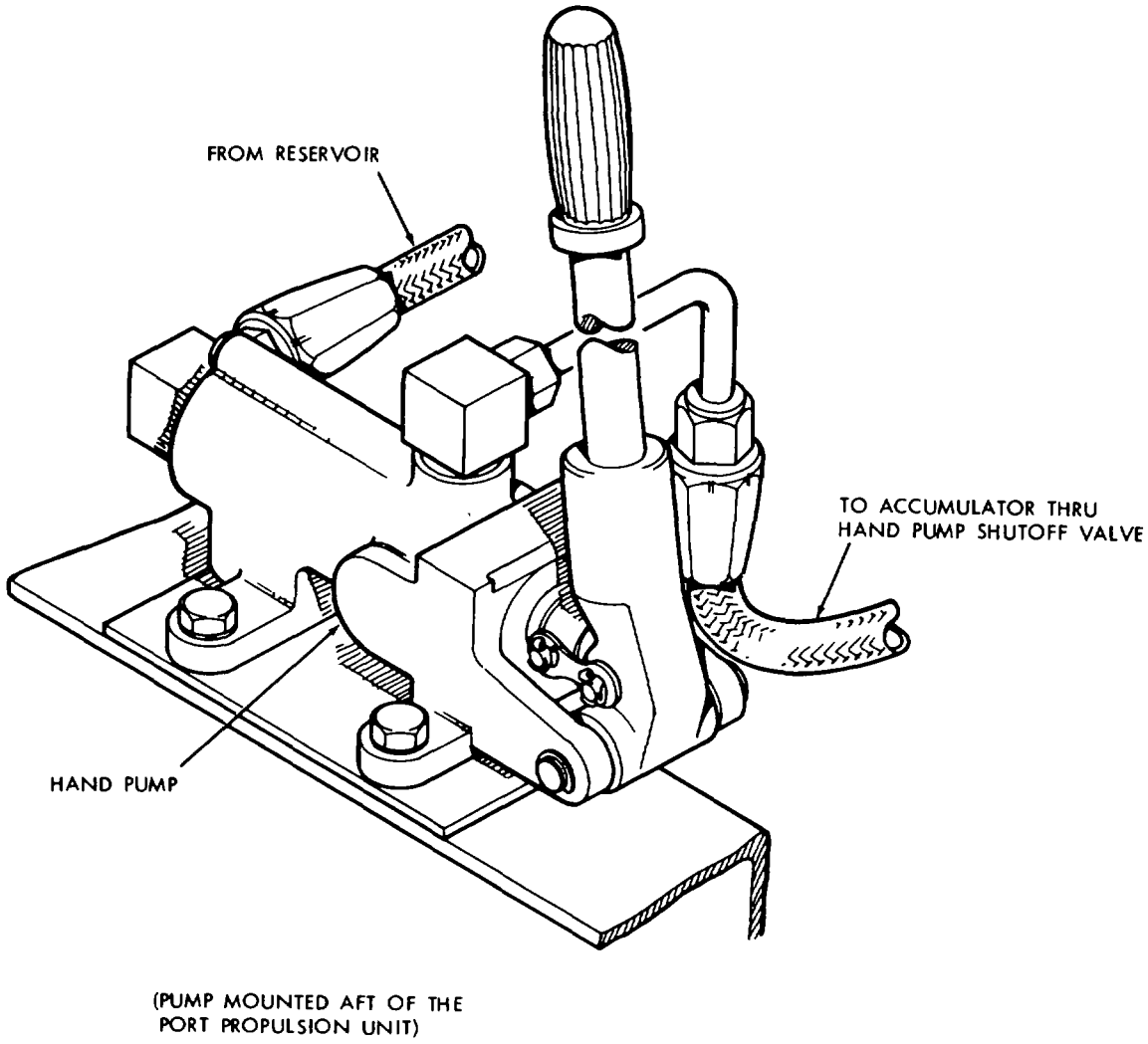


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Figure 2-22. Hydraulic starting system hand pump, hull numbers 8540 thru 8560 and 8580 thru 8618.

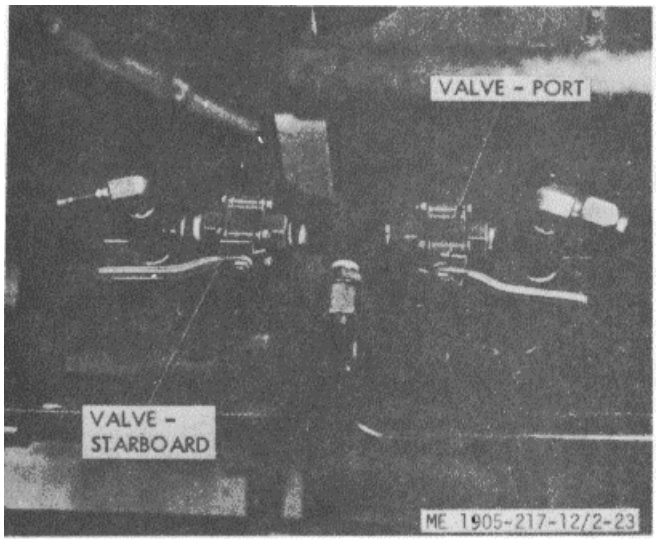


Figure 2-23. Steering system valves, pump discharge, hull numbers 8500 thru 8519.

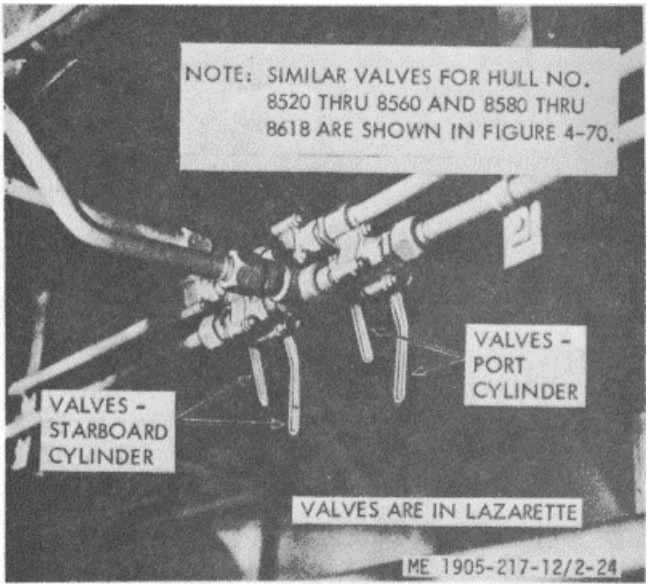


Figure 2-24. Steering system valves, cylinders, hull numbers 8500 thru 8519.

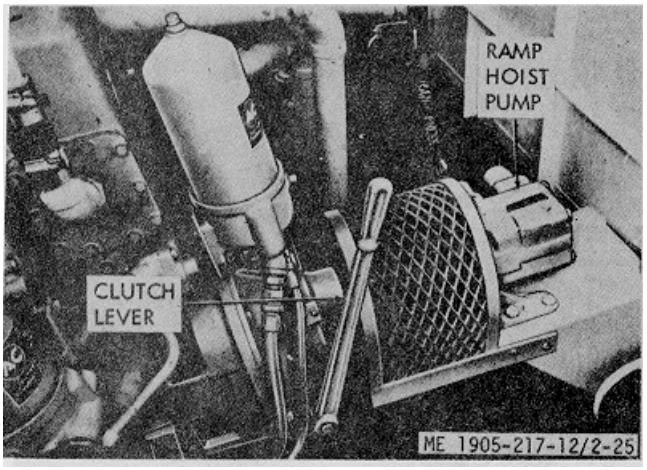


Figure 2-25. Clutch lever and ramp hoist pump.

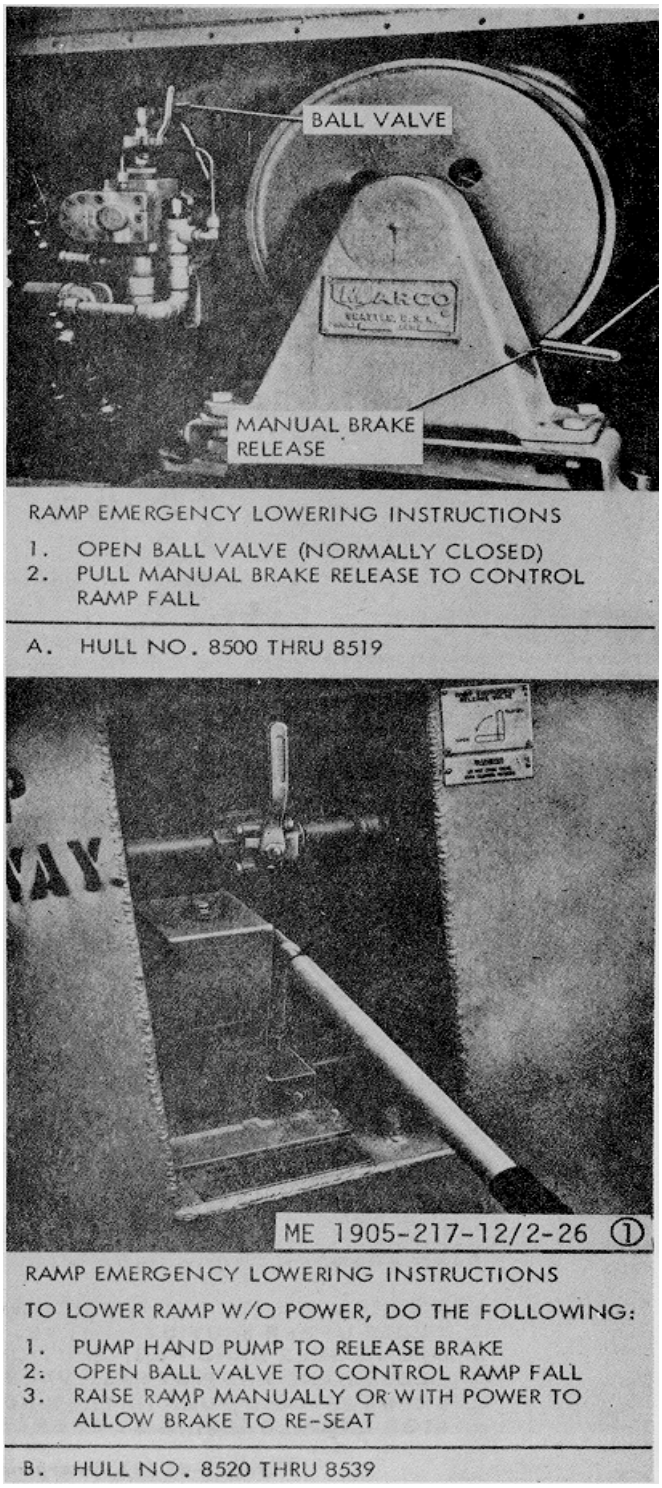


Figure 2-26.1. Emergency winch controls. (Sheet 1 of 2).

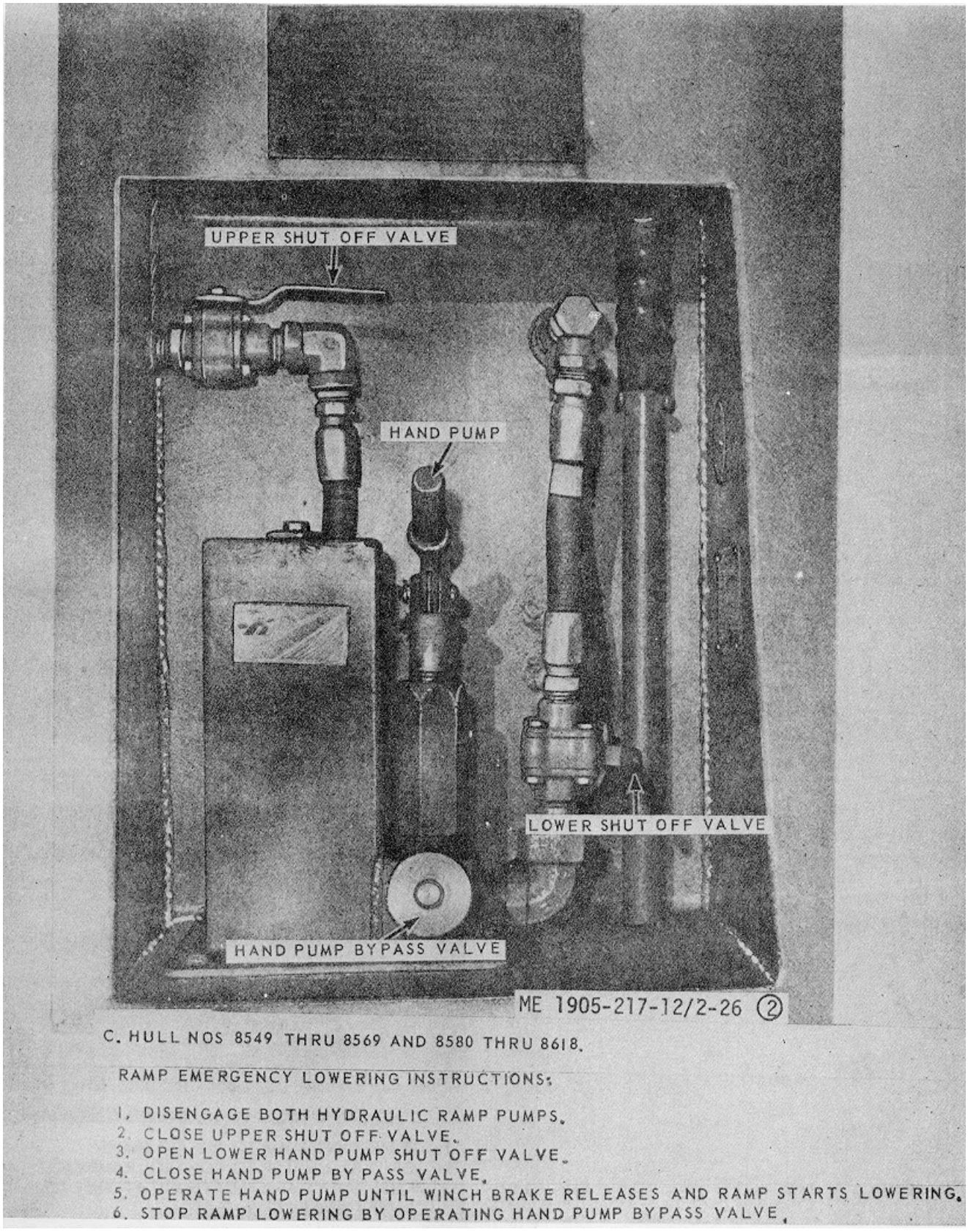


Figure 2-26.2. Emergency winch controls. (Sheet 2 of 2).

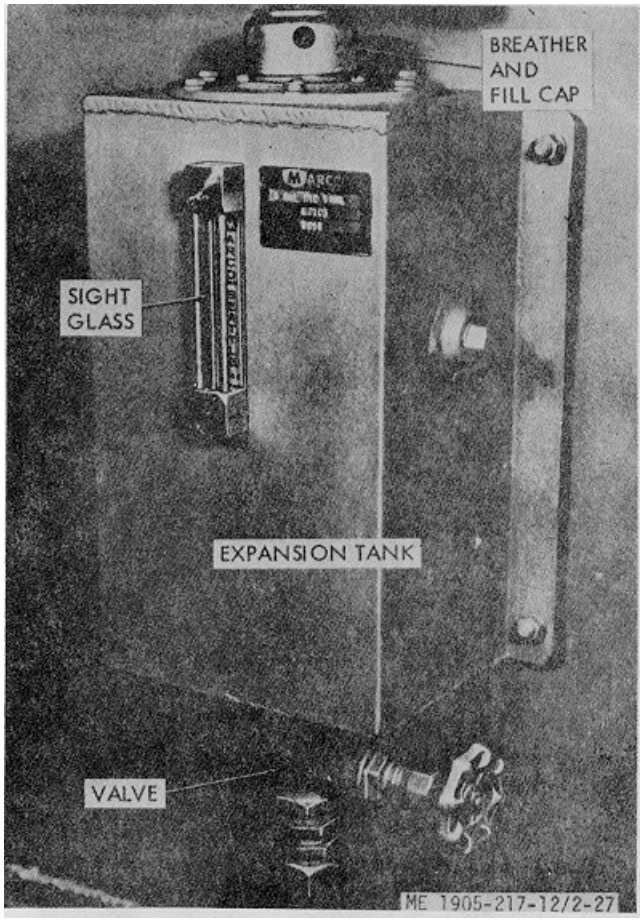


Figure 2-27. Steering system expansion tank with sight glass, hull numbers 8500 thru 8519.

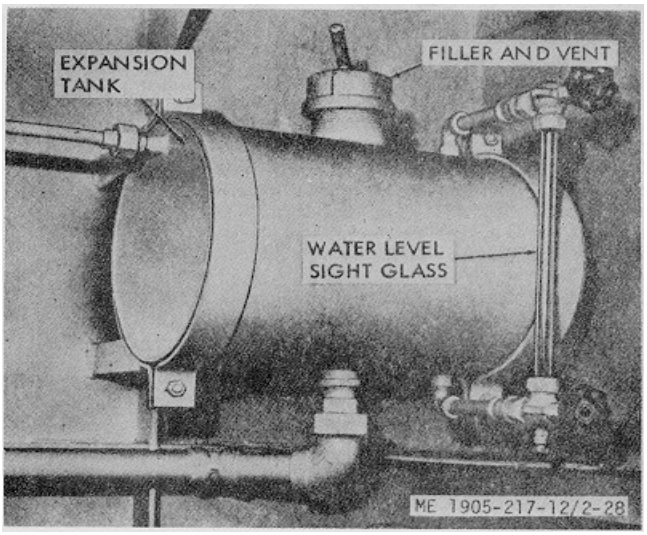


Figure 2-28. Cooing system expansion tank.

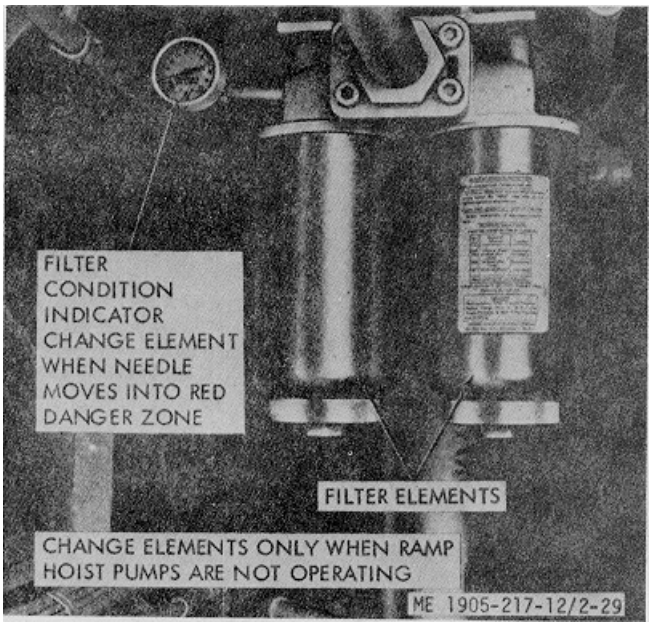


Figure 2-29. Ramp hoist hydraulic system filters.

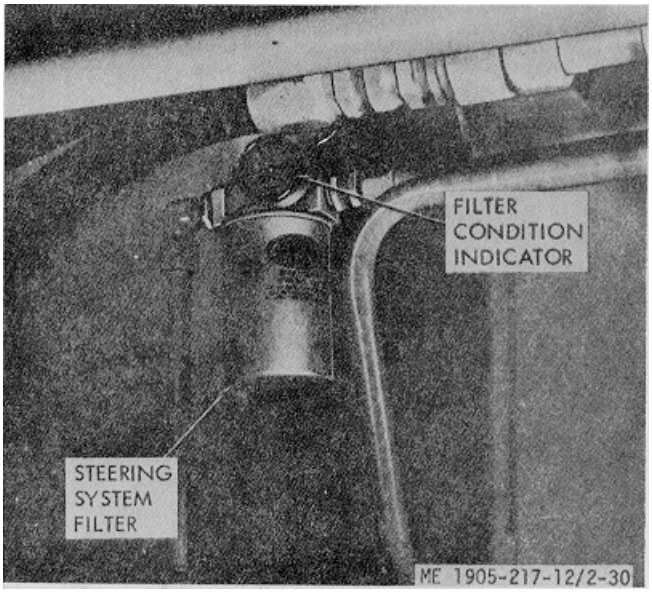


Figure 2-30. Steering system filter.

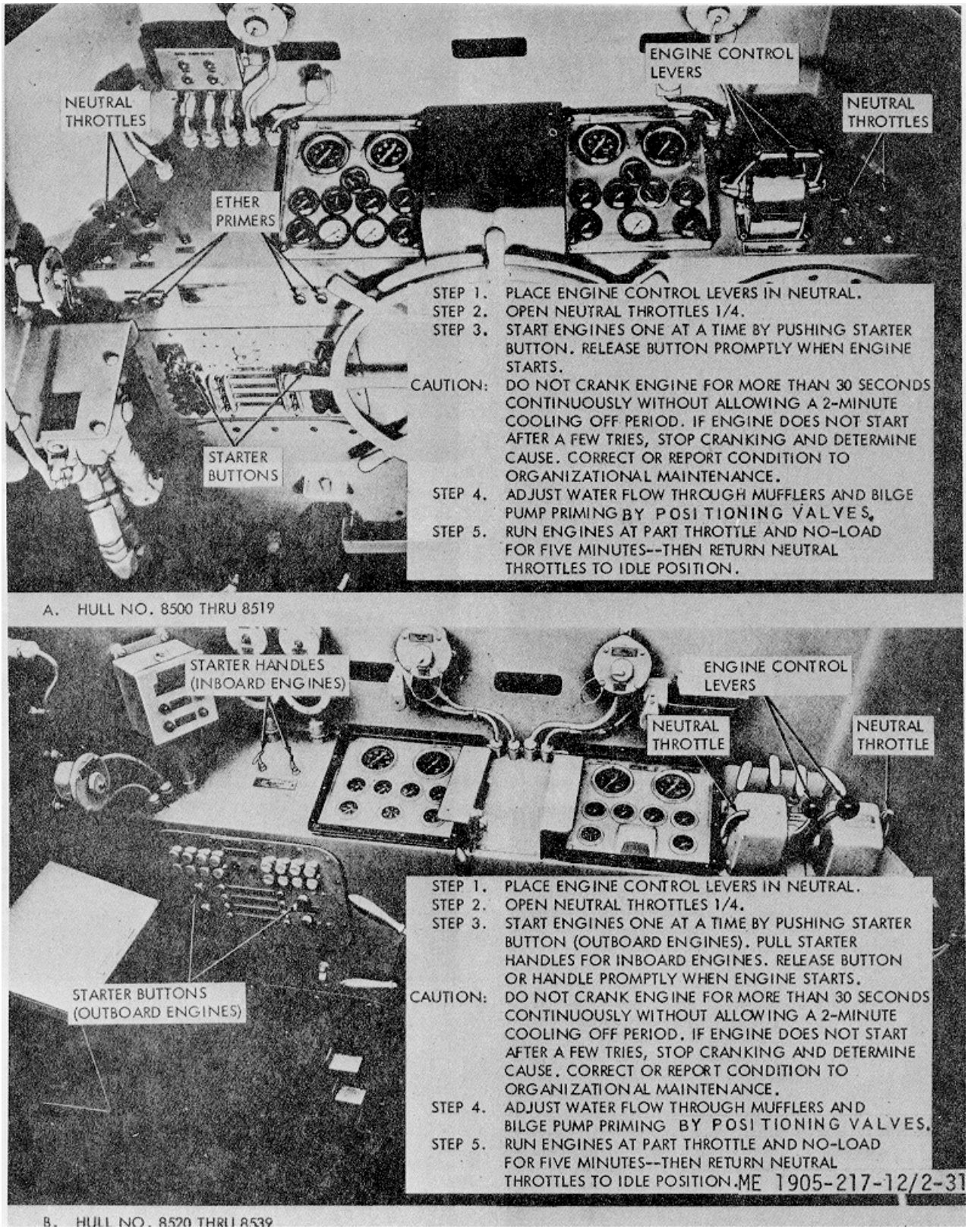
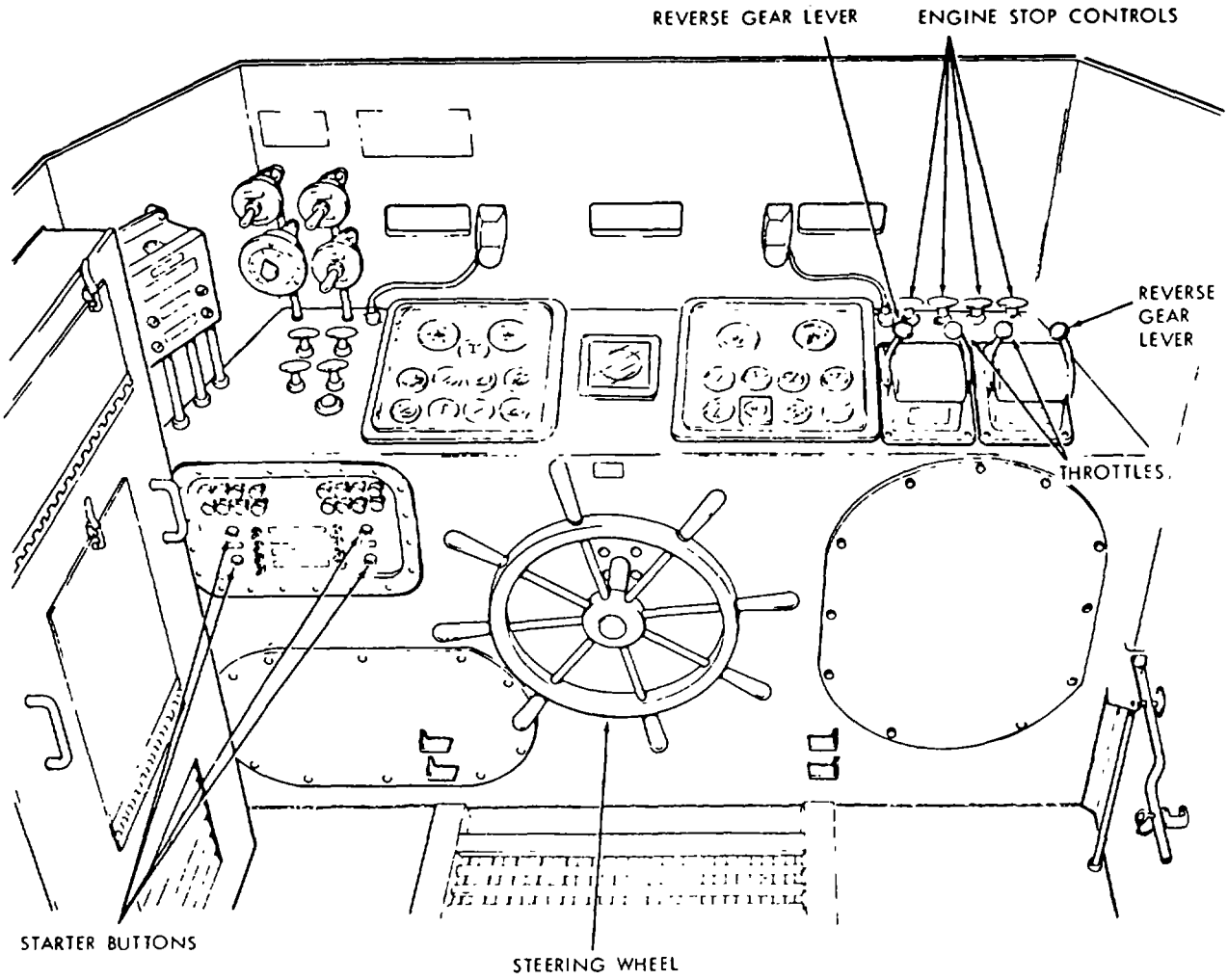


Figure 2-31. Engine starting instructions, hull numbers 8500 thru 8519 and 8520 thru 8539.



STEP 1. PLACE REVERSE GEAR LEVERS IN NEUTRAL.

STEP 2. OPEN THROTTLE CONTROLS APPROXIMATELY 25 PER CENT.

STEP 3. START ENGINES ONE AT A TIME BY PUSHING STARTER BUTTON. RELEASE BUTTON PROMPTLY WHEN ENGINE STARTS.

CAUTION: DO NOT CRANK ENGINE FOR MORE THAN 30 SECONDS CONTINUOUSLY WITHOUT ALLOWING A 2-MINUTE COOLING OFF PERIOD. IF ENGINE DOES NOT START AFTER A FEW TRIES, STOP CRANKING AND DETERMINE THE CAUSE. CORRECT OR REPORT CONDITION TO ORGANIZATIONAL MAINTENANCE.

STEP 4. ADJUST WATER FLOW THROUGH MUFFLERS AND BILGE PUMP PRIMING BY POSITIONING VALVES,

STEP 5. RUN ENGINES AT PART THROTTLE AND NO-LOAD FOR 5 MINUTES--THEN RETURN THROTTLES TO IDLE POSITION.

ME 1905-217-12/2-32

Figure 2-32. Engine starting instructions, hull numbers 8540 thru 8560 and 8580 thru 8618.

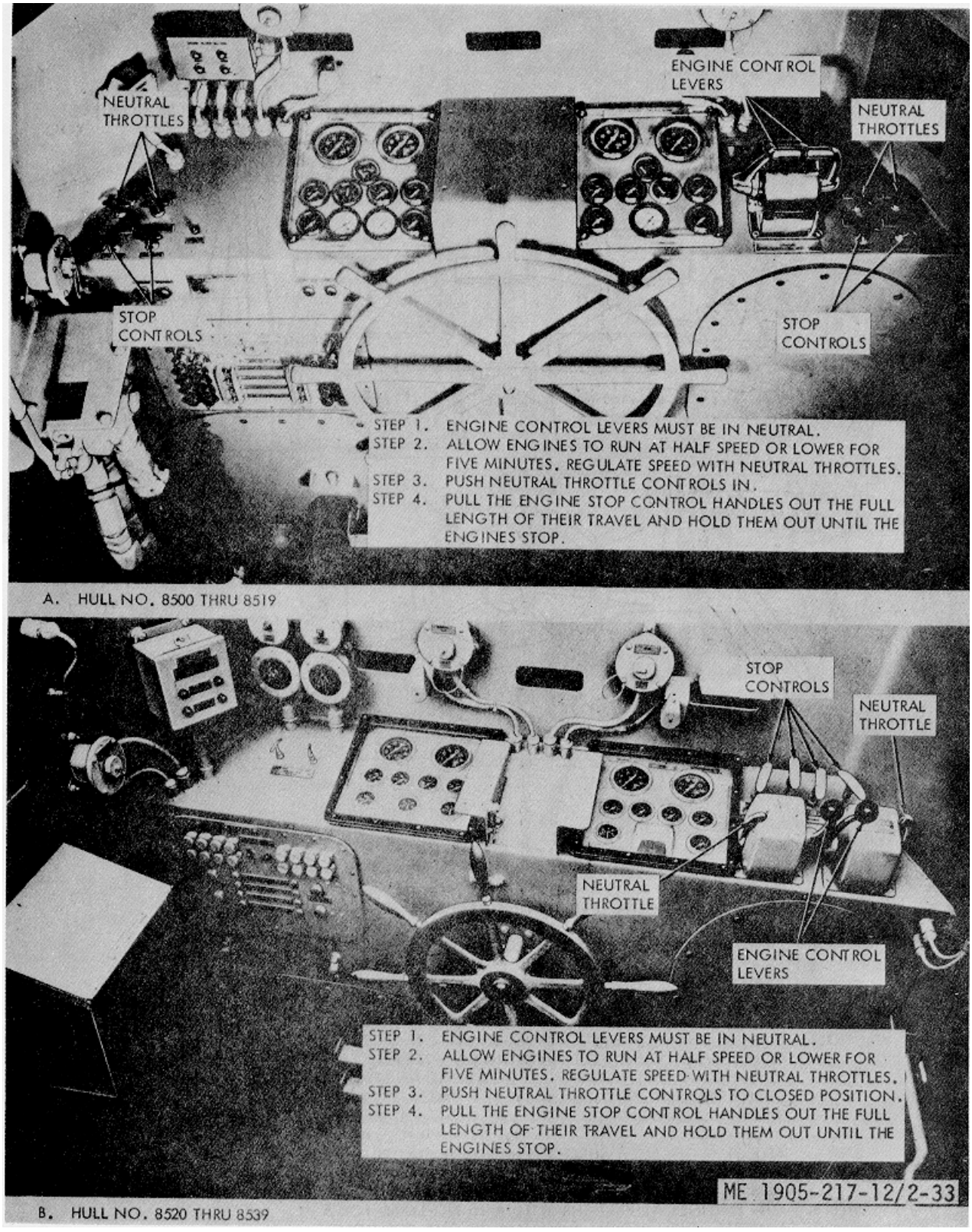
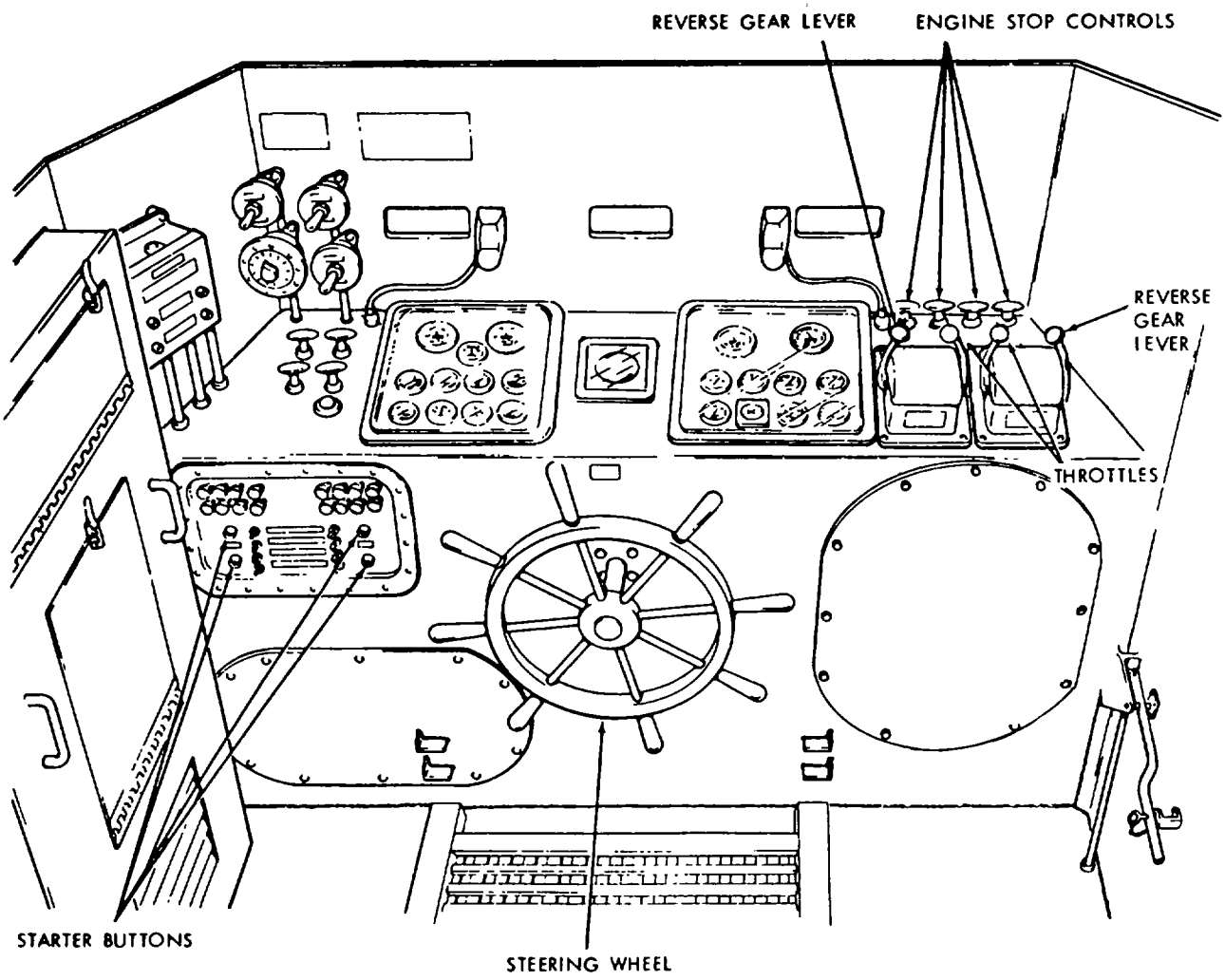


Figure 2-33. Engine stopping instructions, hull numbers 8500 thru 8519 and 8520 thru 8539.



STEP 1. ENGINE REVERSE GEAR LEVERS MUST BE IN NEUTRAL POSITION.

STEP 2. ALLOW ENGINES TO RUN AT HALF SPEED OR LOWER FOR 5 MINUTES. REGULATE SPEED WITH THROTTLE CONTROLS.

STEP 3. PULL THROTTLE CONTROLS TO CLOSED POSITION.

STEP 4. PULL THE ENGINE STOP CONTROL HANDLES OUT THE FULL LENGTH OF THEIR TRAVEL AND HOLD THEM OUT UNTIL THE ENGINES STOP. PUSH STOP CONTROL HANDLES IN AFTER ENGINES STOP.

ME 1905-217-12/2-34

Figure 2-34. Engine stopping instructions, hull numbers 8540 thru 8580 thru 8618.

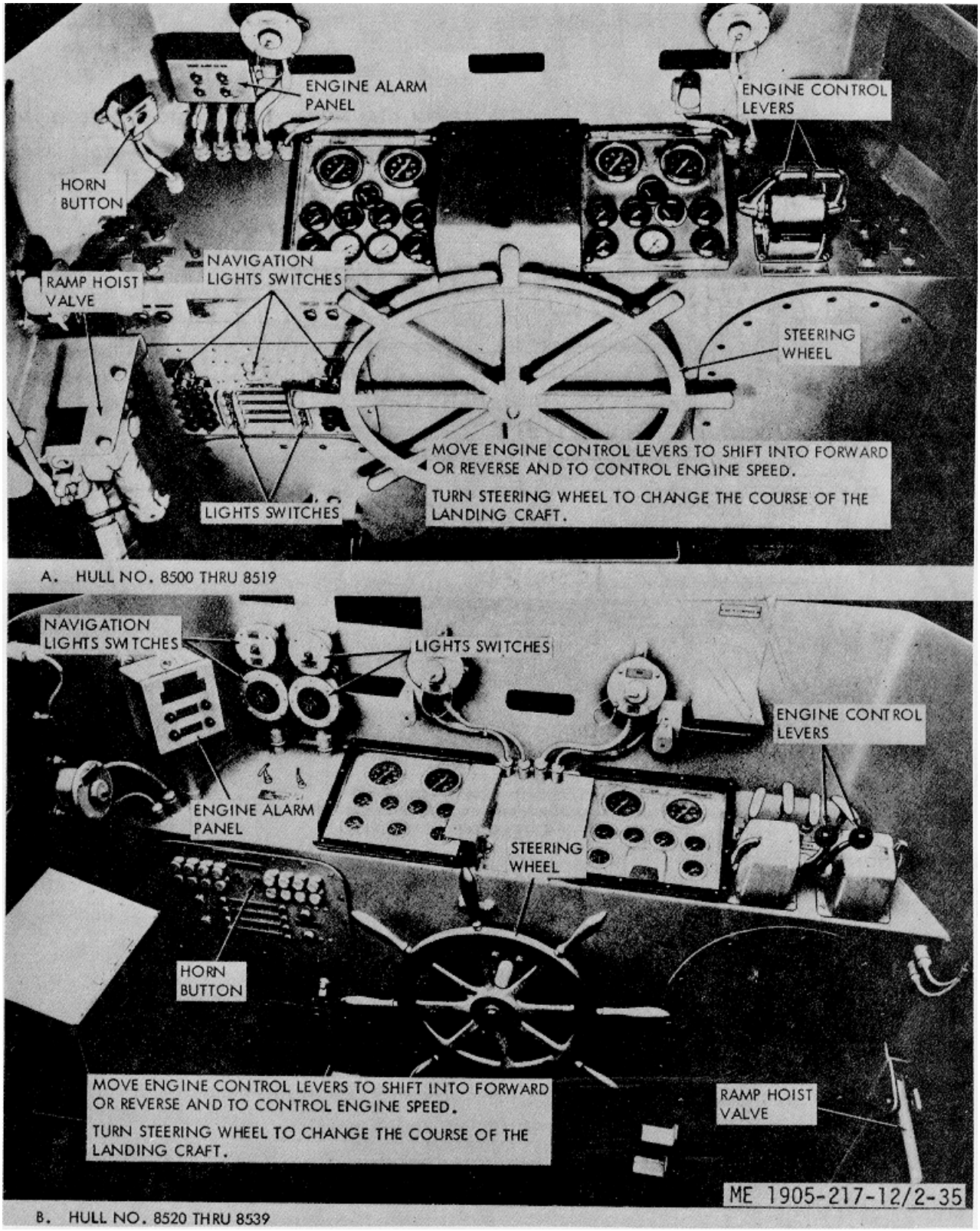
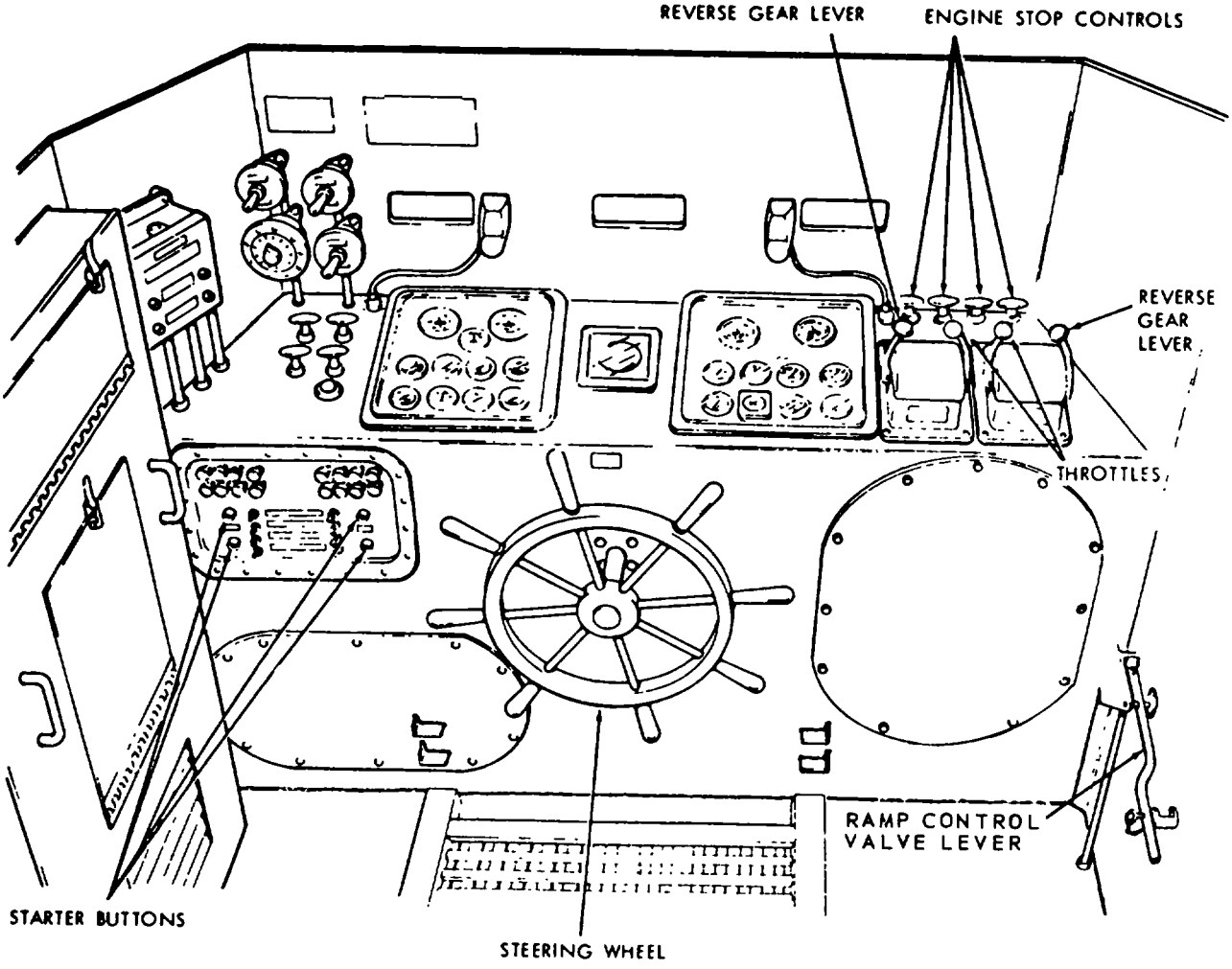


Figure 2-35. Landing craft operational procedures, hull numbers 8500 thru 8519 and 8510 thru 8539.



MOVE ENGINE REVERSE GEAR LEVERS TO SHIFT INTO FORWARD OR REVERSE AND ENGINE THROTTLE CONTROLS TO CONTROL ENGINE SPEED.

TURN STEERING WHEEL TO CHANGE THE COURSE OF THE LANDING CRAFT.

ME 1905-217-12/2-36

Figure 2-36. Landing craft operational procedures, hull numbers 8540 thru 8560 and 8580 thru 8618.

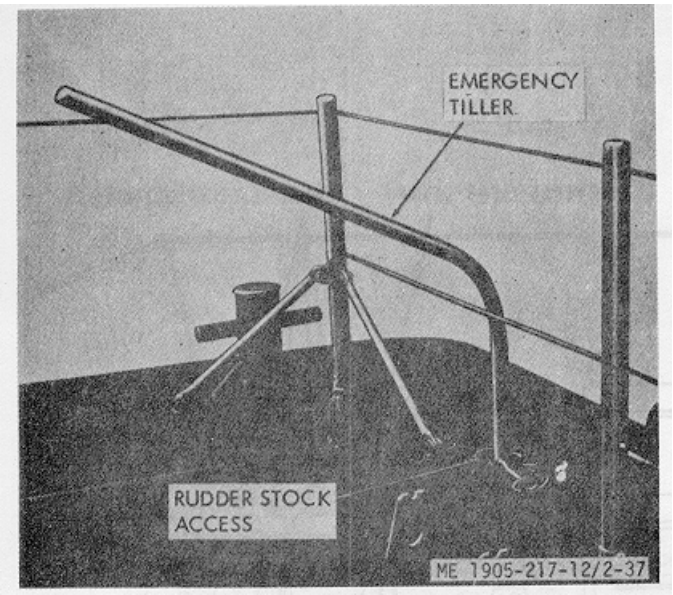


Figure 2-37. Emergency tiller.

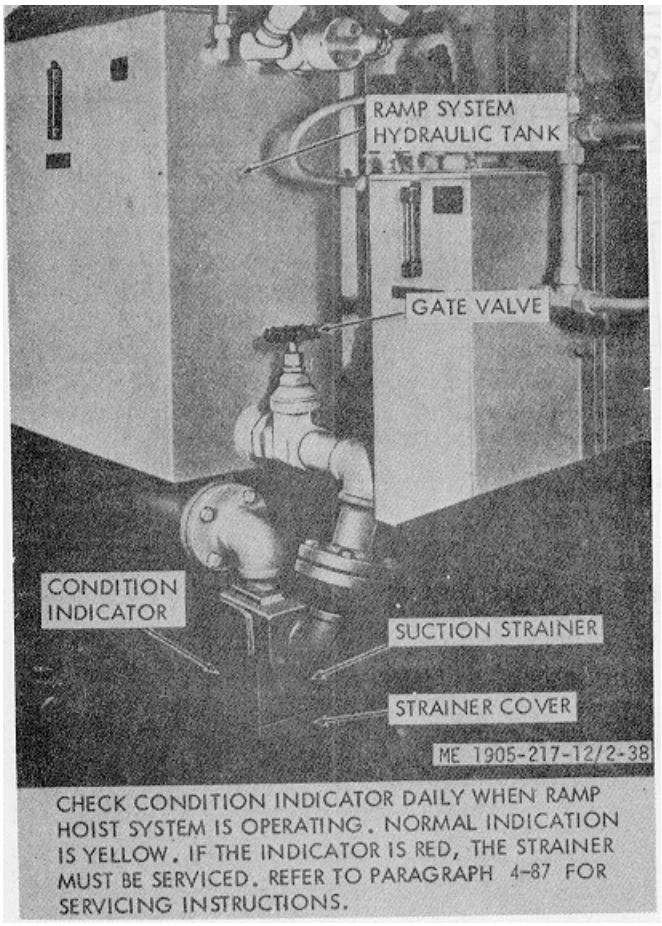


Figure 2-38. Ramp hoist hydraulic system suction strainer, hull numbers 8500 thru 8519.

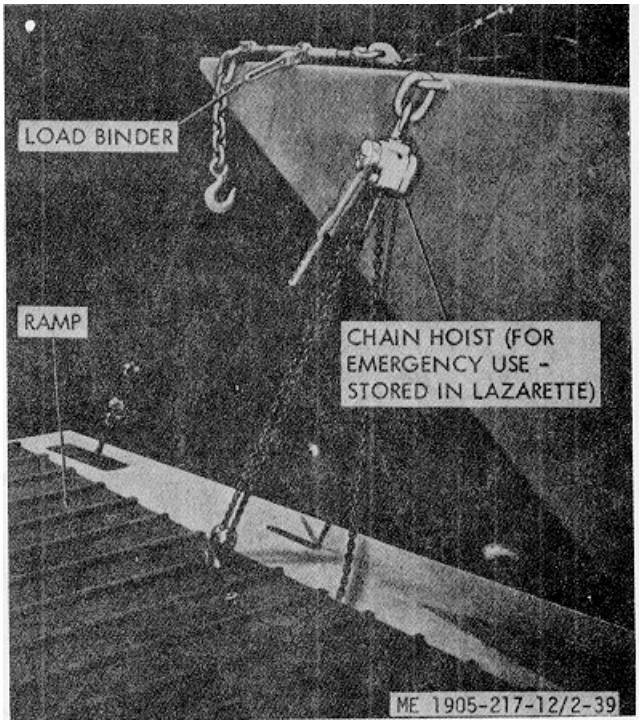


Figure 2-39. Ramp load binders and chain hoist. 2-34

SECTION II. OPERATION OF AUXILIARY EQUIPMENT

2-7. Bilge Pumping System (fig. 1-15.1 and 2-14) a. a.

a. Description. The bilge pumping system includes three bilge pumps which are belt-driven from the inboard engines, a suction manifold with nine lines to the various bilge areas, bilge strainers and check valves, discharge lines, and priming lines from the sea water system to the bilge pumps. Hull numbers 8540 thru 8560 and 8580 thru 8618 incorporate three bilge pumps with friction type clutches to allow manual engagement or disengagement of the pump shaft and impeller assemblies.

b. Operation.

(1) Open the valves in the priming lines.

(2) Open bilge pump overboard discharge valve (fig. 2-15).

(3) Open bilge pump suction valves (figs. 1-15.1 and 2-14) gas needed to pump the bilge compartments.

(4) Open bilge line valves (fig. 1-15.1 and 2-14) as necessary to pump out the various bilge compartments.

(5) On hull numbers 8540 thru 8560 and 8580 thru 8618, engage clutch on applicable bilge pumps (fig. 1-15).

2-8. Fire Extinguishers

There are four CO. fire extinguishers aboard the vessel. On hull numbers 8500 thru 8539, one is in the pilot house, one in the engine compartment, and two in the cargo well. On hull numbers 8540 thru 8560 and 8580 thru 8618, there is one in the pilot house, two in the engine room, and one in the lazarette.

a. Operating Squeeze Grip CO, Extinguisher.

(1) Carry the extinguisher in an upright position and approach the fire as closely as the heat permits.

(2) Remove the locking pin from the valve.

(3) Grasp the horn handle.

(4) Squeeze the release lever and at the same time direct the carbon dioxide flow toward the base of the fire.

(5) Fight the fire from the windward side so the wind will blow the heat away from the operator and at the same time direct the carbon dioxide over the fire.

(6) In fighting fire in electrical equipment, or on a bulkhead, direct the discharge at the bottom of the flaming area. Move the horn slowly from side-to-side and follow the receding flames upward.

(7) Release the lever to close the valve as soon as conditions permit and continue to open and close the valve as necessary.

NOTE

The valve can be opened and closed repeatedly without loss from leakage.

(8) When continuous operation is desired, the D-yoke ring on the carrying handle may be slipped over the operating handle when the handle is depressed.

b. Operating Disk-Type Valve CO_2 Extinguishers.

(1) Follow the instructions in a (1) and (3) above.

(2) Open the valve by turning the valve wheel to the left; this starts the discharge of the carbon dioxide on the fire.

(3) Follow procedures in (4), (5), and (6) above.

(4) Close the valve as soon as conditions permit and continue to open and close the valve as necessary.

NOTE

On the disk-type valve extinguisher, the discharge of gas may be temporarily halted by turning the valve wheel clockwise. Do not atop the discharge too soon. When the flame has been extinguished, coat the entire surface involved in the fire with carbon dioxide snow. The coating will check incandescence and prevent reflash.

2-9. Communication Equipment

Operating instructions for the communication equipment may be found in the technical manual covering the specific component. These manuals are listed in Appendix A. The AN/GRC-106 or AN/SRC--32 and AN/VRC-47 may be installed in the LCM-8 landing craft.

2-10. Navigation Equipment

a. Description. The Remote Magnetic Heading System (RMHS) includes an induction compass transmitter, located on the mast support, that senses the landing craft's heading relative to magnetic North; and a heading indicator, located in the pilot house, that indicates the landing craft's heading as determined -by the induction compass transmitter.

b. Operation. To engage the RMHS, set RMHS COMPASS RECP switch (switch No. 6 on distribution panel) on.

2-11. Cold Weather Operation

a. Starting Aid Pressurized Cylinder (fig. 2-40).

(1) All craft use the same type starting aid. On hull numbers 8500 thru 8519 the starting aid can be actuated from the pilot house or in the engine room. On hull numbers 8520 thru 8560 and 8580 thru 8618 the starting aid cylinders are clamped to overhead brackets in the engine room. They must be removed from the bracket and individually applied to prime each engine.

(2) Use the starting aid as follows:

(a) Pull out knob for one-or two-seconds (below zero hold 3 seconds).

*(b***)** Wait 3 seconds and then push starter button.

WARNING

Do not actuate the starting aid more than once with the engine stopped.

OVER-LOADING THE ENGINE AIR BOX WITH THIS HIGH VOLATILE FLUID COULD RESULT IN A MINOR EXPLOSION.

CAUTION

Do not crank the engine more than 30 seconds at a time when using an electric starting motor. Always allow two minute intervals between cranking attempts to allow the starting motor to cool.

b. Engines.

(1) *General*. Keep engine compartment as warm as possible without shutting off ventilation completely.

(2) *Batteries*.

(a) Keep batteries fully charged to prevent freezing.

(b) Check specific gravity and adjust to suit particular conditions (TM 9-6140-200-15).

(c) Check batteries for correct terminal voltage. It may be necessary to add an additional battery to start the engine. Disconnect additional battery, if used, as soon as engine has started.

(3) *Cooling system*. Add antifreeze to engine fresh water cooling system to prevent freezing (para 4-2).

(4) *Lubricating oil system*. Refer to L0551905-217-12/3 for instructions concerning lubrication of engines during operation in cold weather.

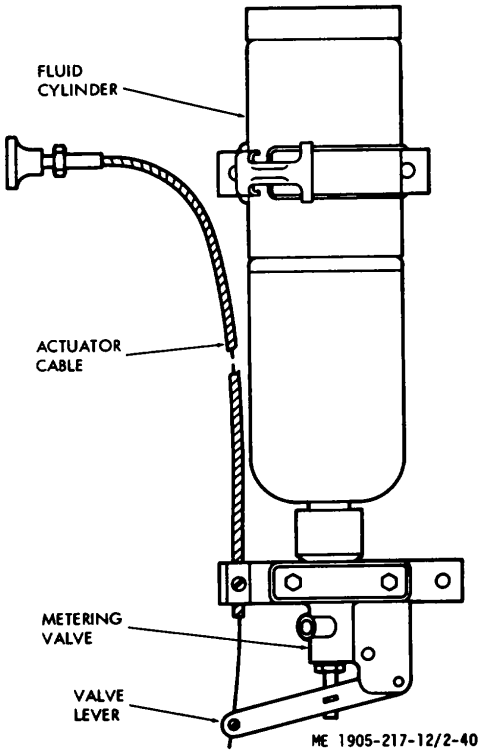


Figure 2-40. Starting aid.

WARNING

Never use a blow torch or other similar means for heating fuel or lubricating oil lines.

c. Steering System. Test steering system thoroughly by moving steering wheel from left to right. Turn steering wheel slowly at first to loosen any ice that may have formed between the hull and rudders at waterline.

d. Hull and Fittings.

(1) Keep caps installed on all hose connections, except when filling.

(2) Remove ice from ladders and passage ways on main deck.

e. Navigating Lights and Horn. Ice may form on any of these units and prevent proper operation. Carefully remove ice from unit.

2-12. Hot Weather Operation

WARNING

Fuel oil and other similar materials are highly volatile in hot weather and these vapors increase the possibility of an explosion. Be sure all spilled petroleum products are wiped up. Inspect for leaks in fuel lines and fittings. Pump bilges regularly.

a. General. Keep engine compartment as cool as possible by use of ventilation fans.

b. Batteries.

(1) Check electrolyte level often and fill as necessary.

(2) Keep terminals free of corrosion.

(3) Reduce specific gravity (TM 9-6140200-14).

c. Cooling System. Check water temperature gage often. Temperature should not rise above 185°F. If this temperature is exceeded, check for the following:

(1) Insufficient supply of fresh water in the Keel cooling system. If so, fill expansion tank and check for leakage.

(2) Engine coolant thermostat faulty.

Remove and inspect; replace if found faulty.

(3) Sea water (raw water) inlet clogged at sea chest. Blow out sea chest with compressed air.

(4) Engine fresh water jump faulty. Remove and inspect; replace if found faulty.

(5) Scale or deposits in raw water side of heat exchanger. If present, clean heat exchanger.

d. Lubricating Oil System.

(1) Check lubricating oil pressure gage often. Pressure will drop slightly as water temperature rises.

(2) Refer to L055-1905-217-12/3 for instructions concerning lubrication of engines during operation in hot weather.

2-13. Foul Weather Operation

a. Check to see that all gear and equipment is properly stowed and secured.

b. Should the engines be operated at high speed in rough water the engines will surge when the propellers leave the water, causing excessive vibration. The governor may be overworked under these conditions, and it will be necessary for the protection of the engines and safety of the vessel to reduce the speed of the engines until a safe operating speed is attained as determined by the roughness of the sea.

CHAPTER 3
OPERATOR/CREW MAINTENANCE INSTRUCTIONS

SECTION I. LUBRICATION INSTRUCTIONS

3-1. General Lubrication Information

a. This section contains lubrication instructions which are supplemental to, and not specifically covered in, the lubrication orders.

b. For lubrication orders, refer to LO55-1905-217-12/1-8.

3-2. Detailed Lubrication Information

a. General. Keep all lubricants in closed containers and store in a clean, dry place away from external heat. Allow no dust, dirt, or other foreign material to mix with the lubricants. Keep all lubrication equipment clean and ready to use.

b. Cleaning. Keep all external parts not requiring lubrication clean of lubricants. Before lubricating the equipment, wipe all lubrication points free of dirt and grease. Clean all lubrication points after lubricating to prevent accumulation of foreign matter.

c. Points of Lubrication. Service the lubrication points at proper intervals as illustrated in current lubrication orders.

d. OES Oil.

(1) The crankcase oil level must be checked frequently, as oil consumption may increase.

(2) The oil may require changing more frequently than usual because contamination by di lution and sludge formation will increase is under cold weather operation conditions

(3) Use special hand pump 6164884 to pump oil out of the crankcase.

e. Engine Oil Filter Maintenance (fig 3-1 or 3-2).

(1) This is a full-flow filter with a replaceable element. A bypass valve is located in the base to insure engine lubrication if the filter is plugged.

(2) Change the element every time the engine oil is changed (every 100 hours).

f. Transmission Oil Strainer (fig 3-3 or 3-4)

(1) The oil strainer is mounted in the suction line near the transmission oil pump. The strainer contains a cleanable element.

(2) Each time the transmission oil is changed (250 hours), remove the strainer from the suction line and remove the element.

(3) Wash the inside and outside of the element in clean fuel oil and blow dry with compressed air.

CAUTION

Do not use a wire brush or scrape the screen when cleaning, thus avoiding the possibility of damaging the wire mesh.

(4) Assemble strainer and install in suction line. Tighten the three bolts to 1317 ft-lb. torque.

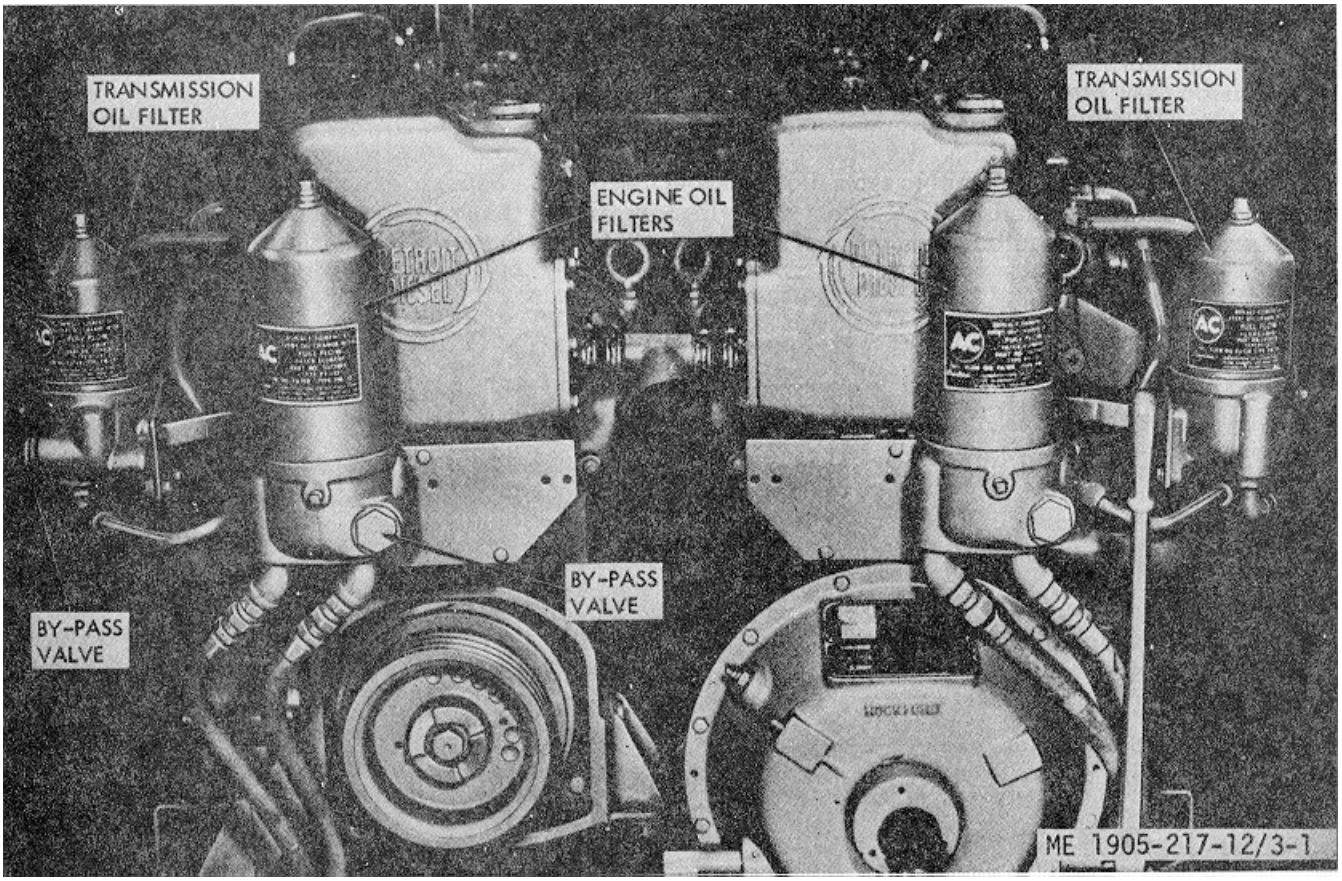


Figure 3-1. Engine and transmission oil filters.

CLEANING INSTRUCTIONS:

STEP 1. DRAIN OIL FROM FILTER DRAIN (IN ADAPTER).

STEP 2. REMOVE CENTER BOLT AND FILTER SHELL.

STEP 3. REMOVE FILTER ELEMENT AND DISCARD.

STEP 4. CLEAN FILTER SHELL IN CLEAN FUEL OIL -- DRY WITH AIR.

STEP 5. REMOVE GASKET AND DISCARD.

STEP 6. CLEAN OLD OIL FROM ADAPTER.

STEP 7. INSTALL NEW GASKET IN THE ADAPTER.

STEP 8. INSTALL NEW ELEMENT ON CENTER STUD IN SHELL.

STEP 9. PLACE SHELL, STUD AND ELEMENT AGAINST THE ADAPTER AND TIGHTEN THE CENTER STUD.

STEP 10. INSTALL OIL DRAIN PLUG.

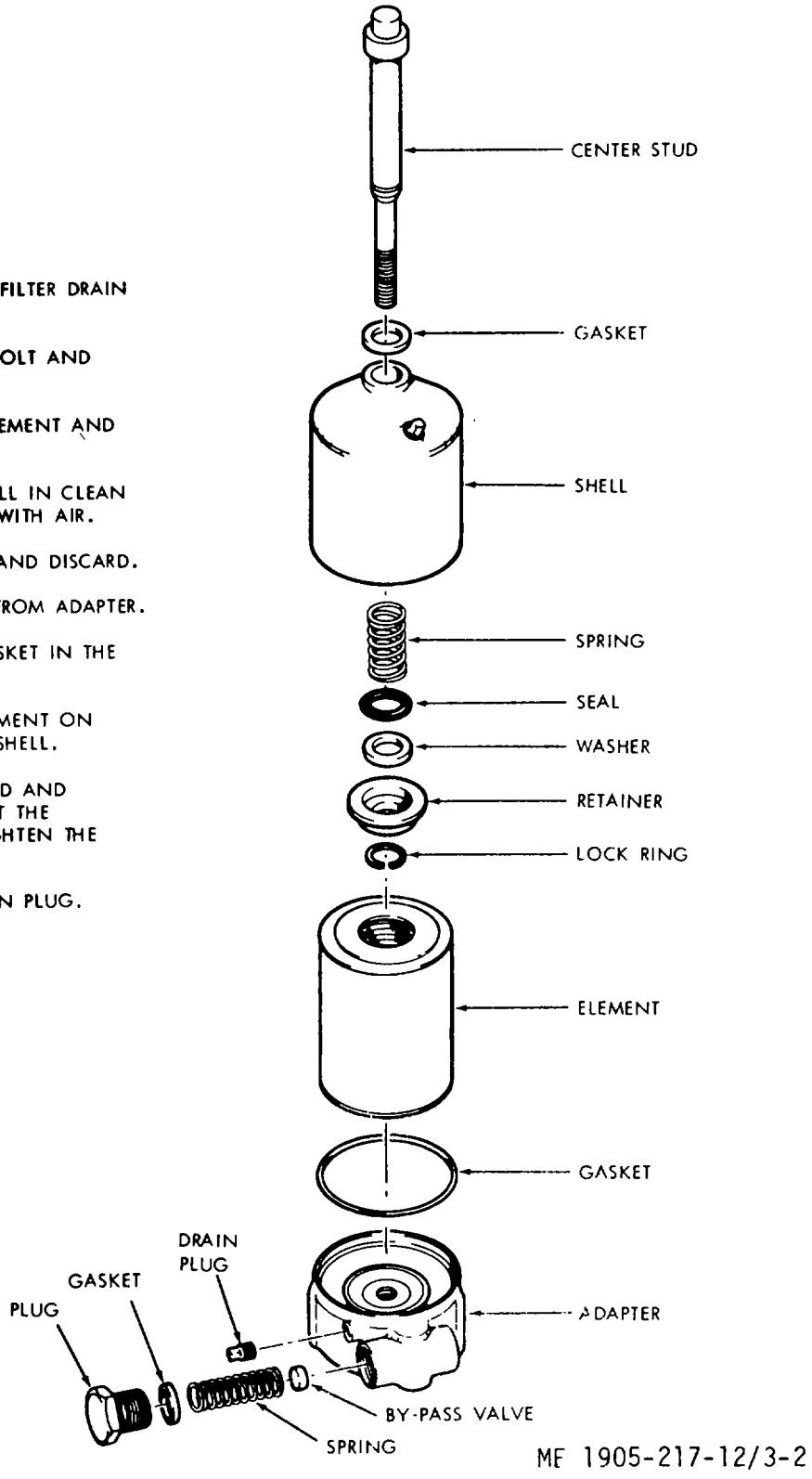


Figure 3-2. Engine and transmission oil filter servicing.

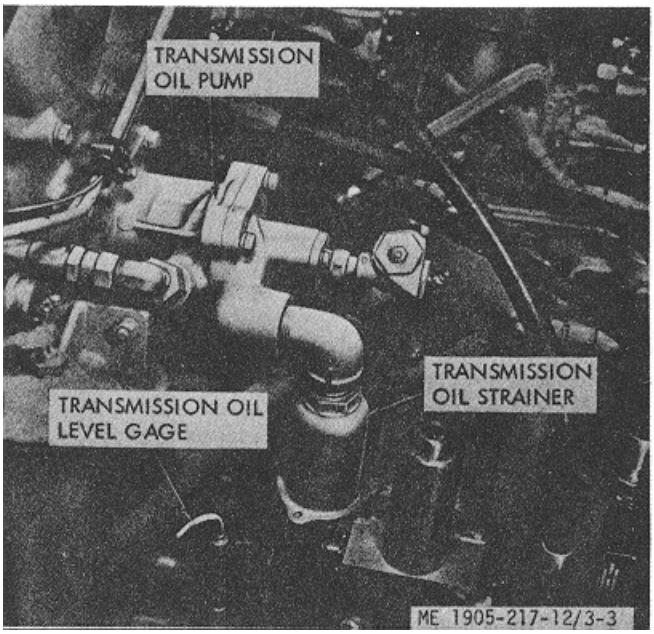
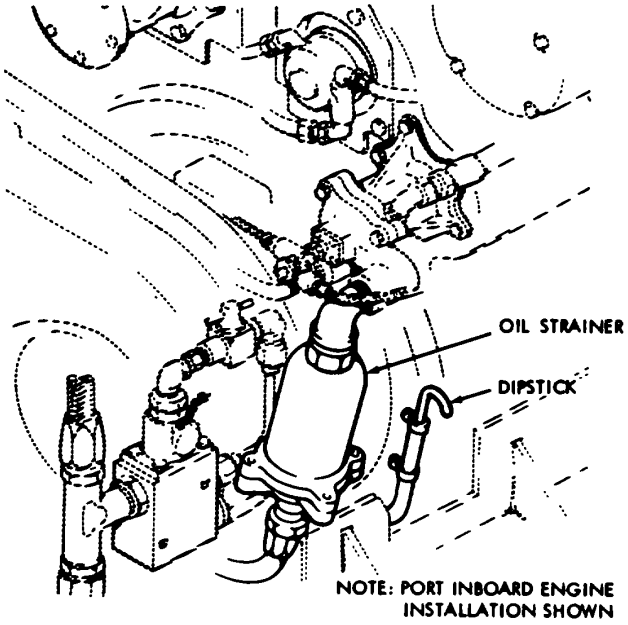
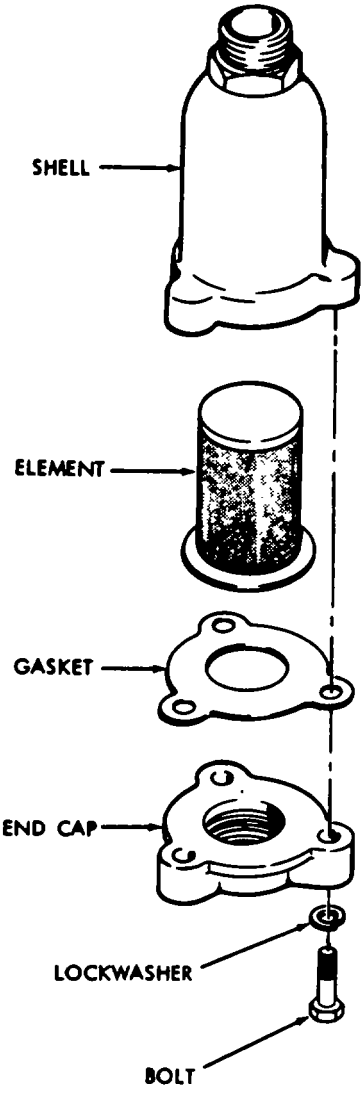


Figure 3-3. Transmission oil strainer, hull numbers 8540 thru 8560 and 8580 thru 8618.





STEP 1. REMOVE THE END CAP BOLTS (3) AND WITH DRAW THE STRAINER ELEMENT.

CAUTION: DO NOT USE A WIRE BRUSH OR METAL SCRAPER WHEN CLEAN NG THE STRAINER. DAMAGE TO THE WIRE MESH CAN RESULT.

STEP 2. WASH THE INSIDE AND OUTSIDE OF THE STRAINER ELEMENT IN CLEAN FUEL OIL AND DRY WITH AIR OR LINT FREE CLOTH.

STEP 3. ASSEMBLE THE STRAINER AND TIGHTEN THE END CAP ATTACHMENT BOLTS. (TORQUE TO 15+ 2 FT. LBS.)

ME 1905-217-12/3-4

Figure 3-4. Transmission oil strainer servicing.

SECTION **II. PREVENTIVE MAINTENANCE**

CHECKS AND SERVICES

3-3. General

Preventive maintenance is the systematic care, servicing and inspection of equipment. The purpose of P.M. is to keep the equipment in serviceable condition, and to prevent, find and repair conditions that could render the equipment unserviceable. The vessel crew is responsible for operator/organizational maintenance. The engineering/deck personnel engaged in preventive maintenance checks and services should correct any deficiencies noted at the time of the check/inspection. Deficiencies noted that are above the crew level of maintenance will be reported to DS/GS level utilizing DA Form 2407 (Maintenance Request) in accordance with TM 38-750.

3-4. Procedures for Preventive Maintenance Checks and Services.

The personnel performing the PMCS will utilize DA Form 2404 (Equipment Inspection and Maintenance Work Sheet). The form will be annotated in accordance with paragraph 3-4, figures 3-4 and 3-5, TM 38-750. The DA Form 2404, used for recording the PMCS, will be furnished to the appropriate supervisor for action. When all corrected faults have been recorded on DA Form 55-40 (Deck Department LOG), DA Form 55-44 (Engine Depart LOG) and all uncorrected faults have been transcribed on to DA Form 2407 (Maintenance Request), the DA Form 2404 can be discarded unless it is required for historical data.

3-4.1 PMCS Schedule.

PMCS will be accomplished as outlined in the enclosed table. To ensure that the vessel is serviced and ready for operation at all times, it will be serviced in accordance with the intervals outlined in the PMCS Table.

a. Before Operation. The required preventive maintenance services will be performed before operating. Any deficiencies noted will be corrected prior to operating the equipment.

b. During Operation. The during operation services is a check on the vessels performance. If any deficiencies are evidenced that will result in damage to the equipment, operation of said equipment will be halted.

c. After Operation. After operation services are the basic daily preventive maintenance services.

These services will be performed at intervals based on the normal operation of the equipment.

When abnormal conditions exist, the services will be performed at intervals to allow for them.

d. Monthly Operation. The required monthly services will be performed to ensure vessels stay ready for continued operation.

e. Quarterly and Biannually Operation. These services are accomplished on a scheduled basis, and definite tasks are accomplished, i.e., draining and filling equipment with oil, changing or cleaning the oil strainers and filters, fuel filters and air filters, accomplishing minor and some major adjustments, motor brush checks, etc., to ensure continued operation of vessel equipment.

Table 3-1. Operator/Crew Preventive Maintenance Checks and Services
Landing Craft Mechanized Mod 0 and Mod 1

ITEM	INTERVAL						Item to be inspected	Procedure	Equipment will be reported not ready (red) if:
	B	D	A	M	Q	B/A			
1							External Hull (above waterline)	Inspect for structural damage	Watertight integrity or operational capability is impaired.
2							External Hull (below the waterline)	Crew inspect accessible hull areas from within the hull for damaged/deteriorated to flooding If crew inspection reveals hull damage/flooding, divers will inspect underwater hull to confirm damage.	Under water hull is extent that water tight integrity is compromised.

Table 3-1 Operator/Crew Preventive Maintenance Checks and Services-Continued
Landing Craft Mechanized Mod 0 and Mod 1

ITEM	INTERVAL B	D	A	M	Q	B/A	Item to be inspected	Procedure	Equipment will be reported not ready (red) if:
3		•					Propeller and Propeller shaft	Check for misaligned/bent propeller shaft and worn cutlass bearings; stand on stern of vessel while running free. Should the vibration be above normal propeller and shaft will be inspected by Marine divers.	Shaft is misaligned or bent, propeller blades are bent or damaged or cutlass bearing is excessively worn.
4		•	•	•			Rudders and steer- existing system	Inspect steering rams and linkage for normal and safe operation Check for excessive play/damage to linkage and steering rams Check for air or hydraulic leaks at pumps rams and attaching lines. Check steering system return line filter frequently. Change filter if indicator is in red area.	Rudder is damaged to tent the steering is impaired, to the extent that rudder cannot be turned freely through a 350° port and starboard arc.
5				·			Life lines and	Ensure life lines are in good stanchions place Ensure safety chains are utilized	Life lines are not in repair, and are secured in place/available on board the vessel.
6							Keel coolers temperatures	Marine diver inspect for damage Vessel operating personnel check in expansion tank. Engine for loss of engine coolant, and or abnormal high operating engine denced in coolant.	Coolant is not evidenced temperatures are above normal Saline is evi
7		·					S. W. Strainers	Check strainer for mud, sediment and other foreign materials. Ensure plastic cylinder, and screen are clean and in good repair. Ensure selector handle is functional	Mufflers are leaking exhaust fumes into engine room due to mechanical muffler failure-burned rubber boot.
8							.Anodes	Inspect anodes to see if deteriora- tion exist to the point that they fail to provide adequate mass and surface area. Maximum allowable waste before replacement is fifty percent. Marine diver is required to perform this check.	
9							Sea chest	Ensure sea chest openings are free of marine growth, and other foreign bodies	Openings are restricted to a degree normal operation is hampered 50% or more.

ITEM	INTERVAL B	D	A	M	Q	B/A	Item to be inspected	Procedure	Equipment will be reported not ready (red) if:
	•	•	•				Ramp Assembly`	Ensure ramp will operate through all phases (up and down). Inspect and replace pulleys, bushings and cable if defective. Replace ramp assembly gaskets if defective Replace excess covers if defective Check for cracked welds/visual structural damage. Ensure ramp locking dogs are functional.	Ramp is inoperative ative/defective No oil evidenced in sight glass on reservoir in engine room. System does not respond smoothly to all demands.
11	•						Void covers	Inspect for proper installation, missing/defective fasteners, also check gasket for proper seal.	Void covers missing/are not installed.
12						•	Bitts and chocks	Inspect for damage and cracked base welds.	
13	•	•					Mast and yardar	Inspect for mechanical damage and ensure lights are functional are not properly supported.	If mast is damaged to extent that apportenances
14	•						Engine room and lazaratte hatch covers	Ensure hatches can be secured at night to prevent tampering and damage to craft, pilferage of on board spare/BIIL items. Check bilges for presence of oil or excessive water.	
15	•						Navigational lights	Visually inspect to ensure that all lights operate properly with the switch in the on position. Inspect all lenses for damage and cleanliness. Check vessels horn for proper operation.	Lights are inoperative. Circuits are defective.
16	•						Magnetic Compass	Check heading on two known courses Check deviation whenever metal structural changes are made to vessel; or when electronic equipment is added/removed. Ensure deviation card is up to date and annual deviation is posted. Ensure deviation card is located in immediate vicinity of compass. Remove any bubbles in compass bowl. Refer to TB 55-6605-262-24 and Mfg. manual for additional detailed information.	Magnetic compass is inoperative. Compasswill not swing freely in gimbal.

ITEM	INTERVAL B	D	A	M	Q	B/A	Item to be inspected	Procedure	Equipment will be reported not ready (red) if:
17	*					·	Communication Equipment AN/URC 80 (V) 1 AN/URC 47	Conduct radio check to ensure satisfactory operation, see commercial manual and TM 11-5820-820-15. Ensure TAMMS forms and records are accomplished IAW TM 38-750.	A N / U R C80 and AN/URC92 is inoperative.
18						·	Life Jackets	Life jackets shall be inspected for rips, oil stains, broken straps, fiber deterioration and hull marking of vessel. See AR 56-9 and Reg 22, CG 227.	There is not on board one life jacket for each passenger/crew member.
19							Life Rings	Inspect for damage and proper marking. Ensure marker lights function when casing is turned upside-down.	
20							Instrument:		
							A. Oil pressure gauge	Inspect the gauge to ensure that functions correctly. If the oil pressure gauge does not indicate properly, stop the engine and investigate the cause. 1800 RPM: Normal: 38:60 PSI Minimum 27 PSI.	Gauge does not function, reads inaccurate Oil pressure below 27 PSI.
							B. Ammeter	The ammeter should show a high charging rate for the first few minutes after starting until the generator restores to the battery the current used in starting. After this period the ammeter should register a zero or slight positive charge with lights turned off. Any unusual fall or rise in reading will be investigated.	
							C. Tachometer	See that the tachometer is operating properly and indicating engine revolutions.	
							D. Coolant temperature gauge	Engine temperature should increase gradually during the warm190°F. up period. Should high temperatures exist, caused by a defect in the cooling system the engine should be stopped and the trouble investigated. Normal engine coolant temperature is 160° to 185^{0}F.	Temperature exceeds

Table 3-1. Operator/Crew Preventive Maintenance Checks and Services-Continued
Landing Craft Mechanized Mod 0 and Mod 1

ITEM	INTERVAL B	D	A	M	Q	B/A	Item to be inspected	Procedure	Equipment will be reported not ready (red) if:
								Batteries: Inspect the batteries to see that they are clean, secure and not leaking - check electrolyte level and add distilled water if necessary. Cables and vent caps should be cleaned and properly fastened. If hydrometer test indicates low charge (full charge 1.220), charge batteries immediately.	
22 *					*			Main propulsion engines by accelerating and decelerating through full operating range, ahead and astern. Analyze engine performance and listen for any unusual noise, lack of power, flat spots engine hunting, unusual exhaust smoke, high temperatures and loss or low fuel oil/lubriating oil pressures.	Ensure that engines idle and respond to the controls satisfactory
							A. Engine Coolant	Check level and condition of coolant, ensure coolant is evidenced in expansion tank sight glass (1/3 Full). During winter months when anti-freeze is used, run engine and make hydrometer test and add anti-freeze as necessary. Protect to at least -30^{0}F or as local conditions dictate.	Engine temperature 190^{0}F on F.W. Side.
				.			B. Engine Lubricating Oil	Use SAE 30 HD Oil. Ensure oil is level with top mark on dip stick	Oil level is below low mark on dip stick.
							C. Oil Change Intervals	200 - 500 hrs or sooner if dilution/emulsion exists. Oil testing should be accomplished IAW TB43-0210.	
							D. Lubricating Oil Filters	Change oil filters at every 500 hours or sooner/at `each lubricating oil change. Run engine for five minutes and check for leaks.	
							E. Fuel filters and strainers	Change filters and clean strainer at lubricating oil change intervals.	

Table 3-1. Operator/Crew Preventive Maintenance Checks and Services-Continued
Landing Craft Mechanized Mod 0 and Mod 1

ITEM	INTERVAL W	M	A	Q	B/A	Item to be inspected	Procedure	Equipment will be reported not ready (red) if:
						F. Air box drains	Check air box drain discharge for excessive oil waste. If excessive oil is present, pull covers and investigate cause.	
						G. Fw pump engine	Inspect FW and SW pumps for proper operation and leakage.	Pumps are defective adversely affecting engine and muffler cooling.
						H. Air cleaner Engine	Check intake screen for dirt or other foreign materials. Clean air cleaner every six months or as local conditions dictate. Ensure air emergency shut-down is functional.	
						I. Engine alarm panel	Test to ensure alarm panel lights are operational.	
						J. Hydraulic starting system	Inspect lines, valves, pump and filters for leakage. Change filter every 2000 hours of operation. Check operating pressure 3000 - 3200 PSI.	
23						Marine gear transmission	The marine gear oil level should be checked with the engine running (idling). The oil level should be even with the high mark on the dip stick.	Oil level is below low mark on dip stick/transmission fails to turn screw.
						A. Marine gear	1800 RPM: 180 PSI. See TM for operating pressure:	additional detailed information.
						B. Oil change intervals	Oil should be changed every 1000 operating hours or sooner if dilution or emulsion exist.	
24						Propeller Shaft stuffing box	Inspect shaft packing gland for excess leakage. Adjust gland with unit running. Check gland for excess heat by placing hand on gland after adjustment. Ensure slot mounting plates are installed. Check flex hose for proper installation and deterioration.	Engine room is taking on water from stuffing tube area.

ITEM	INTERVAL B	D	A	Q	B/A	Item to be inspected	Procedure	Equipment will be reported not ready (red) if:
25						Bilge Pumps	Check to ensure clutch engages. On pumps not equipped with clutches, ensure pumps can maintain a suction by checking overboard discharge.	Clutch will not engage; pumps fail to maintain a suction.
26						Alternator & Voltage Regulators	Check alternators for arcing and excess play for looseness. Ensure belts are in good repair and tension is correct. Check ammeter to ensure regulators are functioning correctly.	
27						Fuel Tank	Check fuel level in fuel tank with sounding rod/tape.	Fuel tank leaks.
28						Fire Extinguishers	Inspect for corroded nozzles/ damaged hoses. Ensure seal is intact. Check weight of cylinder monthly. Replace if discharged or under prescribed weight.	
29						Battle Lantern	Ensure lantern works and batteries are in good repair.	
30						Anchor Light	Ensure cable, plug, lense and jack staff are in good repair and functional.	
31						Tools and Repair Parts	Ensure tools are accounted for on DA Form 2062 and marked IAW para 1.8J AR 735-5. Ensure running spares are protected from the elements (S. W. laying in bilges sitting on fuel tank, etc.).	

Table 3-2. Deleted.

SECTION III. TROUBLESHOOTING

3-5. General

a. This section contains troubleshooting information for locating and correcting most of the operating troubles which may develop. Each malfunction for an individual component, unit, or system is followed by a list of tests or inspections which will help you to determine the probable causes and corrective actions to take. You should perform the tests/inspections and corrective actions in the order listed.

b. This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, report to higher authority.

3-6. Troubleshooting

Refer to Table 34. This table provides troubleshooting instructions at the operator/crew maintenance level.

NOTE

Before you use this table, be sure you have performed all applicable operating check

Table 3-3. Troubleshooting-Operator/Crew

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE
1. ENGINE HARD TO START.
Step 1. Check the battery charge.
If charge is low, start inboard engine with hydraulic starter and start outboard engine by engaging clutches. Check ammeters for charge rate. Tighten any loose connections
Step 2 Check for loose connections or defective starting motor switch.
Tighten connection. Replace switch if necessary.
Step 3.Check lubricating oil used
Use proper oil as specified in lubrication order.
Step 4. Check for low fuel supply.
Refill fuel tank if empty or low.
Step 5. Check for loose connection or cracked lines between fuel pump and tonir
Tighten connection or replace lines
Step 6. Check that the Injector racks are in FULL FUEL position.
Inspect for binding governor to injector linkage that will prevent the governor from positioning the injector racks into the FULL FUEL position. Remove any bind found.
2. LACK OF POWER
Check for insufficient fuel
Recheck steps 5 and 6 (1) above.
3. DETONATION.
Check if oil is picked up by air stream.
(1) Clean the air box and drain tubes to prevent accumulations that may be picked up by the air stream and enter the engine's cylinders.
(2) Inspect the blower oil seals by removing the air inlet housing and watching through the blower inlet for oil radiating away from the blower rotor shaft oil seals while the engine is running. If oil is passing through the seals, report to higher authority.
4. HIGH LUBRICATING OIL CONSUMPTION.
Step 1. Check for leaking oil lines or connections
Tighten as necessary. Report the defective parts to higher authority.
Step 2. Check for gasket or oil seal leak
Report defective gaskets or oil seals to higher authority.
5. LOW OIL PRESSURE.
Step 1. Check oil level In crankcase.
Add oil to proper level.
Step 2. Check viscosity of lubricating oil In crankcase.
Refer to lubrication order.
TORQMATIC MARINE GEAR
1. DRIVE SHAFT DOES NOT ROTATE.
Step 1. Check oil pressure
Fill to the FULL mark on the level gage
PROPELLER, PROPELLER SHAFT, AND STUFFING BOX.
1. EXCESSIVE LEAKAGE FROM STUFFING BOX.
Step 1. Check for loose or worn packing.
Adjust or replace packing (para 3-19).
2. EXCESSIVELY HOT STUFFING BOX.
Step ,1. Check if packing gland is too tight.
Adjust packing (para 3-19).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

9. EXCESSIVE VIBRATION IN PROPELLER SHAFT.
   Step 1. Check for bent or broken propeller.
   Replace propeller (para 3-20).

ALTERNATOR

1. ALTERNATOR FAILS TO CHARGE.
   Step 1. Check alternator belt is loose.
   Adjust alternator belt (para 3-11).
   Step 2. Inspect charging circuits and battery connections.
   Tighten connection to make good contact.
2. LOW UNSTEADY OR EXCESSIVE CHARGING RATE.
   Step 1. Check alternator and regulator connections.
   Tighten as required.
   Step 2. Check if alternator belt is too loose.
   Adjust belt to 1/2-inch slack (para 3-1l).
3. NOISY ALTERNATORI
   Step 1. Check for defective or worn bet.
   Replace belt.
   Step 2. Check misaligned belt or pulley.
   Correct alignment.
   Step 3. Check for loose pulley.
   Tighten pulley.

ELECTRIC STARTING SYSTEM

1. STARTER WILL NOT CRANK ENGINE.
   Step 1. Test batteries.
   Recharge batteries

HYDRAULIC STARTING SYSTEM

1. ENGINE DRIVEN PUMP FAILS TO RAISE PRESSURE.
   Step 1. Check fluid level.
   Add oil if necessary.
2. CRANKING SPEED TOO LOW.
   Step ,1. Check system fluid too heavy.
   Use fluid as specified.
   Step 2. Check engine crankcase oil is too heavy.
   Replace oil with proper viscosity grade. Refer to lubrication order.
3. HAND PUMP FAILS TO CHARGE SYSTEM.
   Step ,1. Check manual relief valve if open.
   Close relief valve
   Step 2. Check fluid level.
   Add oil if necessary.

STEERING SYSTEM

1. STEERING WHEEL DIFFICULT TO TURN.
   Step ’1. Check if both ball valves at pump discharge are open (Hulle 8500 thru 8519).
   Close one ball valve.
2. STEERING IS SLOW.
   Step ,1. Inspect ball valve (Hull No. 8500 thru 8519) at pump discharge.
   One valve must be closed, the other open.
3. WHEEL WILL NOT TURN.
   Step 1. Check rudders if Jammed or fouled.
   Remove physical obstruction.
   Step 2. Check one or more ball valves at cylinders are closed.
   Open ball valves at cylinders (in Lazarette).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

4. OIL TOO HOT.
   Step 1. Check pump discharge valves are set properly. (Hulls 8500 thru 8519).
   One discharge valve should be open and the other dosed.

RAMP HOIST HYDRAULIC SYSTEIM

1. CONTROL VALVE LEVER MOVES BUT WINCH DOES NOT TURN WHEN CABLE IS FREE TO MOVE.
   Step 1. Check power takeoff (PTO) is engaged at pumps.
   Engage PTO.
   Step 2. Check ball valve is open
   Close ball valve
2. RAMP CONTINUES TO LOWER WITH CONTROL VALVE IN NEUTRAL.
   Step 1. Check ball valve is open.
   Close ball valve
3. UNUSUALLY SLOW OPERATION.
   Step 1. Check if ball valve is open.
   Close ball valve.
   Step 2. Check engines are up to speed.
   Increase engine speed.
   Step 3. Check only one pump is engaged.
   Engage both pump
4. TANK OVERFLOWING.
   Step 1. Check for aeration of oil.
   Stop system and allow air to separate from oil.

BILGE PUMP SYSTEM

1. LEAK AT PACKING GLAND.
   Step 1. Check packing gland is too loose or needs repacked.
   Tighten or replace the gland
2. PUMP FAILS TO DELIVER WATER.
   Step 1. Check suction valve is closed
   Open suction valves
   Step 2. Check discharge valve is closed.
   Open discharge valve.
   Step 3. Check whether prime is lost.
   Open priming line valves.
   Step 4. Check for clogged strainer
   Clean strainer
   Step 5. Check that clutch is engaged (Hull Nos. 8540 thru 8560 and 8580 thru 8618).
   Engage clutch.
8. PUMP OUTPUT IS LOW.
   Step 1. Check if suction valve is partially closed.
   Open valve.

SECTION **IV. MAINTENANCE PROCEDURES**

3-7. General
The maintenance procedures contained in this section are the responsibility of the operator/ crew.

3-8. Fuel Line Strainers Mounted on Battery Support, Used On Hull Numbers 8;500 thru 8519)
Refer to figure 3-5 and service the strainers every 8 hours.

3-9. Primary Fuel Line Strainers (Mounted on Aft Bulkhead of Engine Room, Hull Numbers 8540 thru 8560 and 8580 thru 8618). Refer to figure 3-6 and service the strainers every eight hours.

3-10. Engine Mounted Fuel Strainer and Fuel Filters and Crankcase Breather Screens Dual fuel strainers (suction) are mounted aft on each propulsion unit. Dual fuel filters (pressure) are mounted on the side of each engine. Refer to

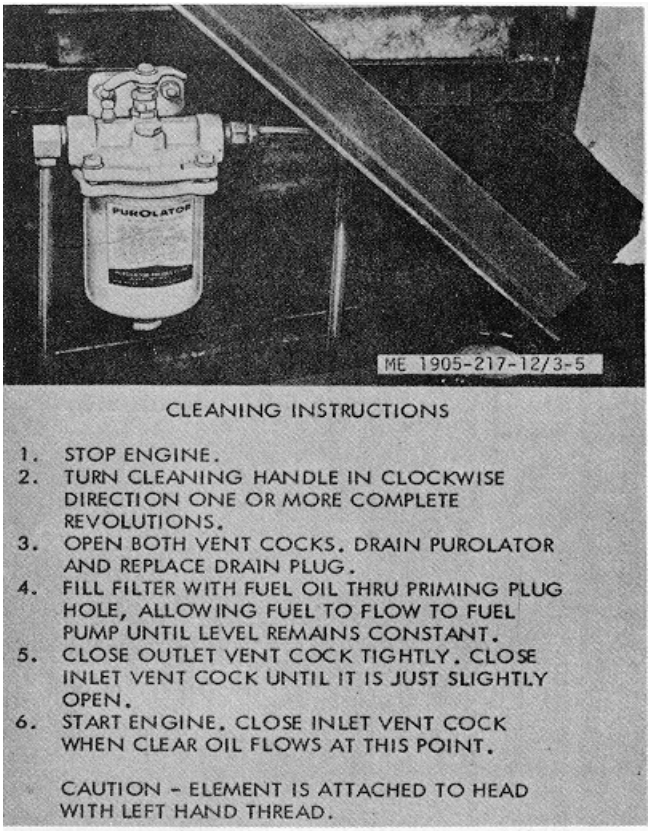


Figure 3-5. Primary fuel line strainers, hull numbers 8500 thru 8519

figure 3-7 and service the strainers and filters every 8 hours. Crankcase breather screens are mounted between the engine blocks, and should be serviced every 8 hours.

3-11. Alternators and Belt Adjustments

There are two alternators, one mounted on the inboard engine of each propulsion unit. The alternators are belt driven from the crankshaft pulley. Refer to figure 3-8 for alternator belt adjustment.

3-12. Fuses

Fuses are located in the distribution paned. The fuses are 15-amp, type AGU. Refer to figure 39 for fuse replacement. In hull numbers 8540 thru 8560 and 8580 thru 8618 the fuses are 10amp, type AGU. Refer to figure 2-5 for fuse location.

3-13. Storage Batteries, Cables, and Terminals (fig. Fig. 3-10)

a. Inspection. Inspect batteries for leaks, corrosion, proper electrolyte level, and breaks or cracks. Inspect cables and terminals for corrosion and for broken cables or terminals.

b Servicing and Testing.

(1) Clean batteries and terminals with a solution of water and baking soda and wipe dry.

Keep batteries filled to proper level with electrolyte.

(2) Test the specific gravity of each cell with a hydrometer. If the specific gravity reading is below 1.225 on the hydrometer, charge the battery. Specific gravity readings of 1.260-to1.270 on the hydrometer indicate a fully charged battery.

c. *Removal.*

(1) Disconnect and remove the negative lead, then disconnect and remove the positive lead at the battery.

(2) Remove battery.

d. Installation. Reverse procedure in c above, using a fully-charged battery.

3-14. Hydraulic Steering System Filter

Observe the filter condition indicator (fig. 230) daily. The filter element must be changed when the needle moves into the red danger zone. If ·filter requires changing, report to higher authority.

3-15. Ramp Hoist Hydraulic System Filter

Observe the filter condition indicator (fig. 2-29) daily when system is in operation. The filter elements must be changed when the needle moves into the red damage zone. If servicing of filter ,is indicated, report to organizational maintenance.

3-16. Ramp Hoist Hydraulic 'System Strainer (Hull Numbers 8500 thru 8519)

Check indicator (fig. 2-8.1) when ramp hoist ,system is in operation. If servicing of strainer is indicated, report to organizational maintenance.

3-17. Bilge Pumps

The landing craft is equipped with three bilge pump. Two pumps ate mounted on the inboard engine of the port propulsion unit and one pump is mounted on the inboard engine of the starboard propulsion unit. Adjust the bilge pump belts as instructed in figure 3-11. Hull numbers

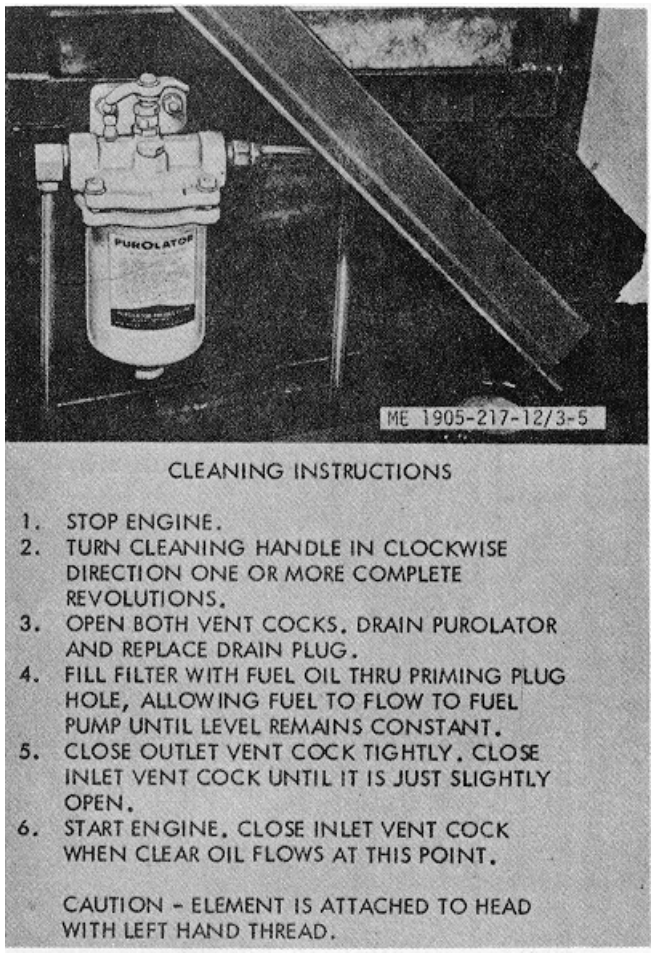


Figure 3-6. Primary fuel line strainers ,hull numbers 8540 thru 8560 and 8580 thru 8618.

8540 thru 8560 and 8580 thru 8618 are equipped with pumps illustrated in figure 3-12. The belt adjustment procedure is the same.

3-18. Sea Water Strainer

a. General. There are two sea water strainers (fig. 3-13), one on each side of the engine **room.** Sea water is used to cool the mufflers and ,is pumped by the raw (sea) water pumps mounted aft on the engines. The strainers are used to remove debris from the water.

b Service. Check the sea water strainers daily or at more frequent intervals if conditions make it necessary. Clean the strainers as instructed in figure 3-13.

3-19. Stuffing Box Adjustment (fig. 3-14)

When necessary adjust the stuffing box as follows:

a. Loosen locknut on stuffing box studs.

b. Tighten adjusting nuts on studs, while turning propeller manually,. until seepage reaches a minimum. Be careful to tighten adjusting nuts equally.

c**.** Tighten locking nuts against adjusting nuts.

d. Refer to figure 3-15 for stuffing box installation procedures on hull numbers 8540 thru 8560 and 8580 thru 8619. Adjustment procedures are as described above.

3-20. Propeller

a. *Removal.*

(1) Remove propeller nut and jamnut (fig. 3-16).

(2) Remove propeller from shaft.

b. Installation. Install propeller in reverse order of removal. Install propeller with a light coating of graphite and grease on the shaft taper.

3-21. Propeller 'Shaft, Strut Bearing, and Rudder Gudgeon Bearing

a. Propeller Shaft and Strut Bearing Replacement.

(1) Disconnect negative lead at battery.

(2) Remove propeller (para 3-20).

(3) Remove strut bearing cap.

(4) Remove the 12 nuts and bolts from the propeller to engine coupling.

(5) Remove nuts from the stuffing box bolts and remove hose.

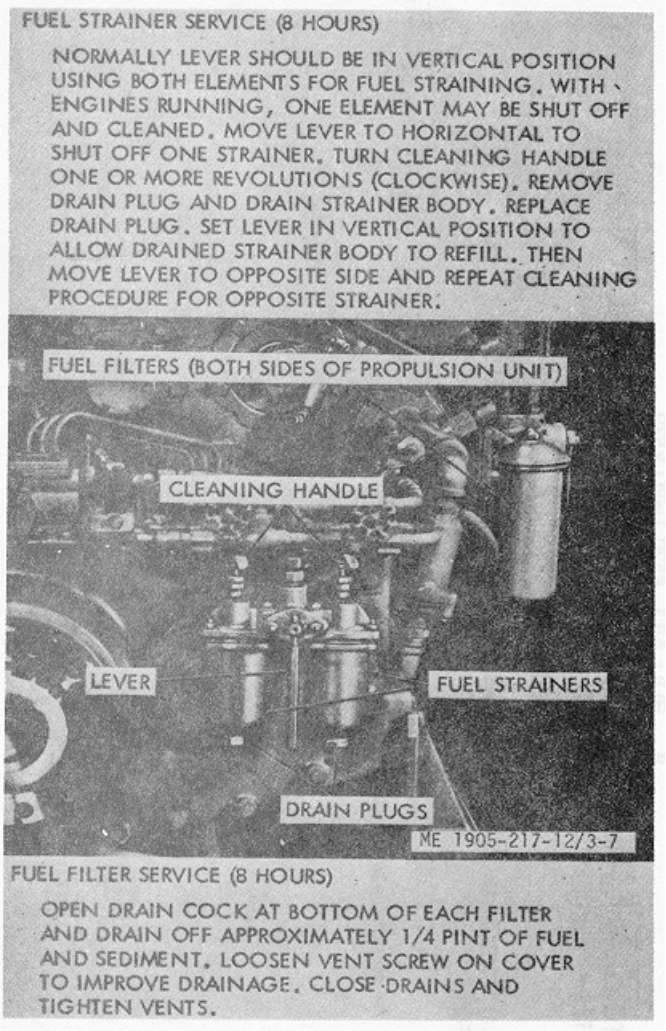


Figure 3-7. Engine mounted fuel strainers and fuel filters.

(6) Remove packing from the stuffing box.
(7) Remove coupling from propeller shaft.
(8) Remove propeller shaft.
(9) Install propeller shaft and strut bearing in reverse order of removal. Replace strut bearing if worn. Install new packing (7/16 tallowed flax). Connect negative lead at battery.

b. Propeller Shaft Alignment.

(1) Alignment of shaft and bearings is not permanently fixed. The alignment changes with every docking due to changes in the keel blocking, temperature variations, and the direction of the sun's rays relative to the fore and aft line of the vessel. The alignment of shafting and bearings is affected by the temporary removal of machinery attached to the shafting or in the vicinity of the shafting because of the redistribution of weights and stresses. The alignment is

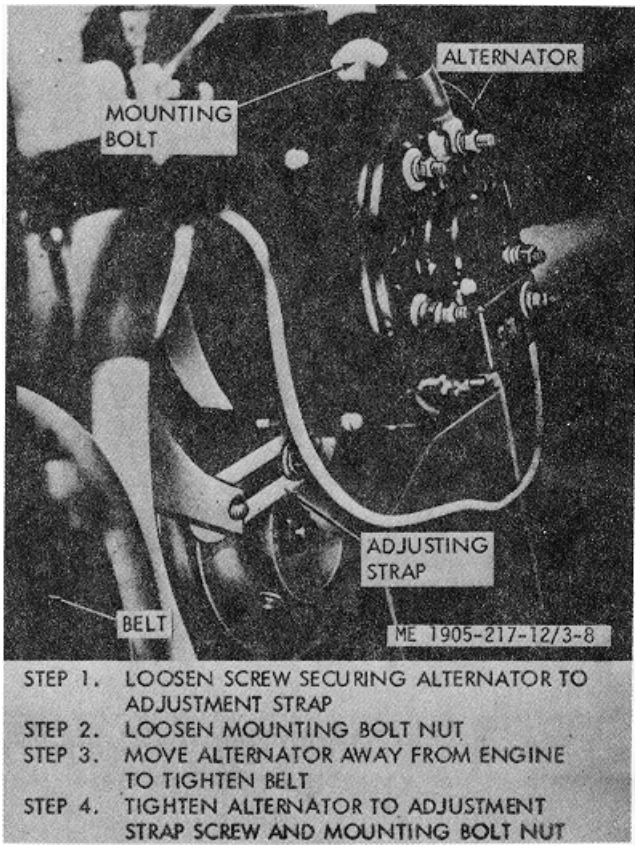


Figure 3-8. Adjusting alternator belts.

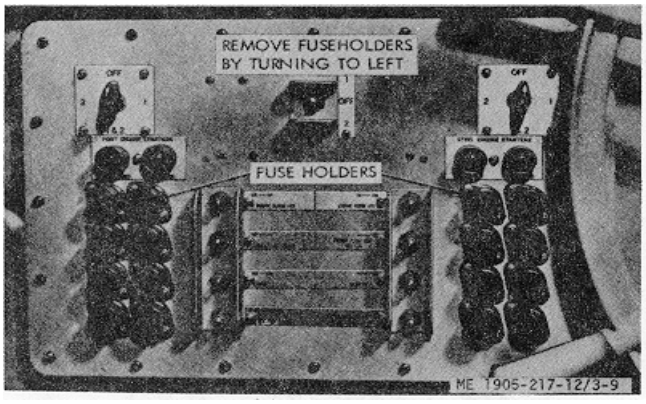


Figure 3-9. Location of fuses.

not the 'same when the vessel is waterborne as when it - is in drydock. The final alignment and bolting of the main propulsion shafting should always be done when the vessel is waterborne.

(2) The primary purpose for providing correct alignment is t) eliminate shaft excited vibrations and to prevent an excessive pressure on any localized portion of the shafting bear

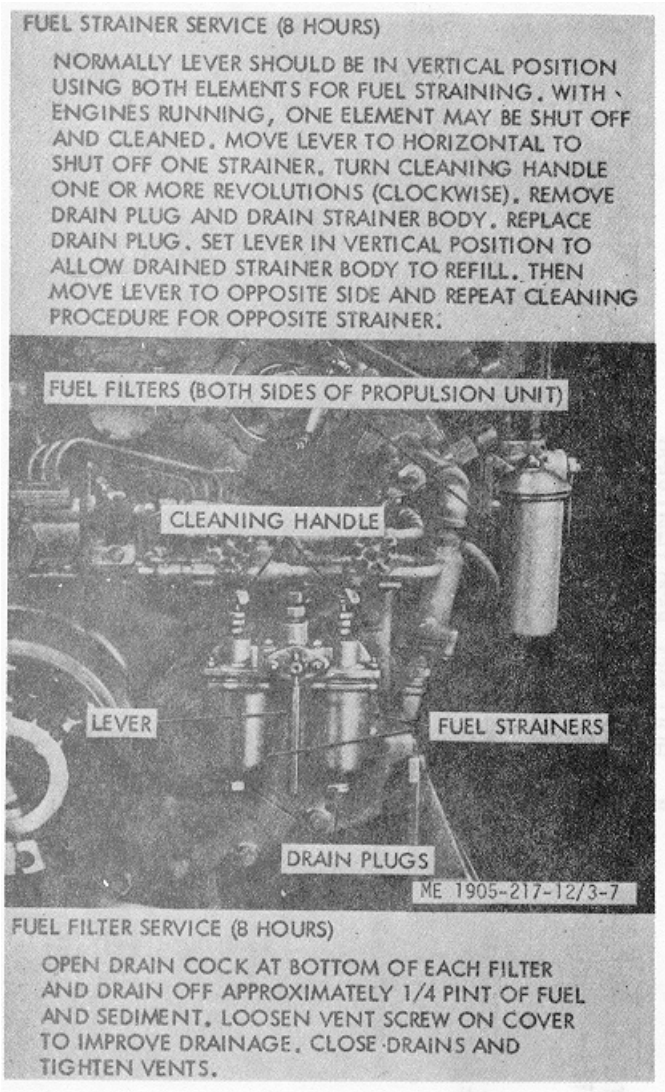


Figure 3-10. Battery service.

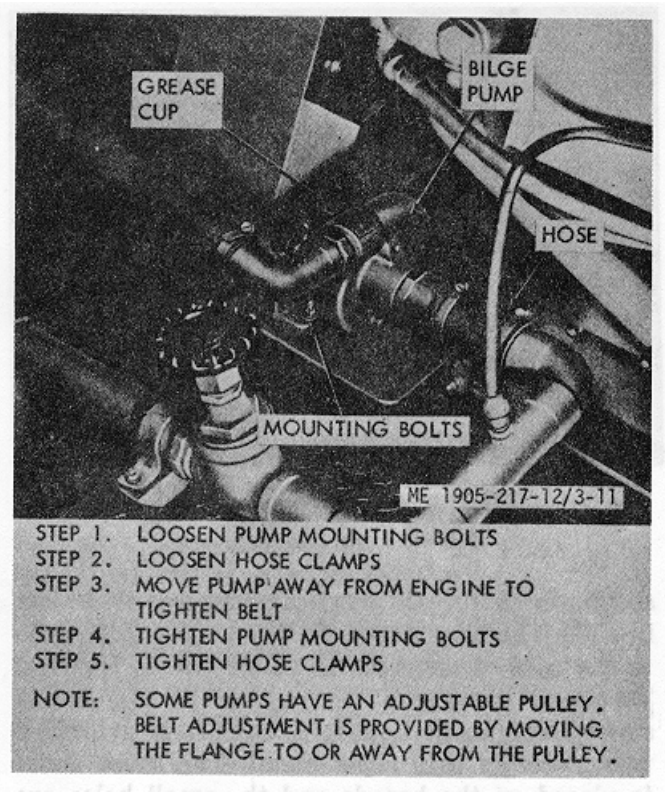


Figure 3-11. Adjusting bilge pump belt

ing surfaces (journal bearing areas). The longitudinal line connecting the lowest extrermities of all shafting journals having the same diameter should form a continuous-faired line when the machinery is at operating temperature. When the shafting is correctly aligned at rest, the bottoms of the shaft journals should be in contact with the bearing material. The bearing clearance at the horizontal centerline of the journal should be equally divided.

(3) In order to obtain and maintain acceptable alignment, the fundamentals of longe-stablished and good practice are as follows:

(a) Each bearing shall guide and support its proportinate share of the shafting weight and load.

(b When shaft couplings are broken, each overhanging shaft length will deflect from the true shaft centerline, depending upon the amount of overhanging shaft weight, the loading, -and the location of the bearing supports.

(c) Alignment of sag charts have been prepared for most vessels showing relative flange positions and the angular slopes of shafting when the coupling 'bolts have been removed. With the bearings adjusted to obtain these measurements, proper alignment of the shafting is

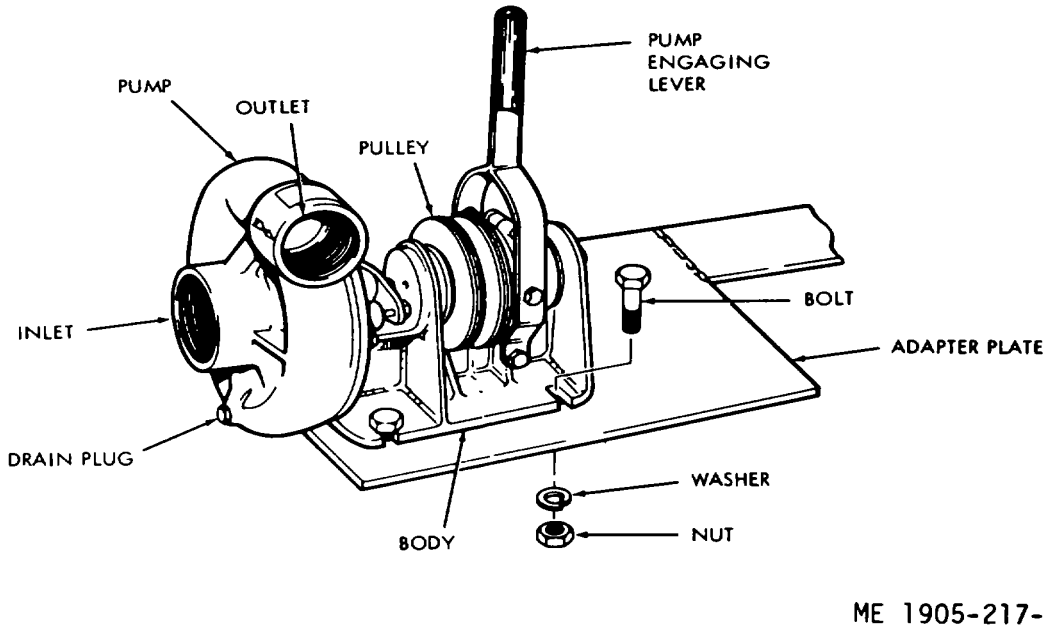


Figure 3-12. Bilge pump installation, hull numbers *8540 thru 8560 and 8580 thru 8018.*

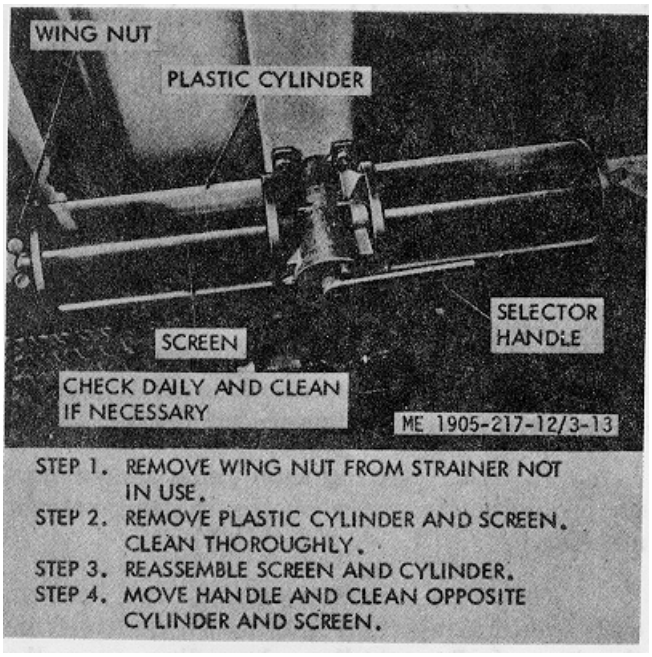


Figure 3-13. Sea water strainer insured when the coupling bolts are secured.

c. Methods of Determining Alignment.

(1) *Running a line wire.* The proper location of the bearings on main propulsion shafting may be checked by running a line wire. This consists of rigging supports just clear of the end of the outer bearings of the set to be aligned. A length of piano wire is stretched between the supports. The supports must be rigid and not subject to deflection when the wire is put under tension. The wire should be attached to the supports in such a way that it can be accurately centered in the end bearings. After the wire has been centered in the end bearings, the wire forms the line of reference (when corrected for sag) for all the intervening bearings.

(2) *Optical method.* Alignment of shafting by the optical method *makes* use of the ,line of

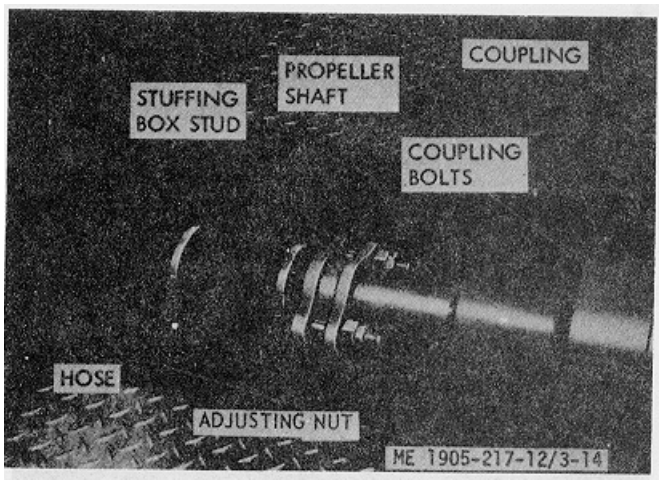


Figure 3-14. Stuffing box adjustment, hull numbers 8500 thru 8519 and 8520 thru 85S9.

sight, which for all practical purposes is a true line. This method consists of boring a large hole in the ends of two boards. One board is fitted at each end bearing of the set to be aligned. A small hole (about 1/16-to 1/8-inch) is drilled in two pieces of thin sheet metal. The sheet metal is placed on the boards and the small holes are adjusted so that they are aligned with the center of the end bearings. A light is placed behind the board on one end and observed through the hole in the board at the other end. The intermediate boards are adjusted so that the light can be seen through all the holes. The center of these holes serves to establish the reference line.

(3) *Flange method.* When it is suspected that the shaft is out of alignment, it should be checked by slacking the coupling bolts at a coupling near the suspected area on the shaft. Feelers are inserted between the coupling flanges, and if there is a greater distance between the faces at one part of the coupling than at another, the shafts are out of alignment at these places.

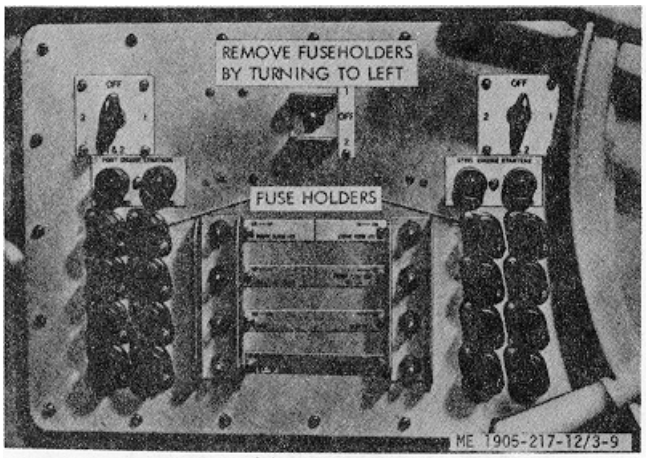


Figure 3-15. Stuffing box installation, hull numbers 8540 thru 8560 and 8580 thru 8618.

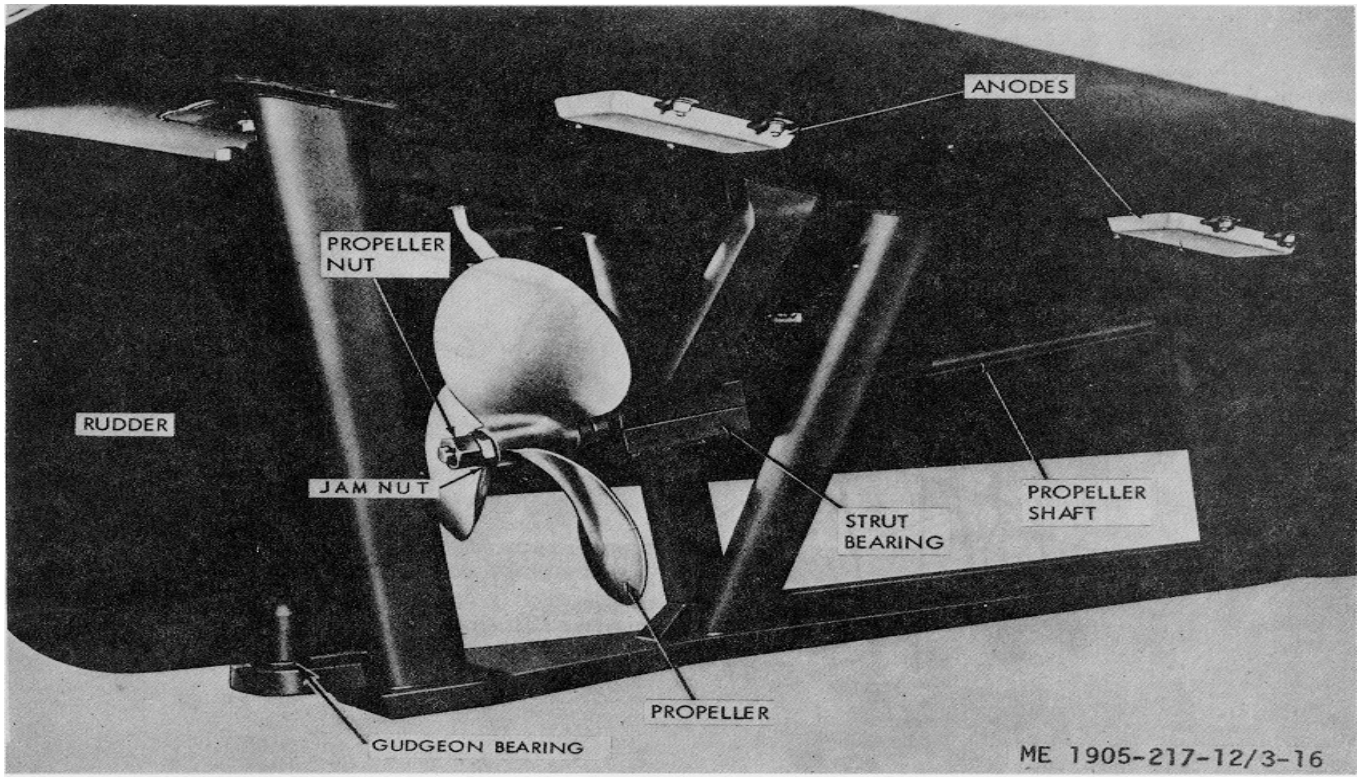


Figure 3-16. Propeller and propeller shaft

SECTION V. FIELD EXPEDIENT REPAIRS

3-22. General

Operator and/or crew maintenance troubles may occur while the landing craft is being operated where supplies and repair parts are not available and normal corrective action cannot be performed. When the condition exists, expedient repairs in paragraphs 3-19 through 3-28 may be used in emergencies. Equipment so repaired must be removed from operation as soon as possible and properly repaired before being placed in operation again.

3-23. Loss of Fuel

Trouble	*Expedient remedy*
Fuel line cracked	Tape cracked line until defective line can be replaced.
Defective element	Remove element and operate (stopping flow of fuel) equipment until a new element can be installed.

3-24. Engine Heats Up

Trouble	Expedient remedy
'Thermostat defective	-------Remove defective thermostat (closed) and operate unit until a serviceable thermostat can be installed (para 4-4).

3-25. Loss of Lubricating Oil

Trouble	*Expedient*
Lubricating oil filter line rebroke	Plug line and close filter line valve until oil **lie can be** replaced.

3-26. Loss of Electrical Power

Trouble	*Expedient*
. Wire broken in electrical system.	Strip and splice ends of wire. Tape splice and continue operations until spliced line can be replaced

3-27. Broken Drive Belts

Trouble	Expedient remedy
Alternator inoperative. Bilge pump inoperative.	Replace drive belts.

3-28. Emergency Clutch Engagement

Trouble	Expedient remedy
Transmission cannot be engaged hydraulically.	Engage emergency engagement bolts (para 4-70

CHAPTER 4

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

SECTION I. SERVICE UPON RECEIPT OF MATERIAL

4-1. General

The services performed upon receipt of a new or used vessel are the responsibility of the using organization and will be performed by the crew and issuing activity.

WARNING

The hand-operated fire extinguishers must be aboard and operative before volatile materials are brought aboard, electrical circuits are energized, fuel tanks are filled, and engines started.

4-2. Inspecting and Servicing the Equipment

The crew and issuing activity personnel will inspect the vessel for completeness. Any evidence of leaks, damage, or missing components or parts will be listed at once and reported to the proper authority for corrective action. During the inspection the crew will perform the daily preventive maintenance services listed in paragraph 3-4. Refer to TB-750-651 for cooling system requirements.

4-3. Used Equipment

A vessel received from storage will be inspected as specified in paragraph 4-2. However, storage ,personnel will have performed the depreservation operation and outfitted and operated the vessel prior to the arrival of the crew.

SECTION II. MOVEMENT TO A NEW WORKSITE

4-4. Dismantling for Movement

a. The landing craft estimated total weight is 134,400 lbs. On hull numbers 8540 thru 8560 and 8580 thru 8618, the estimated hoisting weight is 130,946 pounds. Landing craft with these hull numbers contain an additional lifting eye located on each side of the stern. Eyestraps with a link are welded to the hull at two positions on each side of the cargo well and a wire rope sling with a thimble and four sockets is stored in the lazarette. Attach the sling sockets to the links for lifting the craft from the water.

b. Before the landing craft is lifted the following operations must be performed:

(1) Close the fuel supply and return valves for both fuel tanks (valves are in engine room).

(2) Close the hydraulic steering suction ,valve at tank in engine room (hull numbers 8500 thru 8519).

(3) Close the ramp hoist hydraulic system suction valve at tank in engine room (hull numbers 8500 thru 8519).

(4) Close the hydraulic starting system suction valve at tank in engine room (hull numbers 8500 thru 8519).

(5) Disconnect ground cable from battery (in engine room).

(6) Close the valves at both accumulators.

(7) Close the hatches.

(8) Disconnect electrical connector and remove for mast (5, fig. 4-1), main mast (9), and stern mast (6) and store them in, the lazarette.

4-5. Reinstallation after Movement

a. Use the wire rope sling described in paragraph 4-4 to lower the landing craft into the water.

b. Perform the procedures described in paragraph 4-4b in reverse order.

c. Follow procedures described in paragraph 4-2 before operating the craft.

d. The equipment listed in Appendix B is to be installed as specified after movement.

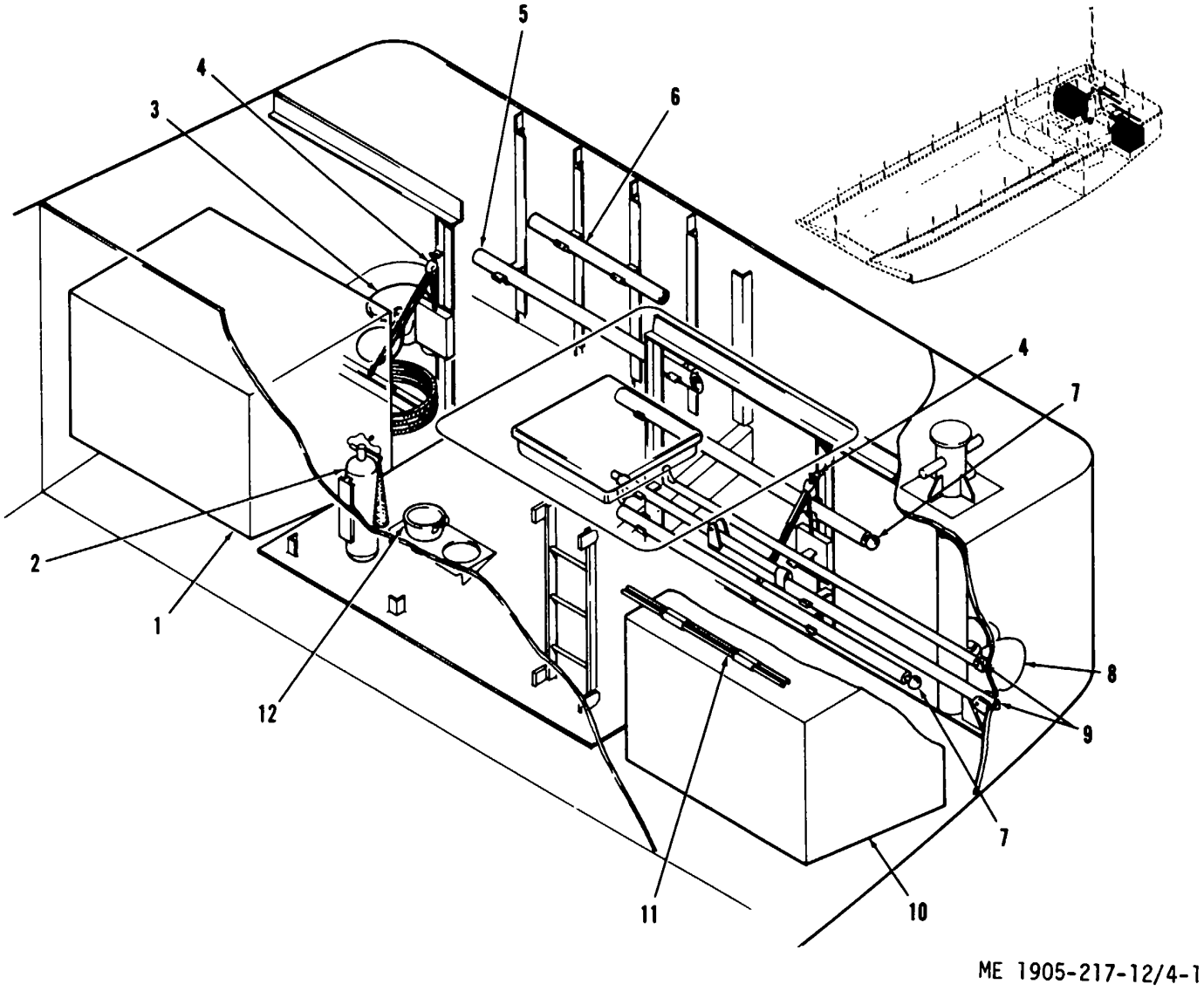


Figure 4-1. Lazarette equipment stowage, hull number 8540 thru 8560 and 8580 thru 8618.

1. Starboard fuel tanks
2. Fire extinguisher
3. Spare propeller (starboard)
4. Ramp emergency hoist (2)
5. Foremast stowage
6. Stern mast stowage
7. Hand bilge pump
8. Spare propeller (port)
9. Main mast
10. Port fuel tank
11. Fuel sounding rod (2)
12. Pails stowage

Figure 4-1 - Continued

SECTION **III. REPAIR PARTS, SPECIAL TOOLS,**

AND EQUIPMENT

4-6. Tools and Equipment

Tools and equipment are contained in Appendixes B&C and are authorized TO&E units to which LCM-8's are assigned.

4-7. Special Tools and Equipment

Repair parts and special tools are listed and illustrated in TM 5-1905-217-20P and in Appendix C of this manual. Special tools required for organizational maintenance are listed in table 4-1. References and illustrations indicating the use of the tools are also listed. The five digit number below the part number is the Federal supply code number for the manufacturer of the tools.

Table 4-1. Special Tools

Item	FSN or Part Number	Reference Fig.	Para.	Use
Gage: Cylinder compression test set	JB19-08 (33287)	4-8	4-20	Compression test
Wrench: Torque, 1/2 in. Drive 0-200 ft. lb.	J1264 (33287)			Torque fittings in general
Gage, Thickness: valve lash	J9708 (33287)	4-9	4-21	Adjust valve
Remover: Injector and spring compressor	J1227-01 (33287)	4-14	4-28	Remove injector from cylinder head
Repair kit: Injector service	J1241-04 (33287)	4-15	4-28	Service and clean injectors
Toot set: Injector tube service	J6286-01 (33287)	4-15	4-28	Repair and clean injector
Fixture: Injector assembly	J6868-01 (33287)	4-16	4-28	Injector holder
Wire: Spray tip cleaner .006 in. (HV7)	J21461 (33287)	4-16	4-28	Clean injector tip spray holes
Gage: Injector timing 1.484 in (HV7)	J1853 (33287)	4-16	4-28	Timing fuel injector
Wrench: Fuel line fittings	J8932-01 (33287)	4-17	4-29	Install and torque fuel fittings
Gage, Gap: Governor spring 0.170	J5407 (33287)	4-33	4-31	Adjust governor spring
Wrench: Fuel and water pump and governor	J4242 (33287)	4-47 4-20 4-39	4-19 4-40 4-44	Fuel and water pump and governor removal
Hose assembly: Accumulator charging	TSE8600 (01843)	4-52	4-60	Charge accumulator with nitrogen
Gage assembly: Accumulator charging	TSE8601 (01843)	4-62	4-60	Charge accumulator
Pump, Hand: Lube oil	5164334 (72582)	3-2	3-1	Remove oil form crankcase
Wrench: Filling cap diesel oil	NS5501-1387636 (80064)	4-12	4-26	Remove filling cap diesel fuel tanks

4-8. Maintenance Repair Parts
Repair parts and equipment are listed and illustrated in TM 6-1905-217-20P.

SECTION **IV. LUBRICATION INSTRUCTIONS**

4-9. General
This section describes how organizational maintenance personnel are to lubricate the LCM4, MOD 1. For lubrication orders refer to paragraph 3-1 of this manual.

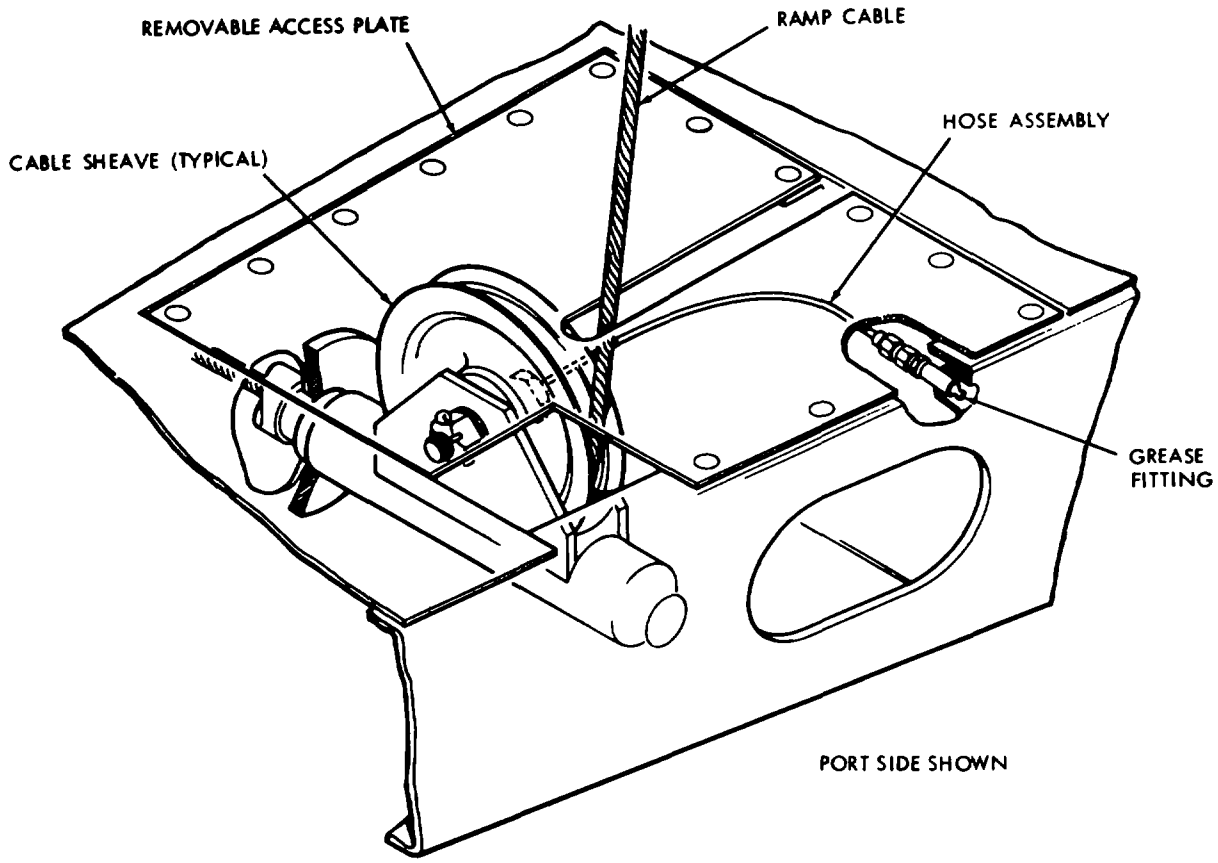
4-10. Detailed Lubrication Information

a. Transmission Oil Fitter (fig. 3-1 or fig. 3-2).

(1) This is a full-flow filter similar to the engine oil filter but a smaller size.

(2) Change the filter element every time the transmission oil is changed (250 hours).

b. Ramp Cable Sheaves (fig. 4-2). Lubrication of the ramp cable sheaves is accomplished thru grease fittings located on the outer ramp door panels. Automotive and artillery grease, MIL-G-10924, is applied by the hand-operated grease gun.



ME 1905-217-12/4-2

Figure 4-2. Ramp cable sheaf details; hull numbers 8540 thru 8560 and 8580 thru 8618.

SECTION V. PREVENTIVE MAINTENANCE CHECKS AND SERVICES

4-11. General

To insure that the landing craft is ready for operation at all times, it must be inspected systematically so that defects may -be discovered and corrected before they result in serious damage or failure. The preventive maintenance checks and services to be performed are listed as described in paragraph 4-12. The item numbers indicate the sequence of minimum inspection requirements. Defects discovered during operation of the unit will be noted for - future correction, to be made as soon as operation has eased. Stop operation immediately if a deficiency is noted during operation which would damage the equipment if operation were continued. All de-

ficienies and shortcomings will be recorded together with the corrective action taken on DA Form 2404 (Equipment Inspection and Maintenance Worksheet) at the earliest possible opportunity.

4-12. Preventive Maintenance Checks and Services
This paragraph contains a tabulated listing of preventive maintenance checks and services. Refer to Table 4-2.

Table 4-2. Organizational Preventive Maintenance Checks and Services

Q - Quarterly
Total man-hours required: 10.1

Sequence Number	ITEM TO BE INSPECTED PROCEDURE	Work Time (M/H)
	SECTION I - FUELS	
1	FUEL FILTERS	
	Replace filter elements (para 3-10) (fig. 3-7).	0.2
	SECTION II -- Steering	
2	STEERING HYDRAULIC SYSTEM SUCTION SCREENS	
	Drain oil in tank and clean screens (para 4-77).	0.5
	SECTION III - RAMP	
3	RAMP HOIST SYSTEM SUCTION STRAINERS AND SCREENS	
	Service strainer on hull numbers 8500 thru 8519 when indicator is red. On hull numbers 8520 thru 8560 and 8580 thru 8618, drain oil and clean screws every 200 hours (para 4-87)	0.5
	SECTION IV - Power Take-off	
4	POWER TAKE-OFF CLUTCH, RAMP SYSTEM PUMPS	
	Check for proper operation, adjust if necessary (fig. 4-78) (para 4-88).	0.2
	SECTION V - Engine	
5	ALTERNATORS	
	Clean brushes and brush holder Replace brushes if they extend less than 1/4 in.	0.9
	beyond brush holder (para 4-48).	0.2
6	GOVERNOR	
	Inspect for loose, worn, or binding linkage. Check to see that governor is securely mounted and in good operating condition (para 4-30).	0.1
7	FILTER--HYDRAULIC STARTING SYSTEM	
	Change filter element at 6-month interval (para 3-14) (fig. 4-51).	0.4
8	ENGINES	
	At 6-month intervals, check valve clearance and adjust if necessary. Perform compression test on each engine (para 4-20, 4-21).	2.1 4.0
9	RAMP LOCKING MECHANISM, FOR HULL NUMBERS 8540 THRU 8660 AND 8680 THRU 8118.	
	Lubricate all fittings monthly (fig. 4-81).	1.0

SECTION **VI. TROUBLESHOOTING**

4-13. General

a. This section contains troubleshooting information for locating and correcting most of the operating troubles which may develop in the LCM-8. Each malfunction for an individual component, unit, or system is followed by a list of tests or inspections which will help you to determine the probable causes and corrective actions to take. You should perform the tests/inspections and corrective actions in the order listed.

b. This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective action. If a malfunction is not listed or is not corrected by listed corrective actions, notify higher authority.

4-14. Troubleshooting

Refer to Table 4-3. This table provides trouble-shooting instructions for the organizational maintenance level.

NOTE

Before you use this table, be are you have performed all applicable operating checks.

Table 4-3. Troubleshooting - Organizational

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINES
1. HARD STARTING
Step 1. Check fuel pump relief valve to determine if properly seated. Test fuel flow as follows: (1) Disconnect fuel return tube and hold open end of the tube in a suitable receptacle. (2) Start and run engine at 1,200 rpm and measure fuel flow from return tube for one minute. It should be at least 1/2 gallon. (3) Be sure all tube connections between the fuel supply and the pump are tight so that no air will be drawn into the fuel system; then immerse the end of the fuel tube into the fuel In the container. Air bubbles rising to the surface of the fuel will indicate a leak on the suction side of the pump. If flow is inadequate replace pump (para 4-29).
Step 2. Check for defective starting motor. Inspect brushes, replace if worn (para 4-48).
2. UNEVEN RUNNING OR FREQUENT STALLING
Step 1. Check for low coolant temperature. The thermostat may not be closing. Remove, inspect, and test the thermostat. Install a new thermostat if necessary. Check the thermostat seal. Replace it if necessary (para 4-44).
Step 2. Test for insufficient fuel flow. Test fuel flow (1. above).
Step 3. Check for faulty injectors. Check injector timing (para 4-28) and the position of the fuel racks (para 4-1).
Step 4. Check for governor instability. Engine hunting may be caused by binding governor-to injector linkage or by faulty adjust ment Refer to paragraphs 4-30 and 4-41.
3. LACK OF POWER
Step 1. Check for insufficient air. Remove air box covers and inspect the cylinder liner ports. If port are over 50 per-cent plugged, clean them. Check compression pressures (para 4-20).
Step 2. Check for insufficient fuel. Test fuel flow (1. above).
4. DETONATION
Step ,1. See if oil is picked up air stream. Check for a defective blower-to-cylinder block gasket. Replace the gasket if necessary. If the blower has been removed, install a new gasket. Refer to direct or general support.
Step 2. Check for low coolant temperature. The thermostat may not be closing. Remove, inspect, and test the thermostat. Install a new thermostat if necessary. Check the thermostat seal. Replace it if necessary (para 4-44).
Step 3. Check for faulty injectors. Check injector timing (para 4-28) and the position of each injector rack (para 4-30). Check injectors (para 4-28) for spray tip holes enlarged or broken spray tip. Replace all injectors found faulty.
5. HIGH LUBRICATING OIL CONSUMPTION
Step 1. Check for leaking oil cooler core. Check the engine coolant for lubricating oil contamination. If contaminated, replace the oil cooler core (para 4-25).
6. LOW OIL PRESSURE
Step 1. See if oil cooler is clogged. A plugged oil cooler is indicated by an excessively high lubricating oil temperature. Remove and clean the oil cooler core (para 4-25).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Step 2. Check cooler by-pass valve.
Remove the by-pass valve and clean the valve and valve seat and inspect. Replace the defective parts (para 4-25).
Step 3. Check gag
Install a serviceable gage (para 4-19).

7. HIGH COOLANT TEMPERATURE
Step 1. Inspect cooling system.
Clean the cooling system and thoroughly flush to remove scale deposits (para 4-41).
Step 2. Check circulation.
Inspect for collapsed or disintegrated hoses Replace all faulty hose Thermostats may be inoperative. Remove, inspect, and test the thermostat; replace it if found faulty (para 4-44). Check the water pump for a loose or damaged impeller. Check for an air leak on the suction side of the water pump Replace defective parts (para 4-68).

TORQUEMATIC MARINE GEAR

1. LOW OIL PRESSURE
Step 1. Check the pressure gage (para 4-68).
Replace if faulty.
Step 2. Check the lubricating oil
Check the oil temperature and if found to be abnormally high, remove and clean, both internally and externally, the marine gear oil cooler. Replace the cooler if necessary (para 4-25). Clean the oil strainer with fuel oil and replace (fig. 3-3. Replace the oil filter element (fig. 3-1 or fig. 4-2).
Step 3. Check for oil leaks in pump suction lines
Inspect the pump suction lines, strainer cap and gaskets for air leaks. Repair or replace leaking liner and fittings (para 4-88).

ALTERNATOR

1. ALTERNATOR FAILS TO CHARGE
Step 1. Check for worn or defective brushes
Replace brushes (para 4-48).
Step 2. Check regulator.
Replace regulator (para 4-49).
2. LOW OR UNSTEADY CHARGING RATE
Step .1. Check for worn, sticky, or intermittent brush contact,
Replace brushes (para 4-48).
step 2. Check regulator.
Replace regulator (para 4-49).
3. EXCESSIVE CHARGING RATE
Step 1. Check regulator.
Replace regulator (para 4-49).
4. NOISY ALTERNATOR
Step 1. Check for worn bearings
Replace alternator (para 4-48).

ELECTRIC STARTING SYSTEM

1. STARTER WILL NOT CRANK ENGINE
Step 1. Check for loose connection or defective wiring.
Replace damaged wiring and tighten all connections to the starter, magnetic switch, and batteries (para 4-47).
Step 2. Check for defective witch.
Inspect all switches to determine their condition. Connect a jumper lead around any switch suspected of being defective. If system functions, replace the bypassed switch (para 4-47).
Step 3. Check commutator to determine if dirty or worn.
Inspect commutator by removing inspection plugs. If commutator is dirty or lightly grooved, polish it by placing a strip of No. 00 sandpaper around the commutator and under brushes (rough side toward commutator) and rotate the armature Blow the dust from the commutator after polishing (para 4-47).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Step 4. Check if starter brushes are worn.
Replace brushes (para 4-80).

HYDRAULIC STARTING SYSTEM

1. ENGINE DRIVEN PUMP FAILS TO RAISE PRESSURE
   Step 1. Check for air in system.
   Purge system (para 4-58).
   Step 2. Check if filter is plugged.
   Replace filter element (para 4-69).
   Step 3. Check if check valves are functioning properly.
   Open the relief valve on the side of the hand pump, while the engine is running, to permit the engine driven pump to wash the check valves free from particles. If the accumulator can be charged with the hand pump but not with the engine driven pump, then a check valve in the engine pump is defective. Replace the faulty check valve assembly (para 4-67).
2. CRANKING SPEED TOO LOW
   Step 1. Check if control valve is fully open.
   Check control valve, replace if necessary (paras 4-64 and 4-65).
   Step 2. Check if inlet line is restricted.
   Check lines for foreign matter (para 4-81).
3. LOSS OF FLUID FROM RESERVOIR
   Step 1. Check for external leaks.
   With pressure in system check air hoses and fittings for leaks. Tighten and replace defective part
   Step 2. Check for internal leaks.
   Check level of oil in reduction gears. A leaking seal in the hydrostarter will allow hydraulic fluid from the starter system to enter the reduction gear case. Replace starter, drain transmission oil, and flush. Replace filter and fill with clean oil.
4. LOSS OF FLUID PRESSURE WHEN ENGINE IS NOT RUNNING
   Step ,1. Check for external leakage in system.
   Examine all hoses and fittings for leaks. Tighten or replace fittings and any defective parts (para 4-57).
5. HAND PUMP FAILS TO CHARGE SYSTEM
   Step 1. Check if check valves are leaking.
   If caused by dirt, open relief valve (maximum of one (1) turn), and operate hand pump slowly for a few minutes to wash particles out of check valves. If this is successful, clean ball seats in pump body and replace balls and springs if necessary (para 4-81).
   Step 2. Check if suction line is plugged. Remove line and clean (para 4-60).
6. LOSS OF ACCUMULATOR PRECHARGE (NITROGEN)
   Step 1. Check air valve.
   Release pressure in system by opening relief valve on hand pump. Then depress air valve to release remaining precharge before attempting to remove valve from acoumulator. Replace air valve (para 4-60).
   Step 2. Check safety fuse.
   Replace safety fuse and holder gaskets (para 4-60).
7. HIGH PRESSURE IN SYSTEM (3500 PSI OR ABOVE)
   Step 1. Check gage.
   Replace gage (para 4-57).
8. FLUID EMERGES FROM RESERVOIR FILLER CAP WHEN HYDRAULIC STARTER IS USED
   Step 1. Check for excessive fluid in reservoir.
   Check fluid level after the accumulator is discharged. The fluid level should be approximately 2 1/2 in. from the top of the filling tube (para 4-57).
   Step 2. Check if filter in filler cap is dirty.
   Clean with fuel oil and blow dry (para 4-57).

STEERING SYSTEM

1. STEERING WHEEL DIFFICULT TO TURN
   Step 1. Check if relief valve is stuck open.
   Readjust relief valve (para 4-80) or (para 4-81).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Step 2. Check setting of overcenter valve.
Reset overcenter valve (para 4-80).
Step 3. Check setting of counterbalance valves (Gunderson, Craft, and Rohr).
Reset counterbalance valves (para 4-81).

2. STEERING IS SLOW
Step 1. Inspect flow control valve.
Disassemble and clean valve. Repair or replace (para 4-81).

3. KICK BACK IN HELM
Step 1. Check for air in system.
Bleed air from system. Correct air leak and refill (para 4-82).
Step 2. Check for restriction in lines.
Clean lines (para 4-82).
Step 3. Check for air in system, low oil level.
Bleed air from system. Correct air leak and refill (para 4-82).
Step 4. Check overcenter valve or counterbalance.
Adjust or replace valve (para 4-80 or para 4-81).

4. WHEEL TURNS BUT RUDDER DOES NOT
Step 1. Check for ruptured line.
Replace ruptured line (para 4-82).
Step 2. Check for air in system.
Bleed air from system' Correct air leaks and refill (para 4-82).

5. NOISY OPERATION OF PUMPS
Step 1. Check for air in system
Bleed air from system. Correct air leak and refill (para 4-81).

6. OIL TOO HOT
Step 1. Check action of flow control valve.
Disassemble, inspect, and clean or replace valve (para 4-80 or para 4-81).

7. OVERFLOWING OF TANK
Step 1. Check for aeration of oil by air leaks in system.
Shut down system, allow air to escape. Repair air leak (para 4-81).

8. LOSS OF OIL
Step 1. Check for ruptured line
Repair ruptured line (para 4-81).

RAMP HOIST HYDRAULIC SYSTEM

1. CONTROL VALVE LEVER DOES NOT MOVE
Step 1. Check control valve.
Replace control valve (para 4-89).

2. CONTROL VALVE LEVER MOVES BUT WINCH DOES NOT TURN WHEN CABLE IS FREE TO MOVE
Step 1. Check hydraulic oil or system pressure.
Check quantity of oil in supply tank. Replenish if necessary (para 449).
Step 2. Check for ruptured hydraulic line.
Replace line (para 4-89).
Step 3. Check system relief valve to see if it is set at correct pressure (para 4-89).
Check system pressure. Adjust relief valve if required (para 4-89 or 4-90).
Step 4. Check foreign material in system.
Flush system completely and clean filter and strainer (para 4-87).
Step 5. Check counterbalance valve to see if it is correctly adjusted (hull numbers 8500 thru 8519 and 8540 thru 8560 and 8580 thru 8618).
Adjust counterbalance valve (para 4-96).

3. BRAKE DOES NOT RELEASE
Step 1. Check insufficient operating pressure.
If pressure is adequate (300 psi for hull numbers 8500 thru 8519, or 2,100 psi for hull numbers 8540 thru 8560 and 8580 .thru 8518), check counterbalance valve setting (hull numbers 8500 thru 8519, and 8540 thru 8560 and 8580 thru 8618 (para 4-96).
Step 2. Check for foreign material in system.
Flush system completely and clean strainer and filter (para 4-86).

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
4. RAMP CONTINUES TO LOWER WITH CONTROL VALVE IN NEUTRAL
Step 1. Cheek counterbalance valve. Adjust counterbalance valve. See paragraph 4-94 or 4-96.
5. UNUSUALLY SLOW OPERATION
Step 1. Check pump or motor. Replace defective component (para 4-93).
Step 2. Check for restriction in line. Clear lines (para 4-93).
Step 3. Check relief valve setting to see if it is set too low (para 4-93). Adjust relief valve See paragraph 4-93.
6. NOISY OPERATION OF PUMP
Step 1. Check for air in system. Purge air from system (para 4-86).
7. EXCESSIVE HEAT BUILDUP IN SYSTEM
Step 1. Check to see if relief valve is leaking at high pressure. Adjust relief valve. See paragraph 4-93.
8. LOSS OF OIL
Step 1. Check for ruptured line Replace line.
Step 2. Check ramp locking system two-way valve for external or internal leakage (hull numbers 8540 thru 8566 and 8580 thru 8618). Tighten connections and replace defective parts (para 4-97).

SECTION VII. RADIO INTERFERENCE SUPPRESSION

4-15. General Methods Used to Attain Proper Suppression

Essentially, suppression is attained by providing a low resistance path to ground for the stray currents. The methods used include shielding wires, grounding the frame with bonding straps, and using capacitors and resistors.

4-16. Radio Interference Suppression Components

a. Primary Suppression Components. The primary suppression components are those whose primary function is ’to suppress radio interference. These components are identified in figure 4-3.

b. Secondary Suppression Components. These components have radio interference suppression functions which are incidental or secondary to their primary function.

4-17. Replacement of Suppression Components

Refer to figure 4-3 and replace the radio interference suppression components.

4-18. Testing of Radio Interference Suppression Components

Test the capacitors for leaks and shorts on a capacitor tester; replace defective capacitors. If test equipment is not available and interference is indicated, isolate the cause of interference by the trial-and-error method of replacing each capacitor in turn until the cause of interference is located and eliminated.

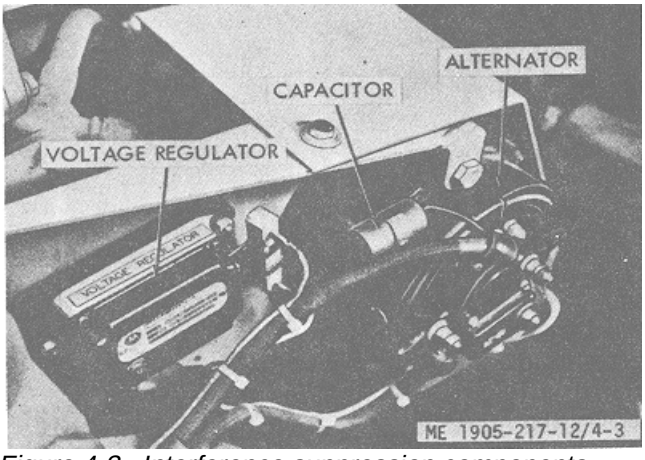


Figure 4-3. Interference suppression components.

SECTION VIII. ENGINES

4-19. General (fig. 4-4 and fig. 4-5)

a. Description. Model 12005A (starboard) and 12006A (,port) twin units each consist of two six-cylinder diesel engines in a side-by-side arrangement coupled to a transfer gear and mounted on a steel base.

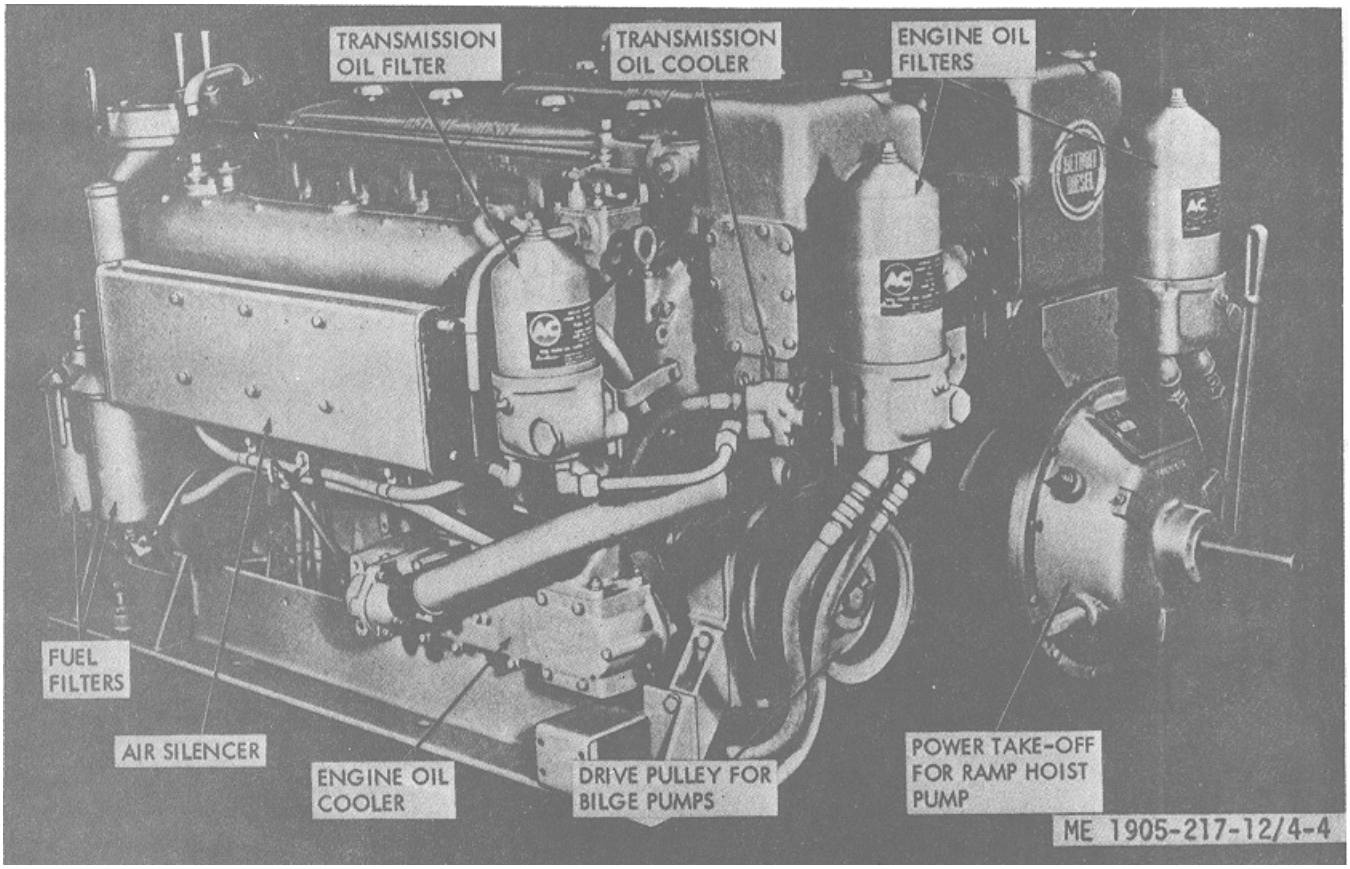


Figure 4-4. Inboard view of port propulsion unit.

b. Engine Arrangement. Model 12005A is built for starboard installation. The two engines of this model are right-hand rotation engines, designated as RB and RD, and furnish clockwise propeller shaft rotation. Model 12006A is built for port installation. The two engines of this model are left-hand rotation engines, designated as LB and LD, and furnish counterclockwise propeller shaft rotation (fig. 4-6). Figure 4-7 illustrates the crankshaft rotation and accessory arrangement of the engines used in each unit. These views also show the direction of rotation of all gears in the train, as well as location of water-and exhaust-manifolds.

4-20. Engine Compression Test

a. Remove the valve rocker cover for the engine to be tested.

b. Start the engine and run it at approximately one-half rated load until normal operating temperature is reached.

c. With the engine stopped, remove the fuel pipes from the injector and fuel connectors for the No. 1 cylinder.

d. Remove the injector from No. 1 cylinder and install an adapter and the pressure gage, J1319-03, in its place as shown in figure 4-8.

e. Use one of the two fuel pipes as a jumper connection between the fuel inlet and return manifold to permit fuel to flow directly to the return manifold.

f. Start the engine and run it at 600 rpm. Observe and record the compression pressure indicated on the gage.

g. Perform the compression pressure check on each cylinder. The compression pressure in any one. cylinder should not be less than 390 psi at 600 rpm when engine is operated at sea level. In addition, the variation in compression pressure between cylinders of the engine must not exceed 25 psi at 600 rpm.

h. Low compression pressure may result from any one of several causes:

(1) Piston rings may be stuck or broken.

(2) Compression may be leaking past the cylinder head gasket, the valve seats, the injector tubes, or through a hole in the piston.

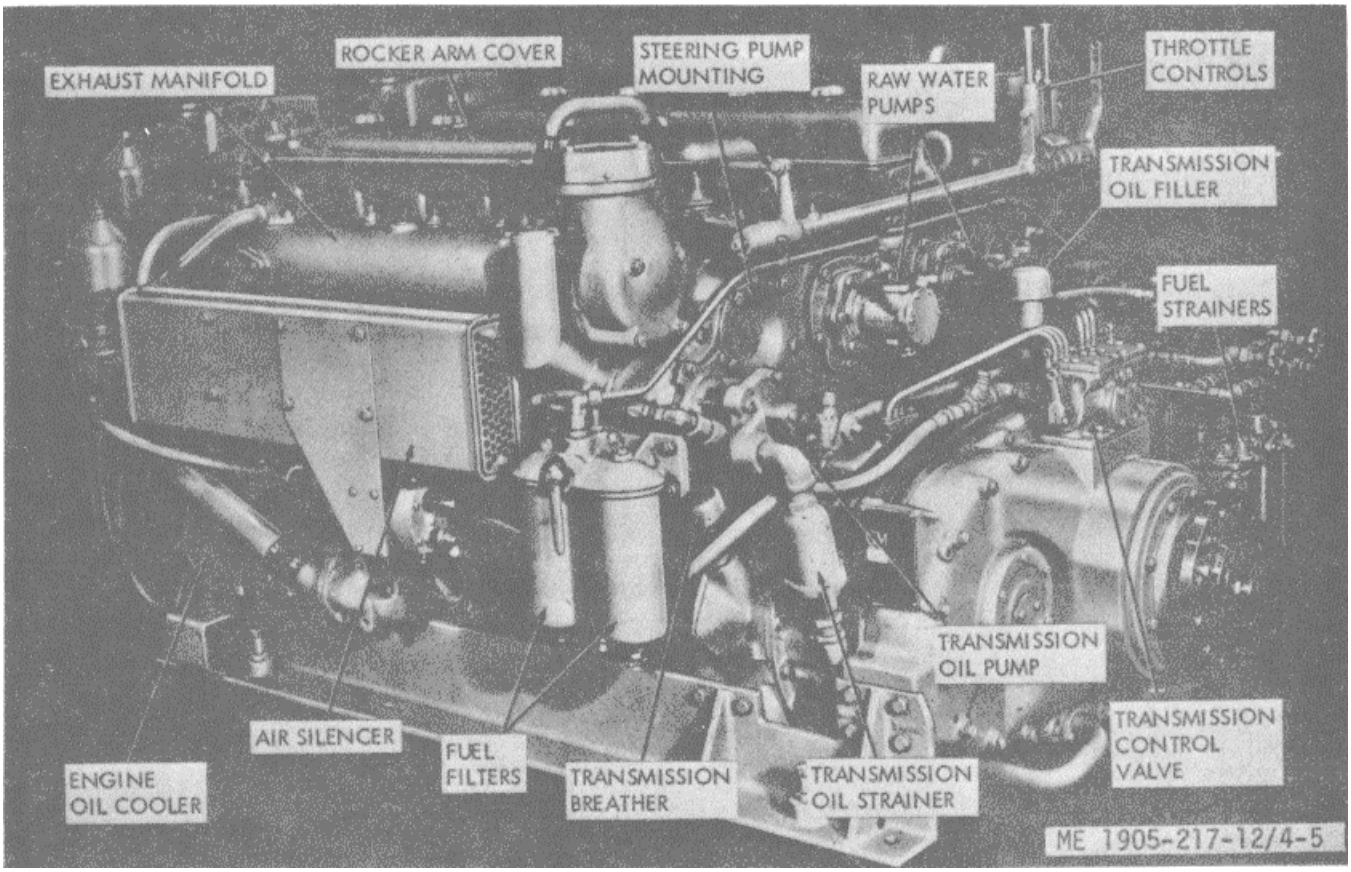


Figure 4-5. Outboard View of port propulsion unit.

4-21. Exhaust Valve Clearance Adjustment

a. General. The correct exhaust valve clearance at normal engine operating temperature is important for smooth, efficient operation of the engine. Whenever the cylinder head is overhauled, the exhaust valves are reconditioned or replaced, or the valve operating mechanism is replaced or disturbed in any way, the valve clearance must first be adjusted to the cold setting to allow for normal expansion of the engine parts during the engine warm-up period. This will insure a valve setting that is close enough to the specified clearance to prevent damage to the valves when the engine is started.

b. Exhaust Valve Clearance Adjustment (Cold Engine).

(1) Place the governor throttle control lever in the NO-FUEL position. Pull engine stop control out.

(2) Rotate the crankshaft until the injector follower is fully depressed on the cylinder to be adjusted.

(3) Loosen the push rod locknut.

(4) Place a 0.013 inch feeler gage, tool J9708, between the valve stem and the rocker arm (fig. 4-9). Adjust the push rod to obtain a smooth "pull" on the feeler gage.

(5) Remove the feeler gage. Hold the push rod with 5/16-inch wrench and tighten the locknut with a 1/2-inch wrench.

(6) Recheck the clearance. At this time, if the adjustment is correct, the 0.011 inch feeler gage, J9708, will pass freely between the valve stem and the rocker arm, but the 0.013 inch feeler gage will not pass through.

(7) Check and adjust the remaining valves in the same manner as outlined above.

c. Exhaust Valve Clearance Adjustment (Hot Engine).

(1) Maintaining the normal engine operating temperature -is particularly important when making the final valve clearance adjustment. If the engine is allowed to cool off before setting any of the valves, the clearance when running at full load may become insufficient.

(2) With the engine at normal operating temperature (160°-185° F.), recheck the exhaust valve clearance with feeler gage J9708. At this time, if the valve clearance is correct, the 0.008-inch feeler gage will pass freely between

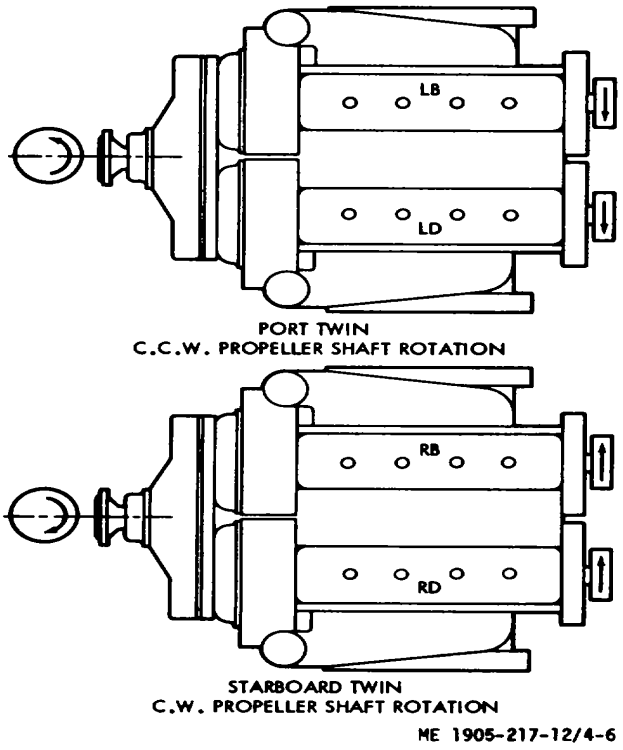


Figure 4-6. Engine arrangement

the valve stem and the rocker arm, but the 0.010-inch gage will not pass through

4-22. Exhaust Manifold and Pipe (fig. 4-10)

The one-piece, water-cooled exhaust manifold is cast with an integral water jacket surrounding the exhaust manifold and is discharged from the forward end through a tube into the lower section of the expansion tank. A drain cock is installed in the bottom of the manifold for draining the water jacket. A plug is provided in the bottom of the exhaust outlet elbow for draining moisture condensed from the exhaust gases. Inspect for cracked or worn hoses, and replace if necessary. Inspect studs for damage and check gaskets for leaks.

a. Removal. Refer to fig. 4-10 and remove the exhaust pipe and manifold.

b. Cleaning Inspection and Repair.

(1) Clean parts with cleaning solvent FED. SPEC. PD-680 and dry thoroughly.

(2) Inspect the pipe for signs of deterioration and wear.

(3) Inspect the manifolds for leaks, cracks, corrosion, and other damage.

(4) Replace all defective parts as required.

c. Installation. Refer to fig. 4-10, position the exhaust pipe and manifold on the engine, and secure with mounting hardware.

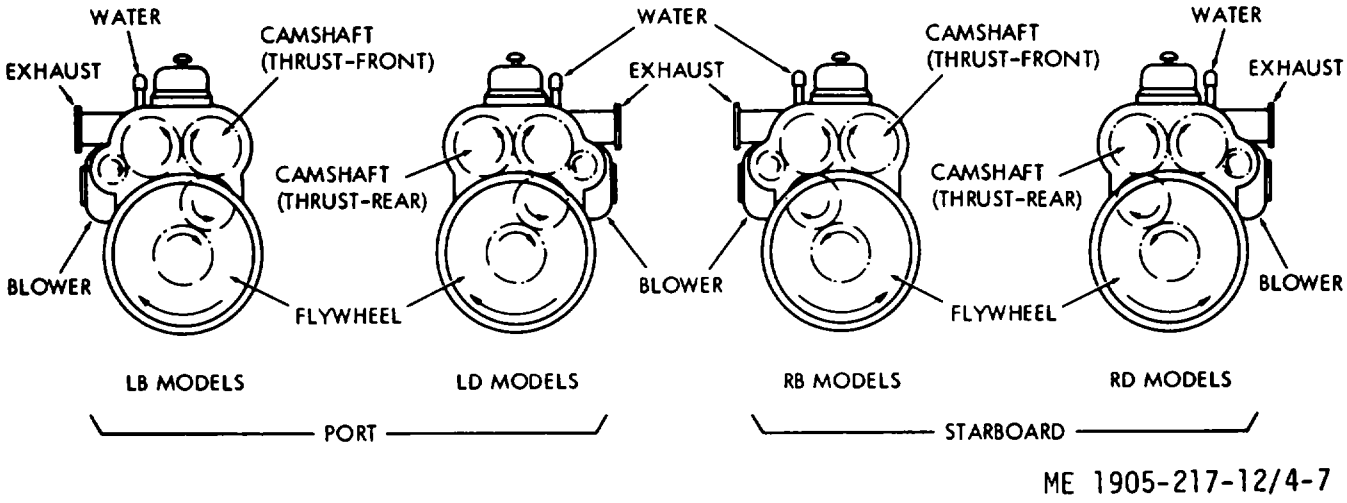


Figure 4-7. Crankshaft rotation and accessory arrangement as viewed from flywheel end.

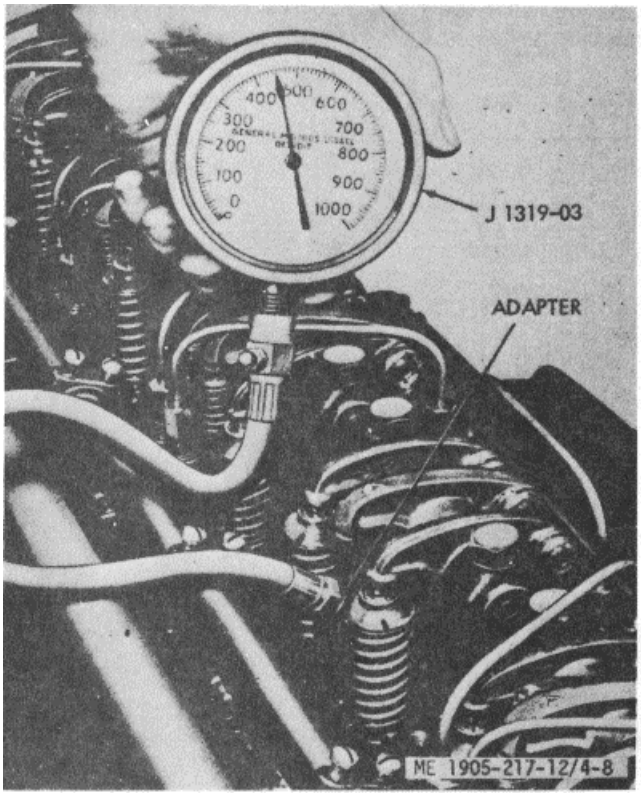


Figure 4-8. Checking compression pressure.

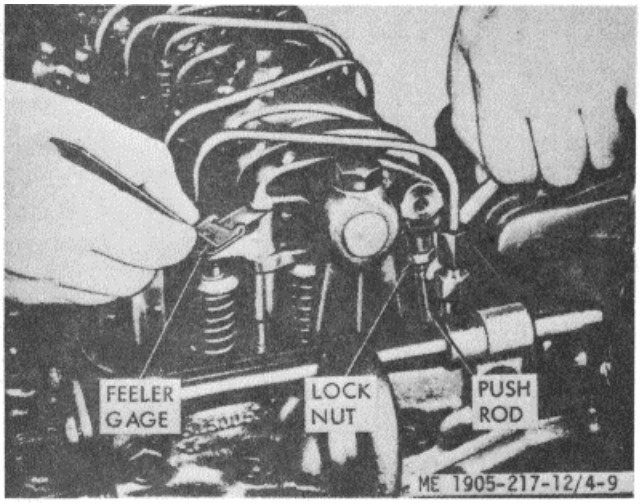


Figure 4-9. Valve clearance adjustment.

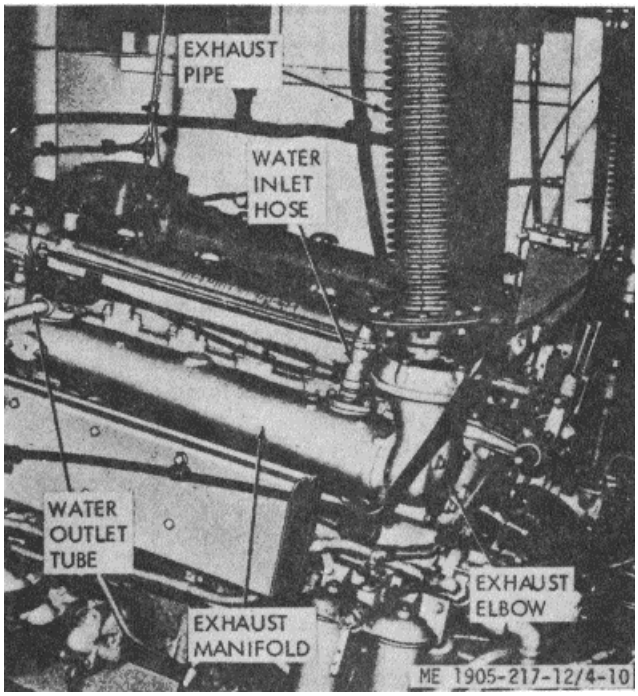


Figure 4-10. Exhaust manifold and pipe removal and installation

SECTION **IX. ENGINE LUBRICATING SYSTEM**

4-23. General

a. Engine lubricating oil is circulated by a gear-type pump gear driven from the crankshaft. All the oil leaving the pump is forced through 'the full-flow oi4 filter to the cooler and then into the oil gallery in the cylinder block from where it is distributed to the various engine ,bearings. The drain from the cylinder head and 'other engine parts leads back to the oil pan.

b. If the oil cooler should become clogged, the oil will flow from the pump through a spring loaded bypass valve directly into the oil gallery.

c. Stabilized lubricating oil pressure is maintained within the engine at all speeds, regardless of the oil temperature, by means of a regulator valve located between the pump outlet and the inlet to the cylinder block. When the oil pressure at the valve exceeds 50 pounds per square inch, the regulator valve opens and remains open until the pressure is less than -the opening pressure.

4-24. Engine Oil Filter

a. Description. This is a full-flow filter with a replaceable element. A bypass valve, which opens at 15 psi, is located in the base.

b. Service. The element must be changed at every oil change interval (100 hours). See figures 3-1 and 3-2.

c. Removal and Installation. Disconnect hoses, then remove the filter from the bracket. Install in reverse order of removal.

4-25. Engine Oil Cooler (fig. 4-11)

a. General. The oil cooler is located on the side of the engine just below the water pump. To assure engine lubrication if the oil cooler becomes clogged, a bypass valve located at the oil inlet to the cooler bypasses oil around the cooler directly to the oil gallery in the cylinder block. The core through which the oil passes while being cooled is sealed to prevent a coolant from getting into the oil. Whenever an oil cooler is assembled, special care must be taken to have the proper gaskets in place and the retaining bolts tight.

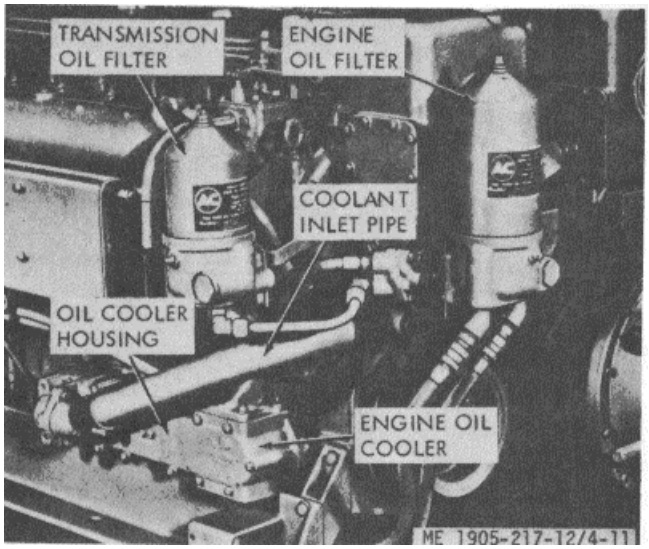


Figure 4-11. Engine oil cooler.

b. Removal.

(1) Drain cooling system.

(2) Remove coolant inlet pipe and outlet elbow.

(3) Remove oil cooler housing and the two elements.

c. Inspection of Oil Cooler.

(1) Inspect the housing for damage, and replace as necessary.

(2) Inspect the two elements for excessive sludge buildup and damage, and replace as necessary.

SECTION X. ENGINE FUEL SYSTEM

4-26. General

The fuel system (fig. 1-18 or 4-12) consists of the fuel tanks (2) and lines, fuel strainers (mounted aft on each propulsion unit), fuel pumps (driven from the blower lower rotor shaft), fuel filters (mounted on the side of each engine), fuel manifolds, and fuel injectors. Hull numbers 8500 thru 8519 have an additional fuel strainer for each propulsion unit. These strainers are mounted on the battery box. Hull numbers 8540 thru 8560 and 8580 thru 8618 incorporate a 2-psi relief valve in the return line. Additionally, these hull numbers include a primary fuel strainer mounted on the aft bulkhead of the engine room in the supply line from each reservoir (fig. 1-17). These hull numbers also incorporate a fuel pressure switch interlocked with the hydrostarters to prevent accidental engagement of the hydrostarter when the engine is running. Hulls 8540 thru 8560 and 8580 thru 8618 have fuel oil heat exchangers installed in the raw water cooling system.

4-27. Engine Mounted Fuel Strainers and Fuel Filters

Refer to paragraph 3-10 and figure 3-7 for daily service. Every 500 hours clean strainer elements and replace filter elements as follows:

a. Fuel Strainers (fig. 3-7).

(1) *Disassembly*.

(a) Drain strainer body.

(b) Remove handle locknut and handle.

(c) Remove four nuts and washers from clamping ring studs. Remove case and clamping

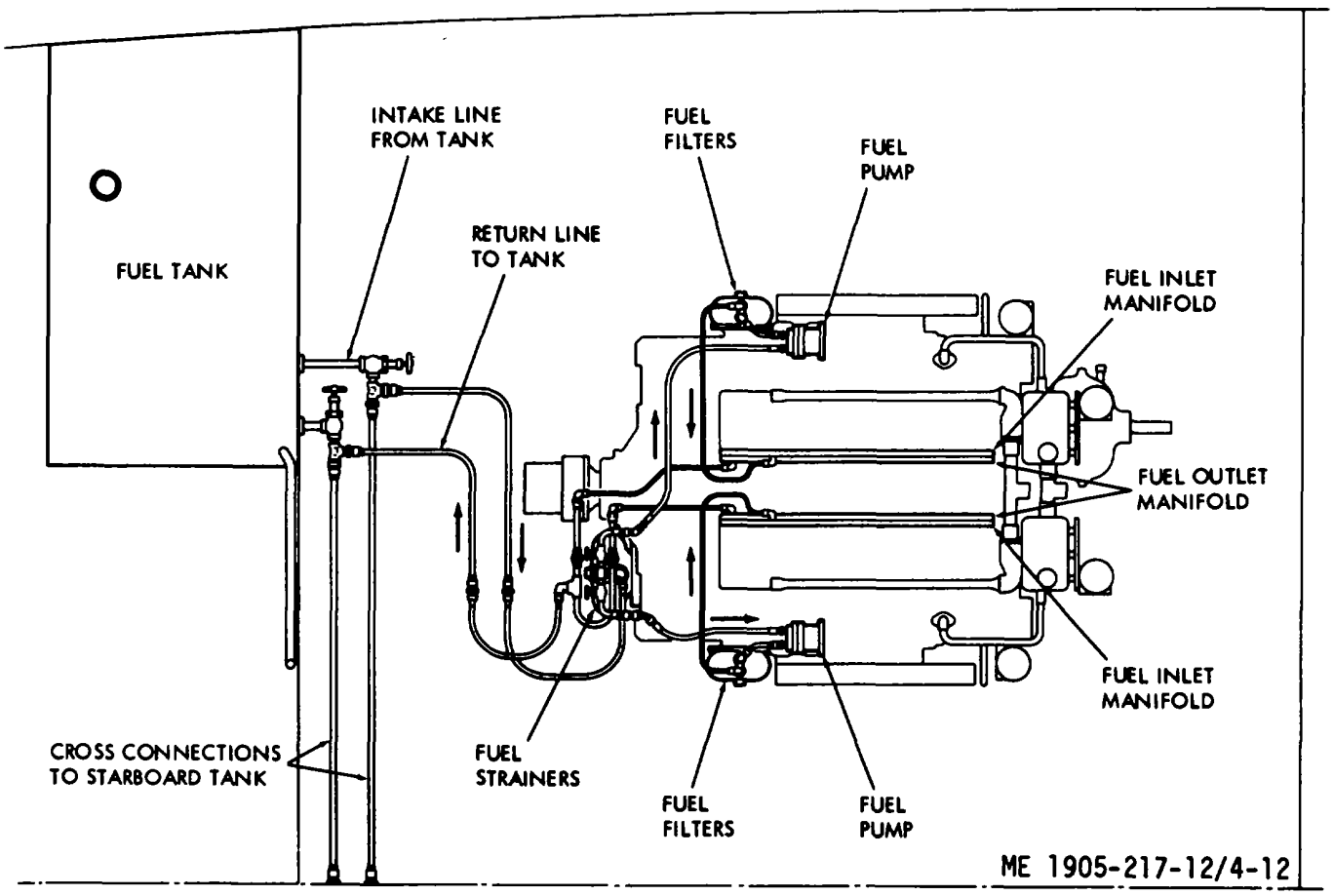


Figure 4-12. Fuel system diagram.

ring together (do not remove clamping ring from case). Care must be taken not to lose or damage case gasket.

(d) Loosen stuffing box nut.

(e) Unscrew element and knife assembly by turning right (left-4and thread) until it is free.

(2) *Inspection and service*.

(a) Inspect edge of cleaning knife for wear.

(b) Inspect element for wear caused by cleaning knives or damage which will allow dirt to pass through the filtering screen.

(c) Submerge element assembly in fuel oil and wash with soft lint-free cloth or soft hair brush. Do not use wire brush or scraper. Exercise care not to allow dirt to enter inside of element.

(d) Reassemble strainer assembly and place in service.

b. Fuel Filters. With engine stopped, loosen top retaining bolt and remove filter shells and elements. Wash shells in clean fuel and discard old elements and gaskets. Using new elements of the type and number specified on shell and the new gaskets provided in the element cage, reassemble the filters. With engine running, check for leaks.

c. Primary Fuel Strainer (hull numbers 8540 thru 8560 and 8580 thru 8618). Refer to figure 84 for strainer servicing instructions.

4-28. Fuel Injectors

a. Description. Fuel injectors are installed as shown in figure 4-18. They are mounted in the cylinder head with their spray tips projecting slightly below the top of the inside surface of the combustion chambers.

b. Removal (fig. 4-14).

(1) Remove the valve rocker cover.

(2) Remove the fuel pipes from both the injector and the fuel connectors.

(3) Install clean shipping caps on the injector fuel inlet and outlet and on the fuel connectors..

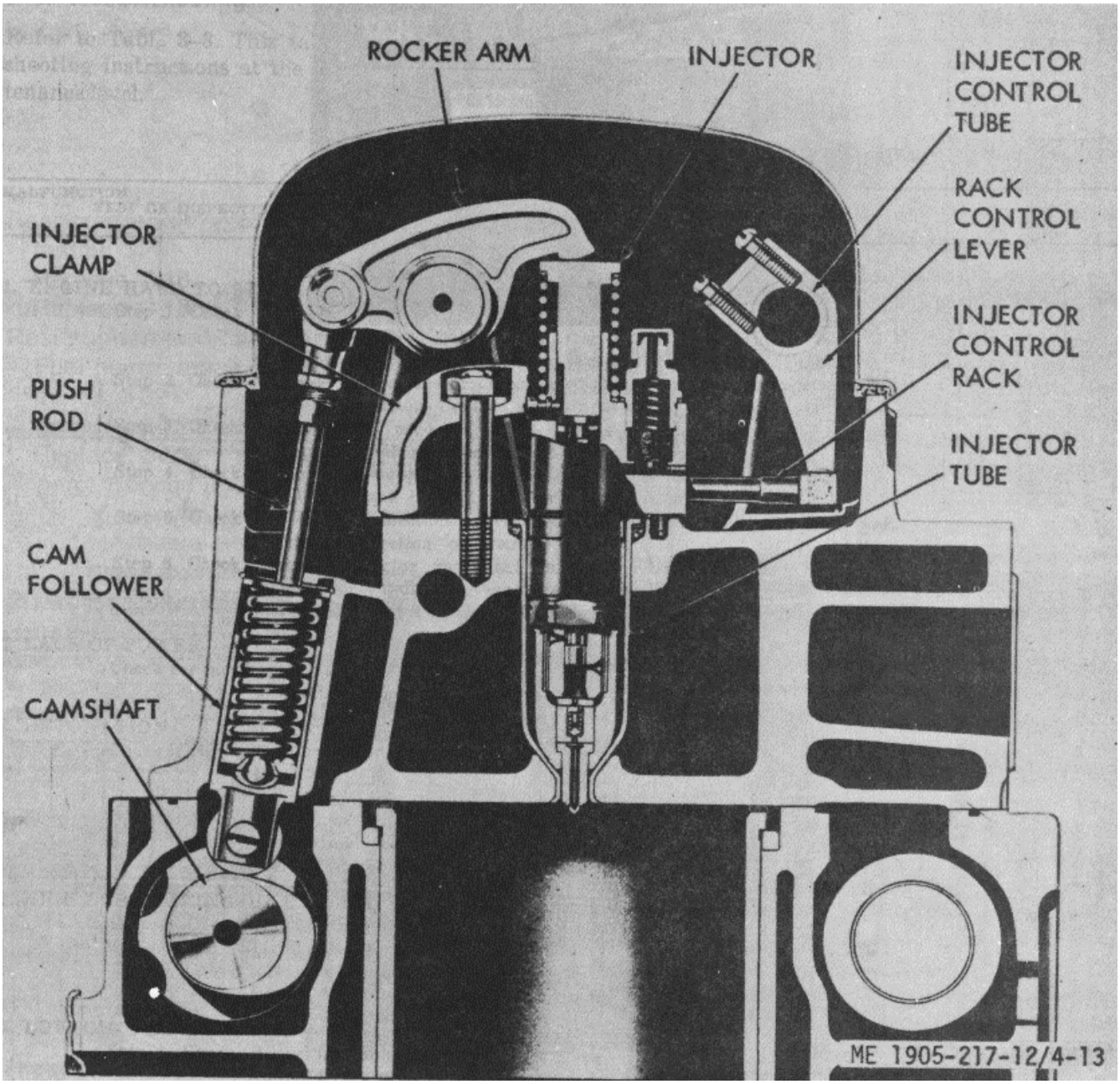


Figure 4-13. Fuel injector mounting.

(4) Crank the engine to bring the outer ends of the push rods of the injector and valve rocker arms in line horizontally.

(5) Remove the two rocker shaft bracket bolts and swing the rocker arms away from the injector and valves.

(6) Remove the injector clamp bolt, special washer, and clamp.

(7) Loosen the inner and outer adjusting screws on the injector rack control lever and slide the lever away from the injector.

(8) Lift the injector from its seat in the cylinder head as shown in figure 4-14. Use special tool J1227-01.

(9) Cover the injector hole in the cylinder ,head to keep foreign material out.

c. Cleaning.

(1) Clean the exterior of the injector with ,fuel oil and dry it with compressed air.

(2) Before installing an injector in an engine, remove the carbon deposits from the bevelled seat of the injector tube in the cylinder head. This will assure correct alignment of the

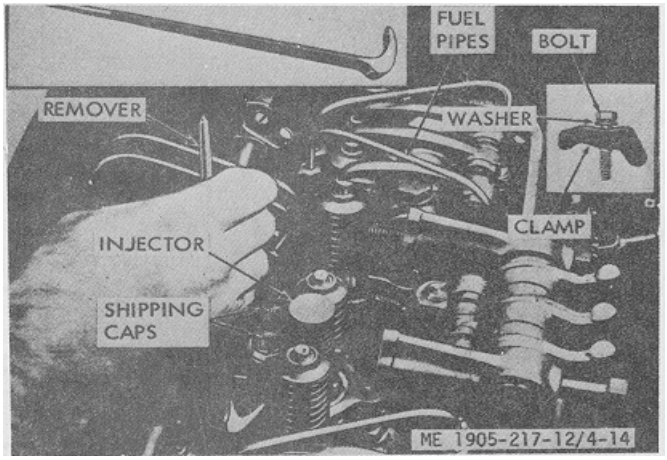


Figure 4-14. Removing injector from cylinder head.

injector and prevent any undue stresses from being exerted against the spray tip.

d. Installation.

(1) Refer to figure 4-13 and insert the injector into the injector tube with the dowel registering with the locating hole in the cylinder head.

(2) Slide the rack control lever over so that it registers with the injector rack.

(3) Place the injector clamp in place and install the special washer. Install the bolt and tighten it to 20-25 ft-lb torque. Make sure that the lamp does not interfere with the exhaust valve or injector springs.

NOTE

Check the injector control rack for free movement. Excess torque can cause the control rack to stick or bind.

(4) Move the rocker arm assembly into position and tighten the rocker arm bracket bolts to 90-100 ft-lb torque.

(5) Remove the shipping caps. Then, install the fuel pipes and connect them to the injectors and the fuel connectors. Tighten the connections to 12-15 ft-lb torque.

CAUTION

Do not bend the fuel pipes and do not exceed the specified torque. Excessive tightening will twist or fracture the flared end of the fuel line and result in leaks. Lubricating oil diluted by fuel oil can cause serious damage to the engine bearings.

(6) After installing the injectors in the engine, perform a complete engine tune-up. However, if only one injector has been removed and replaced and the other injectors and the governor adjustment have not been disturbed, it will only be necessary to adjust the valve clearance and time the injector for the one cylinder, and to position the injector rack control levers. Refer to paragraph 431 to position the rack control levers.

e Timing the Injector (fig. 4-16).

(1) Pull the engine stop control out to the NO-FUEL position.

(2) Rotate the crankshaft until the exhaust valves are fully depressed on the cylinder to be timed.

(3) Place the small end of the injector timing gage J1853 (for HV7 injector) in the hole [provided in the top of the injector body, with the flat of the gage toward the injector follower.

See figure 4-16.

(4) Loosen the push rod locknut.

(5) Turn the push rod and adjust the injector rocker arm until the extended part of the gage will just pass over the top of the injector follower.

(6) Hold the push rod and tighten the locknut. Check the adjustment and, if necessary, readjust the pushrod.

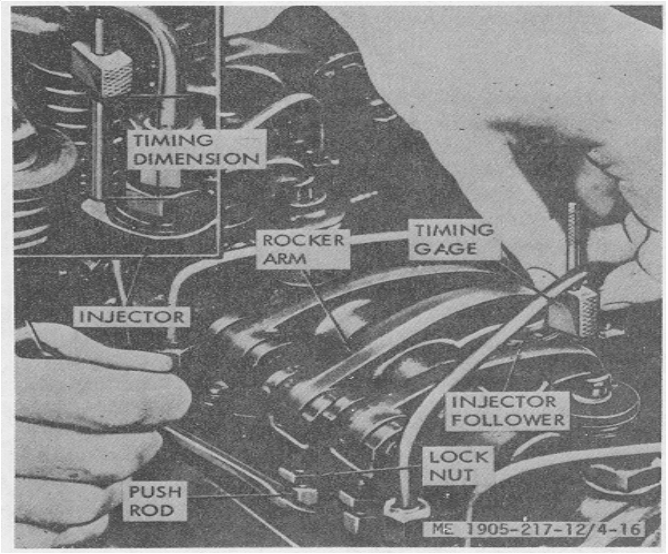


Figure 4-16. Timing fuel injector.

(7) Refer to paragraph 4-31 and make injector rack control adjustment.

4-29. Fuel Pump (fig. 4-17)

a. General.

(1) The positive displacement gear-type fuel pump transfers the fuel from the supply tank to the fuel injectors. The pump circulates an excess supply of fuel through the injectors which purges the air from the system and cools the injectors. The unused portion of fuel returns to the fuel tank by means of a ,fuel return manifold and fuel return line.

(2) The pump is attached to the rear end plate cover of the blower assembly with three bolt and seal assemblies. The seals are flat, soft copper washers which prevent the oil in the blower cover from seeping out around the bolt threads. The pump is driven off the end of the blower lower rotor by means of a drive coupling fork attached to the end of the pump drive shaft and mating with a drive disc attached to the blower rotor.

(3) Fuel pumps are furnished in left-hand or right-hand rotation, according to the engine model, and are stamped, "LH IN" or "RH IN". The left hand -pumps are used on LB-RB engines while the right-hand pumps are used on LD-RD engines. These pumps are not interchangeable, nor can a pump made for one rotation be rebuilt for the other rotation since the relief valve can be installed in only one position in the pump body.

b. Removal.

(1) Disconnect the fuel lines from the inlet and outlet openings at fuel pump.

(2) Disconnect the drain tube from the fuel pump.

(3) Remove the three pump attaching bolt and seal assemblies, using wrench J4242, and withdraw the pump from the blower.

(4) Check the drive coupling fork, and, if broken or worn, replace it with a new coupling.

c. *Installation (fig. 4-17).* The left-hand pump is used on "B" engines and the right-hand pump is used on "D" engines. The pumps are not interchangeable. The pump must always be installed with the inlet opening in the pump cover (marked "LH IN" or "RH IN") on the side toward the cylinder block. Install the pump as follows:

(1) Affix a new gasket to the pump body mounting flange and locate the pump drive coupling fork over the squared end of the drive shaft with prongs of fork directed away from the pump.

(2) Place the fuel pump assembly up against the blower with the prongs of drive coupling fork in registration with slots in drive disc on the blower rotor shaft.

(3) Secure the pump to the)lower, with three bolt and seal washer assemblies.

(4) Connect the inlet and outlet fuel tubes to the fuel pump.

(5) Connect the drain tube to the fuel pump body.

4-30. Governor

a General.

Each governor has an identification plate located on the control housing, containing the governor assembly number type-,

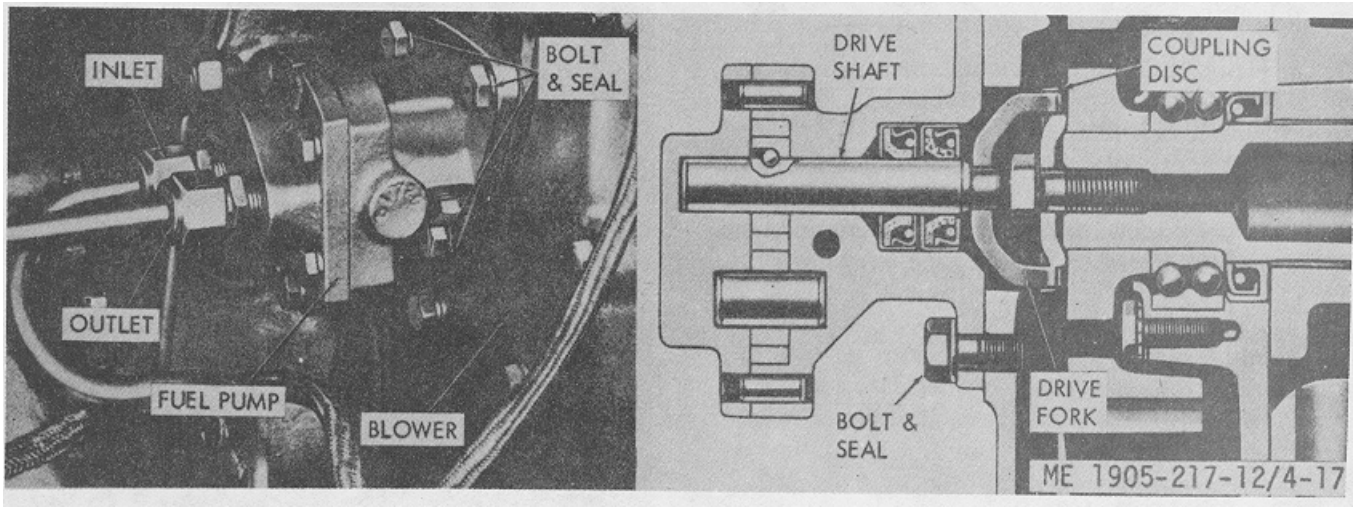


Figure 4-17. Fuel pump.

idle-range rpm, and drive ratio. The maximum engine speed, not shown on the identification plate, is stamped on the option plate attached to the valve rocker cover.

b. Checking Governor Operation.

(1) Governor difficulties are -usually indicated by speed variations of the engine; however, it does not necessarily mean that all such speed fluctuations are caused by the governor. Therefore, when improper speed variations appear, the engine should be checked.

(2) Check the engine to be sure all cylinders are firing. If any cylinder is not firing, replace the injector (para 4-28).

(3) Check for bind that may exist in the governor operating mechanism or in the linkage between the governor and the control tube. With the fuel rod connected to the injector control tube lever, the mechanism should be free from bind throughout the entire travel of the injector racks. If friction exists in the mechanism, it may be located and corrected as follows:

(a) If an injector rack sticks or moves too hard, it may he due to the injector hold-down clamp being too tight or improperly positioned. *To* correct this condition, loosen the injector clamp, reposition, and tighten to 20-25 ft-lb torque.

(b) A binding injector may result from internal dirt accumulation, defective plunger and bushing, or a bent injector rack. A defective injector must be replaced.

(c) An injector rack may bind as the **re**sult of an improperly positioned rack control lever. Loosen the control rack adjusting screws.

If this relieves the bind, relocate the lever on the control tube and position the rack as outlined in paragraph 4-1.

(d) The injector control tube may bind in its support brackets, thus preventing -free movement of the injector racks to their no-fuel position due to tension of the return spring. This condition may be corrected by loosening and realining the control tube supporting brackets. If the control tube support brackets were loosened, realined and tightened, the injector racks must be repositioned as outlined in paragraph 4-31.

(e) A bent injector control tube return spring may cause friction in the operation of the injector control tube. If the spring has been bent or otherwise distorted, install a new spring. Check for bind at the pin which connects the fuel rod to the injector control tube lever; replace the pin if necessary.

(4) If, after making the preceding checks, the governor fails to control the engine properly, the governor should be removed and reconditioned.

c Removing the Governor (fig. 4-18, 4-19, and 4-20).

(1) Disconnect the linkage attached to the governor control levers.

(2) Remove the breather tube.

(3) Remove four screws and lockwashers and lift the governor cover and gasket from the governor housing.

(4) Refer to figure 4-20 and disconnect the fuel rod from the differential lever.

(5) Remove the four bolts and the separate cover from the weight housing.

'(6) Remove two governor-to-cylinder head bolts.

(7) Move the upper end of the control housing away from the cylinder head and free the lower end from the weight housing.

(8) Use tool J4242, to remove the six governor weight housing-to-blower bolts; then withdraw the housing from the blower.

d Installing the Governor.

(1) Affix anew gasket to the governor weight housing. Start the splined end of the weight shaft in the upper blower rotor and position the housing against the blower end plate.

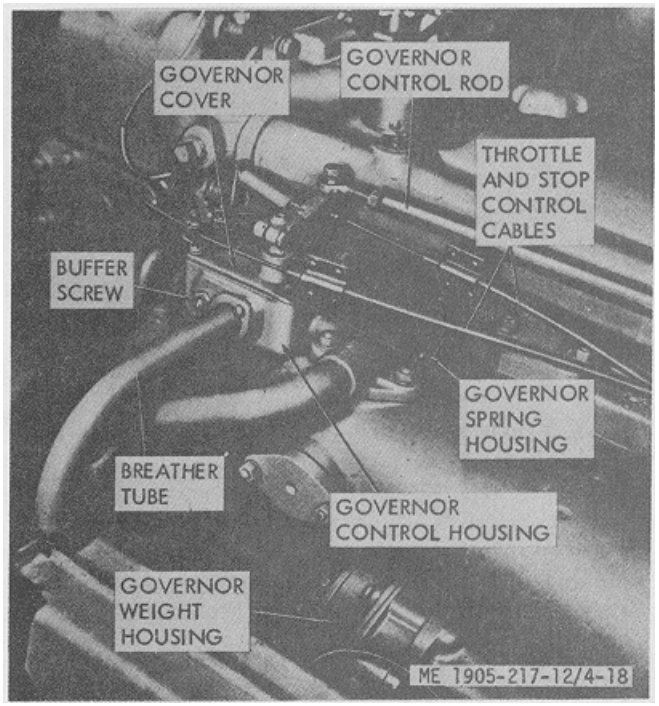
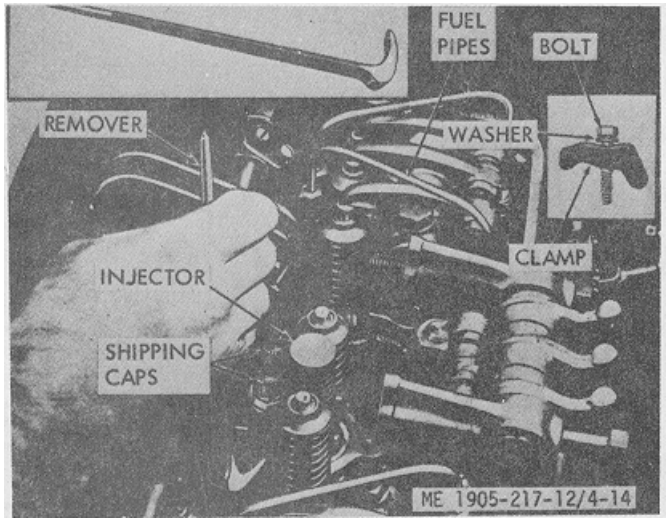


Figure 4-18. Removing the governor.



NOTE: PORT ENGINE INSTALLATION SHOWN.

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Figure 4-19. Removing the governor, hull number 8540 thru 8560 and 8580 thru 8618.

(

(2) Place a new copper gasket on each weight housing to-blower bolt and thread the bolts into the blower end plate, finger tight only.

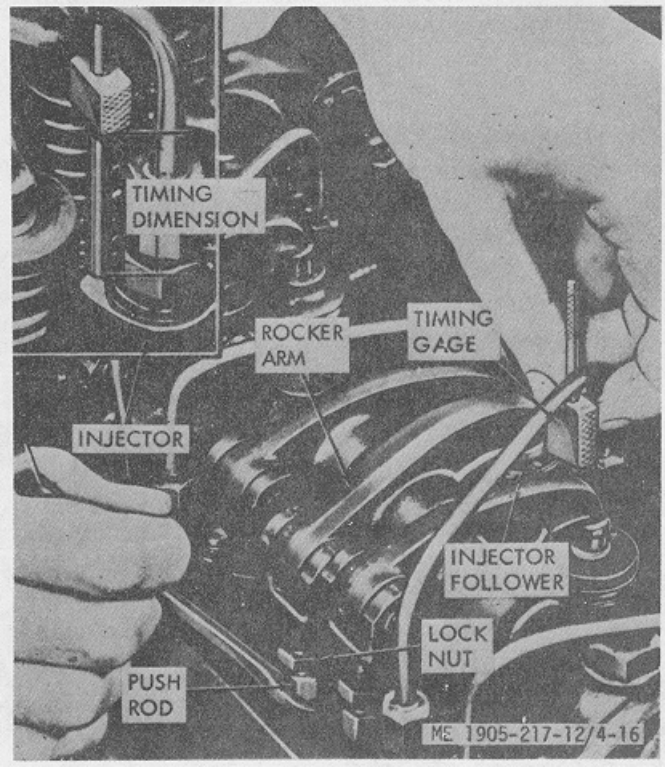
(3) Place a new gasket over the dowels and the side of the weight housing facing the (4) Move the thrust 'bearing assembly and rise toward the weight end of the shaft.

(5) Position the lower end of the control housing over the dowel pins in the weight housing.

NOTE

The finished surface of the operating fork must be placed against 'the outer side of the thrust bearing.

(6) Affix a new gasket to the governor control housing; then attach the governor control housing to the cylinder head with two bolts. Tighten the bolts.



1. Idle speed adjusting screw
2 High speed spring plunge
8. High speed spring
4. Low speed spring seat
5. Low speed spring cap
6. Low speed spring
7. Buffer screw
8. Locknut
9. Retainer locknut
10. High speed spring retainer
11. Locknut
12. Bolt
13. High speed spring retainer cover
14. Speed control lever
15. Throttle shaft lever
16. Cam
17. Fuel rod
18. Locknut
19. Gap adjusting screw
20. Operating shaft bearing
21. Operating shaft
22. Operating shaft busing
23. Gasket
24. Weight housing plug
25. Retaining bolt
26. Shaft end bearing
27. Weight housing cover
28. Riser thrust bearing
29. Governor riser
30. Weight housing
31. Weight carrier
82 Weight shaft assembly
33. Weight assembly
34. Operating shaft fork
36. Governor control housing
36. Operating shaft lever
37. Differential lever
38. Governor cover
39. Lockwasher
40. Screw

Figure 4-20. Governor components.

(7) Tighten the governor-to-blower bolts with wrench J42/-2.

(8) Affix a new gasket to the weight housing cover. Place the cover in position and install four bolts with lockwashers.

(9) Connect the oil tube to the fitting on the cover.

(10) Refer to figure 4-20 and position the fuel rod over the differential lever pin. Place a flat washer over the pin and secure it with the retainer.

(11) Attach the fuel rod to the injector control tube lever with a pin and cotter pin.

(12) Place a new gasket on the governor control housing and mount the governor cover on the housing with the pin on the throttle shaft registering with the machined slot in the differential lever.

(13) Install the four cover screws with lockwashers.

(14) Connect throttle linkage.

(15) Attach the breather tube to the governor housing.

(16) Adjust the governor and position the injector rack control levers as instructed in paragraph 4-31.

4-31. Governor and Injector Rack Control Adjustments

a. Governor Gap Adjustment. With the engine at operating temperature, adjust the governor gap as follows:

(1) With the engine stopped, remove the two attaching bolts and withdraw the governor high speed spring retainer cover (13, fig. 4-20).

(2) Back out the buffer screw (7) until it extends approximately 5/8 inch from the locknut.

(3) Start the engine and ,loosen the idle speed adjusting screw locknut and adjust the idle screw (1) to obtain the desired idle speed.

Hold the screw and tighten the locknut to retain the adjustment. The recommended idle speed is 550 rpm.

(4) Stop the engine and remove the governor cover and lever assembly.

(5) Remove the valve rocker cover.

(6) Remove the fuel rod (17) from the differential lever and the injector control tube lever.

(7) Check the gap between the low speed spring cap and the high speed spring plunger with gage (0.170 in.) J5407 as shown in figure

(8) If required, loosen the locknut and turn the gap adjusting screw until a slight drag is felt on the gage.

(9) Hold the adjusting screw and tighten the locknut.

(10) Recheck the gap and readjust if necessary.

(11) Install the fuel rod between the governor and injector control tube lever.

(12) Install the governor cover and lever assembly.

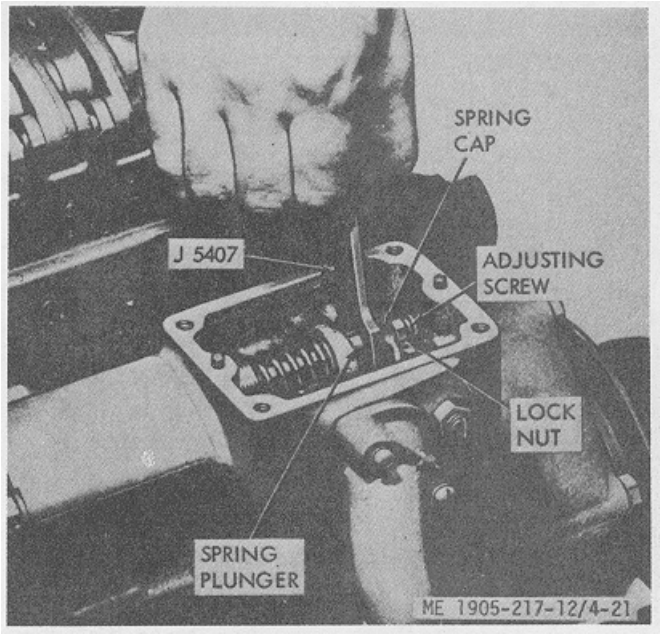


Figure 4-21. Adjusting Gap.

b. Positioning Injector Rack Control Levers.

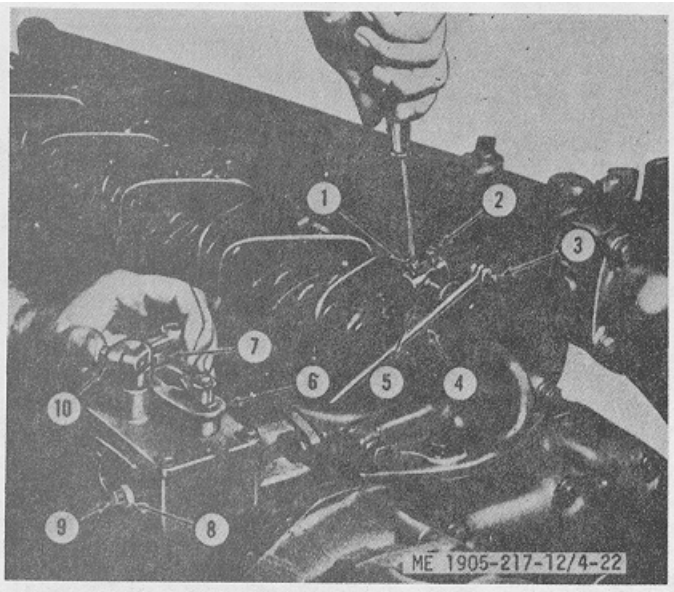
The position of the injector racks must be correctly set in relation to the governor. Their position determines the amount of fuel injected into each cylinder and ensures equal distribution of the load. Adjust the No. 1 injector rack control lever (fig. 4-22) first to establish a guide for adjusting the remaining injector rack control levers.

(1) Disconnect any linkage attached to the governor speed control lever.

(2) Loosen the idle speed adjusting screw locknut (fig. 4-20) and back out the idle speed adjusting screw until 1/2 inch of the threads project from the locknut %-hen the nut is against the high speed plunger.

(3) Loosen all of the inner and outer injector rack control lever adjusting screws. Be sure all of the control levers are free on the injector control tube.

(4) Move the governor speed control lever to the maximum speed position as shown in figure 4-22. Hold the lever in that position with light finger pressure. Turn the inner adjusting screw on the No. 1 injector rack control lever down until a slight movement of the control tube is observed or a step up in effort is noted. This will place the No. 1 injector rack in the full-fuel position. Turn the outer adjusting screw down until it bottoms lightly on the injector control tube. Then, alternately tighten both the inner and outer adjusting screws.



1. Control lever adjusting screw (inner)
2. Control lever adjusting
3. Injector control tube
4. Fuel rod
5. Injector rack control lever
6. Cam screw (outer)
7. Throttle shaft lever
8. Lock nut lever
9. Buffer screw
10. Speedcontrol lever

Figure 4-22. Positioning No. 1 injector rack *control lever.*

NOTE

The above step should result in placing the governor linkage and control tube assembly in the same position that they will attain while the engine is running at full load.

(5) To be sure the control lever is properly adjusted, hold the speed control lever in the maximum speed position and press down on the injector rack with a screw driver or finger tip and note "rotating" movement of the injector control rack (fig. 423) when the speed control lever is in the maximum speed position. Hold the speed control lever in the maximum speed position and using a screw driver, press downward on the injector control rack. The rack should tilt downward (fig. 4-24) and when the pressure of the screw driver is released, the control rack should "spring" back upward.

(6) If the rack does not return to its original position, it is too loose. To correct this condition, back off the outer adjusting screw slightly and tighten the inner adjusting screw slightly.

(7) The setting is too tight if, when moving the speed control lever from the idle to the maximum speed position, the injector rack becomes tight before the speed control lever reaches the end of its travel (as determined by

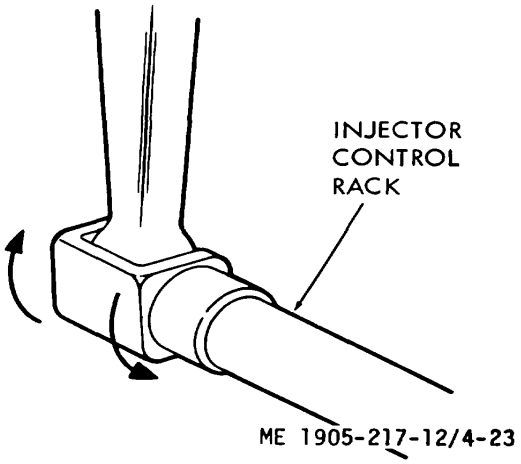


Figure 4-23. Checking rotating movement of injector control rack.

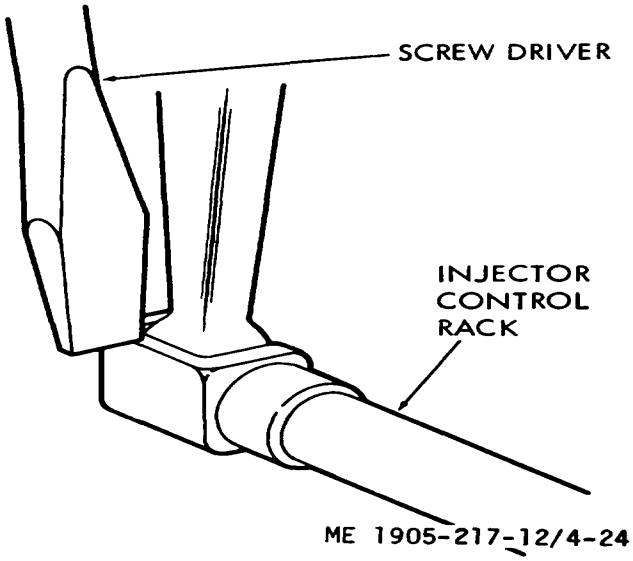


Figure 4-24. Check injector control rack "spring".

the stop under the governor cover). This will result in a step up in effort required to move the speed control lever to the end of its travel. To correct this condition, back off the inner adjusting screw slightly and tighten the outer adjusting screw slightly.

(8) Disconnect the fuel rod from the injector control tube and manually hold the No. 1 injector in the full-fuel position and turn down the inner adjusting screw of the No. 2 injector until the injector rack has moved into the full-fuel position and the inner adjusting screw is bottomed on the injector control tube. Turn the outer adjusting screw down until it bottoms lightly on the injector control tube. Then, alternately tighten both the inner and outer adjusting screws.

(9) Recheck the No. 1 injector rack to be sure that it has remained snug on the ball end of the injector rack control lever while adjusting the No. 2 injector. If the rack of the No. 1 injector has become loose, back off slightly on the inner adjusting screw on the No. 2 injector track control lever and tighten the outer adjusting screw. When the settings are correct, the racks of both injectors must be snug on the ball end of their respective rack control levers.

(10) Position the remaining injector rack control levels as outlined in steps 8 and 9.

(11) Connect the fuel rod to the injector control tube lever.

(12) Turn the 'idle speed adjusting screw until it projects 3/8-inch beyond the locknut. Tighten the locknut.

c . Adjusting Maximum No-Load Engine Speed. All governors are properly adjusted before leaving the factory. However, if the governor has been reconditioned or replaced, and to ensure the engine speed will not exceed the recommended no-load speed as given on the option plate, the maximum no-load speed may be set as follows:

(1) Loosen the locknut (fig. 4-25) and back off the high speed spring retainer approximately five turns.

(2) With the engine at operating temperature and no-load on the engine, place the speed control ,lever in the full-fuel position. T-urn the high speed spring retainer IN until the engine is operating at the recommended no-load speed.

(3) Hold the high speed spring retainer and tighten the locknut.

d Adjusting Idle Speed. With the maximum no-load speed properly adjusted, adjust the idle speed as follows:

(1) Remove the spring housing to uncover 'the idle speed adjusting screw.

(2) With the engine at normal operating temperature and with the buffer screw (fig. 426) backed out to avoid contact with the differential lever, turn the idle speed adjusting screw

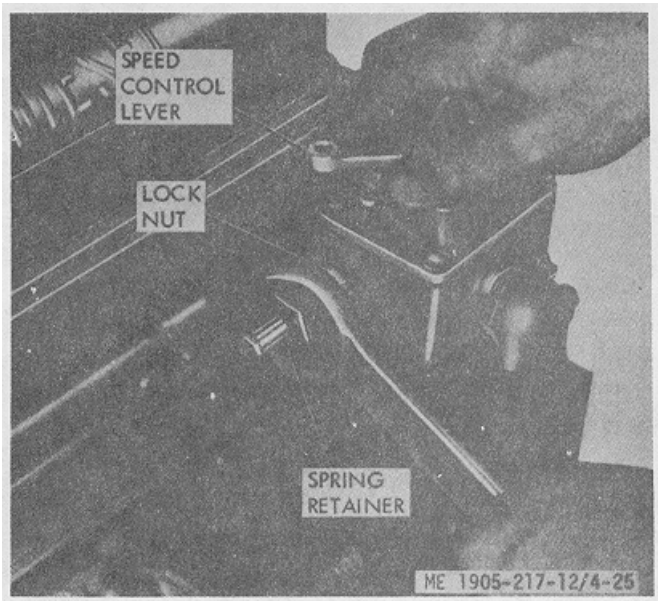


Figure 4-25. Adjusting maximum no-load speed.

until the engine is operating at approximately 15 rpm below the recommended idle speed. The recommended idle speed is 550 rpm.

(3) Hold the idle screw and tighten the locknut.

(4) Install the high speed spring retainer and retain with the two bolts.

e. Adjusting Buffer Screw. With the idle speed set, adjust the buffer screw as follows:

(1) With the engine running at normal operating temperature, turn the buffer screw (fig. 4-26) in so that it contacts the differential lever as lightly as possible and still eliminates "engine roll".

NOTE

Do not increase the engine idle speed more than 115 rpm with the buffer screw.

(2) Hold the buffer screw and tighten the locknut.

(3) Recheck the maximum no-load speed. If it has increased more than 25 rpm, back off the buffer screw until the increase is less than 2-5 rpm.

432. Engine Throttle Controls

a. Each propulsion unit consists of two engines connected by clutches to a common gear box. The throttle adjustment is made so that each engine of a twin unit will carry its share of the load.

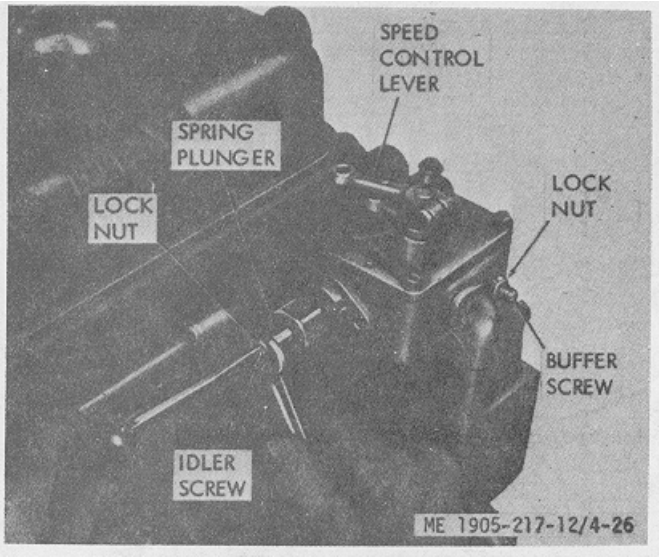


Figure 4-26. Adjusting engine idle speed.

b The throttle linkage may be adjusted after

(1) With engines stopped, set the throttle setting the valves, timing the injectors, adjusting the governor and the injector operating linkage as follows (fig. 4-27).

control cross shaft (15, fig. 4-27) so that throttle control levers (17) are in a vertical position as shown at "A-A".

(2) With engines stopped, adjust turnbuckles (13 fig. 4-27) on the two throttle control rods so that pins in the throttle control levers at governor cover rest against the shoulders of the control cams (8) in the "IDLE" position at the two governors.

(3) Now move master throttle (16) to "FULL" open position, at which setting the pin in throttle lever (24) at both governors should just strike the extreme end of the slot in the cam (8) at the "RUN" position. If either or both pins do not reach end of slot in cams, adjust turnbuckles (13) to bring about this condition. The linkage must be so adjusted that the pins in the throttle ,levers at governor covers reach "RUN" position in the control cam at exactly the same time. Do not put any strain in the throttle linkage when making this adjustment.

(4) Start and warm up both engines to operating temperature. Move master throttle to "IDLE" position. Declutch both engines and set idling speed of each engine to 500 rpm.

NOTE

Engine may be brought up to operating temperature by declutching engines and setting throttle to approximately 1,200 engine Wpm.

If quick warm-up is attempted by burning the propeller, the ship must be securely tied to the clock with no loose lines or floating obstructions to foul the propeller.

(5) Set governor no-load top speed. Usually the top no-load speed is set the same on both governors of twin units before the engines leave the factory. If check as outlined below shows top no-load speeds to be different on the two governors, correct as follows:

(a) With both engines warmed up, stop engines and disconnect throttle control rod (11, fig. 4-27) for "B" engine by removing pin at clevis (14).

(b) Start "D" engine, declutch and move master throttle to "FULL" open position.

(c) Note and record maximum no-load speed as indicated by tachometer.

(d) Stop engine and connect throttle control tube for "B" engine and disconnect "D" engine.

(e) Start "B" engine, declutch, and with master throttle in "FULL" open position, note and record speed.

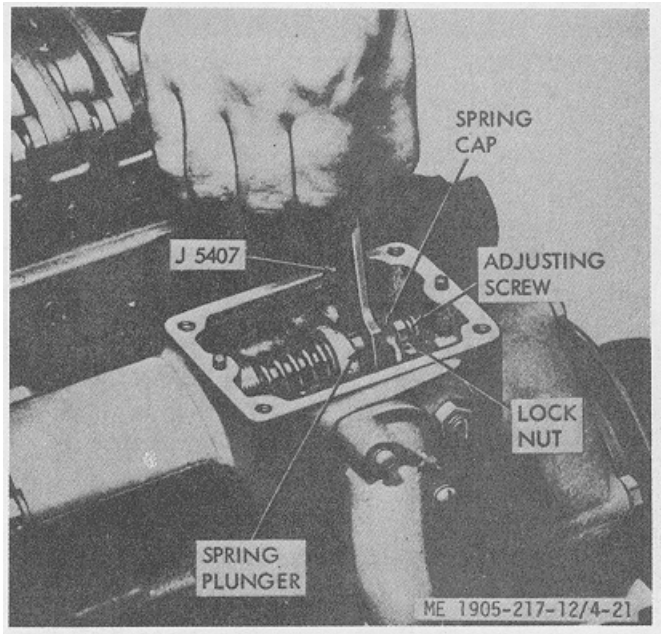
(f) If no-load speeds of the two engines are not the same, increase the speed of low engine by adding shims (5) between the high speed spring (4, fig. 4-27) and the spring plunger (3). To add shims, remove low-speed adjusting screw cover (1), back out nut (2), and place shims -between inner end of spring and shoulder on plunger. Add one shim at a time and check speed after each shim is added.

(6) Synchronize engine speeds at no-load. Speeds of the two engines must be synchonized to obtain, as nearly as possible, the same no-load speeds in the range just below the rated load speed by ’adjusting the linkage to each governor. Thus, a unit rated at 1,850 rpm should have the engines synchronized at 1,700-1,800 rpm. Synchronize as follows:

(a) with engines warmed up, declutch both engines and move master throttle to such ,position that speed of "B" engine is 1,750 rpm as -recorded by the tachometer. Lock the master throttle in this position.

*(b) N*ote speed of the "D" engine. If the speeds of the two engines are not the same, loosen the two locknuts at turnbuckle on the ’"D" engine, and by adjusting turnbuckle, shorten throttle rod to increase or lengthen to decrease engine speed.

(c) Unlock and move master throttle to "FULL" open position. In the "FULL" open position, without strain on the throttle linkage, the



1.Low speed a*djusting* screw cover
2. High speed spring retaining nut
3.Spring plunger
4. High speed spring
5. Shims
6. Low speed spring gaps
7. Govenor
8. Control Cam
9.Govenor control lever
10.Govenor control link (for '"D")" engine)
11. Throttle control rod
12.Throttle control rod locknut
13. Throttle control rod turnbluckle
14. Throttle control rod clevis
15. Throttle control cross shaft

Figure 4-27. Throttle control adjustment dfagram.

16. Master lever
17. Throttle control lever
18. Throttle control support bracket
19. Throttle control to governor link
20. Governor control link
21. Injector control tube lever
22. Injector (for "B" engine)
23. Injector rack control tube
24. Governor throttle control lever

Figure 4-7 -- Continued

pins in throttle control levers (24, fig. 4-27) at the governor covers of both engines should be within 1/16-inch of the same distance from the end of the slot in cam. If the levers are not within this limit, the chances are that the governor gaps or the injector rack adjustments are not identical on the two engines and should be rechecked. The governor with the pin closest to the end of the cam slot may have a "close" gap or the governor with the pin farthest from the end of the cam slot may have the injector racks too "tight". If adjustments are necessary, recheck engine speeds after making adjustments.

4-33. Propulsion Unit Controls (Hull Numbers 8540 thru 8560 and 8580 thru 8618)

a. Throttle Control. Each propulsion unit consists of two engines connected by the power transfer unit. The propulsion unit is controlled by a single throttle control from the pilot house or from the engine room. Individual engines are controlled by individual throttle levers located on each propulsion unit. figure 2-8.1 illustrates the locations of the controls on the port propulsion unit. The throttle adjustment is made after setting the valves (para 3-21), timing the *injec*tors (para 4-28), adjusting the governor (para 4-31), and adjusting the injector operating linkage (para 4-31). The propulsion unit throttle control is inter-locked with the reverse-gear control lever to prevent engagement or disengagement of the clutch until the throttle has been -placed in the idle speed position. Adjust throttle linkage by the procedure listed below. Key numbers refer to figure 2-8.1 unless otherwise noted.

(1) Disconnect pilot house throttle control by pulling out the manual disconnect pin (16) and twisting 90 degrees.

(2) With engines stopped, set throttle control cross shaft (5) so that the individual engine throttle levers (8) are in a vertical position.

NOTE

The propulsion throttle control lever (,17) must maintain an approximate 30 degrees above horizontal position when in idle position.

(3) Loosen lever (14) and lever (10) and disconnect rod (‘9) from lever (10). Adjust so that rod (9) forms and approximate 90 degree angle with both levers. Secure levers (14 and 10) to the shafts and place rod (,9) into appropriate hole in lever (10) to maintain 90 degree angle.

Secure rod.

(4) Adjust turnbuckles (2 and 11) so that the pins in the governor throttle control levers (15, fig. 4-20) contact the shoulders of the slot in the control cams (16) in the idle position.

(5) Move propulsion unit control lever (17) to the full-open position. The pins in the governor throttle control levers (15) should just contact the extreme end of the slot in each control cam (16). If the pins do not contact the end of the slots, readjust the turnbuckles (2, 11). The linkage must be adjusted so that the governor throttle control lever pins on both governors reach the run position of each cam at the same time.

(6) Engage pilot house throttle control by pulling out disconnect pin (16) and turning 90 degrees.

(7) Place pilot house throttle control (15, 16, fig. 2-3) an idle position. Adjust turnbuckles (6) to ensure engine room propulsion unit throttle control (17) is in similar position.

(8) Check that pins in the governor throttle control levers (15) are contacting the shoulder of the cam control slot in the idle position.

NOTE

Do not force linkage or put any strain on throttle linkage when making this adjustment.

(9) If pins are not contacting the idle shoulder, adjust turnbuckles (6) until proper relationship is obtained.

(10) Move pilot house propulsion unit throttle control (15, 16, fig. 2-3) to full-pen position. Repeat step (6) above.

(11) Start and warmup both engines to operating temperatures.

NOTE

Engine may be brought up to operating temperature by declutching engines and setting throttle to approximately 1,200 engine rpm. If quick warmup is attempted by turning the propeller, ,the ship must be securely tied to the dock with no loose lines or floating obstruction to foul the propeller.

(12) Disengage one engine throttle control (8) from cross shaft (5) by pulling upward on the lever. Set idle speed of engine to 550 rpm (para 4-31).

(13) Repeat step (12) for other engine.

(14) Set governor no-load top speed.

(a) With both engines warmed up, stop engines and disconnect throttle control rod (4) for outboard engine by removing bolt (1).

(b) Start inboard engine, declutch and move pilot house throttle control to FULL OPEN position.

(c) Note and record maximum no-load speed as indicated by tachometer.

(d) Stop engine and connect throttle control tube for outboard engine 'and disconnect inboard engine by removing bolt (13).

(e) Start outboard engine, declutch, and with pilot house throttle control in FULLOPEN position, note and record speed.

(f) If no-load speeds of the two engines are not the same, increase the low engine by loosening the lock nut (11, fig. 4-20) and turning the high speed spring retainer (10) in until the engine is operating at the desired no-load speed.

(g) (connect throttle control rod (12) for inboard engine.

(15) Synchronize engine speeds at no-load.

Speeds of the two engines within one propulsion unit must be synchronized to obtain, as nearly as possible, the same no-load speeds in the range just below the rated load speed by adjusting the linkage to each governor. Synchronize as follows:

(a) With engines warmed up declutch both engines and move the pilot house throttle control to such position that speed of the inboard engine is 1,750 rpm as indicated by the tachometer. lock the throttle in this position.

(b) Note speed of the outboard engine.

If the speeds of the two engines are not the same, loosen the ,locknuts at turnbuckle on the outboard engine, and by adjusting turnbuckle, shorten throttle rod to decrease or lengthen to increase engine speed.

(c) Unlock and move pilot house throttle control to FULL-OPEN position. In the full open position, without strain on the throttle link age, the pins in the throttle control levers (15) at the governor covers of both engines should be within 1/16-inch of the same distance from the end of the slot in cam. If the levers are not within this limit, the governor gaps or the injector rack adjustments are not identical on the two engines and should be rechecked (para 4-81).

If adjustments are necessary, repeat steps (14) and (15) above after making adjustments.

b. Reverse Gear Control (fig. 4-28). A single control lever is provided in the pilot house and in the engine room for reverse gear control of each propulsion unit. The reverse gear control is interlocked with the throttle control to prevent engagement or disengagement of the clutch except when propulsion unit is at idle rpm. Control of individual engine reverse gears is provided by a shutoff valve (18) for controlling the flow of oil to each engine. The valves are normally in a vertical (ON) position. The reverse gear control linkage is adjusted as follows (-engine stopped):

CAUTION

If a shutoff valve is placed in an off position, lock it in that position to prevent vibration from moving it to a vertical (ON) position.

(1) Disengage pilot house control lever (14 and 17, fig. 2-3) by pulling out manual disconnect pin (22) and turning 90 degrees.

(2) Place engine room control lever (24) into forward position. Using turnbuckle, adjust rod (23) to insure lever (20) is contacting forward stop.

(3) Place engine room control lever (24) into reverse position. Insure lever (20) is just contacting reverse stop. Adjust turnbuckle and 'rod (23) if required.

(4) Place engine room control lever (24) into neutral position. Insure lever (20) is in neutral position.

(5) Repeat steps (2), (3), and (4) until lever (20) is in correct position in relation to control lever (24).

(6) Engage pilot house control lever by pulling out manual disconnect -pin (22) and turning 90 degrees.

(7) Place pilot house control in forward position and adjust turnbuckles (25) to obtain proper position of engine room control (21).

(8) Repeat step (7) for reverse and neutral positions.

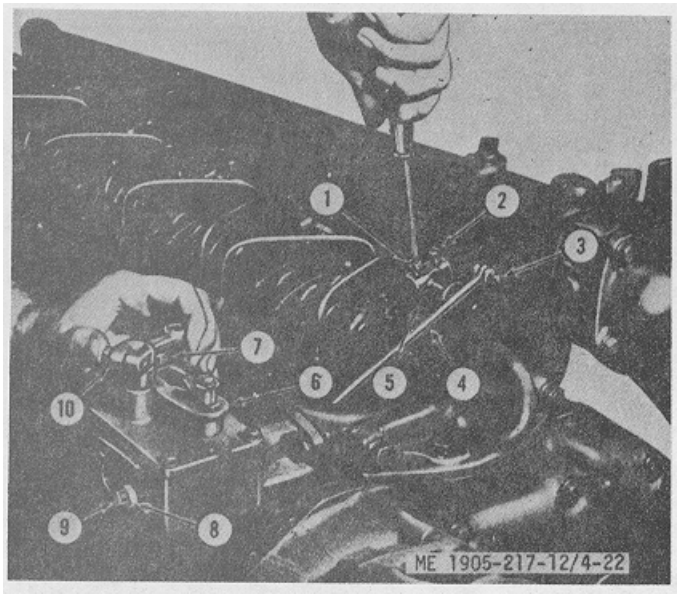


Figure 4-28. Pilot house engine control, hull number 8540 thru 8560 and 8580 thru 8618.

4-34. Pilot House Engine Control System (Hull Number 4500 thru 85'19)

a. *General.* Hull numbers 8500 thru 8519 are equipped with a model MD engine control system which consists of a pilot house control head, terminal blocks, elbows, engine control unit, conduit, and cable as shown in figure 4-29. The twin engine control is designed to allow the operator to control both propulsion units with one hand. Clutch action occurs in the first 30° of the travel each side of neutral, while the remaining 600 of travel provides governor control from idle-to-full ahead or astern. Separate neutral throttle controls and separate stop controls for each engine are located on the pilot house control panel.

b. Maintenance.

(1) Bearings in the pilot house control head and cable elbows have sealed ball bearings and *re* lubricated for life. Terminal block sheaves are of nylon and require no lubrication.

(2) The engine control unit (in engine room) should be lubricated once a year in normal service. A grease fitting is provided. The exposed chain should be painted with grease twice a year. No other maintenance is required.

4-35. Pilot House Engine Control System (Hull Numbers 8520 thru 8539)

a. General. Hull numbers 8520 thru 8569 have a separate model MK control system for each propulsion unit. Each control system consists of a pilot house control head and two push-,pull cables. One cable is for shift control and the other for throttle control. The control head lever operates both cables in proper sequence as shown in figure 4-30. A neutral throttle lever is provided on each control head. If control from the engine room is necessary, the cables can be disconnected by using the quick disconnects shown in figure 4-31.

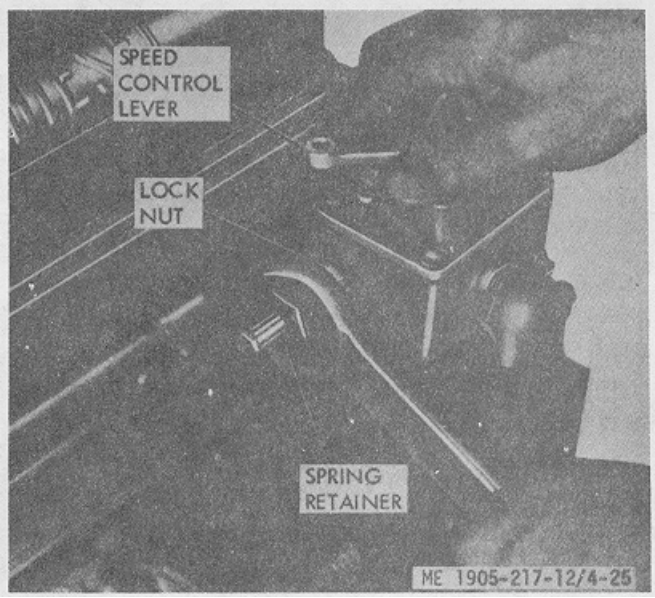


Figure 4-29. Pilot house engine control system, hull num*ber**s** 8500 thru 8519.*

b Adjustments.

(1) Operate the control hand lever several times. The control head lever detent positions and the transmission shift lever detent must coincide exactly at the neutral position. Adjust the clutch cable terminal at the engine as required to synchronize the detent position.

(2) Under no conditions should the operation of the control head hand lever cause the engine clutch lever to jam against its limit stops at either forward or reverse. Otherwise, the control head hand lever will bind and be difficult to move through the forward and reverse throttle ranges.

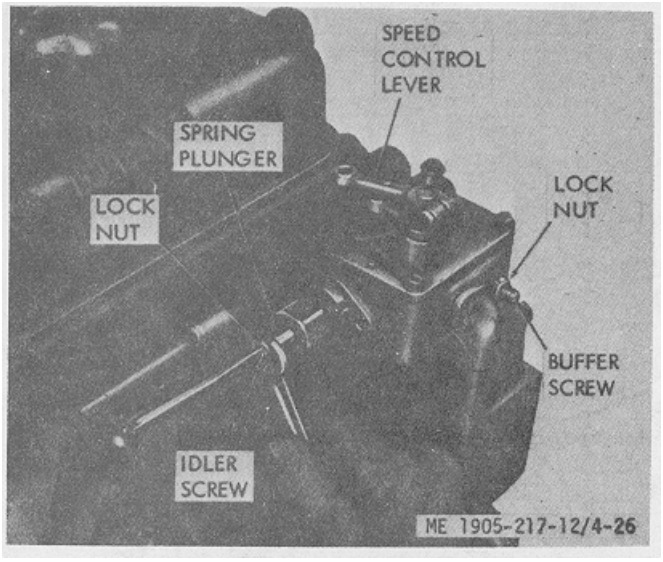


Figure 4-30. Pilot house *engine control, hull number 8520 the 8519**.***

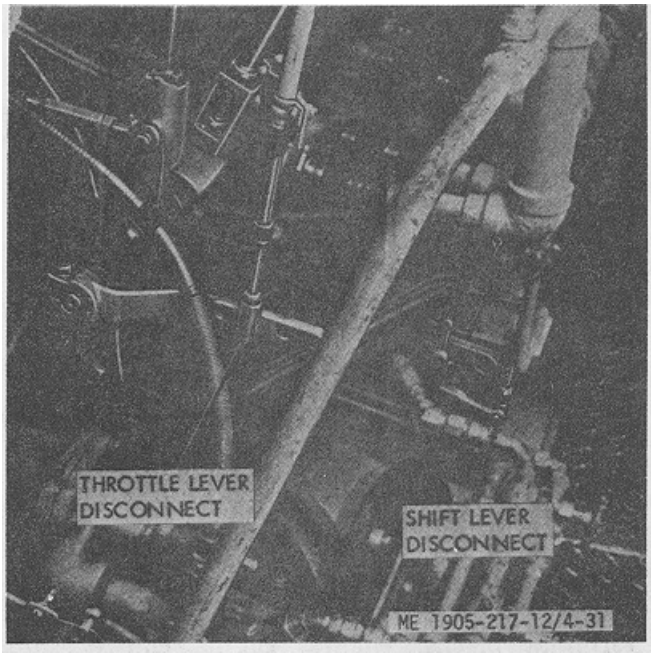


Figure 4-31. Engine controls quick disconnects, hull num*8520 thru 8539.*

(3) To adjust operating tension, remove the nameplate on top of the control head, pry out red plug, and turn adjustment screw. Turning screw to the right increases operating tension.

4-36. Air Silencer

a. General.

(1) The air silencer is attached to the air intake side of the blower rotor housing. A perforated sheet metal partition divides the silencer into two sections. The inner portion forms an air duct the entire length of the silencer. Air enters this duct from both ends and flows toward the outlet opening at the center and then into the blower. The outer portion is filled with sound absorbent, flameproof, felted-cotton waste.

(2) An air intake (blower) screen is used between the air silencer and the blower housing to prevent foreign objects from entering the blower.

b. Removal.

(1) Remove the bolt that retains the breather pipe to the air silencer.

(2) While supporting the silencer, remove the six attaching bolts and washers. Then remove the silencer and air intake screen from the blower.

c. Cleaning. Clean or replace the air intake screen (fig. 4-32).

d. Installation. Install the screen and silencer in reverse order of removal.

4-37. Blower

a. General. The blower supplies the fresh air needed for combustion and scavenging. Its operation is similar to that of a gear-type oil pump. Two hollow three-lobe rotors revolve with very close clearances in a housing bolted to the cylinder block. To provide continuous and uniform displacement of air, the rotor lobes are made with a helical (spiral) form.

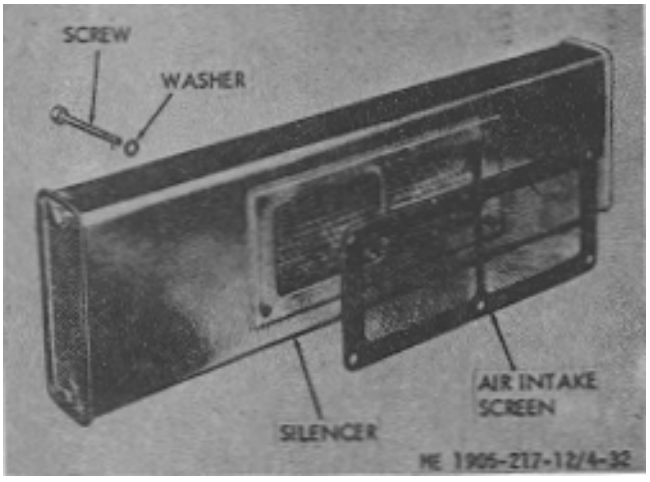


Figure 4-32. Blower air inlet silencer assembly.

b. Inspection. The blower may be inspected for any of the following conditions without being removed from the engine. However, the air inlet silencer must be removed. Refer to higher echelon if inspection indicates that blower repair is required.

CAUTION

When inspecting a blower on an engine with the engine running, keep fingers and clothing away from the moving parts of the blower and run the engine at low speeds only.

(1) Dirt or chips drawn through the blower will make deep scratches in the rotors and housing and throw up burrs around such abrasions. If burrs cause interference between the rotors or between the rotors and the housing, the blower should be removed from the engine and the parts dressed down to eliminate the interference, or the rotors must be replaced if they are too badly scored.

(2) Leaky oil seals are usually manifested by the presence of oil on the blower end plates and rotors or the inside surfaces of the housing. This condition may be checked by running the engine at low speed and directing a light into the rotor compartment at the end plates and the oil seals. A thin film of oil radiating away from the seals is indicative of an oil leak.

CAUTION

Stop engine prior to grasping the top rotor and attempt to rotate it.

(3) A worn blower drive, resulting in a rattling noise inside the blower, may be detected by grasping the top rotor firmly and attempting to rotate it. Rotors may move from 3/8 inch to 5/8 inch, measured at the lobe crown, with a springing action. When released, the rotors should move back at least 1/4 inch. If the rotors cannot be moved as directed above, or if the rotors move too freely, the flexible blower drive coupling should be inspected and replaced if necessary.

(4) Loose rotor shafts or damaged bearings will cause rubbing and scoring between the crowns of the rotor lobes and the mating rotor roots, between the rotors and the end plates, or between the rotors and the housing. Generally, a combination of these conditions exists. A loose shaft usually causes rubbing between the rotors and the end plates. Worn or damaged bearings will cause rubbing between the mating rotor

lobes at some point or perhaps allow the rotor assemblies to rub the blower housing. This condition will usually show up at the end where the bearings have failed.

(5) Excessive back-lash between the blower timing gears usually results in the rotor lobes rubbing throughout their entire length.

(6) To correct any of the above conditions, the blower must be removed from the engine and repaired or replaced. Refer to higher maintenance level.

4-38. Starting Aid - Pressurized Cylinder

a. General. All craft are equipped with the same type starting aid although they are mounted and actuated differently. The craft all have the starting aid mechanism connected to the air inlet housing of the blower with a small metal tube. See figures 2-6.1 and 4-41.1.

b. Service. Periodically perform the following service items to assure good performance:

(1) Remove the fluid cylinder and lubricate the valve around the pusher pin under the gasket with a few drops of oil.

(2) Lubricate the actuator cable.

(3) Actuate the valve with the cable to distribute the oil on the cable and allow the oil to run down through the valve.

(4) Remove any dirt from the orifice by removing the air inlet housing fitting, the orifice block and the screen, and then blow air through the orifice end only.

(5) Assemble and tighten the air inlet housing fitting to the actuator valve and tube.

(6) Check for leakage of fluid (fogging) on the outside of the engine air inlet housing by actuating the starting aid while the engine is stopped. If fogging occurs, disassemble and retighten the air inlet housing fitting to the housing.

WARNING

Do not actuate the starting aid more than once with the engine stopped. OVER-LOADING THE ENGINE AIR BOX WITH THIS HIGH VOLATILE FLUID COULD RESULT IN A MINOR EXPLOSION.

(7) Check the fluid cylinder for hand tightness.

SECTION XI. ENGINE EXHAUST SYSTEM

4-39. General

Each engine has a separate exhaust system consisting of exhaust manifold, exhaust elbow, exhaust pipes, and muffler as shown in figure 4-33 or 4-34. The exhaust manifold is water cooled from the engine cooling system, the exhaust pipes are covered with insulation, and the muffler is water cooled with water pumped by the sea water system. Refer to paragraph 4-22 for description and removal of the exhaust manifold.

4-40. Mufflers

a. Removal.

(1) Disconnect sea water connection to muffler.

(2) Remove bolts attaching muffler to exhaust pipes.

(3) Remove bolts attaching muffler to support brackets.

b. Installation. Install muffler in reverse order of removal.

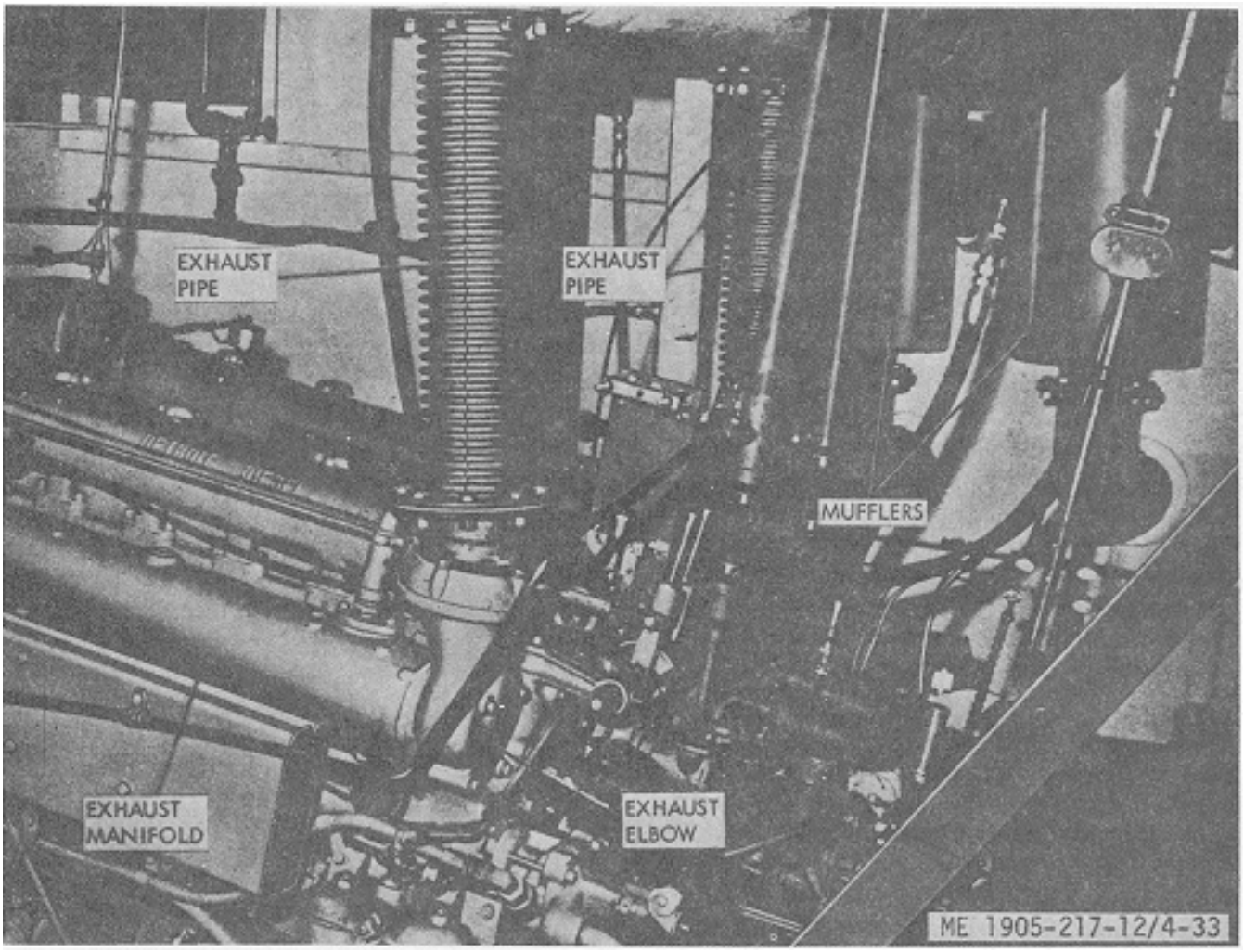


Figure 4-33. Exhaust system.

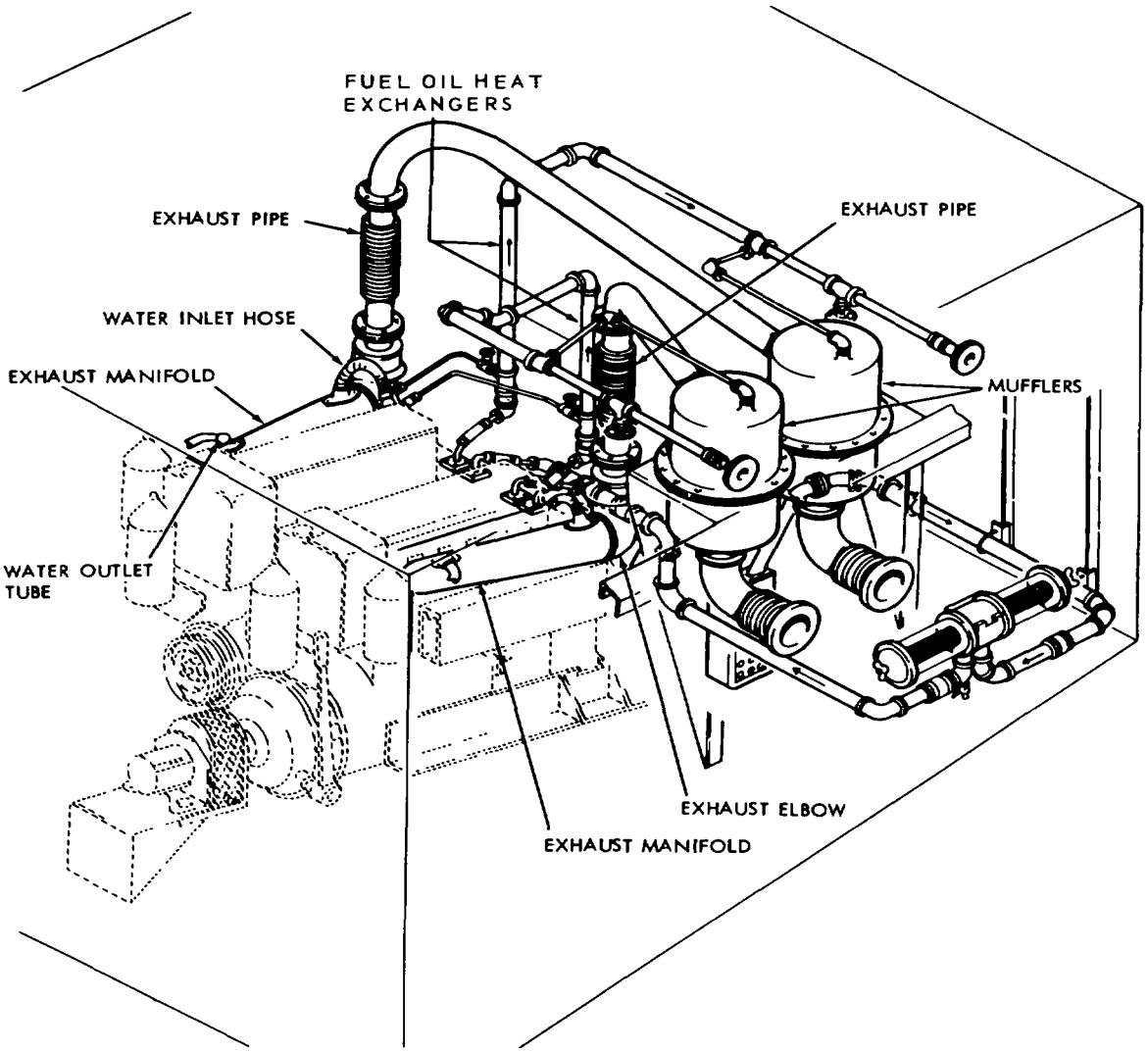


Figure 4-34. Engine exhaust system, hull numbers 8540 thru 8560 and 8580 thru 8618.

SECTION XII. ENGINE COOLING SYSTEMS

4-41. General

a. Fresh Water Cooling Systems. These systems provide cooling for the engines including the exhaust manifolds. See figures 1-16 or 4-35. Water is circulated by the engine water pump through the engine and through the keel-mounted heat exchanger. An expansion bank, with sight glass, is included in each cooling system and is mounted in the engine room. Check the water level daily as indicated in the sight glass.

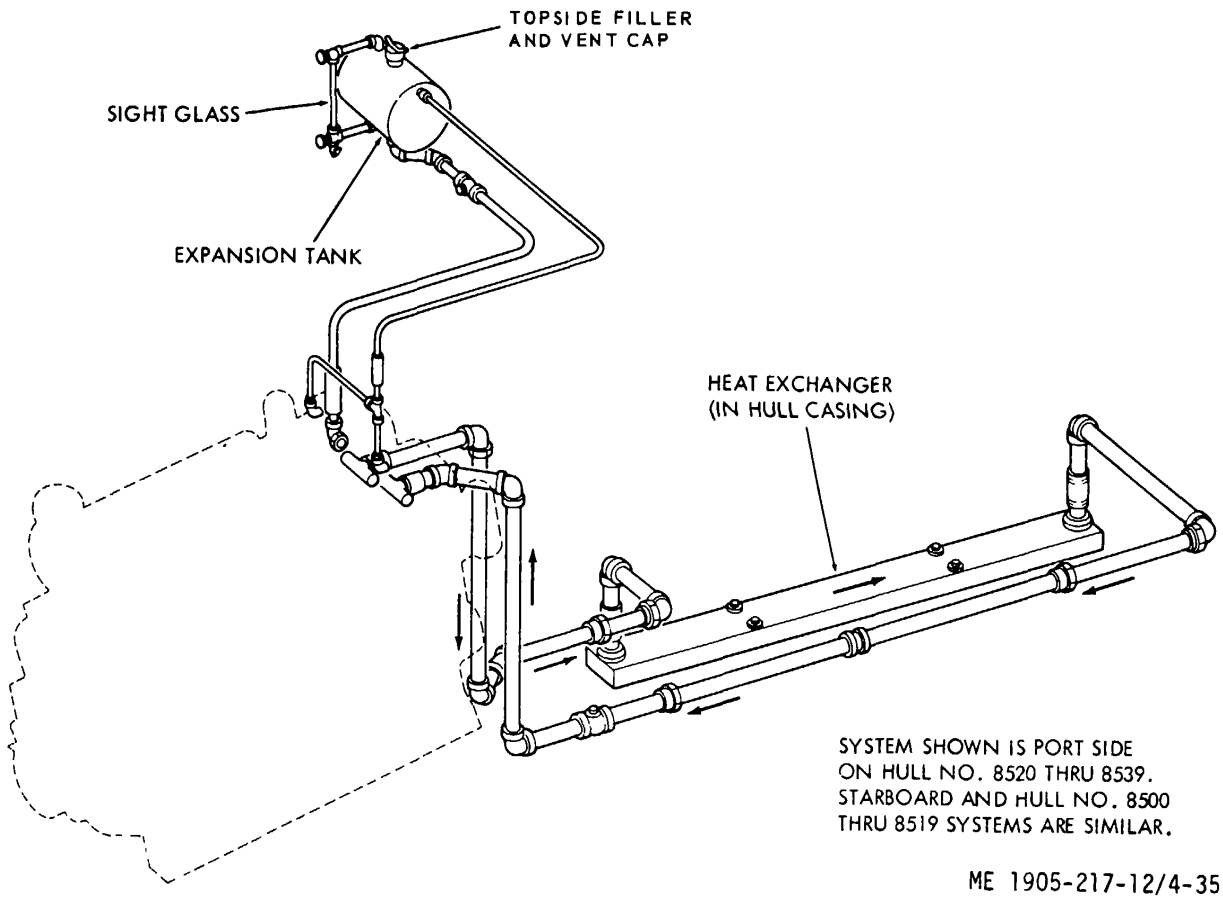


Figure 4-35. Fresh water cooling systems.

b. Raw (Sea) Water Cooling Systems. These systems provide cooling for the mufflers and priming for the bilge pumps. See figures 1-17 or 4-36. Sea water intake is at the sea chest which is in the hull adjacent to the fresh water heat exchanger. There are separate systems for each propulsion unit. Each system includes two raw-water pumps which are mounted aft on the engines. Raw water is pumped through sea mufflers and discharged with the exhaust. The raw water system also provides cooling for the fuel oil heat exchangers installed in hulls 8540 thru 8560 and 8580 thru 8618. Sea water strainers (mounted in the engine room) are connected in the intake lines between the sea chests and the pumps.

4-42. Heat Exchanger (Keel Cooler) Lines and Connections

Inspect heat exchanger lines and connections for leakage. Some are in the engine room and others are in bilge compartments forward from the engine room. See figures 1-16 or 4-35. Report defective hoses and clamps to a higher authority.

4-43. Engine Water Manifold (fig. 4-37)

a. Removal.

(1) Drain cooling system to a level below the water manifold.

(2) Loosen clamp and remove seal between water manifold and thermostat housing.

(3) Remove water manifold stud nuts and lockwashers and lift manifold off studs.

b. Installation. Remove all old gaskets and install new gaskets. Install water manifold in reverse order of removal.

4-44. Thermostat and Housing (fig. 4-38)

a. General. A properly operating thermostat is essential for efficient operation of the engine. If the engine operating temperature deviates from the normal range of 160° to 185°, remove and check the thermostat.

b. Removal.

(1) Drain cooling system to level below the thermostat housing.

(2) Loosen clamp and remove seal between thermostat housing and water manifold.

(3) Remove four bolts and lockwashers and remove the thermostat housing from the water tank. Remove thermostat.

c. Thermostat. Inspect the thermostat for rust and corrosion. A defective thermostat will not maintain correct engine temperature. Check operation of the thermostat by placing in a container of hot water with a thermometer. Replace a defective thermostat.

d. Installation.

(1) Clean the seat for the thermostat.

(2) Affix a new gasket to the thermostat housing.

(3) Install thermostat and housing in reverse order of removal.

4-45. Fresh Water Pump (fig. 4-39)

a. General. The fresh water pump circulates coolant through the cylinder block, cylinder head, heat exchanger (keel cooler), oil coolers, and exhaust manifold. The pump is mounted on the front end of the blower and is driven by the lower blower rotor shaft. The sealed type ball bearing is filled with lubricant at the time it is assembled to the pump shaft and no further lubrication is required.

b. Removal.

(1) Drain cooling system.

(2) Remove the inlet elbow from the pump.

(3) Remove the bolts and lockwashers that attach the pump outlet flange to the cylinder block. Remove the flange and packing ring.

(4) Remove the three bolt and seal ssemblies that attach the pump to the blower assembly. Tool J2242 can be used to loosen the inner bolt.

(5) Withdraw the pump and remove the gasket.

c. Fresh Water Pump Installation.

(1) Place the pump outlet flange over the pump outlet with the flat side of the flange facing the pump body. Slip the packing ring over the pump outlet and next to the flange.

(2) Using a new gasket at the bolting flange, place the pump against the blower end-plate cover so that the lugs on the drive coupling mesh with the lugs on the intermediate shaft coupling. Secure the pump to the blower with the three bolts and seal washers.

(3) Slide the pump outlet packing ring and packing flange against the cylinder block and secure the flange with two bolts and lockwashers.

(4) Install the water pump inlet elbow.

4-46. Raw (Sea) Water Pump

a. General. Raw water pumps are mounted on the flywheel housing of each engine and driven by a coupling from the end of the camshaft. See figure 4-40. The impeller is self-lubricated by

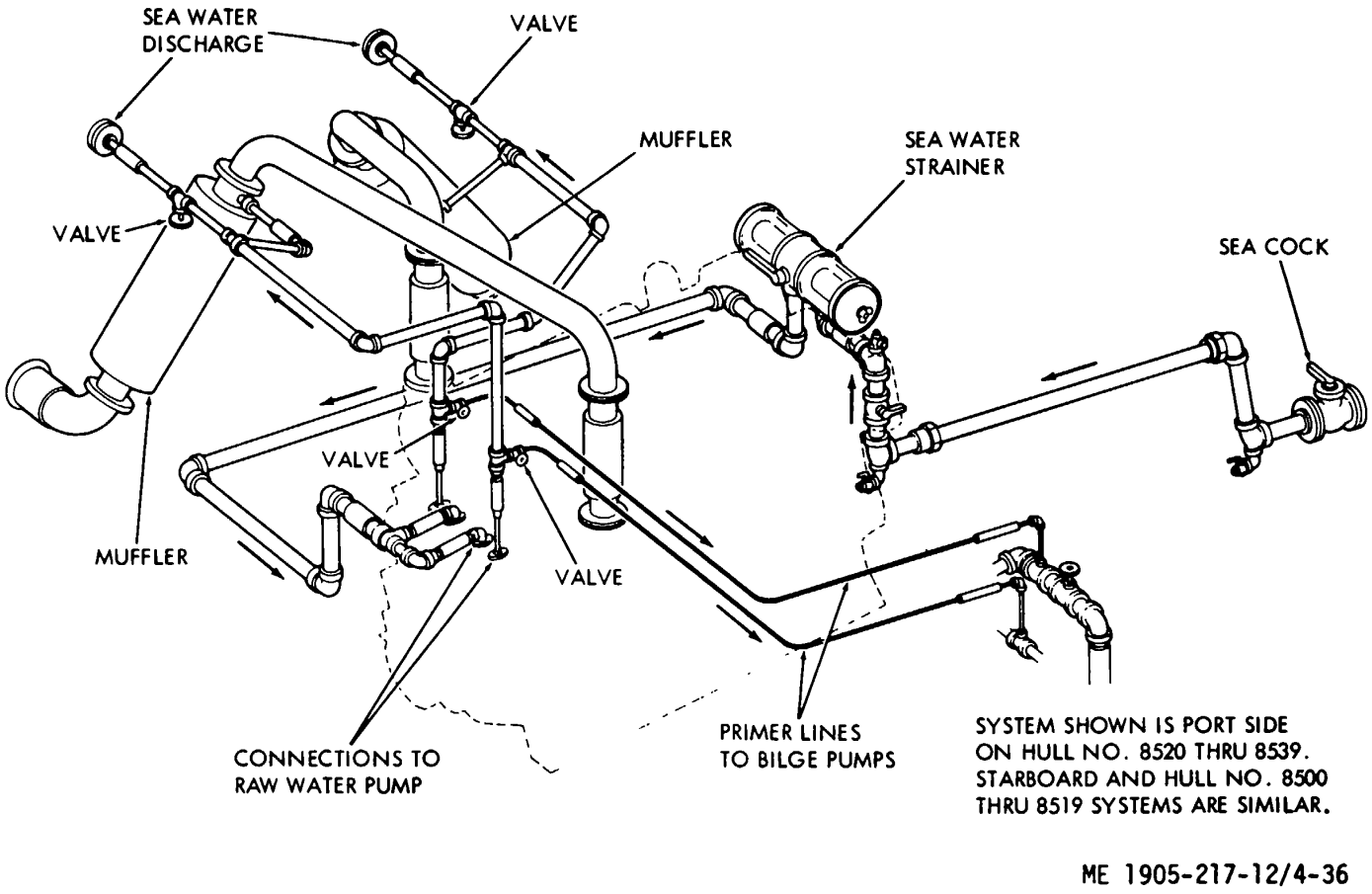


Figure 4-36. Raw (sea) water cooling systems.

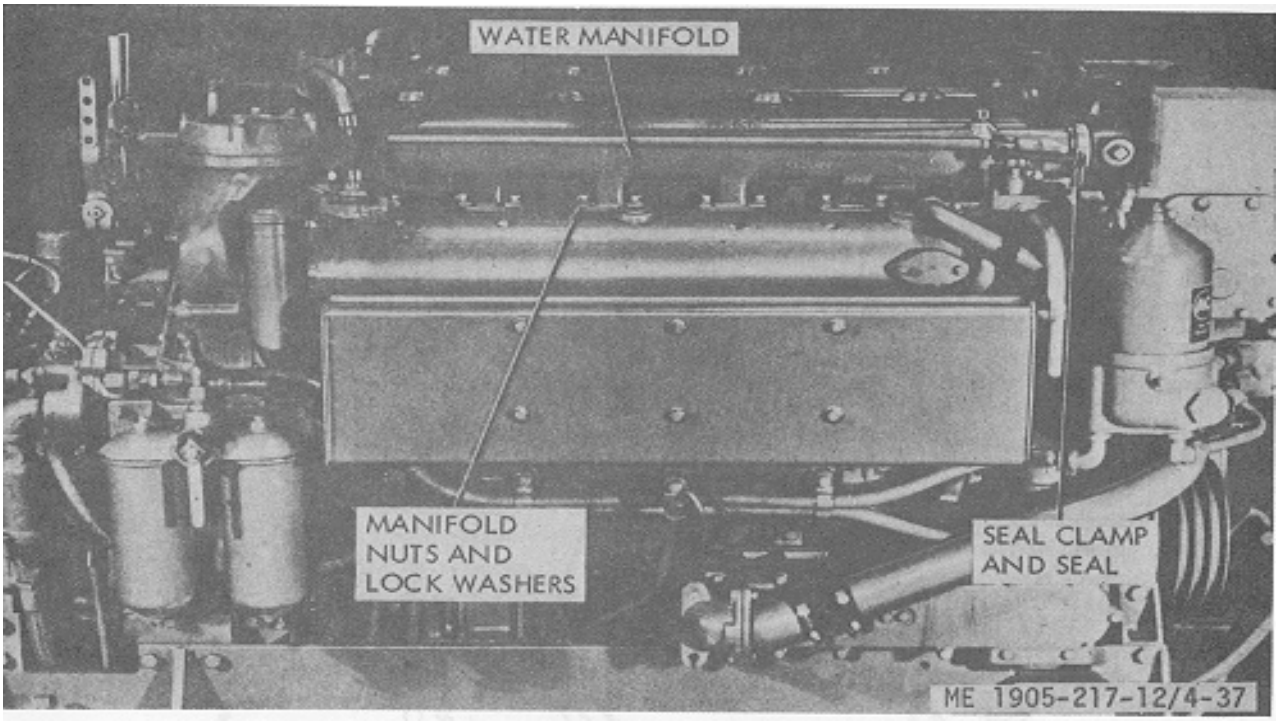


Figure 4-37. Engine water manifold removal

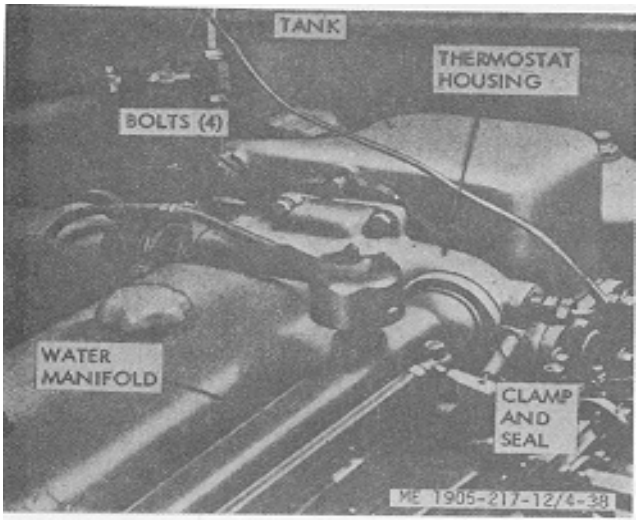


Figure 4-38. Thermostat and thermostat housing removal.

the water pumped and should not be run dry for longer than normally required for the pump to prime itself. A rotary-type seal seals against leakage along the raft.

b. Raw Water Pump Removal. If disassembly or replacement of the pump becomes necessary, it may be removed from the engine as follows:

(1) Remove nuts holding inlet and outlet fittings (fig. 4-40) to water pump. Hull numbers 8540 thru 8560 and 8580 thru 8618 have four nuts at each port mounting flange.

(2) Remove adapter to flywheel housing bolts and lockwashers.

(3) Using wood block or soft hammer, loosen pump from flywheel housing by tapping on edge of adaptor.

(4) Withdraw pump straight out from fly-wheel housing, disengaging drive gear from coupling.

CAUTION

Cover pump opening in flywheel housing with clean cloth to prevent entrance of foreign matter.

c. Raw Water Pump Installation. Install the pump by reversing the removal procedures.

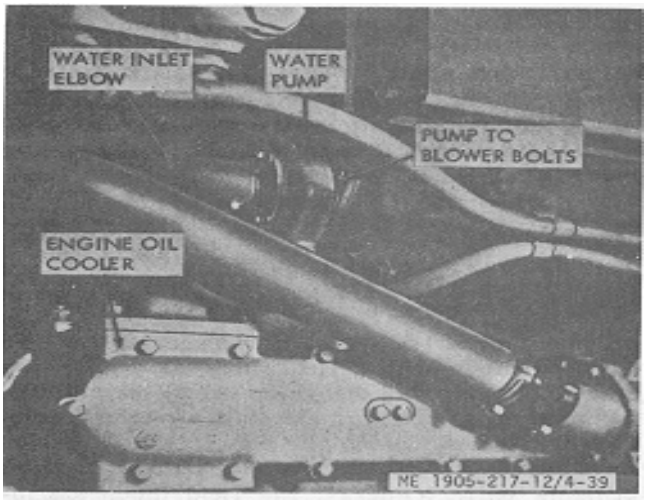


Figure 4-39. Fresh water pump mounting.

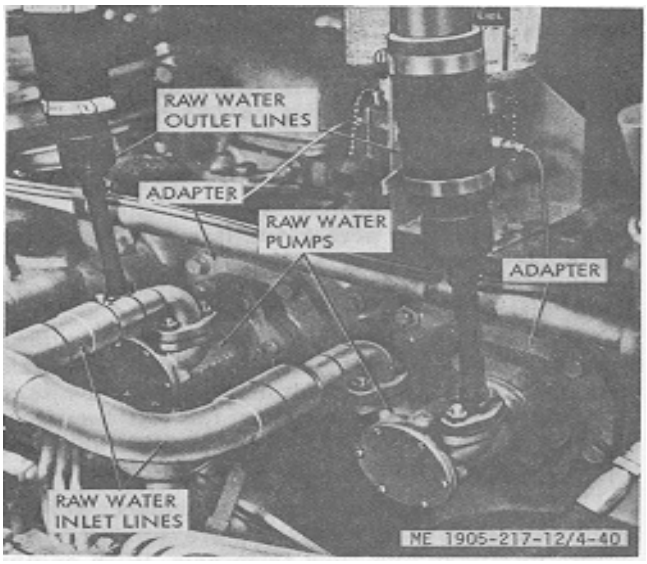


Figure 4-40. Raw (sea) water pump mountings.

SECTION XIII. ELECTRICAL SYSTEM INSTRUMENTS AND GAGES

4-47. General

The electrical system (1-3 and 1-4)includes two 70-amp, 24-volt alternators, one alternator mounted on the inboard engine of each propulsion unit. Four 6-volt batteries, connected in series to provide 24-volt current, are contained in the battery box located aft in the engine room. The alternators and batteries provided electrical power to operate all lights and electrical accessories on the landing craft and for the electric starters which are mounted on the outboard engines of each propulsion unit.

4-48. Alternators

a. Description. One 70-amp, 24-volt alternator is belt driven from the inboard engine crank-shaft pulley. The electrical circuit of the alternator uses six silicon diodes in a full wave rectifier circuit. Since the diodes will pass current from the alternator to the battery or load but will not pass current from the battery to the alternator, the alternator does not require the use of cutout relay. A voltage regulator is the only control required.

CAUTION

Disconnect battery cables when working on alternator or regulator.

b. In-Vessel Testing (Hull numbers 8500 thru 8519 and 8520 thru 8539). The following test procedures may be performed to determine the condition of the alternator and regulator while still in the vessel.

NOTE

When making the alternator system test, the batteries must be in good condition and fully charged.

CAUTION

Do not under any circumstances, short FIELD terminal of alternator to ground. Do not disconnect regulator while alternator is operating. Do not disconnect alternator output lead from alternator while the alternator is operating.

(1) Check voltage across auxiliary terminal (fig. 4-41.1) and negative output terminal with *dc* voltmeter. Correct voltage is 0.2 volt. If the voltage exceeds this value, the isolation diode is defective (fig. 4-41.3).

(2) Place jumper wire across oil pressure switch on propulsion unit to short out switch. Check voltage across auxiliary terminal (fig. 4-41.1) and negative output terminal with *dc* voltmeter. Correct voltage is 1.8-to 2.5-volts. This test evaluates field circuit. If voltage at

auxiliary terminal is higher than specified, field circuit is defective-check brushes. If voltage reads 0 volts at auxiliary terminal, check field excitation device and associated circuit. If voltage is not correct, perform test in (6) below.

NOTE

Disconnect jumper wire after testing.

(3) With propulsion unit or engine running, check voltage across auxiliary and negative output terminals (fig. 4-41.1) with *dc* voltmeter. Correct voltage is 29.4 ± 0.2 volts. If voltage is low, proceed with tests.

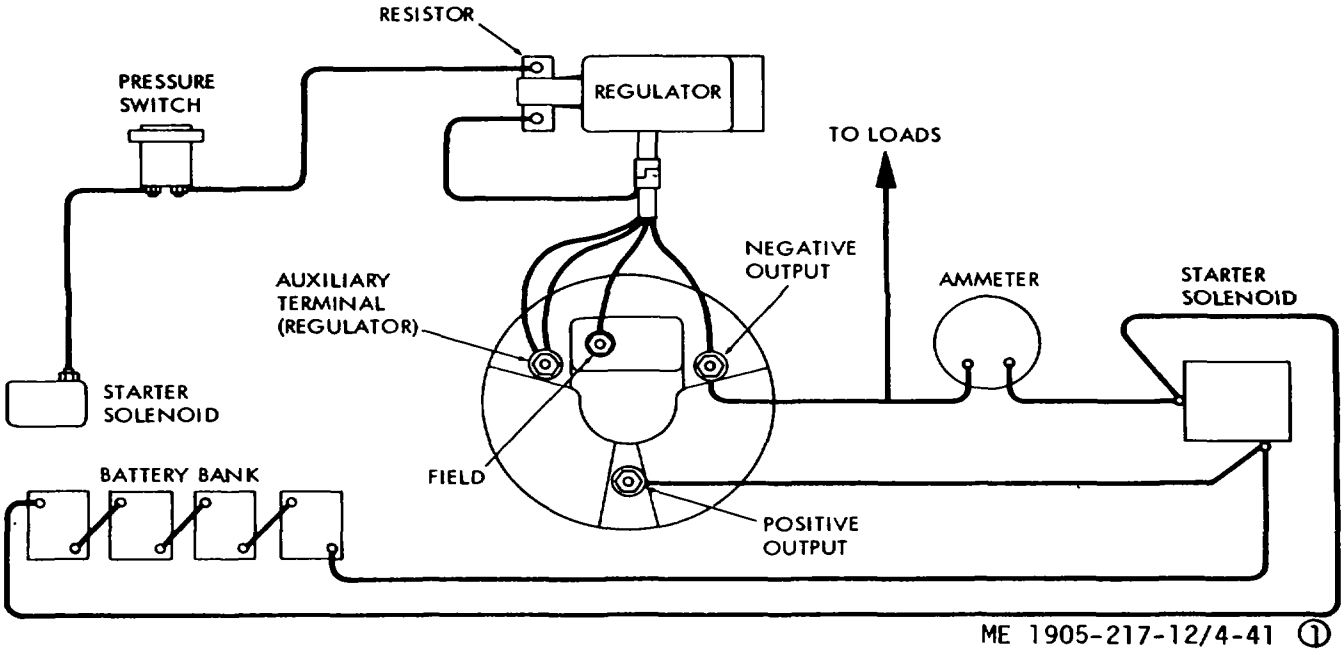
(4) With engine running, check voltage across positive and negative output terminals (fig. 4-41.1) with *dc* voltmeter. Correct voltage at positive output terminal is 1.0 volt less than voltage in (3) above. If voltage difference exceeds 1.0 volt, isolation diode is defective.

(5) Stop engine and disconnect voltage regulator (fig. 4-41.2). Place jumper wire across auxiliary and field terminals. With engine-running at idle, check voltage across auxiliary and negative output terminals. Correct voltage is 29.4 ± 0.2 volts. If voltage was low in (3) above and now rises to correct voltage, regulator is defective and shall be replaced. If voltage remains low, alternator is defective.

(6) Stop engine and remove jumper wire across auxiliary and field terminals. Connect a *dc* ammeter across field and positive output terminals (fig. 4-41.1) to measure field current (regulator disconnected). Current should be 1.5 to 2.0 amperes. Disassemble and repair alternator if current is excessive or low.

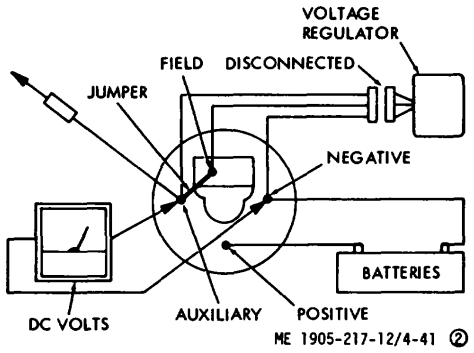
c. In-Vessel Testing (Hull numbers 8540 thru 8560 and 8580 thru 8618.)

(1) Hull numbers 8540 thru 8560 and 8580 thru 8618 contain a revised model of the 70-amp, 24-volt alternator. This model differs from the previous model due to the replacement of the isolation diode with a field diode assembly. The assembly consists of three rectifier diodes, mounted on a common heat sink, electrically connected in parallel with the conventional positive rectifier diodes. After initial alternator excitation utilizing battery energy, the field diode assembly provides the continuing energy requirement. A new voltage regulator is used in conjunction with the new alternator. The new regulator is similar to the previous model but operates the field at a one-volt lower value. Figure 4-41.4 is a schematic of the alternator system. The following test equipment is required to conduct the in-vessel alternator system checks:



A. Alternator connection diagram (hull numbers 8500 thru 8519 and 8520 thru 8589).

Figure 4-41.1. Alternator testing.(Sheet 1 of 8)



B. Alternator schematic diagram (hull numbers 8500 thru 8519 and 8520 thru 8539).

Figure 4-41.2. Alternator testing. (Sheet 2 of 8)

CAUTION
Do not disconnect either alternator output lead while the alternator is operating.

CAUTION
Do not disconnect any battery cable connection while the alternator is operating.

CAUTION
Do not ground alternator field terminal.

CAUTION
Disconnect negative battery cable prior to removing or installing alternator or regulator.

NOTE
When doing alternator systems checks, ensure that landing craft battery is in good condition and fully charged.

(2) Volt-ammeter resistance testing unit with following meter scales:

DC voltmeter	0-40 volts
DC ammeter	0-10 amps, 0-100 amps
Series Resistor	1/4 ohm
Field rheostat	0-50 ohm/65 watt

Carbon pile
Ohmmeter
DC test lamp, 12 or 24 volts
Battery hydrometer
Jumper leads 2, 4, 6, 10 feet in length with alligator clips

(3) Figures 4-41.5 through 4-41.8 provides test instructions and test schematics to follow when testing the alternator system.

(4) The voltage regulator used on hull numbers 8540 thru 8560 and 8580 thru 8618 can be adjusted by two methods to suit operating conditions.

CAUTION
Disconnect battery negative lead prior to removing or installing the voltage regulator.

A step adjustment can be made by removing the voltage regulator and using the metal strap provided on the underside of the regulator. Placing the strap between the center terminal and "LO" terminal, the voltage will be decreased by 0.6 volt. A fine adjustment of the voltage can be made by the following procedure:

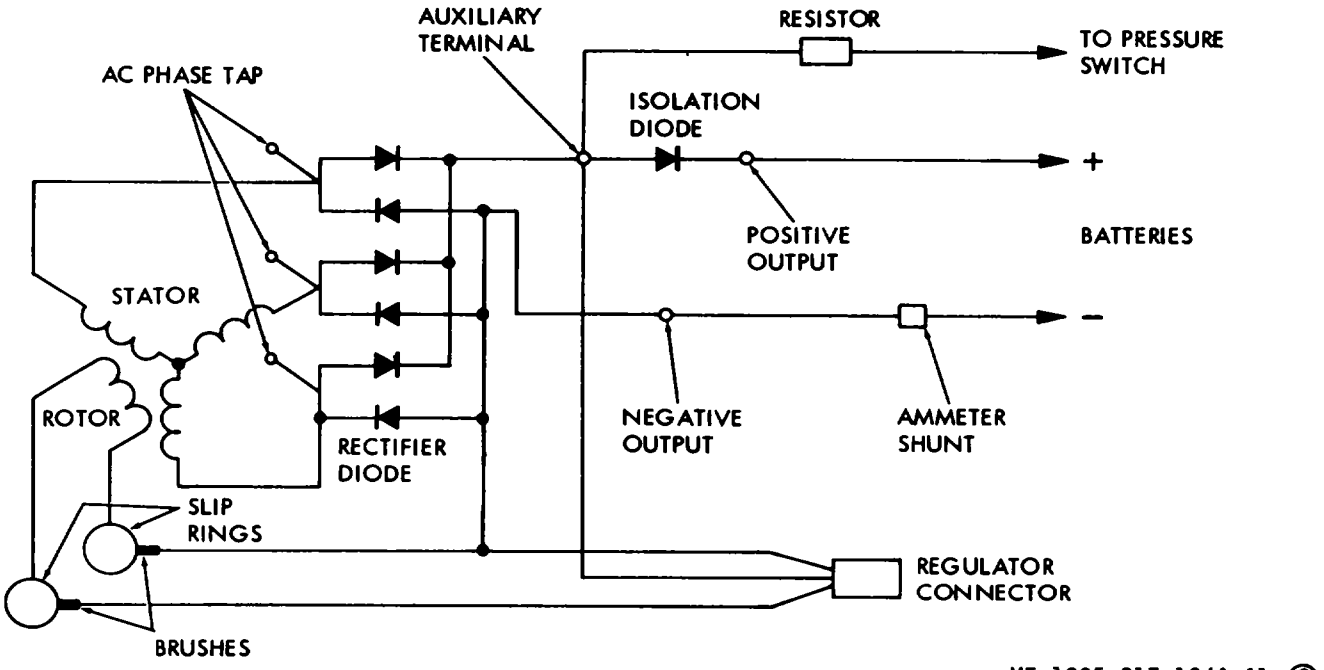
(a) Engine not running.
(b) Connect voltmeter across battery terminals.
(c) Connect ammeter (0-100 amp scale) between the positive terminal of the starter solenoid and the positive output terminal of the alternator.
(d) Start engine and operate at 1000 rpm.
(e) Apply accessory load (or adjust carbon pile) until ammeter reads 10.0 to 15.0 amperes.
(f) Allow electrical system to stabilize (voltmeter stops changing).
(g) Remove the screw in the regulator cover to gain access to the rheostat. Using a No. 0 Phillip screwdriver, turn 1 clockwise to increase voltage or counterclockwise to decrease the voltage until the voltmeter indicates the desired reading.

CAUTION
Do not force rheostat beyond stops.

(h) Replace screw in regulator cover when adjustment is completed.

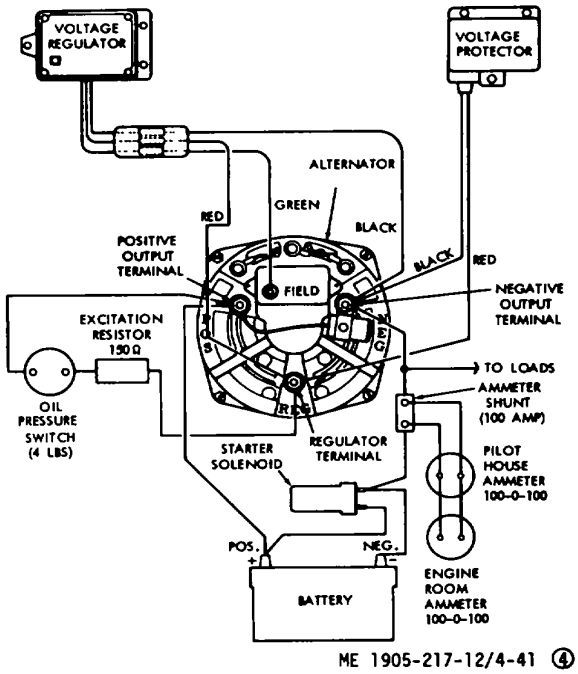
d. Alternator Removal (fig. 4-42 and fig. 4-43) for Hull Numbers 8540 thru 8560 and 8580 thru 8618.

(1) Remove the alternator cover.
(2) Remove and tag electrical leads.
(3) Remove -adjustment strap bolt and move alternator as necessary to remove belt.
(4) Remove mounting bolt and remove alternator.



C. Alternator-regulator test diagram (hull numbers 8500 thru 8519 and 8520 thru 8539).

Figure 4-41.3. Alternator testing. (Sheet 3 of 8)



D. Alternator schematic diagram (hull numbers 8540 thru 8560 and 8580 thru 8618).

Figure 4-41.4. Alternator testing. (Sheet 4 of 8)

NOTE

Alternator illustrated in figure 4-43 is mounted on the inboard engine of the starboard propulsion unit on hull numbers 6500 thru 8519. Alternators on port propulsion units end alternators on hull numbers 8620 thru 8560 and 8580 thru 8619 are mounted differently but removal procedure are similar.

e. Cleaning. Clean all foreign matter (oil, grease, dirt, etc.) from alternator and wiring.

f. Removing Brush and Holder Assembly.

(1) Remove alternator rear housing cover (fig. 4-43).

(2) Remove screws or clips from terminals.

(3) Lift brush assembly up and away from the slip rings.

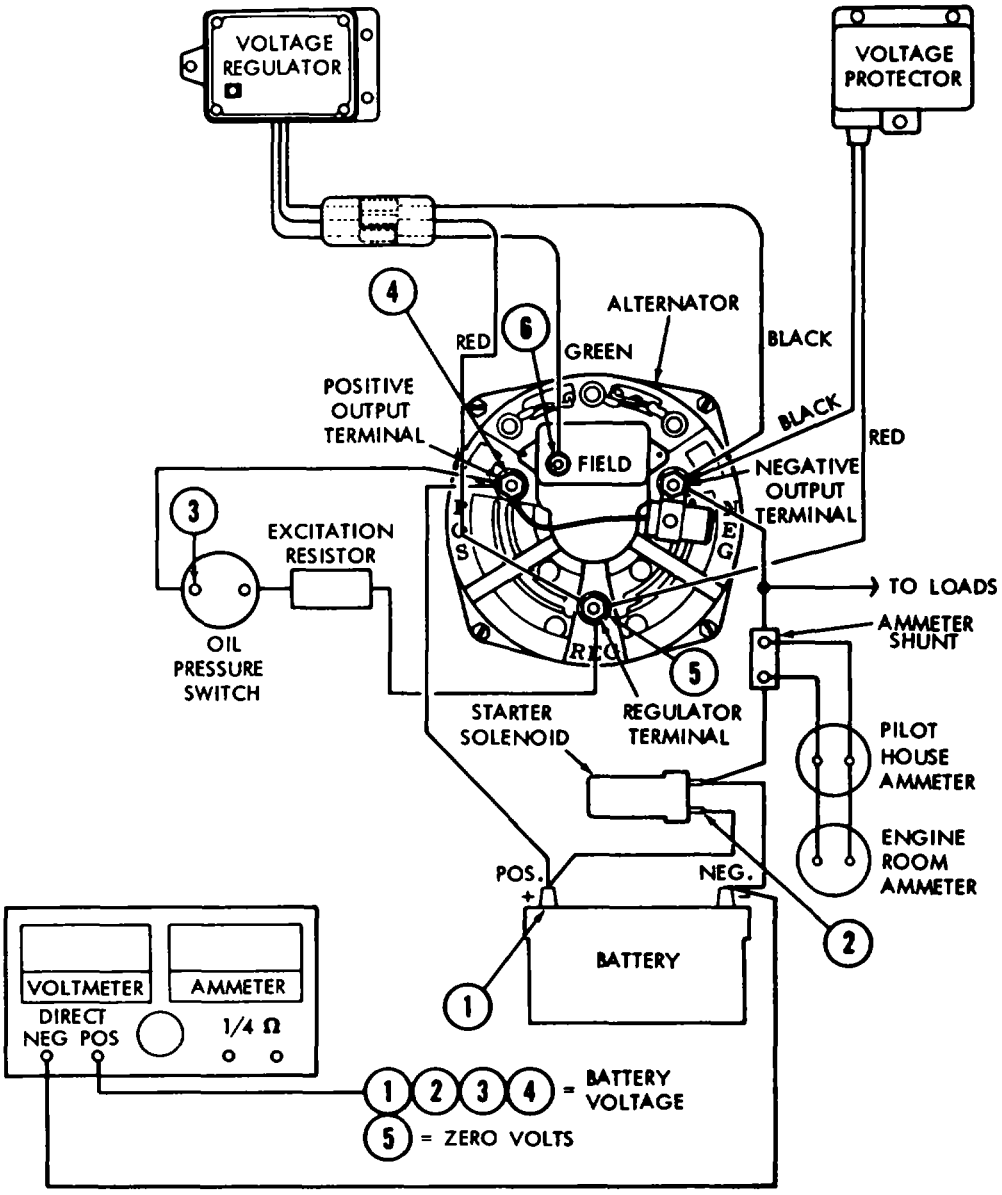
g. Cleaning and Inspection of Brush Assembly.

(1) Clean brush assembly with an air hose.

(2) Check length of brushes; replace if they extend -less than 1/4 inch beyond brush holder.

(3) Check wires and terminals for wear and breakage.

h. Installing Brush and Holder Assembly. Install brush holder assembly in reverse order of removal.



1. ENGINE NOT RUNNING.
2. PLACE VOLTMETER ACROSS BATTERY NEGATIVE POST AND TEST POINTS ①, ②, ③, AND ④--SHOULD READ BATTERY VOLTAGE AT EACH LOCATION.
3. PLACE VOLTMETER ACROSS BATTERY NEGATIVE POST AND TEST POINT ⑤--SHOULD READ ZERO VOLTS. IF ANY VOLTAGE IS NOTED, ACCOMPLISH STEP 4.
4. REMOVE ONE LEAD FROM EXCITATION RESISTOR AND REPEAT STEP 3. IF VOLTAGE IS STILL PRESENT, REMOVE ALTERNATOR AND CHECK FOR SHORTED POSITIVE RECTIFIER DIODE.

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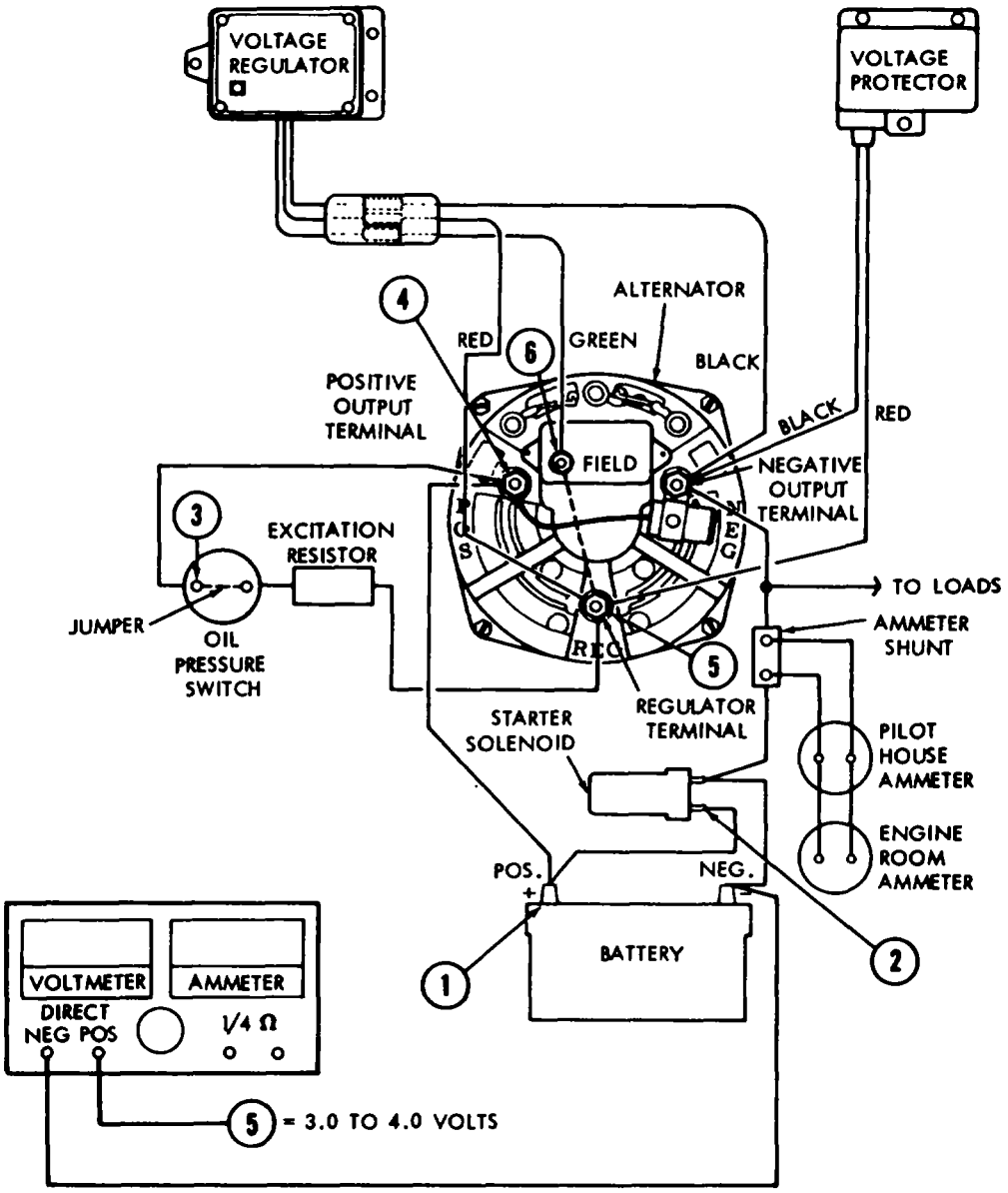
E. Test for battery voltage and shorted diode (hull numbers 8540 thru 8560 and 8580 thru 8618).

Figure 4-41.5. Alternator testing. (Sheet 5 of 8)



1. ENGINE NOT RUNNING.
2. PLACE JUMPER ACROSS OIL PRESSURE SWITCH TERMINALS.
3. PLACE VOLTMETER ACROSS NEGATIVE BATTERY TERMINAL AND TEST POINT (5) --SHOULD READ 3.0 TO 4.0 VOLTS.
4. PLACE VOLTMETER ACROSS NEGATIVE BATTERY TERMINAL AND TEST POINT (6)--SHOULD READ 2.0 TO 3.0 VOLTS.
5. IF READING IN STEP 3 IS TOO HIGH, PLACE JUMPER ACROSS TEST POINTS (5) AND (6). IF THERE IS NO CHANGE IN VOLTAGE READING AT TEST POINT (5), A FAULTY BRUSH OR FIELD ASSEMBLY IS INDICATED. IF THE VOLTAGE READING AT TEST POINT (5) IS BETWEEN 3.0 AND 4.0 VOLTS WITH THE JUMPER IN PLACE, THE VOLTAGE REGULATOR IS DEFECTIVE.
6. REMOVE JUMPER WIRES AFTER MAKING INDICATED REPAIRS OR REPLACEMENTS.

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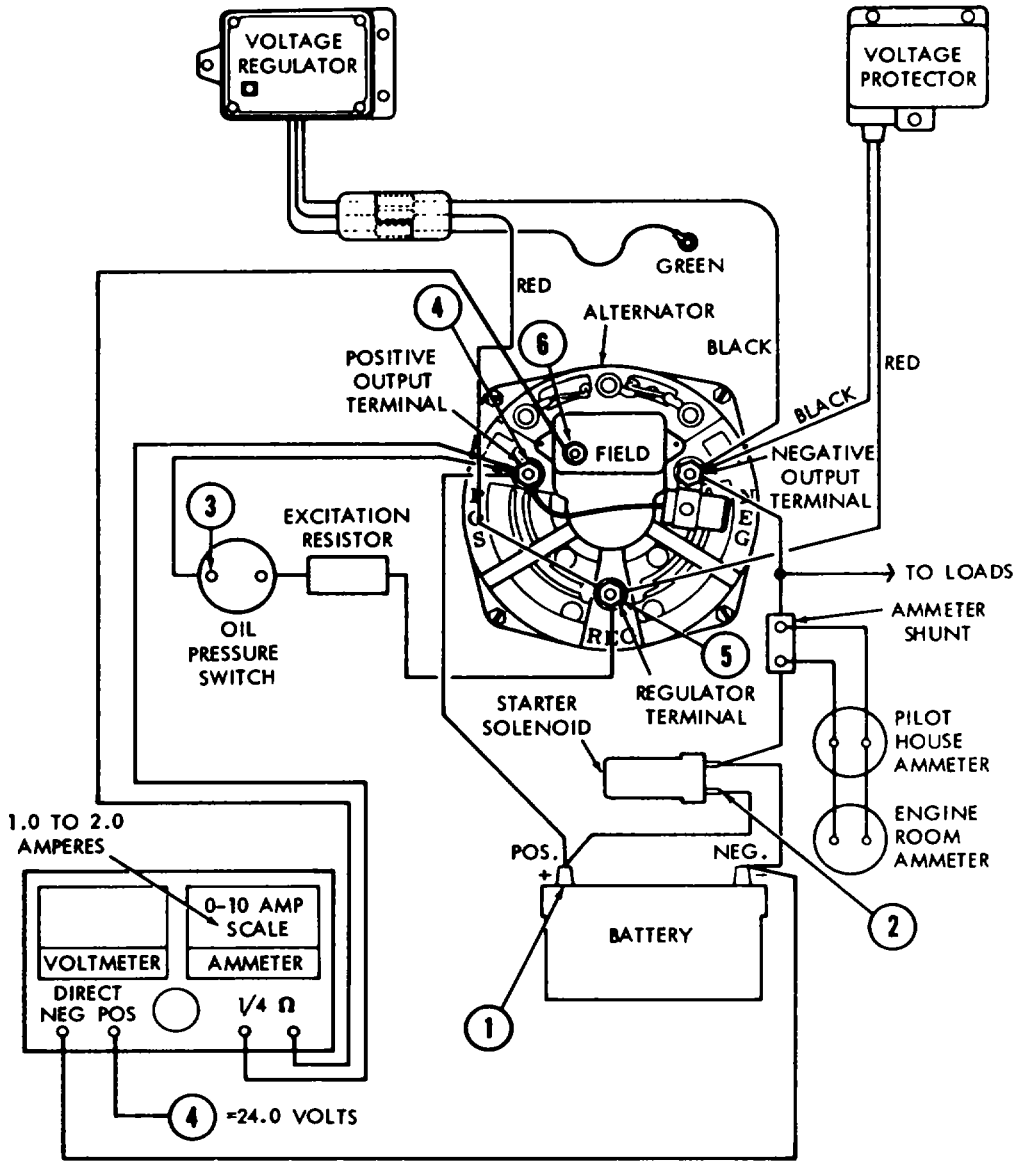
F. Excitation circuit test (hull numbers 8540 thru 8560 and 8580 thru 8618).

Figure 4-41.6. Alternator testing. (Sheet 6 of 8)



1. ENGINE NOT RUNNING.
2. PLACE VOLTMETER ACROSS NEGATIVE BATTERY TERMINAL AND TEST POINT ①, ②, ③, OR ④--SHOULD READ BATTERY VOLTAGE.
3. DISCONNECT GREEN WIRE AT TEST POINT ⑥.
4. PLACE AMMETER ON 0-10 AMP SCALE AND CONNECT BETWEEN TEST POINT ④ AND TEST POINT ⑥--SHOULD READ 1.0 TO 2.0 AMPERES AT 24 VOLTS. IF READING IS ABOVE 2.0 AMPERES, A SHORTED ROTOR WINDING OR FOREIGN MATERIAL BETWEEN THE SLIP RINGS IS INDICATED.
5. TURN ROTOR SLIGHTLY AND OBSERVE AMMETER FOR READING VARIATIONS. IF READING IS LOW OR VARIABLE, CHECK FOR WORN BRUSHES OR FOREIGN MATERIAL ON SLIP RINGS. CLEAN OR REPAIR AS NECESSARY.
6. DISCONNECT AMMETER AND REINSTALL GREEN WIRE AT TEST POINT ⑥.

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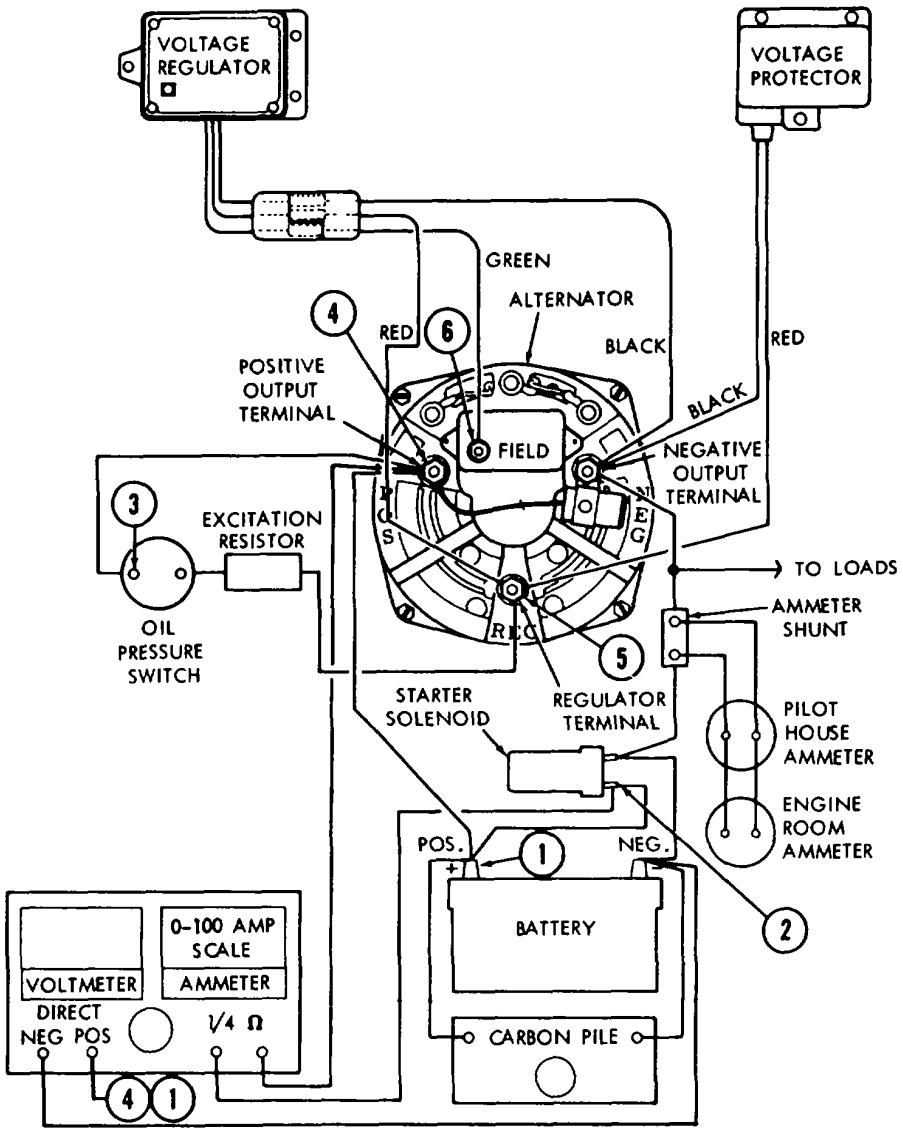
G. Field current test (hull number 8540 thru 8560 and 8580 thru 8618).

Figure 4-41.7. Alternator testing. (Sheet 7 of 8)



NOTE: BEFORE MAKING THIS TEST, ENSURE A ALTERNATOR OR DRIVE BELT IS TIGHT.

1. ENGINE NOT RUNNING.
2. PLACE AMMETER ON 0-100 AMPERE SCALE AND CONNECT ACROSS TEST POINT (2) AND TEST POINT (4).
3. PLACE CARBON PILE LOAD KNOB TO OFF OR UNLOADED POSITION AND CONNECT ACROSS THE BATTERY TERMINALS.
4. CONNECT VOLTMETER ACROSS BATTERY NEGATIVE TERMINAL AND TEST POINT (4) AND SWITCH VOLT-AMMETER CONTROL KNOB TO "DIRECT" POSITION.
5. START ENGINE AND RUN AT 1500 RPM. SWITCH VOLT-AMMETER CONTROL KNOB TO "1/4"--VOLTMETER SHOULD READ BETWEEN 28.0 AND 28.4 VOLTS. RETURN CONTROL KNOB TO "DIRECT".
6. ADJUST CARBON PILE TO OBTAIN A READING OF 8.0 TO 10.0 AMPS ON AMMETER SCALE. PLACE VOLTMETER POSITIVE LEAD ON TEST POINT (1) AND THEN TEST POINT (4). THE DIFFERENCE BETWEEN THE TWO READINGS SHOULD BE .2 VOLT OR LESS.
7. INCREASE ENGINE SPEED TO APPROXIMATELY 2100 RPM. ADJUST CARBON PILE TO OBTAIN MAXIMUM AMMETER READING OF 63 TO 70 AMPS WITH VOLTMETER READING 25.0 TO 28.0 VOLTS.
8. IF VOLTAGE IS LOW WHEN PERFORMING STEP 7, RETURN ENGINE TO IDLE SPEED AND PLACE JUMPER BETWEEN TEST POINTS (5) AND (6). BRING ENGINE SPEED UP TO 1500 RPM--IF VOLTAGE RISES TO 28.0 VOLTS OR HIGHER, THE VOLTAGE REGULATOR OR A VOLTAGE REGULATOR CONNECTION MAY BE AT FAULT. REPAIR AS NECESSARY.

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H. Voltage regulator-alternator output test (hull numbers 8540 thru 8660 and 8680 thru 8618).

Figure 4-41.8. Alternator testing. (Sheet 8 of 8)

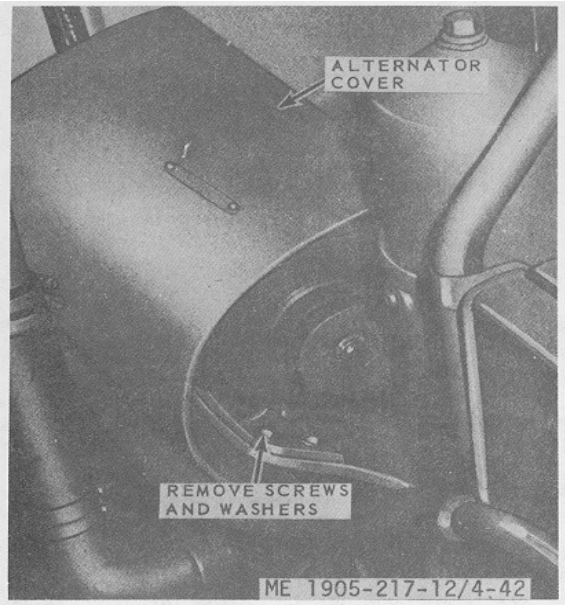


Figure 4-42. Alternator cover, removal.

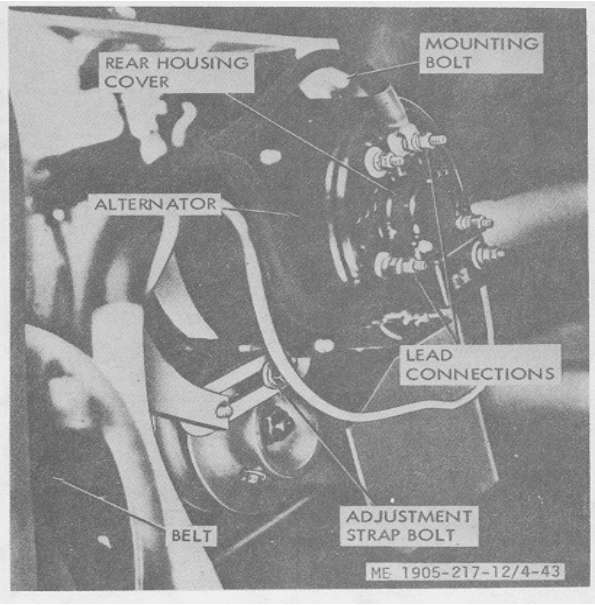


Figure 4-43. Alternator, removal.

i. Installing Alternator.

(1) Install alternator in reverse order of removal.

(2) Install and adjust belt.

4-49. Voltage Regulators

a. Description. The all-electronic transistorized voltage regulator is an electronic device using no mechanical contacts or relays. When the voltage supply is below a predetermined amount the transistor conducts, acting like a closed switch between the supply voltage and the field of the alternator. When the supply is above a predetermined amount the transistor is cut off, acting like an open switch which removes the excitation from the field, reducing alternator output.

b. Removal.

(1) Remove and tag voltage regulator electrical leads.

(2) Remove mounting nuts and remove regulator.

c. Installation. Install voltage regulator in reverse order of removal.

4-50. Electric Starting Motors (fig. 4-44)

a. General. Electric starting motors are installed on the outboard engines of each propulsion unit. The two electric starting motors, model numbers 1108850 and 1108890, are identical except for direction of rotation. Model number 1108850 has a clockwise rotation, viewing from the drive end, and is installed on the outboard engine of the starboard propulsion unit. Model number 1108890 has a counterclockwise rotation, viewing from the drive end, and is installed on the outboard engine of the port propulsion unit.

b. Servicing Starting Motor Brushes.

(1) Disconnect negative lead at battery.

(2) Remove and tag solenoid switch leads.

(3) Remove solenoid switch and switch support.

(4) Remove starter cover band assembly.

(5) Inspect the brushes. The brushes must be making good contact with the commutator. If the brushes are worn down to 5/16 inch (original length 1/2 inch), replace brushes. Make sure that the pigtail leads are tight in the brushes and the clips are fastened securely to the leads.

(6) Install cover band assembly, solenoid switch, and leads in reverse order of removal.

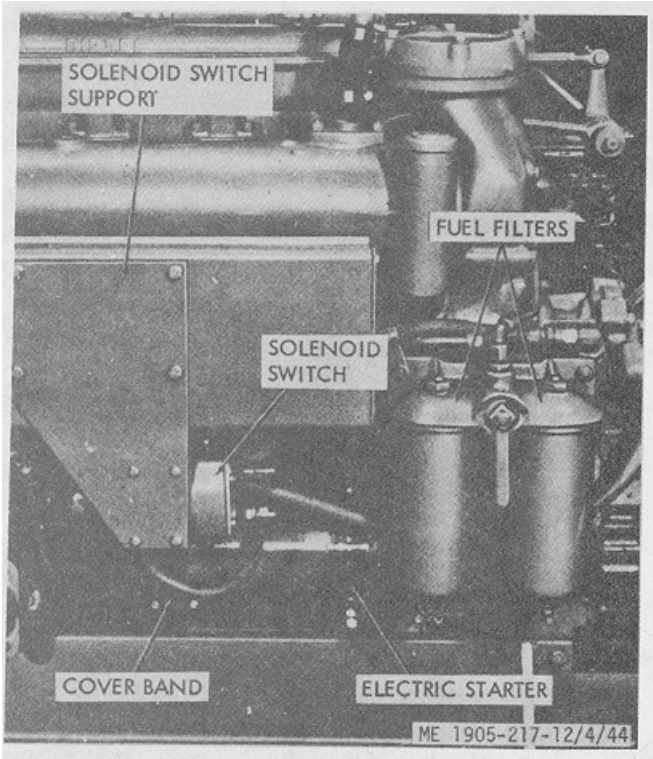


Figure 4-44. Electric starter and solenoid switch.

c. Electric Starter Removal (fig. 4-44).

(1) Disconnect negative lead at battery.

(2) Remove and tag solenoid switch leads.

(3) Remove solenoid switch and switch support.

(4) Remove and tag starter leads.

(5) Turn fuel filter valve lever to shut off the forward filter. Drain filter and remove the shell and element.

(6) Remove the three bolts and lockwashers securing the starting motor to the flywheel housing and remove starting motor from the engine.

d. Starting Motor Installation. Reverse removal procedures, using a serviceable starting motor.

4-51. Battery Cables (fig. 3-10)

a. Removal. Disconnect and remove the negative lead, then disconnect and remove the positive lead.

b. Installation. Reverse procedure above.

4-52. Instruments and Gages

a. General. Instruments and gages are located on panels in the pilot house and in the engine room.

b. Removal (fig. 2-3 or 4-45).

(1) Remove plastic panel cover.

(2) Remove access cover.

(3) Remove attaching clamp at rear of panel and remove instrument or gage.

c. Installation. Install instrument or gage in reverse order of removal.

4-53. Tachometers and Tachometer Drives

a. General. Tachometers are mounted in the pilot house instrument panel, one for each engine. The tachometer drives are mounted on the transmission oil pumps at the rear of each engine.

b. Removal..

(1) Refer to paragraph 4-52 for removal of tachometers from the instrument panel.

(2) Refer to figure 4-46 or 4-47 for removal of tachometer drive.

4-54. Warning Lights and Sending .Units

a. General. Sending units (lobe oil pressure switch and water temperature switch) are installed on each engine to provide warnings to be indicated on the engine alarm panel (fig. 2-8.1 or 4-45) if the engine lubricating oil pressure is too low or if the engine water temperature is too high. To protect the circuit and switches, the circuit is not energized until the fuel oil pressure switch is closed. The fuel oil pressure switches are installed in the fuel oil manifolds which are a part of the engine cylinder head casting.

b. Testing.

(1) With engine stopped, place a jumper wire across the fuel oil pressure switch terminals.

NOTE

On hull number 8520 thru 8560 and 8580 thru 8618, there are two fuel oil pressure switches in the fuel oil manifold of each inboard engine. Place the jumper wire only on the switch with four leads. The switch with two leads is not included in the alarm circuit.

(2) Move the engine alarm indicator switch (on distribution panel) to the ON position. The lamp should light for the circuit being tested. If further testing is required, refer to higher echelon.

4-55. Navigational and Utility Lights

Refer to figures 2-2 (hull numbers 8520 thru 8539), or 2-3 (hull numbers 8540 thru 8560 and 8580 thru 8618) for identification and location of lights.

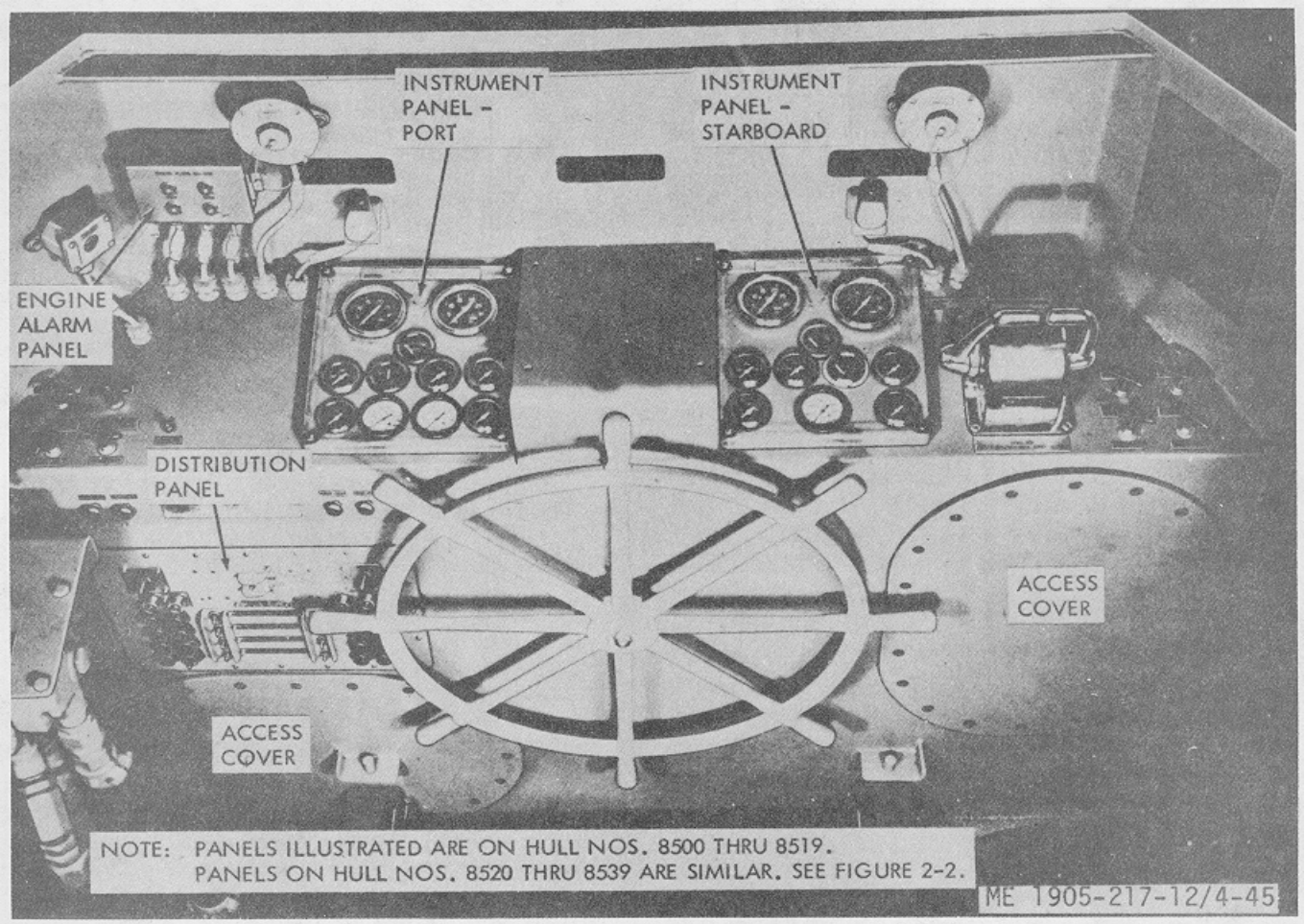


Figure 4-45. Instruments and gages.

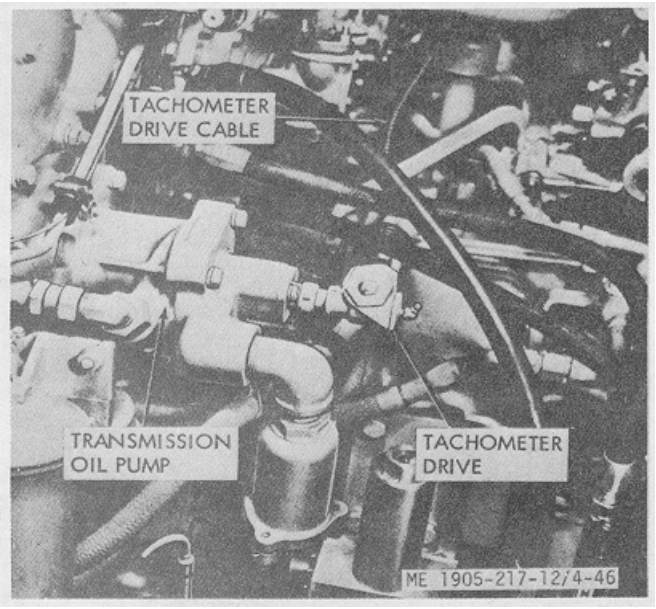


Figure 4-46. Tachometer drive.

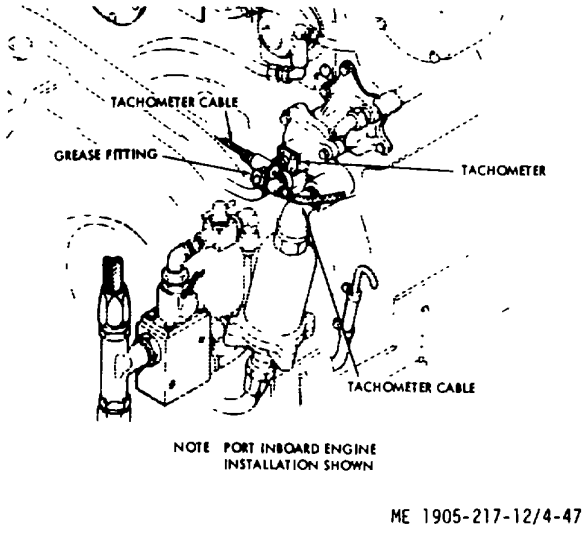
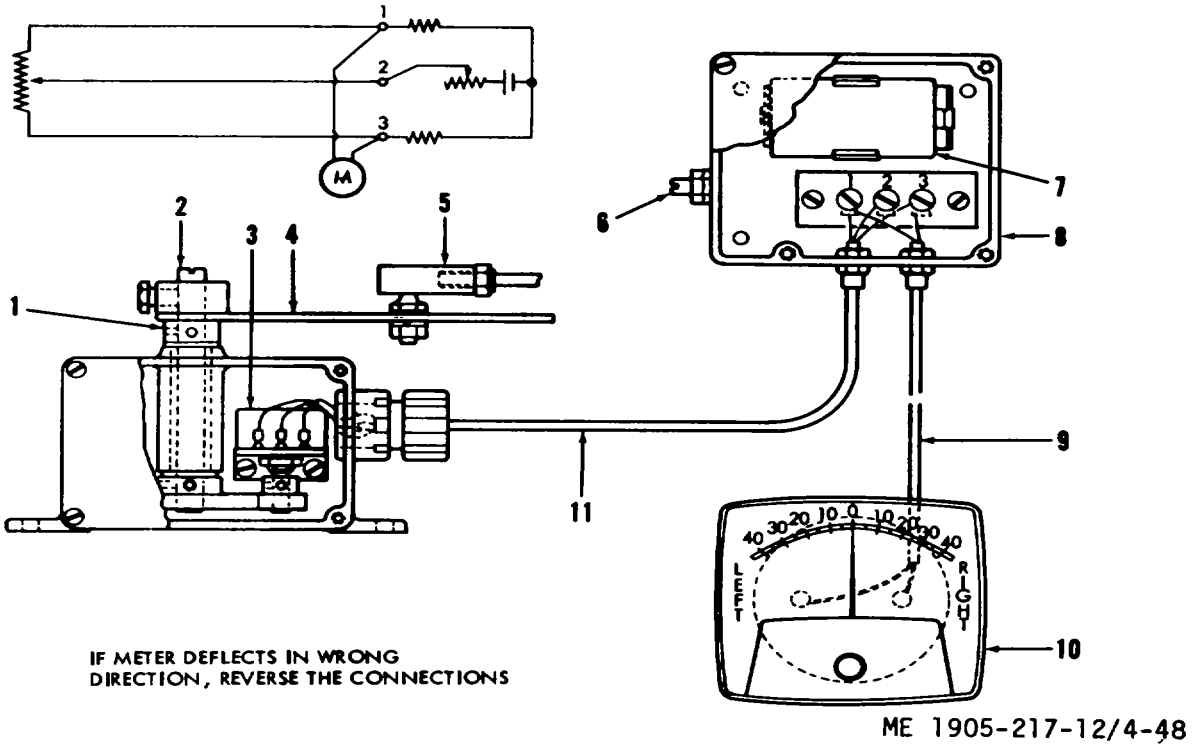


Figure 4-47. Tachometer drive, hull numbers 8540 thru 8560 and 8580 thru 8618.



1. Collar and setscrew
2. Shaft
3. Transmitter pointometer (lazarette)
4. Arm
5. Ball joint washer and nut
6. Battery gain pointometer
7. Battery
8. Battery box (engine room)
9. Cable
10. Meter pilot house
11. Cable

Figure 4-48. Rudder angle indicator installation, hull numbers 8520 thru 8560 and 8580 thru 8618.

4-56. Rudder Angle Indicator (Hull Numbers 8540 thru 8560 and 8580 thru 8618 (fig. 4-48)

a. General. The indicator system consists of the indicating meter, a transmitter, and a battery box. The rudder angle indicator is installed in the pilot house starboard instrument panel. The transmitter is connected by a rod to the port rudder crank and is accessible from the engine room. The battery box provides a gain adjust to compensate for drain of the size "D" 1.5-volt flashlight cell contained within the box. Figure 4-48 contains an electrical schematic of the indicator system and installation details.

b. Inspection. Move rudder to extreme starboard. Check to see if meter indicates approximate angle is correct direction. Move rudder to extreme port and check meter indication. If angle shown does not agree, adjust gain control on battery box (6) to cause it to read correctly. Position rudder amidships. If meter does not indicate zero, loosen collar locking screw (1) on transmitter lever. Turn transmitter shaft with screwdriver until meter reads zero. Tighten locking screw. If meter does not respond to gain control adjustment, replace battery (7) in battery box.

SECTION **XIV. HYDRAULIC STARTING SYSTEM**

4-57. General

a. The landing craft is fitted with a dual cranking system for the propulsion engines. The outboard engine of each propulsion unit is equipped with an electric starting motor and each inboard engine is cranked by a hydraulic starting motor. See figure 1-6 for hull numbers 8500 thru 8519, figure 1-7 for hull numbers 8520 thru 8539; or figure 1-8 for hull numbers

8540 thru 8560 and 8580 thru 8618 which incorporate a fuel pressure switch to prevent accidental engagement of the hydrostarters when the engine is running.

b. Energy required for hydraulic cranking is supplied by fluid stored under approximately 3,000 PSI pressure in two interconnected accumulators. These accumulators are charged first by a hand operated hydraulic pump and then by engine driven pumps. They will not be over-charged during long periods of engine operation because of pressure control built into the pumps. There is also a system relief valve set at 3,400 PSI, which is the safe maximum pressure for this system.

4-58. Filling the Hydraulic Starting System with Fluid

a. Servicing. Fill reservoir with suitable hydraulic oil (Sym. 2135TH or Sym. 2075TH of MIL-L-17672B). Reservoir capacity is 7 gallons.

b. Purging.

(1) *Hand pump.* Loosen discharge connection and operate hand pump slowly until all air is expelled. Retighten connection.

(2) *Engine driven pump.* With the engine running at 1,500 rpm or more, loosen the hose connection at the discharge side of the pump (fig. 4-49) until a full stream of oil is discharged. Connect the hose to the pump and alternately loosen and tighten the swivel fitting on the discharge hose until the oil leaking out, when fitting is loose, appears free of air bubbles.

4-59. Filter

a. General. On hull numbers 8500 thru 8519 the filter is mounted near the reservoir on the starboard side of the engine room. See figure 4-50. The same filter is used on hull numbers 8520 thru 8539 but it is mounted below the central deck plate between the two propulsion unit. The deck plate must be removed to service this filter. On hull numbers 8540 thru 8560 and 8580 thru 8618, a different type filter is mounted on the starboard side of the reservoir. See figure 2-18.

b. Filter service (fig. 4-51). Change the filter every 2000 hours of operation.

(1) Close outlet valve at reservoir (hull numbers 8500 thru 8519).

(2) Relieve pressure in lines on hull numbers 8520 thru 8560 and 8580 thru 8618.

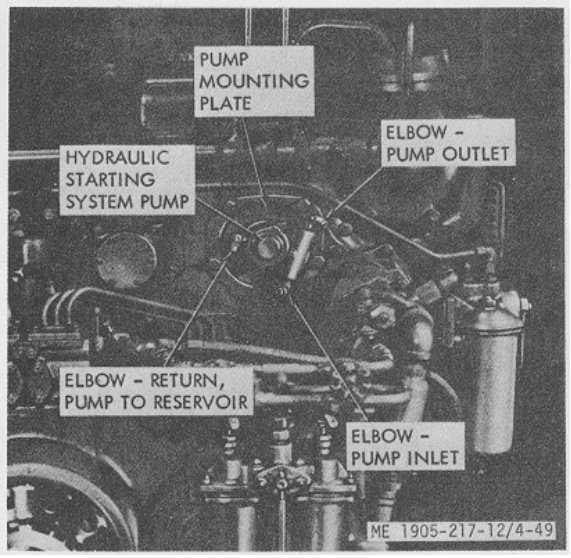


Figure 4-49. Hydraulic starting system pump.

(3) Remove filter from the line connections and remove end cap.

(4) On hull numbers 8540 thru 8560 and 8580 thru 8618, unscrew the filter outer shell and remove the element.

4-60. Accumulator (fig. 4-52)

a. General. Two accumulators are provided, one mounted on each side of the engine room. When both accumulators are at full pressure, one should be secured (valve closed) and held in reserve. One accumulator will service both engines under normal conditions.

b. Accumulator Removal.

(1) Close valve on opposite accumulator.

(2) Release oil pressure in the hydraulic starting system lines.

(3) Refer to figure 4-52 and remove accumulator by removing support clamps.

c. Charging Accumulator with Nitrogen.

(1) Secure accumulator in a pipe vise or a suitable clamp, so that the accumulator is rigid and stable.

(2) Using special charging assembly, attach gage end of assembly to the nitrogen tank.

(3) Mount swivel connector on the accumulator air valve. Hand tighten sufficiently to compress gasket in swivel connector to prevent gas leakage. Loosen locknut on air valve.

(4) Introduce nitrogen gas (50 psi only). DO NOT EXCEED 50 PSI.

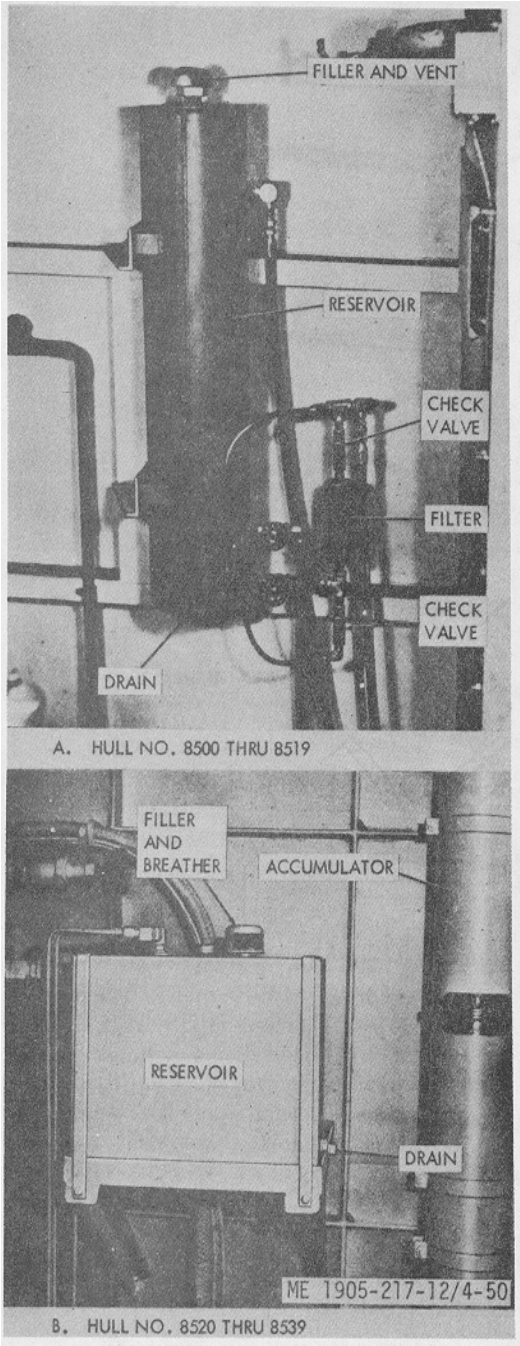


Figure 4-50. Hydraulic starting system reservoirs.

(5) The piston should be against the oil end cap before further charging the accumulator. Determine the position of the piston by inserting a six inch long (1/4 in. dia.) wooden dowel through the oil port opening. If the piston is against the oil end cap, the dowel will touch the piston.

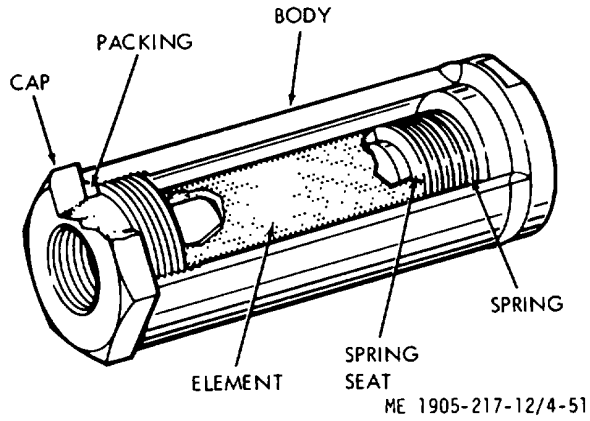


Figure 4-51. Filter, hydraulic starting system.

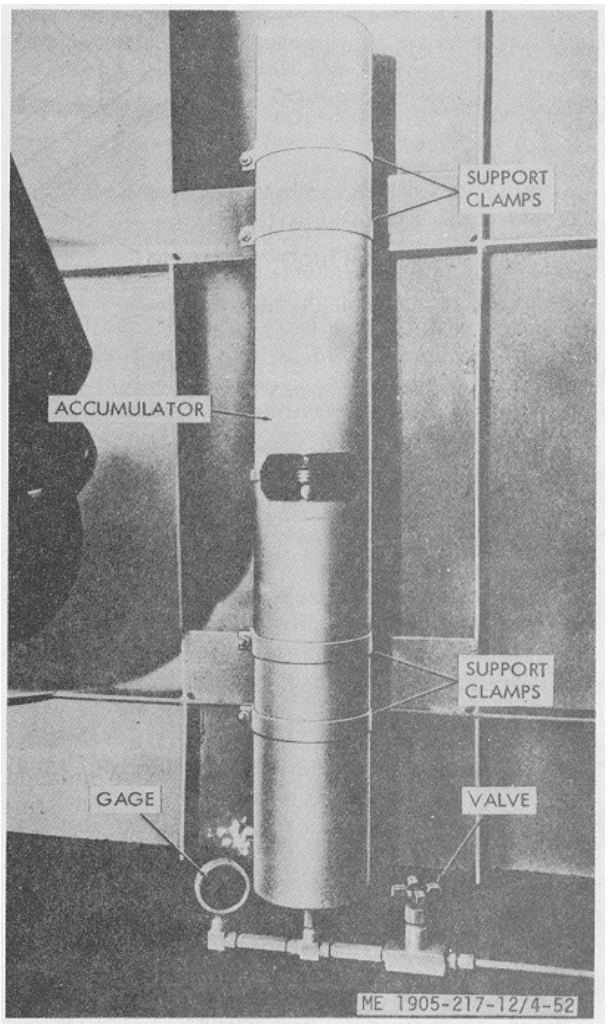


Figure 4-52. Accumulator, Gage and Valve.

CAUTION
DO NOT STAND IN FRONT OF DOWEL IN CASE PISTON IS SEIZED.

(6) If the piston cannot be touched with the six inch dowel, the following must be adhered to:

(a) The gas must be released by opening charging valve.

(b) The gas end cap must be removed.

(c) Inspect and determine the condition preventing movement of the piston.

(d) After corrective action has been made, then manually move piston all the way to the oil end with a long wooden dowel.

(e) Reassemble and charge the accumulator to the prescribed pressure.

CAUTION
NEVER ATTEMPT TO CHARGE ACCUMULATOR WITHOUT FOLLOW-ING THE ABOVE PROCEDURE.

(7) Proceed to charge accumulator by opening valve on nitrogen bottle slowly, closing it occassionally to allow needle on gage (1) to settle in position, thus giving the correct pressure in the accumulator.

(8) Close valve on nitrogen tank, tighten locknut on air valve, and torque to 140-160 in.- lbs. Remove charging hose.

d. Test Procedure for Accumulators.

(1) After the accumulator has been charged to the desired pressure, it should be immersed in a tank containing a non-corrosive liquid and checked for proper sealing of the packings on accumulator piston. The oil inlet port of the accumulator must be left open during this test. Also check for possible leaks of the Air Valve Assembly, (cap removed). Air bubbles in the liquid indicate nitrogen leakage.

(2) Drain dry and allow the accumulator to set undisturbed for a minimum period of one hour. With Service Tool TSE 8601, recheck the gas pressure in the accumulator. See note.

NOTE
With SERVICE TOOL TSE 8601 fastened securely to the Air Valve Assembly, loosen nut on air valve. The gage will indicate the amount of nitrogen gas precharge pressure in the accumulator. Before removing gage, tighten locknut on air valve. When using this tool, the hydraulic pressure in the accumulator should be at zero before attaching the gage device to the accumulator.

(3) If the pressure is lower by more than 5 percent, the accumulator must again be connected to Service Tool TSE 8601 and additional nitrogen added. Repeat steps (1) and (2).

(4) A cycling test should be performed to assure that accumulator is functioning properly. The accumulator may be connected to any simple test circuit, consisting of a reservoir, pump, accumulator and a valve.

(5) The hydraulic valve should remain in the open position until the pump has run a sufficient period to bleed all air from the line. With the pump still operating, close the valve. Allow pump to charge the accumulator to 3,000 PSI. Open the hydraulic valve to allow stored oil in the accumulator to flow back into the reservoir. Repeat this charge and discharge cycle several times to insure the piston is not sticking or binding.

(6) During the cycling test, inspect for possible oil leaks at caps and discharge fitting of accumulator.

(7) When the test cycle has been completed, remove the accumulator from the test circuit.

CAUTION
Always release all hydraulic pressure in the system before disconnecting any lines.

Close the oil port with a suitable plug to prevent entrance of foreign matter during storage and shipping.

4-61. Engine Driven Pumps

a. General. The engine driven charging pump is a single piston positive displacement type. The ball check valves and the unloading valve are automatically controlled by the accumulator pressure. The pump shaft is supported on ball bearings; a seal, pressed into the pump bearing retainer, prevents leakage. The pump is attached to the flywheel housing (fig. 4-49) and is driven by a drive plate bolted to the balance shaft gear.

b. Pump Removal.

(1) Close both accumulator valves.

(2) Release -the oil pressure in the hydraulic starting system.

CAUTION
The oil pressure in the system must be released prior to servicing the engine driven pump or other parts to prevent possible injury to personnel or equipment.

(3) Clean all of the exterior dirt from the pump and the hydraulic lines.

(4) Disconnect the hydraulic lines from the pump and the hydraulic lines.

(4) Disconnect the hydraulic lines from the pump. Then, loosen the bolts holding the mounting plate and remove the plate and pump as an assembly.

c. Pump Installation. See figure 4-49.

(1) Affix a new gasket to the flywheel housing, using a non-hardening gasket cement on the flywheel housing side only.

(2) Aline the tangs on the pump drive with the slobs in the drive plate. Attach the pump and mounting plate securely to the engine with bolts and lockwashers.

CAUTION

Do not force the pump into place. Use of force, or tightening the bolts when the mounting flange is not against the flywheel housing, will force the drive arm against the pump body and result in damage to the pump when the engine is started.

(3) Apply sealant sparingly to all MALE PIPE THREADS only and work it into the threads.

CAUTION

Do not apply sealant to the last thread (that nearest the open end) or to female fittings, as it may wash into the system.

(4) Connect the hydraulic lines to the pump.

4-62. Hand Pump Hydraulic Starting System (fig. 2-21 or fig. 2-22)

a. General. The hand pump is used to provide the initial hydraulic pressure for first starts or to build up pressure in the hydraulic starting system if it has been released for any reason.

b. Removal (fig. 2-21 or fig. 2-22).

(1) Close both accumulator valves.

(2) Release the pressure in the hydraulic starting system.

CAUTION

The oil pressure in the system must be released prior to servicing the hand pump or any other components of the system, to prevent possible injury to personnel or equipment.

(3) Clean all of the exterior dirt from the hand pump and the hydraulic lines.

(4) Disconnect the hydraulic lines to the pump.

(5) Remove the attaching bolts and lockwashers and lift the pump from its mounting.

c. Installation

(1) Secure the pump to its mounting with attaching bolts and lockwashers.

(2) Refer to figure 2-21 and connect the hydraulic lines.

NOTE

Make sure the lines and fittings are clean before any connections are made. With the exception of the thread nearest the open end, sealant must be applied in a small amount to ONLY the male threads. Never apply sealant to the female threads. Work the sealant into the threads and wipe off the excess with a clean, lint-free cloth so that the sealant will not be washed into the system.

4-63. Hydraulic Starting Motors

a. General. Hydraulic starting motors are installed on the inboard engine of each propulsion unit. The two hydraulic starting motors, CMD-2A-111 and CMD-2A-221, are similar except for direction of rotation. Model CMD-2A-111 has a clockwise rotation, viewing from the starter drive end, and is mounted on the inboard engine of the starboard propulsion unit. Model CMD-2A-221 rotates counterclockwise, viewing from the drive end, and is mounted on the inboard engine of the port propulsion unit.

b. Removal.

(1) Close both accumulator valves.

(2) Release pressure in hydraulic system lines.

(3) Clean all of the exterior dirt from the starter and the hydraulic lines.

(4) Disconnect the hydraulic lines from the starting motor. Cover the open ends of the lines with masking tape to prevent the entry of dirt.

(5) Remove the three retaining bolts and lockwashers and lift the starting motor away from the flywheel housing.

c. Installation (fig. 4-5).

(1) Insert the hydraulic starting motor in the flywheel housing opening. When properly alined, the pilot diameter of the hydraulic starting motor adapter will enter easily-do not use force. Rotate the starting motor so that the bolt holes are alined with the tapped holes in the flywheel housing. Then secure the starting motor to the flywheel housing with three bolts and lockwashers.

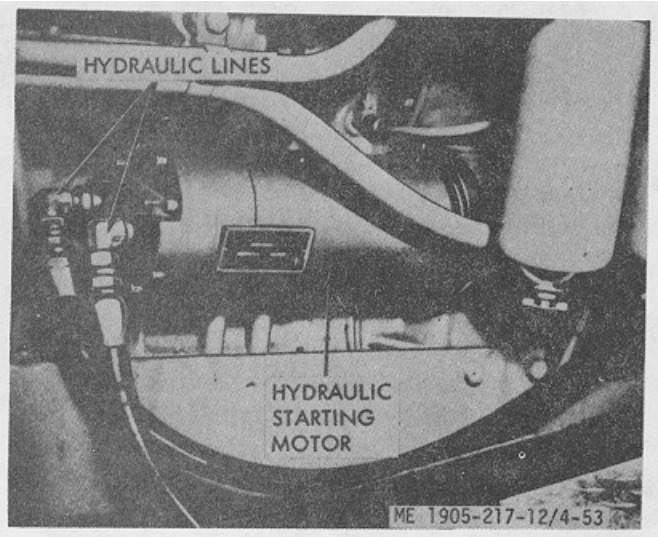


Figure 4-53. Hydraulic starting motor removal.

(2) Connect the hydraulic lines to the hydraulic starting motor.

NOTE
Make cure the lines and fittings a dean before any connections are made.

4-64. Solenoid Valve (Hull Numbers 8500 thru 85,19)

a. General. The solenoid valves are used to control the hydraulic starting motors on hull numbers 8500 thru 8519. They can be actuated electrically from the pilot house or manually in the engine room.

b. Removal (fig. 4-54).

(1) Close accumulator valves.
(2) Relieve pressure in lines.
(3) Remove and tag electrical connections.
(4) Remove hydraulic lines from solenoid valve.
(5) Remove solenoid valve from bracket.

c. Installation. Install solenoid valve in reverse order of removal.

4-65. Hydraulic Starting Control Valve (Hull Numbers 8520 thru 8539)

a. General. This is a mechanically actuated control valve used to control the hydraulic starting motors on hull numbers 8520 thru 8539. The valves are mounted aft on the inboard engines and can be actuated at the valve by pushing the control lever or from the pilot house by pulling on the cable control. See figure 4-55.

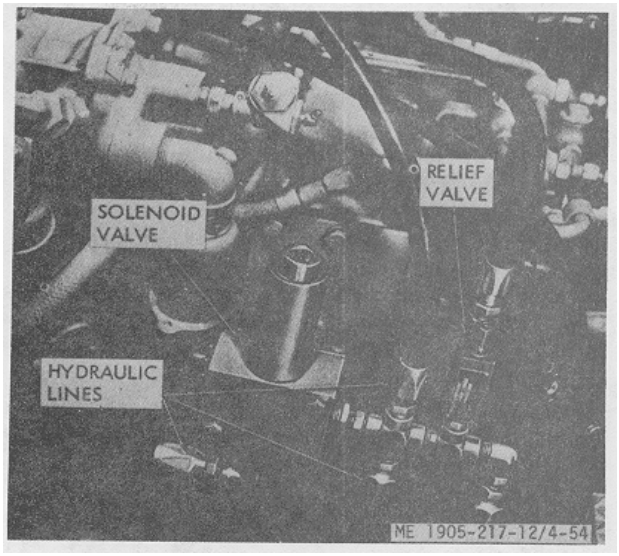


Figure 4-54. Hydraulic starting solenoid valve, hull numbers 8500 thru 8519.

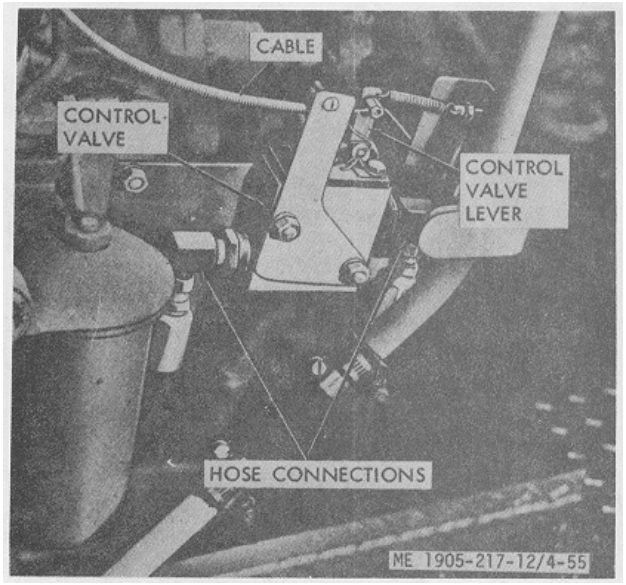


Figure 4-55. Hydraulic starting control valve, hull numbers 8520 thru 8539.

b. Removal.

(1) Disconnect pilot house cable at valve.
(2) Close accumulator valves.
(3) Relieve pressure in lines.
(4) Remove hydraulic lines from control valve.
(5) Remove control valve from bracket.

c. Installation. Install control valve in reverse order of removal.

4-66. Hydraulic Starting Control Valve (Hull Numbers 8540 thru 8560 and 8580 thru 8618)

a. General. The control valve is an electrically actuated poppet-type valve used to port hydraulic pressure to the hydraulic cranking motors. The valve, normally closed, is openel by solenoid action when the engine start pushbutton is depressed. The control valve incorporates a manual override, which is open in normal operation. In the event of electrical failure, the manual override valve is closed and hydraulic pressure opens the poppet valve, allowing fluid to operate the cranking motor.

b. Removal (fig. 2-11).

(1) Remove battery ground lead.

(2) Disconnect and tag electrical leads at control valve.

(3) Relieve pressure in hydraulic starting system.

(4) Disconnect and cap hydraulic lines at valve.

(5) Remove mounting bolts and remove valve.

(6) Tag wheel in pilot house indicating valve removed.

c. Installation (fig. 2-11).

(1) With valve in place, install mounting bolts. Torque to 30-39 foot pounds.

(2) Connect hydraulic lines.

(3) Connect electrical leads.

(4) Connect battery ground lead.

(5) Pressurize and purge system and check connections for leakage.

4-67. Relief Valve

a. General. Each engine hydraulic starting system pump has an inbuilt pressure limiting device. These are backed up by a system relief valve which is set at 3,300 psi on hull numbers 8500 thru 8519 and 3,400 psi on hull numbers 8520 thru 8560 and 8580 thru 8618. The relief valve is mounted adjacent to the starboard solenoid starting valve on hull numbers 8500 thru 8619. On hull numbers 8520 thru 8539 the relief valve is located between the hydraulic system reservoir and the steering system reservoir. On hull numbers 8540 thru 8560 and 8580 thru 8618, the system relief valve is located on the starboard side of the hydraulic starting system reservoir (fig. 2-18).

b. Removal.

(1) Close accumulator valves.

(2) Relieve pressure in hydraulic lines.

(3) Remove hydraulic lines from relief valve.

c. Disassembly and Repair. This is a permanently assembled unit. The only parts serviced are the adjusting screw, the adjusting screw packing, and the external preformed packing.

d. Installation. Install in reverse order of removal.

SECTION XV. TRANSMISSION

4-68. General

a. The torqmatic marine reverse gear and the flywheel assembly provide an emergency forward clutch lock and positive clutch engagement or release by simply moving the selector valve lever to the desired position for forward, neutral, or reverse.

b. Each marine gear consists of a flywheel and forward drive clutch assembly and a reverse drive clutch assembly with a through drive shaft. Also, each has an oil pump for supplying oil under pressure for operating the forward and reverse clutches, a control valve to admit oil to the clutches, an oil strainer, a full-flow oil filter, and an oil cooler.

c. Power from the diesel engine is imparted to the through drive shaft by locking the forward or reverse clutch plate between the hydraulically operated piston and a drive plate.

4-69. Emergency Clutch Engagement

a. If for any reason the clutches on the engines of a unit cannot be engaged hydraulically, the forward clutch plate may be engaged on the engines with three emergency engagement bolts provided.

b. Refer to figure 456 for the location of the emergency engagement bolts. Lock the forward clutch plate in forward drive as follows:

(1) Remove the electric starter in the forward face of the flywheel housing.

(2) With the engine throttle set in the STOP position, rotate the engine flywheel until one of the emergency engagement bolts (48) is in line with {the starter opening in the flywheel housing.

(3) Remove the emergency engagement bolt and jam nut from the flywheel through the starter opening.

(4) Remove the jam nut from the bolt and save the nut; then, thread the bolt back into the flywheel until the end of the bolt just contacts the forward clutch piston.

(5) Remove the remaining emergency engagement bolts and jam nuts, and reinstall the bolts as outlined above.

(6) Tighten all of the bolts uniformly, thus locking the forward clutch plate (47) between the piston (3) and the drive plate (4). Install the starter in the flywheel housing.

NOTE

The emergency engagement bolts must be tightened uniformly to prevent bind between the close-fitting piston and the bore in the flywheel.

NOTE

When the emergency engagement bolts are engaged, do not use reverse drive or the gear will be damaged.

4-70. Transmission Oil Pump

a. General

(1) Oil pressure to operate the forward and reverse-clutches of the torqmatic marine gear is provided by a positive displacement rotor-type oil pump mounted on the rear face of the flywheel housing. The pump is driven by the blower drive shaft through two hubs and a coupling.

(2) For hull numbers 8500 thru 8539 the pump has a constant flow control valve incorporated with the pressure relief valve, forming a constant flow and relief valve assembly. At all engine speeds, the oil flow is approximately 6 gpm. For hulls 8540 thru 8560 and 8680 thru 8618, the pump relief valve is factory adjusted and permanently closed.

(3) Pumps are built for right-hand and left-hand rotation depending on the engine model on which they are used. The direction of rotation is marked on the pump body.

(4) A bleed hole in the oil pump body and the cover leads from the oil seal cavity to intake side of the pump to avoid a pressure build-up back of the oil seals.

b. Removal (fig. 4-57).

(1) Disconnect the tachometer drive cable from the drive.

(2) Remove the transmission oil strainer.

(3) Disconnect the oil pump outlet hose.

(4) Remove the bolts, nuts, and lockwashers securing the oil pump to the flywheel housing. Then, remove the oil pump from the flywheel housing.

c. Installation.

(1) Affix a new gasket to the flange of the oil pump body.

NOTE

The oil pump to flywheel housing gasket and the flywheel housing small hole gasket are very similar in design. When installing a new oil pump to flywheel housing gasket, be sure to use the proper gasket to prevent oil leaks. The oil pump gasket has an inside diameter of approximately 3 17/32 inch.

(2) Position the oil pump assembly in back of the flywheel housing as shown in figure 4-57. Then, with the teeth on the drive coupling hub in position to mesh with the teeth in the drive coupling, place the pump agains the flywheel housing and secure ion place with bolts, lockwashers, and nuts.

(3) Complete the installation in reverse order of removal.

(4) For hulls 8540 thru 8560 and 8580 thru 8598, adjust a newly installed transmission hydraulic oil pump as follows:

(a) Remove the allen head plug in the transmission oil filter.

(b) Insert a pressure gauge (300 psi min.) at the filter.

(c) Remove acorn nut and back off locknut of the pressure regulating valve on the pump.

(d) Back off the regulating valve adjusting screw to the left.

(e) Start the engine.

(f) Insert a screw driver into the slot of the adjusting screw and turn clockwise until the pressure gage reading is 180 PSI.

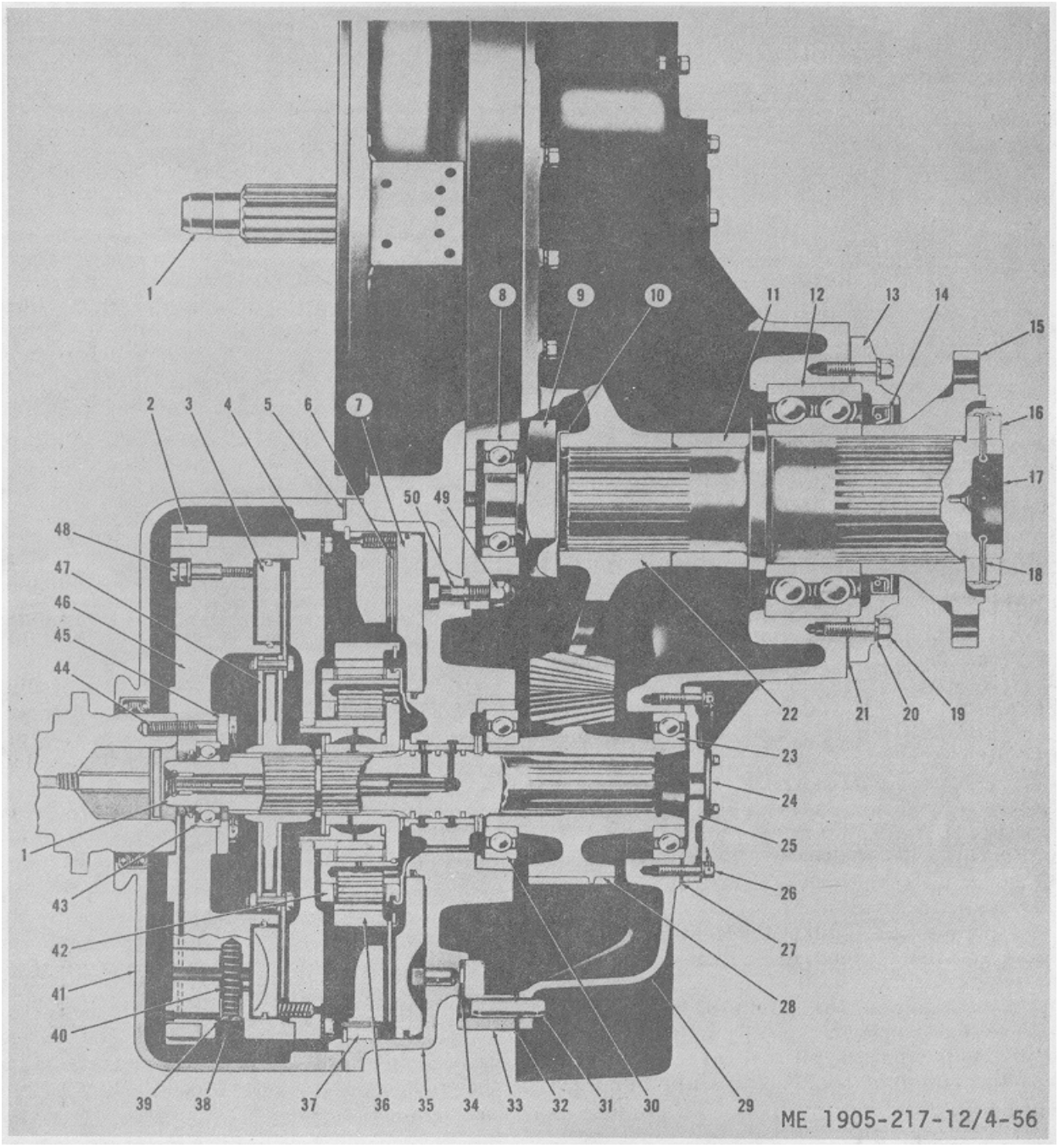
(g) Lock adjusting screw with locking nut and install acorn nut.

(h) Stop engine and after a few minutes carefully remove the pressure gauge and install the allen head plug to the oil filter.

(i) During the adjustment cycle the oil dipstick should be check 2-or 3-times to insure that oil level is about half way up to the PULL mark.

NOTE

For hulls 8540 thru 8560 and 8580 thru 8618, prior to replacing the HYDRECO engine driven hydraulic pump, deactivate existing pressure by removing the acorn nut and turning the adjusting screw clockwise. Replace the acorn nut.



1. Reverse gear drive shaft
2. Flywheel ring gear
3. Forward clutch drive
4. Forward clutch drive plate
5. Reverse gear to flywheel housing gasket
6. Reverse clutch plate
7. Reverse clutch piston
8. Bearing
9. Driven gear locknut
10. Driven gear nut lock-washer
11. Spacer
12. Driven shaft bearing assembly
13. Driven shaft bearing cover
14. Driven shaft bearing cover oil seal
15. Drive flange
16. Drive flange nut
17. Driven shaft
18. Cotter pin

Figure 4-56. Toqmatic marine gear.

19.Bearing cover bolt
2O.Lockwasher
21.Bearing cover gasket
22.Driven gear
23.Drive gear bearing assembly (rear)
24. Cover (special)
25. Reveres gear drive shaft cover
26. Drive shaft cover bolt
27. Drive shaft cover gasket
28. Drive gear (pinion)
29. Transfer gear housing
30. Drive gear bearing assembly (front)
31.Adapter plate dowel pin
32.Transfer gear housing to adapter plate gasket
33.Reverse gear adapter plate
34. Reverse gear to adapter plate gasket
35. Reverse gear housing
36. Reverse ring gear
37. Reverse clutch drive plate
38. Dump valve plug
39. Forward clutch dump valve
40. Dump valve spring
41. Flywheel housing
42. Planetary gear assembly
43. Flywheel pilot bearing
44. Flywheel to crankshaft bolt
45. Flywheel pilot bearing retainer
46. Flywheel
47. Forward clutch plate
48. Emergency engagement bolt
49. Nut
50. Reverse gear to adapter plate bolt

Figure 4-56. Continued.

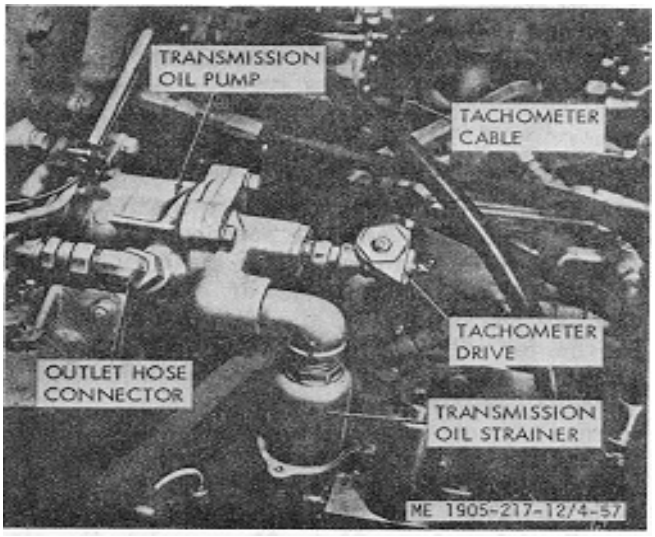


Figure 4-57. Transmission oil pump removal.

4-71. Transmission Control Valve (fig. 4-58)

a. *General.* The control valve assembly consists of a master selector valve for controlling both engines of the power unit simultaneously and separate shutoff control valves for controlling the flow of the oil to each individual engine marine gear. For hull numbers 8540 thru 8560 and 8580 thru 8618, the selector valve is modified to include regulating valve components.

Three oil passages, for forward drive, for reverse drive, and for neutral and lubrication, are provided in each reverse gear housing. Oil grooves and passages are machined in the selector control valve so that, when it is rotated to the forward position by the lever, oil is admitted to the forward oil passage in the gear housing. When the selector control valve is rotated to the reverse position, oil is admitted to the reverse oil passage. The neutral (lubricating) oil passage is never cut off regard-less of the position of the selector control valve.

4-72. Transmission Oil Cooler

a. General.

(1) To provide additional cooling for the lubricating oil used in the torqmatic marine gear, a separate oil cooler is mounted on each engine. Thus, sufficient additional cooling is provided to insure that normal operating temperatures are maintained in the marine gear oil system under all conditions of speed and load in both forward and reverse.

(2) Oil is drawn through the oil strainer from the marine gear oil sump by the marine gear oil pump and then is circulated through the oil filter and oil cooler to the selector control valve.

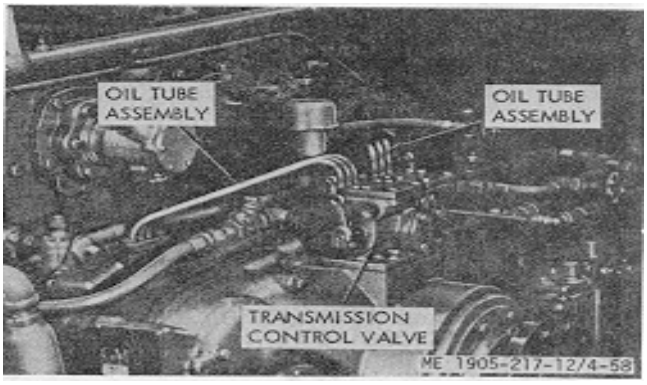


Figure 4-58. Transmission control valve.

(3) The oil cooler element should be removed and cleaned periodically, or at the time of each engine or marine gear overhaul, to prevent overheating of the marine gear oil.

b. Removing Oil Cooler Element (fig. 4-59).

(1) Drain the cooling system.

(2) Remove engine oil filter and bracket.

(3) Remove oil tubes from engine oil cooler cover.

(4) Matchmark the end of the oil cooler cover, cooler element, and cooler housing with a punch or file so they can be installed in their same relative positions.

(5) Remove the bolts and lockwashers securing the oil cooler cover to the oil cooler housing. Then, pull the cover away from the element.

NOTE

If necessary, loosen the oil tube clips at the side of the cylinder block.

(6) Remove the oil cooler element from the oil cooler housing (fig. 4-60).

(7) Remove the gaskets from the oil cooler over, element, land housing.

c. *Cleaning Oil Cooler Element.*

(1) *Clean oil side of element.* Circulate a solution of trichloroethylene through the core passages with a force pump to remove the carbon and sludge.

CAUTION

This operation should be done in the open or in a well ventilated room when trichloroethylene or other toxic chemicals are used for cleansing.

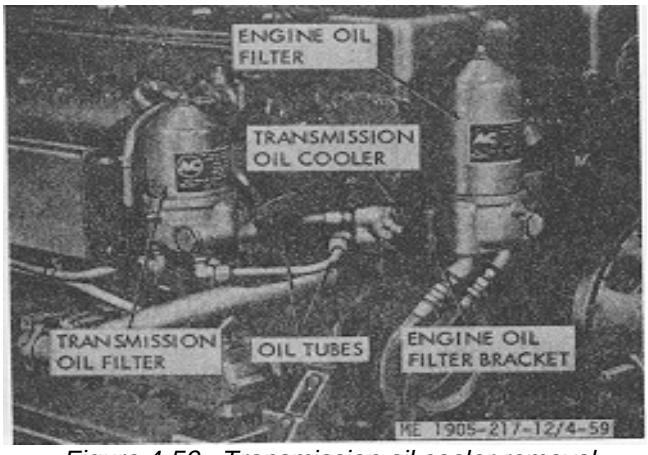
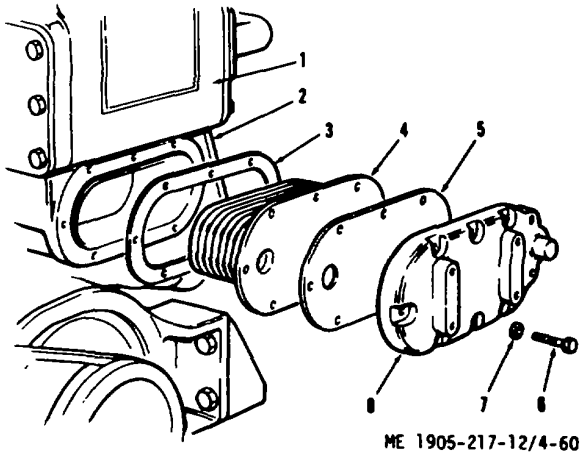


Figure 4-59. Transmission oil cooler removal.



1. Heat exchanger
2. Oil cooler housing
3. Housing gasket
4. Oil cooler element
5. Cover gasket
6. Cover bolt
7. Lockwasher
8. Oil cooler cover

Figure 4-60. Transmission oil cooler details.

(2) *Clean the element before sludge hard*ens. If the oil passages -are badly clogged, circulate an Oakite or alkaline solution through the core and flush thoroughly with clean, hot water.

(3) *Clean water side of element.* After cleaning the oil side of the element, immerse it in the following solution: Add one-half (1/2) pound of oxalic acid to each two and one-half (2 1/2) gallons of solution composed of one-third (1/3) muriatic acid and two-thirds (2/3) water. The cleaning action is evidenced by bubbling and foaming. The process must be care fully watched and, when bubbling stops (this usually takes from 30 to 60 seconds), the element should be removed from the cleaning solution and thoroughly *flushed* with clean, hot water. After cleaning, dip the element in light oil.

NOTE

Cleaning an oil cooler element is not recommen ded where the history of usage shows a marine gear failure which *has released metal* particles from worn and broken parts, into the lubricating oil. In this instance, the replacement of the oil cooler is strongly recommended.

d. Installing Oil Cooler Element.

(1') *Affix* a new gasket to the oil cooler housing (fig. 4460).

(2) Affix a new gasket to the inner face of the oil cooler cover.

(3) Install the oil cooler element into the oil cooler housing with the matchmarks previously placed on the element and housing in alignment.

(4) Place the oil cooler cover against the oil cooler element with the matchmarks in alinement, and install two bolts and lockwashers to hold the cover and element in place.

(5) Install the remaining bolts and lockwashers. Tighten the bolts to 13-17 ft-lb torque.

(6) Attach the two oil tubes to the end of the oil cooler cover.

(7) Install engine oil filter bracket and filter.

(8) Fill the engine cooling system.

(9) Start the engine and check for oil and water leaks.

(10) Check the oil level in the marine gear. Add oil if necessary.

SECTION XVI. POWER TRANSFER ASSEMBLY~

4-73. General

Power developed by the two engines is delivered through the hydraulic marine gear system to the drive gear (4, fig. 4-61), thence to the power driven gear (32) and power driven shaft (13). The power transfer gear is splash lubricated with oil in the marine gear system.

4-74. Service

a. If an oil leak should develop, gaskets (26, fig. 4-61) and (11) can be replaced by removing the appropriate cover.

b. If major repairs are needed, transfer gear 'assembly must be removed from the engine. Refer to higher echelon.

SECTION XVII. HYDRAULIC STEERING SYSTEM

4-75. General

a. The hydraulic steering systems for these craft are similar, but some components are different. See figure 1-9 for diagram of hull numbers 8500 thru 8519 steering system or figure 1-10 for diagram of hull numbers 8520 thru 8539 steering system. See figure 1-11 for diagram of hull numbers 8540 thru 8560 and 8580 thru 8618 steering system. Hull numbers 8540 thru 8560 and 8580 thru 8618 incorporate a closed system. Return lines from the actuating cylinders and counterbalance valves return hydraulic fluid to the steering reservoir.

b The hydraulic steering systems use medium pressure hydraulic oil to actuate cylinders which position the rudders. Oil is supplied by the hydraulic pumps to the helm unit which is the principal metering and directional controlling device. By directing hydraulic oil to one side or the other of the cylinders they will extend or retract giving the desired position to the rudders.

c. The helm unit and other valves control the 'direction and volume of flow of hydraulic oil. The relief valve protects the system by limiting hydraulic oil pressure. The flow control valve (flow divider)'limits the volume of oil to the value at which this system is designed to work. The flow control valve (flow divider) divides the oil supplied into two flows (2.5 gpm hull numbers 8500 thru 8518, 2 gpm hull numbers 8520 thru 8560 and 8580 thru 8618) to the helm unit, and the remainder returned to the storage tank.

NOTE

The hull numbers 8500 thru 8519 steering system is designed to be supplied by one pump. Using both pumps will only cause a doubled by-pass flow resulting in excessive heating of oil. The steering system pump discharge valves (fig. 223) should be set with one valve open and one valve closed.

NOTE

The hull numbers 850o thru 8560 and 8580 thru 8618 steering system is designed to use the flow from both pumps. However, this system will function with only one pump operating.

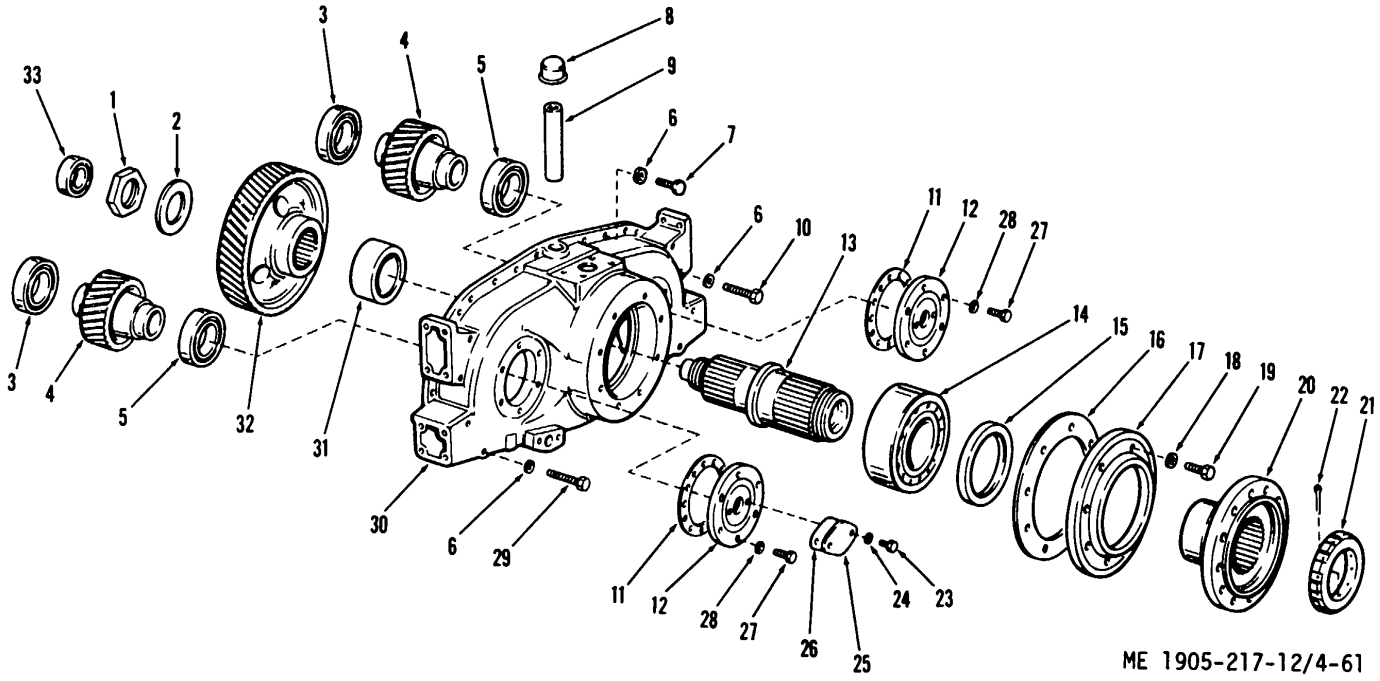
4-76. Filling Hydraulic Steering System with Fluid

a. *General.* The hydraulic oil for this system should be a high grade oil compounded for use in a hydraulic system. Recommended oils are 2135 TH., MIL-17672B; and 2075 TH., MIL17672B.

b. Filling Hydraulic Steering System, hull numbers 8500 thru 8519.

(1) Fill this system through the fill-vent cap in the pilot house expansion tank. Open valves (fig. 2-16 and 2-27) at bottom of each tank and open the vent pet cock on the storage tank (in engine room). Fill until oil appears at the vent pet cock, then close it. Continue filling the expansion tank until it is full (check sight glass).

(2) Open all ball valves in the system. Pre-fill suction lines and pumps by loosening pump discharge hoses at the union swivel. Turn pumps



1 Driven gear locknut
2.Driven gear lockwasher
3.Drive gear bearing (front)
4. Power drive gear
5. Drive gear bearing (rear)
6.Lockwasher
7. Gear housing bolt
8. Breather cap assembly
9. Oil filer and breather tube
10. Bolt
11 Drive shaft cover gasket
12.Drive shaft cover
13. Power driven shaft
14. Driven shaft bearing
15.Driven shaft bearing retainer oil seal
16.Bearing retainer gasket
17.Retainer
18.Lockwasher
19. Bearing retainer bolt
20. Drive flange
21 Drive flange retainer nut
22. Cotter pin
23.Special cover bolt
24. Washer
25.Special cover
26 Special cover gasket
27. Drive shaft cover bolt
28. Plain washer
29. Gear housing bolt
30. Transfer gear housing
31. Driven gear spacer
32. Power driven gear
33. Driven shaft pilot roller *bearing*

Figure 4-61. Power transfer assembly.

over slowly with engines idling, to draw oil into them. When pumps have taken a suction, reconnect discharge lines and close one ball valve in the pump discharge line. This directs oil to the remainder of the hydraulic system. Continue filling the expansion tank and venting the storage tank throughout the filling operation.

(3) Oil levels will drop as lines, valves, and cylinders become filled. Air displaced by the oil will collect in the storage tank and must be vented off. Turn pumps over at engine idling speed while continuing to purge the system. When pumps and lines up to the helm unit appear to be full, rotate the steering wheel from hardover to hardover to work air out of cylinders and the lines leading to the helm unit. Air may be removed from the cylinders by backing off the air bleed Allen screws located on the cylinder walls near the end caps. Air in the hydraulic system will cause a spongy feeling in the helm, noisy operation, and/or rapid fluctuation of oil level in the expansion tank. Continue the above procedures to work air out of the system. If air in the system persists, check suction lines for air leaks.

(4) Check the return line filter (fig. 2-8.1) after the system has been purged and operated for about 15 minutes. Replace the filter element if necessary.

(5) Clean suction strainer (in storage tank) after the first 25 hours of operation. Pieces of metal or other foreign matter should be investigated to determine their source.

c. Filling Steering System, Hull Numbers 8520 thru 8560 and 8580 thru 8618.

(1) Filling procedures for the steering system on hulls 8520 thru 8560 and 8580 thru 8618 are similar to the procedures described in paragraph *b* for hulls 8500 thru 8519 craft. Hulls 8520 thru 8560 and 8580 thru 8618 do not have an expansion tank in the pilot house. Filling is done in the 12-gallon tank in the engine room. Check level in the sight glass as the system is being filled.

(2) Hulls 8520 thru 8539 do not have ball valves in the pump discharge lines. The output from both steering pumps is used normally. If one pump should fail or is not running, the check valve will prevent fluid from reversing through the pump.

4-77. Steering System Filters and Strainers

a. *Filters (Return Line).* Refer to figure 2-8.1 for service of return line filter.

b. Suction Strainer, Hull Numbers 8500 thru 8519.

(1) This strainer is located inside the 10gallon storage tank in the engine room. See figure 2-16. The shiner element should be removed and cleaned after the first 25 hours and thereafter every 500 hours of operation.

(2) Oil should be changed when the suction strainer is cleaned. Continued coloration of the oil or known contamination is cause for changing oil prior to the regular interval.

(3) Drain oil from 10-gallon storage tank (fig. 2-16).

(4) Remove storage tank top cover. Turn suction strainer retaining ring 1/8 turn to release element**.**

(5) Clean element thoroughly in solvent and reinstall.

(6) Refer to paragraph 4-76 to refull steering hydraulic system.

c. Suction Screens, Hull Numbers 8520 thru 8660 and 8580 thru 8618.

(1) These screens (2) are located in the 12gallon steering system storage tank in the engine room. It is necessary to remove the top cover of the storage tank for access to the screens. See figure 4-62.

(2) Drain oil and clean the screens every 200 hours.

(3) Refer to paragraph 4-76 to refill the steering hydraulic system.

4-78. Steering System Pumps

a. General. Steering system pumps are mounted aft on the outboard engine of each propulsion unit. Pumps mounted on the starboard propulsion unit are left-hand rotating as viewed from the shaft end of the pump. Pumps for the port propulsion unit are right-hand rotating. The pump made for the left-hand rotation is identified by an "L" in the model code.

NOTE

Pumps must be driven in the direction of the arrows cast on the pump ring. If it is desired to change the direction of drive rotation, it is necessary to reverse the ring.

b. Removal.

(1) Close suction line valve at tank (hull numbers 8500 thru 8519).

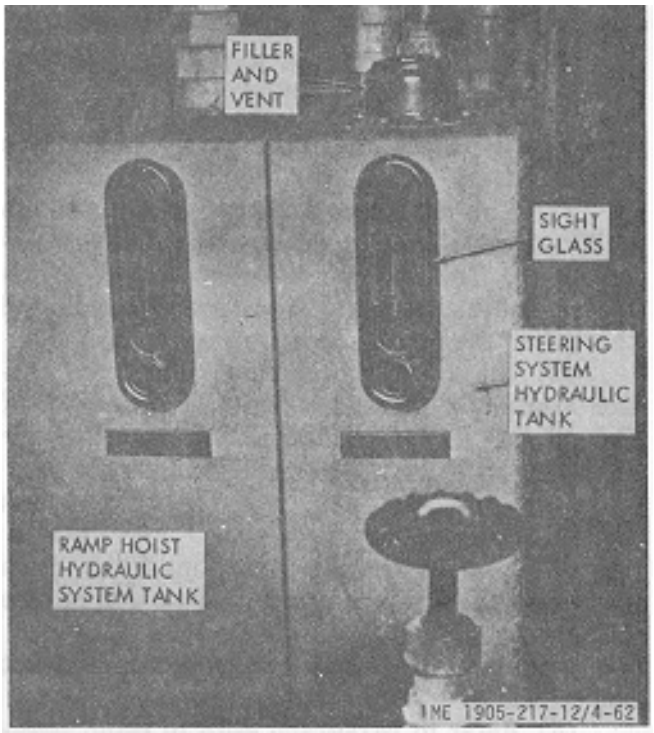


Figure 4-62. Steering and *ramp hoist hydraulic. system* tanks.

(2) Remove Inlet and outlet connections from pump (fig**.** 4-63).

(3) Remove two attaching bolts and remove pump**.**

NOTE

Steering pump)s for hull numbers 8500 thru 8519 and hull numbers 8520 thru 8560 Land 8580 thru 8618 are similar but not identical.

c. .Installation. Install pump In reverse order of removal. Accurate positioning of the adapter gear on the pump shaft is necessary for proper alinement of drive components.

4-79. Steering Cylinders (fig. 4-64)

a *General.* Steering cylinders are mounted in the lazarette with the rod ends attached to rudder post arms. There are two ball valves **in** the lazarette for each cylinder. The valves can be closed to isolate a cylinder in case of failure.

b. Service (fig. 4-65). Steering cylinders normally live no trouble other than excessive leakage-internal or external. Tightening the "V" rod packing assembly will usually stop external leakage. Should leakage persist, examine the rod for scoring and/or replace seals Mild scores or

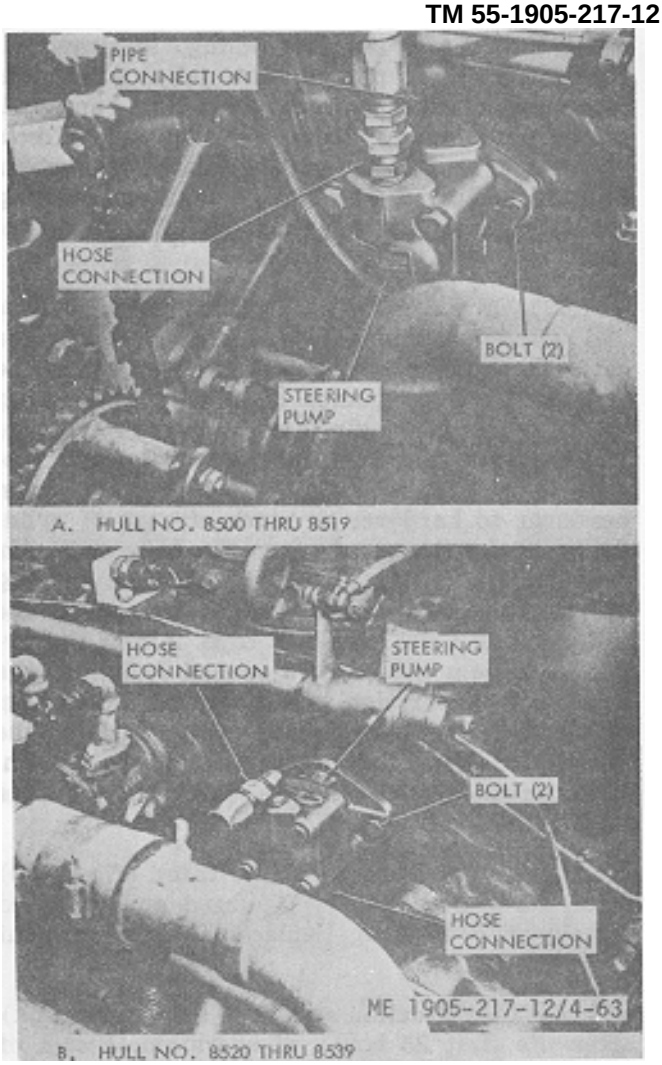


Figure 4-63. Hydraulic steering pump.

nicks in rods call be removed by light stoning.

c.. R*emoval (fig. 4-64).*

(1) Close hall valves for cylinder to be removed.

(2) Disconnect cylinder hoses at cylinder.

(3) Remove pins at cylinder ends and remove cylinder.

d . Installation. Install cylinder in reverse order of removal.

e . Rudder Stop Adjustment Refer to figure 4-66 for rudder stop locations.

4-80. Steering System Valve Adjustments (Hull Numbers 8500 thru 8519)

a. General. Before adjusting the relief valve or the double over-center valve, place a 0-2000 psi pressure gage in the line between the flow control valve and the helm unit. See figure 1-9.

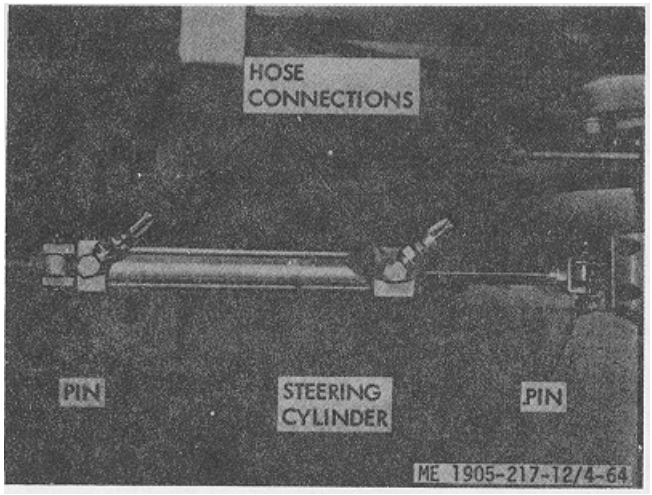


Figure 4-64. Steering cylinder removal

b. Relief Valve (fig. 4-67). Adjust by putting the helm hardover in either direction with engines running (1 pump only supplying system). Remove cap from the relief valve, loosen nut, and back off screw until it no longer bears on the spring. Hold the helm in a hardover position and slowly turn down screw until the pressure gage reads 1,500 psi indicating that the valve is relieving at 1,500 psi. Lock this setting with nut and replace cap.

c. Flow Control Valve. This valve is preset at the factory and cannot be adjusted.

*d. Double Over-Center Valve (fig. 4-68). A*djust with the screws. Loosen nuts and back off screws until they no longer bear on springs. Rotate the helm and slowly turn down screws until the pressure gage reads 150 psi indicating that a pressure of 150 psi is required to open the over-center valve and start motion in the cy1.inders. This operation must be performed 'first in one direction, adjusting one side of the over-center valve, then repeated for the other side. With the above setting the over-center valve will resist a kick-back force from the rudders equal to the force exerted by the cylinders at 1,500 psi. This adjustment must be made with the cylinders at mid-stroke and the craft motionless in the water so that no load is applied to the cylinders.

4-81. Steering System Valve Adjustments (HuIH1 Numbers 8520 thru 8560 and 8580 thru 8618)

See figure 1-9 or 1-10 for valve locations in system.

a. Relief Valve. This valve is to be set for a maximum system pressure of 1050 psi. Refer to paragraph 4-80b and figure 4-69 for adjusting procedure.

b. Flow Divider. This valve is a preset priority type supplying a constant 2 gpm to the helm unit. Excess oil is bled back to the reservoir.

c. Counterbalance Valves (2). The counterbalance valves induce an artificial pressure on the low pressure side of the steering cylinders to prevent the rudder from running ahead of the pumps. See figure 4-70. These valves are set at 1,000 psi.

4-82. Helm Unit and 'Steering Wheel

a. General. The helm unit and other valves control the direction and volume of flow of the hydraulic oil in the steering system. The helm unit directs the oil to one side or the other of the cylinders and limits the flow according to the speed at which the steering wheel is turned. In event of pump failure the helm unit will also act as a pump when turned manually.

b. Removal (fig. 4-71).

(1) Remove steering wheel.

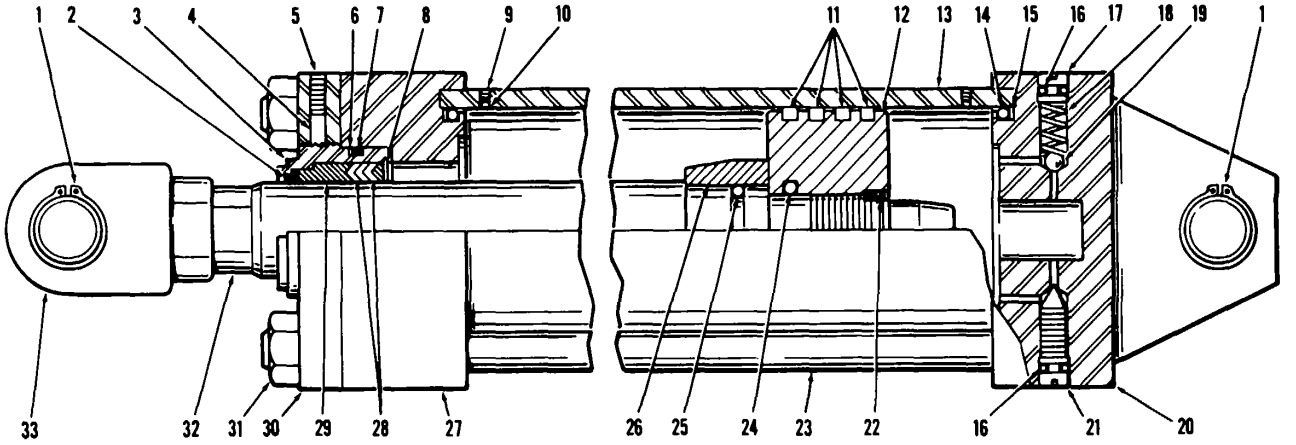
(2) Remove access covers in pilot house panel.

(3) Clean the four tube connections at helm unit with a solvent-wetted cloth so that contamination will not enter the system.

(4) Disconnect the four tubes or hoses **as** applicable from the helm unit

(5) Remove four mounting bolts and remove helm unit.

c. Installation. Install helm unit in reverse order of removal.



1. Clevis pin
2. Rod wiper
3 Cartridge
4. Cartridge slug
5.Lockscrew
6 Cartridge ring
7. Cartridge packing
8 Packing retaining ring
9. Bleeder screw
10. Bleeder ball
11. *Piston* packing
12 Piston
13 Tube
14,. Preformed packing
15. Ring
16. Preformed packing
17. Ball check screw
18. Ball cheek spring
19. Ball check ball
20. Cap end cover
21. Adjusting needle
22. Lockscrew
23. Tie rod
24. Preformed packing
25. Preformed packing
26. Head end cushion nose
27. head end cover
28 V rod packing assembly
29. Rod bearing
3*0.* Cartridge retainer
31. Tie rod nut
32. Tie rod nut
33. Rod clevis

Figure 4-65. Steering cylinder, sectional view.

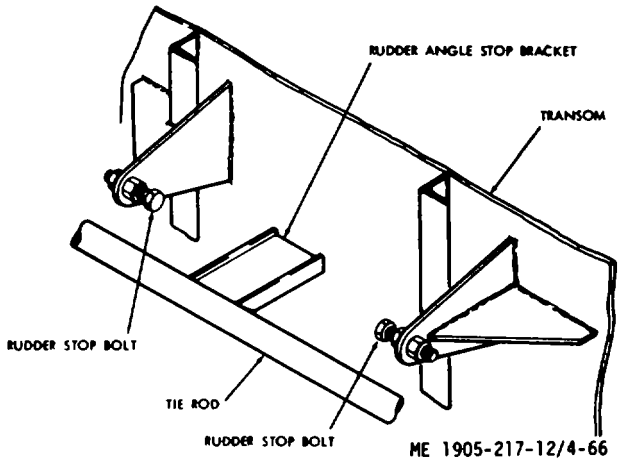


Figure 4-66. Rudder stops installation, hull numbers 8540 thru 8560 and 8580 thru 8818.

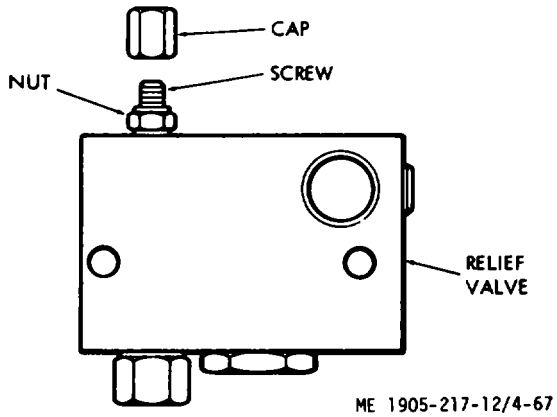


Figure 4-67. Relief valve adjustment, steering system, hull numbers 8500 thru 8519.

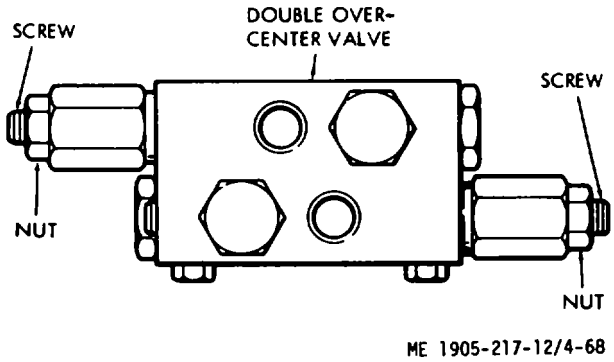


Figure 4-68. Double over-center valves, steering system, hull numbers 8500 thru 8519.

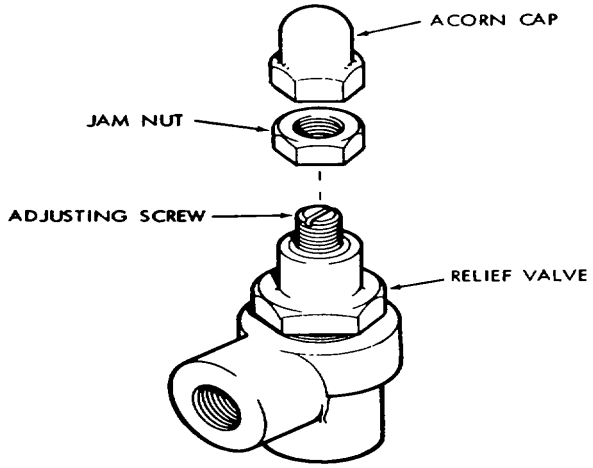


Figure 4-69. Relief valve, hull numbers 8540 thru 8660 and 8580 thru 8618.

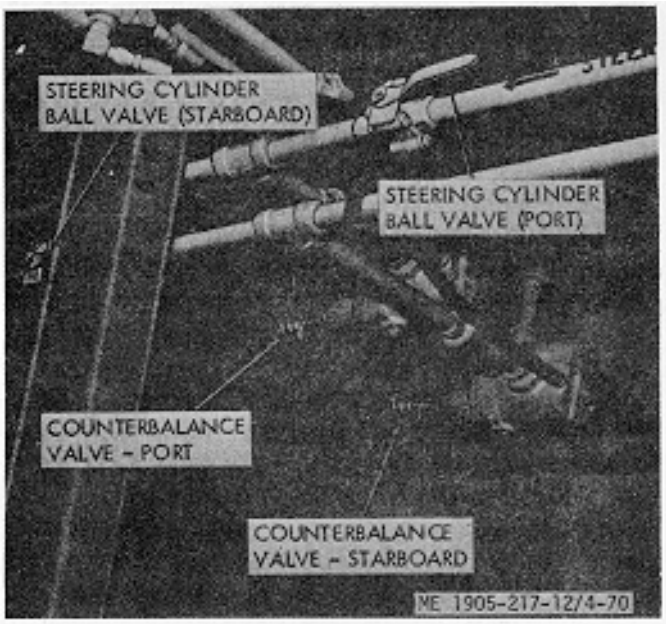


Figure 4-70. Counterbalance valves, steering system, hull numbers 8520 thru 8560 and 8580 thru 861R.

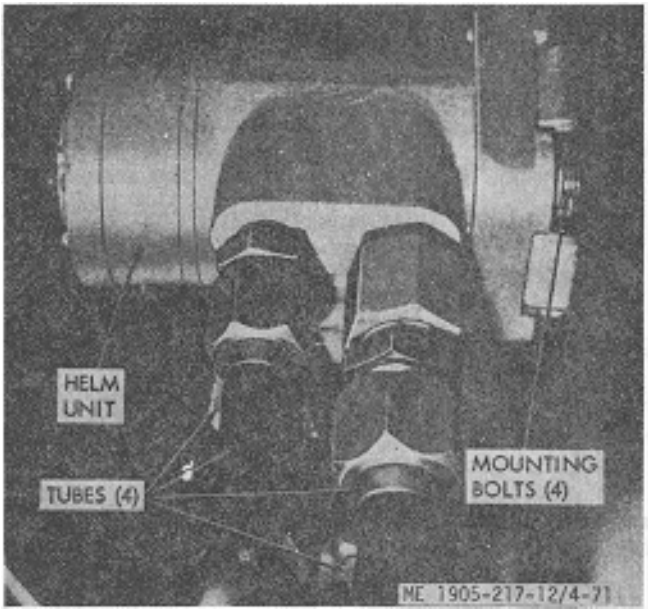


Figure 4-71. Helm unit removal

SECTION **XVIII. POWER TAKE-OFF**

4-83. General

The outboard engine of each propulsion unit is equipped with a front-mounted power take-off (fig. 4-72) to drive the hydraulic pumps for the ramp hoist system. Each power take-off includes a lever operated clutch. A front end power takeoff adapter supports the power take-off assembly and surrounds the clutch and drive mechanism. The adapter retains the crankshaft oil seal and is bolted to the engine front end plate and cylinder block.

4-84. Clutch Adjustment

When the clutch is properly adjusted, heavy pressure is required at the outer end of the hand lever to move the throw out linkage to the "over-center" or locked position. Adjust clutch as follows:

a Disengage the clutch.

b Remove the inspection hole cover to expose the clutch adjusting ring.

c Rotate the clutch, if necessary, to bring the clutch adjusting ring lock within reach. See figure 4-73**.**

d Remove the clutch adjusting ring spring lock screw and lock from the inner clutch pressure plate and adjusting ring. Then, while hold ing the clutch drive shaft to prevent the clutch from turning, turn the clutch adjusting ring counterclockwise and tighten the clutch until the desired pressure on the outer end of the hand lever, or at the clutch release shaft is obtained. Then, reinstall the clutch adjusting ring spring lock, making sure the ends of the lock are in the notches in the adjusting ring.

e. When the clutch is properly adjusting, the approximate pressure required at the outer end of the hand lever to engage the clutch is 55 lbs.

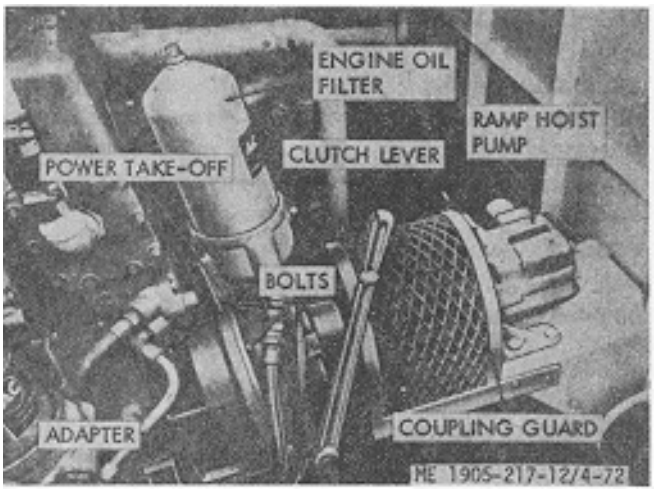
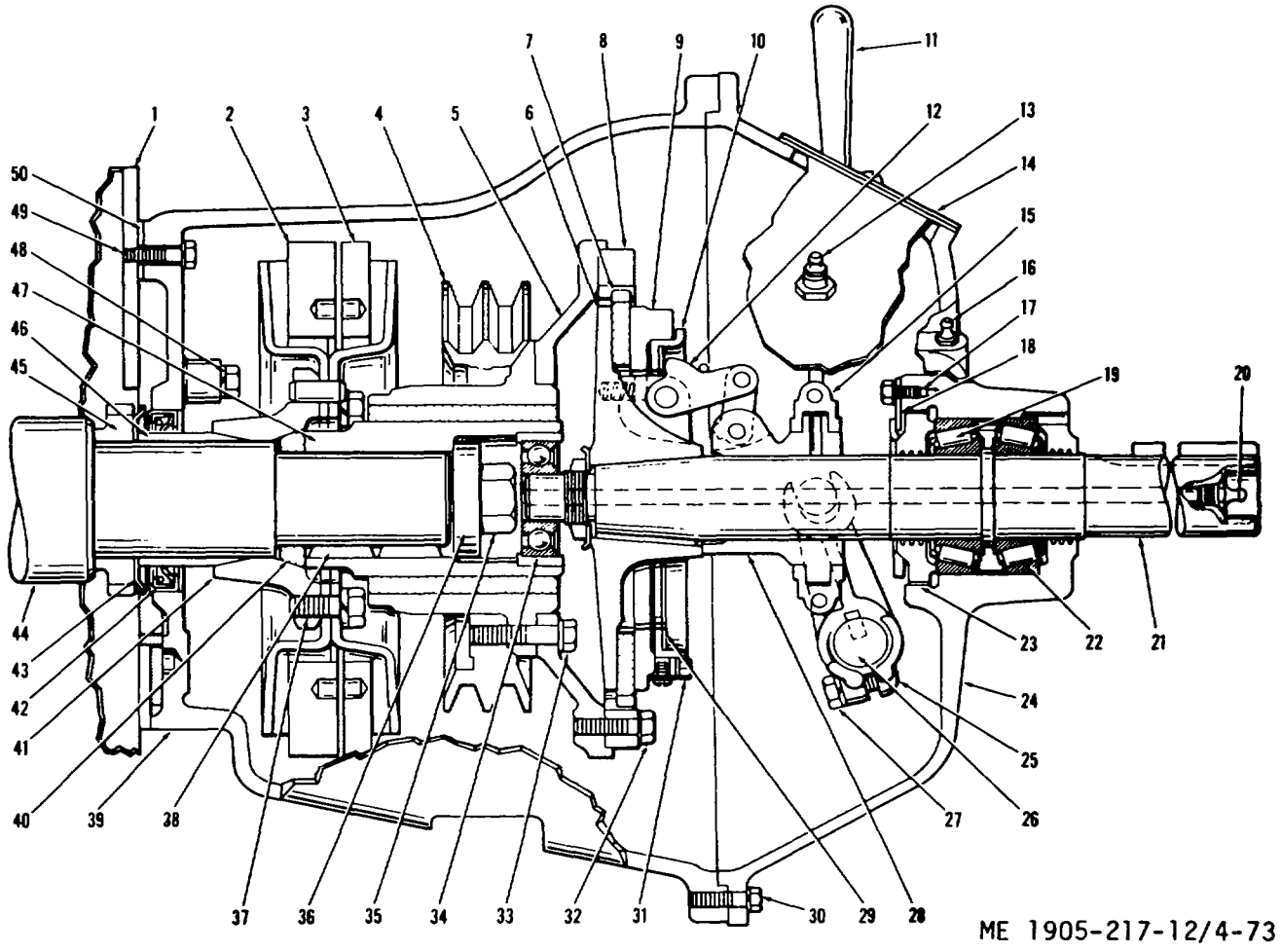


Figure 4-72. Power take-off.



1. Cylinder block end plate
2 Vibration damper assembly (heavy)
3. Vibration damper assembly (light)
4. Accessory drive pulley
5. Clutch drive adapter
6. Clutch pressure plate (outer)
7. Clutch facing (one piece)
8. Clutch driving ring
9. Clutch pressure plate (inner)
10. Clutch adjusting ring
11. Clutch hand lever
12. Clutch release lever
13. Grease fitting
14. Inspection cover
15. Clutch collar
16. Grease fitting
17. Retainer lock plate bolt
18. Bearing retainer lock plate
19. Roller bearing (inner)
20. Grease fitting
21. Clutch drive shaft
22. Roller bearing (outer)
23. Drive shaft bearing retainer
24. Clutch housing
25. Clutch release yoke
26. Clutch release shaft
27. Yoke to shaft bolt
28. Clutch release sleeve
29. Adjusting ring wear plate
30. Clutch housing bolt
31. Clutch adjusting ring spring lock
32. Clutch driving ring bolt
33. Drive adapter and pulley to coupling flange bolt
34. Clutch drive shaft pilot bearing
35. Bolt
36. Washer, coupling assem-'bly to crankshaft
37. Vibration damper to hub bolt
38. Woodruff key
39. Power take-off adapter
40. Vibration damper hub cone (front)
41. Vibration damper hub
42. Crankshaft oil ea (front)
43. Crankshaft oil slinger
44. Crankshaft
45. Oil pump drive gear
46. Vibration damper hub cone
47. Coupling and flange assembly
48. Adapter to cylinder block bolt
49. Adapter to end plate bolt
50. Adapter to end plate gasket

Figure 4-73. Power take-off assembly, sectional view.

SECTION XIX. HYDRAULIC RAMP HOIST

4-85. General

a. The ramp hoisting arrangement consists of a hoisting cable deadended to one side of the craft, running through fairlead sheaves through the ramp and to a winch on the opposite side. The systems for hull numbers 8500 thru 8619 and hull numbers 8620 thru 8560 and 8580 thru 8618 are similar in operation but most components differ. The winch on hull numbers 8500 thru 8519 is on the ,port side and on hull numbers 8520 thru 8560 and '8580 thru 8618 the winch is on the starboard side.

b. Winches are powered by hydraulic motors. Other system components include a four way control valve, counterbalance valve, two engine driven pumps, two check valves, suction line strainers, and return line filters. See figure 1-12 for the hull numbers 8500 thru 8519 ramp system diagram, or figure 1-13 for the hull numbers 8520 thru 8539 ramp system diagram, or figure 1-14.1 for hull numbers 8540 thru 8660 and 8580 thru 8618 ramp system diagram. Hull numbers 8540 thru 8560 and 8580 thru 8618 incorporate a closed hydraulic system. Return hydraulic fluid from the counterbalance valve is routed to the reservoir.

c. Emergency lowering of the ramp is accomplished by a manual brake release on hull numbers 8500 thru 8'519 and by a hand operated hydraulic pump brake release on hull numbers 8520 thru 8560 and 8580 thru 8618. Two chain hoists are stored in the l1azarette to be used for emergency lifting of the ramp. See figure 2-9.

d. On hull numbers 8540 thru 8560 and 8580 thru 8618, a hydraulically actuated mechanical latch is provided to secure the ramp in an up position. The latch is unlocked by hydraulic pressure applied by placing the ramp hoist lever (fig. 2-3) in the RAMP-DOWN position. The latch is automatically locked when the ramp is raised. The latch can be unlocked during emergency conditions (no pressure in ramp hydraulic system engines not operating, etc.) by ,applying hydraulic pressure with the winch brake release hand pump, located on the starboard side of the forward cargo hull. A selector valve, located on the starboard side of the forward cargo hull, selects the source of hydraulic pressure for unlocking the ramp latch. In the NORMAL position, pressure from the engine driven pumps is applied to the latch. When in the EMERGENCY position, the hydraulic pressure originates at the hydraulic ramp system hand pump.

4-86. Filling Ramp Hoist Hydraulic System with Fluid

a. .Recommended oils are 2135 TH., MIL ,17672B; and 207.5 TH., MIl17672B.

b. The 76-gallon ramp hoist hydraulic system tank is located in the engine room. FU the hydraulic system through the tank filler. Open gate valve at bottom of tank (hull numbers 8500 thru 8519). Fill tank until oil appears at tank sight gage. Place control valve in neutral. Fill lines and pumps by loosening pump discharge hoses at union swivel. Tighten hoses when oil appears.

c. Turn pumps over slowly, with engines idling, to draw oil into pumps. Oil level will drop as system fills. Continue adding oil to tank throughout filling operation. Continue purging air from system.

CAUTION

Air in system will cause spongy, erratic operation of winch or rapid fluctuation of oil level.

d. If *air* persists in system, check suction lines for leak.

e. Run one pump approximately 15 minutes. Shut *down* pump.

f. Remove and inspect filter and strainer; clean strainer clement in either cleaning solvent Federal Specification P-4D-80, type I, or kerosene, and replace filter element if it is dirty. Repeat steps *e* and f until strainers and filters remain clean.

CAUTION

if metal particles or other foreign matter are found in filter or strainer, investigate to determine source.

g. On hull numbers i840 thru 8560 and 8680 thru 8618, the ramp system is purged of air as described above. Additionally, it is necessary to remove air from the ramp latch system. This is done as follows:

(1) With the ramp hoist cable disconnected from the winch and one engine driven pump running, place the ramp hoist control valve lever in the RAMP-DOWN Edition.

(2) Loosen connection at selector valve from engine driven pump, retighten when fluid is free of - bubbles.

(3) With selector valve in normal position (IN). Loosen connection tat each ramp locking cylinder, retighten when fluid is free of bubbles.

(4) Disengage engine driven pump and place sector valve in EMERGENCY position (OUT). Pump hand pump to build up pressure.

(5) Loosen connection at selector valve from hand pump, retighten when fluid is free of air bubbles.

(6) 'Return all controls to normal or neutral position.

4-87. Ramp Hoist System Filters and Strainers

a. Filters (Return Line). Observe the filter condition indicator (fig. 2-9) daily when the system is in operation. Filter elements must be changed when the needle moves into the red danger zone. Change the elements only when the ramp hoist pumps are not in operation.

b. Suction Strainer Service, Hull Numbers 8500 thru 8519. See figure 2-8.1.

(1) The strainer contains a reusable twin element. A bypass valve opens as the element becomes clogged, to allow fluid to flow without passing across the element. A vacuum indicator shows a red sleeve to indicate that fluid is bypassing the element. When the red sleeve appears the elements must be cleaned.

(2) Close gage valve between filter and tank.

(3) Place a pan below the strainer to catch the oil; then remove cover at bottom of strainer. Inspect seal ring and replace if in poor condition. Clean cover thoroughly.

(4) Carefully remove the element assembly. Avoid striking the wire cloth against edges of filter housing as wire cloth may be easily damaged.

(5) Place the element assembly, with flat end down, on a flat surface. Reach through the top and open conical end of the element sidewise, inner and outer element assembly will come apart easily.

(6) Inspect housing and clean thoroughly.

(7) Place both inner and outer elements in a container of clean solvent and al-low to soak 'long enough to soften accumulated contaminant. A non-metalic bristle brush may be used to remove caked contaminant.

(8) When caked dirt has been thoroughly removed, rinse element in clean solvent. If available, use air hose to blow the element clean. When cleaning outer element blow air from inside toward outside and when cleaning the inner element, blow outside inward.

(9) Reassemble elements ,by installing the outer element over the inner element, snapping it into the flat end cap of the inner element and pressing together.

(10) Place conical shaped end member of the element into the housing and carefully push the entire filter assembly into the housing. Rotate element slightly to 'be sure the conical shaped seal surface of the outer element is properly seated.

(11) Install the cover seal, 'being careful that the ring is in the correct position and is not twisted. Be sure the element spring is securely fixed to spring retainer in the center of the cover. Push the cover into place, being sure the end member of the element is in its pocket. Install bolts.

c. Suction Screen Service, Hull Numbers 8520 thru 8560 and 8580 thru 8618.

(1) These screens are located in the 75gallon ramp hoist hydraulic system tank in the engine room. The tank cover must be removed for access to the screens which are attached to the suction lines ,near the bottom of the tank.
See figure 4-62.

(2) Drain oil and clean the screens every 200 hours.

4-88. Ramp Hoist System Pumps

a. General. Power for the ramp hoist system is supplied by two hydraulic pumps which are di4rect driven by front power take-offs on the outboard engine of each propulsion unit. Each -power take-off includes a manually operated clutch. The system may be operated using one or both pumps; however, both pumps are needed for maximum rated winch speed.

b. Removal (fig. 4-74).

(1) Clean hose connections at pump, disconnect lines, and cap open ends.

(2) -Remove pump coupling.

(3) Remove pump from support.

c. Installation. Install pump in reverse order of removal. Align pump with power take-off shaft before tightening mounting bolts.

4-89. Control Valve

a. General. Hull numbers 8500 thru 8519 and hull numbers 8520 thru 8560 and 8580 thru 8618 use similar, but not identical, control valves for the ramp hoist system. Hull numbers 8500 thru 8519 have a Vickers CM2N02-jR20B-L-30 control valve which is mounted on the pilot house on the port side. Hull numbers 8520 thru 8.560 and 8580 thru 8618 have a Vickers CM3-N02

Figure 4-74. Ramp hoist hydraulic pump.

R20BL valve mounted just below the deck in the engine room. The control lever is on the starboard side of the pilot house. The control valve used on hull numbers 8540 thru 8560 and 8580 thru 8618 incorporates an internal relief valve which limits system pressure to 2100 psi. See figure 4-75 for control valve linkage installation details for hull numbers 8540 thru 8560 and 8580 thru 8618.

b. Removal (fig. 4-76).

(1) Clean hose connections, disconnect, and cap open ends. Tag hoses to assure proper reconnection.

(2) Disconnect operating lever link (,hull numbers 8520 thru 8560 and 8580 thru 8618).

(3) Remove mounting bolts and remove control valve.

c. Installation. Install control valve in reverse order of removal.

4-90. Winch (Hull Numbers 8500 thru 8519 (fig. 4-77) The winch is mounted forward in the port side of the hull. It is rated at 200 psi operating pressure, with a line pull of 14,2.50 pounds and a line speed of 100 feet per minute at the first cable layer (bare drum). Hoist or lower time is approximately 11 seconds. The winch -is driven by a hydraulic motor through a double reduction gear reducer. Cable is underwound on the winch.

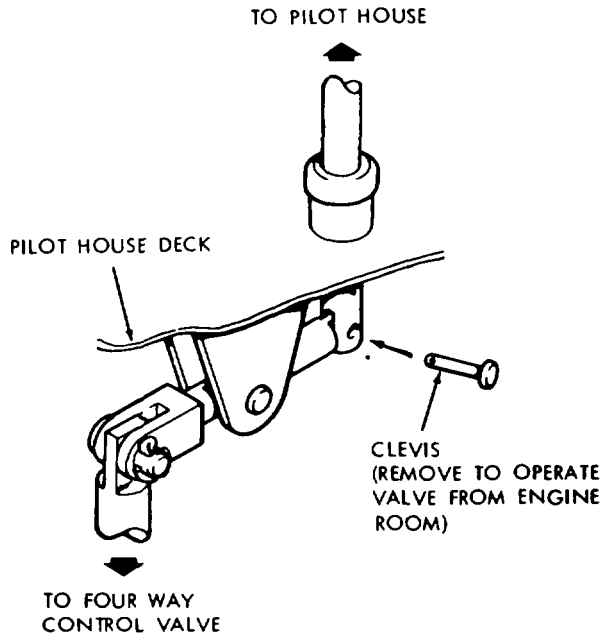


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Figure 4-75. Ramp hoist control valve linkage installation, hull numbers 8540 thru 8560 and 8580 thru 8618.

4-91. Winch (Hull Numbers 8520 thru 8539 (fig. 4-78)) The winch is located forward on the starboard aside of the hull. Maximum line pull is 22,000 pounds at 1,900 psi. The winch consists of a primary drive housing and a final drive housing fastened to a winch base 'by dowel bolts which hold the housings concentric. The primary drive housing contains a hydraulic motor which drives the sun gear of a primary planetary reduction.

4-92. Ramp Hoist Pump (Hull Numbers 6520 thru 8539)

a. General. See figure 2-26.1. The hand pump is used only for emergency lowering of the ramp**.** Pressure provided by the hand pump will release the winch brake as controlled by the ball valve

b. Service. Oil level in the hand pump reservoir should be approximately 2/8 full.

c. Removal.

(1) Clean pipe fitting and disconnect oil line.

(2) Remove mounting nuts and remove hand pump.

d. Installation. Install hand pump in reverse order of removal.

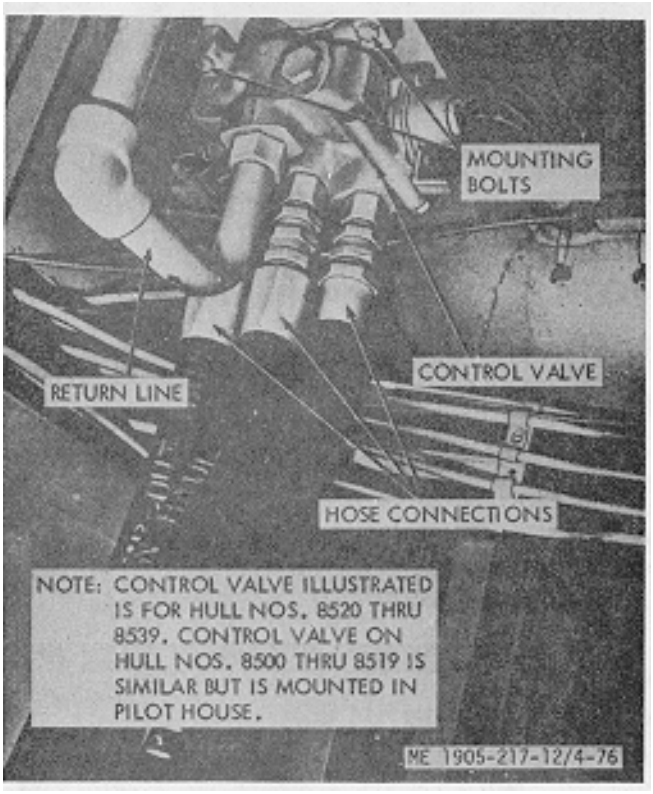

Figure 4-76. Ramp hoist control valve.

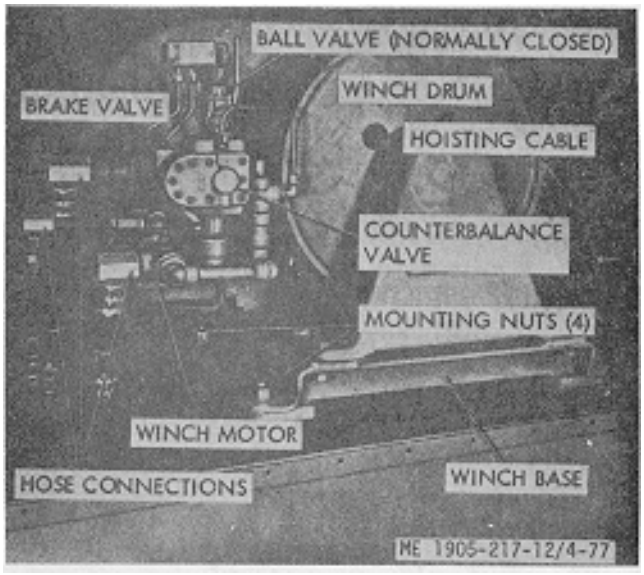

Figure 4-77. Ramp winch, hull numbers 8500 thru 8519.

4-93. Relief Valve, Ramp Hoist System (Hull Numbers 8500 thru 8519)

a. General. The main system relief valve is used for system protection. It has an operating range of 1500-,to 3000-Ipsi, but is normally adjusted to 2000, psi.

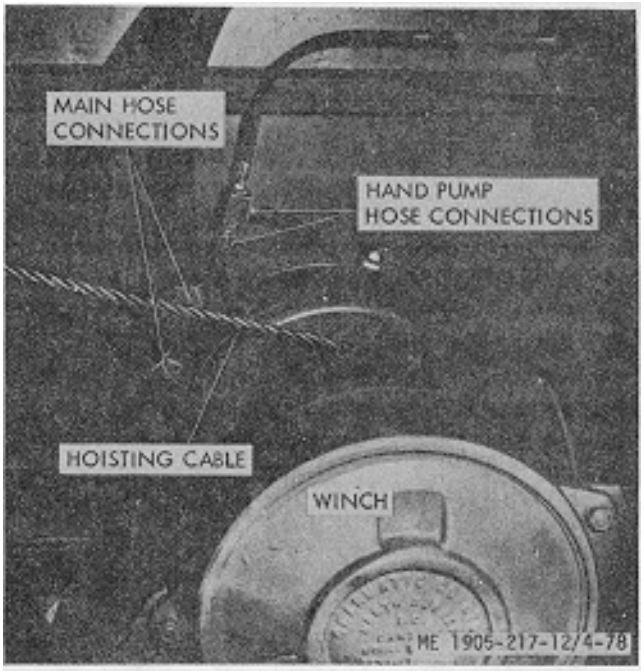

Figure 4-78. Ramp winch, hull numbers 8520 thru 8559.

b. Adjustment. See figure 4-79. If adjustment is required proceed as follows:

(1) Install 3,000 psi pressure gage, with shutoff valve, in system at tee fitting or port in relief valve.

(2) Wrap several turns of heavy manila rope around winch drum and belay running end to prevent operation of winch.

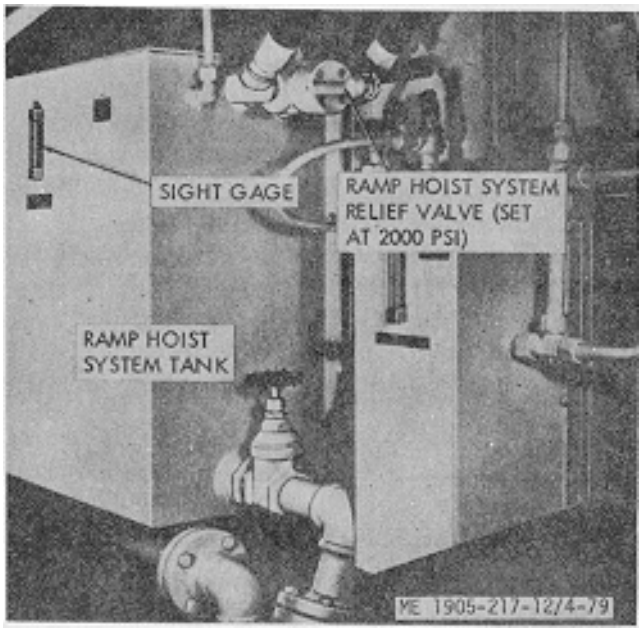

Figure 4-79. Ramp hoist system relief valve, hull numbers 8500 thru 8519.

(3) Slowly open control valve to fully open position and check indication on test gage. Pressure should be no greater than 2,000 psi.

(4) Adjust pressure, if necessary, by rotating adjusting screw on relief valve. Turn screw in (clockwise) to increase pressure; turn out (counterclockwise) to decrease pressure.

(5) Close shutoff valve at test gage to prevent rapid and sudden pressure changes from damaging gage.

c. Removal.

(1) Clean hose connections, disconnect hoses from relief valve, and cap open ends.

(2) Remove relief valve.

d. Installation. Install relief valve in reverse order of removal.

4-94. Counterbalance Valve, Ramp Hoist System (Hull Numbers 8500 thru 8519)

a. General. This bypass and check valve is used as an adjustable pressure bypass valve to maintain sufficient pressure -in the pump circuit for operation of the winch brake. It ensures positive control of ramp lowering.

b. Adjustment. See figure 4-77 for counterbalance valve location. Set counterbalance valve at 300 psi as follows:

(1) Disconnect cable from winch to remove load from system.

(2) Install 3,000 psi pressure gage, with shutoff valve, in system at tee fitting or port in counterbalance valve.

(3) Place control valve in position for lowering pump.

(4) Adjust knob on top of valve until system pressure is 300 psi. A pilot pressure of 800 psi will open the counterbalance valve and allow the ramp to be lowered.

4-95. Winch Brake Valve (Hull Numbers 8500 thru 8519)

a. General. See figure 4-77 for brake valve identification. This is a spool-type, pressure-operated valve which directs hydraulic fluid to the brake release cylinder whenever pressure is applied to either port.

b. Removal.

(1) Clean tube connections, disconnect tubes from valve, and cap open ends.

(2) Remove valve from winch.

c. Installation. Install brake valve, in reverse order of removal.

4-96. Counterbalance Valve, Ramp Hoist System (Hull Numbers 8520 thru 8560 and 8580 thru 8618)

a. General. This valve operates .automatically and is designed to create artificial back pressure against the winch motor to prevent the winch from falling unrestricted. The relief should be set at 2,100 psi.

b. Adjustment. See figure 4-80 for counterbalance valve location. Be certain that the relief is set at 2,100 psi by performing the following:

(1) Disconnect cable from winch to remove load from system.

(2) Install 3,000 psi pressure gage, with shut off valve, in system at tee fitting or port in counterbalance valve.

(3) Place control valve in position for lowering pump.

(4) Adjust knob on top of valve until system pressure is 2,100 psi. A pilot pressure of 2,100 psi will open the counterbalance valve and allow the ramp to be lowered.

c. Removal. See figure 4-80. The valve is installed in the hull near the winch.

(1) Clean pipe connections, disconnect pipe from valve, and cap open ends.

(2) Remove valve.

c. Installation. Install valve in reverse order of removal.

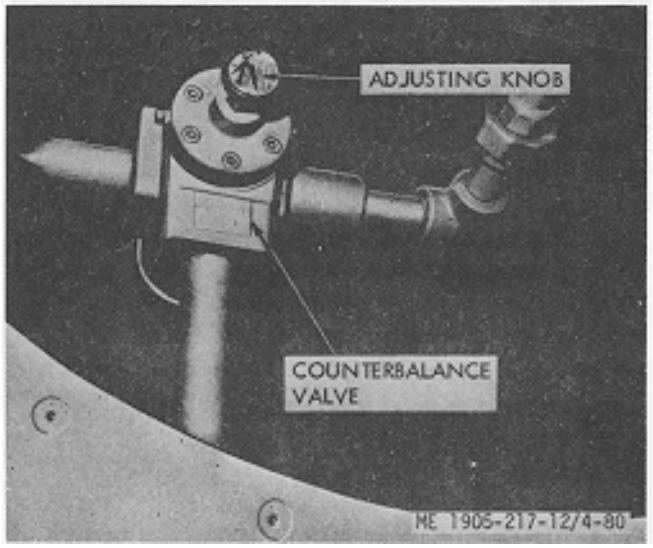

Figure 4-80. Counterbalance valve, ramp hoist system hull numbers 8520 thru 8560 and 8580 thru 8618.

4-97. Ramp Locking Cylinder-(Hull Numbers 8540 thru 8560 and 8580 thru 8618 (fig. 4-81)

a. General. The ramp locking cylinders (one at each side of the forward cargo well) provide a means of locking the ramp in an up position. The cylinders have an internal spring which returns the mechanism to a locked position upon removal of hydraulic pressure. The cylinders normally move to the unlocked position by means of hydraulic pressure from the engine driven ramp hydraulic pumps or in emergency from the winch ,brake release hand pump, located on the starboard side of the forward cargo hull.

b. Removal. Remove either cylinder by the following procedures

(1) Relieve pressure in the ramp hydraulic system. As certain that ramp load binders are in place.

(2) Place ramp hoist control valve lever in neutral position.

(3) Remove access cover on applicable side of cargo hull.

(4) Disconnect hydraulic lines at cylinder cap lines.

(5) Remove clevis between cylinder shaft and mechanical lock.

(6) Remove cylinder mounting bolts and remove cylinder.

(7) Tag ramp control lever to indicate removal of cylinder.

c. Installation. Install either cylinder by the following procedures:

(1) Ascertain that ramp load binders are in place.

(2) Relieve pressure in ramp hydraulic system and place ramp control valve in neutral position.

(3) With cylinder in place, install mounting bolts. Torque to 71-75 foot pounds.

(4) Connect hydraulic line to cylinder.

(5) Connect cylinder shaft to mechanical lock with clevis pin.

(6) Install access cover.

(7) Purge system of air and check for leaks.

4-98. Ramp Selector Valve (Hull Numbers 8540 thru 8560 and 8580 thru 8618 (fig. 2-26.2)

a. General. In the normal position the upper shut off valve is open and the lower shut off and liquid pump bypass valves are closed. In these positions pressure from the ramp system engine driver pumps is directed to the ramp locking cylinders. In the emergency position the upper shut off valve is closed, the lower shut off valve is open and the hand pump bypass valve is closed. In these positions pressure from the hand pump is directed to the locking cylinders control ramp lowering by opening and closing the hand pump bypass valve.

b. Removal. Remove the valve by the following procedures:

(1) Ascertain that ramp load binders are in position.

(2) Relieve pressure in the ramp hydraulic system.

(3) Place ramp control valve in neutral position.

(4) Disconnect and cap hydraulic lines.

(5) Remove mounting bolts and valve.

(6) Tag ramp control valve lever to indicate removal of valve.

c. Installation. Install the valve in revere order of removal. Bleed the air from the system.

4-99. Winch Automatic Reversing Mechanism (Hull Numbers 8540 thru 8560 and 8580 thru 8618 (fig. 4-82)

The above hull numbers incorporate an automatic winch reversing mechanism. The mechanism, attached to the ramp winch, prevents cable overrun and coiling when the ramp lowering cycle is completed or interrupted. When the cable goes slack, the direction of rotation is automatically reversed.

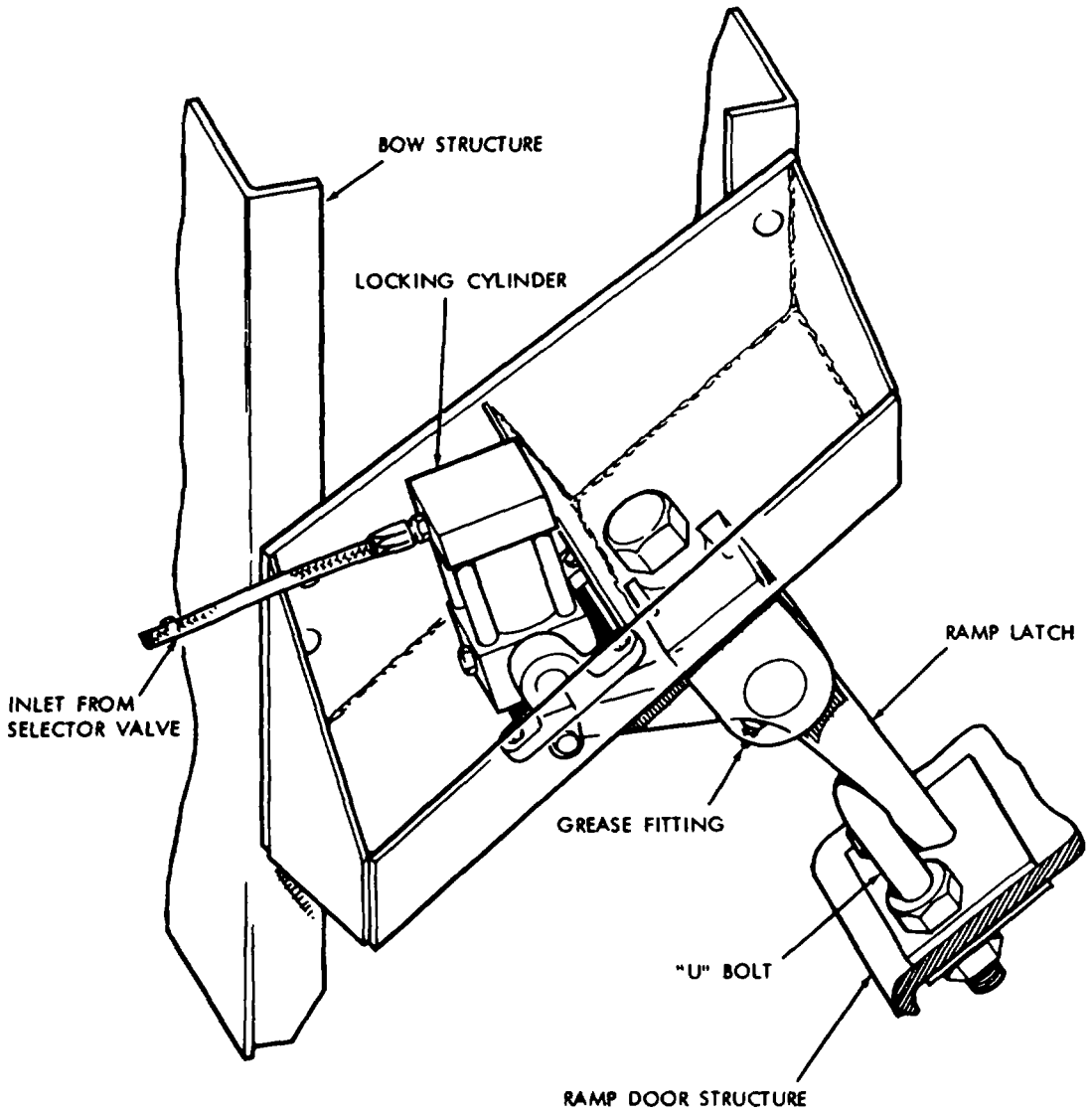

Figure 4-81. Ramp locking cylinder, hull number 8540 thru 8560 and 8580 thru 8618.

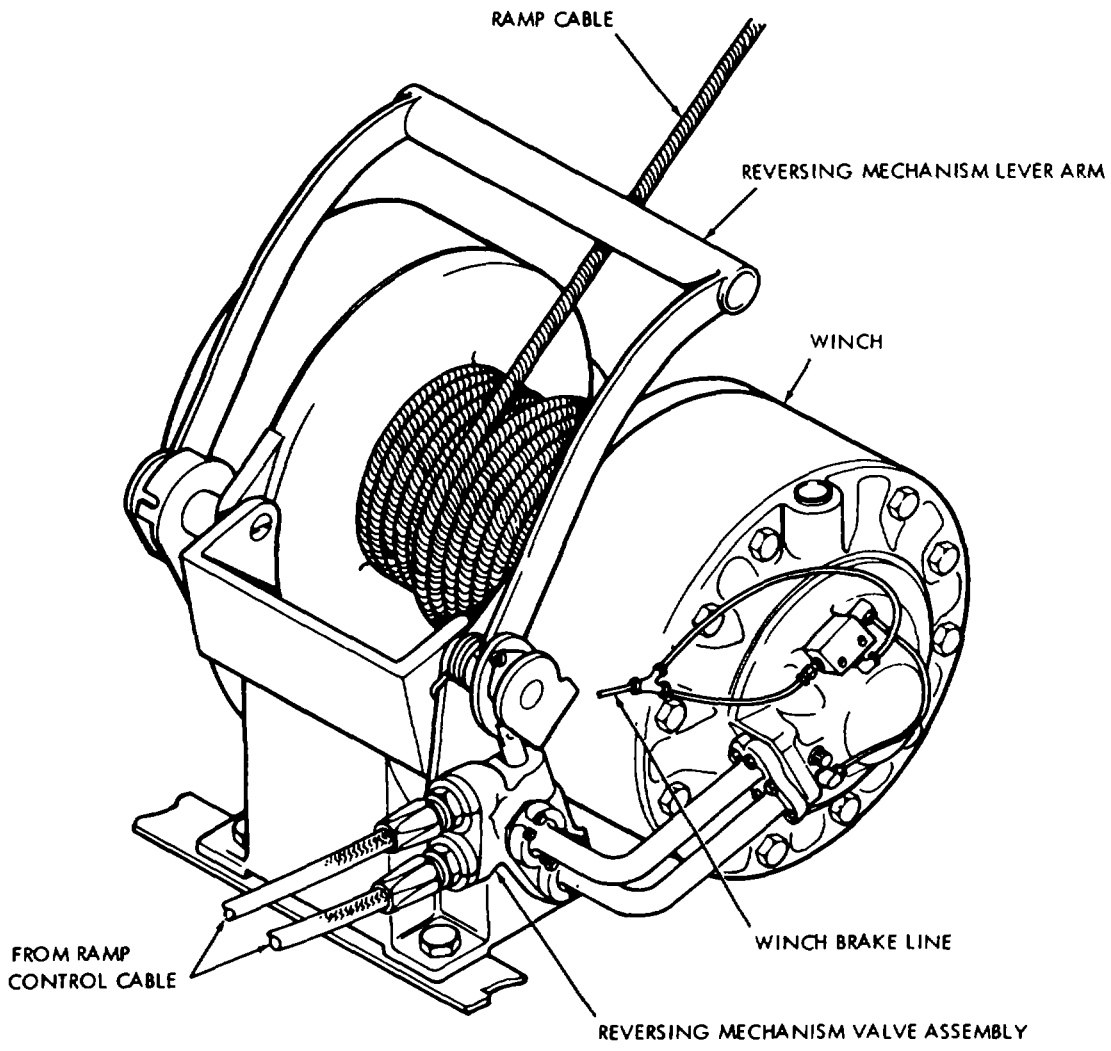

Figure 4-82. Winch automatic reversing mechanism, hull numbers 8540 thru 8560 and 8580 thru 8618.

SECTION **XX. BILGE PUMP SYSTEM**

4-100. Bilge Pump System

Refer to paragraph 27 for description of bilge pump system. The system is illustrated in figure 2-14.

4-101. Bilge Pumps

a. General. Each landing craft has three bilge pumps. Two are belt-driven from the inboard engine of the port propulsion unit and the other

pump is belt-driven from the inboard engine of the starboard propulsion unit. See figure 4-83. See figure 3-12 for bilge pump installation on hull numbers 8540 thru 8560 and 8580 thru 8618. These pumps have a single moving part, the impeller and shaft assembly. Only one grease cup requires attention. See lubrication order. The grease cup provides lubrication for the bronze bushing on impeller end of shaft. Ball bearing at other end of shaft is grease-pack and requires no attention.

b. Packing Gland Adjustment. Do not tighten more than necessary to stop leakage of water. Repack when necessary with 1/8-inch metallic string packing.

c. Pump Removal (fig. 4-83).

(1) Close primer line valve and suction valve.

(2) Loosen hose clamps and slide hoses away from pump.

(3) Loosen mounting bolt nuts and remove belt.

(4) Remove mounting bolts and remove pump.

d. Disassembly (fig. 4-84).

(1) Remove the pump housing from the clutch body by removing the six attaching nuts and, washers. Remove carefully to protect gasket.

(2) Remove end nut and clamp washer from the clutch end of unit and press or drive out the shaft and impeller assembly from ball bearing and while supporting the clutch body. When the shaft is being removed, look for spacing shim before pulling the shaft through the packing and gland as shim will be damaged if left on the shaft.

(3) To remove ball bearing, first remove the packing and gland. Remove the bearing snap retaining rings and insert a brass drift through the -housing end to the inner race of the bearing. Tap the drift lightly and remove the bearing. The impeller should not be removed from the shaft.

e. Inspection and Repair.

(1) Inspect impeller housing and pressure plate for excessive wear.

(2) Inspect shaft for wear, scores, or burrs. Inspect impeller for wear or damage.

(3) Inspect packing glands for serviceability.

(4) Remove burrs by careful stoning or lapping. Round out nicks and uneven edges on impeller. Fit new parts to replace defective items. If impeller is damaged, a new shaft assembly is required.

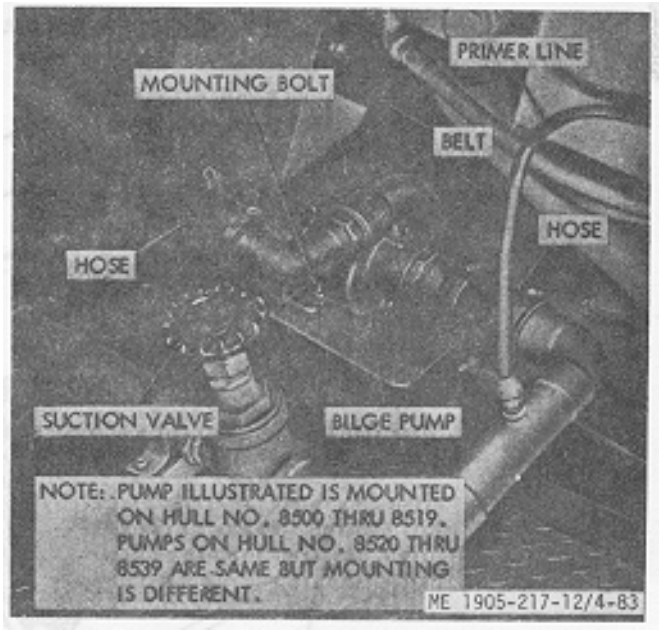

Figure 4-83. Bilge pump removal

f. Reassembly.

(1) Reassemble in reverse order of disassembly.

(2) After 'pump has been assembled and nuts tightened, check clearance between face of impeller and housing. The clearance shall be 0.010-to 0.012iinch and is controlled by the number of gaskets between housing and body. Check the clearance between the back face of the impeller and the clutch body. The clearance shall be 0.010-to 0.015-inch and -is controlled by shim thickness at shaft shoulder.

(3) Shaft bearings are packed and do not require lubrication.

g. Installation. Install pump in reverse order of removal.

4-102. Strainers and Lines

Locations of lines and strainers are indicated in, figure 2-14. No service is required except inspection of strainers to be sure they are free from debris. Figure 4-85 depicts a typical foot valve installation used on hull -numbers 8540 thru 8560 and 8580 thru 8618.

4-103. Fuel Oil Heat Exchangers Hull 8540 Thru 8618)

a. General. The fuel oil heat exchangers are vertically mounted in the raw water cooling lines -for each engine muffler. The exchangers cool the surplus fuel returning from the outlet side of the injector back to the fuel tank.

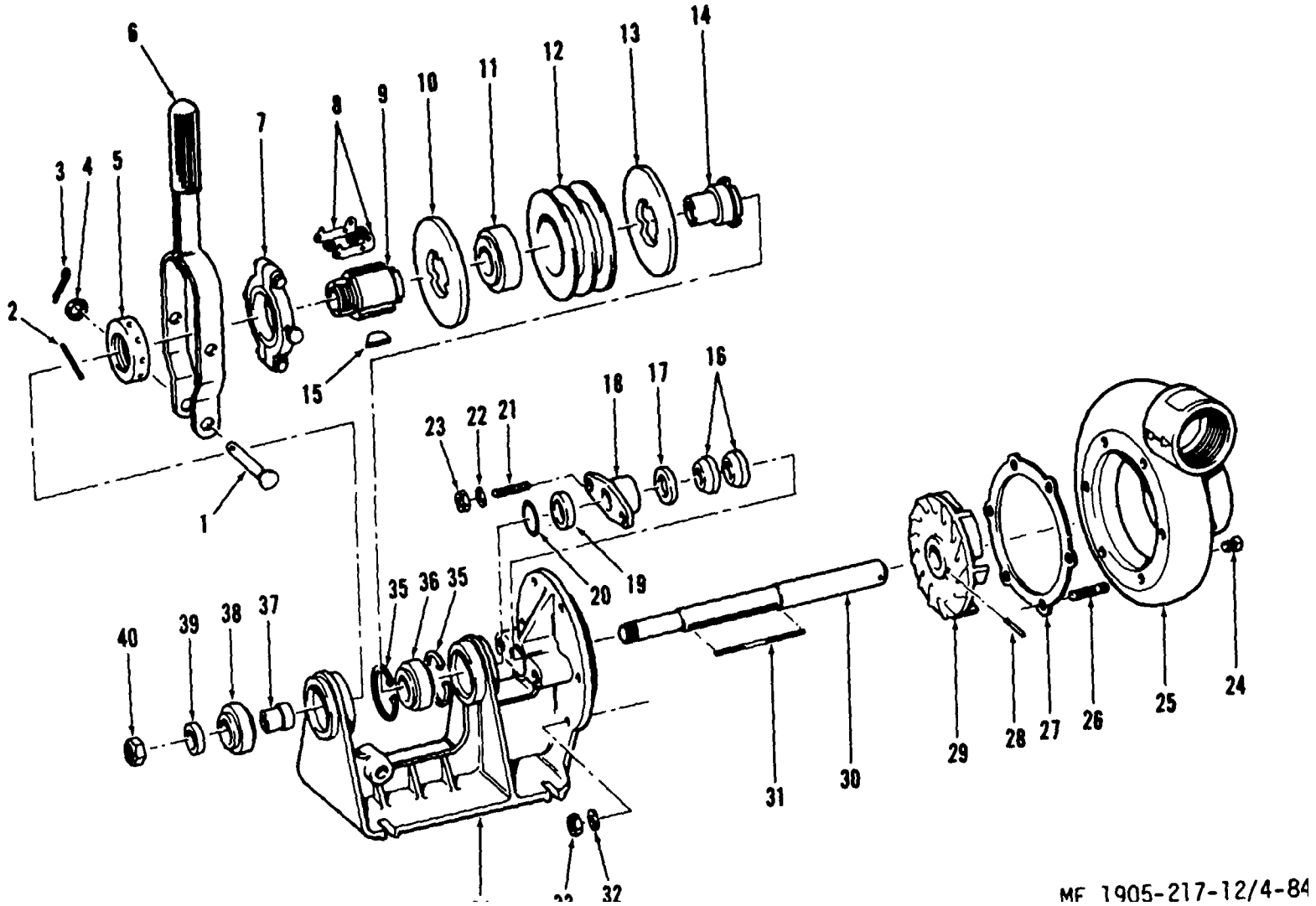

Figure 4-84. Bilge pump, exploded view, hull numbers 8540 thru 8560 and 8580 thru 8618.

1. Pin
2. Lock Spring
3. Cotter
4. Washer
5. Adjusting
6. Lever
7. Collar assembly
8. Levers and rollers
9. Hub, long
10. Pressure plate
11. Bearing
12. Pulley
13. Pressure plate
14. Hub, short
15. Key
16. Packing, solid
17. Packing service
18. Packing gland
19. Slinger
20. Shim
21. Stud
22. Washer
23. Nut
24. Drain lug
25. Housing
26. Stud
27. Gasket
28. Pin
29. Impeller
30. Shaft
31. Key
32. Washer
33. Nut
34. Body
35. Snap Ring
36. Bearing
37. Spacer
38. Bearing
39. Clamp washer
40. Nut

Figure 4-84. Continued.

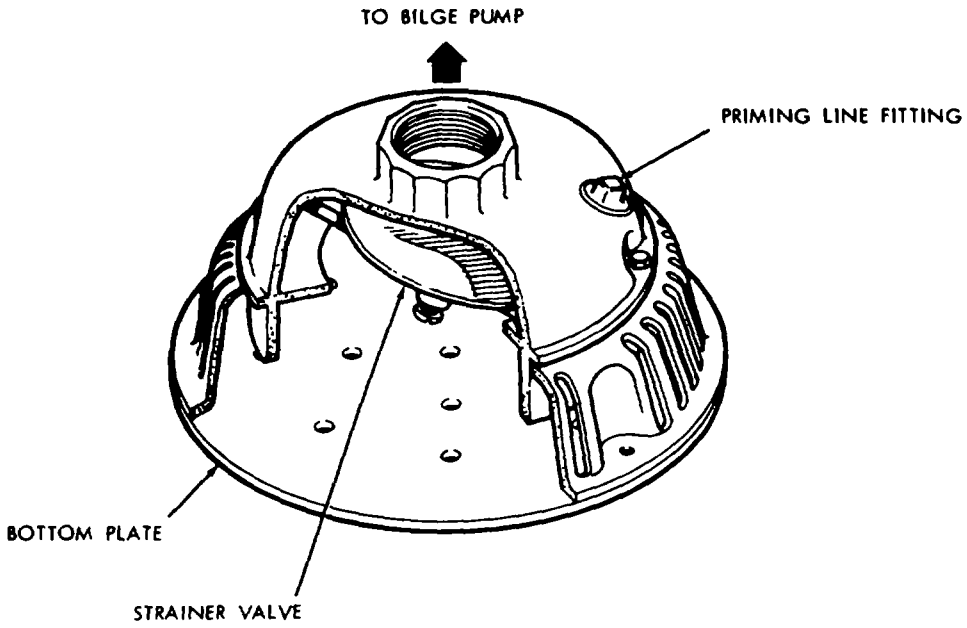

Figure 4-85. Bilge system foot valve, hull numbers 8540 thru 8560 and 8580 thru 8618.

b. Removal.

(1) Close fuel oil valve from the fuel tank (in Lazarette).

(2) Disconnect top and bottom hoses from fuel oil heat exchangers.

(3) Drain fuel oil from the heat exchangers.

(4) Remove clamps and hoses at the top of the heat exchangers that connect to the raw water line.

(5) Apply heat to the solder around the bottom of the heat exchanger until the heat exchanger can be freed from the raw water line.

c. Installation. Resolder heat exchanger to the raw water line and reconnect hoses and clamps.

SECTION **XXI. HULL**

4-104. General

A steel hull is subject to both mechanical and corrosive deteriorating forces. Mechanical forces include normal twisting and vibrations, as well as more violent events such as collisions, grounding, and explosions. These forces can weaken and loosen rivets end welded seams in the hull and damage frames ad plates. All vessels that contain metal are subject to deterioration by electrolytic corrosion or electrolysis. This chemical re .action exists naturally where two underwater metals of different chemical composition are connected electrically, which causes the wasting *way, or going into solution, of one of the metals. Zinc or magnesium protective anodes (fig. S16) are used to prevent corrosion of the hull. Electrolysis can also occur when the ship's battery is connected between two underwater pals through error. The inspection and correction of stray electrical current will aid in the reduction of damage by electrical corrosion.

4-105. Inspection and Repair

a. Hull. The hull of the landing craft should be inspected for leaks, punctures, cracks, dirt, and rust. The paint should be checked for flaking, chipping, and peeling.

b. Ramp. The ramp surfaces should be checked for damage and deterioration. Check for leaks around the ramp when the landing craft is afloat.

c. Hatches and Deck Port. Inspect hatches and deck ports for damage. Inspect gaskets for deterioration. Replace unserviceable items.

d. Ladders. Inspect bolts on access ladders for t1rtness. Tighten or replace loose bolts.

e. Ramp Load Binders. Check ramp load binders and pulleys for mechanical weaknesses and corrosion. Replace unserviceable items.

f. Cargo Cover. Inspect the cargo cover for tears. Replace torn cover. Treat canvas cover with canvas preservative.

g. Data Plates. Inspect all data plates for dirt, rust, and legibility. Clean and/or replace the plates as neccessary.

4-106. Painting

Paint all surfaces where paint has been removed or damaged. Refer to TB 746-984 for detailed cleaning and painting instructions.

CHAPTER 5

MATERIAL USED IN CONJUNCTION WITH MAJOR ITEM

SECTION I. FIRE FIGHTING EQUIPMENT

5-1. Fire Extinguishers
There are four fire extinguishers on each craft. Refer to paragraph P28 for their locations.

5-2. Inspections
The fire extinguishers will be inspected according to instructions contained in TB 5-4200-200-10.

SECTION II. COMMUNICATION AND NAVIGATIONAL EQUIPMENT

5-3. Communication Equipment (Hull Numbers 9540 thru 8560 and 6580 thru 861 B)

a. General. This equipment will be operated and maintained in accordance with applicable technical manuals (Appendix A). Refer to Appendix C for maintenance allocation.

b. Static Isolation Equipment. The static is isolation equipment is in the static isolation cabinet located outside of the pilot house, against the pilot house aft bulkhead. Input power from the 24-volt battery assembly in the engine room is protected by a 12 ampere 24-volt dc circuit breaker (also located in the engine room).

c. Radio Sets. The radio sets are looted in the radio cabinet built into the port side of the pilot house. See figures 5-1 and 5-2 for location and identification of the specific communication equipment that can be installed.

5-4. Navigational Equipment (Hull Numbers 9540 thru &560 and W590 thru 8618)

a. General. The Remote Magnetic Heading System includes an induction compass transmitter located on the mast support, and a heading indicator located in the pilot house. Both assemblies are seated and require no maintenance.

b. Inspection. Inspect heading indicator and induction campus transmitter case for physical damage. Inspect interconnect cables for excessive wear and breakage. Inspect terminal boxes for loose terminals.

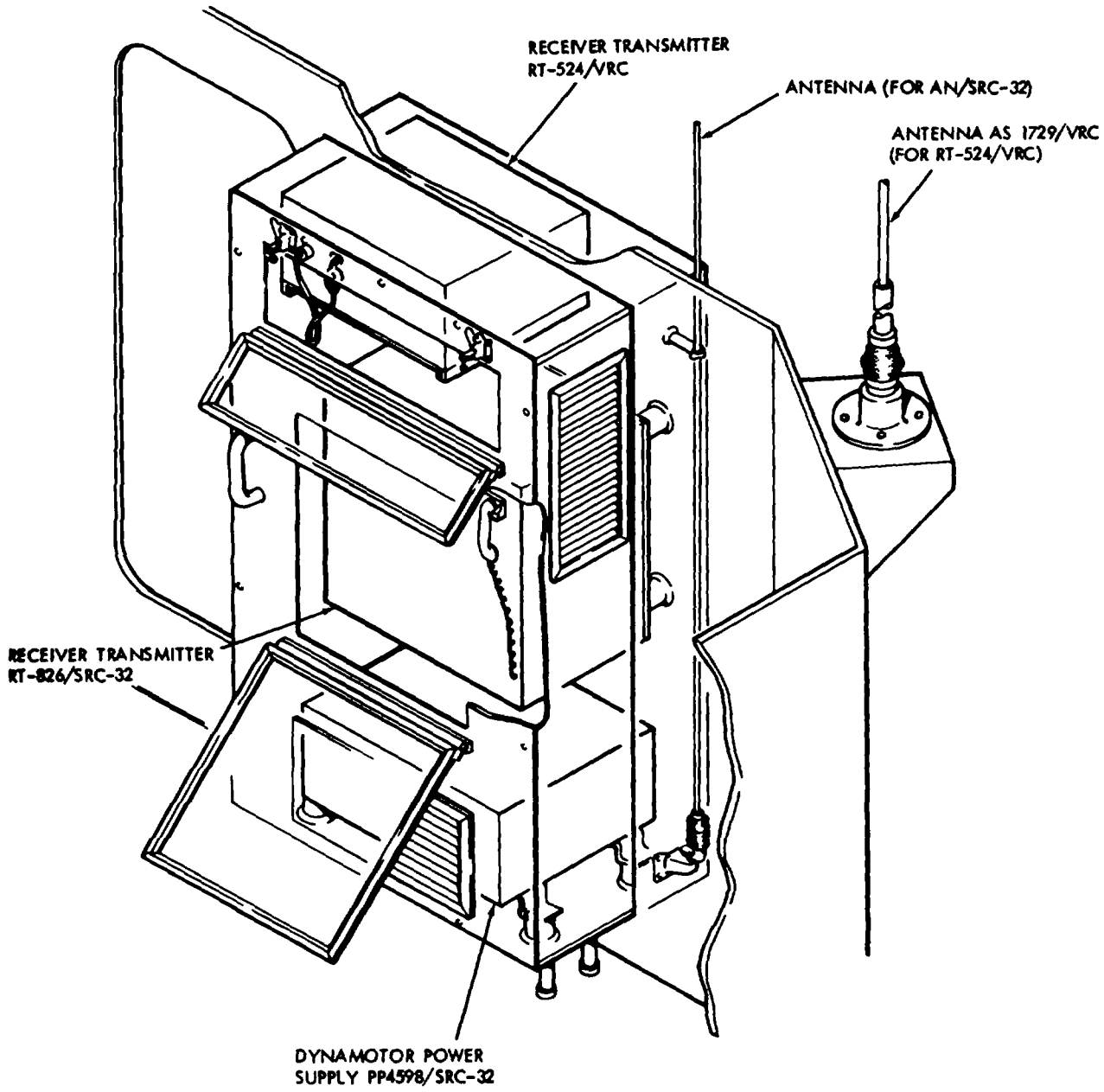

Figure 5-1. Communications equipment (AN/VRC-46 AND AN/SRC-32, hull numbers8540 thru 8560 and 8580 thru 8618.

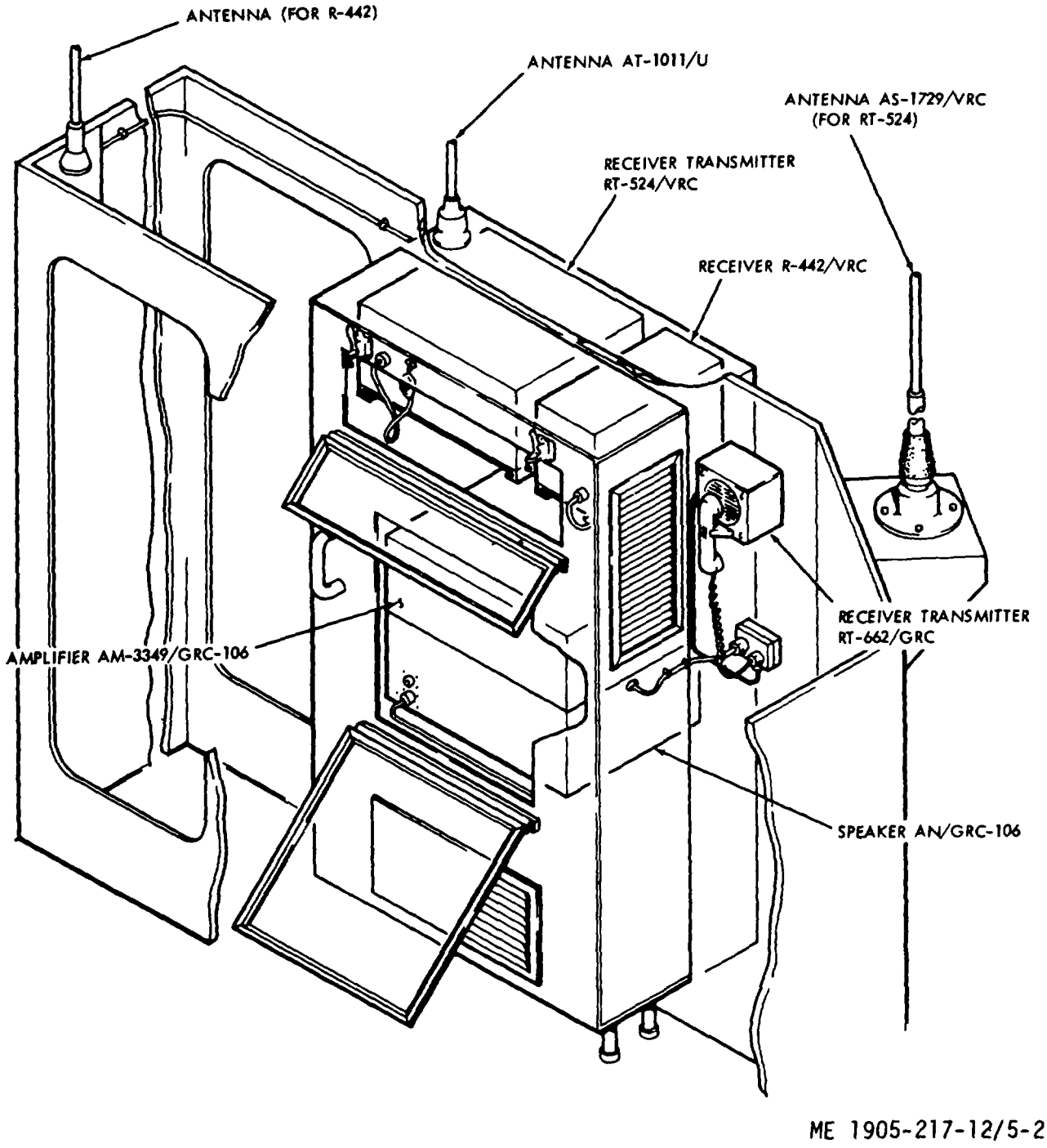

Figure 5-2. Communication equipment (AN/VRC-47 and AN/GRC-106, hull numbers 8540 thru 8560 and 8580 thru 8618.

APPENDIX A
REFERENCES

A-1 Fire Protection

TB 5-4200-200-10	Hand Portable Fire Extinguishers Approved for Army Users

A-2 Lubrication

LO 55-1905-217-12/1	Landing Craft, Mechanized; steel; Diesel-Power Driven, 74 Ft. Lg. Hull Numbers LCM 8500 thru LCM 8519
LO 55-1905.-217-12/2	Landing Craft, Mechanized; Steel; Diesel-Power Driven, 74 Ft. Lg. Hull Numbers LCM 8-520 thru LCM 8560 and Hull Numbers LCM 8580 thru LCM 8618
LO 55 1905-217-12/3	Landing Craft, Mechanized; Steel; Diesel-Power Driven, 74 Ft. Lg. Propulsion Unit, (Detroit Diesel Models 12005A and 12006A) Hull Numbers LCM 8500 thru LCM 8560 and Hull Numbers 8580 thru 8618

A3 Painting

TB 746-9-4	Painting of Vessels

A-4 Maintenance

TB 750-651	Use of Antifreeze Solutions arid Cleaning Compounds in Engine Cooling System
TM 9-6140-200-15	Operational and Organizational Field and Depot Maintenance Storage BT0tterlies, Lead-Acid Type
TM 11-5820-399-35	Direct and General Support and Depot Maintenance Manual, Receiver-transmitter RT-246/VRC and RT-524/VRC
TM 11-5820-401-10	Operator Manual Radio Sets AN/ViRC-46 and AN/VRC-47
TM 11-5820-409-35	Direct and General Support and Depot Maintenance Manual, Receiver, Radio R-4421/VRC
TM 11-5820-520-12	Operator and Organizational Manual, Radio Set AN/GRC-106
TM 11-5820-520-35	Direct and General Support and Depot Maintenance Manual, Radio Set AN/GRC-106
TM 11-5820-689-15	Operator and General Support, and Depot Maintenance Manual, Radio Set AN/SRC32-
DA Pam 738-750	The Army Maintenance Management System (Tamms)
TM 55-1905-217-20P	Organizational Maintenance Repair Parts and Special Tool List
TM 55-1905-217-34P	Direct Support and General Support Maintenance Repair Parts and Special Tools list
TM 55-1905-217-34	Direct Support and Central Support Maintenance Manual

A-5 Shipment and Storage

TB 740-93-4	Preservation of Vessels for storage
TB 740-97-2	Preservation of USAMEC Mechanical Equipment for Shipment and Storage
TM 740-93-3	Administrative Storage of Equipment

A-6 Demolition to Prevent Enemy Use

TM 750-244-3	Procedure for Destruction of Equipment to Prevent Enemy Use

APPENDIX B. CREW/OPERATOR BOAT SET LIST, BASIC ISSUE ITEMS (BII), ACCESSORY LIST, AND ON-BOARD REPAIR PARTS

SECTION I. INTRODUCTION

B-1. SCOPE. This appendix lists basic issue items for the Landing Craft, Mechanized, Mark VIII (LCM-8) to help you inventory the items for safe and efficient operation of the equipment

B-2. GENERAL. These items are part of the LCM-8. As part of the end item, these items must be with the end item during operation and whenever it is issued or transferred between property accounts. These essential items are required to place the LCM-8 in operation, operate it, and to do emergency repairs. Listing items is your authority to request/requisition them for replacement based on authorization of the end item by the TOE/MTOE. The Basic Issue Items (Bll) Lists are divided into the following sections:

a. Section II, Operating Equipment.
b. Section III, Operating Supplies.
c. Section IV, On-Board Repair Parts.
d. Section V, Accessory Equipment
e. Section VI, Firefighting, Safety, and Damage Control Items.

B-3. EXPLANATION OF COLUMNS.

a. Column (1), Illustration Number; Not applicable.
b. Column (2), National Stock Number, identifies the stock number of the item to be used for requisitioning purposes.
c. Column (3), Description and Useable On Code, identifies the Federal item name (in all capital letters) followed by a minimum description when needed. The last line below the description is the CAGEC (commercial and Government entity code) (in parenthesis) and the part number.
d. Column (4), U/I (unit of issue), indicates how the item is issued for the National Stock Number shown in column two.
e. Column (5), Qty Rqr, indicates the quantity required.

SECTION II. OPERATING EQUIPMENT

(1) ILLUS NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION, CAGEC and Part Number	Usable On Code	(4) U/I	(5) QTY rqr
	75100-889-3494	BINDER, Equipment Log Book (81349) B-43064		EA	1
	5120-00-529-4124	CARRIER, Battery, Hand (81349) C-19482		EA	1
	2040-00-565-9145	FENDER, Maine, 18" Dia. x 36'' Long (14348) Fendaire		EA	8
	8345-00-245-2040	FLAG, National, U.S., 1',6' x 2'2" (81348) DD-F-416, Type III, Class 2		EA	1

(1) ILLUS NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION, CAGEC and Part Number	Usable On Code	(4) U/I	(5) QTY rqr
	8345-00-375-0221	FLAG SET, Semaphore, M113 (81349) F-40050		EA	1
	6230-00-264-8261	FLASHLIGHT, Watertight, 2 Cell (81349) F-3747		EA	1
	4240-00-052-3776	GOGGLES, Plastic, Safety (81348) GG-G-531		EA	3
	4930-00-253-2478	GREASE GUN, Hand, 16 Oz (81349) G-3859		EA	1
	5120-00-224-4111	HAMMER, Scaling, Hand, 1 lb. (81348) GGG-H-86		EA	2
	6630-00-171-5126	TESTER, Battery (81348) GG-T-258, GSAFSS		EA	1
	6545-00-922-1200	KIT, FIRST AID, General Purpose, 12 Units (33333) NOREF		EA	1
	6230-00-781-3189	LANTERN, Electric, 6V, w/o relay (96906) 100-2		EA	2
	5120-00-293-1039	LIFTER, Scraper, Battery (74267)177		EA	1
	4930-00-266-9182	OILER, Hand, 8 Oz (81348) GGG-591		EA	1
	5120-00-372-0652	PULLER, Propeller (72201) Fig. 802, Size 3		EA	1
	4320-00-574-7645	PUMP, Reciprocating, Hand (Engine Sump) (46643) 3799		EA	1
	5120-00-278-1280	SCREWDRIVER, Flat, 8 in (81348) GGG-S-121		EA	1
	5180-00-629-9783	TOOL KIT, General Mechanics (50980) SC5180-90-CL-N28		EA	1
	8465-00-254-8803	WHISTLE, Life Jacket, w/Lanyard (81349) W-1053		EA	16
	5120-00-277-1575	WRENCH, Box, Prop Nut (81348) GGG-W-636		EA	1
	5120-00-277-1576	WRENCH, Box, Shaft Nut (81348) GGG-W-636		EA	1
	5120-00-712-0517	WRENCH, Fuel Sounding Tube (80064) LCM-8 S55D1 H1387536		EA	1

SECTION **III. OPERATING SUPPLIES**

(1) ILLUS NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION, CAGEC and Part Number	Usable On Code	(4) U/I	(5) QTY rqr
	6135-00-050-0915	BATTERY, Battle Lantern (80063) BA-23		EA	2
	6135-00-120-1020	BATTERY, Flashlight (80063) BA-30 (See Note E)		EA	6
	7920-00-291-8305	BROOM, Upright, Corn (81348) A-B-51		EA	1
	792-00-240-6358	BRUSH, Dusting, Bench (81348) H-B-190		EA	1
	7920-00-291-5815	BRUSH, Wire, Curved Handle (81348) H-B-178		EA	1
	7240-00-256-7700	CAN, Flammable Waste, 10 Gal. (81348) RR-114		EA	1
	5110-00-222-2117	CHISEL Round, 1/4 in. (81348) GGGC-313		EA	1
	5110-01-242-3457	CHISEL, Cold, 3/8 in. (81348) GGGC-313		EA	1
	7920-00-224-8308	DUST PAN, (81348) RR-D-800		EA	1
	7240-00-527-9868	FUNNEL, w/Strainer, 1 qt. capacity, (81348) RR-F-800, Type I, Class B, Style 2		EA	1
	7920-00-267-1218	HANDLE, Mop, Wood (81348) NN-H-101		EA	1
	7240-00-2336025	MEASURE, Liquid, 1 Gal. (81348) RR-M-1 90		EA	1
	7920-00-171-1148	MOPHEAD, Cotton (81348) T-M-561		EA	1
	7240-00-160-0455	PAIL, Metal, 3-1/2 gal. (81348) RR-P-35		EA	1

SECTION **IV. ON BOARD REPAIR PARTS**

(1) SMR Code	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION, CAGEC and Part Number	Usable On Code	(4) U/I	(5) QTY rqr
		All Hulls		EA	1
		ENGINE, Diesel, Detroit		EA	1
		Model 12005ARHSTBDCW		EA	1
		Model 12006APORTCCW		EA	1
		Fuel Strainer, Primary Engine		**EA**	**1**
PACZZ	5300-00-599-4823	WASHER, Non-metallic, Cover 5193704 (72582)		EA	4
PACZZ	5330-00-364-2674	GASKET, Plug 694203 (72582)		EA	4
		Fuel Filter Secondary			
PACZZ	2910-00-287-1912	ELEMENT, Fuel Filter MIL-E-20627 (81349)		EA	8
PACZZ	5330-00-285-3825	GASKET, Cover Nut 2243465 (72582)		EA	8
PACZZ	5330-00-627-4085	GASKET, Filter Shell 5192801 (72582)		EA	8
		Lube Oil Filter, Engine			
PACZZ	2940-00-480-6283	ELEMENT, Filter PF132, 5573014 (72582)		EA	4
PACZZ	5330-00-290-7860	WASHER, Non-Metallic, Shell 5571024 (72582)		EA	4
PACZZ	5330-00-604-8094	PACKING, Preformed, Cover Nut 5187310 (72582)		EA	4
		Marine Gear Oil Filter			
PACZZ	2940-00-019-087	ELEMENT, Filter, Oil 5574978 (72582)		EA	4
PACHH	2010-00-540-7689	PROPELLER, Ship, LH		EA	1
PACHH	12010-00-540-7690	PROPELLER, Ship, RH		EA	1
PACZZ	5330-00-290-7860	WASHER, Non-Metallic, Shell 5571024 (72582)		EA	4
PACZZ	2940-00-841-5964	GASKET, Oil Filter, Cover Bolt 5574130 (72582)		EA	4

(1) SMR Code	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION, CAGEC and Part Number	Usable On Code	(4) U/I	(5) QTY rqr
		Transmission Oil Strainer			
PACZZ	5330-00-786-5320	GASKET, Oil Strainer Cover 5112511 (72582)		EA	4
		Sea Water Strainer			
PACZZ	2040-00-929-8730	GASKET Cylinder 10 (72922)		EA	4
		Alternator			
PACZZ	3030-0529-0479	BELT, V, At Drive MS39256B51 (96906)		EA	2
		Bilge Pump			
PACZZ	3030-00-529-0482	BELT, V, Pump Drive (R200) MS39256B42 (96906)		EA	1
PACZZ	3030-00-460-2502	BELT, V, Pump Drive (R&L130) MS39256B58 (96906)		EA	1
		Electrical Control Panel			
PACZZ	5920-00-686-9548	FUSE, Cartridge 10A FO9A250V1OA (81349)		EA	8
PACZZ	5920-00-280-3163	FUSE, Cartridge 15A FO7A32V15A (81349)		EA	4
		Remote Magnetic Heading System (RMHS)			
PACZZ	5920-00-296-0445	FUSE, Cartridge 5A F06C500V5A (81349)		EA	2

SECTION **V. ACCESSORY EQUIPMENT**

NATIONAL STOCK NUMBER	DESCRIPTION FSCM AND PART NUMBER	U/I	Qty rqr
2040-00377-8599	ANCHOR, Marine, 75 lb (81349) A-1 570718	EA	1
6140-00-184-3415	BATTERY, Storage, Engine Starting, 6V (81348) W-B-131, Type 7D	EA	4
6350-00-256-9061	I BELL, Ship, 20 lb (81349) B-674	EA	1
4010-00-555-9510	CHAIN ASSEMBLY, Anchor, 3/8 in. (81349) C-2683	EA	1

NATIONAL STOCK NUMBER	DESCRIPTION FSCM AND PART NUMBER	U/I	Qty rqr
4020-00-022-2946	EAR PROTECTOR, MIL-P-38268 (81349)	ST	6
4210-00-889-2491	EXTINGUISHER, FIRE, Dry Chemical, 10 lb., ABC, USCG Approved (81348) O-E-915C	EA	4
	Remote Magnetic Heading System (RMHS)		
6605-00-106-9560	INDICATOR, Repeater, Heading (07187) 2593843-901	EA	1
6605-00-106-9562	TRANSMITTER, Indicator, Compass (07187) 2590057-901	EA	1
3950-00-235-4239	HOIST, Chain, (Ramp Emergency Closing) (81349) H-904, Class 1 or 2, Type H, Style 1	EA	1
2040-00--268-9250	HOOK, Boat, Wood, 10f(81348)H-3496	EA	2
	KEY, Adjustable, Deck Plates, AN Figure 826 (46576)	EA	3
4220-00-2000538	LIFE PRESERVER, Vest, Adult (81349) MIL-L-10845, Type 1	EA	6
6260-01-086-8077	LIGHT, MARKER, Distress, Life Preserver (81349) L-573, Type II, Class I	EA	16
6230-00-782-0643	LIGHT, MARKER, Distress, Ring Buoy (80064) 815-119249 Symbol 289	EA	2
4220-00-275-3157	RING, BUOY, Floating, 30 in. od, w/Line (81349) R-16847	EA	3
	* Rope, Nylon; Mooring Line, Required, 48 ft. long, Manufacture from NSN 4020-X)-752-8878 (81349) R-1 7343	EA	2
	* Rope, Nylon; Mooring Line, Required, 18 ft. long, Manufacture from NSN 4020-00-752-8878 (81349) R-1 7343	EA	2
	* Rope, Nylon; Mooring Line, Required, 90 ft. long, Manufacture from NSN 4020-00-752-8878 (81349) R-1 7343	EA	1
	* Rope, Nylon; Anchor Line, Required, 450 ft. long, Manufacture from NSN 4020-00-752-8878 (81349) R-1 7343	EA	1
8340-00-753-6438	TARPAULIN, No. 6, Cargo Cover	EA	1
	(Deleted)		

* Note E - - The quantity and unit of issue shown for this item denotes the maximum required for this set and does not conform to the standard package or authorized unit of issue.

SECTION **VI. BASIC ISSUE ITEMS LIST**
Firefighting, Safely, and Damage Control Items

(1) Item Number	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION, CAGEC and Part Number	Usable On Code	(4) U/I	(5) QTY rqr
	4220-0276-8926	Buoyant Vest, Work Type		EA	6
	N/A	Bum Dressing Kit: * Contains:		EA	1
		8'' x 18'' Dressing		EA	2
		4''x 16'' Dressing		EA	1
		4" x 4'' Dressing		EA	4
		12'' x 16'' Face Mask Dressing		EA	2
		Burn-Jel Topical Dressing		PK	1
		* Ordering location:			
		Water-Jel AWK Kit			
		H & H Associates, Inc.			
		P.O. Box 4469			
		Alexandria, VA 22303			
		Phone: 1800326-5708			
	N/A	Coverall, Anti-exposure,			
		Sterns Model 1 FS-580, Orange **		EA	4
		** Ordering Information:			
		Lifesaving Systems Corp.			
		720 4th SL SW, Rusldn, FL			
		33570-1829			
		Phone: (813) 645-2768			
	4240-01-116-9888	Emergency Escape Breathing Device			
		(EEBD)		EA	1
	N/A	Emergency Position Indicating Radio		EA	1
		Beacon (EPIRB), Category 1, 406 MHz			
		Satellite, F.C.C. Approved (No NSN, Local			
		Purchase Item)			
	4240-00-542-2048	Face Shield, Industrial, Tilting		EA	1
	4210-00-142-4949	Fire Ax		EA	1
	N/A	Fire Blanket, 72' x 6 ***		EA	1
		*** Ordering Information:			
		Water-Jel AWK Fire Blanket			
		H & H Associates, Inc.			
		P.O. Box 4469			
		Alexandria, VA 22303			
		Phone: 1 -800-326-5708			
	8345-00-935-0445	Flag, Signal, ''A'' Intn'l Code, Size 6		EA	1
		(81349) MIL-F-2692			
	8345-00-926-6803	Flag, Signal, ''B'' Intn'l Code, Size 6		EA	1
		(81349) MIL-F-2692			
	8345-00-935-0451	Flag, Signal, "O'' Intn'l Code, Size 6		EA	1
		(81349) MIL-F-2692			

SECTION **VI. BASIC ISSUE ITEMS LIST**
Firefighting, Safety, and Damage Control Items

(1) Item Number	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION, CAGEC and Part Number	Usable On Code	(4) U/I	(5) QTY rqr
	8345q30-926-6814	Flag, Signal, 'U" Intn'l Code, Size 6 (81349) MIL-F-2692		EA	1
	8345-00-935-0455	Flag, Signal, V' Intn'l Code, Size 6 (81349) MIL-F-2692		EA	1
	834540-935-0456	Flag, Signal, Intn'l Code, Size 6 (81349) MIL-F-2692		EA	1
	4240-01-258-1245	Fountain, Eye and Face Wash, Portable, 16Gallons		EA	1
	6840-01-315-9841	Bacteriostatic Additive (Eye & Face Wash Fountain)		BX	1
	8415-01-267-9661	Gloves, Anti-Flash		PR	6
	4240-00-190-6432	Goggle, Industrial, No Vents, (Chemical Splash)		EA	1
	8465-01-004-2893	Goggles, Safety, Wind, Dust, Sand, Spray		EA	4
	8415-00-935-3136	Hard Hat, Orange		EA	3
	8415-00-935-3139	Hard Hat, White		EA	1
	4240-00-022-2522	Harness, Safety, Torso		EA	2
	8415-01-268-3473	Hood, Anti-Rash		EA	6
	4240-00-022-2518	Lanyard, Harness, Safety, Torso		EA	2
	4020-01-344-0552	Line, Heaving, Safety, 100'		EA	2
	5120-00-255-1476	Maul, Ship's, 5 lb. (Damage Control Plugs)		EA	1
	5510-00-260-8953	Plug, Soft Wood 1'' x 0'' x 3" Long		EA	5
	5510-00-260-8962	Plug, Soft Wood 3'' x 0'' x 8'' Long		EA	10
	5510-00-260-8969	Plug, Soft Wood 7'' x 3'' x 10'', Long		EA	5
	2090-00-058-3737	Shoring, Steel, Adjustable, Short 3' to 5'		EA	1
	2090-00-052-1581	Shoring, Steel, Adjustable, Long 6' to 11'		EA	1
	1370-01-030-8330	Signal, Distress, Orange Smoke, Red Illumination		EA	12
	9390-01-078-8660	Tape, Retroreflective, 3'' x 50 yds Long		RL	1
	5510-00-268-3479	Wedge, Plug, Tapered, Hardwood 2" x 2" x 8" Long		EA	6
	5510-00*268-3475	Wedge, Shoring, Tapered, Hardwood 1-1/2'' x 2'' x 2" Long		EA	6

APPENDIX C

MAINTENANCE ALLOCATION CHART

SECTION I. INTRODUCTION

C-1. General

a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance levels.

b. Section II designates overall responsibility for the performance of maintenance functions on the identified end item or component. The implementation of the maintenance functions upon the end item or component will be consistent with the assigned maintenance functions.

c. Section III lists the special tools and test equipment required for each maintenance function as referenced from Section II.

d. Section IV contains supplemental instructions, explanatory notes, and/or illustrations required for a particular maintenance function.

C-2. Maintenance Functions

Maintenance functions shall be limited to and defined as follows:

a. Adjust. Maintain within prescribed limits by bringing into proper or exact position, or by setting the operating characteristics to the specified parameters.

b. Align. To adjust specified variable elements of an item to bring about optimum or desired performance.

c. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipment used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

d. Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination.

e. Install. The act of emplacing, seating, or fixing into position an item part, module, component, or assembly in a manner to allow the proper functioning of the equipment/system.

f. Overhaul. That maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (e.g., DMWR) in pertinent technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

g. Rebuild. Consists of those services/actions necessary for the restoration of equipment to a like-new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc.) considered in classifying Army equipment/components.

h. Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module, component, assembly, end item, or system.

i. Replace. The act of substituting a serviceable like-type part, subassembly, module, component, or assembly in a manner to allow the proper functioning of an equipment system.

j. Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean, preserve, drain, paint, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

k. Test. To verify serviceability and to detect incipient failure by measuring the mechanical or electrical characteristics of an item and compar-

ing those characteristics with prescribed standards.

l. Symbols. The uppercase letter placed in the appropriate column indicates the lowest level at which that particular maintenance function is to be performed.

C3. Explanation of Format

Purpose and use of the format are as follows:

a. Column (1), Group Number. Column 1 lists group numbers, the purpose of which is to match components, assemblies, subassemblies, and modules with the next higher assembly.

b. Column (2), Functional Group. Column 2 lists the next higher assembly group and the item names of components, assemblies, subassemblies and modules within the group for which maintenance is authorized.

c. Column (3), Maintenance Function. Column 3 lists the maintenance functions defined in C-2 above. Each maintenance function required for an item shall be specified by the symbol among those listed in d below which indicates the level responsible for the required maintenance. Under this symbol there shall be listed an appropriate work measurement time value determined as indicated in e below.

d. Use of symbols. The following symbols shall be used to prescribe work function responsibility:

C - Operator/Crew
O - Organization
F - Direct Support
H - General Support
D - Depot

e. Work Measurement Time. The active repair time required to perform the maintenance function is included directly below the symbol identifying the level of maintenance. Active repair time is the average aggregate time required to restore an item (subassembly, assembly, component, module, end item or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, fault isolation/diagnostic time, and QA/QC time in addition to the time required to perform specific maintenance functions identified for the tasks authorized in the maintenance allocation chart. This time is expressed in man-hours and carried to one decimal place (tenths of hours).

f. Column 4, Tools and Equipment. This column shall be used to specify, by code, those tools and test equipment required to perform the designated function.

g. Column 5, Remarks. Self-explanatory.

(1) GROUP NUMBER	(2) FUNCTIONAL GROUP	(3) MAINTENANCE FUNCTIONS A INSPECT	B TEST	C SERVICE	D ADJUST	E ALIGN	F CALIBRATE	G INSTALL	H REPLACE	I REPAIR	J OVERHAUL	K REBUILD	(4) TOOLS AND EQUIPMENT	(5) REMARKS
01	Air Inlet Silencer	C		O					O					A-C
		0.3		1.0					1.0					
02	Exhaust Manifold													
	Manifold Assembly	O							O					
		0.3							3.0					
	Gaskets	O							O					
		0.1							0.5					
	Hoses	C							O					
		0.2							1.0					
	Studs, Washers and Nuts	O							O					
		0.2							1.0					
03	Filter Assembly Oil													
	Filter Assembly	O							O					
		0.2							0.5					
	By-Pass Valve	C							O					
		0.2							0.5					
	Filter Elements & Gaskets	C		C					O					B-C
		0.2		03					0.5					
04	Oil Filter, Dipstick and Breather	C		C					O					C-C
		0.2		0.5					0.2					
	Cap, Gage and Gaskets	O							O					
		0.1							0.2					
05	Oil Cooler (Engine)													
	Core & Plate Assembly	O							O					
		0.2							1.5					
	Gaskets, Hoses	C							0					
		0.2							1.0					
	By-Pass Valve	O							O					
		0.1							0.5					
06	Fuel Filter Assembly	C		C					C					
	Filter Assembly	0.1		0.2					0.2					
	Filter Element			C					C					
				0.2					0.2					
	Gaskets and Packing	C							C					
		0.1							0.2					

(1) GROUP NUMBER	(2) FUNCTIONAL GROUP	(3) MAINTENANCE FUNCTIONS A INSPECT	B TEST	C SERVICE	D ADJUST	E ALIGN	F CALIBRATE	G INSTALL	H REPLACE	I REPAIR	J OVERHAUL	K REBUILD	(4) TOOLS AND EQUIPMENT	(5) REMARKS
07	Fuel strainer (Eng Mtg)	C		C					O					
	Filter Assembly	0.1		0.2					0.2					
	Filter Element (Knife Type)			C					C					
				0.2					0.2					
	Gaskets and Seals	C							C					
		0.1							0.2					
08	Fuel Strainer (Line)													
	Filter Assembly	C							0					
		0.1							0.2					
	Filter Element(Knife-Type)			C					C					
				0.2					0.2					
	Gaskets and Seals	C		C					C					
		0.1		0.2					0.2					
09	Fuel Piping													
	Fitting, Seals & Sleeves, Tanks	C		C					O				1	D-H
	and Tubes	0.5		0.1					8.0					
10	Fuel Pump													
	Pump Assembly	O							O	F		H	2	
		0.1							0.5	3.5		4.0		
	Bearings and Shaft	F							F					
		0.1							1.5					
	Gaskets and Seals	O							O					D-H
		0.1							0.4					
	Valve Relief	F							F					
		0.1							0.2					
11	Rocker Arm Cover													
	Cover	0							0					
		0.2							0.3					
	Gaskets and Seals	0							0					
		0.2							0.4					
	Fuel Injectors	O	F	O	O				O	F		H	3-4-5-6-7	E-C
		0.1	0.3	0.4	0.2				0.1	2.5		6.0		
	Tip Assembly	F		F					F				8	
		0.1		0.4					0.2					
	Filter	C		C					C					
		0.1		0.1					0.1					

(1) Group No.	(2) Functional Group	(3) Maintenance Functions A Inspect	B Test	C Service	D Adjust	E Align	F Calibrate	G Install	H Replace	I Repair	J Overhaul	K Rebuild	(4) Tools and Equipment	(5) Remarks
13	Injector Control Tube													
	Tube, Lever and Arms	O							F					
		0.1							0.3					
	Links and Pins	O							O					
		0.1							0.2					
14	Throttle Controls													
	Bearings, Shaft, Links and Rods	O		C	O				F	F				
		0.1		0.1	0.2				1.5	2.0				
	Gaskets	F							F					
		0.1							0.5					
15	Heat Exchanger (Engine)													
	Expansion Tank	O							F					
		0.1							2.0					
	Gasket, Clamps, Hoses, Lines, & Valves	C							O					
		0.3							1.0					
	Thermostat	O							O					
		0.1							1.0					
16	Engine Cooling Piping	C							O				H-H	
	Hoses, Clamps & Gaskets	0.4							3.0					
	Valves, Fittings & Tubes	O							O	O				
		0.3							2.3	4.0				
	Gage, Expansion Tank	O							O	O				
		0.1							1.5	0.5				
17	Sea Water Piping													
	Hose, Clamps & Gaskets	C							O					
		0.4							3.0					
	Valves, Fittings and Piping	O							O	O				
		0.3							2.4	4.0				
18	Muffler & Exhaust Piping													
	Muffler, Fittings	O							O	O			J-H	
		0.5							4.0	1.5				
	Flexible Couplings	O							O					
		0.3							1.5					
	Hoses and Gaskets	C							O					
		0.2							0.7					

(1) Group No.	(2) Functional Group	(3) Maintenance Functions A Inspect	B Test	C Service	D Adjust	E Align	F Calibrate	G Install	H Replace	I Repair	J Overhaul	K Rebuild	(4) Tools and Equipment	(5) Remarks
19	Fresh Water Pump	C	----	----	----	----	----	----	O	F	----	H	9	
		0.1	----	----	----	----	----	----	0.5	3.0	----	5.0		
	Gaskets, Packing	O	----	----	----	----	----	----	O					
		0.1	----	----	----	----	----	----	0.4					
	Impeller, Shaft and Seals	F	----	----	----	----	----	----	F					
		0.2	----	----	----	----	----	----	1.2					
20	Raw water Pump	C	----	----	----	----	----	----	O	O	----	H	10	
		0.1	----	----	----	----	----	----	0.5	3.0	----	5.0		
	Gaskets & Packing	O	----	----	----	----	----	----	O					
		0.1	----	----	----	----	----	----	0.4					
	Bearings, Shaft and Seal	F	----	----	----	----	----	----	F					
		0.2	----	----	----	----	----	----	1.2					
	Impeller	O	----	----	----	----	----	----	O					
		0.2	----	----	----	----	----	----	0.6					
	Gear Drive Coupling	O	----	----	----	----	----	----	O					
		0.1	----	----	----	----	----	----	0.8					
21	Water Manifold (Engine)	O	----	----	----	----	----	----	O					
		0.3	----	----	----	----	----	----	0.8					
	Gaskets, Clamps, Hoses & Packing	O	----	----	----	----	----	----	O					
		0.4	----	----	----	----	----	----	1.5					
22	Sea Water Strainer Duplex	O	----	----	----	----	----	----	O	O				
		0.2	----	----	----	----	----	----	0.8	2.0				
	Cylinder, Screen & Gasket	C	----	C	----	----	----	----	C		----	----	----	J–C
		0.2	----	0.4	----	----	----	----	0.5					
23	Keel Cooler Heat Exchanger Core Assembly	H	H	----	----	----	----	----	H	H				
		0.3	1.0	----	----	----	----	----	6.0	3.0				
	Hoses, Clamps & Gaskets	H	----	----	----	----	----	----	H					
		1.0	----	----	----	----	----	----	4.0					
24	Engine Speed Governor	----	F	----	O	----	----	----	O	F	H		11	
		----	0.5	----	0.4	----	----	----	3.2	8.0	12.0			
	Gaskets, Seals & Sprgs	O	----	----	----	----	----	----	F				12	K–H
		0.3	----	----	----	----	----	----	0.5					
25	Blower Assembly	F	----	O	H	----	----	----	F	H			13,14,15,16	
		0.3	----	0.3	0.5	----	----	----	2.5	12.0				

(1) Group No.	(2) Functional Group	(3) Maintenance Functions A Inspect	B Test	C Service	D Adjust	E Align	F Calibrate	G Install	H Replace	I Repair	J Overhaul	K Rebuild	(4) Tools and Equipment	(5) Remarks
	Bearings, Gears, Rotor	H			H				H					
	Gaskets & Seals	0.4			0.5				6.0					
	Blower Drive	H							H	H				
		0.3							2.5	3.5				
26	Transmission Oil Filter	C		C					O					
		0.1		0.3					0.5					
27	Transmission Oil Strainer	C		C					O					L-C
		0.2		0.3					0.7					
	Strainer Element (Screen)	C		C					O					
		0.3		0.3					0.4					
28	Transmission Oil Cooler	O							O					
	Core & Plate Assy	0.3							2.1					
	Gaskets & Fittings	O							O					
		0.3							0.4					
29	Transmission Control	O			O			F	F					
	Valve & Tubes	0.2			0.3				0.6	4.2				
	Bearing, Gaskets and Seals	F							F					
		0.4							0.5					
30	Tachometer Drive Cable,	O		O					O					
	Adapter & Shaft	0.1		0.3					0.5					
31	Transmission Oil Pump	O							O	H			17	
		0.2							0.5	3.5				
	Rotor Set and Gears	H							H					
		0.3							1.4					
	Regulator Valve	O							O					
		0.1							0.3					
	Gaskets, Hose and Tubes	O							O					
		0.3							0.7					
32	Power Take-Off Assembly	O							F	H				
		0.4							3.5	3.2				
	Clutch Gaskets & Seals	H							H					
		0.4							2.8					
	Shaft, Springs, Links and	H							H					
	Bearings	0.5							3.1					

(1) Group No.	(2) Functional Group	(3) Maintenance Functions A Inspect	B Test	C Service	D Adjust	E Align	F Calibrate	G Install	H Replace	I Repair	J Overhaul	K Rebuild	(4) Tools and Equipment	(5) Remarks
33	Alternator, Regulator & Voltage Protector Alternator Assembly	O	O	----	----	----	----	----	O	F	H			
		0.3	0.7	----	----	----	----	----	1.4	3.6	8.0			
	Bearings & Slip Rings	F	----	----	----	----	----	----	F					
		0.3	----	----	----	----	----	----	3.1					
	Belt Drive	C	----	----	----	----	----	----	C					
		0.1	----	----	----	----	----	----	0.6					
	Brush Assembly	O	----	O	----	----	----	----	O					
		0.2	----	0.3	----	----	----	----	0.4					
	Leads and Capacitors	F	----	----	----	----	----	----	F					
		0.2	----	----	----	----	----	----	0.4					
	Diodes and Rectifiers	H	----	----	----	----	----	----	H					
		0.3	----	----	----	----	----	----	1.5					
	Seals and Gaskets	F	----	----	----	----	----	----	F					
		0.2	----	----	----	----	----	----	----					
	Regulator	----	O	----	O	O	----	----	O					M-D
		----	0.3	----	0.2	0.2	----	----	0.6					
	Voltage Protector	O	----	----	----	----	----	----	O					
		0.1	----	----	----	----	----	----	0.6					
34	Electric Cranking Motor Starter Assembly	O	----	O	----	----	----	----	O	F	H			
		0.3	----	0.5	----	----	----	----	4.2	6.1	8.0			
	Armature and Coils	H	----	----	----	----	----	----	H					
		0.2	----	----	----	----	----	----	1.2					
	Bearings, Sleeve	F	----	----	----	----	----	----	F					
		0.2	----	----	----	----	----	----	1.9					
	Brushes and Holders	O	----	O	----	----	----	----	O					N-C
		0.2	----	0.9	----	----	----	----	0.7					
	Gaskets and Packing	O	----	----	----	----	----	----	O					
		0.2	----	----	----	----	----	----	0.4					
	Relay Solenoid	O	----	----	----	----	----	----	O					
		0.3	----	----	----	----	----	----	1.5					
35	Hydraulic Starting Piping System	O	----	O	----	----	----	----	O					
		1.5	----	0.5	----	----	----	----	4.2					
	Gage, Hose Fittings & Valves	O	----	----	----	----	----	----	O					
		0.9	----	----	----	----	----	----	2.8					

(1) Group No.	(2) Functional Group	(3) Maintenance Functions A Inspect	B Test	C Service	D Adjust	E Align	F Calibrate	G Install	H Replace	I Repair	J Overhaul	K Rebuild	(4) Tools and Equipment	(5) Remarks
	Lines and Fittings	O							O					
		1.4							3.5					
	Reservoir	O		O					F	H				
		0.5		1.5					2.3	2.8				
36	Starting Engine, Hydraulic Starter	O							O	F	H			
		0.3							3.5	6.2	8.0			
37	Solenoid Valve, Starting Motor	O							O	F				
		0.2							1.5	2.3				
38	Pump, Hydraulic Starter	F							F					
	Bearings, Gaskets and Seals	0.4							3.2					
39	Accumulator, Hydraulic Starting	O		O					F	H			20-21	O-C
		0.2		1.3					1.5	2.4				
	Packing and Seals	F							F					
		0.2							0.6					
40	Pump Hand Hydraulic Starting	O							O	F				
		0.3							1.1	5.2				
	Bearings, Gaskets and Seals	F							F					
		0.3							3.2					
41	Filter Oil Hydraulic Starting	O		O					O					
		0.2		0.4					0.5					
42	Transfer Gear Assembly	O		C					F	H	H			
		0.3		0.7					7.4	5.6	10.2			
	Gaskets and Seals	F							F					
		0.3							1.5					
	Gears, Shafts and Bearings	H							H					
		0.8							6.2					
	Coupling (Prop Shaft)	O							F				22-23	
		0.2							1.5					
43	Gear Assembly reverse	O		C					F	F	H		24-25-26	
		0.3		0.7					10.0	12.0	16.0			
	Plate and Clutch Disk	F							F					
		0.4							4.5					
	Gear Planetary, Shaft & Bearings	H							H					
		0.5							8.0					

(1) Group No.	(2) Functional Group	(3) Maintenance Functions A Inspect	B Test	C Service	D Adjust	E Align	F Calibrate	G Install	H Replace	I Repair	J Overhaul	K Rebuild	(4) Tools and Equipment	(5) Remarks
	Gaskets and Seals	F							F					
		0.3							1.5					
44	Flywheel Housing													
	Flywheel and Ringgear	F							F					
		0.3							1.5					
	Gage, Hose and Breather	O		C					O					
		0.2							0.6					
	Gaskets & Seals	F							F					
		0.3							1.4				27–28–29	
45	Power Take-Off Coupling	F							F				30	
	And Vibration Damper	0.5							4.7					
	Coupling and Adapter	F							F					
		0.3							1.5					
	Damper and Pulley	F							F					
		0.3							1.7					
46	Rocker Arm	O			O				F				32	P–D
		0.4			1.5				5.2					
	Push Rods & Cam Follower	F							F				33	
		0.6							8.0					
47	Cylinder Head	O							F	F			34	Q–H
		0.5							12.0	22.0				
	Valves and Springs	F							F				35	
		0.4							6.7					
48	Cam & Balance Shaft Brg	H							H					
	Gears & Weights	0.5							5.8					
	Gaskets	F							F					
		0.3							1.2					
49	Idler Gears and Bearings	H							H					
		1.5							7.8				44–45	
50	Engine Lifting Brackets	F							F					
		0.1							0.2					
51	Oil Pan	F							F					
		0.2							7.5					

(1) Group No.	(2) Functional Group	(3) Maintenance Functions A Inspect	B Test	C Service	D Adjust	E Align	F Calibrate	G Install	H Replace	I Repair	J Overhaul	K Rebuild	(4) Tools and Equipment	(5) Remarks
	Hose and Fittings	O							O					
		0.2							0.5					
52	Oil Pump Assembly (Eng)	F							F	H				
		0.3							1.8	4.6				
	Gaskets, Regulator & Screen Assembly	F							F					
		0.3							2.3					
	Bearings & Gears	H							H					
		0.4							3.2					
53	Piston and Connecting Rods													
	Bearings	F							F					
		1.2							3.0					
	Pins	F							F				46–47–48,49	
		1.2							1.7					
	Piston Assembly	F							F				50–51	
		2.5							3.0					
	Ring Set	F							F				52–53–54	
		1.3							3.8					
	Rod, Connecting Assy	F							F					
		1.9							3.2					
54	Crankshaft	H							H			D		
		1.2							4.1			24.0		
	Gears, Oil Pump	F							H				55	
		0.2							1.5					
	Bearings	H							H				56	
		0.3							3.0					
	Seals	F							F				57	R–H
		0.2							1.2					
55	Power Unit	C	O	C	O				F	O	H	D	58	S–B
		1.2	4.0	1.2	2.1				19.0	23.0	56.0	80.0		
	Cylinder Block	F							H					
	Sleeve								12.0					
	Seals	F							F					
		0.2							1.2					
	Engine Base	H							H					
		0.3							3.5					

(1) Group No.	(2) Functional Group	(3) Maintenance Functions A Inspect	B Test	C Service	D Adjust	E Align	F Calibrate	G Install	H Replace	I Repair	J Overhaul	K Rebuild	(4) Tools and Equipment	(5) Remarks
56	Engine Pilot House													
	Controls	O							F	H				
		0.3							3.2	6.1				
	Bearings and Shafts	H							H					
									2.1					
	Cables and Arms	O			O				F					
									8.0					
57	Fan; Cabin	C		O					O	O				
		0.2		0.1					0.5	4.0				
	Brush, Switch	O							O					
		0.3							0.5					
58	Engine Control & Distribution													
	Fuse, Lamps	C							C					T–H
		0.1							0.3					
	Gages, Switches and Lights	O							O					U–C
		0.3							3.5					
	Cables (Control)			C	O				F					V–C
				0.4	0.5				4.0					
	Battery (Ship)	C		C					C					W–C
		0.2		0.4					0.5					
	Cables and Clamps	C		C					O					
		0.1		0.3					0.6					
59	Navigational Lights & Horn	C							O					
		0.2												
	Lights, Switches & Horn	C							O	O				
		0.4							0.5	1.3				
	Lens, Gaskets & Lamps	C							O					
		0.3							0.5					
	Sending Units & Warning Switches	C							O	O				
		0.4							1.5	3.2				
	Hull Wiring Harness	C							O	O				X–H
		1.5							3.2	4.0				
60	Helm Unit Steering	O							F	H				
61	Piping Steering													
	Hose and Fittings	O							O					
		0.5							3.5					

(1) Group No.	(2) Functional Group	(3) Maintenance Functions A Inspect	B Test	C Service	D Adjust	E Align	F Calibrate	G Install	H Replace	I Repair	J Overhaul	K Rebuild	(4) Tools and Equipment	(5) Remarks
	Lines and Fittings	O	----	----	----	----	----	----	O					
		0.5	----	----	----	----	----	----	5.2					
	Valves	O	----	----	----	----	----	----	O	F				
		0.3	----	----	----	----	----	----	3.0	6.2				
62	Pump Steering	O	----	----	----	----	----	----	O	H				
		0.1	----	----	----	----	----	----	2.0	8.0				
63	Pump Drive (Coupling)	O	----	----	----	----	----	----	O					
		0.2	----	----	----	----	----	----	1.5					
64	Filters Hydraulic	O	----	----	----	----	----	----	O	O				
		0.1	----	----	----	----	----	----	1.4	1.2				
	Elements	----	----	O	----	----	----	----	O					
		----	----	0.2	----	----	----	----	0.3					
65	Valves Steering													
	Valve Check, By-Pass	O	----	----	----	----	----	----	F	H	----	----	68	
	Relief & Control	0.2	----	----	----	----	----	----	2.0	6.5				
66	Valve Flow Divider	O	----	----	----	----	----	----	F	H				
		0.2	----	----	----	----	----	----	2.0	4.5				
67	Cylinder, Hydraulic	O	----	C	----	----	----	----	O	F	H	----	64	Y-A
	Steering	0.3	----	----	----	----	----	----	0.5	3.5	7.5			
	Fittings	O	----	----	----	----	----	----	O					
		0.2	----	----	----	----	----	----	0.4					
68	Tank Hydraulic	----	----	----	----	----	----	----	F					
		----	----	----	----	----	----	----	3.2					
	Gage, Sight Glass	O	----	----	----	----	----	----	F	F				
		0.1	----	----	----	----	----	----	0.5	1.5				
	Breather	----	----	O	----	----	----	----	O					
		----	----	0.2	----	----	----	----	0.1					
69	Piping, Hydraulic Ramp Hoist													
	Hose, Fittings & Gasket	O	----	----	----	----	----	----	O					
		0.5	----	----	----	----	----	----	3.2					
	Piping and Fittings	O	----	----	----	----	----	----	F					
		0.5	----	----	----	----	----	----	4.0					

(1) Group No.	(2) Functional Group	(3) Maintenance Functions A Inspect	B Test	C Service	D Adjust	E Align	F Calibrate	G Install	H Replace	I Repair	J Overhaul	K Rebuild	(4) Tools and Equipment	(5) Remarks
70	Pump Hydraulic (Ramp)	----	----	----	----	----	----	----	O	H				
		----	----	----	----	----	----	----	1.5	6.5				
	Bearing Shaft & Cartridge	H	----	----	----	----	----	----	H					
	Assembly	0.2	----	----	----	----	----	----	1.5					
	Coupling, Flex	O	----	----	----	----	----	----	O					
		0.5	----	----	----	----	----	----	0.5					
	Seals	H	----	----	----	----	----	----	H					
		0.3	----	----	----	----	----	----	1.5					
71	Winch, Ramp Hoist (MARCO)	O	----	O	----	----	----	----	F	H	H			
		0.5	----	0.4	----	----	----	----	6.0	20.0	40.0			
	Gear Reducer Assembly	H	----	----	----	----	----	----	----	H				
		0.4	----	----	----	----	----	----	----	16.0				
	Bearings, Gaskets, Seals, Gears,	H	----	----	----	----	----	----	H					
	Shaft, & Retainer	0.5	----	----	----	----	----	----	6.2					
	Drum Winch	O	----	----	----	----	----	----	H					
		0.2	----	----	----	----	----	----	4.5					
	Cable Hoist	C	----	C	----	----	----	----	O					
		0.5	----	0.4	----	----	----	----	1.5					
	Brake Assembly (HYD)	H	----	----	----	----	----	----	H	H				
		0.2	----	----	----	----	----	----	2.5	6.5				
	Bearings, Bushings, Retainers,	H	----	----	----	----	----	----	H					
	Plates, Drive, Driven Plunger	0.3	----	----	----	----	----	----	12.0					
	Rod, Springs & Seals													
	Motor Assembly Winch	H	----	----	----	----	----	----	H					
	Bearings, Retainers Cam	0.4	----	----	----	----	----	----	12.0					
	Ring Assy Plate, Port &													
	Seals													
	Valves	O	----	----	----	----	----	----	O					
		0.3	----	----	----	----	----	----	1.5					
72	Winch Ramp Hoist (Gearmatic)	O	----	O	----	----	----	----	F	H	H			
		0.5	----	0.4	----	----	----	----	6.0	20.0	40.0			
	Drum Base Assy Brgs,	H	----	----	----	----	----	----	H				65–68	
	Bushings and Ret. Rings	0.4	----	----	----	----	----	----	6.0					
	Shaft, Sungears and Seals	H	----	----	----	----	----	----	H					
		8.0	----	----	----	----	----	----	16.0					
	Primary Drive Assy	H	----	----	----	----	----	----	H					
	Gear Plates and Segments,	5.0	----	----	----	----	----	----	12.0					
	Retaining Rings, Seals,													
	Springs & Cover													

(1) Group No.	(2) Functional Group	(3) Maintenance Functions A Inspect	B Test	C Service	D Adjust	E Align	F Calibrate	G Install	H Replace	I Repair	J Overhaul	K Rebuild	(4) Tools and Equipment	(5) Remarks
	Motor Assembly	H							H	H			67	
		6.0							12.0	16.0				
	Bearings, Bushings Gears, Shaft Piston Brake, Plate & Seals	H							H					
		4.0							8.0					
	Final Drive Assy Brgs, Gears and Retainers Plate, Thrust & Seals	H							H					
		6.0							12.0					
	Automatic Reverse Assy	H							H	H				
		1.5							3.0	7.5				
73	Valve Ramp Control	O							O	H				
	Control Valve	0.5							1.0	6.2				
74	Filter Strainers	O		O					O	O				
	Hydraulic Oil	0.3		0.5					0.4	0.6				
75	Relief Valve	O							O	H				
		0.2							1.2	3.0				
76	Check Valve	O							O	H				
		0.2							1.5	2.0				
77	Counterbalance Valve	O							O	H				
		0.2							1.5	6.0				
	Valve Check & Shut-Off	O							O					
		0.2							1.5					
78	Hand Pump Hydraulic	O							O	H				
		0.3							2.0	6.0				
79	Tanks Hydraulic Oil	O		O					F	H				
	Winch	0.2		2.5										
	Gage Sight	O								O				
		0.1												
	Vent Cap	O		O					O					
		0.1		0.4										
80	Cylinders Hydraulic (Ramp Latch)	O							O	F	H			
		0.2							2.0	2.5	4.0			

(1) Group No.	(2) Functional Group	(3) Maintenance Functions A Inspect	B Test	C Service	D Adjust	E Align	F Calibrate	G Install	H Replace	I Repair	J Overhaul	K Rebuild	(4) Tools and Equipment	(5) Remarks
81	Propeller Shaft	C	----	----	----	C	----	----	C	H				
		0.3	----	----	----	1.5	----	----	1.8	12.0				
	Stuffing Box	C	----	C	----	----	----	----	H				68-69-70	Z-D
		0.1	----	0.1	----	----	----	----	4.0					
	Strut Bearing	C	----	----	----	----	----	----	C					
		0.3	----	----	----	----	----	----	8.0					
	Coupling, Packing and Hoses	C	----	----	----	----	----	----	C					
		0.5	----	----	----	----	----	----	2.0					
	Propeller	C	----	----	----	----	----	----	C	H				
		0.3	----	----	----	----	----	----	1.0	12.0				
	Anode	F	----	----	----	----	----	----	F					
		0.5	----	----	----	----	----	----	6.0					
82	Indicator, Rudder Angle and Transmitter	C	----	C	O	----	----	----	O	O				AA-C
		0.3	----	0.2	0.2	----	----	----	3.0	4.0				
83	Rudder													
	Rudder, Bergs	O	----	----	----	----	----	----	O					
		1.5	----	----	----	----	----	----	12.0					
	Gaskets, Packing	O	----	----	----	----	----	----	O					
		0.5	----	----	----	----	----	----	12.0					
84	Hull	O	----	O	----	----	----	----	----	O				AB-C
		4.0	----	16.0	----	----	----	----	----	16.0				
	Hull Assemblies	O	----	----	----	----	----	----	O					
		4.0	----	----	----	----	----	----	6.0					
	Data Plates	C	----	C	----	----	----	----	O					
		0.2	----	0.2	----	----	----	----	0.5					
	Hatches & Deck Ports	C	----	----	----	----	----	----	O	F				
		0.2	----	----	----	----	----	----	3.0	2.2				
	Gaskets	C	----	----	----	----	----	----	O					AC-A
		0.2	----	----	----	----	----	----	1.5					
	Ramp Assembly	O	----	C	----	----	----	----	H	H				
		0.5	----	0.5	----	----	----	----	30.0	24.0				
	Ramp Load Binders	C	----	C	----	----	----	----	O					
		0.2	----	0.5	----	----	----	----	2.0					
	Pulley and Bushings	O	----	C	----	----	----	----	O					
		0.5	----	0.3	----	----	----	----	8.0					
	Gaskets	C	----	----	----	----	----	----	O					
		0.4	----	----	----	----	----	----	8.0					

(1) Group No.	(2) Functional Group	(3) Maintenance Functions A Inspect	B Test	C Service	D Adjust	E Align	F Calibrate	G Install	H Replace	I Repair	J Overhaul	K Rebuild	(4) Tools and Equipment	(5) Remarks
	Cargo Cover	C							O					AD–I
		1.0							4.0					
	Erection Support	F							F					AE–H
		1.0							6.0					
85	Piping Bilge													
	Gaskets, Hose	C							O					
		0.4												
	Lines and Fittings	C							O					
		0.5												
	Strainer, Bilge & Check Valves	C		C					O					
		0.3		0.6					1.5					
86	Pump Bilge	C		C					O	O				
		0.3		0.2					2.5	4.5				
	Housing, Gaskets & Seals,	C		C					O					
	Packing Gland & Shims	0.3		0.4					2.5					
	Impellers, Shaft	O							O					
	Bearings & Bushings	0.3							2.5					
	Pump Drive	O		C					O					
	Pulley Clutch Friction	0.3		0.2					1.5					
	Bearings, Rings Sheaves and Springs													
	Belts	C							C					
		0.1							1.5					
	Lubricators, Grease Cup	C		C					O					
		0.1		0.1					0.2					
87	Pump, Bilge Hand								O	O				
									0.2	1.5				
88	Radio System													
	Radio Transmitter, Receiver	O		F					F	H	D			
	Assembly	0.5		1.4					0.6	1.5	16.0			
89	Compass system-RMHS	O							F					
		0.5							1.5					
	Compass Assy & Indicator	O					H		F		D			
		0.2					6.5		1.5		40.0			
	Fuses (See GR 58)	C							C					
		0.1							0.1					

(1) Group No.	(2) Functional Group	(3) Maintenance Functions											(4) Tools and Equipment	(5) Remarks
		A Inspect	B Test	C Service	D Adjust	E Align	F Calibrate	G Install	H Replace	I Repair	J Overhaul	K Rebuild		
90	Magnetic Compass													
	Compass Assembly	O	—	—	—	—	O	—	F	—	D			AF–H
		0.2	—	—	—	—	6.5	—	0.4	—	40.0	—		
	Lamp	O	—	—	—	—	—	—	O					
		0.2	—	—	—	—	—	—	0.2					

SECTION III. SPECIAL TOOL AND SPECIAL TEST EQUIPMENT REQUIREMENTS

Reference Code	Maintenance Category	Nomenclature	Tool Number
1H	0	Wrench: Fuel Line Fittings	J8932-1 (33287)
8C	F	Repair Kit: Injector Service	J1241-06 (3287)
4C	F	Tool Set: Injector Tube Service	J5286-01 (33287)
5H	O	Remover: Injector and Spring Compressor	J1227-01 (33287)
6C	F	Fixture: Injector Assembly	J6868-01 (39287)
7D	O	Gage: Injector Timing 1.460 (HV7)	J1853 (33287)
8C	F	Wire: Spray Tip Cleaner .006 in (HV7)	J21461 (33287)
9I	F	Remover: Coupling, Fresh Water Pump 011 Seal	J1980 (33287)
IOH	0	Wrench: Fuel and Water Pump	J4242 (33287)
11K	H	Installer: Governor Bearing	J21068 (33287)
12H	F	Gage: Gap, Governor Spring, 0.170 in	J5407 (33287)
13I	H	Tool Set: Blower Service	J6270-02 (88287)
14I	H	Adapter Set: Slide Hammer	J6471-02 (33287)
15I	H	Installer: Blower Drive Cam	J1471 (33287)
16D	H	Gage: Feeler, Blower Clearance	J1698-02 (33287)
17I	H	Tool Kit: Service, Marine Hydraulic 0il Pump	J6904 (33287)
18I	F	Installer: Oil Pump Piston, Hydrostarter	J7191 (33287)
19I	F	Installer: Oil Pump Seal, Hydrostarter	J7192 (01843)
20C	O	Hose Assembly: Accumulator Charging	TSE8600 (01843)
21C	O	Gage Assembly: Accumulator	TSE8601 (33287)
22H	F	Wrench: Coupling Flange Lock Nut	J4385-01 (33287)
23H	F	Wrench: Remover-Replacer, Shaft ,1 Lock Nut	J4384-01 (33287)
24H	F	Puller Set: Slide Hammer, Reverse Gear	J65901 (33287)

Reference Code	Maintenance Category	Nomenclature	Tool Number
25H	F	Remover-Replacer: Seal, Reverse Gear	J4700 (33287)
28H	F	Remover-Installer: Reverse Gear Piston, Model M	J4746 (33287)
27H	F	Installer: Oil Seal, Flywheel Housing	J9727 (33287)
28H	F	Expander: Oil Seal, Crankshaft, Rear	J1359 (33287)
29H	F	Installer Handle: Oil Seal, Flywheel Housing	J3154-1 (33287)
30H	F	Puller: Crankshaft Pulley	J4558 (33287)
31H	F	Wrench: Torque, 3/4 in Drive, 0-300 Ft Lb	J9187 (33287)
32D	O	Gage Set: Feeler, Valve Lash	J9708 (38287)
33H	F	Fixture: Cam Follower Pin Remover	J5340 (33287)
34H	F	Wrench, Torque, 1/2" Drive, 0-200 Ft Lb	J1264 (33287)
35B	F	Tester: Spring Valve Compression	J9666 (33287)
35H	F	Compressor: Spring Valve	J7455 (33287)
36H	H	Remover: Valve Guide	J267 (33287)
37H	H	Installer: Valve Guide	J9530 (33287)
38H	H	Brush: Valve Guide Cleaner	J5437 (33287)
89H	H	Remover: Insert, Valve Seat	J4824-01 (33287)
40H	H	Installer: Insert, Valve Seat	J1736 (33287)
41H	H	Grinder Set: Valve Seat	J8185 (33287)
42H	H	Adapter: Puller, Crankshaft Oil Plug	J8183 (33287)
43H	H	Hammer: Slide, Crankshaft Oil Plug Removal	J6471-1 (33287)
44H	H	Puller: Camshaft Gear	J1902-01 (33287)
45H	H	Adapter Plate Set: Camshaft Gear Removal	J6202 (33287)
46H	F	Installer-Remover Set: Piston and Connecting Rod Bushing	J1513-02 (33287)
47H	F	Installer: Piston Pin Retainer	J4895-01 (33287)

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	TOOL NUMBER
48H	F	Reamer Set: Piston Bushing	J3071-01 (33287)
49H	F	Gage Set: Feeler, Piston-to-Liner	J5438 (33287)
50H	F	Remover - Installer: Piston Rings	J8128 (33287)
51H	F	Inserter: Piston	J3272-02 (33287)
52H	F	Remover: Spray Nozzle, Connecting Rod	J8995 (33287)
53H	F	Holder: Connecting Rod Bearing Removal and Installation	J7632 (33287)
54H	F	Fixture: Reamer, Connecting Rod Bushing	J1686-02 (33287)
55H	H	Puller: Gear, Oil Pump Drive, Crankshaft	J3051 (33287)
56A	H	Attachment: Ball Micrometer	J4757 (33287)
57H	F	Installer: Oil Seal, Crankshaft, Front	J9783 (33287)
58B	O	Gage: Cylinder Compression Test Set	J1319-03 (33287)
59A	F	Gage: Cylinder Bore	J5347 (33287)
60A	F	Gage: Ring, Cylinder Bore, 4.2500	J5580-1 (33287)
61H	H	Remover: Cylinder Liner	J1918-02 (33287)
62H	H	Clamps: Cylinder Hold-down	J21793 (33287)
63I	H	Installer: Helm Unit Valve Spring	600057 (96151)
64H	H	Puller: Bearing, Ramp Winch (Gun)	C13115 (36581)
65H	H	Installer: Bushing, Ramp Winch (Gun)	B1397 (36581)
66H	H	Remover: Snap Ring, Ramp Motor (Gun)	B13009 (36581)
67H	H	Jib Crane	J33050A (25341)
68H	H	Load Rotor	J36130-812 (25341)
69H	H	Positioning Sling	J36130-806 (25341)

SECTION IV. REMARKS

REFERENCE CODE	REMARKS
A-C	Service is limited to silencer and air passage - keep free of foreign material.
B-C	Cleaning of filter assembly induded when changing filters.
C-C	Clean breather pipe and silencer air intake area.
D-H	Caution: Do not over torque fuel line fittings.
E-C	Service of injectors and seat is limited to cleaning and carbon removal.
H-H	Replacement of hoses and damps is from keel cooler shut off valve to water pump and adjacent areas.
I-H	Replace includes exhaust insulation.
J-C	Service indudes cleaning of debris.
K-H	Replacing governor springs indudes readjustment.
L-C	Service of strainer indudes strainer housing.
M-D	Caution: Do not parallel regulator - this will damage diodes in alternator.
N-C	Service of brushes is cleaning and seating new brushes.
O-C	Service indudes charging accumulator with gas (nitrogen).
P-D	Engine tune-up is required if any changes are made to valve operating mechanism.
Q-H	Use torque wrench to draw down cylinder head.
R-H	Replacement of front seal only.
S-B	Compression test indicates condition of engine.
T-H	Replacement of panel gages includes general maintenance of control panel.
U-C	Service of miscellaneous electrical items includes cleaning of any corrosion.
V-C	Service includes cleaning and lubrication of wire and chain - Hull Nos 8500 - 8519.
W-C	Service of batteries includes cleaning of racks and adjacent area.
X-H	Replacement of hull wiring includes sections and harness.
Y-A	Inspection of steering cylinders includes tightening of rod packing gland.
Z-D	Service of packing in stuffing box includes adjustment of glands.
AA-C	Service indudes replacement of "DE batteries.
AB-I	Minor repair above water line only.
AC-A	Inspection of gaskets includes cleaning with wooden stick cut off square.
AD-I	Repair includes patching rips and tears.
AE-H	Applicable to Hull Nos. 8500 - 8539.

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