US MARINE POWER®

Inboards

Diesel Engine **OPERATOR'S MANUAL**

Models 6-393N
6-393T

HINO ENGINE MODEL EH-700

MP104-1

US MARINE® POWER

A Brunswick Company

DIESEL ENGINE MANUAL

MODELS 6-393N AND 6-393TI

This manual provides basic information for the operation and maintenance of your US Marine Power Engine. Before starting your engine, we urge you to carefully read this manual and familiarize yourself with its contents. As the owner, you are responsible for following proper operating procedures and fulfilling maintenance requirements. Safe, economical performance and trouble-free cruising are directly related to the proper care of your engine.

Due to our ongoing commitment to product improvement, we reserve the right to change, without notice or other obligation, the specifications or information contained in this manual.

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Hartford, WI. 53027

A WORD ABOUT YOUR DIESEL ENGINE

US Marine Power purchases diesel engines from Hino Motors, Ltd., of Japan. The engines are manufactured by Hino to meet the special requirements established by US Marine Power for pleasure craft application.

Hino is by no means a "newcomer" to the diesel engine arena.

Founded over 75 years ago, Hino, Japan's oldest manufacturer of motor vehicles, has grown to be an industry leader. For the past eleven years - competing with firms such as Nissan, Isuzu and Mitsubishi - Hino has been number one in Japan for sales of diesel powered medium and heavy duty trucks. Recently Hino achieved the position of second in the world for diesel truck production.

No novice in the marine industry, Hino has produced diesel engines for sales to the commercial fishing business under the Yamaha banner. In addition, production by Hino of passenger cars and light duty trucks for Toyota continues to increase (total production is over 300,000 units per year).

With profitable sales exceeding $1.65 billion annually, Hino has been able to provide state-of-the-art research, development, test and production facilities for its more than 8000 employees. Anechoic test rooms, photoelastic coating test methods, and x-ray microanalysis are just some of the indications of an industry leader committed to growth, innovation and quality.

Features that distinguish US Marine Power diesels from much of the competition are:

--Direct injection
--Bosch type fuel injection pump
--Counterweighted, induction hardened, die-forged crankshaft
--Dry-type replaceable cylinders
--Heat resistant aluminum alloy pistons
--Integral oil cooler
--Designed for durability, reflecting a commercial application heritage
--High output to weight ratio

US MARINE POWER DIESELS . . . . designed and manufactured to reliably and efficiently meet your most demanding performance requirements!

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1.0 ENGINE SPECIFICATIONS

MODELS	US Marine Power 6-393N and 6-393TI
TYPE	Diesel, 6 Cylinder, 4 Cycle (Naturally-Aspirated or Turbo-charged-Intercooled)
HORSEPOWER	175 @ 3000 RPM (6-393N) 220 @ 3000 RPM (6-393TI)
CYLINDER BORE X STROKE	4.33 in. x 4.45 in./110mm x 113mm
DISPLACEMENT	393.2 cu. in./6.443 liters
COMPRESSION RATIO	17.9:1
FIRING ORDER	1-4-2-6-3-5
DIRECTION OF ROTATION	Counterclockwise (viewed from the flywheel)
INJECTION TIMING	15° BTDC (6-393TI) 17° BTDC (6-393N)
DRY WEIGHT (INCL. TRANSMISSION)	Approximately 1450 lbs./660 kg. (6-393N) Approximately 1600 lbs./730 kg. (6-393TI)
LUBRICATING OIL CAPACITY	10.62 U.S. quarts/8.75 Imp. qts./10 liters
FRESHWATER COOLING SYSTEM CAPACITY	25.56 U.S. quarts/21.88 Imp. qts./25 liters

1.0 PRESTART INSPECTION

Before starting the engine, check the following:

1.1 Engine oil level (page 13).

1.2 Coolant level page 18).

WARNING! **THE HEAT EXCHANGER CAP SHOULD NOT BE REMOVED WHILE THE ENGINE AND COOLING SYSTEM ARE HOT.**

1.3 Fuel level.

1.4 Transmission oil level (page 23 or 24).

1.5 Check that the fuel supply (and return, if so equipped) valves are open.

1.6 Check that the seawater intake valves (seacocks) are open.

1.7 Water separators -- visual check for moisture or contamination (page 15).

1.8 Seawater strainers -- visual check for debris.

1.9 V-belt tension (page 19 and 22).

1.10 Visual check for indications of fuel, oil, coolant and exhaust leaks.

2.0 STARTING PROCEDURE

2.1 Turn the battery switch on.

2.2 Place the transmission selector lever in the neutral ("N") position.

2.3 Position the throttle control in the "Start" position.

2.4 Turn on the D.C. ignition breaker switches if the boat is so equipped.

2.5 For a low temperature start (below 14°F./-10°C.), use the preheater system. Push the button and hold it in for 15-30 seconds (do not exceed 30 seconds).

2.6 Turn the ignition key clockwise to start the engine.

WARNING! **DO NOT CONTINUOUSLY OPERATE THE STARTER FOR MORE THAN 15 SECONDS AT A TIME.**

2.0 STARTING PROCEDURE (Cont'd)

2.7 If the engine does not start, wait at least 30 seconds before making another attempt. If after two attempts the engine does not start, try to determine the cause before proceeding.

2.8 A buzzer will activate when the key is turned on. **IF THIS WARNING DOES NOT CEASE WITHIN A FEW SECONDS AFTER START-UP, TURN THE ENGINE OFF AND INVESTIGATE BEFORE A RESTART IS ATTEMPTED.**

2.9 When the engine starts, release the key and allow it to automatically return to the running position.

WARNING! **DO NOT USE ETHER OR STARTING FLUID AS A STARTING AID AS THIS MAY RESULT IN A FIRE OR EXPLOSION.**

2.10 Do not "race" the engine or allow the engine RPM to exceed slow speed (750-1200 RPM) until it is warmed up.

3.0 ENGINE IDLING INSPECTION

3.1 As the engine is warming up:

- Check that the oil pressure reading is at least 40 PSI. **IMMEDIATELY** stop the engine if low oil pressure is indicated and determine the cause prior to attempting a restart.

- Observe the exhaust outlets to verify cooling water discharge.

3.2 Allow the engine to warm up 10-15 minutes. With the idle speed at approximately 1000 RPM, check the following:

- Oil pressure . . . . . 20 PSI or higher

- Water temperature . . . 135°-190°F./57°-87°C.

- Voltage meter . . . . . 12-15.5 volts

- Fuel gauge . . . . . Sufficient fuel

- Exhaust gas . . . . . Should be colorless or light blue. Also, there should be water out-flow with the exhaust; this indicates cooling water circulation.

3.0 ENGINE IDLING INSPECTION (Con't)

3.3 Prior to closing the engine hatch, check for liquid or exhaust leaks and remove tools, gloves, rags, etc. from on and around the engine.

4.0 NEW ENGINE BREAK-IN

All engines are test run prior to delivery. Nevertheless, it is extremely IMPORTANT to follow break-in procedures to insure many years of economical and trouble-free operation.

4.1 During the first 5 hours of operation, do not exceed an engine speed of 2500 RPM.

4.2 From 5 to 30 hours of operation, do not run at full throttle speed for more than 5 minutes.

4.3 During the first 30 hours, it is recommended that the engine is neither idled nor operated at a single RPM setting for extended periods.

5.0 OPERATION UNDER NORMAL CONDITIONS

5.1 During operation under all environmental conditions, it is a good practice to frequently check the instruments for indications of possible malfunctions.

5.2 Special attention should be paid to the water temperature and oil pressure gauges. Normal operating ranges are:

- Water temperature . . . 135°-190°F./57°-87°C.

- Oil pressure . . . . . 30-70 PSI

5.3 In addition, particular awareness and periodic inspection of the following is recommended:

- Water out-flow with the exhaust, indicating cooling water circulation.

- Exhaust coloration -- watch for excessive smoking.

- Unusual engine noises.

5.0 OPERATION UNDER NORMAL CONDITIONS (Cont'd)

5.4 Engine Speed

- The engine is quite capable of continuous cruising operation at 2800 RPM.

- DO NOT exceed 3300 RPM with the transmission in neutral or 3000 RPM with the transmission in gear.

- AVOID prolonged low RPM idling -- the temperature can drop below the safe operating range.

6.0 OPERATION UNDER EXTREME CONDITIONS

When operating in extreme conditions, observe the following practices in addition to the normal procedures listed in section 5.0 above.

6.1 Hot Weather Conditions

- Be particularly attentive to the cooling system indicators (water temperature gauge, water out-flow in the exhaust, etc.).

- Change the freshwater coolant more often than shown on the maintenance chart.

6.2 Overheating Conditions

- You will be automatically warned by a buzzer when the engine operating temperature reaches a dangerously high level (approximately 210°F./98°C.).

- Immediately reduce the engine speed and load by first moving the throttle control to the idle position and then placing the transmission lever in the neutral position.

  WARNING! DO NOT STOP THE ENGINE.

- While the engine is idling, watch the temperature gauge to see if the temperature is dropping into the normal operating range (135°-190°F./57°-87°C.).

- If the temperature remains unchanged or rises, turn the engine off.

- If the temperature drops, follow the "Engine Shut-down" instructions (page 6).

6.0 OPERATION UNDER EXTREME CONDITIONS (Cont'd)

6.2 Overheating Conditions (Cont'd)

- Before starting any troubleshooting, allow the engine to cool.

- Follow the troubleshooting guidelines to determine the cause for overheating.

- The heat exchanger cap should never be removed while the engine and cooling system are hot.

- Never add cold coolant to a hot engine. Always allow the engine to cool down first.

- When topping off the cooling system, avoid excessive dilution of the coolant mixture by adding the proper amounts of both antifreeze and water (refer to the notes on page 18).

- Do not run the engine with the heat exchanger cap off or loose.

6.3 Cold Weather Conditions

- Make sure that the proper lubricating oil, anti-freeze/water mixture and fuel are used.

- Keep the battery as fully charged as possible.

- Be sure to charge the battery after the addition of distilled water.

- Maintain a high fuel tank level to avoid moisture accumulation (as fuel is consumed, air is drawn into the fuel tank through its vent and moisture may accumulate).

7.0 ENGINE SHUT-DOWN

7.1 Cool the engine down gradually, allowing it to idle in neutral for at least 5 minutes.

WARNING! GRADUAL COOL-DOWN OF A TURBOCHARGED ENGINE IS ABSOLUTELY NECESSARY TO AVOID SHORTENED TURBOCHARGER LIFE.

7.0 ENGINE SHUT-DOWN (Cont'd)

WARNING! **IT IS IMPORTANT TO FOLLOW STEPS 7.2, 7.3, 7.4 AND 7.5 IN SEQUENCE TO AVOID THE POSSIBILITY OF ELECTRICAL SYSTEM DAMAGE.**

7.2 To turn the engine off, push the stop button.

7.3 Turn the ignition key counterclockwise to the off position.

7.4 Turn off the D.C. ignition breaker switches (if the boat is so equipped).

7.5 Turn the battery switch off.

7.6 Close the seawater intake valves (seacocks).

7.7 Close the fuel supply and return valves.

7.8 Carefully inspect the engine and compartment for indications of oil, fuel, water or exhaust leakage.

NOTE: Steps 7.6, 7.7 and 7.8 need not be followed for short term shut-down (overnight). For longer term storage, refer to the storage sections of this manual.

MAINTENANCE

The following chart indicates recommended maintenance intervals. Service is based upon average operating conditions. More frequent intervals are required when repeated starting and stopping, extended slow speed, heavily laden or other unusual operations are encountered.

Replacement parts for maintenance or repairs must be genuine US Marine Power or dealer approved equal components. Receipts related to maintenance and repairs should be retained for reference purposes.

daily
yearly

MAINTENANCE CHART

SECTION	DESCRIPTION	INTERVAL BY OPERATION HOURS						REMARKS
		AFTER FIRST 30 HRS.	-----EVERY----- 30 HRS.	120 HRS.	250 HRS.	500 HRS.	1000 HRS.	
1.0	**LUBRICATION SYSTEM**							
1.1	CHECK OIL LEVEL							DAILY INSPECTION
1.2	CHANGE OIL/FILTER	0		0				
2.0	**FUEL SYSTEM**							
2.1	PRIMARY FUEL FILTER REPLACEMENT				0			
2.1	PRIMARY FUEL FILTER/WATER SEPARATOR INSPECTION							DAILY INSPECTION AND DRAIN AS REQUIRED
2.2	SECONDARY WATER SEPARATOR INSPECTION							DAILY INSPECTION AND DRAIN AS REQUIRED
2.3	SECONDARY FUEL FILTER REPLACEMENT			0				
2.4	FEED PUMP STRAINER CLEANING	0		0				
2.5	CHECK/ADJUST INJECTION PUMP TIMING	0				0		15° BTDC
2.6	INJECTION NOZZLES INSPECTION					0		
2.7	AIR BLEEDING							AFTER MAINTENANCE OR AS REQUIRED
2.8	FUEL/FUEL TANK							SEE TEXT ON PAGE 17

MAINTENANCE CHART (CONT'D)

SECTION	DESCRIPTION	INTERVAL BY OPERATION HOURS						REMARKS
		AFTER FIRST 30 HRS.	-----EVERY----- 30 HRS.	120 HRS.	250 HRS.	500 HRS.	1000 HRS.	
3.0	**COOLING SYSTEM**							
3.1	COOLANT CHANGE	0						EVERY 6 MONTHS OF OF NORMAL OPERATION OR AT LEAST ONCE PER YEAR
3.2	SEAWATER PUMP V-BELT INSPECTION	0	0					
	SEAWATER STRAINER							DAILY INSPECTION AND CLEAN AS REQUIRED
3.3	SEAWATER PUMP INSPECTION					0		OR ONCE PER YEAR MINIMUM
3.4	COOLANT PUMP LUBRICATION					0		OR ONCE PER YEAR MINIMUM
3.5	INTERCOOLER INSPECTION				0			OR ONCE PER YEAR MINIMUM
	HOSE INSPECTION	0	0					CAREFULLY INSPECT AND REPLACE AS NECESSARY
4.0	**ENGINE**							
4.1	VALVE CLEARANCE CHECK AND ADJUST	0				0		
	COMPRESSION CHECK						0	470-510 PSI/33-36 KG/CM2 AT 280 RPM
	CYLINDER HEAD BOLT CHECK AND TIGHTEN	0					0	SEE TIGHTENING TORQUE TABLE & FIGURE 9

MAINTENANCE CHART (CONT'D)

SECTION	DESCRIPTION	INTERVAL BY OPERATION HOURS						REMARKS
		AFTER FIRST 30 HRS.	-----EVERY----- 30 HRS.	120 HRS.	250 HRS.	500 HRS.	1000 HRS.	
4.0	**ENGINE (Cont'd)**							
	ENGINE MOUNT BOLT CHECK AND TIGHTEN			0				SEE TIGHTENING TORQUE TABLE
	TURBOCHARGER INSPECTION	0		0				CHECK FOR PLAY IN THE ROTOR, FREEDOM OF ROTATION, BOLT TIGHTNESS AND OIL LEAKS
5.0	**ELECTRICAL SYSTEM**							
5.1	BATTERY CHECK	0	0					CHECK ELECTROLYTE LEVEL
5.2	BATTERY CHARGE				0			SPECIFIC GRAVITY CHECK
	STARTER							PERIODICALLY CHECK MOUNTING BOLT TIGHTNESS AND ELECTRICAL CONNECTIONS
5.3	ALTERNATOR							PERIODICALLY CHECK MOUNTING BOLT TIGHTNESS, V-BELTS AND ELECTRICAL CONNECTIONS
6.0	**AIR INTAKE/EXHAUST**							
6.1	AIR FILTER CLEAN			0				
6.2	AIR FILTER REPLACE					0		

MAINTENANCE CHART (CONT'D)

SECTION	DESCRIPTION	INTERVAL BY OPERATION HOURS						REMARKS
		AFTER FIRST 30 HRS.	-----EVERY----- 30 HRS.	120 HRS.	250 HRS.	500 HRS.	1000 HRS.	
6.0	**AIR INTAKE/EXHAUST**							
	INTAKE AND EXHAUST MANIFOLD BOLTS	0					0	CHECK AND RE-TIGHTEN AS NECESSARY
7.0	**TRANSMISSION (MG-502)**							
7.1	FLUID LEVEL CHECK	0	0					WEEKLY INSPECTION IF OPERATED DAILY
7.2	FLUID CHANGE	0				0		OR ONCE PER YEAR MINIMUM
7.3	STRAINER CLEANING	0				0		OR ONCE PER YEAR MINIMUM
8.0	**TRANSMISSION (HBW-450)**							
8.1	FLUID LEVEL CHECK	0						DAILY INSPECTION
8.2	FLUID CHANGE	0		0				
8.3	SHIFT LEVER TRAVEL	0		0				CHECK AND ADJUST AS REQUIRED

1.0 LUBRICATION SYSTEM

1.1 Oil Level

- The oil level should be kept between the maximum and minimum marks on the dipstick (see Figure 2).

- Check the oil level before starting the engine, or after the engine has been off for at least 30 minutes.

- Remove the dipstick, wipe it clean, fully reinsert the dipstick, remove again and check the oil level indication. After checking, replace the dipstick.

- Add oil as necessary, making sure that the oil added is the same brand and grade as is currently in the system (reference 1.2 below).

1.2 Oil and Filter Change

This engine is equipped with a dual oil filtration system--a full-flow paper element type and a centrifugal type.

Full-flow Filter Change

- Remove the oil filler cap from the valve cover.

- Remove oil from the pan by attaching an appropriate pump to the drain tube. Remove the pump when draining is completed.

- Remove the plug from the underside of the oil filter cap to allow oil to drain (see Figure 8). Replace the drain plug.

- Loosen the cap bolt and, if possible, remove the cap, bolt and filter as an assembly. Otherwise, remove the cap bolt and then the cap, being careful to catch the parts and not allow them to drop into the bilge.

- Clean the filter mounting base, filter cap contact surface and cap interior with solvent or diesel fuel. Discard the old O-ring.

- Coat the new base O-ring with oil and insert it into the filter mounting base groove.

1.0 LUBRICATION SYSTEM (Cont'd)

1.2 Oil and Filter Change (Cont'd)

- Using a new filter element, preassemble the filter assembly components and carefully mount them on the base (avoid disturbing the O-ring).

- Tighten the cap bolt 29-36 ft.-lbs./400-500 cm.-kg. (hold the filter cap to prevent it from turning while tightening the bolt).

Centrifugal Filter Cleaning

- Release the securing clamp and remove the cap.

- Remove the rotor retaining nut and disassemble the filter assembly. Clean the components with either solvent or diesel fuel. Discard the old O-ring.

- Reassemble the filter in the reverse order using a new O-ring.

Oil Refill

- Plug the pan drain tube and add oil.

- Oil capacity: 10.62 U.S. Qt./8.75 Imp. Qt./10 liters

- Oil type: Your engine was originally filled with high quality (SAE 30 weight) oil. It is important that this oil, or an equal quality oil meeting API service classification CD, is used. Do not mix different grades or brands of oil in your engine.

NOTE: SAE 30 weight engine oil is recommended for year round use. Do not use multi-viscosity oil. Do not use oil with less than a SAE 30 weight rating unless cold weather starting is a problem (and then replace it with SAE 30 weight oil as soon as practical).

- Engine oil additives and "break-in" oils should never be used.

- Check the dipstick again to insure that the proper oil level has been achieved. Reinstall the oil filler cap.

2.0 FUEL SYSTEM

Prior to commencing work on the fuel system, make sure that the fuel supply valve is closed. Also, do not smoke or introduce open flame inside the engine compartment area.

2.1 Primary Fuel Filter/Water Separator

- Refer to the filter literature supplied with your boat for information related to this filter/separator (mounted in the engine compartment, not on the engine).

2.2 Secondary Water Separator

- Frequently check the secondary water separator (mounted on the engine) for accumulated water as indicated by the float (see Figure 7).

- Before the float indicator reaches the "drain level", drain the water by loosening the plug on the underside of the bowl. Drain the water, then retighten the plug.

2.3 Secondary Fuel Filter Replacement

- Remove the drain plug threaded into the head of the cap holding bolt (see Figure 6). Discard the old O-ring.

- Loosen the vent plug to aid in draining fuel from the cap.

- Loosen the cap bolt and remove the cap and filter assembly.

- Replace the old O-ring in the filter assembly mount.

- Clean the filter cap base surface and cap interior with either solvent or diesel fuel.

- Preassemble the cap and filter components (using a new filter element and new O-rings).

- Mount the filter assembly and tighten the cap bolt 30-35 ft.-lbs./400-500 cm.-kg. Be sure to retighten the drain plug.

- Bleed the fuel system per sub-section 2.7.

2.0 FUEL SYSTEM (Cont'd)

2.4 Feed Pump Strainer

- Disconnect the fuel infeed line from the feed pump and remove the strainer--strainer is inside the hollow connection bolt (see Figure 3). Discard the old gaskets.

- Clean the strainer with fuel and compressed air.

- Reinstall the strainer and fuel line using new gaskets.

- Use care to prevent dirt from entering the fuel line.

- Bleed the system per sub-section 2.7.

2.5 Injection Pump Timing

- Timing should be set by your authorized dealer. The setting is 15° (6-393TI)/17° (6-393N) before top dead center (BTDC) for the no. 1 cylinder on the compression stroke.

- The timing can be checked by removing the timing port cover (see Figure 4) on the flywheel housing and turning the engine over to the 15°/17° BTDC position on the flywheel. At this point, the scribe line (not the notch) on the timer housing (see Figure 3) should be aligned with the scribe line on the timing plate.

- If a timing adjustment is necessary, loosen the two flange bolts (in the slotted holes) at the coupling and rotate the timer housing by hand until the scribe lines are aligned. Tighten the flange bolts 25 ft.-lbs./350 cm.-kg.

2.6 Injection Nozzle Inspection

- Your authorized dealer should check the operation and condition of the injection nozzles.

2.7 Air Bleeding

Following maintenance of the fuel system, air must be bled in accordance with the following:

- Loosen the vent plug on top of the primary fuel filter/ separator by rotating it counterclockwise (Figure 10).

- Also loosen the pump knob next to the vent plug by rotating it counterclockwise. Begin pumping and continue until no air bubbles are visible in the fuel being pumped out of the vent (Figure 10).

- Close and tighten the pump and vent plug by rotating them both clockwise.

2.0 FUEL SYSTEM (Cont'd)

2.7 Air Bleeding (Cont'd)

- Loosen the vent plug on top of the secondary water separator (Figure 7).

- Turn the priming pump knob (Figure 3) counterclockwise to release it, and pump until no air bubbles are mixed with the fuel being pumped out of the vent plug.

- Close and tighten the vent plug.

- Loosen the vent plug (Figure 6) on top of the secondary fuel filter and operate the priming pump until air is no longer present. Close and tighten the vent plug.

- Air bleeding between the secondary fuel filter and the injection pump can be accomplished, in most instances, by manually operating the priming pump. However, for more thorough results, loosen the return line check valve (Figure 3) and operate the priming pump. After any air is pumped out, retighten the check valve.

- During all bleeding operations, take appropriate steps to catch overflowing fuel and wipe up all splashed fuel.

- Screw in and tighten the priming pump by pushing in on the pump knob and turning clockwise.

2.8 Fuel/Fuel Tank

WARNING! Do not use fuels or fuel additives that incorporate any form of alcohol or alcohol derivatives. Alcohol destroys marine fuel system hoses and components, which could lead to hazardous leaks, fire or explosion.

- Make sure your supplier of fuel is reputable and can be relied upon to furnish clean, proper, high quality fuel. Keep your tank as full as possible to help minimize condensation inside the tank and use a diesel fuel conditioner! This is a must with today's poorer quality fuels.

- Diesel fuel of ASTM grade 2-D is recommended. The minimum cetane value is 40 (45 for cold temperature operation), and the maximum sulfur content is 0.5%. If the sulfur content exceeds 0.5%, oil changes should be performed twice as frequently as indicated in the maintenance schedule.

2.0 FUEL SYSTEM (CONT'D)

2.8 Fuel/Fuel Tank (Cont'd)

- If you suspect that dirt, water or other impurities have contaminated the fuel system, or that your boat has been fueled with gasoline instead of diesel fuel, it is imperative that the engines are not started. Contact your authorized US Marine Power dealer for assistance in removing the impurities or gasoline safely.

3.0 COOLING SYSTEM

3.1 Coolant Change

- To drain the freshwater cooling system, open the heat exchanger petcock (flywheel end, underside of the heat exchanger) and loosen the cylinder block drain plug (behind the starter motor). Also, remove the heat exchanger cap.

  WARNING! DO NOT REMOVE THE HEAT EXCHANGER CAP, OPEN THE PETCOCK, OR LOOSEN THE CYLINDER BLOCK DRAIN PLUG WHILE THE ENGINE OR COOLING SYSTEM ARE HOT.

- Flush the heat exchanger with clean water. Allow the water to completely drain out.

- Close the drains and refill the system slowly with recommended coolant until it reaches the lower level indicator (larger protruding pointer) seen inside the heat exchanger filler opening. Reinstall the heat exchanger cap.

- A 50/50 mixture of water and good quality, ethylene glycol base antifreeze is recommended.

- Do not use more than 60% or less than 15% concentration of antifreeze.

- Never use water alone without antifreeze.

- To avoid potential pump damage, do not operate the engine without water in both the seawater and freshwater cooling systems.

3.0 COOLING SYSTEM (Cont'd)

3.1 Coolant Change (Cont'd)

- Additives that are sealers or anti-leak solutions, or those that claim to improve heat transfer should not be used.

3.2 Seawater Pump V-belt Inspection

- When applying significant finger pressure halfway between the seawater pump and crankshaft pulley, the belt deflection should be between 3/8"-5/8" (10-15mm) --it is undesirable for the belt to be too loose or too tight.

- Inspect the belt for signs of wear or damage and replace it upon detecting such indications.

- Adjustment:

  --Loosen the four mounting bolts beneath the base of the seawater pump.

  --Turn the adjustment bolt on the side of the pump mount clockwise to increase belt tension, or counterclockwise to decrease the belt tension.

  --Retighten the mounting bolts.

  --After installing a new belt, run the engine for five minutes, shut it down and recheck the tension. New belt stretching is normal and several readjustments may be necessary before the correct tension is achieved.

3.3 Seawater Pump Inspection

- For access to the impeller housing, the pump should be unbolted and moved to provide sufficient clearance.

- Remove the impeller housing cover (6 bolts) and pull the impeller out using a rotating motion. Discard the old gasket.

- Inspect the impeller for wear, damage or directional set (curved vanes) and replace as necessary.

3.0 COOLING SYSTEM (Cont'd)

3.3 Seawater Pump Inspection (Cont'd)

- Reassemble and remount the pump (use a new gasket when attaching the cover.

- Inject good quality grease meeting MIL-G-10924B specifications at the grease fitting with a manually operated "gun"--avoid seal damage by stopping the injection as soon as back pressure is felt.

3.4 Coolant Pump Lubrication

- Lubricate the coolant pump bearings by injecting grease meeting MIL-G-10924B specifications at the pump grease fitting using the procedure described in 3.3 above.

3.5 Intercooler Inspection

- Remove the seawater hoses and both end cap castings (10 nuts each).

- Clean the end caps and interior of the heat exchanger tubes.

- Remove the inspection plate (4 bolts) from the underside of the intercooler and examine the cooling fins inside.

- If there is an excessive accumulation of particles on or between the fins, contact your authorized dealer for assistance in determining the proper corrective procedure.

- Reassemble the components using new gaskets (torque: end cap nuts = 14-18 ft.-lbs./190-260 cm.-kg., underside cover bolts = 8 ft.-lbs./110 cm.-kg.

4.0 ENGINE

4.1 Valve Clearance Adjustment

- Remove the valve cover and the flywheel timing port cover.

- Turn the crankshaft clockwise (facing the V-belt end of the engine) until the "1/6" indication on the flywheel is aligned with the notch on the flywheel housing.

5.0 ELECTRICAL SYSTEM (Cont'd)

5.1 Battery Electrolyte Level (Cont'd)

- Add distilled water to any cells with low electrolyte level (water level should be 1/4" above the internal plates).

5.2 Battery Specific Gravity

- Using a hydrometer, check the specific gravity of the electrolyte.

- The specific gravity should be above 1.22 at 68°F./ 20°C. (1.25-1.27 at full charge).

WARNING! **THE BATTERY PRODUCES EXPLOSIVE HYDROGEN GAS--DO NOT BRING OPEN FLAME OR AN ELECTRIC SPARK NEAR THE BATTERY. DO NOT LET ELECTROLYTE, WHICH IS ACID, CONTACT YOUR SKIN, EYES OR CLOTHING--THOROUGHLY FLUSH THE CONTACT AREA WITH WATER IMMEDIATELY FOLLOWING CONTACT.**

- Reinstall the battery cell caps.

5.3 Alternator V-belt Inspection

- When applying significant finger pressure halfway between the alternator and crankshaft pulleys, the belt deflection should be between 3/8"-5/8" (10-15mm) --it is undesirable for the belt to be too loose or too tight.

- Inspect the belt for signs of wear or damage and replace it upon detecting such indications.

- Adjustment:

--Loosen the alternator pivot and slotted bracket bolts.

--Tighten the belt by pivoting the alternator away from the engine until the correct tension is achieved (do not pry against the alternator).

--Retighten the pivot and slotted bracket bolts.

5.0 ELECTRICAL SYSTEM (Cont'd)

5.3 Alternator V-belt Inspection (Cont'd)

--After installing a new belt, run the engine for five minutes, shut it down and recheck the tension. New belt stretching is normal and several readjustments may be necessary before the correct tension is achieved.

6.0 AIR INTAKE/EXHAUST

6.1 Air Filter Cleaning

- Remove the perimeter foam filter (fastened by "velcro") and wash it in warm water with non-abrasive soap (example: dishwashing liquid).

- Squeeze out the excess water and either air dry or force dry the filter with compressed air prior to re-installation.

NOTE: Do not use solvent or fuel for cleaning the filter.

6.2 Air Filter Replacement

- The air filter should be replaced whenever obvious foam deterioration has occurred.

7.0 TRANSMISSION (TWIN DISC MG-502)

7.1 Fluid Level Check

- The oil level can only be checked when the engine is running at idle speed with the transmission in neutral and at operating temperature.

- Remove the dipstick (see Figure 11), wipe the end, reinsert, remove again and inspect to see that the oil level is at the "full" mark.

NOTE: Be sure to look at both sides of the dipstick because often one side will give a false indication, picking up oil from the dipstick guide tube.

7.0 TRANSMISSION (TWIN DISC MG-502) (Cont'd)

7.1 Fluid Level Check (Cont'd)

- To add oil, shut down the engine and remove the breather assembly. Pour approved oil into the housing and reinstall the breather. Start the engine and recheck the oil level.

7.2 Fluid Change

- Remove the breather assembly (see Figure 11).

- Remove the oil drain plug and drain the fluid.

- Replace the plug and refill the transmission with approximately two quarts of SAE 30 weight motor oil (Mobil Delvac 1230 or equal).

  NOTE: Do not use multi-viscosity (i.e. 10W-40, etc.) oil in the transmission. Do not mix different brands or grades of oil.

- Reinstall the breather assembly (after cleaning it with solvent or diesel fuel) and check the fluid level by following the procedures in 7.1 above.

7.3 Strainer Cleaning

- Remove the oil strainer access plug (see Figure 11) and strainer. Discard the old O-ring.

- Clean the strainer with solvent or diesel fuel and inspect it for damage to the wire mesh (replace if damaged).

- Using a new O-ring, reinstall the strainer and access plug.

8.0 TRANSMISSION (Hurth HBW-450)

8.1 Fluid Level Check

- Unscrew the dipstick (see Figure 12), wipe the end, reinsert (but do not screw in), remove and inspect to see that the fluid level is up to the index mark.

- Add fluid as necessary. Use a good quality automatic transmission fluid (Mobil Dextron II). Do not mix different brands or grades of fluid.

8.0 TRANSMISSION (Hurth HBW-450) (Cont'd)

8.1 Fluid Level Check (Cont'd)

- Screw in and tighten the dipstick.

8.2 Fluid Change

- Remove the transmission drain plug and drain the fluid (see Figure 12).

- Replace the plug and refill the transmission with approximately 1.75 quarts /1.7 liters of quality automatic transmission fluid (Mobil Dextron II). Do not mix different brands or grades of fluid.

- Run the engine to circulate the fluid. Check the level again after shut-down and add fluid if necessary.

8.3 Shift Lever Travel

- Make sure that the transmission shift lever zero position corresponds with the neutral position on the control lever at the helm.

- To adjust it, position the helm control lever in neutral, then loosen the clamp bolt on the shift lever (on top of the transmission; see Figure 12) and reset it as required. Retighten the clamp bolt and check that there is equal shift lever travel from the zero position to either the forward or reverse positions (1-3/16" - 1-3/8"/30-35mm travel).

- After completing the adjustment, check that the clamp bolt is tight. Push down firmly on the shift lever shaft to ensure that there is some up and down play in the shift lever shaft.

1.0 SHORT TERM STORAGE

For storage of less than a month during normal, relatively warm weather conditions (above freezing temperatures),follow all of the steps for "Engine Shut-down" (page 6).

2.0 WINTER STORAGE

For storage during longer periods, particularly through the winter months, perform the following:

2.1 Freshwater Cooling System

- Unless recently performed, completely drain, flush and refill the freshwater cooling system (page 18).

NOTE: The cooling system should never be left empty or dry during storage.

2.2 Fuel System

- Drain the water from the separators.

- Fill the fuel tank with the correct grade of diesel fuel. The fuel should also have the proper additives for winter storage.

- Replace the secondary fuel filter cartridge.

- Run the engine to circulate the fuel (do not forget to turn the fuel supply valves on and off).

2.3 Seawater System

- With the seacock closed, remove the sea-strainer cap.

- Following engine start by another person at the helm, slowly pour 3 gallons of coolant (equal parts of water and antifreeze) into the sea-strainer.

- Signal the helm for engine shut-down as soon as the coolant mixture has been poured into the system.

- Replace the sea-strainer cap.

NOTE: Do not run the engine without water in the seawater cooling system--pump damage can result.

2.0 WINTER STORAGE (Cont'd)

2.4 Lubrication System

A good time to change the engine oil is immediately prior to winter storage. Follow the maintenance instructions in the lubrication section.

2.5 Battery

- Remove the battery and store in a cool (33-50°F./ 1-10°C.), dry place.

- Coat the battery terminals with a light covering of grease to prevent corrosion.

- The battery should be fully charged prior to storage and should be checked once per month for the correct water level and specific gravity (1.23 minimum).

- If the battery becomes discharged during storage, recharge it at a slow rate ("trickle charge").

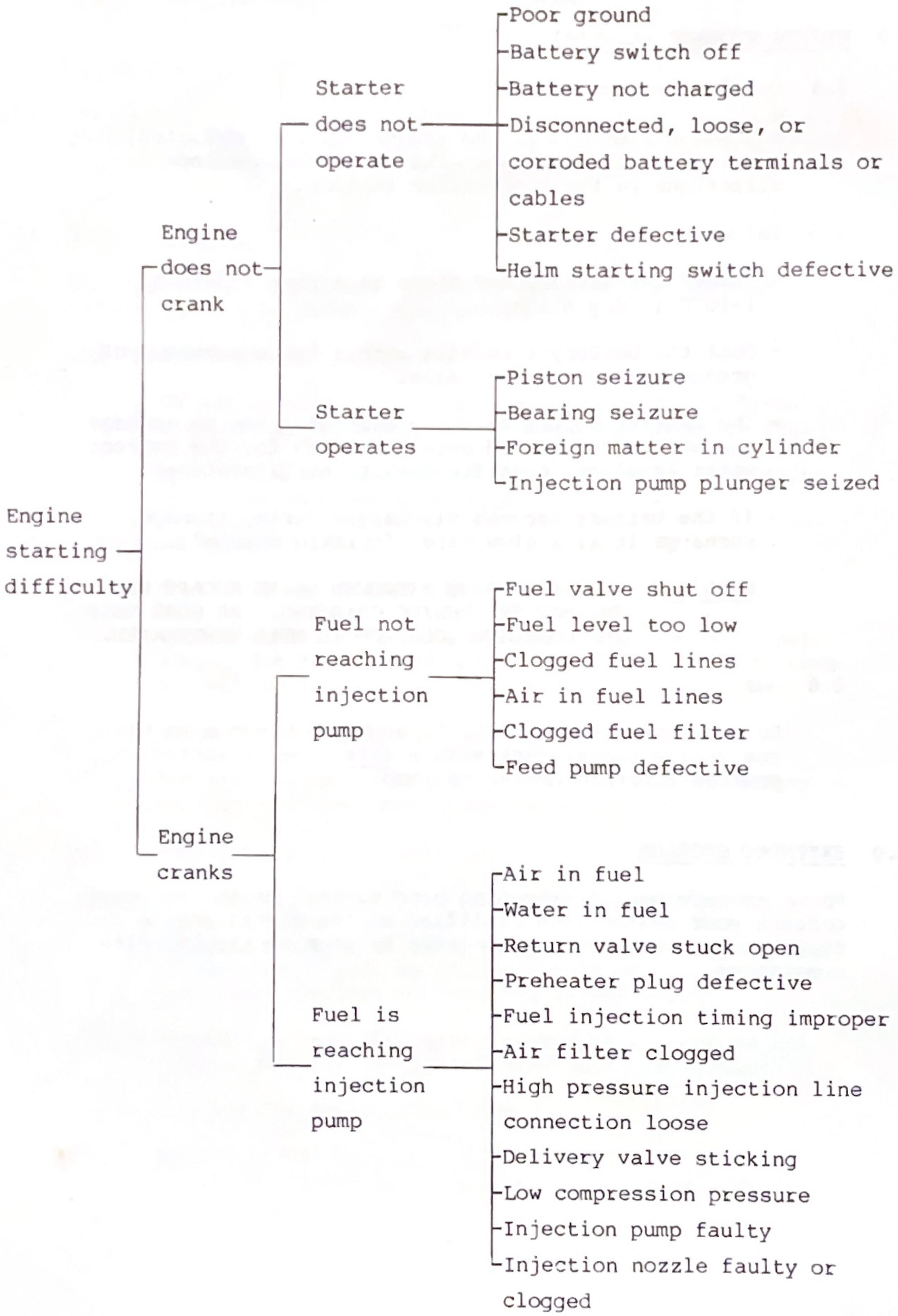
WARNING! **VERY EXPLOSIVE HYDROGEN GASES ESCAPE FROM THE BATTERY DURING CHARGING. BE SURE THAT THE CHARGING LOCATION IS WELL VENTILATED.**

2.6 Heat

During winter storage, it is highly advisable to heat the engine compartment with a safe type of shore-powered electric heater or lamp.

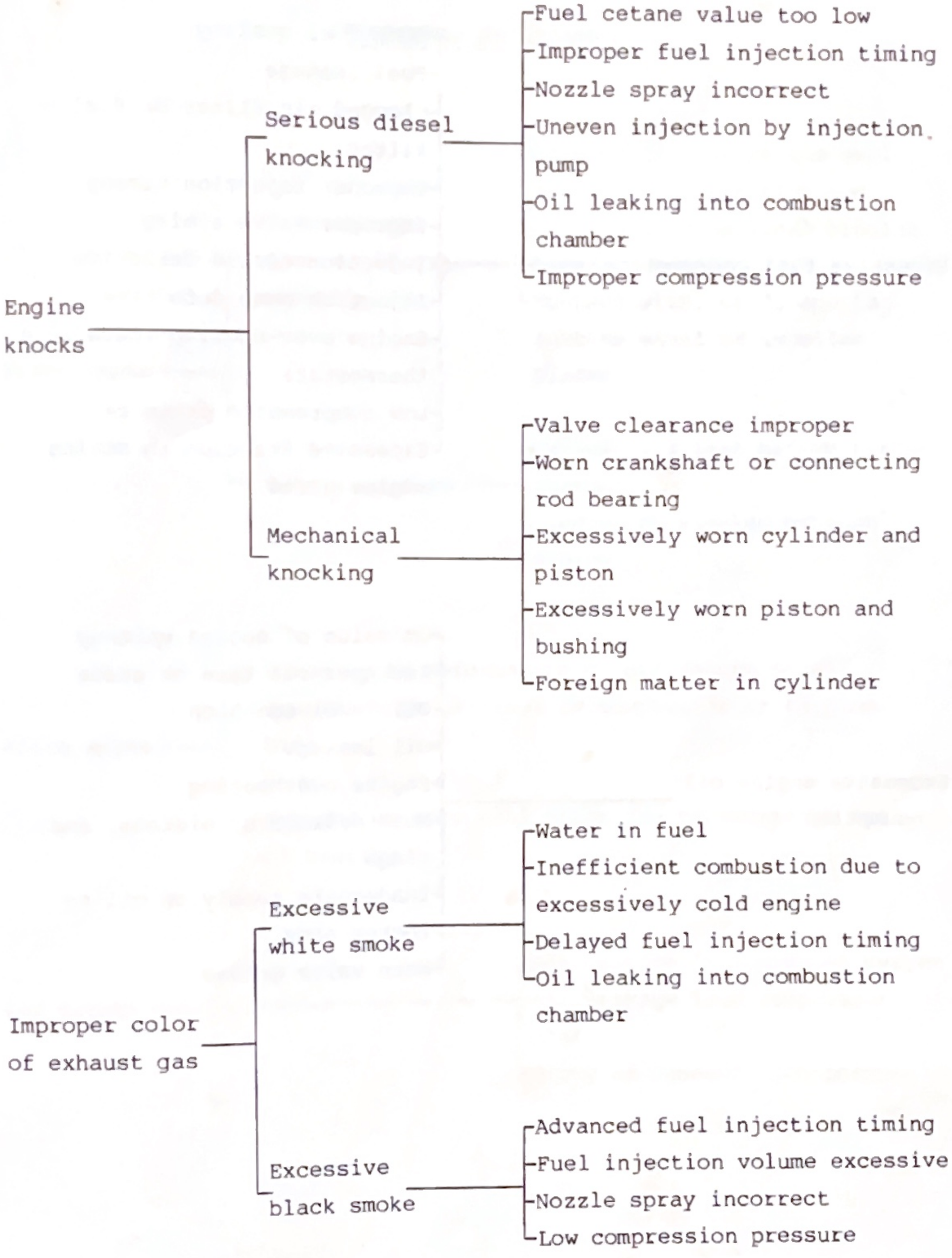
3.0 EXTENDED STORAGE

For a storage period extending over several months or years, contact your dealer or a qualified marine diesel engine supplier for instructions specific to your particular circumstances.


Engine starting difficulty
Engine does not crank
Starter does not operate
Poor ground
Battery switch off
Battery not charged
Disconnected, loose, or corroded battery terminals or cables
Starter defective
Helm starting switch defective
Starter operates
Piston seizure
Bearing seizure
Foreign matter in cylinder
Injection pump plunger seized
Engine cranks
Fuel not reaching injection pump
Fuel valve shut off
Fuel level too low
Clogged fuel lines
Air in fuel lines
Clogged fuel filter
Feed pump defective
Fuel is reaching injection pump
Air in fuel
Water in fuel
Return valve stuck open
Preheater plug defective
Fuel injection timing improper
Air filter clogged
High pressure injection line connection loose
Delivery valve sticking
Low compression pressure
Injection pump faulty
Injection nozzle faulty or clogged

- Engine stalls at low speed
  - Fuel pump defective
    - Governor out of adjustment
    - Rack and pinion malfunctioning
  - High pressure injection line clogged
  - Injection nozzle defective
    - Nozzle spring adjusting screw loose
    - Nozzle port clogged
    - Injection pressure too low
    - Nozzle spray incorrect
    - Delivery valve defective
- Engine lacks power
  - Insufficient fuel supply
    - Clogged fuel line or air in system
    - Improper injection timing
    - Feed pump defective
    - Clogged fuel filter
    - Injection nozzle defective
    - Nozzle spray incorrect
  - Insufficient air intake
    - Clogged air filter
    - Intake valve improperly adjusted
  - Others
    - Low compression pressure
    - Engine overheating

- Engine over-heating
  - Cooling system defective
    - Coolant pump or seawater pump defective
    - Loose or slipping belt
    - Seacock closed
    - Seawater strainer clogged
    - Thermostat defective
    - Heat exchanger cap defective
    - Clogged or corroded heat exchanger
  - Fuel injection system defective
    - Improper injection timing
    - Injection pump timer defective
    - Nozzle injection defective
  - Lubrication system defective
    - Engine oil level too low
    - Oil pump defective
    - Engine oil deteriorated
  - Cylinder head or piston carboned-up
  - Cylinder head cracked
  - Gas leak from cylinder head gasket


Engine knocks
Serious diesel knocking
Fuel cetane value too low
Improper fuel injection timing
Nozzle spray incorrect
Uneven injection by injection pump
Oil leaking into combustion chamber
Improper compression pressure
Mechanical knocking
Valve clearance improper
Worn crankshaft or connecting rod bearing
Excessively worn cylinder and piston
Excessively worn piston and bushing
Foreign matter in cylinder
Improper color of exhaust gas
Excessive white smoke
Water in fuel
Inefficient combustion due to excessively cold engine
Delayed fuel injection timing
Oil leaking into combustion chamber
Excessive black smoke
Advanced fuel injection timing
Fuel injection volume excessive
Nozzle spray incorrect
Low compression pressure

- Excessive fuel consumption
  - Poor fuel quality
  - Fuel leakage
  - Clogged air filter or fuel filter
  - Improper injection timing
  - Improper valve timing
  - Injection nozzle defective
  - Injection pump defective
  - Engine over-cooling (defective thermostat)
  - Low compression pressure
  - Excessive friction in moving engine parts
- Excessive engine oil consumption
  - Omission of engine warm-up
  - Improper oil type or grade
  - Oil level too high
  - Oil leakage
  - Engine overheating
  - Worn cylinders, pistons, and rings
  - Inadequate supply of oil to rocker arms
  - Worn valve guides

TURBOCHARGER RELATED

- Black smoke
  - Turbocharger does not rotate smoothly
    - Carbon build-up on the seal rings of turbine side resulting in rotational binding
    - Bearing seized
    - Contact with, or damage to turbine wheel or impeller blades
  - Exhaust system
    - Exhaust gas leak before turbocharger
    - Clogged or blocked exhaust piping
- White smoke
  - Clogging or deformation of oil return pipe, resulting in oil leak to compressor or turbine side
  - Damaged or worn seal rings due to excessive wear of bearing
- Low output
  - Gas leakage from exhaust system
  - Air leakage from compressor side
  - Dirty or damaged turbocharger

TURBOCHARGER RELATED (CONT'D)

- Poor turbocharger response
  - Carbon build-up on the seal rings of turbine side, resulting in rotational binding
- Abnormal noise and vibration
  - Noise
    - Contact of rotating parts
    - Loose connection between turbocharger and intake or exhaust piping
  - Vibration
    - Damaged bearing, contact of rotating parts, or damaged turbine wheel or impeller blades due to entrance of foreign material

ONE YEAR LIMITED WARRANTY

ONE YEAR LIMITED WARRANTY

US Marine Power hereby warrants to the original purchaser of its diesel engines operated under normal, non-commercial use in the United States and Canada that it will repair or replace any parts found to be defective in materials or workmanship within one year from the date of retail delivery.

WHAT IS NOT COVERED

This warranty does not apply to: a) equipment or accessories carrying their own individual warranties; b) parts or accessories not installed as factory equipment; c) abuse, accident, operation beyond recommended limits, or owner/operator negligence; d) use of non-recommended fuels, lubricants or coolants; e) failure to follow minimum maintenance requirements and schedules; f) engines used for racing; g) parts needing replacement due to normal wear; h) transportation, haul-out, dockage, storage or other costs incurred by the owner.

OTHER LIMITATIONS

There is no other express warranty related to this engine. To the extent allowed by law:

Any implied warranty, including any implied warranty of merchantability or fitness, is limited to the duration of this written warranty.

Neither US Marine Power nor the selling dealer shall have any responsibility for the loss of use of the engine, loss of time, inconvenience, commercial loss or consequential damages.

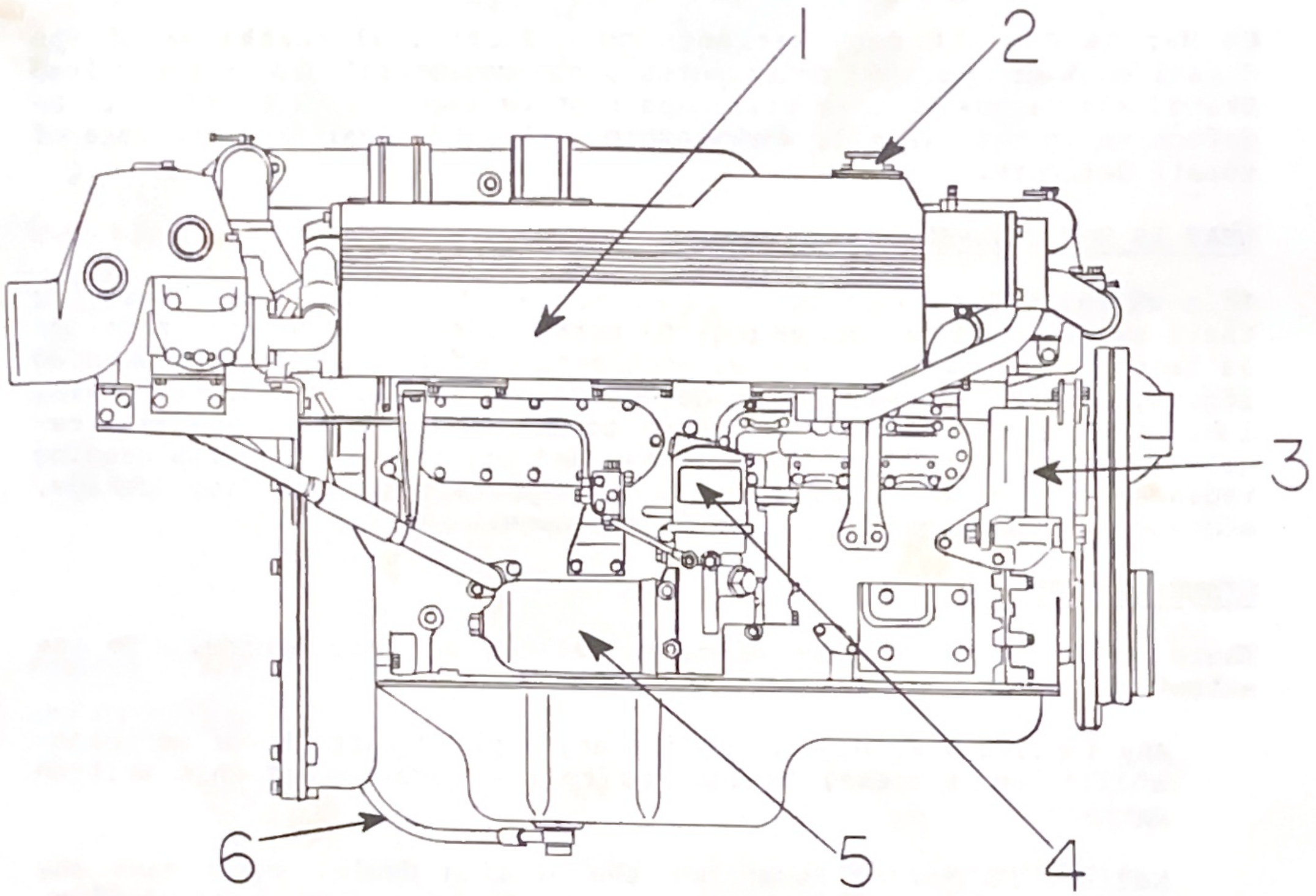
Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

YOUR OBLIGATION

Before any warranty work is performed on the engines, we require that you contact the selling dealer or US Marine Power to request warranty assistance. We also require that the engine be returned to the selling dealer for warranty service whenever possible.

US Marine Power
Customer Service Department
105 Marine Drive
Hartford, Wisconsin 53027
Phone: (414) 673-2200

FIGURE 1 - ENGINE SIDE VIEW (STARBOARD)



1 - Heat Exchanger
2 - Coolant Filler Cap
3 - Alternator
4 - Centrifugal Oil Filter
5 - Full-flow Oil Filter
6 - Oil Drain Tube

FIGURE 2 - OIL DIPSTICK

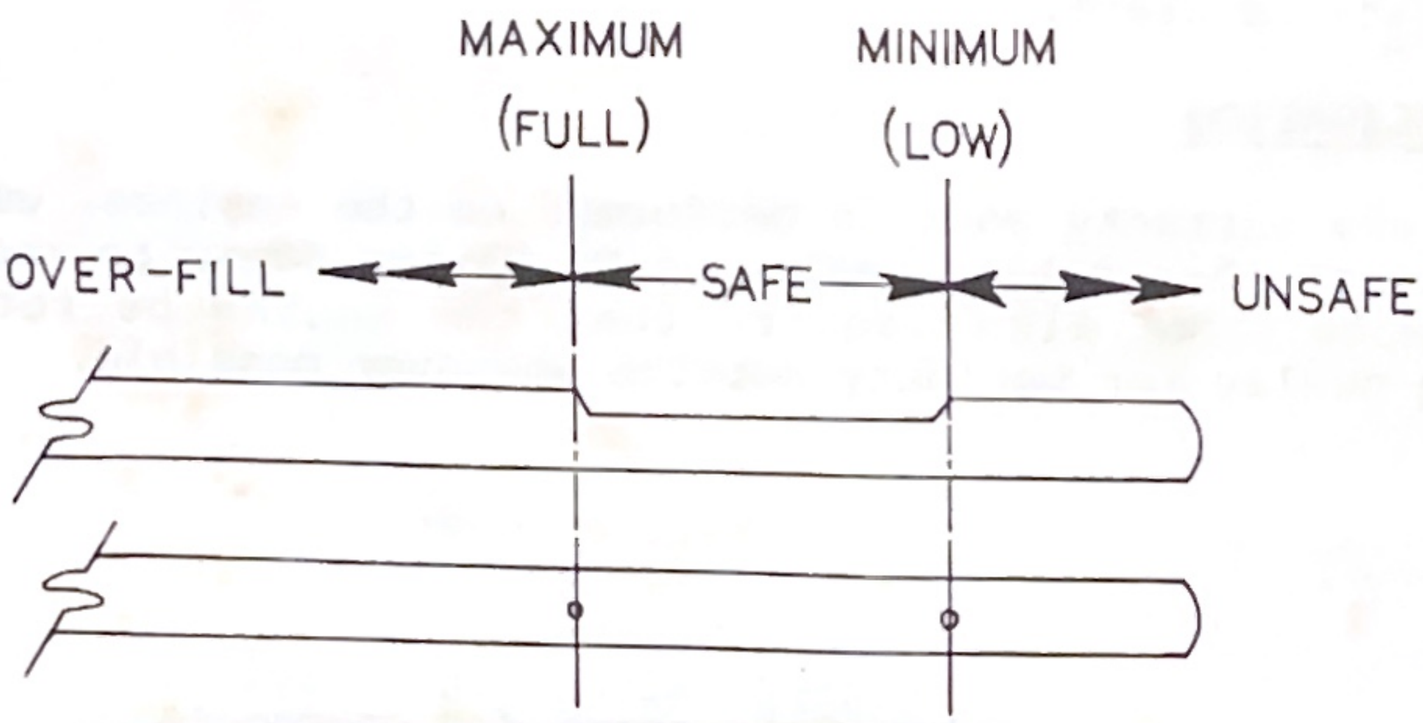
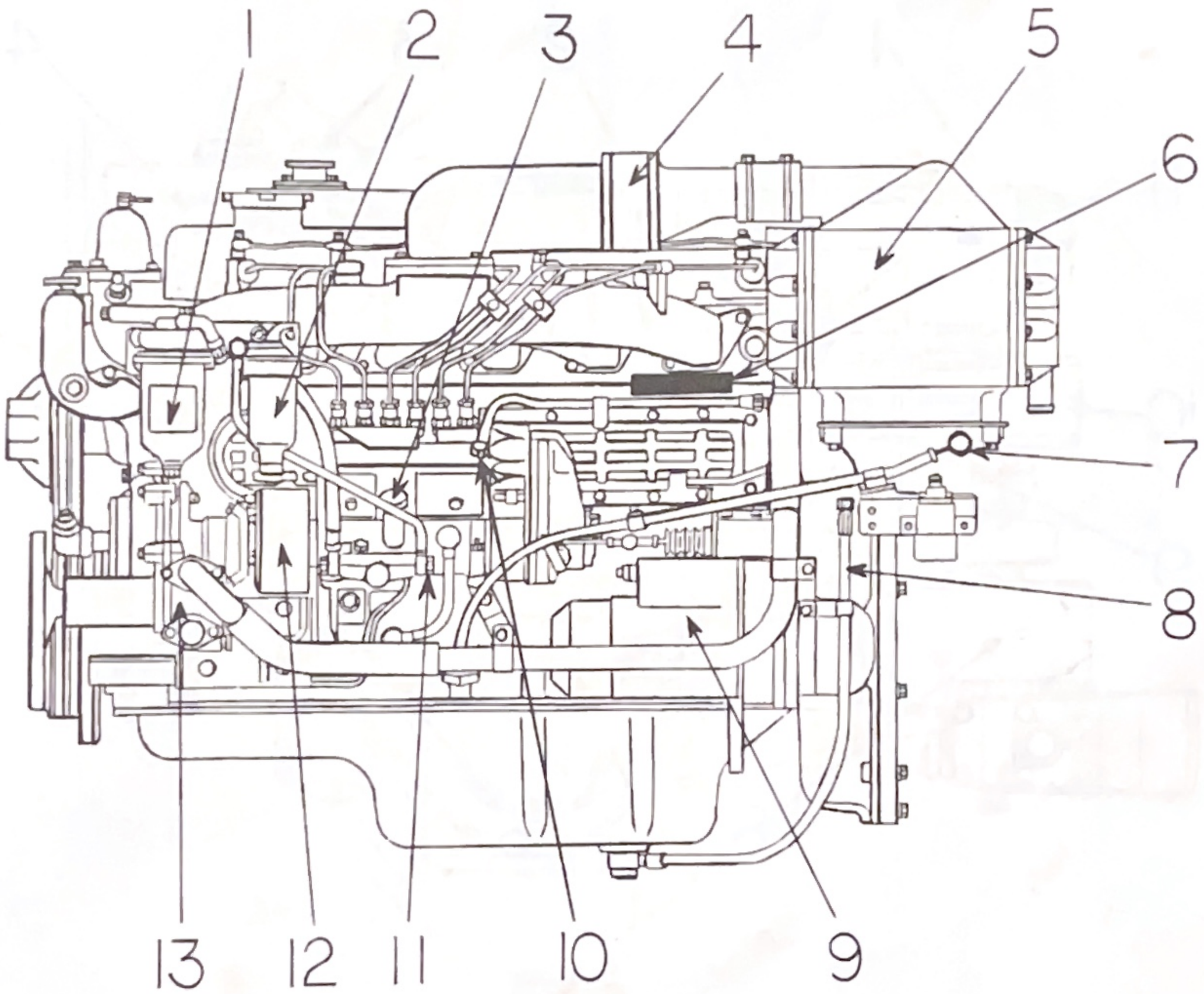
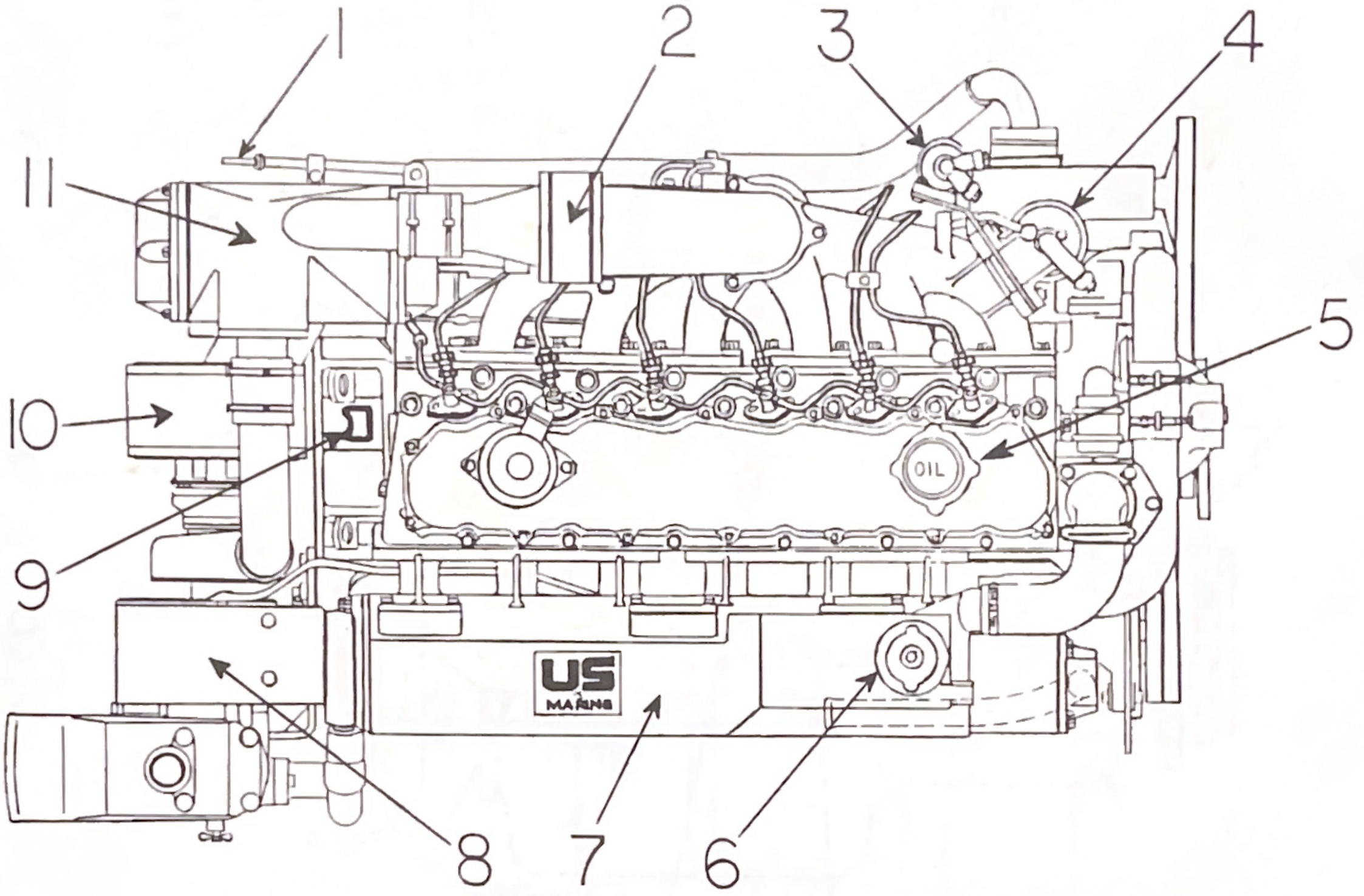


FIGURE 3 - ENGINE SIDE VIEW (PORT)



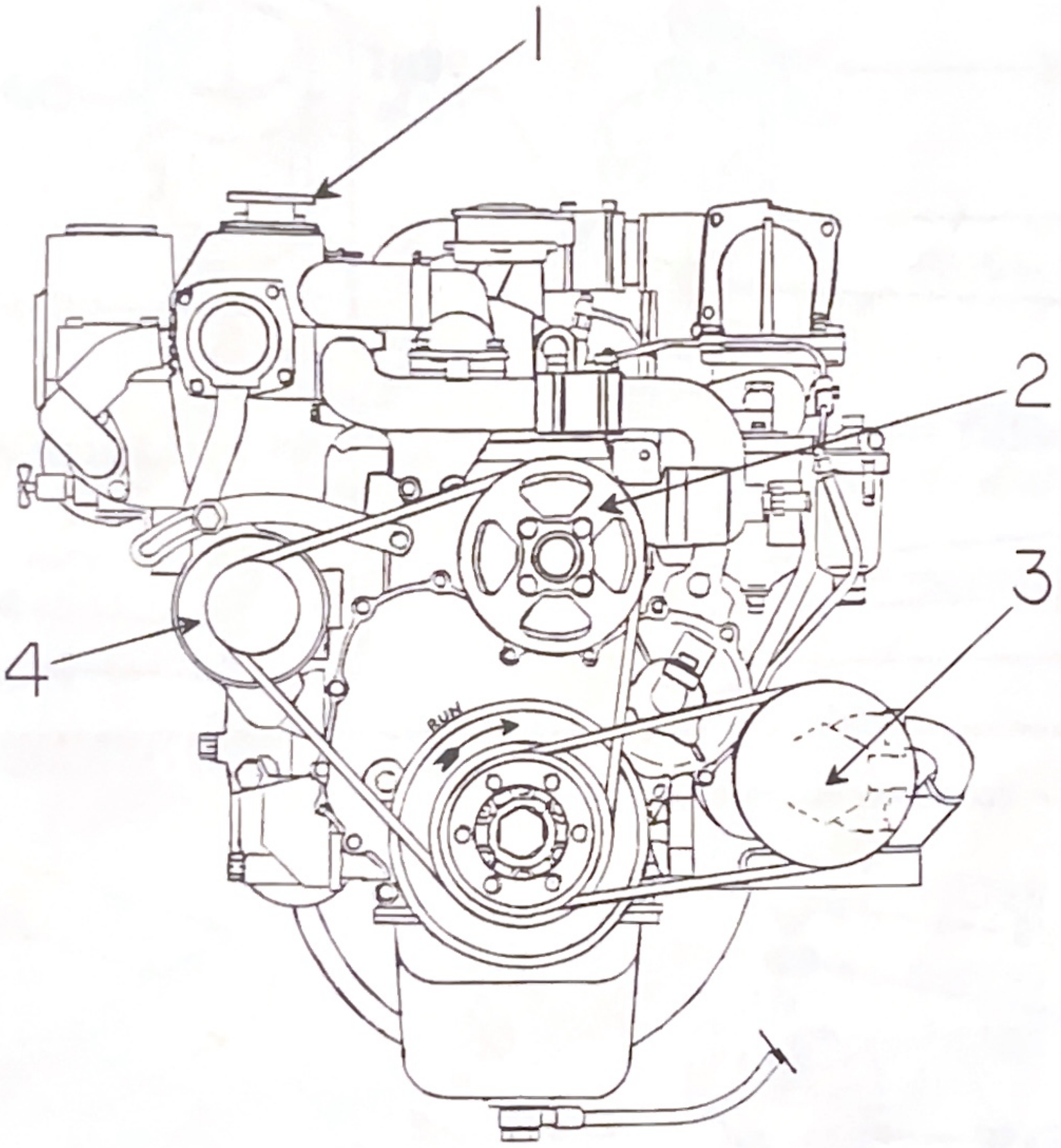
1 - Secondary Fuel Filter
2 - Secondary Water Separator
3 - Priming Pump
4 - Air Preheater
5 - Intercooler
6 - Serial Number
7 - Oil Dipstick
8 - Oil Drain Tube
9 - Starter Motor
10 - Return Line Check Valve
11 - Feed Pump Strainer
12 - Timer Housing
13 - Seawater Pump

FIGURE 4 - ENGINE TOP VIEW



1 - Oil Dipstick
2 - Air Preheater
3 - Secondary Water Separator
4 - Secondary Fuel Filter
5 - Oil Filler Cap
6 - Coolant Filler Cap
7 - Heat Exchanger
8 - Turbocharger (under shroud)
9 - Timing Port
10 - Air Filter
11 - Intercooler

FIGURE 5 - ENGINE FRONT VIEW



1 - Coolant Filler Cap
2 - Coolant Pump (behind pulley)
3 - Seawater Pump (behind pulley)
4 - Alternator

FIGURE 6 - SECONDARY FUEL FILTER

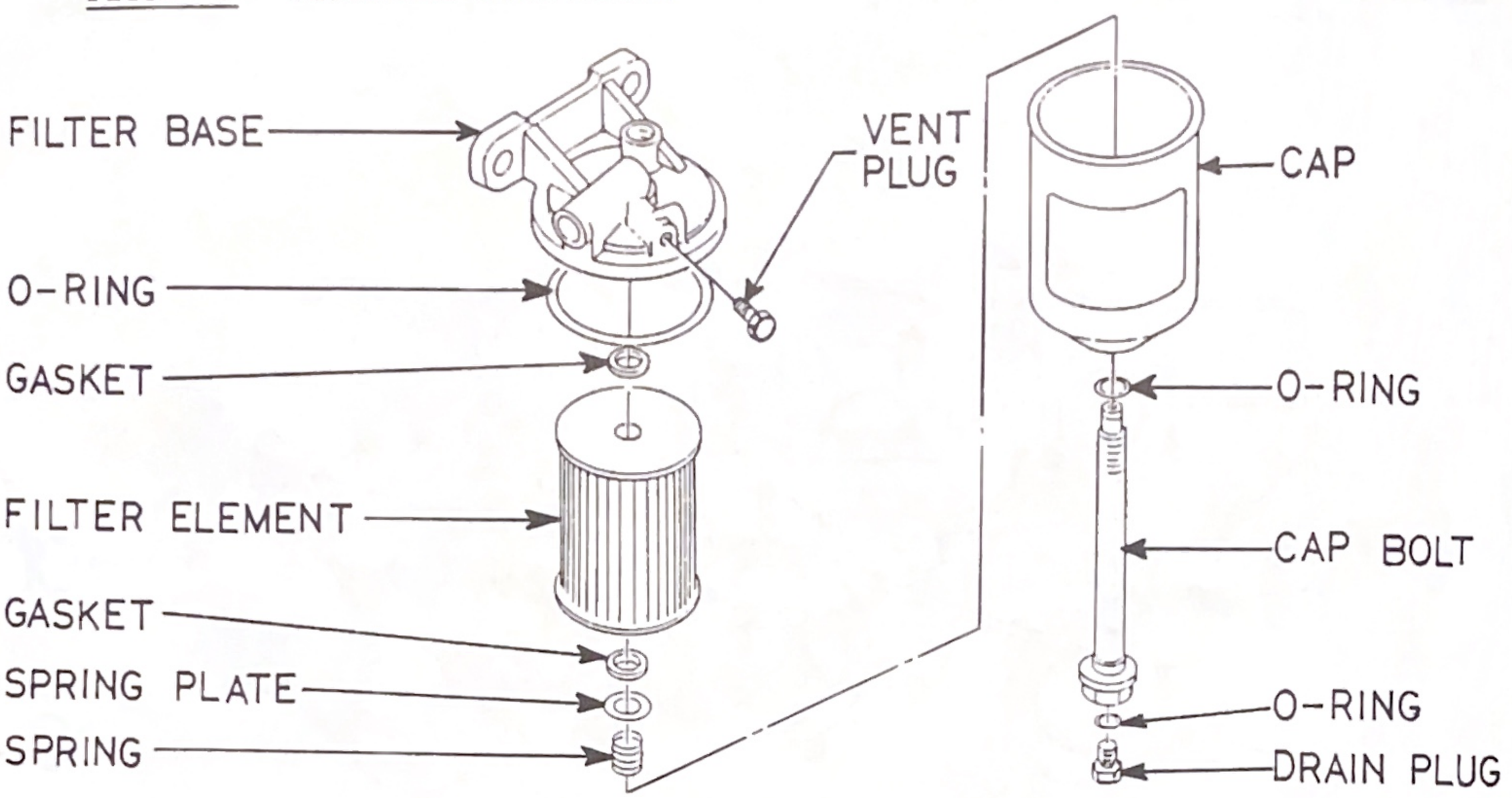


FIGURE 7 - SECONDARY WATER SEPARATOR

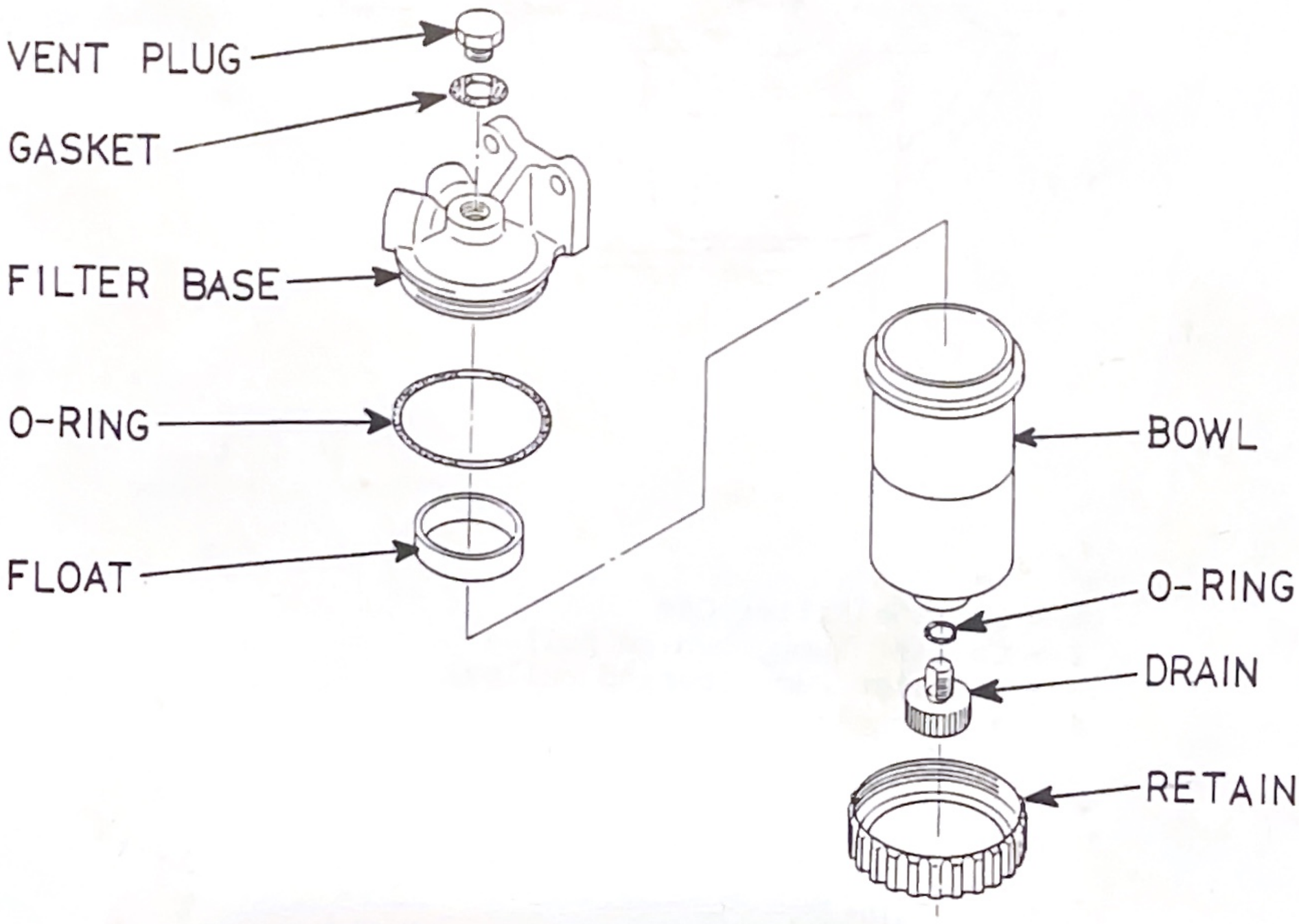


FIGURE 8 - OIL FILTERS

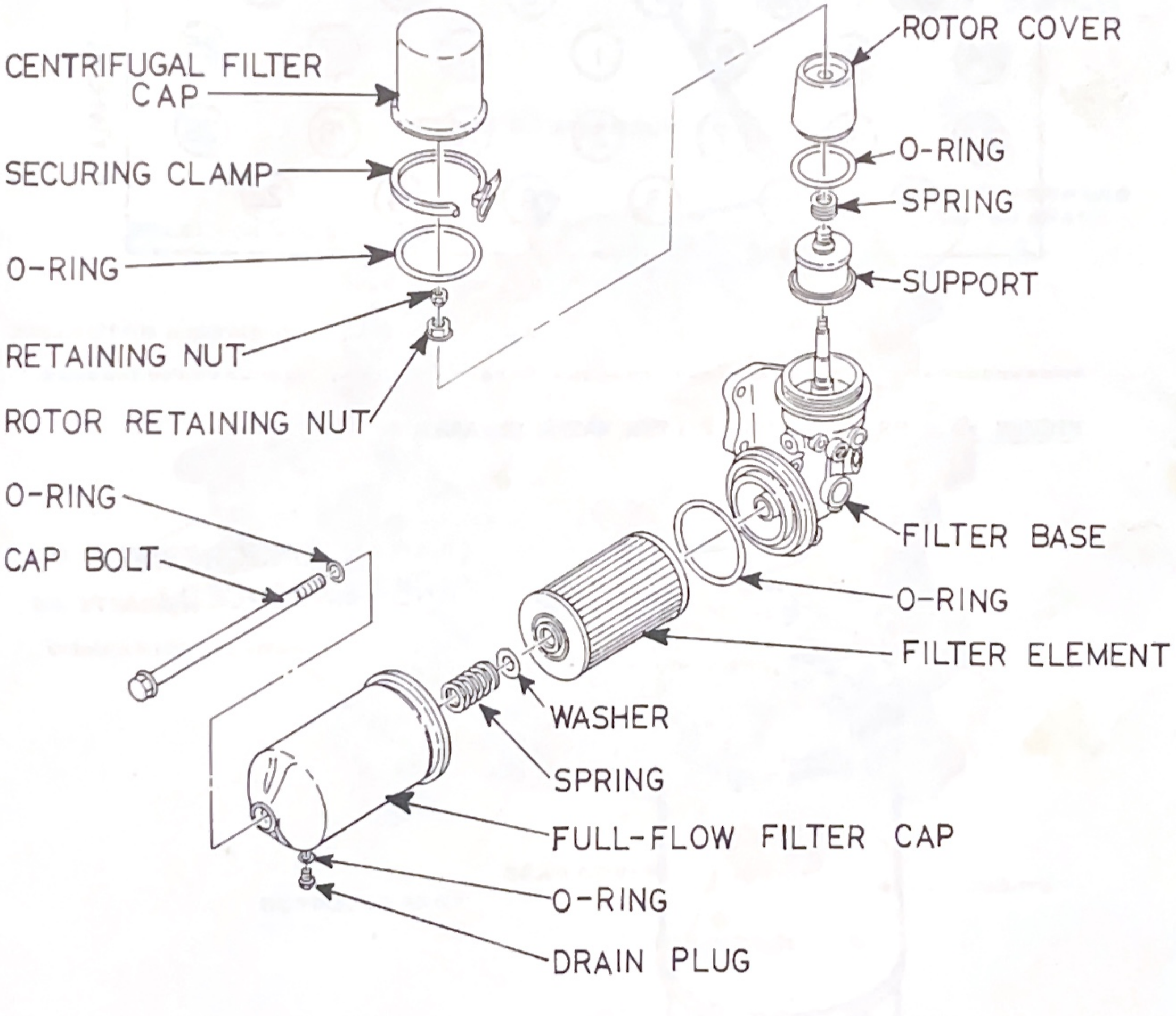


FIGURE 9 - CYLINDER HEAD BOLT TIGHTENING SEQUENCE

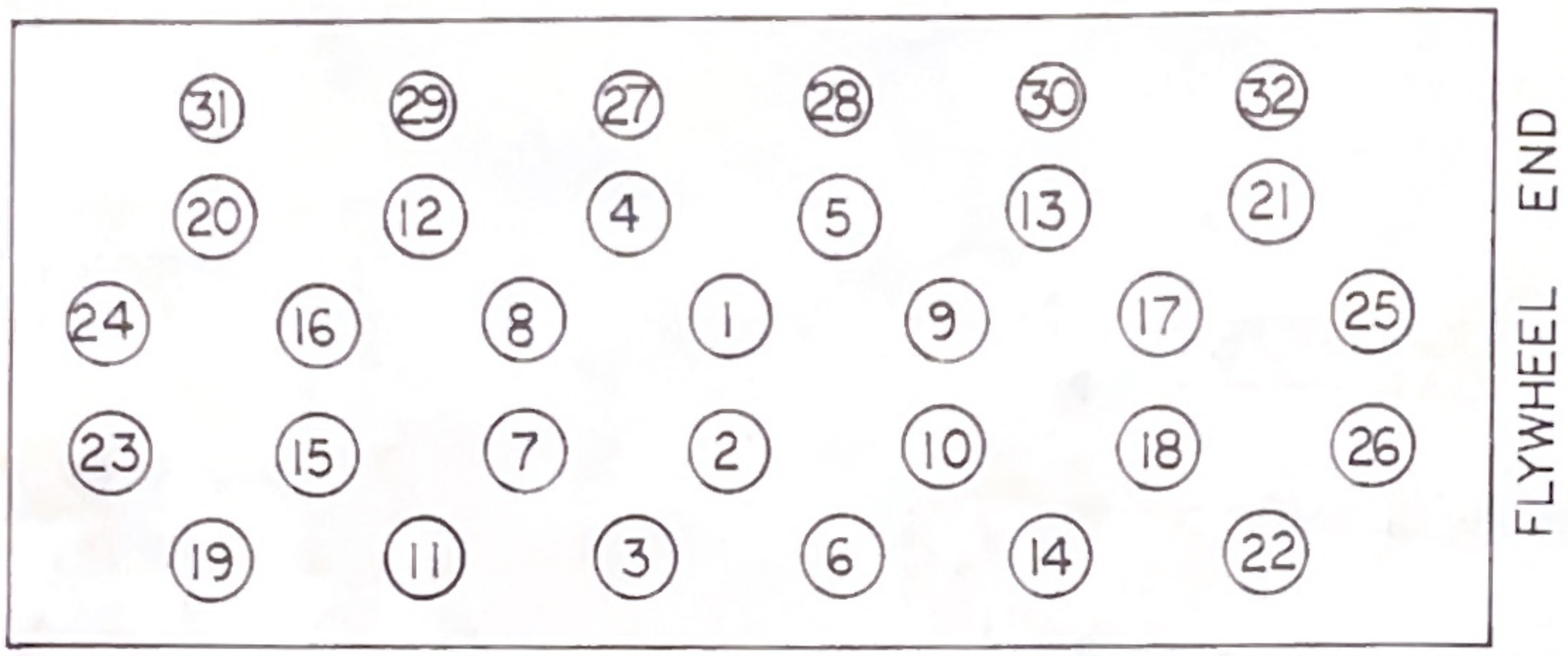


FIGURE 10 - PRIMARY FUEL FILTER/WATER SEPARATOR

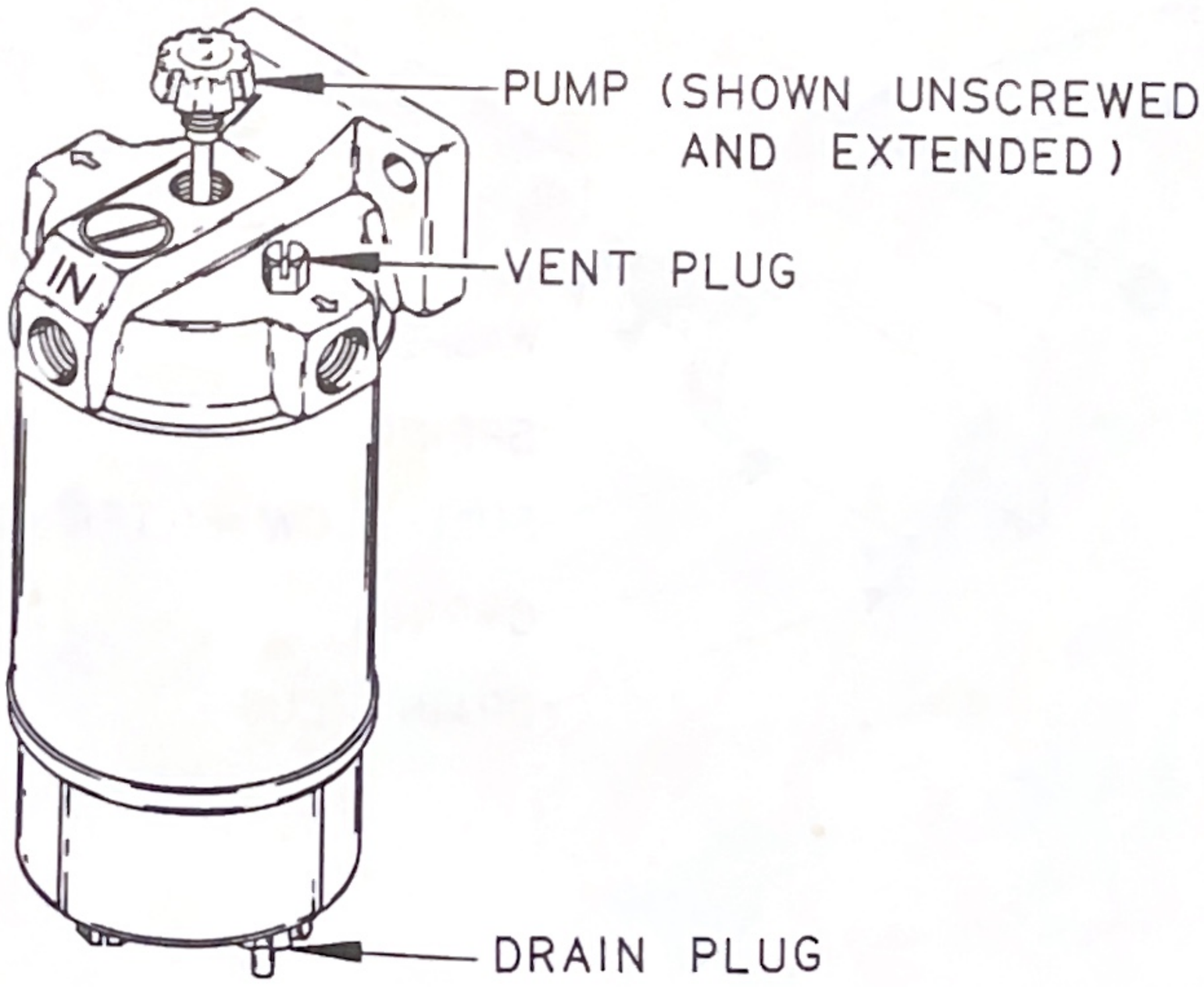


FIGURE 11 - TRANSMISSION (TWIN DISC MG-502)

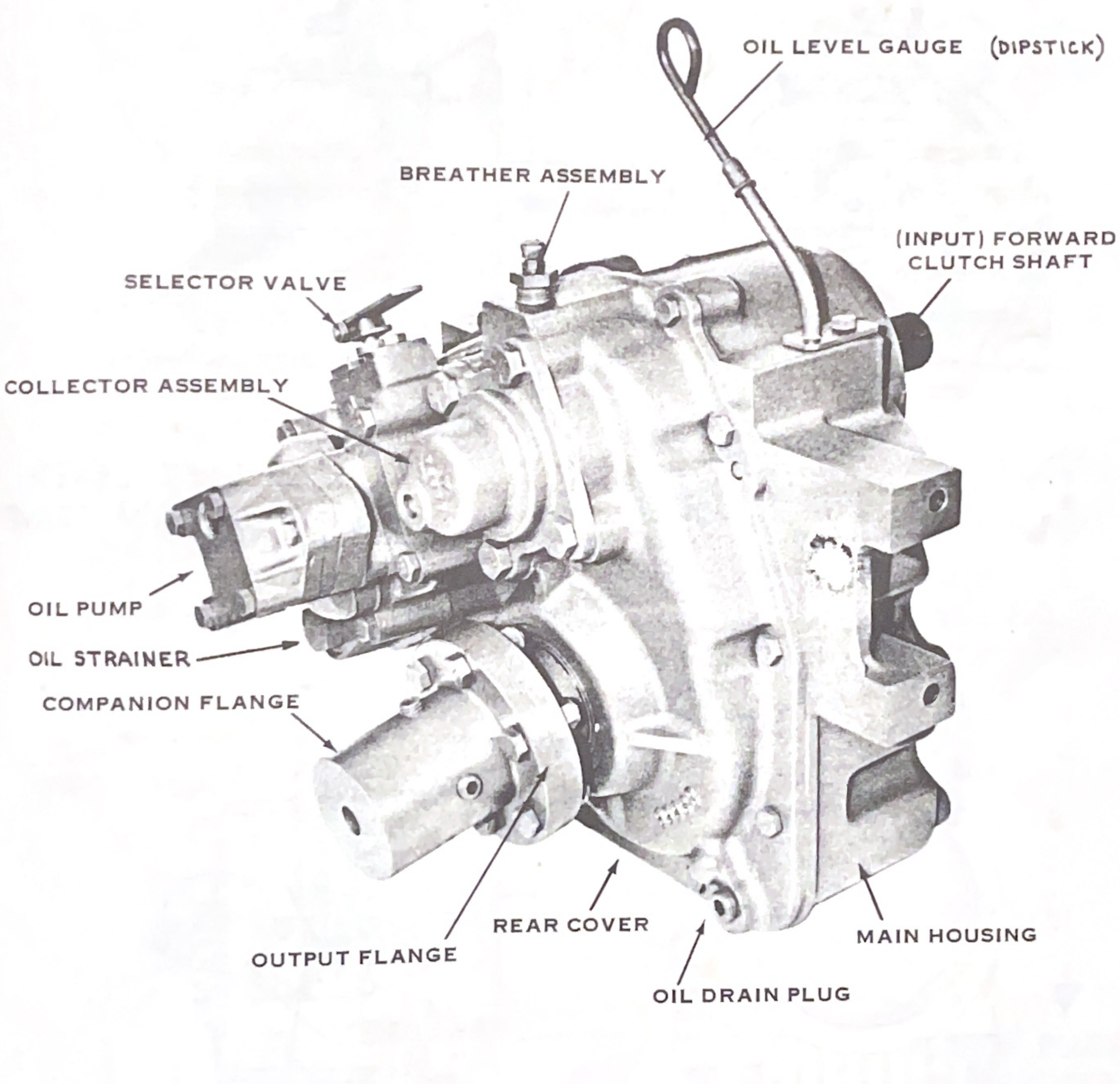
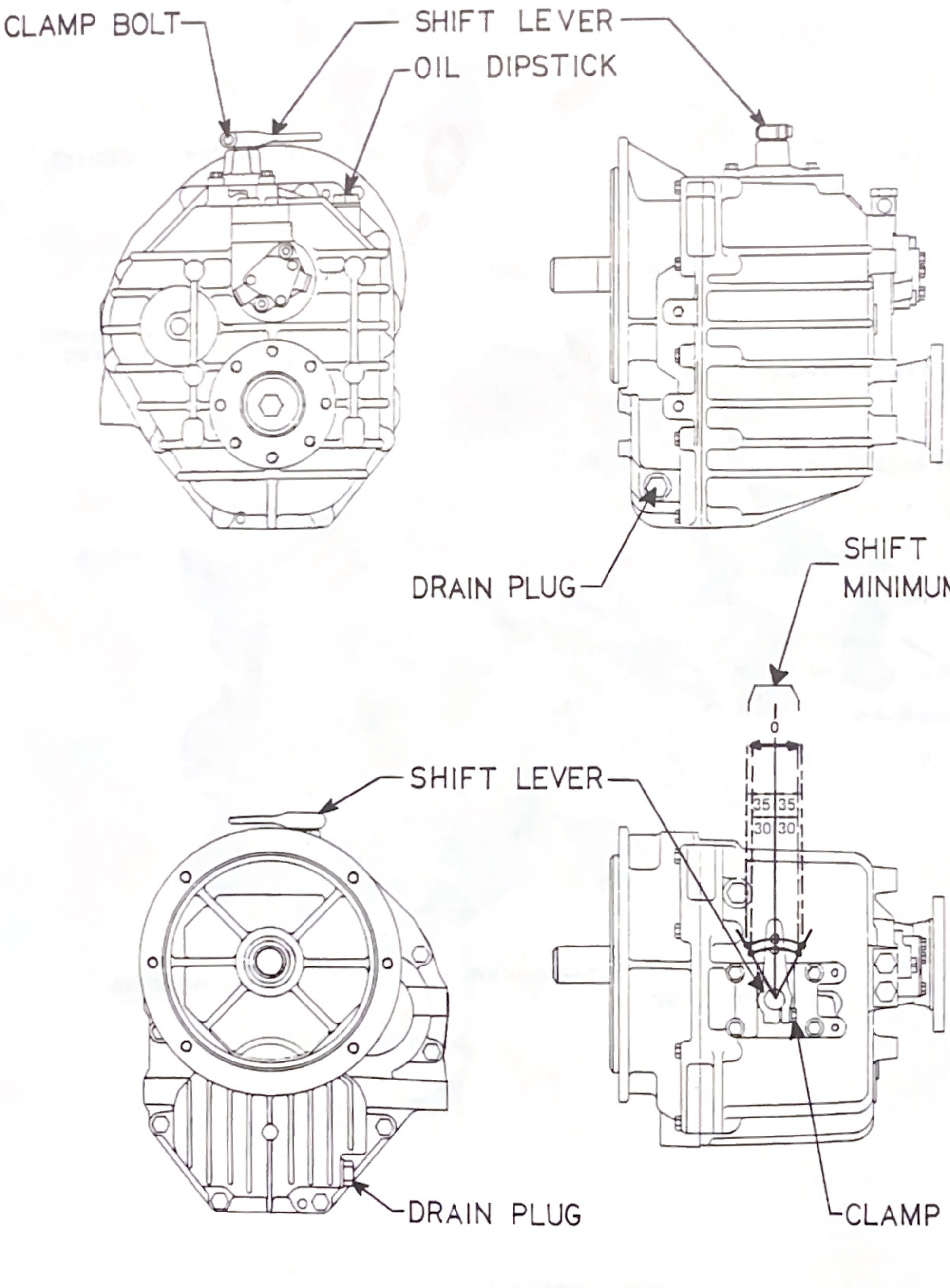


FIGURE 12 - TRANSMISSION (HURTH HBW-450)



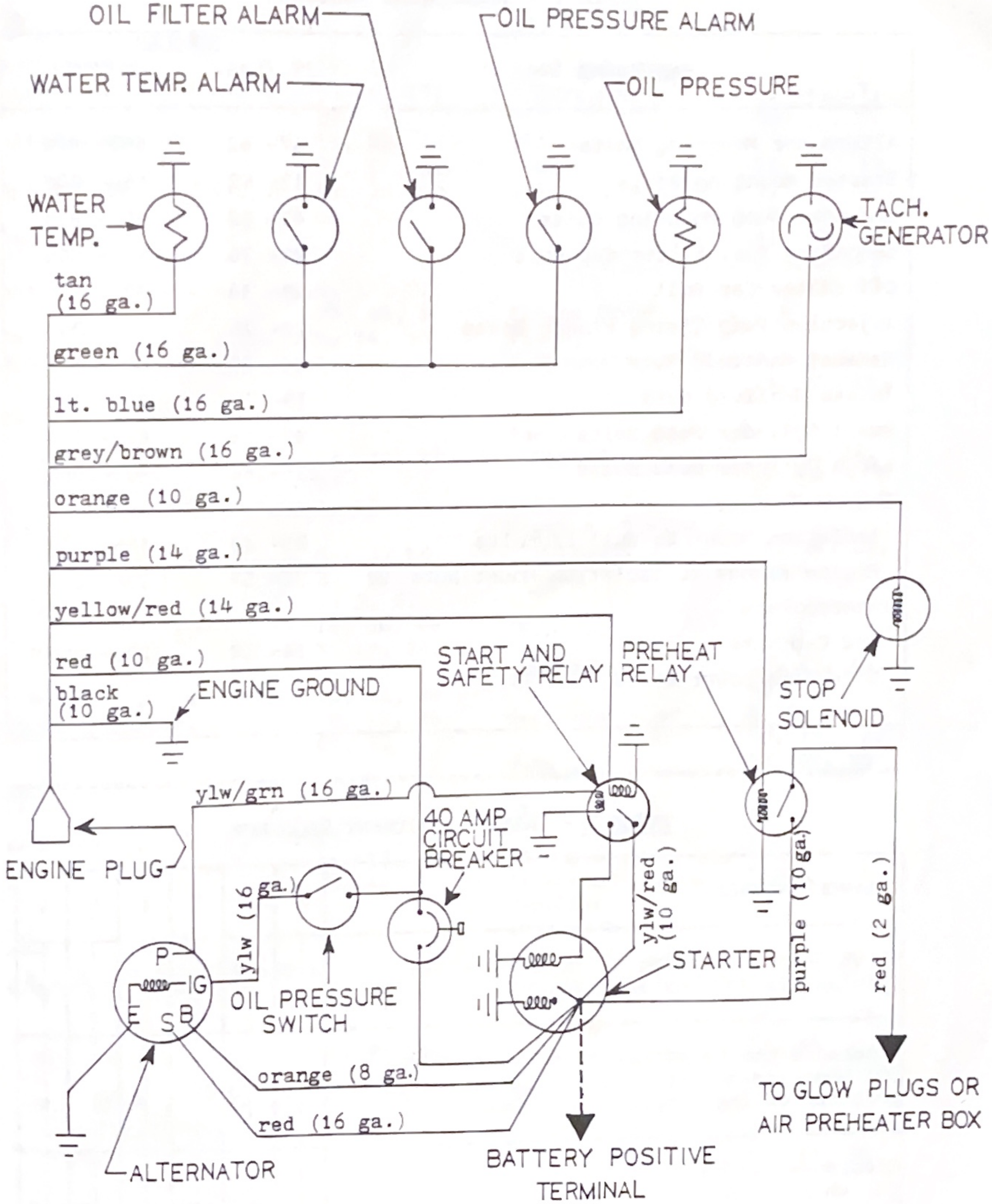

OIL FILTER ALARM
WATER TEMP. ALARM
OIL PRESSURE ALARM
OIL PRESSURE
WATER TEMP.
TACH. GENERATOR
tan (16 ga.)
green (16 ga.)
lt. blue (16 ga.)
grey/brown (16 ga.)
orange (10 ga.)
purple (14 ga.)
yellow/red (14 ga.)
red (10 ga.)
black (10 ga.)
ENGINE GROUND
START AND SAFETY RELAY
PREHEAT RELAY
STOP SOLENOID
ylw/grn (16 ga.)
40 AMP CIRCUIT BREAKER
ENGINE PLUG
ylw (16 ga.)
ylw/red (10 ga.)
purple (10 ga.)
red (2 ga.)
P
IG
E
S
B
OIL PRESSURE SWITCH
STARTER
orange (8 ga.)
red (16 ga.)
ALTERNATOR
BATTERY POSITIVE TERMINAL
TO GLOW PLUGS OR AIR PREHEATER BOX

TABLE 1 - TIGHTENING TORQUES

FASTENERS	TORQUES FT./LBS.	TORQUES CM./KG.
Alternator Mounting Bolts	47- 62	650- 870
Starter Mounting Bolts	47- 62	650- 870
Seawater Pump Mounting Bolts	47- 62	650- 870
Secondary Fuel Filter Cap Bolt	29- 36	400- 500
Oil Filter Cap Bolt	29- 36	400- 500
Injection Pump Timing Flange Bolts	22- 25	300- 350
Exhaust Manifold Nuts	22- 25	300- 350
Intake Manifold Nuts	19- 23	260- 320
Small Cylinder Head Bolts	47- 54	650- 750
Large Cylinder Head Bolts	131-144	1800-2000
Engine Mounts:		
Isolation Mount to Hull Lagbolts	33- 48	455- 667
Engine Flange to Isolation Mount Nuts	51- 57	700- 800
Intercooler:		
End Cap Nuts	14- 18	190- 260
Underside Cover Bolts	8	110

TABLE 2 - VALVE ADJUSTMENT SEQUENCE

CYLINDER NUMBER	1		2		3		4		5		6	
VALVE ORDER (starting at front of engine; I=intake valve/E=exhaust valve)	I	E	I	E	I	E	I	E	I	E	I	E
Clearance can be adjusted at these valves (O) when the number 1 piston is at the TDC position on the compression stroke.	O	O		O	O			O	O			
Clearance can be adjusted at these valves (X) when the number 6 piston is at the TDC position on the compression stroke.			X			X	X			X	X	X

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PRE-DELIVERY INSPECTION

[ ] Check the propeller shaft stuffing box gland nut(s). Check the tightness of all zincs and propeller shaft nuts.
[ ] Check the rudder stuffing gland.
[ ] Check all engine and transmission mounting bolts for tightness.
[ ] After the vessel has been in the water for 48 hours, check the alignment of the propeller shaft coupling; recheck the tightness of the flange nuts after any readjustment.
[ ] Check the oil level in the engine and marine transmission.
[ ] Check the oil level in the trim tab fluid reservoir and check that the tabs go through full travel.
[ ] Complete lubrication of all grease fittings on the water pumps, steering components and all other linkage as necessary.
[ ] Check the drive belt tension.
[ ] Check the fresh water coolant level; test and adjust the anti-freeze mixture as necessary to prevent freezing or overheating.
[ ] Check the battery electrolyte levels, tighten the battery cable clamps and coat the battery terminals with approved grease.
[ ] Check all electrical connections and tighten as necessary.
[ ] Check the operation of all seawater cocks and fuel system cocks, making sure they are open before starting the engine.
[ ] Check the tightness of all through hull fittings and hose fittings.
[ ] Check the steering fluid reservoir level and operation of the steering system.
[ ] Start the engine and check that:
    [ ] No leakage of fuel, oil, water or exhaust gases occurs.
    [ ] Engine oil pressure is normal.
    [ ] All cables and engine controls operate correctly.
    [ ] All instruments and warning devices operate normally and there are no indications of malfunctions.
    [ ] Engine idle rpm is within specifications (after the engine is warmed-up).
    [ ] Exhaust gas is colorless or light blue and there is water outflow with the exhaust, indicating cooling water circulation.
    [ ] Engine stop system is operating.
[ ] Review new engine break-in procedures and other important points of the engine owner's manual with the customer. Also, go over the instruments and the engine control functions.
[ ] Advise the owner to return for the initial (30 hour) servicing and to follow the recommended maintenance schedules.

FIRST SERVICE INSPECTION

[ ] Check the propeller shaft stuffing box gland nut(s) and the packing leak rate.
[ ] Check the rudder stuffing gland.
[ ] Check alignment of the propeller shaft coupling; recheck the tightness of the flange nuts after alignment.
[ ] Check all engine and transmission mounting bolts for tightness.
[ ] Retorque the cylinder head, intake manifold and exhaust manifold bolts.
[ ] Check the valve adjustment.
[ ] Change the oil in the engine and marine transmission.
[ ] Check the oil level in the trim tab fluid reservoir, and check that the tabs go through full travel.
[ ] Check the steering fluid reservoir level, and check for correct operation of the steering system.
[ ] Complete lubrication of all grease fittings on the water pumps, steering components and all other linkage as necessary.
[ ] Change the fresh water coolant.
[ ] Clean the seawater strainers.
[ ] Check the engine injection pump timing.
[ ] Clean the fuel pump infeed strainer.
[ ] Check and drain the fuel filters and water separators.
[ ] Bleed the fuel system.
[ ] Clean the air filter.
[ ] Check the battery electrolyte levels, tighten the battery cable clamps and coat the battery terminals with approved grease.
[ ] Check all electrical connections and tighten as necessary.
[ ] Check the drive belt tension.
[ ] Check the tightness of all through hull fittings and hose fittings.
[ ] Start the engine and check that:
    [ ] No leakage of fuel, oil, water or exhaust gases occurs.
    [ ] Engine oil pressure is normal.
    [ ] All cables and engine controls operate correctly.
    [ ] All instruments and warning devices operate normally and there are no indications of malfunctions.
    [ ] Engine idle rpm is within specifications (after the engine is warmed-up).
    [ ] Exhaust gas is colorless or light blue and there is water outflow with the exhaust, indicating cooling water circulation.
    [ ] Engine stop system is operating.
[ ] Advise the owner to follow the recommended maintenance schedules.

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