

R.197



**THORNYCROFT**

**OPERATOR'S  
INSTRUCTIONS**

**154**

**Marine Engines**



**THORNYCROFT**

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## INTRODUCTION

The instructions contained within the following pages are restricted to those necessary for the efficient operation and maintenance of the engine; operators are urged to read them carefully, to observe the lubrication recommendations and to note carefully the advice given in Section D about fuel cleanliness.

Certain overhaul operations are impracticable without the use of special tools, and those operators who are not equipped to undertake major repairs, are urged to consult their Thornycroft or British-Leyland Dealer or Distributor.

Besides being kept informed of the latest developments, Dealers and Distributors have skilled personnel and fully equipped workshops thus enabling them to maintain efficient after-sales service.

## RUNNING IN

All diesel engines manufactured by the Company are checked for performance on a test-bed but the duration of this test is insufficient to complete the "running-in" process. After installing the engine, the running-in process must be continued by commencing with a light load and gradually increasing to normal load during the initial 50 hours running. This will result in greater efficiency and dependability throughout the life of the engine.

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## **SECTION A - DATA & OPERATION**

### **A.1 GENERAL DESCRIPTION**

#### **(1) Engine**

The Thornycroft 154 marine diesel engine is based upon the British Leyland 2.52 litre, 4 cylinder diesel engine.

#### **(2) Lubrication System**

The lubrication system is a full pressure system with external full flow oil filter and oil cooler.

#### **(3) Cooling System**

The standard cooling system is a fresh water system, thermostatically controlled, pump assisted. It is cooled by sea water passing through a heat exchanger.

The External Keel Cooling is a fresh water system, thermostatically controlled and pump assisted. Pressure is maintained by a header tank. Cooling is achieved by passing the fresh water through a series of pipes mounted on the outside skin of the boat, below the water line where it is cooled by the continual immersion of these pipes in sea water.

A water jacketted exhaust manifold is fitted as standard.

#### **(4) Reverse/Reducing Gears**

Full details are given in the service manuals for the Borg Warner, TMP and P.R. Motors gearboxes.

## A.2. GENERAL DATA

### (1) Engine

Number of cylinders .. ..	4.
Cylinder bore .. .. .	3.5" (88.9mm)
Piston stroke .. .. .	4" (101.6mm)
Swept volume .. .. .	154 cu.in. (2.52 litres)
Compression ratio .. ..	19.5 : 1
Cylinder liner .. .. .	Dry, slip fit.
Crankshaft.. .. .	3 bearing TUFTRIDED on all journals and crankpins.
Injection order .. ..	1, 3, 4, 2.
Oil pressure: Idling.. ..	15 lb./sq.in. (1.05 kg/sq.cm.)
Normal running	50 lb./sq.in. (3.52 kg./sq.cm)
Oil pressure warning light goes out at .. .. .	5 to 9 lb./sq.in. (.35 to .63 kg./sq.cm)
Oil capacity (including filter) .. .. .	11 pints (6.25 litres)
Fresh water capacity ..	20 pints (11.3 litres)
Valve rocker clearance (cold)	
Inlet .. .. .	.012 in. (.30mm)
Exhaust.. .. .	.015 in. (.380 mm)



Valve timing (with .021 in.  
(.53 mm) rocker clearance) :

	<u>Opens</u>	<u>Closes</u>
Inlet valve	5° B.T.D.C.	40° A.B.D.C.
Exhaust valve	60° B.B.D.C.	5° A.T.D.C.
Weight of engine (with Direct Drive) .. .. .	812 lbs. (369 kg.)	
Overall length (with Direct Drive) .. .. .	45.7/8" (1,165 mm)	
Overall width .. .. .	25" (635 mm)	
Overall height .. .. .	31" (787 mm)	

### (2) Fuel System

Fuel injection pump .. .. .	C.A.V. Type D.P.A. 3248880A
Fuel lift pump .. .. .	A.C. mechanical type U
Fuel injectors .. .. .	C.A.V. Pintaux
Nozzle .. .. .	BDN.0.SPC.6209
Nozzle holder .. .. .	BKB.35.SD.5283
Main fuel filter .. .. .	C.A.V. type FS5836130
Injector nut tightness .. .. .	12 lb. ft. (1.7 kg.m.)

### (3) Electrical System

Starter.. .. .	Lucas M45G
Alternator .. .. .	Lucas, 11AC
Battery .. .. .	C.A.V. 6MT17
Heater plugs.. .. .	Champion AG32

### A.3. ENGINE RATING

The 154 engine may be set to develop continuous outputs from 28 to 50 b.h.p., according to requirements. These continuous powers may be used under any conditions of duty where long periods of full output are required. For special applications where full power will not be required for periods in excess of one hour in any 12 hours, the engine can be supplied with an intermittent rating of 60 b.h.p. at 3,500 r.p.m.

Note:- All ratings quoted are at the engine flywheel. Due allowance must be made for transmission losses, which will depend on the type of gearbox fitted.

For tropical use it is necessary to derate the engine by 2% for each 10 degrees F. (5.1/2 degrees C.) above 85 degrees F (30 degrees C) at sea level. In some parts of the world further derating for humidity is necessary and advice on this will be given on request.

The following table shows the continuous full power ratings and corresponding fuel consumptions:

B.H.P.	28	33	37	41	45	48	50
R.P.M.	1,500	1,750	2,000	2,250	2,500	2,750	3,000
<u>Approx. fuel consumption</u>							
Gallons/hour	1.62	1.81	1.98	2.18	2.41	2.60	2.77
Litres/hour	7.36	8.23	9.00	9.90	10.95	11.82	12.60

#### A.4 SEA INLET AND BILGE PUMP SUCTION STRAINERS.

Examine and clean the sea inlet and bilge pump suction strainers at regular intervals. No definite inspection periods can be set due to varying local conditions.

#### A.5 BEFORE STARTING THE ENGINE FOR THE FIRST TIME

Before starting up the engine for the first time, deal with the following points -

- (1) Clean off with paraffin the rust preventative applied to all bright parts. Particular attention should be paid to the reverse gear and tailshaft coupling faces which must be cleaned before the engine is lined up.
- (2) Remove the valve gear cover and give all rockers and valve stems an initial feed of oil.
- (3) Go over both engine and accessories with an oil gun. Put a little oil in moving parts such as joints of control gears, etc., and fill up all lubricators and greasers.
- (4) Put into the engine sump and reverse gear, the correct quantity of lubricating oil as indicated by the dipsticks and levelling plugs. Use only high grade lubricants.
- (5) By means of a barring lever give the engine at least two complete turns to ensure that everything is free and that all moving parts are clear of obstruction.
- (6) Drain and flush out the fresh water cooling system - See Cooling System Section, para.E.3 (1) Close the drain cock and refill through the filler cap on the top of the heat exchanger/header tank. Use clean fresh water only, preferably soft water. Where freezing is anticipated, anti-freeze should be added to the system - See Cooling System, Para E.2

- (7) Fill the fuel tank with the correct fuel and vent the pipe line, filters and fuel injection pump.
- (8) Examine the batteries. Make sure they are in good condition, topped up, fully charged and correctly wired up.
- (9) Check all terminals and make sure they are tight.

#### A.6. TO START AND STOP THE ENGINE

To start the engine, proceed as follows:-

- (1) Open wide the sea inlet cock.
- (2) Check that the engine control lever is in the idling position and that the gearbox is in neutral.
- (3) Operate the priming lever on the fuel feed pump to prime the system. This is particularly important if the engine has been idle for some time.
- (4) Set the throttle fully open.
- (5) Turn the starter switch key to the heat position for 30 seconds.
- (6) Turn the starter switch to the heat and start position to operate the starter motor.
- (7) When the engine starts, release the starter switch and return the throttle control to its normal idling position.
- (8) Check the engine lubricating oil pressure.
- (9) Check the sea water flow and the discharge over-board.
- (10) Remove the valve gear cover and check the lubrication of the rocker gear.

- (11) After about twenty minutes running, stop the engine. Top up the oil in the crankcase, reverse gear and reducing gear to the maximum on the dipsticks. (A certain amount of oil will be trapped on the oil cooler and filter.) Check the level of fresh water in the heat exchanger/header tank.

Whenever the engine is subsequently started from cold, instructions (1) to (9) above should be observed. With a warm engine, however, it will not be necessary to stop the starter switch in the "heat" position and the throttle does not have to be fully open.

To stop the engine, pull the stop lever on the side of the governor body.

#### A.7. LAYING UP THE ENGINE

- (1) Run the engine until hot, drain the oil from the engine sump, reverse gear and reducing gear (if fitted), and re-fill with clean new oil.
- (2) Turn off the main fuel cock on the fuel tank and disconnect the fuel suction pipe from the suction connection on the fuel feeder pump. Rig up a small temporary fuel tank connected to the suction side of the feeder pump and fill it with a high quality low viscosity corrosion inhibiting oil such as Shell Fusus A. (It is essential to pipe up the temporary line as described, so as to include the feeder pump and filter in the circuit)
- (3) Run the engine at about half speed for a further 15-20 minutes to circulate the new oil through the bearings, and the corrosion inhibitor through the injection equipment.
- (4) Drain the cooling system thoroughly, including the exhaust manifold jacket and any jacketed exhaust bends or silencer, and the engine and reverse gear oil cooler jackets. It is desirable to flush out with fresh water any jackets in the sea water circuit.

Turn off the sea cock, disconnect the water suction connection on the sea inlet and drain the suction pipe to the engine.

- (5) Remove the valve gear covers and well lubricate the valve gear and valve springs with clean oil.
- (6) Clean or renew the fuel filter and lubricating oil filter elements.

Check and clean the sea inlet strainer (if fitted).

- (7) Remove the electrical equipment components from the engine and store them ashore in a warm dry place. Wrap the components securely if they are liable to get dirty or dusty while ashore.
- (8) Remove the engine sea water pump and the bilge pump (if fitted). These pumps are of the rubber impeller type and these should be stored, preferably with the impellers removed and tied up to the exterior of the pump and kept in the dark. On no account must the impellers be oiled as this will cause swelling and consequent failure.
- (9) Blank off the engine air intake and also the exhaust outlet and any cooling water discharge pipes at the skin of the boat.
- (10) Well grease any parts of the engine liable to rust or corrode.

If the boat is to be hauled out of the water for storage

- (11) Disconnect the tailshaft coupling before hauling the boat out of the water.

If the sterngear is equipped with external sand excluders, care must be taken to prevent the shaft from sliding aft more than 1/2 in. (12 mm) when the couplings are disconnected.

- (12) Check the propeller and external sterngear for damage.
- (13) Open the sea cock (if fitted) to drain the sea inlet.

If the boat is to lie afloat.

- (14) Tighten the sterntube gland to prevent leakage.
- (15) Check that the sea cock (if fitted) is absolutely tight.

A.8. ROUTINE MAINTENANCE DURING LAY UP

- (1) Turn the engine at least 3 - 4 revolutions every four weeks to maintain satisfactory oil films on bearings, bores etc.
- (2) If the boat is lying afloat, check that bilge water does not rise enough to enter the engine or reverse gear through the dipstick holes or shaft seals.

A.9. RE-COMMISSIONING

- (1) Make good all cooling circuit connections and refill the cooling system.
- (2) Replace the electrical equipment and check that all connections are good.  
  
Adjust belt tension as necessary.
- (3) Replace the engine sea water pump and bilge pump (if fitted). Adjust belt tension as necessary.
- (4) Slack off the sterntube gland if it was tightened up when preparing the boat for laying-up.
- (5) Remove all plugs and covers from skin-side fittings and air intake.
- (6) Turn the engine by hand at least two complete turns to ensure that everything is free before attempting to start up.

## SECTION B - ROUTINE MAINTENANCE

Note:- For the routine maintenance instructions for the Reverse/Reduction Gear see separate publications.

The following is a summary of the routine maintenance, and the periods at which it should be carried out, to maintain the efficient and economic running of the engine under normal operating and climatic conditions. Under abnormal conditions it may be necessary to adjust the recommended servicing intervals.

### B.1. DAILY OR EVERY 10 HOURS

Check the engine oil level and top up as necessary (see Section C).

Check water level in heat exchanger tank and, if required, replenish with soft water.

### AFTER FIRST 25 HOURS

Change engine oil (See Section C).

Check and, if necessary, tighten the cylinder head nuts (See Page B.3.).

Check and adjust (if necessary) valve rocker clearances (See Page B.2.).

### EVERY 50 HOURS

Check electrolyte level in battery (See Section F).

### EVERY 200 HOURS

Change engine oil.

Check air cleaner element (See Section D).

Clean the fuel lift pump filter (See Section D).

Change engine oil filter element (See Section C).

Check state of charge of battery (See Section F).

### EVERY 800 HOURS

Check and adjust (if necessary) valve rocker clearances.

Renew fuel filter element (See Section D).

Renew oil filler cap (See Section C).

Test injectors for spray (See Section D).

Remove heater plugs and clean orifice (See Section F).



## B.2. VALVE ROCKERS (FIG 2)

The correct clearance between the valve rockers and the valve stem is given in "DATA & OPERATION". Unscrew the rocker cover retaining nuts (1) and lift off the cover. Check the clearances at the position illustrated and in the order as follows:-

Check No.	1.	valve	with	No.	8.	fully	open.
"	"	3	"	"	6	"	"
"	"	5	"	"	4	"	"
"	"	2	"	"	7	"	"
"	"	8	"	"	1	"	"
"	"	6	"	"	3	"	"
"	"	4	"	"	5	"	"
"	"	7	"	"	2	"	"

Adjust, if necessary, by slackening the locking nut (2) and turning the adjusting screw (3) until the clearance is correct. Hold the screw against rotation and tighten the locking nut. Refit the rocker cover, checking that its gasket (4) is serviceable.

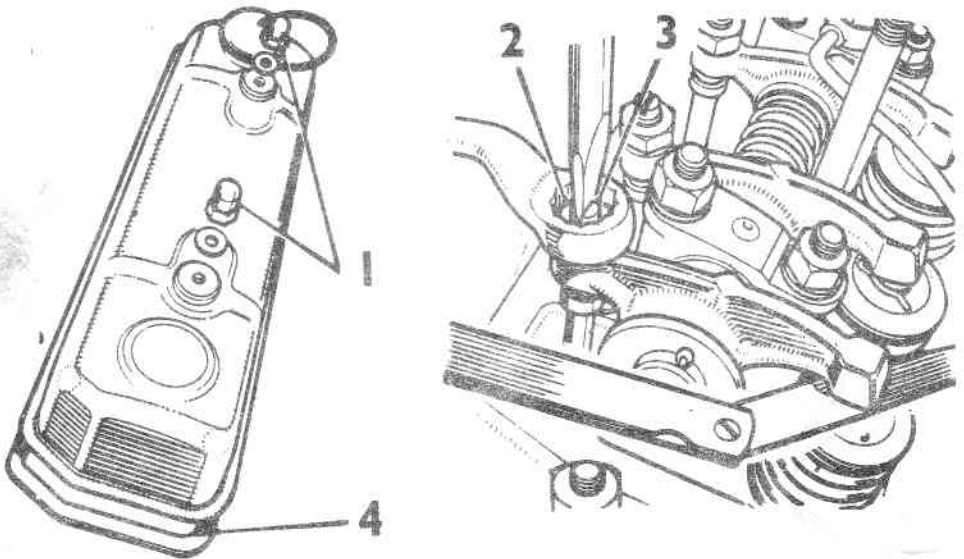


Fig. 2 Valve rockers

### B.3. CYLINDER HEAD NUTS (FIG 3)

Tighten the cylinder head nuts in the order shown in Fig 3. Torque wrench setting 75 lb.ft (10.37 kg.m).

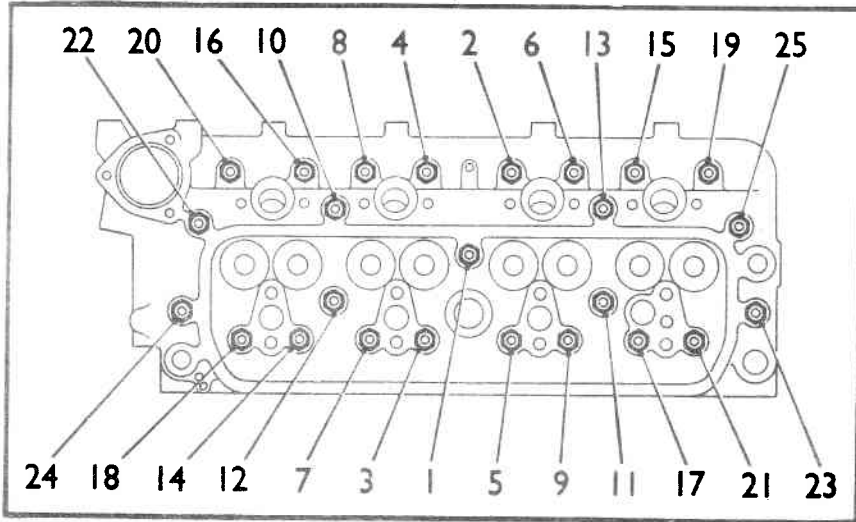


Fig. 3 Cylinder head nuts.

## SECTION C - ENGINE LUBRICATION

### C.1. GENERAL DESCRIPTION (FIG.4)

The Thornycroft 154 engine is fitted with an external full flow oil filter and oil cooler. Oil is drawn from the engine sump and delivered under pressure to the oil filter (1) and from there by means of a transfer fitting (2) to the oil cooler (3). After passing through the cooler, oil is returned to the engine.

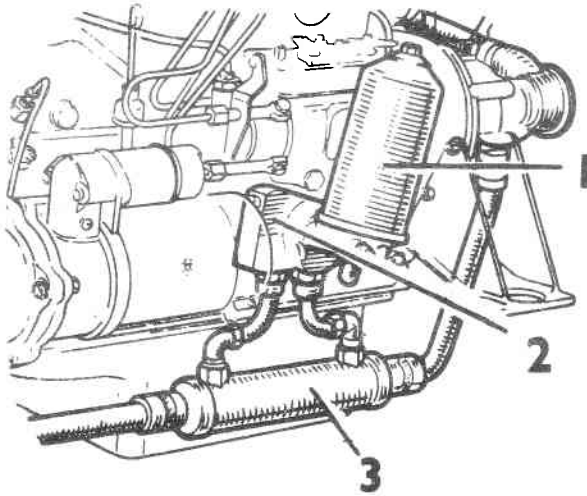


Fig. 4 Oil cooler & filter

C.2. GRADE OF LUBRICATING OIL.

RECOMMENDED ENGINE LUBRICANTS

Climatic Conditions				
	*	*	*	+
	Above 32°C. (90°F.)	-12°C. <sub>3</sub> (10°F. <sub>3</sub> ) to 32°C.(90°F.)	-18°C.(0°F.) to -12°C.(10°F)	Below -18°C. (0°F.)
FILTRATE	Filtrate Diesel 30	Filtrate Diesel 20	Filtrate Diesel 10	Filtrate 5W/20
STERNOL	Panther 30	Panther 20	Panther 10	Sternol W.W. Multigrade 5W/20
DUCKHAMS	Duckhams Fleetol HDX 30	Duckhams Fleetol HDX 20	Duckhams Fleetol HDX 10	Duckhams Q.5-30
CASTROL	Castrol CRI 30	Castrol CRI 20	Castrol CRI 10	Castrol CR 5W/20
ESSO	Essolube HDX 30	Essolube HDX 20	Essolube HDX 10W	Esso Extra Motor Oil 5W/20
MOBIL	Delvac 1130	Delvac 1120	Delvac 1110	Mobiloil 5W/20
BP	BP Vanellus S.A.E. 30	BP Vanellus S.A.E. 20.	BP Vanellus S.A.E.10W	BP Super Visco-Static 5W/20
SHELL	Shell Rotella S Oil 30	Shell Rotella S Oil 20W/20	Shell Rotella S Oil 10W	Shell Winter Special Motor Oil or Shell Super Motor Oil 5W/20

\* The appropriate multigrade oil, supplied by approved companies, is approved for the particular conditions prevailing.

+ Or the current practice of the country concerned.

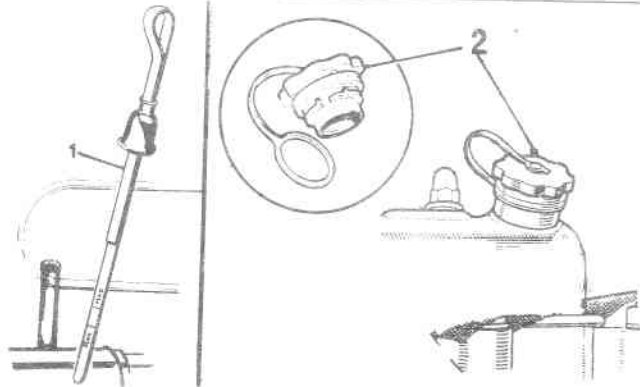


Fig. 5 Oil filler cap & dipstick

C.3. TO CHECK ENGINE OIL LEVEL (FIG.5)

Check the oil level by removing the dipstick (1)  
The level should show at the "MAX" position on the dipstick.

C.4. TO CHANGE ENGINE OIL (FIG.5)

Using the hand pump, drain all oil from the engine sump. The sump is best drained when the engine is warm.

Turn the oil filler/filter cap (2) to remove. Fill the sump with new oil until the dipstick registers the correct level.

The oil filler cap incorporates an air filter which cannot be cleaned. Fit a new cap at the recommended intervals.

C.5. TO CHANGE THE ENGINE OIL FILTER ELEMENT (FIG.6)

This operation is carried out at the same time as an engine oil change.

When the sump is empty, proceed as follows:-

- (1) Clean the exterior of the filter assembly, remove the central bolt (1) and detach the filter bowl (2).
- (2) Discard the element (3) and thoroughly clean the bowl and the exposed face of the filter casting (4).

(3) Renew the bowl sealing gasket (5).

(4) Fit a new element and re-assemble the bowl to the filter head.

### C.6. THE ENGINE OIL COOLER (FIG. 4)

The oil cooling is achieved by passing water through a series of small tubes and guiding the oil over the tubes.

The oil cooler is integrally constructed and cannot be dismantled.

(1) To remove the oil cooler

Note - It is advisable to perform this operation when the engine has been drained of oil.

- (a) Drain the sea water system (See Para E/(3)).
- (b) Disconnect the water pipes (1 and 2).
- (c) Disconnect the oil pipes (3 and 4).
- (d) Unscrew the hose clip (5) and remove the oil cooler from the engine

(2) To refit the oil cooler

The procedure is exactly opposite to removing the oil cooler.

Check all connections for oil leaks when the engine has been refilled with oil.

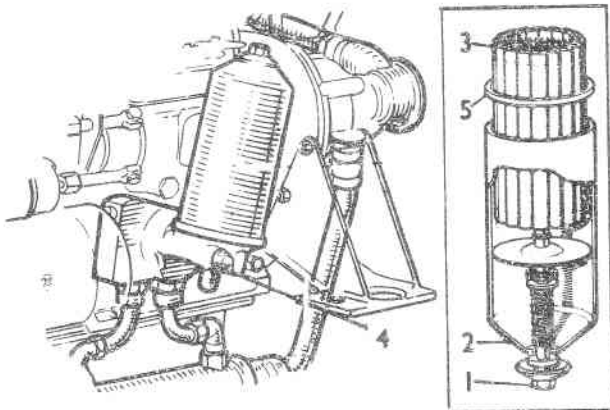


Fig. 6

Oil filter element

## SECTION D - FUEL SYSTEM

### D.1. CLEANLINESS

The fuel injection equipment is made to very accurate limits and even the smallest particle of dirt entering the system will destroy its efficiency by causing scoring or premature wear on the highly finished parts.

Considerable care has, therefore, been taken in the design and layout of the fuel system to ensure that fuel oil of normal cleanliness is adequately filtered before it reaches the pump and injectors. The use of dirty fuel will quickly foul the filters and have an adverse effect upon the equipment.

A clean fuel system is absolutely essential and this can only be accomplished by always ensuring that scrupulous cleanliness is observed when handling the fuel system components and also in handling the fuel.

At all times, take care that water or moisture is not allowed to contaminate the fuel oil. Wherever the fuel system is disconnected at any point, fit suitable blanking plugs to the pipes and unions.

If the fuel pipes are disconnected or in the event of the engine running out of fuel, bleed the system (See paragraph D.6.)

NEVER CLEAN THE INSIDES OF CONTAINERS, OR ANY COMPONENT OF THE FUEL SYSTEM, WITH A FLUFFY CLOTH.

### D.2. FUEL HANDLING AND STORAGE

#### (1) Storage of fuel oil

NEVER USE A GALVANISED TANK.

There are two methods of storing fuel, barrel storage and bulk storage, depending upon the quantity in use.

(a) Barrel Storage

If the fuel is kept in drums or barrels, keep them under cover on a concrete floor in clean dry surroundings.

When a new barrel of fuel is to be used, it should be mounted on trestles and allowed to stand for at least 24 hours to allow any sediment that may be present, to settle.

The barrel should slope downwards  $1/2$ " per foot (13 mm per 30 cm) away from the supply tap.

Never tilt the barrel and use the fuel which is below the level of the tap as this may include sediment

(b) Bulk Storage

The size of the storage tank should be such that intervals between draining and replenishing are not too long.

The storage tank should be under cover and have a suitable manhole cover to provide access for cleaning. The final outlet cock should be located so as to allow 3" (7.6 cm) settling depth for water and sludge: it should feed through a detachable filter with 120 mesh screen. There should be a fall of about  $1/2$ " per foot (13 mm per 30 cm) towards the sludge drain plug and away from the outlet cock.

The tank vent pipe should have an inverted intake fitted with a coarse mesh filter.

Always drain water and sludge just before delivery of a fresh supply of fuel.



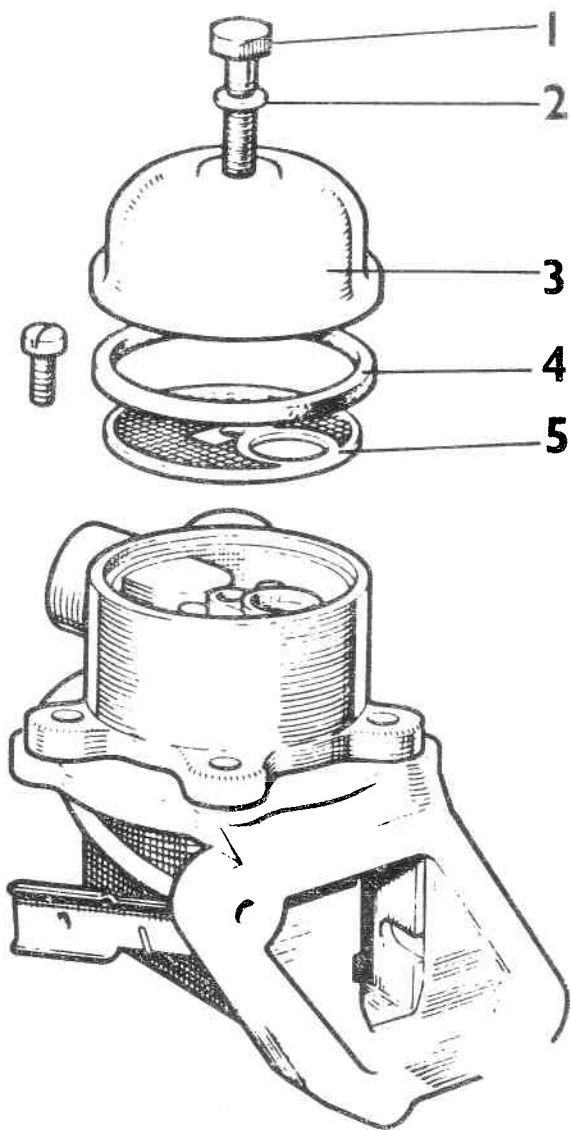


Fig 7 Fuel lift pump

(c) Refuelling the boat fuel tank

Ensure that only clean fuel oil is poured into the fuel tank, preferably through a clean funnel fitted with a filter.

It is advisable to fill the fuel tank after use to minimise overnight condensation.

Always wipe the fuel tank around the filler cap before and after filling and immediately replace the cap.

D.3. FUEL LIFT PUMP (FIG 7)

To clean the fuel lift pump, proceed as follows:-

- (1) Remove the screw (1) and washer (2) from the top of the fuel lift pump and lift off dome (3) and sealing washer (4)
- (2) Lift out the gauze filter (5) and clean it.
- (3) Clean the pump chamber and dome cover with a non-fluffy cloth.
- (4) Using a new sealing washer, re-assemble the pump by tightening the dome cover retaining screw just sufficiently to ensure a leak-proof joint.

D.4. FUEL INJECTORS

Injector cleaning and spray testing can only be carried out with specialised equipment and this work should be done by your Distributor or Dealer.

## 1.5. MAIN FUEL FILTER (FIG. 8)

To remove the filter element proceed as follows:--

- (1) Remove the banjo and bolt (2)
- (2) Unscrew the centre bolt (3) and support the filter base (4)
- (3) Detach the base and twist the element (1) to remove it from the filter head.(5)
- (4) Remove the three sealing washers (6) from the head and base.

Clean the filter base and re-assemble the filter unit using a new filter element and sealing washers. Refit the banjo and bolt.

The fuel system must be bled of air after dismantling and re-assembling the filter unit.

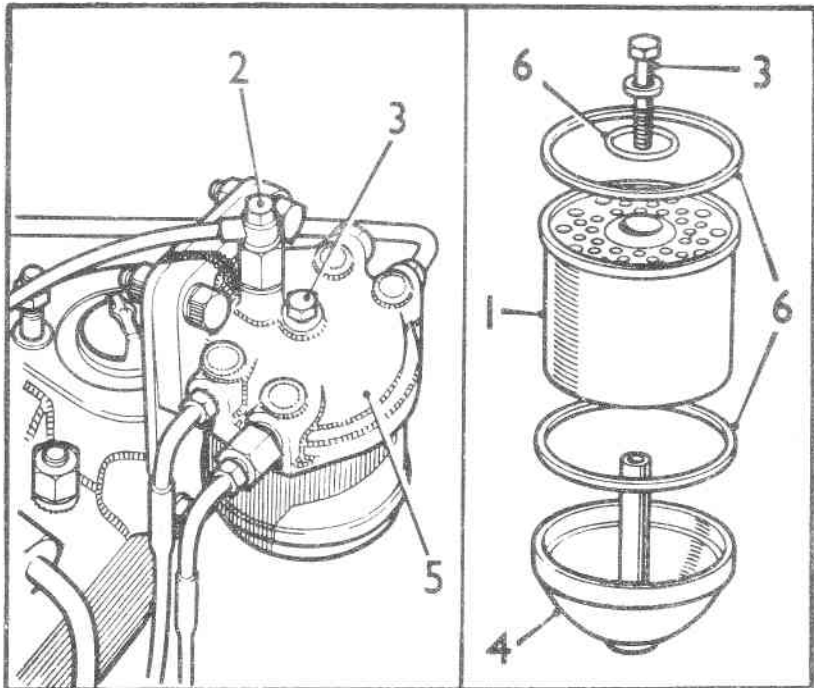


Fig 8 Fuel filter

#### D.6. BLEEDING THE SYSTEM

- (1) Ensure that there is an adequate supply of fuel in the tank.
- (2) Slacken the union at the filter end of the injection pump feed pipe. Operate the lift pump and, when the fuel coming from the union is free of air bubbles, tighten the union.
- (3) Slacken the plug in the unused connection on the filter head. Operate the lift pump and, when the fuel coming from the connection is free of air bubbles tighten the plug.
- (4) Slacken the two bleed screws on the injection pump. Operate the lift pump and, when the fuel coming from both screws is free of air bubbles, tighten the screws.
- (5) Slacken the unions at the injector end of any two high-pressure pipes, Ensure that the stop control is in the run position and the throttle in the fully open position. Crank the engine until the fuel coming from both pipes is free of air bubbles, then tighten both pipe unions.
- (6) Start the engine and allow it to run until it is firing on all cylinders.

#### D.7. AIR CLEANER (FIG.9.)

- (1) The air cleaner is integrally constructed and cannot be dismantled. To clean the element, remove from breather pipe by loosening the pipe clip beneath the filter and pulling the filter in an upward direction.
- (2) After removal the complete filter should be immersed in an oil solvent (not celuose thinners) and agitated until the mesh filter is free from foreign matter.

- (3) Shake off all remaining cleaning solvent or preferably blow dry with an air line. Before replacing, introduce a small quantity of medium grade oil into the mesh filter through each of the holes on the underside. Replace the air cleaner on to the breather pipe and tighten the clip.

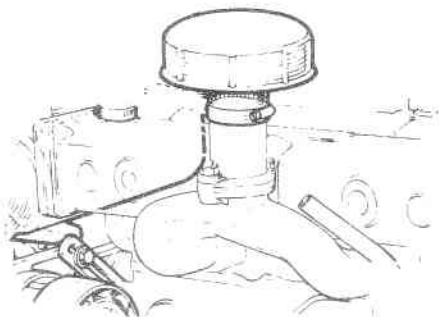


Fig 9 Air cleaner

## SECTION E - COOLING SYSTEM

UNDER NO CIRCUMSTANCES MUST THE ENGINE BE STARTED WITHOUT WATER IN THE COOLING SYSTEM.

### E.1. GENERAL DESCRIPTION (FIG 10)

Two alternative cooling systems can be fitted. Either (1) internal heat exchanger cooled fresh water system with sea water pump and fresh water circulator, or (2) fresh water external keel cooling system with fresh water pump.

#### (1) Internal Cooling System

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The engine is cooled by the circulation of fresh water. The heated water flows assisted by a pump (1) to the heat exchanger (2) where it is cooled by sea water. A thermostat promotes rapid "warming up" and assists in maintaining a constant engine operating temperature.

The fresh water system is filled through the filler cap (3) of the heat exchanger/header tank. Fill to the bottom of the filler orifice and use clean rain water, distilled water or tap water. NO NOT USE SEA WATER.

The water level should be inspected daily and "topped up" as necessary.

It is dangerous to remove the filler cap until the water has been allowed to cool down.

A sea water pump (4) draws sea water through the gearbox oil cooler (5) (when fitted) and delivers it to the engine oil cooler (6). It then passes through the heat exchanger (2) to the water jacketted exhaust manifold (7) and from there it is either injected into the exhaust line or is discharged overboard.

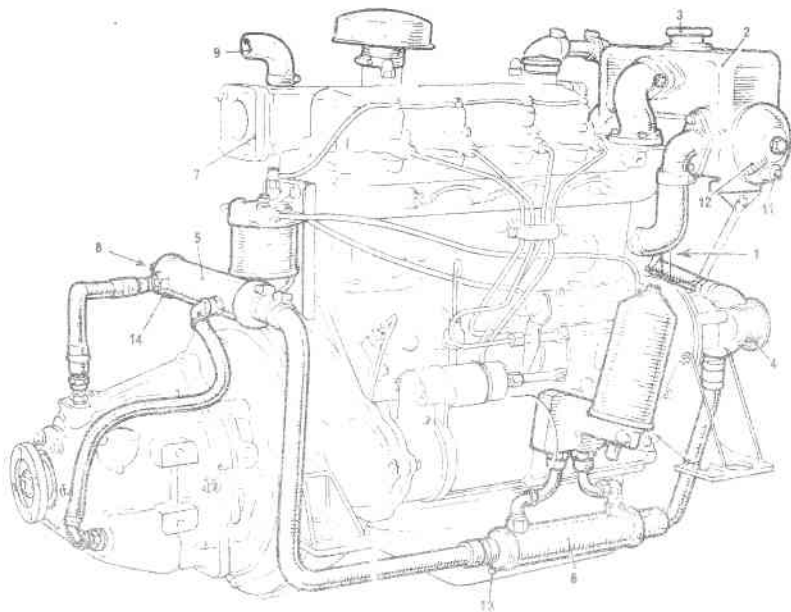
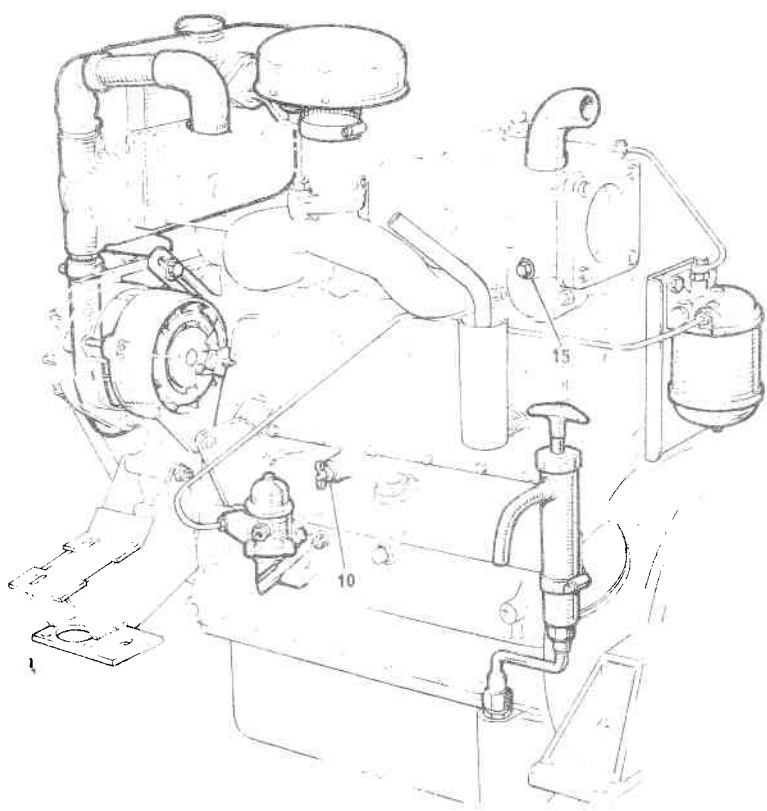


Fig. 10 Water cooling system

## 2) External Cooling System (or keel cooling)

The system is basically the same as the internal cooling system. It differs, in that the heat exchanger is replaced by a header tank and extra pipes are fitted alongside the keel. These pipes are connected to the inlet (8) and exhaust (9). These extra pipes are constantly immersed in water.

## E.2. FROST PRECAUTIONS

In cold weather it is advisable to use an anti-freezing mixture in the cooling system.

The following are the recommended percentages

- (a) Temperatures down to 7°F (-14°C), 15% solution
- (b) Temperatures down to 0°F (-18°C), 20% solution

Use only a good quality anti-freeze solution and carefully follow the maker's recommendations.

Do not use anti-freeze compounds containing oil based rust inhibitors, as this will cause early failure of the water pump impellers.

The engine fresh water capacity, including the heat exchanger, is 20 pints approximately.

As anti-freezing mixture is only added to the fresh water system, it is essential that the sea water system be drained when the engine is not in use (see Para. E3 (3)).

## E.3. DRAINING AND CLEANING THE WATER SYSTEM

### (1) Draining the fresh water system

The fresh water system is pressurised and before the system can be drained it is necessary to remove the filler cap on the heat exchanger.



It is dangerous to remove the filler cap (3) until the water has been allowed to cool down. If the cap is removed when the water is hot, it is necessary to turn the cap slowly and release pressure before removing the cap.

When the filler cap has been removed, the system can be drained by opening the drain cock (10).

(2) Cleaning the fresh water system

Occasionally the entire system should be flushed out thoroughly. All that is necessary is to drain the cooling system and keep pouring clean fresh water into the filler (3) until the water running out of the drain cock (10) is clear.

(3) Draining the sea water system

The sea water system is drained at the following points -

- (a) Drain plug (11) in the heat exchanger.
- (b) Sea water pump (4). Loosen the end cover (12). After draining ensure that the joint is water-tight.
- (c) Drain plug (13) in the engine oil cooler.
- (d) Drain plug (14) in the gearbox oil cooler.
- (e) Drain plug (15) in the exhaust manifold.

E.4. ROUTINE MAINTENANCE OF THE SEA WATER SYSTEM

- (1) Regularly examine and clean the sea inlet strainer. If the strainer has to be removed, DO NOT do this whilst the engine is running, as foreign matter can be drawn into the system.
- (2) Ensure that the sea cock is fully open when the engine is running; to run the engine with the cock partly closed may result in the sea water pump sucking air with consequent failure of water flow and over-heating.

- (3) Immediately the engine has been started, check the sea water discharge from the exhaust outlet pipe to ensure that the pump has picked up properly. If the engine is run with no sea water flow, it can suffer severe damage.

#### E.5. THE SEA WATER PUMP

The sea water pump is a Jabsco Self Priming with a Neoprene impeller.

The pump depends on the liquid pumped for lubrication. DO NOT RUN DRY for more than 30 seconds. Lack of liquid will burn the impeller.

When replacing the gasket, it is essential to use the correct part. A thicker gasket will reduce priming ability and a thinner gasket will cause the impeller to bind and subsequently fail.

#### E.6. THE HEAT EXCHANGER (FIG. 11.)

- (1) The purpose of the heat exchanger is to provide -

(a) Header tank to allow for expansion and evaporation of the fresh water.

(b) A method of cooling the fresh water by means of sea water. This is accomplished by passing sea water through a series of small bore tubes (1) and guiding the fresh water over the outside of these tubes.

- (2) The heat exchanger comprises the following -

(a) Casing (2) providing the header tank and machined compartment into which the tube stack is located.

(b) A tube stack (3)

(c) End covers (4 and 5)

(d) A tie rod (6) which passes through cover (4) and screws into cover (5)

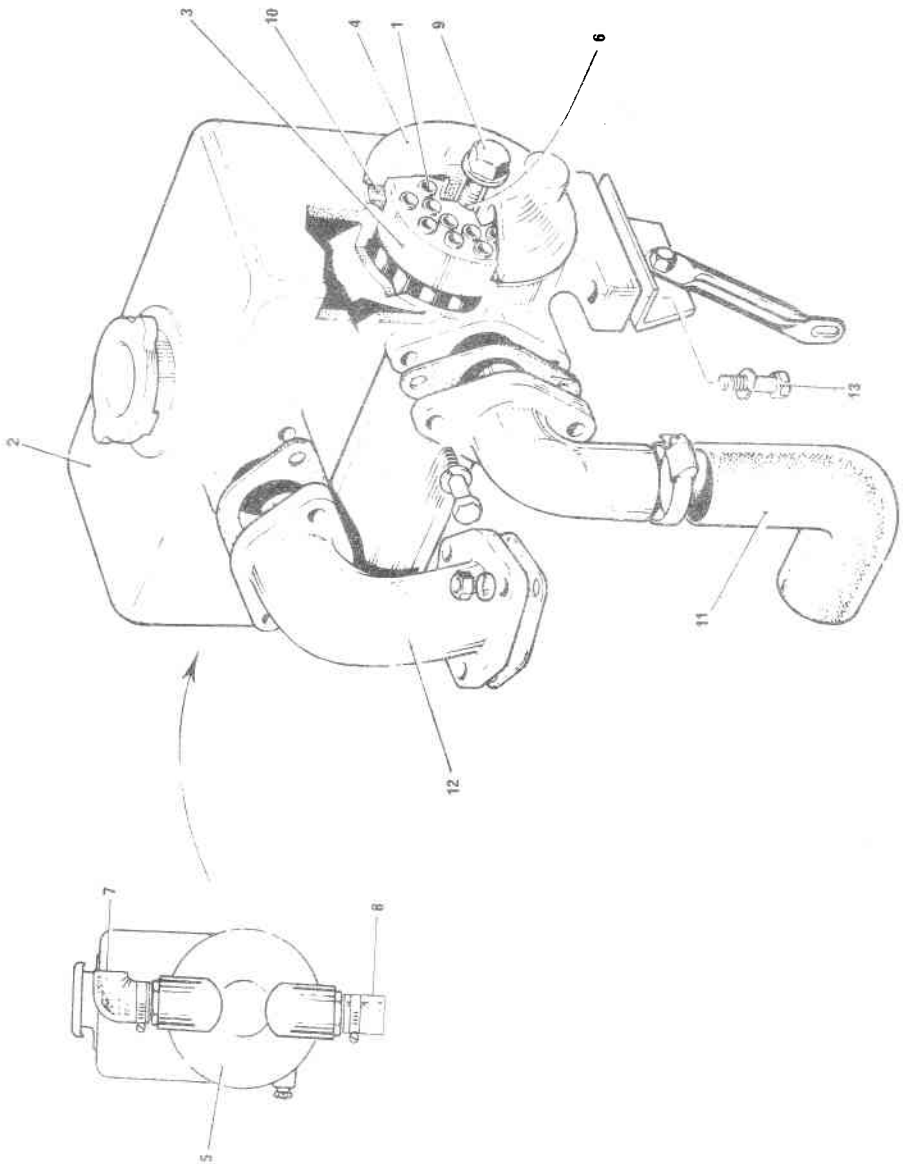


Fig. 11 Heat Exchanger

## To dismantle the heat exchanger

- (a) Drain the sea water system and drain from the fresh water system enough water to empty the heat exchanger.
- (b) Remove the sea water pipe hoses (7 and 8) from the end cover.
- (c) Remove nut (9) and washer.
- (d) Remove end cover (4).
- (e) Remove end cover (5) complete with tie rod (6).
- (f) Remove the "O" seals (10) and withdraw the tube stack.
- (g) Disconnect the fresh water pipes (11 and 12).
- (h) Remove the setbolts and washers (13).

The main casing can now be lifted from the engine.

## 4) To clean the heat exchanger

If the tube stack appears to be badly choked, it should be placed in a degreasing plant. This will loosen all foreign matter adhering to it.

The inside of the tubes which have sea water passing through them, are more likely to require cleaning. If these are badly choked, they can be cleaned by pushing a length of 1/8" dia. steel rod down the tube so as to dislodge all foreign matter. It is **IMPORTANT**, when doing this, to push the rod through the tubes in the opposite direction to that in which the water flows.

The other components should be cleaned before assembly, and as these contain no hidden surfaces, no special instructions are required.

To reassemble, the procedure is exactly the opposite to dismantling the unit. If the "O" seals appear badly deformed, it is advisable to replace them.

## E.7. THE BILGE PUMP

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### (1) General description.

The bilge pump (if fitted) is driven by a belt. It is a self-priming pump and has a friction cone type clutch. The bearings are sealed and pre-lubricated.

### (2) Routine maintenance.

(a) The pump has a neoprene impeller and depends on liquid for lubrication. DO NOT RUN DRY for more than 30 seconds. Lack of liquid will burn the impeller.

(b) When it is necessary, the pump can be drained by loosening the cover.

(c) When replacing the gasket, it is essential to use the correct part. A thicker gasket will reduce priming ability and a thinner gasket will cause the impeller to bind and subsequently fail.

(d) Clutch adjustment. It is important not to allow the clutch cone to wear until the "engage" clutch lever touches the "ON" stop, but readjust when approximately 1/8" (3mm) is still left, otherwise clutch begins to slip and will wear out rapidly.

### (3) Strainer

It is essential that the pump should be protected by an adequate and easily cleaned strainer fitted in the suction line.

### (4) Belt adjustment

The belt can be adjusted by releasing the setbolts in the pump base and moving the pump. When the correct tension is obtained, tighten the bolts.

The correct tension allows the belt to be deflected by hand and a total of 3/8" (9.50 mm) at the centre of its longest run. Overtight belt load will reduce pump bearing life and cause clutch cone wear.

## SECTION F - ELECTRICAL SYSTEM

### F.1. ALTERNATOR

The alternator requires no attention except to see that the cable connections are clean and tight.

#### (1) General precautions

Reversed battery connections will damage the diode rectifiers. Battery polarity should be checked before the connections are made to ensure that they correspond to the boat battery earth polarity.

The alternator should never be run on open-circuit (with main output lead disconnected) with the field winding energised, or the rectifier diodes are likely to be damaged.

#### (2) Belt adjustment (Fig 13)

The correct tension allows the belt to be deflected 1/2" (13 mm) when moderate finger pressure is applied at a point midway on the longest side.

The belt can be adjusted by releasing setbolt (1) and moving the alternator (2). When the correct tension is obtained, retighten the setbolt.

If the drive belt is worn or oily, it should be replaced by a new one.

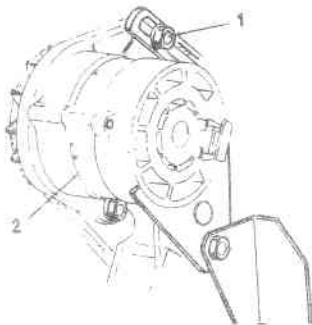


Fig. 13. Belt adjustment.

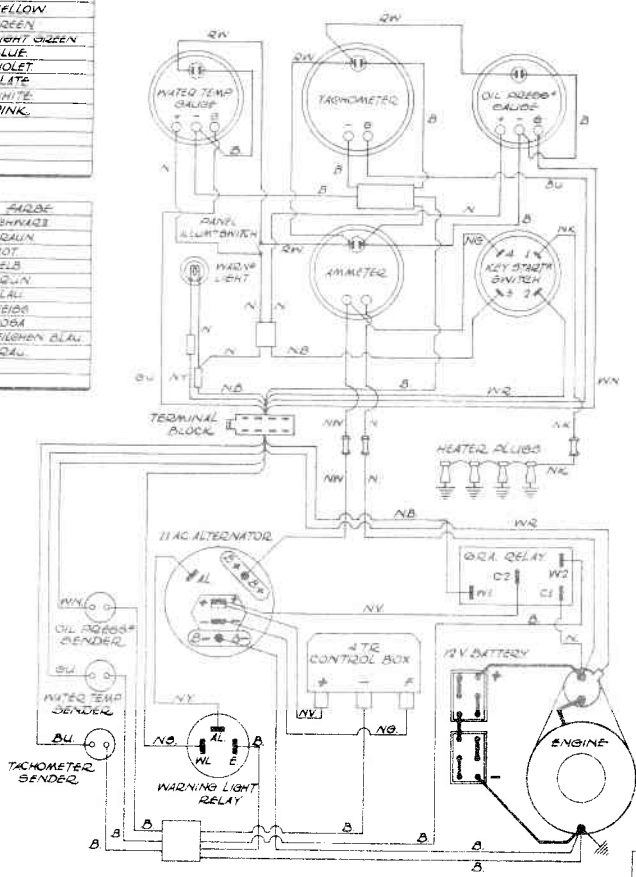
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CODE	COLOR
B	BLACK
BR	BROWN
R	RED
O	ORANGE
Y	YELLOW
G	GREEN
LG	LIGHT GREEN
B	BLUE
V	VIOLET
S	SLATE
W	WHITE
K	PINK

ZIPPER	SIZES
B	38/44
N	34/40
R	30/36
Y	26/32
G	22/28
U	18/24
W	14/20
K	10/16
V	16/22
S	12/18



WIRING DIAGRAM FOR 12 VOLT ELECTRICAL INCLUDING ALL STANDARD ELECTRICAL INSTRUMENTS WITH 11AC ALTERNATOR FOR TYPE 154 ENGINE

SK01952

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Fig 12. Wiring Diagram

7MP L.  
F.2. BATTERIES

2 x 12V gives 12V.

Lead acid batteries are supplied to customers' requirements.

A typical specification is as follows -

Type - 6 MT 17                      Voltage - 6 V.  
No. of batteries - 2                Capacity - 108 amp. hour.

The length of life which you obtain from your battery depends largely on the maintenance carried out. To ensure that you receive the maximum life from your battery the following points should be observed :-

- (1) Inspect the electrolyte level once each week and ensure that it is maintained level with the perforated splash guard; overtopping is the most frequent cause of external corrosion.
- (2) To remove connectors never use force. If a connector cannot be removed easily, wash it using a rag soaked in hot water. When the corrosion between the connector and the terminal has dissolved it will be removed easily. To replace the connector, tap it gently onto the terminal post, using the handle of a screwdriver, ensuring that it fits firmly and correctly, then insert and tighten the retaining screw. This retaining screw should never be used to pull the connector down onto the terminal post.

Should the screw be inadvertently stripped an oversize screw is available. Note only one oversize is available so that extra care must be taken not to strip the second thread.

- (3) Keep the terminal posts clean and smear them with vaseline or petroleum jelly. The top of the battery should also be kept clean and dry at all times.



- (4) Check vent plugs to see that the vent holes are not blocked. Where the battery has a manifold this does not apply.
- (5) Do not over-tighten the fixture which holds the battery as this may crack the battery case. Where the battery is secured by means of a metal strap along the top edge of the battery, the strap should be insulated with P.V.C. or similar acid proof material. Alternatively, the strap should be given two coats of anti-sulphuric paint.
- (6) Take hydrometer readings, at monthly intervals, to check the state of charge of the battery. A reading of 1.270-1.290 on each cell indicates that the battery is fully charged, 1.190-1.210 indicates that the battery is half discharged. In the latter case the battery should be recharged at the correct recharge rate. A trickle charger may be used for this purpose.

### F.3. STARTER MOTOR

The starter motor requires no attention beyond seeing that the cable connections are clean and tight, commutator is kept clean and the brushes are renewed when necessary.

### F.4. HEATER PLUGS (FIG 14)

- (1) To remove heater plug and clean orifice
  - (a) Remove the electrical leads (1) and unscrew each plug (2) from the cylinder head.
  - (b) Insert a twist drill (3) of 11/64 in (4.37 mm) diameter into the screwed holes (4) in the head and turn the drill by hand to remove the carbon build up.
  - (c) Withdraw the drill and remove any particles of carbon from the conical seatings in the cylinder head.
  - (d) Refit the heater plugs and electrical leads.

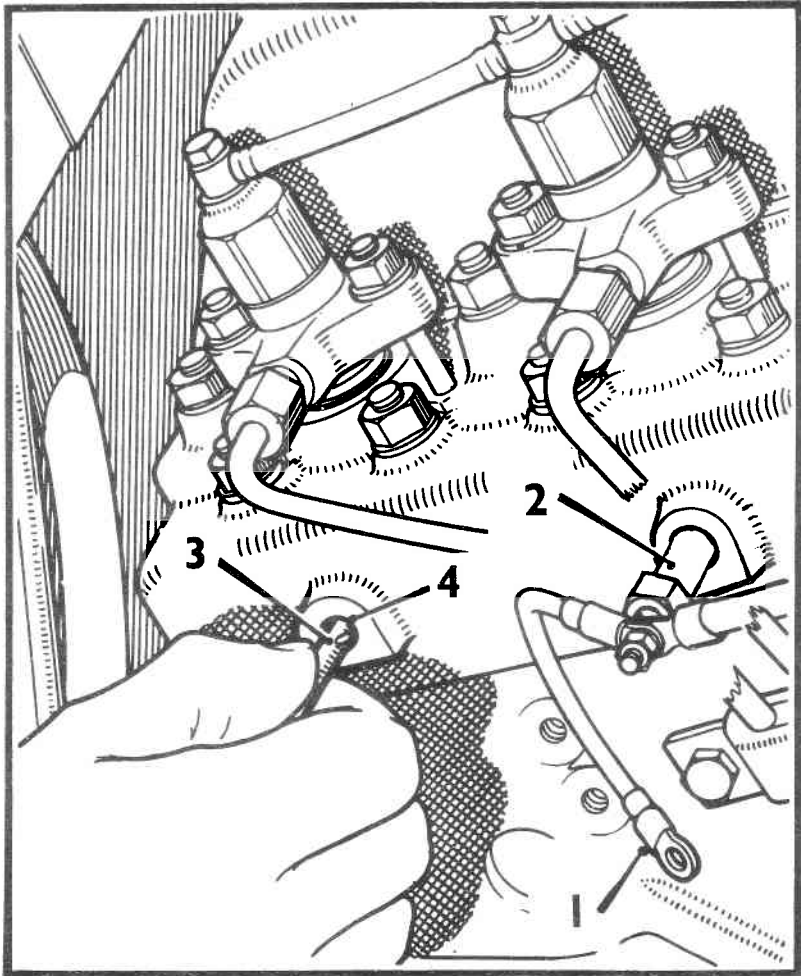


Fig. 14 Heater Plug

## SECTION G - REVERSE/REDUCTION GEARS

### G.1. BORG WARNER GEAR

#### (1) General description

Full details of the general description and routine maintenance are given in the Borg Warner Service Manual.

#### (2) Oil Cooling (FIG 15)

The oil is cooled by an Oil Cooler (1) which is fitted to the gearbox.

The oil is transferred from the gearbox to the oil cooler via hose (2) and it returns to the gearbox via hose (3).

Water for the oil cooler is supplied by the sea water cooling system.

The oil cooler is integrally constructed and cannot be dismantled.

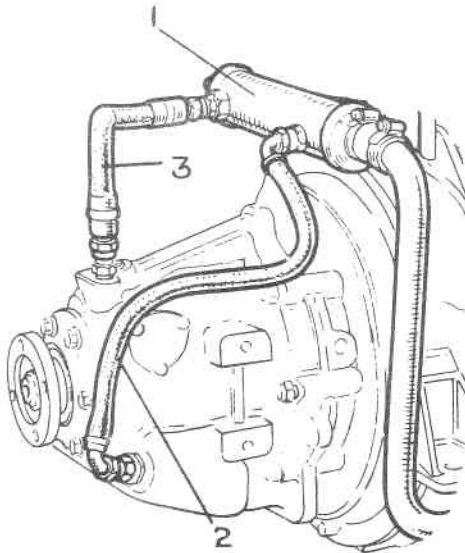


Fig. 15 Gearbox oil cooler

G.2.      TMP GEARBOX

(1) General description

Full details of the general description and routine maintenance are given in the "Working Instructions" for the TMP gearbox.

(2) Oil Cooling

Full details are given in the "Working Instructions" for the TMP gearbox.