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Instruction Manual For Bolinders 1053 - 1054

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Type and serial numbers
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General Instructions
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Specification

Type and serial numbers

The engine type and serial numbers etc, are stamped on a plate on one side of the engine. The reverse-reduction type and serial numbers and the ratio are stamped on a plate on the rear. The first group of figures in the type number shows the engine type and the last group the chassis type. The serial number is divided up in the same manner.

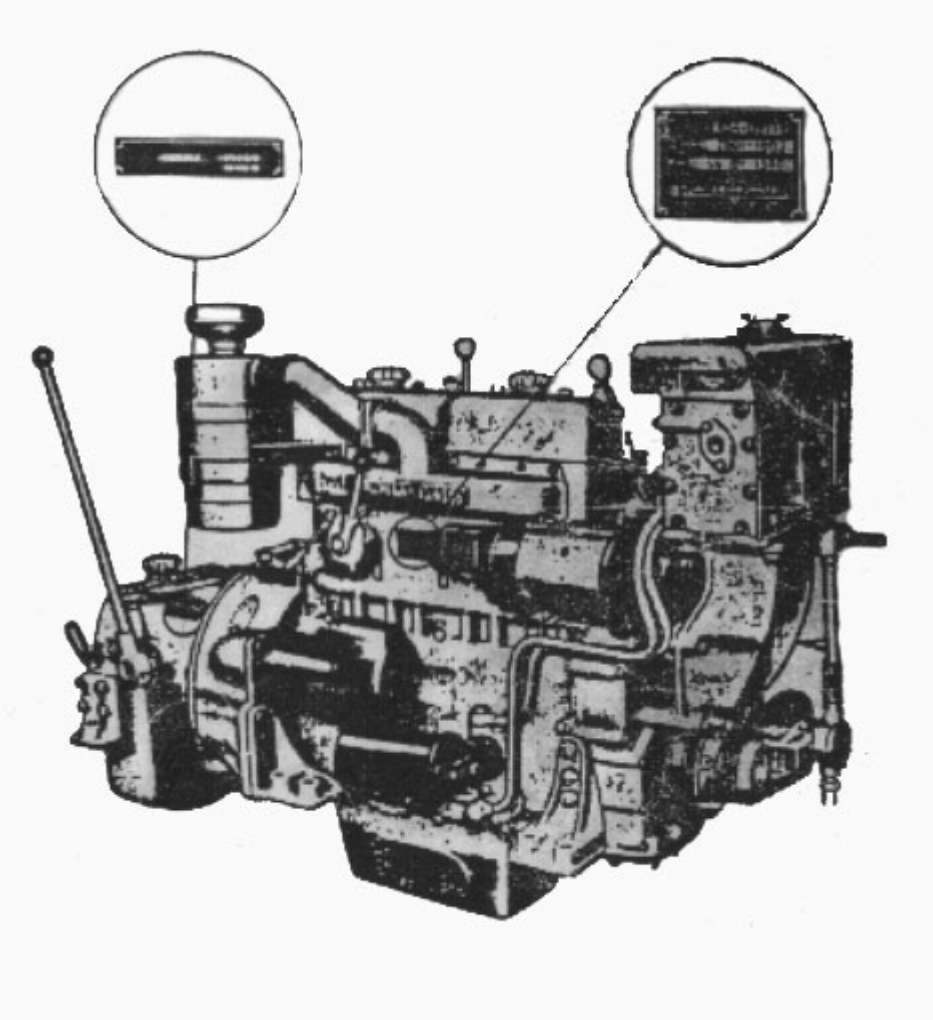


Fig 1. Type plate location on four-cylinder engine with mechanical reverse-reduction gearbox

Always quote type and serial numbers when ordering spare parts and in correspondence with the factory on service matters.

Example. Engine: Type 1054-12977, serial number 2801-1003. Reverse-reduction gearbox : Type 774698, serial number 1095.

Top

General description of engine

Bolinders Marine Diesel is a four stroke, direct-injection engine with overhead valves. The series ranges From single to four-cylinder engines. This manual covers the three and four-cylinder engines. Cylinder Liners, pistons and several other engine components are common to the entire series.

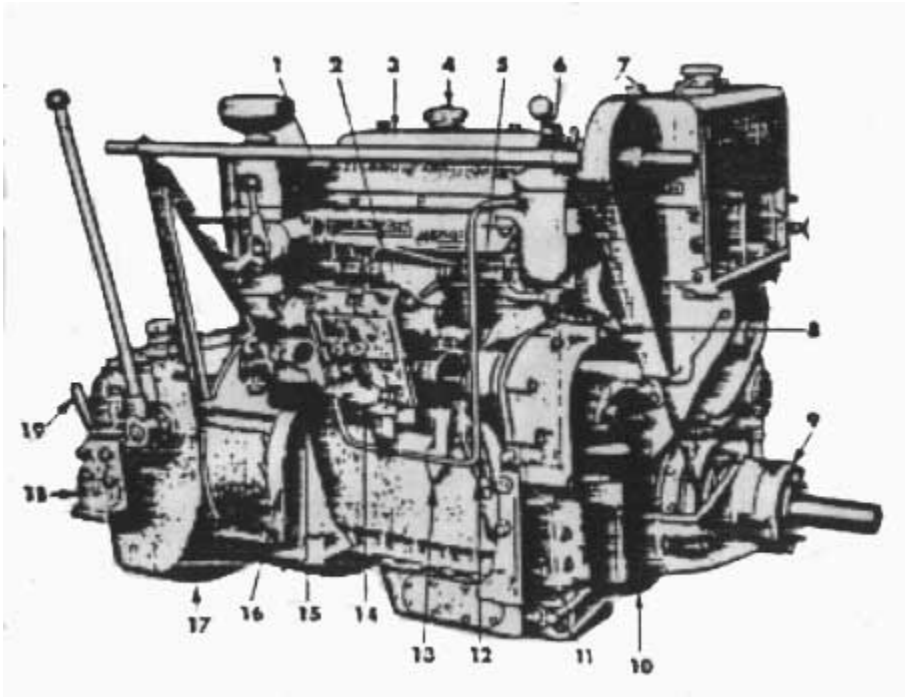


Fig 2. Three-cylinder marine diesel with mechanical reverse-reduction gearbox Right-hand side (control side).

1. ***Induction manifold***
2. ***Pressure pipe***
3. ***Valve cover***
4. ***Ventilator (oil filter)***
5. ***Fine filter, sealed***
6. ***Fine filter, unsealed***
7. ***Heat exchanger***
8. ***Drain, fresh water***
9. ***Power take-off***
10. ***Lubricant filter***
11. ***Front engine bracket***
12. ***Dipstick, engine***
13. ***Crankcase ventilator***
14. ***Fuel Pump***
15. ***Injection pump***
16. ***Central engine bracket***
17. ***Reverse-reduction gearbox, mechanical***
18. ***Rear engine bracket***
19. ***Dipstick, reverse-reduction gear***

Top

The cylinder block of cast iron has wet-type liners, i.e. replaceable liners directly flushed by cooling Water. Two rubber seals in grooves in the lower liner seat prevent water from penetrating into the crankcase. At the upper edge of the liner the water is prevented from penetrating upwards by the cylinder head gasket. Water circulation is maintained by a centrifugal pump and governed by a thermostat. The thermostat strives to keep the water at the best temperature for the engine, approx 160 – 175 deg F. (70 – 80deg C)

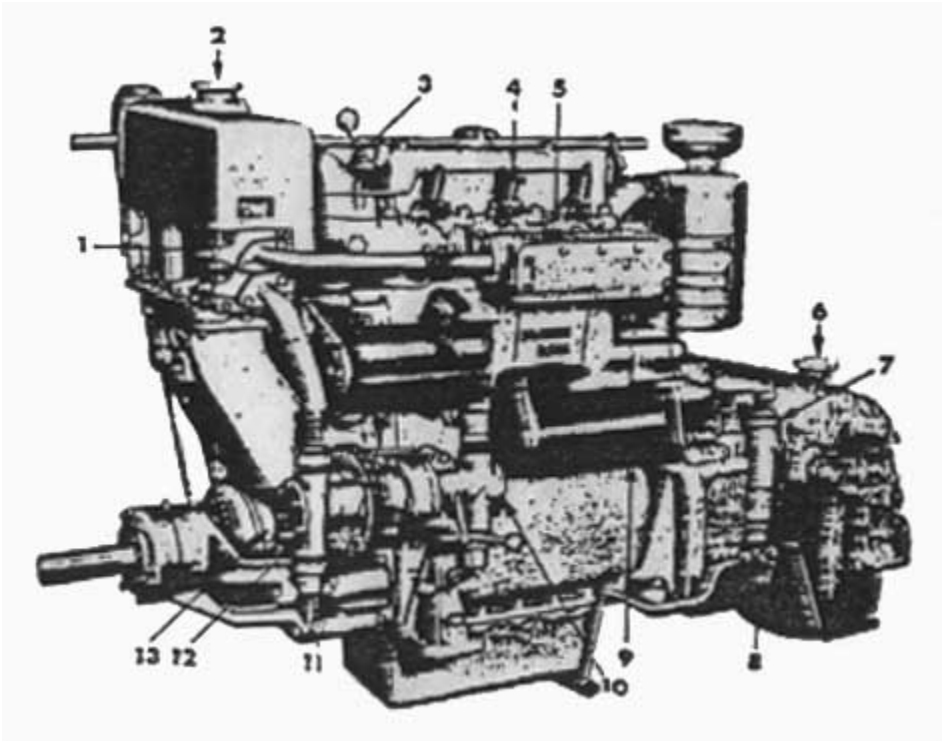


Fig 3. Three-cylinder marine diesel with mechanical reverse-reduction gearbox Left-hand side.

1. ***Plug with zinc electrode***
2. ***Cap (fresh water filler)***
3. ***Thermostat housing***
4. ***Injector***
5. ***Water-cooled exhaust manifold***
6. ***Ventilator (oil filler of reverse-reduction gear***
7. ***Draining pump, lubricant***
8. ***Three-way cock for 7***
9. ***Starting motor***
10. ***Bilge pump***
11. ***Generator***
12. ***Cooling water pump***
13. ***Adjustable belt pulley***

The crankshaft is carried in main bearings with replaceable shells. The bearing metal is lead-bronze, lead-indium flashed. At the front end the shaft carries a gear which drives the camshaft, injection pump and oil pump. The rear end carries the flywheel.

The aluminium-alloy pistons have three compression and two oil rings. The upper compression ring of every piston is hand chromium plated to cut wear on cylinder liners and piston rings to a minimum. Like the main bearings, the big-end bearings are fitted with replaceable shells.

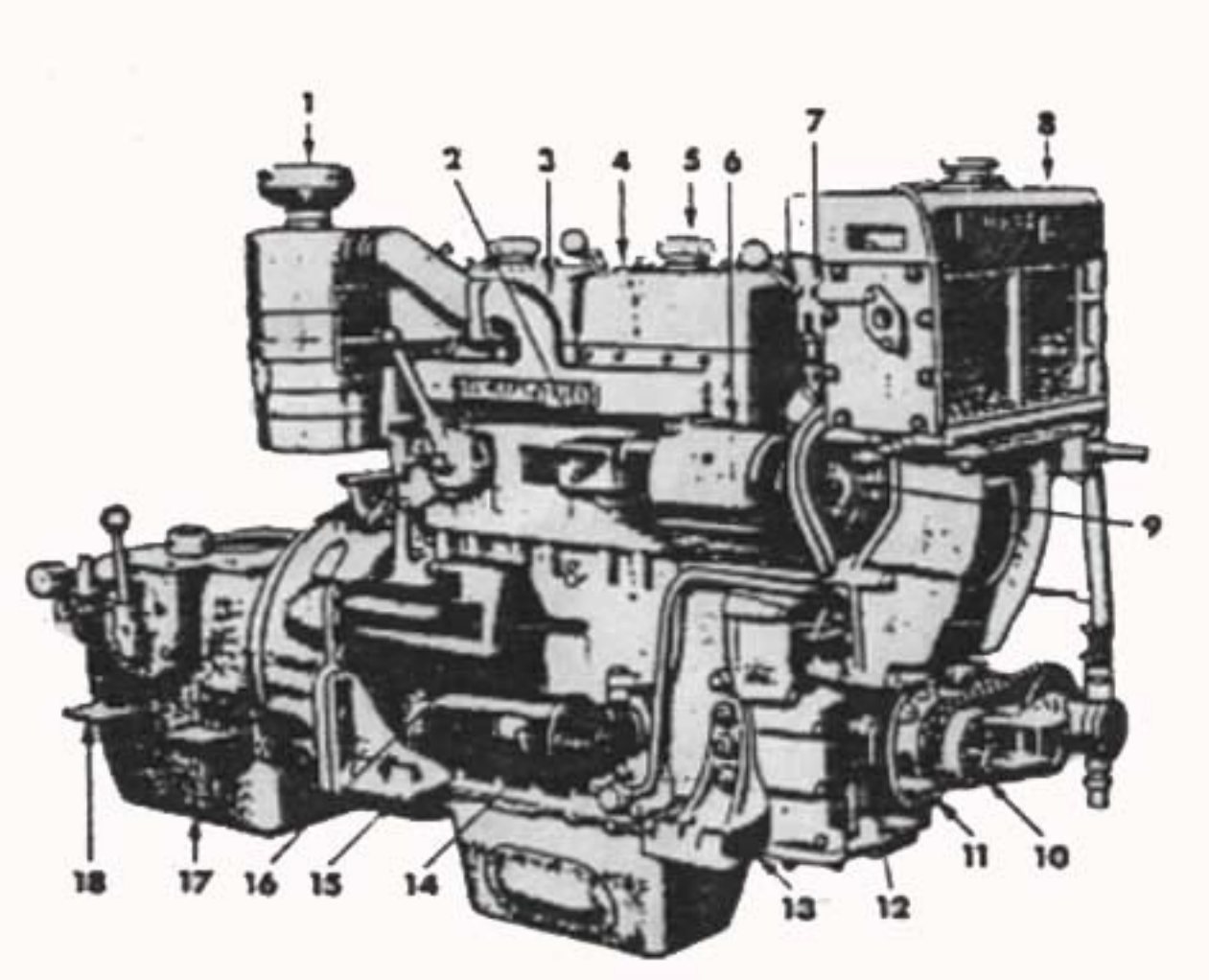


Fig 4. Four-cylinder marine diesel with hydraulic reverse-reduction gearbox
Right-hand side (control side)

1. *Air filter*
2. *Relay*
3. *Induction manifold*
4. *Valve cover*
5. *Ventilator*
6. *Generator*
7. *Plug with zinc electrode*
8. *Heat exchanger*
9. *Pipe bend with drain cock for fresh water*
11. *Front engine bracket*
12. *Dipstick, engine*
13. *Crankcase ventilator*
14. *Fuel Pump*
15. *Injection pump*
16. *Central engine bracket*
17. *Reverse-reduction gearbox, mechanical*
18. *Rear engine bracket*
19. *Dipstick, reverse-reduction gear*

Top

The cylinder head carries the inlet and exhaust valves and the injectors. Exhaust valve sealing surfaces and all valve stem ends are faced with stellite, a heat-resisting alloy which greatly lengthens the working life. Valve seats are shrunk-in replaceable insert rings of alloy-steel.

The timing gear drives the camshaft and the injection and lubricant pump

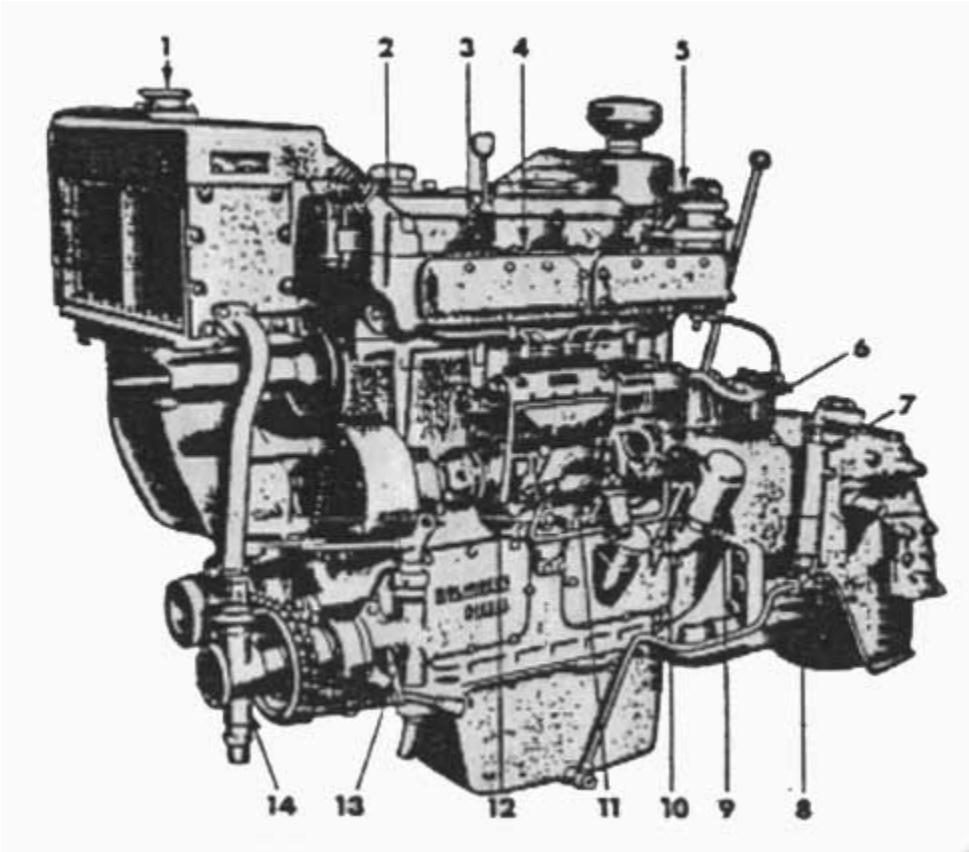


Fig 5. Four-cylinder marine diesel with mechanical reverse-reduction gearbox Left-hand side

1. *Cap (fresh water filter)*
2. *Thermostat housing*
3. *Injector*
4. *Water-cooled exhaust manifold*
5. *Fine filter, unsealed*
6. *Fine filter, sealed*
7. *Draining pump for lubrication*
8. *Three-way cock for 7*
9. *Crankcase ventilation*
10. *Oil dipstick*
11. *Feed pump*
12. *Injection pump*
13. *Bilge pump*
14. *Cooling water pump*

Top

Working Principals

The engine is designed on the four-stroke principle and it's operating cycle is illustrated in the following figures.

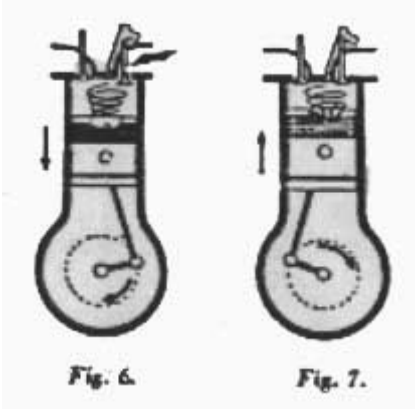


Fig 6. Inlet stroke.

Just before the top dead centre is reached the inlet valve opens so that the piston sucks fresh air through the air filter and into the cylinder on it's way down again. The inlet passage in the cylinder head is shaped to give the entering air a rotation in the cylinder.

Fig 7. Compression stroke.

The piston now moves upwards with both valves closed. This compresses the air, raising it's temperature above that of fuel's ignition temperature. A specially shaped combustion cavity in the piston top increases air rotation during this stroke. Shortly before the piston reaches the top dead centre again fuel is injected to mix with the swirling air and combust as the pressure increases.

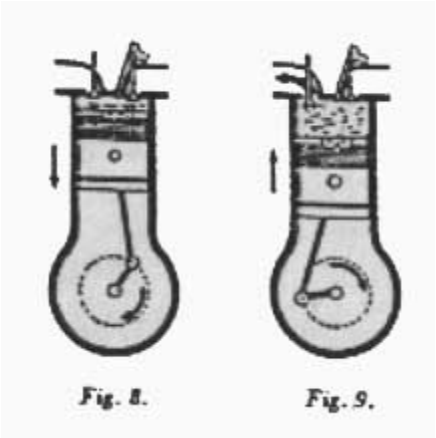


Fig 8. Power stroke.

Combustion vastly increases pressure and forces the piston downwards increases pressure and forces the piston downwards in the cylinder to perform the useful work..

Fig 9. Exhaust stroke.

The exhaust valve opens immediately before the bottom dead centre is reached and the piston starts moving upwards again to expel the combustion gases.

Top

Lubricating system

The dependability, life economical operation of an engine are largely determined by the efficiency of it's lubricating system and the care and attention devoted to it. It is for this reason that the Bolinder lubricating system has been designed for simplicity and automatic function. Under normal conditions all that is needed is to maintain the correct oil level, change the prescribed times and check the oil pressure at regular intervals.

The engine is pressure lubricated (fig 10). Pump 4 sucks the oil from sump 6 and feeds it to the various lubricating points. To prevent the pump sucking up impurities deposited at the bottom of the sump, the oil Is first compelled to pass through strainer 5 in the float on the pump section pipe.

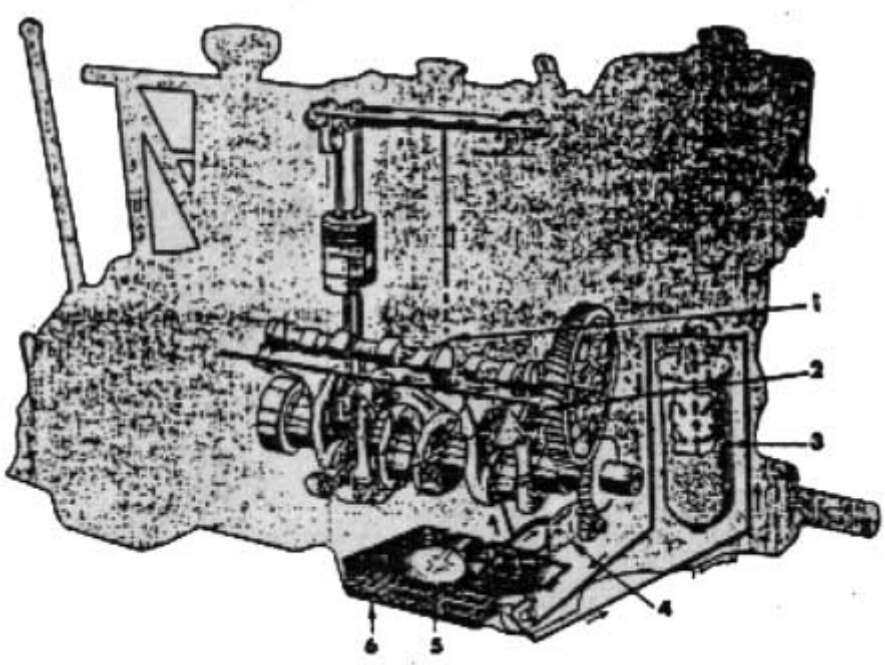


Fig 10. General arrangements of oil system, three-cylinder engines.

1. ***Shot lubrication of valve mechanism***
2. ***Reduction valve***
3. ***Lubricant filter***
4. ***Oil Pump***
5. ***Strainer***
6. ***Oil sump***

From the pump the oil is forced through oil filter 3 for efficient cleaning. It is then distributed to all main and big-end bearings, camshaft bearings, piston pins, valve mechanism and timing gears. Oil is fed to the valve mechanism by so-called shot lubrication from the central camshaft bearing, implying that the oil is supplied intermittently (1. fig 10). This arrangement restricts the amount of oil supplied and prevents excessive lubrication.

On the right-hand side of the cylinder block front edge there is a reduction valve 2. This maintains the oil pressure in the system at 40 – 60 lb/sq.in. (3 – 4 kg/sq.cm.) at normal r.p.m. (1500) and normal engine temperature (160 – 175deg F [70 – 80deg C]).

Top

Fuel system

The fuel system (fig. 11) consists of fuel tank, feed pump with pre-filter, two fine-filters in series, overflow valve, injection pump with centrifugal governor, injectors and piping.

Feed pump 5 (fig 11) sucks the fuel from tank 1 and into prefilter 4, where it is given a preliminary cleaning. From the feed pump the fuel is forced out through two fine filters, 6 and 7, connected in series. In the first of these the fuel is compelled to pass through a pack of filtering plates which clean it thoroughly. The second filter is sealed and is provided as an extra safety measure.

From the sealed filter the fuel passes to the fuel chamber of injection pump 8. This constant-stroke pump has one pumping element for every engine cylinder. The plungers in these elements force the fuel through the pressure pipes to injectors 9. The pressure pipes are connected to the injectors by special unions containing a final edge filter which serves to stop any particles which may get into the pipes when they are disconnected from the engine. From the injector nozzles the fuel is sprayed into the engine cylinders through four holes. The high opening pressure ensures sufficient atomization of the fuel to achieve sure starting even if the engine is cold. Leak-off oil from the nozzles is piped back to the fuel tank through line 10.

The first fine-filter has an overflow valve 11 (fig. 11). This opens when fuel pressure inside the filter reaches approx. 10 lb/sq.in. (0.7 kg/sq.cm.). Fuel then flows out through the valve and is led back to the tank through pipe 12. This arrangement also ensures automatic venting of the fine-filter as the fuel continuously passes through the valve back to the tank. The centrifugal governor on the injection pump permits engine r.p.m. setting at and desired speed up to a given maximum.

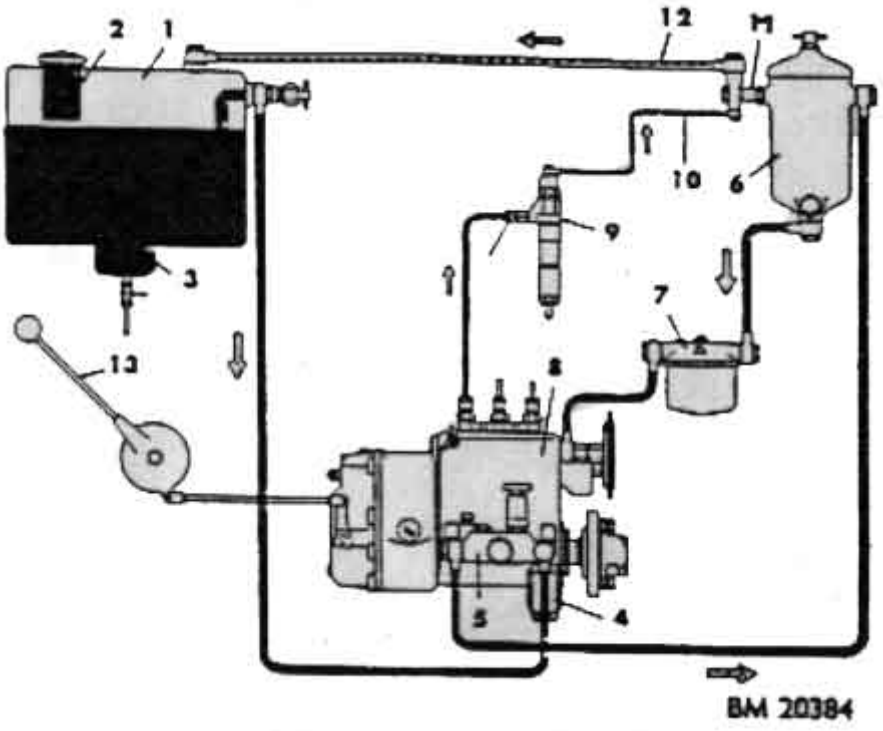


Fig 11. General arrangement of fuel system, three-cylinder engine.

1. ***Fuel tank***
2. ***Strainer in filter***
3. ***Sludge pocket wish drain cock***
4. ***Prefilter***
5. ***Feed pump***
6. ***Fine-filter***
8. ***Injection pump***
9. ***Injector***
10. ***Leak-off pipe***
11. ***Overflow valve***
12. ***Return line to fuel tank***
13. ***Speed governor***

7. Sealed fine-filter

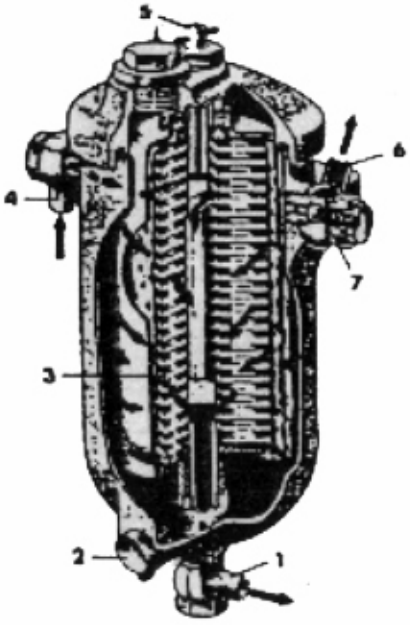


Fig 12.Fine-filter, unsealed

1. *Pipe line to sealed filter*
2. *Strainer in filter*
3. *Sludge pocket wish drain cock*
4. *Prefilter*
5. *Feed pump*
6. *Fine-filter*
7. *Sealed fine-filter*

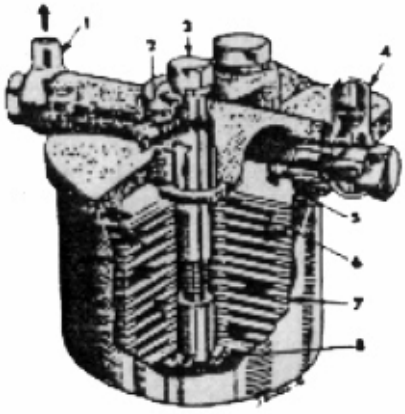


Fig 13.

1. *Pipe line to injection pump*
2. *Air vent screw*
3. *Holding screw*
4. *Pipe line from unsealed fine-filter*
5. *Gasket*
6. *Felt ring*
7. *Pad filter*
8. *Felt ring*

Top

Marine diesels are fitted with two fuel systems

Three-cylinder engine, 1053 Bosch
Four-cylinder engine, 1054 CAV

In both pump types the amount of fuel is controlled by a centrifugal governor built integral with the injection pump. The injection pump is also fitted with a cold-start device which primes the engine with extra fuel at the moment of start. On CAV pumps the cold-start device is controlled by a readily accessible button. On Bosch pumps it is controlled by a built-in, automatic link system.

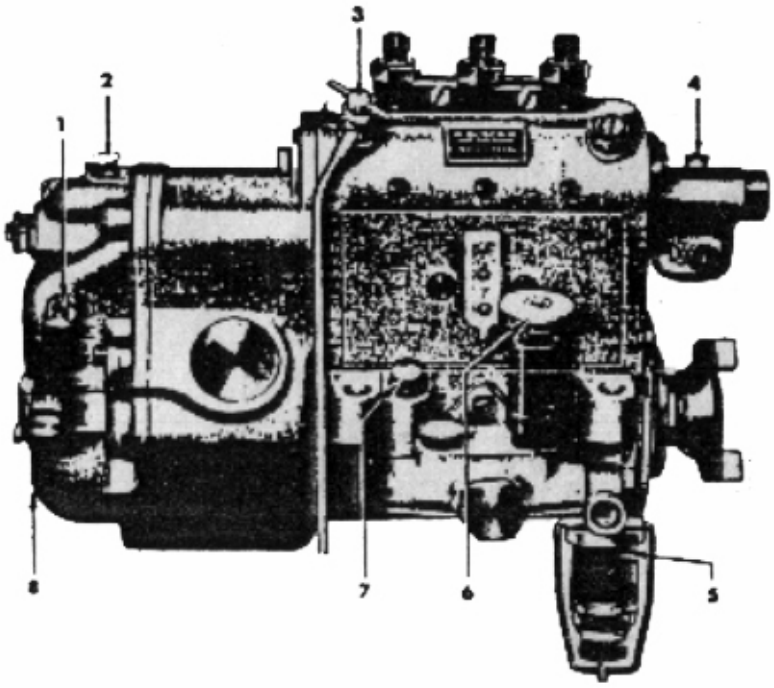


Fig 14. Bosch injection pump for engine 1053

1. ***Lever for centrifugal governor***
2. ***Lubricator***
3. ***Air vent screw***
4. ***Stop lever***
5. ***Prefilter***
6. ***Hand pump***
7. ***Oil dipstick***
8. ***Level plug for lubricant***

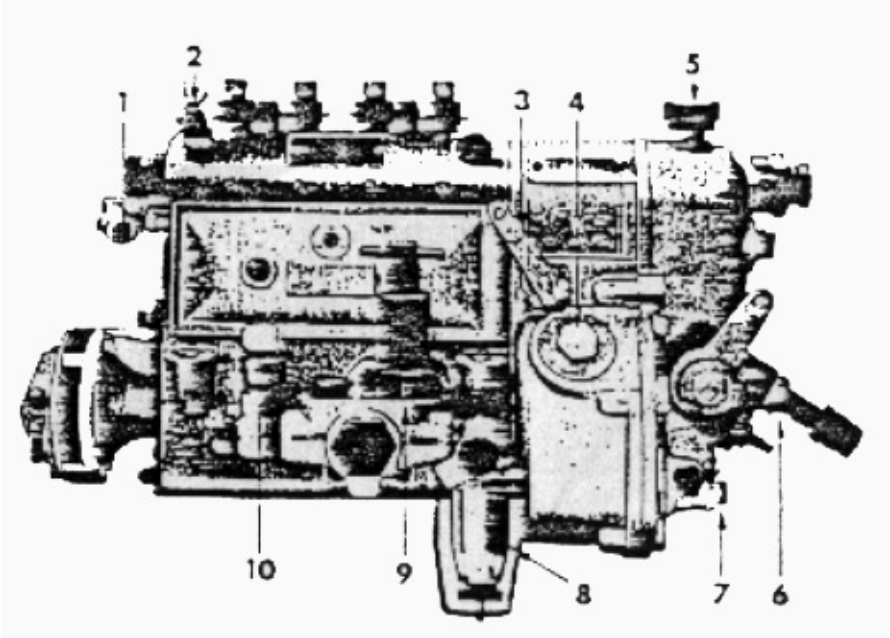


Fig 15. CAV injection pump for engine 1054

1. *Cold start device*
2. *Air vent screw*
3. *Stop lever*
4. *Plug for inspection and oil filling*
5. *Ventilation filter*
6. *Idling screw*
7. *level plug for lubricant*
8. *Prefilter*
9. *Hand pump*
10. *Oil dipstick*

Top

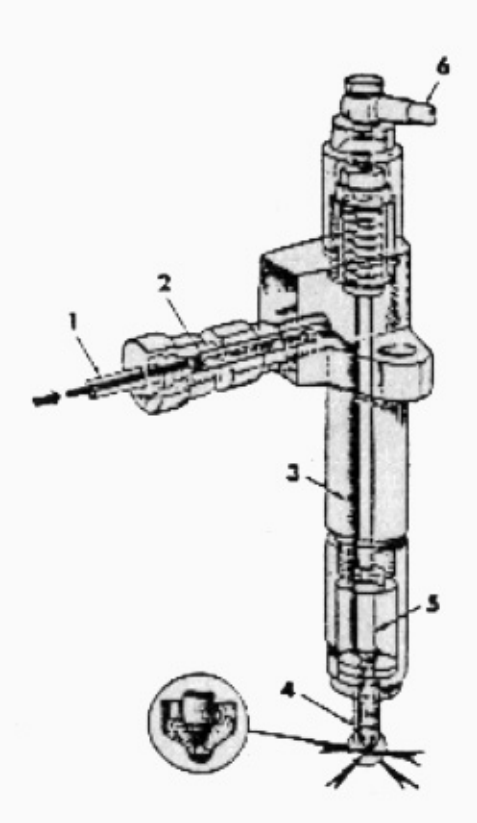


Fig 16. Injector.

1. ***Pipe line from injection pump***
2. ***Edge filter***
3. ***Fuel passage***
4. ***Nozzle***
5. ***Nozzle needle***
6. ***Pipe line for leak-off fuel***

The fuel enters the injector through pipe 1. passes edge filter 2 and is led through passage 3 down to nozzle 4. When fuel pressure reaches approx.. 1,920 lb/sq.in (135 kg/sq.cm.) nozzle needle 5 lifts and the fuel is sprayed into the cylinder through four holes. Leak-off fuel is carried back to the fuel tank through pipe 6.

Cooling system

The engine is water cooled (figs. 27 and 28), the coolant being circulated by fresh water pump 3. This pump is mounted at the front of the engine and is V-belt driven from the crankshaft pulley. The pump sucks coolant from the lower part of the heat exchanger and feeds it into the cylinder block where it first cools the liners and then passes through passages up into the cylinder head.

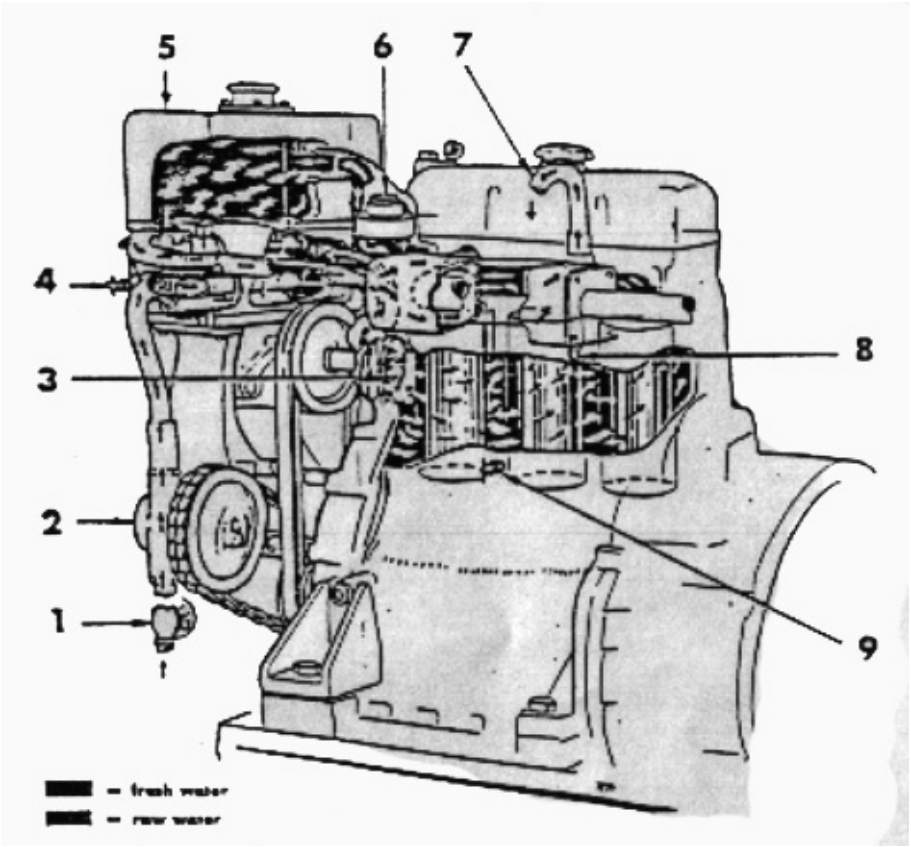


Fig 17. Cooling system, three-cylinder engine

1. ***Bottom valve (not delivered with engine)***
2. ***Cooling water pump***
3. ***Fresh water pump***
4. ***Drain cock for raw water in heat exchanger***
5. ***Heat exchanger***
6. ***Thermostat***
7. ***Raw water discharge***
8. ***Drain cock for raw water in exhaust manifold***
9. ***Drain cock for fresh water in engine***

Top

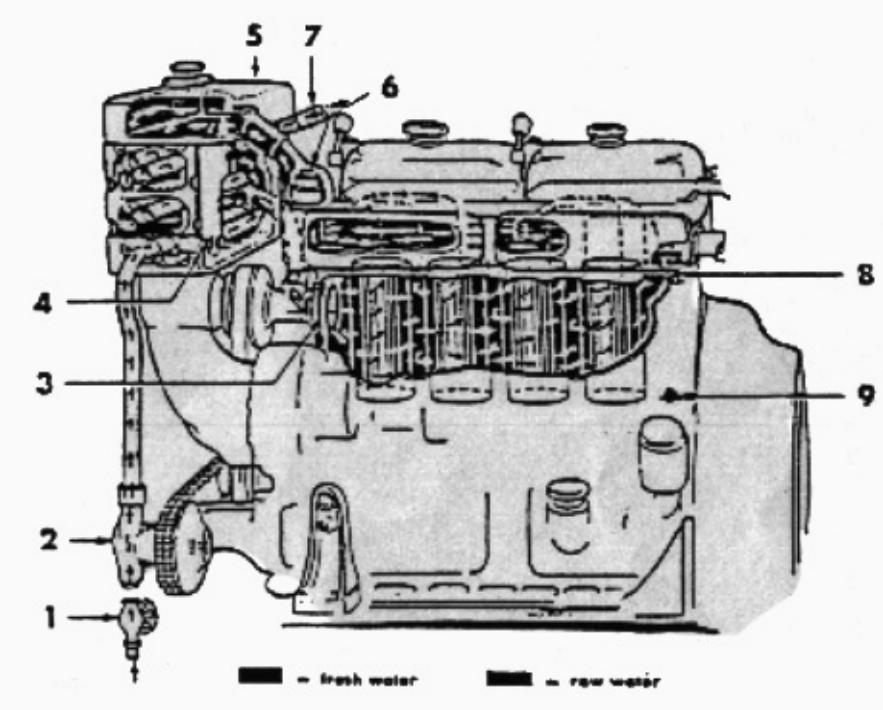


Fig 18 . Cooling system, four-cylinder engine

1. ***Bottom valve (not delivered with engines)***
2. ***Cooling water pump***
3. ***Fresh water pump***
4. ***Drain cock for raw water in heat exchanger***
5. ***Heat exchanger***
6. ***Thermostat***
7. ***Raw water discharge***
8. ***Drain cock for fresh water in exhaust manifold***
9. ***Drain cock for fresh water in engine***

Here it is sprayed out to provide concentrated cooling of the exhaust passages and the nozzles. The heated coolant returns via the thermostat 6 to heat exchanger 5 where it is cooled by the raw water circulating in the cooling coil Raw or sea water is pumped through the heat exchanger by pump 2.

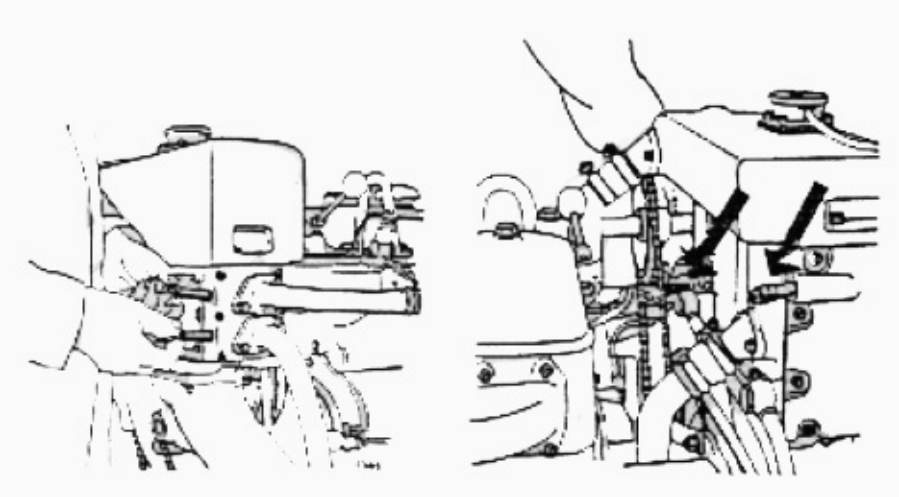
As long as the coolant is cold, the thermostat is closed for return flow to the heat exchanger and it passes instead through a bypass line direct to the pump suction side. This bypass consists of a special passage in the cylinder head and block. Flow through the bypass line is slow and the coolant quickly heats up to approx 160 deg F (70 deg C). At this temperature the main passage through the thermostat begins to open and is fully open by the time the temperature has reached approx 175 deg F (80 deg C), the best temperature for the engine.
To protect the engine against salt water corrosion and deposits, only fresh water or mixed with a suitable amount of ethylene should be used in the cooling system

In the three-cylinder engine the raw water is led through the water jackets of the exhaust manifold after it has passed through the heat exchanger. This cools the manifold and eliminates overheating and fire hazards.
In the four-cylinder engine the raw water is discharged overboard when it leaves the heat exchanger. In

this engine the exhaust manifold is cooled by the fresh water, which is led to the manifold after passing through the cylinder block and head.
From the manifold it passes via the thermostat to the heat exchanger. The lower part of the four-cylinder engine's heat exchanger is arranged for cooling of the engine lubricating oil. This fed by the oil pump in the crankcase through the heat exchanger and the lubricant cleaner and from there to the various engine lubrication points.

Zink Electrodes

As a result of the potential difference between the different parts the cooling surface materials, galvanic can arise during the circulation of salt-water through the cooling system of an engine.
This can happen to all salt-water cooled on the market. In spite of the use of high-quality material, the galvanic current causes removal of material from parts of the cooling system having a higher potential, so that "corrosion" occurs which weakens the material effected.
In order to prevent such damage occurring on BM engines, zinc electrodes (zinc plugs) are fitted into the cooling systems of marine engines. In this way a difference in potential is caused between the zinc electrode and the cooling surface material which is higher than that existing between the various parts of the cooling surface. Because of this, any galvanic currents occurring will cause material to be removed from the zinc electrode instead, so that reaction on the cooling surface material is prevented.



1053 Engine ***1054 Engine***

Because of the removal of material from the zinc electrodes which will occur as described above, there will, after a certain time, be used up, so that replacement must be made.

The zinc electrodes must be removed for inspection every 200 running hours or once a month. If any depositing is found on them, this must be carefully scraped off or brushed off with a wire brush.
If the electrode has been worn away by more than 50% of it's original size, it should be replaced.

When refitting the electrode it is of the utmost importance that good metallic contact is obtained between the electrode and the engine contact surface. Ensure that the zinc electrode is fitted into it's adapter plug and carefully clean the contact surfaces of the adapter plug, copper gasket and engine material before carrying out refitting.

Top

Starting Devices

As standard the engine is fitted both with 12-volt electric starting equipment and hand starting.

Electric starting

The electric starting equipment, which is effectively protected against water and provides sure starting, consists of starting motor, charging generator with relay, instruments and starter battery.

The 4-h.p. starting motor is mounted on the flywheel housing. It has a magnet coupling and a displaceable armature. Engagement with the flywheel ring is by displacement of the entire armature.

The 130-watt generator is fitted with a voltage regulator and is mounted on the front end of the engine. It is V-belt driven from a pulley on the water pump shaft.

Hand starting

Hand starting equipment consists of a raised cranking arrangement and decompression device. Cranking is transferred to the crankshaft by chain and sprocket wheels. The arrangement includes automatic release of the crankshaft sprocket as soon as the engine starts.

The decompression device consists of an eccentric shaft carried in the rocker shaft bearing brackets. This eccentric can be used to lift exhaust valves from their seats. It is actuated by a shaft with handle mounted valve cover.

Top

Instruments and Controls

All controls for the marine diesel are located so that they are accessible from the right-hand side of the engine. The instrument panel, supplied separate from the engine, contains coolant thermometer, oil pressure gauge, starting switch, starting button, instrument panel lighting and charging indicator lamp.

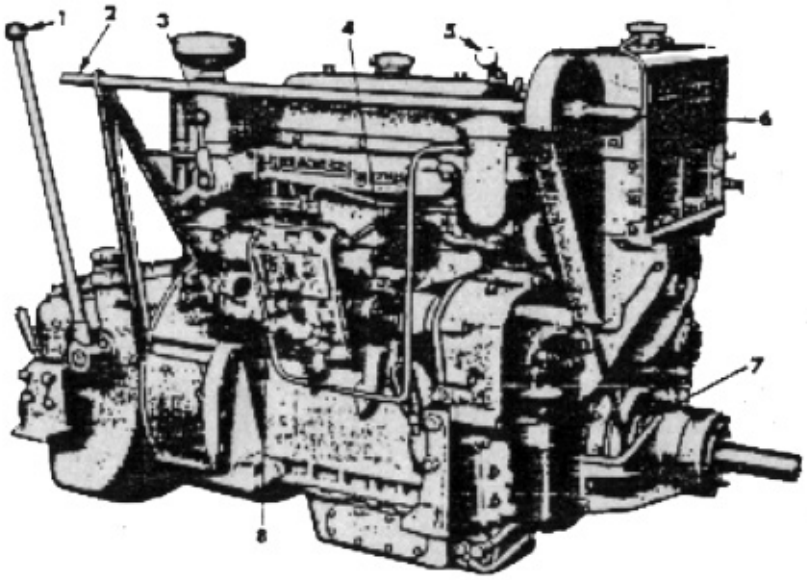


Fig 19. Instruments and Controls, three-cylinder engine.

1. ***Control lever***
2. ***Crank attachment***
3. ***Speed control***
4. ***Stop control***
5. ***Decompression handle***
6. ***Crank attachment***
7. ***Automatically disengaging sprocket***
8. ***Connecting for pipe to oil pressure gauge***

Before starting up a new engine, check location, operation and effect of the various controls. Make a habit of glancing at the instruments every now and then during running to ensure discovery of abnormal readings in good time.

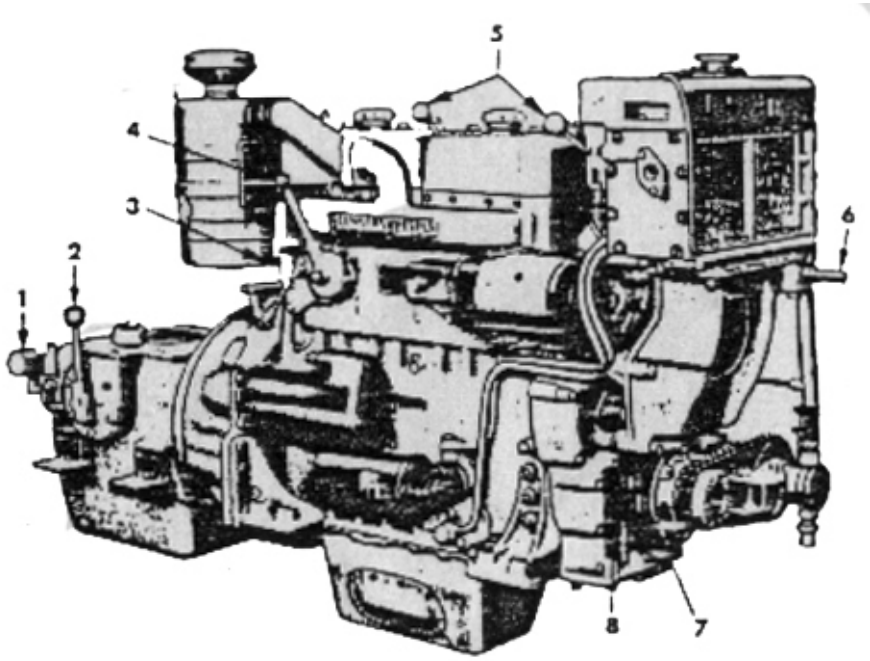


Fig 20. Instruments and controls, four-stroke engine.

1. *Oil pressure gage (hydraulic)*
2. *Control lever*
3. *Stop control*
4. *Speed control*
5. *Decompression handle*
6. *Crank attachment*
7. *Automatically disengaging sprocket*
8. *Hour counter*

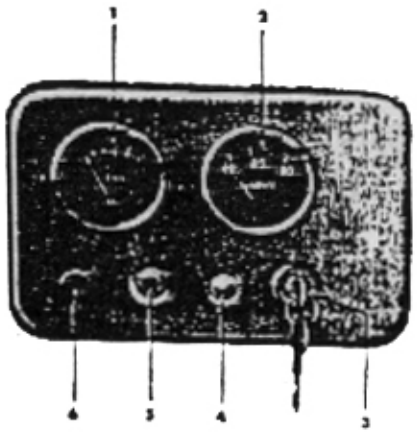


Fig 21. Instrument panel.

1. *Oil pressure gauge*
2. *Coolant thermometer*
3. *Starting switch*
4. *Starting button*
5. *Changing indicator lamp*
6. *Instrument lighting switch*

Top

Oil pressure gauge

The oil pressure gauge shows the oil pressure in the engine lubricating system. It does not, however, show how much oil there is in the crankcase. At normal r.p.m. and load the pressure is to be 40-60 lb/sq.in. (3-4 kg/sq.cm.). Higher pressure than the above can be caused by oil that is too viscous for the prevailing temperature.

If the oil pressure falls to zero or near to it during running, the engine must be stopped immediately and the fault traced..

Coolant thermometer

The thermometer shows the temperature of the coolant and, consequently, the working temperature of the engine. Normal coolant temperature is 160-175 deg F (70-80 deg C). If the normal temperature shows excessively high temperature for a long period at a time, this may be due to circulation difficulties caused by clogged cooling system passages,

Charging indicator lamp

Normally, the charging indicator lamp is not alight when the engine is running; this shows that the battery is being charged. When the lamp lights this indicates that the battery is discharging, which is normal when idling. If the lamp lights when running at higher speeds, there is usually a fault in the electrical system.

Starting switch

The starting switch is below the thermometer on the instrument panel. The circuit is closed through the switch when the key is turned clockwise. Do not forget to switch off the current when the engine is stopped.. Otherwise the battery will discharge.

Starting button

The engine is started electrically by pressing in the starting button to the left of the starting switch on the instrument panel. Release the button as soon as the engine starts.

On the left-hand side of the instrument panel there is a switch for the panel lighting.

Equipment
Reverse-Reduction Gearbox

General
Bolinder Marine Diesels are equipped with a sturdy, highly reliable reverse-reduction gearbox. This self-contained unit is directly flanged to the flywheel housing and is available in two models ; one mechanically and one hydraulically operated. The same reverse-reduction gearbox is used for both the three and the for cylinder engines.

Mechanically Operated Reverse-Reduction

Gearbox
Power from the engine flywheel is referred to the reverse-reduction gear through a twin-disc friction clutch. The gearbox is designed for full power transfer in both ahead and stern drive.
The reverse reduction gear is used both for reversing the direction of propeller shaft rotation and for reducing the r.p.m. This is done by gearing which, via the drive shaft, transfers the power to the propeller shaft when either the ahead or the astern clutch plate in the powerful, spring-loaded duplex clutch is engaged. The clutch is designed to transmit the maximum torque developed by these engines with a wide margin to spare.

The reduction gear is available with a ratio of either 1.5 to 1 (more exactly : 1.51 :1 ahead and 1.97:1 astern) or 3 to 1 (more exactly : 2.88:1 ahead and 2.53:1 astern).
The gears are of nickel-chrome steel and case-hardened. The lowest gear works in an oil bath provides automatic lubrication of all of them. The design permits continuous drive for long periods at a time.
The gear shafts are carried in ball and roller bearings. Shaft seals prevent water from penetrating into and oil from leaking out of the gearbox.

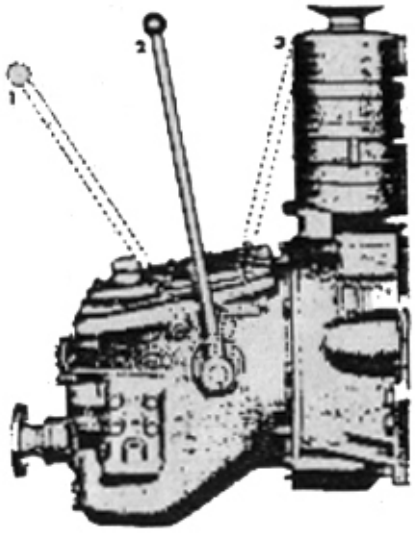


Fig 22. control lever position

1. ***Ahead drive***
2. ***Natural***
3. ***Ahead Drive***

Top

Neutral

Both clutch plates are disengaged. Gears and propeller shaft stationary

Ahead Drive

The figures in the following description refer to fig. 23.

When the control lever is pushed forward this movement is transferred via clutch operating mechanism and bearing 11 and a link system with toggle mechanism 8 to pressure plate 3. This plate engages the clutch plate 6 farthest from the engine with rear plate 7 of the clutch compartment. Engine shaft rotation is transferred via this disc to ahead shaft 10 with gear 15 and further through gear 22 to driven shaft 25. The propeller shaft then rotates in the opposite direction to the engine shaft (right-hand propeller).

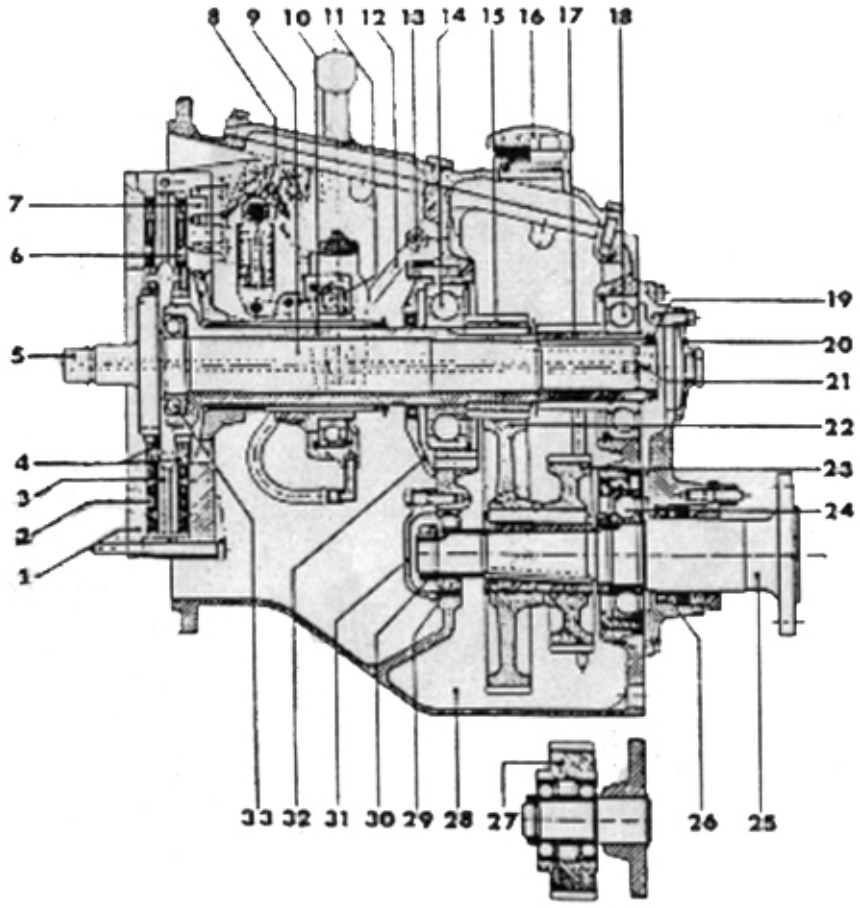


Fig 23. Mechanically controlled reverse-reduction gearbox

1. *Clutch compartment, front plate*
2. *Clutch plate, front (for astern drive)*
3. *Pressure plate*
4. *Flange on plate hub*
5. *Shaft end for support bearing*
6. *Clutch plate, rear (for ahead drive)*
7. *Clutch compartment, rear plate*
8. *Toggle mechanism*
9. *Astern shaft*
10. *Ahead shaft*
11. *Ball bearing, clutch operating mechanism*
12. *Lubricating hose, clutch bearing*
18. *Ball bearing, astern shaft*
19. *Knurled nut*
20. *End cover*
21. *Lubricating nipple, support bearing*
22. *Gear, ahead gearing*
23. *Gear astern gearing*
24. *Propeller thrust bearing*
25. *Driven shaft*
26. *Seals*
27. *Idler gear*
28. *Oil sump*
29. *Roller bearing, driven shaft*

13. Clutch compartment, front plate
14. Clutch plate, front (for astern drive)
15. Pressure plate
16. Flange on plate hub
17. Shaft end for support bearing
30. Nut
31. Cover
32. Cover with seal
33. Support bearing between ahead and - astern shafts

Ahead Drive

When the control lever is pushed backwards this movement is transferred via clutch operating mechanism and link system to the plate which engages forward clutch plate 2 with forward clutch plate 1 of the clutch compartment. Engine shaft rotation is transferred via gear 17 on astern shaft 9, idler gear 27 and gear 23 to driven shaft 25, which, together with the propeller shaft rotates in the opposite direction to the previous case.

Adjusting

The powerful duplex clutch with toggle mechanism is spring loaded by the springs in each of the spring housings. This spring loaded mechanism is designed so that it follows up and compensates wear on the clutch plates, making all adjustment unnecessary. The mechanism permits a clearance of 0.08 – 0.12 in. (2.1 – 3.2 mm.) on both sides of a plate when the other clutch is engaged. This clearance increases to a maximum of ¼ in. (6.5 mm.) in the worn condition. The easiest way to check plate wear and determine when they need replacing is to check the position on the coupling mechanism shaft end. When the plate facings are new the distance between the shoulder on the shaft and upper part of the spring housing is approx. 5/32 in. (4mm.) (see fig 24) when the clutch is engaged in one direction or the other. When the facings are worn so much that they need replacing the shoulder on the shaft is about 1/32 in. (1 mm.) above the upper part of the spring housing. (see fig 25).

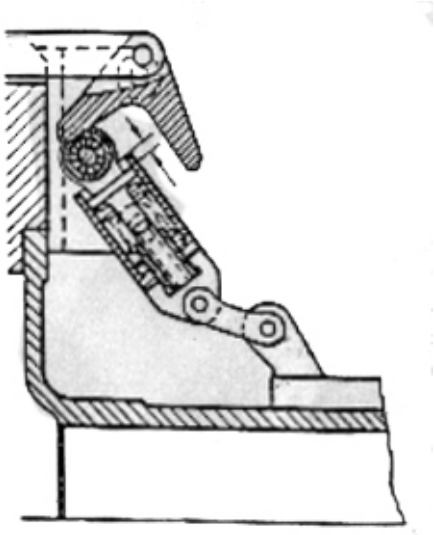


Fig 24.

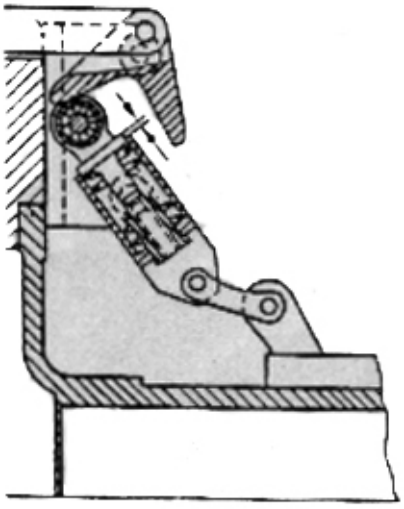


Fig 25.

Facing Replacement

If, for some reason or other the clutch is disassembled or worn facings are replaced, the following must be observed :
The flanges on the spliced plate hubs must be turned towards each other, see 4, fig 23. Otherwise the plates will not take up the correct positions during operation.

Oil level and recommended oils

The lower part of the reverse reduction gearbox forms an oil sump in which the reduction gears work in a bath of oil. Oil level in the reverse-reduction gearbox must be maintained between the level marks on the dipstick, fig 26. Check the level daily and top up with new high-grade oil when necessary. Use oil with the same viscosity as that of the oil in the engine.
The oil capacity of the reverse-reduction gearbox is 5.8 Imp pints (3.3 litres)

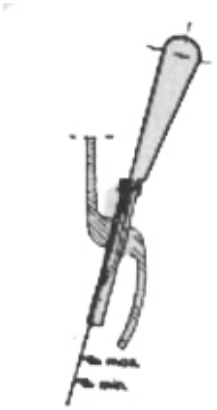


fig 26.

Oil Changing

Changing the oil in the reverse-reduction gearbox the first time after 100 hours running and then every 6000 hours, but at least once a year. If the engine operates at a higher speed than 1,5000 r.m.p the oil must be changed every 300 hours. Use oil of the same grade and viscosity as for the engine.

Ball Bearing Grease

The release bearing is lubricated through a nipple (13, fig 23) which is connected to the bearing by flexible hose 12. The support bearing in the flywheel and bearing 33 between the ahead and astern shafts in the reverse and astern shafts in the reverse-reduction gear are lubricated through nipple 21 fig23 at the rear end of the astern. Shaft. The hexagon plug in end cover 20 must be removed to gain access to this nipple. Lubricate both these nipples with a high-grade, heat-resistant ball bearing grease every 25 hrs.

DRAINING PUMP

Oil changing in the engine and reverse-reduction gear is facilitated by the provision of a draining pump on the left-hand side of the flywheel housing. Pipes lead from the pump to the oil sumps of the engine and the reverse-reduction gearbox.
The cock underneath the crankcase pump can be set in three positions. Handle straight down : Draining pump connected to oil sump of engine. Handle straight forward : Draining pump connected to oil sump of reverse-reduction gearbox.
Handle straight back : Cock closed. (Always set the cock in this position after changing oil)

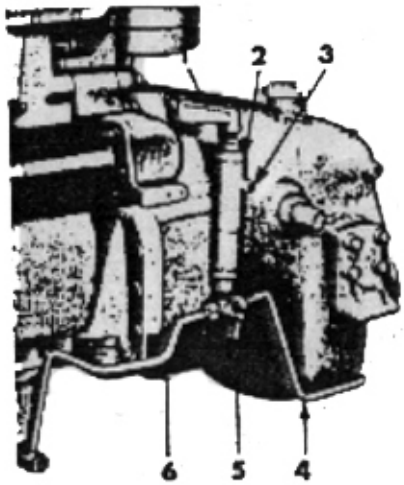


Fig 29. Draining pump

1. ***Pump handle***
2. ***Draining pump***
3. ***Connection for oil discharge pipe***
4. ***Drain pipe from reverse-reduction gear***
5. ***Three-way cock***
6. ***Drain pipe from engine***

COOLANT PUMP

The coolant pump is mounted on the left-hand side of the engine and V-belt driven from the crankshaft. The pump impeller of oil proof rubber has been splined metal hub and easily removed after taking off the end of the pump. The working principals of the coolant pump are illustrated below.

Fig 30. Working principals of coolant pump.

Top

1. When the impeller blades leave the pressure plates they straighten out. As they continue to rotate a vacuum arises behind them and water flows into the pump.
2. Continued rotation of the impeller moves the water from the inlet to the discharge port. Each blade carriers a given amount of water with it.
3. When the blades regain contact with the pressure plate the y flex and the blades following up force the water out through the discharge port. Warning. Always check before starting that the bottom valve (1. figs 17 and 18) is open. If the pump is allowed to run without water the impeller (of rubber) may be So badly damaged by friction that it becomes unserviceable.

BILGE PUMP

The engine is fitted with a bilge pump of the same design as the coolant pump. The pump is driven via a manually operated friction clutch. The control lever 6, fig 31, is pushed upward to engage the clutch. When the stop on the clutch lever contacts the stop lug on the pump housing in it's engaged position, the clutch must be adjusted.
Adjust as follows : Stop the engine and engage the clutch. Loosen the clamping screw for the drive sleeve and turn the sleeve a little in a clockwise direction seen from the flywheel end. Do not turn the sleeve too much each time and make sure that the coupling element does not following the sleeve round. Lock the sleeve to the coupling element with the clamping screw.
After engaging, check that the clutch arm tensioning device passes the dead point. If it does not, loosen the drive sleeve again, turn it clockwise a little further and relock..

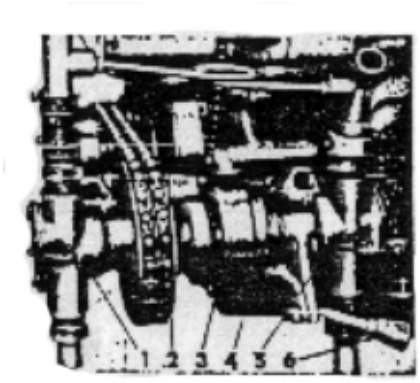


Fig 31. Coolant and bilge pumps

1. ***Coolant pump***
2. ***Pipe (Bypass to bilge pump }***
3. ***Connection for oil discharge pipe***
4. ***Drain pipe from reverse-reduction gear***
5. ***Three-way cock***
6. ***Drain pipe from engine***

NOTE. When adjusting set the distance between the stop lugs as 3/16 -3/8 in. (5-10mm.)
After using the bilge pump it must be disconnected as soon as the boat has been pumped dry. To prevent the impeller being damaged by friction if the bilge pump continues running when there is no bilge water left to pump out, the pump is connected to the coolant pump pressure line by pipe 2, fig 31,which continuously supplies the pump with a little water.

Installation

Great attention should be paid to practicability and accessibility when installing the marine diesel engines.
The bed must be right and designed to distribute the load over the largest possible area of the hull. Before bolting down the engines, make sure that there are no bending loads between the frame and the bearing brackets or engine bed. Make sure also that the engine and propeller shafts line up properly. Alignment, which is best done with the help of shims, should be rechecked both after launching and when the engine has been in service some time in order in order sure that the engine bed has not given.

WARNING. Engine stern slope must not exceed 15”

All coolant pipe lines should be of copper and run without sharp bends. Drain cocks should be fitted wherever water locks can arise.
If there is no engine casing, the marine diesel should be installed with a belt guard. This can, for instance, be in the form of a light angle-iron structure, covered with wire netting and attached to the engine bed by wing nuts for easy removal for belt replacements, etc

Directions for use

In order to help you make the best use of the engine’s good operating properties we have prepared the following advice for its care and maintenance.
Make a habit of listening to the engine every now and then while it is running.
If it runs unevenly or badly the reason should be traced at once and the fault remedied.
If the oil consumption has become abnormally high or if there are other indications of wear it is usually sufficient to give the engine a thorough overhaul. This overhaul should be performed by a repair shop or specially trained mechanic. All that is required otherwise is a certain amount of preventative checking. This checking should be done by the operator himself. No special tools are required. Some advice should on this care and attention, as well as engine starting, is given below.
Correct lubrication is of extreme importance, ensuring trouble-free running and long life. Always keep the fuel and oil, the engine and its filters quite clean. This prevents foreign particles from getting into the engine and causing abnormal wear. Refill the fuel tank in good time; this prevents air lock in the fuel system. It is inadvisable to race an old engine or put it under full load immediately after start. Check that all nuts are properly tightened.

RUNNING IN

The running in period of an engine is the most important part of its entire life. During the first 50 hours of this period the engine must be run carefully, This is done to entire that the cylinder walls pistons and bearing surfaces acquire the hare bright surface that provides maximum length of life.
Do not subject the engine to long hard loads during the running- in period. On the other hand, however the engine should not be run all too slowly as the piston rings might then stick and cause high fuel consumption, Although 50 hours running marks the end f the running-in period, it is still inadvisable to operate the engine under heavy load for long period the engine lubrication oil must be changed more often than is subsequently normal, Change the first time after 30 hours, at the same time cleaning the oil sump strainer and draining off any sediment from the lubricant cleaner. Change again at the 100-hour mark and then regularly every 200 hours.
Every time the oil is changed, drain the lubricant cleaner to avoid mixing new and old oil. Never rinse the engine out with flushing oil; bearing pressures in a diesel engine are too high to permit the use of such oil.

Top

Before delivery, all engines are run on the factory test bench/ These tests show that all fits are satisfactory and we therefore disclaim all responsibility for any piston or bearing seizing caused by neglectful running-in etc. Filter all fuel before filling.
Absolute cleanliness is essential in connection with all work on the diesel engine, particularly the injection pump and injectors.

RPRECAUTIONS BEFORE STARTING

1) Make sure that the cooling system is quite full. Use only pure water, preferably rain water which is the best coolant. The filler cap is of pressure type and it is therefore necessary to exercise caution if it has to be removed when the engine is warm. Turn the cap slowly anti clockwise until resistance is felt. Any steam will then blow off through the overflow pipe and the cap may then be removed without risk. Never fill up with cold water when the engine is hot, this can cause cracking. Check that the cooling system bottom valve is open. Check also at regular intervals that the strainer in the coolant inlet is clean and free from impurities that might clog the inlet and interfere with the cooling. After the engine has started, check the salt water discharge to make sire that the salt water is circulating properly.

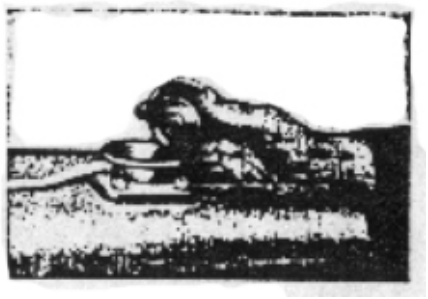


Fig 33.

2) Check oil level in engine and reverse-reduction gearbox. The level should be between the two marks on the dipsticks. Always use diesel lubricant " For Service DG" when changing or topping up. If oil consumption has brought the level to the lower mark, top up with new oil. Before the level is checked the engine must have stood idle long enough for the oil to run down into the sump.

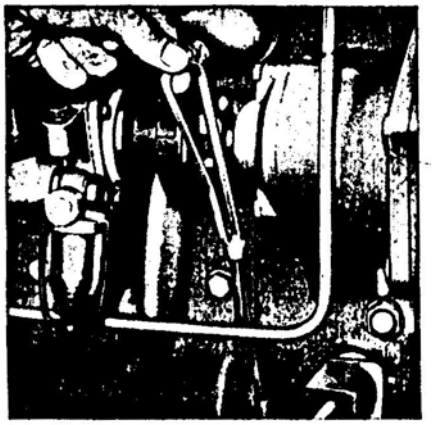


Fig 34. Checking engine oil level.

3) Check that there is fuel in the tank. Always use clean fuel and take care to prevent dirt from getting into the tank when filling. Also check, every now and then, that the breather holes in the cap are not clogged.

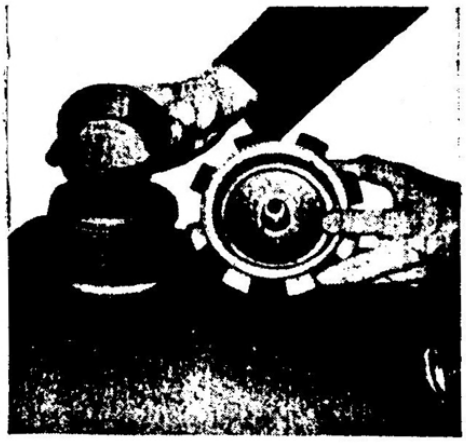


Fig 35.

STARTING

Electric starting

1. Turn staring key (to close circuit through starting switch). Charging indicator lamp on instrument panel lights.
2. Advance speed control lever about ¾.
3. Press in start button.
4. Release start button.
5. In cold weather, press in cold-start button before trying to start. Note that this does not apply to the three-cylinder engine, which is fitted with Bosch injection pump. For this engine please see instructions under "Starting in cold weather" Page 43

WARNING. If the engine does not start at the first attempt, both the engine and the starter must be stopped before a new attempt is made. Otherwise the starter motor and ring gear teeth may be damaged.

Hand Starting

Position 1. Position of decompression lever when engine is running. Decompression device not in use

Position 2. Decompression device holds open all exhaust valves except that of first cylinder in which compression is obtained.

Position 3. No compression in any of cylinders. All exhaust valves depressed.

Hand Starting Procedure as follows:

1. Set decompression lever at engine front end on position 2, fig.36. On the four-cylinder engine, which is fitted with two decompression levers (one for each cylinder block), the front lever is set on position 2 and the rear on position 3.
2. Advance hand control on injection pump governor about ¾.
3. Press in cold-start button on governor. (Does not apply to three-cylinder engine, which is fitted with Bosch injection pump)

4. Turn crankshaft with starting handle until there is compression in the first cylinder. The crank should be applied so that its handle is on the way up at this moment.
5. Pull round steadily until compression resistance has just lightened; at that moment the piston has passed the T.D.C. and this crankshaft has practically two revolutions to go before there is again compression in the cylinder.
6. Crank two powerful turns to obtain compression and ignition in the first cylinder. As soon as ignition is obtained, quickly return the decompression lever to position 1; the engine will then work on all cylinders

The engine can also be hand started as follows:
1. Set the decompression lever on position 3; all exhaust valves are then depressed and there will will be no compression in any of the cylinders.
2. Advance the speed control lever ¾.
3 Give 6-7 powerful turns with the crank to attain sufficient rotational speed.
4. Quickly return the decompression lever to position 1 to obtain compression and ignition in the cylinders. Run the engine a few minutes with the reverse-reduction gear in neutral. In cold weather the lubricating oil is so viscous at the start that it must be warmed up before it can pass quickly enough through the oil passages to the pistons and bearings; otherwise the engine may seize.
Check oil pressure as soon as the engine has started. Lowest permissible pressure is 28 lb/sq.in. (2 kg/sq.cm). Make a habit of checking the oil pressure every now and then; it should be between 40 and 60 lbs/sq.in. (3-4 kg/sq.cm.).
Check coolant temperature when engine has been running a while. It should be between 160 and 170 deg F (70-80 deg C), which is the best working temperature for the engine.
Do not forget to make sure that the charging indicator lamp goes out when the engine starts. This shows that the generator is supplying current. If the lamp fails to go out, something is wrong.

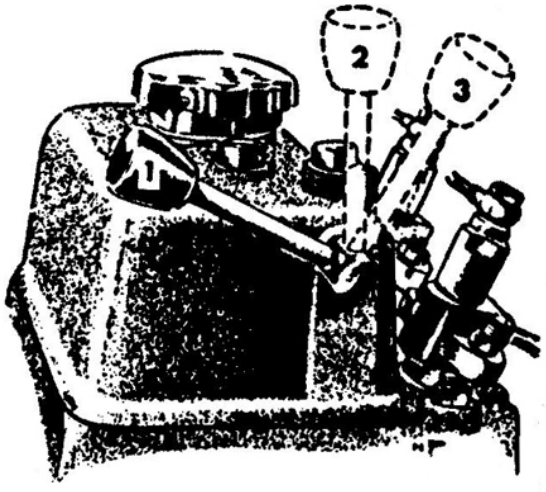


Fig 35.

STOPPING

Stop the engine by moving the injection pump stop lever backwards to the stop position and holding it there until the engine no longer turns over.
Break the circuit by turning the key in the starting switch when the engine has stopped. If this is not done the battery will discharge.
If the engine is to stand idle for a longer period or if there is a danger of frost, all cooling water should be

drained off. Turn off the bottom cock and drain the salt water from the coolant pump, pipe lines and heat exchanger (4, fig. 17 and 18). On the three-cylinder engine salt water must also be drained from the exhaust manifold (8, fig. 17).

Fresh water that does not contain anti-freeze must also be drained off whenever there is a danger of frost. To drain, first loosen the cap on the heat exchanger, otherwise some of the water might remain in the cooling system and damage in cases of frost. Fresh water is drained from the engine through a cock on the engine block (9. fig. 17 and 18) and, on the four-cylinder engine, also through a cock on the exhaust manifold (8, fig.18). Fresh water in the heat exchanger is drained through cock 8, fig.2, and the cock on inlet bend, 9 fig. 4.

STARTING IN COLD WEATHER

If the temperature is in the neighbourhood of or below 32 deg F (0 deg C), starting should be facilitated as follows:

Three-cylinder engine

When the engine is to be stopped, set the governor hand control lever on the idling position before pulling out the stop control. As soon as the engine has stopped, push in the stop control and then advance the hand control lever again about ¾.

This procedure when the engine and injection pump are worm and the oil is thin, ensures certain engagement of the automatic cold-start device in the injection pump governor. The governing rod in the pump is then pushed forward past the normal stop and the engine receives an extra portion of fuel at the starting instant.

Four-cylinder engine

Press in the cold-start button. This pushes the pump governing rod past the normal stop and the engine receives an extra portion of fuel at the starting instant. Note that the speed control lever must be advanced about half way before the button is pressed in. Under no circumstances whatever may the button be locked in the pressed-in position once the engine has started; the amount of fuel injected will then be so great that it can cause serious damage to the engine.

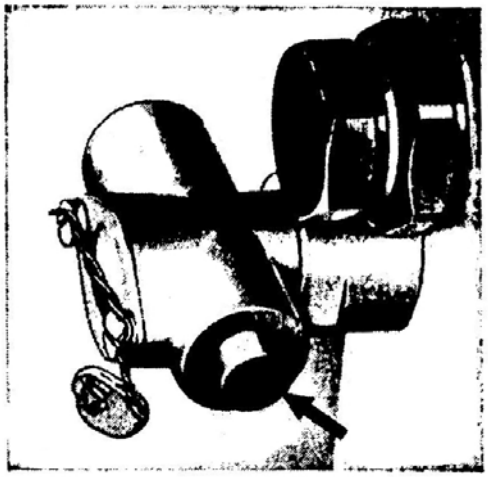


Fig 37.

Disengage the engine when starting. It will then turn over easier and permit a higher starting motor speed. At exceptionally low temperatures it is advisable to store the battery on warm premises if the engine is to stand idle for any length of time. Refit the battery just before starting; it is then warm and can provide maximum power.

WARNING

Never put the engine under heavy load immediately after start. Failure to warm up at low r.p.m. and light load subjects the engine to abnormal stresses. This is because the oil is so viscous when it is cold that it cannot pass quickly enough through the fine passages to the pistons and bearings. There is, of course, also a danger of the engine seizing under these conditions.

BLEEDING THE FUEL SYSTEM

If the engine is new, if the fuel tank has been run dry or if air has got into the fuel system in some way or other, the system must be bled before the engine can be started.

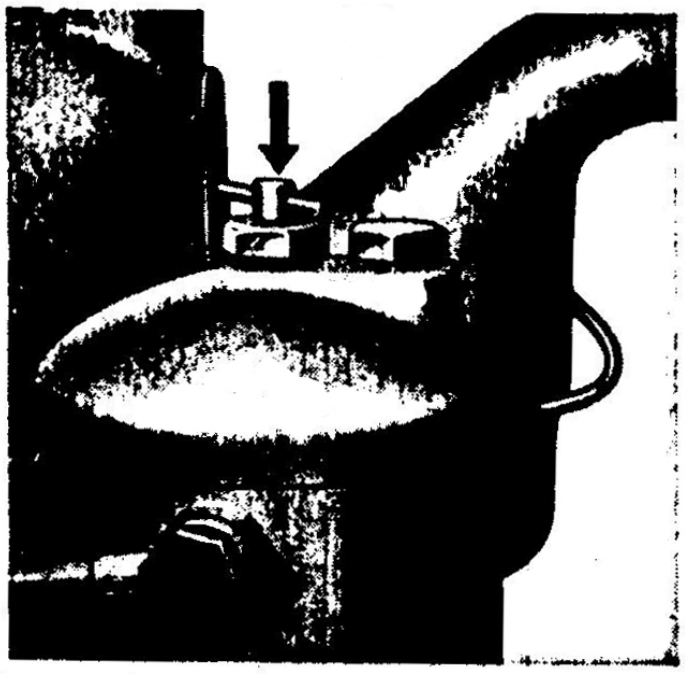


Fig 38.

1. Bleed the large fine filter first. Open the bleeder screw on the filter and work the hand pump until fuel free from air bubbles flows out at the vent.

2. Close the screw and open instead the corresponding screw on the injection pump. Pump with the hand pump again until fuel free from bubbles flows out. When the screw has been closed again the engine is ready to start. The pressure pipes can, of course, also be bled, but a quick start can usually be obtained without going to this trouble.

Top

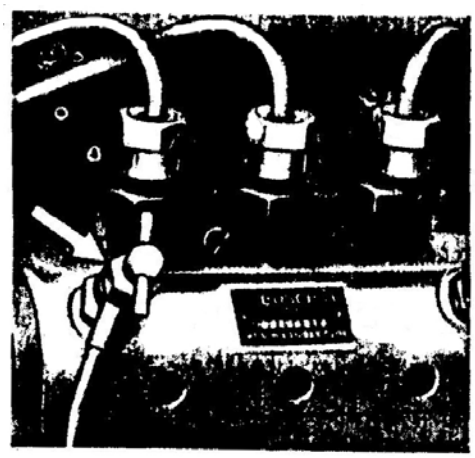


Fig 39.

Regular checking and preventive maintenance

DAILY

1. Remove and clean the air filter oil chamber and refill with oil to the level mark. Used engine oil will be good enough for this purpose. At regular intervals remove the entire air filter and clean the filtering element in paraffin or petrol.
The condition under which the engine operates are, of course, decisive for how often the air filter must be cleaned. It will, however, soon be found whether it needs cleaning every day or if the period between cleanings can be extended.
Always pay special attention to the air filter and its maintenance; the life of the engine is greatly dependent upon the cleanliness of the air sucked into the cylinders.

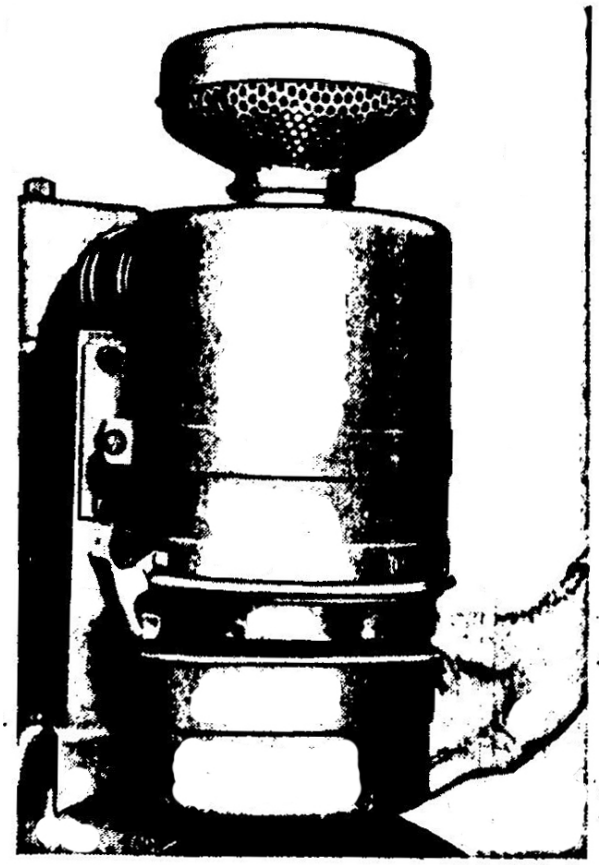


Fig 40.

2. Check that no oil, fuel or water leaks out of the engine anywhere. If a leak is found, see that ii is remedied as soon as possible. Try also to keep the engine clean; it will then be easier to find any leaks. A clean engine is also much easier to keep in good trim.

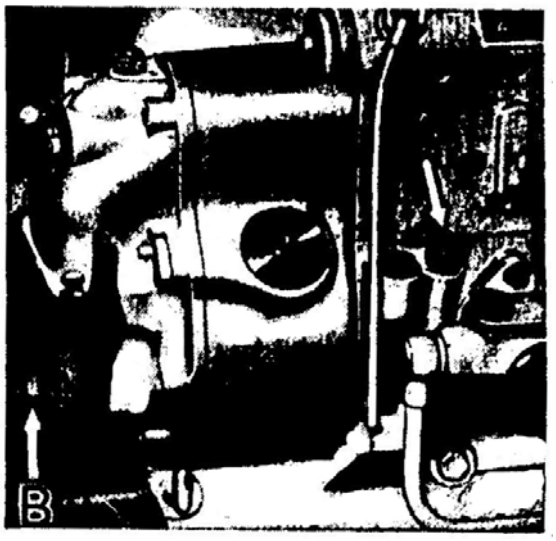


Fig 41.

Top

EVERY 50 HOURS

1. Check oil level in injection pump and centrifugal governor. In the pump it should be between the two marks on dipstick A, and in the governor at plug B. If the level is too low, top up with the same oil as is used for the engine.

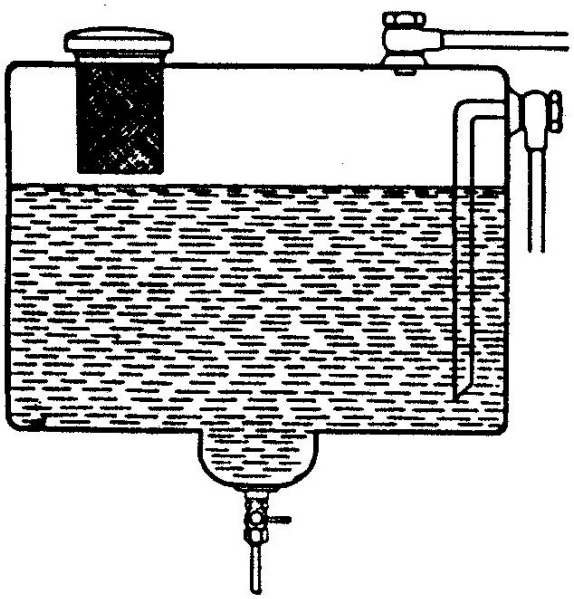


Fig 42.

2. Drain off sludge from fuel tank. Open the cock and let some of the fuel run out and take the sludge with it. This should be done when the fuel has stood still for at least one whole night.

3. Check belt tension. Adjust the generator belt by loosening the two holding screws and the adjustable mounting so that the generator can be pulled outwards. It must be possible to depress the belt about 3/16 in. (5 mm.) at arrow A.
Adjust the belt between crankshaft and pump shaft by screwing the outer half of the crankshaft pulley inwards or outwards in relation to the inner half. It must be possible to depress the belt about 3/8 in. (10 mm.) at arrow B. The two pulley halves are locked relative to each other with locking screws.
Adjust the cooling water pump belts about ¾ in. (20 mm.) at arrow C.

Top

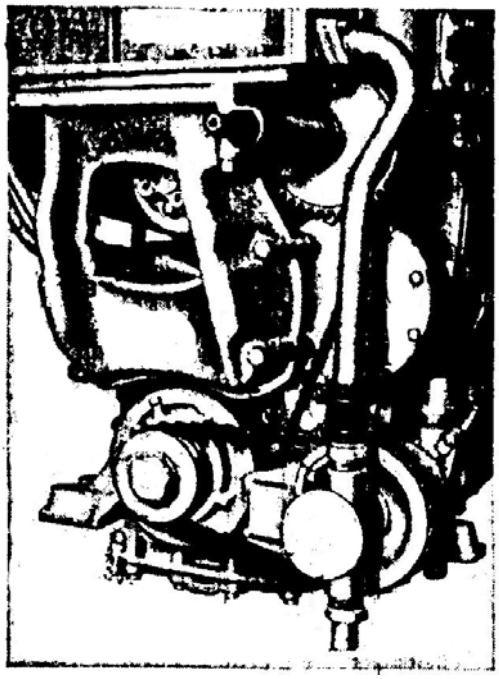


Fig 43.

4. Check that the battery electrolyte is about 3/8 in. (10 mm.) above the plates. Top up with distilled water if the level is too low. Make sure that the cable lugs are clean, properly tightened, and smeared with a thin coat of Vaseline or similar to protect them against corrosion. Be careful when working on the battery, the electrolyte is corrosive.
Check the degree of charge with a hydrometer. This shows the specific gravity of electrolyte (fig. 44), which is 1.275-1.285 when the battery is fully charged. When the specific gravity has fallen to 1.230 the battery must immediately be re-charged at a charging station.

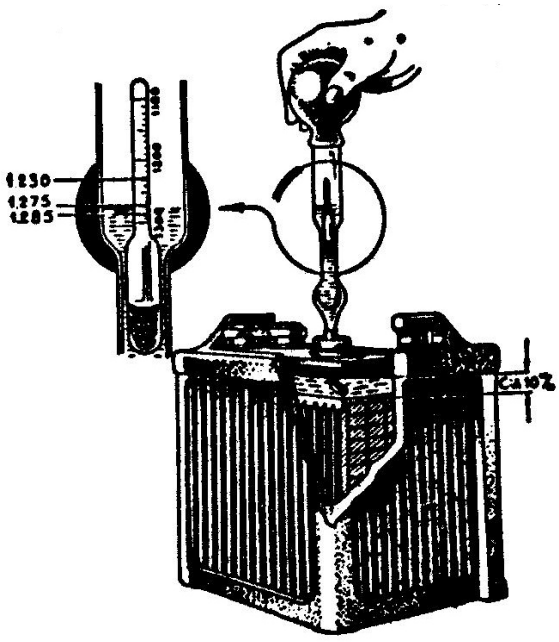


Fig 44.

Top

EVERY 100 HOURS

1. Lubricate the water pump with heat-resistant ball bearing grease. Do not apply too much grease, 4-5 shots with the grease gun are quite sufficient.

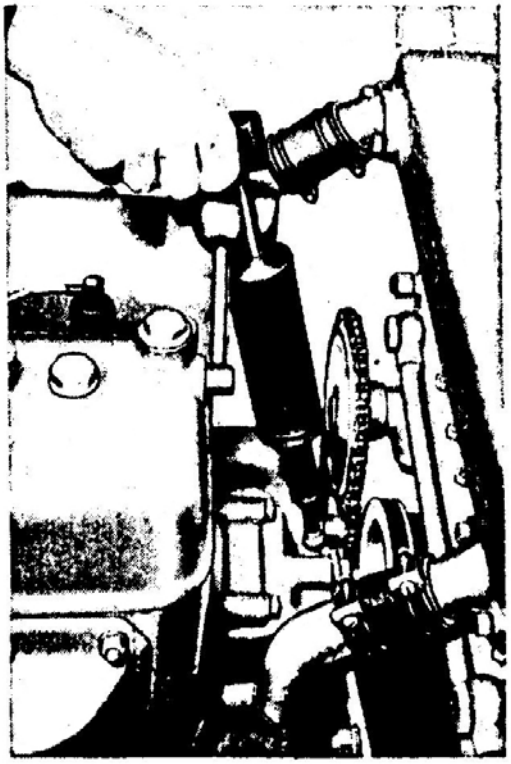


Fig 45.

2. Lubricate the starting motor. Remove the plug in the end and lubricate with engine oil. Do not add more than a few drops at a time. Too much oil can damage the starting motor.

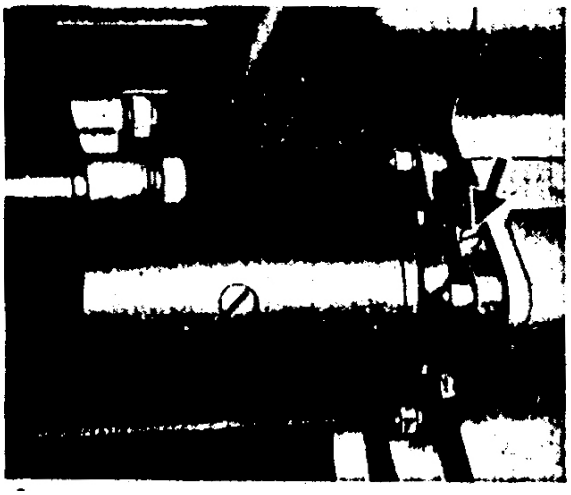


Fig 46.

Top

EVERY 200 Hours

1. Change the engine oil. See that the engine is run warm before pumping out the oil. Turn the cock on the drain pump suction side so that the handle points straight down, fig. 29. Pump out all oil.
Remove the plug in the lubricant filter, fig. 47, and make sure that the oil runs out properly.
Replace the plug. Shut off the cock and fill with diesel lubricating oil “For Service DG” to the upper level mark on the dipstick. Do not forget that it must always be “For Service DG” oil, never ordinary engine oil; bearing pressures in a diesel engine are too high to permit the use of such oil.

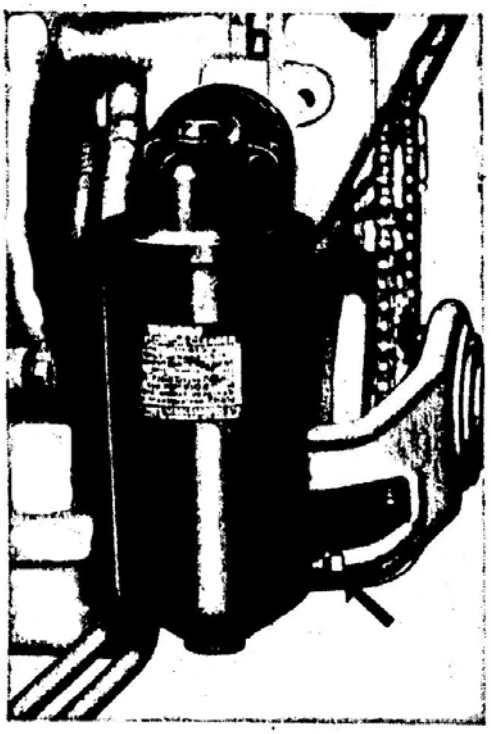


Fig 47.

2. Clean the injection pump pre-filter. Loosen the nut and swing the clamp to one side so that the glass and filter cloth can be removed. Wash the glass and cloth in clean petrol and refit. To prevent air leaks, check that the gasket for the glass is undamaged.

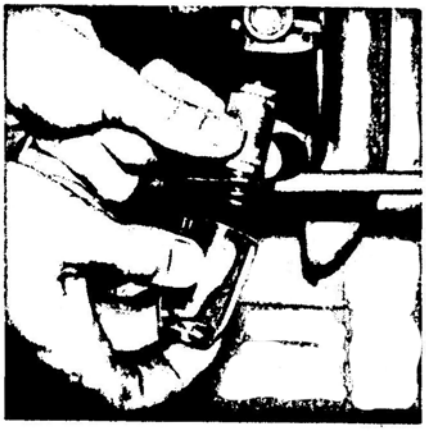


Fig 48.

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3. Remove the plug in the bottom of the fine-filter and drain off the sludge. Never make any adjustments to the filter element itself; if you suspect that it is clogged, let a diesel mechanic check she filter. The element must never be cleaned and should instead be replaced when it becomes clogged. With the help of a low pressure gauge, a diesel mechanic can easily see if the element is clogged or not.

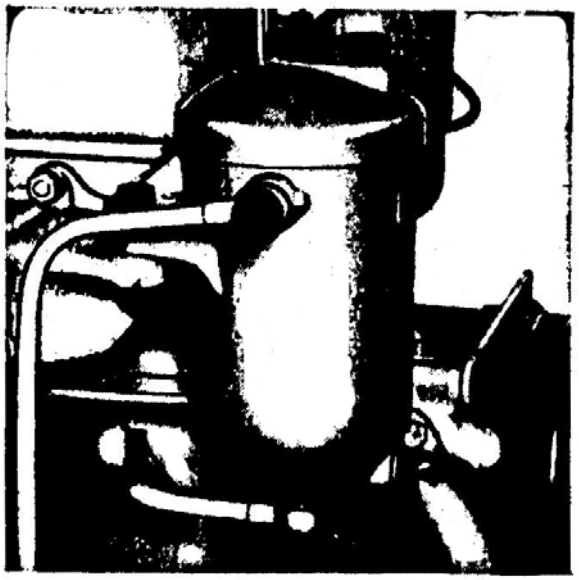

Fig 49.

4. Remove the ventilator from the cover over the valve mechanism and wash it in clean petrol or paraffin

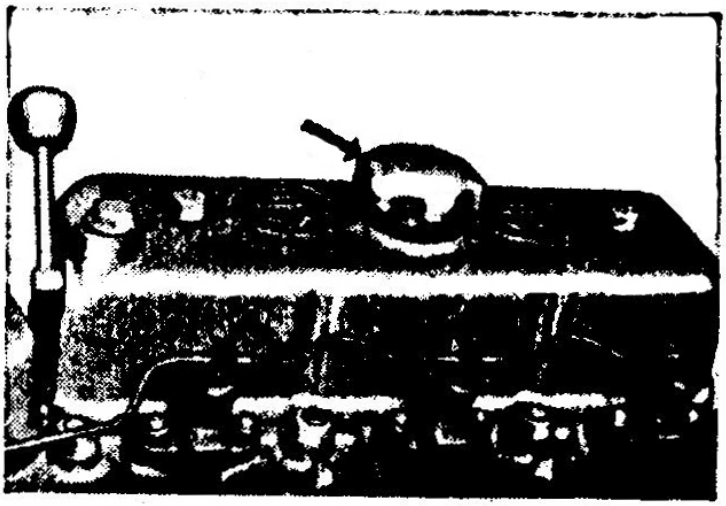

Fig 50.

EVERY 500 Hours

1. The lubricant cleaner on the right-hand side of the engine has a replaceable filtering element. This element gradually becomes clogged by the impurities it collects and must therefore be replaced every 500 hours – earlier if the oil dirties quickly.
This is done by loosening the screw in the lid and lifting out the cleaner and element, fig. 51. Clean the lubricant cleaner thoroughly with petrol or paraffin. See that the gasket seals properly when the cleaner is re-fitted. If it does not, fit a new one. Take care that no dirt gets into the piping.

Top

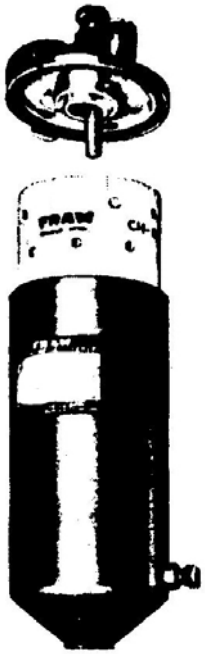

Fig 51.

2. Check the valve clearance. This check must also be performed every time the cylinder block has been removed or the cylinder head nuts re-tightened. The valves must not be adjusted with the engine running; valve and piston might then knock together.
Correct valve adjustment is of great importance and we therefore recommend careful study of the procedure to be followed. The valves are numbered from the front end of the engine.

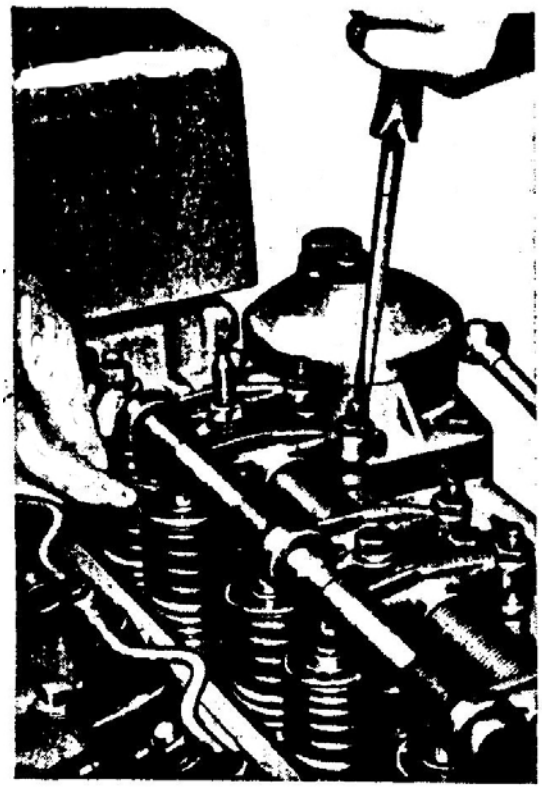

Fig 52.

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Three-cylinder engine

1. Pull the crankshaft round and watch the movement of the first valve rocker arm. Note the point where the valve is widest open and turn the crankshaft one full revolution. Now adjust the first and third valves.
2. Check the rocker arm of the fourth valve. Pull the crankshaft round one revolution after the valve has opened to a maximum. Now adjust the fourth and fifth valves.
3. Check the rocker arm of the second valve. Pull the crankshaft round one revolution after the valve has opened to a maximum. Now adjust the second and sixth valves.

Remember : 1-3, 4-5, 2-6

Four-cylinder engine

This engine can be adjusted in a manner equal to the three-cylinder engines but in the sequence 1-6, 2-4, 3-8, 5-7.

The first figure in every group denotes the valve to be watched when pulling round the crankshaft. The two valves in each pair must be adjusted together. The valves of the four-cylinder engine can also be adjusted when the pistons in the respective cylinders are at the T.D.C. following the compression stroke. When the piston is in this position the camshaft cam is at its downward position. The best way to set the piston at its T.D.C. is to watch the rocker arm. When the exhaust valve closes and the inlet valve is just about to open for the 1st cylinder, the piston in the 4th cylinder is at its T.D.C. following the compression stroke. When the exhaust valve closes and the inlet valve is just about to open for the 4th cylinder, the piston in the 1st cylinder is at its T.D.C. following the compression stroke.

The above relationship also applies to the 2nd and 3rd cylinders. Adjust with the setting screw on the rocker arm after loosening the lock nut. Check with the feeler gauge. This is to be 0.016 in. (0.40 mm.) for inlet valves and 0.018 in. (0.45 mm.) for exhaust valves. Tighten the nut properly.

Note that the valve clearances are for warm engines.

3. Check injector opening pressure and spray shape. This work should be done by an authorized shop having the necessary testing pump. When opening pressure is correct injection takes place at 1920 +70 -0 lb/sq.in. (135 +5 -0 kg/sq.cm.). If there is no authorized shop available, spray can be checked by removing the injectors from the engine, one at a time, and refitting them with the nozzle pointing outwards from the engine. Set the decompression lever on position 3 and turn over the engine with the starting motor or crank. The fuel must then leave the nozzle thoroughly atomized (shape A) and the spray must cut off sharply after delivery of the fuel. If the fuel discharges as a jet or dribbles from any of the nozzles after injection, such nozzles must be adjusted or replaced. B and C show incorrect spray shapes.

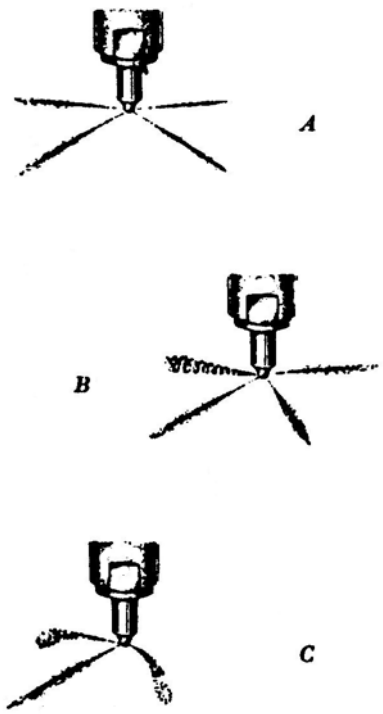

Fig 53. Spray shapes

Exercise care when testing, the sprays posses considerable penetrative force and can harm eyes, etc

EVERY 1000 HOURS

1. Check injection pump setting.
2. Check centrifugal governor (max. speed and idling).
3. Check cold-start device.
4. Replace element in un-scaled fine-filter.
5. Check fuel feed pressure.
6. Clean strainer in oil sump.
8. Check starting motor and generator brushes.
9. Check thermostat.

EVERY 2500 HOURS

1. De-carbonize engine and grid valves.
2. Recondition starting motor and generator.
3. Replace element in sealed fine-filter

If oil consumption is excessive (more than 0.053 oz-h.p.h [1.5 g/h.p.h.] excel.oil changes) or if there are other signs of wear:

1. Replace piston rings and check pistons and liners.
2. If necessary, recondition engine.

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General Instructions

It is obvious that a complicated piece of machinery like a diesel engine must be taken well care of if it is to give trouble-free service. The instructions we have already given for the care, maintenance and checking of the engine will now be complemented with other directions of a more general nature.

Lubricating System

We have already mentioned the necessity of using special so-called diesel lubricant in the engine. This is not just to make things as complicated as possible; the diesel engine really needs a special lubricant if it is to give its best. High combustion pressure and running temperature demand special attention to lubrication and have led to the development of the so-called HD (Heavy Duty) oils. These oils contain chemical additives which prevent them oxidizing at high temperatures, etc. Ordinary engine oil, on the other hand, oxidizes rapidly and the products easily cause trouble in the form of stuck piston rings and valves, clogged oil passages, etc.
Therefore, use only the special diesel oil "For Service DG" recommended by well-known oil companies. Never mix oils of different grades or makes.

Recommended lubricating oils for engine.

At temperatures above 32 deg F (0 deg C) SAE 20 or 20 W

At temperatures below 32 deg F (0 deg C) SAE 10 or 10W

The carbon-dissolving properties of the HD oils make it difficult to judge the condition of an oil by its colour. It is therefore important to follow the oil changing instructions based on our experience.
Correct lubrication with suitable oil is an important part of an engine's maintenance. Lubricant costs are insignificant compared to the probable cost of neglected lubrication. Make a habit of lubricating all round and changing oil at the regular intervals listed on the lubricating chart at the end of this book. These times presuppose the use of high-grade lubricants.

FUEL SYSTEM

Clean fuel is an absolute pre-requisite for trouble-free engine running. Just how important this is, will perhaps be more readily understood if we explain the precaution working of the fuel pump. At an exact piston position and during an extremely short period – 1 ½ thousandths of a second in normal operation – the nozzle needle must lift, an accurately measured amount of fuel be injected and the spray be sharply cut off. The quantity injected into every cylinder is smaller than one drop for every pump stroke. If there is to be any possibility whatever of such performance, every part of the injection system must be made with extreme precision. We can, for instance, mention that the clearance between the pump plunger and its cylinder is only 4/1000,000 in. (1/1000mm.). This is about 25 times smaller than the thickness of an ordinary hair. It is thus obvious that even the most minute foreign particles in the fuel can have a highly destructive influence if they get into the fuel system. To prevent this, the engine is provided with effective filtering arrangements. However, these filters cannot stop any large quantities of impurities without clogging. As soon as a filter becomes clogged, resistance becomes excessive and the engine runs poorly. This is readily prevented by keeping the fuel a clean as possible when filling it into the tank. To this end we are including the following some advice on storing and filling fuel.

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Storing in tank

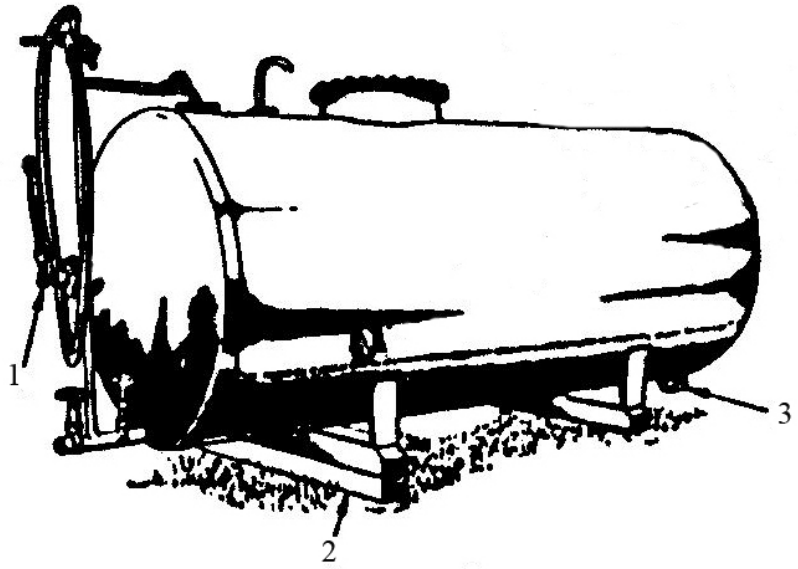

Fig 54.

1. ***Fuel cock. (pump)***
2. ***Tank to slope 1 in. (25 mm.) per yard (metre) of length***
3. ***Drain cock for sediment***

The best way to store fuel is to tank it as shown in fig. 54. This gives the fuel time to stand long enough for the foreign particles that it always contains to sink.

Storing in barrels

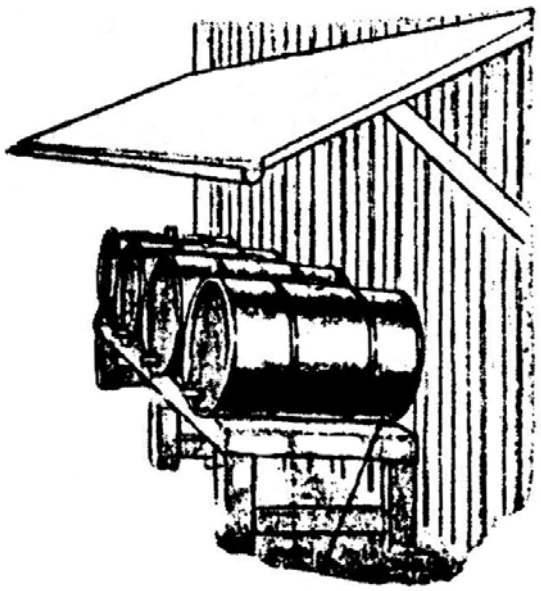

Fig 55.

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If it is not possible to store the fuel in the tank and barrels have to be used instead, several should be laid up on a cradle so that the fuel can stand at least 24 hours. The barrels must be protected against rain and

dust. Never fill the engine fuel tank with fuel from barrels that have newly been moved. An extra safeguard is to use a funnel with milk filter when filling the tank. Although this takes longer, the extra time will be repaid time and time again by lessened running interruptions and reduced repair costs. In the winter the fuel tank should be kept as full as possible. This counteracts the formation of condensation water in the tank..

Remember, then, that it pays to use clean fuel.

Fine filter

On the other hand, it never pays to attempt to clean a fine filter. When the filter clogs, the entire element must be replaced, and this should be done by a diesel mechanic.

Sealing

All seals have been applied to prevent other than authorized diesel shops from repairing these parts. Never remove the seals, this makes the factory guarantee non-valid. Although there are no seals on the injectors we do not recommend dismantling them if they are suspected of being faulty. It is far better to keep one or two injectors in reverse. The faulty injector can then be replaced with one of the spares and handed in to a diesel shop for repair.

COOLING SYSTEM

The cooling system functions effectively only if all passengers in the cylinder block, cylinder head and heat exchanger are free from deposits and impurities. It is therefore of primary importance to use the purest water possible, preferably rain water. It is also advisable to use an anti-rust additive in the fresh water. This prevents the formation of deposits caused by rusting. See that the fresh water is changed at regular intervals. It will then be seen at once if the water contains rust: if it does the system should be flushed out thoroughly before re-filling.
Fresh water temperature is also very important and should be carefully checked. See that the temperature remains between 160 and 175 deg F (70-80 deg C) when the engine is running. Do not run the engine with low fresh water temperature, this only results in normal wear.

Anti-freeze coolant additive

During the seasons when air temperatures may drop below freezing point, the cooling water should be mixed with an anti-freeze additive. This avoids the necessity of draining off the water whenever the engine is to stand idle. The best coolant is neutral ethylene glycol – water. Denatured alcohol can, of course, also be used but is not as good as it evaporates rather quickly at the engine working temperature. Do not forget to flush out the cooling system thoroughly before filling with antifreeze coolant. The following table shows the freezing points of various mixtures of ethylene glycol and water.

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Ethylene glycol or Denatured alcohol	Specific gravity		Freezing point	
In percentage by Volume	denatured alcohol	ethylene glycol	denatured alcohol	ethylene glycol
10	0.988	1.012	27 deg F (- 3 deg C)	25 deg F (- 4 deg C)
20	0.975	1.027	18 deg F (- 8 deg C)	16 deg F (- 9 deg C)
30	0.964	1.041	7 deg (- 14 deg C)	5 deg F (- 15 deg C)
40	0.954	1.055	- 6 deg F (-21 deg C)	-7.5 deg F (- 22 deg C)
50	0.933	1.068	-22 deg F (-30 deg C)	-36 deg F (-38 deg C)
60	0.913	1.076	-40 deg F (-40 deg C)	-69 deg F (-56 deg C)
70	0.897	-	-65 deg F (-54 deg C)	------

Note that the content of ethylene glycol should not exceed the 60% that gives maximum lowering of the freezing point.

ELECTRICAL SYSTEM

Pay proper attention to the battery. Make sure that the electrolyte is always about3/8 in. (10 mm.) above the upper edge of the plates. Check this once a week and top up with distilled water whenever necessary. At the same time, check that the battery is properly fixed and that the cable lugs are thoroughly tightened, and smeared with Vaseline or similar. Remember that a neglected battery is soon ruined, causing starting trouble and unnecessary experience.

In the wintertime it is particularly important to keep the battery charged. The electrolyte in a charged battery freezes and destroys it. Under particularly severe conditions of cold it is therefore best to store the battery on warm premises. This not only reduces the frost hazard, it also ensures that the battery delivers full output when reconnected to the system at room temperature.

The generator requires no special attention. On the other hand, the starter motor has a lubricator on the rear bearing cap and this should be given a few drops of thin oil every 100 hours. Once a year, the generator and starter motor should be overhauled in a special workshop.

In any defect arises in the generator, relay or starting motor, have it remedied by a qualified electrician. It most often turns out more expensive if you try to do this work yourself.

Fault Finding

In the following we have listed some of the most commonly occurring troubles and how they are remedied. Do not, however, try faults that should be repaired by an authorized workshop. Such faults require special tools and specially trained personnel.

Never forget the necessity of absolute cleanliness in all work on the engine and, in particular, on the injection equipment.

Engine Fails To Start **Engine Starts But Tends To Stop** **Poor Engine Output** **Diesel Knock**

Smokey Exhaust **Engine Runs Erratically** **Engine Fails To Reach Top r.p.m.** **Engine Races**

Oil Pressure Gauge Shows Insufficient Pressure

Top

Symptoms	Possible Cause	Remedy
Engine fails to start	Fuel tank empty	Fill with fuel and bleed
	Clogged pre-filter	Clean Filter
	Air in injection pump	Bleed system
	Stop control in stop position	Chang to running position
	Leakage in a fuel line	Check pipe lines
Back		
	Condensation water frozen in fuel tank, clogging suction pipe	Thaw out tank and drain off sediment (water and fuel)
	Faulty feed pump	Repair by authorized workshop
	Battery discharged	Charge or replace battery
Engine starts but tends to stop	Clogged air holes in fuel tank	Clean out holes
	Clogged Pre-filter	Clean Filter. Check gasket
	Clogged fine-filter	Repair by authorized workshop
	Clogged overflow valve on fine-filter	Disassemble overflow valve and check for proper sealing
Back	Faulty feed pump	Repair by authorized workshop
	Water in fuel	Drain water and fuel from sludge pocket of fuel tank
	Sticking intake or exhaust valves	Loosen valves
	Broken valve spring	Replace broken spring
Poor engine output	Leaking pressure pipe	Check alignment at connections. Tighten thoroughly but not hard. Replace broken pipes.
	Faulty injectors	Replace with spare, Repair faulty injector at authorized workshop
	Incorrect Injection pump setting	Check pump setting at authorized workshop.
	Clogged air cleaner	Clean air cleaner

	Faulty injector pump	Check pump at authorized workshop
Back		
	Unsuitable fuel	Drain tank and refill with correct fuel
	Incorrectly adjusted valves	Adjust valve-clearance (warm engine)
	Other engine faults	Have engine checked by authorized workshop or mechanic
Diesel knock	Faulty injector	Replace faulty injector with spare. Repair faulty injector at authorized workshop
	One or more of injectors faulty	Replace with spare
	Mechanical knock	Have authorized workshop or mechanic check engine
	Clogged air filter	Clean air filter
Smokey exhaust	Faulty injection pump	Check pump at authorized workshop
	Faulty Injector	Replace faulty injector
Back		
	Clogged air cleaner	Clean air cleaner
Engine runs erratically	Air in injection pump	Bleed system
	Clogged fine filter	Check filter at authorized Workshop
	Faulty injection pump	Check pump at authorized workshop
	Broken valve spring	Replace spring
Engine fails to reach top r.p.m.	Faulty controls	Check controls
	Clogged air cleaner	Clean air filter
	Faulty centrifugal	Have authorized workshop or mechanic check governor
Back		
	Faulty spring at injector pump	Replace spring
Engine races	Faulty injection pump	Have authorized workshop or mechanic check pump
	Faulty governor	Have authorized workshop or mechanic check governor
Oil pressure gauge shows insufficient pressure	Leakage in lubricating system	Check lubricating system
	Leaky reduction valve	Removal and clean valve

	Mechanical fault	Have authorized workshop or mechanic check engine
	Faulty gauge	replace gauge

Top

Specification

Engine output is rated in accordance with British Standard B.S. 649/1949

THREE-CYLINDER ENGINE	
General	
Type Number	1053
Number of cylinders	3
Bore	4 1/8 in. (104.77 mm.)
Stroke	5 1/8 in. (130 mm.)
Swept volume	68.4 cu.in. (1.12 litres)
Compression ratio	16.5 : 1
Compression at 1,500 r.p.m.	570 1b/sq.in. (40 kg/sq.cm.)
200 r.p.m. (starting motor speed)	425 1b/sq.in (30 kg/sq.cm.)
Direction of rotation	Anti-clockwise (seen from Flywheel end)
Valve arrangement	Overhead
Valve clearance (warm engine) intake valve exhaust valve	 0.016 in. (0.40 mm.) 0.018 in. (0.45 mm.)
R.p.m.	1500
Output	35 B.H.P.
Lubricating System	
Oil Pressure, engine	40-60 lb/sq.in. (3-4 kg/sq.cm.)
Hydraulic reverse-reduction	Approx. 100 lb/sq.in (7 kg/sq.cm)
Capacity, engine (incl. lubricant cleaner)	2.2 Imp.gall (10 litres)
Engine (when changing oil)	2.1 Imp.gall. (9.5 litres)
Capacity, reverse-reduction gearbox	0.72 Imp.gall. (3. 3 litres)
Hydraulic Reverse-reduction (ratio 2.5:1)	Approx 2.2 Imp.gall. (10 1.)
(ratio 1.5:1)	Approx 2.6 Imp.gall. (12 1.)
Fuel System	
Injector pump	Bosch
Injector	Bosch
Injector opening pressure	1,920 + 70 - 0 lb/sq.in (135 +5 - 0 kg/sq.cm.)
Injector hole diameter	0.016 in. (0.27 mm.)

Pump setting	**28 deg before T.D.C.**
Working pressure, overflow valve	**10-18.5 lb/sq.in. (0.7-13 kg/sq.cm.)**

Cooling System

Cooling water Temperature	**160-175 deg F (70-80 deg C)**
Capacity, incl heat exchanger	**3.3 Imp.gall. (15 litres)**

Electrical System

Voltage	**12 Volts (Negative Pole Earthed)**
Battery capacity	**152 amp-hr**
Generator output	**130 watts**
Starting motor output	**4.0 H.P.**
Starting motor engagement	**Sliding armature**

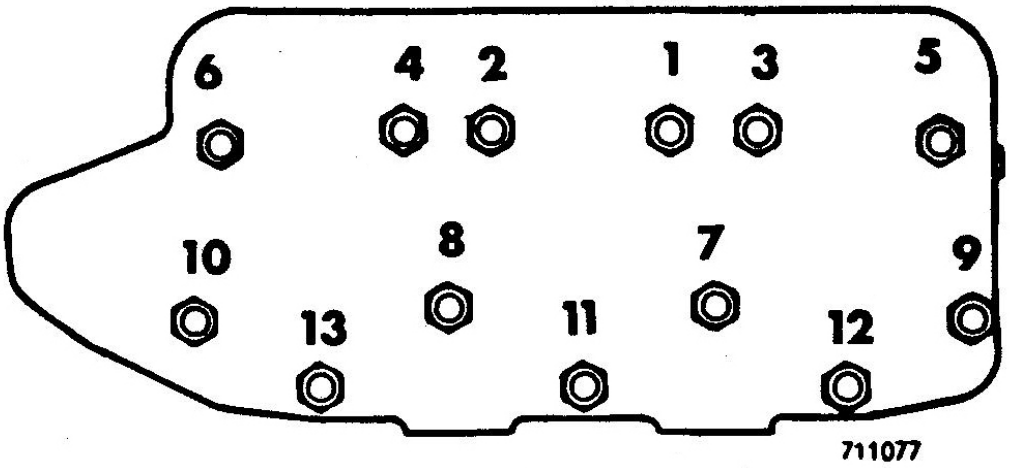

Fig 56.
Tighten cylinder head nuts in order shown in figure. Torque to be 125 ft. – lb. (17.3 kpm.).

Four-Cylinder Engine

General

Type number		1054
Number of cylinders		2
Bore		4 1/8 in. (104.77 mm.)
Stroke		5 1/8 in (130 mm.)
Swept volume		273.8 cu.in. (4.48 litres)
Compression ratio		16.5 : 1
Compression at 1.500 r.p.m.		570 lb/sq.in (40 kg/sq.cm.)
200. r.p.m.		425 lb/sq.in. (30 kg/sq.cm.)
Direction of rotation		Anti-clockwise (seen from flywheel end)
Valve arrangement		Overhead
Valve clearance (warm engine),		
	intake valve	0.016 in. (0.40 mm.)
	exhaust valve	0.018 in. (0.45 mm.)
R.p.m.		1,500

Output	46 B.H.P.

Lubricating system

Oil Pressure, engine	40-60 lb/sq.in. (3-4 kg /sq.cm.)
Hydraulic reverse-reduction	approx. 100 lb/sq.in. (7 kgsq.cm.)
Capacity, (engine incl, lubricant cleaner)	2.75 Imp.gall. (12.5 litres)
Engine (when changing oil)	2.6 Imp.gall. (12 litres)
Mechanical reverse-reduction	0.72 Imp.gall. (3.3 litres)
Hydraulic reverse-reduction (ratio 2.5:1)	approx 2.2 Imp.gall. (10 1.)
(ratio 1.5:1)	approx 2.6 Imp.gall. (12 1.)

Fuel system

Injector pump	CAV
Injector	CAV
Injector opening Pressure	1,920+70 -0 lb/sq.in. (135 +5 -0 kg/sq.cm.)
Injector hole diameter	0.0106 in. (0.27 mm.)
Injection sequence	1-3-4-2
Pump setting	24 deg before T.D.C.
Working pressure, overflow valve	14 – 20 lb/sq.in. (0.7 – 1.3 kg/sq.cm.)

Cooling system

Capacity, incl. heat exchanger	4.18 Imp.gall. (19 litres)
Cooling water temperature	160 – 175 deg F (70 – 80 deg C)

Electrical system

Voltage	12 volts (negative pole earthed)
Battery Capacity	152 amp.hr
Generator output	130 watts
Starting motor output	4.0 H.P.
Starting motor engagement	Sliding armature

Top

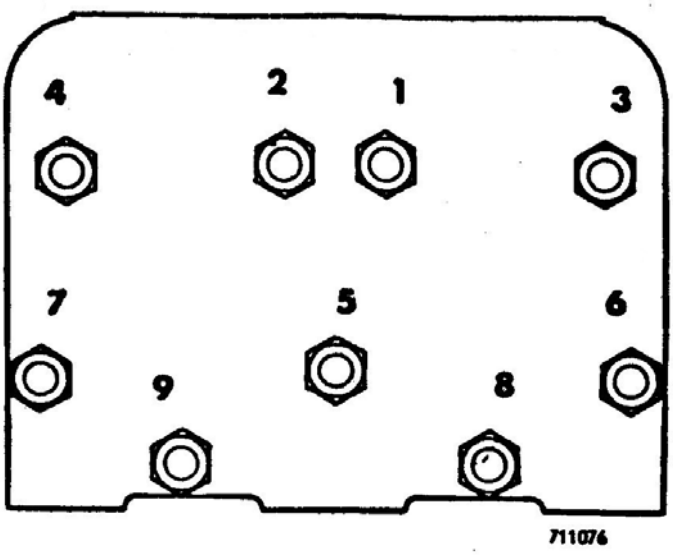

Fig 57.

Tighten cylinder head nuts in order shown in figure. Torque to be 125 ft. – lb. (17.3 kpm.).

Fuel recommendations

	Min	Max
Cetane	45	
Vescosity : centristokes at 100 deg F (37.8 deg C)	2.0	7.5
Conradson carbon, per cent by weight		0.1
Distillation, vol. to 350 deg C, per cent	85	
Flash point, F deg (C deg)	150 (65)	
Pour point, F deg (C deg)		approx. 9deg(5 deg) below lowest working temperature of the fuel
Calorific value, B.Th.U./lb. (keal/kg.)	18,000 (10,000)	
Water content, per cent by volume		0.1
Ash content, per cent by weight		0.01
Hard asphalt content, per cent by weight		0.01
Sulphur content, per cent		1.0
Alkalise and acids	Neutral	

Wiring diagram for electrical system

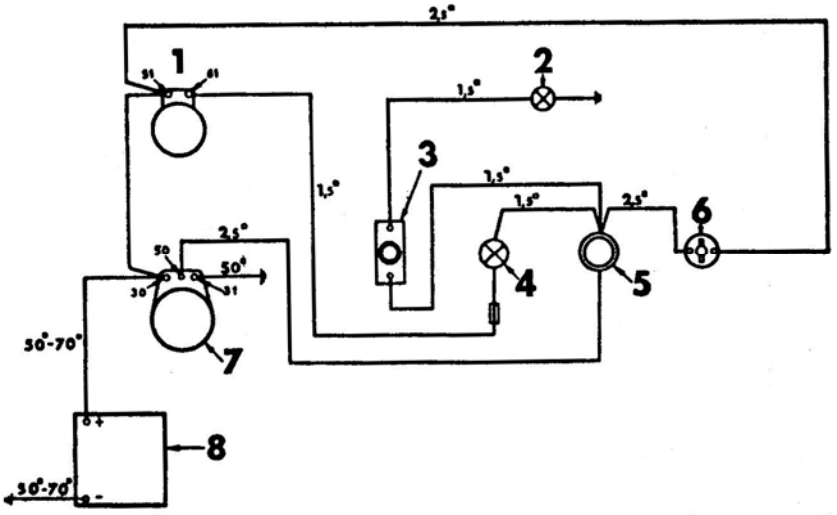

Fig 58.
Wiring diagram for three-cylinder engine, 1053

1. *Generator*
2. *Instruments panel lighting*
3. *Switch*
4. *Charging indicator lamp*
5. *Starting button*
6. *Starting switch*
7. *Starting motor*
8. *Battery*

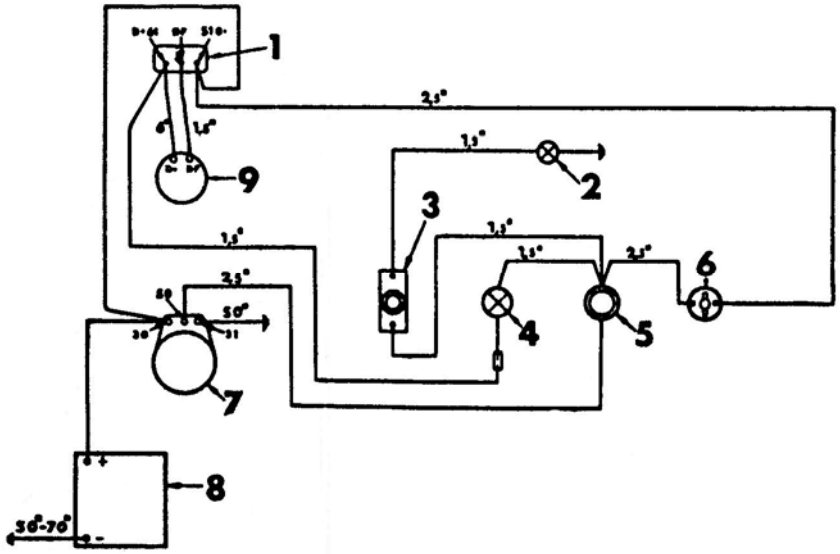

Fig 59.

1. *Relay*
2. *Instruments panel lighting*
3. *Switch*
4. *Charging indicator lamp*
5. *Starting button*
6. *Starting switch*
7. *Starting motor*
8. *Battery*

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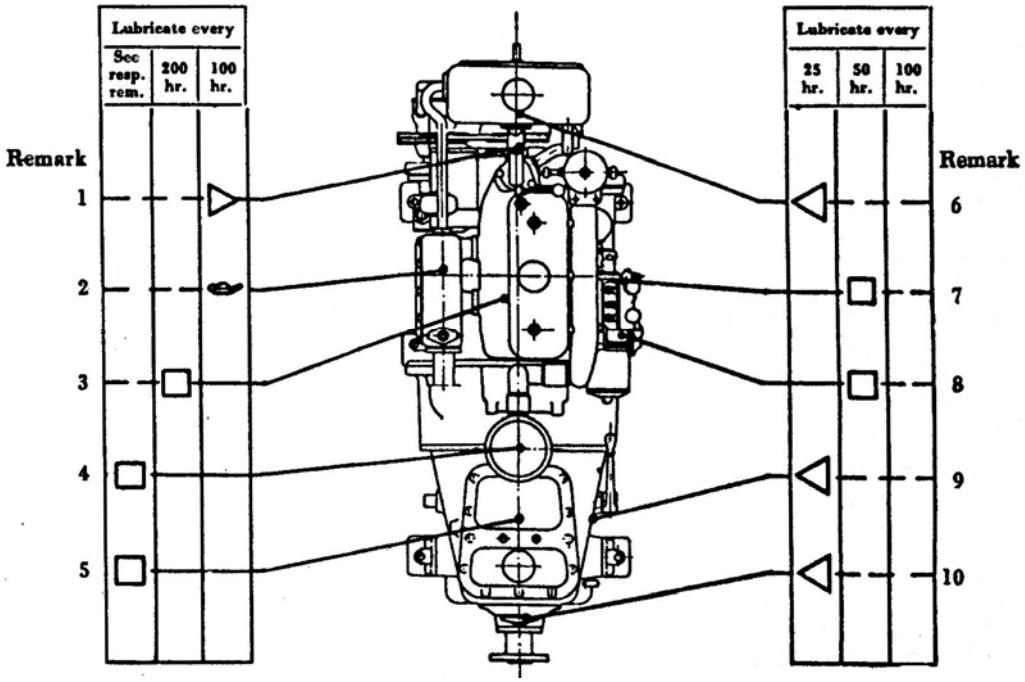
Lubricating Chart for three-cylinder engine



Symbols
□ Engine oil “For Service DG”. At temperatures Above 32 deg F (0 deg C). SAE 20 or 20 W . At temperatures below 32 deg F (0deg C) SAE 10 or 10 W

Thin engine oil
►Heat resistant ball bearing grease

Engine. When changing (incl lubricant filter) 2.1 Imp.gall. (9.5 litres).
Mechanically operated reverse-reduction. When changing 0.72 Imp.gall. (3.3 litres)
Hydraulically operated reverse-reduction.
Ratio 1.5:1, approx, 2.6 Imp.gall. (12 litres)
Ratio 2.5:1, approx. 2.2 Imp.gall. (10 litres)

1.Fresh water pump

Lubricate sparingly. Add new heat-resistant ball bearing grease every time the engine or pump is reconditioned.

2. Starting motor

There is a lubricating hole at the rear end of the starting motor. To lubricate, remove screw and add a few drops of thin engine oil. Too much can damage the motor.

3. Engine

Change engine oil. Pump out the old oil when the engine is warm. Drain lubricant filter through plug at bottom. Check oil level every day. Use “For Service DG”.

4. Air filter

Clean air filter oil container every day and top up with used engine oil to level mark.

5. Reverse-reduction

Mechanically operated reverse-reduction. Change oil every 600 hours if the engine operates at a max, speed 1,500 r.p.m. If the engine is set for a higher r.p.m., the oil must be changed every 300 hours. Pump out the old oil when the engine is warm (immediately following operation). Check oil level daily. Use oil of the same grade and viscosity as in the engine.
Hydraulically operated reverse-reduction. Change oil every 800 hours if the engine operates at max. speed of 1.500 r.p.m. If the engine is set for a higher r.p.m., the oil must be changed every 400 hours. Pump out the old oil when the engine is warm (immediately following operation). Check oil level daily. Use an acid and resin free oil of high grade and I viscosity of approx. 6-8 Engler degrees at 122 deg F (50 deg C) (SAE 20-30).

6. Power take-off

On engines with power take-off, lubricate the bearing housing of the power take-off shaft through the front lubricating nipple on the bracket. Lubricate sparingly to avoid unnecessary leakage of grease. The nipple leads to the sprocket wheel for the hand starter and should be lubricated as required.

7. Injection pump camshaft housing

Check that oil levels in injection pump camshaft housing is between marks on dipsticks. Top up through hole for dipstick. Use same oil as in engine.

8. Injection pump centrifugal governor

Check that oil in injection pump centrifugal governor is on level with level plug. If necessary, top up with new engine oil through lubricator on top of governor. Use same oil as in engine.

9. Reverse-reduction release bearing

On engines with mechanically operated reverse-reduction, lubricate release sleeve bearing through nipple on right-hand side reverse-reduction gearbox. Lubricate sparingly to avoid unnecessary leakage of grease.

10. Support bearing in reverse-reduction and flywheel

On engines with mechanically operated reverse-reduction, lubricate bearing between ahead and astern shafts in gearbox as well as support bearing in flywheel through nipple at rear end of astern shaft. Remove hexagon plug on rear of gearbox to gain access to nipple. Lubricate sparingly to avoid unnecessary leakage of grease and danger of grease penetrating in to friction facing.

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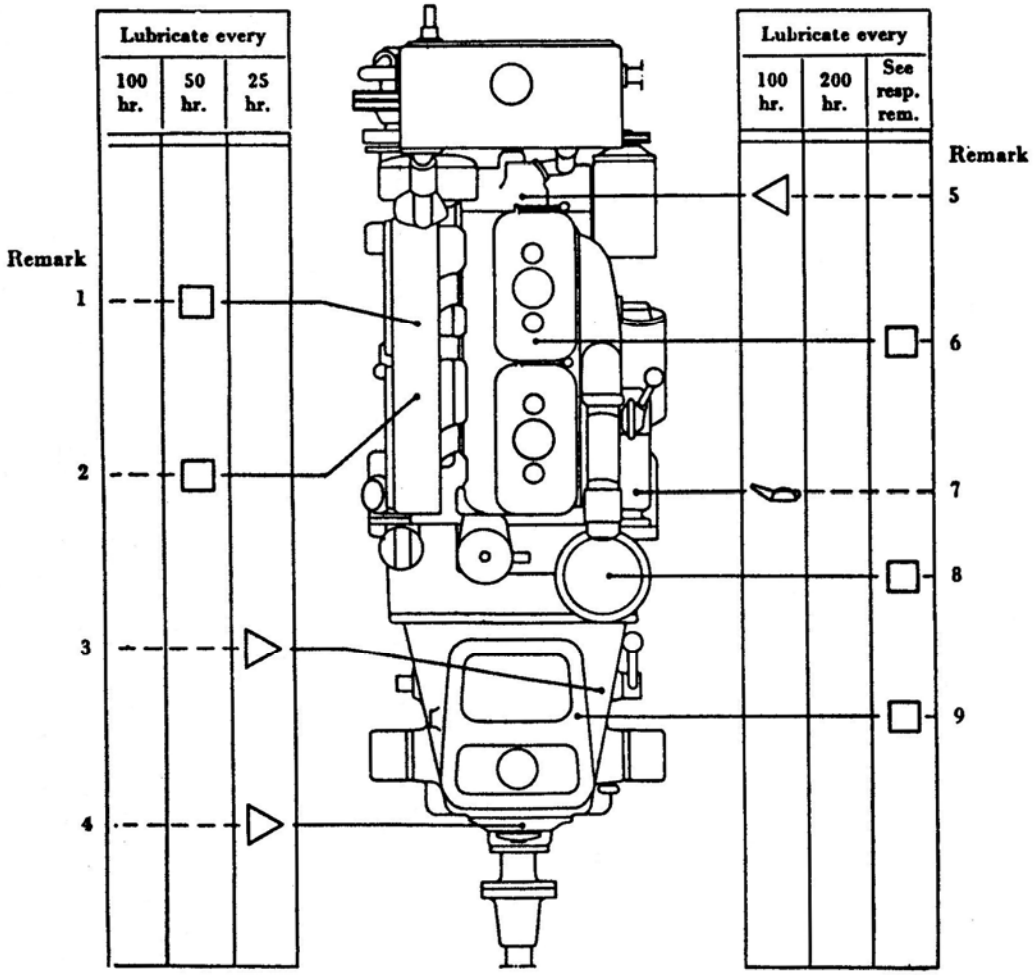
Lubricating Chart for four-cylinder engine



Symbols
□ Engine oil “For Service DG”. At temperatures Above 32 deg F (0 deg C). SAE 20 or 20 W . At temperatures below 32 deg F (0deg C) SAE 10 or 10 W

Thin engine oil
►Heat resistant ball bearing grease

Engine. When changing (incl lubricant filter) 2.6 Imp.gall. (12.0 litres).
Mechanically operated reverse-reduction. When changing 0.72 Imp.gall. (3.3 litres)
Hydraulically operated reverse-reduction.
Ratio 1.5:1, approx, 2.6 Imp.gall. (12 litres)
Ratio 2.5:1, approx. 2.2 Imp.gall. (10 litres)

1. Injection pump camshaft housing

Check that oil level in injection pump camshaft housing is between marks on dipstick. Top up through hole for dipstick. Use same oil as in engine.

2. Injection pump centrifugal governor

Check that oil in injection pump centrifugal governor is on level with plug, If necessary, top up with new engine oil through hole for inspection plug on side of governor housing, Use same oil as in engine,

3. Reverse-reduction release bearing

On engines with mechanically operated reverse-reduction lubricate release sleeve bearing through nipple on right-hand side of reverse reduction gearbox, Lubricate sparingly to avoid unnecessary leakage of grease.

4. Support bearing in reverse-reduction and flywheel

On engines with mechanically operated reverse-reduction lubricate bearing between ahead and astern shafts in gearbox as well as support bearing in flywheel through nipple at ear end of astern shaft. Remove hexagon plug on rear of gearbox to gain access to nipple. Lubricate sparingly to avoid unnecessary leakage of grease and danger of grease penetrating in to friction facings.

5. Fresh water pump

Lubricate sparingly, Add new heat-resistant ball bearing grease every time the engine or pump is reconditioned.

6. Engine

Change engine oil every 200 hours. Pump out the old oil when the engine is warm. Drain lubricant filter through plug at bottom. Check oil level every day. Use “For Service DG”.

7. Starting motor

There is a lubricating hole at the rear end of the starting motor. To lubricate, remove screw and add few drops of thin engine oil. Too much oil can damage the motor.

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	BOLINDER'S DIESEL ENGINE SERIES 105 TECHNICAL DATA In accordance with B.S. 649:1949	100068.01 April 1955 Dept. KMB

	DESCRIPTION	UNITS OF MEASURE-MENTS	DATA			
General data			Watercooled, vertical, 4-stroke with direct injection			
	Engine		1051	1052	1053	1054
	Number of cylinders		1	2	3	4
	Cylinder bore	in.	4 1/8			
		mm	104.775			
	Stroke	in.	5 1/8			
		mm	130			
	Swept volume	cu.in.	68.389	136.785	205.174	273.569
		litres	1.1207	2.2415	3.3622	4.4830
Outputs for engine incl. cooling water-pump, fan and battery charg-ing gene-rator Note. 1 B.H.P. =1.0139 CV (hk)	Automotive output (No B.S. rating)					
	at 1800 r.p.m.	B.H.P.	-	28	42.5	57
	at 1500 r.p.m.	B.H.P.	13	26	40	53
	12 hour's output (rated output)					
	at 1800 r.p.m.	B.H.P.	-	25	37	50
	at 1500 r.p.m.	B.H.P.	11.5	23	35	46
	at 1200 r.p.m.	B.H.P.	10	19.5	29	38.5
	10 % overload allowed for 1 hour (intermittent output)					
	24 hour's output (continuous output)					
	at 1800 r.p.m.	B.H.P.	-	23.5	33.5	45
	at 1500 r.p.m.	B.H.P.	10.5	21	32	42
	at 1200 r.p.m.	B.H.P.	9	17.5	26	36
	Torque at rated output for 12 hours' running at 1500 r.p.m.	lb.ft.	40.3	80.5	122.5	161.1
		kgm	5.6	11.1	17.0	22.3
	Rated speed	r/min	1500			
	Max speed	r/min	1500	1800		
	Idling speed					
	Traction engine	r/min	500		450	550
	Stationary engine	r/min	600		450	550
	Marine engine	r/min	400 - 450		450	550

Approved for distribution March 1954	Alt.	1	2	3	4	5	6	7	8	9	10
	Date	3/54	10/54	4/55							