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Instruction Book For Bolinder

Single and Two Cylinder Marine Engines

This instruction book covers Bolinders single and two-cylinder marine diesel engines. By following the advice and directions contained in this manual you will be making sure that the engine receives the care and attention it needs to give the best results possible. None of the specifications in this manual are binding and we reserve the right to alter them without previous notice.

Note: Use ctr + click to follow Links

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General Instructions
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Type & Serial Numbers

The type and serial numbers are stamped on a plate on the right-hand side of the engine, seen from the flywheel end; as seen in the illustration below

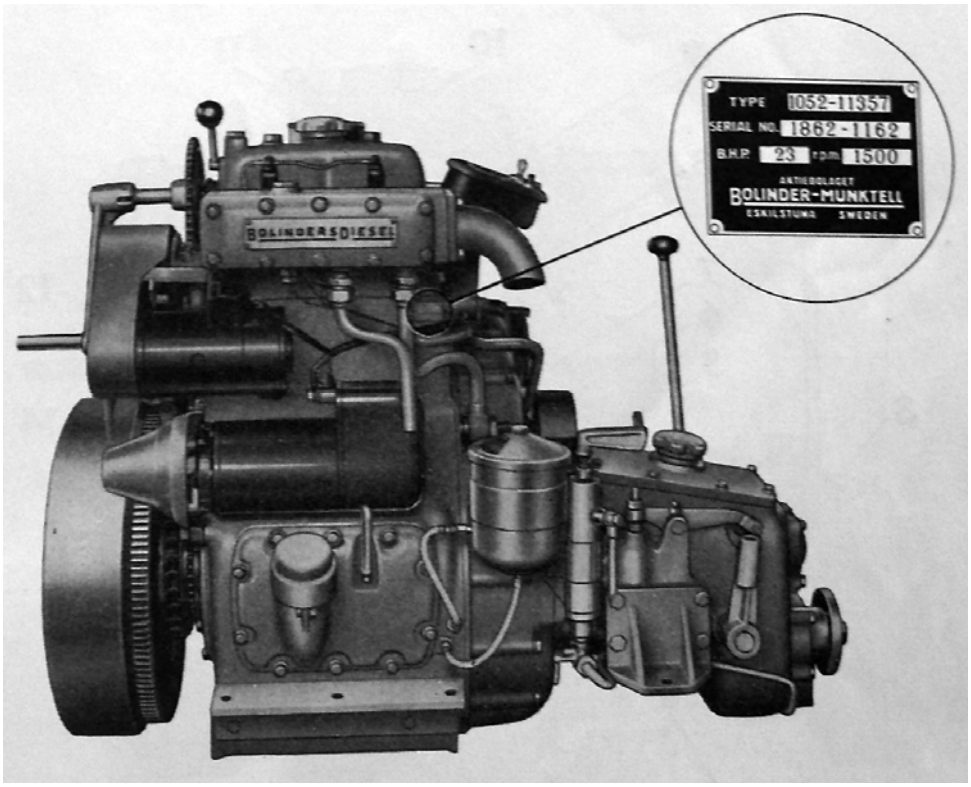


Fig 1

Two-cylinder Marine Engine. Name Plate Location

Top

General Description of Engine

Bolinders Marine Diesel is a four-stroke, direct-injection engine with overhead valves. The series ranges from single and two-cylinder engines. Cylinder liners, pistons and several other engine components are common to the entire series.

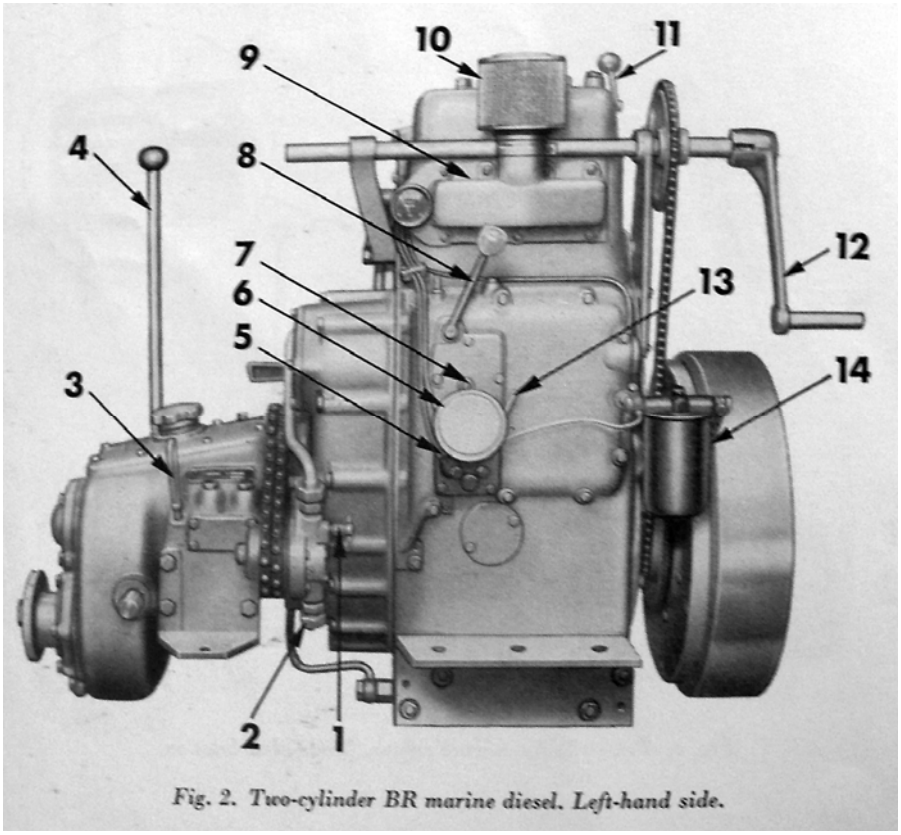


Fig. 2. Two-cylinder BR marine diesel. Left-hand side.

Two-cylinder BR marine diesel. Left-hand side

1 Coolant drain cock, water pump
2 Connections, coolant pipe line
3 Oil dipstick reverse-reduction gear
4 Control lever
5 Injection pump
6 Pressure equalizer
7 Cold-start device
8 Speed control
9 Induction manifold
10 Air Filter
11 Decompression handle
12 Starting crank
13 Stop control lever
14 Fuel filter

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 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 object of the thermostat is to keep the water at the temperature for the engine, approx 160-175deg F (70-80deg C)

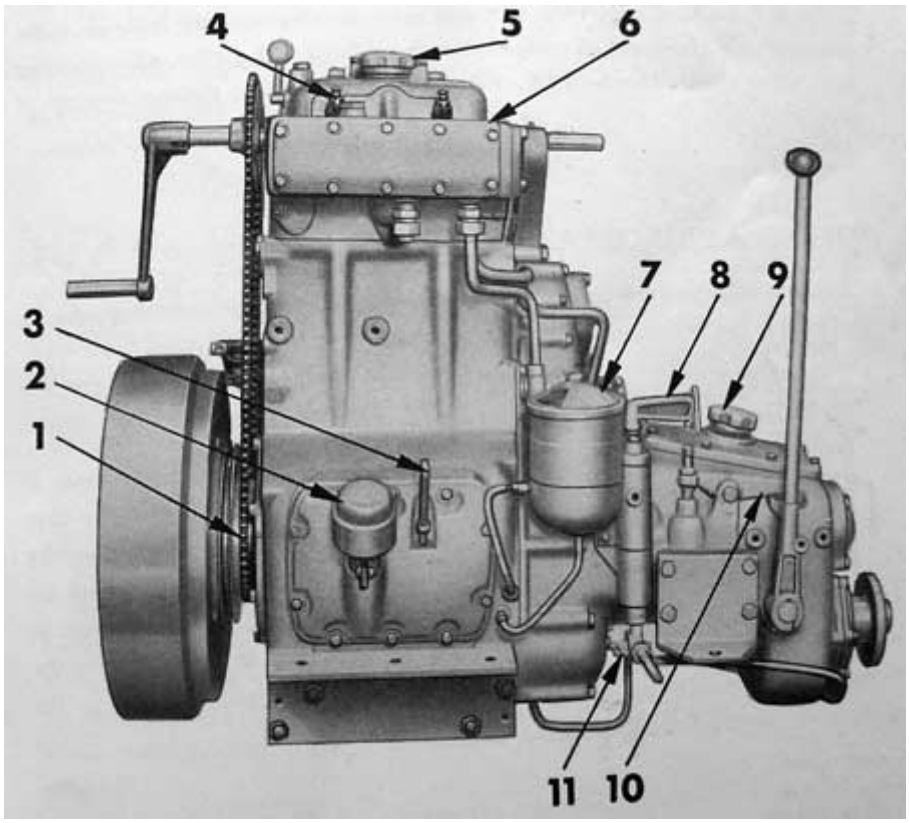


Fig 3

Two-cylinder BR engine. Right-hand side

1 Sprocket with automatic release
2 Crankcase ventilation
3 Oil dipstick
4 Injector
5 Ventilator, oil filter
6 Exhaust manifold
7 Lubricant filter
8 Crankcase pump
9 Ventilator, reverse-reduction gear oil filter
10 Control lever
11 Cock, crankcase pump

Top

The crankshaft is carried in main bearings with replaceable steel shells lined with a thin layer of special bearing metal. 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 hard 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 replacement shells.
The cylinder head carries the inlet and exhaust valves and the injectors. Inlet valve sealing surfaces

and all valve stem ends are faced with stellite, a heat-resisting alloy which greatly lengthens life.

Working Principles

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

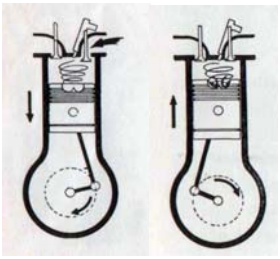


fig 5 fig 6

Fig 4. 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 rotating motion in the cylinder.

Fig 5. Compression Stroke
The piston now moves upwards with both valves closed. This compresses the air, raising it's temperature above the ignition temperature of the fuel. A specially shaped combustion cavity in the piston top increases air rotation during this stroke. Shortly before the piston reaches the top d

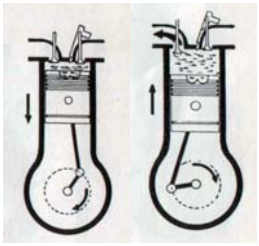


fig7 fig8

Fig 6. Power Stroke
Combustion vastly increases pressure and forces the piston downwards in the cylinder to perform the useful work.

Fig 7. Exhaust Stroke
The exhaust valve opens immediately before the bottom dead centre is reached and the piston starts moving upwards again to expel the combusted gases.

Top

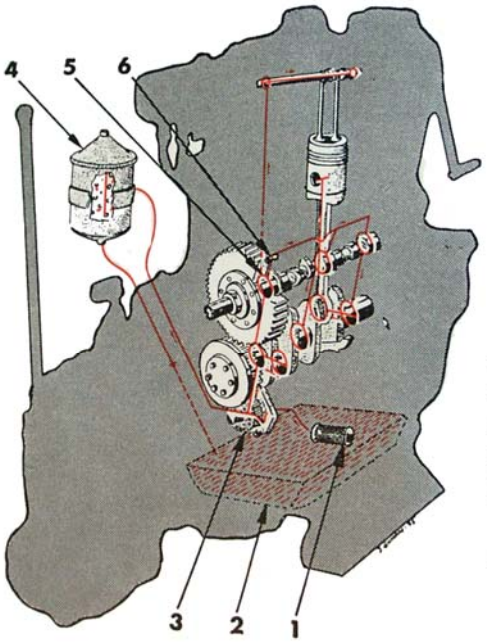
Lubricating System

The dependability, life and 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 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 and check the oil pressure at regular intervals. The oil pump, driven from a gear o the crankshaft front end, sucks oil from the sump and feeds it to the various lubricating points - main and big-end bearings, piston pins, valve mechanism timing gear, etc. Part of the oil is bypassed through the filter back to the sump to achieve continuous oil cleaning.

Oil is fed to the valve mechanism by so-called shot lubrication from the camshaft bearing at the front end of the engine, implying that the oil is supplied intermittently. This arrangement restricts the amount of oil supplied and prevents excessive lubrication. To prevent the pump sucking up particles collecting at the bottom of the sump, the oil is first passed through a strainer in the sump. The cylinder walls are splashed lubricated by oil from the big-end and piston pin bearings. Governor lubrication is by splash oil from the timing gears.

To prevent excessive oil pressure when starting in cold weather and to maintain constant oil pressure (pump capacity exceeds that required for lubricating the engine) a reduction valve permits oil to return to the sump without passing through the lubricating system. This valve is on the side of the cylinder block, under the camshaft gear. Oil pressure is 40-60 lb/sq.in. (3-4 leg/sq.cm.) at normal r.p.m. (1.500) and normal engine temperature 160-175deg F(70-80deg CD). Always make sure that vessels and containers, measures, funnels, filter pipes, etc for oil are absolutely clean. if there are even the smallest particles in the lubricating oil of an engine it is certain to give trouble before long.

Top



1. *Oil strainer*
2. *Oil sump*
3. *Oil pump*
4. *Oil filter*
5. *Shot lubrication of valve mechanism*
6. *Reduction valve*

Fig. 8. Lubricating system.

Lubricating System

1 Oil strainer
2 Oil sump
3 Oil pump

4 Oil filter
5 Shot lubrication of valve mechanism
6 Reduction valve

Top

Fuel System

The fuel system consists of fuel tank, pipe-filter, injection pump, injectors and piping. As extras the engine can also be fitted with feed pump and overflow valve.

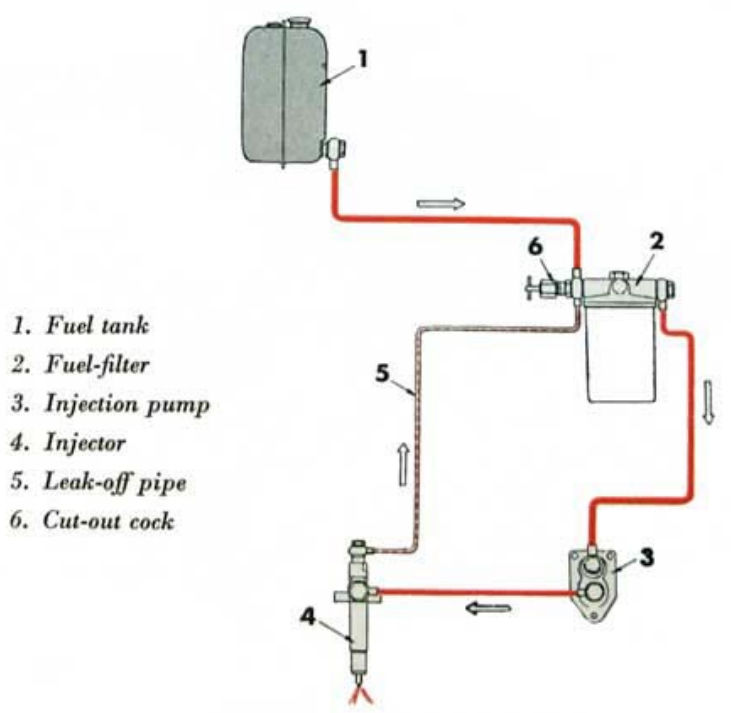


Fig. 9. Fuel system.

Fuel System

1	Fuel tank
2	Fuel filter
3	Injection pump
4	Injector
5	Leak off pipe
6	Cut out lock

From the fuel tank 1, fig 9, the fuel self-feeds through the fine-filter 2 to the fuel chamber of the fuel pump3. This constant-stroke pump has one plunger for every engine cylinder so that every pump has as many elements as there are cylinders in the engine. These pump elements are actuated by special cams on the camshaft, which rotates at half engine speed. The plungers force the fuel through the pressure pipes to the injectors 4. The pressure pipes are connected to the injectors by special unions containing an edge filter. This filter serves to stop any particles which may get into the pipes when they are removed from the engine.

From the injector nozzles the fuel is sprayed into the engine cylinders through four holes. The high opening pressure atomises the fuel completely to ensure starting even if the engine is cold. Leak off oil from the nozzles is piped back to the filter. On engines with feed pump the leak-off fuel is led from the injectors to the overflow valve and from there back to the fuel tank.
As previously stated, the pump element works with a constant stroke. To permit variations of the fuel quantity supplied by every stroke so that it corresponds to the load on the engine at every particular moment, the pump element has been given a special shape. This design allows variation of the injected fuel quantity by rotation of the pump element. Rotation is controlled by the engine governor.

Top

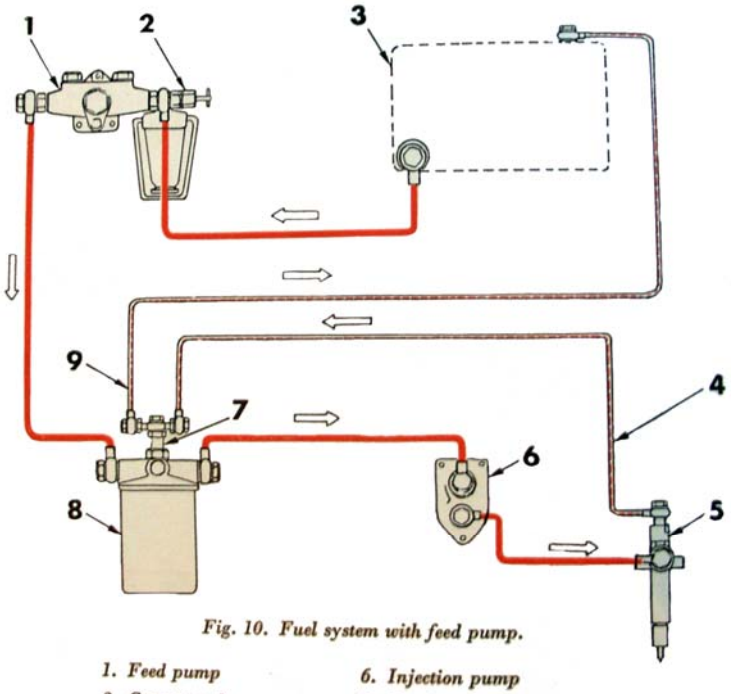


Fig. 10. Fuel system with feed pump.

1. *Feed pump*
2. *Cut-out cock*
3. *Fuel tank*
4. *Leak-off pipe*
5. *Injector*
6. *Injection pump*
7. *Overflow valve*
8. *Fuel-filter*
9. *Return pipe line to fuel tank*

Fuel system with feed pump

1	Feed pump
2	Cut-out cock
3	Fuel tank
4	leak off pipe
5	Injector
6	Injector pump
7	Overflow valve

8 Fine-filter 9 Return pipe line to fuel tank

Top

The governor 2, fig 11, of this engine is of the centrifugal type and driven from the camshaft. The governing weights 1 act on the shaft 8 towards the lever 9. In its turn, this lever acts on the injection pump 11 so that the pump element rotates.

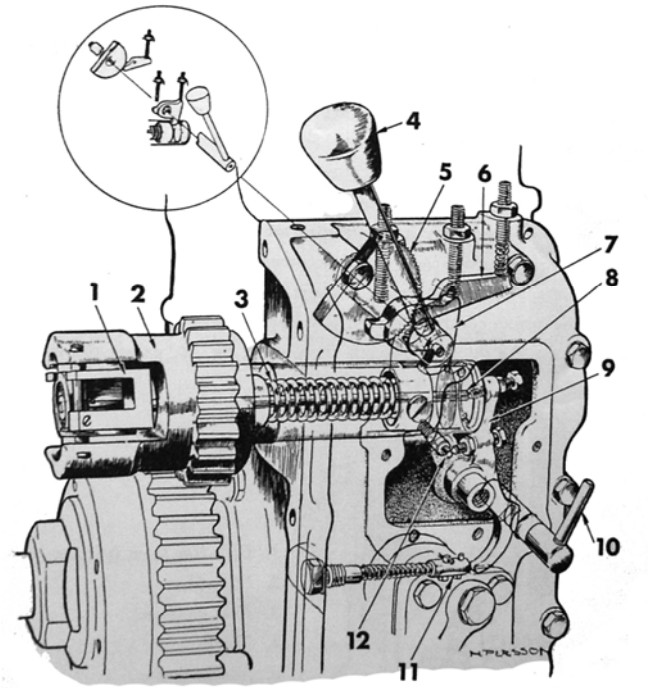


Fig. 11. Governor.

1. Governing weights
2. Governor
3. Spring
4. Speed control
5. Ratchet
6. Pawl
7. Tensioning arm
8. Shaft
9. Lever
10. Stop control
11. Injection pump
12. Cold-start device

Governor

1 Governing weights 2 Governor 3 Spring 4 Speed control 5 Ratchet 6 Pawl 7 Tensioning arm 8 Shaft 9 Lever 10 Stop control 11 Injection pump 12 Cold-start device

Top

If engine r.p.m. increases, due to decreased load, the weights move outwards and compress the spring 3. The shaft then actuates the lever 9 and thus also the fuel pump so that the effective pump

stroke shortens. The amount of fuel injected then releases in proportion and the engine r.p.m. drops until it corresponds with the set speed. When engine r.p.m. decreases the governor works conversely. The speed control 4 can be used to alter spring pressure on the shaft 8 and vary the speed of the engine.

The governor is fitted with a cold-start device 12 to ensure engine starting even at low temperatures. Depression of the cold-start button enables the injection pump to supply extra fuel at the starting instant and thus facilitate starting.

The button returns to it's initial positions as soon as the engine has started. Under no circumstances whatever may it be locked in the depressed position while the engine is running; this might otherwise cause severe damage to the engine. For engine stopping the governor is fitted with a special device 10, which acts on the injection pump control rod set the pump for zero feed. The fuel enters the injector through the pipe 1, fig. 12, passes the edge filter 2

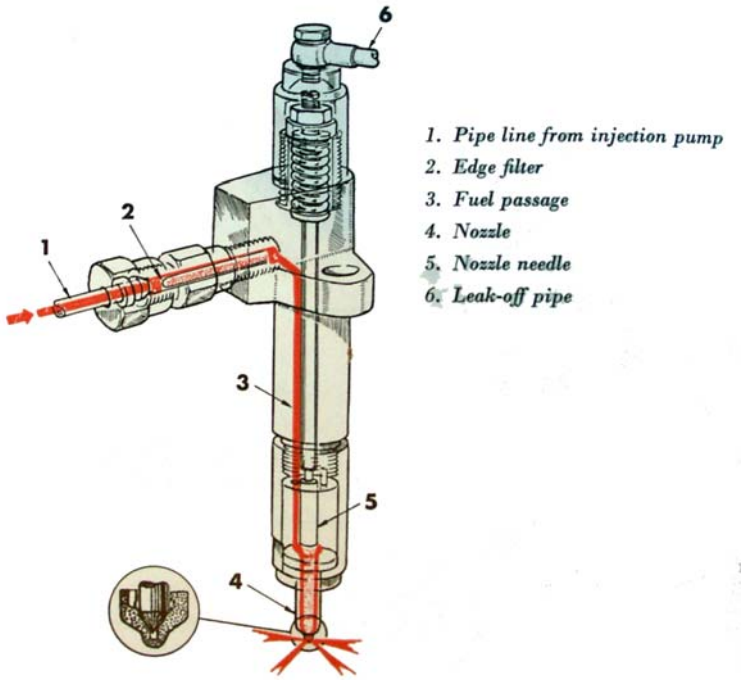
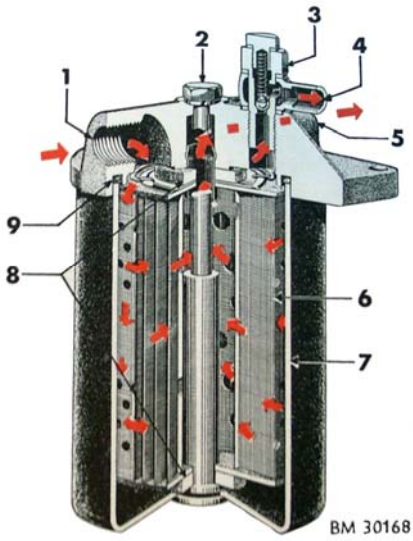


Fig. 12. Injector.



Fine Filter

1	Pipe to injection pump
2	Air vent screw
3	Pipe from fuel tank
4	Filter insert
5	Leak off pipe

and is led through the passage 3 down to the nozzle 4. When fuel pressure reaches approx 1,920 lb/sq.in. (135 kg/sq.cm) the nozzle 5 lifts from it's seat and the fuel is sprayed into the cylinder through four holes. Leak-off fuel from the injector is carried back to the overflow valve on the filter and from there to the fuel tank.

Top

Cooling System

The engine is water cooled, the coolant being circulated by a special pump mounted on the timing gear casing on the left-hand side of the engine and driven from the camshaft. The pump draws in seawater through the bottom valve and feeds it into the cooling jacket around the exhaust manifold. From here the water is led through the cylinder block where it first cools the cylinder liners and then passes through passages up into the cylinder head. Here it is sprayed out
to provide concentrated cooling of the exhaust passages and the nozzles. The heated coolant passes via the thermostat to the discharge.

As long as the coolant is cold, the thermostat is closed for supply to the engine; the greater part proceeding direct to the discharge. This causes the water in the engine to rapidly heat up to 160deg F (70deg C). At this temperature the thermostat begins to open and is fully open by the time temperature has reached 175deg F (80deg C), permitting maximum supply of water to the engine. The thermostat thus operates to maintain the coolant at 160-175deg F (70-80deg C), the best temperature for the engine. Running at too low temperature causes poor combustion and abnormal cylinder wear.

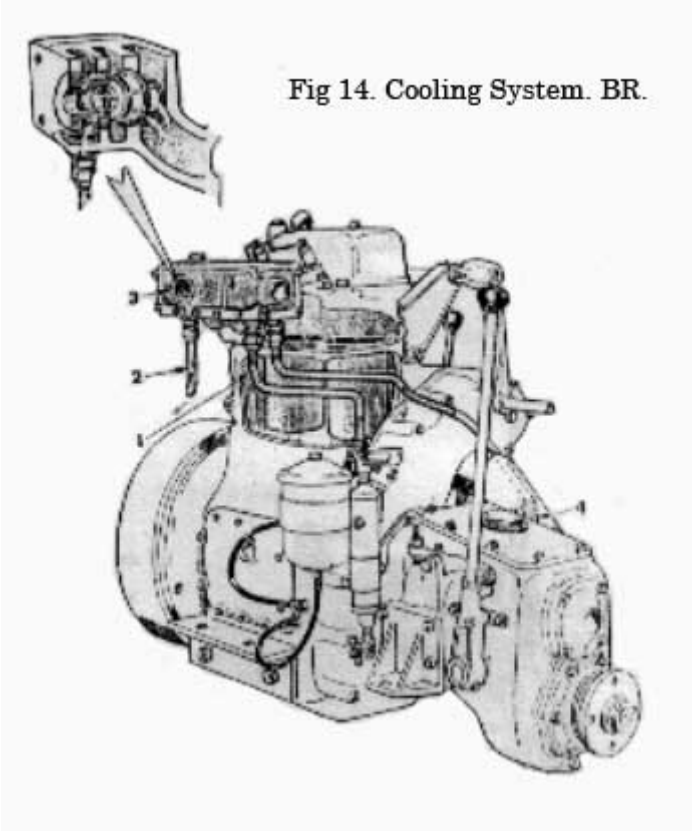


Fig 14. Cooling System. BR.

1 Coolant pipe line between exhaust manifold and engine block
2 Discharge pipe line
3 Thermostat housing
4 Water pump

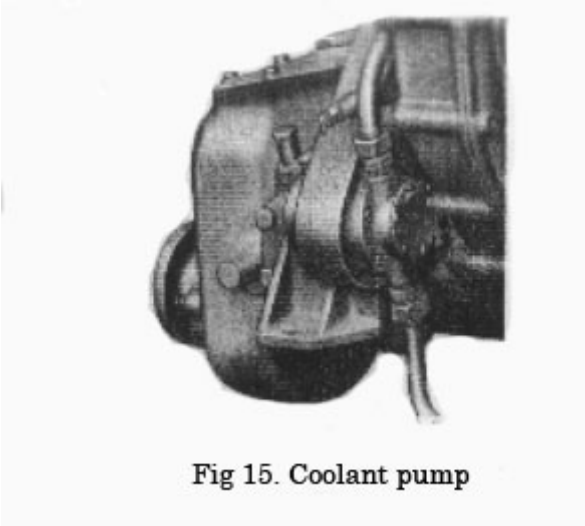


Fig 15. Coolant pump

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Starting Devices

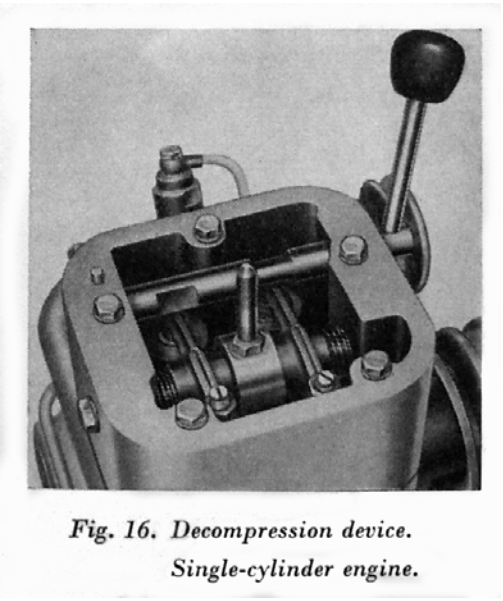


Fig. 16. Decompression device. Single-cylinder engine.

Hand Starting **Back**

As Standard the engine is fitted with a crank and decompression device for hand starting. The starting crank is located on a special bracket above the flywheel. Cranking movement is transferred to the crankshaft by chain and sprocket wheels. The arrangement includes automatic releases of the crankshaft sprocket as soon as the engine starts.

Electric Starting

The engine can also be fitted with electric starting equipment consisting of starter motor, charging generator with relay, instruments and starter battery. The generator is mounted on the right-hand side of the cylinder block, seen from the flywheel end, and is V-belt driven from a pulley on the crankshaft. The starter motor is under the generator. The starter motor drive pinion is engaged with the flywheel ring gear by a magnet on the single-cylinder engine and by displacement of the entire armature on the two-cylinder engine. The relay of voltage regulation type is mounted on the generator. Battery negative poles are earthed to the engine.

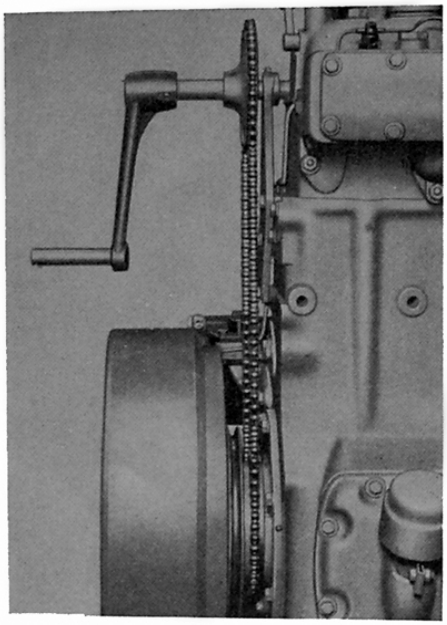


Fig. 17. Starting device with automatic release.

Top

Instruments And Controls

The engine is equipped with all necessary instruments and controls, so located that they are accessible from the left-hand side (screen from fly-wheel end).

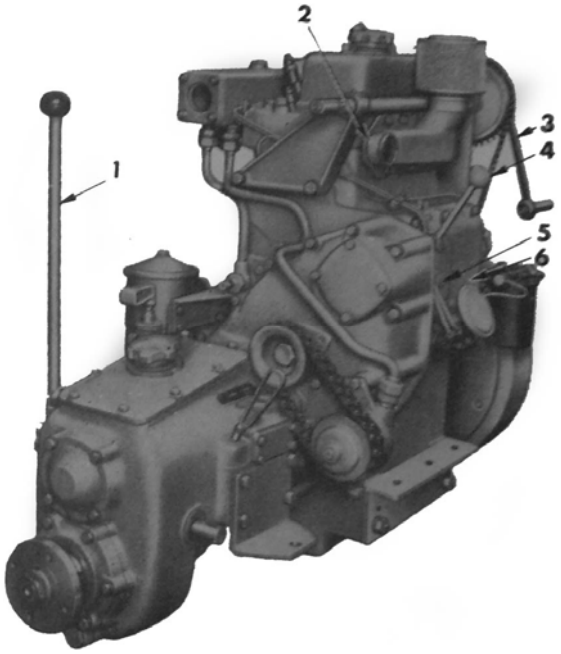


Fig 18 Instruments and controls, two-cylinder engine.

1 Reverse-reduction gear control
2 Oil pressure gauge
3 Starting crank
4 Speed control
5 Cold-start device
6 Stop control

Before starting up a new engine, check location, operation and effects of controls. Make a habit of glancing at the instruments every now and then during running to ensure discovery of abnormal readings in good time.
Engines fitted with electric starting equipment have an instrument panel located as shown on fig19

Top

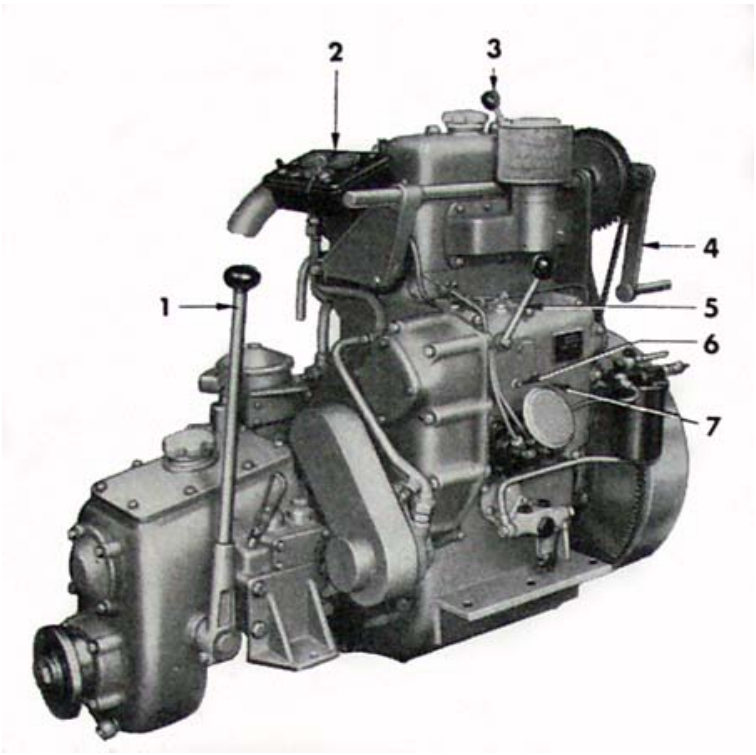


Fig 19 Instruments and controls. Engine with electric start.

1	Reverse-reduction gear control
2	Instrument panel
3	Decompression handle
4	Starting crank
5	Speed control
6	Cold start device
7	Stop control

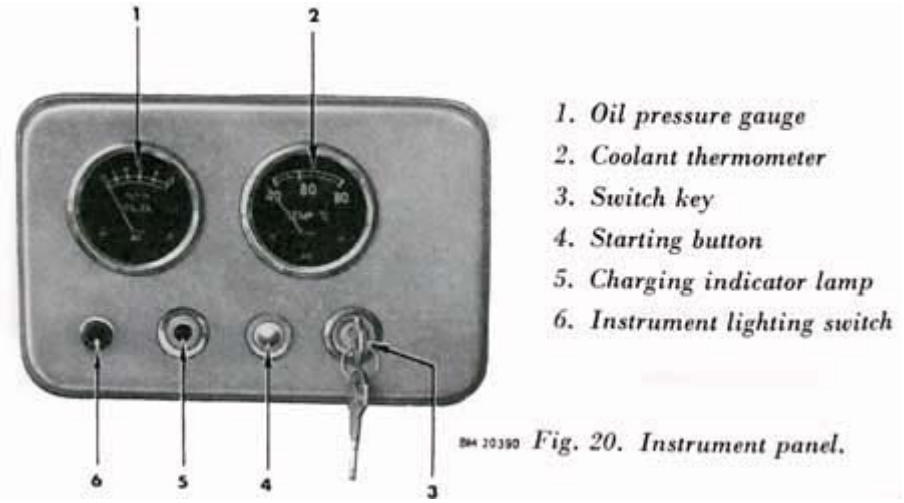


Fig. 20. Instrument panel.

Oil Pressure Gauge

The oil pressure gauge shows the oil pressure in the engine lubricating system. 1 does not, however, show how much oil there is in the crankcase. It is graduated in kg/sq.cm. or in colour

sectors; red for 0-18 lb/sq.in. (0-125 kg/sq.cm) and green for 18-100 lb/sq.in (1.25-7.0 kg/sq.cm.). At normal r.p.m. and load the pressure is to be 40-55 lb/sq.in. (3-4 kg/sq.cm.). Higher pressure than the above can be caused by all that is too viscid for the prevailing temperature or by a faulty reduction valve. 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. it is graduated in deg C or in colour sectors, white for 32-140 deg F (0-60deg C), green for 140-195deg F (60-90deg C) and red for 195-230deg F (90-110deg C). Normal coolant temperature is 160-175deg F (70-80deg C). If the thermometer 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.

Switch Key

The switch key is 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.

Instrument Panel Lighting

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

Decompression Device

The principle of the decompression device is as follows: An eccentric shaft connected to a lever depresses the exhaust so that they lift from their seats and prevent the pistons from producing compression in the cylinders. The eccentric shaft is rotated with the help of a handle journaled in the valve cover.

Top

Equipment

Reverse-Reduction Gearbox

BR and LBR diesels are equipped with a sturdy, highly reliable reverse-reduction gearbox. This compact unit has been specially designed for convenient dismantling and reassembly. The same gearbox is used for both the single and the two-cylinder engine.
The gearbox has a robust, effective over-centre friction clutch. It consists of two outer clutch plates

3 fig 21, with friction facing on both sides, which are pressed together between the outer 6 and the inner 2 pressure plates against a plate 5 of hardened and tempered steel, mounted on a coupling gear. Pressing together of the clutch is controlled by control lever 12 via a linkage. The clutch is engaged when the lever is moved forward.

Astern drive is provided by a planetary gearing 8. A break band 1 prevents the planetary gear housing and it's planet wheel from rotating. The planetary gears are made of hardened nickel-chrome steel and carried in needle bearings on case-hardened pins. The gearbox casing a double-ended lever 9. One end of this lever is fitted with a roller which bears against a cam on the control lever attachment. When the control lever is moved backwards, the roller is lifted by the cam and actuates the double-ended lever This makes the adjusting screw 7 the other end of the lever press against the tensioning pin 4 so that the brake hand 1 is applied and engages the engine for astern drive.

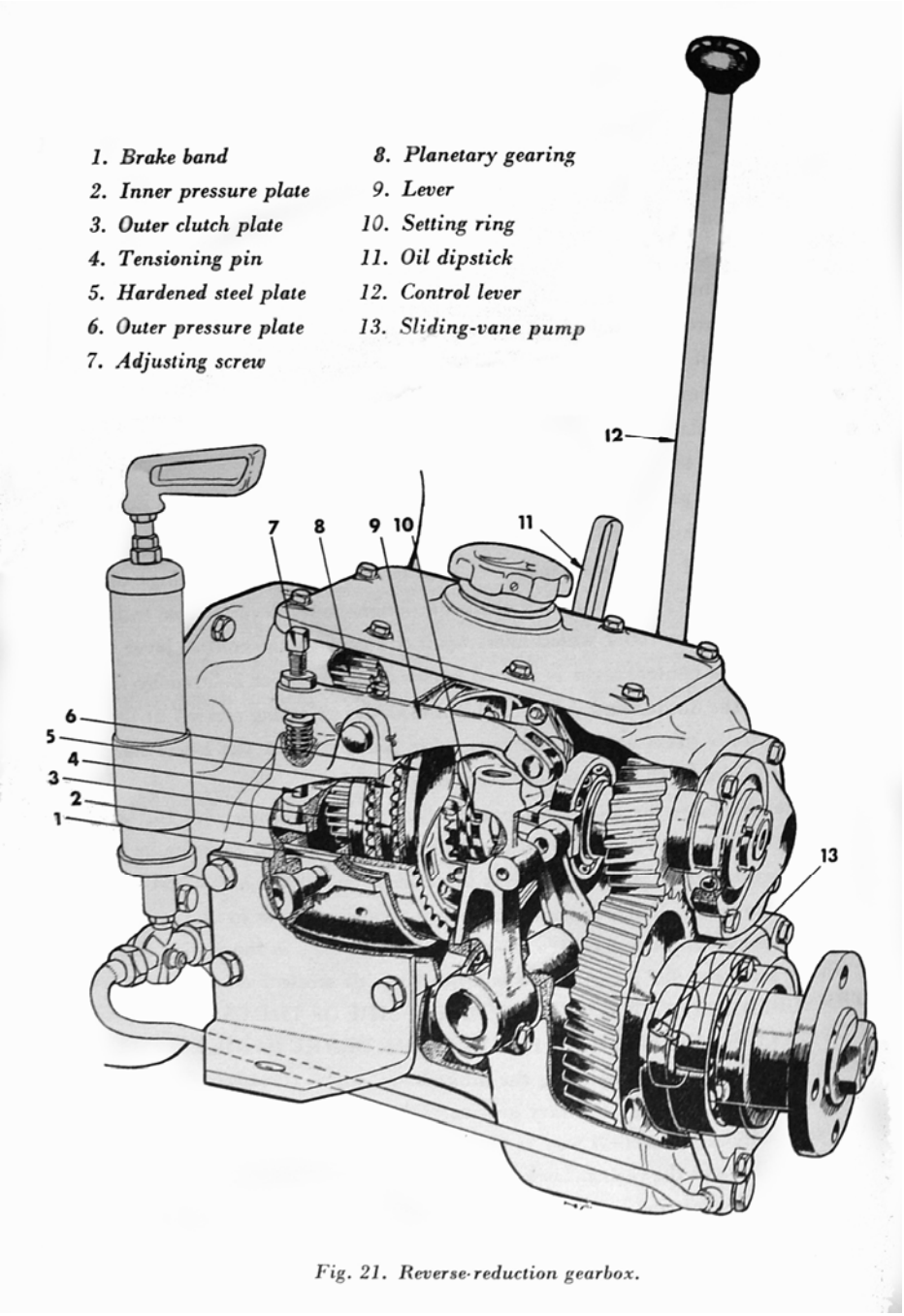


Fig. 21. Reverse-reduction gearbox.

The clutch plates for ahead drive are adjusted with setting ring 10, which is accessible once the cover on the casing has been removed. The ring can be coated with a screwdriver or similar, which is inserted in one of the holes, and is locked with the stop screw. If this screw should come

opposite a lever so that it cannot be tightened, move the stop screw to the other threaded hole in the setting ring.

The brake band for astern drive is adjusted with screw 7 on the outer lever. THE SUPPORT SCREW ON THE OPPOSITE SIDE OF THE CASING SHOULD NOT BE LOOSENED OR RESET UNLESS THE BRAKE BAND, ETC HAS TO BE REPLACED. When replacing the brake band, adjust these screws so that the band does not touch the planetary gearing casing when the control lever is in the forward position. The easiest way to check this is to insert a piece of paper under the band all round the casing. Lock the screws after adjustment.
The reduction gearing has hardened helical gears of nickel-chrome steel. Reduction ratio is 2 to 1 (more exactly: 2.04: 1 ahead and 2.30: 1 astern) or 1.5 to 1 (more exactly: 1.45: 1 ahead and 1.63: 1 astern).

The entire reverse-reduction gearing works in a bath of oil and a sliding vane pump 13 built into the casing also feeds extra lubricant to the planet wheel and needle bearings. The lower part of the gearbox serves as an oil sump. Oil level must be maintained between the cranks on the dipstick 11. Use the same oil as in the engine and change every 600 hours, or at least once a year. Oil changing is facilitated by a pipe line between the sump to a crankcase pump on the engine. The gearbox and the crankcase pump are connected when the cock on the suction side of the pump is turned in towards the engine.

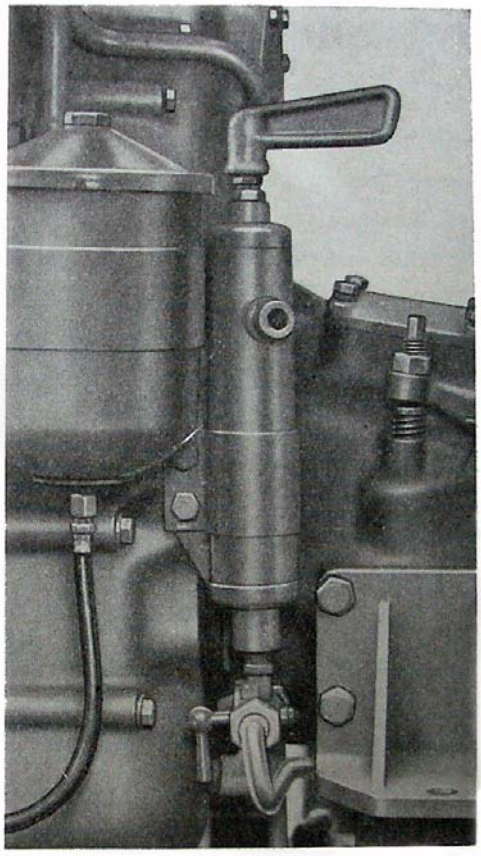


Fig. 22. Crankcase pump.

Top

Bilge Pump

The engines can be fitted with a bilge pump of the same design as the coolant pump. The pump is then V-belt driven from the camshaft via a manually operated friction clutch.

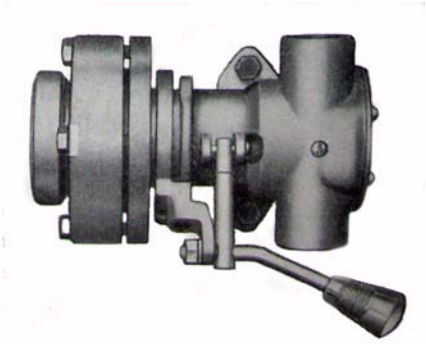


Fig. 23. Bilge pump.

Bailing Pump

The LBR diesel engine is a watertight design and has elevated pipes for intake and ventilation air. It is thus possible to start the engine even if the boat is full of water.

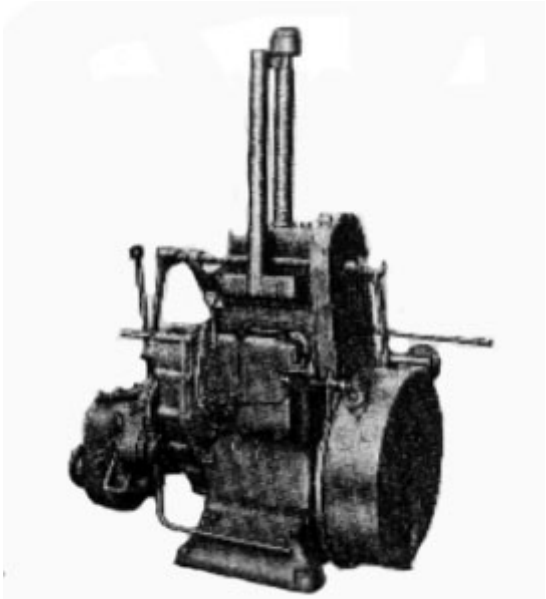


Fig 24. LBR diesel engine

For bailing purposes the flywheel casing is designed as a pump. If the boat fills with water, the water enters the flywheel casing through the hole 1, fig 25 and is thrown out through the pipe 2 centrifugal force.

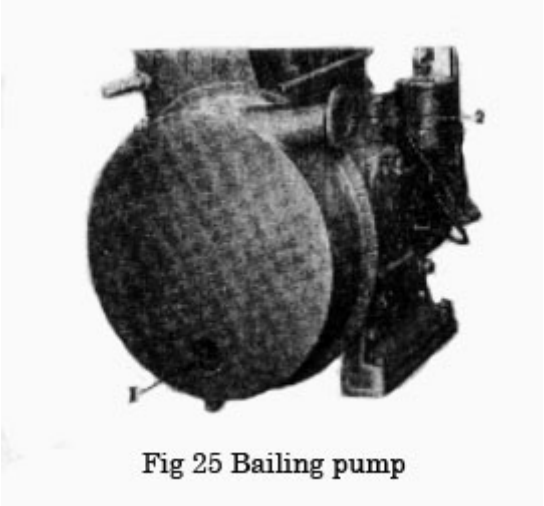


Fig 25 Bailing pump

Top

Installation

Great attention must be paid to practicability and maximum accessibility when installing the engine. The bed must be extremely rigid and should extend as far as possible fore and aft of the engine in order to obtain maximum distribution of load. Engine slope must not exceed 15 deg

Engine and propeller shaft must line up perfectly. Before tightening the flange bolts, use a feeder gauge to make quite sure the shaft flanges contact each other all the way round. After launching, recheck that no bending loads have developed between the propeller shaft and the engine due to changes in the shape of the hull.

All coolant pipe lines should be of copper and run with as few and smooth bends as possible. Connect the exhaust pipe to the engine so that there are no bending loads and run it aft with a few and smooth bends as possible. The pipe should discharge high enough above the surface of the water to prevent water splashing in when the engine is not running. Fit a drain cock at the lowest point of the exhaust pipe. Check that no other water locks can arise in the pipe line.

Install fuel tanks and pipe lines with great care in order to prevent fuel leakage. Keep in mind that the fuel tank must be placed at least 250 mm (10 in) higher than the injection pump, if the engine is not equipped with feed pump. If there is a feed pump, remember that it's max. suction height is 2000 mm (6' 63/4").

Fit a belt and flywheel guard to protect the moving parts of the engine. It can take the form of a light angle-iron structure, covered with wire and attached to the engine bed by wing nuts for easy removal. If an engine casing is fitted, this provides sufficient protection and no belt and flywheel guard is required.

Directions For Use

Running-in - **Precautions Before Starting** - **Starting** - **Electric Start** - **Stopping** - **Bleeding The Fuel System**

In order to help you make the best use of the excellent mechanical operating qualities of the engine we have prepared the following advice for it's 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 When 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 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 it's 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 a cold engine or put it under full load after start. Check that all nuts are properly tightened.

Running In

Back

**The running-in period of an engine is the most important part of it's entire life. During the first 50 hours of this period the engine must be run carefully. This is done to ensure that the cylinder walls
pistons and bearing surfaces acquire the hard 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 stick and cause high fuel consumption. Although 50 hours running marks the end of the running-in period, it is still
inadvisable to operate the engine under heavy load for long periods at a time. Continued care should therefore be exercised until the 2000-hour mark has been passed.**

**During the running-in period the engine lubricating oil must be charged more often than is subsequently normal. Change the first time 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 out the engine with flushing oil; bearing pressures in a diesel engine are too high to permit the use of such oil.**

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.

Absolute cleanliness is essential in connection with all work on the diesel engine, particularly the injection pump and injectors. Filter all fuel before filling

Precautions Before Starting

Back

Check that the cooling system bottom valve is open fig. 26. Check also at regular intervals that the strainer in the coolant inlet is clean and free from impurities that might clog the inlet and interface with the cooling. After the engine has started, check the coolant discharge to make sure that the coolant is circulating properly.

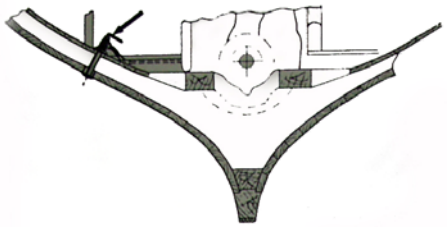


Fig. 26.

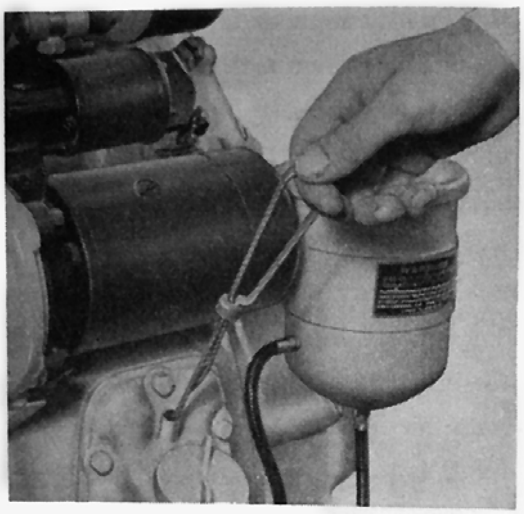


Fig. 27. Engine.

Top

Check oil level in engine and reverse-reduction gearbox. The level should be between the two marks on the dipstick. Always use diesel lubricant (HD oil) when changing or topping up.

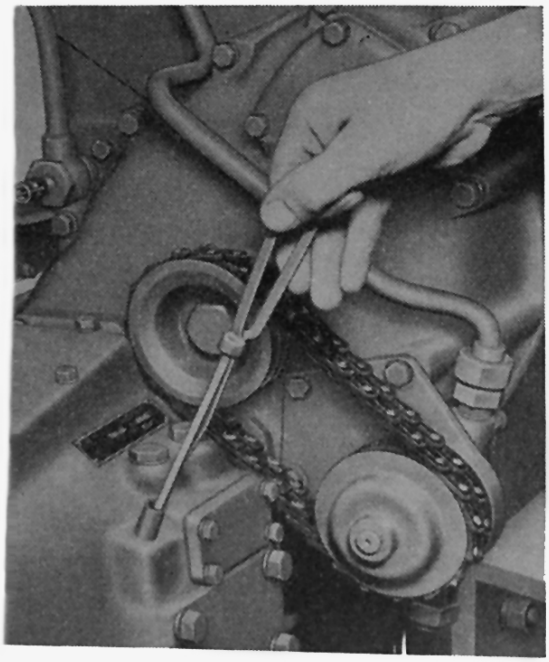


Fig. 28. Reverse-reduction gearbox.

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 and that, if there is a strainer in the filter hole, this is quite clean.

Fig. 29.

Starting

Hand Starting

1 De-compression lever position when engine is running. (Decompression device disengaged)

2 Compression in first cylinder only. (This position does not exit on single-cylinder engine.)

3 No Compression in any of cylinders. (All exhaust valves depressed by de-compression device.)

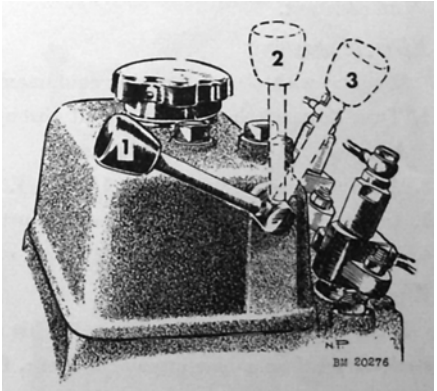


Fig. 30. Positions of decompression lever.

1 Single-cylinder engines. Set decompression lever at engine front end oil position 1 (fig. 30) Two-cylinder engines. Set decompression lever at position 2.

2 Advance speed control lever about 3/4 and set stop lever at running position.

3 Press in cold start button on governor.

4 Fit starting handle and turn the crankshaft until there is compression in the cylinders. To obtain maximum power from the crank it should be fitted so that the handle is on it's way up at this moment.

5 Pull round steadily until compression resistance has just lightened; at that moment the piston has passed T.D.C. and the 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 cylinder. As soon as ignition is obtained in the two-cylinder engine, return decompression lever to position 1; the engine will then work on both cylinders.

It is also possible to start as follows :

1 Set the decompression lever at position 3; all exhaust valves are then depressed and there will be no compression in any of the cylinders.

2 Advance the speed control lever about 3/4.

3 Give 6-7 powerful turns with the crank to attain sufficient rotational speed.

4 Quickly return the decompression lever to position to obtain ignition.
The latter method is recommended if the decompression lever is operated by an assistant.

Electric Starting **Back**

Engines with electric starting equipment are best as follows ;

1 Turn key switch to close circuit through starting switch. (Charging indicator lamp on instrument
panel lights.)

2 Advanced speed control lever 1/2 to 3/4

3 In cold weather, press in cold-start button before trying to start.

4 Press in start button to switch in and operate starter motor.

Warning

If the engine should not start at the first attempt, the engine should be completely stationary before a new attempt is made. Otherwise there is a danger of damaging the starter motor and rigg gear teeth. Check the oil pressure immediately after start. Lower permissible pressure is 28 lb/sq.in. (2 kg/sq.cm.). Make a habit of checking oil pressure every now and then when the engine is running. Pressure should then be 40-60 lb/sq.in. (3-4 kg/sq.cm.).

Run the engine a few minutes to warm it up before putting it under load. It is extremely inadvisable to rev up or heavily load the engine immediately after start ; the oil in a cold engine is so viseid that it takes some time for it to reach the various lubrication points. Check the water temperature gauge when the engine has been running a while. temperature should be between 160-175deg F (70-80deg C).

On engines with charging generator it is also necessary to check that the charging indicator lamp goes out when the engine has started. This shows that the generator is supplying current. If the lamp fails to go out, something is wrong.

Stopping **Back**

Stop the engine by moving the stop lever to the left. This sets the pump for zero feed. If the engine
has electric starting equipment, break the current circuit as soon as the engine has stopped by turning the key switch until the charging indicator lamp goes out.

Top

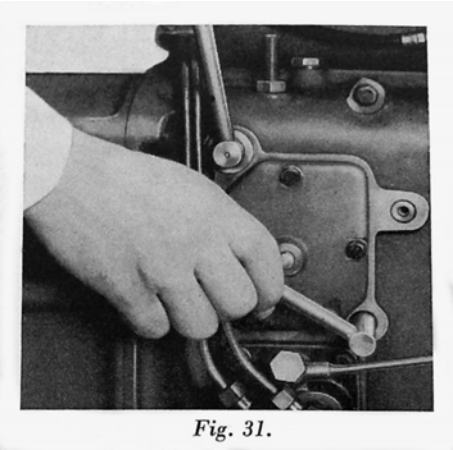


Fig. 31.

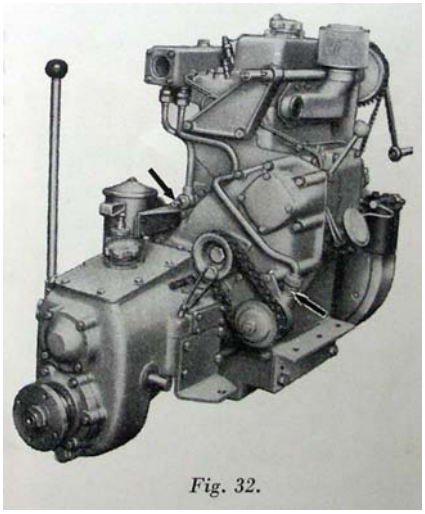
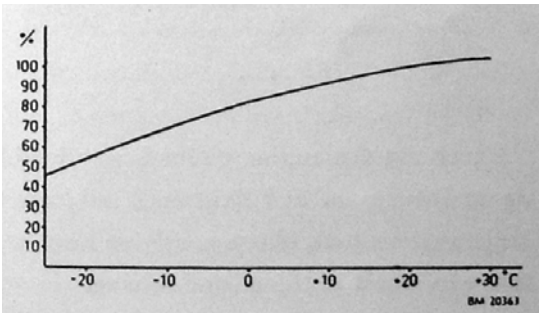


Fig. 32.



If the engine is to stand idle for a long period or if there is the slightest danger of frost, all cooling water should be drained off. make sure that no water whatever is left in the coolant and bilge pumps. The easiest way to do this is to open the cocks on both sides of the pumps. When the water steps running, rotate the fly-wheel a few turns against the direction of rotating until the rest of the water has drained off.

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 full power.

Bleeding The Fuel System **Back**

If the engine is new, if the fuel tank has run empty or if air has otherwise entered the fuel system, it must be held before the engine can be started. First bleed the fuel filter by screwing out the bleeder screw on it's top. Now screw in the bleeder screw again and disconnect the fuel pipe from the pump until the fuel flowing out is free from bubbles. If necessary, the pressure pipes may be disconnected at the injectors and the crankshaft drawn round a few turns fuel flows out through them.

Top

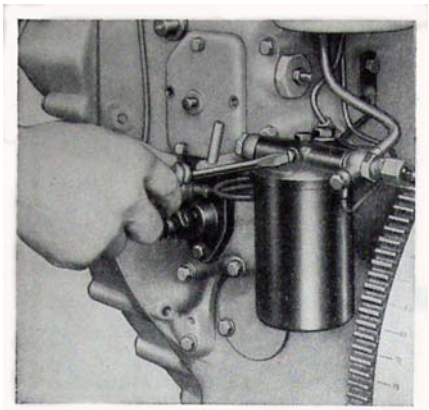


Fig. 34.

Make sure that the cold start button is pressed in before turning the crankshaft. On engine with feed pump the crankshaft must be turned during the bleeding so that the pump can feed fuel to the filter and injection pump.

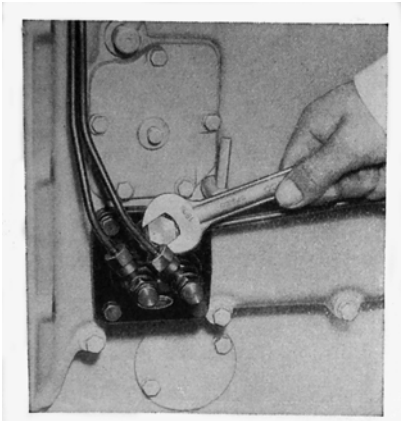


Fig. 35.

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 circulates poorly as long as it is cold and an immediate load application can result in the engine seizing.

Top

Regular Checking And Preventive Maintenance

Every 50 Hours - **Every 200 Hours** - **Every 500 Hours** - **Single-cylinder Engines** - **Every 1000 Hours** - **Every 2500 Hours**

Daily

1 **Make sure that the cooling system is properly filled.**

2 **Check that oil level in the engine and reverse-reduction gearbox lies between the dipstick marks. When oil consumption has lowered the oil level to the vicinity of the lower level mark, top up with new oil. Checking should be done after the engine has been standing idle long enough for the oil to run down into the sump.**

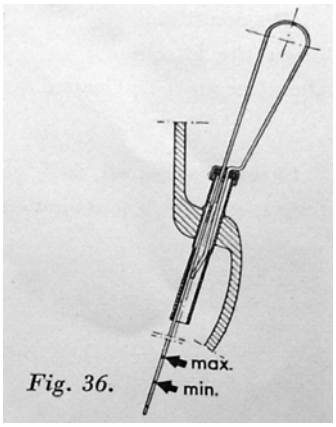


Fig. 36.

3 **See that there is sufficient fuel in the tank. If fuel is filled from barrels, make sure that they are stored on the site a day or two before tapping them. This is done to allow any foreign particles time to sink to the bottom. Always tap the barrels with a pump, taking care never to lower it's suction pipe to the bottom of the barrel. The sludge, which always contains foreign particles and impurities, must be discharged.**

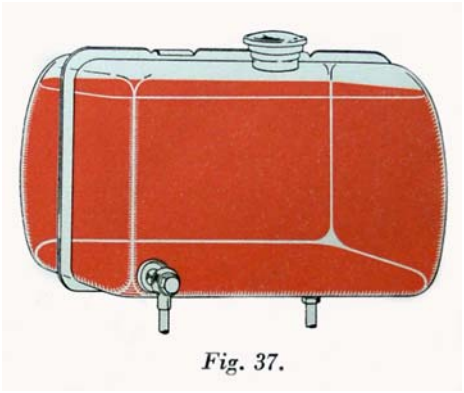


Fig. 37.

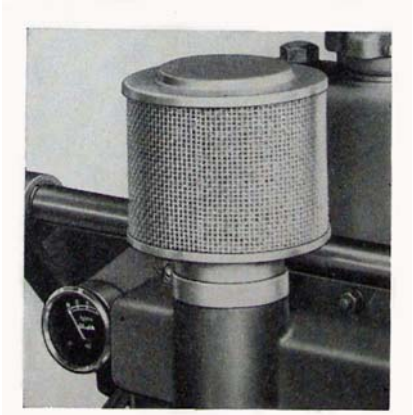


Fig. 38.

Top

4 **Check condition of air cleaner. As required, clean the air filter and re-dip in oil. Let the oil run off before re-fitting the filter. The condition under which the engine operates are, of course decisive for how often the filter must be claimed. However, it will soon be discovered whether the filter must be cleaned daily or if this interval can be extended.**

5 **Check that no oil, fuel, or water leaks out of the engine anywhere. If a leak is found, see that it 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.**

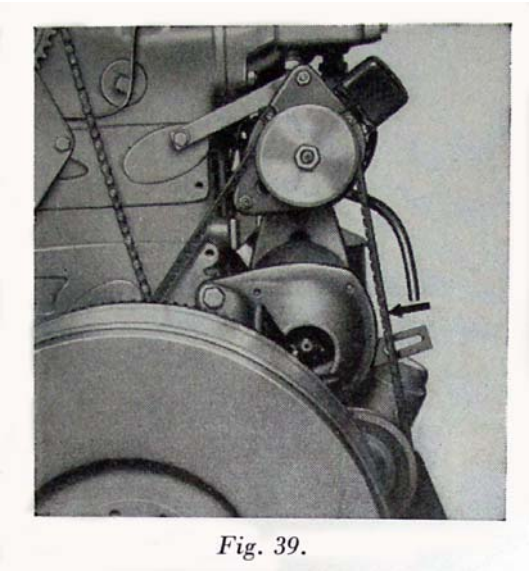


Fig. 39.

Every 50 Hours **Back**

1 **Check belt tensions. Adjust belt between crankshaft and generator with the help of the idler pulley. it must be possible to depress the belt about 3/8 in (10 min.) under a pressure of 11 lb (5 kg.) at the arrow.**

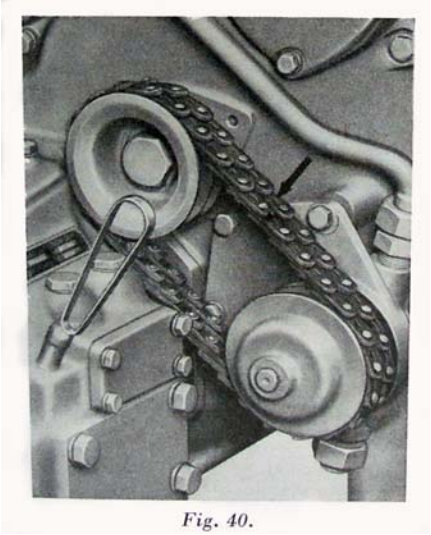


Fig. 40.

Top

2 **Adjust the cooling water pump belts by removing a suitable number of links. It must be possible to depress the belts about 3/8 in. (10 mm.) under a pressure of 11 lb. (5 kg.) at the arrow.**

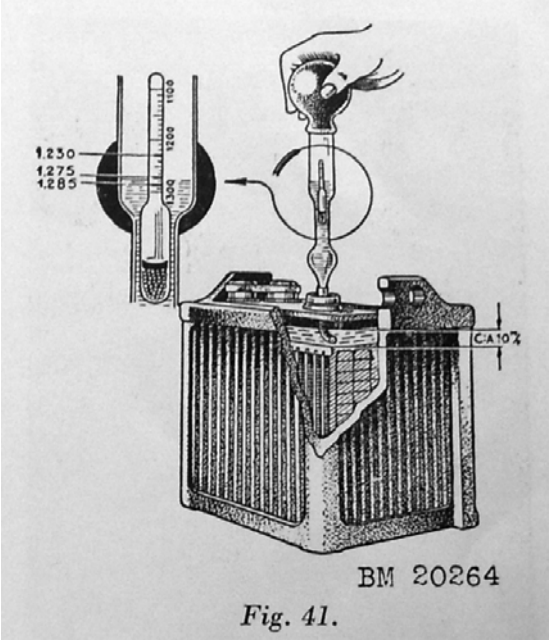


Fig. 41.

3 **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. The charging of the battery can be checked with a hydrometer which shows the specific gravity of the electrolyte (fig 41). This is at a fully charged battery 1,275-1,285. If the hydrometer shows a specific gravity of 1,230 the battery must be charged as soon as possible at a batter charging station.**

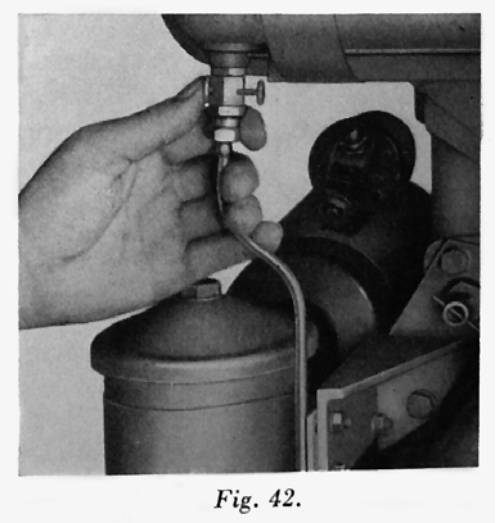


Fig. 42.

Top

4 **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.**

Every 200 Hours **Back**

1 **Change the engine oil. See that the engine is run warm before pumping out the oil. Turn the cock on the crankcase pump suction side out from the engine and pump out the oil. Make sure that the reverse-reduction gearbox is not drained by mistake. Fill the sump with HD oil to the upper level mark on the dipstick. Do not forget that it must be HD oil, never ordinary engine oil ! never rinse out the engine with flushing oil ; bearing pressures in a diesel engine**

are too high to permit the use of such oil.

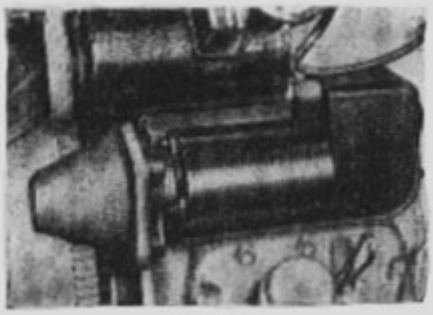


Fig 44

Top

2 Lubricate the starting motor of the two-cylinder engine. (the starting motor of the single cylinder engine is not fitted for lubrication.) Do not add more than a few drops at a time - too much oil may damage the motor.

Every 500 Hours Back

1 Check the valve clearance with feeler gauges. This must be done when the engine is warm. Correct clearance is 0.016 in. (0.40 mm.) for inlet valves and 0.018 in. (0.45 mm.) for exhaust valves. Necessary clearance adjustment can be done by loosening the lock nut and turning the adjusting screw. Re-tighten the adjusting screw thoroughly . Do not check or adjust valves when the engine is running ; valve and piston might then knock together and cause damage.

Correct valve adjustment is of great importance and we therefore recommend careful study of the following detailed description of the procedures to be followed.

Fig 45

Top

Single -Cylinder Engines Back

Determine the crankshaft position where the exhaust valve closes and the inlet valve is just about to open. At this instant the piston is at T.D.C. Now rotate the crankshaft a half turn and adjust both

valves. crankshaft rotation can be made easier by setting decompression lever as the open position.

Two-cylinder Engines

Proceed as for single-cylinder engines and adjust one cylinder at a time.
NOTE THAT VALVE ADJUSTMENT IS DONE WHEN THE ENGINE IS WARM.

2 Replace lubricant cleaner insert. This is done by loosening screw in lid, lifting off lid and removing insert. Clean lubricant cleaner thoroughly and fit new insert. Never use cotton waste for cleaning. 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.

Fig. 46.

3 Check injector opening pressure and spray shape. This work should be done by an authorized shop having the necessary testing pump. Spray shape can, however, be checked by removing the injector from the engine and re- fitting it with the nozzle pointing outwards from the engine. Open the de-compression drive, set the speed control lever for full fuel supply and rotate the crankshaft. The fuel must leave the nozzle thoroughly atomized and the spray must cut off sharply after delivery of the fuel. If the fuel discharges as a jet or dribble from the nozzle after injection, the nozzle must be overhauled.

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

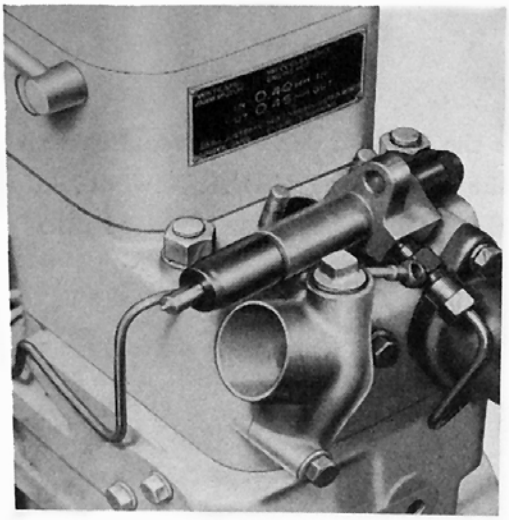


Fig. 47.

Top

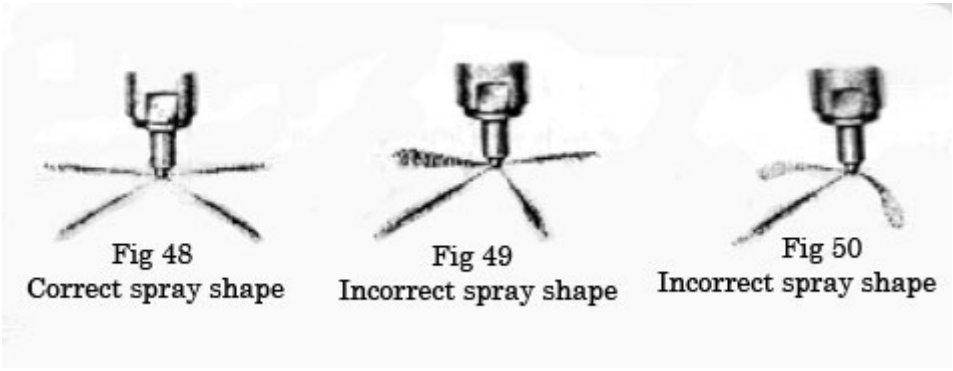


Fig 48
Correct spray shape

Fig 49
Incorrect spray shape

Fig 50
Incorrect spray shape

Every 1000 Hours Back

At 1000-hour intervals the following work should be performed by an authorized workshop or mechanic :

1 Check injection pump setting
2 Check centrifugal governor (Max . speed and idling)
3 Check cold-start device
4 Replace element in fuel filter
5 Check fuel feed pressure
6 Clean strainer in oil sump
7 Take apart and thoroughly clean air cleaner
8 Check starting motor and generator brushes
9 Check thermostat

Every 2500 Hours Back

1 De-carbonize engine and grind valves

2 Recondition starting motor and generator

If oil consumption is excessive (more than 0.053 oz/h.p.h. (1.5 g/crh.) excl. oil changes) or if there are other signs of wear.

1 Replace piston rings and check pistons and liners

2 If necessary, recondition engine

Top

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 complimented with other directions of more general nature.

Lubricating System

We have already mentioned the necessity of using 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 it's 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 temperature, etc.

Ordinary engine oil, on the other hand, oxidizes rapidly and products easily cause trouble in the form of stuck piston rings and valves, clogged oil passages, etc
Therefore, use only the special diesel oils (HD oils) recommended by well-known oil companies. Never mix oils of different grades or makes.

Recommended Lubricating Oils For Engine

At temperatures above 32deg F (0 deg C) SAE 20 or 20 w.
At temperatures below 32deg F (0 deg C) SAE 10 or 10 w.
The carbon-dissolving properties of the HD oils make it difficult to judge the condition of an oil by it's colour. It is therefore important to follow the oil changing instructions based on our experience.

Correct lubrication with a suitable oil is an important part of an engines 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 charts at the end of this book. These times presuppose the use of high-grade lubricants

Fuel System

Clean fuel is an absolute prerequisite for trouble-free engine running. Just how important this is will perhaps be more readily understood if we explain the precision working of the fuel pump. At an exact crankshaft angle and during an extremely short period - 1 1/2 thousandths of a second in normal operations - the nozzle needle must lift, an accurately measure 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 a 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 it's cylinder is only 4/1000.000 in. (1/1000 mm.). 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 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 as clean as possible when filling it into the tank. To this end we are including in the following some advice on storing and filling fuel.

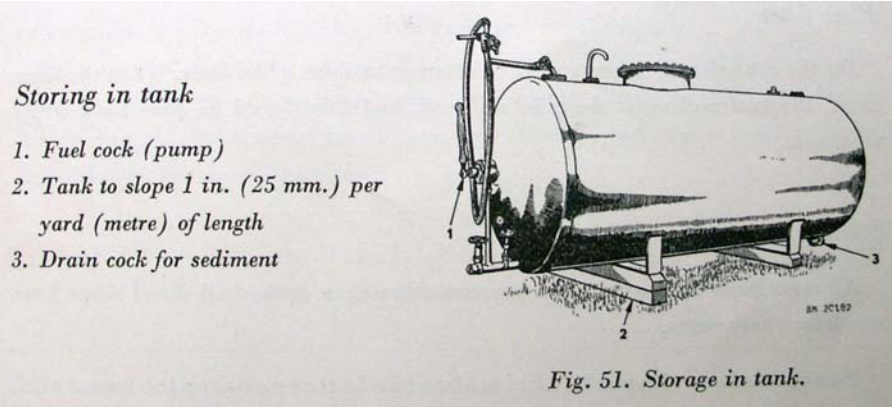


Fig. 51. Storage in tank.

Top

The best way to store fuel is to tank it as shown in fig 51. This gives the fuel time to stand long enough for the foreign particles that it always contains to sink to the bottom.

Storing In Barrels

If it is not possible to store the fuel in a 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 tanks 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 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.

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

Symptoms	Possible Cause	Remedy
Engine fails to start	Fuel tank empty	Fill with fuel and bleed
	Broken spring (fig.11) at injection pump	Replace spring
	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 fine-filter	Repair by authorized workshop
	Clogged overflow valve on fine-filter	Disassemble overflow valve and check for proper sealing
Back		
	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	Tighten pipes
	Faulty injectors	Replace with spare, Repair faulty injector 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
	Mechanical knock	Have authorized workshop or mechanic check engine
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
	Decompression lever at open position	Set level at position 1
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

SINGLE-CYLINDER ENGINE	
General	
Type Number	**1051**
Number of cylinders	**1**
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**
Direction of rotation	**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.	**1.500**
Output	**11.5 B.H.P.**
Lubricating System	
Oil Pressure, engine	**40-60 lb/sq.in. (3-4 kg/sq.cm.)**
Capacity, engine	**8.8 Imp.pints (5 litres)**
Capacity, reverse-reduction gearbox	**5.3 Imp.pints (3 litres)**
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.)**

Top

Cooling System

Cooling water Temperature	**160-175 deg F (70-80 deg C)**

Electrical System

Voltage	**12 Volts (Negative Pole Earthed)**
Capacity	**85 amp.hr.**
Generator output	**130 watts**
Starting motor output	**1.8 H.P.**
Starting motor engagement	**Sliding Pinion Magnet Coupling**

Cylinder head bolts (Tightening Torque)

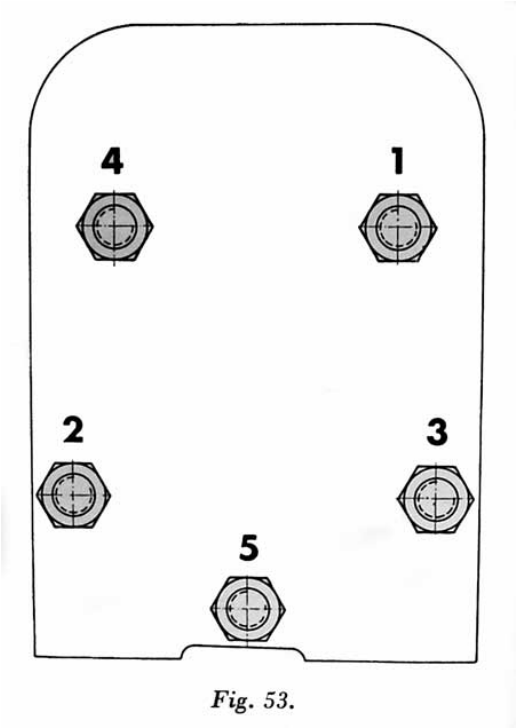


Fig. 53.

Tighten nuts in the order shown in figure. Torque to be 123 ft.-lb. (17 kgm).

Two-Cylinder Engine

General

Type number		1052 BR
Number of cylinders		2
Bore		4 1/8 in. (104.77 mm.)
Stroke		5 1/8 in (130 mm.)
Swept volume		136.8 cu.in. (2.24 litres)
Compression ratio		16.5 : 1
Direction of rotation		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		23 B.H.P.

Lubricating system

Oil Pressure, engine	40-60 lb/sq.in. (3-4 kg /sq.cm.)
Capacity engine	14 Imp.pints (8 litres)
Capacity, reverse-reduction gearbox	5.3 Imp.pints (3 litres)

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	0.0106 in. (0.27 mm.)
Pump setting	28 deg before T.D.C.
Working pressure, overflow valve	10 – 18.5 lb/sq.in. (0.7 – 1.3 kg/sq.cm.)

Cooling system

Cooling water temperature	160 – 175 deg F (70 – 80 deg C)

Electrical system

Voltage	12 volts (negative pole earthed)
Capacity	135 amp.hr
Generator output	130 watts
Starting motor output	2.5 H.P.
Starting motor engagement	Sliding armature, auxiliary winding

Cylinder head bolts (tightening torque):

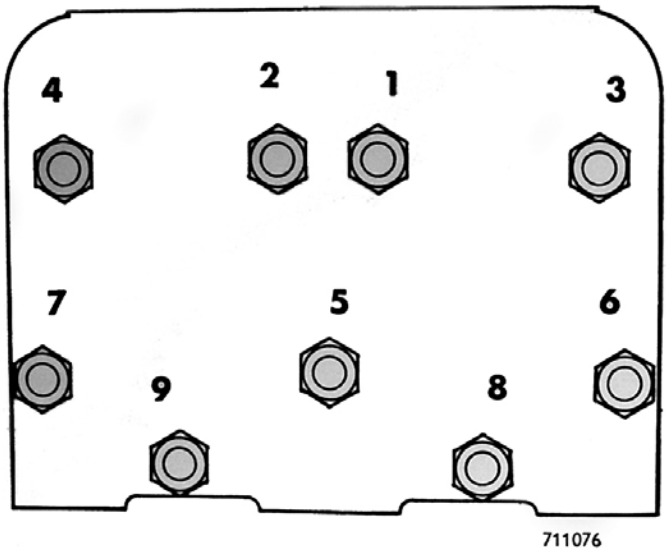


Fig. 54.

Tighten nuts in the order shown in figure. Torque to be 123 ft.-lb. (17 kgm)

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

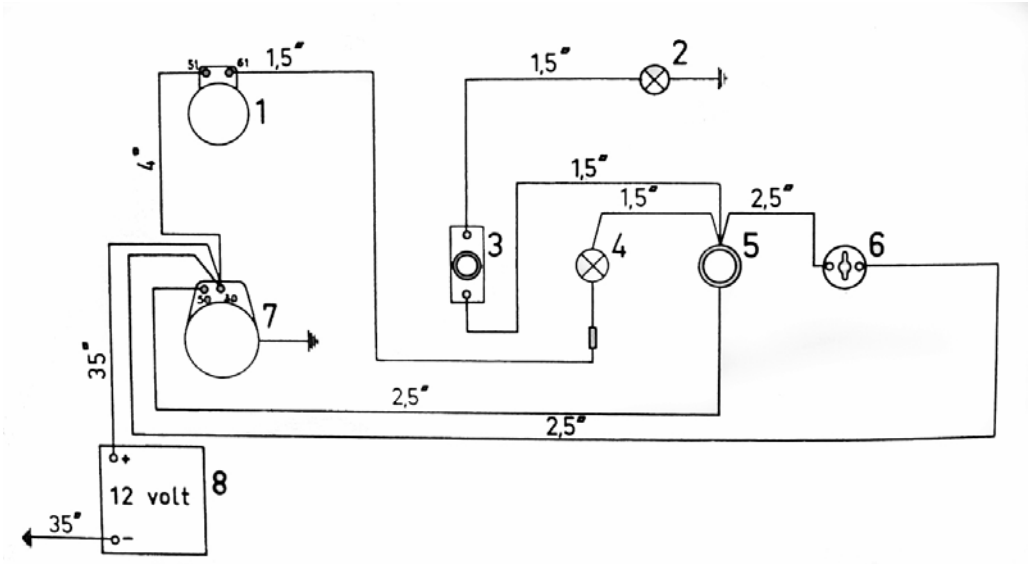


Fig. 55.

1. *Generator*
2. *Instrument panel lighting*
3. *Switch*
4. *Indicator lamp*
5. *Starting button*
6. *Switch key*
7. *Starting motor*
8. *Battery*

Lubricating chart for diesel engine 1051 BR

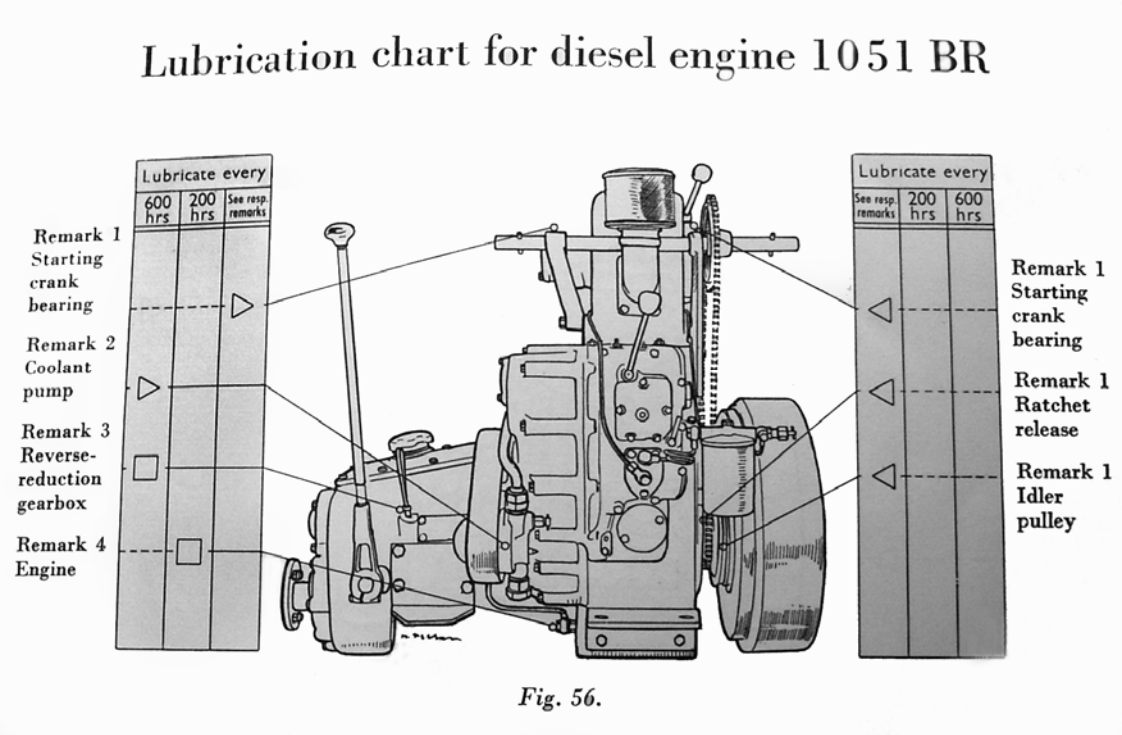


Fig. 56.

Symbols

□ Engine oil (HD oil for service DG)
Over 32 deg F (0deg C)
SAE 20 or 20 W
Below 32deg F (0deg C)
SAE 10 or 10 W

►Heat resistant ball bearing grease

Remark 1. Lubricate sparingly as required.

Remark 2. Refill with new heat-resistant grease whenever the engine is reconditioned. Lubricate sparingly every 6000 hours

Remark 3. Change oil every 6000 hours. Use Same kind of oil as in engine. Check oil level daily.

Remark 4. Change engine oil. Drain off old oil when engine is warm. Check oil level daily. USE HD OIL "For Service DG"

Oil capacity

Engine 8.8 Imp. Pints (5 litres)
Reverse-reduction gearbox 5.3 Imp. Pints (3 litres)

Lubricating chart for diesel engine 1052 BR

Lubrication chart for diesel engine 1052 BR

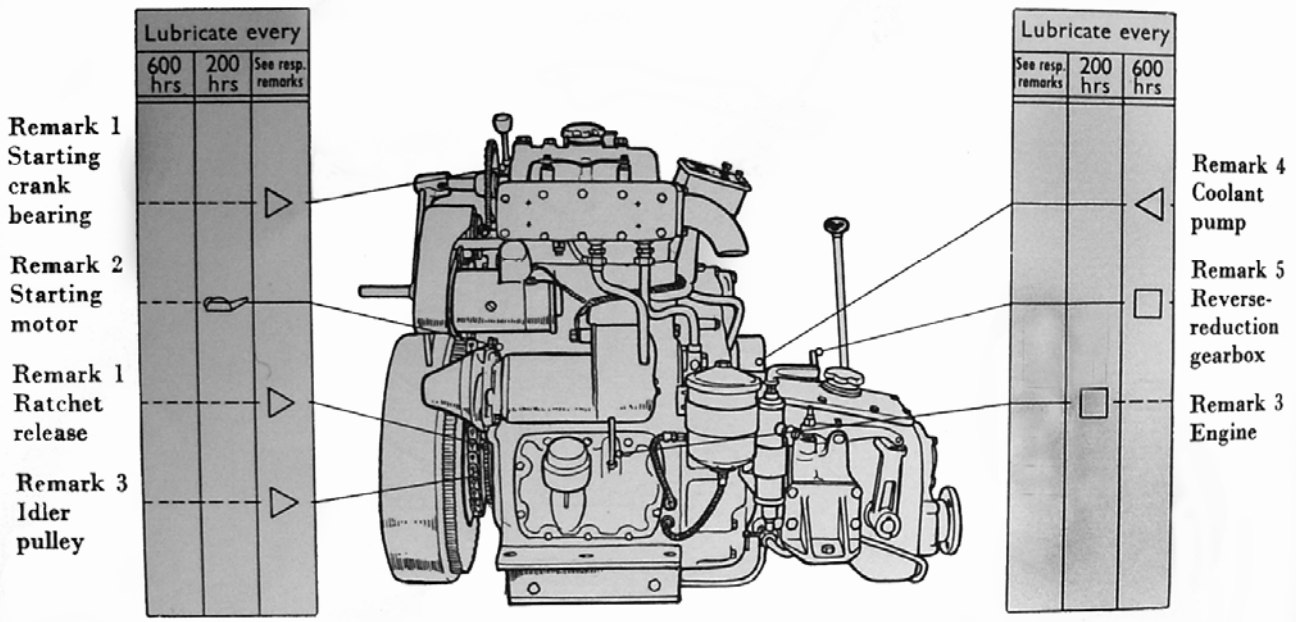


Fig. 57.

Symbols
□ Engine oil (HD oil "For service DG")
Over 32 deg F (0deg C)
SAE 20 or 20 W
Below 32deg F (0deg C)
SAE 10 or 10 W

Thin engine oil
►Heat resistant ball bearing grease

Remark 1. Lubricate sparingly as required.
Remark 2. There is a lubricating hole in the starting motor at the flange. To lubricate, remove screw and add a few drops at a time. Too much oil can damage the motor
Remark 3. Drain off old oil when engine is warm.
Remark 4. Refill with new heat-resistant grease whenever the engine is reconditioned. Lubricate sparingly every 600 hours.
Remark 5. Change oil in reverse-reduction gearbox Every 600 hours. Use same oil as in engine. Check oil level daily

Oil capacity

Engine 8.8 Imp. Pints (8 litres)
Reverse-reduction gearbox 5.3 Imp. Pints (3 litres)