PART 1

ENGINE

DESCRIPTION

GENERAL

Engines with type designation B 16 B are 4-cylinder, overhead-valve carburetor engines.

B 16 B engines are fitted with twin SU horizontal carburetors.

The engine has a hardened crankshaft with special bearing shells and a camshaft giving a relatively large lift.

The appearance of the engine is shown in figs. 1 and 2 and the illustrations in the end of this book. The output and torque curves are on fig. 3.

Output, B.H.P./r.p.m.	85/5500
Torque, kgm/r.p.m.	12/3500
lb.ft./r.p.m.	86.8/3500
Cubic capacity, liters	1.58
(cu.in.)	96.4
Compression ratio	8.2:1

CYLINDER BLOCK

The cylinder block is cast in one unit with the cylinders bored directly in the block. On the engine block, the right side has been designed so that the oil cleaner is connected directly without any external lines.

CRANKSHAFT

The crankshaft is made of drop-forged steel with precision ground and surface-hardened main and connecting rod bearing journals. The crankshaft is statically and dynamically balanced and is carried in three main bearings in the upper part of the crankcase. These bearings consist of replaceable bearing shells. The rear bearing journal also gives axial location. Apart from standard sizes there are also undersize bearing shells available to provide the correct clearance without shaving or filing even after the bearing journals have been reground.

MAIN BEARINGS AND CONNECTING ROD BEARINGS

The main bearings and the connecting rod bearings are of the tri-metal type. They are made of steel with lead-bronze alloy linings. This lining is coated with a very thin layer of lead-indium.

The crankshaft guide bearing, which has a greater bearing surface than the other main bearings, is babbit-lined.

CAMSHAFT

The camshaft is made of special steel with hardened and ground cams and bearing surfaces. The camshaft is guided axially by means of a washer at the front end.

PISTONS AND PISTON RINGS

The pistons are made of light-alloy and are coated with a thin layer of tin.

The piston pin hole is slightly displaced from the center line of the piston. A letter is stamped in the top of each piston showing the class to which it belongs and there is an arrow showing in which direction the piston should be fitted.

Each piston has two compression rings and one oil control ring. The upper ring on each piston is chromed.

CONNECTING RODS

The connecting rods are made of drop-forged, I-section steel since this gives maximum rigidity combined with low weight.

On B 16 engines, the cylinder bores are not directly over the connecting rod bearings but are somewhat displaced along the longitudinal axis of the engine.

The consequence of this is that the center line of the connecting rods is displaced relative to the center line of the bearing surface.

The connecting rod bearings consist of replaceable shells while the piston pin bearings consist of precision finished bushings.

PISTON PINS

The piston pins are made of low carbon steel which has been surface-hardened and ground. This ensures a tough core which can stand the stresses caused by the high combustion pressure to which the pistons are subjected as well as a hard surface to resist

abrasion. The piston pins are fully floating, i.e. they can rotate both in the connecting rod bushing and in the piston boss. Axial movement is prevented by means of circlips in the piston bosses.

VALVES

The valves are made of special steel. There are spherical recesses in the face of the valve disks. This means low weight which is a great advantage particularly at high engine speed. This recess in each valve also ensures a certain amount of elasticity and better sealing properties.

LUBRICATING SYSTEM

The engine is provided with a pressure lubricating system. The oil cleaner is of the full-flow type and all oil on its way to the lubricating points must first pass through the oil cleaner.

On the B 16 engine the oil cleaner is fitted directly on the right side of the cylinder block and there are no external oil lines. Oil passes to and from the cleaner through channels in the block.

The oil cleaner element consists of a replaceable paper unit. The cleaner is fitted with a by-pass valve which permits oil to by-pass the element if resistance to flow exceeds a certain value.

A relief valve in the system prevents the oil pressure from becoming too high.

IGNITION SYSTEM

Distributor

The distributor in the electrical system is fitted with both centrifugal and vacuum ignition regulators.

When the crankshaft is standing still, its position can be checked both by markings on the flywheel and with the aid of a raised spot on the timing gear casing. In the top dead center position this raised spot is opposite a groove in the pulley.

FUEL SYSTEM

B 16 B engines are fitted with twin SU horizontal carburetors which are connected together.

SU carburetors

The design of the two types used is identical in principle. The carburetors are made by SU, see fig. 8. Since the carburetors are of the horizontal type, the fuel/air mixture passes in horizontally. In this particular case, the carburetors are fitted at a certain angle to the horizontal.

Both the carburetors are fitted with a rapid idling device. The front carburetor is not fitted directly with this device but receives the same impulse through the shaft connecting the carburetors together.

There is an equalizer tube between both the inlet manifolds which are very short. There is only one jet in each of the carburetors. Fuel flow is varied by a tapered needle which is guided by a plunger in the carburetor, this plunger being influenced by the degree of partial vacuum in the carburetor barrel.

There is no choke in the normal sense of the term. Instead there is a cold starting device which, when engaged, gives a richer fuel/air mixture by depressing the jet whereupon the fuel flow area increases.

The function of the carburetor can be divided into the following groups:

1. Float system
2. Running
3. Cold starting
4. Rapid idling
5. Idling

1. Float system

The fuel flow is controlled by the float system so that the correct fuel level is obtained in the carburetor.

The float system consists of float bowl (6, fig. 11) which is flexibly attached to the carburetor housing through the medium of rubber gaskets, as well as a float (5), cover (1) and the flexibly attached lever (4) together with the needle valve (3) which is attached to the cover. There is a strainer (2) with a spring in the cover. The float is guided by a center bolt in the float bowl.

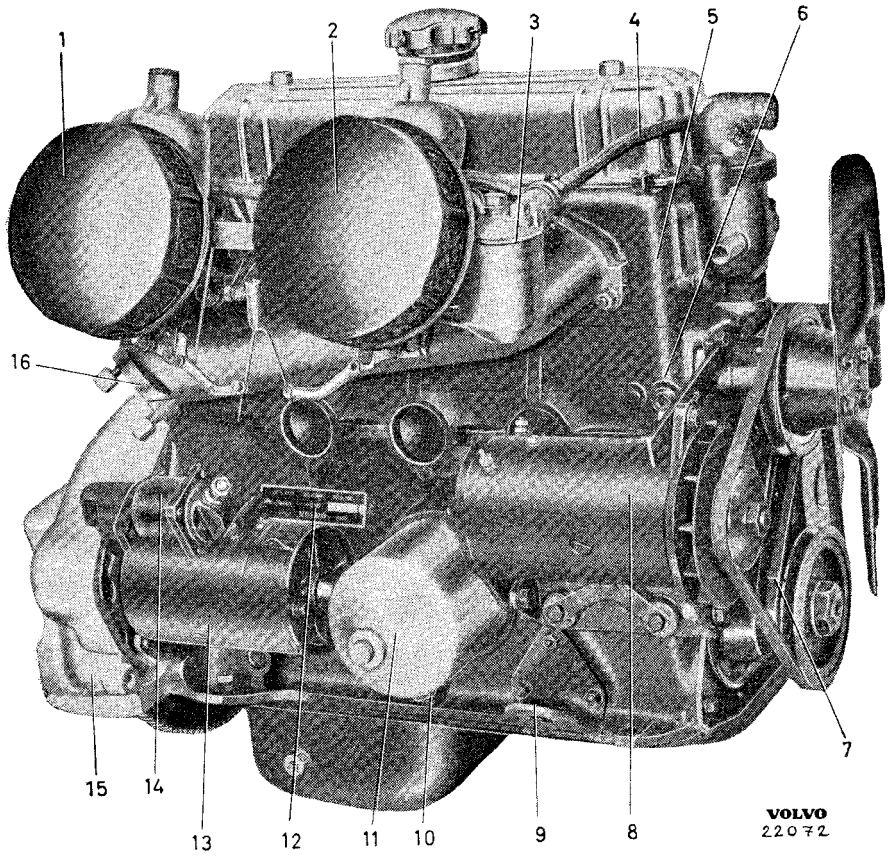
When fuel is forced by the pump to the float bowl, it first passes through the strainer which removes all impurities. When the fuel level rises, the float is lifted upwards and when the fuel level has reached the correct height, the needle is pushed up by the lever so that the flow of fuel is stopped. When the level sinks, the valve opens again and more fuel flows in.

2. Running

The amount of fuel/air mixture which flows to the engine is regulated with the aid of the butterfly throttle (6, fig. 12) in the carburetor housing (7).

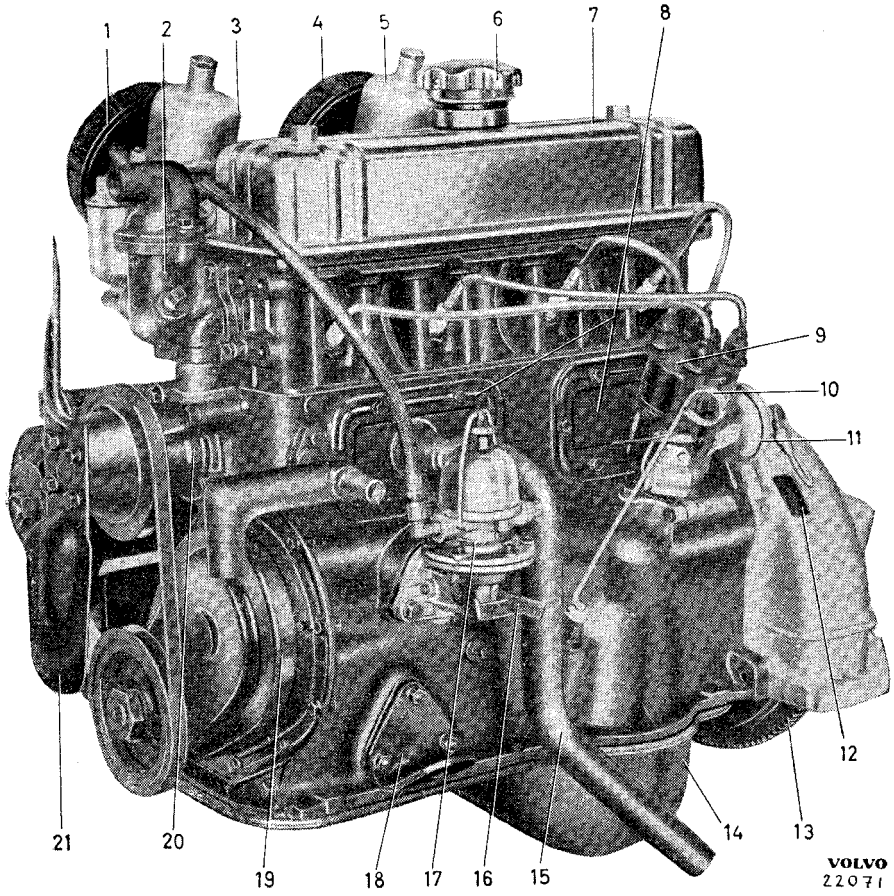
The housing is in the shape of a channel but is also a body on which the various parts of the carburetor are assembled.

Above the jet (10) which is fitted from below, the channel narrows due to the projection known as



1. Rear air cleaner
2. Forward air cleaner
3. Float bowl (forward carburetor)
4. Fuel line
5. Cylinder head
6. Cylinder block
7. Ignition setting mark (T.D.C)
8. Generator
9. Engine support
10. Oil relief valve
11. Oil cleaner
12. Serial number plate (number stamped directly into block on distributor side, late production engines)
13. Starter motor
14. Starter solenoid
15. Flywheel housing
16. Exhaust manifold

Fig. 1. B 16 B engine (carburetor side).



1. Forward air cleaner
2. Thermostat housing
3. Forward carburetor
4. Rear air cleaner
5. Rear carburetor
6. Oil filler cap
7. Rocker cover
8. Inspection cover
9. Distributor
10. Oil dipstick
11. Vacuum regulator
12. Inspection hole
13. Flywheel
14. Oil pan
15. Crankcase breather
16. Hand primer pump
17. Fuel pump
18. Engine support
19. Timing gear casing
20. Water pump
21. Fan

Fig. 2. B 16 B engine (distributor side).

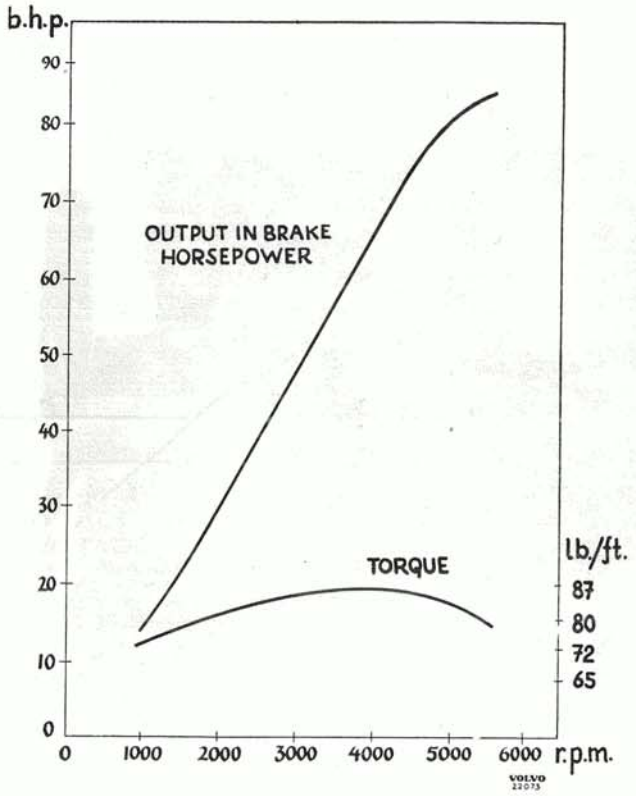


Fig. 3. Output and torque curves, B 16 B engine.

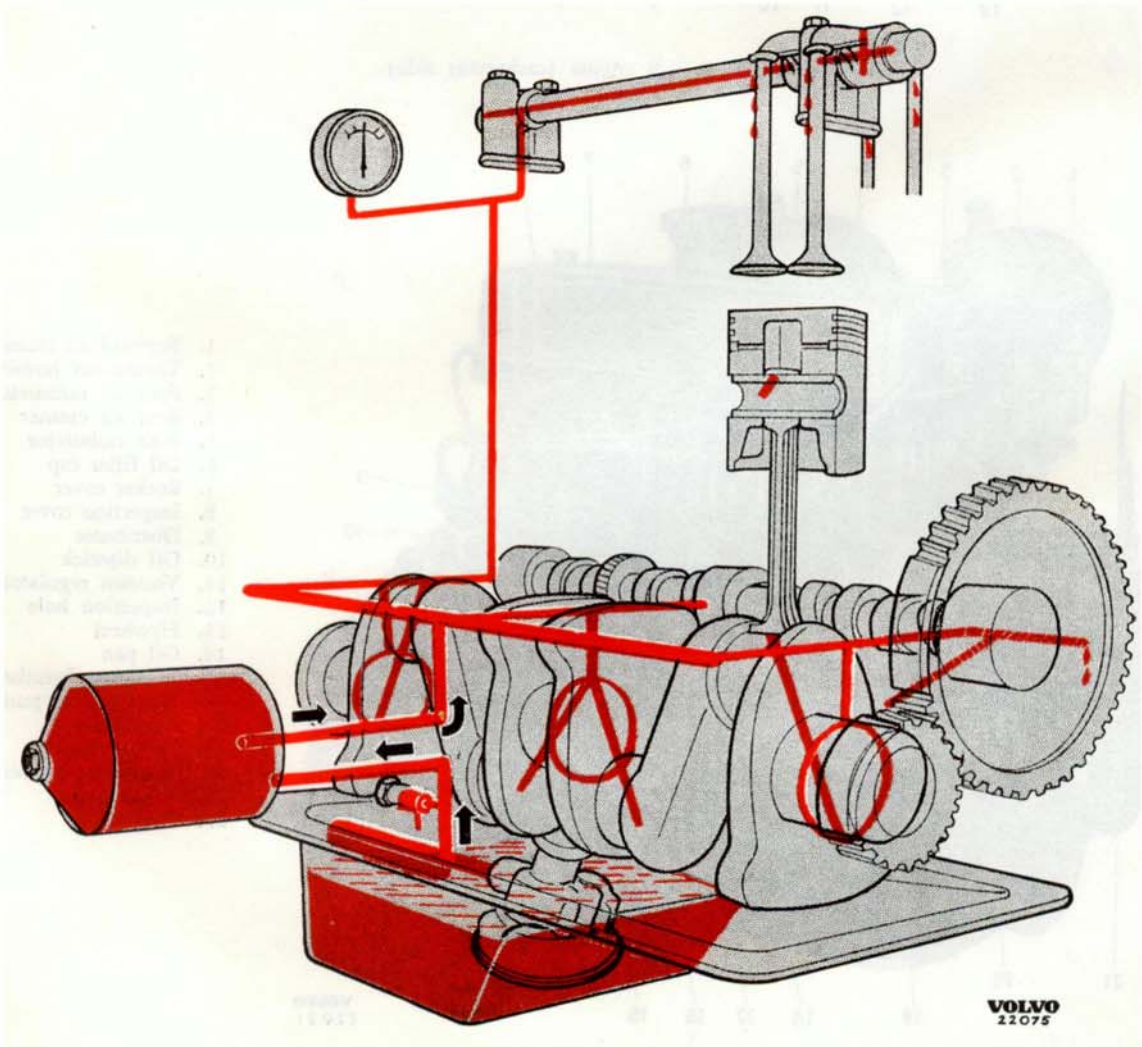


Fig. 4. Lubricating system.

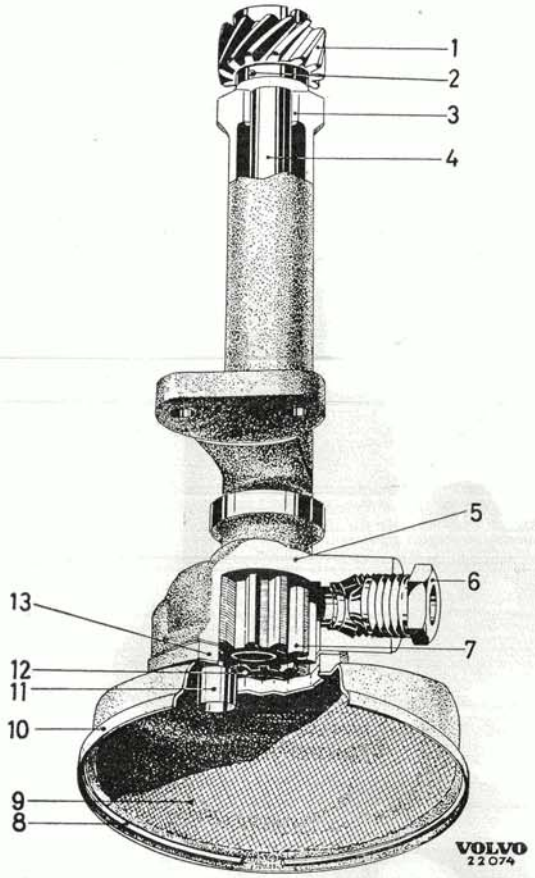


Fig. 5. Oil pump.

1. Drive gear
2. Lock pin
3. Bushing
4. Shaft
5. Housing
6. Pressure pipe connection
7. Gear (driven)
8. Lock ring
9. Strainer
10. Strainer housing
11. Inlet
12. Gear (driving)
13. Cover

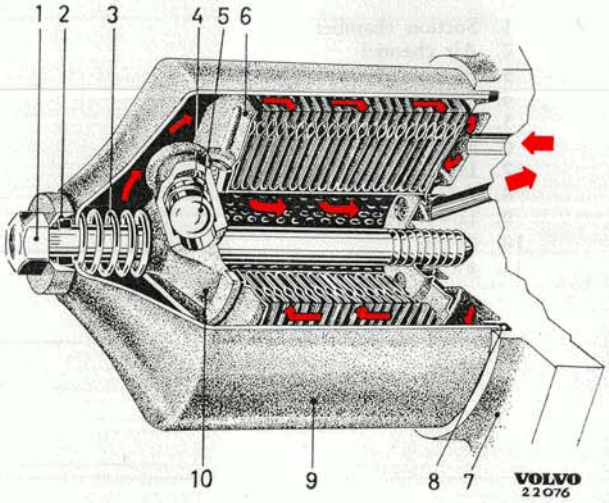


Fig. 6. AC oil cleaner.

1. Bolt
2. Washer and seal
3. Spring
4. Valve spring
5. Valve ball
6. Filter element
7. Cylinder block
8. Gasket
9. Housing
10. Valve housing

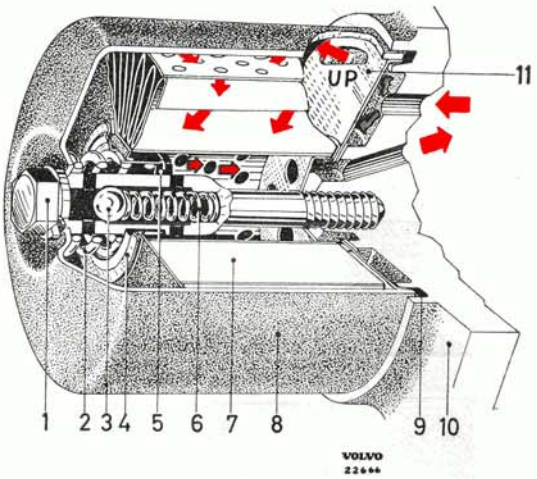


Fig. 7. Mann oil cleaner.

1. Bolt and washer
2. Spring
3. Valve ball
4. Sealing sleeve
5. Gasket
6. Valve spring
7. Filter element
8. Housing
9. Gasket
10. Cylinder block
11. Intermediary plate (late production engines, independent of cleaner make)

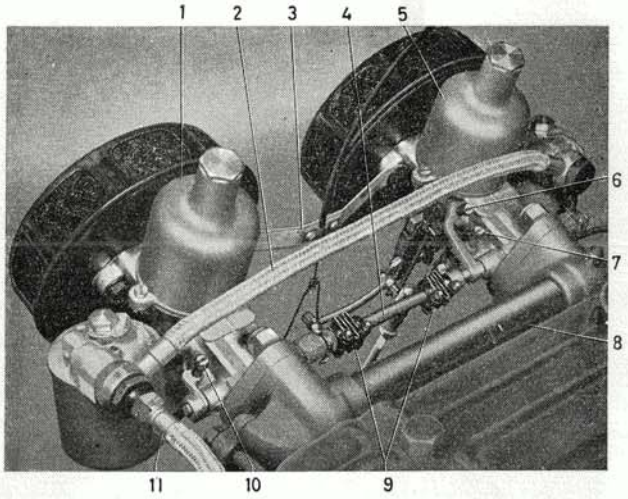


Fig. 8. SU carburetors.

1. Forward carburetor
2. Fuel pipe between carburetors
3. Retainer for controls
4. Shaft between carburetors
5. Rear carburetor
6. Rapid idling adjuster screw
7. Idling adjuster screw
8. Equalizer tube
9. Couplings
10. Idling adjuster screw
11. Fuel line from pump

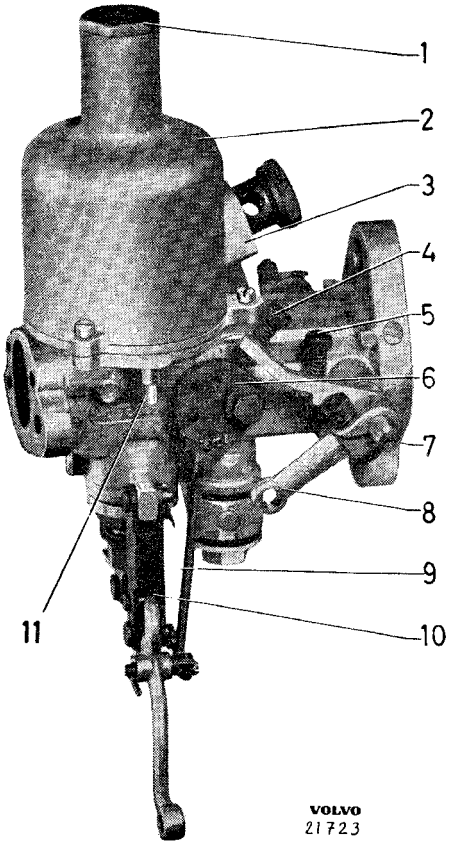


Fig. 9. Rear SU carburetor from control side.

1. Nut for damping plunger (also for oil filling)
2. Suction chamber
3. Float bowl cover
4. Rapid idling adjuster screw
5. Idling adjuster screw
6. Cam plate
7. Throttle shaft
8. Throttle shaft lever
9. Link rod
10. Link
11. Lift pin for piston

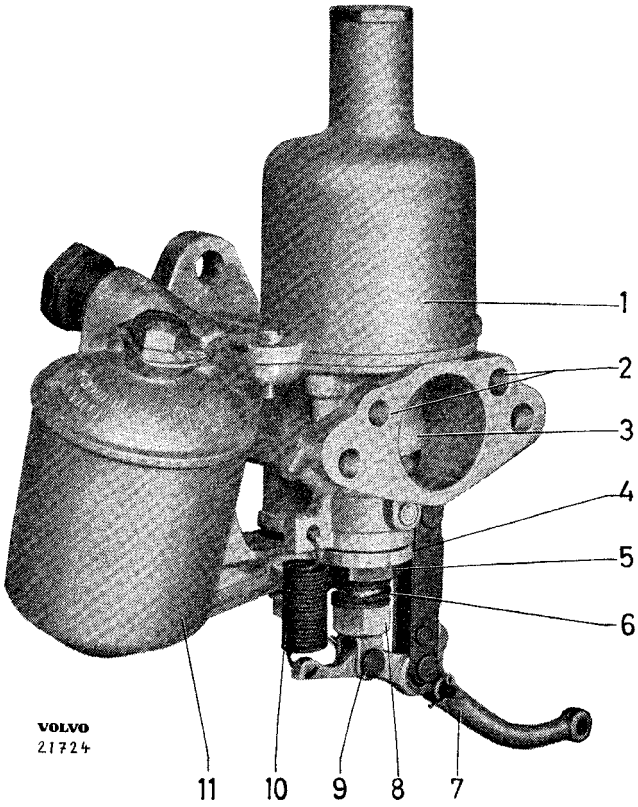


Fig. 10. Rear SU carburetor from float bowl side.

1. Suction chamber
2. Air channel
3. Piston
4. Seal washer
5. Lock nut
6. Spring
7. Lever
8. Adjuster nut
9. Lower part of jet
10. Spring
11. Float bowl

the bridge (22) and the piston (4) which is situated above the bridge. The air flow speed increases when it passes through this restriction whereby the fuel is picked up more easily.

Opposite the bridge on the top of the carburetor, there is a suction chamber (1) with the piston (4). There is a tapered needle (24) attached to the lower section of the piston.

The piston is guided by a centrally located spindle which runs in the center part of the suction chamber where there is a bushing. The upper part of the piston is precision fitted into the suction chamber. The lower section functions as a shutter and restricts the cross-sectional area of the main air passage above the jet as the piston moves downwards. The piston, under the influence of its own weight and assisted by the spring (2) always shows a tendency to assume its lowest position. When the piston is in its lowest position it rests against the bridge by means of the pin fitted in it.

When the engine is running and the butterfly throttle opening increases, the degree of vacuum in the space between the bridge and the throttle increases and then the cavity above the piston is connected through a little channel (5) to the above-mentioned cavity and the piston moves upwards. The space below the upper section of the piston is connected to the outer air by means of two channels (23).

When the piston rises, the carburetor channel cross-section above the jet is enlarged and an additional quantity of air is permitted to pass through. Since the fuel needle is attached to the piston, it also moves upwards and the effect of opening between the fuel needle and the jet is enlarged. A quantity of fuel corresponding to the larger quantity of air is then sucked in. The amount of fuel is regulated partly by the piston (fuel needle) position and partly by the air flow speed.

The jet is fed with fuel from the space in the carburetor housing at the float bowl connection through the hole in the jet walls.

The position of the piston will be stable for any given air flow through the carburetor. The degree of this air flow is determined by the degree of throttle opening as well as the speed of the engine and the loading on the engine. Every tendency on the part of the piston to move downwards will be accompanied by a reduction of the flow area between the bridge and the underside of the piston with the consequent increase of the degree of partial vacuum between the piston and the throttle. This immediately results in an increase in the partial vacuum in the upper part of the suction chamber. The piston will then be raised so much that balance is once more restored.

There is a damping device in the recess in the piston spindle to prevent the piston from coming into any pendular motion or moving excessively rapidly.

This device consists of a damping plunger (3) attached to the rod. The hollow interior of the spindle contains a quantity of light engine oil. The retarding effect of this damping device on rapid movement of the piston prevents the engine from stalling due to an excessively lean fuel/air mixture when the accelerator pedal is depressed rapidly.

Opposite the throttle (rear carburetor) there is a connection for the pipeline to the vacuum regulator on the distributor.

3. Cold starting

In order to enrich the fuel/air mixture when starting a cold engine, there is a carburetor device by means of which the jet can be lowered. When the jet is lowered there will be a wider flow area for the fuel since the needle in the jet is tapered. There is no choke shutter on the carburetors. The jet, the lower part of which is yoke formed, is not fitted directly in the carburetor housing but is carried in two bearings (12 and 20, fig. 12) so that it can move up and down.

When the lock nut (15) is loosened the jet can also be moved laterally (for centralizing). The upper bearing has a flange which with the aid of a washer (21), seals against the recess in the carburetor housing, the lower bearing flange sealing with the help of a washer (18) against the top of the lock nut. The lock nut seals against the carburetor housing by means of a washer and a gland (16). Inside the bearings there is a spring (17) exerting pressure against two washers with sealing glands (13 and 19) which prevent any leakage of fuel at the jet.

When a cold engine is being started the outer end of the lever (25, fig. 13) is pulled upwards by means of a control system, the movement being transmitted to the link (26) so that the jet, which is connected to the inner end of the lever, is pulled downwards. This movement is limited by means of a projection on the lever and return to the normal position is taken care of by the return spring (27) when the control is pushed in.

At the same time as this lever is operated, the throttle is opened slightly by means of the rapid idling device described below.

4. Rapid idling

When the rapid idling device is operated, a larger throttle opening is obtained than is usual during normal idling and this is used during the engine warming-up period in order to obtain a somewhat higher idling speed. See fig. 14. This device, which is connected to the cold starting device, consists of a link rod (31) connected to the lower lever which influences a cam-shaped plate (30) attached to the carburetor housing. There is an adjuster screw which contacts this plate when the rapid idling device is in operation. This screw is attached to the throttle lever (28). When the lower, outer end of the lever is lifted, the cam-shaped plate is turned by which the throttle is opened slightly. (The end of the lever can be lifted slightly before the jet is influenced depending upon the large clearance in the lever hole on the link).

The cam-shaped plate has three holes for the different positions of the link rod (31).

5. Idling

When the engine is idling the carburetor piston is in its lowest position and rests on the bridge at the jet on a pin. The small opening which remains between the bridge and the piston allows the required amount of air to pass for idling without there being a sufficiently great degree of partial vacuum to raise the piston.

The amount of fuel required for idling is very small and the tapered needle almost entirely fills the jet opening.

The jet is pressed upwards by the spring (10, fig. 10) for the lever so that the lower part of the jet is supported against the adjuster nut (8) which is locked in position by means of a spring (6). This nut is used to set the amount of fuel passing through since the fuel needle is tapered.

If the nut is screwed upwards a leaner fuel/air mixture is obtained and if the nut is screwed downwards, the mixture will be richer.

The relationship between fuel and air is set at idling for the complete speed range.

FUEL PUMP

The engine is fitted with a fuel pump of the diaphragh type and the design of this pump is shown in fig. 16.

The fuel pump feeds fuel from the fuel tank to the carburetor and is driven by an eccentric on the camshaft. There is also an idling device through which the pump stops operating when the needle valve in the carburetor float bowl is closed. The pump is adjusted for a maximum pressure of 3.5 p.s.i. (0.25 kg/cm^2).

The camshaft eccentric operates a rocker (16) journaled on a pin (17) and this influences a rocker link (18). The inner end of the rocker is coupled to the pump pull rod (2). The diaphragm (4) center is attached to the upper end of the pull rod. The circumference of the diaphragm is clamped between the two halves of the pump body.

When the diaphragm is pulled downwards, fuel is sucked from the tank through a sediment bowl (9), strainer (12) and inlet valve (13) into the pump chamber. When the eccentric has reached its highest point and begins to recede, the lever is pulled back by a spring (3). The diaphragm is then pressed upwards by the thrust spring which was compressed during the suction stroke and forces the fuel past the outlet valve (7) to the carburetor. When the carburetor float bowl is filled with fuel, the needle valve closes and a counter-pressure builds up in the pump chamber. The diaphragm comes to a stop in the down position and the spring cannot force it upwards for a new suction stroke until more fuel has been consumed. The fuel pump has an external lever (1) for hand priming.

AIR CLEANERS FOR SU CARBURETORS

The air passing to the carburetors is cleaned when it passes through the wire filters (4, Fig. 15) in the cleaners. The space below the piston in the suction chamber in each carburetor is connected with the air cleaner through the air holes (1). Air passing to these spaces is thus cleaned to prevent the pistons from binding. The gasket (3) must not be turned the wrong way since this will block the holes (1).

COOLING SYSTEM

In order to obtain effective cooling water circulation there in an impeller type pump fitted in the cooling system and this is driven from a pulley on the forward end of the crankshaft. The pump shaft is carried in two ball bearings. The fan is fitted on the forward

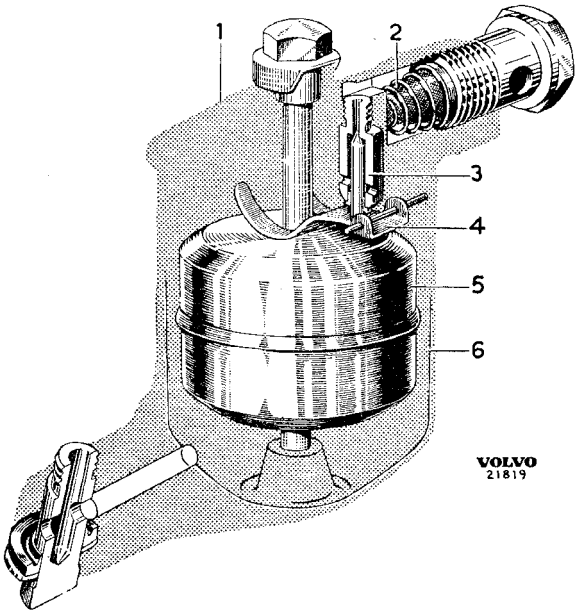


Fig. 11. Float system.

1. Float bowl cover
2. Strainer
3. Needle valve
4. Lever
5. Float
6. Float bowl

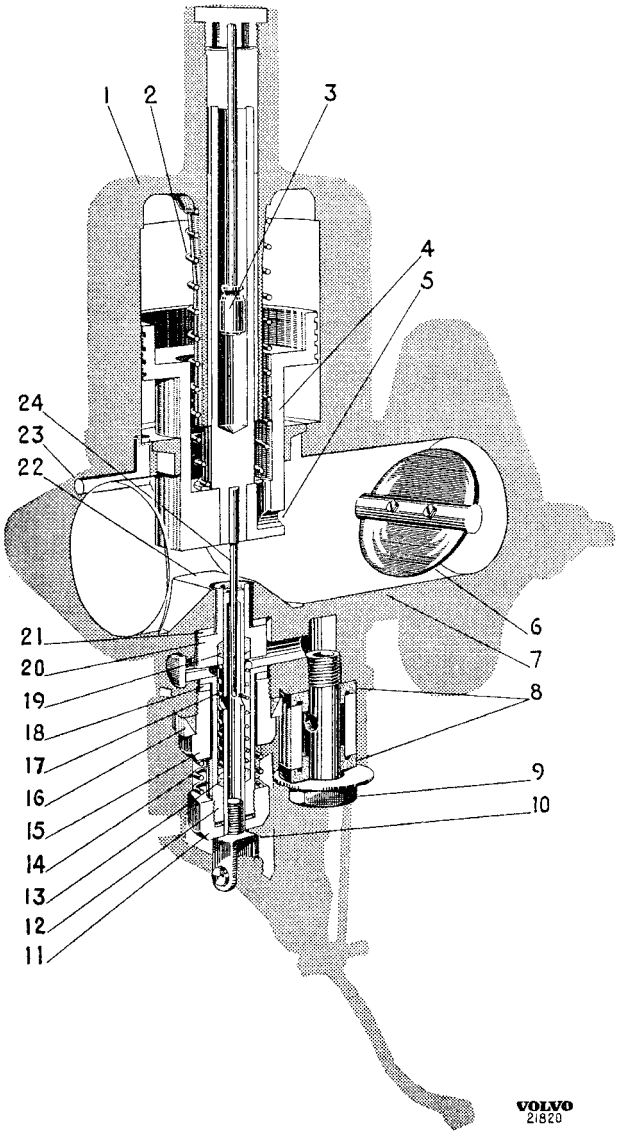


Fig. 12. Carburetor, operating position.

1. Suction chamber
2. Spring
3. Damping plunger
4. Piston in suction chamber
5. Channel
6. Butterfly throttle
7. Carburetor housing
8. Rubber gasket
9. Bolt for float bowl
10. Jet
11. Adjuster nut
12. Lower jet bearing
13. Seal with washer
14. Spring
15. Lock nut
16. Seal washer and gland
17. Spring
18. Washer
19. Seal ring and washer
20. Upper jet bearing
21. Washer
22. Bridge
23. Channel
24. Fuel needle

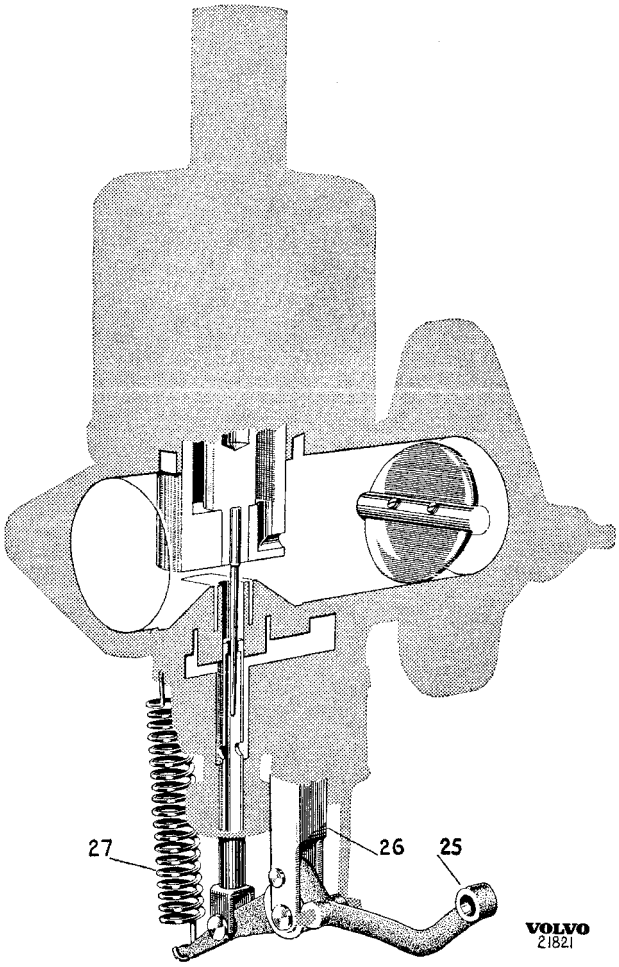


Fig. 13. Carburetor, cold start.

25. Lever
26. Link
27. Spring

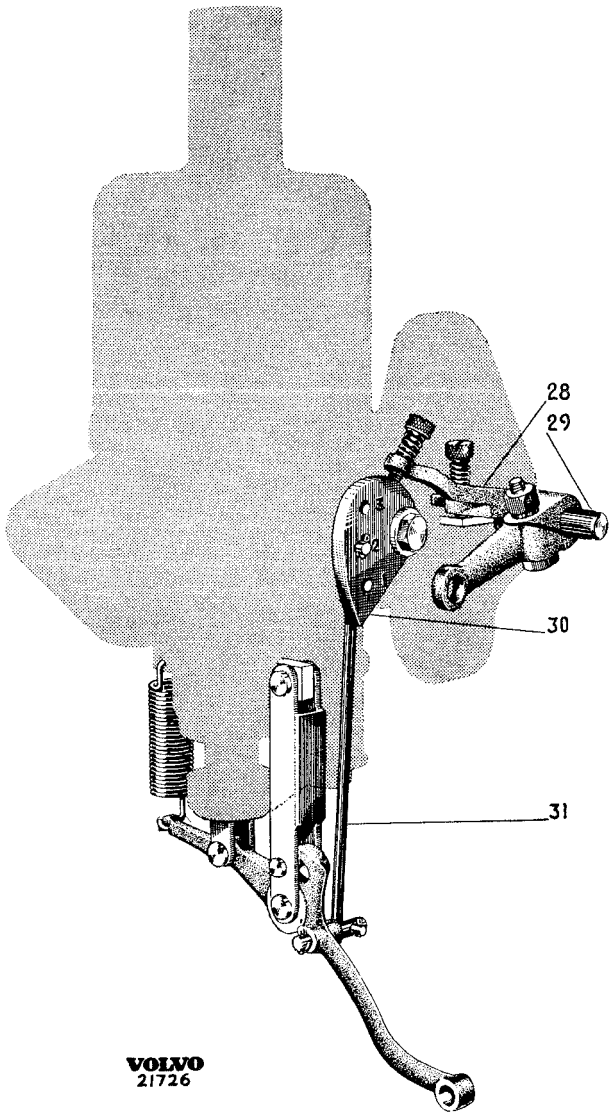


Fig. 14. Carburetor, rapid idling.

28. Lever for throttle
29. Throttle shaft
30. Cam plate
31. Link rod

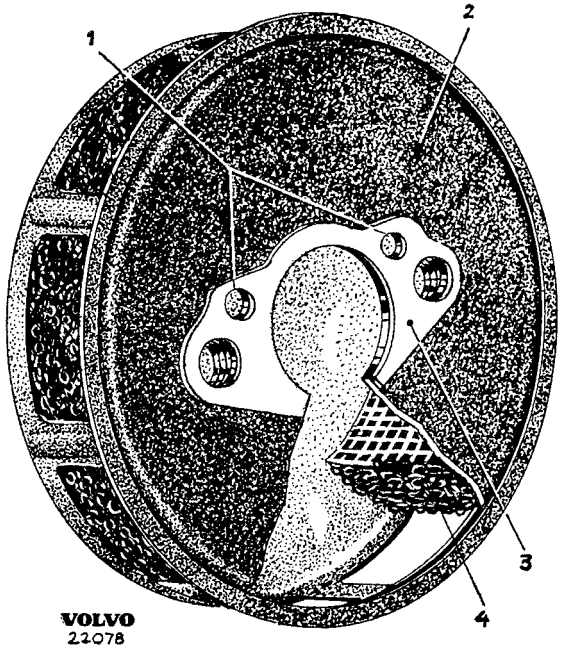


Fig. 15. Air cleaner (SU carburetors).

1. Air holes
2. Housing
3. Gasket
4. Wire filter

end of the pump shaft. This forces a powerful current of air through the radiator which is fitted in front of the engine.

In order to shorten the warming-up period of the engine after starting from cold condition, there is a thermostat in the cooling system and this is located in the upper connection between the engine and the radiator. The thermostat prevents the cooling water from passing out to the radiator and being cooled during the warming-up period. Instead circulation is limited to the engine itself through a hole from the cylinder block to the pump inlet channel in the block. The thermostat is balanced, that is to say it does not open under the influence of the pressure exerted by the water pump.

REPAIR INSTRUCTIONS

WORK THAT CAN BE CARRIED OUT WITHOUT REMOVING THE ENGINE FROM THE CAR

Compression test

The purpose of the compression test is to check the sealing conditions of the piston rings and the cylinder walls. It is carried out by using a compression tester graduated in lb./sq.in. or kg/cm^2. Before the test is carried out the engine should be run until it reaches normal operating temperature, the air cleaner should be cleaned, all spark plugs removed and the throttle fully opened. Check that the choke flap is also fully opened. The battery must be well charged to allow the starter motor to turn the engine over sufficiently fast.

The cylinders are checked one at a time by placing the compression tester in the spark plug hole where it is held securely while the engine is turned over by means of the starter motor until the highest reading is obtained on the gauge (fig. 19).

The maximum reading for each cylinder should be noted unless the tester used is of the self-registering type. The compression pressures for the various types of engines are shown in the specifications in the end of this book. Deviations of up to 10% from this value are permissible. If the values obtained are low, a small quantity of heavy oil is introduced into each cylinder. Be careful not to smear the valve disks. Then repeat the test and note the readings.

By comparing the values of compression pressure obtained with and without oil, some idea can be obtained concerning the sealing efficiency of the piston rings and the valves. If the pressure is higher after the oil has been introduced, the piston rings are probably not tight. If the compression pressure is low in one or more of the cylinders with and without oil, the valves are probably leaky. If two adjacent cylinders have very low compression pressure, there is probably a leak in the cylinder head gasket between the two cylinders.

Tuning up the engine

The purpose behind the tuning up of an engine is to ensure that it starts more easily, develops full output and has minimal fuel consumption. Engines should be tuned up regularly at intervals of 6,000—12,000 miles (10,000—20,000 km).

The best way to tune up an engine is to carry out the operations in the following order:

1. Remove all the spark plugs. Clean, adjust and test them or replace them with new plugs. Clean the air cleaner. Measure the compression on all the cylinders.
2. Examine the degree of charge of the battery. If the specific gravity of the battery electrolyte is lower than 1.230, then the battery must be charged. If any of the individual cells in the battery have a low specific gravity, the cause for this must be determined. Examine all cables. Make sure that they are correctly tightened to their connections. Replace burned or badly insulated cables.
3. Check the dwell angle or remove the distributor cap and adjust the contact breakers to the correct gap. Replace burned breaker points. Examine the distributor cap for cracks and scrape off any oxide on the contact surfaces. Check the ignition cables and make sure that they are free from oxidation.
4. Check the ignition timing in accordance with the instructions given on page 16.
5. Adjust the valve clearance to the specified values, see the specifications.
6. Clean the carburetor and check that all the settings are correct, see under the heading "Carburetor". Check that there is no air leakage

at the carburetor or the intake manifold. Tighten the nuts. Replace the gaskets if required. Clean out the sediment bowl.

ENGINE DECARBONIZING AND VALVE GRINDING

Disassembly procedure

The engine should be decarbonized and the valves ground after about every 20,000—25,000 miles (30,000—40,000 km). On engines used for hard driving, the intervals between decarbonizing can be longer.

1. Drain off the cooling water.
2. Remove the rocker cover with gasket.
3. Remove the rocker arm mechanism and the push rods.
4. Remove the upper radiator hose and loosen the temperature gauge sensitive unit.
5. Loosen the throttle and choke controls at the carburetor.
6. Remove the ignition cables from the spark plugs.
7. Disconnect the exhaust pipe at the exhaust manifold.
8. Loosen all the cylinder head nuts. Lift off the cylinder head.
9. Clean the piston heads and blow off carbon with compressed air. Do not use abrasive cloth since the abrasive material can easily come between the pistons and the walls of the cylinders. Clean the upper surface of the cylinder block using a soft steel brush and compressed air. Cover the openings to the valve lifters.
10. Clean the cylinder head. Also follow the instructions given under the heading "Valves and valve mechanism".

Assembly procedure

Make sure that the sealing surfaces of the cylinder block and the cylinder head are absolutely clean and perfectly flat. Check this with a steel rule. Place the gasket on the block. Make sure that the oil channel for the rocker arm mechanism is not blocked. Oil the cylinder walls with engine oil. Place the cylinder head in position. Tighten the nuts. See "Tightening torque" in the specifications. Make a preliminary adjustment of the valves before screwing in the spark plugs. Fit the other component parts and fill the cooling system. Start the engine and let it run for at least 15 minutes. Then retighten the cylinder head nuts and carry out final adjustment of the valve clearances.

	Inlet	Exhaust
Valve clearance	0.020" (0.50 mm)	0.020" (0.50 mm)

The valves should be finally adjusted while the engine is idling. Then fit the rocker cover with its gasket. Make sure that it is turned the right way. Check the ignition timing and adjust if necessary. Adjust the engine idling speed.

After running for some miles, retighten the cylinder head nuts, adjust valve clearances.

CHANGING THE PISTON RINGS

1. Follow instructions 1 to 9 under the heading "Engine decarbonizing and valve grinding".
2. Lift the front end of the car on to supports until it is about 8" (20 cm) above floor level. Drain off the engine oil. Remove the oil pan in accordance with the instructions given under "Removing and fitting the oil pan" on page 7.
3. Check the connecting rod markings. (They should be marked 1—4, on the side away from the camshaft).
4. Scrape away the ridge in the upper part of the cylinders.
5. Disconnect the connecting rods at the lower end and push them upwards together with the pistons one at a time through the cylinder bores. Replace the bearing shells, bearing caps and nuts in position on the connecting rods.
6. Remove all the piston rings. Clean the pistons and connecting rods. (Note: do not clean the pistons and bearing shells in a degreasing tank). Clean the piston ring grooves and the drain holes in the groove bottom.
   Check that the oil channels in the crankshaft are not blocked.
7. Inspect piston pin clearance. If clearance is excessive, new bushings and oversize piston pins should be fitted. Follow the instructions under the heading "Pistons, piston rings and piston pins".
8. Check that the piston rings have the appropriate clearances in the cylinder bores and the piston ring grooves. Follow the instructions given under the heading "Pistons, piston rings and piston pins".
9. Check and straighten the connecting rods if required.

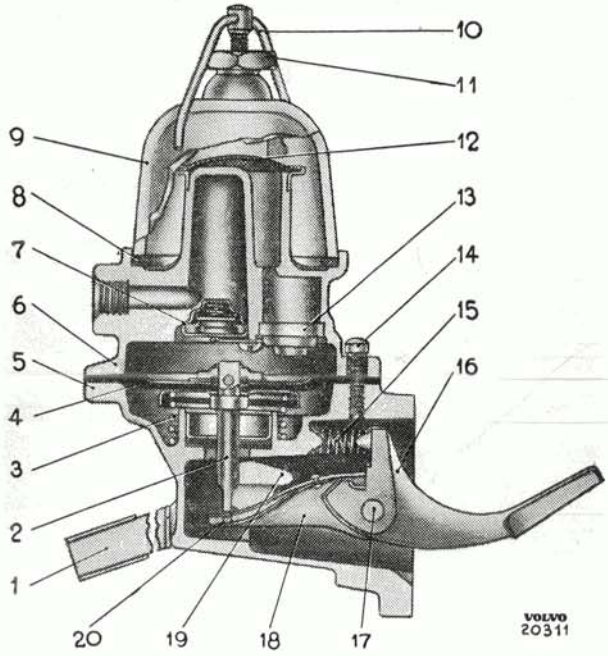


Fig. 16. Fuel pump.

1. Lever
2. Diaphragm rod
3. Spring
4. Diaphragm
5. Lower section
6. Upper section
7. Outlet valve
8. Gasket
9. Sediment bowl
10. Bowl retainer
11. Nut
12. Strainer
13. Inlet valve
14. Screw
15. Spring
16. Rocker
17. Pin
18. Link
19. Lever
20. Lock spring

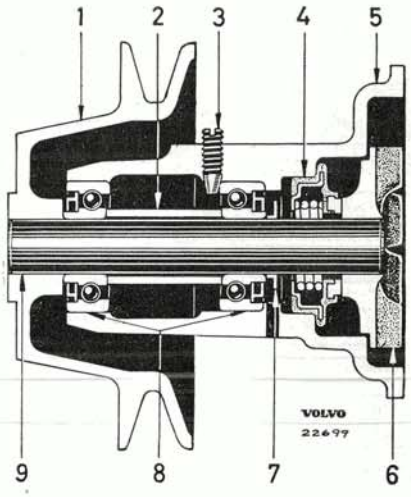


Fig. 17. Water pump.

1. Pulley
2. Spacer
3. Lock screw
4. Seal
5. Housing
6. Impeller
7. Slinger ring
8. Ball bearing
9. Shaft

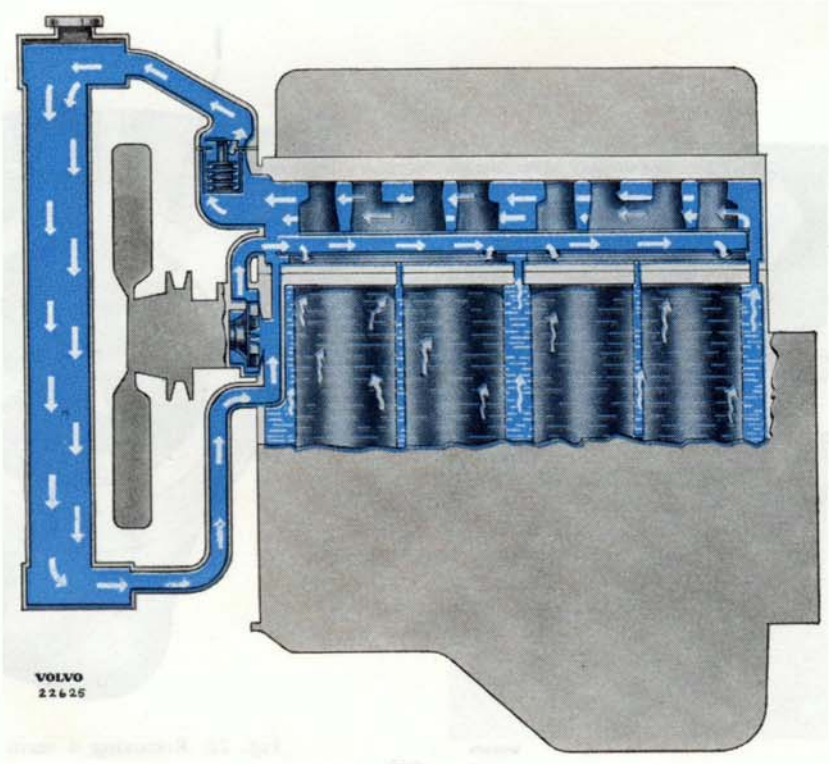


Fig. 18. Cooling system.

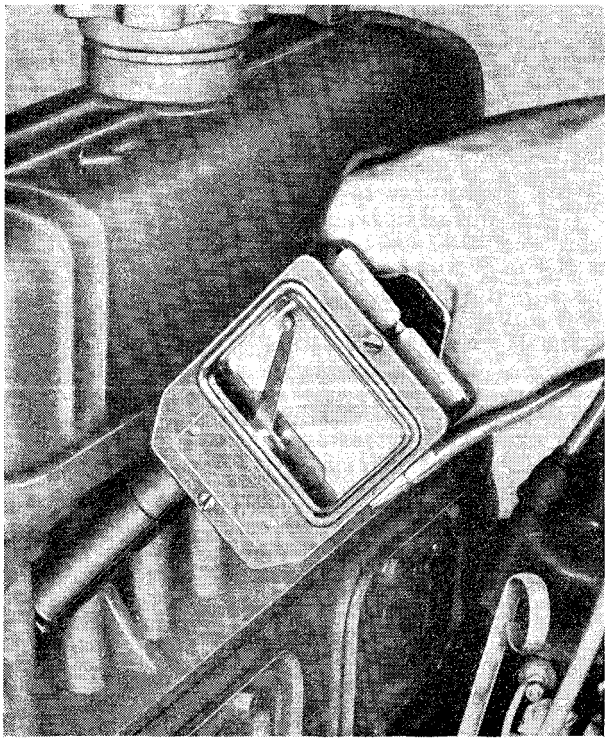


Fig. 19. Measuring compression.

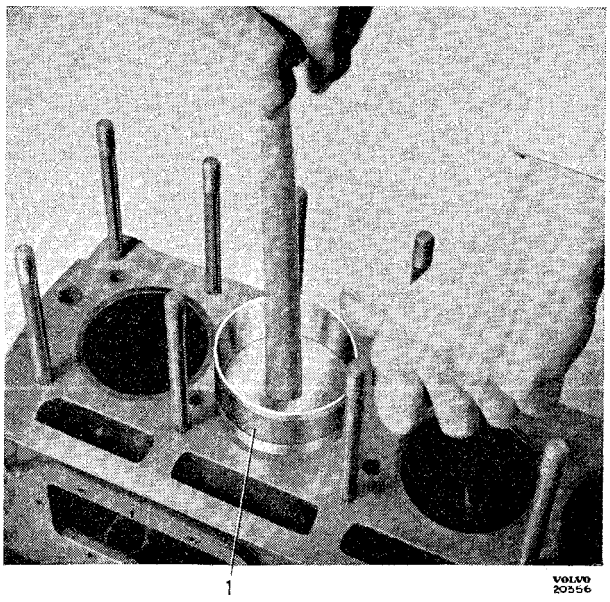


Fig. 21. Fitting a piston.
1. SVO 2278

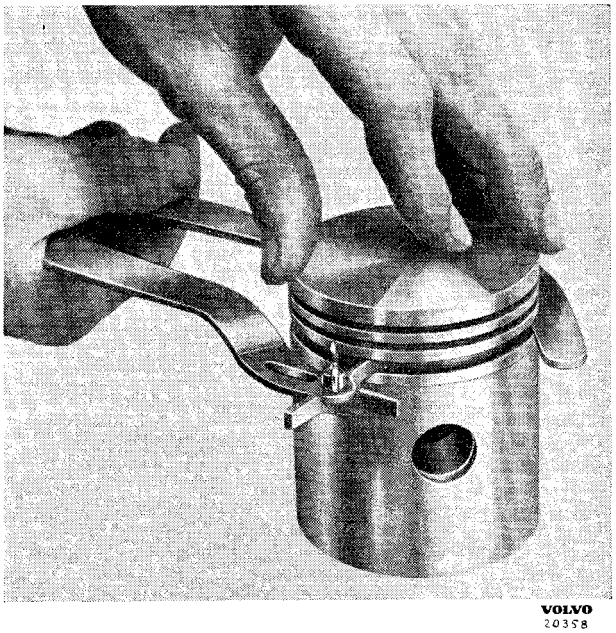


Fig. 20. Cleaning piston ring grooves.

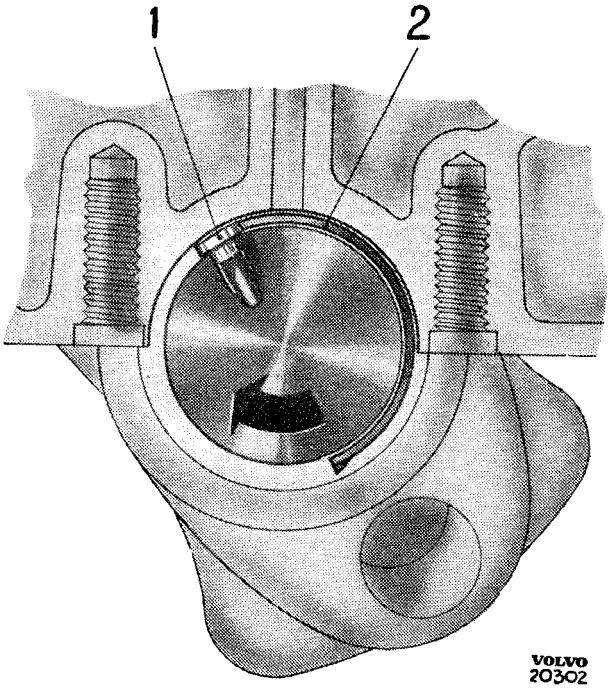


Fig. 22. Removing a main bearing shell.
1. Pin
2. Bearing shell

10. When fitting the pistons make sure that the piston ring gaps are not located directly above each other or opposite the piston pin bosses. Check that the cylinder walls and connecting rod bearing journals are clean and dry.
    Lubricate the pistons, cylinder bores and connecting rod bearing journals.
    Check the marking on the piston tops so that the pistons are installed correctly. Use tool SVO 2278.
11. Fit the connecting rods and pistons. The connecting rod bolts should be replaced each time the engine is reconditioned.
12. Fit the connecting rods on the crankshaft.
13. Fit the cylinder head.
14. Fit the oil pan. Fill up with oil and fill the cooling system with water. Make a rough adjustment of valve clearances.
15. Run the engine until it reaches normal operating temperature.
16. Tighten the cylinder head nuts, adjust the valve clearances and check the ignition timing and the carburetor. See "Running-in the engine" on page 22.

REPLACING MAIN BEARINGS

The main bearing shells can be replaced without removing the engine from the car. The oil pan must, however, be removed. This operation is described under "Removing and fitting the oil pan".

Remove the lock washers for the nuts on the main bearing bolts, remove the bolts and then remove the bearing caps and the lower bearing inserts.

The upper bearing insert is removed by inserting a pin (1, Fig. 22) into the oil passage and then turning the crankshaft in its normal direction of rotation. The bearing shell (2) then moves with the crankshaft and can be removed. Inspect the bearing journal with the help of a dial indicator, the point of which is touching the journal and then rotate the shaft. If the out-of-roundness is more than 0.002" (0.05 mm), the crankshaft must be removed and reground.

Fit new bearing shells. The upper and lower inserts are identical but take care that the keys lodge correctly in their grooves.

See the specifications as far as sizes are concerned.

Fit the bearing caps and tighten the nuts to the torque shown in the table on page 36. Use new lock washers. Fit the oil pan and fill with oil.

REPLACING CONNECTING ROD BEARINGS

The connecting rod bearings can be replaced without removing the engine. Remove the oil pan in accordance with the instructions below. Turn down the crank under the journal of which the bearing is to be replaced. Remove the lock washers for the nuts and remove the nuts. The connecting rod bearing caps can then be removed as well as the lower bearing insert. Push the connecting rod slightly upwards and the upper bearing shell can then be removed.

Wipe the crank clean with a linen cloth and use a micrometer to measure partly the size and partly the out-of-roundness. If the out-of-roundness exceeds 0.0028" (0.07 mm), the crankshaft must be removed and reground since this can be the direct cause of the bearing failure. As far as sizes are concerned see under the heading "Main and connecting rod bearings".

Lubricate and fit the new bearing shells. Use new bearing bolts. Tighten the nuts in accordance with the tightening torques shown in the table on page 36 and fit new washers. Fit the oil pan and fill with oil.

REMOVING AND FITTING THE OIL PAN

The oil pan can be removed without removing the engine from the vehicle, as follows:

1. Drain off the oil from the oil pan.
2. Remove the cover plates from the sides of the engine.
3. Remove the cover from under the flywheel.
4. Loosen the nuts on the forward engine supports without removing them completely.
5. Lift up the engine by means of a jack placed under the front end (see fig. 23).
6. Slide in the spacers SVO 4124 (fig. 24) and lower the jack.
7. Loosen the bolts round the oil pan and then remove the pan by pulling it downwards-backwards.
8. Assemble in the reverse order. Always replace a cork gasket that appears to be damaged or feels hard.

REPLACING THE CAMSHAFT AND/OR CAMSHAFT GEAR

1. Drain off the cooling water and detach the radiator blind cable.

2. Remove the radiator by loosening the hose clamps on the upper and lower radiator hoses and loosening the bolts on each side of the radiator. Lift up the radiator.
3. Remove the fan belt and pull the pulley off the crankshaft. Use puller SVO 2279.
4. Remove the timing gear casing. Note the timing gear markings.
   If only the camshaft gear is to be replaced, the camshaft need not be removed. Remove the lock washer and the nut and then pull off the gear with tool SVO 2250. Fit the new gear by using tool SVO 1356 A, Fig. 25.
5. If the camshaft is to be replaced, the rocker arms, push rods and the fuel pump must be removed. Remove the covers on the side of the engine and remove the valve lifters. This work is facilitated if the distributor is also removed.
6. The camshaft can now be pulled out forwards after the thrust flange and radiator grille have been removed.
7. Fit in the reverse order. Make sure that the timing gears are returned in their original positions. Center the timing gear casing by using tool SVO 1427 A. Check the cork gasket in the casing. Replace the gasket if it does not seal against the pulley hub.
8. Adjust the valve clearances and the ignition timing.

REMOVING THE ENGINE FROM THE VEHICLE

1. Drain off the cooling water, engine oil and transmission oil. Remove the battery and radiator.
2. Disconnect all electrical connections, the fuel line at the fuel pump, the oil pipes, the pipe to the temperature gauge, the throttle and choke connections. Loosen the exhaust pipe at the exhaust manifold.
3. Loosen the forward engine supports, remove the gearshift lever.
4. Lift the vehicle on supports up to a height of about 8″ (20 cm) above the floor level.
5. Remove the cover plates on both sides under the engine. Disconnect the speedometer drive cable at the transmission and any remaining control linkages.
6. Put a jack under the transmission. Disconnect the propeller shaft at the flange on the drive-shaft from the transmission and then remove the support member under the transmission.
7. Place the lifting chain SVO 4118 in position and lift the engine out of the vehicle. This is facilitated if the forward end of the engine is lifted first.

DISASSEMBLING THE ENGINE

When the engine and the transmission have been removed from the vehicle they should be carefully washed and cleaned externally before disassembly is carried out.

Use kerosene or white spirit (less inflammable than gasoline). Then flush the engine with hot water and blow it dry with compressed air. Use only small quantities of kerosene or white spirit at a time.

After washing, remove the transmission from the engine.

The engine is disassembled in the following order:

1. Remove the oil dipstick, crankcase breather, carburetor, fuel pump and distributor as well as the accelerator pedal linkage.
2. Place the engine in a suitable stand. Check that the oil has been drained off.
3. Remove the clutch. The clutch has been balanced as one unit together with the flywheel and the crankshaft and is marked with colored paint. Mark the component parts with punch marks so that they can be refitted in the correct positions.
4. Remove the oil cleaner, starter motor, generator and spark plugs.
5. Remove the inlet and exhaust manifolds, thermostat housing, water pump and water inlet elbow bend.
6. Remove the rocker arm shaft and lift up the push rods.
7. Remove the cylinder head. Remove the side covers and lift up the valve lifters.
8. Pull off the pulley from the crankshaft. Use puller SVO 2279.
9. Loosen and remove the timing gear casing.
10. Check that the marking on the crankshaft timing gear is correct. Then pull off the camshaft gear with tool SVO 2250.
11. Pull off the crankshaft gear with tool SVO 1428 A.
12. Turn the engine upside down and remove the oil pan.

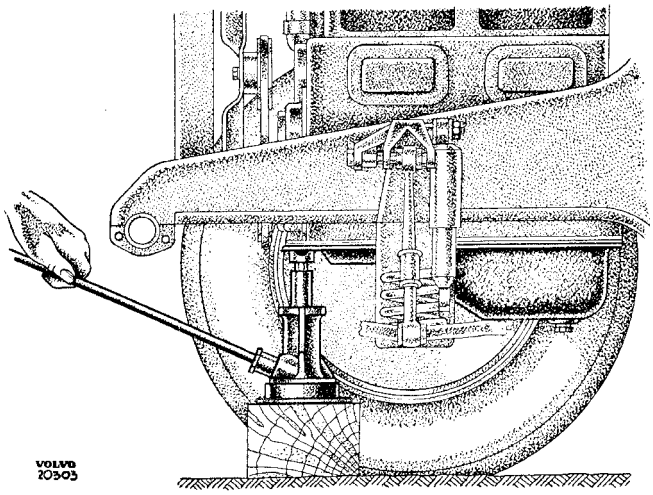


Fig. 23. Lifting the front end of the engine.

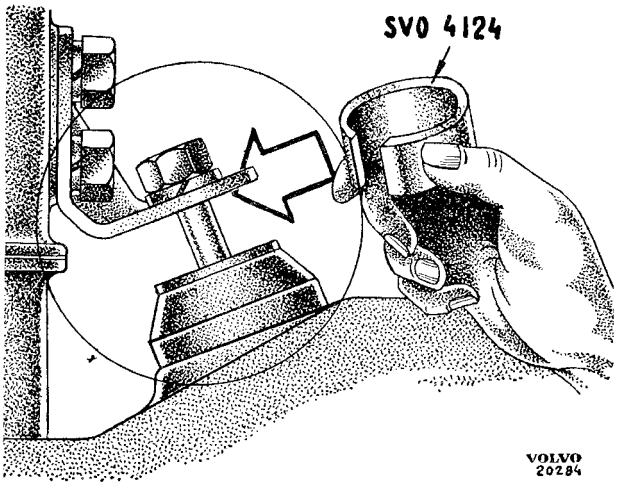


Fig. 24. Fitting spacers.

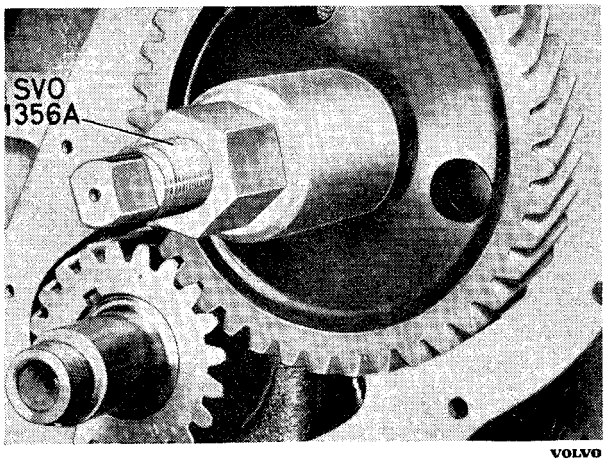


Fig. 25. Fitting the camshaft gear.

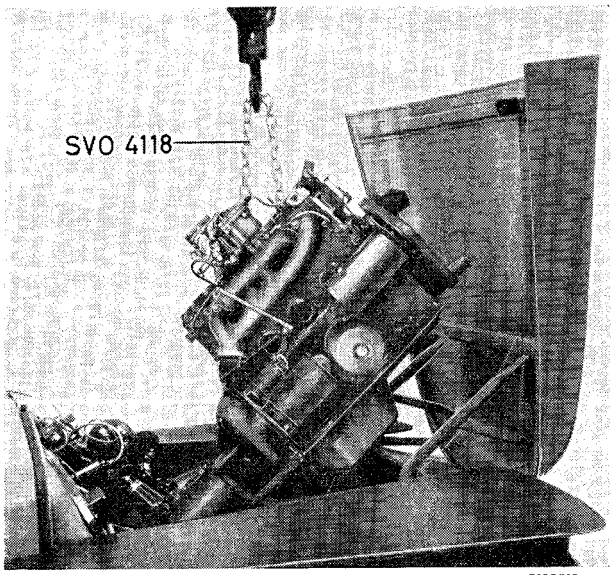


Fig. 26. Lifting out the engine.

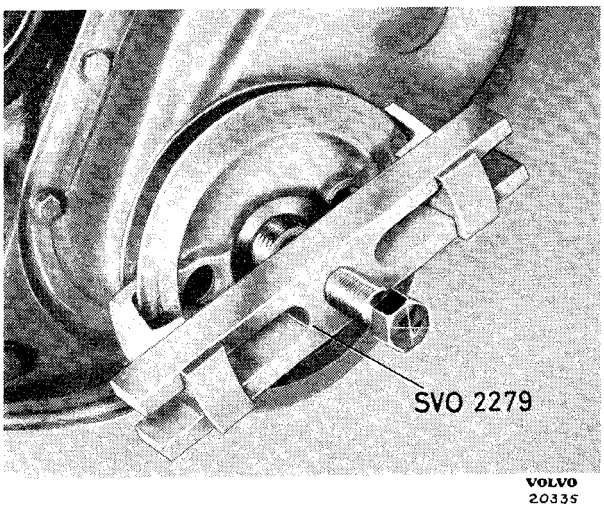


Fig. 27. Removing the pulley.

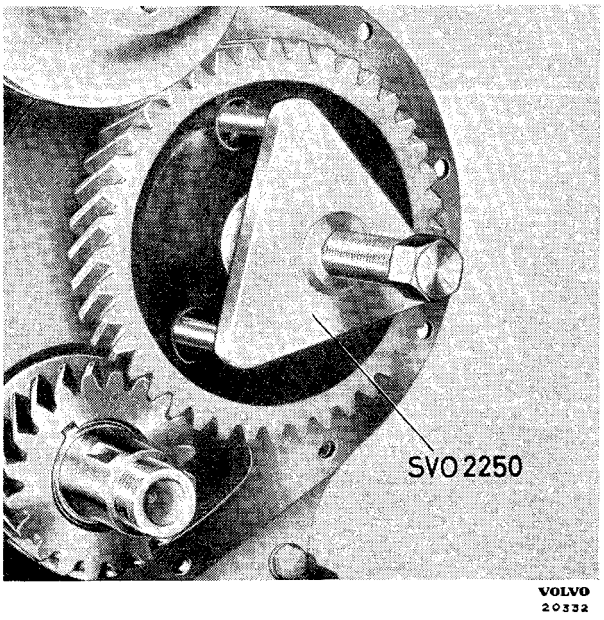


Fig. 28. Removing the camshaft gear.

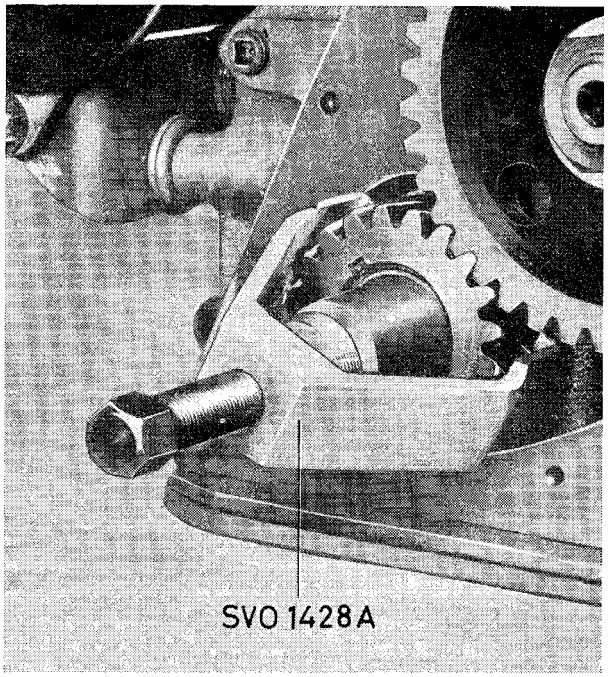


Fig. 29. Removing the crankshaft gear.

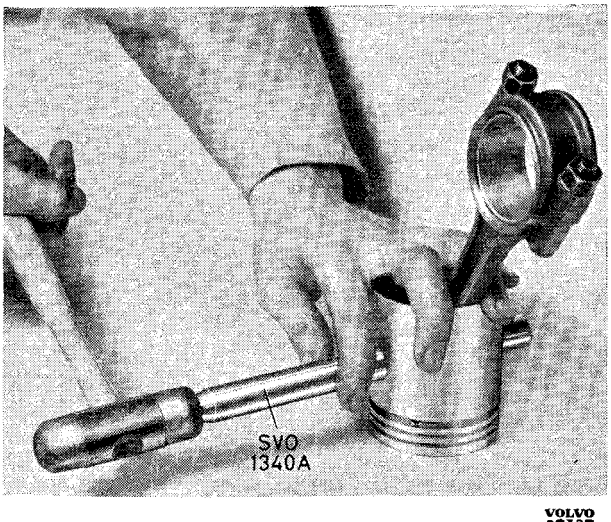


Fig. 30. Removing a piston pin.

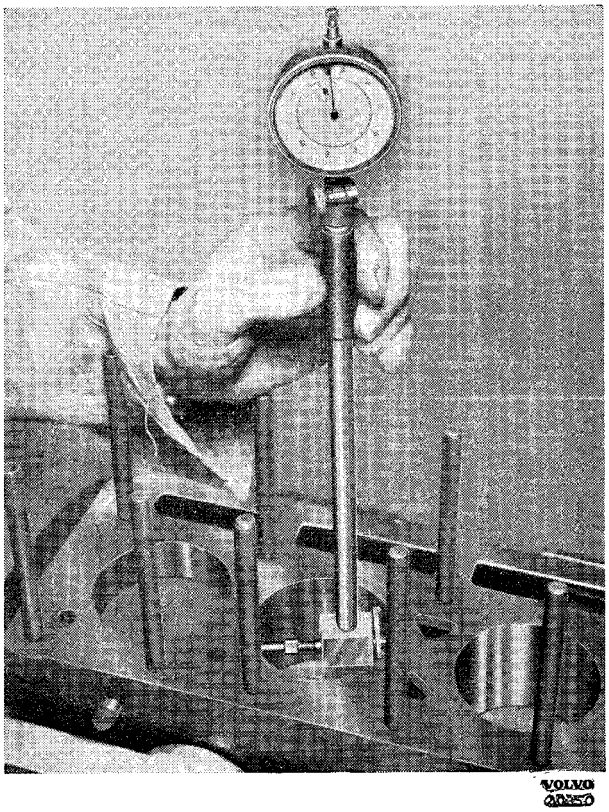


Fig. 31. Gauging cylinder bore.

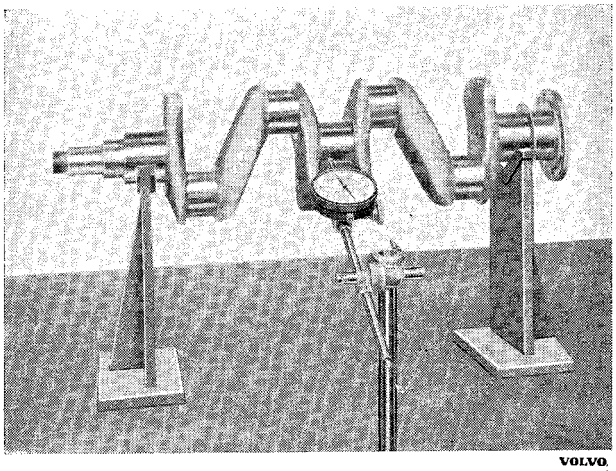


Fig. 32. Gauging the crankshaft journals.

13. Remove the lubricating oil pump complete with strainer and delivery pipe.
    Remove the relief valve plug and pull out the plunger using tool SVO 2079.
    Remove the rear crankshaft sealing flange.
14. Remove the camshaft thrust flange and pull out the camshaft.
15. Remove the connecting rod bearing caps and pull out the pistons complete with connecting rods through the cylinder bores. Return the caps and nuts to the respective connecting rods. Check the markings, 1—4, on the side away from the camshaft.
16. Remove the cover plate for the timing gear casing.
17. Remove the main bearing caps, lift up the crankshaft complete with flywheel and place it in some position where it is not likely to be damaged. The caps are marked with an arrow pointing forwards.
18. Remove the flywheel housing.
19. Separate the pistons from the connecting rods. Use tool SVO 1340 A, Fig. 30.

CLEANING THE ENGINE PARTS

After the engine has been disassembled all parts are first cleaned from carbon, oil sludge deposits and remnants of old gaskets. Kerosene or white spirit are used to wash the parts. Make a habit of only using small quantities at a time and begin by washing the pistons, connecting rods, crankshaft and camshaft. Preferably use a degreasing tank which is electrically or steam heated. Engine parts can be cleaned to advantage in alkali in this type of degreasing tank. Only use cleaning agents which are marketed by reliable firms.

Take great care when washing parts made of light alloy. Such parts must not be left lying in the bath for more than half an hour. Pistons must not be placed in alkali solutions.

After washing, the parts should be thoroughly flushed preferably with hot water. All oil passages should be flushed through and blown dry with compressed air. Use an air gun to ensure that all oil passages and narrow spaces are properly cleaned.

CYLINDER BLOCK

Gauging the cylinders

The cylinders become most worn at their upper ends and thus become tapered. They also become out of round. In order to obtain a complete impression of the appearance of a cylinder, it must be measured at various points both parallel and at right-angles to the piston pin. The cylinder is measured by using a special cylinder indicator, fig. 31.

The dial indicator registers the relative wear in the cylinder walls by comparing the difference between the highest and lowest values obtained. The maximum cylinder wear can be established by zero-setting the indicator with the help of a micrometer gauge.

On each cylinder bore there is a letter stamped showing the original bore (standard) in accordance with the table below. The micrometer is set to the lower limit in each cylinder bore range.

If the engine has been rebored, remove the soot ridge in the upper end of the cylinder and then zero-set the gauge against this.

The amount of wear measured determines the remedy to be used. If the engine has abnormally high oil consumption and wear of up 0.010—0.020" (0.25—0.30 mm) is found or there are signs of scoring in the cylinder walls, reboring should be carried out.

Range	Cylinder bore, standard
C ..	3.1240"—3.1244" (79.35—79.36 mm)
D ..	3.1244"—3.1248" (79.36—79.37 mm)
E ..	3.1248"—3.1252" (79.37—79.38 mm)
F ..	3.1252"—3.1256" (79.38—79.39 mm)
G ..	3.1256"—3.1260" (79.39—79.40 mm)

REBORING THE CYLINDERS

The boring of cylinders is undertaken in special machines. Since demands as far as precision is concerned are extremely high, this work requires highly skilled and experienced workers. It is extremely important to ensure that cylinder bores are completely circular without taper and at right angles to the crankshaft within very close limits.

Another important point is to ensure that the cylinder walls are machined to the very highest finish in order to shorten running-in time.

The cylinders are first measured in order to determine a suitable oversize, see specifications. They are then bored and honed to the exact size. See under the heading "Piston Clearance". After this has been done, the block should be cleaned, preferably in a degreasing tank, in order to remove any metallic particles.

CRANKSHAFT

Gauging crankshaft journals

The crankshaft should be checked for linearity and the journal should be checked for out of roundness, taper and score marks. Place the crankshaft in vee-blocks. Move up the dial indicator against the center main bearing journal and then rotate the crankshaft, see Fig. 32. The dial indicator registers any eventual distortion on the crankshaft and shows also the out of roundness of the journal. A micrometer should be used separately in order to determine the out of roundness of the journals. The maximum admissible runout of the center journal is 0.0020″ (0.05 mm).

A micrometer is used to check out of roundness (see Fig. 33). Measurements should be made on at least 6 points around the periphery of the journal and at three points along the length. The maximum permissible out-or-roundness is 0.0020″ (0.05 mm) on the main bearing journals and 0.0028″ (0.07 mm) on the connecting rod bearing journals. The largest permissible taper is 0.0020″ (0.05 mm). A distorted crankshaft can be aligned in a press. Out of round or tapered bearing journals should be ground to a suitable undersize, see the information in the specifications. Scored bearing journals should also be ground. Grinding should be carried out in a special machine.

Grinding bearing journals

Maximum and minimum diameters when grinding the crankshaft to undersize are in the specifications. The width of the guide bearing, A fig. 34, depends on the journal size.

It is exceptionally important to follow the dimensions given in the table since they, together with the corresponding bearing shells, ensure the correct bearing clearance.

After the grinder has been dressed, the journal radii should be 0.11″—0.12″ (2.75—3.00 mm) as shown in fig. 34. After grinding, the journals should be lapped with fine grinding paste, edges removed from the oil hole and then the whole crankshaft should be thoroughly cleaned.

Oil passages

The crankshaft should be cleaned by boiling it in a degreasing tank and then flushed and cleaned with water and blown off with compressed air. Passages may also be cleaned up with a special brush.

MAIN AND CONNECTING ROD BEARINGS

Undersizes

Replacement bearing insert shells are available in the following undersizes: 0.010″, 0.020″, 0.030″, 0.040″.

All bearings have their respective part numbers stamped into the back.

Undersize bearings are also stamped with 01, 02, 03 or 04 to designate the respective undersizes.

The flange bearing shells have widths with oversizes 0.004″, 0.008″, 0.012″, and 0.016″ (0.1, 0.2, 0.3, and 0.4 mm).

Fitting main and connecting rod bearings

Adjustment of bearing clearance may never be carried out by filing the bearing cap. The bearings are precision machined and must never be filed or scraped. Since they are replaceable, new shells should be fitted if there is any kind of damage or wear. If the bearing journals are damaged or out of round, they should be ground and undersize bearing shells fitted. Always inspect the oil flow to a damaged bearing.

Oil seal

The rear main bearing is fitted with a felt seal in two parts which is attached to the engine block with two flanges.

The front end of the crankshaft carries a sheet metal oilslinger clamped between the crankshaft gear washer and the pulley hub. The timing gear casing contains the felt ring which seals against the pulley hub. Inside both the forward and the rear felt seal there is a limited cavity with a draining hole at the bottom. Always be careful to make sure that these holes are not blocked since they are intended to lead off any oil. Early production rear seals do not have this cavity. In order to have the correct alignment between the casing and the crankshaft an aligning tool SVO 1427 should be used. Then fit the pulley.

As the end play of the crankshaft has a considerable influence on the efficiency of the seal, this play should always be between 0.0004″—0.004″ (0.01—0.1 mm).

PISTONS, PISTON RINGS AND PISTON PINS

Gauging

The pistons are measured with a micrometer at right angles to the piston pin on the lower edge of the piston, Fig. 50.

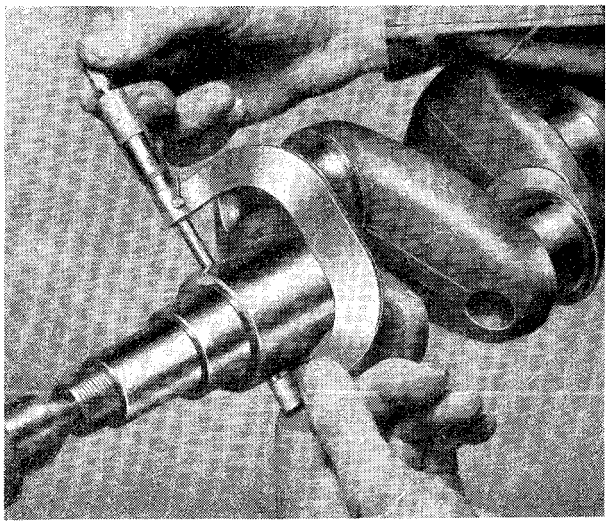


Fig. 33. Gauging a bearing journal.

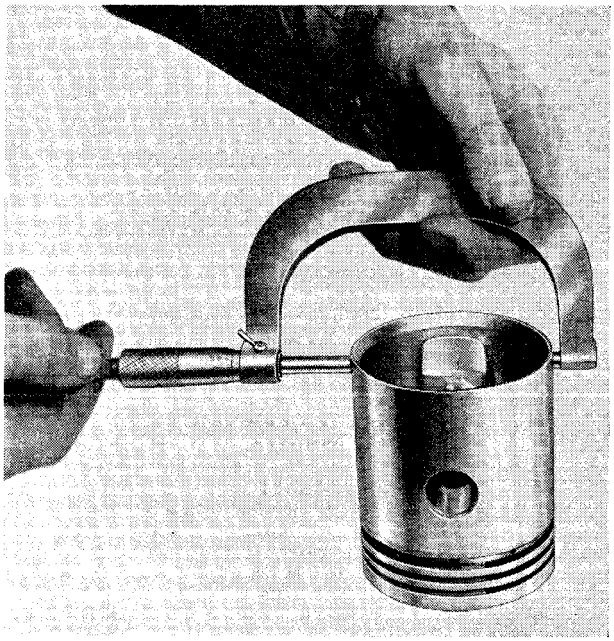


Fig. 35. Measuring a piston.

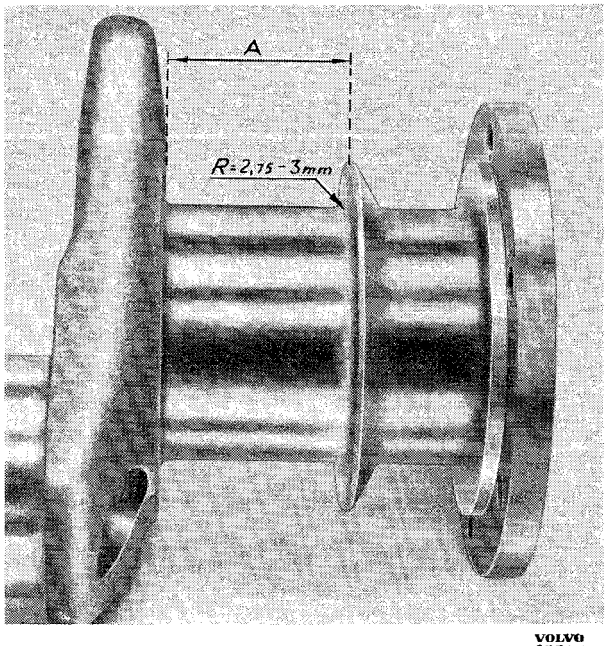


Fig. 34. Guide bearing journal width.

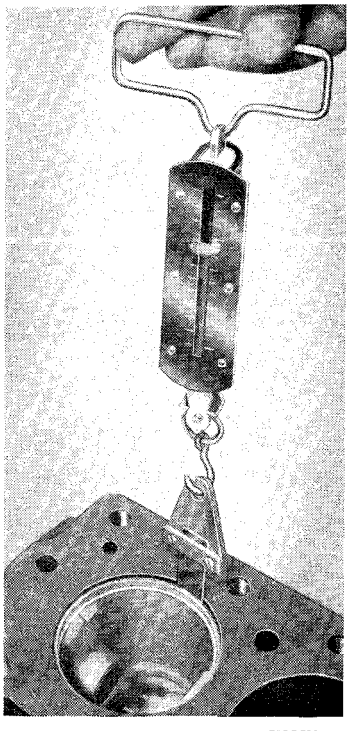


Fig. 36. Checking piston fit.

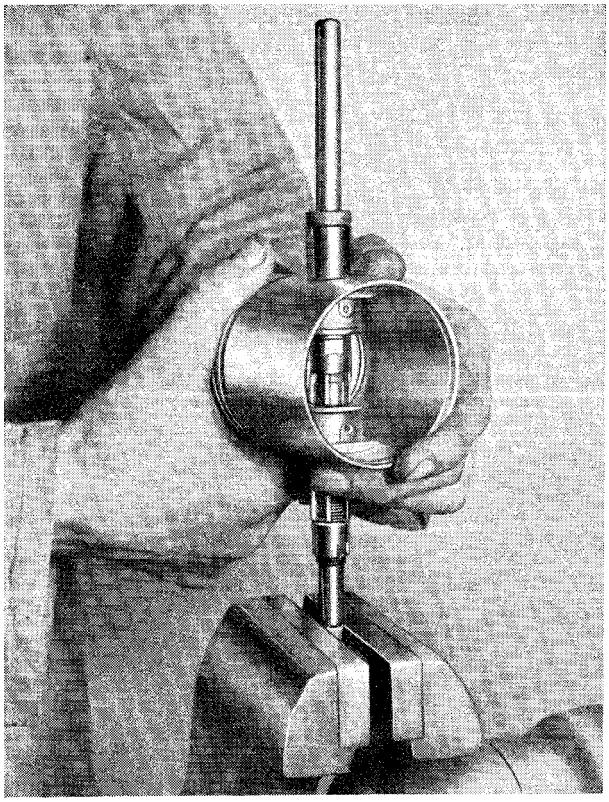


Fig. 37. Reaming a piston.

Fig. 38. Checking piston pin fit.

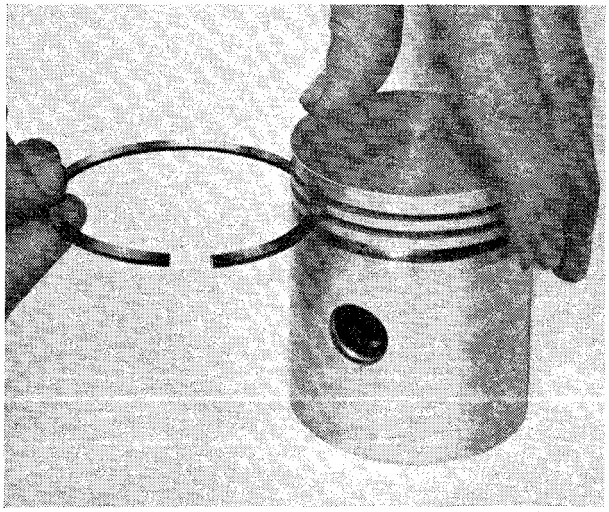


Fig. 39. Checking piston ring clearance in groove.

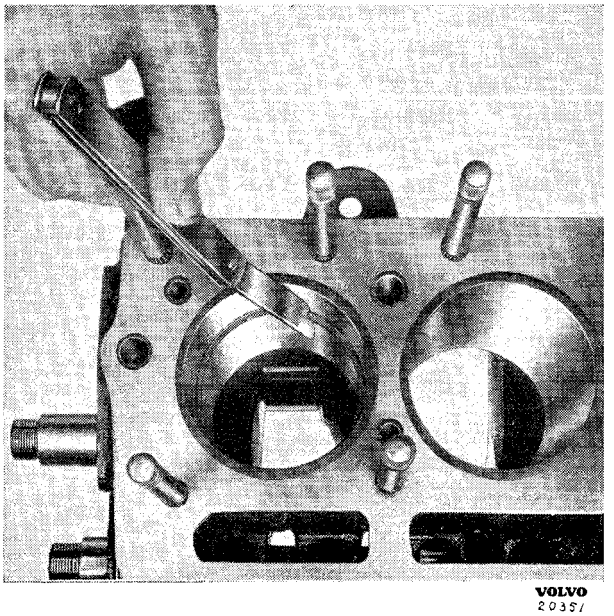


Fig. 40. Checking piston ring gap.

See the specifications for dimensions concerning pistons and cylinder bores.

Piston clearance

The piston should have a certain clearance in the cylinder bore. This clearance is measured with a feeler gauge 0.0018″ (0.045 mm) and ½″ wide fitted on a spring balance. The pull required should be 4½—6½ lb. (2—3 kg), Fig. 36.

Measurement should be carried out in the direction of thrust of the piston along the complete length of the cylinder bore and at several diameters in the cylinder. The piston pin should not be fitted while this measurement is being carried out.

When checking the clearance of a piston in a standard bore cylinder, select the piston which corresponds to the class stamped on each cylinder bore. In cylinder E, for example, a piston of class E should always be fitted.

Note. This only applies to standard cylinder bores.

Piston ring clearance

To obtain the correct clearance for the piston pins, use reamers with guides, Fig. 37. Use these tools carefully and make only a slight cut with each pass. Correct fit is achieved when the piston pin slides into the bosses under thumb pressure (Fig. 38). Pistons and piston pins should both be at normal room temperature when this is done.

Piston ring clearance

a) New or rebored cylinder.

The gap between the piston ring ends, with the ring fitted into the cylinder bore, Fig. 40, should be 0.01″—0.02″ (0.25—0.50 mm). This should be checked with a feeler gauge.

Piston rings must not bind anywhere in the groove. Check this by rolling the ring in the groove around the piston, Fig. 39. Also measure clearance at a few places. The correct value for the clearance is 0.0027″—0.0031″ (0.068—0.079 mm).

b) Worn cylinder bore.

When checking piston ring clearance in a worn bore, the ring gap should always be checked at the bottom dead center position of the piston since the bore is worn to a taper. If the ring gap is faultily checked in the upper part of the cylinder, the ring ends can contact each other at the bottom dead center position, this causing a stress against the cylinder wall with consequent seizure. If the cylinder ridge is not removed, the upper edge of the top compression ring must be beveled.

Weighing pistons

It is important that all pistons in an engine have the same weight within certain specified limits in order to avoid the occurrence of vibrations in the engine. The pistons are checked by placing one of them on one pan of a balance and balancing the other pistons, one by one, against it. The difference in weight between the pistons registered by the balance pointer should not deviate by more than ± 0.18 oz. (± 5 grams).

Assembling the piston and connecting rods

Before proceeding to assemble the pistons and connecting rods, check that the piston pin clearances in the piston bosses and the connecting rod bushings are correct. The connecting rod must also be absolutely straight. The piston rings are not placed on the piston until the piston and the rod have been assembled. The compression rings are beveled on the inside edge and they should be turned to face upwards. The top compression ring is chromed. When fitting the piston rings, use a special piston ring expander tool shown in Fig. 42 to avoid damaging the piston ring. Lubricate the piston pin and the bushing before assembling. Check that the piston is correctly assembled on the connecting rod. Since the piston pin hole in the piston is not exactly central, it is important to ensure that the correct side of the piston faces forward. For this reason the pistons are marked with an arrow which should face the front end of the engine. The connecting rods, which are displaced in the longitudinal axis of the engine, are fitted in accordance with Fig. 43. Fix the circlips in both bosses of the piston.

CONNECTING RODS

Replacement of piston pin bushing

Press out the old bushing by using tool SVO 1355 A and press in a new bushing with the same tool. Use a suitable sleeve below. The bushing is then reamed to the correct size. Make only light cuts and check

repeatedly with the piston pin until it obtains a light thumb fit without noticeable looseness. See Fig. 45.

Straightening connecting rods

When extensive work is carried out on an engine, the connecting rods should always be straightened before they are replaced in the engine. See Fig. 46 and 47. The straightening can be undertaken with or without the piston being fitted on the rod. If the piston has been removed from the connecting rod, it is a good thing to straighten the connecting rods without the piston first and then make a final check with the piston fitted. Greatest deviations should not exceed 0.0004" (0.01 mm) measured over a length of 4" (100 mm).

When a connecting rod has been straightened with the piston fitted, the piston rings should be removed.

Connecting rods should also be checked for freedom from S-distortion, due attention being paid to the fact that the connecting rods are of displaced designs, see Fig. 48.

Weight

The connecting rods of any engine should have the same weight within certain limits. By means of the classification system with various letters, connecting rods which lie within these limits are marked with the same letter. These letters are stamped on the connecting rods immediately above the bearing cap dividing line.

Only connecting rods which are marked with the same letter may be fitted in any one engine. Weights concerning a complete connecting rod with the fully finished bushing are shown in the specifications.

Mark the connecting rods with the correct letter when replacement is carried out.

CAMSHAFT

The camshaft should be inspected for linearity and for wear on the journals, cams and distributor gear. The camshaft must be straight to withing 0.0016" (0.04 mm). A bent camshaft cannot be straightened but should be replaced.

The maximum permissible wear on the bearing journals is 0.003" (0.075 mm) if new bearings are fitted.

If the cams, journals or ignition distributor gear are much worn, the camshaft should be replaced.

Camshaft adjustment

Timing gears are marked, showing the correct adjustment. See Fig. 49.

Replacing camshaft bearings

Camshaft bearings that have worn 0.002" (0.05 mm) or more should be replaced.

This operation requires the use of a boring machine. When pressing in a new bearing, make sure that the holes in the bushings index correctly with the oil passages in the block.

Replacing camshaft gear

The camshaft should be replaced when the backlash reaches 0.0047" (0.12 mm). The gear can be removed with the engine still fitted in the vehicle. See "Replacing the camshaft and/or gear". The new gear is fitted with the help of tool SVO 1356 A. Take care to ensure that the gear is not damaged.

VALVES AND VALVE MECHANISM

In order to obtain maximum power and acceleration combined with optimum fuel economy, it is important to ensure that the valves and the valve mechanism are in perfect condition. The greatest care should be exercised in all work on these parts and the measurements and clearances concerned should be closely observed.

Valves

Valve stems should be perfectly straight and the wear must nowhere exceed 0.0008" (0.02 mm). If the valve disk edge is so worn that it is less than 0.04" (1 mm) wide after regrinding, the valve should be rejected.

Valve guides

The clearance between the valve stems and the valve guides should be checked with new valves. Make sure that an exhaust valve is used to check the exhaust valve guides and an inlet valve to check the inlet valve guides since the exhaust and inlet valve stems are of different thicknesses. Clearance with a new valve may not exceed 0.0006" (0.15 mm).

Clearance is measured as shown in Fig. 50.

Valve springs

The valve springs must conform to the specifications. The springs are close-wound at one end and this end should be placed downward when the valves are fitted. Fig. 51 shows how the valve springs can be tested.

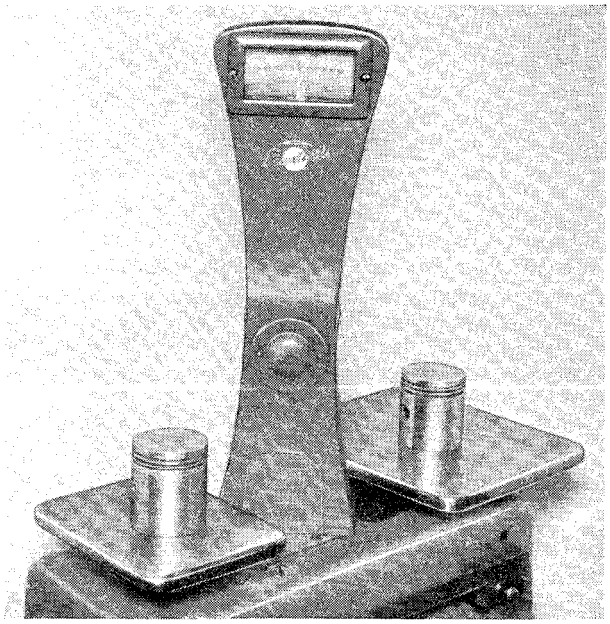


Fig. 41. Weighing pistons.

Fig. 42. Fitting piston rings.

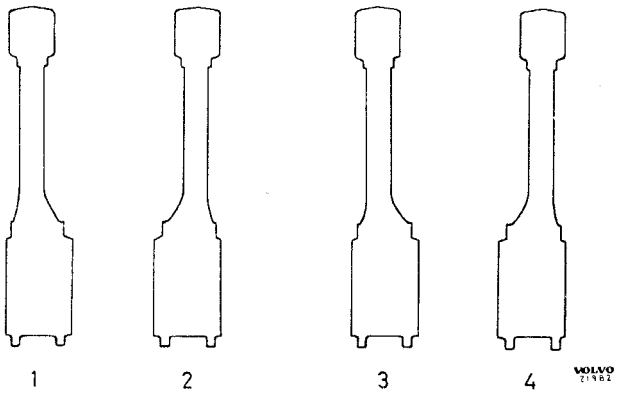


Fig. 43. Connecting rod locations

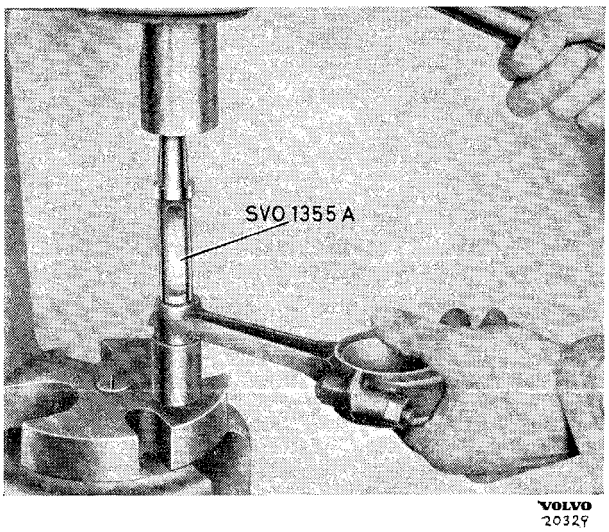


Fig. 44. Removing a bushing.

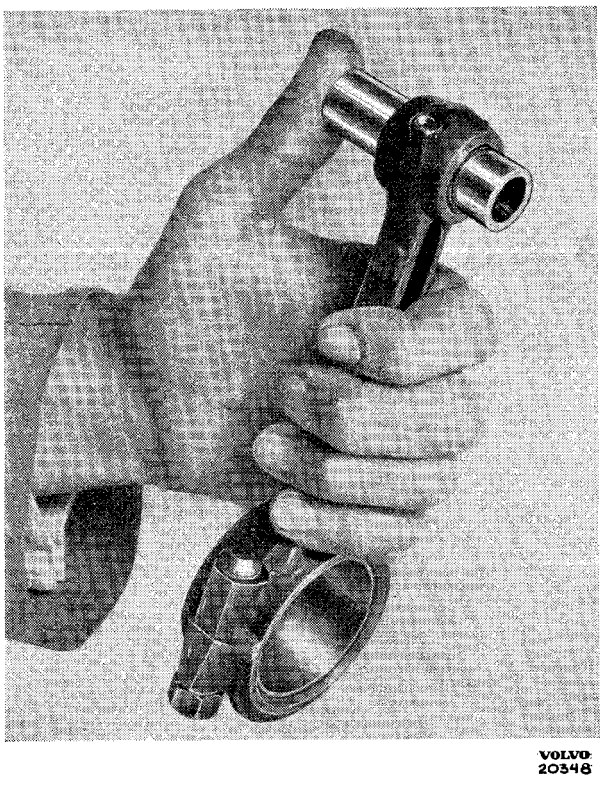


Fig. 45. Piston pin fit.

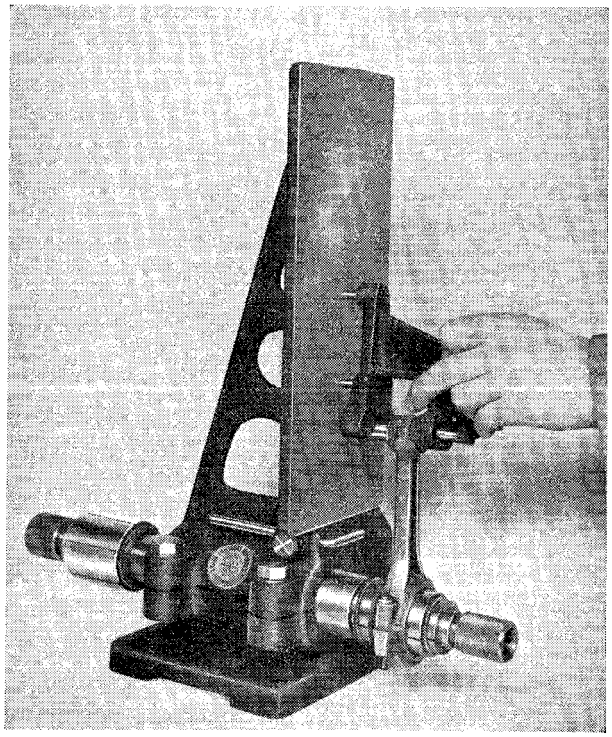


Fig. 46. Checking connecting rod.

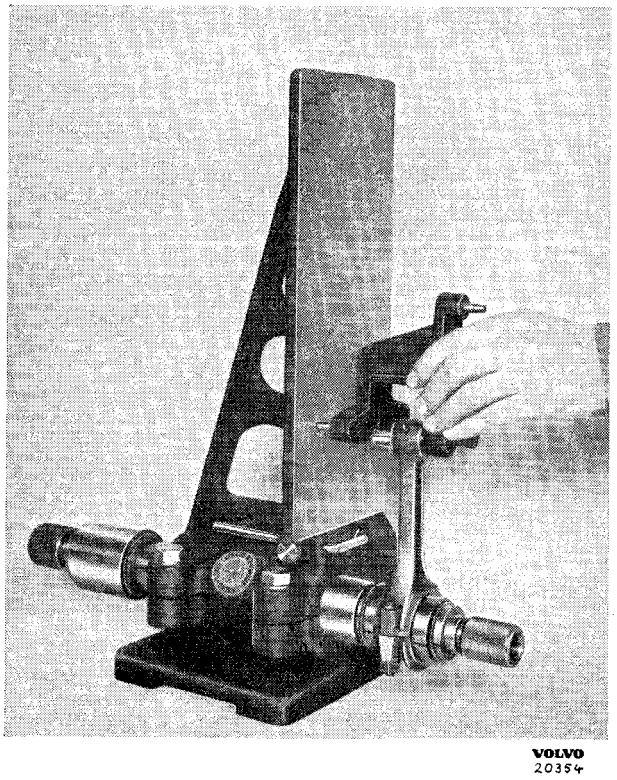


Fig. 47. Checking connecting rod.

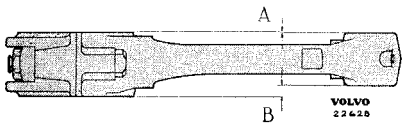


Fig. 48. Connecting rod shank displacement.

A = 0.035" (0.85 mm)

B = 0.230" (5.85 mm)

Permissible deviation = ±0.010" (±0.25 mm)

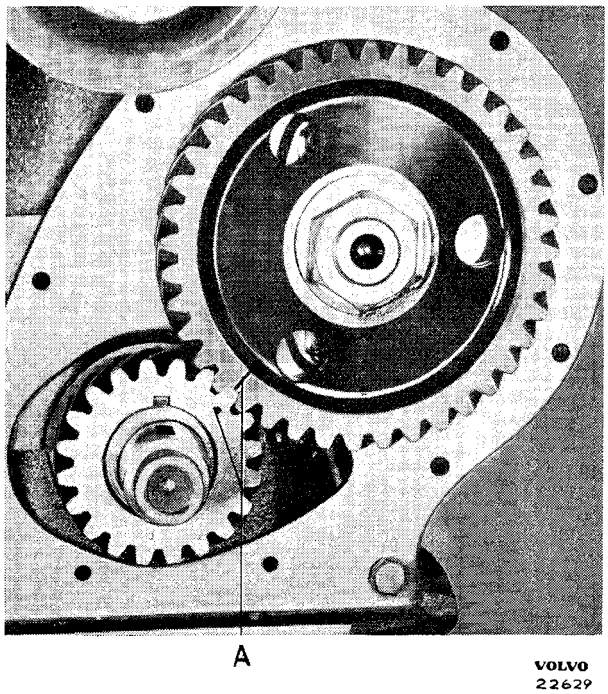


Fig. 49. Timing gear settings.

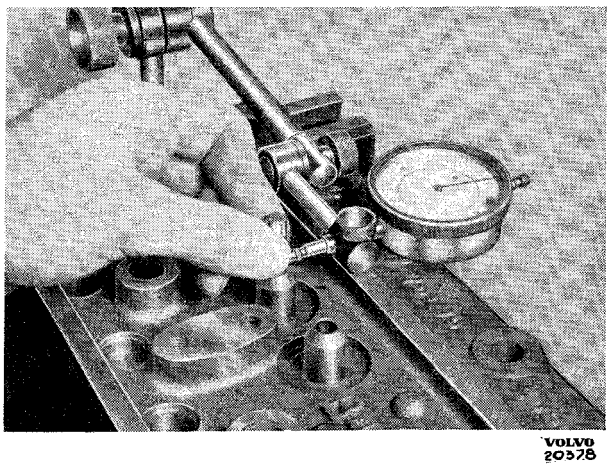


Fig. 50. Measuring valve guide clearance.

Push rods

The push rods should be perfectly straight. Check by rolling them on a surface plate. If they roll irregularly, they are distorted and must be rejected.

Replacing valve guides

Press out the old valve guides with tool SVO 1459 fitted in a press. Use tool SVO 4158 A when fitting since this gives the correct fitting depth. See Fig. 52. When the valve guides have been pressed in, the distance from the valve guide upper end to the cylinder head upper flat should be 0.83″ (21 mm).

New valve guides should be reamed with the special reamer SVO 4128. Use the same reamer for both the inlet and exhaust valve guides. Since the inlet valve stems are thicker than the exhaust valve stems, the clearance in the guide will be greatest for the exhaust valves.

Valve seat grinding

Before valve seat grinding is carried out, the cylinder head should always be very carefully cleaned in the combustion chambers and gas ports and, if required, new valve guides should be pressed in and reamed.

When grinding take care not to remove more material than is absolutely necessary in order to obtain the correct angle and width of the seat.

Regrinding is carried out either with hand milling cutters, Fig. 53, or, preferably, with electrically driven grinders. Grinding wheels used should be carefully dressed and adjusted to an angle of 45°. This should be carried out in a special attachment which can be adjusted to the desired angle.

When grinding, a pilot spindle, which is part of the equipment, is inserted in the valve guide where it is centered and locked by means of an expander. The pilot spindle then should be lightly oiled with thin oil after which the grinding wheel is placed on the spindle and driven electrically under light pressure. The wheel should only be allowed to rotate for a few seconds at a time after which the machine should be switched off. It should not be lifted out until it has completely stopped rotating. Continue this procedure until the complete seating surface is perfectly smooth. If necessary, the width of the seat face is reduced from above by means of a 20° angle grinding wheel and inwards by means of a 70° wheel. After grinding is completed, the seat width should be 0.060″ (1.5 mm). See dimension A in Fig. 54.

Valve grinding

Valve grinding comprises refacing of the valve disk sealing surface, cut-off grinding of the valve stem end and lapping-in of the valve disk against the valve seat with the help of an abrasive compound.

The facing of the valve disk is carried out in a special machine in which the valve is chucked and brought into rotation against the fine-grain grinding wheel which also rotates. The valve seat angle should be 44.5°. Before this operation is carried out, the valve should be cleaned completely free from carbon and oil. When the sealing face is finally ground, the edge of the valve disk should be at least 0.04″ (1 mm). Otherwise the valve should be rejected since valves with thinner edges will soon be scorched and warp.

To grind the end of the valve stem, place the valve in a vee-block and press the stem against the side of a grinding wheel at the same time as the valve is being rotated. The final lapping-in of the valve is carried out against the valve seat proper in the cylinder head. The valve sealing face should be smeared with a little abrasive grinding compound which has been mixed with oil. The valve is then placed in position, pressed against the seat, and rotated back and forth a few times, lift out the valve and thoroughly clean the valve and the seat. Then check the sealing surfaces by applying a coat of paint to the valve sealing face, insert the valve in the valve guide, press against the seat and give it about one-quarter of a turn. If the contact is satisfactory, the paint will cover the entire surface of the valve seat.

Fitting new valve seats

Note. Before a valve seat is replaced, always press in a new valve guide and ream it to the correct size.

If a valve seat is so heavily burnt that it cannot be reconditioned by milling or grinding, it must be removed and a new seat must be fitted. This is done by using a special end milling cutter and a new steel insert must be pressed into position. It is absolutely essential to ensure that the new seat insert is very carefully milled to size and pressed into place in order to ensure that it seats properly. This operation requires special equipment with a milling attachment and drifting tools.

The new seat insert is cooled with liquid carbon dioxide, and is then pressed into place with the particular tool required. The new seat is then ground to the correct width and angle as above.

Rocker arms

It is very important to ensure that the rocker arm bushings are not too much worn. The maximum permissible wear is 0.0004″ (0.1 mm). Take care that the rocker arm pad has the correct form, that the oil passages are not clogged and that the locknut and the ball and thread on the adjusting screw are in good condition.

When fitting new bushings, take care to turn them-the correct way. The passage in the bushing should form a 30° angle with the ball screw. Use tool SVO 4154 A Fig. 56. A suitable sleeve should be used as a support. The new bushings should be reamed with the special tool SVO 4153, Fig. 57.

The surface of the rocker arm pad is ground smooth with the help of a special tool. Remember that the pads are hardened and, for this reason, the grinding depth should be restricted to max. 0.02″ (0.5 mm). The oil passages in the bushing should be blown clean with compressed air.

Defective adjusting screws and locknuts should be rejected and replaced if there is any fault whatsoever on the ball or the screw.

Rocker arm shaft

The rocker arm shaft should be replaced when the rocker journals have worn more than 0.002″ (0.05 mm). A good shaft should be blown clean with compressed air, and new seal washers should be fitted.

Valve lifters

Valve lifters with worn or damaged bearing surfaces should be replaced.

Valve clearance adjustment

After an engine has been reconditioned, the first thing to do is to make a preliminary adjustment of the clearances on all the valves. This rough adjustment is carried out in the following way. All the spark plugs should be removed.

Number one piston is cranked to its firing position as observed by the closing of the exhaust valve on number four cylinder which occurs when number one piston is in its firing position.

Back off the locknut and turn the ball screw until the feeler gauge binds. Then slacken the ball screw enough to allow the gauge to be moved back and forth with some resistance. Tighten the locknut, taking care to ensure that the screw does not turn with it. Now move number four piston to the firing position by noting the closing of the exhaust valve in number one cylinder and adjust the valves on number four cylinder. Adjust the valves on cylinder two and three in the same way. When the exhaust valve on number three cylinder closes, this means that number two piston is in the firing position and vice versa.

Valve Clearances

Inlet Valve	*Exhaust Valve*
0.020″ (0.50 mm)	0.020″ (0.50 mm)

Fit the spark plugs when all the valves have been adjusted. Make sure that oil and water is added to the engine and then start it.

Final adjustment should be carried when the engine has reached normal operating temperature and is idling slowly.

FLYWHEEL

Replacing the flywheel bushing

If the flywheel center bushing is so much worn that the pilot bearing has become loose, the bore may be turned to increase the diameter to receive an insert ring. The diameter of the bearing bore should be $1.378'' \pm {}^{0.0002''}_{0.0004}$ ($35 \pm {}^{0.006}_{0.010}$ mm). Maximum runout is 0.001″ (0.025 mm).

Refacing the flywheel

If the face of the flywheel is scored or blued, it may be refaced by grinding. Grinding should be carried out by using a special grinding attachment in a lathe, Fig. 61. The total depth available for grinding is restricted to 0.03″ (0.75 mm).

Replacing the ring gear

Remove the old ring gear with a hammer and a drift. Heat the new ring gear to about 355° F (180° C). and place it on the flywheel, the beveled side of the teeth upwards. Then tap the gear lightly so that it seats well against the shoulder all round on the flywheel. Do not strike too hard since this can damage the flywheel.

Pilot bearing

The pilot bearing in the flywheel should be replaced if play is evident or, if, after cleaning, there are signs of damage on the balls, ball races or retainers. Pull out the old bearing by using tool SVO 4090 and drive in a new one with tool SVO 1426.

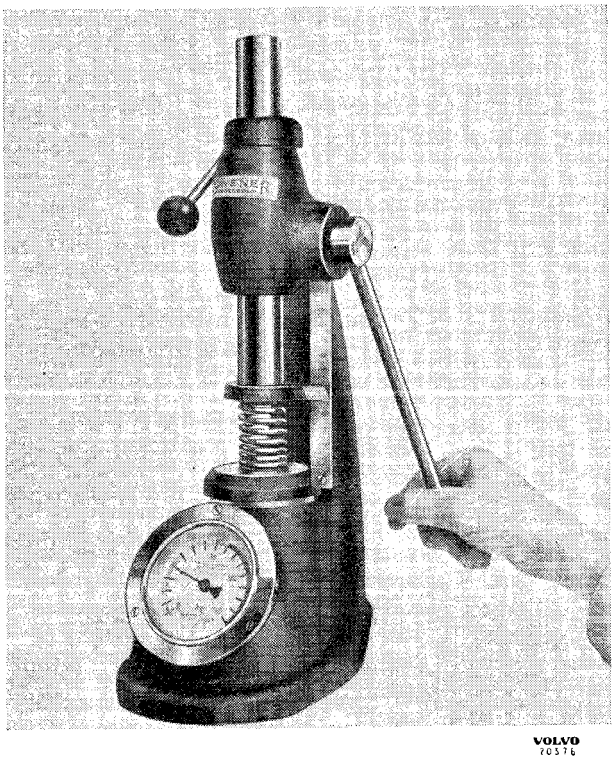


Fig. 51. Testing a valve spring.

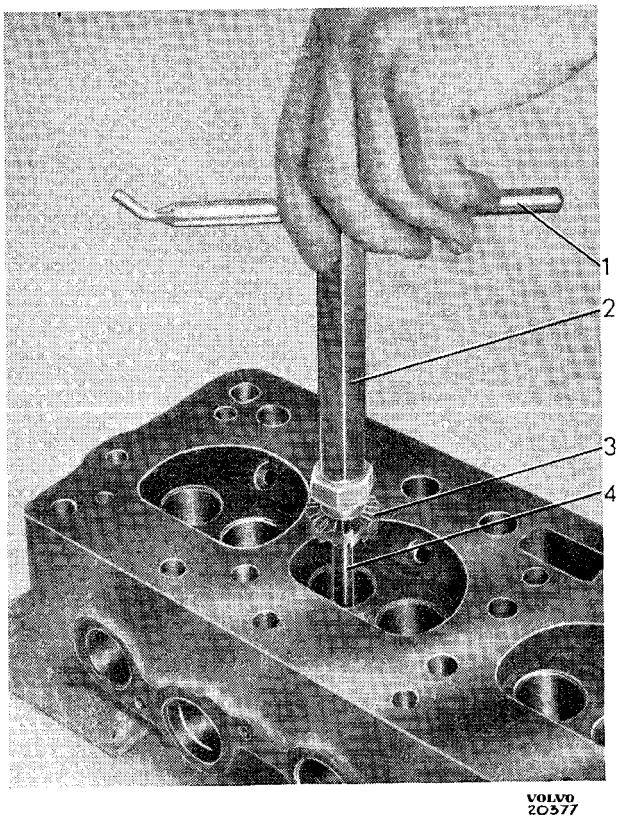


Fig. 53. Refacing valve seats.

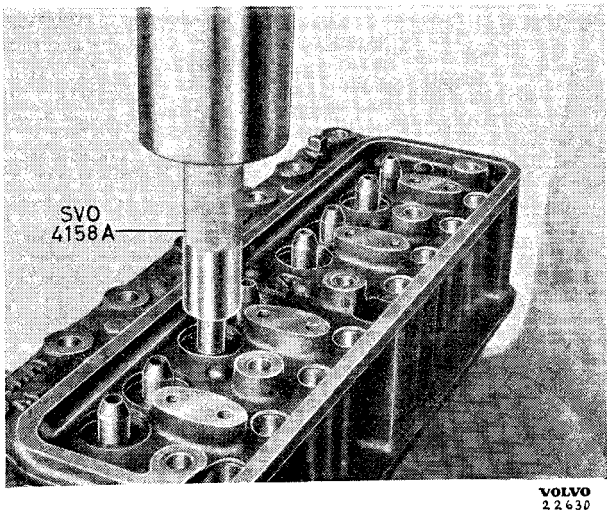


Fig. 52. Fitting valve guides.

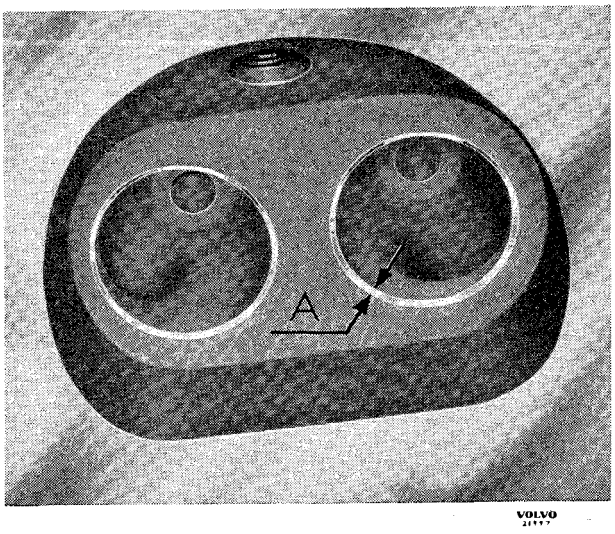


Fig. 54. Valve seat width.
A=0.060″ (1.5 mm)

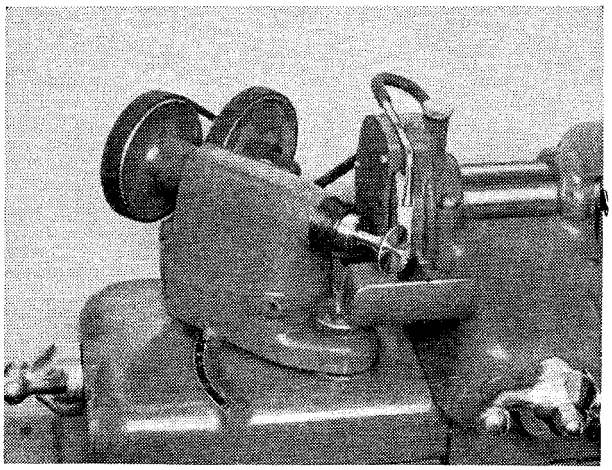


Fig. 55. Grinding a valve mechanically.

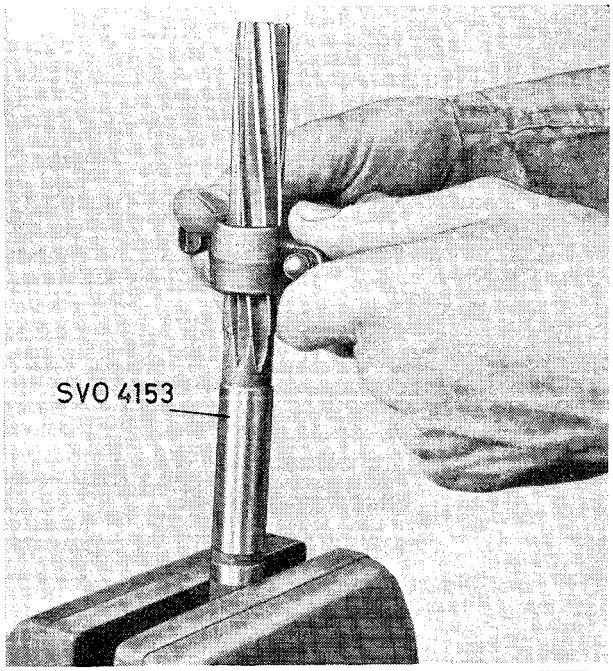


Fig. 57. Reaming rocker arm bushings.

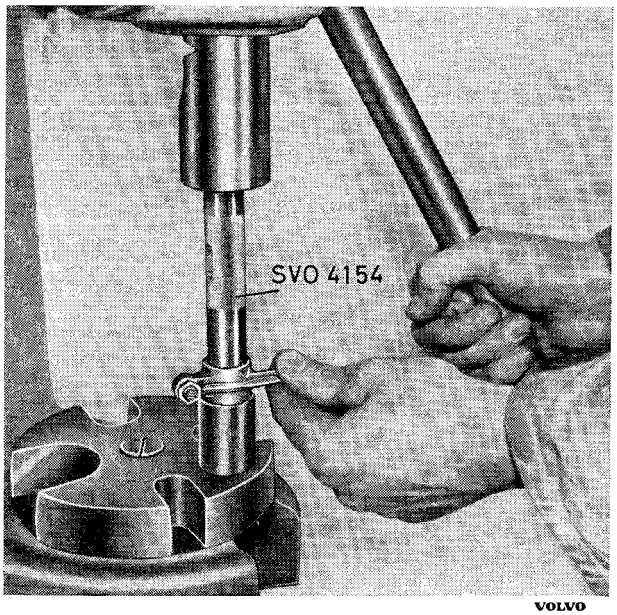


Fig. 56. Replacing rocker arm bushings.

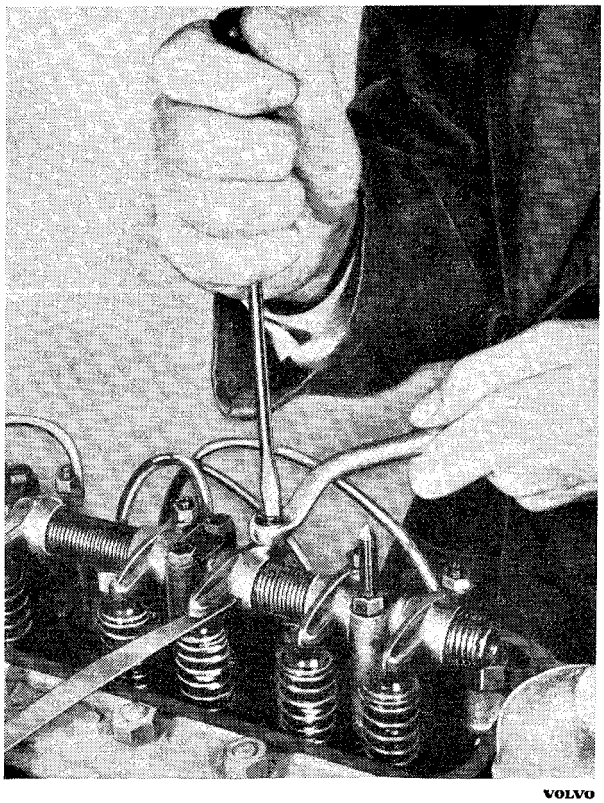


Fig. 58. Adjusting valve clearance.

LUBRICATING SYSTEM

Oil Pump

Reconditioning

The most important requirement is that the pump shaft does not have too much clearance in the housing. Clean the pump and check this clearance. Worn or damaged bushings or shaft should be replaced. If the housing is scored on the inside, it should be replaced. Shaft bushings should be pressed into position and reamed to size. Use a reamer with a guide bush. Holes for slotted pins are drilled after the gears have been fitted on the shaft. Before locking the driving gear in position, check that there is an axial clearance of 0.008" (0.02 mm) and that gear backlash (Fig. 59) is between 0.006—0.014") (0.15—0.35 mm). The driven gear should be fitted with the ground side facing the pump housing cover. A scored cover can be refaced on a facing grinding machine.

Check the clearance between the cover and the gears before fitting the cover. This clearance should be 0.002" (0.05 mm). Measurement is carried out as shown in Fig. 60.

Fitting the oil pump

The installation of the pump is facilitated if the distributor is removed and fitted back in position when the oil pump has been secured. With the engine cranked to 0° and with number one cylinder in its firing position, the driving gear should be in the position shown in Fig. 62.

Relief valve

The relief valve plunger is extracted by using tool SVO 2079. Clean the plunger before refitting it. The spring should be tested in the manner shown in Fig. 51. If the spring does not hold the specified length, it should be replaced.

Oil passages

It is extremely important to ensure that the oil passages are perfectly clean and great care should be taken to ensure the removal of all obstructions. It is necessary to remove the seal plugs at the end and scrape the walls of the passages clean by using a special brush. Flushing with water should then be carried out and blowing dry with compressed air. The rocker arm system oil passage should also be cleaned. This passage goes through the block and the cylinder head beside the number four cylinder.

Oil cleaner

The oil cleaner element should be replaced for the first time in a new or reconditioned engine after 3000 miles (5000 km) the second change after a total mileage of 6000 miles (10000 km) and later replacements after every 6000 miles (10000 km).

Replacing element

1. Clean the oil cleaner housing and the adjacent parts of the engine to prevent dirt from getting into the lubricating system when removing.
2. Loosen the center bolt (3) on the cleaner housing, Fig. 63. Collect the oil that runs out.
3. Remove the oil cleaner. Remove the old element and clean the housing with white spirit. The element cannot be washed but should be replaced with a new, original Volvo element which is especially made for this type of oil cleaner. If the wrong type of element is fitted, there is a risk that the function of the lubricating system can be disturbed.
4. Check that the plate marked "UP" has the hole and the marking at the top (not fitted on early production unit). Fit the element and the gasket and then the housing. Guide the housing with the hand so that it comes into its groove correctly. Tighten the bolt with a torque of 15 lb.ft. (2 kgm).
5. If the element is replaced without changing the engine oil, topping up should be carried out by adding 1½ U.S. pints=2 Imp. pints, (0.75 liters).
6. Clean the parts around the oil cleaner. Start the engine and check for leakage at the gasket.

Crankcase breather

The purpose of the crankcase breather is to remove vapor and blowby gases from the crankcase. This is done by means of a pipe on the left side of the crankcase. If this pipe is blocked, there will be a pressure rise in the crankcase and this can cause oil leakage. The oil filler cap filter and this crankcase breather pipe should be cleaned out every time major work is carried out on the engine.

IGNITION SYSTEM

Ignition setting

Accurate adjustment of ignition timing should always be carried out with the help of stroboscope while the engine is running at a rapid idling speed. The

basic setting when assembling the engine is carried out with the help of a small bulb which is connected to the distributor.

The ignition setting should preferably be suitable for high-octane petrol (93 octane Research Method).

Basic adjustment

1. Crank the engine to T.D.C. and the firing point for number one cylinder. Check that the driving gear on the oil pump is in the correct position as shown in Fig. 62.
2. Turn the crankshaft about ¼ of a turn backwards and then forwards again to the firing position, i. e. 4° before T.D.C. (with 93 octane fuel). When rotating forwards, check that the indicator pointer, Fig. 67 is registering the correct reading and has not gone past this. If the crankshaft is rotated too far, it should be rotated backwards and then forwards again to the correct position so as to avoid a faulty reading depending on gear backlash.
3. Turn the distributor coupling to the correct position and push down the distributor into position. Connect the lamp (Max. 3 W.) as shown in Fig. 64. Switch on the current.
4. Loosen the clamp screw on the attaching plate and turn the distributor housing in a clockwise direction until the breaker points close, then slowly in a counter-clockwise direction until the bulb just lights up. Tighten the distributor in this position.
5. Check that the rotor points to the terminal leading to number one cylinder. Fit the distributor cap and cables as shown in Fig. 65. The rotor moves clockwise. The order of firing is 1—3—4—2.

Fine adjustment

1. Disconnect the distributor vacuum regulator by loosening one end of the pipe.
2. Mark out the graduation 21° before T.D.C. on the flywheel with chalk (93 octane fuel).
3. Connect up a lamp, Fig. 66 with the ignition cable to the spark plug in number one cylinder and the other cables to the battery.
4. Run the engine at 1500 r.p.m. and hold the lamp directed at the flywheel graduations. If the ignition setting is correct as described, then the chalk mark on the flywheel should appear to be stationary opposite the indicator.
5. If necessary, adjust the setting by turning the distributor after loosening the clamp screw.
6. Remove the lamp and retighten the vacuum pipe.

Testing spark plugs

After cleaning and adjusting spark plugs, test them in the special spark plug tester as it is impossible to judge their true condition from ocular inspection only.

Mount the spark plug and place the pressure chamber of the apparatus under 100 lb./sq.in. (7 kg/cm²) pressure. Connect the lead to the plug ferrule; if the plug is in good working order, a powerful spark will then be seen in the inspection window when the switch is pressed.

Observe instructions accompanying the tester.

FUEL SYSTEM

B 16 B engines are fitted with twin SU horizontal carburetors.

Carburetors, SU H4

The hollow spindle on the suction chamber piston is filled with oil and functions together with the small damping plunger (3, Fig. 12) as a damper. This should be topped-up with oil at regular intervals, for example when the car is greased. Screw off the nut at the top of the suction chamber, lift up the nut and the damping plunger and top-up with oil through the hole. Fill only the center spindle and not the part above this. Use thin engine oil (SAE 10 W).

Disassembly

1. Blow the carburetors clean externally.
2. Loosen and remove the air cleaners and the control retainer with the control rod between them.
3. Remove the fuel line connections and the vacuum line connections (to the distributor).
4. Loosen the nuts on the connections on the shaft between the carburetors. Move up the connections on the shaft. Loosen the throttle controls. Remove the carburetors.

Disassembly and cleaning

Float bowl

1. Loosen the float bowl from the carburetor housing.

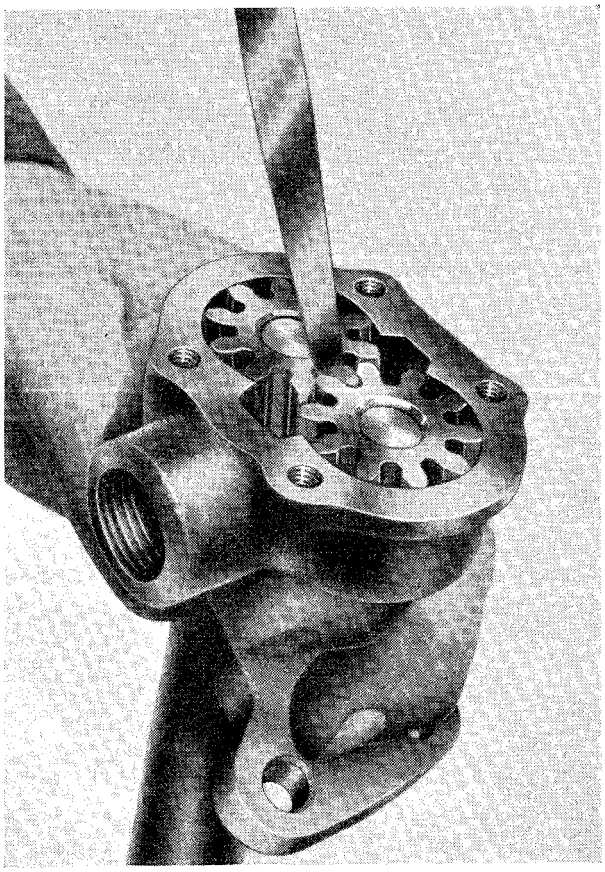


Fig. 59. Measuring backlash.

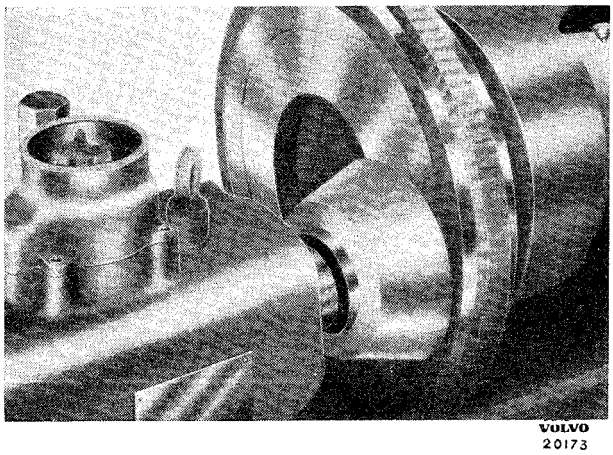


Fig. 61. Grinding the flywheel.

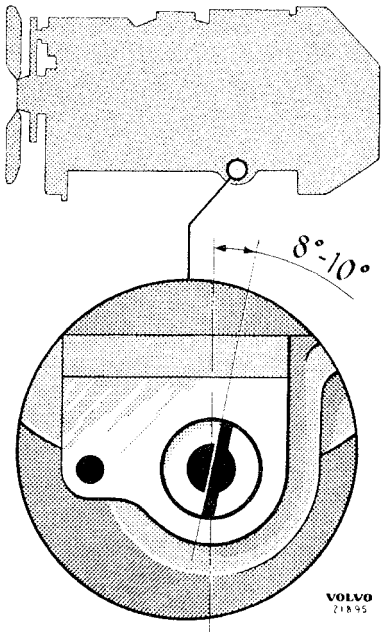


Fig. 62. Driving gear position.

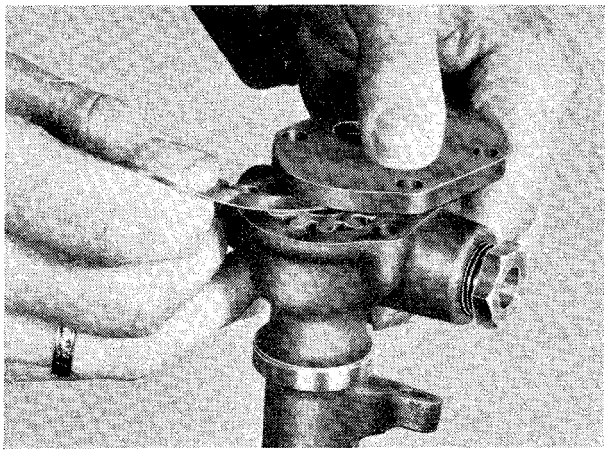


Fig. 60. Checking axial clearance.

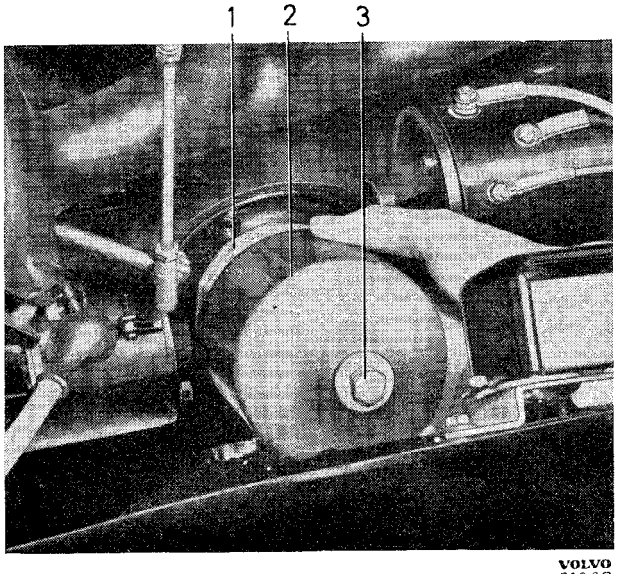


Fig. 63. Replacing the oil cleaner element.
1. Element 2. Housing 3. Bolt

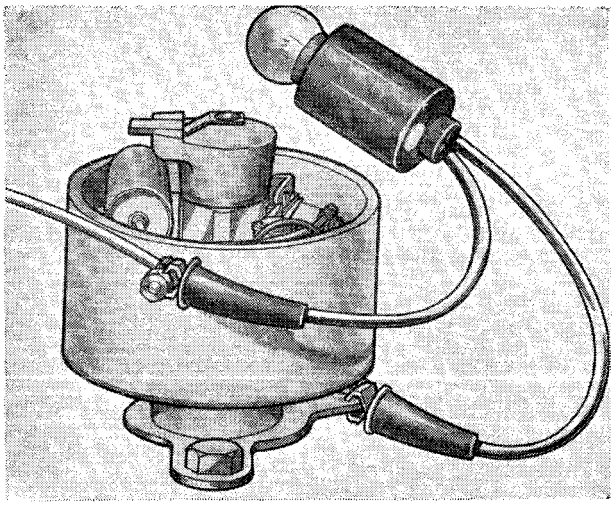


Fig. 64. Adjusting ignition timing.

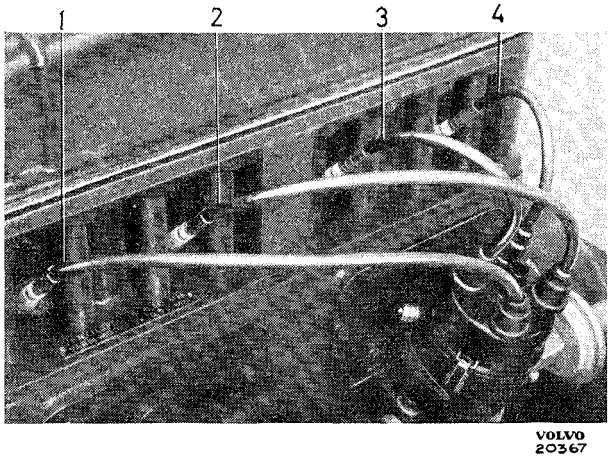


Fig. 65. Order of firing 1—3—4—2.

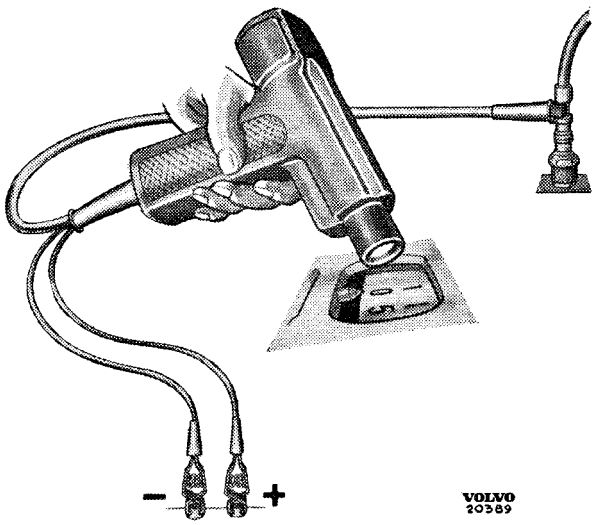


Fig. 66. Checking ignition timing.

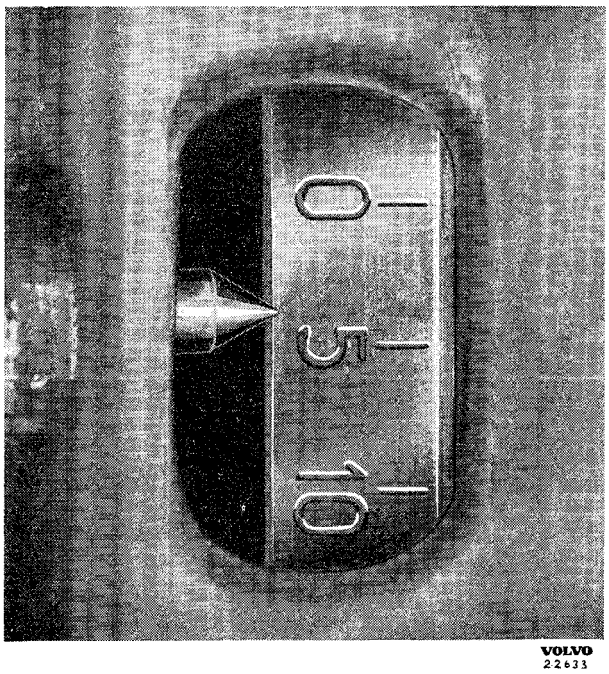


Fig. 67. Flywheel markings.

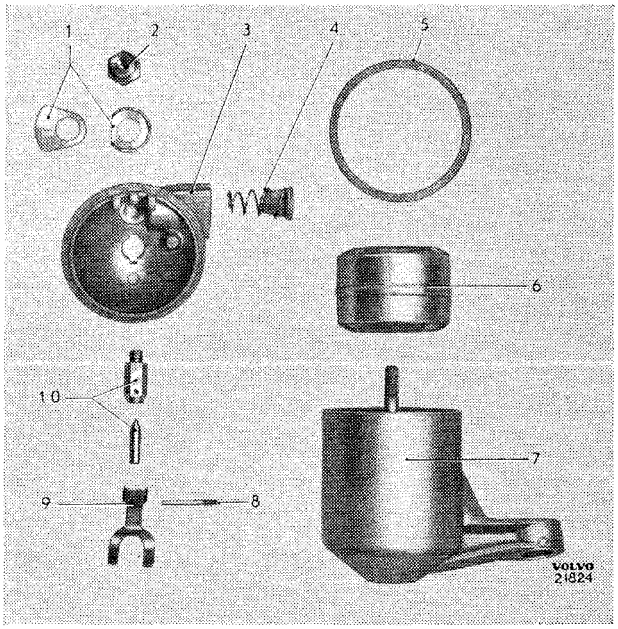


Fig. 68. Float-bowl assembly (SU).

1. Washers
2. Nut
3. Float bowl cover
4. Strainer and spring
5. Gasket
6. Float
7. Float bowl
8. Pin
9. Lever
10. Needle valve

2. Remove the nut on the float bowl cover. Remove the cap and lift out the float. See Fig. 68.
3. Remove the float arm by pulling out the pin upon which it pivots.
4. Loosen the neede valve in the cover and the hollow bolt and strainer.

Jet unit.

1. Remove the return spring for the jet lever and the link rod between the lever and the cam-shaped plate.
2. Remove the bolt for the jet head and the upper bolt for the link and then remove the lever. See Fig. 69.
3. Remove the lock nut and take out the jet bearings with the spring and gland. Pull out the jet. Screw off the adjuster nut and remove its spring.

Suction chamber with piston and fuel needle.

The suction chamber and the piston are matched as units and if one of these is replaced then the other must be replaced at the same time. The suction chamber has three attaching screws which are staggered to ensure that it is fitted the right way. Do not turn suction chamber.

1. Remove the damper (1 Fig. 70) from the suction chamber.
2. Loosen the screws on the suction chamber and lift it out.
3. Lift up the spring and the piston. Take care to ensure that the needle is not damaged (bent).
4. Screw out the lock screw on the fuel needle and pull it out.

Cleaning

After diasassembly, all parts should be cleaned in kerosene and then blown clean with compressed air.

Assembly and fitting

Assembly and refitting of the engine is carried out in the reverse order to that used when disassembling and removing.

Before assembling, check that all gaskets and sealing glands are free from damage. Replace these if necessary. Make sure that all other parts are neither damaged or worn.

Neither the suction chamber nor the piston may be filed or rubbed with emery paper since this will change the fit and this has been very carefully calculated so that the carburetor will function properly. Any small unevenness can, however, be carefully rubbed away.

When attaching the needle in the piston it is very important to ensure that the needle assumes the right position as far as gap is concerned. See under the heading "Replacement of fuel needle". The piston in the suction chamber is grooved and a guide projection in the carburetor housing fits into this groove. Lubricate the piston spindle lightly with thin engine oil before reassembling.

When the jet is fitted, it must be centralized before it is tightened. Otherwise the needle can jam or, under unfavorable circumstances, become damaged. See under the heading "Centralizing the jet".

Add oil (engine oil SAE 10 W) to the damping cylinders after reassembling the carburetors. The air holes in the air cleaners must not be blocked.

Checking the fuel level

The fuel level can be checked indirectly after removing the float bowl cover.

1. Loosen the fuel line and remove the float bowl cover.
2. Turn the float bowl cover upside down.
3. Measure the distance from the float bowl cover to the arm by means of a gauge with diameter 27/64″ (11 mm) as shown in Fig. 73. (This gauge can be made from a rod about 3⅛″ long). When the needle valve is closed, the needle valve arm should just contact the gauge.
4. If necessary, bend the arm where it joins the yoke-shape section in order to maintain the clearance mentioned in point 3 above.

Replacement of fuel needle

1. Remove the suction chamber and the piston and fuel needle.
2. Loosen the screw on the fuel needle and pull out the fuel needle.
3. Fit a new fuel needle. Check that this is marked as mentioned in the Specifications. Push the needle so far into the piston that only the tapered working section is outside it. See Fig. 72. Tighten the lock screw.
4. Fit the parts into the carburetor. Then check that the piston moves easily up and down. The piston can be lifted slightly without having to remove the air cleaner with the help of the pin. When the pin is slowly released, the piston should be heard to meet the bridge with a characteristic sound.

Replacement of jet

1. Remove the jet as described under the heading "Disassembly and cleaning, jet unit". The adjuster nut does not need to be removed. If the carburetor is fitted on the engine the wire on the jet lever should be loosened.
2. Fit the new jet in the lower bearing and then fit the lower seal washer and packing, the spring, the upper seal washer with packing and the upper bearing with its copper washer. The brass washer for the upper and lower seals should be in contact with the spring.
3. Push in the jet together with the assembled parts into the carburetor housing, see Fig. 71. Screw on the lock nut loosely. Centralize the jet as shown below and then fit the lever and the other disassembled parts.

Centralizing the jet

In order to ensure that the carburetor functions in the correct way it is extremely important to make sure that the fuel needle moves easily up and down in the jet without jamming against the walls of the jet. For this reason a very careful fit (centralizing) of the jet relative to the fuel needle is necessary.

The jet bearings are attached with quite a large lateral clearance so that they can be moved laterally when adjustment is carried out.

1. Remove the air cleaner. Screw up the adjuster nut (8, Fig. 10) as far as possible against the carburetor housing.
2. Check that the lock nut (5) is loosened.
3. Check that the jet is in its highest position, i.e. that the jet head is in contact with the nut and the needle is in its lower position.
4. Centralize the jet by carefully turning the lower jet bearing. Be careful not to disturb the adjuster nut. If the jet bearing requires moving slightly this can be carried out by slightly tapping the adjuster nut.
5. Lift the piston and the needle. When the piston is released it should strike against the bridge with a fully audible sound on condition that the jet is correctly centralized and the piston is running easily.
6. Tighten the lock nut. Check the pre-movement of the piston as described in point 5 above. Fit the air cleaner and make sure that the ventilation channels are not blocked.

Idling settings and the coupling together of the carburetors

Idling setting is carried out partly by means of the screws (7 and 10, Fig. 8) on the throttle arms which regulate engine speed, and partly by turning the adjuster nuts on the jet heads whereby the richness of the fuel mixture is altered. When the nuts are screwed down, a richer fuel mixture is obtained. If the nuts are screwed up the mixture will be leaner. The richness of the mixture is set during idling to cover the whole speed range of the engine.

When the correct idling speed has been obtained and both carburetors have been adjusted to the same level, they are then connected together. Individual settings should be carefully carried out before the carburetors are connected together in order to get the highest output for the engine.

1. Run the engine until it is thoroughly warmed up. If the jets have not been adjusted, a rough adjustment can be first carried out by screwing the adjuster nuts to their upper position and then screwing them down again one complete turn.
2. Loosen one of the couplings (9, Fig. 8) on the shaft between the carburetors. Make sure that the jets on both the carburetors are pressing against the adjuster nuts and that the screw (6) for rapid idling is not in contact with the cam-shaped plate on each carburetor.
3. Adjust both throttles to the same position by screwing out the throttle adjuster screws (7 and 10) and then screwing them in again until contact with the stop projections is just made. Then screw down each screw exactly one turn.
4. Start the engine. Check that the throttles are open to the same extent in both carburetors by listening to the sound with the aid of a rubber pipe placed in contact with the same point on the air cleaner of each carburetor. Adjust the idling screws until the air intake sound on both carburetor has exactly the same strength.
5. Adjust the jets by turning the adjuster nuts so that the idling speed is as high as possible with unchanged throttle opening. Adjust the carburetors one at a time. First screw the adjuster nuts upwards (leaner mixture) until the engine runs unevenly and then in the opposite direction until the engine runs perfectly smoothly. If the idling speed is too high it can be decreased by unscrewing the idling screws on the throttle

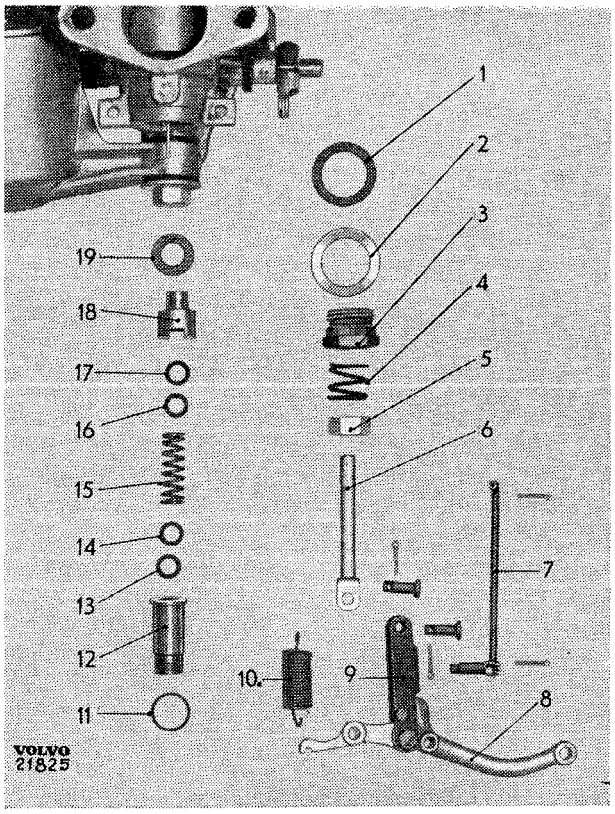


Fig. 69. Jet unit disassembled (SU).

1. Washer
2. Seal washer
3. Lock nut
4. Spring
5. Adjuster nut
6. Jet
7. Link rod
8. Lever
9. Link
10. Spring
11. Washer
12. Lower jet bearing
13. Seal ring
14. Washer
15. Spring
16. Washer
17. Seal ring
18. Upper jet bearing
19. Washer

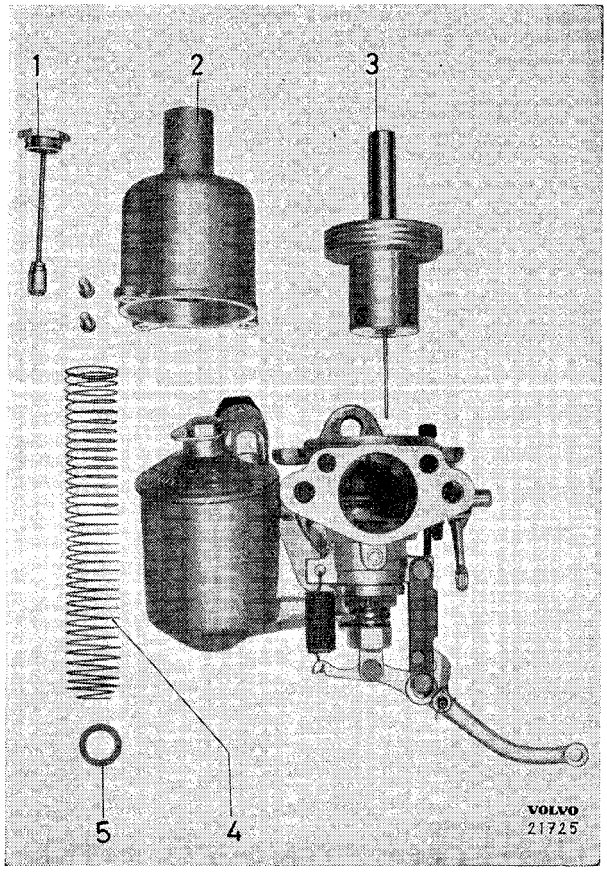


Fig. 70. Suction chamber disassembled (SU).

1. Damping plunger
2. Suction chamber
3. Piston
4. Spring
5. Washer

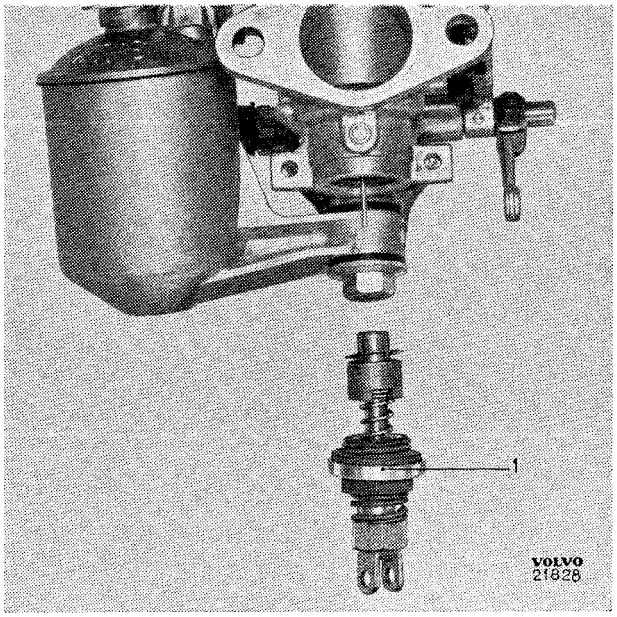


Fig. 71. Jet unit assembled (SU).

1. Jet and associated parts

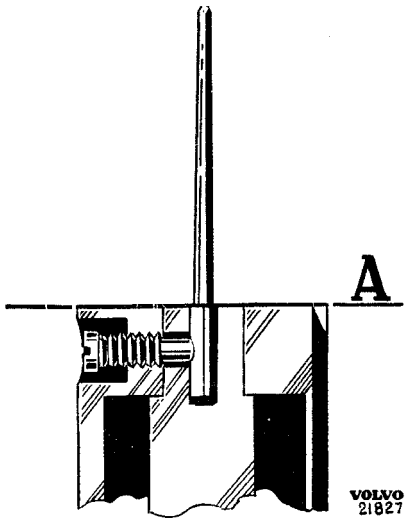


Fig. 72. Attachment of fuel needle (SU).
A = Attaching level

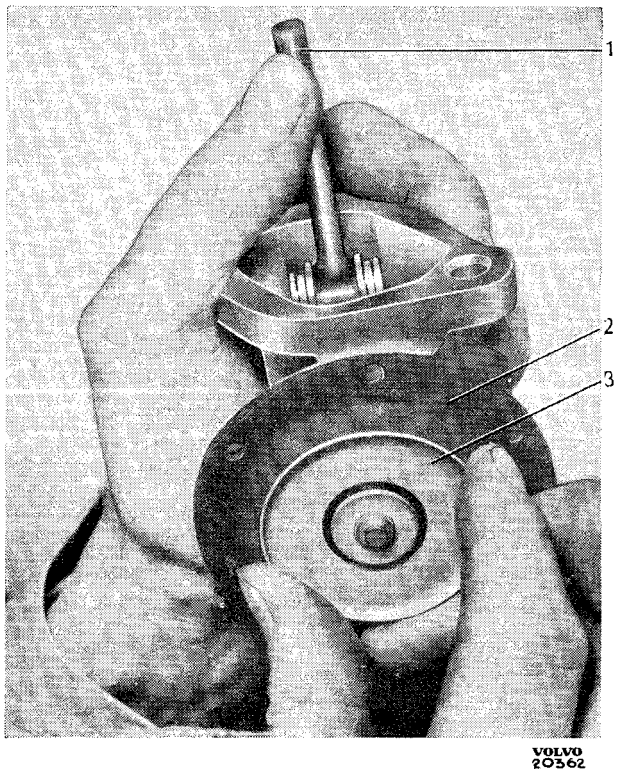


Fig. 74. Replacing the diaphragm.
1. Rocker 2. Diaphragm 3. Washer

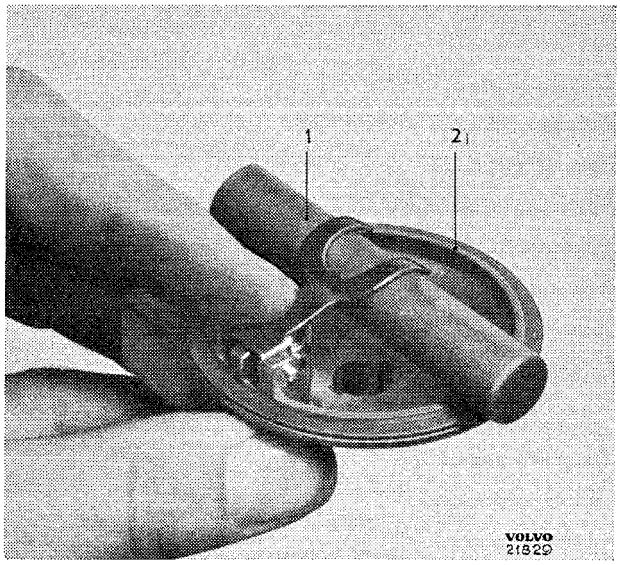


Fig. 73. Checking fuel level (SU).
1. Gauge (27/64" diameter)
2. Float bowl cover

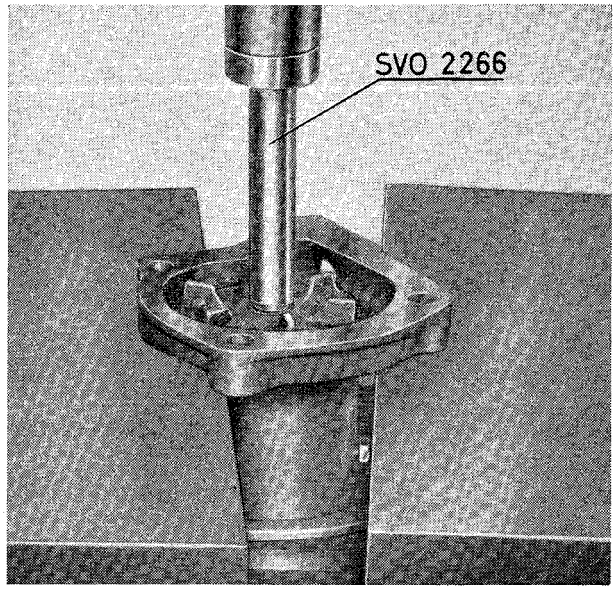


Fig. 75. Removing impeller and shaft with ball bearings.

shaft levers. Then check again as specified above that the air intake sound is equally strong on both carburetors.

6. Check that the fuel-air mixture is correct on both carburetors. First lift the piston on one of the carburetors slightly by means of the pin beside the air intake. Then release the pin and carry out the procedure on the other carburetor. The degree of uneven running on the engine should be the same in both cases.
   If the engine stalls when the piston on one of the carburetors is lifted, this usually means that the mixture on the other carburetor is too lean. The jet adjuster nut on the carburetor in question should be screwed carefully downwards to remedy this.
7. Connect the carburetors together by tightening the couplings on the shaft. Adjust the rapid idling screw. This is done by turning the screw until it is in contact with the cam plate and then screwing it back until a certain clearance is obtained. Check once again that the air flow through both carburetors is the same. See point 4 above.

Rapid idling and control mechanism

The rapid idling system (Fig. 14) can be adjusted to suit varying conditions by means of the adjuster screw against the cam plate. See the specifications.

When the choke control is completely pushed in, the clearance between the adjuster screw and the cam plate should correspond to one turn of the screw.

The clamp on the end of the choke cable should be attached so that the jets begin to go down when the choke button on the instrument panel has been pulled out about ½" (rapid idling movement). Increased resistance will be felt on the choke button when the jets begin to move downwards.

When the choke control button is pulled out as far as it will go, the long lever ends should be lifted so far that the jets are completely lowered i.e. the levers should contact the stops in the links. Make sure that both levers are influenced to the same extent through the curved cable so that both jets start to move downwards at the same time.

Fuel pump

Testing fuel pump

If no fuel arrives at the carburetor, disconnect fuel pipe at the carburetor and work fuel pump by hand. If no fuel issues from the open end of the fuel pipe, check that there is fuel in the tank and that the suction line is not stopped, or has sprung a leak through which air is drawn into the pump. If the suction line is in order, remove fuel pump.

Before dismantling pump, check pumping action with a special apparatus or in the following manner.

Connect a length of hose, not less than 32 in. = 80 cm, to the suction side of the fuel pump and hold the other end of the hose in a vessel containing fuel. With pump 28 in. = 70 cm above the fuel level, the pump should draw up fuel when worked by hand. Otherwise, proceed by dismantling the pump for a check on diaphragm, valves and gaskets.

Replacing diaphragm

1. Remove screws securing upper and lower halves of pump housing, and separate body halves.
2. Take the lower half in the left hand as shown in Fig. 74, and press rocker (1) with left thumb. Depress washer (3) with right hand thumb, rotate washer one quarter turn, and remove washer, diaphragme (2), and pull rod.

Diaphragm, washer, and pull rod are assembled to a unit, and are replaced together. Reassembly of the pump is carried out in the reverse order. Take care that the pump pull rod is placed in its proper position on the rocker, and that the diaphragm is clamped evenly between the two pump housing halves.

Replacing the valves

To replace pump valves, separate the two halves of pump housing, then remove two screws fastening valve holder, and take out valves.

Check that replacement valves are turned the right way and that gaskets are in good order.

Repairing fuel tank

Leaky fuel tanks shall be soldered tight. Remove tank from vehicle and drain all fuel. Then wash through tank carefully with hot water or with steam for at least 10 minutes in order to remove the last traces of fuel.

Clean carefully before soldering, and apply a smooth coat of tin, preferably using an electric soldering iron.

Flush through tank with compressed air during entire soldering process in order to prevent concentrations of gases which might produce an explosion.

Alcoholic fuels

Do not use alcoholic together with SU carburetors since these dissolve the gum deposits left by gasoline in the tank.

Fuel

Since the engines have a comparatively high compression ratio, 93 octane (Research Method) fuel should be used. If lower octane fuel is used the ignition setting should be retarded. This is however not to be recommended since it means a lower output and uneven running.

COOLING SYSTEM

Water pump

Removing pump

Drain cooling water. To remove water pump, first remove fan which is held by four screws in the pulley, then remove fan belt. Next remove four screws securing pump to engine block, and pump is free. The radiator need not be removed.

Disassembling

1. Remove lock screw (3, Fig. 17) retaining rear ball bearing. Use tool SVO 2266 to press out pump shaft (Fig. 75), while guiding pulley with one hand to prevent binding. Remove impeller. Ball bearings and spacer sleeve generally come out with the shaft; if not, remove sealing ring and press out bearings using large end of tool SVO 2266.
2. Turn pump housing and take out sealing ring with tool SVO 2266. Unscrew grease cup.
3. Remove oilslinger. Place ring SVO 2271 in the press, large diameter end downward. Use tool SVO 2266 to press shaft through the ring so that pulley, ball bearings, and spacer sleeve come loose, Fig. 76.

Inspection

Wash all parts carefully before inspecting for damage. The bearings should rotate freely without sticking, and the sealing ring must be free from cracks and press firmly and smoothly against the impeller.

Replace damaged and worn parts.

Assembly

1. Place the front bearing on ring SVO 2271 open side upwards as shown in Fig. 77. Press shaft into bearing until shaft end bottoms against press table, then into pulley until shaft end is flush with pulley face.
2. Place spacer sleeve on shaft, turn shaft round and press on rear bearing with ring SVO 2271 as support. The ball bearing is turned so as to show open side towards spacer. Place rings as shown in Fig. 76 but with drift tool against pulley face. Install grease nipple.
3. Install assembled shaft in housing. Take care that shaft does not bind when pressed into housing. Insert lock screw at rear bearing.
4. Install oilslinger (7, Fig. 17), flange away from bearing. Install sealing ring 4 with tool SVO 2270.
5. Mount impeller with tool SVO 2266, placing large end against impeller.
6. Check that pulley turns easily. Check impeller to housing flange clearance, which should be 0.012 in.=0.3 mm. Place a straight edge across housing end and check with feeler gauge. The clearance between impeller rear face and housing should be 0.02—0.04 in.=0.5—1 mm.
7. Fill pump with heat-resistant grease.

Fitting pump

When fitting pump on engine, proceed in reverse order to removal. Always install a new gasket between pump housing and cylinder block. Inspect water hose and replace if soft and mushroomed on inside.

Thermostat

The thermostat has the important function of reducing the time for warm-up to normal operating temperature. If defective, it must not be removed, but should be replaced by a new one.

Cylinder wear and corrosion are especially prominent when the engine is cold. The function of the thermostat is to block the passage for the water from the engine to the radiator, and to recirculate it through the engine. It is thereby rapidly brought to operating temperature, and cylinder wear is reduced. Inside the engine, the water can circulate through a bypass to ensure even heat distribution without local overheating.

If it is suspected that the thermostat has become stuck in the open position, or has sprung a leak, it should be taken out and tested. Tie thermostat to a piece of string and suspend it in a beaker with water, together with a thermometer, Fig. 79. Take care that the thermometer does not stand on the

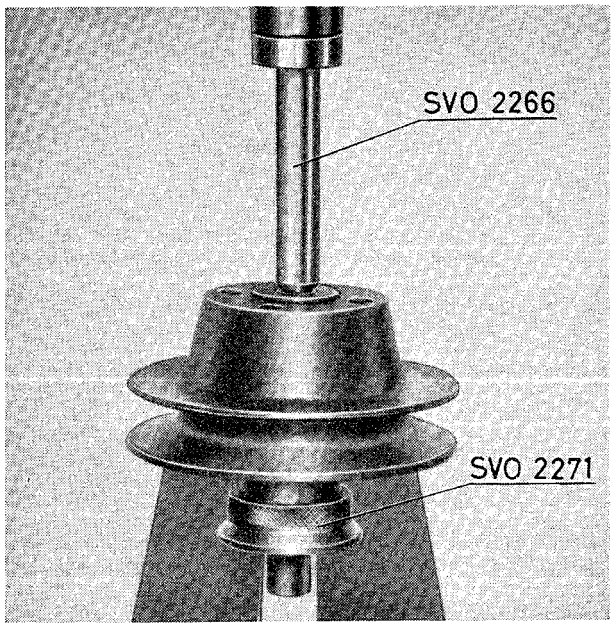


Fig. 76. Removing the pulley.

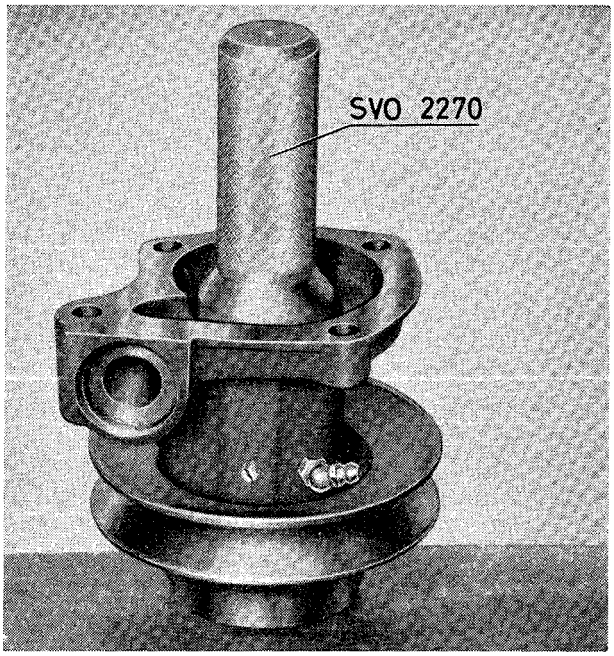


Fig. 78. Fitting the sealing ring.

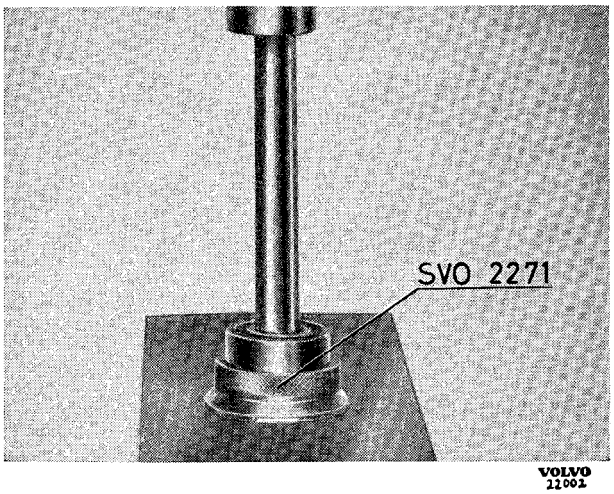


Fig. 77. Fitting the ball bearings.

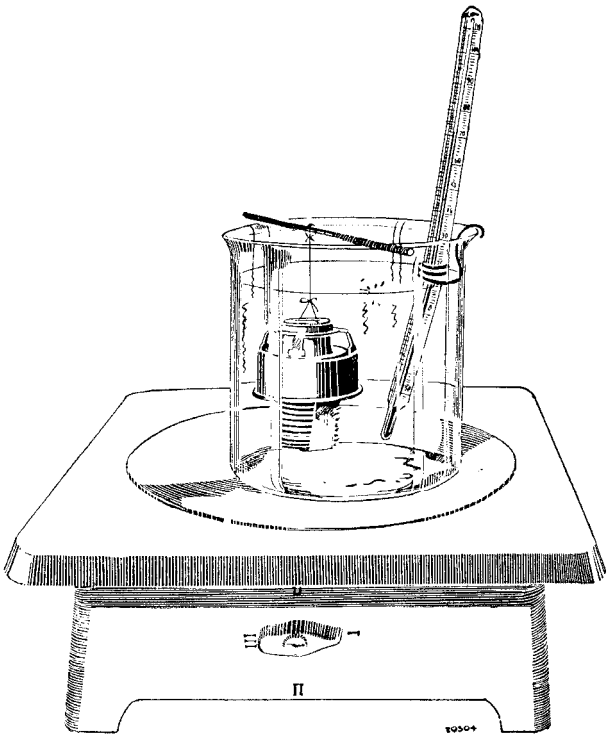


Fig. 79. Testing the thermostat.

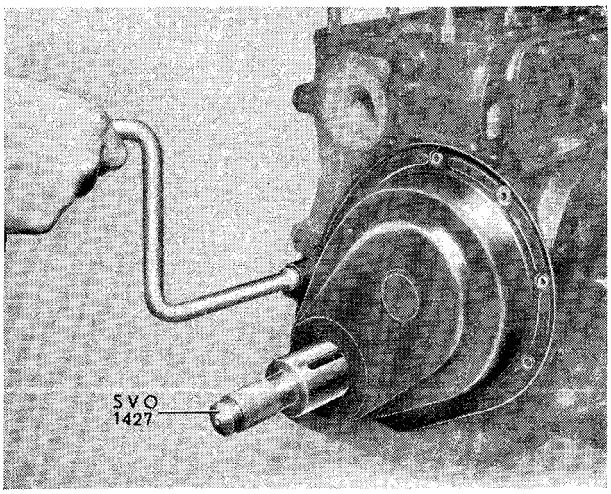


Fig. 80. Fitting the timing gear casing.

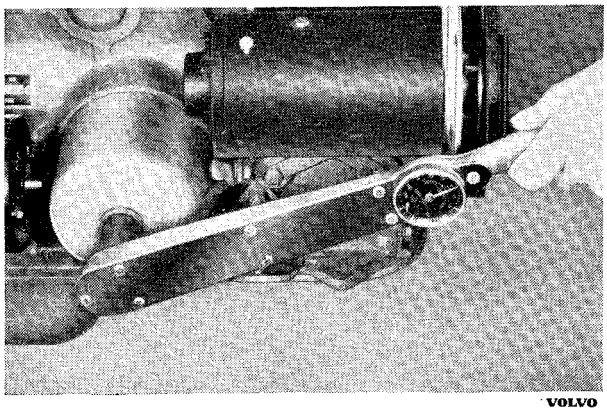


Fig. 81. Tightening the oil cleaner bolt (B 16).

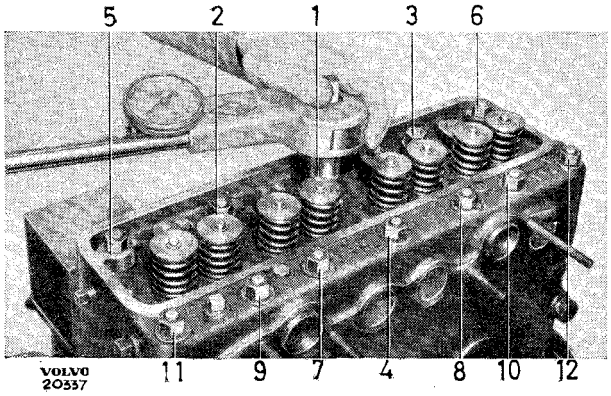


Fig. 82. Tightening sequence for cylinder head nuts

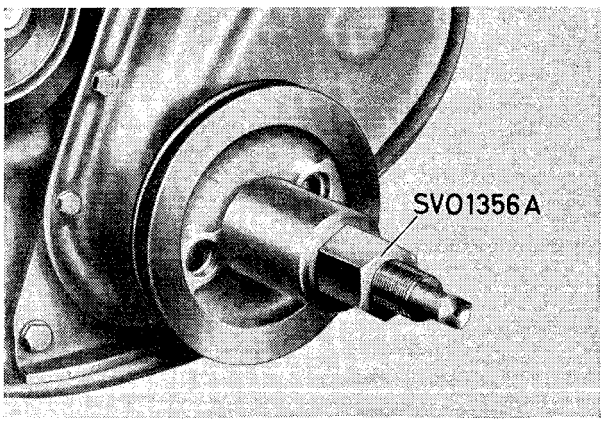


Fig. 83. Fitting the pulley.

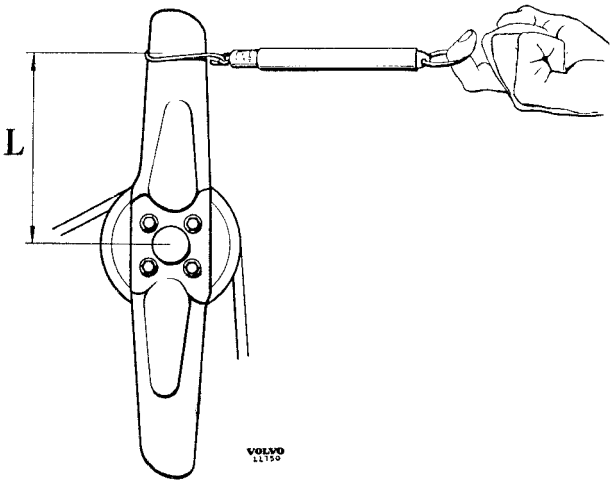


Fig. 84. Pulley belt tension.
L=6" (150 mm)

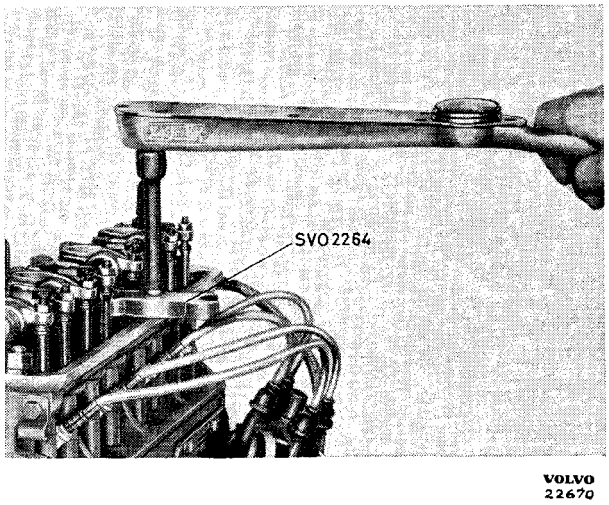


Fig. 85. Re-tightening the cylinder head nuts.

bottom of the beaker. Heat the water and observe the thermometer reading when the thermostat begins to open. The opening temperature should be between 167°—172° F, i.e. (75° and 78° C). 162°—169° = (72°—76° C on early production engines). Raise temperature until thermostat is fully open, which should happen at 194° F (90° C) or 185° F (85° C) on early production engines. If the thermostat operating range does not agree with this, replace it.

Radiator

A leaky radiator shall be soldered. If the leak is somewhere in the cellular system, the radiator must be dismantled and tested to establish the correct location of the leak. Do not solder haphazardly.

The radiator is tested by connecting a compressed air hose to one radiator pipe and sealing off the other. Use a reducing valve to take the pressure down to max 3 lb./sq.in. = 0.2 kg/cm^2. Submerge the radiator in water and trace air bubbles issuing from it.

Removing radiator

Disconnect the radiator blind wire, and drain off the cooling water from the engine. If the water contains antifreeze, collect water in a clean vessel. After disconnecting upper and lower radiator hoses and removing screws on either side of radiator, lift off radiator.

Stopped radiator

Blockage can be avoided by using clean water (preferably rain water) with rust inhibitor added.

If it is suspected that the radiator may be wholly or partially blocked, check by feeling the front of the radiator while the engine is running. If part of the radiator front feels cold although the engine water is excessively hot, the radiator must be partly blocked. It is often rather difficult to clean out a stopped radiator perfectly. Dissolve approx. 9 oz. of soda in 5 US quarts of hot water (250 grams in 5 liters), fill solution in radiator and top up with water. Cleaners are also available commercially. If caustic soda is used, take about half amount in same quantity of water. Let this solution remain in engine for about 4 hours running, then drain cooling system and flush through carefully with water, preferably against the normal direction of circulation, engine and radiator separately with thermostat removed.

If necessary, repeat this cleaning procedure once more. If without result, have radiator cleaned by specialist, or replace it.

Antifreeze

To prevent freezing of the engine during cold weather, antifreeze is added to the cooling water.

Ethylene glycol is an effective antifreeze agent which raises the boiling point of water above 212° F = 100° C. Ethylene glycol is not volatile.

Denaturised spirit is sometimes used but has the disadvantage of vaporizing even at normal temperature, making a regular check necessary. Moreover, if spilled onto body parts, the spirit damages the paint.

Before adding antifreeze:

1. Flush out cooling system carefully.
2. Check radiator for leaks, and inspect all rubber hoses, not forgetting the hot water heating system.
3. Tighten the cylinder head nuts, check all hoses and gaskets for leaks, replace collars and gaskets which do not seal properly, and also check radiator filler cap gasket.
4. Check that thermostat is in good order.

The amount of antifreeze to be added to the cooling system is determined from the tables in Part 13.

After draining antifreeze in spring, flush out cooling system carefully in a reverse direction.

REASSEMBLING ENGINE

When reassembling engine, use a suitable stand or dolly to support the cylinder block. The order of assembly is the reverse of that used when disassembling, see page 8.

It is very important that all parts are carefully cleaned before assembling, and oiled or greased where suitable. All gaskets, packings, and other sealing parts must be installed with care. The table in the specifications gives the torque values to be used for various bolts and nuts.

Pack in the flywheel ball bearing with heat-resistant grease before fitting. Use tool SVO 1426 to drive in bearing. Secure flywheel nuts with new washers.

Clutch, flywheel, and crankshaft are balanced together as a unit, and are marked with paint. Take care that they are mounted in their correct positions according to the markings.

Use tool SVO 1356 A to install crankshaft gear and camshaft gear. Hammer in the sealing laths at the rear main bearing, and cut off flush with engine block.

Make sure that the generator tensioner is clean and free from paint on the contact surfaces to ensure good grounding.

Use only new gaskets and seals when reassembling engine.

The timing gear casing must be perfectly centered in order to seal effectively. This is achieved by using pilot tool SVO 1427 A, Fig. 80.

It is of the utmost importance that the cylinder head nuts are pulled in the prescribed order, as the head may otherwise warp or crack. The proper torquing order of the nuts is shown in Fig. 82. Always use a calibrated torque wrench.

FITTING ENGINE IN VEHICLE

To fit engine in vehicle, proceed in reverse order to removal procedure. Take care not to damage engine, cables, or paint. Attach securely to engine supports, but not too tight. Secure nuts with new cotters.

RUNNING-IN

A reconditioned engine or on which new pistons, piston rings, main bearings or connecting rod bearings have been fitted must always be operated with great care during the first time of operation so that the new parts wear in correctly.

This running-in is preferably made in a test stand, if available.

Check that oil and water have been filled.

The oil pressure gauge should show a reading immediately after the engine starts.

If not, stop the engine and remedy the fault. The normal oil pressure is 36—50 lb./sq.in. (2.5—3.5 kg/cm^2).

If everything seems in order, let engine fast idle for a few hours, then load engine and raise the speed to about 1000 r.p.m. The total running time in the test stand should be some 3 hours. Drain and fill new oil at the end of the running-in period. If no test stand is available, running-in will have to be carried out with engine installed in the vehicle. Fill oil and water, start engine and observe oil pressure as above. Let engine fast idle for a few hours.

Check oil pressure and cooling water temperature at intervals. Look out for possible leakage of oil or water and, listen for abnormal noises.

Before loading engine and increasing speed, re-tighten cylinder head nuts and adjust valve lash. Use tool SVO 2264, with extension bar and torque wrench, in order to avoid dismantling the rocker arm shaft. If the extension bar is so long that it penetrates through the tool and touches the cylinder head, shorten it by grinding. See specifications for tightening torques.

Change oil after running-in.

The fan belt should be tensioned so that the pulley begins to slip when a pull of 12—14½ lb. (5.5—6.5 kg) is applied 6″ (150 mm) from the hub center. See Fig. 84.

The running-in of the engine is not finally completed until the precautions detailed in the Instruction Book for the vehicle have been observed.

FAULT TRACING

Before having a look through the engine, or attempting to dismantle it, always remember the following points:

When complaints are made about excessive fuel or oil consumption or lack of power, the first course is to find out under what conditions the vehicle is operated.

Question the driver about the nature of operation and about his manner of driving.

Also ask him to take you for a short run and observe his driving habits.

Rapid acceleration, racing the engine, high idling speed setting, and high cruising speeds all produce high fuel and oil consumption.

High oil consumption may be effect of an too high an oil level.

The oil need not be replenished until the level has fallen to, or slightly above, the lower mark on the dipstick. It must never be allowed to drop below this mark.

Various instruments can be used for fault tracing and the instructions for use with each individual instrument should be carefully followed.

FAULT TRACING

POSSIBLE CAUSE	CORRECTION
Engine will not start	
No fuel in carburetor	
No fuel in tank.	Fill fuel.
Fuel pump diaphragm faulty.	Replace diaphragm.
Leaking fuel pump valve.	Replace defective valve.
Fuel filter clogged.	Dismantle and clean.
Leaking filter gasket.	Replace defective gasket.
Fuel line clogged, or leaky.	Flush out, trace and repair leak.
Fuel tank vent hole stopped.	Remove filler cap and clean.
Ignition system	
Spark plugs fouled.	Clean plugs, adjust gap, and test or replace plugs.
Distributor defective, breaker point gap too large.	Inspect distributor for cracks, adjust breaker gap.
Battery run down.	Check acid density and recharge if below 1.230.
Condenser defective.	Test and replace if necessary.
Ignition coil defective.	Test and replace if necessary.
Damaged suppressor on spark plug.	Replace.
Carburetor	
Fuel inlet valve or jets clogged.	Dismantle and clean carburetor.
Defective gaskets.	Replace with new gaskets.
Air cleaner clogged.	Clean it.
Jets not fully lowered (SU).	Adjust control attachments.

Low compression

Cylinders, pistons or piston rings worn.	Check compression pressure in all cylinders.
Valves sticky.	Measure compression in all cylinders.
Cylinder head gasket defective.	Replace gasket.

Hard starting

Carburetor

Improper fuel level in float bowl.	Verify cause, and effect adjustments.
Clogged jets or passages.	Dismantle and clean carburetor.

Oil

Thick or dirty oil.	Change oil.

Engine will not idle

Carburetor

Improper fuel level in float bowl.	Leakage at vacuum line fitting.
Flooding.	Verify cause, and effect corrections to level and valve.
Defective gasket between carburetor and intake manifold.	Replace gasket.
	Trace leak and repair, tighten fitting.

Hard starting (cold)

Rapid idling faultily adjusted.	Check setting, see "Adjusting rapid idling"
Jets not fully lowered (SU).	Adjust control attachments.

Excessive fuel consumption

Leakage

Damaged fuel tank.	Check for leaks, and repair.
Damaged fuel line.	Replace damaged part.
Leaky nipples and fittings.	Tighten or replace defective part.

Ignition system

Defective ignition timing.	Adjust ignition timing.
Defective distributor.	Test and adjust.
Defective ignition coil.	Test and replace if irreparable.
Defective condenser.	Test and replace if necessary.

Carburetor

Mixture too rich.	Adjust settings. See below under "Fuel system".
Air cleaner clogged.	Clean thoroughly.
Faulty jet washers (SU).	Replace washers.

Excessive oil consumption

Leakage

Leaky oil pan gasket.	Replace gasket.
Leaky gasket between fuel pump and cylinder block.	Replace gasket.
Damaged oilslinger or felt washer in timing gear casing.	Replace damaged parts.
Defective sealing at rear main bearing.	Replace felt seal.
Leakage at rocker cover.	Check mounting of rocker cover.
Defective gasket on oil cleaner.	Replace gasket after checking.

Cylinders, pistons, piston rings

Worn cylinders, pistons, or piston rings.	Check compression pressure in all cylinders; see "Compression Test".
Gummed or broken piston pins.	Replace.
Worn valve guides.	Replace.

Low oil pressure

Oil pressure gauge

Pressure gauge damaged.	Test gauge, replace faulty gauge.
Clogged oil line to gauge.	Clean, replace if damaged.

Relief valve

Plunger stuck in open position.	Dismantle valve and replace plunger.
Broken or weak spring.	Replace spring.
Plunger worn.	Replace with new plunger.

Oil strainer and pipe

Strainer clogged up.	Clean.
Leak in output pipe.	Examine.

Oil pump

Worn gears.	Replace pump.

Main and connecting rod bearings

Bearings damaged or worn.	Replace bearings. If crankshaft damaged, regrind journals.
Bearings much worn.	Regrind crankshaft and install undersize bearings.

Oil cleaner

Element blocked.	Fit new element.
Faulty bypass valve in cleaner.	Replace valve.

Engine does not deliver full power

Low compression

Worn cylinders, pistons, piston pins.	Check compression in all cylinders.
Valves sticking.	Grind valves.

Fuel tank, lines, and pump

Improper fuel.	Drain tank and clean.
Leaking valves in fuel pump.	Replace valves.
Filter clogged.	Dismantle and clean filter.

Carburetor

Air cleaner stopped.	Dismantle filter and flush clean.
Jet clogged.	Clean jets.
Carburetor adjustment disturbed.	Clean and adjust carburetor.
Carburetors not correctly set relative to each other (SU).	Adjust settings. See "Idling settings and the coupling together of the carburetors".

Engine overheats

Coolant

Too little water in cooling system.	Add water.

Water pump and thermostat

Fan belt slips.	Tighten belt.
Pump impeller damaged.	Replace impeller.
Thermostat defective.	Replace thermostat.

Radiator, coolant hoses and passages

Radiator stopped.	Clean.
Hoses or passages stopped by dirt and sludge.	See under "Stopped radiator".
Water distributor pipe clogged.	Dismantle and clean pipe.

Ignition timing and carburetion

Wrong ignition timing.	Adjust ignition timing.
Too lean fuel mixture.	Clean and adjust carburetor.

Engine misses

Fuel tank, lines, and pump

Improper fuel, or water in fuel.	Drain tank, flush out, and fill new fuel.
Fuel line partly obstructed.	Examine and flush.
Fuel pump defective.	Verify cause and replace damaged part.

Distributor

Wrong breaker gap.	Measure and adjust gap.
Poor contact in coil terminal.	Examine and adjust.
Loose contact in primary circuit.	Examine and adjust.
Open or short-circuit in primary circuit.	Trace fault and effect corrections.
Defective ignition cables.	Clean connections. Replace cables if insulation poor.
Faulty contact breaker gap.	Check and adjust.

Carburetor floods or leaks

Float system

Too high fuel level in float bowl.	Verify cause, adjust level.
Fuel inlet valve clogged.	Clean valve and seat.
Valve or valve seat worn.	Replace damaged parts.
Float damaged.	Repair float.
Fuel pump pressure too high.	Check pressure.
Fuel line leakage at fitting.	Replace defective line or fitting.

Engine will not idle or is hard to start

Damping plungers (SU)

Damping plungers binding.	Check movement of plungers with pin at air intake. Remove and clean plungers if necessary. Lubricate spindle. See "Suction chamber with piston and fuel needle".

Jet and controls (SU)

Badly centralized jet prevents needle movement.	Centralize jet, see page 18.
Cold starting jet does not lower jet completely.	Adjust controls and attachement of cable to carburetor levers.

Uneven acceleration

Damping device and settings (SU)

No oil in carburetor damping devices resulting in excessively lean fuel/air mixture when accelerator pedal quickly depressed.	Poor synchronisation of carburetors. Top-up with oil (SAE 10 W). See "Carburetors".
Excessively lean fuel/air mixture.	Adjust jet height. See "Idling settings and the coupling together of the carburetors". Check fuel needle position. See "Replacement of fuel needle". Couple carburetors together so that the flow through both is identical during idling. See "Idling settings and the coupling together of the carburetors".

Excessive fuel consumption

Settings (SU)

Fuel needle faultily attached.	Adjust attachment. See "Replacement of fuel needle" on page 17. Adjust jet height. See "Idling settings and the coupling together of the carburetors" on page 18.

Leakage from lower part of jets (SU)

Jet seals damaged.	Fit new seals.

Cold starting device operates stiffly

Jets (SU) Binding jet	Lower jet by pulling out choke button and lubricate the exposed part.

SPECIFICATIONS

GENERAL

Type designation:	B 16 B
Output, B.H.P./r.p.m.	85/5500
Max. Torque: lb.ft./r.p.m.	86.8/3500
kgm/r.p.m.	12/3500
Number of cylinders	4
Bore: in.	3.125
mm.	79.37
Stroke: in.	3.15
mm.	80
Displacement: cu.in.	96.4
liters	1.58
Compression ratio	8.2:1
Compression pressure at 200 r.p.m.,	
lb/sq.in.	10—11
kg/cm²	142—156
Weight, including clutch, carburetor, starter motor and generator: lb	330
kg	150

CYLINDER BLOCK

Material	Special-alloy cast-iron
The cylinder bores are drilled directly in the block	
Bore, standard	3.125″ (79.37 mm)
Bore, 0.010″ oversize	3.135″ (79.62 mm)
0.020″ „	3.145″ (79.88 mm)
0.030″ „	3.155″ (80.13 mm)
0.040″ „	3.165″ (80.39 mm)
0.050″ „	3.175″ (80.64 mm)

PISTONS

Material	Light-alloy
Weight	14.46 ± 0.18 oz. (410 ± 5 grams)
Permissible weight difference between pistons in same engine	0.35 oz. (10 grams)
Total height	3.390″ (86 mm)
Height from piston pin center to piston top	1.81″ (46 mm)
Piston clearance	0.0012″—0.0020″ (0.03—0.05 mm)
Diameter, measured at right angles to piston pin at lower edge, standard	3.1230″ (79.33 mm)
0.010″ oversize	3.1328″ (79.58 mm)
0.020″ oversize	3.1431″ (79.84 mm)
0.030″ oversize	3.1535″ (80.09 mm)
0.040″ oversize	3.1638″ (80.35 mm)
0.050″ oversize	3.1736″ (80.60 mm)

PISTON RINGS

Upper side marked "TOP".

Piston ring oversizes	0.01″ 0.02″ 0.03″ 0.04″ 0.05″

Compression rings

Beveled on upper inner edge.

Number on each piston	2
Height upper ring (chromed)	0.078″ (1.97 mm)
lower ring	0.078″ (1.97 mm)
Ring gap width	0.010″—0.020″ (0.25—0.50 mm)
Ring clearance in groove	0.0027″—0.0031″ (0.068—0.079 mm)

Oil rings

Number on each piston	1
Height	0.186″ (4.73 mm)
Ring gap width	0.010″—0.020″ (0.25—0.50 mm)
Ring clearance in groove	0.0017″—0.0029″ (0.045—0.073 mm)

PISTON PINS

Fully floating. Circlips at both ends in position.

Fit in connecting rod (65° F = 18° C)	Close running fit
Fit in position (65° F = 18° C)	Slide fit
Diameter, standard	0.748″ (19 mm)
0.05 mm oversize	0.750″ (19.05 mm)
0.10 mm oversize	0.752″ (19.10 mm)
0.20 mm oversize	0.754″ (19.20 mm)

CYLINDER HEAD

Height measured from cylinder head contact surface to cylinder head nut flats	3.84″ (97.5 mm)

CRANKSHAFT

Replaceable bearing shells for main and connecting rod bearings	0.0004″—0.0040″ (0.01—0.10 mm)
Crankshaft end play	
Main bearings, radial play, flange bearing	0.0005″—0.0025″ (0.014—0.064 mm)
Main bearings, radial play, others	0.0020″—0.0039″ (0.051—0.100 mm)
Connecting rod bearings, radial play	0.0020″—0.0034″ (0.051—0.087 mm)

MAIN BEARINGS

Main bearing journals

Journal diameter, standard	2.1240″—2.1244″ (53.950—53.960 mm)
0.010″ undersize	2.1140″—2.1144″ (53.696—53.706 mm)
0.020″ undersize	2.1040″—2.1044″ (53.442—53.452 mm)
0.030″ undersize	2.0940″—2.0944″ (53.188—53.198 mm)
0.040″ undersize	2.0840″—2.0844″ (52.934—52.944 mm)
Journal width, flange bearing, standard	1.5329″—1.5344″ (38.935—38.975 mm)
0.1 mm oversize (for 0.010″ undersize shell)	1.5369″—1.5384″ (39.035—39.075 mm)
0.2 mm „ „ 0.020″ „ „	1.5407″—1.5423″ (39.135—39.175 mm)
0.3 mm „ „ 0.030″ „ „	1.5447″—1.5463″ (39.235—39.275 mm)
0.4 mm „ „ 0.040″ „ „	1.5486″—1.5502″ (39.335—39.375 mm)

Main bearing shells

Flange bearing shells

Thickness, standard	0.0752″—0.0755″ (1.911—1.918 mm)
0.010″ undersize	0.0802″—0.0805″ (2.038—2.045 mm)
0.020″ „	0.0852″—0.0855″ (2.165—2.172 mm)
0.030″ „	0.0902″—0.0905″ (2.292—2.299 mm)
0.040″ „	0.0952″—0.0955″ (2.419—2.426 mm)

Other main bearing shells

Thickness, standard	0.0746″—0.0748″ (1.894—1.900 mm)
0.010″ undersize	0.0796″—0.0798″ (2.021—2.027 mm)
0.020″ „	0.0845″—0.0848″ (2.148—2.154 mm)
0.030″ „	0.0895″—0.0898″ (2.275—2.281 mm)
0.040″ „	0.0946″—0.948″ (2.402—2.408 mm)

Connecting rod bearings

Connecting rod bearing journals

Bearing seat width	1.2953″—1.2992″ (32.900—33.00 mm)
Journal diameter, standard	1.8736″—1.8740″ (47.589—47.600 mm)
0.010″ undersize	1.8635″—1.8640″ (47.335—47.347 mm)
0.020″ ,,	1.8536″—1.8540″ (47.081—47.092 mm)
0.030″ ,,	1.8436″—1.8440″ (46.827—46.838 mm)
0.040″ ,,	1.8336″—1.8520″ (46.573—46.584 mm)

Connecting rod bearing shells

Thickness, standard	0.0615″—0.0617″ (1.562—1.568 mm)
0.010″ undersize	0.0665″—0.0667″ (1.689—1.695 mm)
0.020″ ,,	0.0715″—0.0717″ (1.816—1.822 mm)
0.030″ ,,	0.0765″—0.0767″ (1.943—1.949 mm)
0.040″ ,,	0.0815″—0.0817″ (2.070—2.076 mm)

Connecting rods

Marked 1—4 on side away from camshaft. Classified A—D showing weight classification. Only connecting rods with same weight classification may be used in the same engine. Axial play at crankshaft	0.0060″—0.0140″ (0.15—0.35 mm)
Length, center-center	5.905 ± 0.004″ (150 ± 0.1 mm)
Weight, Class A	20.39— 21.44 oz. (578—608 grams)
,, ,, B	21.44—22.50 oz. (608—638 grams)
,, ,, C	22.50—23.56 oz. (638—668 grams)
,, ,, D	23.56—24.62 oz. (668—698 grams)

FLYWHEEL

Permissible axial play	0.008″ (0.20 mm)
Ring gear (chamfer facing inwards)	116 teeth

Flywheel housing

Permissible axial play for rear surface	0.0016″ (0.08 mm)
Max. radial play for rear guide	0.0060″ (0.15 mm)

CAMSHAFT

Drive	Fiber gear on camshaft
Number of bearings	3
Forward bearing journal, diameter	1.8494″—1.8504″ (46.975—47.000 mm)
Center bearing journal, diameter	1.6919″—1.6929″ (42.975—43.000 mm)
Rear bearing journal, diameter	1.4557″—1.4567″ (36.975—37.000 mm)
Radial clearance	0.0010″—0.0029″ (0.025—0.075 mm)
Valve clearance for check of camshaft setting (cold engine)	0.045″ (1.15 mm)
Inlet valves should then open at	0° (T.D.C)

Camshaft bearings

Forward bearing, diameter	1.8514″—1.8524″ (47.025—47.050 mm)
Center bearing, diameter	1.6939″—1.6949″ (43.025—43.050 mm)
Rear bearing, diameter	1.4577″—1.4587″ (37.025—37.050 mm)

Timing gears

Crankshaft gear	20 teeth
Camshaft gear	40 teeth
Backlash	0.0004″—0.0016″ (0.01—0.04 mm)

VALVE SYSTEM

Valves

Inlet

Disk diameter	1.46″ (37 mm)
Stem diameter	0.3094″—0.3100″ (7.859—7.874 mm)
Valve seat angle	44,5°
Cylinder head seat angle	45°
Seat width in cylinder head	0.060″ (1.5 mm)

Exhaust

Disk resistant to ethyl fuel

Disk diameter	1.34″ (34 mm)
Stem diameter	0.3082″—0.3089″ (7.830—7.845 mm)
Valve seat angle	44,5°
Cylinder head seat angle	45°
Seat width in cylinder head	0.060″ (1.5 mm)

Valve clearances

Clearance, inlet, warm engine	0.020″ (0.50 mm)
Clearance, exhaust, warm engine	0.020″ (0.50 mm)

Valve guides

Length	2.44″ (62 mm)
Inner diameter	0.311″—0.312″ (7.905—7.920 mm)
Length above cylinder head upper surface	0.83″ (21 mm)
Clearance valve stem-valve guide, inlet valves	0.0012″—0.0024″ (0.031—0.061 mm)
Clearance valve stem-valve guide, exhaust valves	0.0024″—0.0035″ (0.060—0.090 mm)

Valve springs

Springs close-wound at one end. This end should be turned downwards

Length, unloaded	1.77″ (45 mm)
Length, in./loading, lb.	1.54/56 ± 4½
mm/loading, kg	39/25.5 ± 2
in./loading, lb.	1.20/145 ± 8
mm/loading, kg	30.5/66 ± 3.5

LUBRICATING SYSTEM

Oil capacity of crankcase	5¾ US pints = 4⅞ Imp. pints (2.75 liters)
Oil capacity, incl. oil cleaner	7½ US pints = 6¼ Imp. pints (3.5 liters)
Oil pressure, warm engine (200 r.p.m. = 30 m.p.h. (50 km.p.h.) in top gear)	36—50 lb./sq.in. (2.5—3.5 kg/cm²)
Lubricant	Engine oil (For Service MS)
viscosity, below 32° F (0° C)	SAE 10W
from 32° F (0° C) to 90° F (30° C)	SAE 20
above 90° F (30° C)	SAE 30

Oil pump

Type	Gear pump
Number of teeth	10
Axial clearance	0.0008″—0.004″ (0.020—0.10 mm)
Radial clearance	0″—0.004″ (0.00—0.10 mm)
Backlash	0.006″—0.010″ (0.15—0.25 mm)

Oil cleaner

Type	Fullflow
Make and designation	AC or Mann
Element, designation including gasket	AC 1531572 Mann H 10.18 +Di 105—02

Relief valve spring

Length unloaded	1.575″ ± 0.002″ (40 ± 0.5 mm)
Length loaded with 5½ ± ½ lb. (2.5 ± 0.2 kg)	1.340″ (34 mm)

FUEL SYSTEM

Fuel pump, make and type	AC diaphragm pump
Fuel pressure	Min. 2 lb./sq.in. (0.14 kg/cm²) Max. 3.5 lb./sq.in. (0.25 kg/cm²)
Capacity at idling speed	1 US pint/min. = ⅞ Imp. pint/min. (0.5 liters/min.)
Fuel gauge, type	Electric

Carburetors

Type	Horizontal
Make and designation	SU H4
Number of carburetors	2
Size (air intake diameter)	1½″ (38 mm)
Fuel control jet, designation	AUC 2112
Fuel needle, designation	GT
Float level gauge (placed between the float bowl cover and the yoke-formed part of the needle arm), diam.	7/16″ (11 mm)
Rapid idling, setting of rod in camshaped lever	Position 2
Idling speed	500—700 r.p.m.
Oil for damping cylinders	SAE 10

IGNITION SYSTEM

Order of firing	1-3-4-2
Ignition setting, basic, (93 octane Research Method)	4° before T.D.C.
Ignition setting, stroboscope setting 1500 engine r.p.m. with vacuum regulator disconnected	21° before T.D.C.
Spark plugs	Champion J 6 or similar (14 mm)
Spark plug gap	0.028″—0.032″ (0.7—0.8 mm)

Distributor

Make and designation	Bosch V JU 4 BR 20
Direction of rotation	Clockwise
Contact breaker gap	0.016″—0.020″ (0.4—0.5 mm)
Breaker arm tension	14—18 oz. (0.4—0.5 kg)
Dwell angle	50 ± 3°

COOLING SYSTEM

Type	Pressure
Filler cap valve opens at	3.2—4.2 lb./sq.in. (0.23—0.30 kg/cm²)
Thermostat marked	170
Starts to open at	167—172° F (75—78° C)
Fully open at	194° F (90° C)
Fan belt, designation	HC .380″×33″

WEAR TOLERANCES

Cylinders

Rebore when worn (if oil consumption abnormal)	0.010″ (0.25 mm)

Crankshaft

Maximum main bearing journal out-of-round	0.0020″ (0.05 mm)
Maximum connecting rod journal out-of-round	0.0028″ (0.07 mm)
Maximum crankshaft end play	0.0060″ (0.15 mm)

Valves

Maximum valve stem to valve guide clearance	0.0060″ (0.15 mm)
Maximum valve stem wear	0.0008″ (0.02 mm)
Minimum width of valve disk edge	0.04″ (1 mm)

Camshaft

Maximum out-of-round (with new bearings)	0.0030″ (0.075 mm)
Maximum bearing wear	0.0008″ (0.02 mm)

TIGHTENING TORQUES

	lb.ft.	*kgm.*
Cylinder head	50—60	7—8
Main bearings	60—70	8—10
Connecting rod bearings	30—35	4—5
Flywheel	17—20	2.3—2.7
Oil cleaner center bolt	15	2
Spark plugs, 14 mm	25	3.5

TOOLS

The following special tools are required when carrying out repair and service work on the engine and water pump.

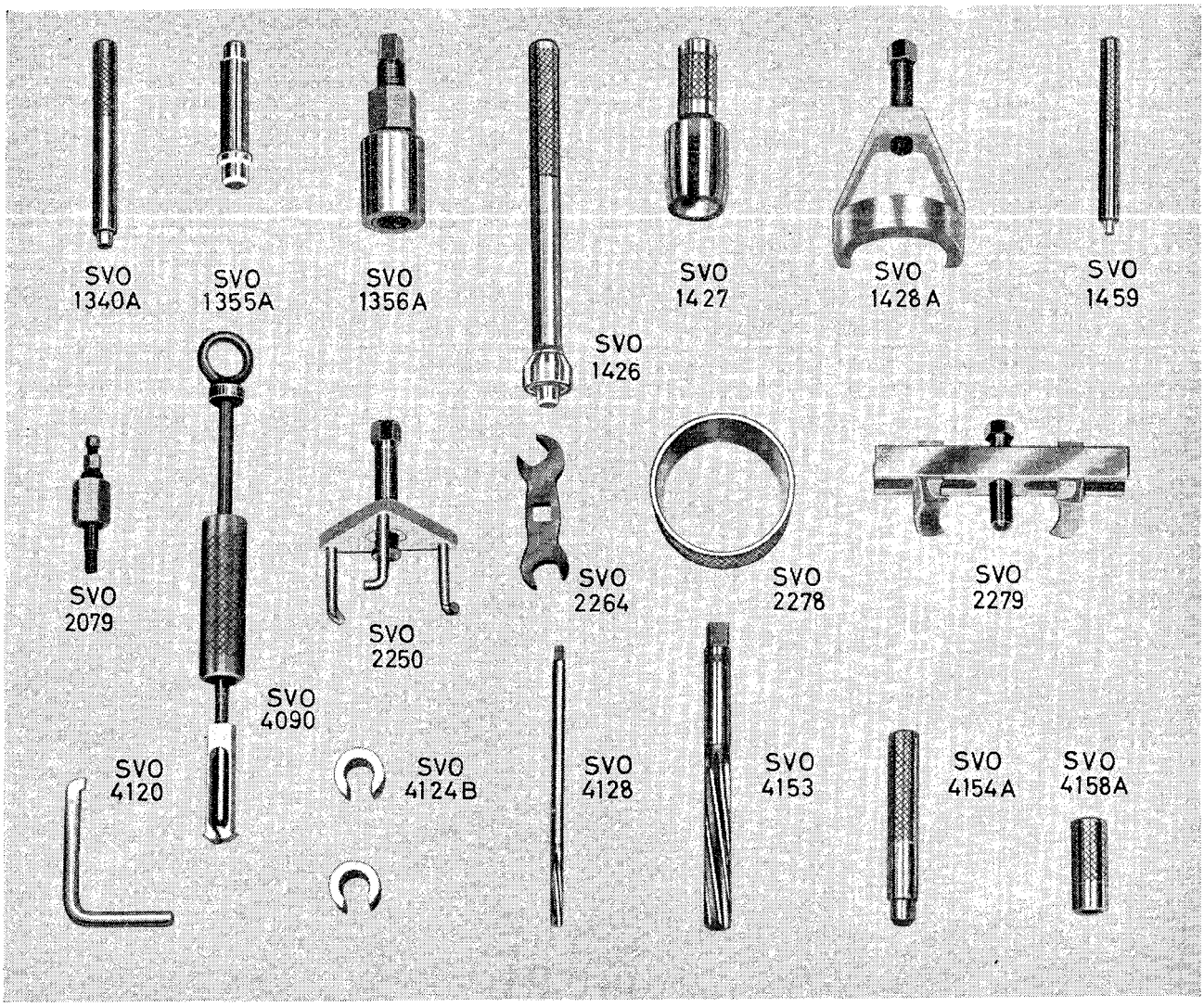


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Fig. 86. Special tools for engine.

SVO 1340 A Drift for removing and fitting piston pins

SVO 1355 A Drift for removing and fitting connecting rod bushings

SVO 1356 A Press tool for camshaft gear and crankshaft pulley

SVO 1426 Drift for fitting ball bearing in flywheel

SVO 1427 A Centering tool for timing gear casing and crankshaft gear

SVO 1428 A Puller for crankshaft gear

SVO 1459 Drift for removing valve guides

SVO 2079 Puller for oil relief valve plunger

SVO 2229 Installating ring for pistons, B 14 engines

SVO 2250 Puller for camshaft gear

SVO 2264 Wrench for tightening cylinder head nuts under rocker arm shaft

SVO 2278 Installation ring for pistons, B 16 engines

SVO 2279 Puller for crankshaft pulley and generator

SVO 4090 Puller for ball bearing in flywheel

SVO 4120 Puller for water distributor pipe

SVO 4124 B Spacer for engine supports (2)

SVO 4128 Valve guide reamer

SVO 4153 Reamer for rocker arm bushings

SVO 4154 A Drift for removing and fitting rocker arm bushings

SVO 4158 A Drift for fitting valve guides

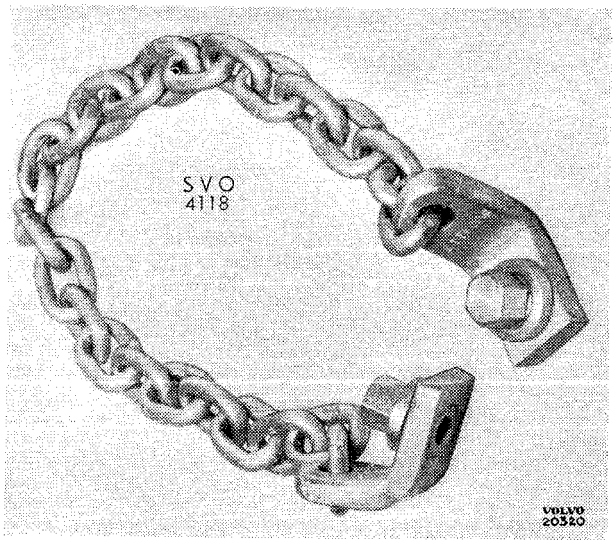


Fig. 87. SVO 4118 Lifting chain.

TOOLS FOR CARBURETORS

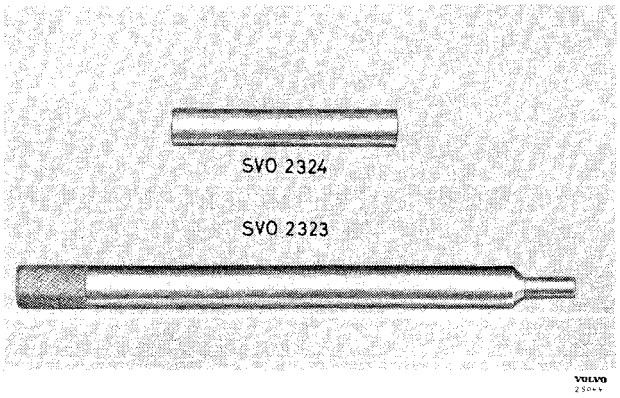


Fig. 87 a.

SVO 2323 Centering tool for upper jet sleeve.
SVO 2324 Gauge for float level.

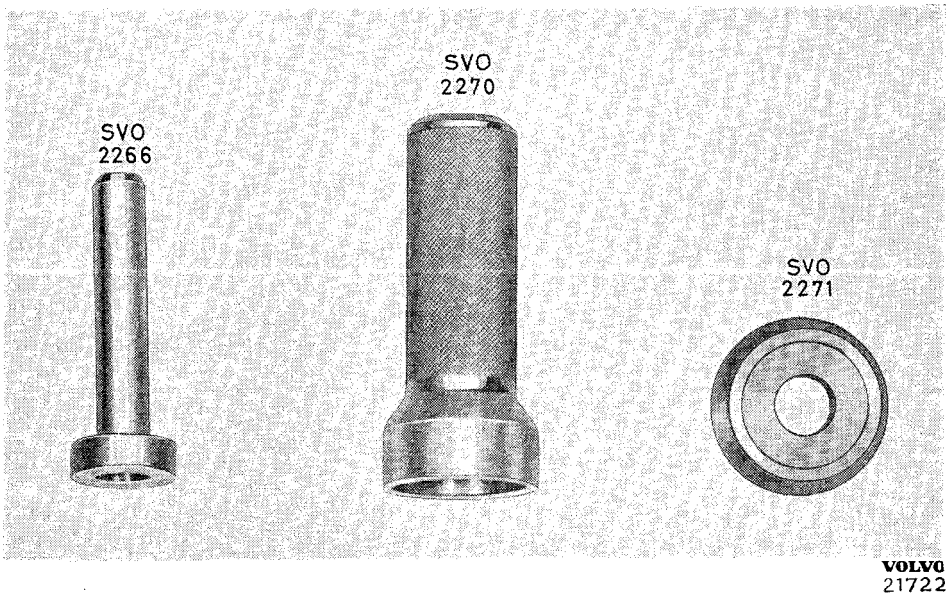
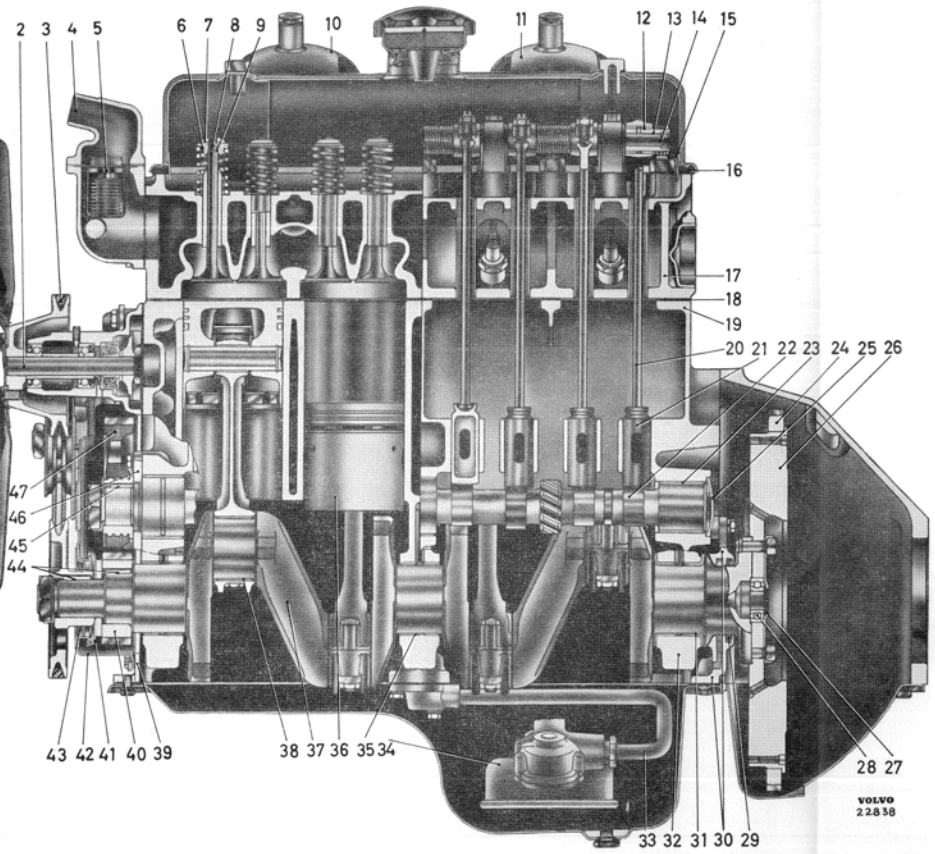
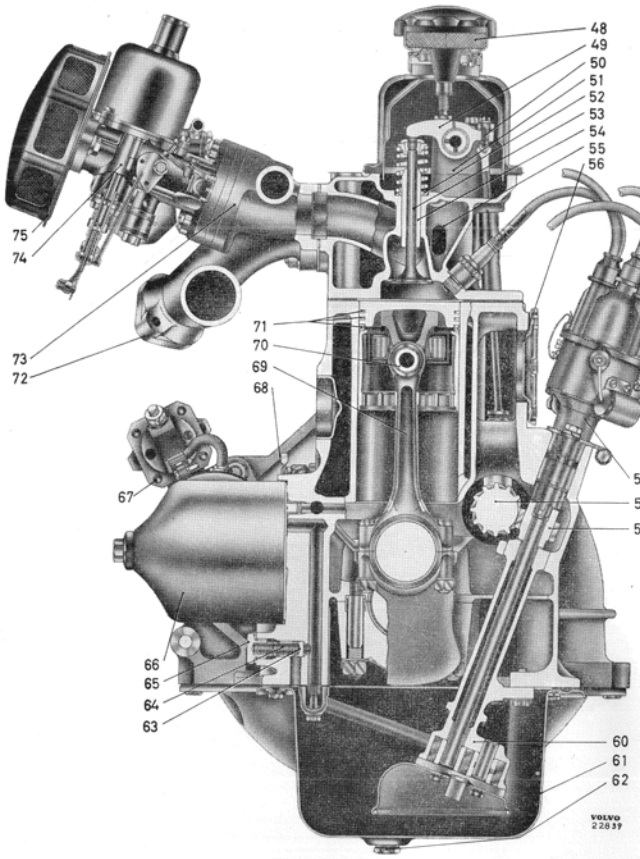


Fig. 88. Special tools for water pump.

SVO 2266	Drift for removing and fitting pump shaft and impeller
SVO 2270	Drift for fitting seal
SVO 2271	Ring for removing and fitting ball bearings.





LONGITUDINAL AND CROSS SECTIONS OF B 16 B ENGINE

1. Fan
2. Water pump
3. Fan belt
4. Thermostat housing, upper part
5. Thermostat
6. Valve spring seat
7. Rubber ring
8. **Valve**
9. Valve retainer
10. Forward carburetor
11. Rear carburetor
12. Bushing
13. Rocker arm shaft
14. Seal washer
15. Rocker cover
16. Gasket
17. Cylinder head
18. Cylinder head gasket
19. Cylinder block
20. Push rod
21. Valve lifter
22. Camshaft
23. Bushing
24. Ring gear
25. Seal washer
26. Flywheel
27. Retainer
28. Ball bearing
29. Felt seal
30. Sealing flangers, upper and lower
31. Main bearing shell (flange bearing)
32. Bearing cap
33. Oil pipe
34. Oil pump
35. Main bearing shell
36. Piston
37. Crankshaft
38. Connecting rod bearing shell
39. Seal plate
40. Crankshaft gear
41. Oil slinger ring
42. Timing gear casing
43. Felt seal
44. Key
45. Key
46. Guide flange
47. Camshaft gear
48. Filler cap (right-hand illustration)
49. Rocker arm
50. Setscrew
51. Bearing bracket
52. Valve spring
53. Valve
54. Valve guide
55. Water distribution pipe
56. Inspection cover
57. Distributor
58. Camshaft gear
59. Pump gear
60. Oil pump
61. Oil pan
62. Drain plug
63. Relief valve plunger
64. Relief valve spring
65. Nut and washer for relief valve
66. Oil cleaner
67. Starter motor solenoid
68. Water drain cock
69. Connecting rod
70. Piston pin
71. Piston rings
72. Exhaust manifold
73. Intake manifold
74. Carburetor (rear)
75. Air cleaner