SERVICE MANUAL

CARS AND VANS

PV 444—445

Part 1

ENGINE

B 4 B

Export Service Department

AKTIEBOLAGET

VOLVO

GÖTEBORG . SWEDEN

Table of Contents

(See also alphabetical index)

GENERAL DESCRIPTION

Introduction

The Volvo Model PV 444 and PV 445 cars are fitted with a 4-cylinder overhead valve engine designated B 4 B.

There are three versions of this engine; the respective part nos. and the chassis nos. when first mounted are listed below.

Engine part no.	First mounted in PV 444 chassis no.	First mounted in PV 445 chassis no.
495 300	1	1
495 301	12129	232
495 302	94155—94306 94345—94571 94607—	D, 3454 DS, 1109 DH, 5654 PH, 667

The second version differs from the first by virtue of a revised cam lobe design, and new valve springs, valves and rockers. The third version of the engine has a higher compression ratio, shorter push rods, yet another cam lobe

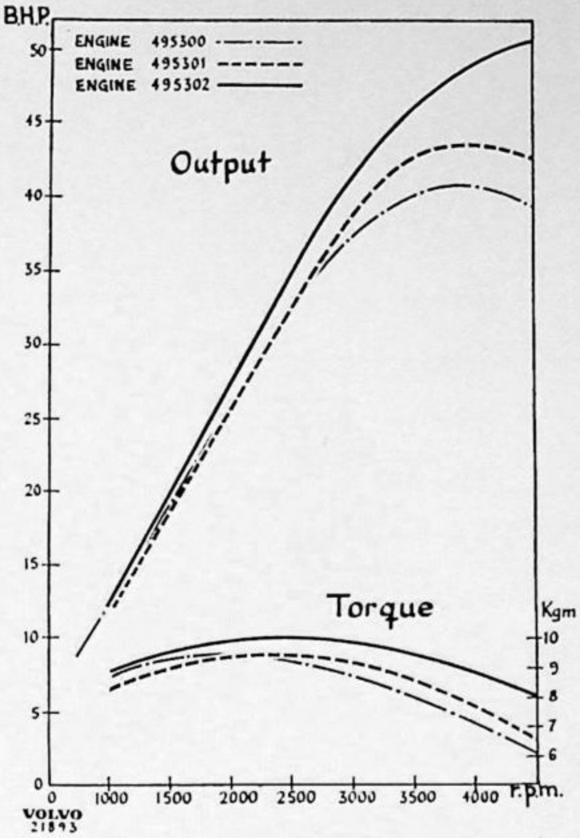

Fig. 1.

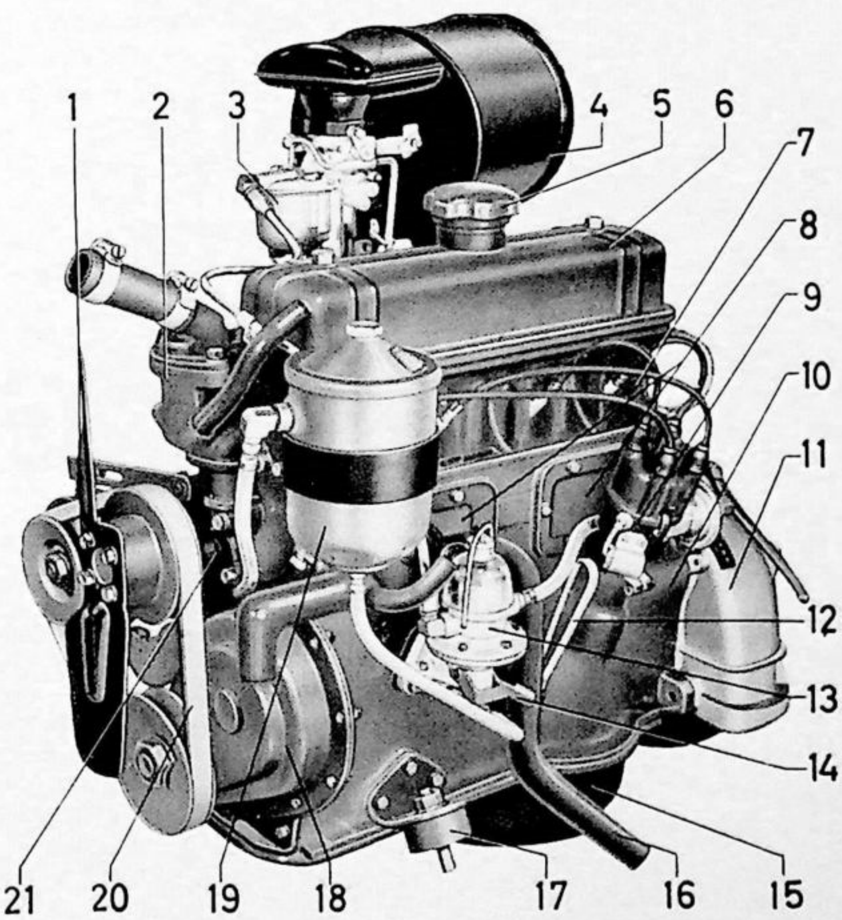

Fig. 2. Engine from the left.

1. Fan
2. Thermostat housing
3. Carburetor
4. Air cleaner
5. Oil filler cap
6. Rocker arm cover
7. Cylinder head
8. Inspection cover
9. Distributor
10. Cylinder block
11. Flywheel cover
12. Oil dipstick
13. Fuel pump
14. Pump hand lever
15. Oil pan
16. Crankcase breather
17. Engine support
18. Timing gear cover
19. Oil cleaner
20. Fan belt
21. Water pump

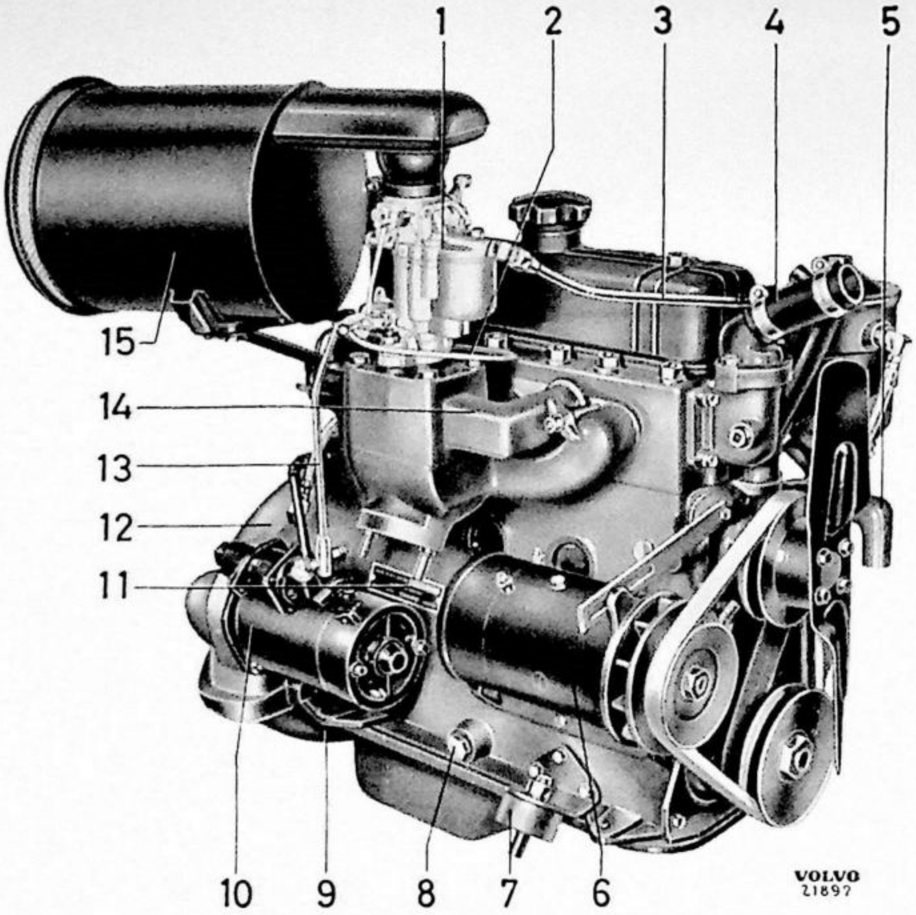

Fig. 3. Engine from the right.

1. Carburetor
2. Vacuum line
3. Fuel pipe
4. Coolant outlet housing
5. Coolant inlet housing
6. Generator
7. Engine support
8. Reducing valve
9. Protection plate
10. Starter motor
11. Serial number plate
12. Flywheel cover
13. Throttle linkage
14. Intake manifold
15. Air cleaner

design, new valve springs, and lacks the heat control valve in the intake manifold hot-spot chamber.

The part no. is stamped on the same plate as the engine no., which is placed on the right side of the engine above the starter motor. Output power and torque diagrams are given in Fig. 1; Figs. 2 and 3 show left and right front views of the engine, and Plate I contains transverse and longitudinal sections through the engine.

The engine bore is 75 mm = 2.953 inches and the piston stroke, 80 mm = 3.15 inches, corresponding to a total piston displacement of 1.414 liters = 86.28 cubic inches. The compression ratio is 6.5: 1 for engines nos 495300 and 495301, and 7.3: 1 for no. 495302.

Cylinder Block

The special cast-iron cylinder block is cast integral with the upper crankcase, with the cylinders bored direct in the block without liners. The cooling jackets run the entire length of the cylinder walls and also surround the combustion chambers, thus providing efficient and evenly distributed cooling.

Crankshaft

The crankshaft is of forged steel with precision ground main and rod bearing journals, is statically and dynamically balanced and is supported by three precision insert main bearings in the upper crankcase. The replaceable bearing inserts are available for service in standard and undersizes for use on journals that have been reground, so that no shaving, filing or line reaming will be necessary. The sealing of the crankshaft front end is ensured by an oil slinger and a felt washer. Rear end sealing is obtained by means of another oil slinger integral with the crankshaft which returns the oil to the crankcase, and a felt washer behind the oil slinger.

Main and Rod Bearings

The babbit-lined steel-backed bearing inserts are machined to correct diameter within very close limits. The rear main bearing has a babbitt lined collar to absorb the axial thrust which occurs when braking and accelerating, and when the clutch is disengaged.

Camshaft

The camshaft, in high-tensile steel, has case-hardened and carefully ground cams, and is supported in three insert type bearings. It is driven from the crankshaft by a 2: 1 helical gearing, with a steel pinion on the crankshaft and a fiber gear on the camshaft for long life and silent operation. The camshaft bearing diameters are stepped, with the largest bearing at the front end and the smallest at the rear end.

Besides controlling the opening and closing of the valves, the camshaft drives the oil pump and the ignition distributor via a 1: 1 spiral gearing placed between cylinders 3 and 4, and also carries an eccentric operating the fuel pump.

Pistons and Piston Rings

The aluminum alloy full-skirt pistons have a thin coating of tin to prevent seizing during the running-in period. The three cast-iron piston rings consist of two compression rings to seal against the compression and combustion pressures and prevent blowby, and one oil ring which scrapes off surplus oil thrown up onto the cylinder walls by the revolving crankshaft. The periphery of the oil ring is provided with slots corresponding with drain holes in the bottom of the ring groove through which the scraped-off oil returns to the crankcase

Connecting Rods

The forged steel, I-section, connecting rods give greatest strength and rigidity combined with low weight. They contain a bronze bushing at their upper ends for the installation of the piston pin, while the lower ends have selected fit bearing inserts like the main bearings. When scored or out-of-round crank pins are reground, undersize bearing inserts are mounted to give the proper bearing fit for the new journal diameter. Later versions of connecting rods are graded into weight classes.

Piston Pins

The piston pins, of low carbon steel, are surface hardened and ground to size. This leaves a very high-tensile core capable of taking the stresses inflicted on it by the high combustion pressures acting on the piston, and a very hard surface resisting abrasion. The pins are fully-floating, i.e. they can rotate both in the rod bushing and in the piston boss. Axial movement is prevented by means of retainer circlips in the piston bosses.

Valves

The valves, with disks of a material resisting ethyl fuels, are placed in insert type valve guides in the cylinder head. They are controlled from the camshaft by means of tappets, push rods, and rocker arms, the latter mounted on a tubular rocker arm shaft supported by four brackets on top of the cylinder head.

Lubricating system

The engine is provided with a pressure lubricating system. A gear pump (1, Fig. 5), draws oil from the oil pan in the lower crankcase through a strainer (2) which removes mechanical impurities before the oil enters the pump. The pump was formerly fitted with a floating strainer, i.e. the strainer was attached to a length of pipe

1. Spiral gear
2. Grooved pin
3. Bushing
4. Shaft
5. Bushing
6. Oil outlet fitting
7. Gasket (optional)
8. Screw
9. Driven gear
10. Driving gear
11. Pump cover
12. Cotter
13. Abutment for strainer
14. Inlet tube
15. Strainer

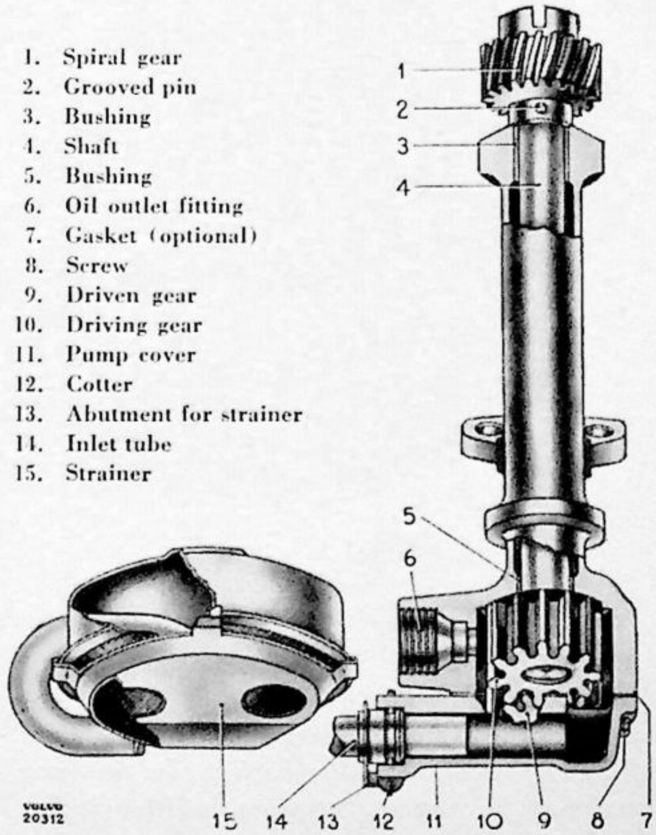

Fig. 4. Oil pump (earlier version). Later version has fixed strainer.

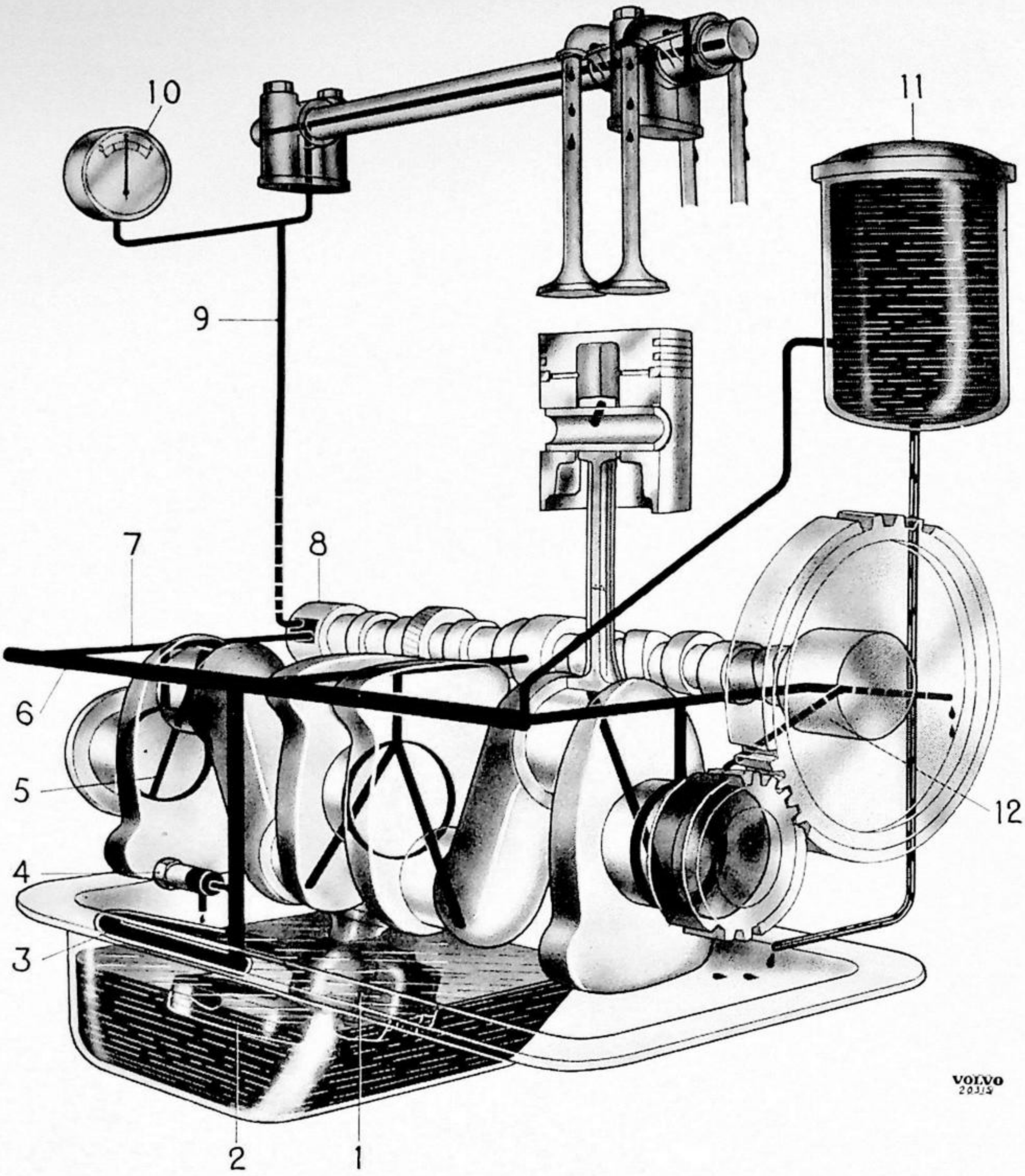

Fig. 5. Lubricating system.

hinged at the pump. This strainer will ride on the oil and draw oil from the surface. In the later version of the engine, the pump is fitted with a fixed strainer.

The pump forces the oil through oil line (3) to an oil gallery (6) running the full length of the cylinder block. From this gallery drilled passages (7) in the block branch off to the main and camshaft bearings (8). The oil pressed into the main bearings continues through drilled passages (5) in the crankshaft to the connecting-rod bearings. The piston pin is lubricated by oil scraped off the cylinder wall which enters the bushing through two holes drilled in the small end of the connecting rod.

A passage (9) from the rear camshaft bearing through the block, cylinder head, and rocker shaft support, supplies oil through the tubular rocker shaft to the rocker arm bushings. From the rocker shaft the oil returns to the crankcase through a cast passage in the cylinder head. The timing gears are lubricated from the front camshaft bearing by a sheet-metal spout. The front camshaft bearing also lubricates the axial guide washer. The oil is returned from the timing gear case to the crankcase by way of the front main bearing. Normal oil pressure is 1.5—2.5 kg/cm^2 =20—35 lb./sq.in. To provide against abnormal pressure rises, e.g. before the engine has warmed up after a cold start, a relief valve (4) has been incorporated with the oil system. It is placed immediately after the oil pump in the main oil supply line, and comprises a spring-loaded plunger which opens to by-pass part of the pumped oil back to the crankcase when the pressure exceeds the predetermined maximum value.

The lubrication of rockers and valve stems was formerly arranged as intermittent "shot" lubrication in the rocker arm shaft; in later engines the oil flow is continuous. In order to guard against oil penetrating through the valve guides into the cylinders, later valves have a groove containing a rubber ring. This revision is effective as from engine no. 22359.

Ignition system

Auto-Lite equipment was formerly installed, but has been replaced by Bosch. The two makes are otherwise equivalent.

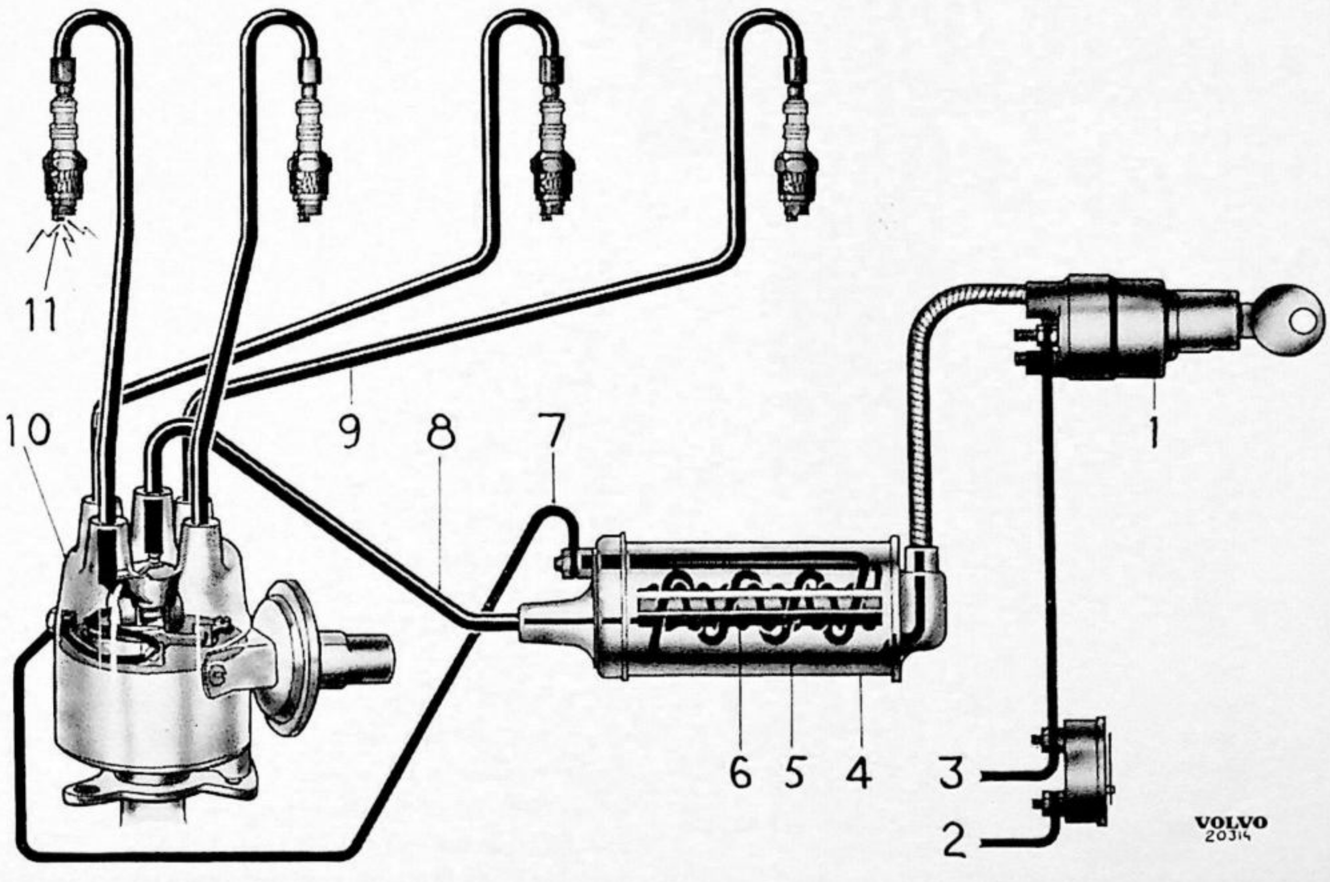

Fig. 6. Ignition system.

1. Ignition switch
2. From battery via solenoid
3. From generator via relay group
4. Ignition coil
5. Primary winding
6. Secondary winding
7. Low voltage cable
8. High voltage cable
9. Spark plug cable
10. Distributor
11. Spark plug

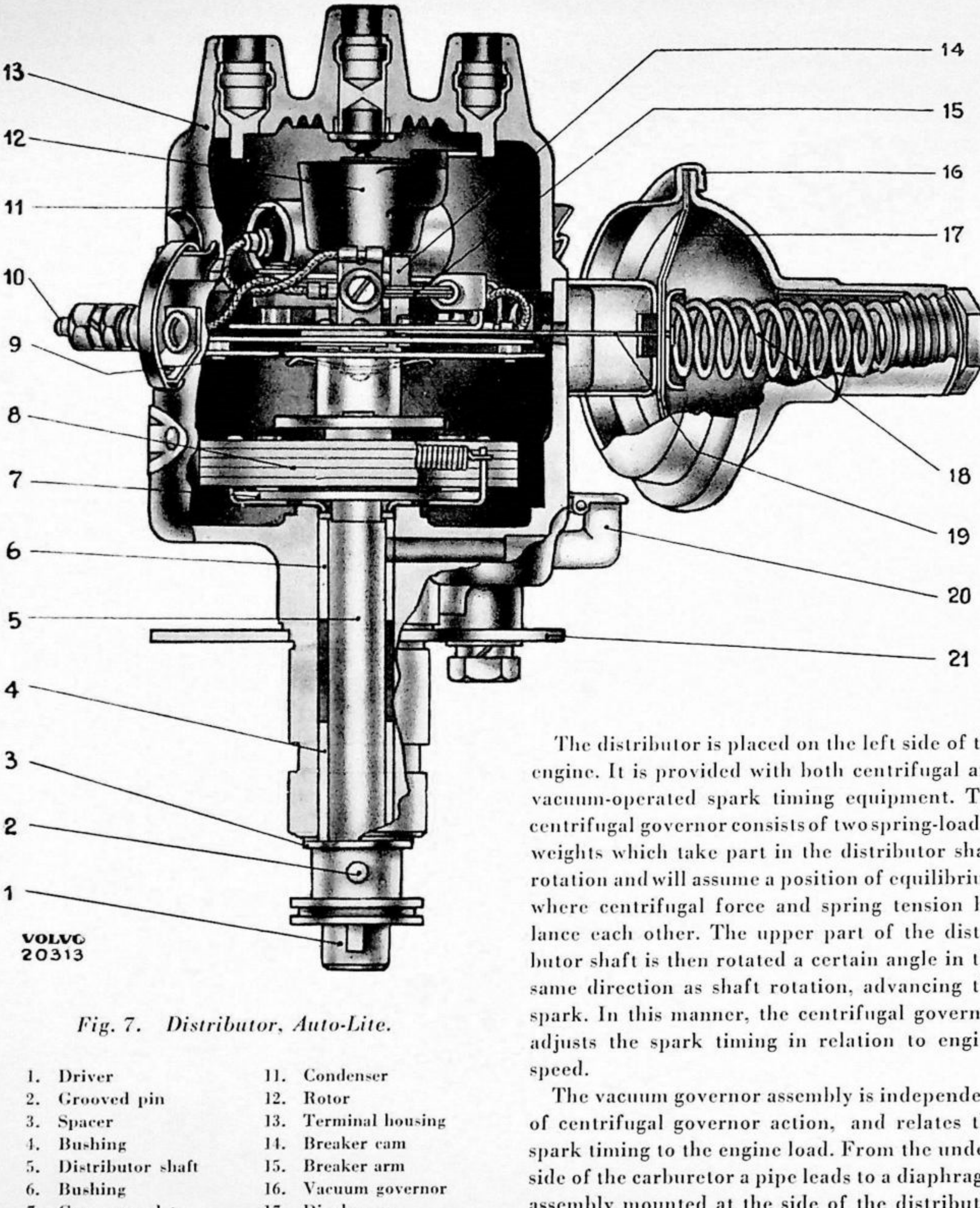

Fig. 7. Distributor, Auto-Lite.

1.	Driver	11.	Condenser
2.	Grooved pin	12.	Rotor
3.	Spacer	13.	Terminal housing
4.	Bushing	14.	Breaker cam
5.	Distributor shaft	15.	Breaker arm
6.	Bushing	16.	Vacuum governor
7.	Governor plate	17.	Diaphragm
8.	Governor weight	18.	Thrust spring
9.	Breaker plate	19.	Link
10.	Low voltage terminal	20.	Oiler
		21.	Mounting

The distributor is placed on the left side of the engine. It is provided with both centrifugal and vacuum-operated spark timing equipment. The centrifugal governor consists of two spring-loaded weights which take part in the distributor shaft rotation and will assume a position of equilibrium where centrifugal force and spring tension balance each other. The upper part of the distributor shaft is then rotated a certain angle in the same direction as shaft rotation, advancing the spark. In this manner, the centrifugal governor adjusts the spark timing in relation to engine speed.

The vacuum governor assembly is independent of centrifugal governor action, and relates the spark timing to the engine load. From the underside of the carburetor a pipe leads to a diaphragm assembly mounted at the side of the distributor housing. The diaphragm is mechanically linked with the breaker plate assembly which is free to rotate on the upper distributor shaft bushing. The position of the diaphragm and, consequently, that of the breaker plate, will be determined by the vacuum existing in the intake manifold which, in turn, varies with engine load. When the vacuum is high, i.e. at no load or light loads, the breaker plate is rotated in a direction opposed to distributor shaft rotation, advancing the spark. As the engine is loaded, the vacuum decreases, and the diaphragm and breaker plate are pulled back by a spring until at full load the spark is retarded to initial timing. The centrifugal and vacuum governors thus combine to give a correct spark timing suited to both engine speed and engine load.

NOTE: With the engine idling, the vacuum governor is inoperative as the throttle valve obstructs the port to the vacuum line.

Ignition coil

Like a transformer, the ignition coil (4, Fig. 6) has a primary winding (5) and a secondary winding (6). The primary which works at the battery voltage of 6 volts and has relatively few turns of heavy copper wire (approx. 1 mm diam.), is wound on top of, and well insulated from, the secondary winding which has a high number of turns of very fine wire (approx. 0.08 mm diam.).

The primary winding connects to the battery via the breaker assembly in the distributor housing. When the breaker points open the primary current, the magnetic field traversing the secondary coil undergoes a change which induces, across the terminals of the secondary winding, a voltage that is proportional to the number of turns in the winding. To produce a powerful speed across the spark-plug gaps, a very high voltage is required, which is the reason for the great number of turns in the secondary winding.

Fuel system

The engine was formerly fitted with a Carter carburetor, and later had a Zenith carburetor.

Carter Carburetor

The Carter carburetors mounted were of the two types W—O 618 S and W—O 618 SA which differ mainly in the method of mounting the main jet in the carburetor body. Different type jets must not be interchanged. The carburetor is equipped with an accelerator system and a manually operated choke valve.

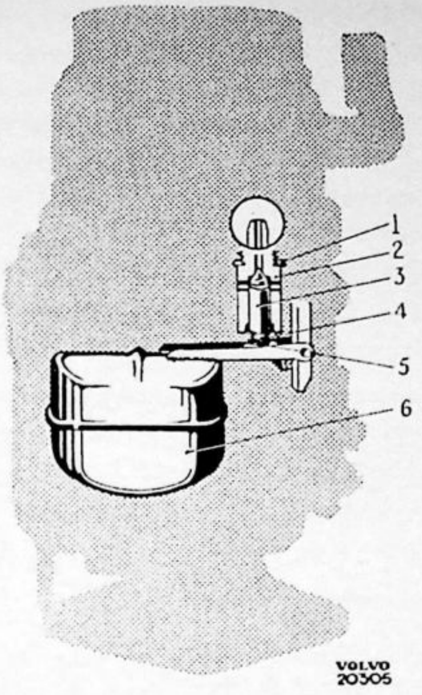

Fig. 8. Float assembly.

The various functions of the carburetor are preferably studied separately according to the five systems:

1. Fuel Inlet System.
2. Accelerator System.
3. Idle System.
4. High-Speed System.
5. Choke System.

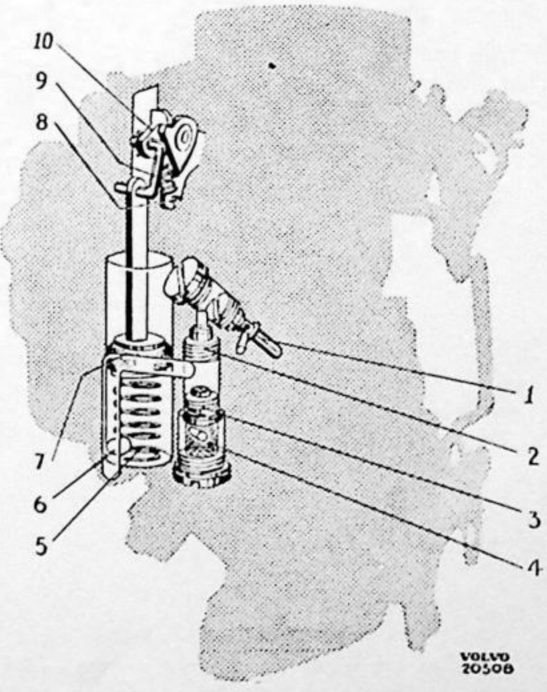

Fig. 9. Accelerator pump.

1. Fuel Inlet System

The purpose of the fuel inlet system, Fig. 8, is to establish a predetermined fuel level in the float bowl and to accurately maintain this level under all driving conditions so as to guarantee perfect operation of the engine and good fuel economy.

The fuel inlet system comprises the float bowl with cover, float and lever assembly (6), fuel inlet valve seat (2), and needle (3).

The amount of fuel that enters the float chamber is controlled by the fuel inlet valve. There are two types of needle valve; with and without spring loading.

2. Accelerator System

The accelerator system, Fig. 9, is mainly a pump mechanism comprising a pump plunger with rod, an inlet valve, an outlet valve, and an accelerator pump jet. The pump plunger is coupled with the shaft of the throttle valve by means of the throttle connector rod.

When the plunger moves upward, fuel is drawn in through strainer (4) and inlet valve (3) into the pump cylinder (6). When the accelerator pedal is pressed down, the plunger (7) moves downward, forcing the fuel out of the cylinder past the discharge check valve (2) and through pump jet (1) out into the carburetor throat.

In order to prevent fuel from being drawn in through the pump jet when the throttle is stationary, the pump jet is vented to the carburetor air horn. A spring (9) is placed between the pump control lever (10) and the connector rod (8) for the purpose of lengthening the fuel inlet time, if the pump movement is very rapid.

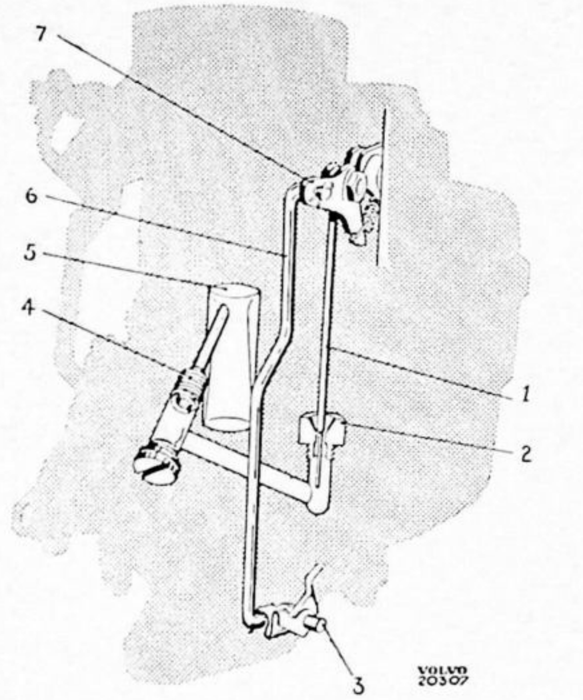

Fig. 11. High-speed system.

3. Idle System

The idle system, Fig. 10, meters the fuel quantities required during idling and early part throttle conditions.

The fuel supply is determined by the idle jet (4) in the carburetor.

The strong vacuum occurring under idling and low speed conditions, when the throttle is very nearly closed, gives rise to strong suction through the idle passage (3) and the idle air passages (5) and (6). Fuel is then drawn from the idle jet, is mixed with air and partially vaporized in the idle restriction on its way down the idle passage (3) to idle port (1) where the fuel-air mixture is discharged into the carburetor air stream.

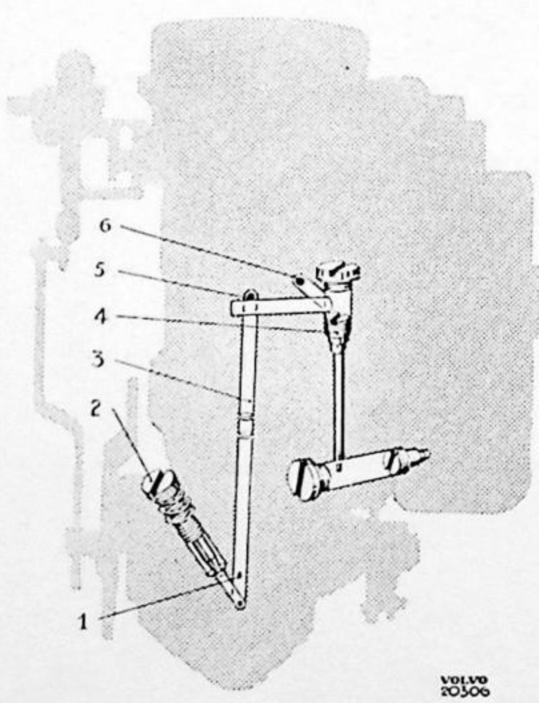

Fig. 10. Idle system.

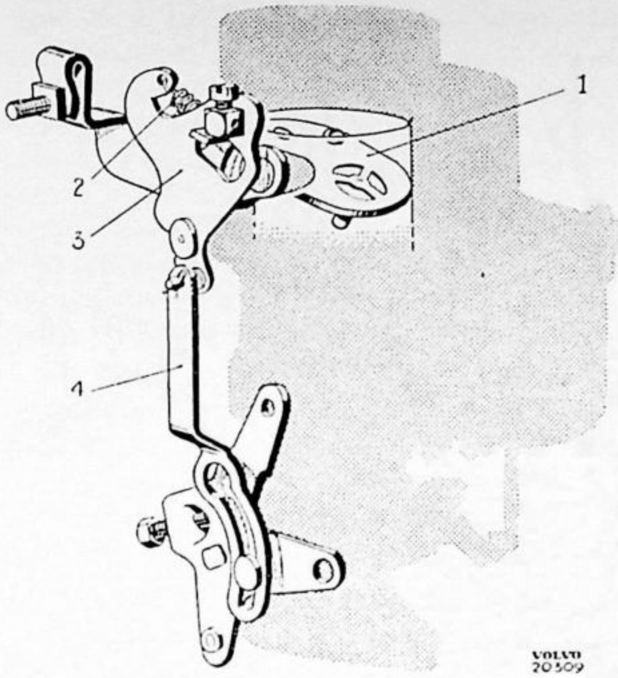

Fig. 12. Choke system.

The idle discharge port is a vertical slot type so located that the upper end is above the throttle plate at idle. As the throttle is opened further, a larger portion of the slot is exposed to the low pressure area and an increased quantity of fuel is discharged into the carburetor throat.

In order to obtain a suitable fuel-air ratio, an idle mixture adjusting screw (2) has been provided. It should be turned to a position where it ensures smooth and silent running and furthers a gradual transition to the high-speed system without flats or surging spots.

The idle speed is adjusted by means of a set-screw on the throttle shaft, and should not be less than 300 rpm.

4. High-Speed System

The high-speed system, Fig. 11, becomes operative at higher revs, and when the engine is loaded. The fuel is discharged into the air stream through the main nozzle (4) debouching in the venturi (5).

As the throttle is opened, the vacuum acting on the idle port decreases and fuel is therefore forced through metering rod jet (2) and the main well to the low pressure area at the end of the main jet (4) from where it is discharged into the air stream in the venturi.

The fuel flow is controlled by the metering rod (1) in the jet (2). The rod is operated by a connector rod (6) and lever (7) system from the throttle shaft (3).

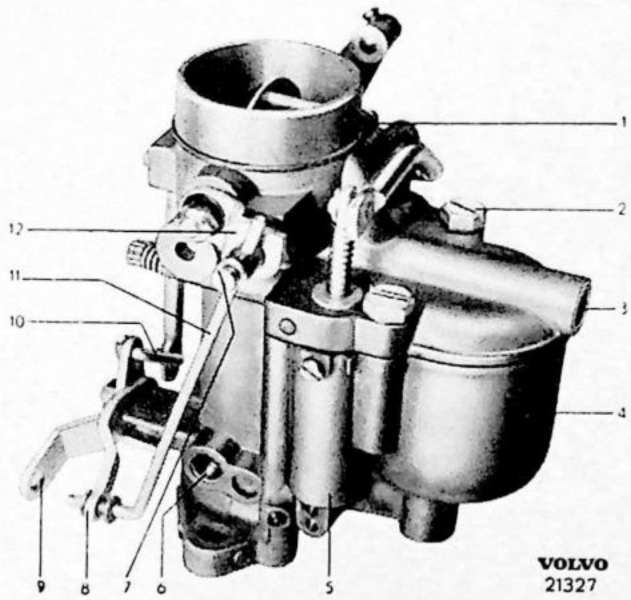

Fig. 13. Carburetor viewed from the right.

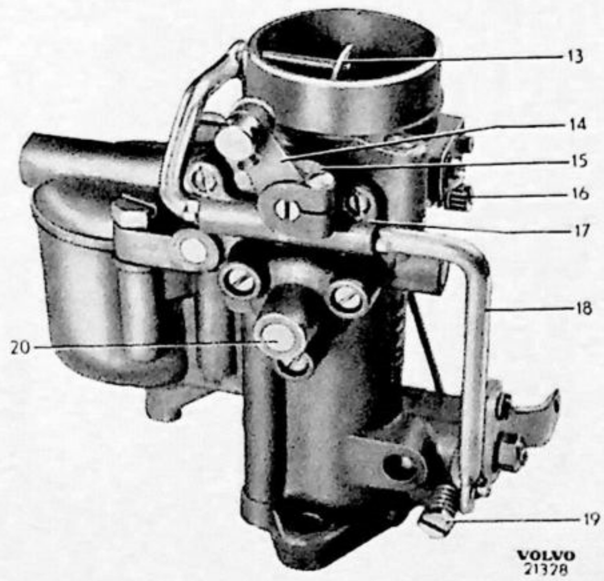

Fig. 14. Carburetor viewed from the left.

1. Carburetor body
3. Float bowl screw
3. Fuel inlet fitting
4. Float bowl
5. Accelerator pump
6. Vacuum pipe fitting
7. Lock screw
8. Throttle connector lever
9. Throttle lever
10. Link
11. Fast idle connector rod
12. Lever assembly
13. Choke plate
14. Choke plate lever
15. Choke plate retract spring
16. Idle mixture adjusting screw
17. Connector rod support
18. Accelerator pump connector rod
19. Idle speed adjusting screw
20. Compensating air valve

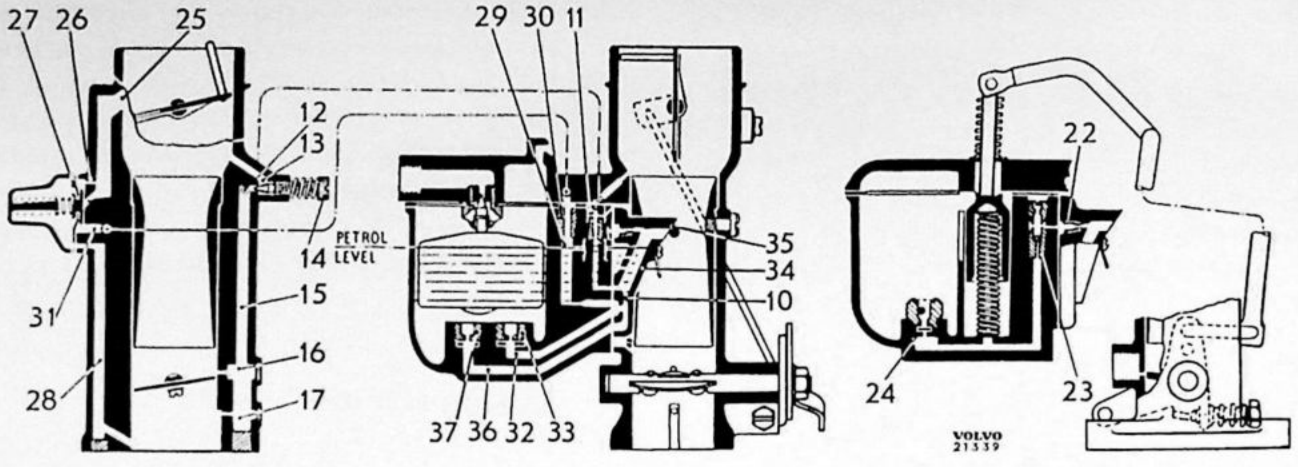

Fig. 15. Phantom view of carburetor.

5. Choke System

The choke system, Fig. 12, is used only when starting a cold engine and during initial warm-up. It consists of an air choke plate (1) located in the air horn which is controlled from the instrument panel by means of a Bowden cable attached to lever (3) provided with a pullback spring (2) and supplies the engine with a richer fuel-air mixture during starting.

When the choke plate is wholly or very nearly closed, the throttle plate is held slightly open by the linkage (4) to eliminate the risk that the engine splutters and dies during warm-up.

Zenith Carburetor

Zenith carburetors installed in PV 444—445 vehicles engines have the designations, 30 VIG—9/C 1412 (earlier version) and 30 VIG—9/C 1412 B (later version). Carburetor adjustment and certain parts in the latter are slightly changed as compared with the earlier version.

The Zenith carburetors differ from the Carter

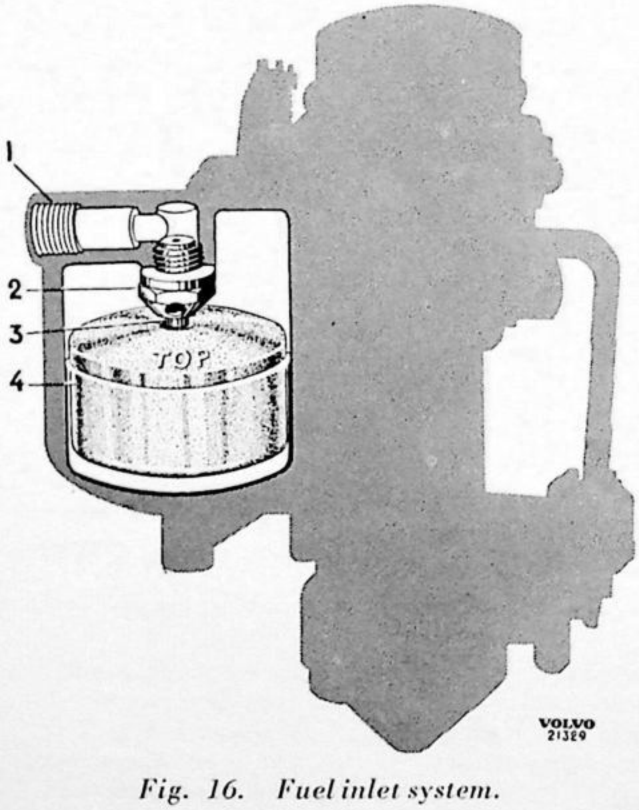

Fig. 16. Fuel inlet system.

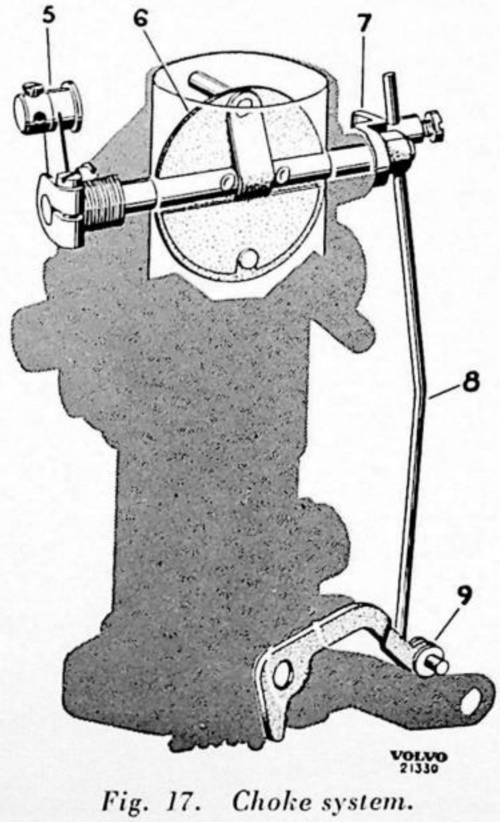

Fig. 17. Choke system.

carburetors described above mainly in that all fuel is metered by fixed jets and mixed with a regulated supply of air to richen or lean out the fuel-air mixture according to operating requirements. All jets are placed in the float housing and are accessible after the float bowl has been removed from the carburetor body. From the jets, passages lead to an emulsion block from where the fuel mixture is discharged through a pointed nozzle projecting into the carburetor throat.

The various carburetor functions are preferably discussed separately, i.e.

1. Fuel Inlet System
2. Choke System
3. Idle System
4. Accelerator System
5. Economiser valve System
6. Main jet System
7. Compensating jet System

1. Fuel Inlet System

The purpose of the fuel inlet system, Fig. 16, is to establish and maintain correct fuel level in the carburetor under all driving conditions. The fuel first passes through a strainer in inlet fitting (1) and from there down to fuel inlet valve (2). The float (4) is cylindrical and loosely placed in the float bowl; it acts direct on the valve needle (3).

The fuel level in the float bowl is determined by washers placed between the float valve and the float bowl cover.

2. Choke System

The choke system, Fig. 17, is used only when starting a cold engine and during initial warm-up. It consists of a choke plate (6) located in the carburetor air horn which is controlled from the instrument panel by means of a Bowden cable attached to lever (5) on the choke plate shaft. Its purpose is to supply the engine with a richer fuel-air mixture by restricting the air flow into the carburetor.

The choke system is combined with a fast idling arrangement consisting of connector rod (8) and levers (7) and (9) which link the choke plate and throttle plate shafts. When the choke valve is closed, the throttle plate is automatically opened a little, increasing engine breathing so that there is less risk of the engine dying during warm-up because of ice formation at the choke and throttle plates.

3. Idle System

The idle system is shown in Fig. 18. The strong vacuum produced in the carburetor throat below the nearly closed throttle valve causes a powerful suction through the idle passage (15). This passage communicates with the air passage (13) to the air horn by way of the idle air regulator screw (14), and with the fuel idle passage (10) via fuel passage (12) and idle jet (11). Because of the suction, fuel is drawn in through the idle

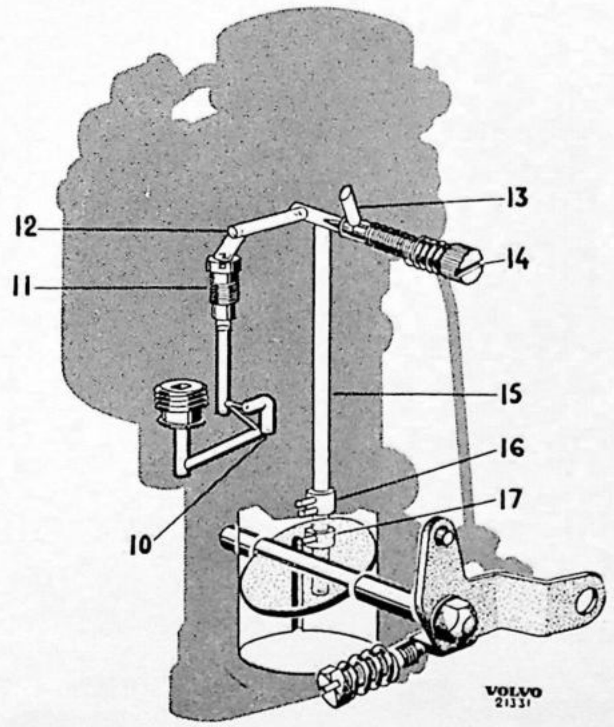

Fig. 18. Idle system.

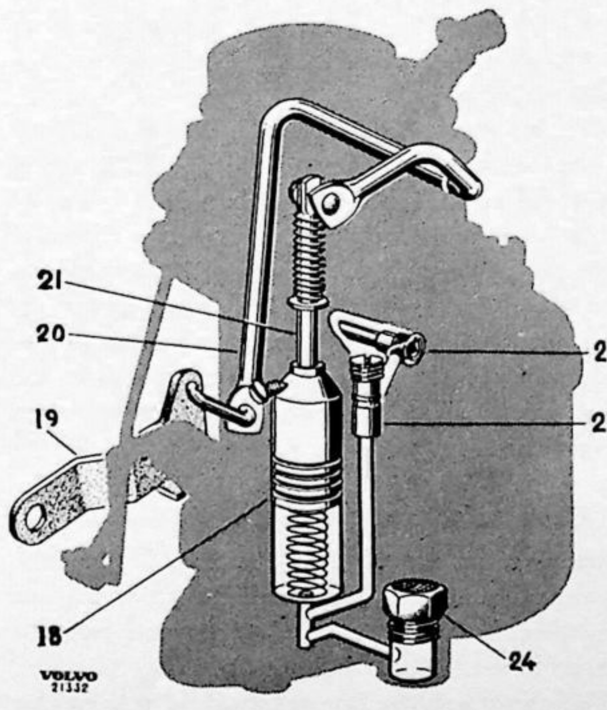

Fig. 19. Accelerator pump system.

jet, is mixed with air from the air passage, and moves on through the idle passage to discharge into the carburetor throat at the idle port (17). When the throttle valve is opened slightly, the vacuum acting on the idle port decreases, and less fuel mixture is discharged into the air stream through the carburetor. As a remedy, two supplementary transfer ports (16) are provided above the idle port, connecting with the idle passage. When the throttle is opened, the main suction shifts to the transfer ports which take over from the idle port the task of furnishing the carburetor air stream with sufficient fuel. Fuel is, consequently, discharged at all three ports.

The purpose of the air adjusting screws is to give a suitable fuel-air ratio that will allow the engine to run smoothly at idle and low speed settings.

4. Accelerator System

The accelerator pump (Fig. 19), features a plunger (18) with piston rod (21) which is operated from the throttle lever (19) by a connector rod (20). Fuel is drawn into the pump cylinder through inlet valve (24) during the upward movement of the plunger.

Depressing the accelerator pedal causes the plunger to travel downward, forcing the fuel contained in the pump cylinder out through a passage past ball check valve (23), the ball of which lifts and obstructs the upper opening; the fuel then passes the accelerator pump jet (22) and discharges through the emulsion block nozzle into the carburetor throat.

The inlet valve has a small hole which allows the fuel in the pump to return to the float bowl if the pump jet should be clogged up, and when the accelerator pedal is depressed slowly. Since a vacuum exists at the accelerator jet during normal operation, an air bleed is incorporated to counteract this vacuum, thereby preventing siphoning of fuel when the accelerator pump is not operating, the ball check valve (23) acting as air bleed valve.

5. Economiser valve System

The economiser valve system (Fig. 20) has the opposite function of the accelerator system, i.e. admitting extra air to the jets to lean out the mixture.

The vacuum in the intake manifold acts on the diaphragh (27) via the vacuum passage (28). The diaphragm carries a small disc which obstructs an air passage connecting with the compensating air chamber (29) by way of the air jet (30). A third passage (26) places the inside of the diaphragm in communication with the air passage (25) from the carburetor air horn.

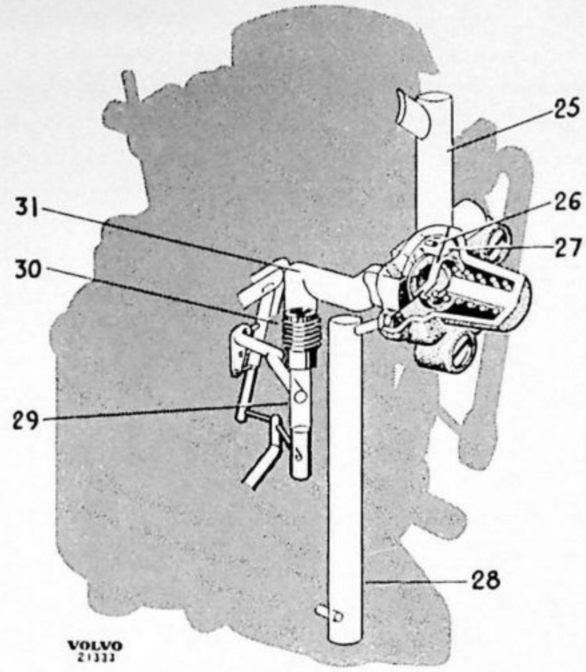

Fig. 20. Compensating air valve.

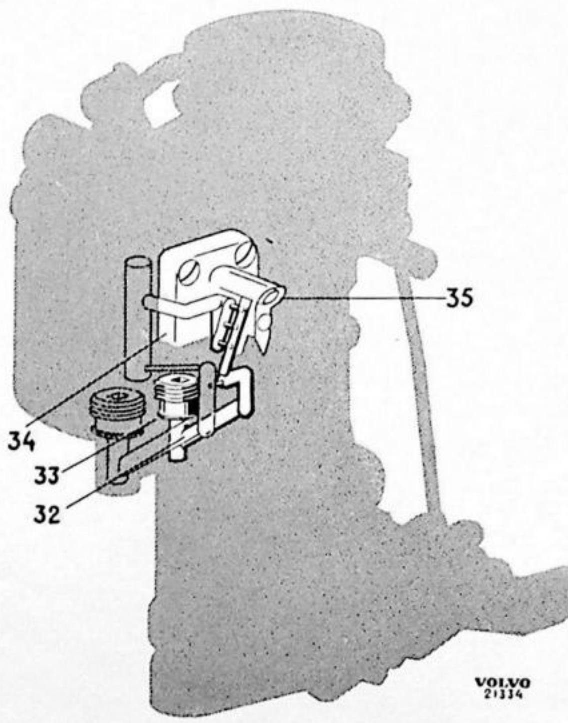

Fig. 21. Main metering system.

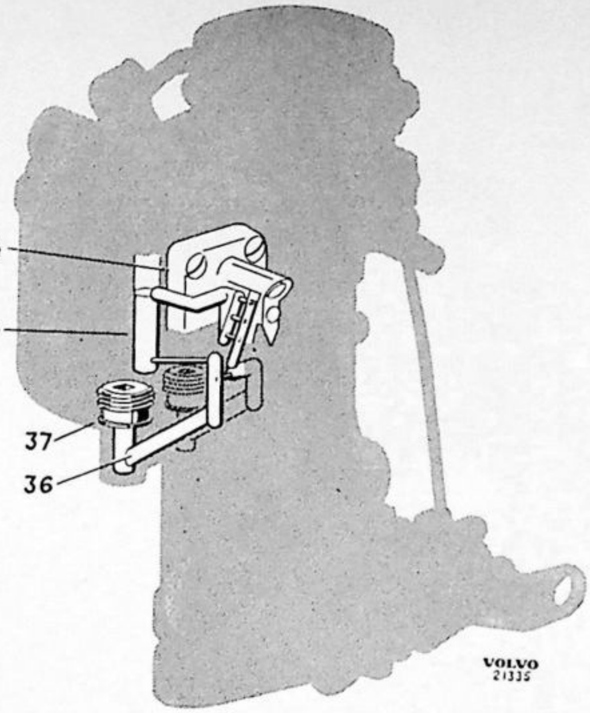

Fig. 22. Compensating system.

With the throttle opened part way, the vacuum increases on the outside of the diaphragm, the valve opens to admit air, and the fuel-air mixture becomes leaner.

6. Main jet System

The purpose of the main jet system (Fig. 21) is to supply the engine with the main part of the fuel needed at cruising speeds above the idle and low speed range. Fuel travels from the main jet (33) through the passage (32) in the float bowl to the emulsion block (34) and through the pointed nozzle (35) into the carburetor throat.

7. Compensating jet System

The main jet is dimensioned to be able to supply normal fuel requirements, but the richer "power" mixtures needed with wide-open throttle and high-speed operation call for additional fuel to be supplied by a compensating jet (37), Fig. 22. The compensating jet communicates with the emulsion block (34) via a passage (36), which also connects with a vertical passage (38) (29, Fig. 15), called the capacity well. At the upper end of the capacity well are two passages which are part of the above-mentioned connection between the economiser valve and the emulsion block. The fuel in the capacity well is normally level with the fuel in the float bowl, the capacity well acting as an extra reservoir for the compensating jet.

When, at lower engine speed, the main jet cannot deliver the required amount of fuel because of the low vacuum in the venturi, the extra quantity of fuel needed is supplied by the compensating jet.

As the throttle opening increases, more fuel is required. If the vacuum then exceeds a certain value, the capacity well will be drained.

The fuel supply through the main jet increases at higher engine speeds as there is a higher vacuum around the jet. The supply from the compensating jet, on the other hand, remains practically unchanged, or decreases when the capacity well has been drained, and only air passes through the well. This air mixes with the fuel from the main jet to produce an optimum fuel-air ratio.

Fuel Pump

The B 4 B engine is fitted with a mechanical diaphragm type fuel pump which is shown in Fig. 23.

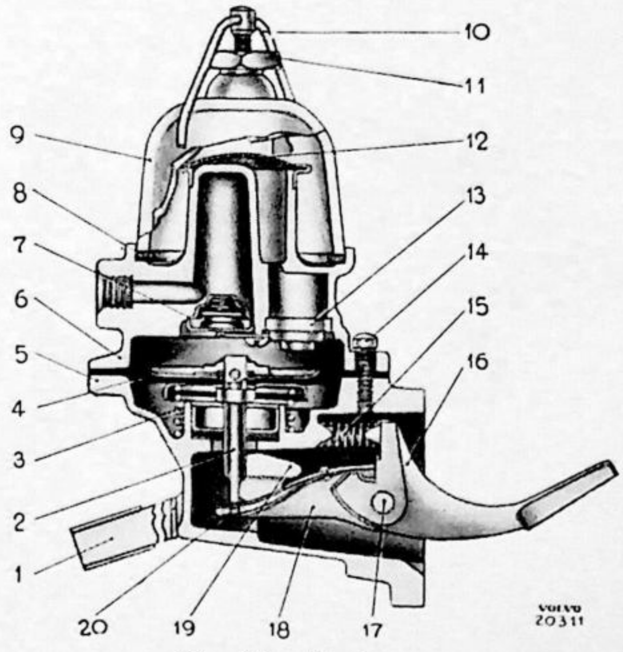

Fig. 23. Fuel pump.

The pump feeds gasoline from the fuel tank to the carburetor. It is driven by an eccentric on the camshaft and has a special arrangement to cut off the pumping action when the fuel inlet valve in the carburetor is closed. The pump is adjusted for a maximum pressure of 0.25 kg/cm^2 = 3.5 lb./sq. in.

The camshaft eccentric operates a rocker arm (16) and rocker arm link (18) which are both journalled on the rocker arm pin (17). The inner end of the rocker arm link is coupled to the pump pull rod (2) whose upper end is connected to the pump diaphragm (4). The diaphragm is clamped between the two halves of the pump body.

When the diaphragm is pulled downward, fuel is drawn in through 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 spring (3). The diaphragm is then pressed upward 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, the needle valve closes and a counter-pressure builds up in the pump chamber. The diaphragm comes to a stop in the pulled-down position, and the spring cannot force it upward for a new suction stroke until more fuel has been consumed.

The pump has an external hand lever (1) for priming.

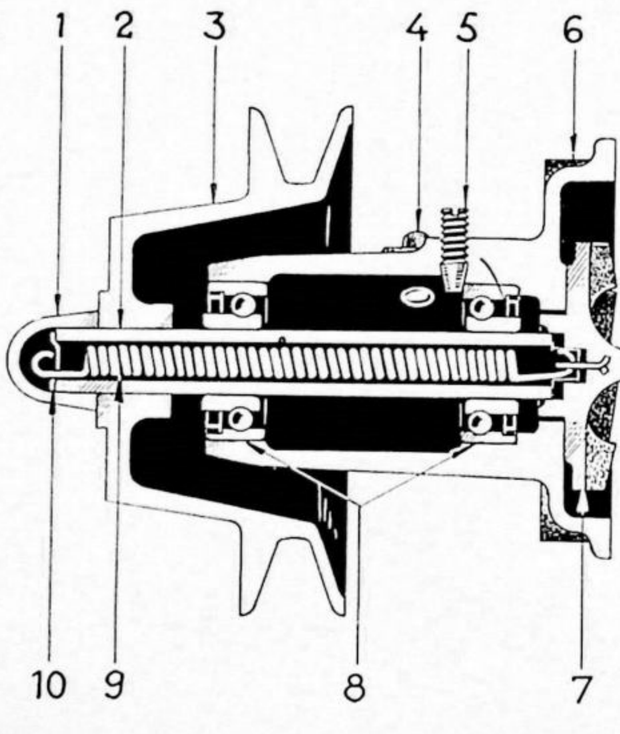

Fig. 24. Water pump, earlier version. Mounted on engines up to no. 8668.

1. Rubber cap
2. Shaft
3. Pulley
4. Grease nipple
5. Set-screw
6. Pump housing
7. Impeller
8. Ball bearing
9. Impeller spring
10. Spring seat

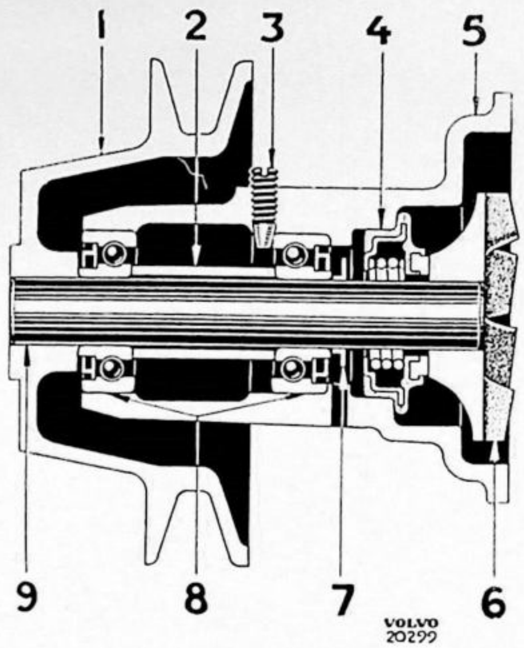

Fig. 25. Water pump, present version. Mounted on engines no. 8667 and higher.

1. Pulley
2. Spacer sleeve
3. Set-screw
4. Sealing ring
5. Pump housing
6. Impeller
7. Oil slinger
8. Ball bearing
9. Shaft

Cooling system

The cooling system works on the forced circulation principle with a vane-type impeller pump driven by a vee-belt from the crankshaft. The pump shaft runs in two ball bearings and also carries the ventilator fan which is mounted on the forward end of the pump shaft pulley. The fan causes a powerful draft of air through the radiator which is placed in front of the engine. The capacity of the cooling system is approx. 8 liters = 2 gallons.

To shorten the warm-up time when starting a cold engine, a thermostat is located in the water outlet housing between the engine and the upper radiator tank. The thermostat blocks the passage for the water into the radiator to prevent it from

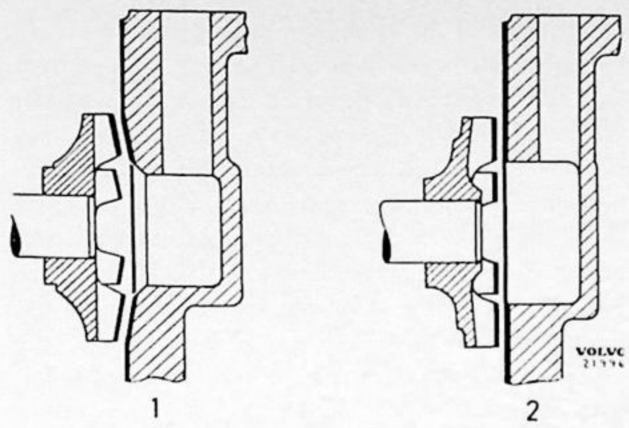

Fig. 26. Pump impeller, later version pump.

1. Impeller mounted up to engine no. 61123
2. Impeller mounted on engines no. 61124 and higher

being cooled off. Instead, the water is directed through a passage from the cylinder head to the inlet side of the water pump, and is recirculated through the engine block. When the temperature reaches 74° C=165° F, the thermostat begins to open, and is fully open at 85° C=185° F. The thermostat is balanced, i.e. it does not open under the influence of the pump pressure.

Coolant Circulation

The water pump forces the cooling water through the water jackets in the engine block and cylinder head and distribution pipe. The distribution pipe has four holes which terminate at the exhaust valve seats and cool them very effectively. The water then continues past the thermostat housing into the upper tank of the radiator and returns through the radiator to the suction side of the water pump.

From engine no. 5103 to 8789 there is a sealing plate fitted between the cooling water pump and the cylinder block to blank off water flow between the pump and the block. A sealing plate between the thermostat housing and the cylinder head forces the water through the distribution pipe.

From engine no. 8790 there is no hole in the cooling water intake in the front end of the block and the hole in the cylinder head front end is smaller so there are no sealing plates from engine no. 8789.

As and from engine no. 61124, the inlet hole in the engine block facing the pump is no longer beveled at the edges, and the old type of impeller with slanting vanes has been superseded by one with straight vanes. The old type of impeller cannot be fitted on engines no. 61124 and subsequent, as the vanes would interfere with the engine block, whereas the new straight-sided type of impeller can be used to replace the old type.

SERVICE INSTRUCTIONS

General Inspection

Compression Test

The purpose of the compression test is to check the sealing conditions of the piston rings and the cylinder walls; it is performed with a compression tester graduated in kg/cm² (kilograms per square centimeter) or lb./sq. in. (pounds per square inch). The engine is run before the test until it reaches normal operating temperature: all spark plugs are then taken out and the throttle set to wide open. Check that the choke plate is also fully open. The battery must be well charged to allow the starter motor to crank the engine at a sufficient speed.

The cylinders are checked one at a time by placing the compression tester in the spark plug opening where it is held securely while the engine is pulled round with the starter motor, until the gauge indicates maximum pressure, Fig. 27. The maximum reading for each cylinder is recorded. Compression pressure should be between 8.1—8.4 kg/cm² (115—120 lb./sq. in.) for a 6.5: 1 compression ratio, and 9.2—9.6 kg/cm² (130—136 lb./sq. in.) for an engine with 7.3: 1 compression ratio, in both cases at 200 rpm. Deviations of some 10 per cent from these values are admissible. A small quantity of heavy-bodied oils is introduced into all of the cylinders, taking great care not to smear the valve heads. The test is repeated, and the new readings noted. By comparing the values of compression pressure with and without oil, an idea is obtained about the sealing efficiency of piston rings and 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, but independent of lubrication, 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.

Vacuum Test

The general condition of the engine can also be ascertained by investigating the vacuum in the intake manifold. The engine shall be at normal operating temperature during the test which is carried out with the help a vacuummeter graduated in inches of mercury. The instrument is connected to the intake manifold by means of a length of hose, Fig. 28, and the engine is started and run at idle. The gauge needle should then be more or less at rest at some reading between 17 and 21. If the throttle is rapidly opened and shut, the gauge should drop to 2 (when throttle is opened) and then rise to 25 (when throttle is closed), finally returning to the steady-state value at idle. Defects in the engine, if any, influence the manifold vacuum, causing the gauge reading to depart from the above-mentioned values.

Always carefully observe the instructions accompanying the vacuum gauge.

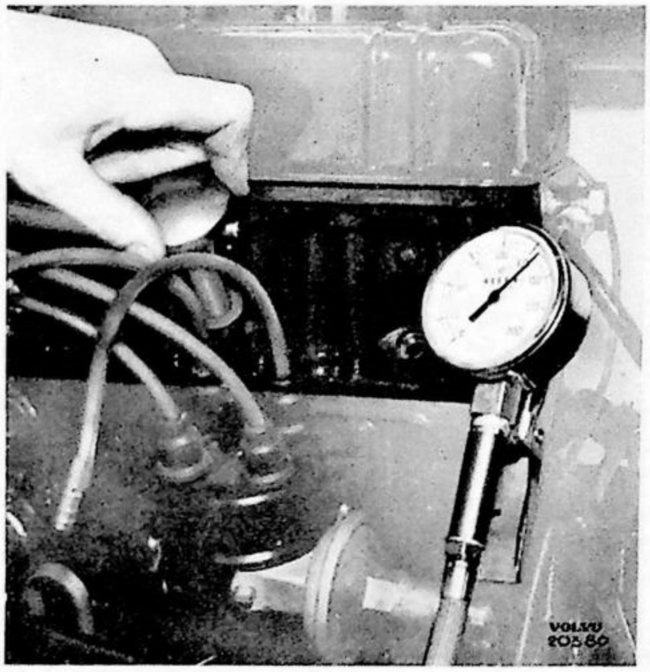

Fig. 27.

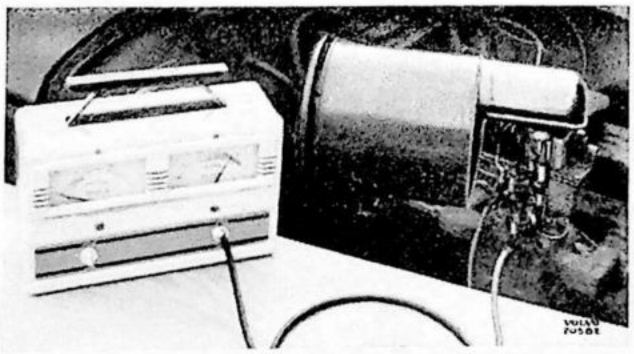

Fig. 28.

Exhaust Test

Tests with an exhaust analyser are carried out in order to determine the fuel-to-air ratio in the fuel mixture. If the test is to be of any value, the engine must be in good condition mechanically, with well sealing piston rings and valves. Attach the cell to the exhaust pipe, Fig. 29, and connect up the cable between the cell and the instrument, Fig. 30. A first test is made with the engine idling and with a vacuum gauge connected. The idle mixture is adjusted so as to make the engine idle smoothly, the vacuum gauge reading between 17 and 21. The exhaust analyser should then read as near to 13 as possible, and not less than 11.5. Deviations indicate that a carburetor readjustment is required.

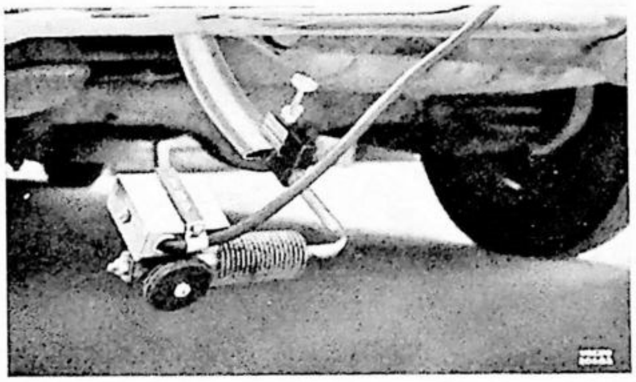

Fig. 29.

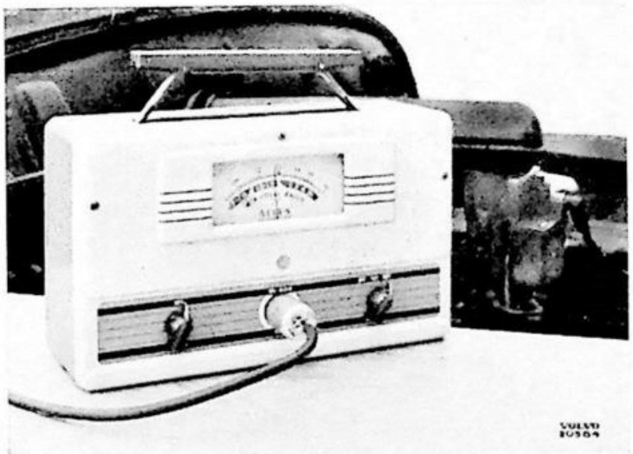

Fig. 30.

The high-speed system of the carburetor is tested under road conditions at an engine speed of 2000 rpm. corresponding to some 50 km. p.h. (30 m.p.h.) in third. The instrument should then read between 12.5 and 14.5. If the reading is lower than 12.5, a new test is made with the air cleaner removed. If this gives a higher reading, the air cleaner is partly clogged. If the reading is still low, the defect lies in the carburetor.

The accelerator pump can be tried during the driving test by abruptly pressing down the accelerator pedal. The analyser needle should then immediately move towards "Rich" if the accelerator pump is functioning.

Testing Fuel Pump

Pressure

The fuel pump is tested with a pressure gauge graduated in kg/cm² or lb./sq. in. which is connected to the inlet pipe nipple at the carburetor, Fig. 31. With the engine idling at 300 rpm. the pressure should be between 0.14—0.25 kg/cm² (2—3.5 lb./sq. in.).

Rate of Flow

To test the pumping capacity of the pump, measure the volume pumped during one minute. The pump should deliver 0.5 liter of fuel (0.14 gall/min.) at 300 rpm engine speed.

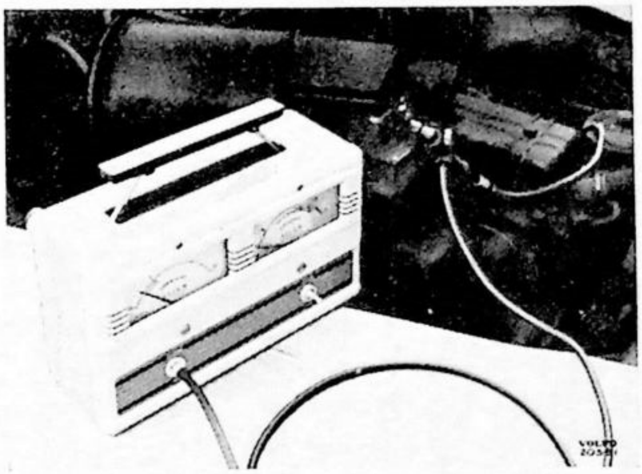

Fig. 31.

Service Operations – Engine in Vehicle

Engine Tune-Up

The purpose of engine tune-up is to increase engine power and reduce fuel consumption, and to make starting easier. An engine tune-up should be carried out regularly at 10,000—15,000 km (6000—10,000 mile) intervals. Before proceeding to a tune-up check compression pressure and vacuum according to instructions on page 16. If the compression pressure and vacuum do not meet stipulated requirements, the cause must be investigated and the fault put right.

Tune-up is performed in the following order:

1. **Spark plugs.** Remove all spark plugs, clean, adjust, and test plugs according to instructions on page 39.
2. **Battery and cables.** Check the condition of the battery. If the specific gravity of the acid is below 1.230, the battery must be recharged. If specific gravity is low in one cell, make a check to find the cause. Inspect all cables for satisfactory connections. Replace broken or badly insulated cables.
3. **Distributor.** Remove the distributor head and adjust breaker contacts to proper spacing (see under "Ignition System", page 37). Replace damaged contacts. Inspect distributor head for cracks and scrape off oxide from contacts.
4. **Ignition.** Check ignition according to instructions on page 39.
5. **Valves.** Adjust valve rocker clearance to prescribed values.
6. **Carburetor.** Remove the carburetor according to instructions on page 43 and 44.

Decarbonising Engine - Valve Grinding

Preliminary Operations:

The engine and valves should be decarbonised every 30,000—40,000 km (5000—7000 miles). Cars with mainly light operation schedules should be overhauled at shorter intervals.

1. Drain off cooling water.
2. Remove rocker cover with gasket.
3. Remove rocker mechanism and take out push rods.
4. Remove upper coolant hose, and temperature gauge sender.
5. Remove air cleaner.
6. Disconnect all controls and linkages at the carburetor.
7. Remove spark plug cables at the plugs.
8. Unscrew exhaust pipe at exhaust manifold.
9. Unscrew all cylinder head nuts, and remove cylinder head.
10. Clean the piston heads — do not use abrasive cloth — and blow away the carbon with compressed air. Clean the upper surface of the cylinder block using a soft steel brush and compressed air. Block the openings down to the valve lifters.
11. Clean the cylinder head.

Further, follow instructions under "Valves and Valve Mechanism", page 31.

Assembling

Take care to see that the bearing surface of cylinder block and cylinder head are perfectly clean and flat, checking with a straightrule. Oil the cylinder head gasket slightly and place it on the cylinder block, bead side upwards. Oil cylinder walls with motor oil, place cylinder head, and tighten cylinder head nuts. See under "Torque Values" in the specification at the end of the manual. Make a preliminary adjustment of the valves before installing spark plugs. Mount all other parts and fill cooling system. Start the engine and let it idle for at least 15 minutes, then pull cylinder head nuts tight and adjust valves.

Engine part no.	Intake valve clearance		Exhaust valve clearance	
495300	0.15 mm	0.006 in.	0.20 mm	0.008 in.
495301	0.30 mm	0.012 in.	0.35 mm	0.014 in.
495302	0.40 mm	0.016 in.	0.45 mm	0.018 in.

The valves are adjusted with engine idling.

Mount rocker cover with gasket, taking care to orientate the cover correctly.

Check ignition timing and adjust, if required.

Adjust idle speed.

After some miles, retighten cylinder head nuts (see under "Running-In").

Changing Piston Rings

1. Proceed as under "Decarbonising Engine—Valve Grinding", points 1—9.
2. Lift front end of car onto supports, about 20 cm = 8 in. above floor level. Drain the crankcase oil.
   Remove the oil pan according to instructions under "Dismantling and Assembling Oil Pan", page 20.
3. Check marking of connecting rods. (They should be marked 1—4, on the side away from the camshaft).
4. Scrape away the cylinder ridge in the upper part of the cylinder. Use tool SVO 4125.
5. Disconnect the connecting rods at the lower ends, and push them upwards with the piston, one at a time. Investigate to see if the forward end of piston head is marked. Put back all bearing, inserts, caps and nuts in their places on the connecting rods.

6. Remove all piston rings. Clean pistons and connecting rods.
(N.B. Do not clean pistons and bearing inserts in a degreasing tank). Clean piston ring grooves carefully, also drain holes in groove bottom lands. Check that passages in crankshaft are not clogged.

Fig. 32.

7. Inspect piston pin clearance. If clearance is excessive, install new bushing and oversize piston pin. See instructions under "Pistons, Piston Rings and Piston Pins", page 27.
8. Check that the piston rings have the appropriate clearance in the grooves. Follow instructions under "Piston, Piston Rings and Piston Pins".
9. Check and straighten connecting rods, if required. See page 29.
10. When installing pistons, take care that the piston ring gaps are not located directly above each other, or opposite the piston pin bosses. Also check that cylinder walls and connecting rod bearing journals are clean and dry.
Apply a thin coat of oil to piston, cylinder wall, and rod bearing journal. Check marking on piston tops, if any, to see that the pistons are installed correctly. Use installation ring SVO 2229.
11. Install connecting rods with the stamped number facing away from the camshaft. The connecting rod bolts should be replaced by new ones every time the engine is overhauled.
12. Mount connecting rod on crankshaft journal.
13. Replace cylinder head as described under "Assembling" page 18.
14. Mount oil pan and fill oil.
15. Run engine until it reaches normal operating temperature.
16. Tighten cylinder head nuts, adjust valve clearances, and check ignition carburetor as under "Running-In", page 54.

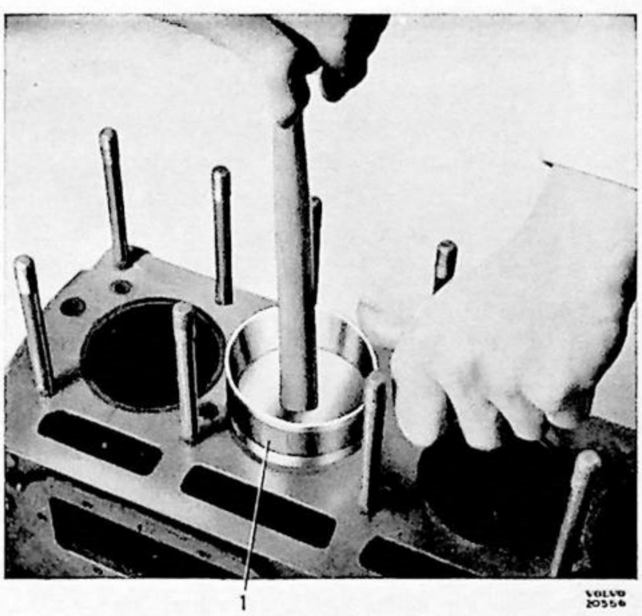

Fig. 33. Installation ring SVO 2229.

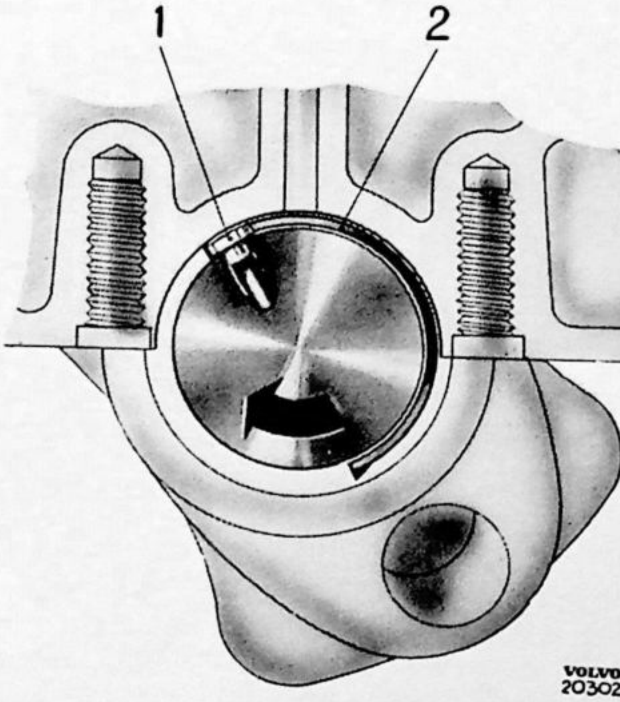

Fig. 34.

Replacing Main Bearings

To replace the main bearings without removing engine from vehicle, the oil pan must be removed as described under "Dismantling and Assembling Oil Pan".

Remove lock washers from main bearing nuts, back off nuts, and remove bearing caps and lower bearing inserts.

The upper bearing insert is removed by inserting a pin 1, Fig. 34, into the oil passage and then turning the crankshaft in its normal direction of rotation. Bearing shell 2 then moves with the crankshaft and can be removed. Inspect the bearing journal. If it is out-of-round by more than 0.05 mm = 0.002 in., take out crankshaft and regrind.

Install new bearings. The upper and lower bearings are identical, but take care that the keys lodge in their grooves.

For sizes see under "Main and Rod Bearings".

Mount bearing caps and tighten nuts according to torque table on page 73. Use only new lock washers. Mount oil pan and fill new oil.

Replacing Rod Bearings

The connecting rod bearings may be replaced with the engine in vehicle. Dismantle oil pan according to instruction below. Turn the crank journal where the bearing shall be replaced, downward, remove lock washers for the nuts, and back off nuts. Remove bearing cap and lower bearing insert, push connecting rod slightly upward and remove upper bearing insert.

Wipe crank clean with a used linen cloth, and measure journal diameter and out-of-round with

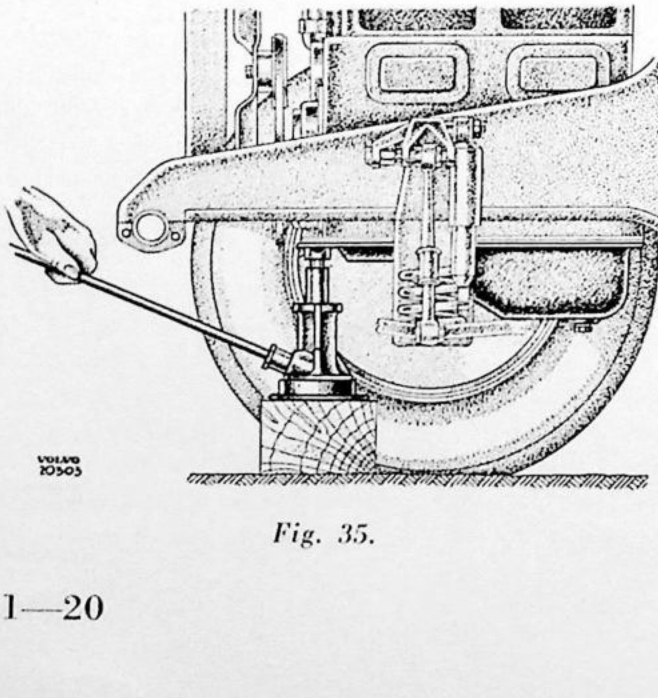

Fig. 35.

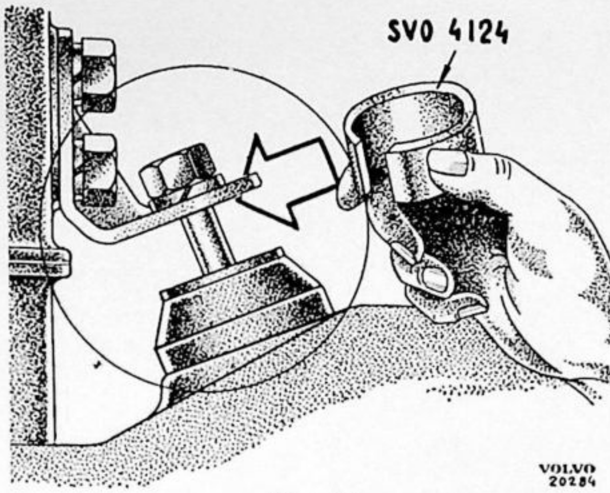

Fig. 36.

a micrometer gage. If out-of-round exceeds 0.07 mm (0.0028 in.), dismantle crankshaft and regrind journal. Out-of-round may often be the direct cause of excessive wear or cracks in a bearing. See under "Main and Rod Bearings" about sizes.

Oil and install the new bearings. Use new bearing bolts and tighten cap nuts according to torque table on page 73. Lock nuts with new washers. Mount oil pan and fill oil.

Dismantling and Assembling Oil Pan

The oil pan may be dismantled with engine in vehicle in the following manner:

1. Drain oil from oil pan.
2. Remove cover plates from engine sides.
3. Remove cover under flywheel.
4. Back off nuts on front engine supports, but do not remove them.
5. Lift engine with jack placed at front end of engine, Fig. 35.
6. Push spacers SVO 4124, Fig. 36, on to engine support studs, and lower jack.
7. Remove screws securing oil pan and remove pan by pulling downward-backward.
8. Assemble in reverse order. Always replace a cork gasket that looks damaged or feels hard.

Dismantling Flywheel

The flywheel may be dismantled with engine in vehicle in the following manner:

1. Remove transmission, see Part 3.
2. Remove clutch, see Part 2.
3. Remove nuts from six bolts securing flywheel to crankshaft, remove lockwasher and press screws forward.

4. Pull flywheel backward (screw should not slide with flywheel). If it is not possible to lift off flywheel in this manner, back off screws securing flywheel cover to cylinder block and pull flywheel cover so far backward that the flywheel can be taken off.

To reassemble flywheel, proceed in the reverse order. Always mount new lockwashers.

Replacing Camshaft and/or Camshaft Gear

1. Drain cooling water and unfasten radiator blind wire.
2. Dismantle radiator by loosening collars of upper and lower radiator hoses and two screws on either side of radiator. Lift out radiator.
3. Remove fan belt and pull fan belt pulley off crankshaft. Use tool SVO 1449 for earlier version pulley, tool SVO 4155 for pulley now mounted.
4. Remove timing gear case and pilot pin with spring. Note timing gear markings, Fig. 60.

If only camshaft gear is to be replaced, camshaft need not be taken out. Remove lockwasher and nut and pull off gear with tool SVO 1449 and pilot pin SVO 4130, Fig. 42. For gears now mounted, having three holes, use tool SVO 2250. Mount new gear using tool SVO 1356 or SVO 1356 A, Fig. 37.

5. If camshaft must be replaced, dismantle rockers, push rods, and fuel pump. Remove valve inspection covers and take out lifters. If desired, distributor may also be removed for greater ease of working.

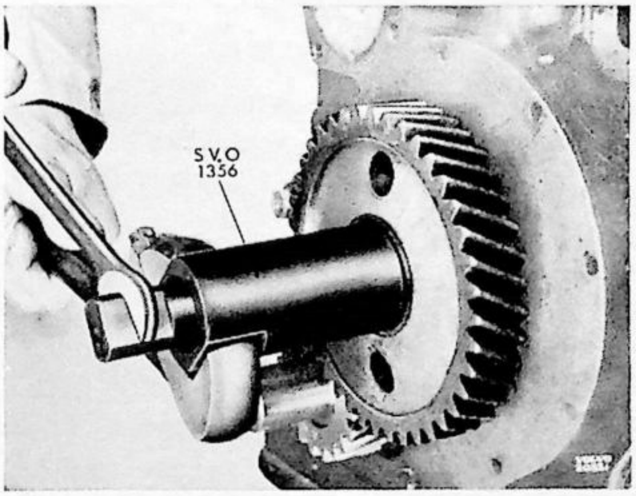

Fig. 37.

6. Pull out camshaft towards the front after removing thrust flange 1, Fig. 43.
7. Assemble new crankshaft in reverse order, taking care that timing gears are returned to their original positions. Locate timing gear case using tool SVO 1427. Inspect felt gasket in cover and replace, if it does not seal against pulley hub.
8. Adjust valve clearance and ignition timing.

Removing Engine from Vehicle

1. Drain cooling water, crankcase oil and transmission oil. Remove battery, radiator, and air cleaner.

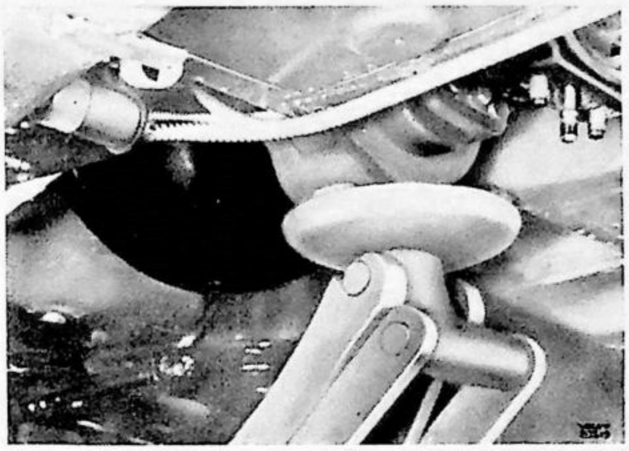

Fig. 38.

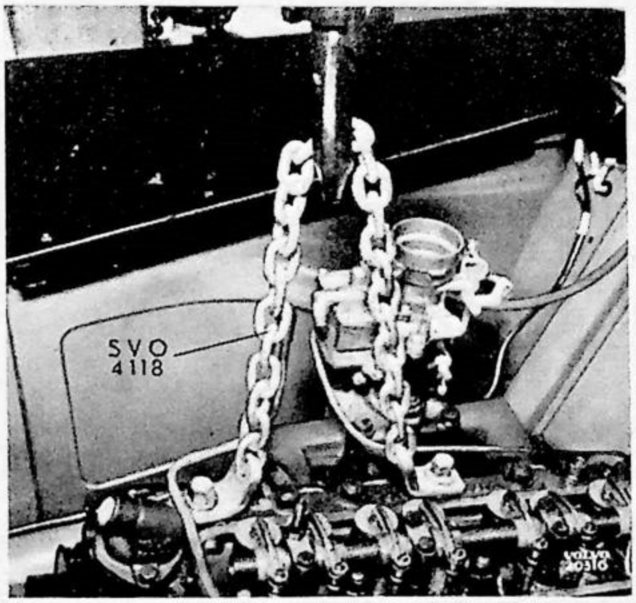

Fig. 39.

2. Disconnect all electric connections, fuel line at fuel pump inlet, line to oil gauge, vacuum hose, pipe to temperature indicator gauge, and hand throttle accelerator pedal, and choke linkages. Loosen muffler inlet pipe at manifold.
3. Loosen front engine support, remove gear shift lever.
4. Lift car onto supports some 20 cm = 8 in. above floor level.
5. Remove cover plates on both sides under engine. Disconnect speedometer cable at transmission case, clutch linkage and retract spring, and brake pedal retract spring.

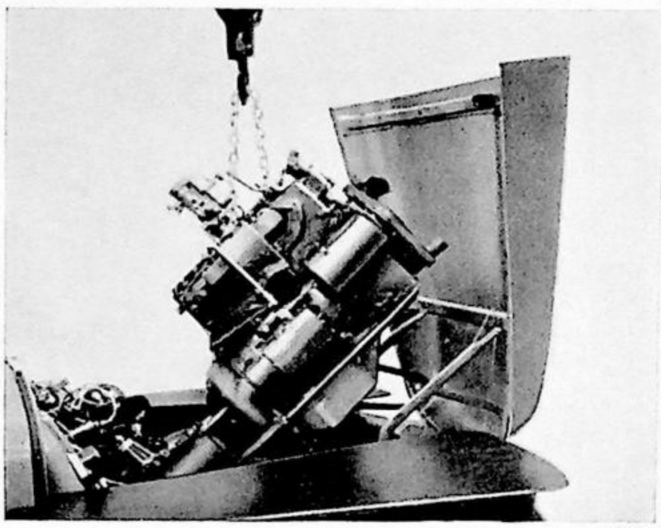

Fig. 40

6. Place a jack under the transmission case, Fig. 38, and disconnect propeller shaft at the transmission output shaft, and remove cross member under transmission case (in PV 444, a mounting plate).
7. Connect lifting chain SVO 4118 and lift engine; lifting is easier if front of engine is raised first.

Dismantling Engine

When engine and transmission have been removed from vehicle, they should be carefully washed and cleaned before proceeding to dismantling, preferably using kerosene or fuel oil (less inflammable than gasoline). The engine is then flushed with hot water and blown dry with compressed air. Use only a small quantity of kerosene at a time.

After washing, remove transmission from engine.

The engine is dismantled in the following order:

1. Remove dipstick, crankcase breather, carburetor, distributor, oil filter and accelerator pedal linkage.
2. Place engine in a suitable dolly.
3. Dismantle clutch. From engine no. 49746 onwards, clutch, flywheel and crankshaft are balanced together as a unit and marked with yellow paint. Identify the parts by punch marks to enable reassembly in the same positions.

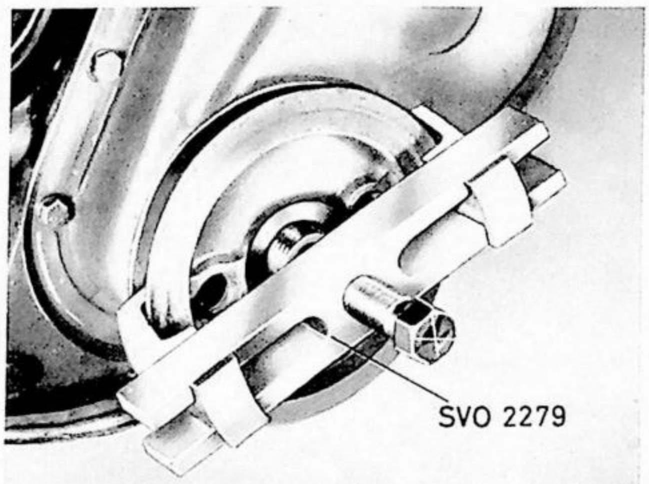

Fig. 41.

4. Remove starter motor, generator, and spark plugs.
5. Remove intake and exhaust manifolds, thermostat housing, water pump and below tube for water inlet.
6. Remove rocker cover and rocker shaft, and lift out push rods.
7. Remove cylinder head.
8. Pull fan belt pulley off crankshaft, Fig. 41, using tool SVO 1449 for earlier version of pulley, SVO 4155 for present version.
9. Remove valve inspection covers and lift out valve lifters. Remove timing gear cover and pilot pin complete with spring, woodruff key, oil slinger, and washer from crankshaft.
10. Check that marking on crankshaft timing gears is correct. Then pull off camshaft gear with tools SVO 1449 and 4130, Fig. 42. For later type of gear with three holes, use tool SVO 2250.

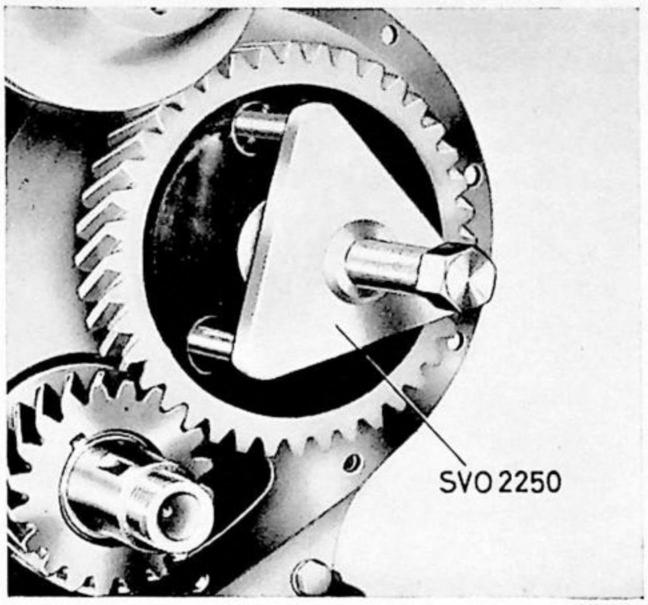

Fig. 42.

11. Pull off crankshaft gear with tool SVO 1428 A (SVO 1428), Fig. 43.
12. Turn engine upside down and remove oil pan.
13. Remove oil pump complete with strainer and output pipe. Remove reducing valve plug and pull out plunger using tool SVO 2079. Also remove rear crankshaft sealing flange.
14. Remove camshaft thrust flange and pull out camshaft.
15. Remove rod bearing caps and pull out pistons complete with connecting rods through cylinders. Return caps and nuts to appropriate connecting rods. Check markings 1—4 on side away from camshaft.

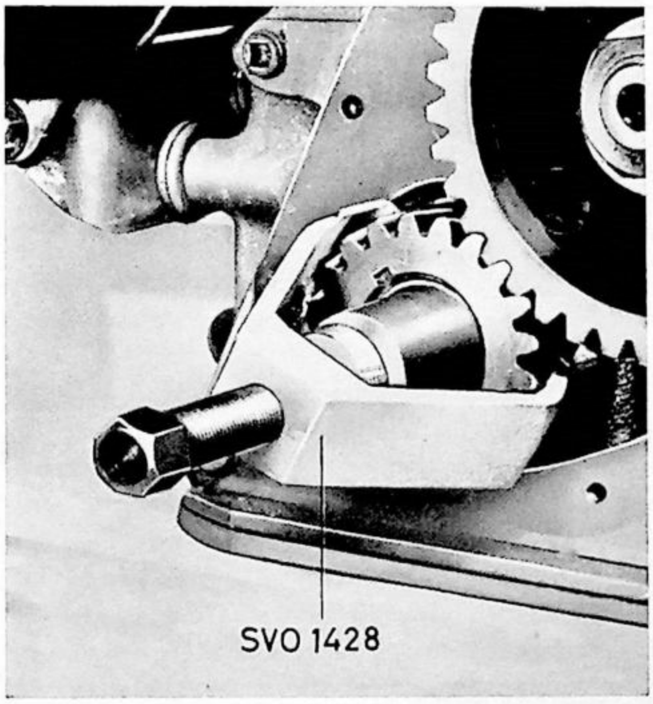

Fig. 43.

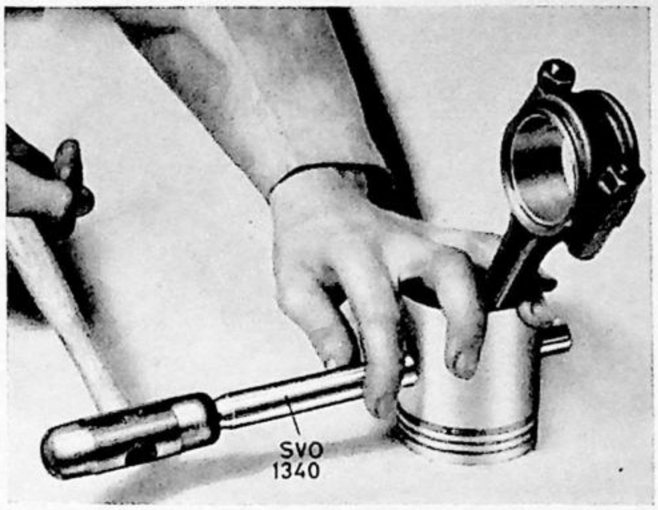

Fig. 44.

16. Remove the cover plate to which timing gear cover is secured.
17. Remove main bearing caps and lift crankshaft complete with flywheel and place it where it is not likely to be damaged. Return caps to block in proper order. The caps are marked with an arrow pointing forward.
18. Remove flywheel cover.
19. Dismantle connecting rods from pistons by driving out piston pins with tool SVO 1340 A, Fig. 44.

Cleaning Engine Parts

After dismantling the engine, all parts are first scraped clean of carbon, oil sludge deposits, remnants of old gaskets etc., and then washed in kerosene or fuel oil. Pour out only a small quantity of kerosene at a time, and begin by washing pistons, connecting rods, crankshaft and camshaft.

Preferably use a degreasing tank, electrically or steam heated. Use only cleaning agents marketed by reliable firms, even at a higher cost.

Take great care when washing parts made of light alloy. Such parts must not be left lying in the bath for more than a half hour. The pistons must not be placed in a basic solution.

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

Cylinder Block

Gauging Cylinders

The cylinders wear more rapidly at their upper ends, and become tapered and out-of-round. To provide a complete idea about a cylinder, it must be measured in several places both parallel to, and at right angles to, the piston pin. The cylinder is measured with a special cylinder indicator gauge, Fig. 45.

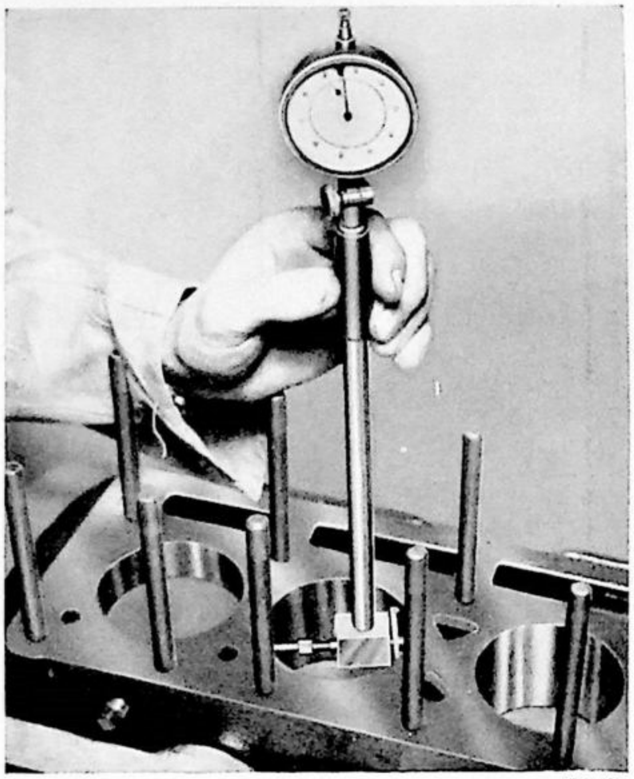

Fig. 45.

The dial indicator registers the relative wear of the cylinder wall, i.e. the difference between the highest and lowest values found. The maximum cylinder wear can be established by zero-setting the dial indicator with the help of a micrometer gauge. Beside each cylinder is stamped — on the upper surface of the cylinder block — a letter giving the original (initial) standard diameter according to the table below.

The micrometer is set to the lower limit in each cylinder bore range.

If the engine has been rebored, remove the cylinder ridge in the upper end of the cylinder and place the gauge against it.

The amount of wear measured determines the remedy to be resorted to. If oil consumption is abnormal and 0.25—0.30 mm (0.010—0.012 in.) wear is found, or the cylinder walls are scored, the engine should be rebored.

Range	Cylinder bore
A	74.96—74.97 mm
B	74.97—74.98 mm
C	74.98—74.99 mm
D	74.99—75.00 mm
E	75.00—75.01 mm
F	75.01—75.02 mm
G	75.02—75.03 mm
H	75.03—75.04 mm

Reboring Cylinders

The boring of cylinders is undertaken in special machines. The demands on precision being extremely high, only highly skilled and experienced workers are permitted to carry out this operation. It is extremely important that the cylinders become perfectly circular, without a taper, and orthogonal to the crankshaft within very narrow limits, and 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, page 66, and are then bored ground and honed to exact size. Do not measure piston clearance with feeler gauges. See under "Piston Clearance", Page 27.

Oil Passages

The cylinder block contains drilled oil passages, one main oil gallery extending the entire length of the right side of the block, and one passage in the rear end of the block feeding oil to the rocker arm mechanism. Side passages lead from the main gallery to the main and camshaft bearings. It is of fundamental importance that all oil passages are free and unobstructed by sludge in order to permit satisfactory circulation of the oil. If all auxiliary parts have been removed, the naked cylinder block may be put in a degreasing tank containing a suitable degreasing agent for at least an hour. A powerful water jet is then directed through the oil passages, and the water afterwards blown out with compressed air, not forgetting the passages communicating with the oil pump, reducing valve, main bearings and camshaft bearings, the rocker lubrication passage, and the oil pressure gauge nipple. The end plugs for the main oil gallery and the reducing valve plunger must be removed during the blowing.

Cracks

If leakage is suspected, the block is tested with water under pressure. The upper surface of the block is then sealed off with gasket and cylinder head, or with a special rigid metal plate. The water pressure should be approx. 3 kg/cm² =40 lb./sq.in.

Cylinder Head

Leakage

If cracks are suspected in the cylinder head, it should be tested with water under pressure, using the same plate as used when testing the cylinder block. Remove the water distributing pipe with tool SVO 4120 and mount instead a flange with water hose nipple.

The water pressure should be approx. 3 kg/cm² =40 lb./sq.in.

Push Rod Sealing Tubes

If there is an oil leakage from the push rod tubes, they are sealed using the flanging tool SVO 2050.

See also under "Valves and Valve Mechanism".

Crankshaft

Gauging Crankshaft Journals

The crankshaft is checked for linearity and the journals for out-of-round, taper, and score marks. Place the crankshaft between centers and

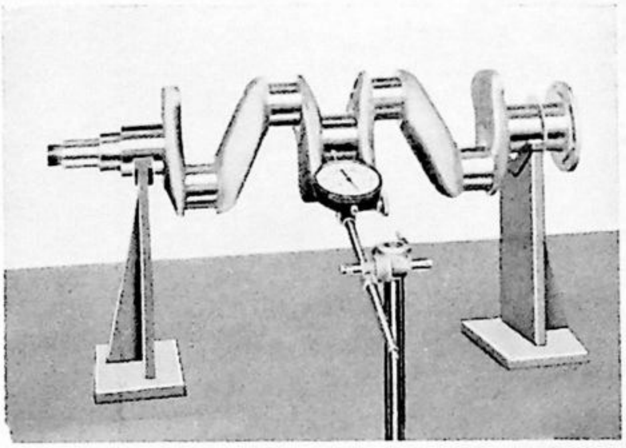

Fig. 46.

touch a dial indicator against the center main bearing journal. Fig. 46. The indicator registers both journal out-of-round and journal runout at the same time, and the reading will have to be broken up by gauging the journal out-of-round separately with a micrometer. The maximum admissible runout at the center journal is 0.05 mm=0.002 in.

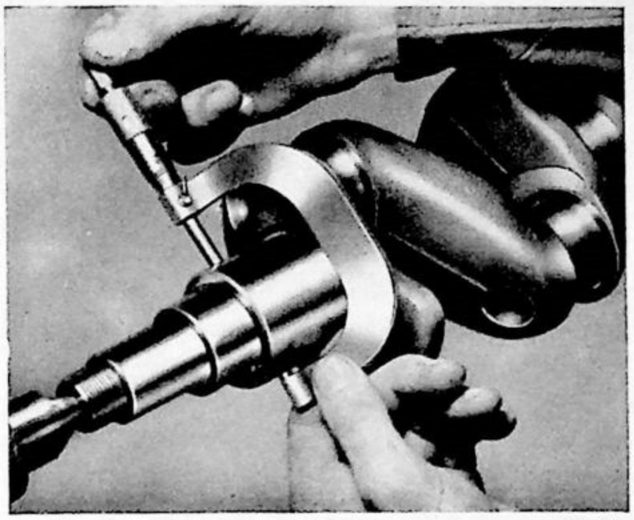

Fig. 47.

Out-of-round is checked by means of a micrometer gauge, Fig. 47, in at least 6 angular settings on the journal periphery and in 3 places along its length. Maximum admissible out-of-round is 0.05 mm—0.0020 in. for main bearing journals and 0.07 mm—0.0028 in. for rod journals, and maximum taper is 0.05 mm—0.0020 in. A bent crankshaft shall be replaced. Out-of-round, taper, and scored journals are reground to suitable undersize according to the table below. The grinding is performed in special crankshaft grinding machines.

The sizes given in the table must be closely respected as they are chosen to give the proper bearing clearance together with the respective replacement bearing inserts.

A grinding wheel should be dressed to give radii of 2.75—3.00 mm = 0.11—0.12 in. at the journal ends, as shown in Fig. 48.

Grinding Journals

The maximum and minimal diameters of crankshaft journal standard and undersizes are given in the table below. All measurements are in mm (dimensions in inches, see Specification, pages 67—68).

Main Bearing Journals

	Min.	Max.
Standard	53.950	53.960
0.010" undersize	53.696	53.706
0.020" ,,	53.442	53.452
0.030" ,,	53.188	53.198
0.040" ,,	52.934	52.944

Rod Bearing Journal

	Min.	Max.
Standard	47.589	47.600
0.010" undersize	47.335	47.346
0.020" ,,	47.081	47.092
0.030" ,,	46.827	46.838
0.040" ,,	46.573	46.584

Grinding Rear Main Bearing Journals

Great care is required in grinding the rear main bearing, where journal width A, Fig. 48, requires special attention. The proper oversizes corresponding to journal undersizes are listed below, dimensions given in mm.

	Min.	Max.	For Main Bearing	Re-marks
Standard	38.935	38.975	Standard	
0.1 mm oversize	39.035	39.075	0.010" undersize	*
0.2 mm ,,	39.135	39.175	0.020" ,,	
0.3 mm ,,	39.235	39.275	0.030" ,,	*
0.4 mm ,,	39.335	39.375	0.040" ,,	

*) Not for rear main bearing with separate thrust washer See also below "Main and Rod Bearings".

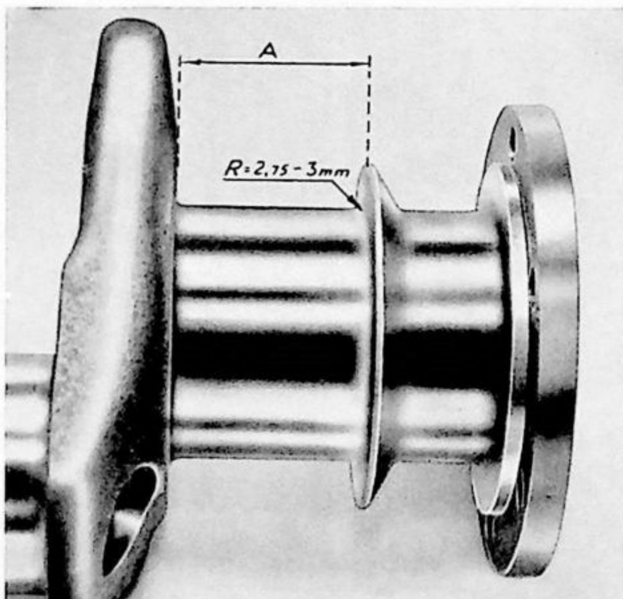

Fig. 48.

Oil Passages

Clean crankshaft by submerging and boiling it in degreasing tank, afterwards flushing clean with water and blowing off water with compressed air. Passages may be cleaned out with a special brush.

Main and Rod Bearings

Undersizes

Replacement bearing inserts are available in undersizes

0.010" — 0.020" — 0.030" — 0.040".

Part nos. are stamped into the backing of all bearings; undersize bearings also carry the figure groups 01, 02, 03, or 04, designating the four above undersizes.

The thrust washer for the rear main bearing is available in standard and two oversizes, 0.1 mm 0.004", and 0.3 mm — 0.012". Separate thrust washers are available for engines up to and including no. 8652, excepting nos. 3410, 3411, 5503—7969, and 8010—8511. This should be taken into consideration when regrinding journal width.

For engines 3410, 3411, 5503—7969, 8010—8511, and from no. 8653 onwards, the rear bearing has an integral thrust flange, and is available in four oversize widths: 0.1, 0.2, 0.3, and 0.4 mm (i.e. 0.004 — 0.008 — 0.012 — 0.016 in.). Engines with numbers other than those specified may, however, be fitted with bearings with integral thrust flange following a replacement of cylinder block.

Installing Main and Rod Bearings

Adjustment of bearing clearance of bearing pressure must never be carried out by filing the bearing caps. The bearings are precision machined and must not be either filed or scraped. In the event of damage or wear, the bearing inserts are replaced; out-of-round journals are reground to specified undersizes, and new undersize bearing inserts installed. Always inspect the oil flow to a damaged bearing.

Oil Sealing

The rear main bearing is fitted with a felt sealing ring in two parts which is secured to the engine block with two flanges. Between the lower flange and the block, sealing is achieved by means of two wood laths which are inserted into their respective grooves after the lower flange has been installed.

The front end of the crankshaft carries a sheet metal oil slinger clamped between the crankshaft gear and the pulley hub. The timing gear cover contains a felt ring sealing against the pulley hub.

This seal is placed concentric with the crankshaft by means of tool SVO 1427 when the timing gear cover is mounted. The pulley is then mounted.

The axial clearance of the crankshaft has considerable influence on the efficiency of the seals, and should always be between 0.01—0.1 mm (0.0004—0.004 in.).

Fig. 49.

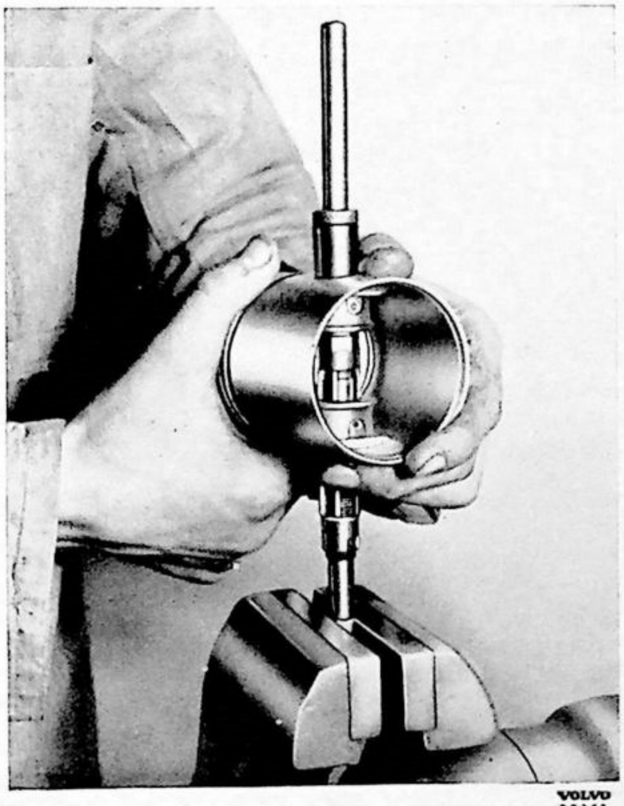

Fig. 50.

Pistons, Piston Rings, and Piston Pins

Gauging Pistons

The pistons are measured with a micrometer at the bottom edge of the skirt, Fig. 49, at right angles to the piston pin.

When reconditioning, fit a piston which is lighter and fitted with a narrower upper ring (1.5 mm instead of 2.5 mm). This piston should be measured 9.5 mm from the lower edge.

The standard and oversize cylinder bores and pistons are collated in the Specifications at the end of this Manual.

Fig. 51.

Piston Clearance

The correct values of piston clearance are:

Specialloid pistons, 0.03—0.05 mm — 0.0012—0.0020 in.

Mahle pistons, 0.04—0.06 mm — 0.0016—0.0024 in.

WEDA pistons, 0.02—0.04 mm — 0.0008—0.0016 in.

The task of choosing a piston to suit a certain cylinder bore is therefore reduced to selecting one bearing the same code letter, i.e. a Class D piston for a Class D bore.

Piston clearance is measured (in the direction of thrust) by using a feeler gauge in a spring balance. The thickness of the feeler gauge is selected in accordance with the largest measurement in the tolerance range. For Mahle pistons with a clearance of 0.04—0.06 mm, take an 0.06 mm gauge. The width should be 1/2" and pull 2—3 kg (4 1/2—6 1/2 lb.).

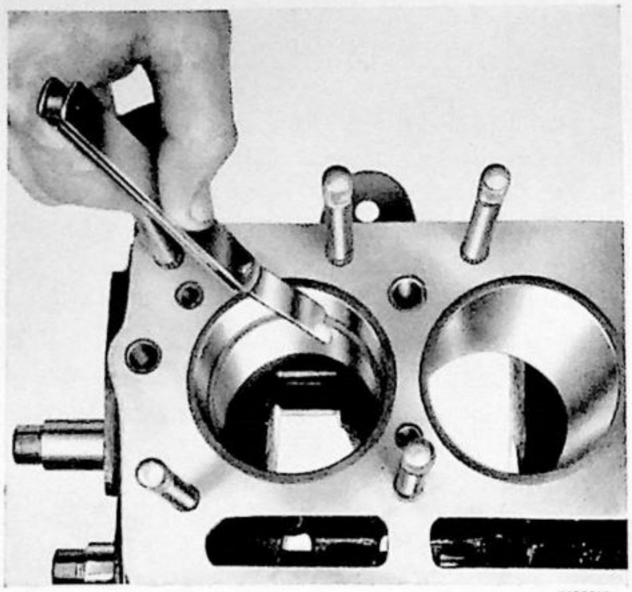

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Fig. 52.

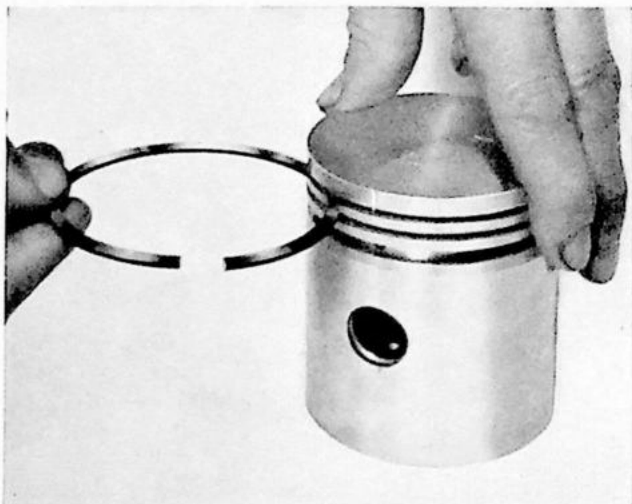

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Fig. 53.

Piston Pin Clearance

To obtain correct clearance for the piston pin, use reamers with guide bush 2, Fig. 50, taking only slight cuts in each pass. Correct fit is achieved when the piston pin slides into the bosses under thumb pressure, Fig. 51, piston and pin having the same room temperature.

Piston Ring Clearance

a) New or rebored cylinder.

The gap between the piston ring ends, with the ring fitted into the cylinder bore, Fig. 52 is checked with a feeler gauge. The piston rings must not bind anywhere in the groove — check

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Fig. 54.

by rolling the ring in the groove around the piston, Fig. 53. Measure clearance in a few places with a feeler gauge; the correct value is shown in the specifications.

b) Worn cylinder bore.

Piston rings to be used in a worn cylinder bore should generally be the same as those mounted before. If a larger size is chosen, it must be filled down to obtain correct fit at the lower turning point of the piston stroke. As the cylinder wears least at this point, so much must be filed away from the ring ends that it becomes out-of-round.

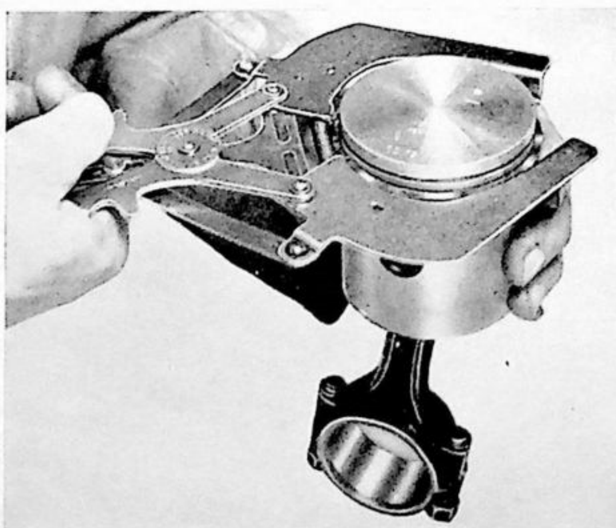

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Fig. 55.

The sealing action suffers, and running-in time is lengthened. 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, lest vibrations arise 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 differences registered by the balance pointer must not exceed ± 3 grams = ± 0.11 oz.

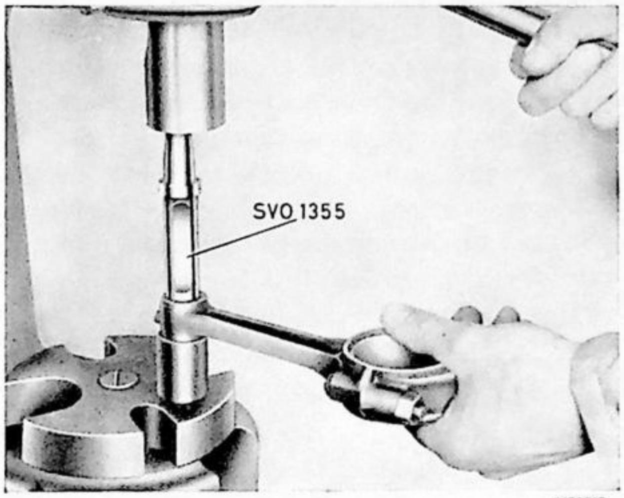


Fig. 56.

Assembling Piston and Connecting Rod

Before proceeding to assembling piston and connecting rod, check that the piston pin clearances to piston bosses and connecting rod bushing are correct, and that the connecting rod is straight. The piston rings are not placed on the piston until the piston and the rod have been assembled. The top compression ring has a beveled inside edge which should face upward, and the second ring has one outside edge beveled which should face downward. To install the piston rings, use the special piston ring expander tool, Fig. 55. Oil piston pin and bushing before assembly. Check that the piston is correctly assembled with the connecting rod. In Mahle pistons, the piston pin bore is slightly off center, and it is very important that the correct side is turned forward. The pistons are generally marked with an arrow or the word "vorn" = "front" which should point forward. Put retainer circlips in both piston bosses.

Connecting Rods

Replacing Piston Pin Bushing

Using tool SVO 1355 A (SVO 1355), press out the old bushing and install a new one, placing a

Fig. 57.

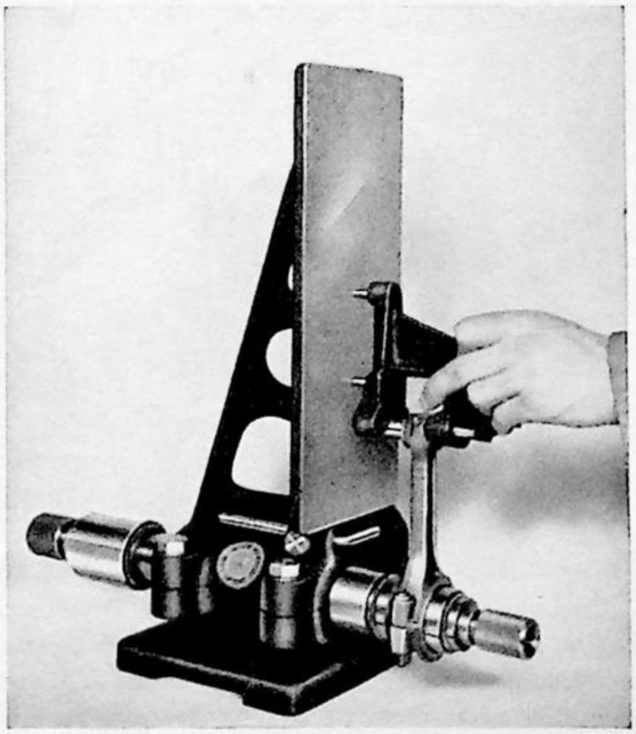


Fig. 58.

suitable sleeve below the rod small-end, Fig. 56. The bushing is then reamed to size. Take only light cuts and check repeatedly with the pin until it can be pressed in by a light pressure of the thumb, Fig. 57.

Straightening Connecting Rod

When an engine is being overhauled, the connecting rods shall always be straightened before they are replaced in the engine, Figs. 58—59. The straightening can be undertaken with, or without, the piston mounted on the rod. If the piston has been disassembled, it is advisable to straighten the rods before the piston is replaced and then make a check after reassembling the piston.

The piston rings must be taken off if the connecting rod is to be checked complete with piston.

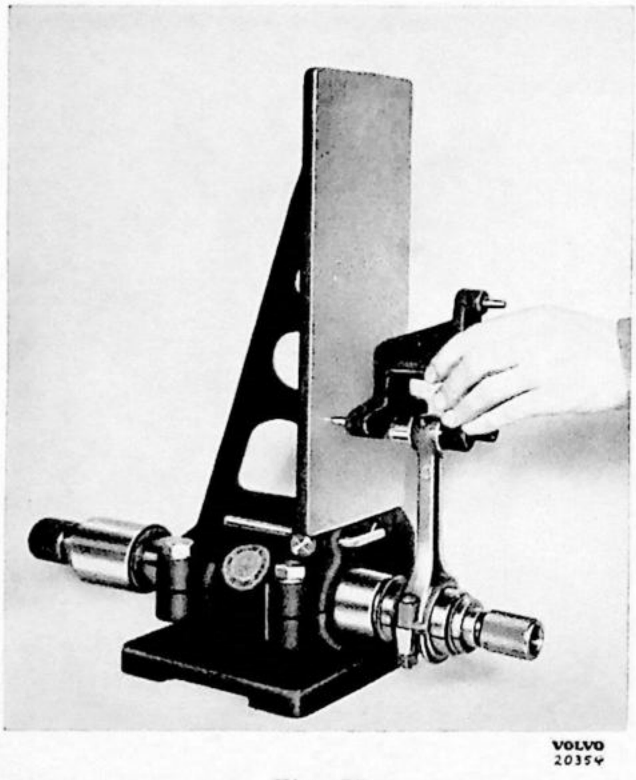


Fig. 59.

Weight

The connecting rods of one and the same engine shall have as nearly as possible the same weight. Connecting rods are graded in four weight classes, denoted by the letters A—D, which are stamped on the rods immediately above the splitting line for the bearing cap.

Only connecting rods with the same letter may be installed in one and the same engine. When replacing connecting rods in earlier engines where no lettering of the connecting rods was used, the weight of the rods must be determined. The weights listed in the specification part of the Manual refer to the complete rod with reamed bushing ready for installation. Mark the connecting rod with the correct letter when removing.

Bearings

As the connecting rod bearings have replaceable inserts precision machined to correct size, the bearing caps must not on any account be adjusted by filing in order to take up clearance. In this case, new bearing inserts shall be installed. If the rod journal is scored or so much worn that new bearings also would have too much clearance, the journal must be reground and new undersize bearings installed. See under "Grinding Bearing Journals".

Camshaft

Different versions of the engine have camshafts that differ slightly in respect of cam lobe form. A new type of camshaft may be installed in an older engine, if the valve to rocker clearances prescribed for the new camshaft are observed. In this case, also mount a new plate on the engine specifying the new clearance values.

The clearances are stated in the specifications at the end of the Manual.

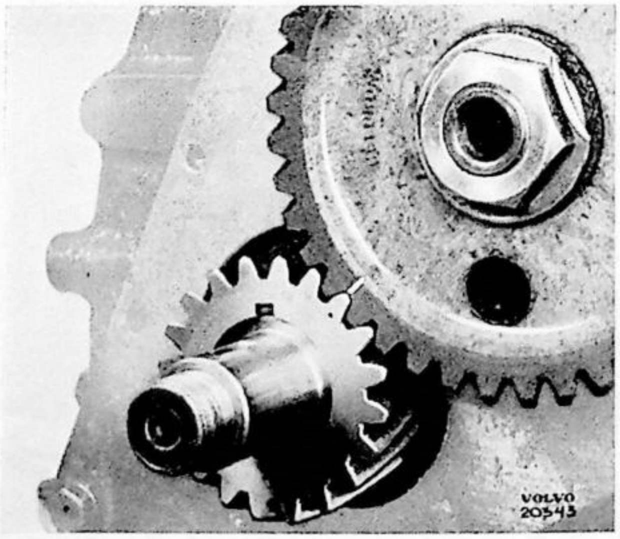


Fig. 60.

Inspection

The camshaft is inspected for linearity and for wear of journals, cams and distributor gear. The camshaft must be straight within 0.04 mm = 0.0008 in. A bent camshaft cannot be straightened but should be replaced.

The maximum admissible wear is 0.075 mm = 0.003 in. if new camshaft bearings are mounted.

If cams, journals, or ignition distributor gear are much worn, replace camshaft.

Replacing Camshaft Bearings

Camshaft bearings that have worn 0.05 mm = 0.002 in, or more, are to be replaced. This operation requires a boring machine and should not be undertaken by anyone but a skilled worker. When pressing in new bearings, take care that the oil-holes in the bearings mate with the oil passages in the block.

Replacing Camshaft Gear

The camshaft gear is replaced when the backlash reaches 0.12 mm = 0.0047 in. The camshaft can be taken out with the engine still mounted in the vehicle, see page 21. The new gear is mounted with tool SVO 1356A while taking care not to damage the gear.

Camshaft Timing

The timing gears are indexed for correct timing, Fig. 60.

Valves and Valve Mechanism

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

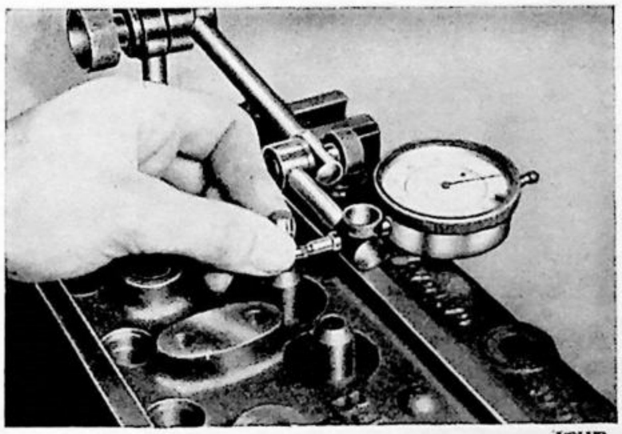


Fig. 61.

Inspection

Valves

The valve stem must be perfectly straight, and the wear must nowhere exceed 0.02 mm = 0.0008 in. on the diameter. If the valve head edge falls below 1 mm = 0.04 in. in width after regrinding, the valve is rejected.

Valve Guides

The valve stem to valve guide clearance is checked by means of a new valve. An intake valve is always used to check the intake valve guides, and exhaust valve to check the exhaust valve guides, as the stem diameters are different. Given a new valve, the clearances should not exceed 0.13 mm = 0.005 in. for the intake valve and 0.15 mm = 0.006 in. for the exhaust valve.

The method of measuring the clearance is shown in Fig. 61.

Valve Springs

The valve springs must conform to the specifications given in the table below. Please note that different engines may have different types of valve springs, depending on the serial number (stamped on engine identification plate). The springs are close-wound at one end which is placed downward when installing the spring. Fig. 63 illustrates the testing of a spring.

Engine Part no.	Spring	
	Load (kg)	Length (mm)
495300	0 40±2 60±3	68 49 41,5
495301	0 30±2 56±3	50 39 32
495302 earlier version	0 27±2 78±4	42,5 37 28,5
495302 late version spring marked blue	0 22.5±2 66±3.5	45 39 30,5

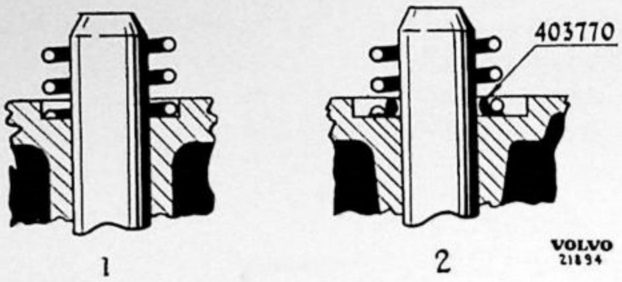


Fig. 62.

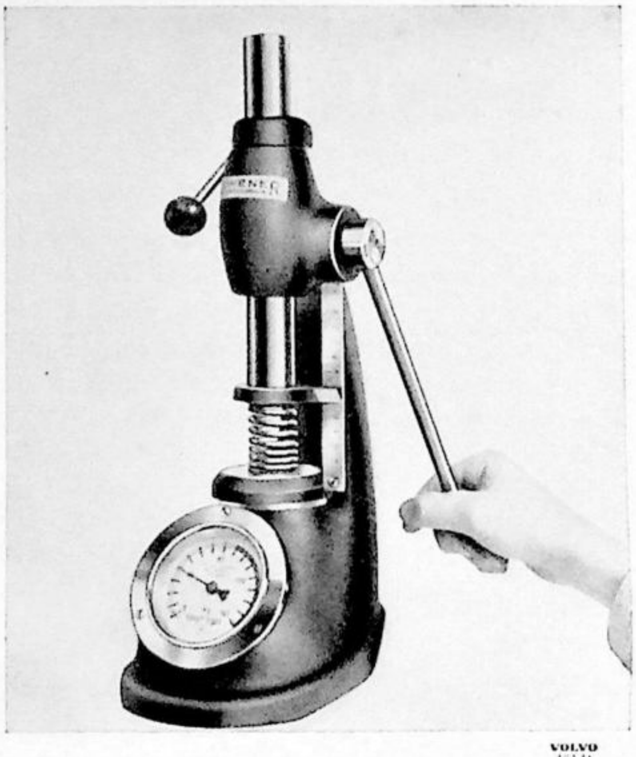


Fig. 63.

The later version valve spring, marked blue, is mounted in the cylinder heads without a lower seat washer. This is possible because the spring is longer, and is held by a hole recessed in the cylinder head. 1, Fig. 62.

If the blue-coded spring is to be mounted in a cylinder head of the earlier type where the recess is intended for a larger diameter spring, a special guide washer must be installed as shown in 2, Fig. 62. The usual lower valve spring seat washer cannot be used with a spring of the new type. — Valve springs of different types should not be installed in one and the same engine.

Push Rods

The push rods must be perfectly straight; check by rolling them on a surface plate. If they roll irregularly, they are bent and must be rejected. The push rods of engine item no. 495302 are 1.5 mm = 0.06 in. shorter than the rods in the older engines.

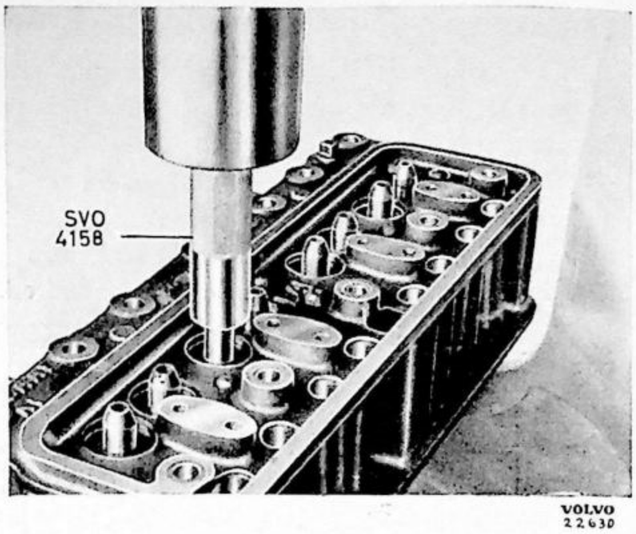


Fig. 64.

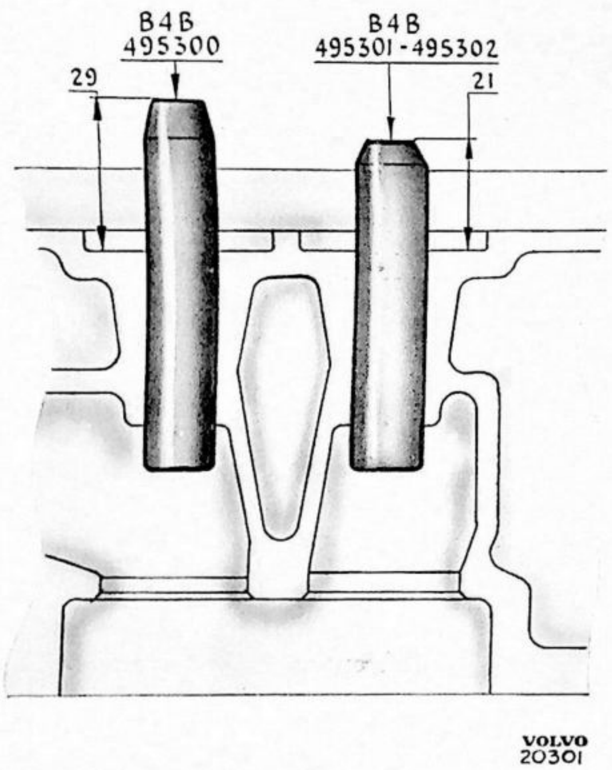


Fig. 65.

Replacing Valve Guides

Press out the old valve guides with tool SVO 1459 mounted in a press. Installing new valve guides, tool SVO 1458 for engine no. 495300 and tool SVO 4158 for later engines, Fig. 64, automatically give correct mounting depth. After installation, the distances from the valve guide upper end to the cylinder head upper flat should be as specified in Fig. 65, where 29 mm = 1.14 in., and 21 mm = 0.83 in.

New valve guides are reamed with reamer SVO 4128, which is used for both intake and exhaust valve guides. As the intake valve stems have slightly larger diameter than the exhaust valve stems, the intake valve to valve guide clearance becomes automatically slightly smaller.

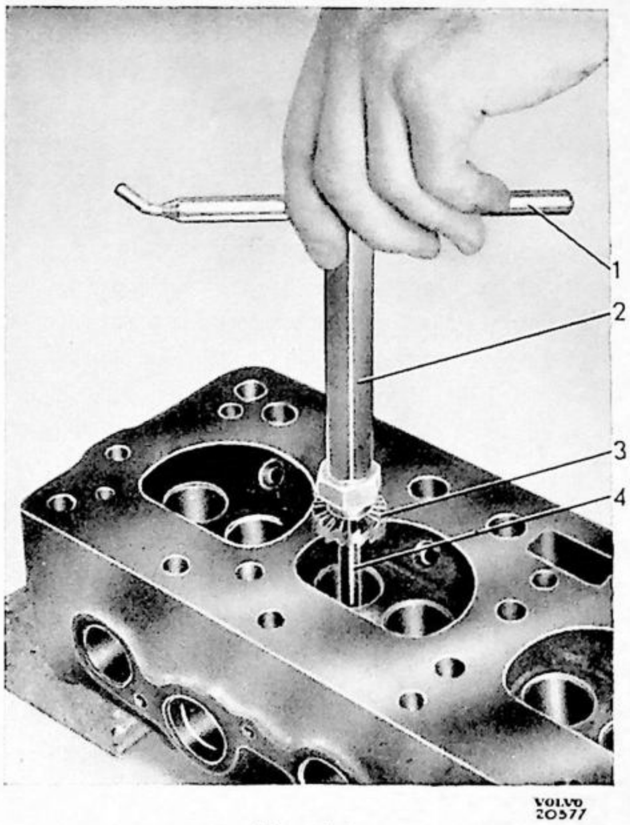


Fig. 66.

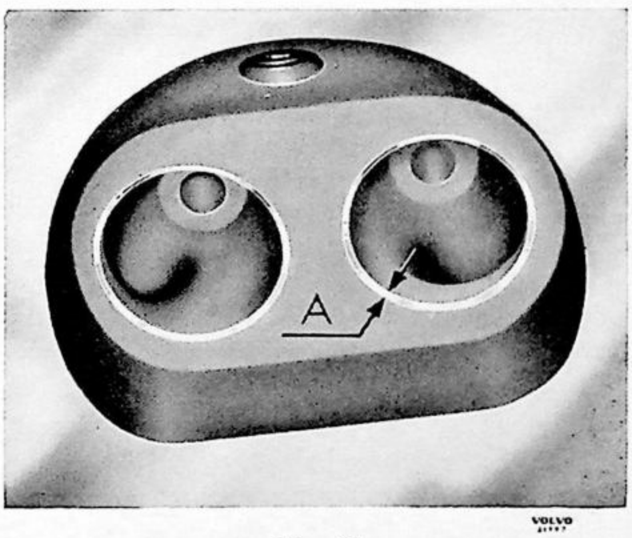


Fig 67.

Valve Seat Grinding

Before grinding valve seats, always clean the combustion chambers and gas passages in the cylinder head, and install and ream new valve guides, if required.

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

The refacing is performed either with hand milling cutters, Fig. 66, or, preferably, with an electrically driven high-speed grinder. The grinding wheels used must be carefully dressed and adjusted to 45° using a special attachment which is set to the desired angle. The wheel with center is placed on the shaft of the attachment, and is rotated by the electric machine while a dressing diamond is moved back and forth over the working surface of the wheel.

To reface the valve seat, a spindle which is part of the equipment, is first placed in the valve guide where it is centered and locked in positon by means of an expander arrangement. The spindle is then lightly oiled, the mounted grinding wheel placed on the spindle and driven by the electric machine under light pressure. The wheel should be allowed to rotate only a few seconds at a time; the machine is then switched off but is not lifted until the wheel has come to a stop. This procedure is continued until the entire seating surface is smooth. If necessary, the width of the seat face is reduced from above by means of a 20° angle grinding wheel, and from the bottom by means of a 70° wheel. After grinding is completed, the seat width should be A= 1.5 mm=0.06 in., Fig. 67.

Valve Grinding

Valve grinding comprises three operations: refacing of the valve head sealing surface, cut-off grinding of the stem end, both performed in special machines, and the final lapping-in of the valve head against the valve seat with the help of an abrasive compound.

The facing of the valve head is carried out in special machines. The valve is chucked and brought into rotation against a fine-grain grinding wheel, also rotating. Before the operation, the valve must be carefully cleaned from carbon and oil. The feed is adjusted so that the face does not blue owing to excessive heat. After the operation, the thickness of the valve head at the edge should be at least 1 mm=0.04 in., or the valve is reject. Valves with thinner edges will soon be scorched and warp.

To grind the stem end, place the valve in a vee-block and press the stem against the side of a grinding wheel, while at the same time rotating the valve.

The final lapping-in of the valve is carried out against the seat proper which is given a light coat of an abrasive compound mixed with oil. The valve is placed in position, pressed against the seat, and rotated back and forth a few times by means of a suitable implement. After repeating this operation a few times, lift out the valve and clean valve and seat. Next, apply a coat of paint to the valve head surface, insert the valve in the valve guide, press it against the seat and turn about one-quarter turn. If the contact is satisfactory, the paint will cover the entire surface of the seat.

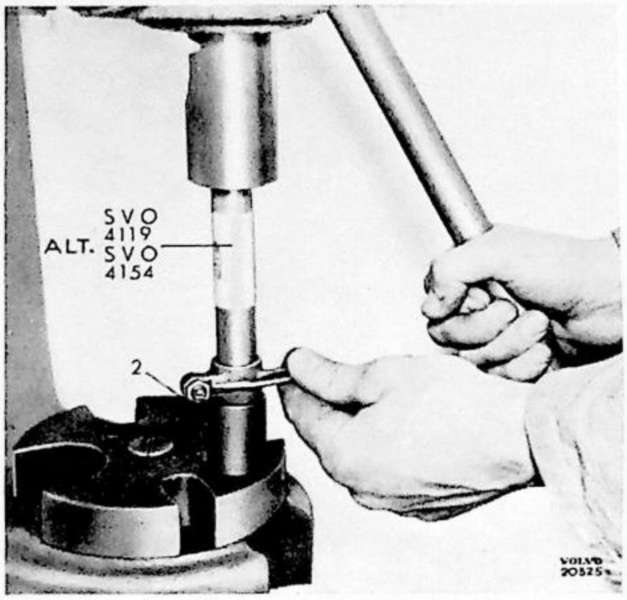


Fig. 68.

Fig. 69.

Installing New Valve Seats

Note! Before a valve seat is replaced, always install a new valve guide and ream to correct size.

When a valve seat is so heavily scored that it cannot be reconditioned by milling or grinding, it must be removed altogether by means of a special end milling cutter, and a new, steel or cast iron, insert installed in its place. The new seat insert must be very carefully milled to size and pressed into place in order to seat perfectly. — The operation requires a special equipment containing a milling attachment and drifting tools.

The new seat insert is cooled with carbon dioxide snow, and is then pressed into place with the formed drift. The new seat is then ground to correct width and angle as above.

Rocker Arms

The rocker arms carry numbers, beginning from the front end. When a new rocker arm is mounted, it should be marked with its appropriate number before installation. All rockers in the late version of the B 4 B engine have oil passages.

It is important that the rocker bushings are not too much worn, 0.1 mm = 0.004 in. being admissible. Take care that the rocker arm pad has the correct form, that the oil passages are not clogged up, and that the locknut and the ball and thread of the adjusting screw are in good condition.

When replacing rocker arm bushings, take care to turn them the correct way; the passage in the bushing should form 30° angle with the ball screw. Earlier type bushings are mounted using drift SVO 4119 and a press, present type bushings using tool SVO 4154, Fig. 68. A suitable sleeve 2, Fig. 68, is used as rapport. The new bushings are reamed to size with reamer SVO 4129 in the case of earlier type bushing, reamer SVO 4153 for late type bushing, Fig. 69.

The surface of the rocker arm pad is ground smooth with the help of a special tool. The pads are case-hardened, restricting grinding depth to max. 0.5 mm = 0.02 in. The oil passages in the bushings are blown clean with compressed air.

Defective adjusting screws and locknuts are rejected and replaced.

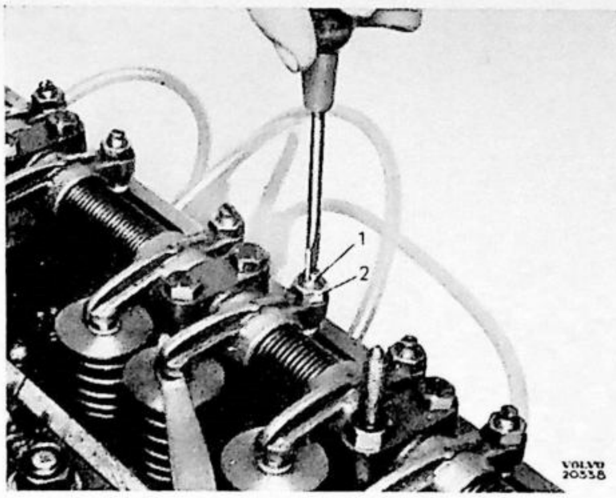


Fig. 70.

Rocker Arm Shaft

The rocker arm shaft must be replaced when the rocker journals have worn 0.05 mm = 0.002 in. Good shafts are blown through with compressed air.

Valve Lifters

Valve lifters with worn or damaged bearing surfaces are rejected and replaced.

Valve Adjustment

After reconditioning an engine, the first thing to do is make a preliminary adjustment of rocker to valve clearances. This is done in the following manner, with all spark plugs removed.

Number one piston is cranked to ignition position, as observed by the closing of the exhaust valve on no. four cylinder.

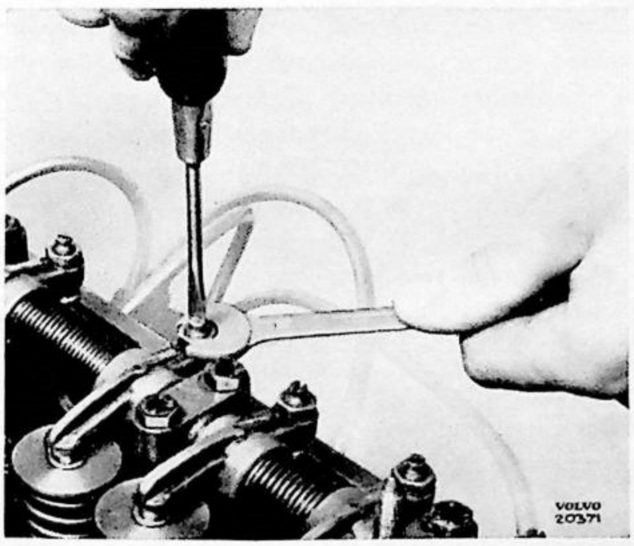


Fig. 71.

Back off locknut 2, Fig. 70, and turn ball screw 1 until feeler gauge binds, then slacken screw enough to allow the gauge to be moved with some friction. Tighten locknut, taking care that the screw does not turn with it, Fig. 71. Now place no. four piston in ignition position by observing the closing of no. one cylinder exhaust valve, and adjust the valves. Then proceed to adjust valve clearances of cylinders nos. two and three. The closing of no. three cylinder exhaust valve signifies ignition in cylinder no. two, and vice versa.

The proper rocker to valve clearances are:

Engine part no.	Intake valve mm	Exhaust valve mm
495300	0.15	0.20
495301	0.30	0.35
495302	0.40	0.45

When the valve clearances have been adjusted, refit spark plugs and start engine. Do not forget to fill oil and water.

A final adjustment is made when the engine has reached normal operating temperature.

Then check clearances while engine is idling.

Flywheel

Replacing Flywheel Bushing

If the flywheel center bushing is so much worn that the transmission mainshaft 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 $35 \pm {}^{0.006}_{0.010}$ mm, and maximum runout is 0.025 mm = 0.001 in.

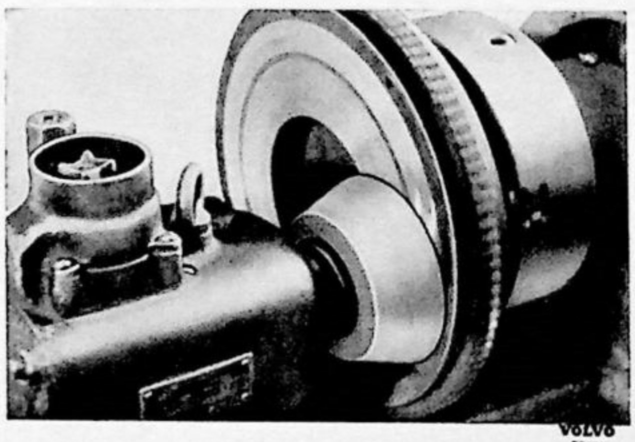


Fig. 72.

Refacing Flywheel

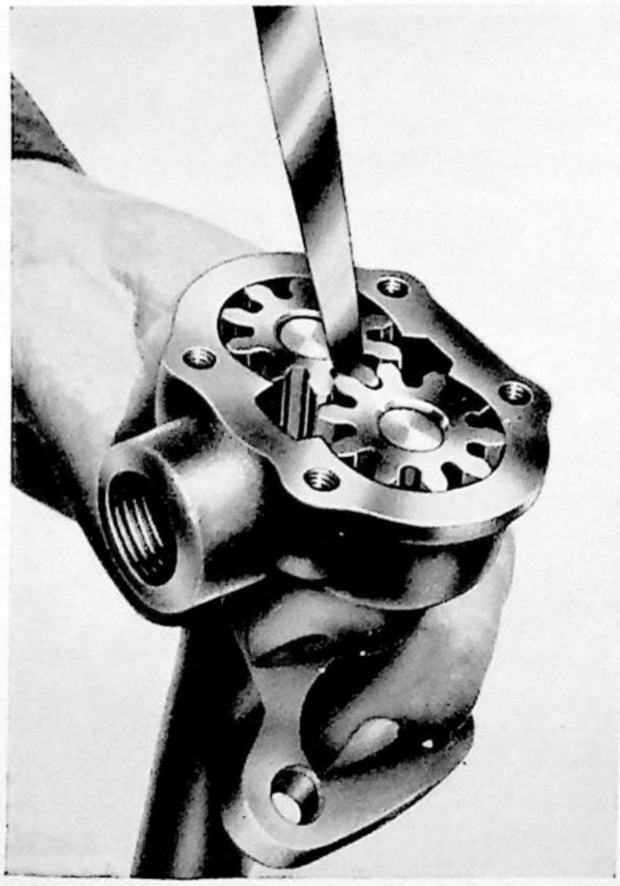
If the face of the flywheel is scored, it may be refaced by grinding with a special grinding attachment in a lathe, Fig. 72. The total depth available for grinding is restricted to 0.75 mm = 0.03 in.

Replacing Ring Gear

Remove the old ring gear with hammer and drift (chisel), heat the new ring gear to about 180° C = 355° F and place it on the flywheel with the beveled side of the teeth upwards (i.e. facing the front of the engine after mounting flywheel). Tap the gear lightly to seat it well against the shoulder on the flywheel.

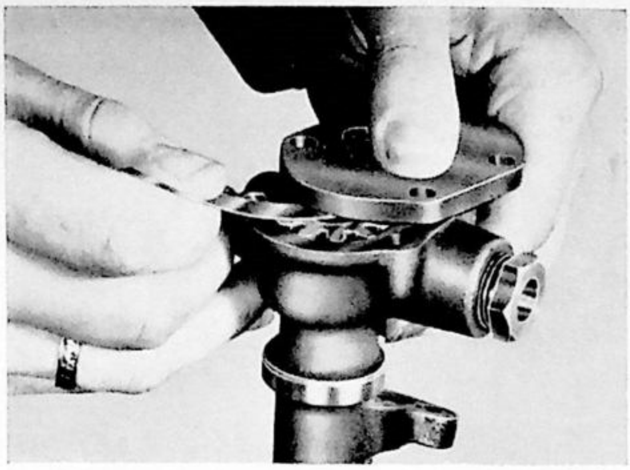
Clutch Pilot Bearing

The clutch pilot bearing in the flywheel should be replaced if play is evident, or if it shows damage to balls, ball-cage, or races after cleaning. Drive out the old bearing and install a new one with tool SVO 1426. If flywheel and flywheel cover are mounted, use tool SVO 4090 to extract bearing.



VOLVO 20361

Fig. 73.



VOLVO 20360

Fig. 74.

Lubricating System

Oil Pump

Testing

To test oil pump, disassemble, fill with oil, and turn it backwards while holding a finger across the inlet port. A pressure shall be clearly felt.

Reconditioning

The most important requirement is that the pump shaft must not have too much clearance in the housing. Clean the pump and check clearance. Worn or damaged bushings are replaced; if housing is scored, replace entire housing. The shaft bushings are pressed into position and reamed to size, using a reamer and guide bush. Holes for grooved pins are drilled in shaft after gears have been mounted. Before locking driving gear in place, check that there is an axial clearance of 0.02 mm = 0.0008 in., and that gear backlash is between 0.15—0.35 mm, i.e. 0.006—0.014 in., Fig. 73. The driven gear is mounted with the ground side facing the pump housing cover. A scored cover may be refaced on a plain grinding machine.

Before assembling cover, check clearance between cover and gears as shown in Fig. 74. The correct value is 0.05 mm = 0.002 in.

Always use Volvo original gasket between cover and housing, as the thickness of this gasket determines the gear to cover clearance.

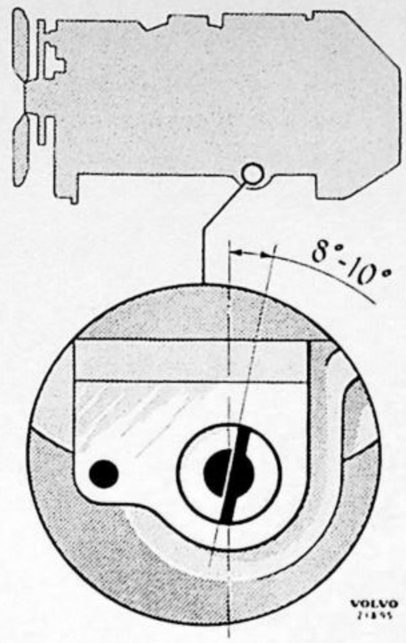


Fig. 75.

Installing Oil Pump

If the pump has been removed, with distributor left in place, take care to rotate pump shaft when reassembling pump so that the slot in the upper pump shaft end engages the driver on the distributor shaft. If the engine has been cranked over, or the distributor shaft rotated, while the oil pump was disassembled, it will be necessary to retime the ignition after reassembling the pump. The installation of the pump is facilitated if the distributor is removed and put back when the oil pump has been secured. With the engine cranked to 0° and no. one cylinder ignition, the driving gear shall be in the position shown in Fig. 75.

Reducing Valve

The reducing valve plunger is extracted by means of tool SVO 2079. Clean plunger before reassembling. The spring is tested in the manner shown in Fig. 63; if it differs from the specified length, replace spring.

Oil Strainer

Clean oil strainer by washing with suitable solvent and blowing dry with compressed air. It may also be brushed with a hard brush — do not use a steel wire brush. If the strainer wire has come loose at the edge, repair by soldering, or replace strainer.

Oil Passages

It is very important that the oil passages are perfectly clean and great care should be taken to ensure the removal of all obstructions. The best method is to remove the plugs at both ends of the main oil gallery and scrape the walls of the passages clean with a piece of steel wire or other suitable implement, afterwards flushing out with water and blowing dry with compressed air. Then remove the three plugs on the left side of the cylinder block and clean the side passages in the same manner. Do not forget the rocker system oil passage rising through the cylinder block and cylinder head beside the last cylinder.

Oil Cleaner

The cleaner cartridge should be replaced on the occasion of any major reconditioning of the engine, and at the regular 10,000 km, i.e. 6000 mile, maintenance intervals. Remove the nut on top of the cleaner cover, and lift cover and cartridge. When reassembling, check that gasket is in good condition and seals well, otherwise replace it. — On cars with cleaners which cannot be disassembled, replace entire cleaner.

Crankcase Breather

The purpose of the crankcase breather is to remove vapor and blowby gases from the crankcase through a pipe on the left side of the crankcase. If this pipe should become obstructed, a pressure rise occurs in the crankcase which may lead to oil leakage at the main bearings and crankcase gaskets. The ventilating pipe and the oil filler cap filter should be cleaned carefully at regular intervals and in connection with major overhaul.

Ignition System

Ignition Distributor

Dismantling Distributor

1. Remove distributor head and rotor assembly.
2. Disconnect vacuum governor link and remove governor assembly by removing two screws securing governor to distributor housing.
3. Remove screws securing breaker assembly carrier plate in distributor housing, and lift out breaker assembly.

4. Drive out grooved pin holding shaft coupling dog, and remove shaft.
5. Remove breaker cam retainer ring and remove breaker cam.

To reassemble, proceed in reverse order.

Inspection

Inspect separately the various distributor parts, shaft, governors, breaker assembly, condenser, and terminal head.

Distributor shaft

The distributor shaft runs in two bushings with a clearance which must not exceed 0.127 mm = 0.005 in. Replace worn bushings. If the governor mounting plate is damaged, replace shaft

Centrifugal Governor

The centrifugal governor is located in the bottom part of distributor housing, and consists of two springloaded weights. Replace damaged weights and stretched springs.

Breaker assembly

The breaker cam is a sleeve riding on the distributor shaft, and connected with the governor weights by means of linkages. The surfaces of the four cams must not be too rough or too much worn as reliable distributor action is then impaired. Replace a damaged breaker cam.

The breaker assembly carrier plate acts as a support for the breaker plate proper on which the breaker arms are mounted. In the first version of Auto-Lite distributor used, the breaker plate was mounted on the carrier plate by means of a ball bearing.

Inspect the breaker points for burning and pitting. If damage is considerable, replace contact strips. Replace also, if the dwell surface of the moving breaker arm, or the arm pivot, are so much worn that adjustment is no longer possible.

Condenser

An electric condenser consists of two conducting electrodes separated by an insulating medium called the dielectric. The purpose of the condenser is to prevent arcing at the breaker points which would cause pitting and carbon formation, resulting in bad contact.

The condenser is connected in parallel with the breaker contacts. If found defective, the condenser should be replaced, but not until the charging current from the generator has been measured. Too high charging currents, and overcharging of the battery, will destroy the condenser.

Fig. 76.

Terminal head and cables

The distributor terminal head is held in place by two clamps. Check their springiness when assembling to see that they hold terminal head securely.

Scrape all terminals perfectly clean, then test distributor head for cracks, particularly between terminals and from terminals to the bottom edge of the head. Such cracks are apt to cause ignition troubles.

The spark plug cables must be in perfect condition in order to give reliable and safe service. Cables with broken or otherwise damaged insulation are replaced.

Vacuum governor

Two screws secure the vacuum governor to the distributor. housing The movement of the

Fig. 77.

Fig. 78.

diaphragm is transmitted to the breaker plate by means of a link. See below under "Testing Distributor", page 41.

Spark Plugs

The selection of suitable spark plugs for the engine is important. Recommended types are listed in the specification at the end of the Manual.

The spark plugs must be free from carbon and other deposits, and must have the prescribed electrode gap.

Spark plugs will keep clean of deposits if operated at the temperature for which they have been designed. If a spark plug is clogged with carbon, or wet with oil, the reason may be either a defective insulator or wrong electrode spacing. Sand blast electrodes, adjust spacing, and test plug as detailed below.

If it does not remove the defect, the spark plug is probably too "hot", i.e. its heat resistance is too high. Replace with plug with lower heat number. If the plugs are burnt or pitted, the temperature has probably been too high; replace with plug with higher heat number.

Cleaning of spark plugs is best carried out by sand blasting in a special apparatus shown in Fig. 76. Oily plugs are washed in gasoline before blasting.

Blow plugs clean, inspect for electrode erosion, and reject plugs that are heavily pitted. Change spark plugs regularly at 20,000 km — 12,000 mile intervals.

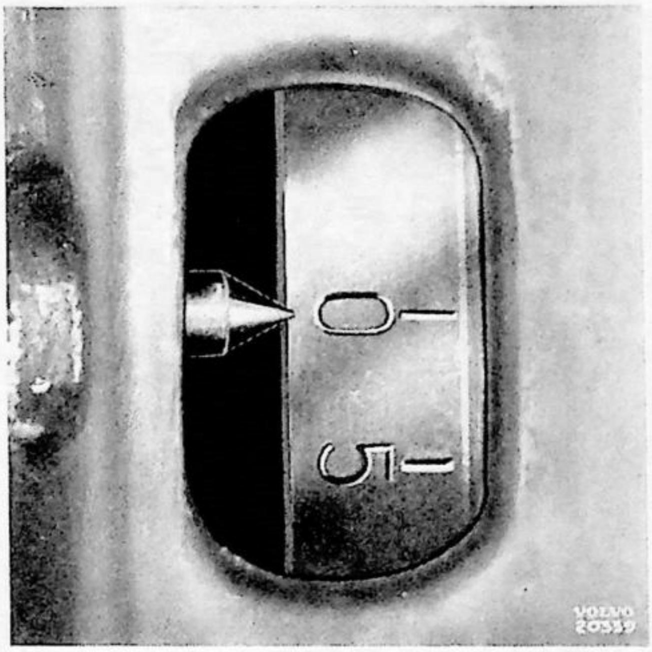


Fig. 79.

Adjust electrode spacing to 0.7—0.8 mm = 0.028—0.032 in. Always use a wire gauge to measure gap, Fig. 77, as a feeler gauge gives too large electrode gaps. To adjust gap, bend side electrode with a pair of pliers, Fig. 78. For the testing of plugs, see "Ignition System Testing".

Ignition Coil

Defects occurring in ignition coils can generally not be repaired, and the coil must be replaced. See under "Ignition System Testing" for ignition coil testing procedure.

Ignition Timing

The ignition is timed by rotating the crankshaft until the piston of no. one cylinder is in the ignition position, and then placing the distribu-

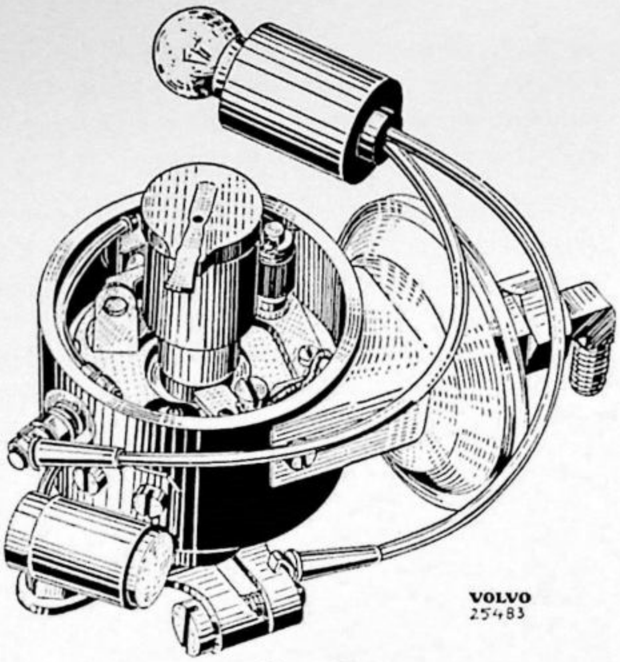


Fig. 80.

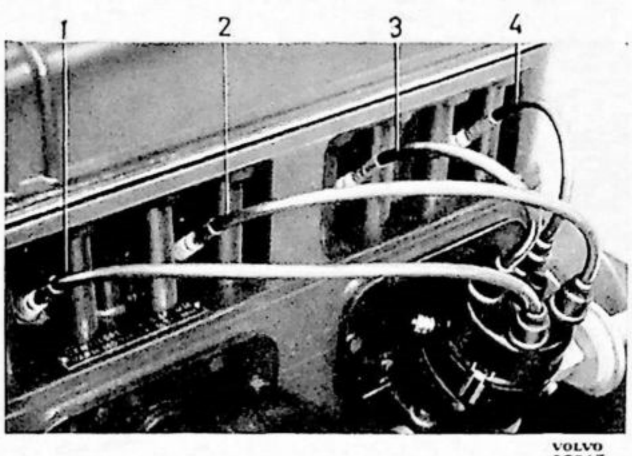


Fig. 81.

tor breaker arm in breaking position. The actual procedure is outlined below.

1. Remove rocker cover and spark plugs.
2. Turn engine slowly by pulling the fan (in the normal running direction) and observe the valves of no. one cylinder. When both valves are closed, the piston is rising on the compression stroke toward ignition point.
3. Now observe the window in the left side of flywheel cover, and turn engine until the ignition setting stated in the specification is directly opposite the index, Fix. 79. If the engine is inadvertently pulled past this setting, return a suitable amount and advance again to obtain the correct setting.
   In some cars, which are equipped with a new type of heater, reading is a little difficult, and the marks have been supplemented by other means, i.e. a raised index on the timing gear cover which coincides with a notch in the crankshaft pulley at 0° setting. This change is effective as from engine no. 29841.

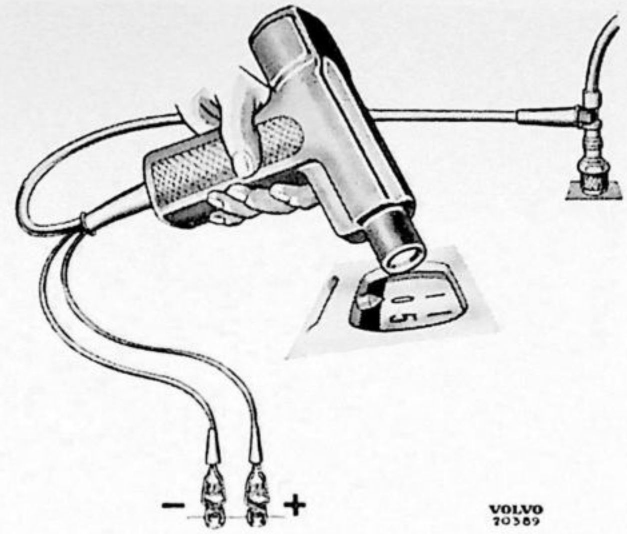


Fig. 82.

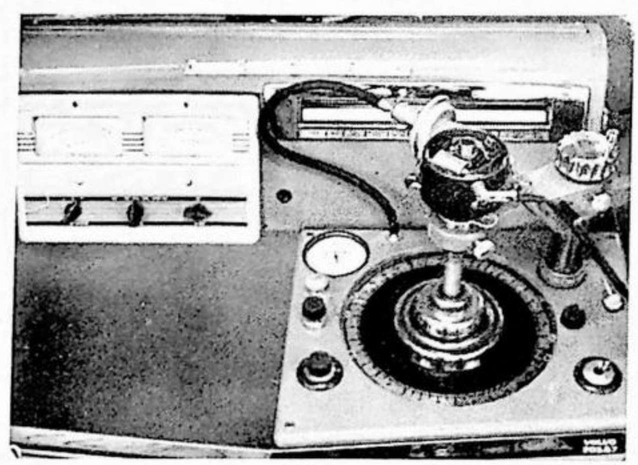


Fig. 83.

4. Remove screw under distributor and rotate distributor clockwise until breaker contacts close. Connect a test lamp of max. 3 watts as shown in Fig. 80 and turn on the ignition.
5. Rotate distributor slowly counter-clockwise until test lamp lights up, and then tighten screw under distributor.
6. Check that the distributor rotor points to the terminal which connects to no. one spark plug. Then assemble the other spark plug cables in the distributor head in the

proper direction (distributor shaft rotates clockwise) and firing order, Fig. 81. The firing order of the cylinders is 1—3—4—2.

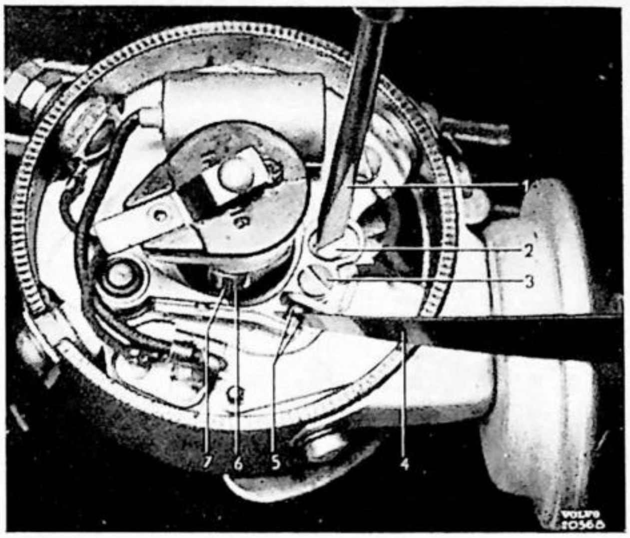


Fig. 84.

7. Use the lamp shown in Fig. 82 to check the ignition timing when the engine is running and point it to the flywheel cover window. The lamp connects to the battery and to no. one spark plug, and lights up every time no. one plug fires. Owing to the stroboscopic effect, the flywheel markings will appear as stationary. The engine should run at idle speed; at higher speeds the distributor governor becomes operative and advances the ignition timing so that the idle timing cannot be checked.

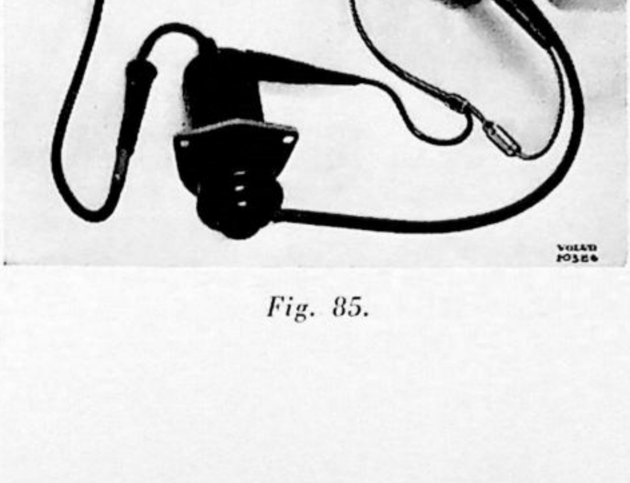


Fig. 85.

Ignition System Testing

Testing Ignition Distributor

The ignition distributor is tested in a special distributor tester, Fig. 83.

Place the distributor in the receptacle and run it at the speeds given in the specification.

If the test values do not agree with those in the specifications, inspect the centrifugal governor. A defective vacuum governor must generally be replaced, the usual cause being a ruptured or damaged diapragm.

Observe instructions accompanying the distributor tester.

Adjusting Breaker Point Spacing

Correct breaker point spacing, (5, Fig. 84), is set by running the distributor in the tester of Fig. 83 and observing the dwell angle. Run distributor at 250 rpm, and adjust gap by means of the setscrew. The correct value of dwell angle is given in the specification.

If no distributor tester is available, adjust the breaker point spacing to 0.4—0.5 mm = 0.016—0.020 in. Rotate the shaft to a point where the gap is maximum, then loosen the setscrew of the fixed contact and adjust gap by turning the eccentric screw, and finally pull setscrew tight. In the Bosch distributor, the distance between setscrew and adjusting screw is larger than in the Auto-Lite distributors.

Testing Spark Plugs

After cleaning and adjusting spark plugs, test them in the special spark plug tester, Fig. 76, as it is impossible to judge their true condition from ocular inspection only.

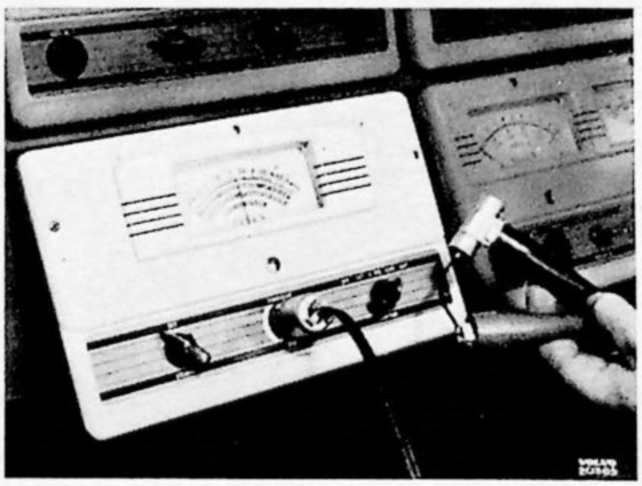


Fig. 86.

Mount the spark plug and place the pressure chamber of the apparatus under 7 kg/cm^2=100 lb./sq.in. 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.

Testing Ignition Coil

The ignition coil is tested in a special coil tester, Fig. 85. Tests should be made with the coil at normal temperature, and heated by being connected to a 6-volt battery for about 15 minutes.

A test lamp connected into the primary circuit should light up if the coil in order. If the lamp remains dark, the primary is open. Replace the coil.

The secondary is tested with 220 volts D. C. A. neon bulb connected in series with the secondary winding should glow if the winding is in order. The bulb is grounded to one of the terminal screws.

Testing Condenser

The condenser is tested with a special instrument, Fig. 86. For the test, the condenser is disconnected from the distributor in order to exclude influence of unsatisfactory terminal insulation on the result. Follow instructions shipped with the tester.

The condenser is tested for leakage by connecting it in series with a neon bulb to 220 volts D.C. Connect the condenser sleeve to one cable, and place the other cable on the condenser connector cable; the neon will then light up brightly during a short moment when the condenser is charged. Depending on the condition of the condenser, the bulb will continue to glow more or less brightly, or go out again. Remove the cable and short-circuit the condenser — a powerful spark shall ensue. If no spark is obtained, the condenser dielectric is damaged, and the condenser is rejected and replaced.

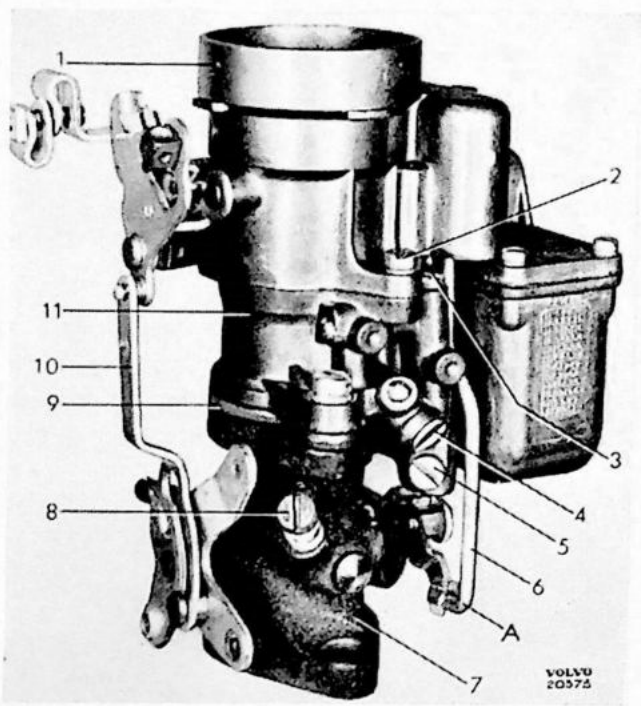


Fig. 87.

1. Air horn
2. Air horn assembling screw
3. Idle jet plug
4. Main jet plug
5. Idle jet plug
6. Connector rod
7. Main body flange
8. Air screw
9. Spacing flange
10. Connector rod
11. Main body with float bowl

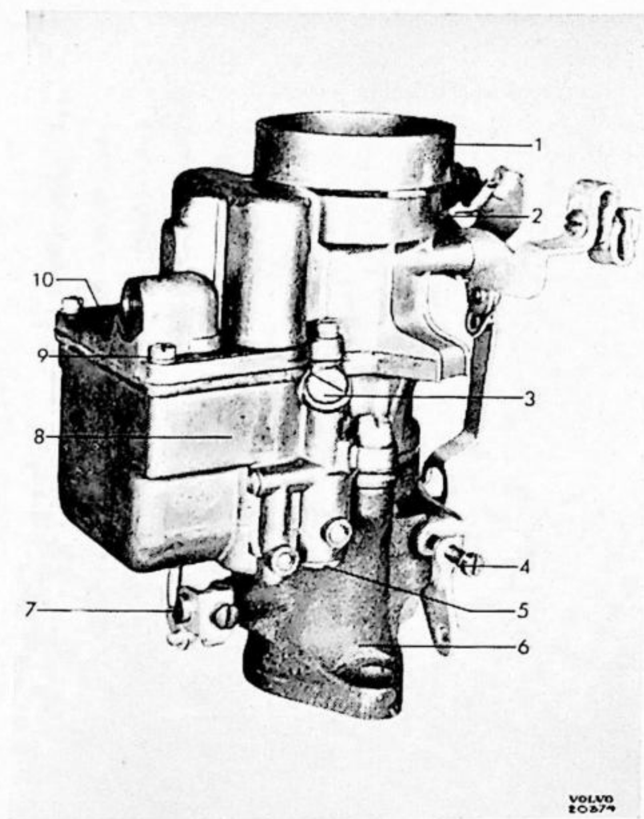


Fig. 88.

1. Air horn
2. Choke plate shaft
3. Pump jet plug
4. Idle mixture screw
5. Pump filter plug
6. Main body flange
7. Throttle plate shaft
8. Main body with float bowl
9. Float bowl cover assembling screw
10. Float bowl cover

Testing Distributor Terminal Head

Wash distributor head carefully in clean gasoline and test its insulating properties by connecting its terminals, in pairs, to 220 volts D.C. via a neon bulb. If the bulb glows, the distributor head is cracked or fouled by carbon deposits which spring the current between terminals.

Fuel System

Carter Carburetor

Cleaning

Carburetor cleaning includes cleaning of float bowl, accelerator pump, fuel passages, and jets.

Disconnect connector rods (6 and 10, Fig. 87), remove air horn (1) from main body (11), and four screws securing float bowl cover and take

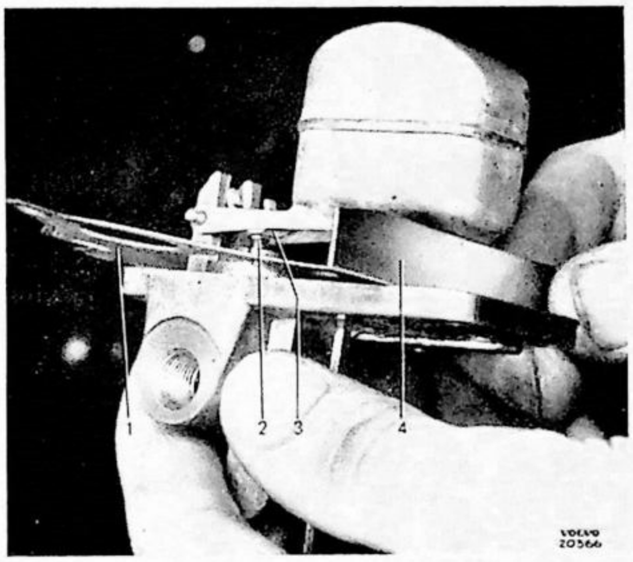


Fig. 89.

off bowl cover. Separate main body (11) and body flange (7). Remove air screw (8), main jet plug (4) and idle jet plugs (3 and 5), also pump filter plug (5, Fig. 88), inlet and outlet valves, and accelerator jet plug (3).

Wash all parts carefully in clean gasoline and blow dry with compressed air. Carefully blow out all impurities from float bowl, pump barrel, passages and jets.

Use only compressed air to clean stopped jets — do not scrape with metal wires or similar implements. The idle jet, for example, is manufactured to a tolerance of 0.006 mm = 0.00024 in. and would be ruined by even a minute scratch.

After blowing clean, test inlet and outlet valves by blowing through them with the mouth. They must pass air in one direction only. Replace defective valves.

Install valves and all plugs, assemble main body on flange, check and adjust if necessary:

1. Float level and front.
2. Pump stroke.
3. Metering rod.

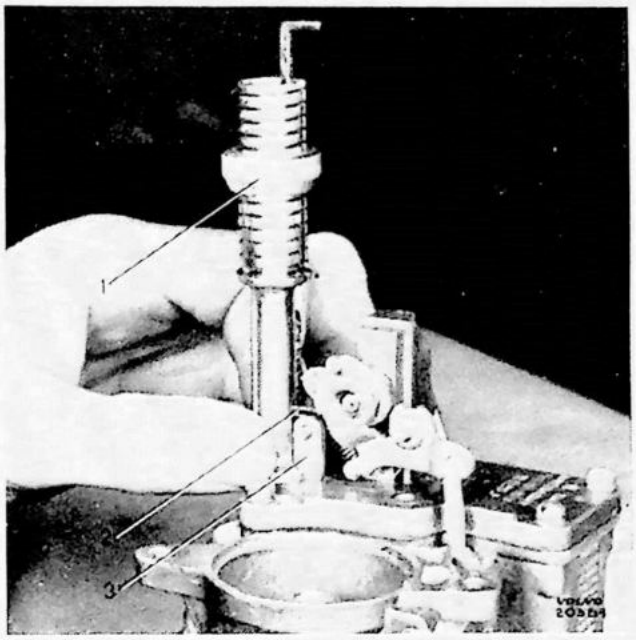


Fig. 90.

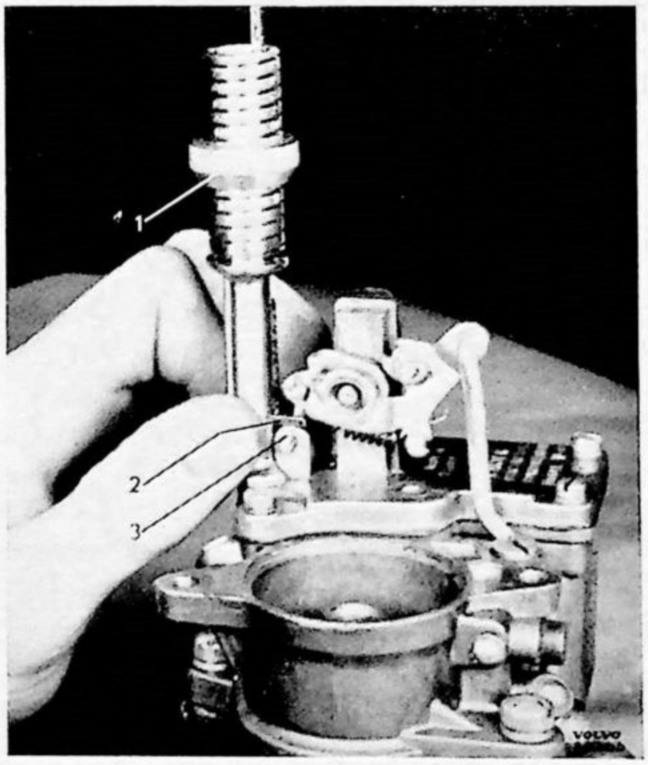


Fig. 91.

Checking Float Level

The float level is checked by means of gauge T 109—80, or a 9.5 mm wide feeler gauge (4, Fig. 89), which is placed between float and bowl cover. Turn gasket aside for the check. The tongue shall bear on the needle valve (2) without exerting a load on it.

If the spacing differs from 9.5 mm, adjust by bending tongue. Bending toward the valve reduces fuel level, and vice versa. If it is suspected that the float has sprung a leak, e.g. if carburetor is flooding, remove float and shake it to find out if it contains fuel. In this case, submerge in hot water to find location of puncture, then drill a 1 mm = 1/16" hole in float directly opposite the puncture. Shake out the fuel, then solder both holes, using only a minimum amount of tin to keep down the increase in weight.

Checking Accelerator Pump Stroke

Assemble float bowl cover, complete with float on float bowl, and connect throttle to pump connector rod.

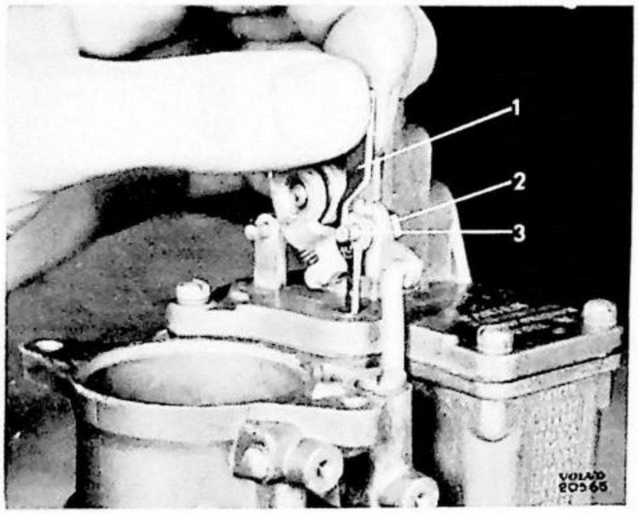


Fig. 92.

The flow through accelerator pump jet determines the acceleration properties of the engine. Check flow by measuring plunger stroke with gauge T 109—117 S which is placed on top bowl cover; throttle should be completely closed. Turn nut (1) on the gauge to make finger (2) just touch the upper end of plunger rod (3, Fig. 90). Note scale reading.

Turn throttle to wide open, and move finger (2) to position shown in Fig. 91.

The difference between the two readings, with throttle valve fully closed and wide open, should be 9/64" = 3.5 mm. Adjust by bending connector rod at A, Fig. 87.

Checking Metering Rod

Final adjustment of the metering rod can not be effected until the accelerator pump stroke adjustment has been made. Never bend connector rod in order to adjust metering rod.

Place gauge T 109—26 as shown by Fig. 92. With the throttle closed, loosen nut (2) on rod holder (3), and place holder in recess in gauge (1). Tighten nut and install metering rod, taking care that it is correctly placed in the jet.

Alternative Metering Rod Adjustment

The metering rod can also be adjusted in the following manner.

Open throttle and place gauge T 109—44 between carburetor throat and throttle plate beside the idle port slot. This opening corresponds to 0.015 in. = 0.38 mm.

Push metering rod down until it bottoms in main jet. Adjust rod holder so that it touches the top of the rod eye, and tighten nut.

A certain leaning-out of the mixture at low speed can be achieved if the metering rod is lowered slightly, by using an 0.6 mm dia. wire instead of gauge T. 109—44.

Metering Rods

There is a choice of three metering rods for Carter carburetor WO—618 as used in the B 4 B engine:

1. Metering rod, Standard, 75—590 (Volvo no. 71491), for gasoline. Used with main jet 120—151S.
2. Metering rod, 75—697 (Volvo no. 71630), for ethyl fuel. Used with main jet 120—151S.
3. Metering rod, special, 75—676 (Volvo no. 71626) for reduced fuel consumption, though at the expense of engine power. Used with main jet 121—151S.

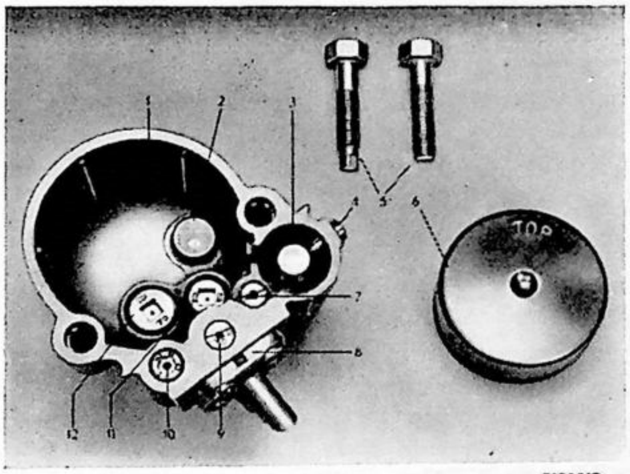
Zenith Carburetor

Disassembling

1. Blow carburetor outside clean.
2. Remove air cleaner, disconnect fuel pipe, vacuum pipe, throttle and choke linkages.
3. Remove carburetor from intake manifold.

Cleaning

1. Remove two float bowl cover screws, and take off bowl cover.
2. Drain float bowl and take out float.
3. Unscrew jets(9—12, Fig. 93), and ball check valve (7) of accelerator pump system. Use a medium size screwdriver to remove jets provided with slots. Remove jets in float bowl bottom using the bowl screw which is fitted with a square dog. Back off setscrew (4) and remove pump plunger (3). Remove pump inlet valve (2) using a 12 mm socket wrench. The accelerator pump jet becomes accessible after the emulsion block has been separated from the float bowl housing, Fig. 94. Observe that the four top screws must be



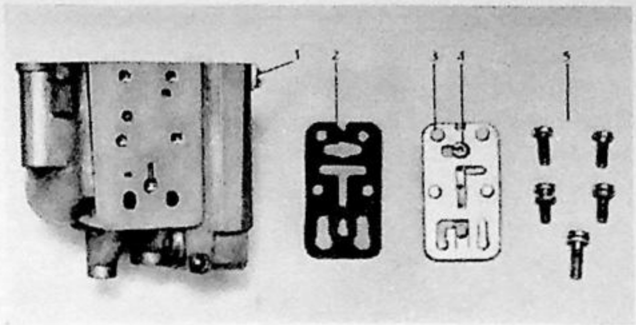
VOLVO 21321

Fig. 93.

1. Float bowl
2. Pump inlet valve
3. Plunger
4. Set screw
5. Float bowl screw
6. Float
7. Ball check valve
8. Emulsion block
9. Idle jet
10. Air jet
11. Main jet
12. Compensating jet

removed before the bottom screw is loosened in order to prevent damage to the bead on the emulsion block which localizes it on the side of the float bowl housing.

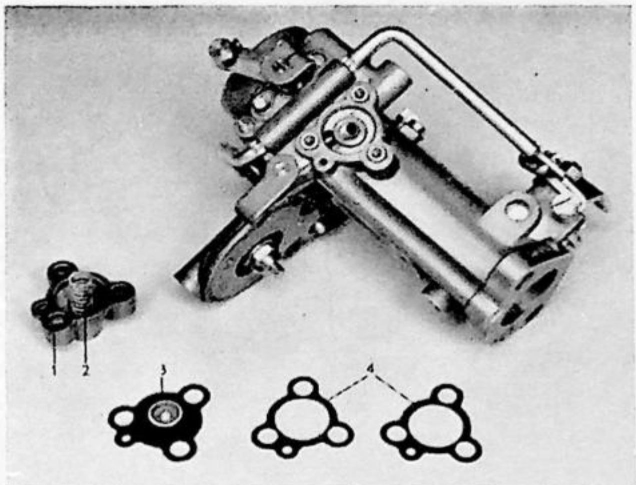
4. Remove compensating air valve, Fig. 95, fuel inlet valve, idle adjusting screw and idle air adjusting screw.



VOLVO 21323

Fig. 94.

1. Float bowl
2. Emulsion block gasket
3. Emulsion block (inside)
4. Pump jet
5. Emulsion block assembling screw



VOLVO 21322

Fig. 95.

1. Compensating air valve
2. Spring
3. Diaphragm
4. Gasket

5. Wash all parts carefully in clean gasoline or white spirit. Blow out jets, ball check valve, mixing chamber etc. Check ball valve by shaking it.
6. Install jets and mount mixing chamber (put in bottom screw first), and accelerator pump plunger, inlet valve, and ball check valve. Place float in bowl with marking TOP facing upward.
7. Install fuel inlet valve, idle screw, idle air screw, and compensating air valve. Replace damaged gaskets.
8. Assemble float bowl. Pull screws evenly, pressing float bowl housing against main body.

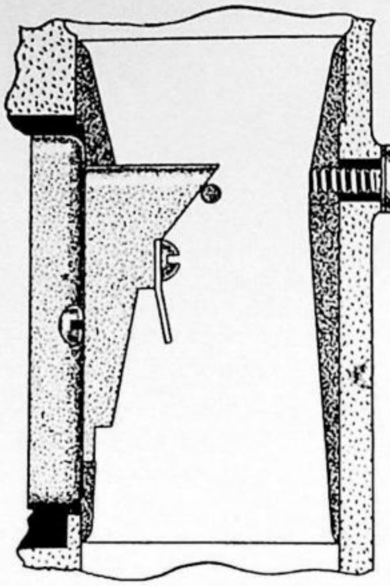


Fig. 96.

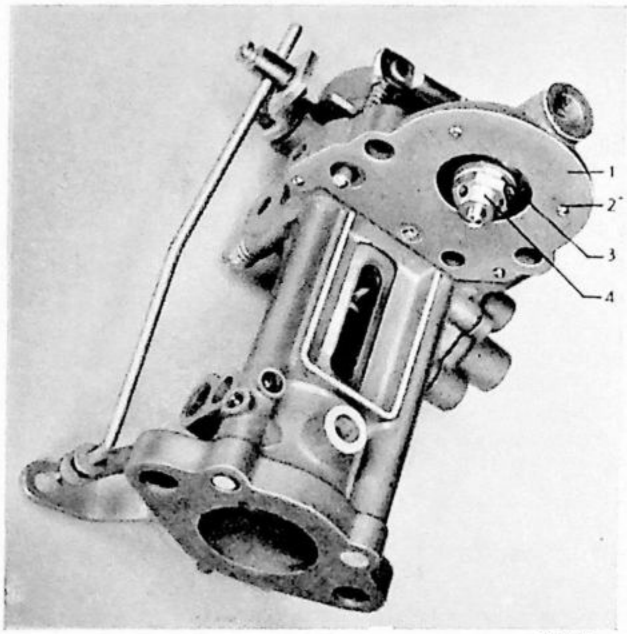


Fig. 97.

1. Float bowl gasket
2. Gasket pilot pin
3. Float level washer
4. Fuel inlet valve

9. Check that the cross member in the carburetor throat bears against the emulsion block nozzle, Fig. 96. If necessary, loosen screw and press throat insert upwards, then retighten screw.

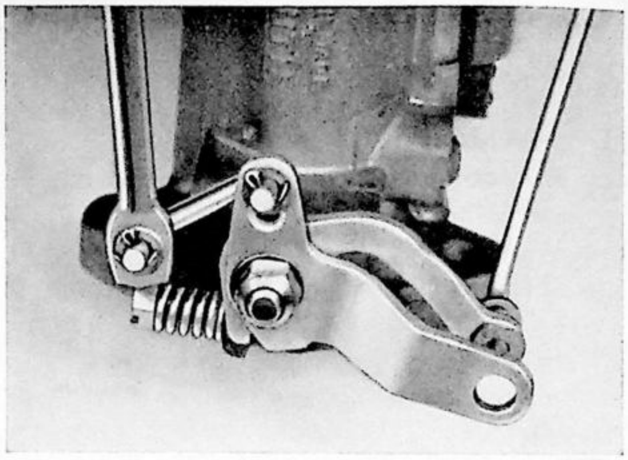


Fig. 98

Float Level

The float level is determined by the thickness of washer (3, Fig. 97), which is placed between fuel inlet valve and float. Correct thickness is 2.0 mm.

Accelerator Pump Stroke

The carburetor affords a choice of two pump strokes, Fig. 98. For normal acceleration, the connector rod is attached at the outer hole in the earlier version, and at the inner hole in the late version.

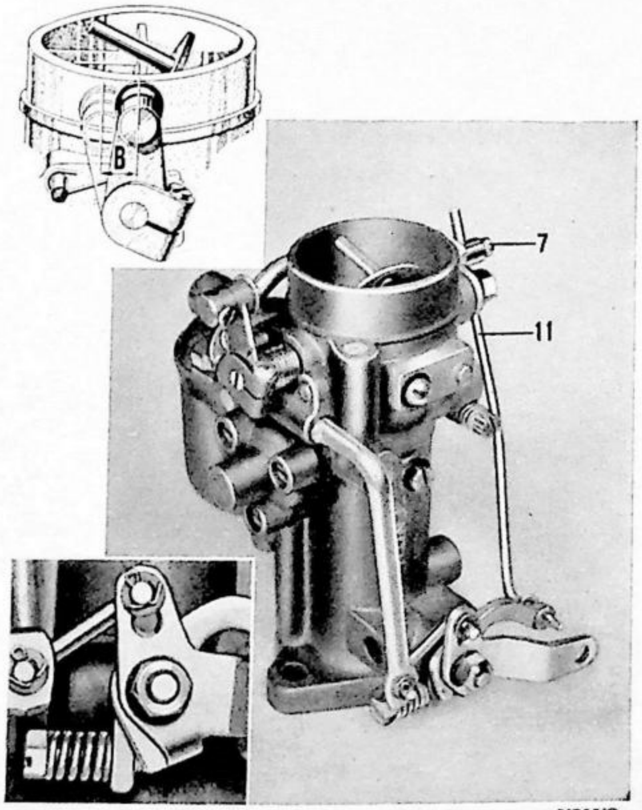


Fig. 99.

Fast Idle Adjustment

Fast idle adjustment is carried out in the following manner:

1. Close throttle completely by backing out idle screw.
2. Loosen screw (7, Fig. 99) in connector rod support to allow connector rod (11) to slide in the hole.
3. Close choke plate corresponding to 7 mm = 0.27 in. (B) movement of choke plate lever.
4. Place connector rod lower lever in a position where its hook touches the throttle shaft lever, then tighten screw (7).
5. Adjust idle speed after carburetor has been installed. To check the fast idle setting of a mounted carburetor, proceed in the following manner:

1. Leave idle screw in position for normal idle speed.
2. Close choke plate corresponding to 9 mm = 0.35 in. movement of choke plate lever, see B, Fig. 99.
3. Check that hook on fast idle connector rod lower lever just touches throttle shaft lever. If not, adjust with screw (7) as above.

The standard setting described here may be slightly altered to suit different weather conditions.

In humid air and at temperatures between —5° and +10° C, i.e. +25° and +50° F, the distance B should be reduced to 4 mm and 6 mm, 0.16 in. and 0.24 in., respectively, the latter figure when carburetor is mounted. This will start fast idle slightly earlier, thereby preventing stalling during the warm-up period. During longer spells of severe cold, distance B should be increased to 10 mm and 12 mm, 0.40 in. and 0.48 in. respectively, giving a richer fuel mixture during fast idling which is favorable in such conditions.

Assembly

To assemble carburetor, proceed in the reverse order to above.

Idle Adjustment

1. Set engine to idle slightly faster than normal by turning idle screw (19, Fig. 14).
2. Back out idle air screw (16) slowly (mixture becomes leaner) until engine nearly stalls, then return screw inward (richer mixture) until engine runs smoothly.
3. Reduce idle speed to normal with idle set screw.

If the air screw must be screwed all the way in, in order to make engine run smoothly, check idle jet. The normal position of the idle air screws is 1 turn (earlier version) or 2.5—3 turns (late version) from fully closed position. It should be set a little on the rich side in order to avoid explosions in the exhaust pipe.

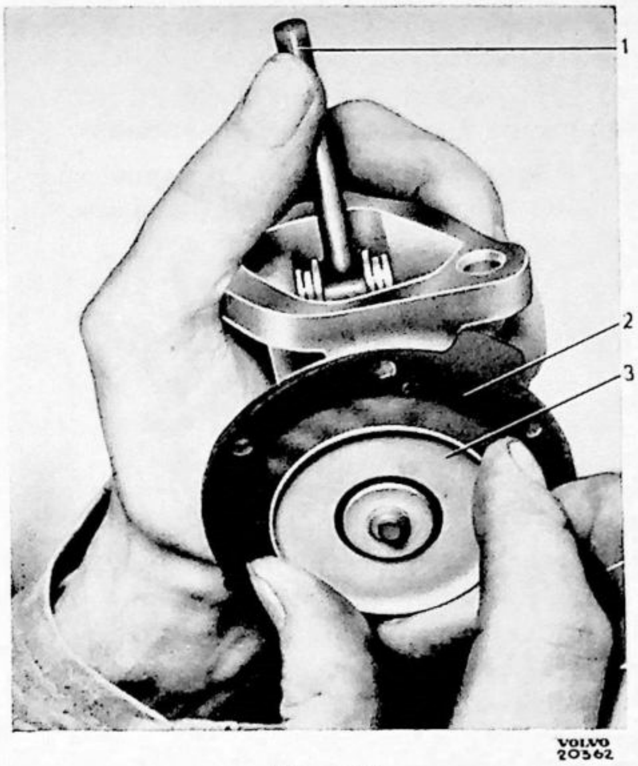


Fig. 100.

Alternative Jets

In order to obtain a leaner mixture, the main jet may be replaced by a smaller size, no. 95 for the earlier version, or no. 100 for the late version.

If the engine is run on ethyl fuel, the power jet should be replaced with a larger size, no. 75, and the part throttle air jet should be no. 2.4 (late version).

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 tank and that 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 in the following manner.

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

Replacing Diaphragm

1. Remove six 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. 100, and press rocker arm (1) with left thumb. Depress washer (3) with right hand thumb, rotate washer one-quarter turn, and remove washer, diaphragm (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 arm, and that the diaphragm is clamped evenly between the two pump housing halves.

Replacing 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.

Fuel Tank

Removing Fuel Tank, PV 444

1. Remove bottom plug and drain fuel into clean vessel. Remove the spare wheel support (earlier version) and disconnect cable to fuel gauge sender.
2. Disconnect hose from filler pipe, vent pipe, and fuel line to engine.
3. Remove screws securing tank to body.
4. Lift tank and clean tank outside.
5. Remove fuel gauge sender.

When installing new tank, take care that felt seal under tank is not damaged and that enough sealing compound is used. The installation is carried out in reverse order to the removal.

Removing Fuel Tank, PV 445

1. Drain fuel.
2. Remove fuel line, cable to fuel gauge sender, and collar of filler pipe.
3. Remove four screws securing tank to frame, and take out tank downward.

To install new tank, proceed in reverse order.

Repairing Fuel Tank

Observe the strictest caution with regard to every kind of open fire during all work on fuel tanks. Gases remaining in tank are highly inflammable and will explode, if ignited

Leaky fuel tanks shall be soldered tight. Remove tank from vehicle as described above under "Removing Fuel Tank", aid 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.

Ethyl Fuels

The use of gasoline for fuel gives rise to gum deposits in the engine. These deposits are soluble in alcohol, and this fact must be kept in mind when a transition from gasoline to ethyl fuel is contemplated.

In this case, it is highly advisable to remove and clean the tank very carefully before taking on board the first fill of the new fuel. The cleaning is best carried out in the following manner: Fill the tank to capacity with pure spirit and let stand until deposits have dissolved, then drain and wash tank carefully. Flush through all fuel lines as well, and clean fuel pump and carburetor.

Fuel

The B 4 B engine has a compression pressure of 8.1—8.4 kg/cm^2 = 115—120 lb./sq.in. in the earlier version, and 9.2—9.6 kg/cm^2 = 130—136 lb./sq.in. in the late version; in other words, it is designed for burning high grade fuel with an octane number of at least 83 (Research Method).

If an inferior grade fuel is used the engine may knock even at light load. The knocking may be removed by retarding the ignition, although this will mean reduced engine power and increased fuel consumption, and therefore is not a good solution.

Cooling System

Water Pump

As already mentioned in the General Description, two types of water pump have been fitted on the B 4 B engine, the earlier version expiring with engine no. 8668.

As from engine no. 61124, the later version of the pump is fitted with a new impeller with straight-sided vanes, which was introduced when the beveled edge of the water inlet port in cylinder block was discontinued. The old impeller with slanting vanes cannot be used on engines without this beveled edge, but the new impeller can be mounted on any engine.

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, and disconnect pump to radiator hose. Next remove four screws securing pump to engine block, and pump is free. Check if plate is mounted. — The radiator need not be removed.

Servicing Earlier Type Pump

Dismantling

1. Remove rubber cap (1, Fig. 24) from front end of pump shaft (2).
2. Remove washer (10) holding spring (9), and pull out spring and impeller (7). Detach spring from impeller.
3. Pull fan belt pulley (3) off pump shaft with puller SVO 1461 A (1461), Fig. 101. Use correct end of screw.
4. Remove setscrew (5) retaining rear end bearing.
5. Press pump shaft out of pump housing (6) by means of tool SVO 1309 and ring SVO 4132. Place tool on impeller end. Both ball bearings generally come out with the shaft; if not, drive out bearings with tool SVO 1233 and ring SVO 4132.
6. Press bearings off shaft, using tool SVO 1309 and supporting inner ring of bearing.
7. Unscrew grease nipple (4).

Inspection

After dismantling water pump and washing off old grease, inspect all pump parts for damage and wear. It is particularly important that the sealing surfaces of the impeller and pump housing are flat and without score marks. Replace damaged and worn parts.

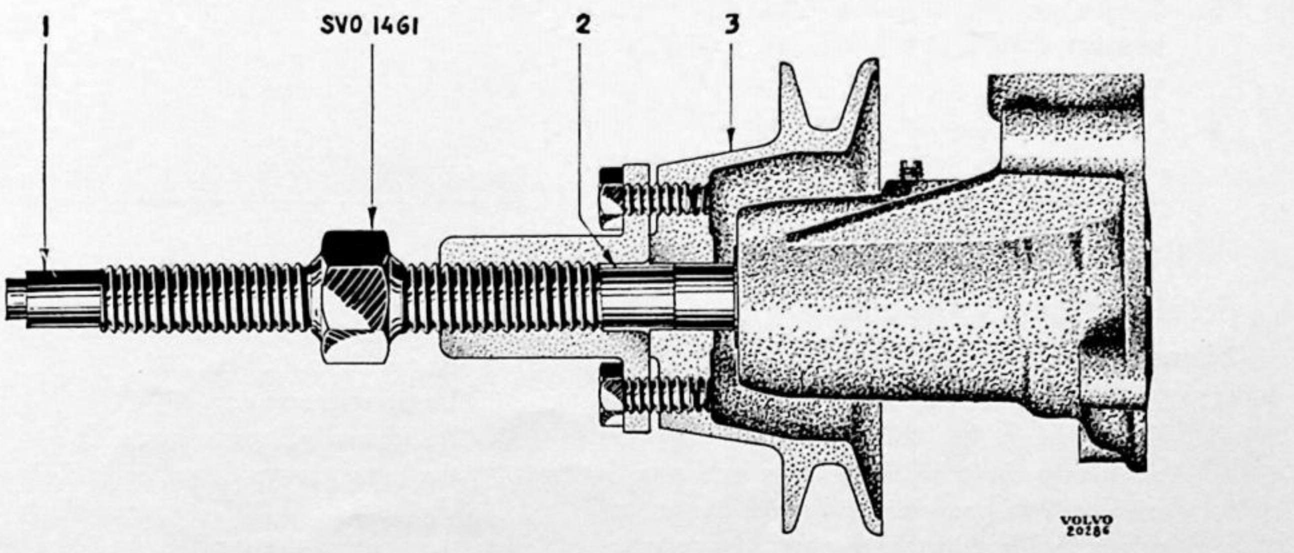


Fig. 101. The later version of the tool has number SVO 1461 A.

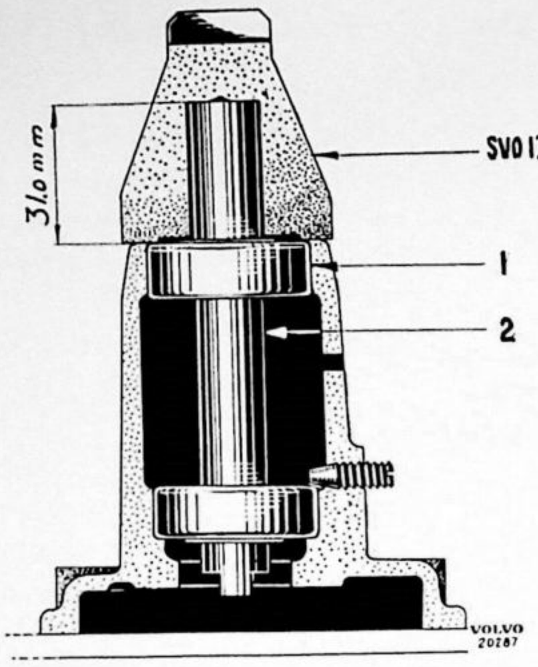


Fig. 102.

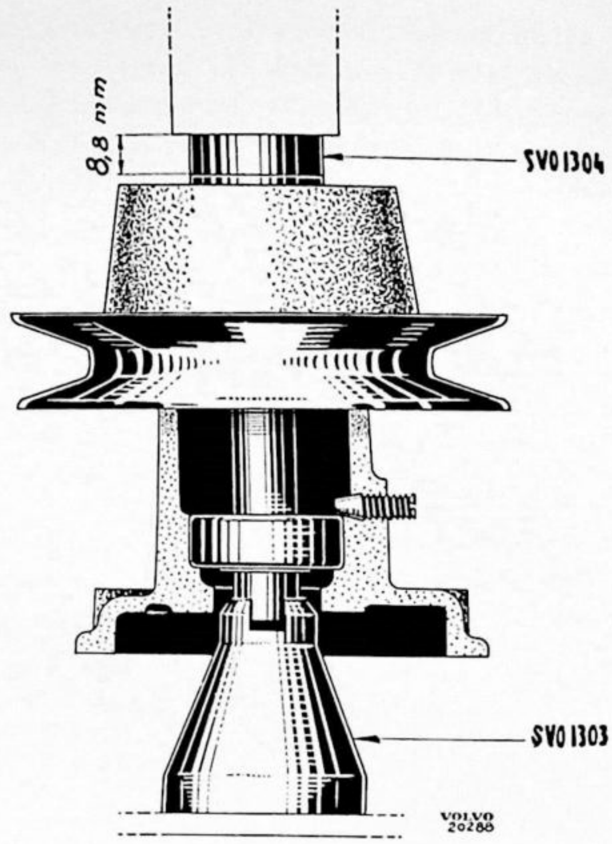


Fig. 103.

Assembly

1. Press rear bearing into pump housing with tool SVO 1233. Assemble setscrew (5), Fig. 24.
2. Press up front bearing some 10 mm on shaft (2), using tool SVO 1303.
2. Place shaft in pump housing and press in shaft with tool SVO 1303, until tool bears against housing. Fig. 102.
4. Press pulley onto shaft with tool SVO 1304 which localizes pulley in correct position. The opposite end of the shaft is supported with tool SVO 1303 (Fig. 103).
5. Fasten spring in impeller, place impeller in housing, and hook other end of spring into washer.
6. Put rubber cap back on shaft end, replace grease nipple, and lubricate pump using heat-resistant grease.

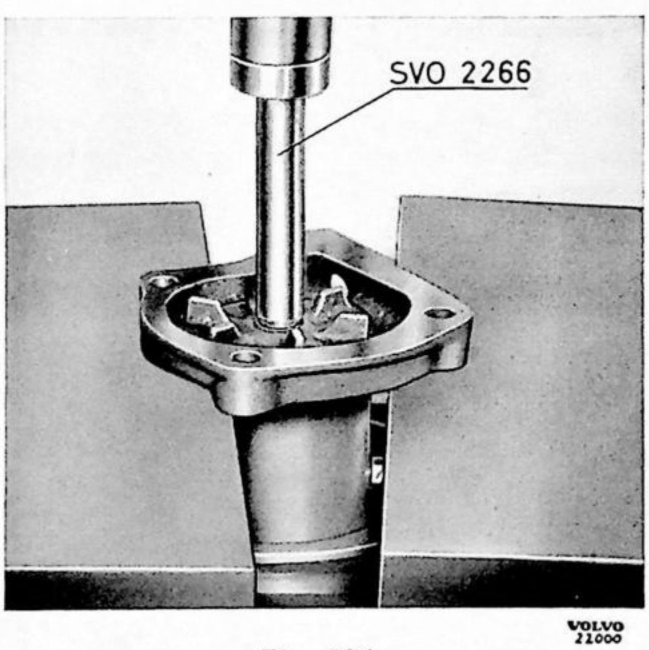


Fig. 104.

Servicing Late Type Pump

Dismantling

1. Remove setscrew (3, Fig. 25), retaining rear ball bearing. Use tool SVO 2266 to press out pump shaft, while guiding pulley with one hand to prevent binding. Remove impeller. Ball bearings and spacer sleeve generally come out with the shaft.
2. Turn pump housing and take out sealing ring with tool SVO 2266.
   Unscrew grease cup.
3. Remove oil slinger. 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. 105).

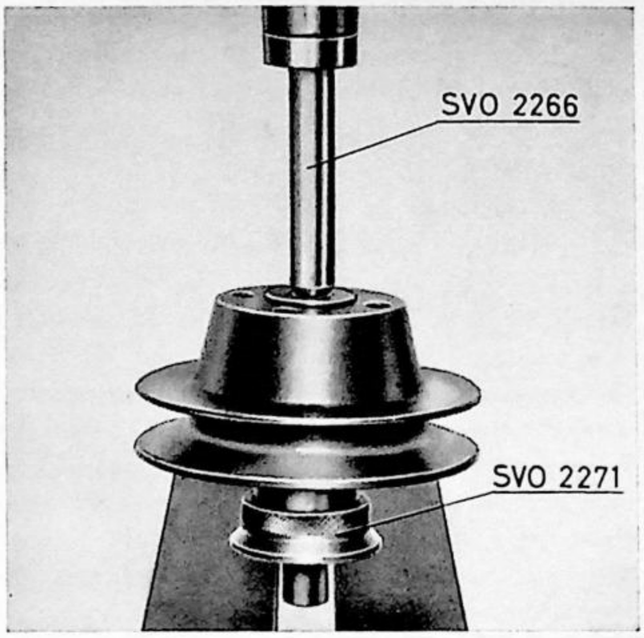


Fig. 105.

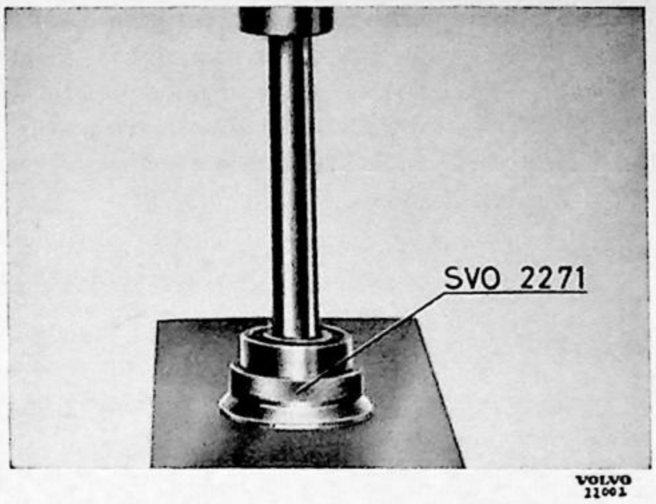


Fig. 106.

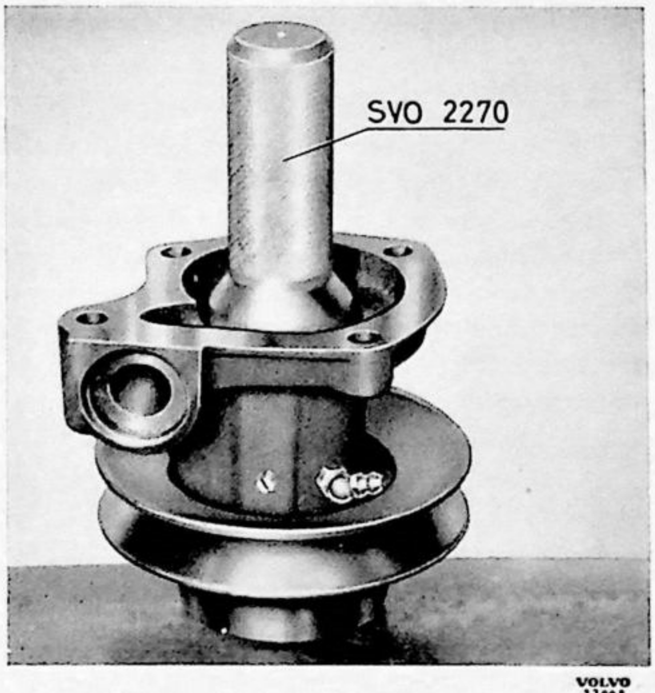


Fig. 107.

Inspection

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

The shaft must not be worn where the sealing ring is located as water may then easily leak through.

Replace damaged and worn parts.

Assembly

1. Place the front bearing on ring SVO 2271 as shown in Fig. 106. Press shaft into bearing until shaft end bottoms against press table, then into pulley 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 toward spacer. Place rings as shown in Fig. 105, and place 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 setscrew at rear bearing.
4. Install oil slinger (7), flange away from bearing. Install sealing ring (4) with tool SVO 2270 (or SVO 1465 B).
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 0.3 mm = 0.012 in. for the straight vane type impeller. Place a straightrule across housing end and check with feeler gauge. The clearance between impeller rear face and housing should be 0.5 mm—1 mm = 0.02—0.04 in.

7. Fill pump with heat-resistant grease.
8. If the pump has no spacer sleeve, install one; alternatively, first install rear bearing with tool SVO 2266, then setscrew, and finally shaft with ball bearing and pulley as described above.

Reinstalling Pump

When reinstalling pump on engine, proceed in reverse order to removal. Always install a new gasket between pump housing and cylinder block, and do not forget sealing plate and extra packing if required (see General Description). 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.

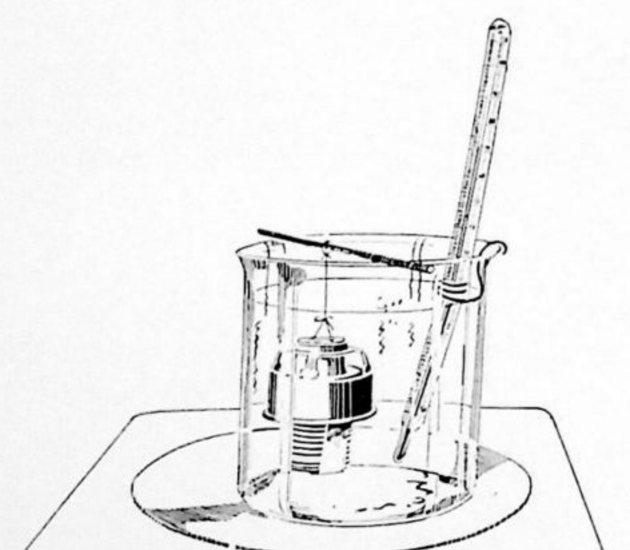


Fig. 108.

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 o thermometer, Fig. 108. Take care that the thermometer does not stand on the bottom of the beaker. Heat the water and observe the thermometer reading when the thermostat begins to open. The opening temperature should be between 72° and 76° C, i.e. 161°—169° F. Raise temperature until thermostat is fully open, which should happen between $85 \pm 2^\circ$ C ($185 \pm 4^\circ$ F). If the thermostat operating range is another, replace it. Check that the new thermostat is marked 165.

Radiator

A leaky radiator shall be soldered. The method and extent of the repairs depend on the location and size of the leak. 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. $0.2\ kg/cm^2 = 3$ lb./sq.in. 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 two screws on either side of radiator, lift off radiator.

Stopped Radiator

If it is suspected that the radiator may be wholly or partially blocked, check by feeling the front of the radiator. If part of the radiator front feels cold although the engine water is hot, the radiator must be partly blocked.

It is often rather difficult to clean out a stopped radiator perfectly. Dissolve approx. 250 grams of soda in 5 liters of hot water (9 oz. in 5 US quarts), fill solution in radiator and top up with water. If caustic soda is used, take about half amount in same quantity of water. Let this solution remain in engine for about 500 km = 300 miles, then drain cooling system and flush through carefully with water, preferably against the normal direction of circulation.

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

Radiator Hoses

Replace dry and cracked hoses, also soft hoses that are mushroomed on the inside, even if they seem able to pass the water.

Anti-Freeze

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

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

Denaturated 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.

Glycerine may also be used, but entails the risk of seizing, if it should enter the engine through a possible leak in the water system.

Preparatory to adding anti-freeze

1. Flush out cooling system carefully.
2. Check radiator for leaks, and inspect all rubber hoses, not forgetting the hot water heating system.
3. Pull 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 anti-freeze to be added to the cooling water is determined from the tables in Part 13.

After draining anti-freeze in spring, flush out cooling system carefully.

Reassembling Engine

When reassembling engine, use a suitable stand or dolly to support the cylinder block. The order of reassembly is the reverse of that used when dismantling the engine, see page 22.

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 on page 73 gives the torque values to be used for various bolts and nuts. As from engine no. 49746, clutch, transmission, flywheel, and crankshaft are balanced together as a unit, and are marked with yellow paint. Take care that they are mounted in their correct positions according to the markings.

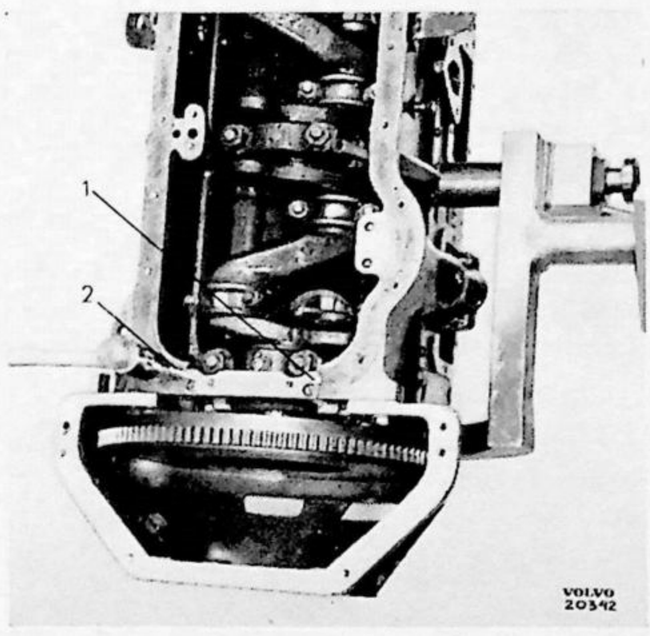


Fig. 109.

Use tool SVO 1336 A (1356) to install crankshaft gear and camshaft gear. Hammer in the sealing laths at the rear main bearing, and cut off flush with engine block, Fig. 109.

Use only new gaskets and seals when reassembling engine.

The timing gear case must be perfectly centered in order to seal effectively. This is achieved by using pilot tool SVO 1427, Fig. 110.

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 Figs. 111 and 116. Always use a calibrated torque wrench.

Engine Supports

The engine is carried by two supports at the front end and one support behind the transmission. In Model PV 444, the rear support is part of a mounting plate secured to the body floor, and in Model PV 445, is placed on a cross member joined to the frame side members. Always replace damaged engine supports. The rear support nut must not be pulled so tight that it prevents engine movements.

Installing Engine in Vehicle

To install 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 must always be operated with great care during the first time of operation so that the new parts wear in correctly.

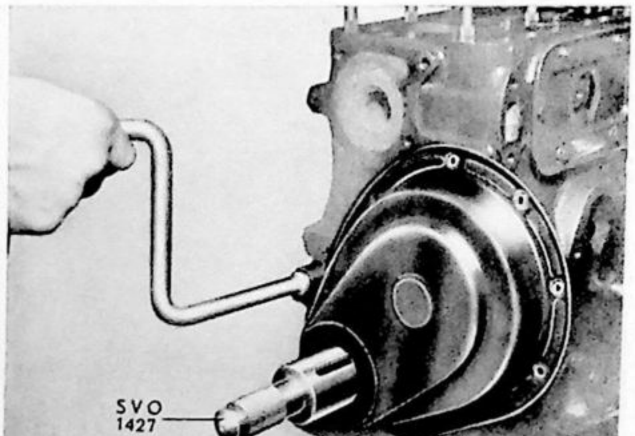


Fig. 110.

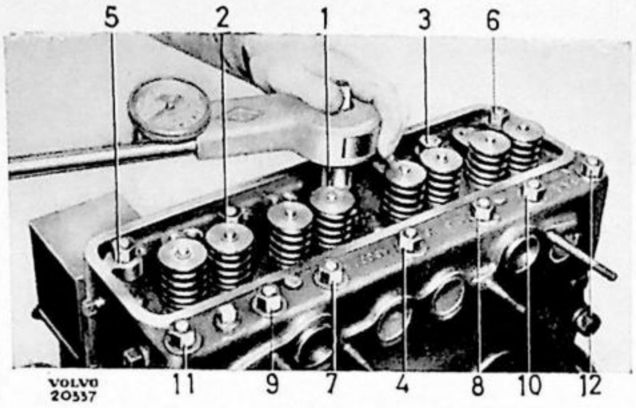


Fig. 111.

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

Check that oil and water have been filled, and start engine. The oil pressure gauge should read 1.5—2.5 kg/cm², i.e. 20—35 lb./sq.in., practically immediately after starting. If not, stop engine at once and investigate.

If everything seems in order, let engine fast idle for a few hours, then load engine and raise the speed to about 1000 rpm. The total running time in the test stand should be some 6 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, checking 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, retighten 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, but remove oil filter. If the extension bar is so long that it penetrates through the tool and touches the cylinder head, shorten it by grinding. After running-in, change oil.

The running-in of the engine is not completed, but the precautions detailed in the Instruction Book for the vehicle must still be observed.

TROUBLE SHOOTING

The tracing of faults in an engine and its auxiliary equipment is often a tricky task, and a fundamental principle of all trouble-shooting is pursuing it in an orderly manner. No engine fault has been properly remedied until all possible causes have been investigated and the defects put right.

It is also of prime importance that the serviceman is fully conversant with the construction and operating principles of the engine and its auxiliary equipment.

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

1. 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 idle speed setting, and high cruising speeds all produce high fuel and oil consumption.

2. Whenever possible, check up on information given about the engine to see that it is correct. This is important in order to be in a position to verify improvements.
   High oil consumption may be the effect of a too high oil level. Many people are wont to keep the oil level with the Max. mark, or even above it. This is bad policy as the engine rapidly burns the excess oil to soot in the cylinders.
   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 belows this mark.

FAULT

Possible reason	Remedy

Engine Will Not Start

No fuel in carburetor

No fuel in tank	Fill fuel
Fuel pump diaphragm ruptured	Replace diaphragm
Leaking suction or pressure valves	Replace defective valve.
Fuel filter clogged	Dismantle and clean with solvent
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
Distributor defective, breaker point gap too large	Inspect distributor for cracks, adjust breaker gap
Battery run down	Check acid density and recharge, if below 1.23
Condenser defective	Replace
Ignition coil defective	Replace

Carburetor

Throttle and/or choke plates or linkages binding	Investigate
Fuel inlet valve or jets clogged	Dismantle and clean carburetor
Defective gaskets	Replace with new gaskets
Air cleaner clogged	Flush out cleaner

Low compression

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

Hard Starting

Ignition system

See under "Engine will not start"

Fuel pump and fuel lines

Binding or leaky valves	Replace valves
Partly clogged fuel filter	Dismantle and clean with solvent
Sludge deposits in fuel line	Flush through
Improper fuel	Drain tank, flush out tank and fuel lines. Fill new fuel

Low compression

See under "Engine will not start"

Carburetor

Improper fuel level in float bowl	Verify cause, and effect adjustments
Clogged jets or passages	Dismantle and clean carburetor
Oil too thick	Change to correct grade oil
Suppressors on spark plugs damaged	Replace

Engine Will Not Idle

Ignition system

Defective spark timing	Adjust spark timing
Too short spark plug gaps	Clean plugs and adjust electrode gap
Battery run down	Recharge (See under "Engine will not start")

Carburetor

Improper fuel level in float bowl	Verify cause, and effect corrections
Idle jet too small or partly clogged	Replace with correct size, or clean
Wrong idle setting, idle mixture screw or idle air screw setting	Perform all idle adjustments

Air leaks

Defective gasket between carburetor and intake manifold	Replace gasket
Leakage at vacuum line fitting	Trace leak and repair, tighten fitting

Excessive Fuel Consumption

Type of driving

See introductory remarks

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	Replace defective part
Defective ignition coil	Test and replace if irreparable
Defective condenser	Replace condenser

Carburetor

Mixture too rich	See below under "Fuel system"
Air cleaner clogged	Flush out with solvent

Excessive Oil Consumption

Type of driving

See introductory remarks

Leakage

Leaky crankcase gasket	Replace gasket
Leaky gasket between fuel pump and cylinder block	Replace gasket
Damaged oil slinger or felt washer in timing gear cover	Replace damaged parts
Defective sealing at rear main bearing	Replace felt seal and/or wood laths
Leakage at rocker cover	Check mounting or rocker cover
Leaks in oil lines to filter	Replace damaged lines or fittings

Lubricating oil

Unsuitable grade lubricating oil	Change oil, see specification
Oil level too high	Do not fill oil above "Max" mark

Cylinders, Pistons, Piston rings

Worn cylinders, pistons, or piston rings, sticking or ruptured rings	Check compression pressure in all cylinders; see "General Inspection"
Worn valve guides	Install new valve guides

Low Oil Pressure

Oil quality and quantity

Unsuitable oil	Change oil. See specifications
Too little oil	Fill more oil. See specifications

Oil pressure gauge

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

Reducing 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 with solvent
Strainer binds (floating type)	Clean with solvent
Leak in output pipe	Tighten union, or replace

Oil pump

Worn gears	Replace pump

Main and rod bearings

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

Engine Does Not Deliver Full Power

Ignition system

See under "Ignition system"

Low compression

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

Fuel tank, lines, and pump

Improper fuel	Drain tank and flush with gasoline
Pump diaphragm ruptured	Replace diaphragm
Valves sticking	Replace valves
Filter clogged	Dismantle and clean filter
Fuel line stopped	Clean with solvent

Carburetor

Air cleaner stopped	Dismantle filter and flush clean
Jet clogged	Clean jets
Carburetor adjustment disturbed	Clean and adjust carburetor
Improper fuel level in float bowl	Verify cause and adjust level

Mechanical Causes

Brakes engaged	Readjust brakes
Wheel bearings defective, or too tight	Investigate and correct, replace damaged bearing
Tire pressure too low	Inflate to correct pressure

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	See under "Radiator blocked"
Hoses or passages stopped	
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

Ignition system

See under "Ignition system" and "Weak spark"

Fuel tank, lines, and pump

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

Carburetor

Improper fuel level in float bowl	Verify cause and adjust level
Jets clogged	Clean out jets

Cylinders and valves

Low compression	Check compression pressure in all cylinders. Low compression in adjacent cylinders indicates defective cylinder head gasket
Leaky or sticking valves, broken valve springs	Investigate defect, replace damaged part

Ignition System

Distributor

Wrong breaker gap	Measure and adjust gap
Poor contact in coil terminal	Clean and tighten screw
Loose contact in primary circuit	Check and tighten connections
Open or short-circuit in primary circuit	Trace fault and effect corrections

Ignition coil

Short-circuit in primary or secondary	Test

Weak Spark

Spark plugs

Electrode gap too large	Clean electrodes and adjust gap
Plugs wet or fouled	Clean electrodes
Damaged insulator	Replace plug

Battery and cables

Battery run down	Check spec. grav., recharge if required
Damaged cables	Replace damaged cables
Loose connections	Tighten connections properly

Distributor

Wrong breaker gap, carbon on points	Clean points, adjust gap
Defective condenser	Replace condenser
Distributor head broken	Replace distributor head

Ignition coil

Ignition coil defective	Replace coil

Fuel System

Carburetor Floods or Leaks

Fuel inlet 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
Wrong thickness of spacer (Zenith)	Install 2 mm washer between valve and float bowl cover
Fuel pump pressure too high	Check pressure
Fuel line leakage at fitting	Replace defective line or fitting

Mixture Too Lean When Accelerating

Accelerator system

Plunger packing worn or damaged (Carter)	Replace packing
Leaking inlet or outlet valve	Replace defective valve
Strainer clogged	Clean strainer
Stroke too short	Lengthen stroke
Plunger binds — impurities in barrel (Zenith)	Clean accelerator pump
Accelerator jet clogged	Clean accelerator jet

Idle Mixture Too Lean

Idle System

Idle jet clogged	Dismantle and clean jet
Idle port partly blocked	Remove carburetor and clean idle passage
Idle jet too small	Replace with larger size jet
Air leak at carburetor gaskets	Replace defective gasket
Air leak at vacuum pipe connection	Replace damaged part

Idle Mixture Too Rich

Idle System

Idle jet too large	Replace with smaller size
Idle jet worn	Replace jet
Idle jet loose, or seats imperfectly	Remove jet, clean seating, install and tighten
Idle air passage partly clogged	Clean out air passage

Choke System

Choke plate shafts binds	Lubricate shaft with graphite grease

Cruising Speed Mixture Too Lean

Main metering System

Too low fuel level in float bowl	Verify cause, adjust level
Too low pump pressure	Check pressure
Wrong size metering rod, or badly adjusted (Carter)	Replace rod, or adjust
Main jet too small	Install larger size jet
Main jet partly clogged	Clean jet

Cruising Speed Mixture Too Rich

Main metering System

Too high fuel level in float bowl	Verify cause, adjust level
Too high pump pressure	Check pressure
Wrong size metering rod (Carter)	Replace with correct size
Metering rod worn or badly adjusted (Carter)	Replace with new rod, adjust rod
Main jet worn	Replace jet

Choke System

Choke plate shaft binds	Lubricate shaft with graphite grease

Air Screws Bottoms

Idle jet clogged	Remove jet, and blow clean

Hissing Noise

Air leak between carburetor throat and float bowl (Zenith)	Dismantle float bowl and clean bearing surfaces, reassemble as under points 8, 9 in "Cleaning" page 45

Flat Spots in Acceleration

Dirt in idle jet or other jets	Clean jets
Idle air adjuster screw badly adjusted	Adjust idle mixture with screw

TOOLS

The following special tools are required when performing repair (service repair) work on the engine and the water pump.

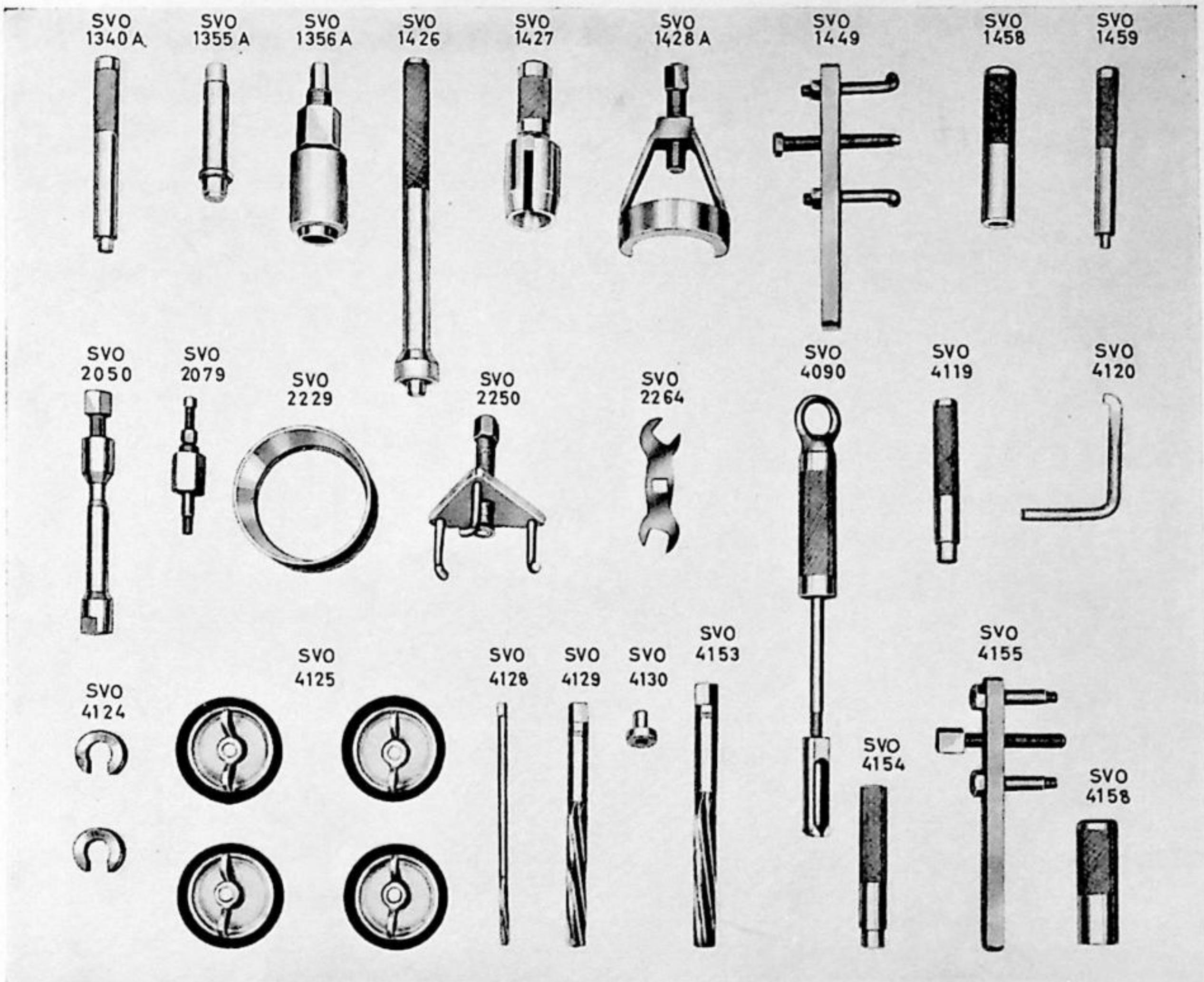


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Fig. 112. Tools for engine repair.

SVO 1340 A	Drift for dismantling and assembling piston pin
SVO 1355 A	Drift for dismantling and assembling piston pin bushing
SVO 1356 A	Press-on tool for camshaft gear and crankshaft pulley
SVO 1426	Drift for assembling ball bearing in flywheel
SVO 1427	Centering tool for timing gear cover
SVO 1428 A	Crankshaft gear puller
SVO 1449	Puller for crankshaft pulley and camshaft gear, earlier version
SVO 1458	Drift for installing valve guides, earlier version
SVO 1459	Drift for removing valve guides
SVO 2050	Flanging tool for sealing push rod tubes
SVO 2079	Puller for reducing-valve plunger
SVO 2229	Installation ring for piston (standard size)
SVO 2250	Puller for camshaft gear, later version
SVO 2264	Double-ended spanner for cylinder head nuts (Rocker shaft need not be dismantled)
SVO 4090	Flywheel ball bearing puller

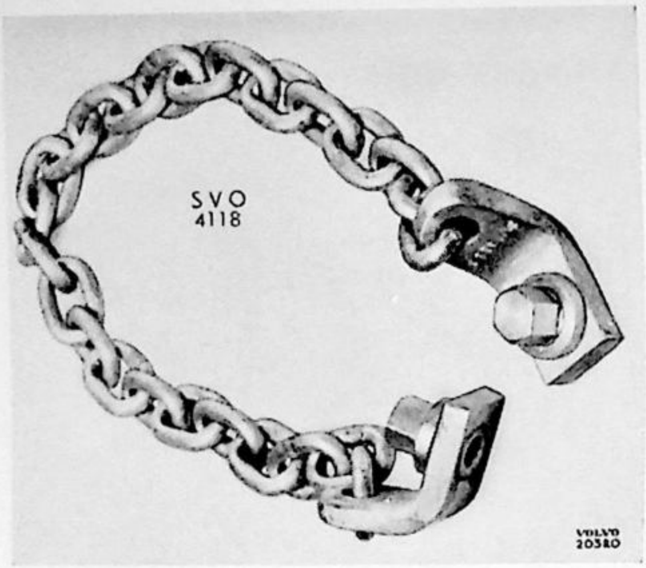

Fig. 113. Lifting chain.

SVO 4118	Lifting chain for engine with cylinder head remaining (Fig. 113)
SVO 4119	Drift for removing and inserting rocker shaft bushing, earlier version
SVO 4120	Extracting tool for water distributor pipe in cylinder head
SVO 4124	Spacers for engine support, (2)
SVO 4125	Cylinder protectors, (4)
SVO 4128	Valve guide reamer
SVO 4129	Reamer for rocker shaft bushing, earlier version
SVO 4130	Center for camshaft gear, to be used with SVO 1449
SVO 4153	Reamer for rocker shaft bushing, later version
SVO 4154	Drift for removing and inserting rocker shaft bushing, earlier version
SVO 4155	Puller for crankshaft pulley, later version
SVO 4158	Drift for installing valve guides, later version

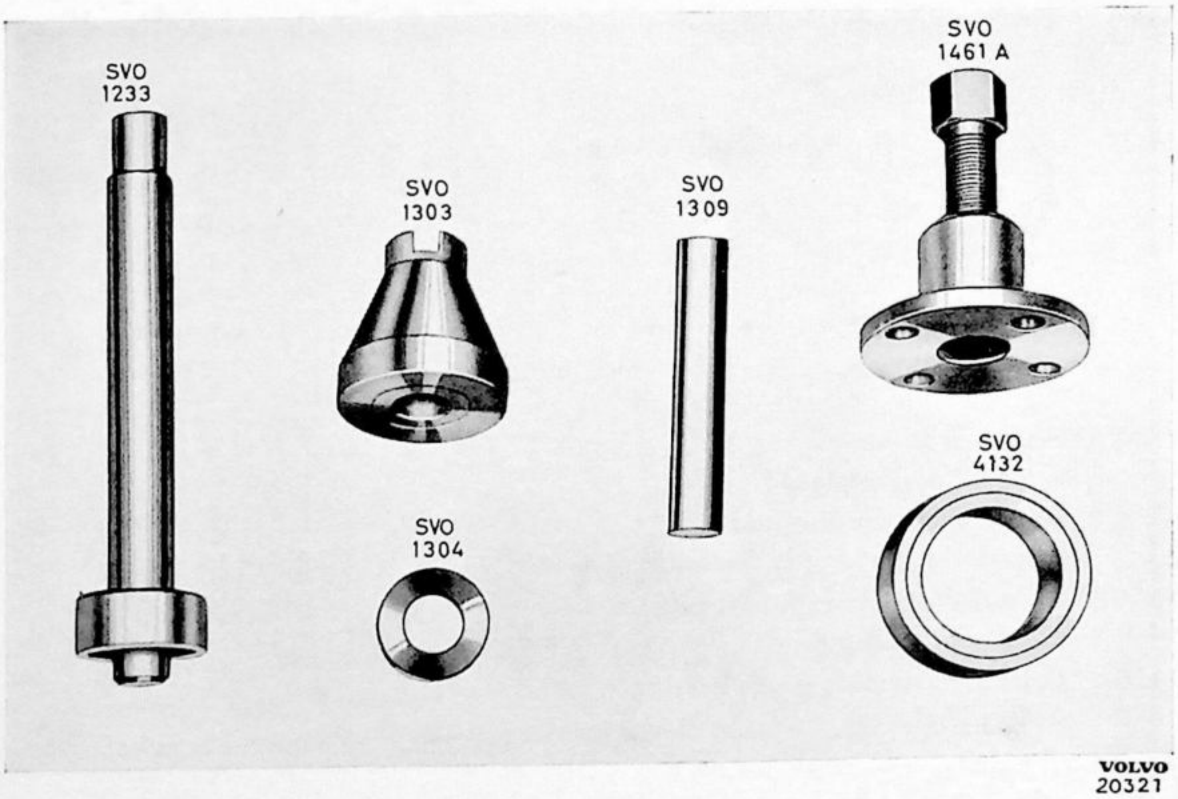

Fig. 114. Service for water pump, earlier version.

SVO 1233 Drift for installing and dismantling pump shaft bearings

SVO 1303 Drift for installing bearings on pump shaft

SVO 1304 Spacer for installing pulley on pump shaft

SVO 1309 Drift for removing pump shaft

SVO 1461 A Puller for fan pulley

SVO 4132 Ring for dismantling bearings

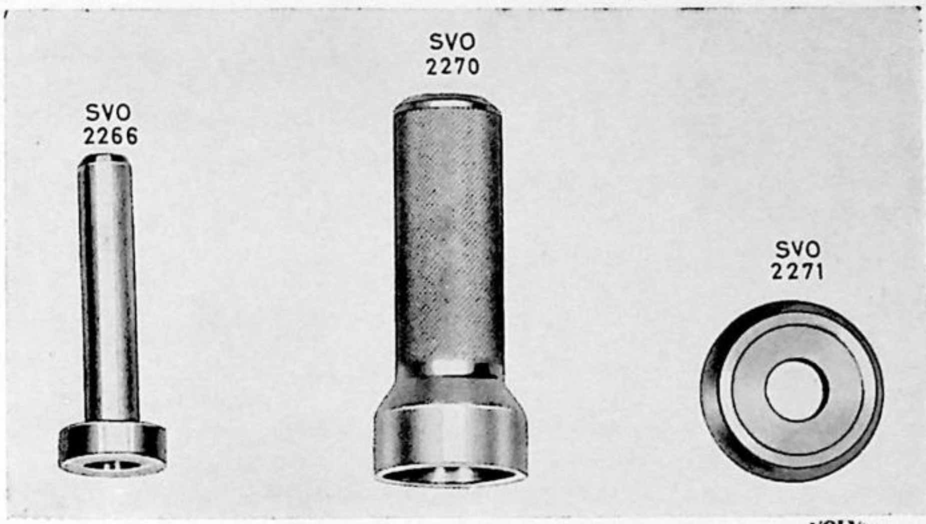

Fig. 115. Service tools for water pump, late version.

SVO 2266 Drift for installing and dismantling pumpshaft

SVO 2270 Drift for installing sealing ring (1465 B may also be used)

SVO 2271 Ring for installing and dismantling pump shaft bearings

SPECIFICATIONS

General Data

Type designation		B 4 B	
Part nos (three versions)	495300	495301	495302
Power output b.h.p./r.p.m.	40/3800 r.p.m.	44/4000 r.p.m.	51/4500 r.p.m.
Maximum torque	9.5 kgm 68.7 lb.ft.	9.5 kgm 68.7 lb.ft.	10.0 kgm 72.3 lb.ft.
measured at r.p.m.	2200 r.p.m.	2200 r.p.m.	2500 r.p.m.
Compression pressure when cranking (hot) engine at 200 r.p.m.	8.1—8.4 kg/cm² 115—120 lb./sq.in.	8.1—8.4 kg/cm² 115—120 lb./sq.in.	9.2—9.6 kg/cm² 130—136 lb./sq.in.
Compression ratio	6.5: 1	6.5: 1	7.3: 1
Number of cylinders		4	
Bore and stroke	75×80 mm		2.953″×3.151″
Piston displacement	1.414 liters		86.28 cu.in.
Weight, complete with starter motor, carburetor, air cleaner, and clutch assembly	155 kg		340 lb.

Cylinder Block

Material, cylinders bored direct in block, without liners	Special cast iron	
Cylinder bore diameters:		
standard	75 mm	2.953″
0.010″ oversize	75.25 mm	2.963″
0.020″ „	75.51 mm	2.973″
0.030″ „	75.76 mm	2.983″
0.040″ „	76.02 mm	2.993″
0.050″ „	76.27 mm	3.003″

Pistons

Material		Aluminum alloy	
Makes	Mahle	Specialloid	WEDA
Weight g.	355±3	329±4	345±4
oz.	12.69±0.11	11.77±0.14	12.23±0.14
Piston to cylinder bore clearance	0.04—0.06 mm 0.0016″—0.0024″	0.03—0.05 mm 0.0012″—0.0020″	0.02—0.04 mm 0.0008″—0.0[illegible]″
Piston diameter, at lower skirt edge, at right angles to piston pin			
late production Mahle pistons 9.5 mm from bottom piston skirt			
standard	74.95 mm 2.9508″	74.96 mm 2.9512″	74.97 mm 2.9516″
0.010″ oversize	75.20 mm 2.9606″	75.21 mm 2.9610″	75.22 mm 2.9614″
0.020″ „	75.46 mm 2.9709″	75.47 mm 2.9713″	75.48 mm 2.9716″
0.030″ „	75.71 mm 2.9807″	75.72 mm 2.9811″	75.73 mm 2.9815″
0.040″ „	75.97 mm 2.9910″	75.98 mm 2.9914″	75.99 mm 2.9918″
0.050″ „	76.22 mm 3.0004″	76.23 mm 3.0008″	76.24 mm 3.0012″

Maximum admissible weight difference between pistons in same engine	6 g	
Height, overall	86 mm	3.386″
top to piston pin center	46 mm	1.811″

Piston Rings

Piston ring gap width	0.25—0.50 mm	0.010″—0.020″
Piston ring oversizes	0.010″ 0.040″ 0.020″ 0.050″ 0.030″	

Compression Rings

Number of rings on each piston (top ring chrome plated)	2	
Ring height	2.5 mm	0.1″
Top ring height, late production	1.5 mm	0.059″

Top ring: inside beveled edge facing upward
2nd ring: outside beveled edge facing downward

Ring side clearance	0.051—0.088 mm	0.002″—0.0035″

Oil Ring

Number of oil rings on each piston	1	
Ring height	4.5 mm	0.18″
Ring height, late production	5 mm	0.196″
Ring side clearance	0.025—0.064 mm	0.001″—0.0025″

Piston Pin

Full-floating with retainers in both piston bosses

Piston pin to connecting rod bushing clearance	Close running fit
Piston pin to piston clearance	Sliding fit

Piston pin diameter

standard	19 mm	0.748″
0.05 mm oversize	19.05 mm	0.750″
0.10 mm „	19.10 mm	0.752″
0.20 mm „	19.20 mm	0.754″

Cylinder Head

Height, gasket surface to cylinder head nut flats,

engine nos. 495300, 495301	100 mm	3.937″
engine no. 495302	98 mm	3.858″

Crankshaft

(Insert type bearings for main and connecting rod bearings)

Crankshaft end play	0.01—0.10 mm	0.0004″—0.0040″
Main bearing radial play	0.014—0.064 mm	0.00055″—0.0025″

Main Bearings

Main Bearing Journals

Journal diameter, standard	53.950—53.960 mm	2.1240″—2.1244″
0.010″ undersize	53.969—53.706 mm	2.1140″—2.1144″
0.020″ „	53.442—53.452 mm	2.1040″—2.1044″
0.030″ „	53.188—53.198 mm	2.0940″—2.0944″
0.040″ „	52.934—52.944 mm	2.0840″—2.0844″

Journal width, flanged bearing,		
standard	38.935—38.975 mm	1.5327″—1.5343″
0.1 mm oversize (for 0.010″ undersize)	39.035—39.075 mm	1.5367″—1.6383″
0.2 mm „ („ 0.020″ „)	39.135—39.175 mm	1.5407″—1.5423″
0.3 mm „ („ 0.030″ „)	39.235—39.275 mm	1.5447″—1.5403″
0.4 mm „ („ 0.040″ „)	39.335—39.375 mm	1.5487″—1.5503″

Main Bearing Inserts

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

Connecting Rod Bearings

Rod Bearing Journals

Rod bearing radial play	0.013—0.049 mm	0.0005″—0.0019″
Rod bearing journal width	32.900—33.000 mm	1.2953″—1.2992″
Journal diameter, standard	47.589—47.600 mm	1.8736″—1.8740″
0.010″ undersize	47.335—47.347 mm	1.8635″—1.8640″
0.020″ „	47.081—47.092 mm	1.8536″—1.8540″
0.030″ „	46.827—46.838 mm	1.8436″—1.8530″
0.040″ „	46.573—46.584 mm	1.8336″—1.8520″

Rod Bearing Insert

Thickness, standard	1.581—1.587 mm	0.0622″—0.0625″
0.010″ undersize	1.708—1.714 mm	0.0672″—0.0675″
0.020″ „	1.835—1.841 mm	0.0722″—0.0725″
0.030″ „	1.962—1.968 mm	0.0772″—0.0775″
0.040″ „	2.089—2.095 mm	0.0822″—0.0825″

Connecting Rods

Marked 1—4 on side away from camshaft. Coded A—D for weight grading; only rods with same letter to be mounted in same engine

Connecting rod side clearance on crankshaft	0.15—0.35 mm	0.006″—0.014″
Length, center to center	150±0.1 mm	5.9055″±0.004″
Weight, Class A	528—558 g	18.63—19.68 oz.
B	558—588 g	19.68—20.75 oz.
C	588—618 g	20.75—21.80 oz.
D	618—648 g	21.80—21.86 oz.

Flywheel

Maximum face runout	0.20 mm	0.008″
Ring gear (front edge beveled), no. of teeth	116	

Flywheel Cover

Maximum axial runout	0.08 mm	0.0016″
radial runout	0.15 mm	0.0059″

Camshaft

Camshaft drive, helical gearing, fiber gear on camshaft

Number of bearings	3	
Journal diameter, front	46.975—47.000 mm	1.8494″—1.8504″
intermediate	42.975—43.000 mm	1.6919″—1.6929″
rear	36.975—37.000 mm	1.4551″—1.4567″
Journal to bearing clearance	0.025—0.075 mm	0.0010″—0.0030″
Play for checking camshaft timing (cold engine)		
engine no. 495300	0.31 mm	0.012″
„ 495301	0.60 mm	0.024″
„ 495302	1.1 mm	0.043″
Intake valve opens		
engines nos. 495300, 495301	5° BTDC	
engine no. 495302	10° ATDC	

Camshaft Bearings

Diameter, front	47.025—47.050 mm	1.8514″—1.8524″
intermediate	43.025—43.050 mm	1.6939″—1.6949″
rear	37.025—37.050 mm	1.4577″—1.4587″

Timing Gears

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

Valve Mechanism

Valves

Intake Valves

Valve head diameter	32 mm	1.26″
Valve stem diameter	7.850—7.875 mm	0.3091″—0.3100″
Valve head angle	44°	
Valve seat angle	45°	
Valve seat width	1.5 mm	0.06″
Valve lash setting (engine hot)		
engine no. 495300	0.15 mm	0.006″
„ „ 495301	0.30 mm	0.012″
„ „ 495302	0.40 mm	0.016″

Exhaust Valves

Valve head resists corrosion by ethyl fuel.

Valve head diameter	32 mm	1.26″
Valve stem diameter	7.84—7.86 mm	0.3086″—0.3094″
Valve head angle	44°	
Valve seat angle	45°	
Valve seat width	1.5 mm	0.06″
Valve lash setting (engine hot)		
engine no. 495300	0.20 mm	0.010″
„ „ 495301	0.35 mm	0.014″
„ „ 495302	0.45 mm	0.018″

Valve Guides

Valve guide bore diameter	7.905—7.920 mm	0.3112″—0.3118″
Valve guide length, earlier version	70 mm	2.76″
present version	62 mm	2.44″

Free length above cylinder head upper surface		
engine no. 495300	29 mm	1.14″
engines nos. 495301, 495302	21 mm	0.83″
Valve stem to valve guide clearance		
intake valve	0.030—0.070 mm	0.0012″—0.0028″
exhaust valve	0.045—0.080 mm	0.0018″—0.0031″

Valve Springs

Springs close-wound at lower end		
Engine no. 495300:		
Spring length, no load	68 mm	2.68″
loaded 40±2 kg (88±4 lb.)	49 mm	1.93″
„ 60±3 kg (132±6 lb.)	41.5 mm	1.63″
Engine no. 495301:		
Spring length, no load	50 mm	1.97″
loaded 30±2 kg (66±4 lb.)	39 mm	1.54″
„ 56±3 kg (123±6 lb.)	32 mm	1.26″
Engine no. 495302:		
Earlier version		
Spring length, no load	42.5 mm	1.67″
loaded 27±2 kg (60±4 lb.)	37 mm	1.46″
„ 78±4 kg (172±9 lb.)	28.5 mm	1.12″
Present version: (spring color-coded blue; lower spring seat washer not used)		
Spring length, no load	45 mm	1.77″
loaded 25.5±2 kg (56±4 lb.)	39 mm	1.54″
„ 66±3.5 kg (146±8 lb.)	30.5 mm	1.20″

Lubricating System

Capacity of crankcase	3.25 liter	0.87 gall
Capacity incl. oil filter	3.75 liter	1.0 gall.
Oil pressure	1.5—2.5 kg/cm²	20—35 p.s.i.
Lubricant	Motor Oil	
Viscosity, summer	SAE 20	
winter	SAE 10W	
Oil pump, type	Gear pump	
no. of teeth	10	
gear end clearance	0.02—0.10 mm	0.0008″—0.004″
gear to housing clearance	0.00—0.10 mm	0.000″—0.004″
backlash	0.15—0.35 mm	0.006″—0.014″
Reducing valve spring length, no load	36±0.5 mm	1.417″±0.020″
loaded 2±0.2 kg (4½±½ lb.)	32 mm	1.260″

Fuel System

Fuel Pump

Type of fuel pump	AC diaphragm type	
Pump pressure, minimum	0.14 kg/cm²	2 p.s.i.
maximum	0.25 kg/cm²	3.5 p.s.i.
Rate of flow	0.5 l/min	0.14 gall/min
Fuel tank capacity	35 liters	9.5 gall.
Fuel gauge	Electrical	

Carburetor

Carter

	Designation	Dimension
Type designation, earlier version	W—O 618 S	
later version	W—O 618 SA	
Venturi		23 mm
Metering rod jet	120—151S	0.070″
gasoline	75—590	0.0590″—0.0532″ (stepped)
ethyl gasoline	75—697	
lean mixture	75—676	
Main jet, W-O 618S	12—255	0.96″
W-O 618SA	12—323	0.96″
Accelerator jet	48—141	0.024″
Idle jet	11—186S	0.029″
Fuel inlet valve	29—93S	
Adjusting gauge for inlet valve	T109—26	2.718″ (length)
needle (for richer mixture)	T109—44	0.015″ (dia.)
Float level (measured between bowl cover and float overside — turn cover upside down, gasket removed)	9.5 mm	3/8″
Accelerator pump stroke	3.5 mm	9/64″
Idle speed (engine hot), minimum	300 r.p.m.	

Zenith

	Designation	Dimension
Type designation, earlier version	30 VIG—9/C1412	
present version	30 VIG—9/C1412B	
Venturi	25	
Main nozzle, standard, earlier version	102	1.02 mm
present version	107	1.07 mm
lean mixture, earlier version	95	0.95 mm
present version	100	1.00 mm
Compensating jet, standard	70	0.70 mm
for ethyl fuel	75	0.75 mm
Idle jet	50	0.50 mm
Accelerator jet	50	0.50 mm
Air jet for part throttle, earlier version	2.0	
present version	2.8	
for ethyl fuel	2.4	
Air inlet opening for full throttle	1.8	
Fuel inlet valve	1.5	
spacer thickness	2 mm	0.0787″
Idle speed (engine hot), minimum	300 r.p.m.	

Ignition System

Firing order	1—3—4—2
Ignition timing, engine nos. 495300, 495301	5° BTDC
no. 495302 (83 octane) (Research method)	5° ATDC
no. 495302 (93 octane) (Research method)	2° BTDC

Spark Plugs

Spark plugs, earlier version 10 mm thread	Bosch	U 175 T 3
	AC	104
	Auto-Lite	P—6
	Champion	Y 6 etc.
late version, 14 mm thread	Bosch	W 175 T 4
	AC	44 com
	Auto-Lite	A 7
	Champion	J 7 etc.
Electrode gap	0.7—0.8 mm	0.030″

Distributor

Type, first version	Auto-Lite	IGS—4210
second version	Auto-Lite	IAT—4006
late version	Bosch	VJU 4 13 R 9

Auto-Lite distributors

Rotation viewing top	Clockwise					
Spark advance characteristics:						
Centrifugal governor:						
Crankshaft degrees	0	8	15	26	35	
speed, r.p.m.	500	710	900	2320	3500	
Vacuum governor:						
Crankshaft degrees	0	2	6	12	15	
Vacuum, inches of mercury	4	5.6	8.7	13.8	15.7	
Breaker contact spacing	0.45—0.55 mm					0.018″—0.022″
arm tension	0.48—0.57 kg					16.5—20 oz.
Condenser capacitance	0.20—0.25 μF					
Dwell angle	47°					

Bosch distributors

Rotation viewing top	Clockwise			
Spark advance characteristics:				
Centrifugal governor				
Crankshaft degrees	0	10	20	30
speed, r.p.m.	280—600	560—900	1120—1840	2360—3160

Advance terminates at 35° and 3000—3800 r.p.m.

Vacuum governor:		
Vacuum, inches of mercury	3.9—5.5	17.3
Crankshaft degrees	0	15±2
Breaker contact spacing	0.4—0.5 mm	0.016″—0.020″
arm tension	0.4—0.5 kg	14—17.5 oz.
Dwell angle	52°—56°	

Cooling System

Pressure type system		
Water capacity, approx.	8 liters	8 Qts.
Filler cap valve opens at excess pressure	0.23—0.30 kg/cm²	3.2—4.2 lb./sq.in.
Thermostat:		
Type	Balanced = does not open because of pump pressure	
Marked	165	
Opening temperature	74±2° C	165±4° F
Fully opened	85±2° C	185±4° F

Water hoses:	Inner dia.	Length Eng. 495300, 495301	Eng. 495302
Hose, water pump to outlet housing	3/4″	41 mm/1 5/8″	41 mm/1 5/8″
upper	1″	90 mm/3 9/16″	90 mm/3 9/16″
waterpipe to engine	1″	90 mm/3 9/16″	—
radiator to water inlet housing	1″	125 mm 5″	—
lower, radiator to engine	1″	—	special elbow type
Fan belt, inside length		810 mm	32″
width		17 mm	6 11/16″
height		11 mm	4 5/16″

Engine Bolt and Nuts Torques

	kgm	lb.ft.
Cylinder head	7—8	50—60
Main bearings	8—10	60—70
Connecting rod bearings	4—5	30—35
Flywheel	2.3—2.7	17—20
Spark plugs, 14 mm	4	30
10 mm	1.5	11

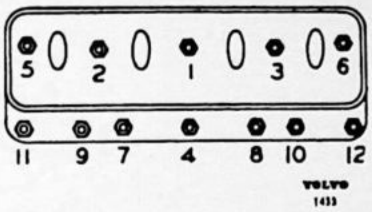

Fig. 116.
Order of torquing cylinder head nuts.

Wear Limits

Cylinder:		
Rebore when worn (if oil consumption abnormal)	0.25 mm	0.010″
Crankshaft:		
Maximum main bearing journal out-of-round	0.05 mm	0.0020″
rod bearing journal out-of-round	0.07 mm	0.0028″
crankshaft end play	0.15 mm	0.0060″
Valves:		
Maximum valve stem to valve guide clearance	0.15 mm	0.0060″
,, ,, wear	0.02 mm	0.0008″
,, head edge	1 mm	0.04″
Camshaft:		
Maximum out-of-round (new bearings)	0.075 mm	0.0030″
bearing wear	0.02 mm	0.0008″

Alphabetical index

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1. Fan
2. Water pump
3. Thermostat
4. Thermostat housing
5. Rocker arm shaft
6. Push rod
7. Adjusting screw and locknut
8. Rocker arm
9. Spacer spring
10. Breather cap
11. Rocker cover
12. Valve spring
13. Valve spring seat
14. Valve
15. Valve guide
16. Cylinder head
17. Cleaning plug
18. Compression ring
19. Oil ring
20. Piston
21. Piston pin
22. Cylinder block
23. Flywheel cover
24. Lock washer
25. Ball bearing
26. Cover
27. Ring gear
28. Flywheel
29. Felt ring
30. Sealing flange
31. Oil pan
32. Bearing cap
33. Connecting rod
34. Bearing insert
35. Crankshaft
36. Fuel pump eccentric
37. Camshaft
38. Valve lifter
39. Crankshaft gear
40. Washer
41. Oil slinger
42. Timing gear cover
43. Felt ring
44. Pulley
45. Camshaft gear
46. Spark plug cable
47. Ignition distributor
48. Vacuum governor
49. Grease nipple
50. Distributor and oil pump drive gear
51. Coupling dog
52. Gear
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56. Reducing valve spring
57. Reducing valve plunger
58. Starter motor
59. Starter motor solenoid
60. Cleaning plug
61. Preheat valve
62. Exhaust manifold
63. Intake manifold
64. Carburetor

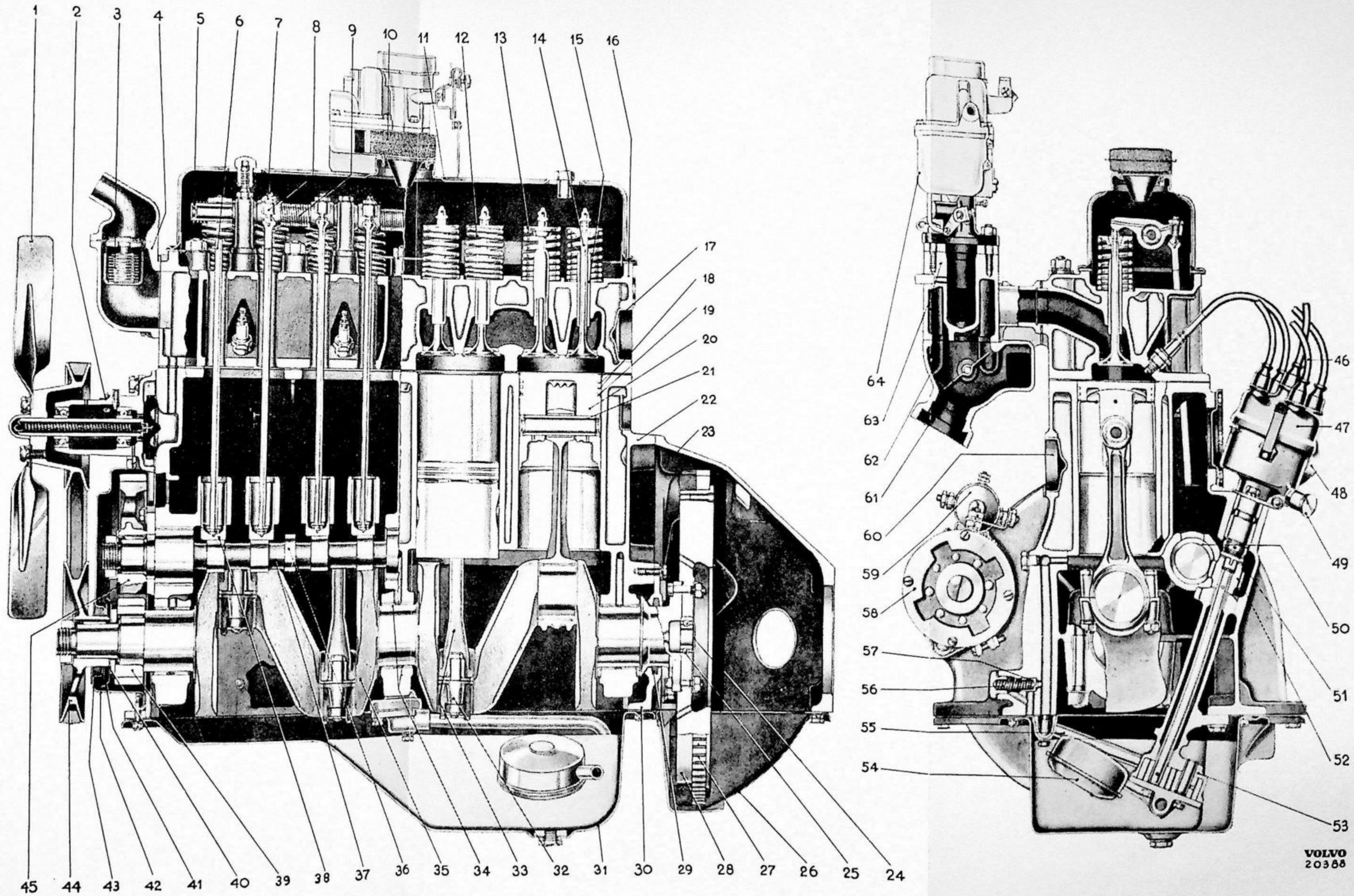

Plate I. Longitudinal and front cross sections of B4B engine, no. 495300