

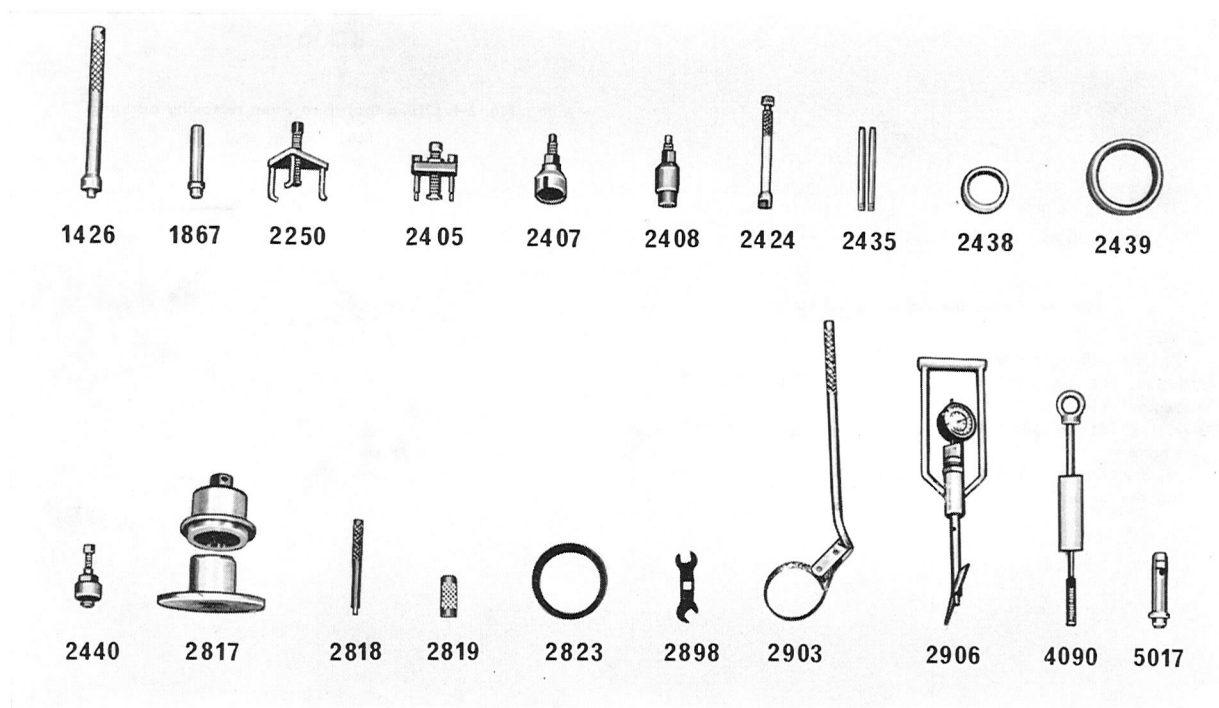
Section 2
ENGINE

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TOOLS

Special tools are preceded by 999 or SVO (e.g. 999 2837 or SVO 2837).



VOLVO
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Fig. 2-1. Tools for engine

999 (SVO)

- 1426 Drift for installing pilot bearing
- 1867 Drift for removing and installing bushing in rocker arm
- 2250 Puller for camshaft gear
- 2405 Puller for crankshaft gear (SVO 2822 can be used as alternative)
- 2407 Press tool for installing crankshaft gear
- 2408 Press tool for installing camshaft gear
- 2424 Grip tool for removing and installing valve tappets
- 2435 Guide pins (2) for installing cylinder head
- 2438 Centering sleeve for timing gear cover and installing ring circlip

999 (SVO)

- 2439 Centering sleeve for rear sealing flange and installing felt ring circlip
- 2440 Puller for crankshaft hub
- 2817 Drift for installing crankshaft oil seal on engine rear end (rubber lips seal)
- 2818 Drift for removing valve guide
- 2819 Drift for installing valve guide
- 2823 Ring for installing standard piston
- 2898 Wrench 11/16" for final-tightening of cylinder head bolts
- 2906 Fan belt tensioner
- 4090 Drift for removing and installing connection rod bushing
- 5017 Drift for removing and installing connecting rod bushing

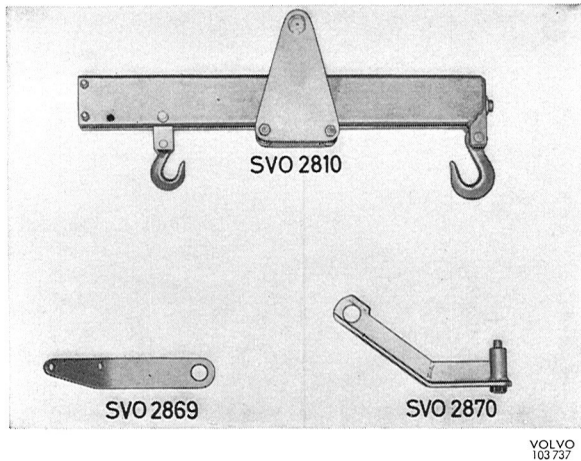


Fig. 2-2. Tools for removing engine

- 999 (SVO)
 2810 Beam for lifting out and installing engine
 2869 Lifting lug for attaching lifting beam 2810 in front end of engine
 2870 Lifting lug for attaching lifting beam 2810 in rear end of engine
 (The previous lifting tool 2425 can also be used for lifting out and installing the engine)

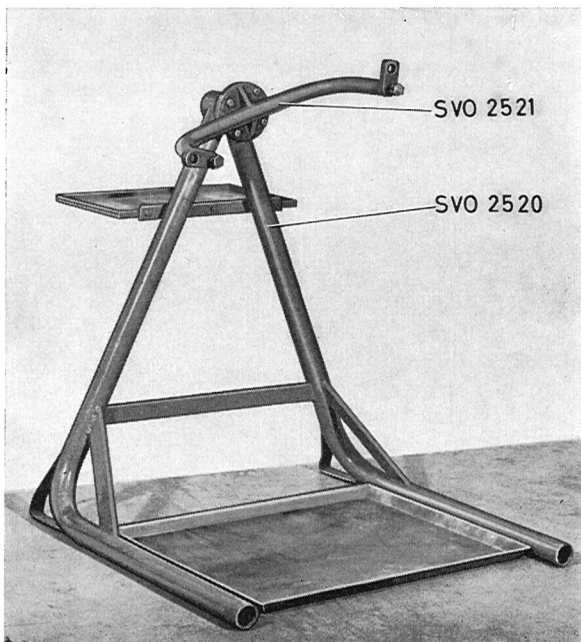


Fig. 2-3. Stand 2520 and fixture 2521 for engine

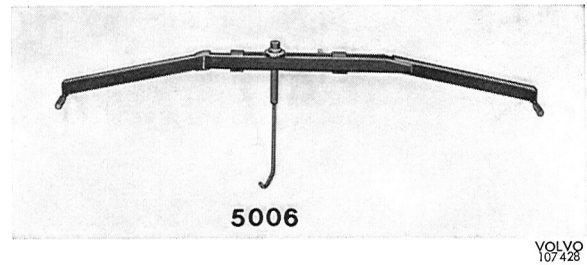


Fig. 2-4. Lifting tool used when removing oil sump.
 5006 Lifting tool

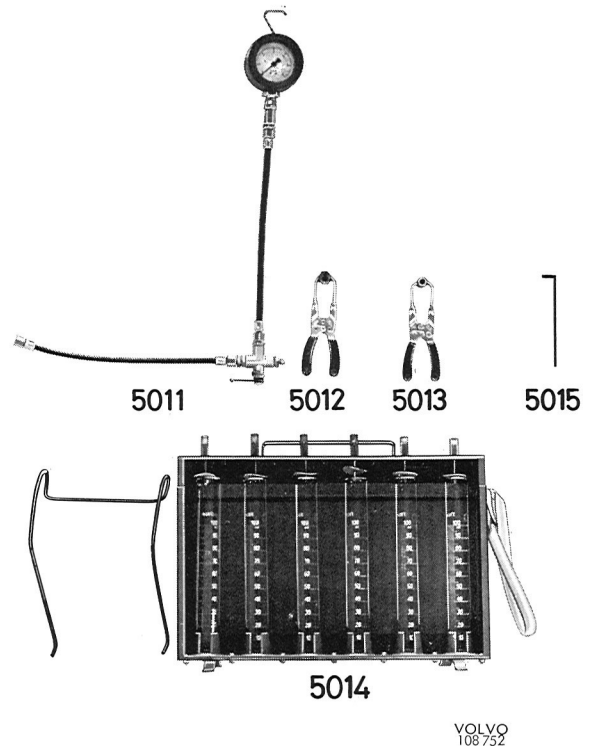


Fig. 2-5. Special tools for B 20 E/F

- 999 (SVO)
 5011 Pressure gauge, for testing line pressure and control pressure
 5012 Tool, for installation of nylon hoses 5 and 8 mm diam.
 5013 Same, but for 10 mm diam. hose
 5015 Gauge, for checking injected fuel quantity for each injector
 5015 Wrench 3 mm, for CO adjustment

GROUP 20

GENERAL

GENERAL INFORMATION

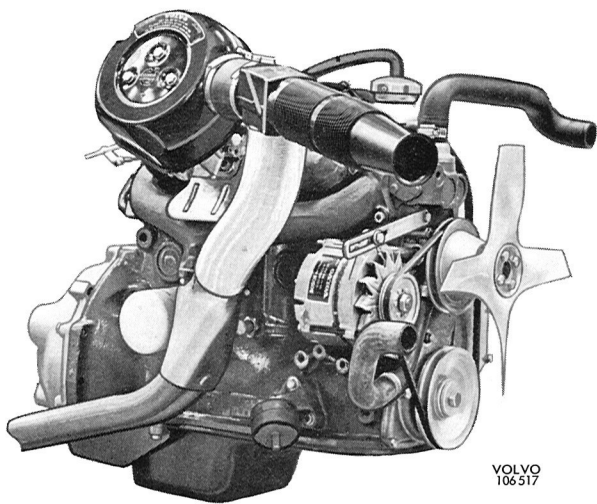


Fig. 2-6. Engine B 20 A viewed from right

The B 20 engine has four type designations: B 20 A (Figs. 2-6 and 2-7), B 20 B (Figs. 2-9 and 2-10) and B 20 E, B 20 F (Figs. 2-11 and 2-12).

The engine is a four-cylinder, water-cooled, overhead-valve unit with positive crankcase ventilation. The crankshaft is journalled in five bearings.

The difference in output between the various engines arises mainly from different camshafts and compression ratios. The engines have a fuel system with low pollutant exhaust gases.

The B 20 A engine is equipped with a single horizontal carburetor, while the B 20 B unit has two horizontal carburetors.

The B 20 E and B 20 F have fuel injection system, called CI system.

On certain cars, the engine has a slip coupling type fan.

Engine output is shown in Figs. 2-8 and 2-13 and specifications.

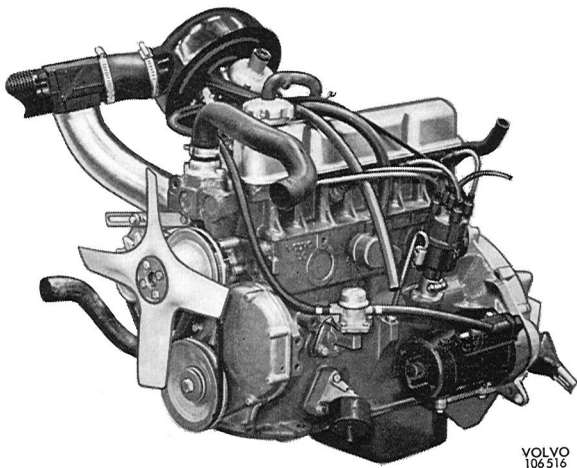


Fig. 2-7. Engine B 20 A viewed from left

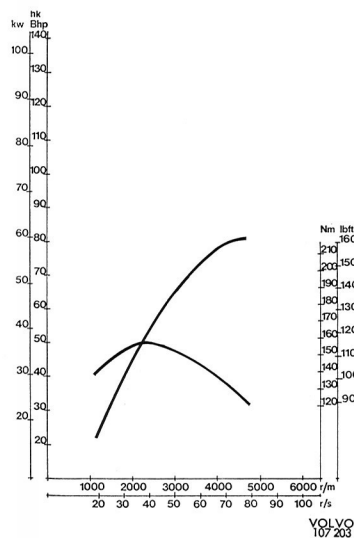


Fig. 2-8. Output and torque curves, B 20 A (DIN)

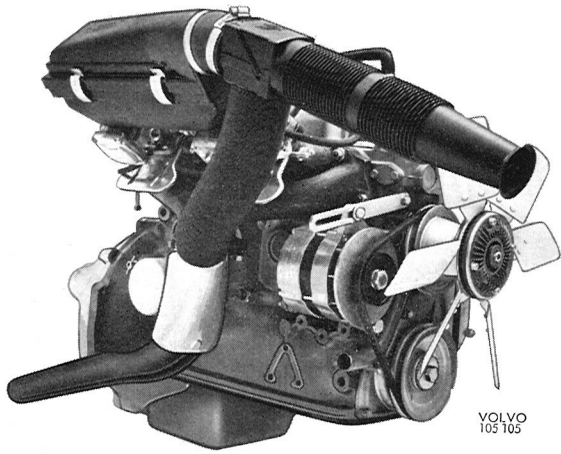


Fig. 2-9. Engine B 20 B viewed from right

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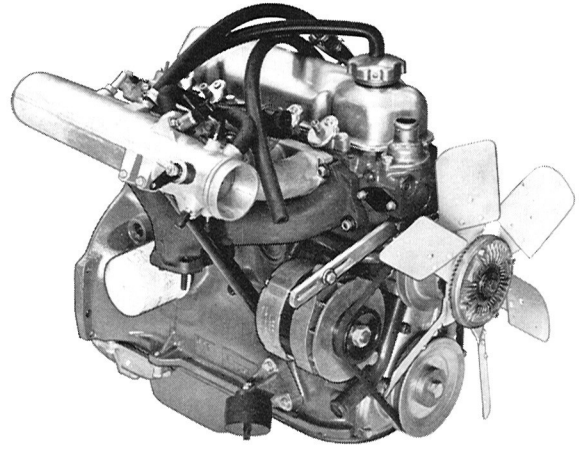


Fig. 2-11. Engine B 20 E (B 20 F) viewed from right

VOLVO
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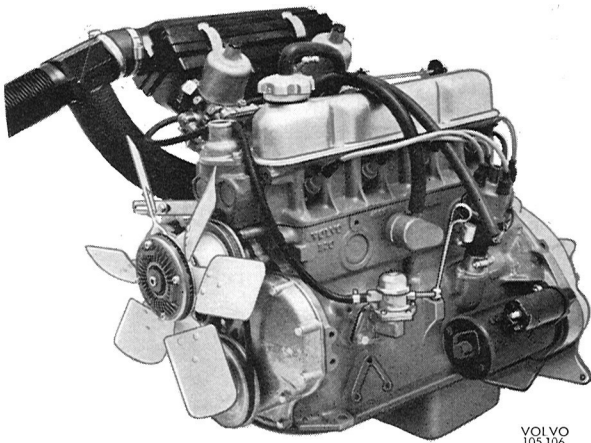


Fig. 2-10. Engine B 20 B viewed from left

VOLVO
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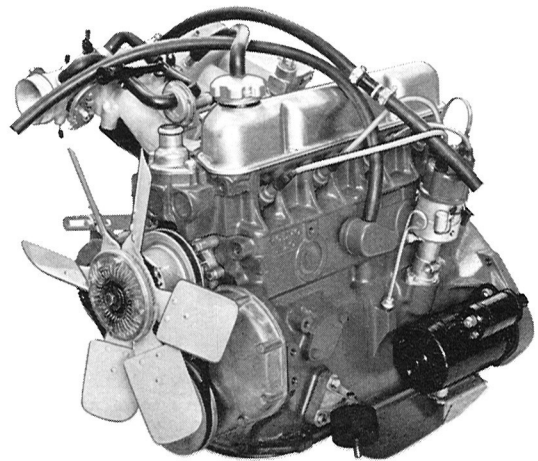
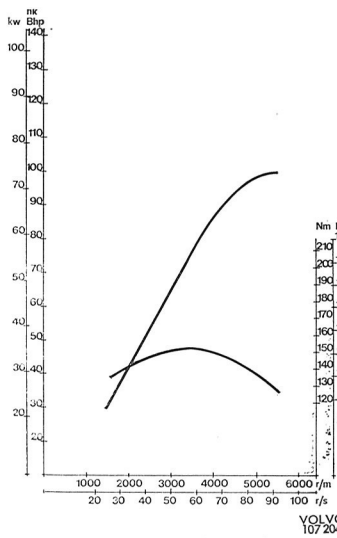


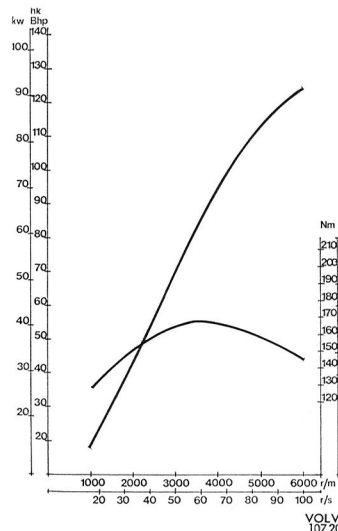
Fig. 2-12. Engine B 20 E (B 20 F) viewed from left

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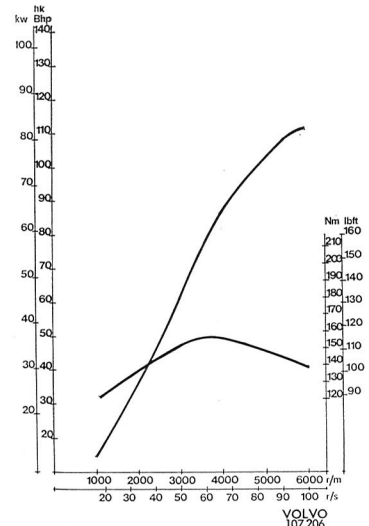
B 20 B (DIN)

VOLVO
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B 20 E (DIN)

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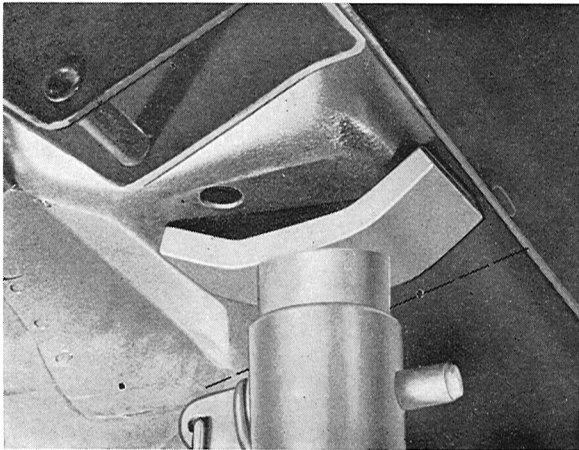


B 20 F (SAE J 245)

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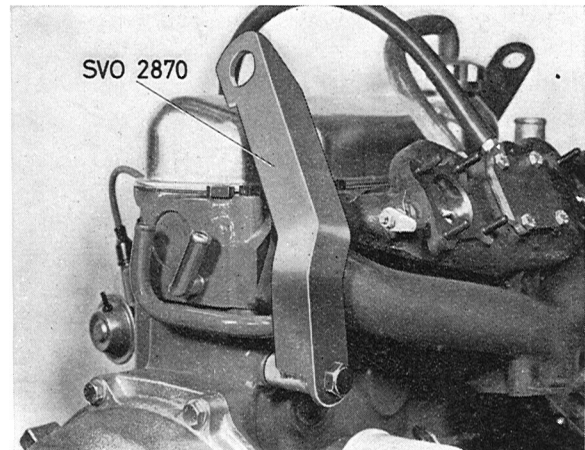
Fig. 2-13. Output and torque curves

SERVICE PROCEDURES



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Fig. 2-14. Location of axle prop



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Fig. 2-16. Lifting lug on engine rear end

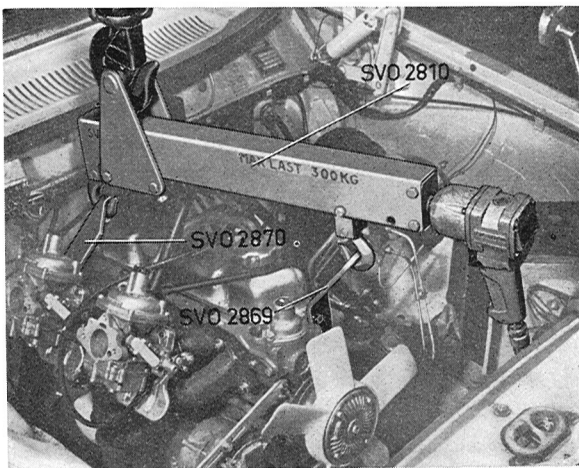
REMOVING ENGINE, B 20 A, B 20 B

Engine, remove, install replacement unit=Volvo Standard Times Op. No. 20114

1. Remove the gear lever.
2. Remove the hood from the hinges.
3. Empty the coolant.
4. Disconnect the battery plus cable.

Remove the distributor cap and the ignition leads from the spark plugs. Remove the electric wire from the distributor. Remove the ignition coil and place it on the one side.

5. Disconnect the fuel hoses from the pump and plug the hose. Remove the electric cables from the starter motor.
6. Remove the air cleaner with air cleaner cover and lift it forwards together with the attached hoses. Remove the electric wires from the alternator and also the temperature and oil pressure units.



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Fig. 2-15. Lifting out engine

Disconnect the electric wire for the back-up lights in the jack box (Remove the wire for the overdrive.)

7. Remove preheating plate and attaching nuts for exhaust manifold flange.
8. Remove throttle cable from the throttle control shaft. Remove throttle control shaft. Remove choke wire from the carburetor and vacuum hose for brake servo from the manifold. Disconnect water hoses for heater element from the engine.
9. Disconnect hose for expansion tank as well as lower radiator hose from the radiator. Remove upper radiator hose from the engine and finally the radiator.
10. Fit lifting arm 2867 to the front end of the engine as shown in Fig. 2-17 and lifting arm 2870 to the engine rear end as shown in Fig. 2-16.
11. Drain engine oil. Remove the lower nuts from the engine front mountings. Install the engine hoist unit with lifting beam 2810 and move the block runner to the rear end of the lifting beam, see Fig. 2-15. (Use a nut puller for this adjustment).
12. Remove return spring and clutch wire from the lever and clutch wire sleeve from the clutch casing.
13. Disconnect the ground cable from the engine.
14. Remove exhaust pipe clamp from the bracket. Remove gearbox member.
15. Remove speedometer hose. Remove propeller shaft from the gearbox.
16. Hoist engine with the lifting unit, lowering at the same time engine rear end by adjusting

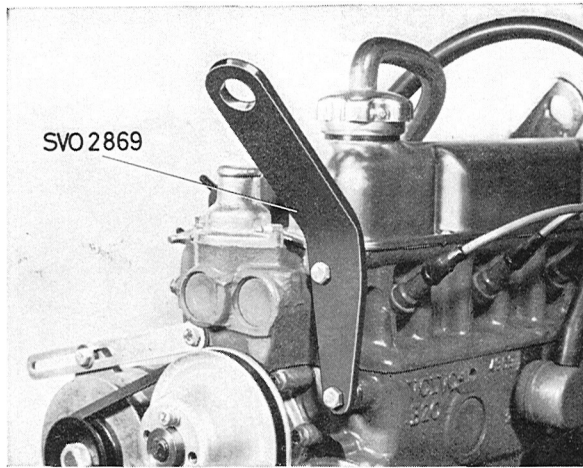


Fig. 2-17. Lifting lug on engine front end

block unit on the lifting beam. Pull the engine forwards across the front member while raising it at the same time. Level out engine and gear-box and pull the entire unit forwards.

INSTALLING ENGINE, B 20 A, B 20 B

1. Install lifting arm 2869 and arm 2870. Install the engine in position with lifting beam 2810.
NOTE: Check that the exhaust manifold does not come into contact with the oil filter.
2. Install the gearbox member.
3. Install the ground cable. Install speedometer hose as well as propeller shaft.
4. Remove lifting beam and lifting lugs from the engine. Install the nuts for the engine front mountings.
5. Secure exhaust manifold together with gasket and install preheating plate.
6. Install the clutch wire sleeve and connect the wire to the lever. Install the return spring. Adjust the clutch according to Section 4 (41).
7. Install the clamp for the exhaust manifold. Lower the vehicle.
8. Connect the water hoses for the heater unit. Install the electric wires to the temperature and oil pressure senders as well as the alternator. Connect the electric wire for the back-up light in the rapid contact. (Connect the wire for the overdrive.)
9. Connect the vacuum hose. Install the throttle control shaft, the throttle cable, the choke wire as well as the air cleaner housing. Connect the hoses to the air intake and preheating plate respectively.

10. Connect the electric cables to the starter motor and connect fuel hose.
11. Install ignition coil, distributor cap and the ignition leads as well as the electric wires.
12. Install radiator and connect radiator hoses and hose for expansion tank. Fill coolant and engine oil.
13. Install the hood and connect the battery cable. Install the gear lever. Check function and for leakage.

REMOVING ENGINE, B 20 E, B 20 F

1. Remove the gear shift lever.
2. Remove the hood.
3. Disconnect the battery plus cable.
4. Place a pan under the engine and drain the coolant by loosening the lower radiator hose.
5. Disconnect following fuel hoses: 1 rubber hose to the control pressure regulator, 2 plastic hose from control pressure regulator at the fuel distributor, 3 hose at the cold start injector, 4 hose at the fuel filter, 5 fuel return hose at the fuel distributor.
6. Remove pipe connecting air cleaner and intake manifold.
7. Disconnect wires from cold start injector, control pressure regulator, auxiliary air valve, coolant temperature sensor and thermal time switch at the engine side.
8. Disconnect the control pressure regulator ground wire.
9. Disconnect the four fuel hoses at the injectors.
10. Disconnect the throttle cable at the throttle and the intake manifold.
11. Disconnect the oil pressure sender wire and alternator wires.
12. Disconnect the heater hoses at the firewall.
13. Disconnect the brake vacuum booster hose at the intake manifold and the crankcase ventilation hose at the air cleaner.
14. Disconnect the ignition wires at the spark plugs and the distributor. Remove the distributor cap. Disconnect the distributor wire.
15. Disconnect the starter cable.
16. Disconnect the hose at the thermostat housing.
17. Remove the fan cover. Disconnect the hose from the radiator at the expansion tank.
18. Remove the radiator grille. Remove radiator screws, lift out the radiator and the fan cover.
19. Vehicle with combined unit: remove the vacuum hose at the intake manifold.

20. Remove the thermal time switch at the right side of the engine block.
21. Install lifting lug 2870 on engine rear end and lifting lug 2869 on the engine front end, see Figs. 2-16 and 2-17.
22. Jack up the vehicle and put it on stands.
23. Drain the engine oil.
24. Remove nuts and washers for front and rear mounts.
25. Remove the exhaust flange nuts. For a vehicle equipped with Exhaust Gas Recirculation: remove the EGR valve pipe.
26. Attach lifting beam 2810 to the lugs and adjust the trolley to the rear position. Lift the engine rear end, see Fig. 2-18.

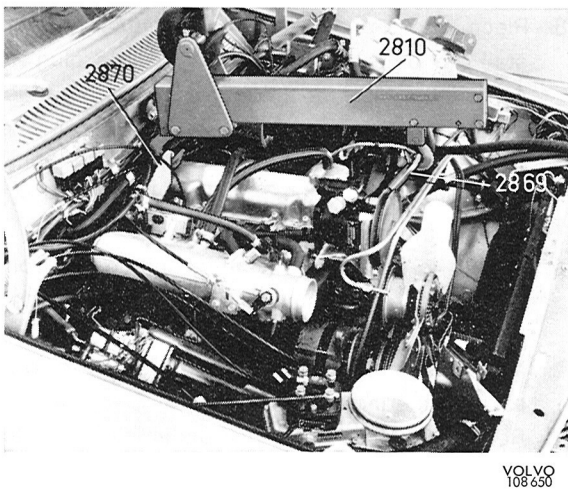


Fig. 2-18. Lifting out engine

27. Disconnect the engine ground strap. Remove clutch spring and clutch cable.
28. Remove front exhaust clamp. Remove transmission member.
29. Remove speedometer wire at the transmission and electrical wires.
30. Remove the propeller shaft at the transmission flange.
31. Lift the engine slightly. Lower the engine rear end by adjusting the trolley forwards. Pull the engine forwards and lift it at the same time.

INSTALLING ENGINE, B 20 E, B 20 F

1. Install the lifting lugs on the engine and hoist the engine to position in the engine compartment.
2. Connect speedometer cable and transmission electrical wires.
3. Attach the propeller shaft.
4. Install transmission member and front exhaust pipe clamp.
5. Re-connect the engine ground strap. Install clutch wire and spring.
6. Check that the engine is in place and resting on the engine mounts. Unhook the lifting beam.
7. Install washers and nuts for the engine mounts.
8. Install the exhaust pipe flange. For vehicles equipped with Exhaust Gas Recirculation: attach the pipe for the EGR valve.
9. Jack up the vehicle, remove the stands and lower the vehicle to the ground.
10. Install the thermal time switch on the engine side.
11. For vehicles equipped with combined unit: connect the hose at the intake manifold.
12. Locate the fan cover over the fan. Install the radiator. Install the radiator grille. Install the fan cover on the radiator.
13. Connect the hose from the expansion tank and the upper radiator hose.
14. Reconnect the starter cable.
15. Reconnect distributor wire. Install rotor and distributor cap. Reconnect high tension leads to spark plugs and ignition coil.
16. Connect the heater hoses at the firewall.
17. Connect the brake vacuum booster hose and the crankcase ventilation hose.
18. Reconnect oil pressure sender wire and alternator wires.
19. Install the throttle cable.
20. Reconnect the four fuel hoses to the injectors.
21. Reconnect the control pressure regulator ground wire. Reconnect cold start injector, control pressure regulator, auxiliary air valve, temperature sensor and thermal time switch wires.
22. Reconnect fuel hoses to control pressure regulator and fuel distributor.
23. Reconnect fuel hoses to fuel filter, cold start injector and the fuel return hose to the fuel distributor.
24. Install pipe between air filter and intake manifold.
25. Install lower radiator hose and fill coolant.
26. Fill engine oil.
27. Reconnect the battery plus cable.
28. Install the hood.
29. Install the gear shift lever.

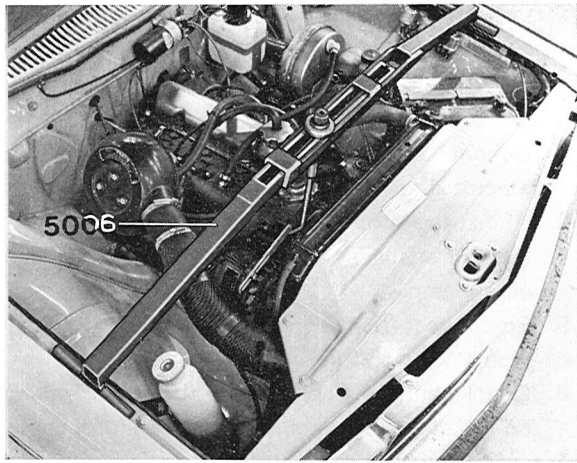


Fig. 2-19. Lifting tool 5006

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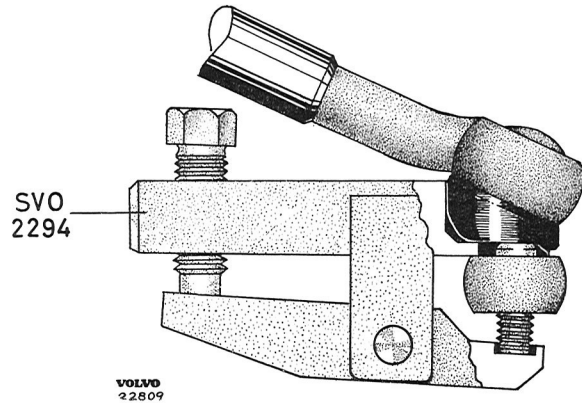


Fig. 2-20. Removing steering rod

REPLACING SUMP GASKET

1. Place the lifting tool 5006 shown in Fig. 2-19 and hook the hook round the alternator tensioning bar next to the engine block. Raise the front end of the engine until there is no weight on the engine mountings. Remove the oil dipstick.
2. Jack up the vehicle and put stands under the front jack points. Drain the engine oil.
3. Remove the lower nuts for the engine mounts. Remove the steering rods from the pitman arm and relay arm with tool 2294 according to Fig. 2-20.
4. Place a jack under the front axle member. Remove the rear bolts on the front axle member and screw on instead two auxiliary bolts (UNC 1/2—13×114). Remove the front bolts for the front axle member. Lower and remove the jack so that the front axle member is suspended in the two auxiliary bolts.
5. Remove the plug for the oil temperature gauge and reinforcing bracket at the flywheel housing.
6. Remove the bolts for the sump and lift off the sump.
7. Remove the old gasket and clean the contact surfaces of cylinder block and sump.
8. Place sump and gasket in position and install the bolts. Tighten well the drain plug as well as the plug for the oil temperature gauge.
9. Place the reinforcing bracket in position and tighten all the bolts by hand. Screw in firmly the bolts in the flywheel housing and then the bolts in the cylinder block.
10. Raise the front axle member, tighten the front bolts. Remove the auxiliary bolts. Install and tighten the rear bolts.
11. Install the nuts for the engine mounts as well as the steering rods.
12. Remove the blocks from under the vehicle. Remove the lifting tool. Install the bolt (with washer) for the timing gear cover.
13. Top up with oil and insert the oil dipstick.
14. Start the engine and check for leakage.

GROUP 21

ENGINE

GENERAL INFORMATION

CYLINDER BLOCK

The cylinder block (Illustration A) is made of special cast iron and is cast in a single unit. The cylinder bores, which are surrounded by cooling jackets, are machined directly in the block. The oilways in the block are arranged so that the oil filter, of the full-flow type, is directly attached to the right side of the block. A reinforcing bracket is mounted to the cylinder block and timing gear cover for taking up vibrations, see Fig. 2-21.

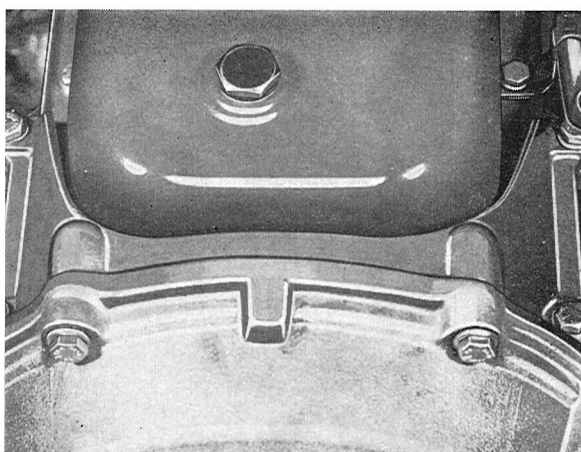


Fig. 2-21. Reinforcing bracket, cylinder block—flywheel housing

CYLINDER HEAD AND VALVES

The cylinder head is secured to the block by bolts. All the combustion chambers are machined throughout and have separate inlet and exhaust ports, one for each valve.

The valves, which are suspended in the cylinder head, are made of special steel and carried in replaceable guides. The valve stems are chromed. The valve collet is provided with three lands and the valve with corresponding grooves, which hold the valve but also make suitable rotation possible. (Compare with Fig. 2-33). The valves are provided with valve guide rubber seals, which are mounted on the guides.

The cooling jackets are designed so that the air around the spark plugs is also cooled. Water distribution is by means of a pipe, the water being directed towards the warmest parts of the engine.

The difference in compression between the engines is due to different cylinder head gasket thicknesses and different cylinder heads.

CRANKSHAFT AND BEARINGS

The crankshaft is made of steel and has ground, case-hardened bearing journals. It is carried in five main bearings, the rear flange bearing also functions as a pilot bearing axially. There are drilled oilways in the crankshaft for the lubricating oil. The bearing shells, which are replaceable, consist of a steel backing with indium-plate lead-bronze bearing metal.

CAMSHAFT AND VALVE TAPPETS

The camshaft is made of special-alloy cast iron and has case-hardened cams. It is driven from the crankshaft through a gear train which has a ratio of 1:2. Camshaft axial location is maintained by a bronze axial washer located at the front end of the camshaft. Axial play is determined by a spacer ring behind the camshaft gear, which has a steel hub. The valve tappets are actuated directly by the camshaft. They are located in holes in the block above the camshaft and transfer movement to the valves by means of push rods and rocker arms. There are no inspection covers for the valve tappets since these are accessible after the cylinder head has been removed.

CONNECTING RODS, PISTONS AND PISTON RINGS

The connecting rods are made of drop-forged steel and are provided with a precision-machined bushing which acts as a bearing for the piston pin. The big-end bearing shells are precision-manufactured and are replaceable.

The pistons are made of light-alloy and have two compression rings and one oil scraper ring. The upper compressing ring is chromed in order to reduce cylinder wear.

The piston pin has a floating fit in both the piston and connecting rod. The axial movement of the piston pins is limited by circlips in the piston pin hole.

POSTIVE CRANKCASE VENTILATION

This arrangement prevents crankcase gases from being released into the atmosphere. They are instead sucked into the engine through the intake manifold and take part in the combustion process. The residue is blown out through the exhaust pipe together with the other combustion residues.

Between the valve cover and the intake manifold there is a hose (4, Fig. 2-22). It is connected to the intake manifold by a calibrated nipple (3). (This nipple should be cleaned every 40.000 km=24.000 miles. Between the oil trap, which is connected to the crankcase, and the air cleaner there is a hose (2) connected for the fresh-air supply. At the connection to the oil trap there is a flame arrester (5), which consists of a metal filter. The partial vacuum which arises in the intake manifold when the engine is running, causes a partial vacuum in the valve cover and crankcase through the hose (4). Fresh air is supplied to the crankcase through the air cleaner via the hose (2).

As the fresh air supply passes through the carburetor air cleaner, impurities are prevented from getting into the engine. Where there is a high or medium degree of partial vacuum in the crankcase (intake manifold), which happens during idling and when operating under a light load, the system functions as described above. When the partial vacuum in the crankcase is less than that in the air cleaner,

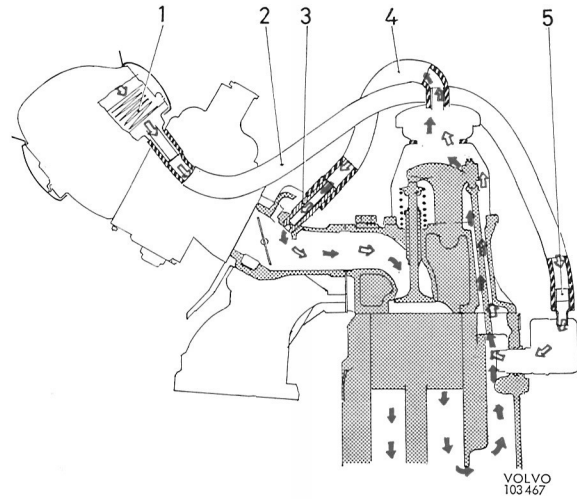


Fig. 2-22. Positive crankcase ventilation

- | | |
|------------------------------|-----------------------------|
| 1. Cleaner insert | 4. Hose for crankcase gases |
| 2. Hose for fresh air supply | 5. Flame arrester |
| 3. Nipple | |

which occurs at full load and/or with large flow quantities, no fresh air is supplied. Instead the flow in the connection between the flame arrester and air cleaner reverses and the crankcase gases go both ways, partly through the hose (4) and partly through the air cleaner and carburetor to the intake manifold. In this way, the crankcase ventilation system can deal with relatively large quantities of crankcase gases without any escaping into the atmosphere.

SERVICE PROCEDURES

DISASSEMBLING ENGINE

After the engine has been lifted out of the vehicle, disassembling is as follows. (Instructions for the individual parts are under the separate headings concerned.)

1. Place the engine on stand 2520 with fixture 2521 (see Fig. 2-23). Check that the oil has been drained.
2. Remove the starter motor and reinforcing plate on the lower front edge of the flywheel housing. Remove the flywheel housing together with the transmission and then remove clutch and flywheel.
3. Remove the rear flange, taking care not to damage the contact surfaces, thereafter the alterna-

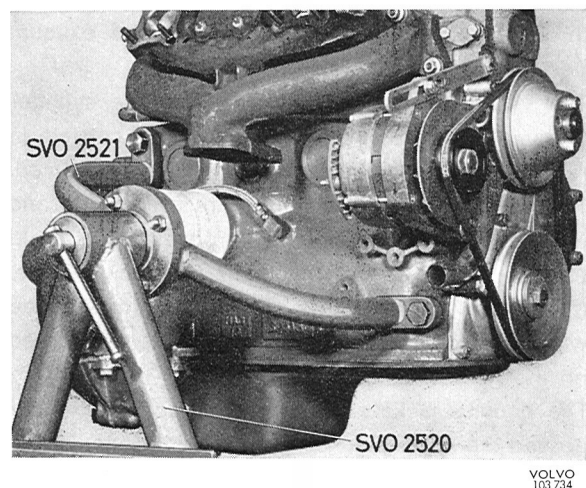


Fig. 2-23. Engine on stand

tor, water pump and distributor, valve cover, rocker arms, manifold, cylinder head and oil filter.

Remove valve tappets with tool 2424, see Fig. 2-24.

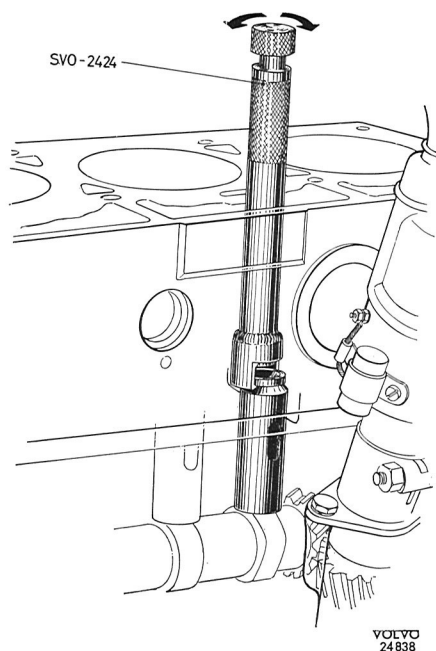


Fig. 2-24. Removing valve tappets

4. Remove the timing gear cover and the timing gears. Regarding tools, see under the heading "Replacing timing gears". Remove the camshaft.
5. Remove the carbon ridge from the cylinder bores. Remove the sump, oil pump and connecting rods with pistons. Replace the caps correctly on their respective connecting rods.
6. Turn the engine upside down and remove the crankshaft. Replace the caps correctly in their respective positions.

CLEANING

After disassembling, all the parts should be thoroughly cleaned.

Pistons, light alloy parts and bearing shells must never be washed in caustic soda. Rinse the parts with warm water and blow them dry with compressed air after washing. Clean the oilways thoroughly. All sealing plugs at the oilway openings in the cylinder block must be removed during the cleaning process.

ASSEMBLING ENGINE

When assembling the engine, follow the instructions for the parts concerned. Check the marking of the bearings according to Fig. 2-25. The main bearings are marked 1—5, and the big-end bearings 1—4, counting from the front.

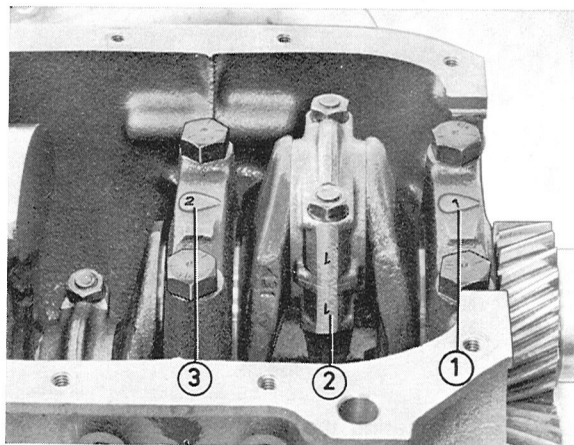


Fig. 2-25. Marking main and big-end bearings

1. Main bearing No. 1
2. Big-end bearing No. 1
3. Main bearing No. 2

Check that all parts are clean and lubricate sliding surfaces with oil before assembling. Always use new gaskets, cotter pins and lock washers. No adhesive should be used on the gaskets. The seals on the ends of both the oil pump delivery pipe and the water pump pipes are rubber rings, "O-rings". These rings, which seal radially, are made of special rubber with very close tolerances. Only genuine Volvo parts should be used. Installation is facilitated by coating the rings with soap solution. The rings are installed on the pipes and then pressed into their correct positions before the attaching bolts are tightened. The oil pump flange should lie flush against the cylinder block before tightening. The timing gear cover and rear seal flange must be accurately centered when installed. See under the headings "Replacing timing gear cover" and "Installing rear seal flange". The big-end bearing bolts and nuts should be replaced with new ones when reconditioning. The reinforcing bracket on the flywheel housing is installed according to point 9 under "Replacing sump gasket" (page 2:8). The cylinder head is installed with the help of guide pins 2435. The bolts must be tightened in a certain sequence as shown in Fig. 2-28 in order to avoid unnecessary stresses. Check that the oil hole (Fig.

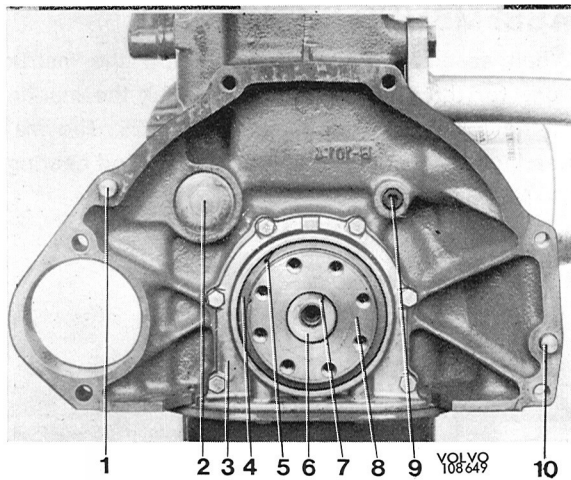


Fig. 2-26. Rear end of engine

- | | |
|-------------------|------------------|
| 1. Guide pin | 6. Pilot bearing |
| 2. Core plug | 7. Circlip |
| 3. Sealing flange | 8. Crankshaft |
| 4. Sealing washer | 9. Lug |
| 5. Circlip | 10. Guide pin |

2-27) for lubricating the rocker arms is clear. The pilot bearing (6, Fig. 2-26) should be lubricated before installation with heat-resistant ball bearing grease. The bearing and protecting washer are held in position by a circlip (6).

The most important bolts and nuts should be tightened with a torque wrench, see "Tightening Torques" in "Specifications". Re-tighten the cylinder head bolts. See "Valve grinding and decarbonizing". Use a cylinder head gasket of the right thickness, see "Specifications".

VALVE GRINDING AND DECARBONIZING, B 20 A, B 20 B

Volvo Standard Times Op. No. 21404

1. Drain the coolant from the radiator and cylinder block. To do this, remove the plug on the right-hand side of the engine and disconnect the lower radiator hose.
2. Disassemble the throttle control. Disconnect the choke control.
3. Remove air cleaner and carburetor.
4. Disconnect the exhaust pipe at the exhaust manifold and disconnect the hoses to the radiator as well as other connections to the cylinder head.
5. Remove valve cover, rocker arm shaft and push rods.
6. Remove the cylinder head bolts and disconnect the water pipe as well as the attachment on the rear exhaust manifold. Loosen the alternator tensioner arm. Lift off the cylinder head.

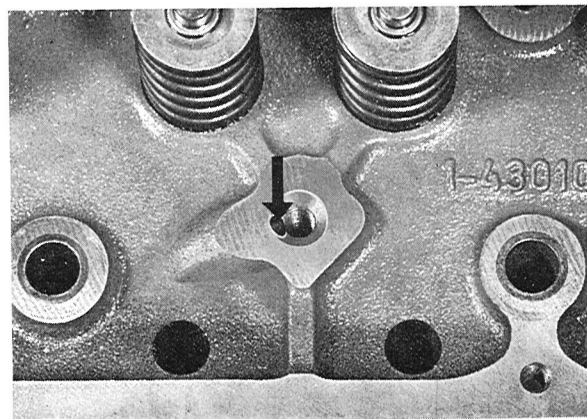


Fig. 2-27. Oil hole in cylinder head

7. Clean the piston, combustion chambers, inlet ports and exhaust ports very thoroughly. Do not use emery cloth since small grinding particles can get in between the piston and cylinder walls and consequently cause scoring.
8. Recondition the valve system as described under "Cylinder head and valves".
9. Install the valves. Screw the guide pins 2435 into the block, one in the front right-hand hole and the other in the left-hand rear hole, see Fig. 2-29. Install a new cylinder head gasket with the "TOP" upwards (wide edge). Install new seals for the water pump and the cylinder head. Screw out the guide pins and install the bolts in these holes as well. For tightening sequence, see Fig. 2-28. Tightening should be in three stages: 1st stage 40 Nm (29 lb ft), 2nd stage 80 Nm (58 lb ft); 3rd stage: after running the engine, see point 11.

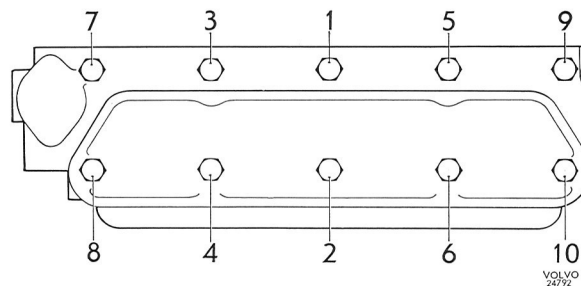


Fig. 2-28. Tightening sequence for cylinder head bolts

Install the other parts. Fill coolant according to the instructions under "Filling coolant when the system has been emptied".

11. Adjust the valve clearance for B 20 A .45—.50 mm (.018—.020") and for B 20 B .55—.60 mm (.022—.024"). (Not final clearance.) Run the engine for 10 minutes. Re-tighten the cylinder head bolts to 90 Nm (65 lb ft) with tool 2889. Fig. 2-30. **Re-adjust** valve clearance according to "Specifications".

VALVE GRINDING AND DECARBONIZING, B 20 E, B 20 F

Volvo Standard Times Op. No. 21404

1. Drain the coolant from the radiator and cylinder block by removing the plug on the right side of the engine and, if necessary, disconnect the lower radiator hose.
2. Remove the positive lead from the battery.
3. Disconnect hoses to brake vacuum booster and crankcase ventilation.
4. Remove the cold start injector hose and the fuel return hoses on both sides of the T-connection (at the control pressure regulator).
5. Remove the outlet fuel hose at the fuel filter and remove fuel filter with clamp from the firewall.
6. Disconnect the fuel hose from the fuel distributor at the control pressure regulator.
7. Disconnect electrical wires at cold start injector, auxiliary air valve, control pressure regulator and temperature sensor.
8. Remove the air cleaner connecting pipe.
9. Disconnect the throttle cable at the intake manifold.
10. Disconnect hose for heater and the upper radiator hose.
11. Remove the alternator adjustment bracket.
12. Remove the straps for the injector hoses. Remove injectors with hoses from the cylinder head.
13. Remove the bracket for the intake manifold, remove the manifold.
14. Remove exhaust manifold from exhaust pipe and cylinder head.
15. Remove ignition leads and spark plugs.
16. Remove cover, rocker arm shaft and the push rods.
17. Remove the cylinder head bolts and lift off the head. Take off the cylinder head gasket, the flange gasket and the rubber rings for the water pump.
18. Clean piston crowns, combustion chambers, inlet ports and exhaust ports very thoroughly. Do not use emery cloth since small grinding particles can get in between the piston and cylinder walls and consequently cause scoring. Recondition the valve system as described under "Cylinder head and valves". Check that the oilway to the rocker arm mechanism on the valve tappet side in the middle of the head is clean. In the cylinder head oil goes up through the bolt hole, between the bolt and hollow partition, through a diagonal oilway to the attaching bolt for the rocker arm shaft and then up into the shaft.
19. Screw the guide pins 2435 into the block, one in the front right-hand hole and the other in the left-hand rear hole, see Fig. 2-29. Install a new cylinder head gasket with the "TOP" upwards (wide edge). Install a new inlet duct gasket and new seal for the water pump. Install the cylinder head. Screw out the guide pins and install the bolts in these holes as well. For tightening sequences, see Fig. 2-28. Tightening should be in three stages: 1st stage 40 Nm (29 lb ft); 2nd stage 80 Nm (58 lb ft); 3rd stage: after running the engine, see point 34.
20. Install push rods and rocker arm shaft. Adjust the valves to .45—.50 mm (.018—.020"). (Not final clearance.)
21. Install the rocker arm cover, the spark plugs and the ignition leads.
22. Attach the exhaust manifold to the cylinder head and connect the exhaust pipe.
23. Install the intake manifold with bracket.
24. Install injectors with hoses. Attach the hose straps.
25. Install the alternator adjustment bracket.
26. Connect heater hose and upper radiator hose.
27. Install the throttle cable.
28. Install the air cleaner connecting pipe.
29. Reconnect wires to cold start injector, auxiliary air valve, control pressure regulator and thermal time switch. Reconnect the control pressure regulator ground wire.
30. Reconnect brake vacuum booster hose and crankcase ventilation hose.
31. Install the hose for the cold start injector and the fuel return hoses on both sides of the T-connection (at the control pressure regulator).
32. Install fuel filter with clamp.
33. Connect the control pressure regulator hose at the fuel distributor.
34. Reconnect the battery cable.

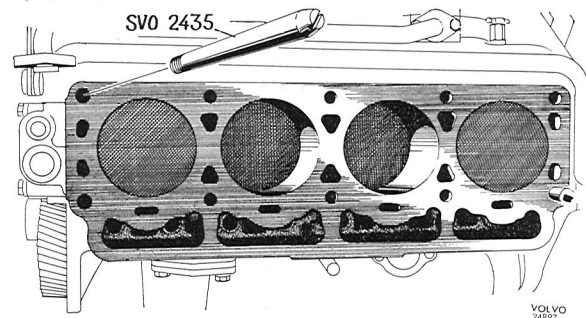


Fig. 2-29. Guide pins for cylinder head installation

35. Install the drain plug on the right side of the engine. Reinstall the lower radiator hose if it has been disconnected.
Fill coolant.
36. Run the engine for 10 minutes. Re-tighten the cylinder head bolts to 90 Nm (65 lb.ft.) with tool 2898. Re-adjust valve clearance according to "Specifications".

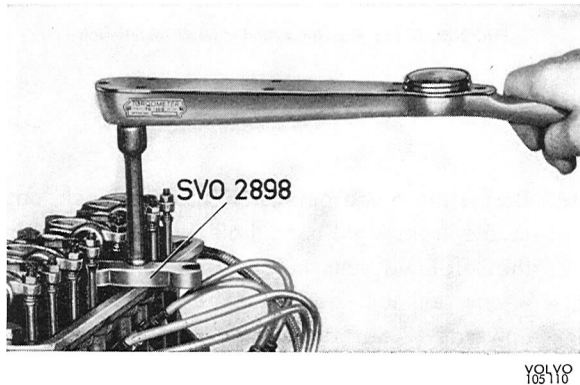


Fig. 2-30. Re-tightening cylinder head bolts

CYLINDER HEAD AND VALVES DISASSEMBLY

1. Remove the valve springs by first compressing them with valve pliers and removing the valve collets, after which the pliers are released. Place the valves in order in a valve rack. Remove the valve guide seals.
2. Measure the clearance between stem and guide. With a new valve the clearance should not exceed .15 mm (.006"). Also check that the valves are not excessively worn. See "Specifications" under "Valve system" and "Wear tolerances".

CLEANING

Remove carbon and combustion deposits from the valves, combustion chambers and ports by using rotating brushes.

GRINDING VALVES AND VALVE SEATS

1. Grind the valves in a machine after they have been cleaned. Install new valves if the old ones are excessively worn.
2. Grind the valve seats. Use an electrically driven grinder or a hand milling cutter. A pilot spindle must be carefully installed before work is started and any worn guides must be replaced with new ones. The seat should be ground until a good sealing surface is obtained. The angle is 45° and the width of the sealing surface should be approx. 2.0 mm (.08"), see "A" Fig. 2-31. If

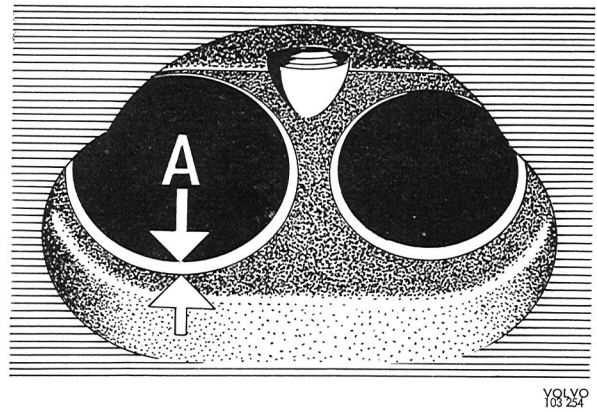


Fig. 2-31. Valve seat width A=2 mm (.08")

the sealing surface is too wide after grinding, it can be reduced by using a 70° grinding stone from the inside and a 20° grinding stone from the outside.

3. Coat the valve sealing surfaces with a thin layer of fine grinding paste and lap in the valves against their seats.
Then clean the valves and seats and check that good sealing is obtained.

REPLACING VALVE GUIDES

Volvo Standard Times Op. No. 21415

1. Press out the old guides with tool 2818.
2. Press in the new guides using drift 2819 which gives the correct depth, see Fig. 2-32. For the B 20 E/F engine a .4 mm (.016") thick washer is placed between the tool and the cylinder head.

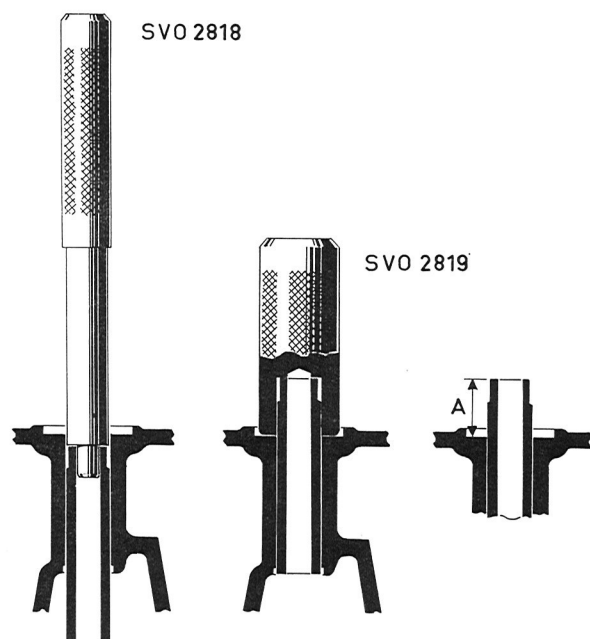
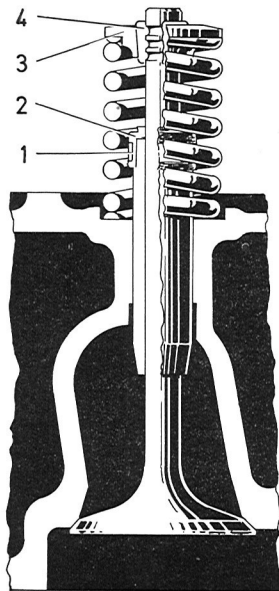


Fig. 2-32. Replacing valve guides
A=17.5 mm (.689") For B 20 E/F, 17.9 mm=.705")



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Fig. 2-33. Valve collet and valve guide seal

- | | |
|----------------|-----------------|
| 1. Metal ring | 3. Washer |
| 2. Rubber seal | 4. Valve collet |

3. Check that the guides are free from burr and that the valves move easily in them.

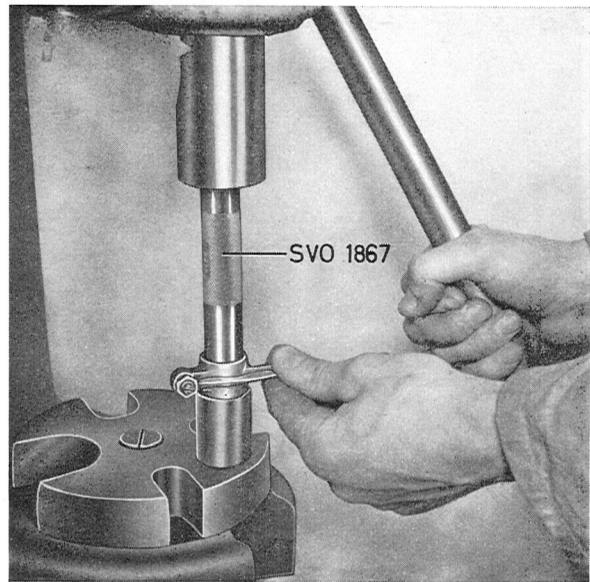
ASSEMBLING

1. Check that the parts are in good condition and clean. Test the springs to ensure that they maintain the values in "Specifications".
2. Place the valves in position. Install valve guide seal, valve spring, upper washer and collet.

REPLACING ROCKER ARM BUSHING AND GRINDING ROCKER ARMS

Volvo Standard Times	Op. No.
ROCKER ARM MECHANISM, remove and install, incl. adjust valves	21439
ROCKER ARMS, machine grind, rocker arm mechanism removed	21477

1. If wear amounts to .1 mm (.004"), replace the rocker arm bushing. Use tool 1867 for pressing the bushing out and in, see Fig. 2-34. Then ream the bushing to an accurate fit on the shaft using a suitable reamer. The hole in the bushing should coincide with the hole in the rocker arm.
2. If necessary grind the pressure surface against the valve in a special machine.



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Fig. 2-34. Replacing rocker arm bushing

INSTALLING CYLINDER HEAD

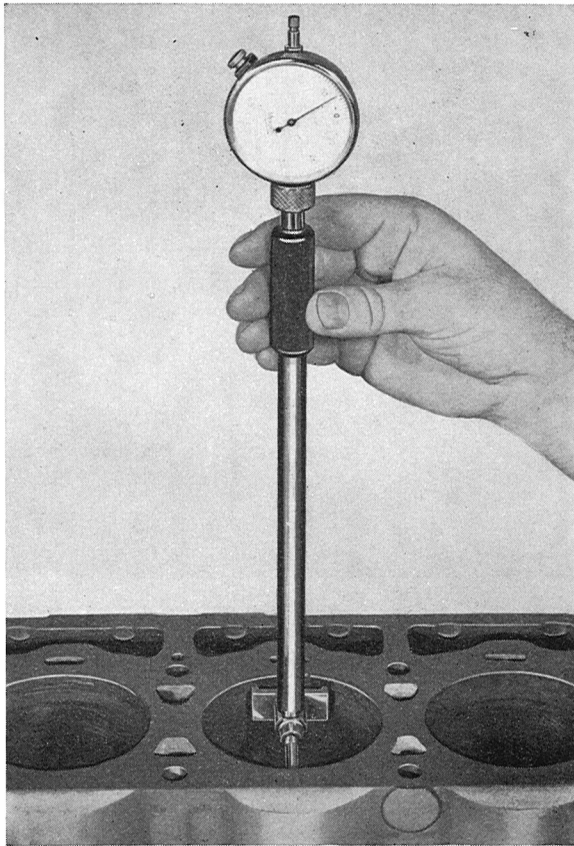
See under "Valve grinding and decarbonizing".

ADJUSTING VALVE CLEARANCE

The valves clearance can be adjusted satisfactorily with the engine stationary, irrespective of whether it is cold or warm. The clearance is the same for both inlet and exhaust valves. When adjusting, use two feeler gauges, one "Go" .40 mm (.016") thick and the other "No-Go" .45 mm (.018") thick for the B 20 A, E and F (.50 and .55 mm = .020—.022" for the B 20 B). The clearance is adjusted so that the thinnest gauge can be inserted easily while the thicker one must not enter.

VALVE ADJUSTMENT PROCEDURE

1. Turn the crankshaft until cyl. No 4 rocker arms "rock" (the exhaust valve has just closed and the intake valve is just to open. Piston No 1 has reached firing position and the crankshaft pulley marking is on 0.)
Adjust No 1 valve clearance.
2. Turn the crankshaft until No 2 rocker arms "rock" and adjust No 3 valve clearance.
3. Turn the crankshaft until No 1 rocker arms "rock" and adjust No 4 valve clearance.
4. Turn the crankshaft until No 3 rocker arms "rock" and adjust No 2 valve clearance.



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Fig. 2-35. Measuring cylinder bore

CYLINDER BLOCK

MEASURING CYLINDER BORES

The cylinder bores are measured with a special dial indicator as shown in Fig. 2-35. Measuring should be done just below the top edge of the bore and only in the transverse direction of the engine. A letter is stamped on each cylinder bore indicating the classification of the bore and piston (standard models only).

PISTONS, PISTON RINGS AND PISTON PINS

Volvo Standard Times Op. No. 21210 comprises "replace piston rings".

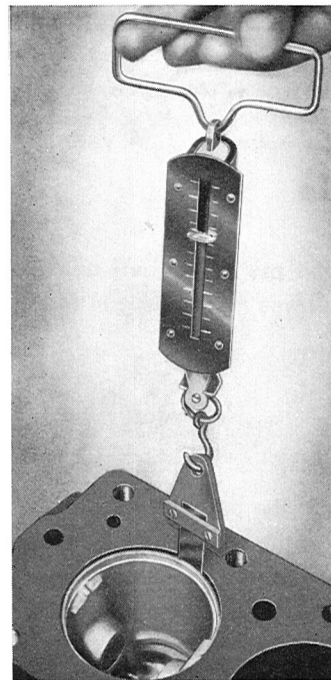
Volvo Standard Times Op. No. 21250 comprises "replace piston rings, lap valves".

Measuring pistons

The pistons are measured with a micrometer at right angles to the piston pin hole 7 mm (.28") from the lower edge.

Fit of pistons in cylinders

The fit of the pistons in their respective cylinders is tested with the piston rings not installed. The clearance should be .01—.03 mm (.0004—.0012"). The clearance at right angles to the piston pin hole is measured with a feeler gauge, 1/2" wide and .02 mm (.0008") thick, attached to a spring balance. The force applied should be 10 N (2.2 lb). This gives the average value for piston clearance. When the above mentioned force is applied, the piston clearance obtained is equal to the thickness of the feeler gauge used. Test at several different depths. See Fig. 2.36.



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Fig. 2-36. Measuring piston clearance

Standard bore cylinders have a letter stamped on which shows the dimensions, and the pistons concerned should be marked with the same letter.

Piston ring fit

IN A NEW OR RE-BORED CYLINDER

1. Push down the piston rings one after another in the cylinder bore. Use a reversed piston to ensure that the rings come into the correct position.

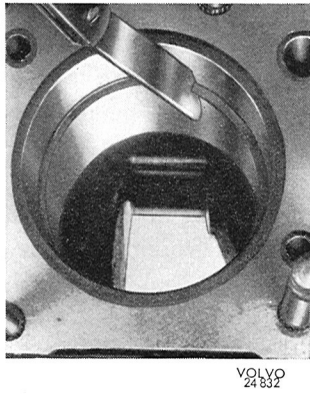


Fig. 2-37. Measuring piston ring gap

2. Measure the ring gap with a feeler gauge, see Fig. 2-37. The gap should be .40—.55 mm (.016—.022"). If necessary, the gap can be increased with a special file.
3. Check the piston rings by rolling them in their respective grooves. Also measure the clearance at a few points. See "Specifications" for measurements.

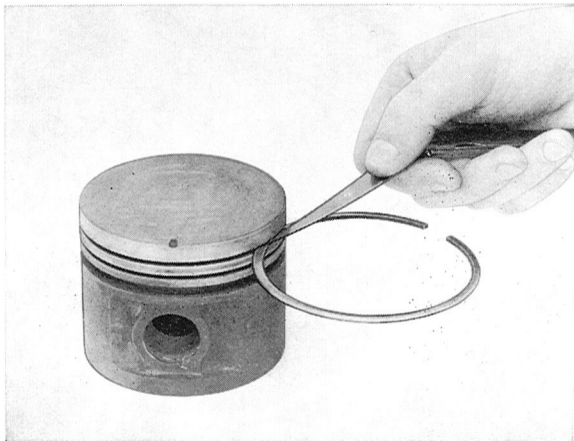


Fig. 2-38. Piston ring clearance in groove

IN A WORN CYLINDER BORE

When checking the fit in a worn cylinder bore, the rings must be checked at the bottom dead center position where the diameter of the bore is smallest.

Piston pins

The piston pins are available in oversize .05 mm (.002") larger than the standard diameter 24.00 mm (.945"). If the piston pin hole in the piston is worn so much that an oversize is necessary, the hole

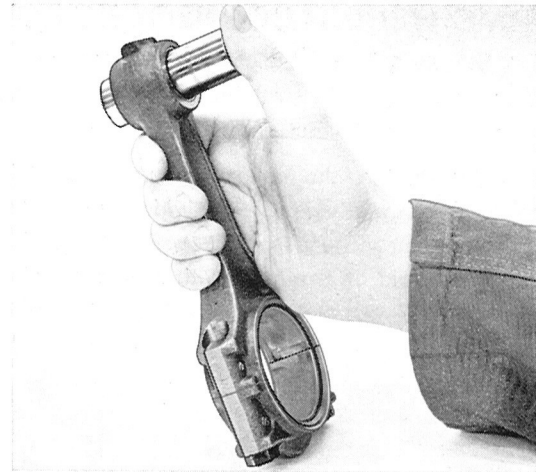


Fig. 2-39. Piston pin fit

should first be reamed to the correct measurement. Use a reamer with a pilot guide and only take small cuts at a time. The fit is correct when the piston pin can be pushed through the hole by hand with light resistance, see Fig. 2-39.

CONNECTING RODS

Replacing bushing

If the old bushing in a connecting rod is worn, press it out by using drift 5017 and press in a new bushing with the same tool, see Fig. 2-40. Make sure that the lubricating holes index with the holes in the connecting rod. Then ream the bushing to the correct fit. The piston pin should slide through the hole under light thumb pressure but without any noticeable looseness, see Fig. 2-39.

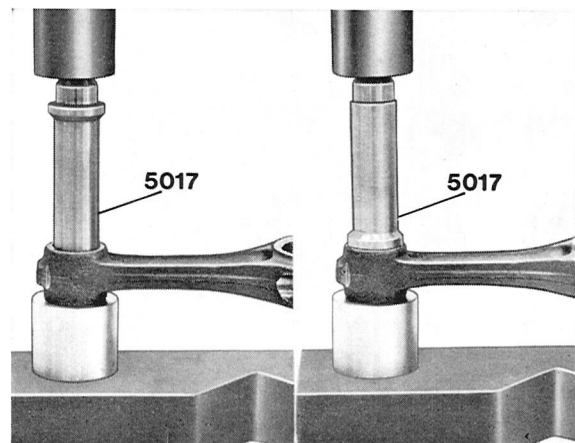
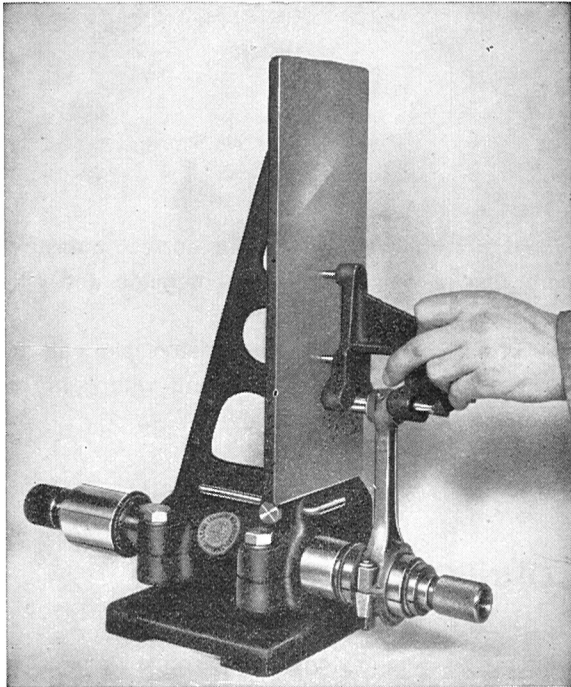


Fig. 2-40. Replacing connecting rod bushing

STRAIGHTENING CONNECTING ROD

Volvo Standard Times Op. No. 21279 comprises: Replace piston, incl. straighten connecting rod, first one (each additional=Op. No. 21281)

Before installation, the connecting rod should be checked for straightness, twist and any S-distortion. Straighten if necessary, see Fig. 2-41. Nuts and bolts should be replaced with new ones when reconditioning.

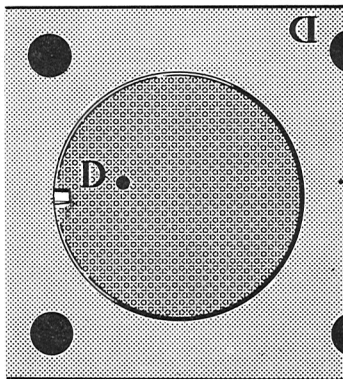


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Fig. 2-41. Checking connecting rod

Assembling and installing piston and connecting rod

When assembling make sure that the piston is facing correctly so that the slot on the piston crown



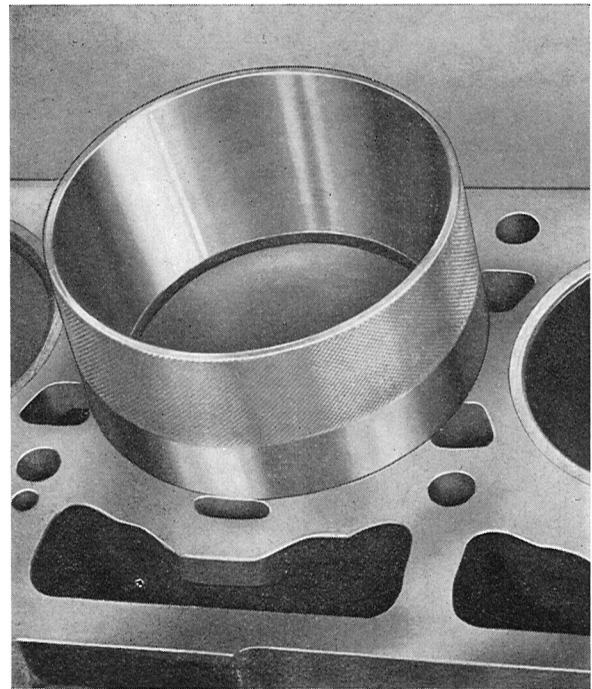
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Fig. 2-42. Marking on piston and block

points forwards, see Fig. 2-42. There will be a loud noise if the piston is turned the wrong way. The connecting rod marking should face away from the camshaft side. The piston pins are then installed, the circlips placed in position and the piston rings installed.

Use piston ring pliers for the rings. The upper compression ring is chromed. Place the bearing shells in their seats. Turn the rings so that their gaps are not opposite one another. Lubricate the piston and bearing surfaces.

Use installation ring 2823, see Fig. 2-43, when installing the piston and a torque wrench, see "Specifications", for the correct tightening torque.



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Fig. 2-43. Piston installation
Installation ring 2823

CRANKSHAFT

Replace crankshaft, Volvo Standard Times Op. No. 21693

After the crankshaft has been cleaned, its journals must be measured with a micrometer. Measuring should be at several points round the circumference and along the longitudinal axis of each journal. Out-of-roundness on the main bearing journal should not exceed .05 mm (.002"), and .07 mm (.003") on the big-end bearing journals. Taper

should not exceed .05 mm (.002") on any of the journals.

If the values obtained are close to or exceed the wear limit mentioned above, the crankshaft should be ground to undersize. Suitable bearing shells are available in 2 undersizes. The measurements are in the "Specifications".

Check that the crankshaft is straight to within .05 mm (.002") by using a dial gauge. The crankshaft is placed on two V-blocks and a dial gauge placed against the center bearing journal after which the crankshaft is rotated. If necessary, straighten the crankshaft in a press.

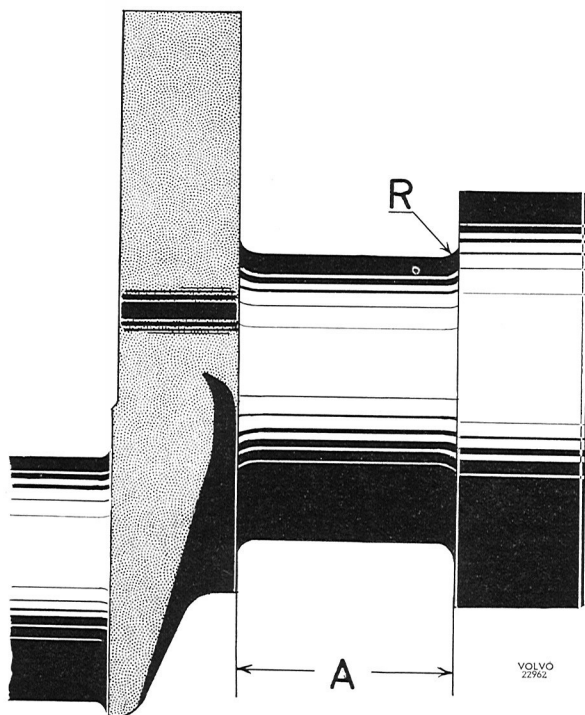


Fig. 2-44. Bearing journal

Grinding crankshaft

Before the crankshaft is ground, a check should be made to ensure that it is straight, this being done as described previously. Grinding is done in a special machine whereby the main bearing journals and the big-end bearing journals are ground to identical measurements. These measurements, which are given in "Specifications", must be care-

fully followed in order to ensure correct clearance with ready-machined bearing shells.

On no account must the bearing shells be shaved or the bearing caps filed.

The fillets at the ends of the journal should have a radius of 2.0—2.5 mm (.080—.100") on all journals, see Fig. 2-44. The width measurement (A) for the pilot bearing depends on the size of the journal and should be ground in order to obtain the correct measurement.

After grinding has been completed, all the burr should be carefully removed from the oilway openings and all the journals lapped with a fine grinding paste to the finest possible surface finish. The crankshaft should then be washed. All the oilways should be cleaned with particular thoroughness in order to remove any metal chippings and grinding residue.

Main and big-end bearings

In addition to standard sizes, bearings shells are available in undersizes of .010" and .020". The rear main bearing shells are provided with flanges and have a larger width relative to their size. If the crankshaft has been ground to the correct measurement, the right bearing clearance is automatically obtained when the bearing shell concerned is installed. The bearing shells must not be shaved and the caps must never be filed in order to obtain closer bearing fit.

The bolts should be tightened with a torque wrench, see "Specifications" for the tightening torque.

REPLACING CRANKSHAFT REAR SEAL

Type "Felt ring"

Volvo Standard Times Op. No. 21667 comprises: replace crankshaft rear seal, transmission removed, incl. replace clutch if necessary.

INSTALLING REAR SEAL FLANGE

1. Make sure that the seal is in good condition and that the flange is clean. The drain hole must not be blocked by incorrect installation of the sump gasket. The seal must not be installed in the flange.
2. Install the flange but do not tighten the bolts.

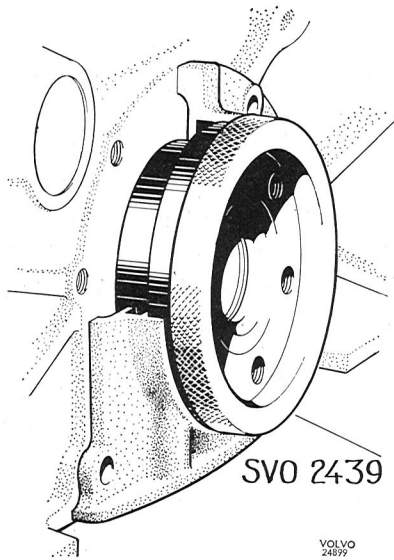


Fig. 2-45. Centering rear sealing flange

3. Center the flange with sleeve 2439, Fig. 2-45. Turn the sleeve round while tightening the bolts and adjust the position of the flange if the sleeve jams. Check that the flange comes flush against the underside of the block.
4. Install a new felt ring and place in the washer and circlip. Press the circlip into position with the centering sleeve. Check that the circlip engages in its groove.

REPLACING CRANKSHAFT REAR SEAL

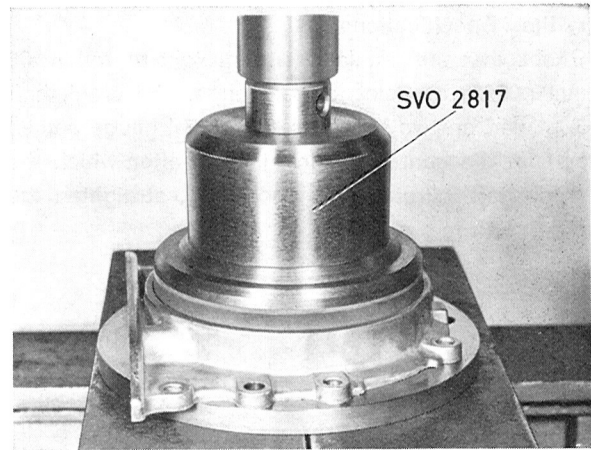
Type "Rubber lip"

Volvo Standard Times Op. No. 21667

1. After having removed the transmission, clutch and flywheel from the engine, remove the two bolts for the oil sump in the flange. Slacken one of the two bolts on each side so that oil sump pressure on the flange will not be so great. Remove the flange.
2. Press out the seal with the drift for tool 2817. Use a suitable cushion for the flange to prevent it from being damaged.
3. Press in the seal with tool 2817, see Fig. 2-46. NOTE: First inspect the wear surface of the crankshaft.

The seal can be installed in various positions with tool 2817. With a new crankshaft or a crankshaft with approved wear surface install the seal in its outer position (fully screwed in

center bolt). With the wear mark on the crankshaft, install the crankshaft with the center bolt screwed out a couple of turns or completely.

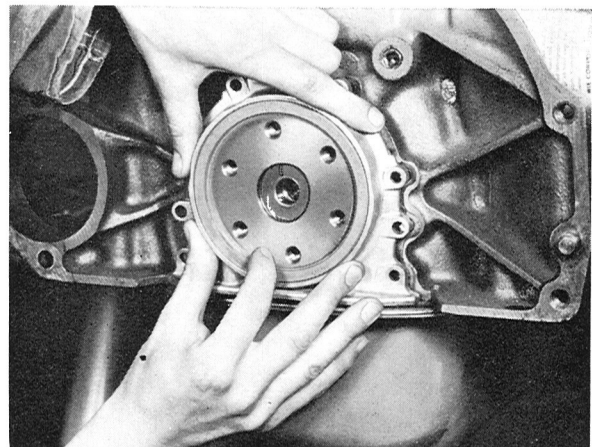


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Fig. 2-46. Seal installation

4. Install the flange, its sealing surface being well cleaned, and a new gasket. (Oil first the seal.) The flange should be mounted on the crankshaft carefully, see Fig. 2-47. Use your finger to position the sealing lip.

The seal retainer is provided with bosses which guide the retainer at installation on the crankshaft journal.



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Fig. 2-47. Flange installation

GRINDING FLYWHEEL

If the wear surface of the flywheel is uneven or burnt, the surface can be ground in a saddle-mounted grinding machine. Not more than .75 mm (.03") of the original thickness must be ground off.

PILOT BEARING FOR INPUT SHAFT

Volvo Standard Times Op. No. 21607 comprises: FLYWHEEL BEARING, replace, pressure plate removed.

The pilot bearing circlip and protecting washer are removed, the pilot bearing pulled out with tool 4090 and checked after cleaning.

If the bearing is worn, it should be replaced with a new one. Before installation, pack the bearing with heat-resistant ball bearing grease. The bearings are installed with drift 1426, the install protecting washer and circlip.

REPLACING OIL SEAL IN TIMING GEAR COVER

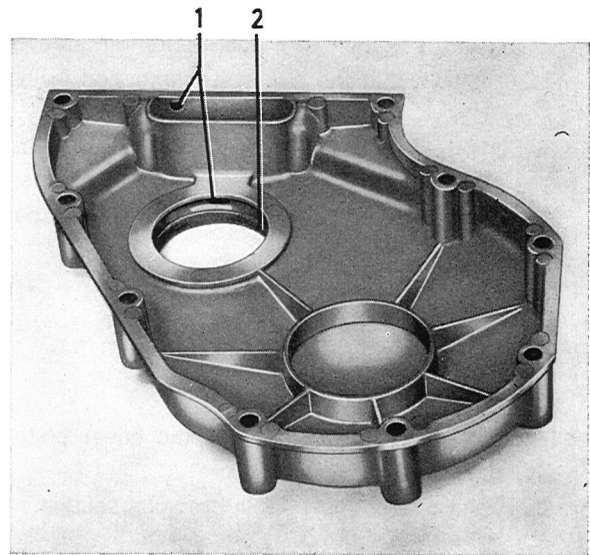
Volvo Standard Times Op. No. 21520

1. Release the fan belt. Loosen the attachment of the stabilizer at the frame.
2. Screw out the bolt in the crankshaft. Remove the belt pulley.
3. Remove the circlip for the washer which retains the felt ring. Remove the washer and felt ring. Check that the cover is correctly installed by inserting a .10 mm (.004") feeler gauge in the gap between cover and hub on the crankshaft and moving it all round. If the feeler gauge jams at any point, the cover should be centered, see under "Replacing timing gear cover".
4. Install a new felt ring. Place the washer in position and install the circlip. Check that the circlip fits properly in position.
5. Install the remaining parts and tension the fan belt.

REPLACING TIMING GEAR COVER

Replace timing gear cover gasket=Volvo Standard Times Op. No. 21502

1. Loosen the fan belt. Remove the fan and pulley on the water pump. Disconnect the stabilizer attachment from the frame.
2. Remove the bolt for the crankshaft belt pulley and remove the pulley.
3. Remove the timing gear cover. Slacken a couple of extra bolts for the sump and be careful not to damage the gasket. Remove circlip, washer and felt ring.
4. Make sure that the gaskets are in good condition and that the drain hole is open and clean inside the timing gear cover. See Fig. 2-48.



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Fig. 2-48. Timing gear cover
1. Drain holes 2. Sealing ring

5. Position cover and bolts without tightening.
6. Center the cover with sleeve 2438, see Fig. 2-49. Turn the sleeve while tightening and adjust the position of the cover so that the sleeve is not jammed. Check after final tightening of the cover that the sleeve can be easily rotated without jamming.

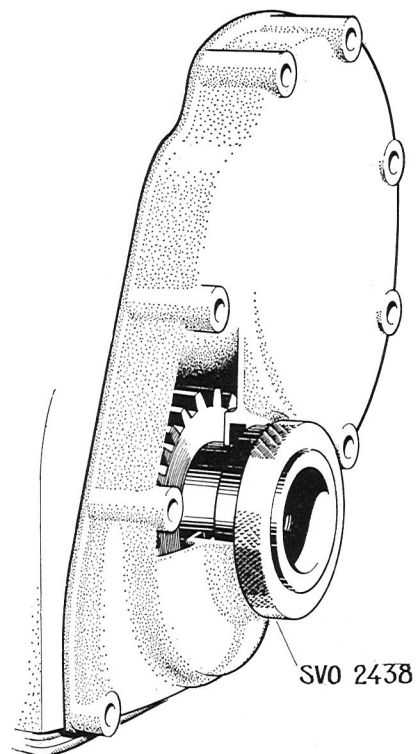


Fig. 2-49. Centering timing gear

7. Install a new felt ring washer and circlip. Push them into position with the centering sleeve 2438. Check that the circlip has engaged in its groove.
8. Install the other parts and tension the fan belt. See "Specifications" for the tightening torque. Fix the stabilizer attachments firmly to the frame.

REPLACING TIMING GEARS

Volvo Standard Times Op. No. 21530

1. Drain the coolant and remove the cover plate and radiator.
2. Carry out operations 1—3 in previous section.

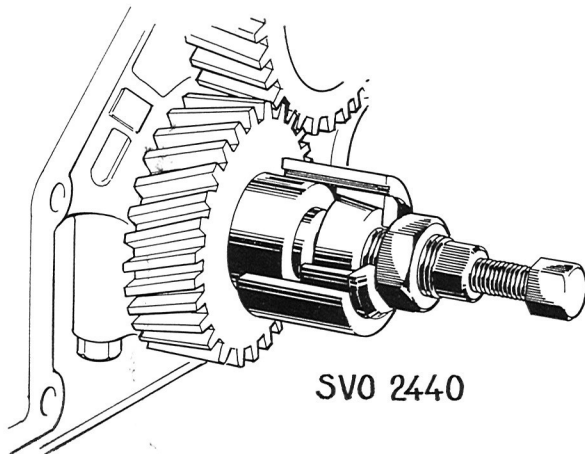


Fig. 2-50. Removing hub on crankshaft

3. Remove the hub from the crankshaft with puller 2440. See Fig. 2—50. Before applying the tool, its large nut must be screwed backwards so that the cone is not tensioned. The center bolt should also be screwed back.

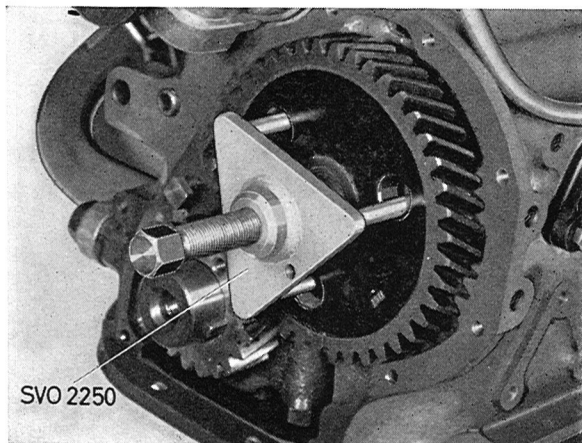


Fig. 2-51. Removing camshaft gear

Then install the tool, screw in the large nut so that the hub is firmly held and pull it off by screwing in the center bolt.

4. Remove the camshaft nut and pull off the gear by using puller 2250, see Fig. 2-51.

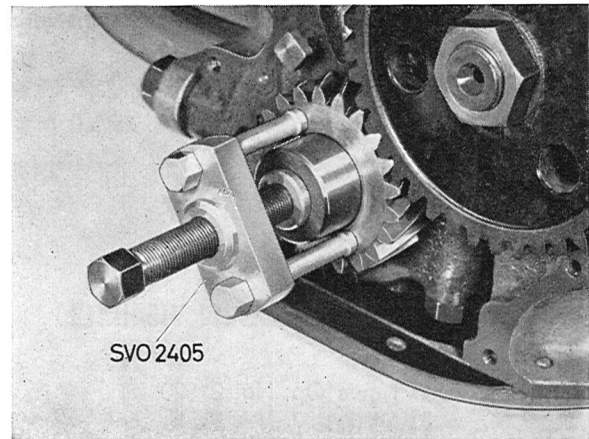


Fig. 2-52. Removing crankshaft gear

5. Pull off the crankshaft gear by using puller 2405, Fig. 2-52. Screw out the oil nozzle, blow it clean and then re-install it as shown in Fig. 2-54. The gears are lubricated by oil fed through this nozzle.

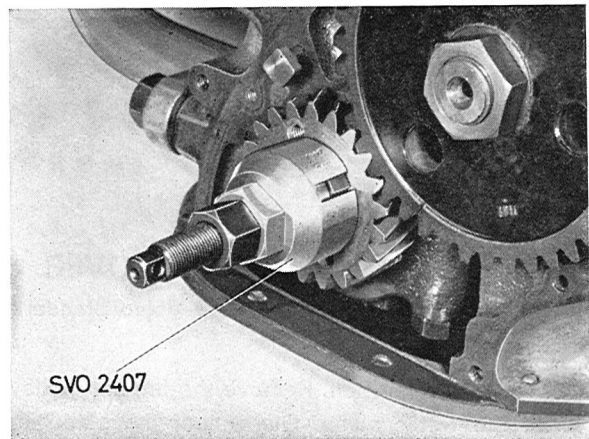


Fig. 2-53. Installing crankshaft gear

6. Install the crankshaft gear by using tool 2407 and the camshaft gear by using 2408, see Figs. 2-53 and 2-54. Install the hub on the crankshaft. Do not push the camshaft backwards so that the seal washer on the rear end loosens.

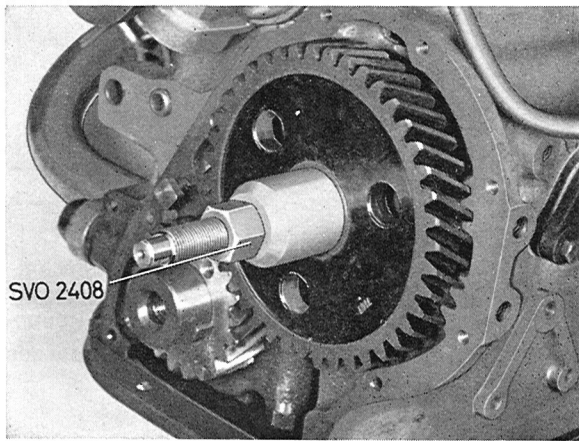


Fig. 2-54. Installing camshaft gear

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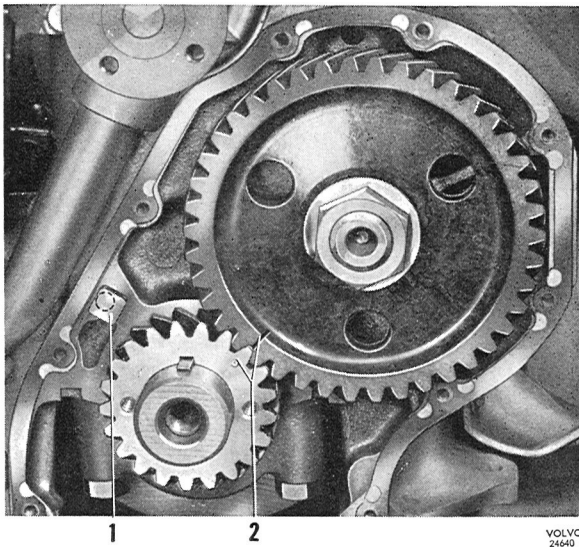


Fig. 2-55. Marking on timing gears
1. Oil nozzle 2. Markings

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Check that gears are in the correct position relative to each other, as shown in Fig. 2-55. Tool 2407 has a socket intended for turning the crankshaft.

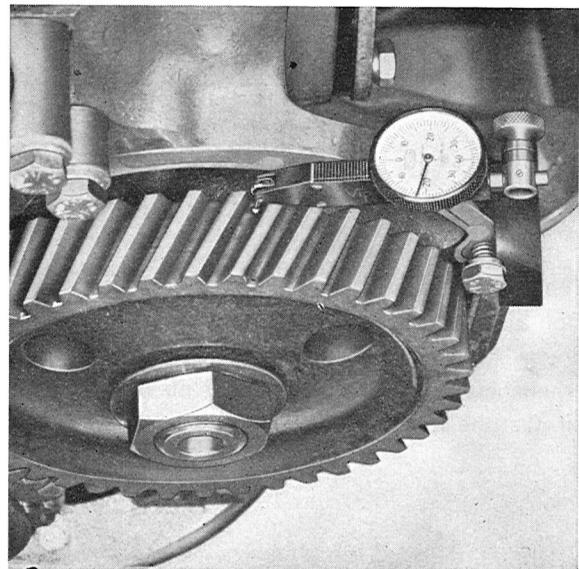


Fig. 2-56. Measuring tooth flank clearance

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The tooth flank clearance and camshaft axial clearance, determined by the spacer ring behind the camshaft gear, are given in the "Specifications".

Center and install the timing gear cover as well as the other parts according to operations 4—8 in the previous section.

POSITIVE CRANKCASE VENTILATION

OVERHAUL

At intervals of 40 000 km (24 000 miles) remove and clean nipple (3, Fig. 2-22), and flame arrester (5). Check the hoses at the same time. Replace any that are in a poor condition.

For U.S.A. vehicles, the nipples are cleaned during the 20 000 km (12 000 miles) servicing.