SERVICE MANUAL

VOLVO 164 1971

Part 2

ENGINE

CONTENTS

TOOLS

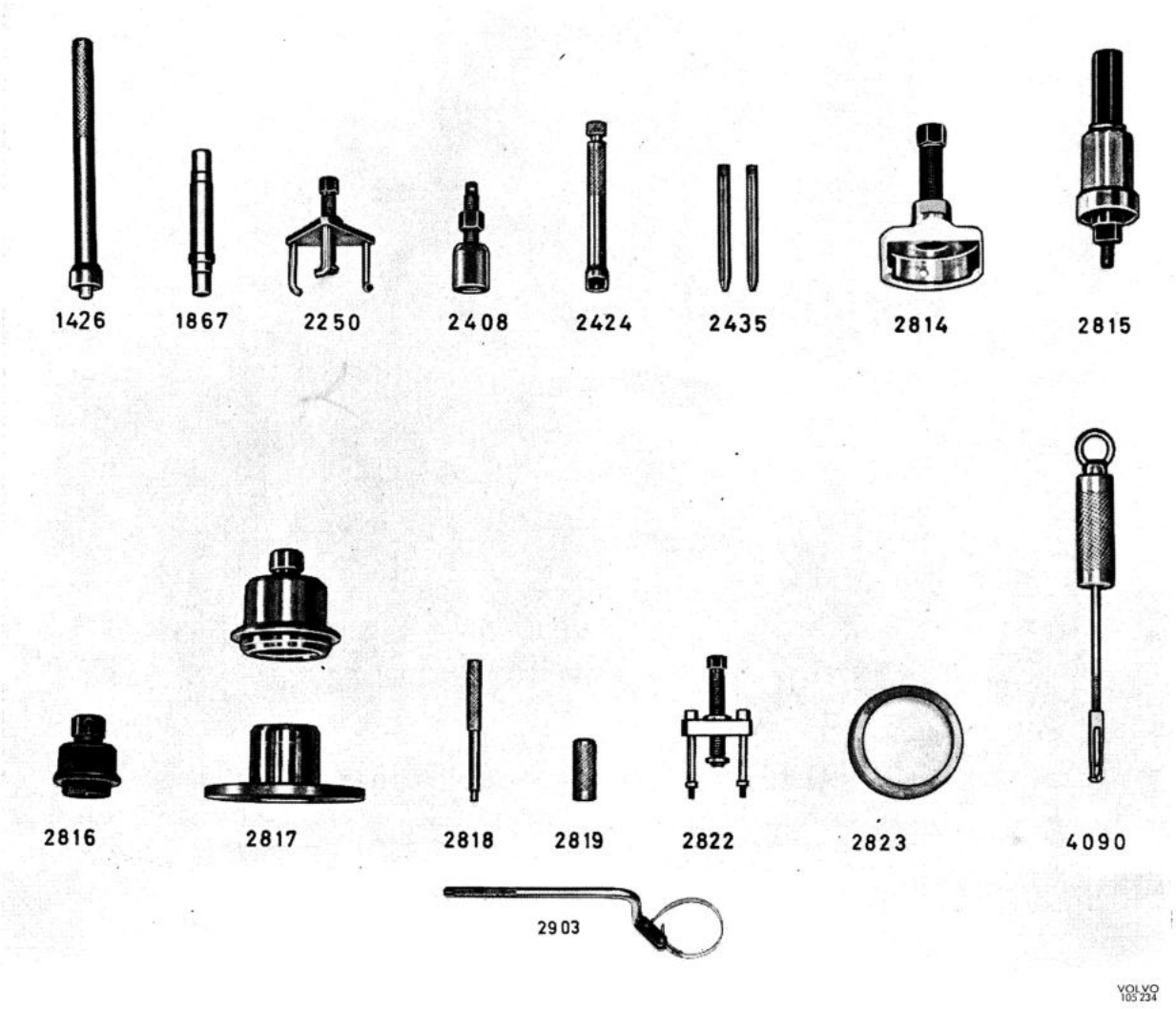

Fig. 2-1. Tools for engine

SVO 1426	Drift for fitting pilot bearing in flywheel (crankshaft)
SVO 1867	Drift for removing and fitting bush in rocker arm and connecting rod
SVO 2250	Puller for camshaft gear
SVO 2408	Press tool for fitting camshaft gear
SVO 2424	Grip tool for removing and fitting valve tappets
SVO 2435	Dowel pin (2) for fitting cylinder head
SVO 2814	Puller for polygon hub
SVO 2815	Press tool for fitting crankshaft drive and polygon hub
SVO 2816	Drift for fitting crankshaft oil seal on engine front end
SVO 2817	Drift for fitting crankshaft oil seal on engine rear end
SVO 2818	Drift for removing valve guide
SVO 2819	Drift for fitting valve guide
SVO 2822	Puller for crankshaft drive
SVO 2823	Ring for fitting standard piston
SVO 2903	Spanner for removing oil cleaner
SVO 4090	Puller for crankshaft pilot bearing

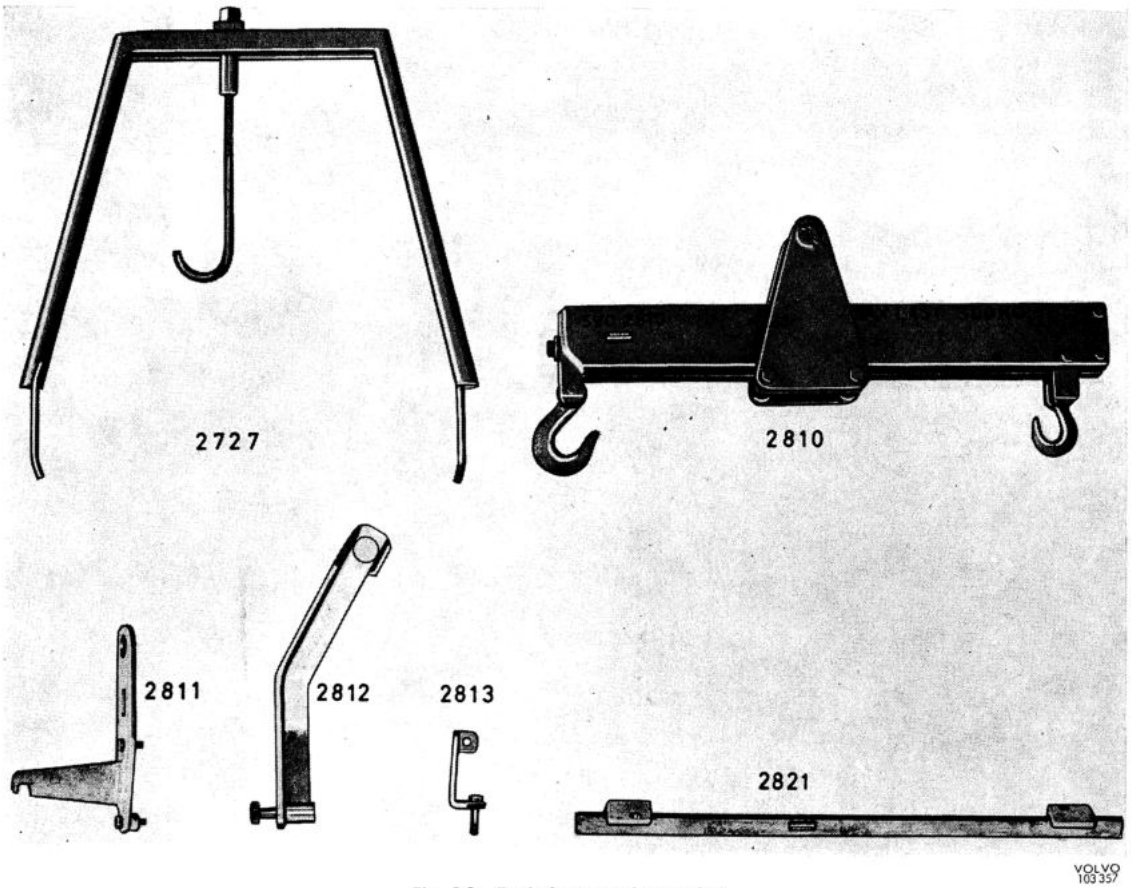

Fig. 2-2. Tools for removing engine

SVO 2727 Tool for lifting engine front or rear end to remove oil sump and gearbox resp.
Used together with tools SVO 2811 and SVO 2812.

SVO 2810 Beam for lifting out and installing engine.
Used together with tools SVO 2811 and SVO 2812.

SVO 2811 Lifting lug for attaching lifting beam 2810 or 2727 in engine front end

SVO 2812 Lifting arm for attaching lifting beam 2810 in rear end of engine

SVO 2813 Support for lifting arm SVO 2811 for lifting engine with cylinder head removed

SVO 2821 Support for lifting tool SVO 2727 for lifting end of engine

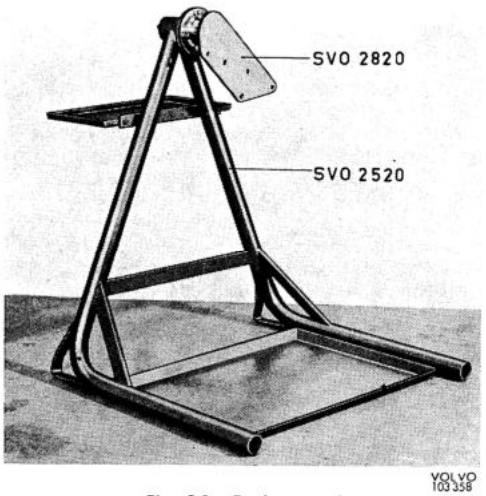

Fig. 2-3. Engine stand

SVO 2520 Stand. Used together with tool SVO 2820

SVO 2820 Fixture for mounting engine on stand 2520

GROUP 20

GENERAL

DESCRIPTION

The B 30 A engine (Figs. 2-4 and 2-5) is an in-line, six-cylinder, water-cooled overhead-valve unit. It is provided with two horizontal carburettors as well as an exhaust emission control system which produces cleaner exhaust gases. The engine is also fitted with an air preheater and positive crankcase ventilation. The fan is of the slip-coupling type. The seven-bearing crankshaft has a flywheel damper mounted on its front end.

The output figures for the engine are given in the "Specifications".

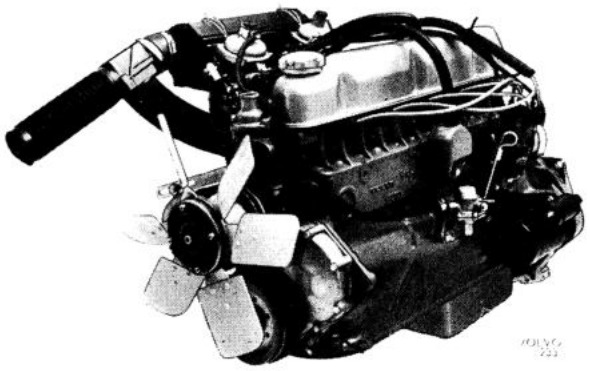

Fig. 2-4. Engine B 30 A viewed from left

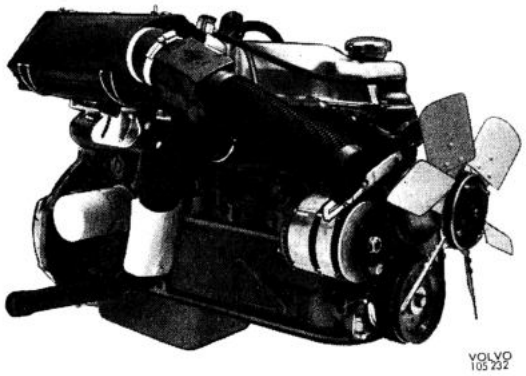

Fig. 2-5. Engine B 30 A viewed from right

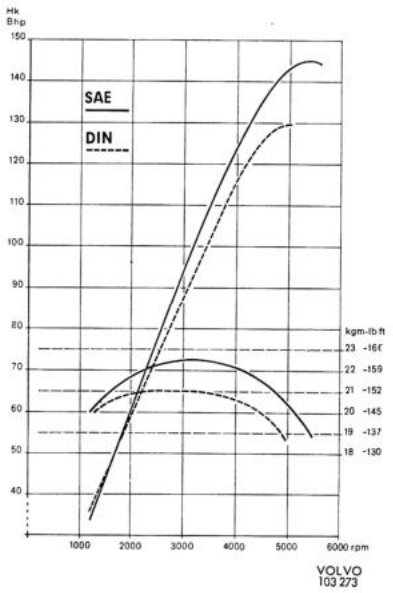

Fig. 2-6. Output and torque curves B 30 A

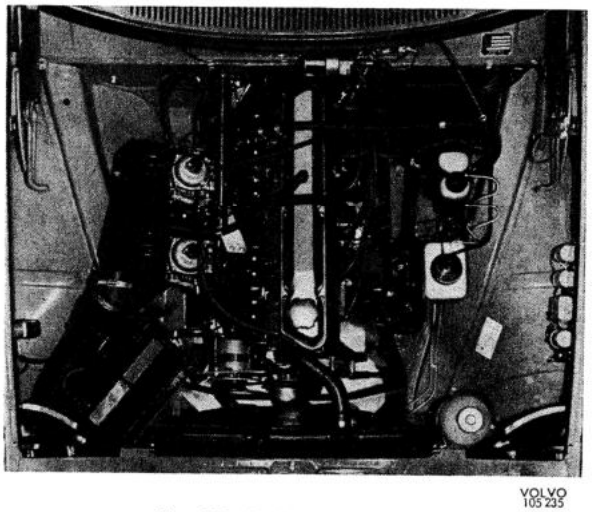

Fig. 2-7. Engine compartment

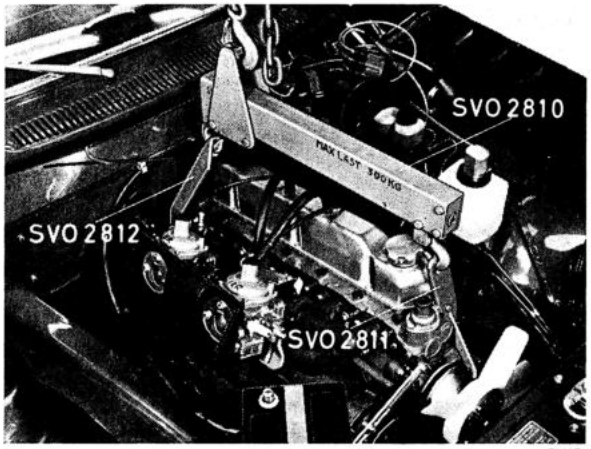

Fig. 2-8. Lifting out the engine with lifting tool SVO 2810

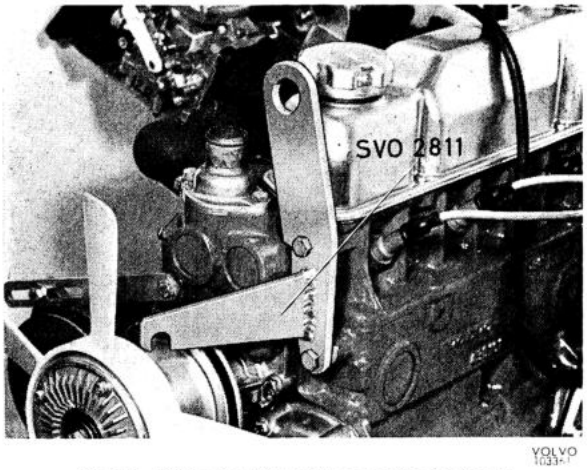

Fig. 2-9. Lifting lug SVO 2811 on engine front end

REMOVING THE ENGINE

1. Remove the gear lever.
2. Disconnect the positive lead from the battery. Empty the coolant.
3. Remove the bonnet (hood) from the hinges.
4. Disconnect the hose for the expansion tank as well as the lower radiator hose from the radiator. Remove the upper radiator hose from the engine and finally the radiator and fan casing.
5. Remove the distributor cap and the ignition leads from the spark plugs. Remove the electric cable from the distributor. Remove the ignition coil and place it to the side.
6. Disconnect the fuel hose from the pump and plug the hose. Remove the electric cables from the starter motor.
7. Remove the air cleaner cover and lift it forwards together with the attached hoses. Remove the electric cables from the alternator and also the temperature and oil pressure tell-tale units.
8. Remove the preheating plate and the attaching nuts for the exhaust manifold flange.
9. Remove the throttle control shaft from the pedal shaft, link rods and bracket. Remove the choke wire from the carburettor and the vacuum hose for the brake servo from the manifold. Disconnect the water hoses for the heater element from the engine.
10. Fit lifting lug SVO 2811 to the front end of the engine as shown in Fig. 2-9 and lifting arm SVO 2812 on the engine rear end as shown in Fig. 2-10. Prop up the vehicle with four blocks.
11. Remove the lower nuts from the engine front mountings. Fit the engine lifting unit with lifting beam SVO 2810 and move the block runner to the rear end of the lifting beam, see Fig. 2-8. (Use a nut puller for this adjustment.)
12. Remove the propeller shaft from the gearbox. Disconnect the earth (ground) cable from the engine and the electric cables from the gearbox and overdrive. Remove the speedometer hose.
13. Remove the exhaust pipe clamp from the bracket. Remove the gearbox member and the rubber block and bracket from the gearbox.
14. Remove the clutch wire pin from the lever and the clutch wire sleeve from the clutch casing.

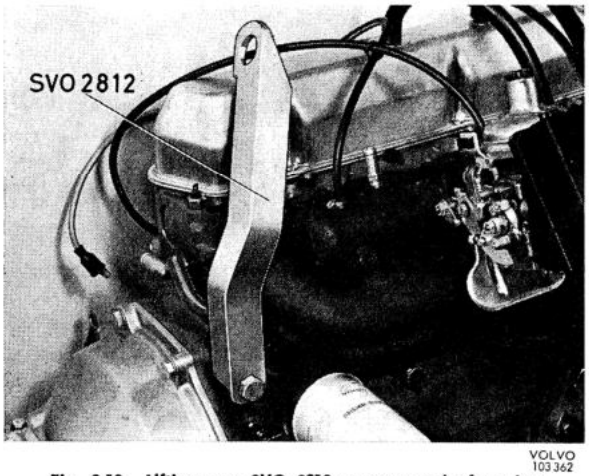

Fig. 2-10. Lifting arm SVO 2812 on rear end of engine

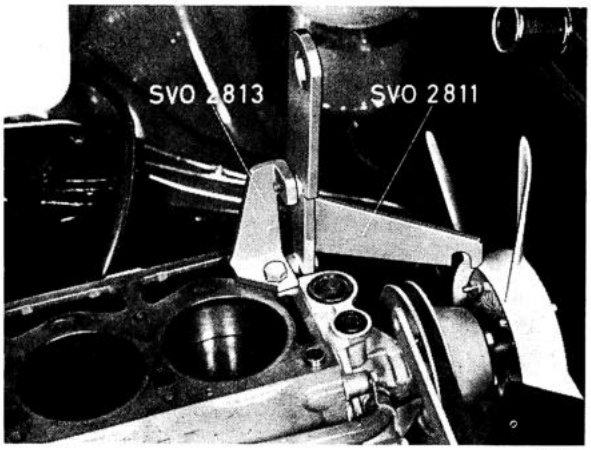

Fig. 2-11. Fitting support SVO 2813 with cylinder head removed

15. Hoist the engine with the lifting unit, lowering at the same time the engine rear end by adjusting the block unit on the lifting beam. Pull the engine forwards across the front member raising it at the same time. Level out the engine and gearbox and pull the entire unit forwards.

INSTALLING THE ENGINE

1. Fit lifting lug SVO 2811 and arm SVO 2812. Install the engine in position with the help of lifting beam SVO 2810.
   Attn. Make sure that the exhaust manifold does not come into contact with the oil filter.
2. Fit the bracket and rubber block on the gearbox. (Do not tighten the bolts finally. This is done at point 7 below.) Fit the gearbox member.
3. Fit the earth (ground) cable as well as the electric cables for the overdrive and gearbox. Install the speedometer hose as well as the propeller shaft.
4. Remove the lifting beam and lifting lugs from the engine. Fit the nuts for the engine front mountings.
5. Secure the exhaust manifold together with gasket and fit the preheating plate.
6. Fit the clutch wire sleeve and connect the wire to the lever. Adjust the clutch according to Part 4 (41).
7. Fit the clamp for the exhaust manifold. Tighten the bolts for the engine rear mountings. Lower the vehicle.
8. Connect the water hoses for the heater unit. Install the electric cables to the temperature and oil pressure tell-tale units as well as the alternator.
9. Connect the vacuum hose. Fit the throttle control shaft, the choke wire as well as the air cleaner casing. Connect the hoses to the air intake and preheating plate respectively.
10. Wire the electric cables to the starter motor and connect the fuel hose.

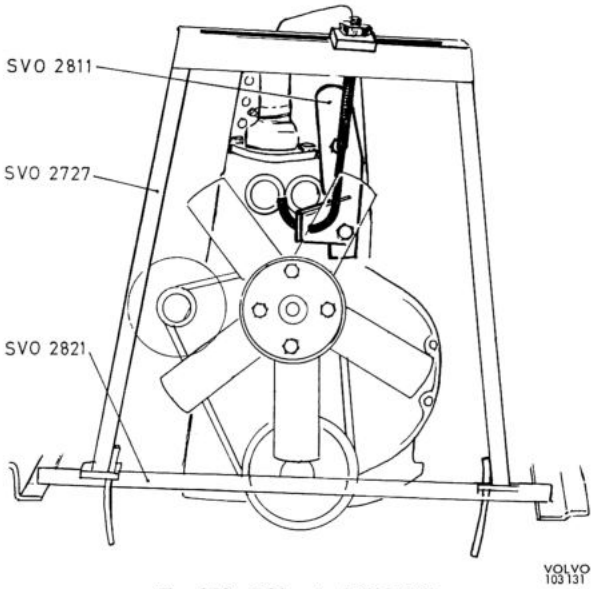

Fig. 2-12. Lifting tool SVO 2727

11. Fit the ignition coil, the distributor cap and the ignition leads as well as the electric cable.
12. Fit the radiator and connect the radiator hoses and hose for the expansion tank. Fill with coolant and check the engine oil.
13. Fit the bonnet (hood) and connect the battery lead. Fit the gear lever. Check the function and for leakage.

OIL SUMP

Since for certain types of work on the engine much time can be spared by being able to remove the oil sump without lifting out the engine, the following working method has been evolved.

REMOVING

1. Place support SVO 2821 on the side-members as shown in Fig. 2-12. The pins should point forwards and lie against the front plates. The support plates should face upwards. Fit lifting lug SVO 2811, see Figs. 2-12 and 2-9. Place lifting tool SVO 2727 on the support and secure the hook in the lifting lug. Raise the front end of the engine to off-load the engine mountings. Remove the oil dipstick.
2. Jack up the vehicle under the front jack attachments. Drain off the engine oil. Remove the lower nuts for the engine mountings.
3. Place a workshop jack under the front axle member. Remove the rear bolts of the front axle member and instead fit 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 hangs in the two auxiliary bolts.

4. Remove the reinforcing bracket (at the flywheel casing). Unscrew the bolts for the oil sump and lift down the sump.
5. Remove the old gasket and clean the contact surfaces of the cylinder block and oil sump.

FITTING

1. Place the oil sump and gasket in position and re-fit the bolts. Tighten securely the drain plug.
2. Place the reinforcing bracket in position and tighten all the bolts manually. Then tighten securely first the bolts for the flywheel casing and then those for the cylinder block.
3. Raise the front axle member and tighten securely the front bolts. Remove the auxiliary bolts, fit and tighten the rear bolts.
4. Fit the nuts for the engine mountings.
5. Lower the vehicle. Remove the lifting tools.
6. Fill with oil and insert the oil dipstick.
7. Start the engine and check for any leakage.

GROUP 21

ENGINE

DESCRIPTION

CYLINDER BLOCK

The cylinder block (43, Illustration 2 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 oil-ways in the block are arranged so that the oil filter, which is of the full-flow type, is directly attached to the right-hand side of the block.

CYLINDER HEAD AND VALVES

The cylinder head (37) is secured to the block by means of bolts. All the combustion chambers are machined throughout and have separate inlet and exhaust ports, one for each valve.

The valves (6 and 9, Illustration 2 A) which are fitted suspended in the cylinder head, are made of special steel and are 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. 2-22.) The valves are provided with valve guide rubber seals, which are mounted on the guides.

Viewed in order from the front, the valves are placed: intake, exhaust, intake, exhaust, and so on.

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.

CRANKSHAFT AND BEARINGS

The crankshaft is made of steel and has ground, case-hardened bearing journals. It is carried in seven main bearings, the rear flange bearing of which also functions as a pilot bearing axially. There are drilled oilways in the crankshaft for the lubricating oil.

A gear mounted on the front of the crankshaft drives the timing gears through a splined joint. The crankshaft end projecting from the gear wheel has a polygon profile. Mounted on this pin is the polygon hub for the flywheel damper.

Both the main-bearing and the big-end bearing shells, which are replaceable, consist of a steel backing with indium-plate lead-bronze bearing metal. Both front and rear crankshaft oil seals are rubber-lip type seals with metal frame.

CAMSHAFT AND VALVE TAPPETS

The camshaft (61) 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. The camshaft is carried in four bearings, all of which have the same diameter. Camshaft axial location is maintained by means of a bronze axial washer located at the front end of the camshaft. Axial play is determined by a spacer ring behind the camshaft gear. The valve tappets (41) 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 they are accessible after the cylinder head has been removed.

CONNECTING RODS, PISTONS AND PISTON RINGS

The connecting rods (55) are made of drop-forged steel and are provided with a precision-machined bush which acts as a bearing for the gudgeon pin. The big-end bearing shells are precision-manufactured and are replaceable.

The pistons (62) are made of light-alloy and have two compression rings and one oil scraper ring. The upper compression ring is chromed in order to reduce cylinder wear.

The gudgeon pin (59) has a floating fit in both the piston and connecting rod. The axial movement of the gudgeon pin is limited by circlips in the gudgeon pin hole.

FLYWHEEL DAMPER

The flywheel damper (76) is of the rubber type. The hub is jointed to the crankshaft by means of a polygon joint. The flywheel mass is journalled on the hub through a rubber suspension. The graduation for the ignition setting is marked on the flywheel damper.

INTAKE AND EXHAUST MANIFOLDS

The intake and exhaust manifolds, the material of which is of nodular iron, are cast on to a branch pipe. They have been designed with a view to the exhaust emission control system, with preheating chamber wherein the temperature of the fuel-air mixture is raised by the heat from the exhaust ports.

A spring-loaded throttle (secondary throttle, 10) is to be found in each of the intakes.

The intake manifold has the following vacuum outlets:

1. To the vacuum governor for the negative vacuum setting
2. Brake servo
3. Positive crankcase ventilation

POSITIVE 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 combusion residues.

Between the oil trap (6, 2-13) and the intake manifold there is a hose (3). It is connected to the intake manifold by means of a calibrated nipple (1). (This nipple should be cleaned every 40 000 km = 25 000 miles.) Between the rocker arm casing and air cleaner there is a hose (2) connected for the fresh-air supply. At the connection to the rocker arm casing there is a flame arrester (4), which consists of a metal filter.

The partial vacuum which arises in the intake manifold when the engine is driven, brings about a partial vacuum in the crankcase through the hose (3).

Fresh air is supplied to the rocker arm casing through the air cleaner via the hose (2). A plate in the rocker arm casing (see Figure) ensures that the fresh air circulates sufficiently in order to mix with the crankcase gases.

As the fresh air supply passes through the carburettor 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, which occurs at full load and/or with large flow quantities, no fresh air is supplied. Instead the flow in the connection between the rocker arm casing and air cleaner reverses and the crankcase gases go both ways, partly through the hose (3) and partly through the air cleaner and carburettor 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.

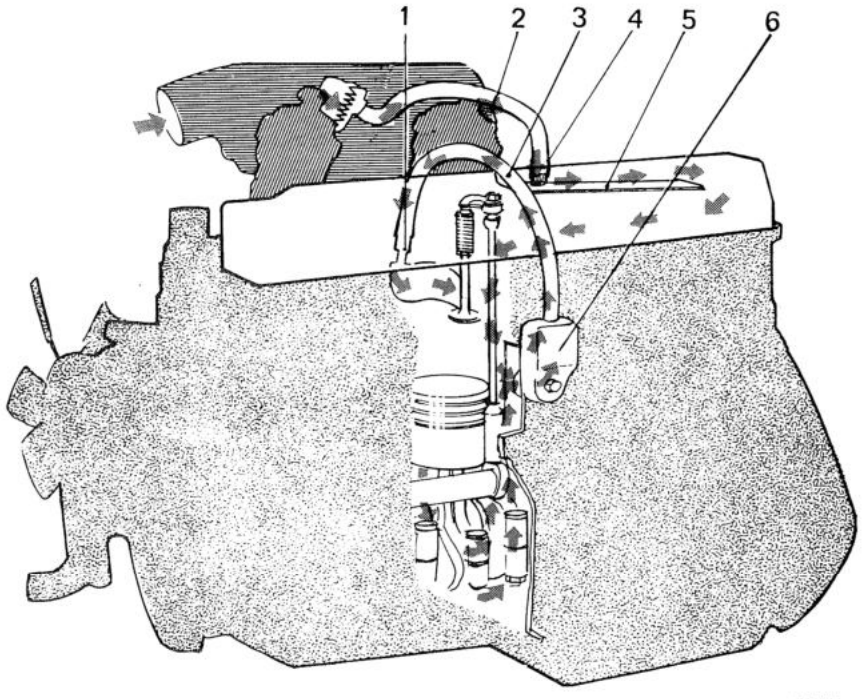

Fig. 2-13. Positive crankcase ventilation

1. Nipple
2. Hose for fresh air supply
3. Hose for crankcase gases
4. Flame arrester
5. Plate
6. Oil trap

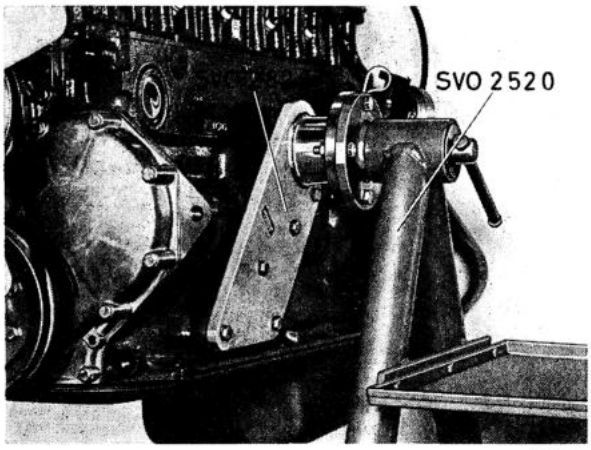

Fig. 2-14. Engine on stand

DISMANTLING THE ENGINE

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

1. Place the engine on stand SVO 2520 with fixture SVO 2820. See Fig. 2-14. Check that the oil has been drained off.
2. Remove the starter motor and reinforcing plate on the lower front edge of the flywheel housing. Remove the flywheel housing together with the gearbox. Then remove the clutch and flywheel.
3. Remove the alternator, water pump, distributor, rocker arm casing, rocker arms and oil filter. Remove the manifolds with carburettors. Take off the cylinder head. Remove the valve tappets with tool SVO 2424, see Fig. 2-25.
4. Remove the timing gear casing and the timing gears. Concerning the tools for this purpose, see under the heading "Replacing The Timing Gears". Remove the camshaft and then the oil nozzle.
5. Decarbonize the top of the cylinders. Remove the oil sump, rear sealing flange, oil pump and connecting rods with pistons. Replace the caps correctly on the respective connecting rods.
6. Invert and turn the engine. Remove the crankshaft. Place the caps correctly in their respective positions.

CLEANING

After dismantling, wash the parts thoroughly. Parts made of steel or cast iron can be washed in a degreasing tank with a caustic soda solution. Light-alloy parts can, however, be damaged by caustic soda so that they should preferably be cleaned with white spirit. Pistons 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 with particular thoroughness. All sealing plugs at the oilway openings in the cylinder block must be removed during the cleaning process.

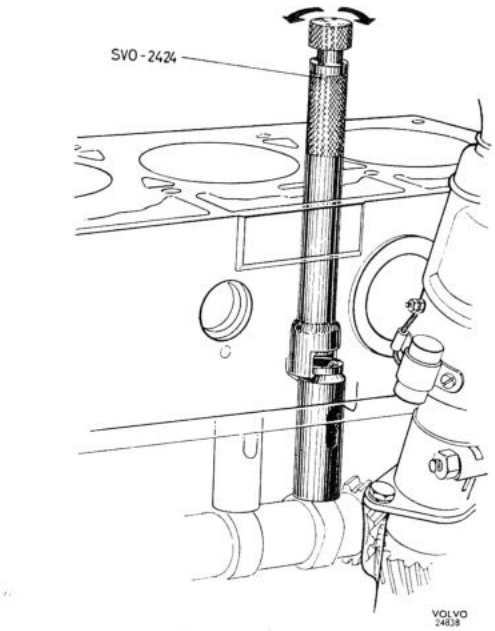

Fig. 2-15. Removing valve tappet

ASSEMBLING THE ENGINE

When assembling the engine, follow the instructions for the parts concerned. Check the marking of the bearings according to Fig. 2-16. The main bearings are marked 1—7, and the big-end bearings 1—6, counting from the front.

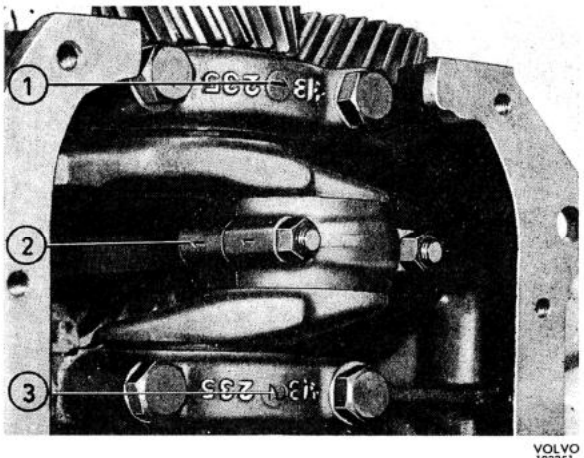

Fig. 2-16. Marking main and big-end bearings

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

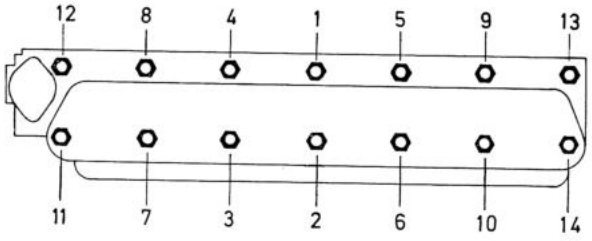

Fig. 2-17. Tightening sequence for cylinder head bolts

To be tightened in two stages
1st stage: 2.5—3.0 kpm (18—22 lb.ft.)
2nd stage: 8.5—9.5 kpm (61—69 lb.ft.)

Check that all parts are clean and lubricate sliding surfaces with oil before assembling. Always use new gaskets, split pins and lock washers. No adhesive should be used on the gaskets. Sealing at the ends of both the oil pump delivery pipe and the water pump pipes is provided by rubber rings. These rings, which seal radially, are made of special rubber with very close tolerances. Only genuine Volvo parts should be used. Fitting is facilitated by coating the rings with soapy water. Slip the rings on the pipes and then press them into their correct positions before finally tightening the attaching screws. The oil pump flange should lie flush against the cylinder block before tightening. Crankshaft seals at the front and rear ends respectively are installed according to the instructions given on page 2: 15.

When reconditioning, replace the connecting rod, bolts and nuts with new ones.

The reinforcing bracket at the flywheel casing is fitted according to Point 2 "Fitting" on page 2 : 6.

The cylinder head is fitted with the help of guide dowels SVO 2435. The bolts must be tightened in a certain sequence, see Fig. 2-17, to avoid unnecessary stresses. The bolts should be tightened in two stages. Check that the oil hole (Fig. 2-18) for lubricating the rocker arms is open.

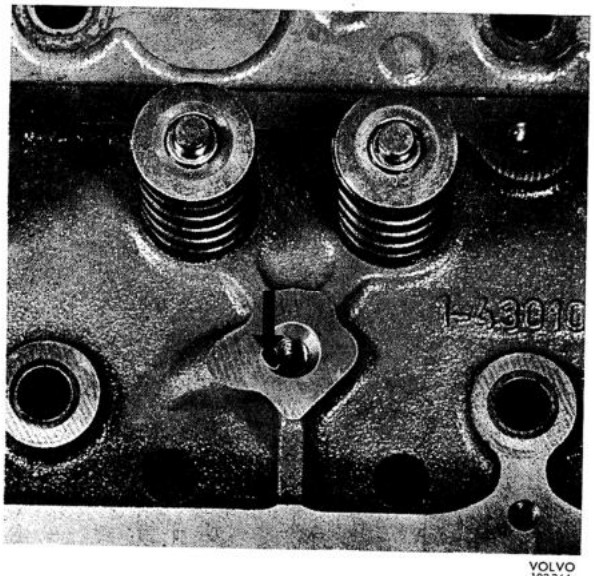

Fig. 2-18. Oil hole in cylinder head

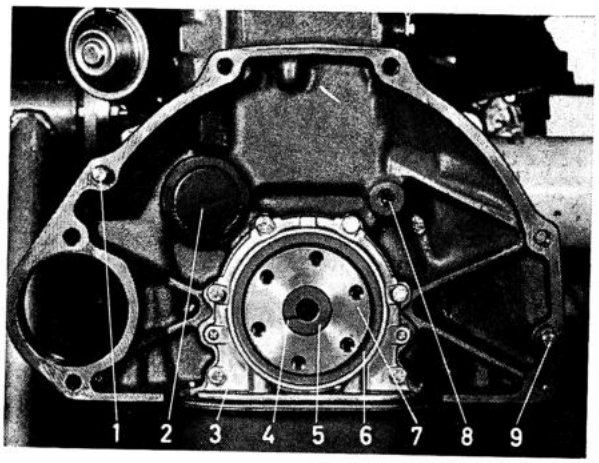

Fig. 2-19. Rear end of engine

1. Dowel pin
2. Core plug
3. Sealing flange
4. Circlip
5. Pilot bearing
6. Sealing ring
7. Crankshaft
8. Plug
9. Dowel pin

The pilot bearing (5, Fig. 2-19) should be lubricated before fitting with heat-resistant ball bearing grease. The bearing and protecting washer are held in position by a circlip (4).

The most important bolts and nuts should be tightened with a torque wrench, see "Tightening Torques" in "Specifications".

VALVE GRINDING AND DECARBONIZING

Removing the cylinder head

1. Drain off the coolant from the radiator and cylinder block.
2. Remove the choke wire and all the hoses from the intake manifold, carburettors and air cleaner casing. Remove the throttle control shaft from the pedal shaft, the link rods and bracket.
4. Remove the heat control valve hose from the engine. Remove the upper radiator hose.
5. Take off the ignition leads from the spark plugs and the electric cable from the temperature telltale.
6. Unscrew the preheating plate from the exhaust manifold as well as the nuts for the exhaust manifold flange.
7. Remove the tensioning iron of the alternator from the cylinder head.

8. Remove the rocker arm casing and the rocker arm shaft. Lift out the push rods. Unscrew the bolts for the cylinder head and lift off the head. Remove the manifold from the cylinder head.
9. Recondition the valve system according to the description given under the heading "Cylinder Head And Valves".

Fitting the cylinder head

1. Check to make sure that the cylinder head and block as well as the pistons and cylinder liners are clean.
   Check that the oilway (Fig. 2-18) for the rocker arm mechanism is clean on the tappet side. In the cylinder head the oil goes up through the bolt hole, between the bolt and the wall cavity and then through an oblique drilling to the attaching bolt for the rocker arm shaft and finally up the shaft.
   Mount the manifold on to the cylinder head. Place the cylinder head gasket and cylinder head in position. (Dowel pins SVO 2435 can be suitably used for this purpose.) Fit the bolts and tighten them according to the tightening sequence given in Fig. 2-17.
   N.B. The bolts should be tightened in two stages.
2. Fit the push rods in position and mount the rocker arm mechanism. Adjust the valve clearance, 0.50—0.55 mm (0.020—0.022") for both the exhaust and intake valves.
3. Fit the rocker arm casing. Fit the alternator tensioning iron to the cylinder head.
4. Fit the nuts for the exhaust manifold flange and also the preheating plate.
5. Fit the throttle control and choke wire, also connect all hoses to the intake manifold and carburettors. Fit the air cleaner cover with hoses.
6. Connect the ignition leads and electric cable for the temperature tell-tale.
7. Fit the hose for the heater control valve and the upper radiator hose. Fill with coolant.
8. Check the function and also for leakage. Fill if necessary with coolant. Adjust the valve clearance if required. The cylinder head bolts need not be subsequently tightened.

CYLINDER HEAD AND VALVES

Dismantling

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 the stem and guide. The clearance with a new valve must not exceed 0.15 mm (0.006"). Also check that the valves are not excessively worn. See "Specifications" under the headings "Valve System" and "Wear Tolerances".

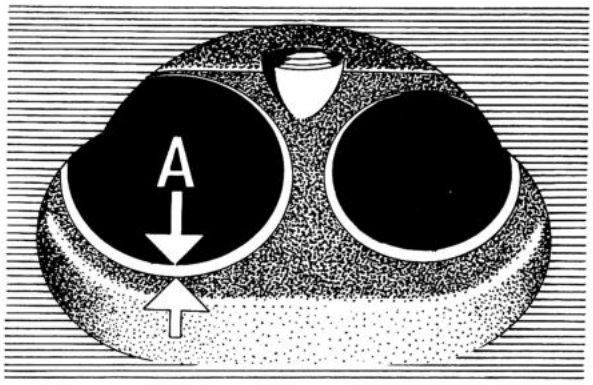

Fig. 2-20. Valve seat width A=2 mm (0.08")

Cleaning

With rotating brushes clean the valves, the combustion chambers and the oilways from carbon and combustion deposits.

Grinding the valves and valve seats

1. Grind the valves in a machine after they have been cleaned. Fit 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 fitted 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 is approx. 2 mm (0.08"), see "A" Fig. 2-20. If 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 the valve guides

1. Press out the old guides with tool SVO 2818.
2. Press in the new guides using drift SVO 2819, which gives the correct pressing-in depth. See Fig. 2-21.
3. Check that the guides are free from burr and that the valves move easily in them.

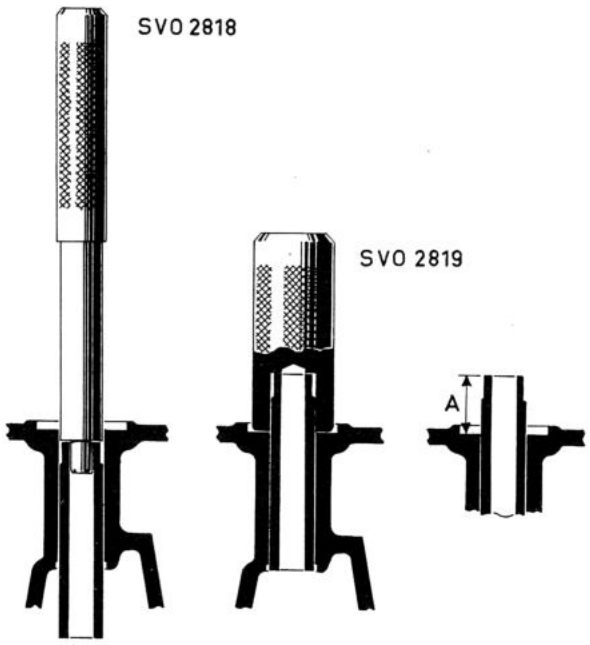

Fig. 2-21. Replacing valve guides
A=17.5 mm (0.689")

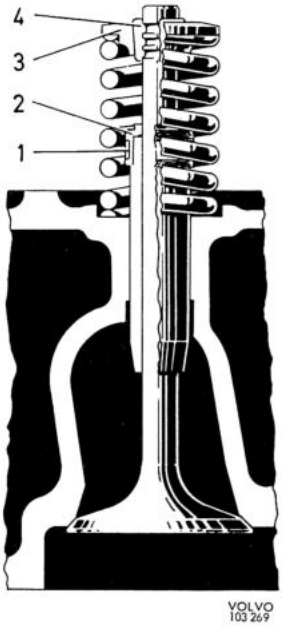

Fig. 2-22. Valve collet and valve guide seal

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

Assembling

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

Replacing the rocker arm bushes and grinding the rocker arms

1. If wear amounts to 0.1 mm (0.004"), replace the rocker arm bush. Use tool SVO 1867 for pressing the bush out and in, see Fig. 2-23. Then ream the bush with a suitable reamer until an accurate fit on the shaft is obtained. The hole in the bush should coincide with the hole in the rocker arm.
2. If necessary, grind the pressure pad of the rocker arm in a special machine.

Adjusting the valve clearance

The valve clearance can be adjusted satisfactorily with the engine stationary, irrespective of whether the engine is cold or warm. The clearance is the same for both the inlet and exhaust valve. When adjusting, use two feeler gauges, one "Go" 0.50 mm (0.020") thick and the other "No-Go" 0.55 mm (0.022) thick. The clearance is adjusted so that the thinnest gauge can be inserted easily while the thicker one must not enter. When the piston in No. 1 cylinder is at top dead centre (the compression stroke), valve Nos. 1, 2, 3, 6, 7 and 10 (counted from the front) are adjusted, and with the piston in No. 6 cylinder at top dead centre, valves Nos. 4, 5, 8, 9, 11 and 12.

CYLINDER BLOCK

Measuring cylinder bores

The cylinder bores are measured with a special dial indicator. Measuring should be carried out just below the top edge of the bore only in the transverse direction of the engine.

A letter is stamped on each cylinder bore indicating the classification of the bore and piston (only on standard models).

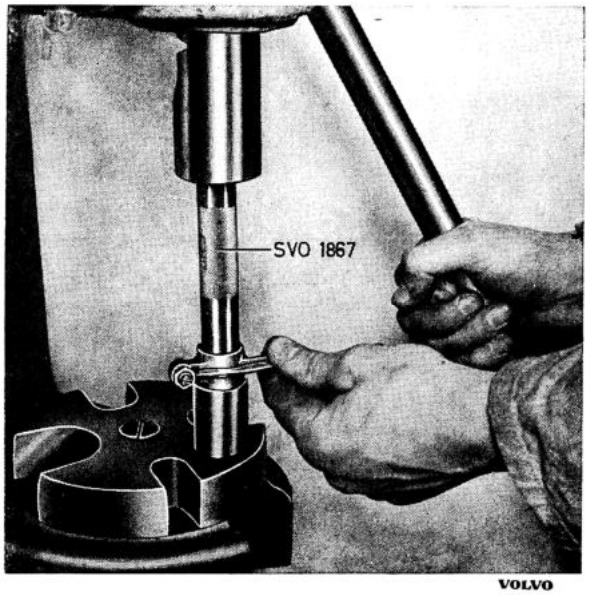

Fig. 2-23. Replacing bush in rocker arm

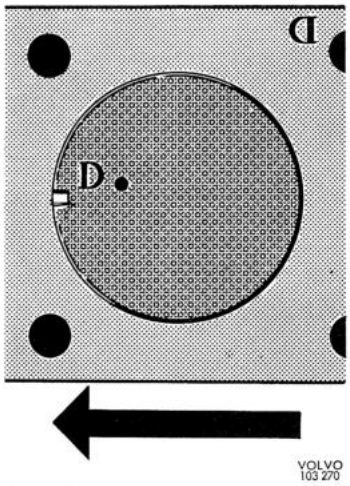

Fig. 2-24. Marking on pistons and cylinder block

PISTONS, PISTON RINGS AND GUDGEON PINS

Measuring the pistons

The pistons are measured with a micrometer at right angles to the gudgeon pin hole 2.5 mm (0.098") from the lower edge on the piston marked 71/4 on the crown face. On late prod. pistons marked 71/9 the corresponding measurement is 12 mm (0.47").

Fit of pistons in cylinders

The fit of the pistons in their respective cylinders is tested without the piston rings being fitted. The clearance at right angles to the gudgeon pin hole is measured with a feeler gauge 1/2" wide and 0.05 mm (0.0020") thick attached to a spring balance. The force applied should be 1 kp (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. Feeler gauges which are 0.04 mm (0.0016") or 0.06 mm (0.0024") thick can, therefore, also be used. The test is carried out at several different depths.

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.
2. Measure the ring gap with a feeler gauge. The gap should be 0.40—0.55 mm (0.016—0.022"). If necessary, the gap can be increased with the help of a special file.
3. Check the piston rings in their respective grooves by rolling them in the groove. Also measure the clearance at a few points. See "Specifications" for the proper measurements.

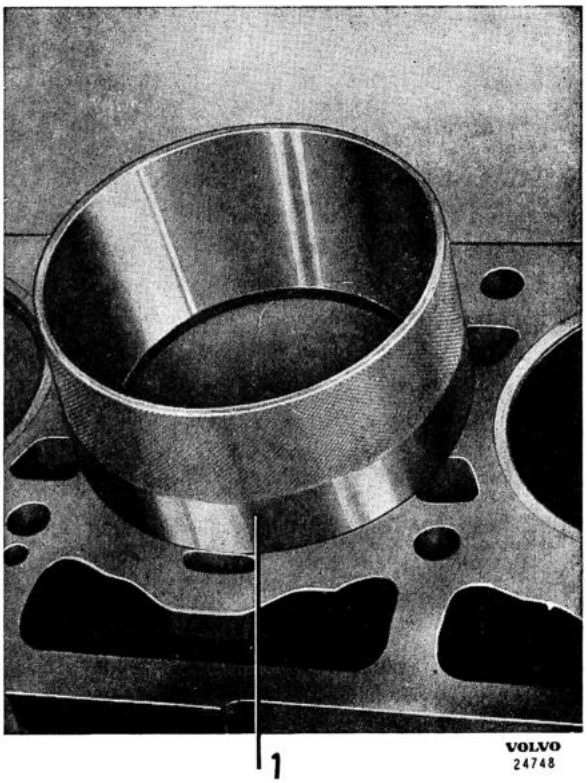

Fig. 2-25. Fitting the piston
1. Fitting ring SVO 2823

IN A WORN CYLINDER BORE

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

Assembling and fitting the piston and connecting rod

When assembling, make sure that the piston is turned correctly so that the slot on top of the piston faces forwards as shown in Fig. 2-24. If the piston is turned the wrong way, this will cause a loud noise. The number marking on the connecting rod should be turned to face away from the camshaft side. The gudgeon pin is then fitted, the circlip placed in position and the piston rings fitted.

Use piston ring grips when fitting the rings. The compression rings are marked "TOP" and the upper ring on each piston is chromed. Place the bearing shells in position.

Turn the rings so that the gaps do not come directly under one another. Then lubricate the piston and bearing surfaces.

Use fitting ring SVO 2832, see Fig. 2-25, when fitting the piston in the cylinder bore. Tighten the connecting

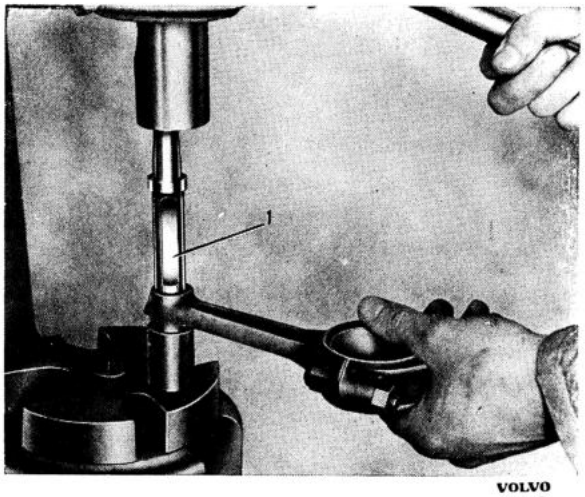

Fig. 2-26. Replacing bush in connecting rod
1. Drift SVO 1867

rod bolts with a torque wrench, see "Specifications" for the correct tightening torque.

Gudgeon pins

The gudgeon pins are available in oversize 0.05 mm (0.002") larger than the standard diameter 22.00 mm (0.866"). If the gudgeon pin hole in the piston is worn so much that an oversize is necessary, the hole should first be reamed out to the correct measurement. Use a reamer fitted with a pilot guide and only take small cuts at a time.

The fit is correct when the gudgeon pin can be pushed through the hole by hand with light resistance.

CONNECTING RODS

Replacing the bushes

If the old bush in a connecting rod is worn, press it out by using drift SVO 1867 and press in a new bush with the same tool, see Fig. 2-26. Make sure that the lubricating holes index with the holes in the connecting rod. Then ream the bush to the correct fit. The gudgeon pin should slide through the hole under light thumb pressure but without any noticeable looseness.

Straightening

Before being fitted, the connecting rod should be checked for straightness, twist and any S-distortion. Straighten them if necessary. Nuts and bolts should be replaced with new ones when reconditioning is being carried out.

CRANKSHAFT

After the crankshaft has been cleaned, its journals must be measured with a micrometer. Measuring

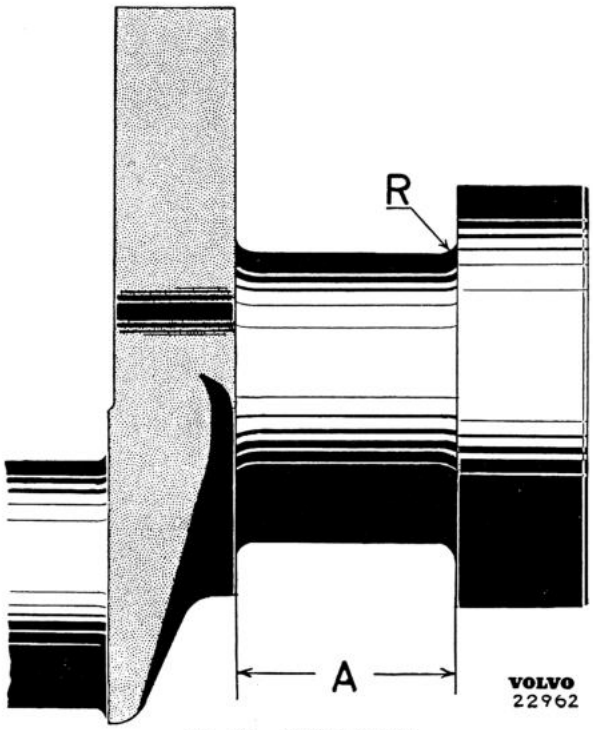

Fig. 2-27. Bearing journal

should be carried out 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 0.05 mm (0.002"), and 0.07 mm (0.003") on the big-end bearing journals. Taper should not exceed. 0.05 mm (0.002") 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 five undersizes. The measurements concerned are to be found in the "Specifications".

Check that the crankshaft is straight to within 0.05 mm (0.002") by using a dial gauge. The crankshaft is placed on two V-blocks and a dial gauge placed against the centre bearing journal after which the crankshaft is rotated. If necessary, straighten the crankshaft in a press.

Grinding the 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 carried out 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 carefully 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 journals should have a radius of 2.0—2.5 mm (0.080—0.100") on all journals, see Fig. 2-27. 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.

Bearing shells

In addition to standard sizes, bearing shells are available in undersizes of 0.010" and 0.020". 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 fitted. The bearing shells must not be shaved and the caps must never be filed in order to obtain a closer bearing fit.

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

Grinding the 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 0.75 mm (0.03") of the original thickness must be ground off.

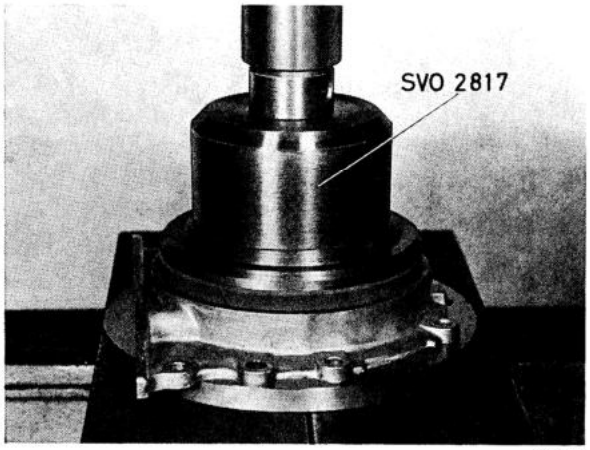

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Fig. 2-28. Fitting oil seal

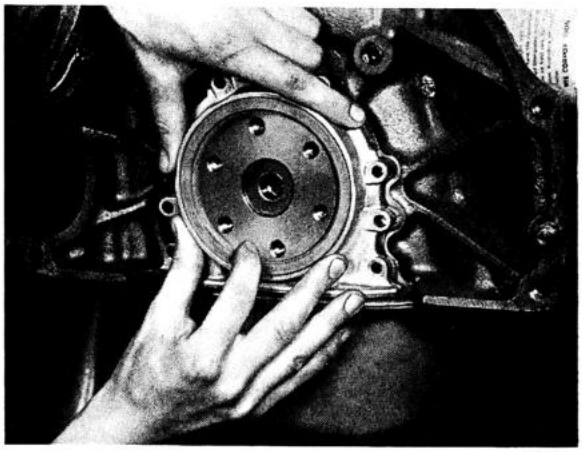

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Fig. 2-29. Fitting sealing flange

Pilot bearing for clutch shaft

The pilot bearing circlip and protecting washer are removed, and the pilot bearing pulled out with tool SVO 4090 and checked after having been washed in white spirit. If the bearing is worn, it should be replaced with a new one. Before fitting, pack the bearing with heat-resistant ball bearing grease. The bearing is fitted with drift SVO 1426, after which the protecting washer and circlip are fitted.

REPLACING THE CRANKSHAFT REAR OIL SEAL

1. After having removed the gearbox, clutch and flywheel from the engine, remove the two bolts for the oil sump in the sealing flange. Slacken one of the two bolts on each side so that oil sump pressure on the sealing flange will not be so great. Remove the sealing flange.
2. Press out the seal with the help of the drift for tool SVO 2817. Use a suitable cushion for the sealing flange to prevent it from being damaged.
3. Press in the sealing ring with tool SVO 2817, see Fig 2-28.

   N.B. First inspect the wear surface of the crankshaft.

   The sealing ring can be fitted in three positions with tool SVO 2817, see Fig. 2-32. With a new crankshaft or a crankshaft with approved wear surface, fit the seal in its outer position (fully screwed in center bolt). With the wear mark on the crankshaft, fit the crankshaft with the center bolt screwed out a couple of turns or completely.
4. Fit the sealing flange, its sealing surface being well cleaned, and a new gasket. (Oil first the sealing ring.) The sealing flange should be mounted on the crankshaft carefully, see Fig. 2-29. Use your finger to fit on the sealing lip.

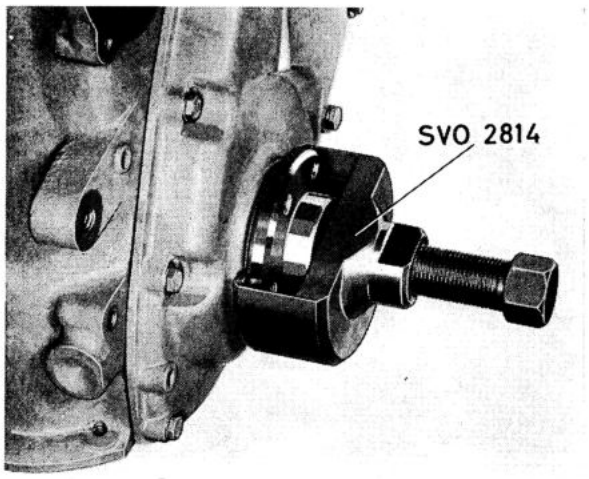

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Fig. 2-30. Removing polygon hub

REPLACING THE OIL SEAL IN TIMING GEAR CASING

1. Empty the coolant from the system and remove the radiator and radiator grille.
2. Release the fan belt. Unscrew the bolts for the pulley and the flywheel damper and remove the bolts.
3. Remove the center bolt and take off the polygon hub with puller SVO 2814, see Fig. 4-30. (First check to see whether it is possible to pull off the polygon hub by hand.)
4. Remove the oil seal. Lubricate the sealing lip on the new seal and fit the seal with drift SVO 2816, see Fig. 2-31.
   N.B. First inspect the wear surface of the polygon hub. The oil seal can be fitted in three positions with tool SVO 2816. With a new polygon hub, the center bolt of the tool should be screwed in fully, see Fig. 2-32. In this position, the seal will be fitted in its outer position (position 1). With a wear mark on the polygon hub, fit the seal in position 2 (1¼ turns of center bolt screwed out). With two wear marks on the hub, fit the sealing in position 3 (center bolt screwed out fully). With three wear marks, the polygon hub should be replaced with a new one.
5. Fit the polygon hub with tool SVO 2815, see Fig. 2-33. Before fitting, the sliding surfaces of the polygon hub should be greased. **Note the marking,** that is, the center punch marks on the crankshaft end and polygon hub. Fit the center bolt and tighten it to a torque of 7—8 kpm (50—57 lb.ft.).
6. Fit the flywheel damper and pulley. Since the bolt holes are not located symmetrically, fitting can only be done in one position.
7. Fit the fan belt. The pulley belt should be so tensioned that it can be deflected 10 mm (3/8") with a force of 11.5—14 kp (25—31 lb.) applied to the belt between the water pump pulley and alternator pulley.
   Fit the radiator.

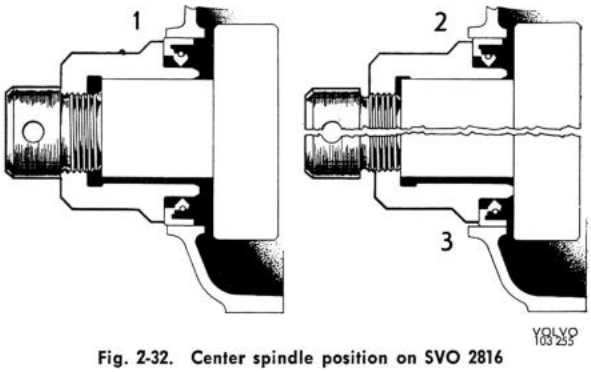

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Fig. 2-32. Center spindle position on SVO 2816

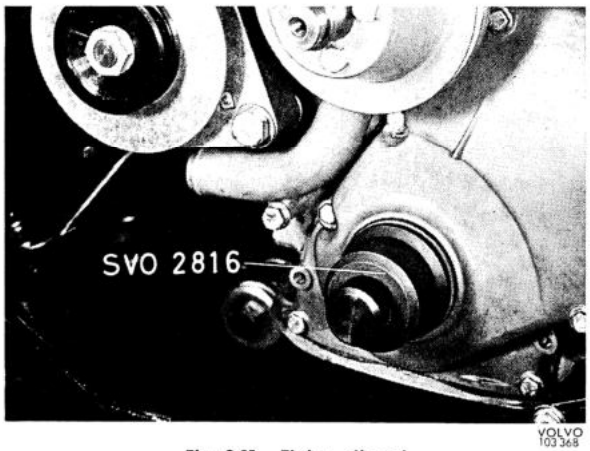

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Fig. 2-31. Fitting oil seal

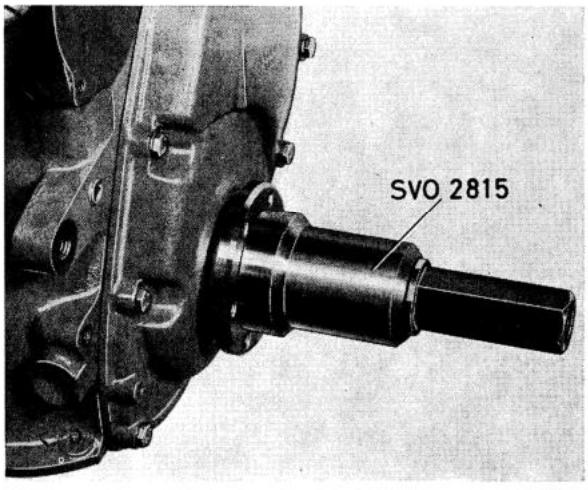

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Fig. 2-33. Fitting polygon hub

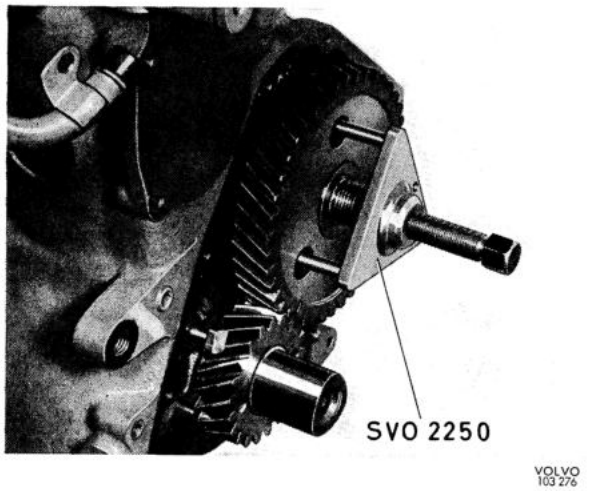

Fig. 2-34. Removing camshaft gear

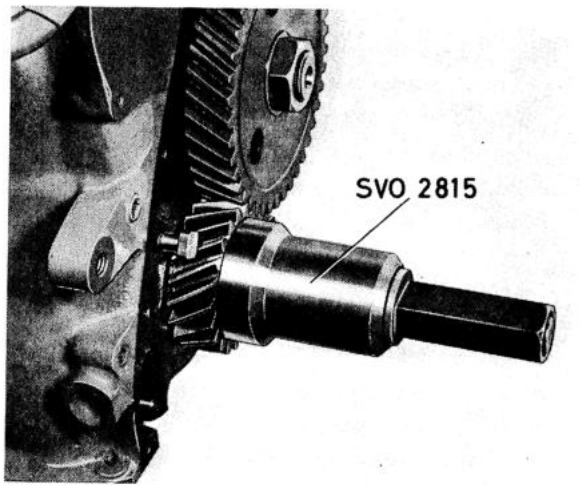

Fig. 2-36. Fitting crankshaft gear

REPLACING THE TIMING GEARS

1. Empty the coolant from the system and remove the radiator and radiator grille. Remove the fan belt and fan.
2. Carry out operations 2—3 from the previous section.
3. Remove the timing gear casing. Slacken a couple of bolts extra for the oil sump and observe due care that the sump gasket is not damaged.
4. Remove the camshaft nut and pull off the camshaft gear with puller SVO 2250, see Fig. 2-34.
5. Pull off the crankshaft gear with puller SVO 2822, see Fig. 2-35.
   Screw out the oil nozzle, blow it clean and re-fit it, see Fig. 2-38. The gears are lubricated from this nozzle.
6. Re-fit the crankshaft with tool SVO 2815, see Fig. 2-36.

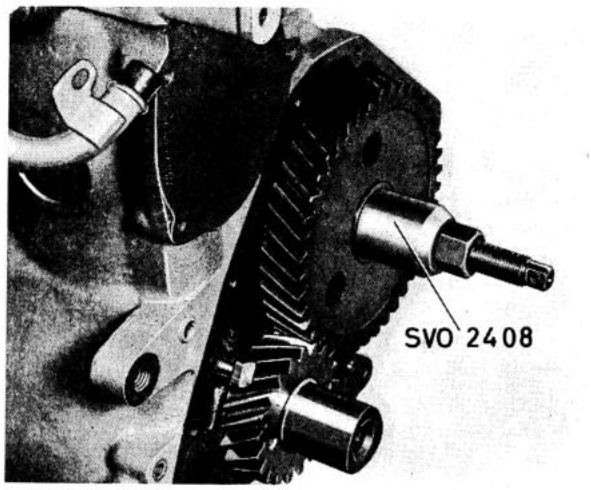

Fig. 2-37. Fitting camshaft gear

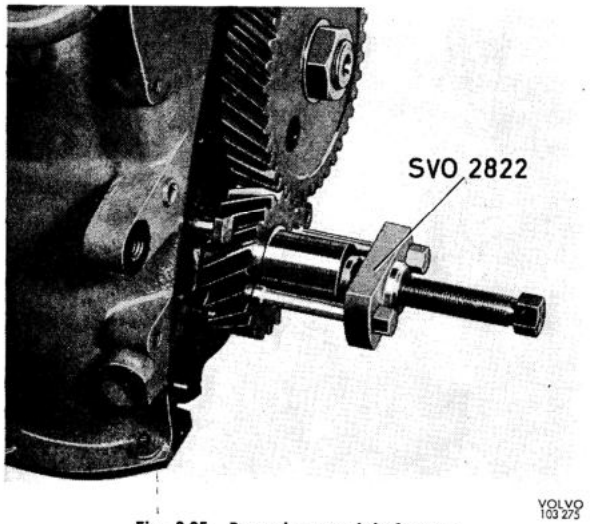

Fig. 2-35. Removing crankshaft gear

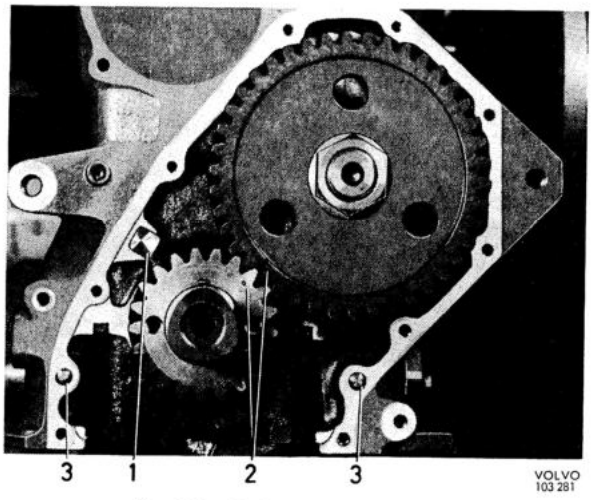

Fig. 2-38. Markings on timing gears
1. Oil nozzle 2. Markings 3. Dowel pin

7. Re-fit the camshaft gear with tool SVO 2408, see Fig. 2-37. Both gear wheels should take up the correct position relative to each other, see Fig. 2-38. When the timing gear drive markings are opposite each other, then the piston for No. 6 cylinder is at top dead center, firing position. Do not press the camshaft backwards so that the sealing washer at the rear end loosens. Fit the nut and tighten it to a torque of 13—15 kgm (94—108 lb.ft.).

   The measuring values for the tooth flank clearance and the camshaft axle clearance, which is determined by the spacing ring behind the camshaft gear, are given in the "Specifications".

8. Re-fit the timing gear casing with gasket. The timing gear casing is located in position by means of the dowel pin. Carry out operations 5—7 from the previous section.

POSITIVE CRANKCASE VENTILATION

OVERHAUL

At intervals of 40 000 km (25 000 miles), the nipple (1, Fig. 2-13) should be screwed out and cleaned. At the same time check the hoses and replace those in poor condition.

GROUP 22

LUBRICATING SYSTEM

DESCRIPTION

The engine has a force-feed lubricating system, see Fig. 2-39. Pressure is provided by a gear pump driven from the camshaft and fitted under the crankshaft in the sump. The gear pump forces the oil past the relief valve, which is also fitted on the pump, through the oil filter and then through oilways out to the various lubricating points. All the oil supplied to the lubricating points, therefore, first passes through the oil filter.

The engine is fitted with an oil cooler for certain markets.

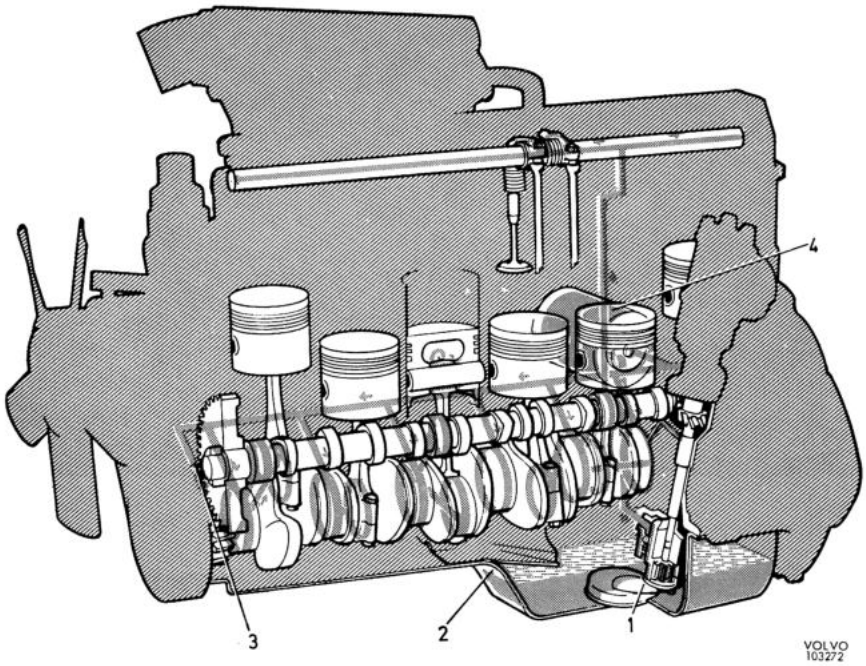

Fig. 2-39. Lubrication system

1. Oil pump
2. Sump
3. Nozzle
4. Oil filter

OIL PUMP, RELIEF VALVE

The oil pump, see Fig. 2-40, is of the gear type and is driven through a gear train from the camshaft. The delivery pipe from the pump to the cylinder block does not have screw unions and is, therefore, automatically tightened in position when the attaching bolts for the pump are tightened. At each end of the pipe there are sealing rings made of special rubber. The relief valve is fitted directly on the pump and consists of a spring-loaded ball. The ball has a cylindrical guide with a stop at the end position and, therefore, operates flexibly. Even at idling speed there is a certain amount of overflow, so that the oil pressure is then relatively low.

OIL FILTER

The oil filter (see Fig. 2-41), which is manufactured as a single unit complete with element, is of the full-flow type and is screwed directly into the cylinder block. The oil which is fed out to the various lubricating points in the engine first passes through the oil filter element which is made of special paper. In the oil filter there is a by-pass valve which allows the oil to by-pass the element if resistance to flow should become excessive. When replacing the filter, the old one is discarded completely and a new one fitted.

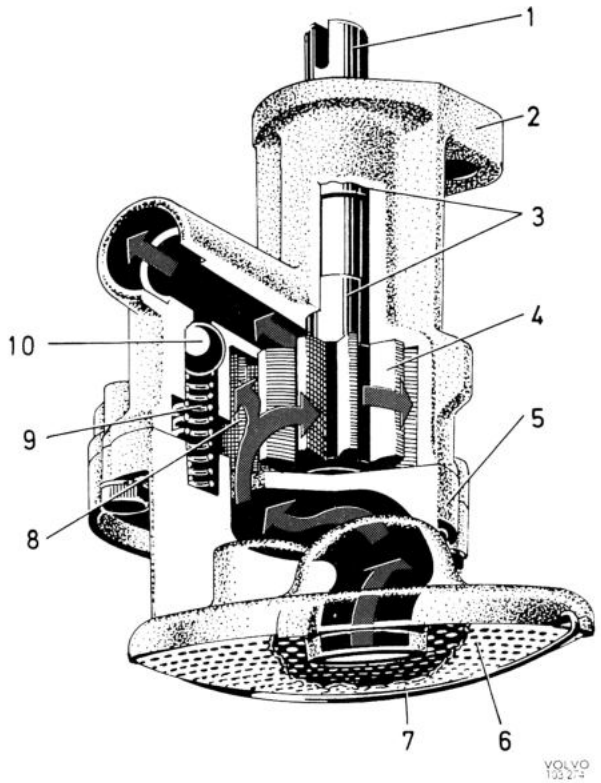

Fig. 2-40. Oil pump

1. Drive shaft
2. Pump body
3. Bushes
4. Driving gear
5. Cover
6. Strainer
7. Retainer clip
8. Driven gear
9. Spring for relief valve
10. Valve ball

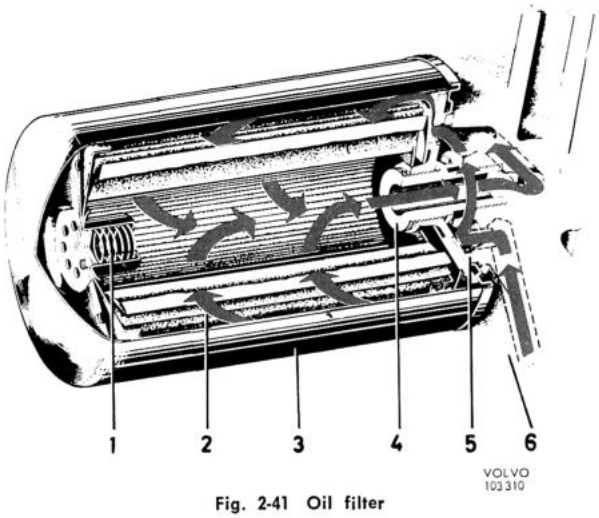

Fig. 2-41 Oil filter

1. Overflow valve
2. Element
3. Body
4. Nipple
5. Gasket
6. Cylinder block

REPAIR INSTRUCTIONS

REPLACING THE OIL FILTER

Together with the element and relief valve, the oil filter (see Fig. 2-41) is screwed as a complete unit on to a nipple fitted in the cylinder block.

The filter should be replaced every 10 000 km (6 000 miles), when the old filter is discarded.

1. Remove the old filter with the help of chain tongs, see Fig. 2-43.
2. Coat the rubber gasket (1, Fig. 2-42) of the new filter with oil and make sure that the contact surface for the oil filter is free from dirt. By smearing it with oil, the gasket slides into better contact with the sealing surface. Screw on the filter by hand until it just touches the cylinder block.
3. Continue to screw on the oil filter a further half turn by hand. **Chain tongs must not be used when fitting.** Start the engine and check that there is no leakage at the joint. Fill up with oil if necessary.

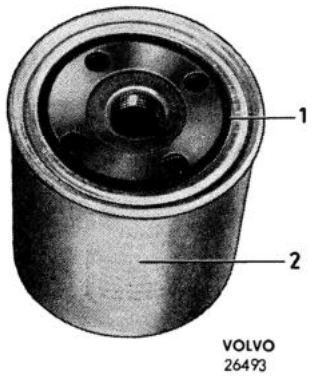

Fig. 2-42. Oil filter ready for fitting

1. Gasket (oiled)
2. Filter

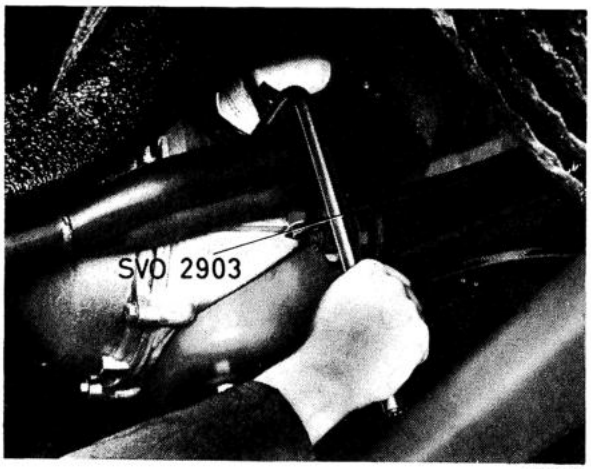

Fig. 2-43. Removing the oil filter

OIL PUMP AND RELIEF VALVE

After the pump has been dismantled and cleaned, check that all the parts are in good condition. Test the relief valve spring (2, Fig. 2-44), see "Specifications" for the values concerned.

Check that the tooth flank clearance is 0.15—0.35 mm (0.006—0.014"), see Fig. 2-45.

Measure the end float, 0.02—0.10 mm (0.0008—0.0040"), with a feeler gauge and a new cover or the old one if not noticeably worn. If the bushes or shaft are worn, replace them with new ones. Note that the driving shaft with gear is replaced as a single unit. The new bushes should be reamed after pressing in with a reamer provided with a pilot guide.

The sealing rings at the ends of the delivery pipe are made of special rubber and are manufactured to very close tolerances, see Fig. 2-47. Use only genuine Volvo spare parts. The delivery pipe must be clamped in its correct position first in the oil pump and then the oil pump and pipe together clamped against the block. The pump connecting flange should lie flush against the block before being tightened. Before fitting the rubber rings on the pipe, apply soapy water since this enables the pipe to take up its position more easily. Tap lightly on the pipe with a soft mallet if necessary.

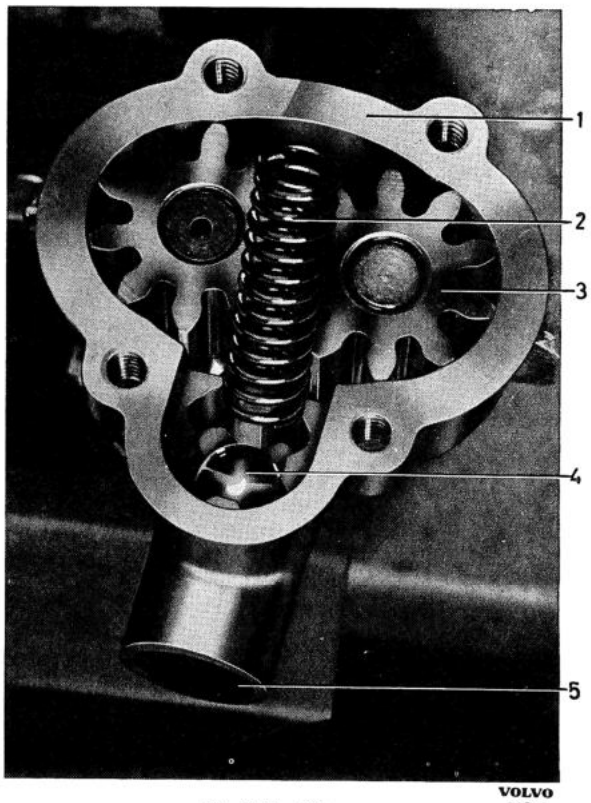

Fig. 2-44. Oil pump

1. Pump body
2. Spring for relief valve
3. Gear
4. Valve ball
5. Hole for oil pipe

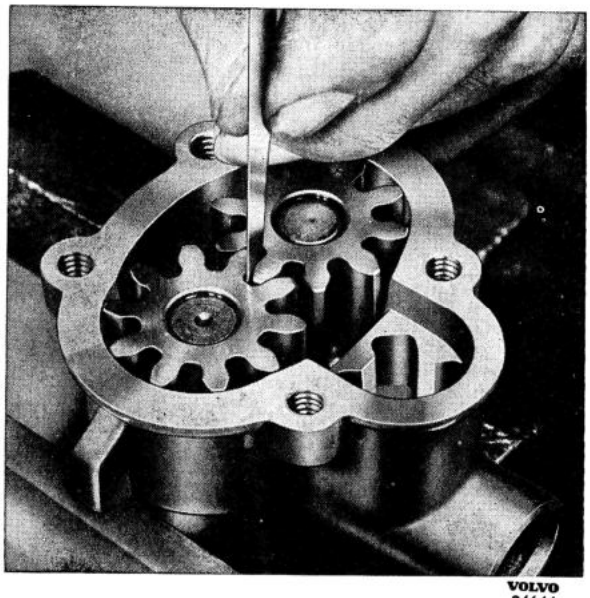

Fig. 2-45. Measuring tooth flank clearance

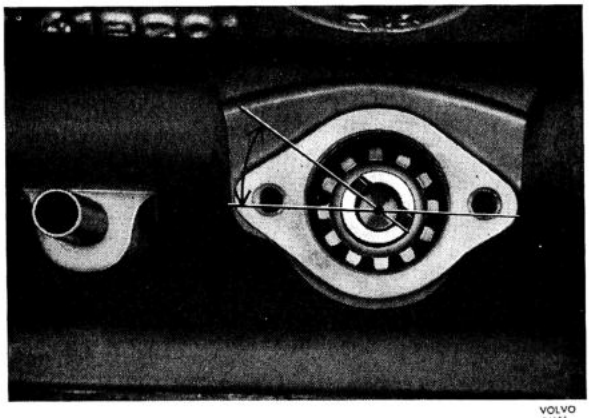

Fig. 2-46. Distributor drive position
A=approx. 35°

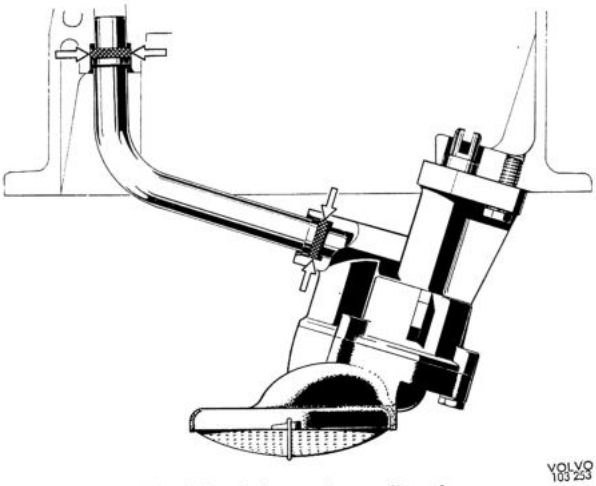

Fig. 2-47. Delivery pipe sealing rings

OILWAYS

Before being fitted, all the oilways must be cleaned very thoroughly to avoid damage to the bearings, bearing journals and other components.

To clean the cylinder block oilways, remove the sealing plugs. After cleaning and drying with compressed air, fit new plugs.

FITTING THE OIL PUMP

When No. 1 cylinder is at top dead centre, fit the oil pump drive and distributor. The small part at the groove is turned obliquely upwards-backwards and the groove set at an angle of 35° to the longitudinal axis of the engine, see Fig. 2-46 (A). Make sure that the shaft goes down into its groove in the pump shaft.

(N.B. When the timing gear marks are opposite each other, then the piston for No. 6 cylinder is in the top dead centre position, firing position.)