



SERVICE MANUAL

TRUCKS

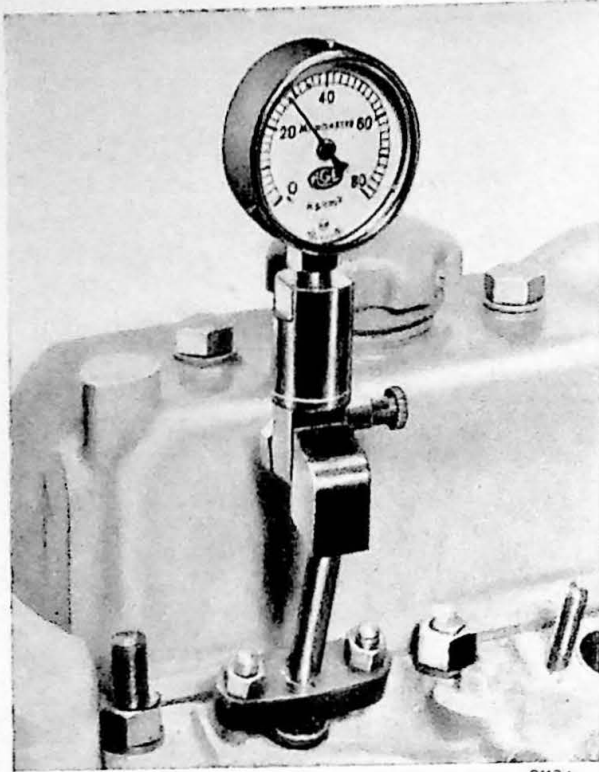
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Export Service Department

AKTIEBOLAGET

VOLVO

GÖTEBORG, SWEDEN



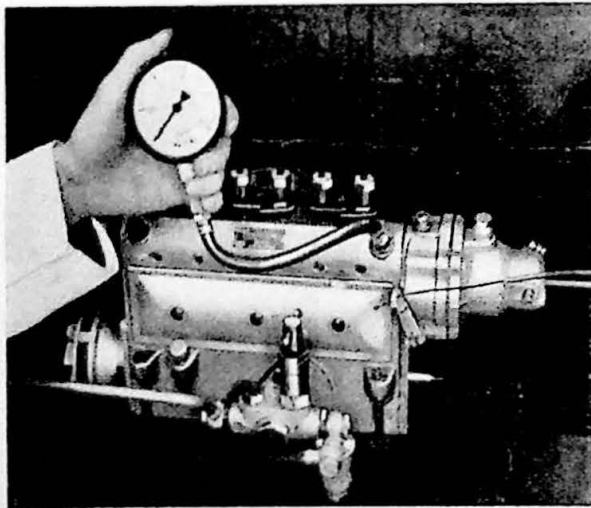
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Fig. 1—28. Measuring compression pressure.



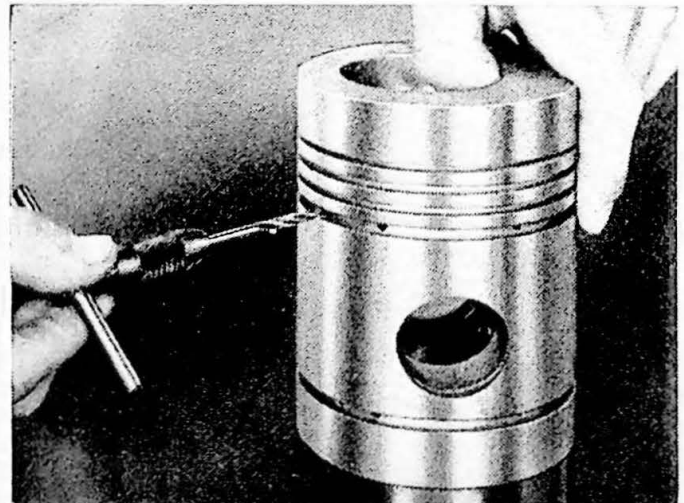
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Fig. 1—30. Cleaning piston ring grooves.



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Fig. 1—29. Measuring feed pressure.



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Fig. 1—31. Cleaning oil holes.

REPAIR INSTRUCTIONS

ENGINE TESTING

Compression tests

In order to determine the condition of the engine, a compression test should be carried out. The pressure gauge for this purpose is usually graduated either in kg/cm^2 or $\text{lb/sq.in. (p.s.i.)}$.

Run the engine until it is warm and then remove the injectors and measure the compression in each cylinder one at a time. While this is being done, the stop control should be pulled out and the engine should be turned over by means of the starter motor with the throttle fully open. Make sure that the battery is in sufficiently good condition to ensure that the starter motor turns over the engine sufficiently fast. It is also important so ensure that there is no leakage on the compression pressure gauge connection.

The highest value obtained on each cylinder should be noted.

Normally the compression pressure should be 27 kg/cm^2 (384 p.s.i.) when the engine is being turned over by the starter motor. A deviation not exceeding 10% from this value is allowed. The difference in pressure between any two cylinders may, however, not exceed 1.75 kg/cm^2 (25 p.s.i.).

Check of fuel feed pressure

It is important to ensure that the fuel has always sufficiently high pressure when it is fed to the fuel injection pump. The feed pressure should thus be checked if the engine output appears to be low or if there is reason to suspect that one of the fuel filters is blocked.

If the spring in the relief valve is weak or the valve is leaking engine output will be low or the engine will be difficult to start.

Fuel feed pressure is checked by using pressure gauge SVO 1385 (Fig. 1-19) which is connected to an air-venting screw on the fuel injection pump. The engine should be running at idling speed while this test is carried out. After the injection pump has been running for some time, read off the pressure gauge. Normal fuel feed pressure should be about $0.6\text{--}1.0 \text{ kg/cm}^2$ (8.5-14.2 p.s.i.).

The pressure may not be lower than 0.50 kg/cm^2 (7.1 p.s.i.) if the feed pump is to supply the fuel injection pump with sufficient fuel under all conditions and maintain the fuel in circulation in the system so that all air is continually being removed. If the fuel feed pressure should be too low, check the pre-filter, fuel filters and relief valve in that order after having first made sure that there is sufficient fuel in the tank.

WORK THAT CAN BE CARRIED OUT WITH THE ENGINE FITTED IN THE VEHICLE

Decarbonizing and valve grinding

1. Empty the cooling system.
2. Clean the upper parts of the engine by using a kerosene spray.
Particular attention should be paid to the component units in the fuel injection system.
3. Remove the delivery pipes and the leak-off line. Fit protector caps.
4. Remove the intake manifold and the exhaust manifold as well as the throttle control system.
5. Remove the upper radiator hose and the temperature gauge connection in the block as well as the water connector pipe.
6. Remove the rocker arm covers.
7. Remove the lubricating oil pipe for the rocker arm mechanism. Remove the bolts retaining the bearing brackets and then lift off the rocker arm mechanism.
8. Remove the cylinder head nuts and lift off the cylinder heads. Remove the gaskets.
9. Scrape away carbon deposits from the crowns of the pistons with a wooden tool and then blow it out with compressed air.
10. Follow the directions given under the heading "Grinding the Valves" on page 1-50.
11. Carry out the work described under the heading "Grinding the Valve Seats" on page 1-49.
12. Assemble the cylinder heads according to the directions given under the heading "Assembly and fitting" on page 1-36.
13. Replace other parts in the reverse order to that used when removing.

Piston ring replacement

1. Drain off the cooling water.
2. Unscrew the oil drain plug and drain off the oil.
3. Carry out operations 2-8 in accordance with the instructions "Decarbonizing and Valve Grinding" above.
4. Remove the oil pan.
5. Release the lock washers on the connecting rod bolts, remove the nuts, lift out the bearing caps, remove the connecting rod and piston by pushing upwards. Place the bearing shells, caps and nuts in position. The ridge in the top of the cylinder should, however, be removed first.
6. Remove all the piston rings from the piston and then clean both the piston and the connecting rod. Take particular care to see that the oil channel in the connecting rod, the piston ring grooves and the oil holes in the oil control ring grooves are thoroughly cleaned.
7. Measure the cylinder bore and the pistons and make sure that wear does

not exceed the tolerances stated in the specification. Also check the circlip grooves to make sure that the circlips are firmly in position. Make sure that there are no signs of melting on any of the piston crowns.

8. Check the connecting rods and carry out alignment if necessary.
9. Check the clearance of the piston pins in the connecting rod bushings. If the clearance exceeds 0.06-0.7 mm (0.0028-0.0035") replacement should be carried out. If the piston pin fits loosely in the piston, an oversize piston pin should be fitted.
10. Check the fit of the piston rings both in the cylinder and in the piston ring grooves. See the instructions under "Fitting of piston rings" on page 1-33.
11. Fit the piston rings using a ring replacing tool. Follow the instructions given in the chapter "Assembly of Piston, Connecting rod and Piston Rings" on page 1-34. Make sure that the piston ring gaps are not in line with one another and that they are not opposite the piston pin holes. Oil in the piston rings, cylinders and crankshaft.
12. Fit the pistons in the cylinder bores making sure that the mark "Front" is turned to face the front. Use a piston inserter SVO 2139. Check that the pistons and the connecting rods have the same cylinder number. The number of the piston is on the crown. The connecting rods are marked with a cylinder number both on the rod itself and on the bearing cap.
13. Fit the connecting rods on the crankshaft. The connecting rod nuts should be tightened to a torque of 14-16 kgm (100-116 lb.ft.). Secure the nuts with lock washers.
14. Fit the oil pan.
15. Fit the cylinder heads in accordance with the instructions given under "Assembly and fitting" on page 1-36.
16. Refill the engine with oil and fill the cooling system with water. Run the engine warm and check the valve clearance.

Replacement of cylinder linings and pistons

1. Drain off the cooling water and the lubricating oil.
2. Carry out the instructions 2-8 under the heading "Decarbonizing and Valve Grinding" on page 1-18.
3. Remove the oil pan.
4. Release the lock washers on the connecting rod nuts, remove the nuts, remove the connecting rod caps and push the connecting rod and piston upwards. Place the bearing shells, bearing caps and nuts in position.

5. Remove the piston pin circlips and drive out the piston pin with tool SVO 2009 and standard handle SVO 1801.
6. Remove the cylinder liners using puller SVO 1531 and puller plate SVO 2178 (see Fig. 1-44).
7. Fit the cylinder liners in accordance with the instructions given in "Fitting Cylinder Liners" on page 1-30.
8. Check the fit of the new piston pin in the connecting rod bushing. No looseness is permissible and should there be any looseness, the bushing should be replaced. This is carried out in accordance with the instructions given under "Replacement of Connecting Rod Bushing" on page 1-43.
9. Before fitting the piston rings check the fit of the rings both in the piston ring grooves and in the cylinder. The fit of the piston in the cylinder lining should also be checked. Negligence in this respect can have serious consequences.
10. Follow the instructions on page 1-34 under "Assembly of Piston, Connecting Rod and Piston Rings".
11. Carry out instructions 12-16 under the heading "Replacement of Piston Rings" on page 1-18.

Replacement of Connecting Rod Bearings

1. Drain off the engine oil and remove the oil pan.
2. Remove the connecting rod nuts, remove the connecting rod caps and then push the connecting rod up so far that the connecting rod bearing shells can be removed.
3. Clean and measure the crankpin. If any of the bearings have seized, careful examination should be carried out in order to determine why since otherwise the work carried out would be in vain.

If there are severe scratches or where out-of-roundness exceeds 0.075 mm (0.0030"), the crankshaft should be removed and ground to a suitable undersize. Read the instructions on pages 1-39 and 1-40 "Measurement" and "Grinding of Crankpins and Main Bearing Journals".
4. Push the upper bearing shell into its position in the connecting rod and make sure that the shell is in such a position that the pin engages correctly in the recess. Check also that the oil holes are indexing correctly.
5. Fit the bearing cap and tighten the nuts to a torque of 14-16 kgm (100-116 lb.ft.). Secure the nuts.
6. Fit the oil pan. Use new gaskets. Refill the engine with oil.

10. Refill the engine with oil.

Replacement of Auxiliary Drive Gears

1. Empty the cooling system and remove the radiator and radiator grille.
2. Loosen the tensioning device and remove the fan belts.
3. Remove the attaching bolt and then remove the pulley and vibration damper from the crankshaft by using puller SVO 2002.

In order to facilitate disassembly the pulley should first be pulled out a little and driven in again to loosen the lock cone.

4. Remove the bolts retaining the casing over the auxiliary drive gears and lift off the casing. On late production engines, only the cover on the auxiliary drive gear casing is removed. Make sure that the oil pan gasket is not damaged. If it should be damaged the oil pan must be removed and a new gasket fitted.
5. Remove, inspect and reassemble the auxiliary drive gears in accordance with instructions on page 1-46 "Auxiliary Drive Gears" .
6. Fit the casing over the auxiliary drive gears and align it with drift SVO 2180. On late production engines this concerns only the cover for the auxiliary drive gear casing. Use a new gasket.
7. Press on the hub with vibration damper and puller (press tool SVO 2099). Tighten the bolt and secure it with a lock washer. See instruction 7 "Front Oil Seal" (page 1-21).
8. Fit and tension the fan belts and the drive belts for the vacuum pump or compressor. These last mentioned drive belts are fitted on late production engines.
9. Fit the radiator and fill up with water.

Replacement of Camshaft

1. Carry out instructions 1-4 under "Replacement of Auxiliary Drive Gears" above.
2. Remove the rocker arm covers and loosen the bearing brackets so that the push rods can be lifted up.
3. Remove the inspection covers on the right side of the engine and take out the valve lifters.
4. Bend up the lock washer on the camshaft nut and remove the nut.
5. Pull off the camshaft gear with puller SVO 2116.
6. Remove the two bolts retaining the camshaft flange and pull out the flange.
7. Pull out the camshaft.

(Fig. 1-38) when assembling since this ensures that the seal ring comes into its correct axial position. This is done by pressing in the drift until the tool flange reaches the auxiliary drive gear casing.

6. Examine the vibration damper hub against which the seal ring comes in contact. There should be no scratches and no signs of wear since this can cause faulty sealing.
7. Fit the hub with the vibration damper and the pulley together with the lock cone. Tighten the bolt and secure it with the lock washer. When assembling use press tool SVO 2099 (Fig. 1-39). On early production engines (vibration damper with fixed hub), this is keyed in position. Use a new key and check the keyway. When tightening the attaching bolt make sure that it is tightened correctly so that the vibration damper lies correctly in position. The tightening torque is 80-90 kgm (578-650 lb.ft).

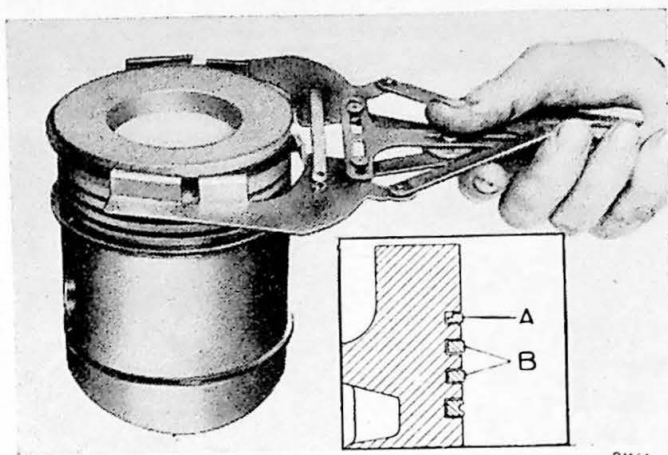
NOTE. The vibration damper may not be subjected to blows since its characteristics can be completely altered in this way, that is to say the carefully calculated space for the liquid can change its shape and volume if it is dented in any way.

8. Fit the fan belts and tension them.
9. Fit the radiator and fill with water.

Rear Seal

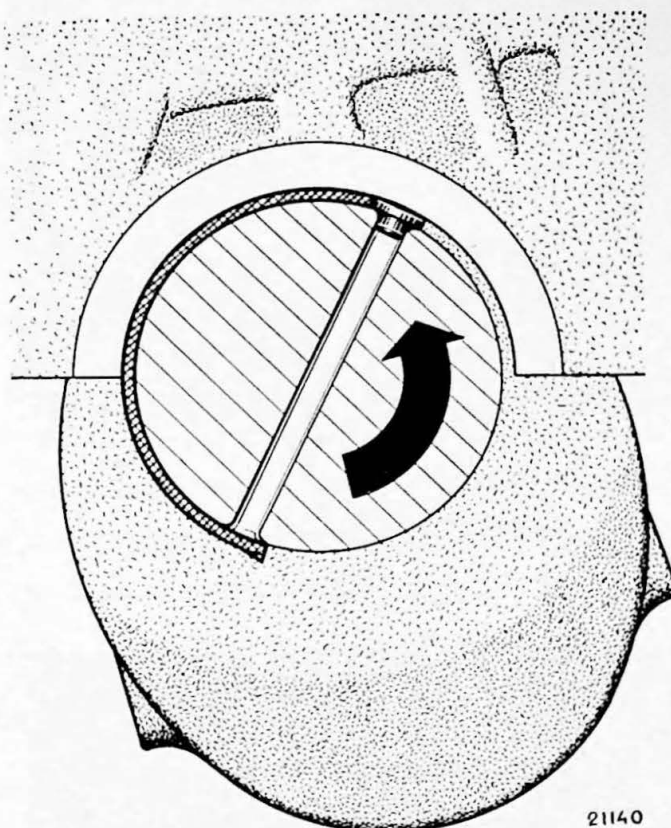
The rear main bearing seal is replaced when the engine is reconditioned since it is necessary to remove the transmission, clutch and flywheel to reach the upper half of the seal. The lower half of the seal, however, can be replaced after the oil pan has been removed. The procedure is as follows:

1. Drain off the oil and remove the oil pan.
2. Remove the two bolts retaining the lower sealing flange and remove the flange.
3. Remove the old felt strip.
4. Dip the new felt strip in melted tallow and fit it in the sealing flange groove.
5. Fit new end gaskets on the sealing flange. Use sealing compound.
6. Push the lower flange into position and tighten the bolts.
7. Smear a little sealing compound on the wooden fillets and press them into the grooves. Take care to ensure that the fillets are not damaged. Make sure that they lie level with the underside of the sealing flange.
8. Fit the oil pan. Use new gaskets.
9. Fit the cover over the flywheel housing into position and tighten the bolts.



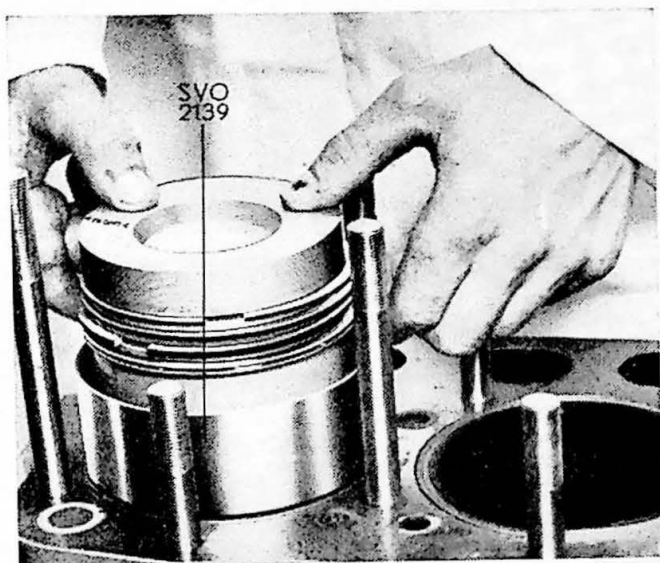
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Fig. 1-32. Fitting piston rings.



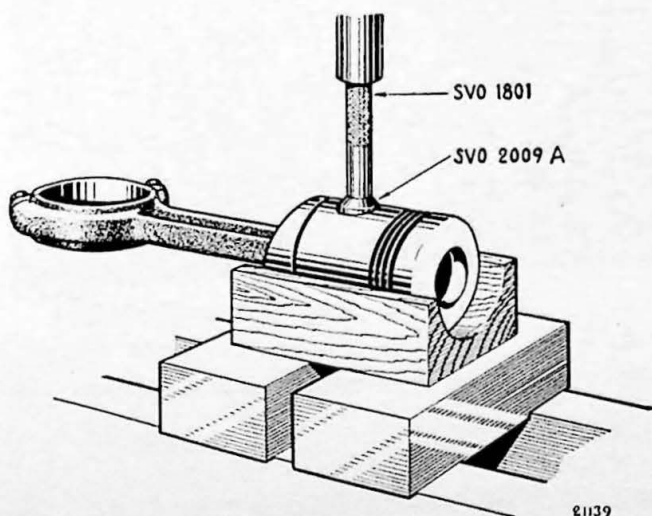
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Fig. 1-35. Replacing upper main bearing shell.



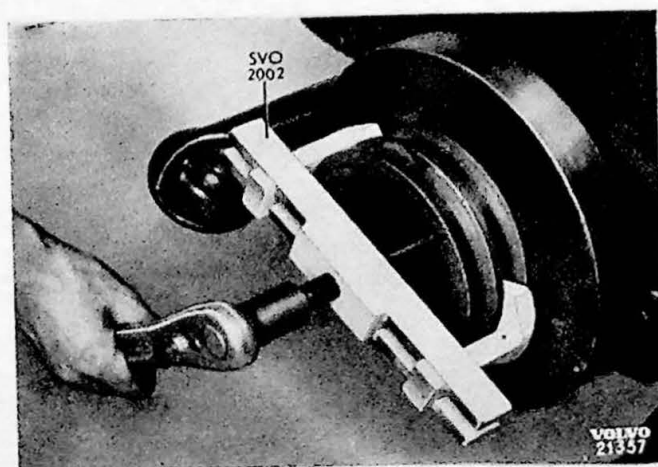
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Fig. 1-33. Fitting piston in engine.



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Fig. 1-34. Removing piston pin.



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Fig. 1-36. Removing pulley.

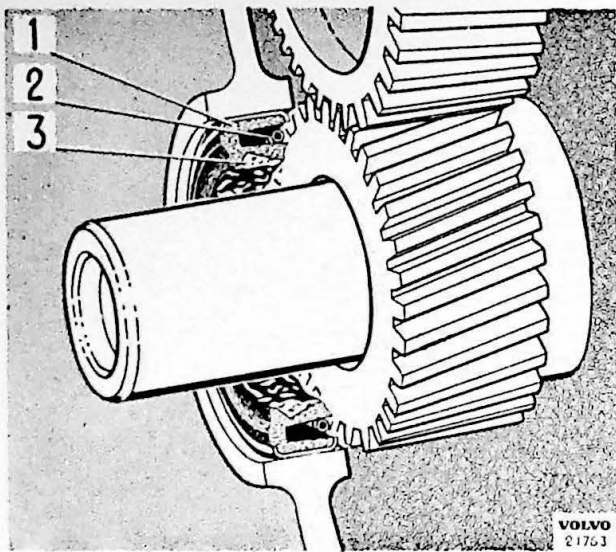


Fig. 1—37.

- 1. Seal ring
- 2. Spring
- 3. Grease

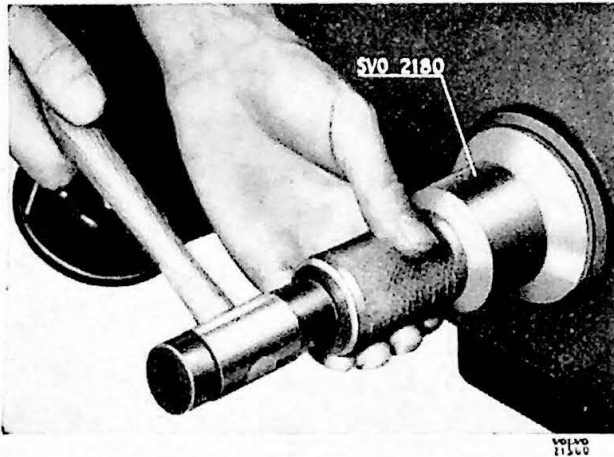


Fig. 1—38. Fitting seal ring.

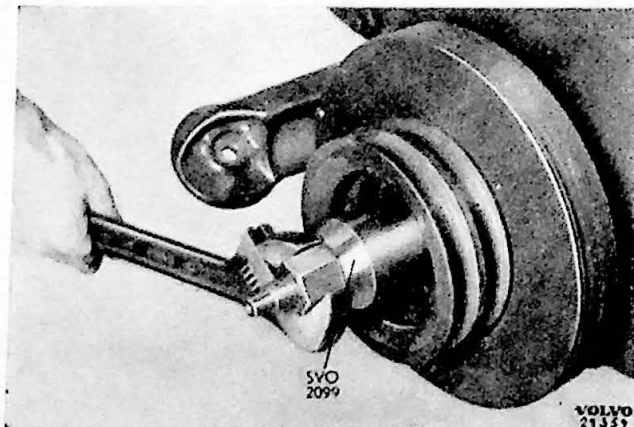


Fig. 1—39. Fitting crankshaft pulley and vibration damper.

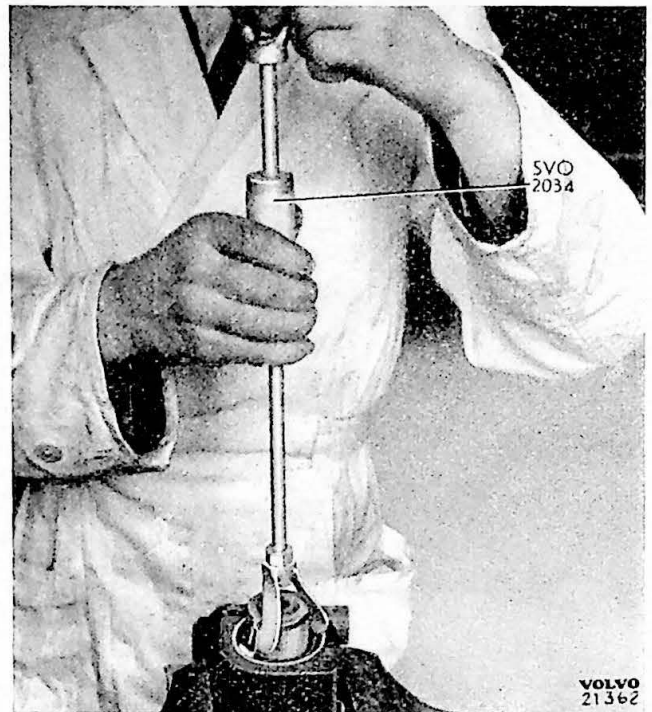


Fig. 1—40. Removing the thermostat.

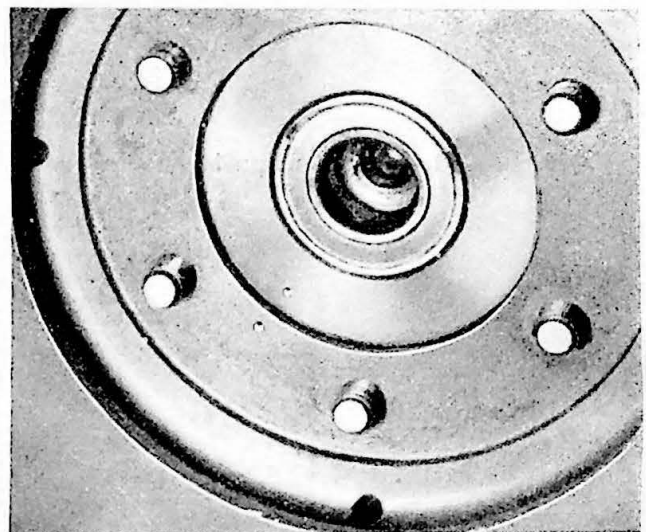


Fig. 1—41. Marking of flywheel when fitting.

10. Refill the engine with oil.

Replacement of Auxiliary Drive Gears

1. Empty the cooling system and remove the radiator and radiator grille.
2. Loosen the tensioning device and remove the fan belts.
3. Remove the attaching bolt and then remove the pulley and vibration damper from the crankshaft by using puller SVO 2002.

In order to facilitate disassembly the pulley should first be pulled out a little and driven in again to loosen the lock cone.

4. Remove the bolts retaining the casing over the auxiliary drive gears and lift off the casing. On late production engines, only the cover on the auxiliary drive gear casing is removed. Make sure that the oil pan gasket is not damaged. If it should be damaged the oil pan must be removed and a new gasket fitted.
5. Remove, inspect and reassemble the auxiliary drive gears in accordance with instructions on page 1-46 "Auxiliary Drive Gears" .
6. Fit the casing over the auxiliary drive gears and align it with drift SVO 2180. On late production engines this concerns only the cover for the auxiliary drive gear casing. Use a new gasket.
7. Press on the hub with vibration damper and puller (press tool SVO 2099). Tighten the bolt and secure it with a lock washer. See instruction 7 "Front Oil Seal" (page 1-21).
8. Fit and tension the fan belts and the drive belts for the vacuum pump or compressor. These last mentioned drive belts are fitted on late production engines.
9. Fit the radiator and fill up with water.

Replacement of Camshaft

1. Carry out instructions 1-4 under "Replacement of Auxiliary Drive Gears" above.
2. Remove the rocker arm covers and loosen the bearing brackets so that the push rods can be lifted up.
3. Remove the inspection covers on the right side of the engine and take out the valve lifters.
4. Bend up the lock washer on the camshaft nut and remove the nut.
5. Pull off the camshaft gear with puller SVO 2116.
6. Remove the two bolts retaining the camshaft flange and pull out the flange.
7. Pull out the camshaft.

2. Unscrew the oil pressure pipe.
3. Loosen the pump attaching bolts and then take out the pump downwards.
4. Carry out the assembly in reverse order to that used when removing.
5. Refill the engine with oil.

Removing and Fitting of Cooling Water Pump

1. Drain off the cooling water.
2. Loosen the tensioning device for the drive belts and remove the drive belts.
3. Loosen the hose clamp on the hose to the thermostat housing. Remove the three nuts retaining the elbow bend for the lower radiator hose.
4. Remove the six attaching bolts and lift up the pump.
5. Fit in reverse order to that used when removing. Use a new gasket.
6. Refill the cooling system with water.

Removing and Fitting the Flywheel

1. Remove the transmission and clutch. See the instructions concerned in part 3 and part 2 of the Service Manuals.
2. Bend out the lock washers from the nuts and remove the nuts. Remove the lock washers.
3. In order to facilitate assembly, the crankshaft flange and the flywheel are marked as shown in Fig. 1-41. Since the flywheel cannot be fitted in the wrong way due to the special arrangement of the bolt holes, this is to avoid the trial and error method when assembling. Lift up the flywheel.
4. Assemble in the reverse order to that used when removing.

When assembly is been carried out it can happen that the bolts go in so far that there is so little left that it is difficult to get the nuts on to the threads. If this should happen the bolts can be pushed out again by removing the cover on the front of the flywheel housing (early production engines only).

REMOVING THE ENGINE

1. Drain off the cooling system.
2. Loosen both the springs on the hood hinges. Remove the hood hinges from the bulkhead by removing the 4 bolts in each attachment and then lift off the hood.
3. Loosen and remove both the stays for the front section which are attached to a support stay and the bulkhead.

4. Loosen the radiator hoses and both the attaching bolts in the bottom of the radiator as well as the bolts retaining the radiator grille to the side plates. The radiator grille complete with radiator can then be lifted out.
5. Disconnect all electrical cables, fuel pipes and controls between the engine and the chassis.
6. Remove the transmission. See part 3 of the Service Manual.
7. Loosen the bolts in the front engine mountings and attach lifting chains to the cylinder head bolts. Take the weight of the engine on the lifting hoist.
8. Loosen the rear engine mountings from the flywheel housing and then lift out the engine.
9. Drain off the engine oil.
10. Clean the engine externally.

DISASSEMBLY OF ENGINE

Since disassembly of the various units in the engine are described under separate headings the following instructions are intended for use to give the right order for disassembly.

1. Remove the bolts retaining the clutch housing and then remove the clutch assembly.
2. Remove the air cleaner, starter motor and generator.
3. Remove the fuel injection pump, delivery pipes, injectors and fuel filters. Before doing this make sure that the pump and the fuel lines are properly cleaned and fit protector caps on the injectors, the delivery pipes and the screw unions on the fuel injection pump.
4. Remove the cooling water pump and the thermostat housing.
5. Remove the induction and exhaust manifolds.
6. Remove the rocker arm covers and remove the bolts retaining the rocker arm shaft bearing brackets. Disconnect the oil pipe for rocker arm lubrication and lift off the rocker arm mechanism.
7. Remove the inspection covers on the right side of the engine and lift up the valve lifters.
8. Remove the cylinder heads.
9. Remove the oil pan, oil pump, oil relief valve and oil filter.
10. Remove the connecting rods from the crankshaft and push out the connecting rods and pistons upwards through the cylinder bores.

11. Remove the cylinder liners.
12. Remove the auxiliary drive gear casing, auxiliary drive gears, camshaft and vacuum pump or compressor depending on the type of brake system fitted.
13. Remove the flywheel and flywheel housing.
14. Remove the main bearings and lift out the crankshaft.

CLEANING THE ENGINE PARTS

If the engine is to be maintained under clean condition it is essential that the workshop and its surroundings are also clean. One can never be too careful in this respect since dirt is the worst enemy to engine performance and length of life. When the engine is to be fully disassembled and reconditioned, all parts such as the cylinder block, crankshaft, camshaft, gears, connecting rods, cylinder heads and oil pan should be carefully cleaned and maintained under clean conditions until they are reassembled in the engine.

All carbon and oil deposits as well as small scraps left from gaskets and packings should be scraped off. The oil galleries and channels in the cylinder block must be cleaned and flushed out with cleaning fluid. After this has been done it should be once again cleaned out with flushing oil. The drilled oil channels in the cylinder block and the crankshaft should be scrubbed and brushed using a brush of the same type used for cleaning rifles. Oil deposits usually form in unexpected positions and prevent the flow of oil or cause large particles of dirt to get into the bearings.

The diameter of the brush used should be about 1.5 mm (1/16") greater than the oil hole being cleaned. The brush should be dipped in kerosene or light oil and pulled in and out through the entire oil channel.

The use of compressed air to blow oil channels clean is not recommended. The air supplied is not always clean so the result can be that it can increase the amount of dirt particularly in sharp bends.

The use of a degreasing tank is recommended to clean the other engine components. These components should be immersed and boiled in alkali solution and should then be blown with steam from a high pressure cleaning machine.

Care should be taken when working with light-alloy parts so that the alkali does not attack this metal. Special solutions are available but care should still be taken so that the parts concerned do not remain too long in the bath. If the above equipment is not available, the parts can be brushed and cleaned in kerosene or fuel oil. The liquid used should be changed often and the precision-made parts such as pistons, connecting rods, crankshaft and camshaft should be cleaned first.