# TOOLS

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

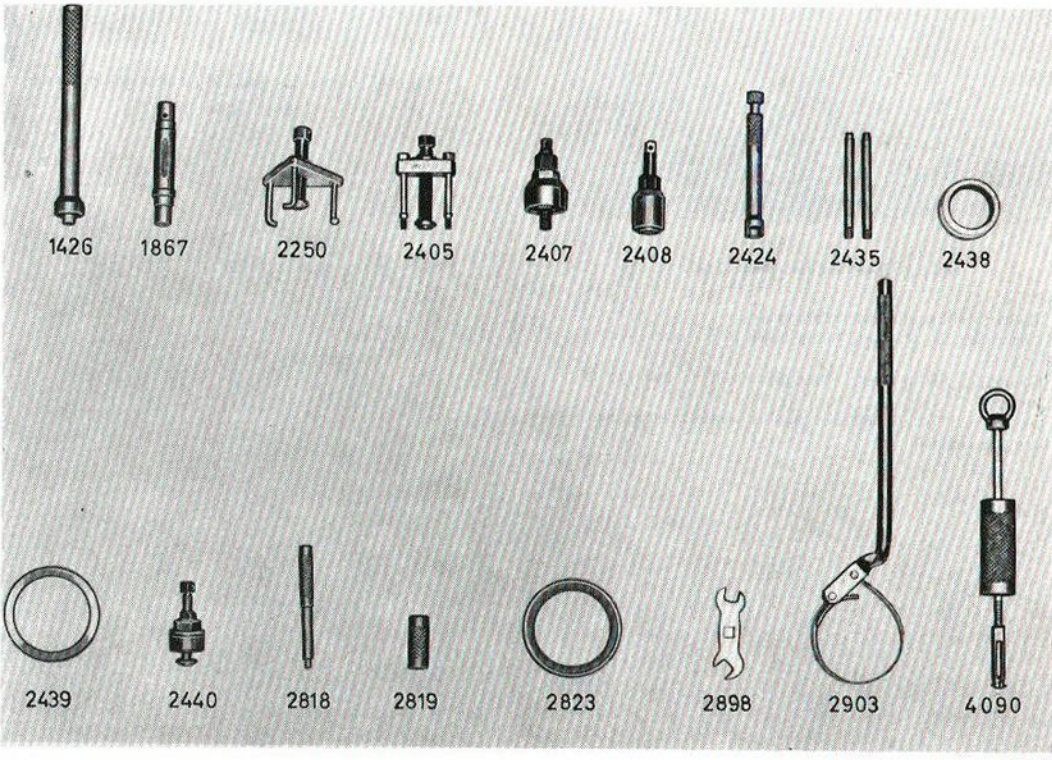



**Fig. 2-1. Tools for engine**

999 (SVO)
1426 Drift for fitting pilot bearing
1867 Drift for removing and fitting bush in rocker arm and connecting rod
2250 Puller for camshaft gear
2405 Puller for crankshaft gear (SVO 2822 can be used as alternative)
2407 Press tool for fitting crankshaft gear
2408 Press tool for fitting camshaft gear
2424 Grip tool for removing and fitting valve tappets
2435 Dowels (2) for fitting cylinder head

999 (SVO)
2438 Centering sleeve for timing gear casing and fitting ring circlip
2439 Centering sleeve for rear sealing flange and fitting felt ring circlip
2440 Puller for crankshaft hub
2818 Drift for removing valve guide
2819 Drift for fitting valve guide
2823 Ring for fitting standard piston
2898 Spanner 11/16" for final-tightening of cylinder head bolts
2903 Spanner for removing oil filter
4090 Puller for crankshaft pilot bearing

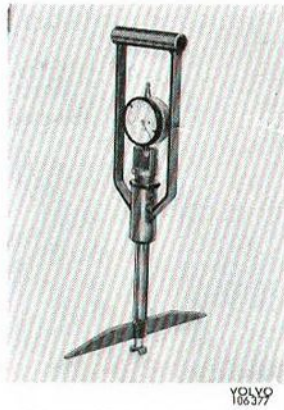
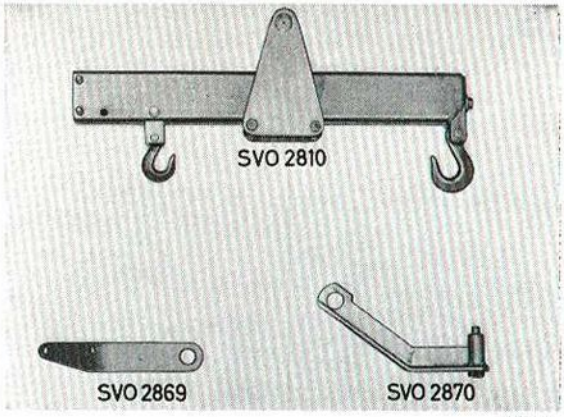


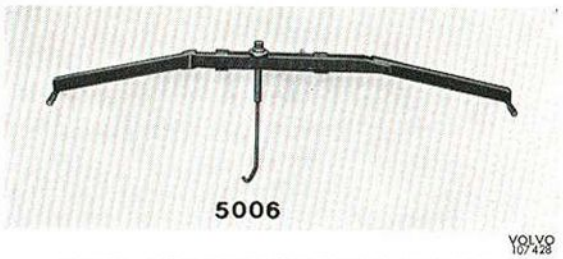

**Fig. 2-2. 2906, fan belt tensioner**




VOLVO 103737

**Fig. 2-3. Tools for removing engine**

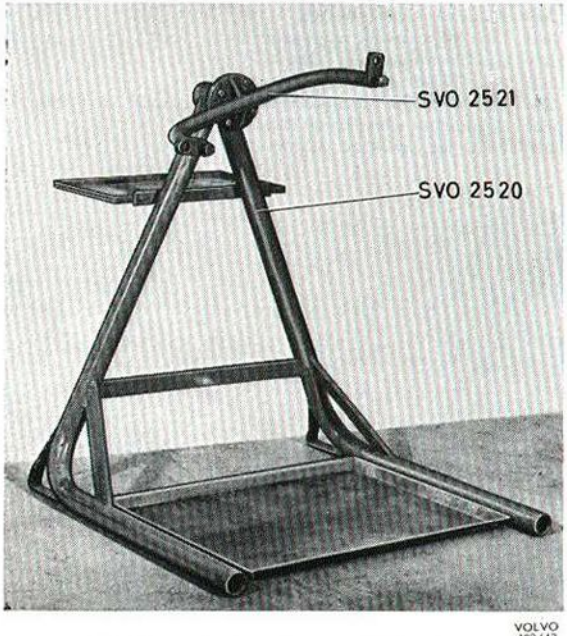
999 (SVO)
2810 Beam for lifting out and installing engine
2869 Lifting lug for attaching lifting beam 2810 in front end of engine
2870 Lifting lug for attaching lifting beam 2810 in rear end of engine
(The previous lifting tool 2425 can also be used for lifting out and installing the engine.)




VOLVO 107428

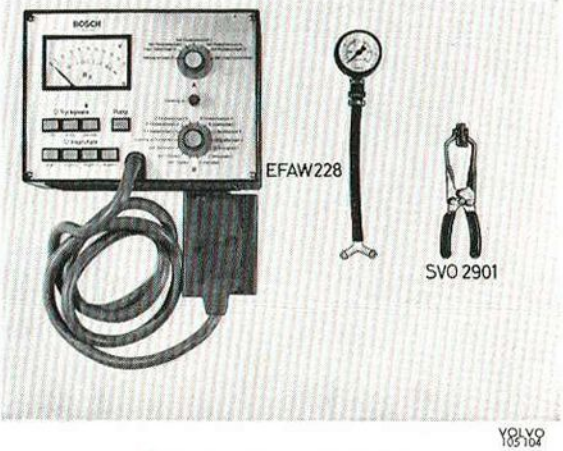
**Fig. 2-5. Lifting tool used when removing oil sump.**

5006 Lifting tool




VOLVO 103643

**Fig. 2-4. Stand 2520 and fixture 2521 for engine**




VOLVO 103104

**Fig. 2-6. Special tools for B 20 E/F**

EFAW 228 Bosch test instrument with pressure gauge
2901 Pinchers, 4 (for pinching fuel lines)

# GENERAL

## DESCRIPTION

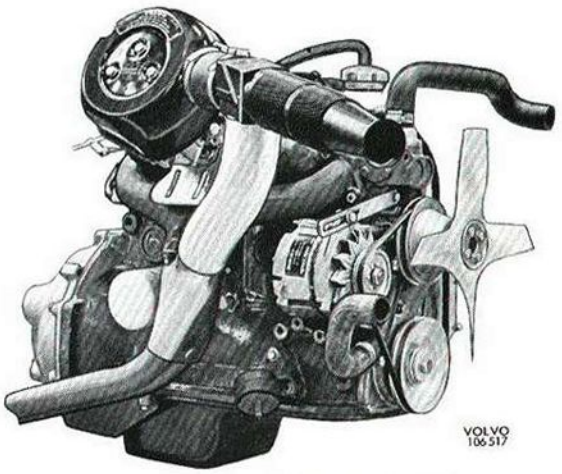



Fig. 2-7. Engine B 20 A viewed from right

The B 20 engine has four type designations: B 20 A (Figs. 2-7 and 2-9), B 20 B (Figs. 2-10 and 2-11) and B 20 E, B 20 F (Figs. 2-12 and 2-13).

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 the different camshafts and compression ratios. The engines have a fuel system with low pollutant exhaust gases.

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

The B 20 E and B 20 F have electronically controlled fuel-injection.

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

Engine output is shown in Figs. 2-8 and 2-14 and specifications.

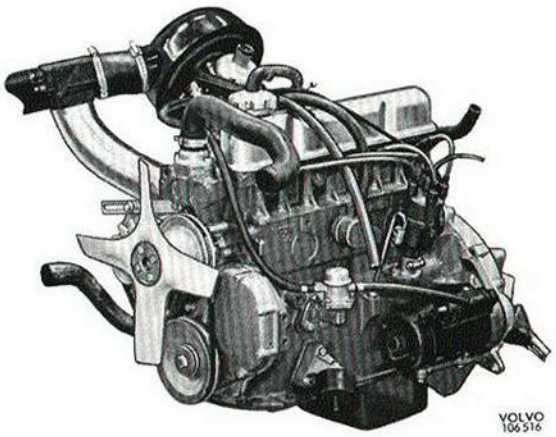



Fig. 2-9. Engine B 20 A viewed from left

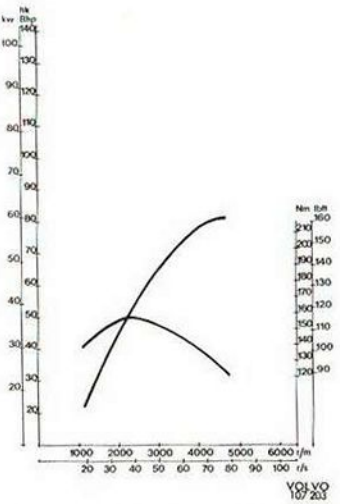



Fig. 2-8. Output and torque curves, B 20 A (DIN)

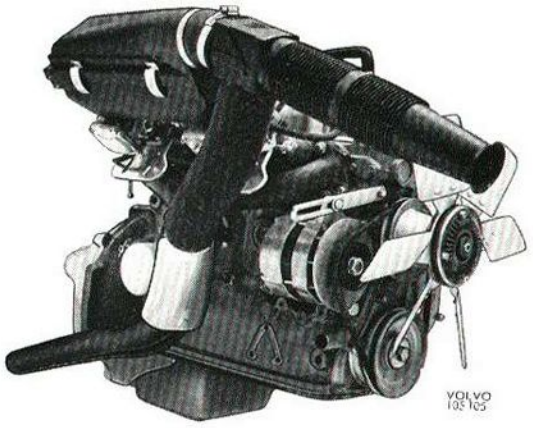



Fig. 2-10. Engine B 20 B viewed from right

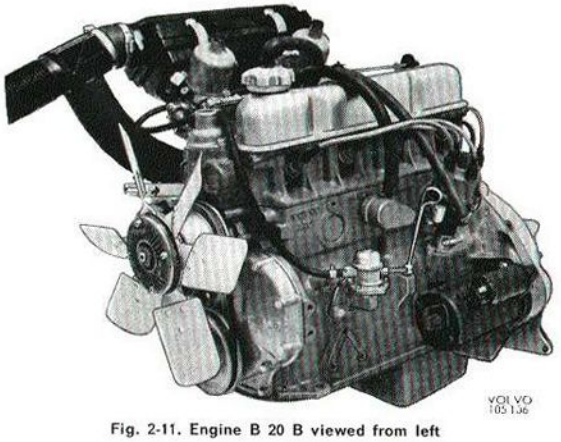



Fig. 2-11. Engine B 20 B viewed from left

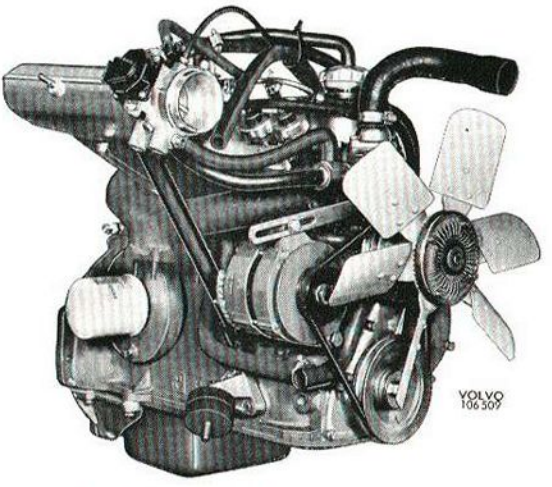



Fig. 2-12. Engine B 20 E (B 20 F) viewed from right

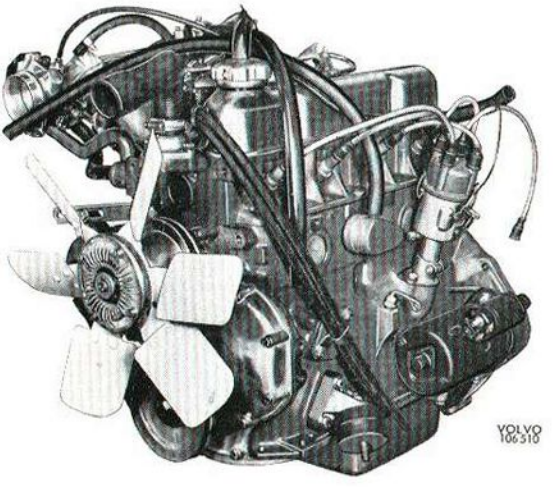
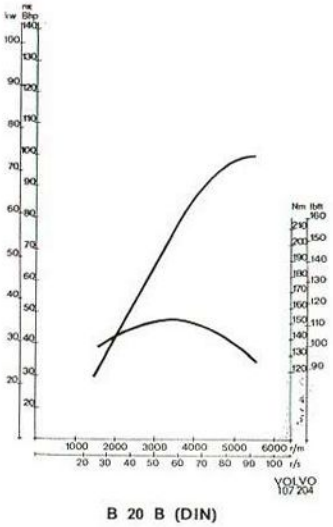
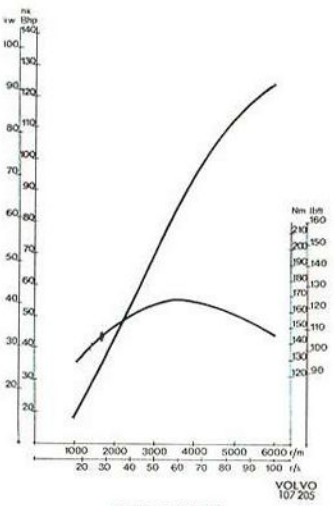


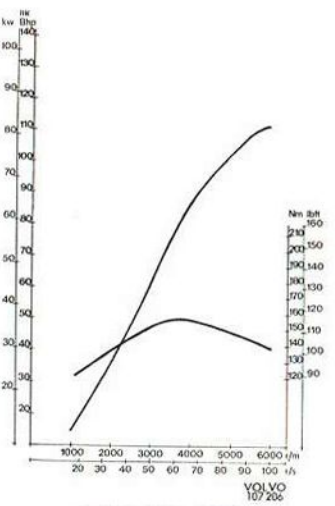

Fig. 2-13. Engine B 20 E (B 20 F) viewed from left




B 20 B (DIN)




B 20 E (DIN)




B 20 F (SAE J 245)

Fig. 2-14. Output and torque curves

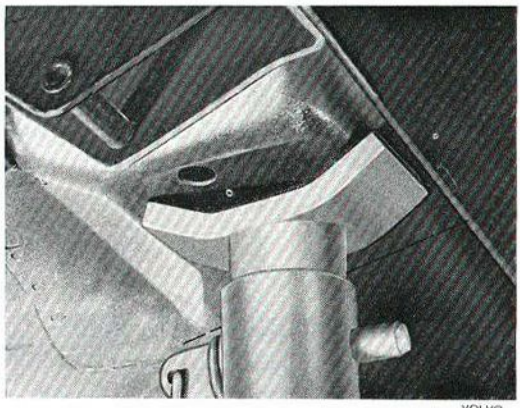


Fig. 2-15. Location of axle prop

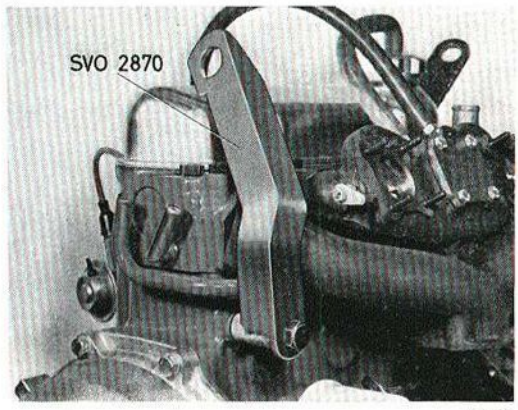



Fig. 2-17. Lifting lug on engine rear end

## REMOVING ENGINE, B 20 A, B 20 B

1. Remove the gear lever.
2. Remove the bonnet (hood) from the hinges.
3. Empty the coolant.
4. Disconnect the positive lead from the battery. 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 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 cables from the alternator and also the temperature and oil pressure tell-tale units.

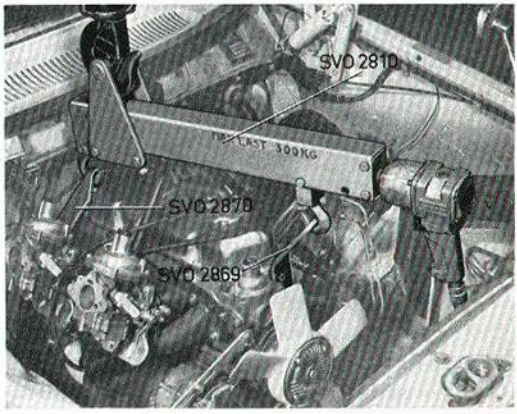



Fig. 2-16. Lifting out engine

Disconnect the electric cable for the back-up lights in the rapid contact. (Remove the electric lead for the overdrive.)

7. Remove the preheating plate and the attaching nuts for the exhaust manifold flange.
8. Remove the throttle cable from the throttle control shaft. Remove the throttle control shaft. Remove the choke wire from the carburetor and the vacuum hose for the brake servo from the manifold. Disconnect the water hoses for the heater element from the engine.
9. 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.
10. Fit lifting arm 2867 to the front end of the engine as shown in Fig. 2-18 and lifting arm 2870 on the engine rear end as shown in Fig. 2-17. Prop up under the vehicle.
11. Drain the engine oil. Remove the lower nuts from the engine front mountings. Fit the engine hoist unit with lifting beam 2810 and move the block runner to the rear end of the lifting beam, see Fig. 2-16. (Use a nut puller for this adjustment.)
12. Remove the return spring and clutch wire from the lever and the clutch wire sleeve from the clutch casing.
13. Disconnect the earth (ground) cable from the engine.
14. Remove the exhaust pipe clamp from the bracket. Remove the gearbox member.
15. Remove the speedometer hose.
    Remove the propeller shaft from the gearbox.
16. Hoist the engine with the lifting unit, lowering at the same time the engine rear end by

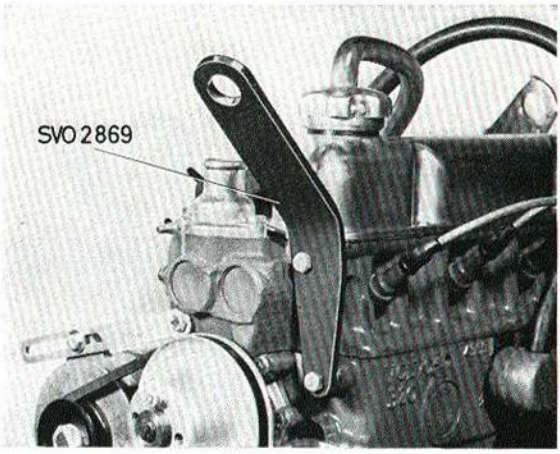



**Fig. 2-18. Lifting lug on engine front end**

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

## INSTALLING ENGINE, B 20 A, B 20 B

1. Fit lifting arm 2869 and arm 2870. Install the engine in position with the help of lifting beam 2810.
   NOTE: Check that the exhaust manifold does not come into contact with the oil filter.
2. Fit the gearbox member.
3. Fit the earth (ground) cable. 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. Fit the return spring. Adjust the clutch according to Part 4 (41).
7. Fit the clamp for the exhaust manifold. 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. Connect the electric cable for the backup light in the rapid contact. (Connect the electronic cable for the overdrive.)
9. Connect the vacuum hose. Fit the throttle control shaft, the throttle cable, 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.
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. Fill with engine oil.
13. Fit the bonnet (hood) and connect the battery lead. Fit the gear lever. Check function and for leakage.

## REMOVING ENGINE, B 20 E, B 20 F

1. Remove the gear lever.
2. Take off the hood (bonnet) from the hinges.
3. Remove the positive lead from the battery.
4. Place a can or similar under the engine and empty the coolant. Take off the filler cap on the expansion tank.
5. Remove the hose for the pressure sensor from the inlet duct, the fuel hose for the cold start valve from the distributor pipe and the fuel hoses from the pipes at the firewall.
6. Remove the plug contacts for the temperature sensor, the cold start valve and the throttle valve switch.
   Remove the hose for the induction air.
7. Remove the electric lead from the temperature sensor and the electric lead for the back-up light in the rapid contact.
   Remove the ground lead from the inlet duct.
8. Remove the bolts for the pressure regulator bracket.
   Remove the injectors and fit them with masking caps and protective plugs in the holes.
   Place the injectors, the distributing pipe and pressure regulator on the container for the washer fluid.
9. Remove the throttle cable from the throttle control shaft. Remove the throttle shaft.
10. Remove the electric leads from the oil pressure sensor and from the alternator.
11. Remove the water hoses for the heater element from the engine.
    Remove the hose from the brake servo unit.
12. Remove the ignition leads from the spark plugs and the distributor cap from the distributor.
    Remove the plug contact and the electric lead from the distributor. Remove the electric lead from the starter motor.
13. Place a collecting can under the radiator.
    Take off the lower radiator hose from the radiator and the upper hose from the the thermostat housing. Remove the cover plate in front

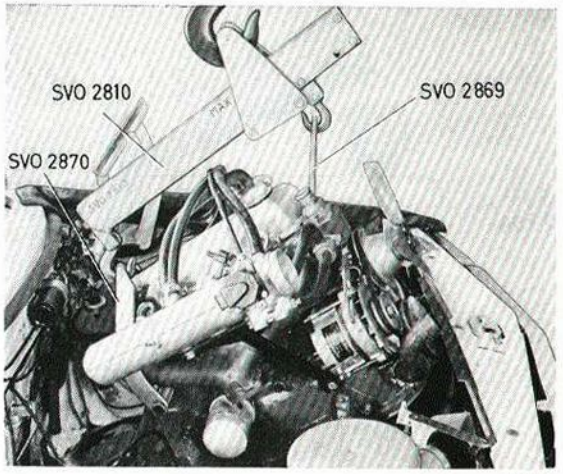



Fig. 2-19. Lifting out engine

of the radiator and take off the radiator. Lift out the expansion tank.

14. Fit lifting arm 2870 in the rear end of the engine (compare Fig. 2-17) and lifting arm 2869 in the front end (compare Fig. 2-18).
15. Prop up under the vehicle. Drain the engine oil.
16. Remove nuts and washers for the front engine mounting.
    Remove the nuts for the exhaust manifold flange.
17. Hook lifting beam 2810 onto the lifting lugs and adjust the block and tackle unit at the rear end. Hoist so that the engine goes up at the rear end (see Fig. 2-19).
18. Remove the ground lead from the engine. Remove the return spring for the clutch and the clutch cable and sleeve.
19. Take off the clamp for the exhaust pipe. Remove the gearbox member.
20. Remove the speedometer cable. Remove the front universal joint.
21. Hoist the engine with the hoist unit and lower the engine's rear end with the block and tackle. Pull the engine forwards over the front member, raise the engine. Level up the engine and gearbox and take out the complete unit.

## INSTALLING ENGINE, B 20 E, B 20 F

1. Fit the lifting arms and lifting beam. Hoist the engine into position in the engine compartment.
2. Fit the universal joint, the speedometer cable and the gearbox member.
3. Remove the engine hoist unit. Fit the exhaust manifold flange with a new gasket.
4. Fit the clamp to the exhaust pipe. Fit the clutch cable, sleeve and return spring. Adjust the clutch play according to Part 4 (41).
5. Connect the ground lead. Fit washer and nuts for the front engine mounting.
   Lower the vehicle. Remove the lifting lugs.
6. Fit the radiator, expansion tank and upper and lower radiator hoses.
   Fit the cover plate in front of the radiator.
7. Connect the electric leads for the starter motor and the plug contact and electric lead to the distributor.
   Fit the distributor cap and leads.
8. Connect the hose to the brake servo and the hoses for the heater element.
9. Connect the electric leads for the oil pressure sensor and alternator.
   Fit the throttle control shaft. Fit the throttle cable.
10. Remove the protective plugs and masking hats. Place new rubber seals on the injectors.
    Fit the injectors and distributor pipe. Fit the pressure regulator.
11. Connect the electric leads for the temperature sensor, back-up lights and ground lead to the inlet duct.
12. Fit the plug contacts for the temperature sensor, cold start valve and throttle valve switch. Connect the hose for the induced air.
13. Fit the fuel hoses and the hose for the pressure sensor.
    Connect the battery lead. Fill with engine oil and coolant.
14. Fit the engine hood (bonnet).
15. Fit the gear lever.

## REPLACING SUMP GASKET

1. Place the lifting tool 5006 shown in Fig. 2-20 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. Lift up the vehicle by propping up under the front jacking points. Drain off the engine oil.
3. Remove the lower nuts for the engine mountings. Remove the steering rods from the pitman arm and relay arm with tool 2294 according to Fig. 2-21.
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

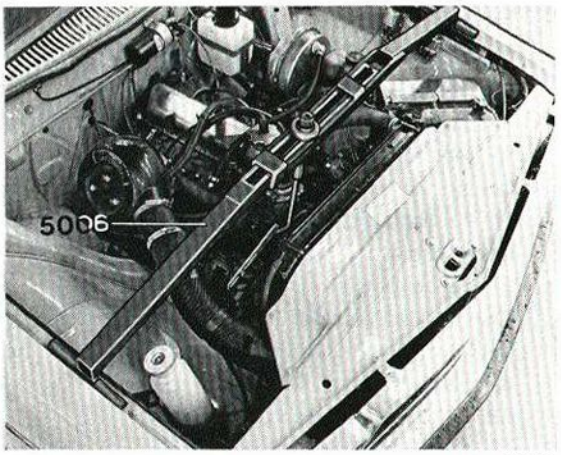



Fig. 2-20. Lifting tool 5006

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 the cylinder block and sump.
8. Place the sump and gasket in position and fit the bolts. Tighten well the drain plug as well as the plug for the oil temperature gauge.

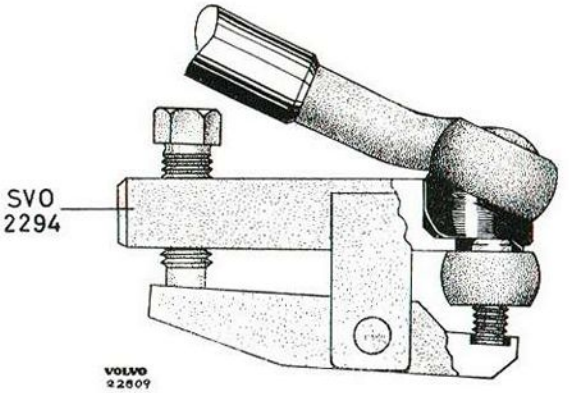



Fig. 2-21. Removing steering rod

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, fit and tighten the rear bolts.
11. Fit the nuts for the engine mountings as well as the steering rods.
12. Remove the blocks from under the vehicle. Take off the lifting tool. Fit the bolt (with washer) for the timing gear casing.
13. Top up with oil and insert the oil dipstick.
14. Start the engine and check for leakage.

# ENGINE
## DESCRIPTION

### 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, which is of the full-flow type, is directly attached to the right-hand side of the block. A reinforcing bracket is mounted to the cylinder block and timing gear casing for taking up vibrations, see Fig. 2-22.

### CYLINDER HEAD AND VALVES

The cylinder head 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, 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. 2-34.) 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 their having 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 of which 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 VALVET 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 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, 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 bush which acts as a bearing for the gudgeon 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 compression ring is chromed in order to reduce cylinder wear.

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

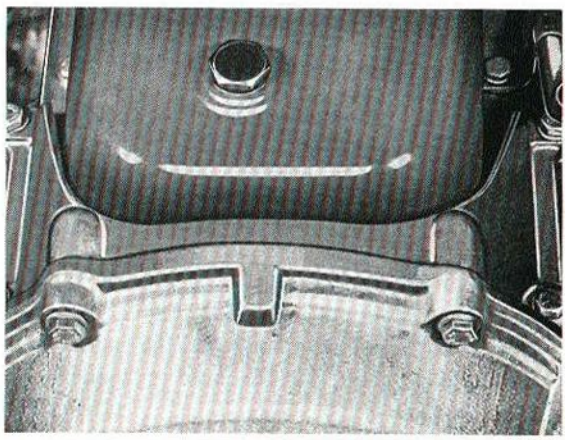



Fig. 2-22. Reinforcing bracket, cylinder block—flywheel housing

## 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 rocker arm casing and the intake manifold there is a hose (4, Fig. 2-23). It is connected to the intake manifold by means of 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 guard (5), which consists of a metal filter. The partial vacuum which arises in the intake manifold when the engine is running, brings about a partial vacuum in the rocker arm casing 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, 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 trap 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.

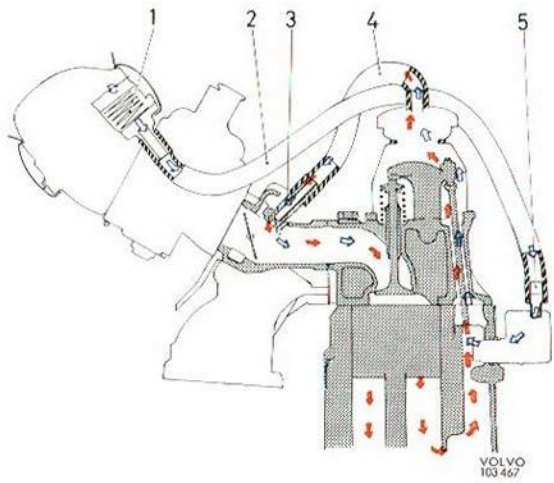



**Fig. 2-23. Positive crankcase ventilation**

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

# REPAIR INSTRUCTIONS

## DISASSEMBLING ENGINE

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

1. Place the engine on stand 2520 with fixture 2521 (see Fig. 2-24). 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 and then remove the clutch and flywheel.
3. Remove the rear flange, taking care not to damage the contact surfaces, thereafter the alternator, water pump and distributor, the rocker casing, rocker arms, the manifold, cylinder head and oil filter.
   Remove the valve tappets with tool 2424, see Fig. 2-25.
4. Remove the timing gear casing and the timing gears. Concerning tools, see under the heading "Replacing the 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. 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 destroyed by caustic soda so that they should preferably be cleaned with white spirit.

Pistons and bearing shells must never be washed in

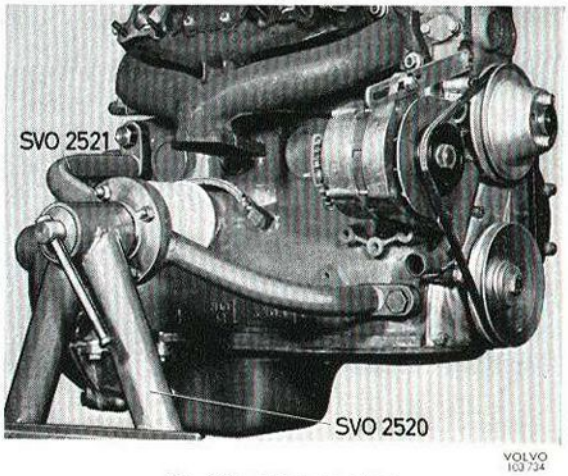



Fig. 2-24. Engine on stand

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. 2-26. The main bearings are marked 1—5, and the big-end bearings 1—4, counting from the front.

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.

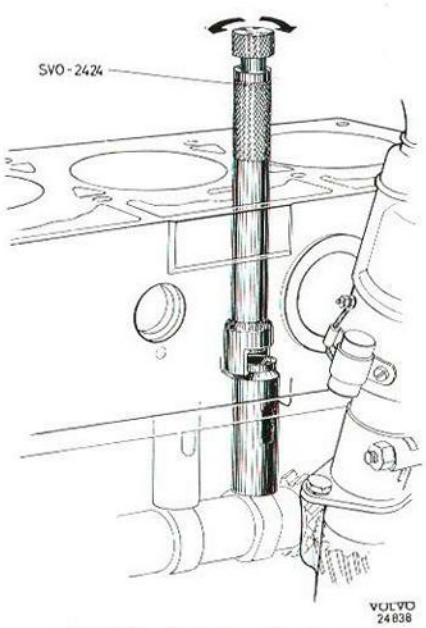



Fig. 2-25. Removing valve tappets

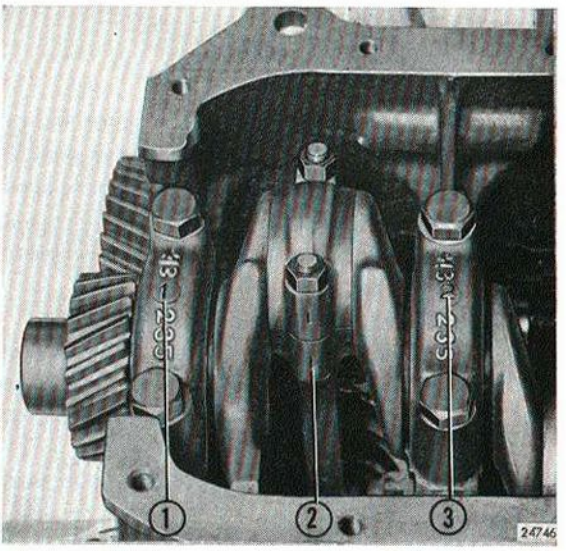



Fig. 2-26. Marking main and big-end bearings
1. Main bearing No. 1 2. Big-end bearing No. 1
3. Main bearing No. 2

The seals on the ends of both the oil pump delivery pipe and the water pump pipes are in the form of 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 soap solution. The rings are fitted 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 casing and rear sealing flange must be accurately centered when fitting. See under the headings "Replacing timing gear casing" and "Fitting rear sealing flange".

The big-end bearing bolts and nuts should be replaced with new ones when reconditioning.

The reinforcing bracket on the flywheel housing is fitted according to point 9 under "Replacing sump gasket" (page 2:7).

The cylinder head is fitted 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. 2-29) for lubricating the rocker arms is clear. The pilot bearing (5, Fig. 2-27) should be lubricated before fitting 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

1. Drain off 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 the 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 the rocker casing, rocker arm shaft and push rods.
6. Remove the cylinder head bolts and disconnect the water pipe as well as the attachement on the rear exhaust manifold. Loosen the alternator tensioner arm. Lift off the cylinder head.
7. Clean the piston crown, 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 the heading "Cylinder head and valves".
9. Fit 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. 2-30. Install a new cylinder head gasket with the "TOP" upwards (wide edge). Install new sealing rings for the water pump and fit the cylinder head. Screw out the guide pins and fit the bolts in these holes as well. For tightening sequence, see Fig. 2-28. Tightening should be in three stages: 1 st stage 40 Nm (29 lb ft); 2nd stage 80 Nm (58 lb ft); 3rd stage: after running the engine, see point 10. Fit the other parts. Fill up with coolant according to the instructions given under "Filling with coolant when the system has been emptied".
10. Adjust the valve clearance for B 20 A 0.45—0.50 mm (0.018—0.020") and for B 20 B 0.55—0.60 mm (0.022—0.024"). (Not final clearance.) Run the engine for 10 minutes. Final-tighten the cylinder head bolts to 90 Nm (65 lb ft) with tool 2889. **Final-adjust** valve clearance to value given in "Specifications".

## B 20 E, B 20 F

1. Drain off the coolant from the radiator and cylinder block by unscrewing the plug on the right-hand side of the engine and, if necessary, disconnect the lower radiator hose.
2. Remove the positive lead from the battery.
3. Remove the hoses for the pressure sensor, brake servo, crankcase ventilation and ignition distributor. Place the upper hoses on left wheel housing.
4. Remove the electric cables from the throttle valve, cold start valve, temperature sensors for coolant and from the injectors.
   Remove the ground cable from the inlet duct and take out the cable harness.

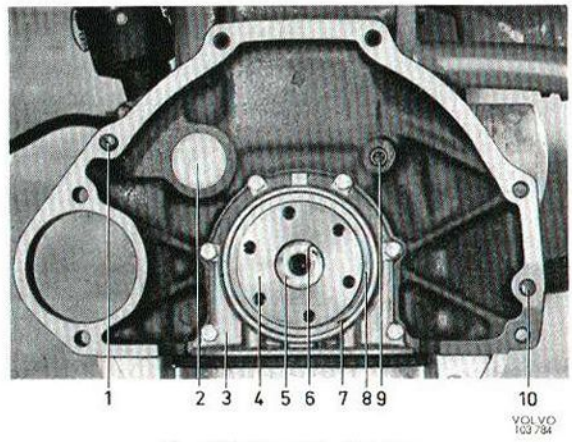



Fig. 2-27. Rear end of engine

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

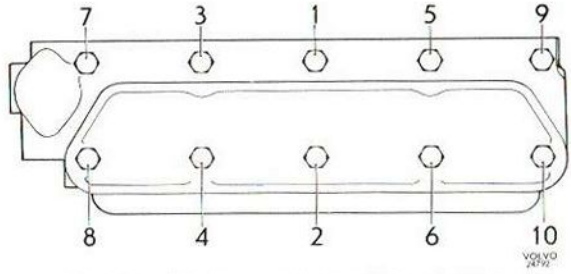



Fig. 2-28. Tightening sequence for cylinder head bolts

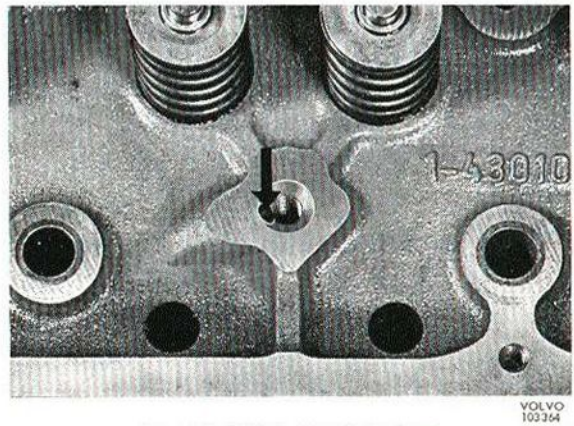



Fig. 2-29. Oil hole in cylinder head

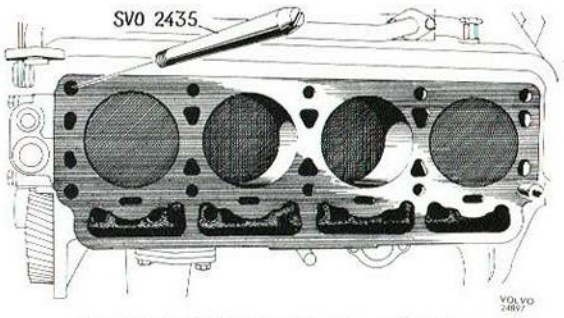



Fig. 2-30. Guide pins for fitting the cylinder head

5. Remove the electric cable from the temperature sensor for the coolant thermometer.
6. Remove the hose for the induction air.
7. Remove the lock pin and bracket for the throttle cable.
8. Pinch the hose from the fuel tank to the distributing pipe and the return line from the pressure regulator. Use pinchers 2901.
9. Remove the hose from the distributing pipe.
10. Remove the heating hose and the upper radiator hose.
11. Remove the alternator tension bar from the cylinder head.
12. Unscrew the bolts for the inlet duct stay.
13. Remove the inlet duct nuts.
14. Remove the clamp for the water pipe.
15. Remove the ignition leads and spark plugs.
16. Remove the rocker arm cover, the 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 the piston crown, 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 the heading "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. 2-30. Install a new cylinder head gasket with the "TOP" upwards (wide edge). Install a new inlet duct gasket and new sealing rings for the water pump. Fit the cylinder head. Screw out the guide pins and fit 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. Fit push rods and rocker arm shaft. Adjust the valves to 0.45—0.50 mm (0.018—0.020"). (Not final clearance.)
21. Fit the rocker arm cover, the spark plugs and the ignition leads.
22. Fit the clamp for the water pipe.
23. Fit and tighten the inlet duct nuts and bolts.
24. Fit the bolts for the inlet duct stay. Fit the alternator tension bar and adjust the fan belt.
25. Connect the upper radiator hose and the hose for the heating system.
26. Connect the fuel hoses and remove the pinchers.
27. Fit the bracket and lock pin for the throttle cable.
28. Fit the hose for the induction air.
29. Connect the electric cable to the sensor for the temperature gauge and the ground cable to the inlet duct.
30. Place the cable harness in position in the inlet duct mounting.
31. Fit the electric cables for the throttle switch, cold start valve, injectors and temperature sensor for coolant.
32. Connect the hose for the pressure sensor, brake servo, crankcase ventilation and ignition distributor. Re-fit the battery lead.
33. Fill with coolant and check function and for leakage.
34. Run the engine for 10 minutes. Final-tighten the cylinder head bolts to 90 Nm (65 lb ft) with tool 2898. **Final-adjust** valve clearance to value given in "Specifications".

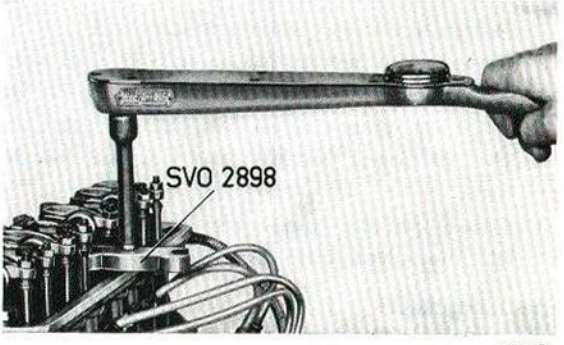



Fig. 2-31. Re-tightening cylinder head bolts

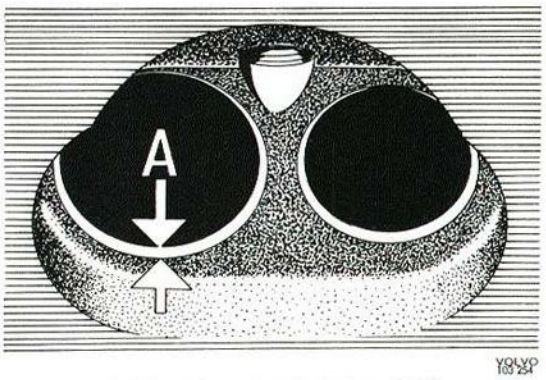



Fig. 2-32. Valve seat width A=2 mm (0.08")

## 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. With a new valve the clearance should not exceed 0.15 mm (0.006"). Also check that the valves are not excessively worn. See the "Specifications" under the headings "Valve system" and "Wear tolerances".

### CLEANING

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


Fig. 2-33. Replacing valve guides
A=17.5 mm (0.689") (For B 20 E/F, 17.9 mm=0.705")

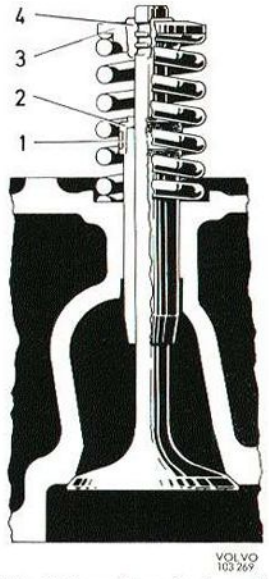



Fig. 2-34. Valve collet and valve guide seal

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

### GRINDING VALVES AND VALVES SEATS

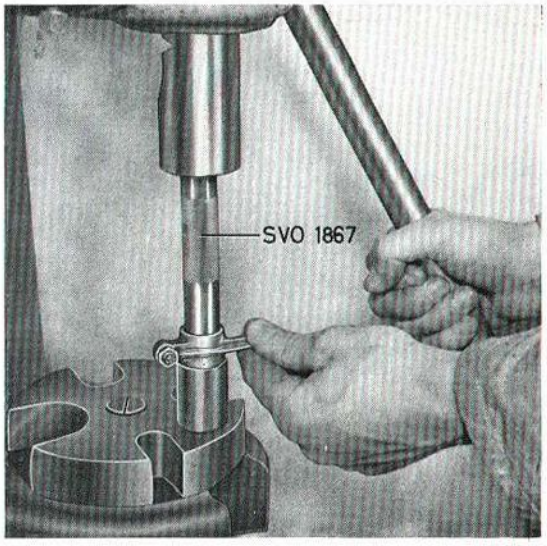
1. Grind the valves in a machine after they have been cleaned. Fit new valves if the old ones are excessively worn.
2. Grind the valve seats. Use an electrically driven grinder or a hand milling cutter. A pilot spindle must be carefully fitted before work is started and any worn guides must be replaced 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 should be approx. 2.0 mm (0.08"), see "A" Fig. 2-32. 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 VALVE GUIDES

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. 2-23. For the B 20 E/F engine a 0.4 mm (0.016") thick washer is placed between the tool and cylinder head.
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 main-




VOLVO
24843

Fig. 2-35. Replacing bush in rocker arm

tain the values given in the "Specifications".

2. Place the valves in position. Fit the valve guide seal, valve spring, upper washer and collet.

### REPLACING 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 1867 for pressing the bush out and in, see Fig. 2-35. Then ream the bush to an accurate fit on the shaft using a suitable reamer. The hole in the bush should coincide with the hole in the rocker arm.
2. If necessary grind the pressure surface against the valve in a special machine.

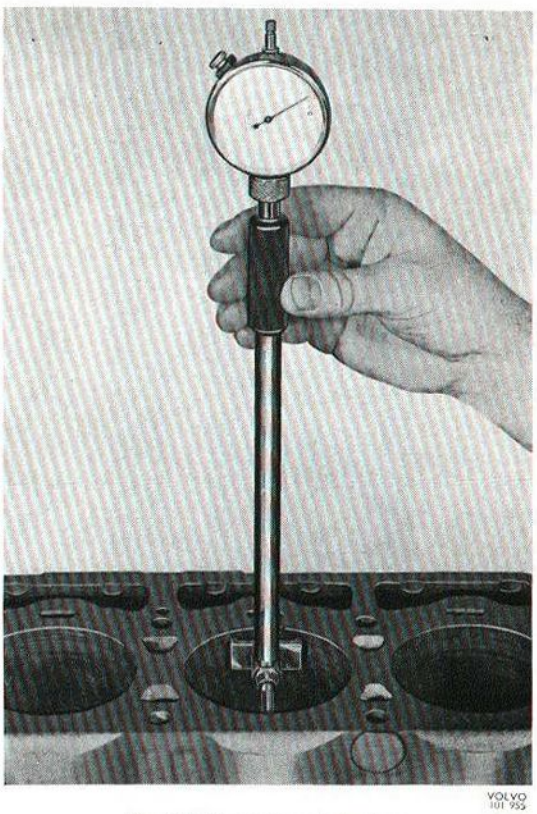
### INSTALLING CYLINDER HEAD

See under "Valve grinding and decarbonizing".

### ADJUSTING VALVE CLEARANCE

The valves clearance can be adjusted satisfactorily with the engine stationary, irrespective of whether or not it is cold or warm. The clearance is the same for both the inlet and exhaust valve. When adjusting, use two feeler gauges, one "Go" 0.40 mm (0.016″) thick and the other "No-Go" 0.45 mm (0.018″) thick for the B 20 A, E and F (0.50 and 0.55 mm = 0.020—0.022″ 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.

When the piston in No. 1 cylinder is at top dead centre (the compression stroke), adjust valves Nos. 1. 2. 3 and 5 (counted from the front), and with the piston in No. 4 cylinder at top dead centre, valves Nos. 4, 6, 7 and 8.



VOLVO
101 955

Fig. 2-36. Measuring cylinder bore

## CYLINDER BLOCK

### MEASURING CYLINDER BORES

The cylinder bores are measured with a special dial indicator as shown in Fig. 2-36. Measuring should be carried out 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 (only on standard models).

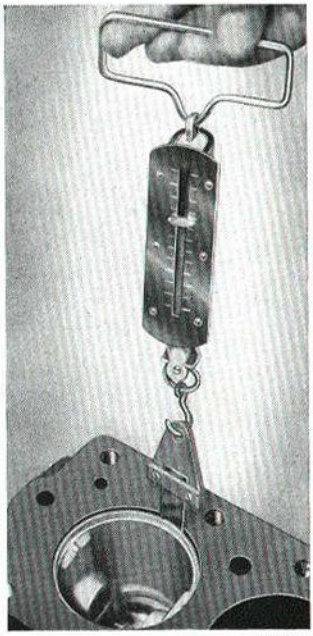
## PISTONS, PISTON RINGS AND GUDGEON PINS

### Measuring pistons

The pistons are measured with a micrometer at right angles to the gudgeon pin hole 12 mm (0.47″) from the lower edge on the piston marked 71/14 on the crown face.

### Fit of pistons in cylinders

The fit of the pistons in their respective cylinders is tested with the piston rings not fitted. The clearance at right angles to the gudgeon pin hole is



VOLVO 22785

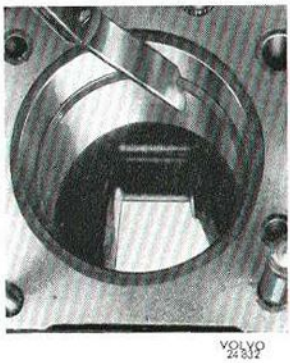
Fig. 2-37. Measuring piston clearance

measured with a feeler gauge 1/2″ wide and 0.04 mm (0.0016″) (For B 20 E and B 20 F: 0.05 mm [0.0020″]) 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. The test is carried out at several different depths. See Fig. 2-37. 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

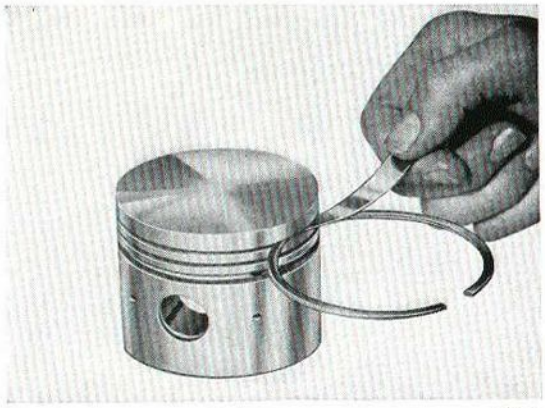
### IN A NEW OR RE-BORED CYLINDER

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, see Fig. 2-38. 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 by rolling them in their respective grooves. Also measure the clearance at a few points. See "Specifications" for measurements.



VOLVO 24 632

Fig. 2-38. Measuring piston ring gap



VOLVO 103 694

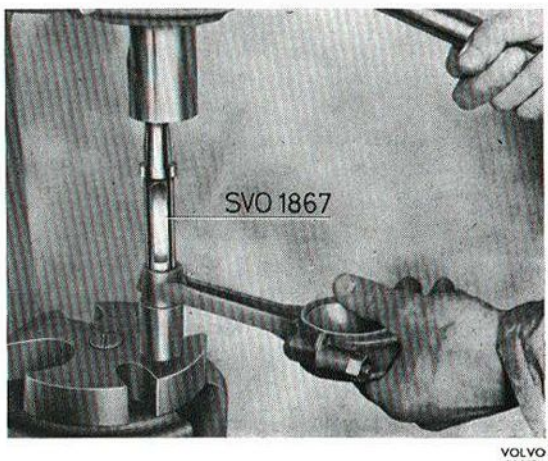
Fig. 2-39. Piston ring clearance in groove

### IN A WORN CYLINDER BORE

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

## 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




VOLVO 24 663

Fig. 2-40. Replacing bush in connecting rod

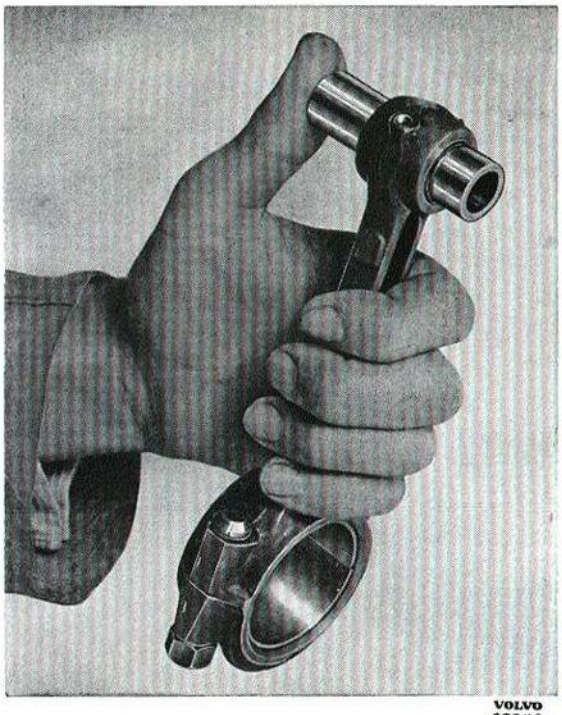



Fig. 2-41. Gudgeon pin fit

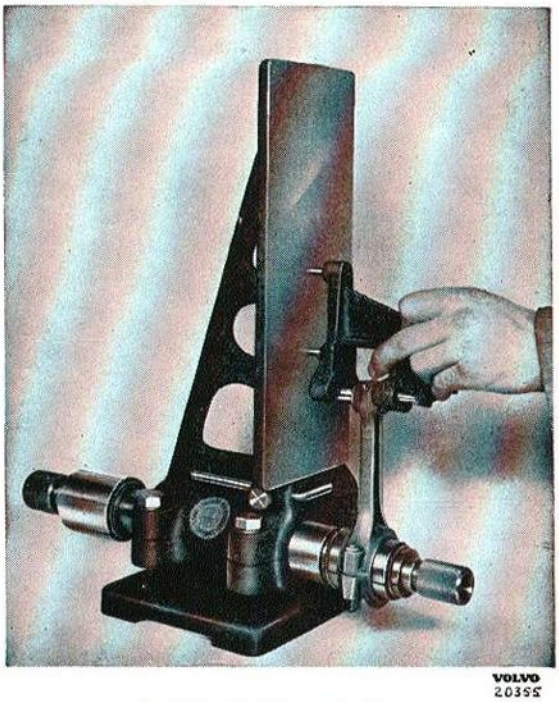



Fig. 2-42. Checking connecting rod

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 bushes

If the old bush in a connecting rod is worn, press it out by using drift 1867 and press in a new bush 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 bush to the correct fit. The gudgeon pin should slide through the hole under light thumb pressure but without any noticeable looseness, see Fig. 2-41.

### Straightening

Before being fitted, the connecting rod should be checked for straightness, twist and any S-distortion. Straighten if necessary, see Fig. 2-42. Nuts and bolts should be replaced with new ones when reconditioning is being carried out.

### 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 points forwards, see Fig. 2-43. 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 gudgeon pins are then fitted, the circlips placed in position and the piston rings installed.

Use piston ring pliers for fitting 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 bearings surfaces.

Use installation ring 2823, see Fig. 2-44, when fitting the piston and a torque wrench, see "Specifications" for the correct tightening torque.

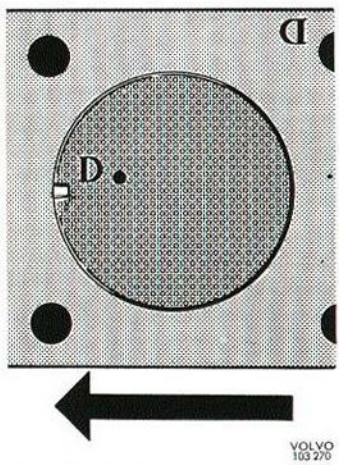



Fig. 2-43. Marking on piston and block

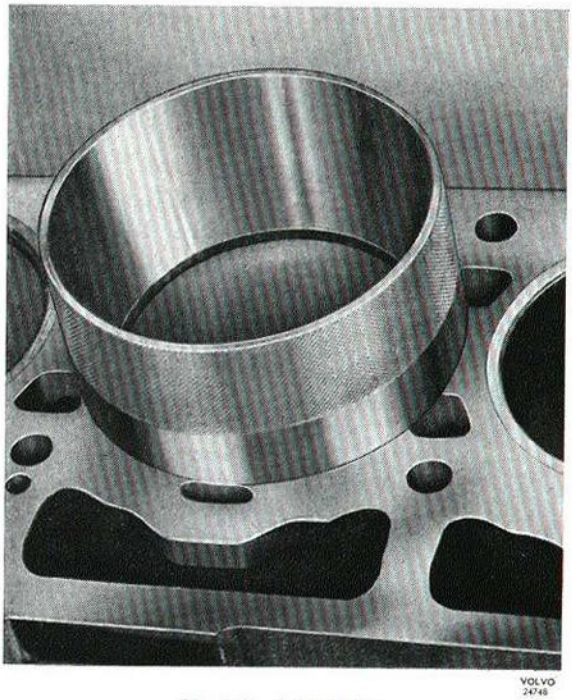


Fig. 2-44. Fitting piston
Installation ring 2823

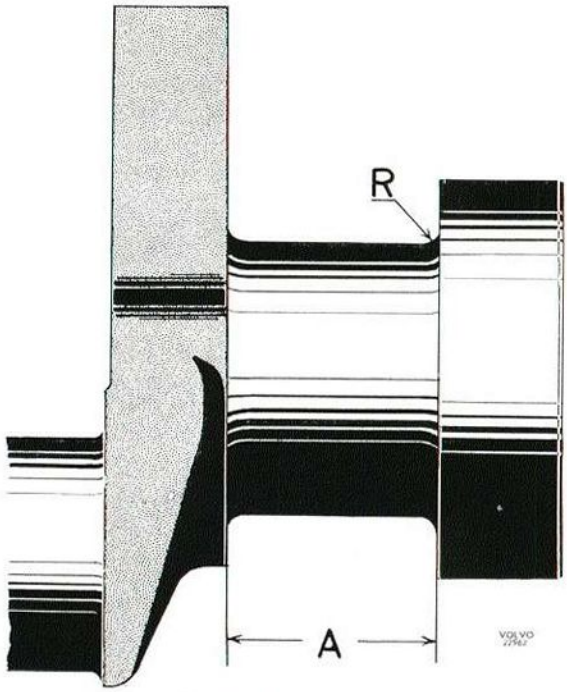



Fig. 2-45. Bearing journal

## CRANKSHAFT

After the crankshaft has been cleaned, its journals must be measured with a micrometer. Measuring 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 2 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 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 journal should have a radius of 2.0—2.5 mm (0.080—0.100″) on all journals, see Fig. 2-45. 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 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 closer bearing fit.

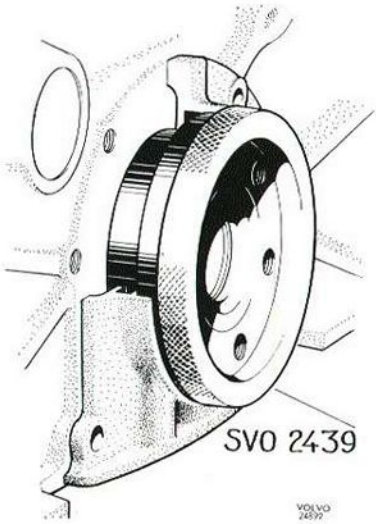



Fig. 2-46. Centering rear sealing flange

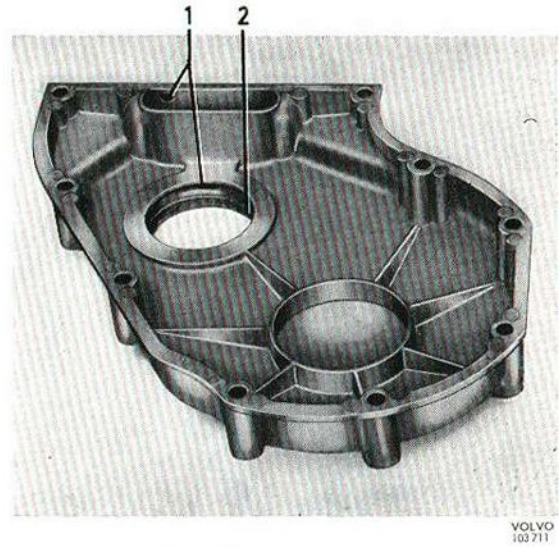



Fig. 2-47. Timing gear casing
1. Drain holes 2. Sealing ring

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

## INSTALLING REAR SEALING 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 fitting of the sump gasket. The sealing ring must not be fitted in the flange.
2. Fit on the sealing flange but do not tighten the bolts.
3. Center the flange with sleeve 2439, Fig. 2-46. 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. Fit 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.

## 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 0.75 mm (0.03″) of the original thickness must be ground off.

## PILOT BEARING FOR INPUT SHAFT

The pilot bearing circlip and protecting washer are removed, the pilot bearing pulled out with tool 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 bearings are fitted with drift 1426, after which the protecting washer and circlip are fitted.

## REPLACING OIL SEAL IN TIMING GEAR CASING

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 casing is correctly fitted by inserting a 0.10 mm (0.004″) feeler gauge in the gap between the casing and hub on the crankshaft and moving it all round. If the feeler gauge jams at any point, the casing should be centered, see under "Replacing timing gear casing".
4. Fit a new felt ring. Place the washer in position and fit the circlip. Check that the circlip fits properly in position.
5. Fit the remaining parts and tension the fan belt.

## REPLACING TIMING GEAR CASING

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.

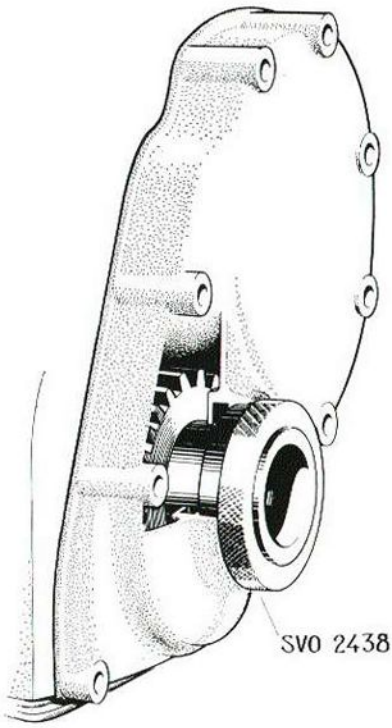



Fig. 2-48. Centering timing gear casing

3. Remove the timing gear casing. Slacken a couple of extra bolts for the sump and be careful not to damage the gasket. Remove the circlip, washer and felt ring from the casing.
4. Make sure that the gaskets are in good condition and that the drain hole is open and clean inside the timing gear casing which is to be fitted, see Fig. 2-47.
5. Place the casing in position and fit the bolts without tightening them.
6. Center the casing with sleeve 2438, see Fig. 2.47. Turn the sleeve while tightening and adjust the position of the casing so that the sleeve is not jammed. Check after final tightening of the casing that the sleeve can be easily rotated without jamming.
7. Fit 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. Fit the other parts and tension the fan belt. See "Specifications" for the tightening torque. Fix the stabilizer attachments firmly to the frame.

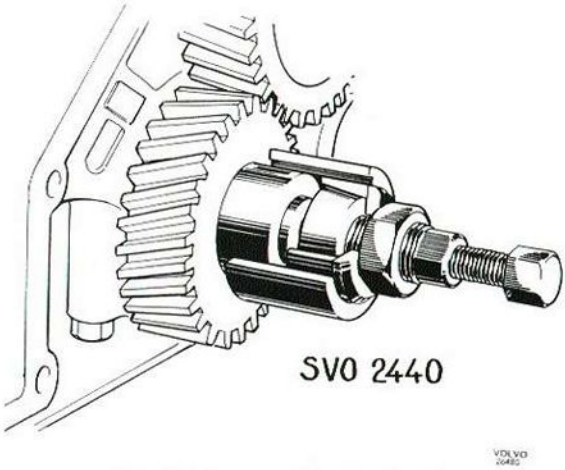



Fig. 2-49. Removing hub on crankshaft

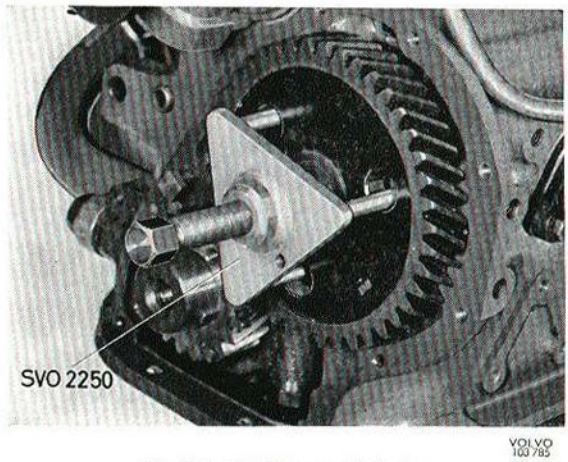
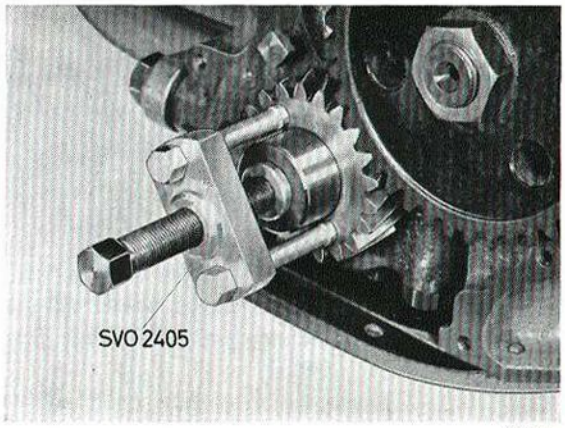



Fig. 2-50. Removing camshaft gear

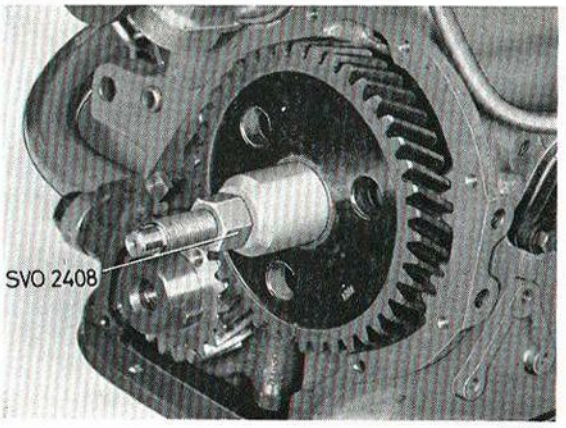
## REPLACING TIMING GEARS

1. Drain off the coolant and remove the cover plate and radiator.
2. Carry out operations 1—3 in previous section.
3. Remove the hub from the crankshaft with puller 2440. See Fig. 2—49.
   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.
   Then fit 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. 2-50.
5. Pull off the crankshaft gear by using puller 2405, Fig. 2-51. Screw out the oil nozzle, blow it clean and then re-fit it as shown in Fig. 2-54. The gears are lubricated by oil fed through this nozzle.
6. Fit the crankshaft gear by using tool 2407 and the camshaft gear by using 2408, see Figs. 2-52 and 2-53. Fit the hub on the crankshaft. Do not push the camshaft backwards so that the seal washer on the rear end loosens.




VOLVO 103 786

Fig. 2-51. Removing crankshaft gear



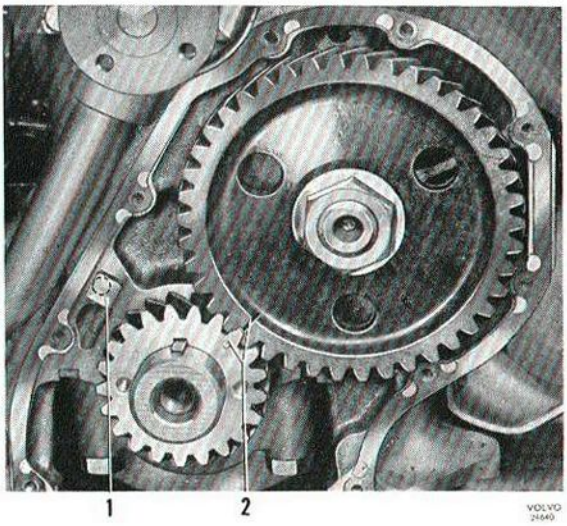

VOLVO 103 788

Fig. 2-53. Fitting camshaft gear

Check that gears are in the correct position relative to each other, as shown in Fig. 2-54. Tool 2407 has a socket intended for turning the crankshaft.

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

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




VOLVO 24640

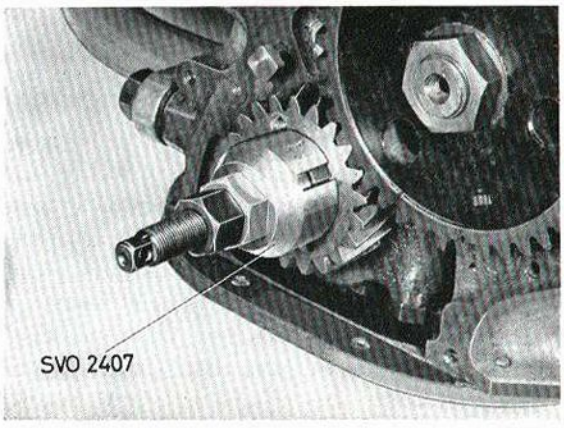
Fig. 2-54. Marking on timing gears
1. Oil nozzle 2. Markings

## POSITIVE CRANKCASE VENTILATION

### OVERHAUL

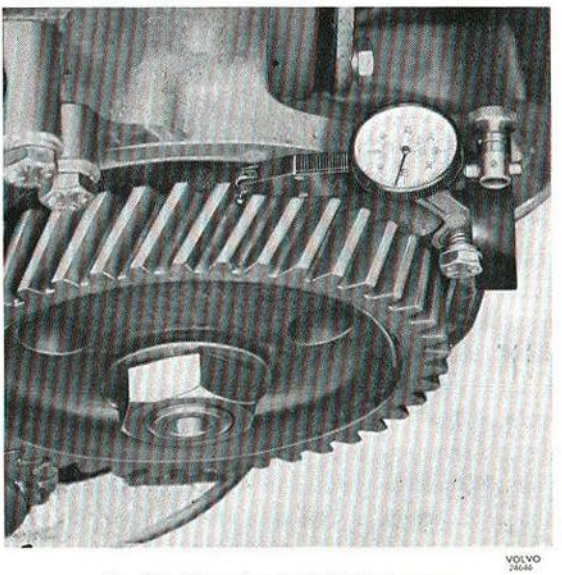
At intervals of 40 000 km (24 000 miles) unscrew and clean the nipple (3, Fig. 2-23) and flame guard (5). Check the hoses at the same time. Replace any that are in a poor condition.

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




VOLVO 103 787

Fig. 2-52. Fitting crankshaft gear



VOLVO 24646

Fig. 2-55. Measuring tooth flank clearance

# LUBRICATING SYSTEM

## DESCRIPTION

The engine has a force-feed lubricating system, see Fig. 2-56. 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 oil-ways out to the various lubricating points. All the oil supplied to the lubricating points, therefore, first passes through the oil filter.

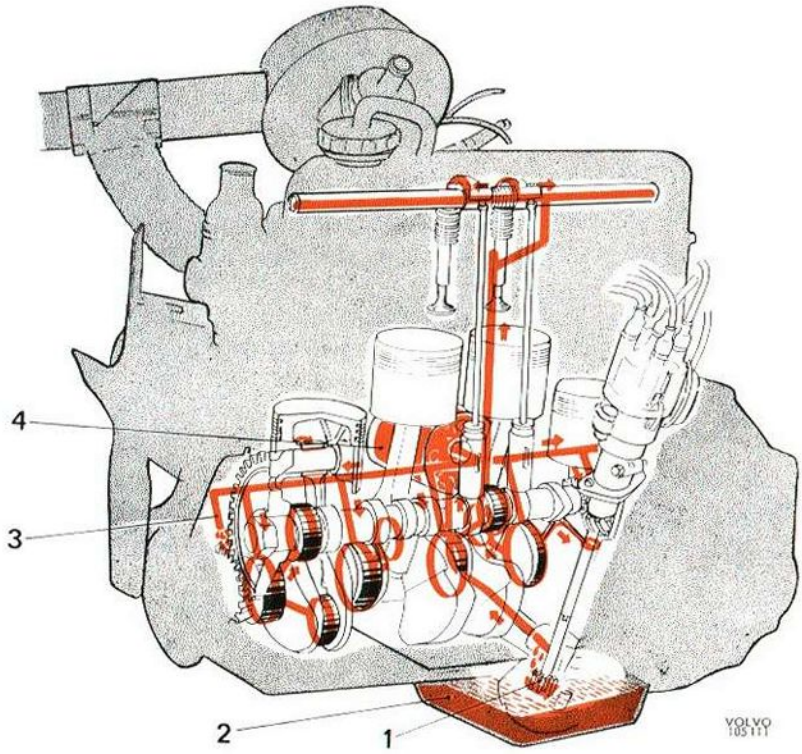



**Fig. 2-56. Lubricating system**
1. Oil pump
2. Sump
3. Nozzle
4. Oil filter

### OIL PUMP, RELIEF VALVE

The oil pump, see Fig. 2-57, 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. 2-58), which is manufactured as a single unit complete with element, is of the full-flow type and is screwed directly onto 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.

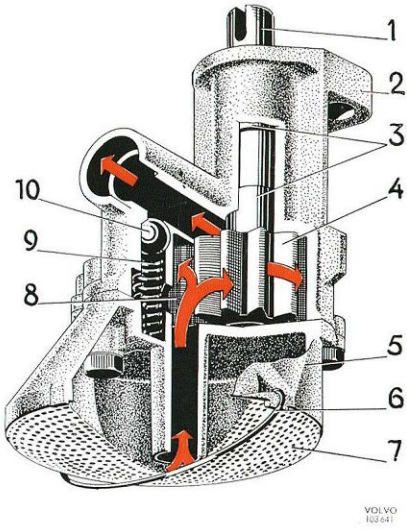



**Fig. 2-57. Oil pump**

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

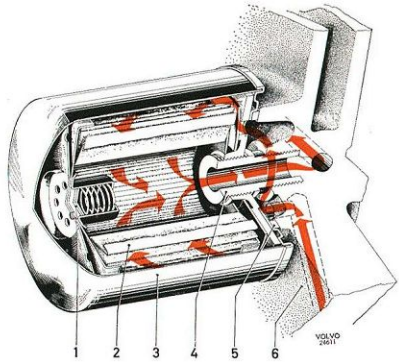



**Fig. 2-58. Oil filter**

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

## OIL COOLER

The B 20 E (for the E.E.C. market also B 20 F) is fitted with an oil cooler.

The oil cooler (Fig. 2-59) is fitted between the oil filter and the cylinder block and consists of an inner section for the oil which is surrounded by a cooling jacket. The engine coolant is led through the cooling jacket. On its way to the oil filter, the oil passes through the cooler and some of the heat in the oil is conducted away by the coolant. The coolant cannot take the shortest path from the inlet (1) to the outlet (3), but is forced by rubber seals (4) to take a zig-zag course and round the cooler, as indicated in Fig. 2-59 by the blue arrows. The discs (2) are cooled by the coolant and are divided by a plate into two compartments, which are linked at the disc periphery. Oil enters the first compartment, nearest the engine block (see red arrows), and is forced the length of the discs (2) into the other compartment and then along its discs, and thereafter into the oil filter.

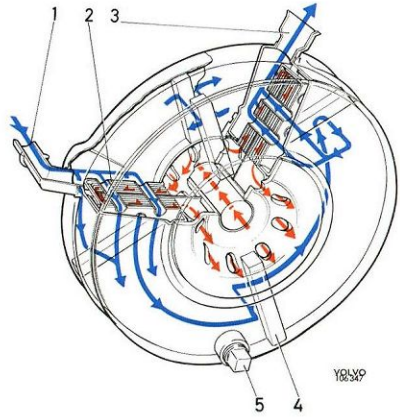



**Fig. 2-59. Oil cooler**

1. Coolant inlet
2. Discs
3. Cooling outlet
4. Rubber real
5. Coolant drain plug


**Fig. 2-60. Removing oil filter**
1. Gasket (oiled) 2. Filter

## REPLACING OIL FILTER

Together with the element and relief valve, the oil filter (see Fig. 2-58) 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. With a new or reconditioned engine, the filter should also be changed the first time after 5 000 km (3 000 miles).

1. Remove the old filter with the help of chain tongs, see Fig. 2-60.
2. Coat the rubber gasket (1, Fig. 2-61) 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. 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.

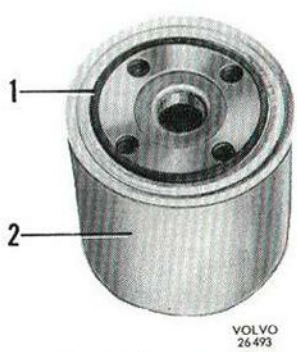



**Fig. 2-61. Oil filter ready for fitting**

## REPLACING OIL COOLER

1. Drain off the engine coolant by removing the plug in the oil cooler.
2. Disconnect the coolant connection on the oil cooler. Remove the oil filter.
3. Unscrew the nut on the nipple for the oil cooler, and pull off the cooler.
4. Fit the oil cooler with a new rubber ring to the connection against the engine block. The O-ring against the cylinder block should be replaced. The new O-ring should be inserted into the groove on the oil cooler before re-fitting. Coat the groove with a thin layer of adhesive for example, Pliobond 20, which is resistant to oil up to temperatures of 140°C (280°F). With the nut tigtened to a torque of 10 Nm (7 lb ft), check that the cooler is in good contact with the cylinder block all round. The nut is finally tightened to a torque of 30—35 Nm (23—25 lb ft).
5. Fit the oil filter and connect the coolant pipe.
6. Fill up with coolant and, if necessary, also with engine oil.
7. Start the engine and check for leakage.

If the nipple for the cooler has been replaced, the new one should be tightened to a torque of 45—55 Nm (33—40 lb ft).

## OIL PUMP AND RELIEF VALVE

After the pump has been disassembled and cleaned, check that all the parts are in good condition. Test the relief valve spring (2, Fig. 2-62), see "Specifications" for the values concerned.

Check that the tooth flank clearance is 0.15—0.35 mm (0.006—0.014″), see Fig. 2-64.

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. 2-65. Use only

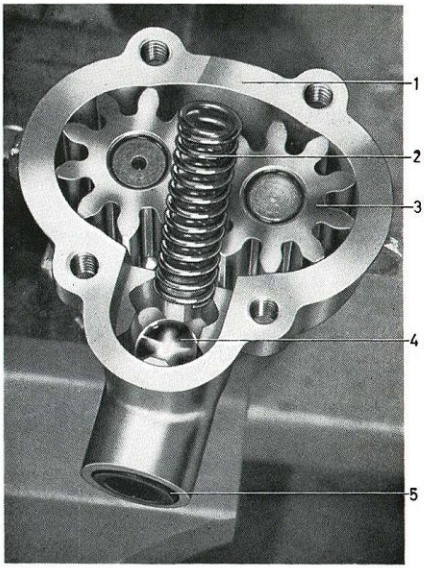



Fig. 2-62. Oil pump

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

genuine Volvo 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 being fitted, the rubber rings on the pipe can be coated with 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.

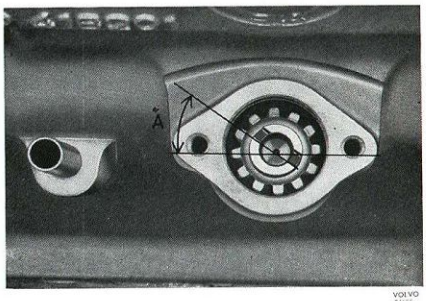



Fig. 2-63. Distributor drive position

For B 20 A: A=approx. 35°
For B 20 B, B20 E and B 20 F: A=approx. 5°

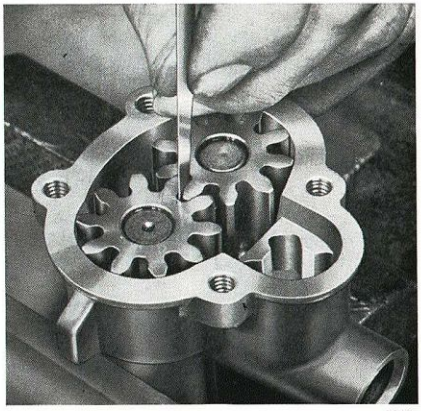


Fig. 2-64. Measuring tooth flank clearance

## 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.

## INSTALLING OIL PUMP

When No. 1 cylinder is at top dead center, install 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° or 5° to the longitudinal axis of the engine, see Fig. 2-63 (A). Make sure that the shaft goes down into its groove in the pump shaft.

NOTE. When the timing gear marks are opposite each other, then the piston for No. 4 cylinder is in the top dead center position, firing position.)

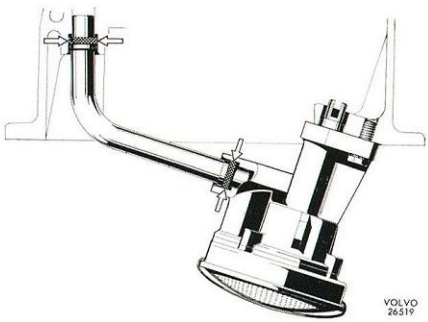


Fig. 2-65. Delivery pipe sealing rings

# FUEL SYSTEM

## CARBURETOR ENGINES

## DESCRIPTION

The B 20 A engine is fitted with a horizontal carburetor of type Stromberg 175 CD-2 SE, see Fig. 2-66.

The B 20 B engine is fitted with two horizontal carburetors of type SU-HIF 6, see Fig. 2-67.

The B 20 B engine in a car with right-hand drive is fitted with two horizontal carburetors of type Stromberg 175 CD-2 SE, see Fig. 2-68.

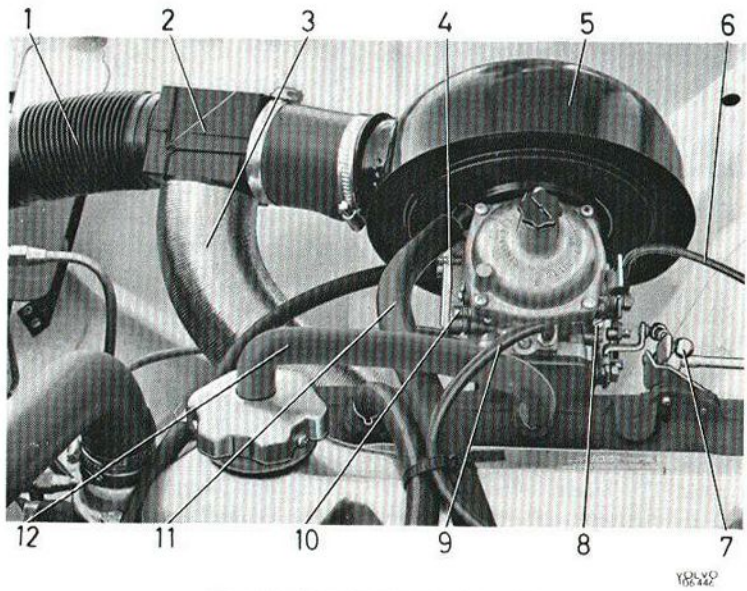



**Fig. 2-66. Stromberg-carburetor on B 20 A**

1. Cold-air hose
2. Constant temperature device
3. Warm-air hose
4. Temperature compensator
5. Air cleaner
6. Choke wire
7. Throttle control
8. Throttle stop screw
9. Vacuum hose for distributor
10. Idle trimming screw
11. Fresh-air hose for crankcase ventilation
12. Hose for crankcase gases

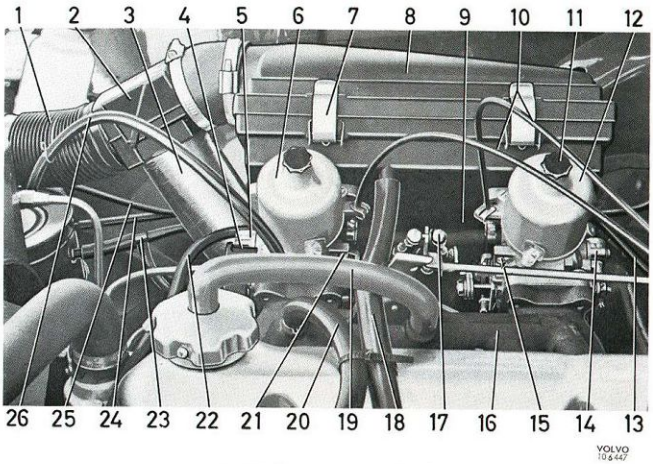
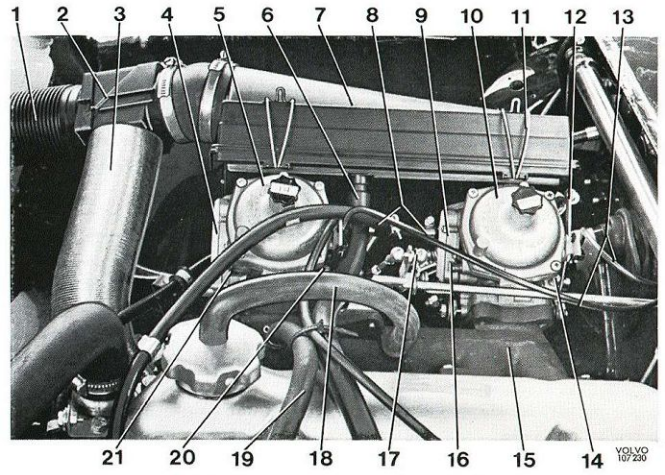



Fig. 2-67. SU-carburetors on B 20 B

1. Cold air hose
2. Constant temperature device flap
3. Warm air hose
4. Guard for throttle spindle
5. Hot start valve
6. Front carburetor
7. Clamp for air cleaner cover
8. Air cleaner
9. Fuel hose
10. Choke wires
11. Hydraulic damper
12. Rear carburetor
13. Vacuum hose for distributor (Negative vacuum setting)
14. Hot start valve
15. Idle trimming screw
16. Manifold
17. Throttle control
18. Fresh-air intake for crankcase ventilation
19. Hose for crankcase gases
20. Hose for brake servo
21. Idle trimming screw
22. Fuel hose
23. Hoses connected to hot start valves
24. Hose to fuel tank
25. Vacuum hose (joined to "negative connection" on carburetor)
26. Hose for fuel fumes




1. Cold-air hose
2. Constant temperature device flap
3. Warm-air hose
4. Temperature compensator
5. Front carburetor
6. Fresh-air intake for crankcase ventilation
7. Air cleaner
8. Fuel hoses
9. Temperature compensator
10. Rear carburetor
11. Clasp for air cleaner cover
12. Hot start valve
13. Choke wires
14. Throttle stop screw
15. Manifold
16. Idle trimming screw
17. Throttle control
18. Hose for crankcase gases
19. Hose for power brake
20. Throttle stop screw
21. Idle trimming screw

Fig. 2-68. Stromberg-carburetors on B 20 B (r-h drive)

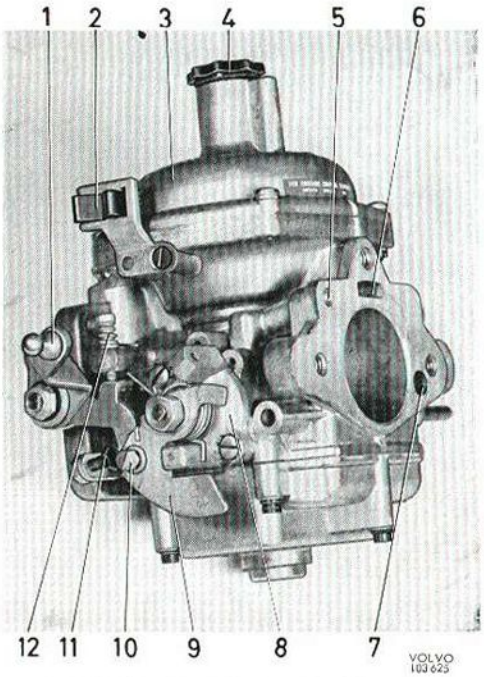



Fig. 2-69. Stromberg-carburetor, left side, B 20 A

1. Lever for throttle control
2. Clamp for choke wire
3. Suction chamber
4. Hydraulic damper
5. Vent drilling from floatchamber
6. Drilling for air supply under diaphragm
7. Drilling for air supply to temp. compensator and idle trimming screw
8. Cold start device
9. Cam disc for fast idle
10. Connection for choke control
11. Fast idle stop screw
12. Throttle stop screw

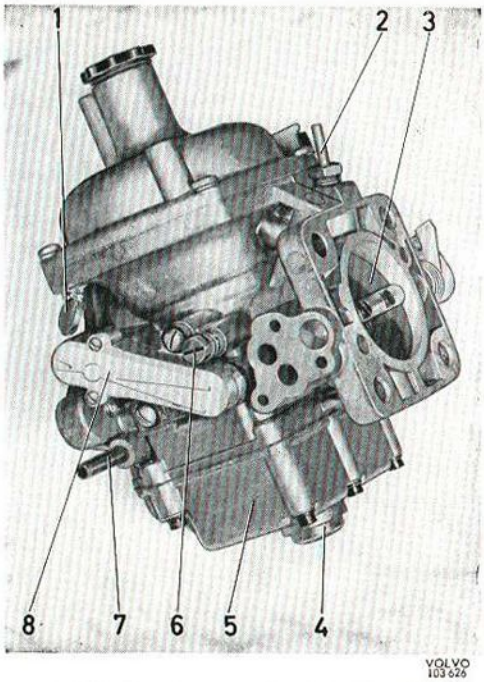



Fig. 2-70. Stromberg-carburetor, right side, B 20 A

1. Sealed plug
2. Connection for vacuum hose to distributor
3. Primary throttle
4. Floatchamber plug
5. Floatchamber
6. Idle trimming screw
7. Connection for fuel hose
8. Temperature compensator

## ZENITH-STROMBERG CARBURETOR

The carburetor for the B 20 A engine is shown in Figs. 2-69 and 2-70. It has been designed with a view to obtaining cleaner exhaust gases by means of a gas evaporative control system.

It is provided with a fixed jet, pressed into the carburetor housing, the fuel flow orifice area of which is varied by means of a movable tapered needle. The position of the needle is determined by the carburetor housing vacuum operating an air valve in which the needle is fitted in a spring-loaded suspension. The spring force always presses the needle against the same side of the jet and this ensures an accurately controlled fuel flow through the jet.

The carburetor consists of three main parts of light-alloy, the middle part of which comprises the carburetor housing. The lower section is made up of a floatchamber, which encloses the jet and the float. The upper section consists of a suction chamber cover, which forms a suction chamber together with a diaphragm fixed in the air valve. The suction chamber regulates the air valve lift and thereby the location of the needle in the jet.

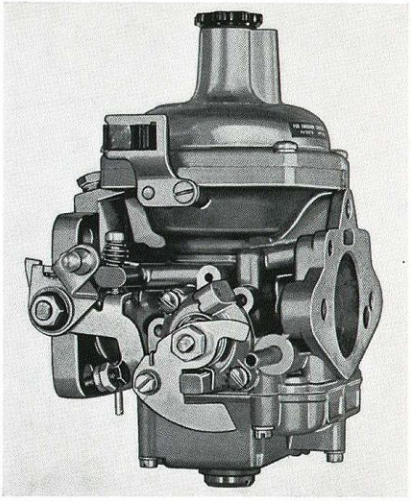
By means of channels in the valve, the suction chamber is linked to the space between the carburetor throttle and valve.

The carburetor is fitted with a cold start device (8, Fig. 2-69) in order to provide the engine with extra fuel for cold starting.

The carburetor is fitted with a temperature compensator (8, Fig. 2-70). This is constructed as an air valve regulated by the carburetor temperature. It maintains the fuel-air mixture constant irrespective of the fuel temperature.

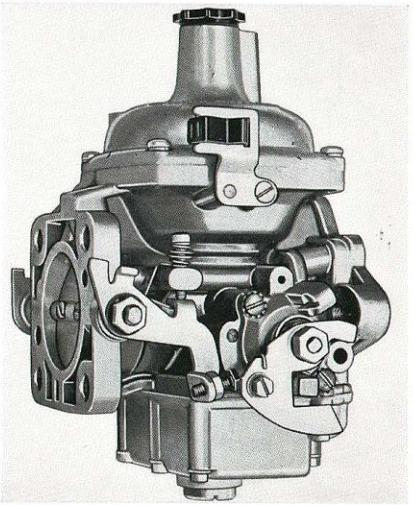
The throttle spindle is provided with seals to reduce wear on the spindles and bushes and also to eliminate air leakage.

On B 20 B engines with twin Stromberg carburetors, these differ structurally from the carburetor for the B 20 A engine as follows: (see Figs. 2-71, 2-72, 2-73 and 2-74).



VOLVO 106382

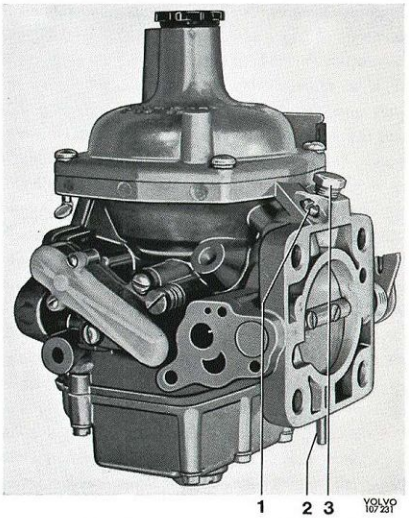
Fig. 2-71. Stromberg-carburetor, front, left side, B 20 B



VOLVO 106388

Fig. 2-73. Stromberg-carburetor, rear, left side, B 20 B

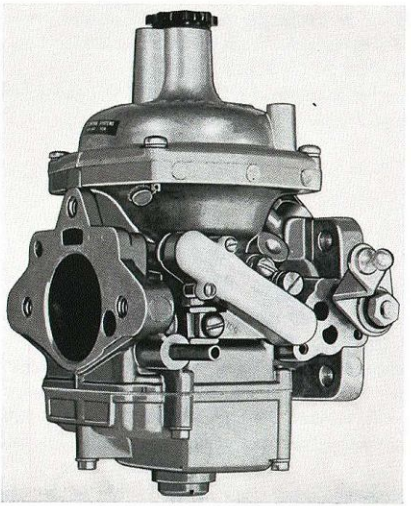
1. Cam for regulating secondary throttle
2. Valve control for hot start valve
3. Cold start device




VOLVO 107231

Fig. 2-72. Stromberg-carburetor, front, right side, B 20 B

1. Plug for outlet for speed compensator (air conditioning)
2. Vacuum hose connection for distributor
3. Plug



VOLVO 106389

Fig. 2-74. Stromberg-carburetor, rear, right side, B 20 B

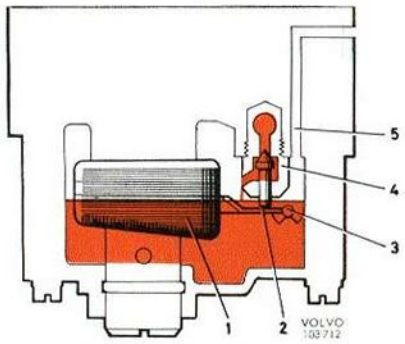



**Fig. 2-75. Float system**

1. Float
2. Float arm
3. Float shaft
4. Float valve
5. Venting channel from float-chamber to air cleaner

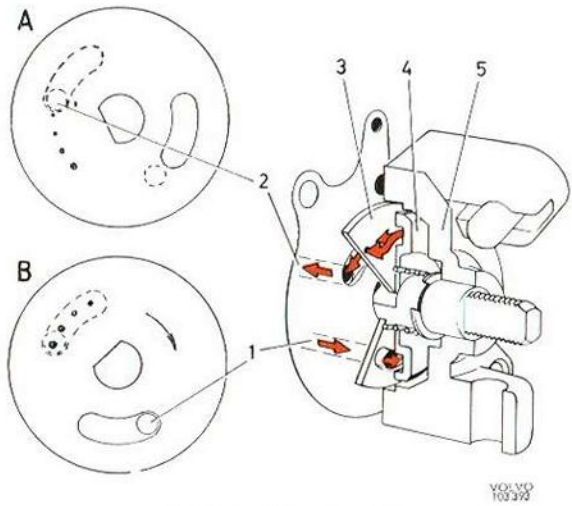



**Fig. 2-76. Cold-start device**

A. Cold-start device, designed
B. Cold-start device, engaged

1. From floatchamber
2. To venturi
3. Choke lever
4. "Channel disc"
5. Housing

The vacuum connection for the ignition distributor is located on the front carburetor (see 2, Fig. 2-72) and is connected to the side of the throttle which is against the manifold. This gives the distributor a so-called "negative vacuum setting" as distinct from the B 20 A distributor, the vacuum setting of which is positive, that is, the connection opens out between the carburetor throttle and air valve.

Both carburetors are fitted with a cold start device, see Figs. 2-71 and 2-73.

The hot start valve (12, Fig. 2-68) is described on page 2:38.

## Float system

Fuel flows into the floatchamber via the flot valve (4, Fig. 2-75). The float (1), which is made up of twin expanded rubber floats, is carried on a bridge in the lower part of the carburetor housing. As the fuel level rises, the float lifts and, by means of the float arm (2) and tag, closes the needle on its seating when the correct level has been attained.

The fuel goes through holes in the floatchamber plug and then to the inside of the jet, where the level is the same as in the floatchamber. Sealing between the floatchamber plug and chamber is provided by an O-ring.

## Cold start device and fast idle

To facilitate starting during cold weather, the carburetor is provided with a cold start device (Figs. 2-76 and 2-77).

The cold start device consists of a choke lever (3, Fig. 2-76) which is provided with four calibrated holes and an elongated opening as well as a channeled disc (4) mounted on a spindle which is operated by the choke control. On the same spindle, outside the housing (5), there is a cam disc (9, Fig. 2-69) with connection for the choke control pull wire. When the cold start device is engaged, the valve disc turns and this links up the channel (1, Fig. 2-76) from the floatchamber via one or several of the calibrated holes to the channel on the other side of the valve disc and further through the drilling in the channel (2), which terminates in the venturi between the vacuum plunger and choke flap. By means of this link-up the engine receives extra fuel (richer mixture) to facilitate cold starting. At the same time, a little extra air is obtained by means of the choke device. When the choke control is pushed in, the valve disc turns and closes the inlet to the channel. At the same time as the cam disc is operated, the throttle flap opening is allso influenced in such a way that turning the cam disc opens the throttle through the fast idle stop screw (11, Fig. 2-69) and the lever, before any of the calibrated holes open the connection to the fuel drilling. With this arrangemant, the idling speed can, if necessary, be raised by the driver of the vehicle during the warming-up period of the engine.

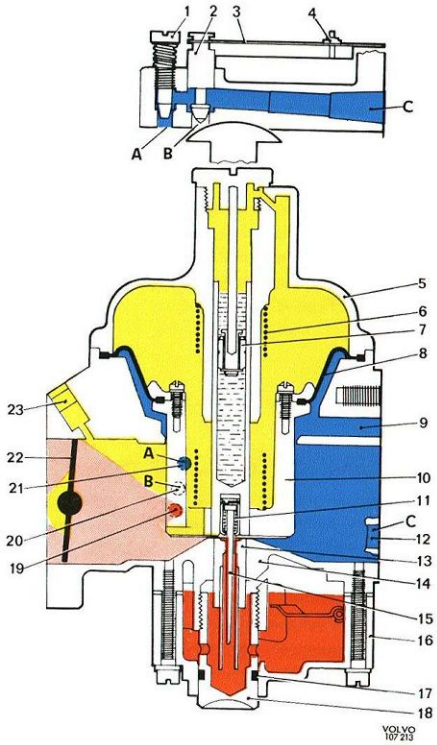



**Fig. 2-77. Cold starting, principle**

1. Idle trimming screw
2. Valve for temperature compensator
3. Bi-metal spring for temperature compensator
4. Adjuster nut
5. Suction chamber
6. Spring
7. Damper plunger
8. Diaphragm
9. Drilling for air supply under diaphragm
10. Air valve
11. Metering needle suspension
12. Drilling for air supply to temp. compensator aid idle trimming screw
13. Fuel jet
14. Carburetor housing (middle section)
15. Metering needle
16. Floatchamber
17. Rubber ring
18. Floatchamber plug
19. Drilling for cold start fuel (located in carb. opposite wall)
20. Drilling for extra air through temperature compensator
21. Drilling for extra air through idle trimming screw
22. Throttle
23. Vacuum outlet for distributor, B 20 A (has another location on B 20 B).

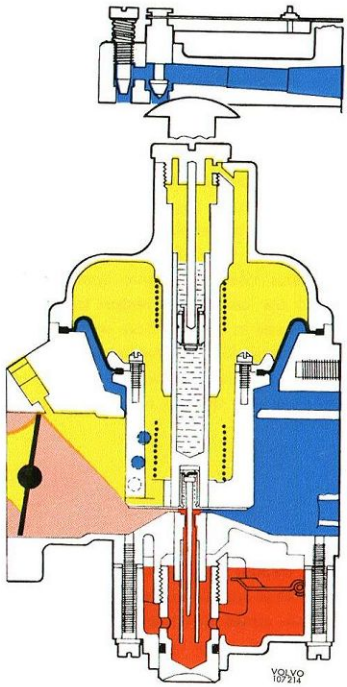



**Fig. 2-78. Idling, warm engine**

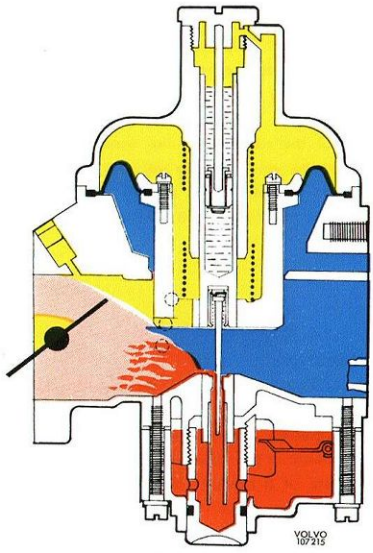



**Fig. 2-79. Normal operation**

## Idling

When the engine is idling, the vacuum in the carburetor suction chamber is low and the column between the air valve and the bridge will be small (see Fig. 2-78). At this stage, the thicker section of the metering needle is in the jet and thus only a small quantity of fuel, corresponding to idling requirements, is sucked into the engine. The temperature compensator (Fig. 2-77) is regulated by a bi-metal spring (3) which influences a valve (2). When the engine is warm and the temperature in the carburetor rises, the valve opens and air is supplied to the carburetor venturi to compensate for the increase in the fuel flow, which is obtained due to the alteration in the fuel's viscosity, see Fig. 2-78. Fine adjustment of the engine idling speed can be carried out with the idle trimming screw (1, Fig. 2-77).

## Normal running

When the throttle flap opens, approximately the same vacuum is obtained in the suction chamber as in the engine intake manifold. Due to the pressure difference between the underside of the air valve, where there is pressure in the carburetor inlet port, and the upper side of the valve, where there is vacuum, the valve lifts from the bridge. This also lifts the tapered metering needle (15, Fig. 2-77), which is attached to the valve, out of the jet. The effective choke area widens and increases the fuel flow. See Fig. 2-79.

Since the vacuum in the engine induction manifold is dependent upon the engine speed and load, the correct fuel flow is obtained under all operating conditions.

Because of the variable choke area between the bridge and the valve, the air velocity and pressure drop across the jet orifice will always remain approximately constant, thus ensuring good fuel atomization at all speeds.

## Acceleration

To provide at any point in the throttle range a temporary richer mixture at the moment the throttle is suddenly opened, acceleration, a hydraulic damper is incorporated in the valve rod. The hydraulic damper consists of a plunger mounted on a rod. The plunger operates in oil. When the throttle is suddenly opened, the vacuum in the suction chamber increases rapidly.

When the air valve (10, Fig. 2-77) lifts, the damper plunger (7) is forced against its seat and oil is prevented from flowing past the lower side of the damper plunger from the upper side, and this retards the movement of the valve (10). A more powerful vacuum is temporarily obtained above the jet so that the fuel-air mixture becomes for the moment richer.

The downward stroke of the air valve is assisted by the spring (6). The rod in the valve should be filled to approximately within a 1/4" from the upper edge with oil which is approved as "Automatic Transmission Fluid, Type A".

## SU CARBURETOR — HIF TYPE

Two SU-carburetors of the above type are used for the twin-carburetor engine. The design can be seen from Figs. 2-80, 2-81, 2-82 and 2-83.

The carburetors are constructed for the exhaust emission control system. They are fitted with a temperature-controlled fuel jet, metering needle, spring suspension, hot start valve and, for the Canadian market, overrev valve in throttle.

The carburetor consists of a carburetor housing (12, Fig. 2-84), the lower part of which is designed as a floatchamber and a upper part which is called a suction chamber (1). A movable spring-loaded air valve (8) is located in the suction chamber. It is the lower section of the valve which regulates the volume of air admitted. The suction chamber is connected by channels to the space between the carburetor throttle and valve.

Located in the carburetor housing is an adjustable fuel jet (10), in which a movable tapered needle (7) varies the through-flow volume of fuel. The needle is mounted in the air valve and in a spring-loaded suspension (5). This spring load always forces the needle against the same side of the jet and results in an accurately regulated through-flow of fuel.

The fuel jet is manually adjusted by means of the adjusting screw (14) and automatically by the bi-metal spring (18).

The adjusting screw is covered with a plastic plug after having been adjusted at the factory.

The bi-metal spring is located in the floatchamber fuel where it is actuated by the temperature of the fuel. When the temperature increases, the viscosity of the fuel changes and a larger volume can pass through the jet. This is compensated for by the bi-metal spring, which bends with change in temperature and alters the location of the jet.

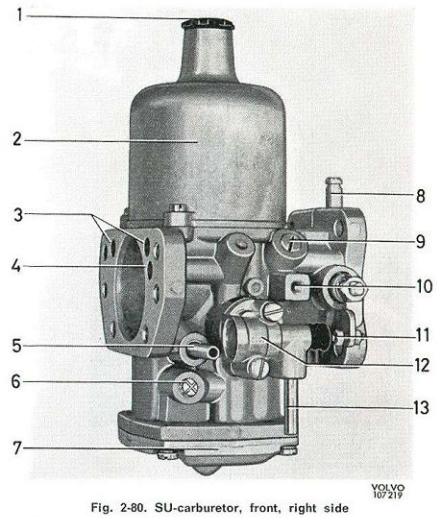



**Fig. 2-80. SU-carburetor, front, right side**

1. Hydraulic damper
2. Suction chamber
3. Drillings for air supply under air valve
4. Vent hole from floatchamber
5. Connection for fuel line
6. Jet adjusting screw
7. Floatchamber cover
8. Connection (positive) for hose to venting filter
9. Plug for outlet for speed compensator (air condition)
10. Boss for guard
11. Hot start valve adjusting screw
12. Hot start valve
13. Outlet from floatchamber

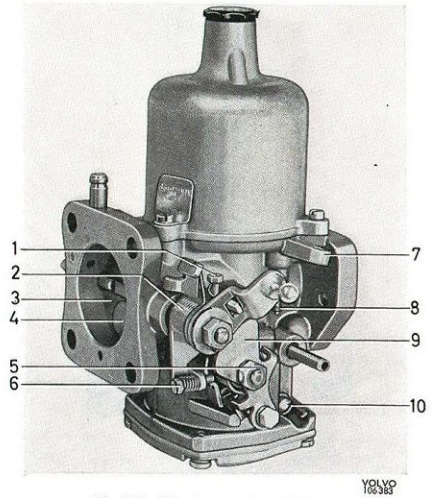



**Fig. 2-82. SU-carburetor, front, left side**

1. Throttle stop screw
2. Return spring
3. Throttle
4. Overrev valve (Only on cars for Canadian market)
5. Cold-start device
6. Fast-idle stop screw
7. Attachment for choke control
8. Lift pin
9. Cam disc for fast idle
10. Screw head for float shaft

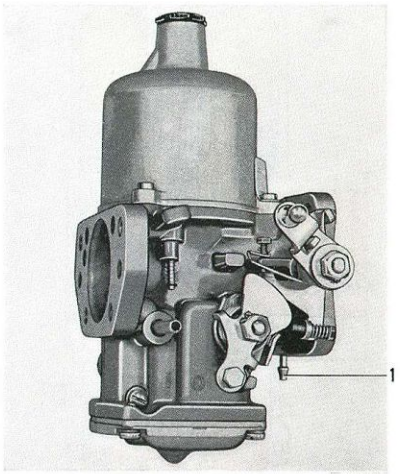



**Fig. 2-81. SU-carburetor, rear, right side**

1. Vacuum hose connection from distributor

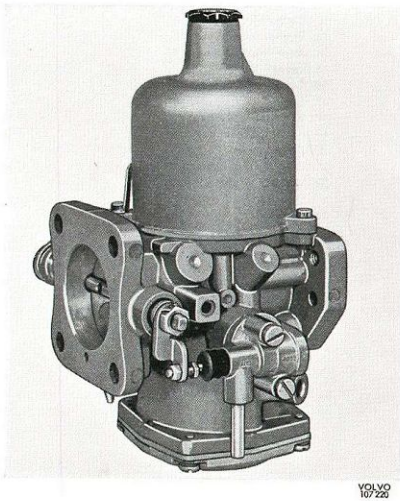



**Fig. 2-83. SU-carburetor, rear, left side**

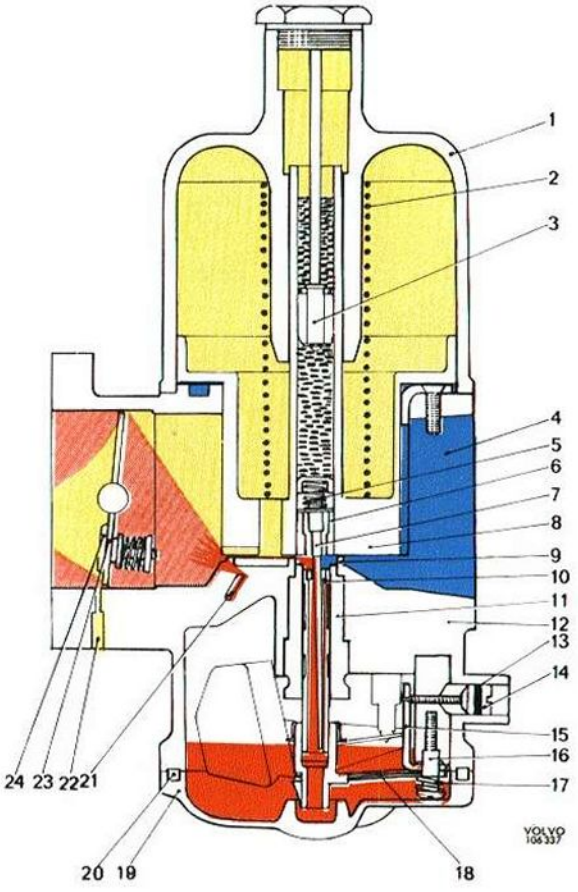



Fig. 2-84. Cold starting, principle

1. Suction chamber
2. Spring
3. Damper plunger
4. Air intake
5. Spring
6. Sleeve
7. Metering needle
8. Air valve
9. Bridge
10. Fuel jet
11. Jet sleeve
12. Carburetor housing
13. Rubber ring
14. Adjusting screw
15. Lever
16. Screw for bi-metal assembly
17. Spring
18. Bi-metal assembly
19. Floatchamber cover
20. Rubber seal
21. Drilling for cold start fuel
22. Vacuum outlet for ignition distributor
23. Throttle
24. By-pass valve

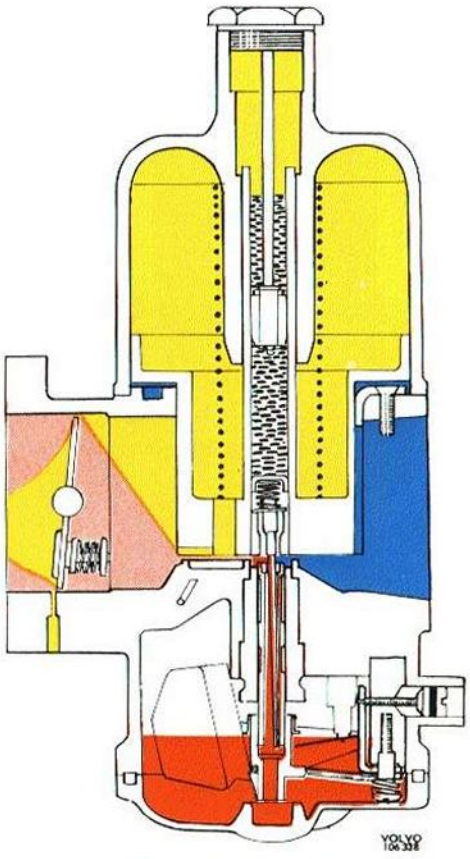



Fig. 2-85. Idling, hot engine

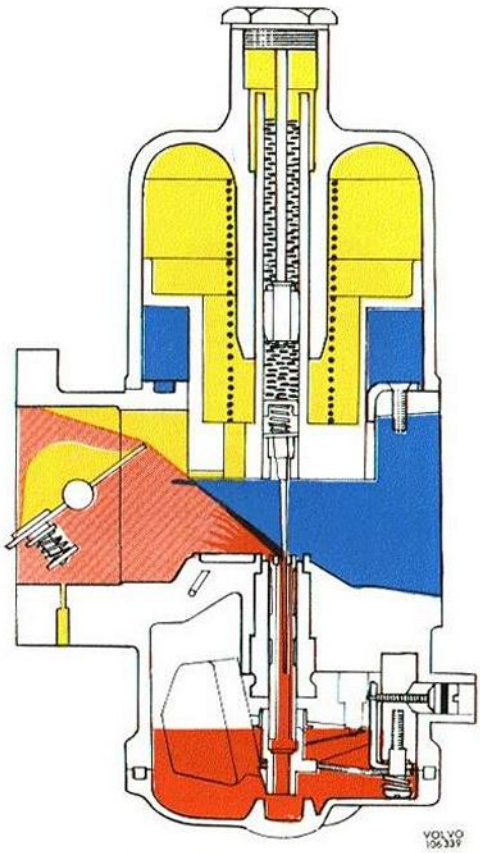



Fig. 2-86. Normal operation

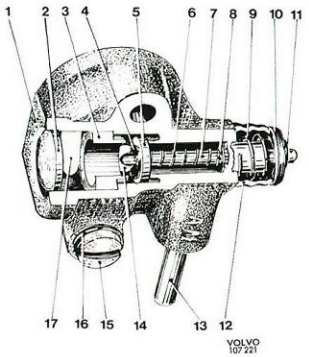



**Fig. 2-87. Hot start valve**

1. Housing
2. Sealing washer
3. Valve seat
4. Circlip
5. Valve washer
6. Thrust spring
7. Control rod
8. Circlip
9. Thrust spring
10. Washer
11. Circlip
12. Rubber seal
13. Hose connection (outlet)
14. Channel from floatchamber
15. Screw for valve
16. Spring washer
17. Channel to air cleaner

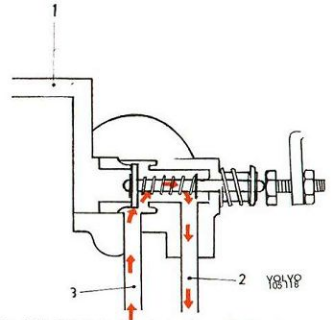



**Fig. 2-88. Principle, hot start valve with throttle control in idling position**

1. Channel to air cleaner
2. Channel to atmosphere or venting filter
3. Channel from floatchamber

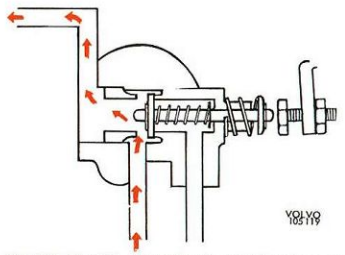



**Fig. 2-89. Principle, hot start valve with throttle control in running position**

This automatic regulation of the jet means that the carburetor is stable from a temperature point of view. The fuel-air mixture relationship does not change with alteration in the temperature of the carburetor.

The carburetor is fitted with a hot start valve (12, Figs. 2-87 and 2-88), the purpose of which is to regulate the outlet for a channel from the floatchamber.

When the weather is warm and the engine hot, a considerable amount of fuel fumes form especially in the flotchamber. When the throttle flap is at idle, the valve is actuated so that the fuel fumes are led out into the atmosphere (Fig. 2-88) via rubber hoses (Fig. 2-90) (or to a venting filter see page 2-37). When throttling takes place (Fig. 2-89), the valve shuts off the outlet to the atmosphere and opens a channel for the air cleaner. The fuel fumes are led to the cleaner under suction with the air current and take part in the combustion.

By evacuating the fuel fumes to the atmosphere when the throttle flap is at idle, hot start difficulties are avoided.

The throttle spindle is provided with seals (Fig. 2-128) in order to reduce the wear on the spindle and bushes as well as eliminate air leakage.

On vehicles for the Canadian market an overrev valve (4, Fig. 2-82) is located in the carburetor throttle. This valve opens when the throttle is closed during engine braking. A suitable quantity of

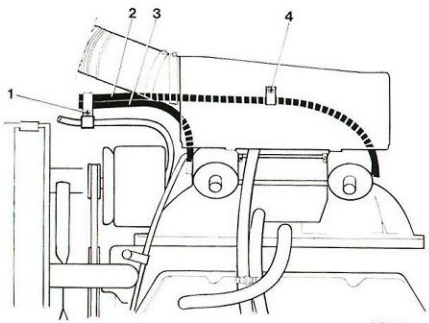



**Fig. 2-90. Hoses installed from hot start valves (does not apply to vehicles with gas evaporative control)**

1. Clamp
2. 3. Hoses from hot start valve
4. Clamp

fuel-air mixture passes through the valve and this reduces considerably the volume of noxious exhaust gases (see Fig. 2-91).

The cold start device (5, Fig. 2-82) is connected manually. Turning the cold start device spindle opens a channel between the floatchamber and venturi.

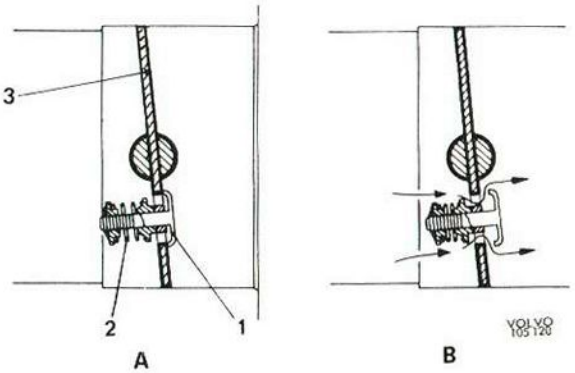



Fig. 2-91. Overrev valve (only on vehicles with gas evaporative control)

A. Idling and running
B. Engine braking

1. Valve
2. Thrust spring
3. Primary throttle

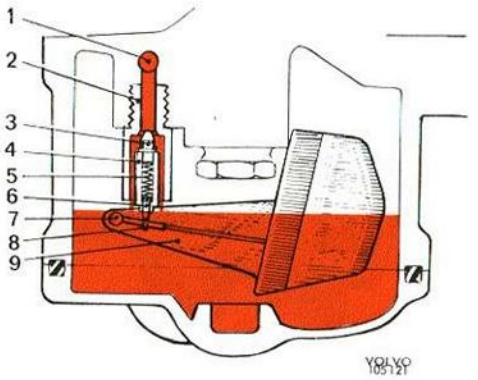



Fig. 2-92. Float system

1. Fuel inlet
2. Float valve house
3. Float valve point
4. Float valve
5. Spring
6. Spring-loaded pin
7. Float spindle
8. Retainer
9. Float

Extra fuel for the venturi is obtained through this channel (see Fig. 2-93).

A damping device (3, Fig. 2-84) is located in the spindle of the valve in order to produce a temporarily richer fuel-air mixture with acceleration.

The vacuum connection (1, Fig. 2-81) for the distributor is located on the rear carburetor and connects with the side of the primary throttle facing the manifold. This gives the distributor so-called negative vacuum setting.

On vehicles fitted with a gas evaporative control system there is a vacuum connection (8, Fig. 2-80) on the front carburetor. It connects to the space between the carburetor throttle and air valve.

## Float system

Fuel flows into the floatchamber through the float valve (4, Fig. 2-92). The float (9) is journalled on a float spindle (7). When the fuel level rises, the float lifts and at the proper fuel level the float valve is shut off by the float tab.

## Cold start device and fast idle

During cold starting, the fuel-air mixture is given extra fuel through the cold start device. This device consists of a valve housing (14, Fig. 2-93) partly located in a space in the lower section of the carburetor housing and is provided with seals (8 and 15). A pivotable spindle (16) is located in the center of the valve housing. When the spindle is turned to cold start position, fuel is drawn from the bottom of the floatchamber through the channel (2) to the space round the valve housing. From there it is taken through a hole in the valve housing, a channel in the center of the spindle and a channel in the carburetor housing to the carburetor venturi at the bridge. The linkage between the hole in the valve housing and the channel in the center of the spindle is made up of a hole and a V-slot. When the spindle turns, the through-flow area is altered gradually in the V-slot, and at full turn, the fuel goes directly through the hole, see Fig. 2-93. In this

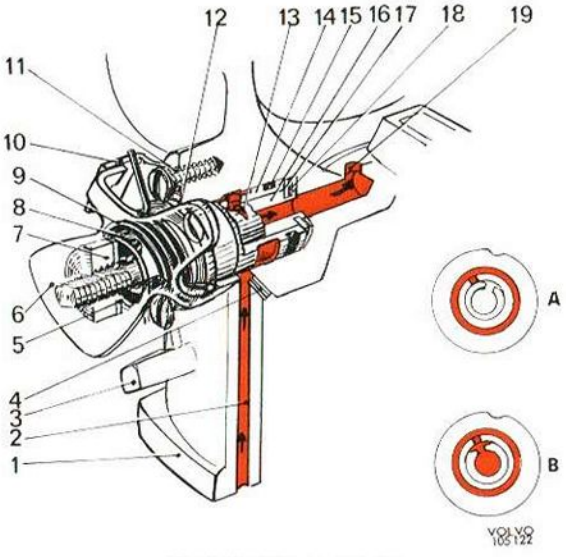



Fig. 2-93. Cold start device

A. Disengaged
B. Engaged

1. Carburetor housing
2. Channel from floatchamber
3. Stop tab for lever
4. Channel for additional air
5. Tab washer
6. Cam for fast idle
7. Nut
8. Seal
9. Return spring
10. Spring retainer
11. Screw
12. Packing
13. V-slot
14. Valve housing
15. Seal
16. Spindle
17. Washer
18. Circlip
19. Channel to carburetor venturi

way the quantity of additional fuel is regulated. A channel (4) between the floatchamber space above the fuel level and the channel (2) for the fuel give the cold start fuel a little extra supply of air.
The fast idle cam (6) follows the pivotal movement of the spindle and actuates the position of the throttle. The fast idle cam opens the throttle slightly before the slot in the spindle reaches the hole in the valve housing. With this arrangement, the driver can raise the idling speed while the engine is warming up.

## Idling

When the engine is idling, the vacuum in the carburetor suction chamber is low and the column between the air valve and bridge is narrow (Fig. 2-86). The metering needle is then positioned in the thicker section of the jet and only a small amount of fuel, corresponding to idling requirements, is drawn into the engine. The amount of air is determined by the size of the column between the valve and bridge.

## Running

When the throttle is opened, the suction chamber obtains about the same vacuum as in the engine intake manifold. Owing to the pressure difference between the bottom side of the air valve, where there is pressure at the inlet port of the carburetor, and the top side of the valve, where there is vacuum, the valve lifts from the bridge and also causes the tapered needle (7, Fig. 2-84) secured at the valve to lift from the jet. The effective choke area widens and increases the fuel flow. Since the vacuum in the engine induction manifold is dependent upon the engine speed and load, correct fuel flow is obtained for all operating conditions. Because of the variable choke area between the bridge and the valve, the air velocity and pressure drop across the jet will always remain approximately constant, thus ensuring good fuel atomization at all speeds.

## Acceleration

To provide at any point in the throttle range a temporarily richer mixture at the moment the throttle is suddenly opened, acceleration, a hydraulic damper is incorporated in the valve rod. The hydraulic damper consists of a damper plunger (3, Fig. 2-84) mounted on a rod. The plunger operates in oil. When the throttle is suddenly opened, the vacuum in the suction chamber increases rapidly.
When the air valve (8) lifts, the damper plunger is forced against its seat and oil is prevented from flowing past the lower side of the damper plunger from the upper side, and this retards the movement of the valve (8). A more powerful vacuum is temporarily obtained above the jet so that the fuel-air mixture becomes for the moment richer.
The downward stroke of the air valve is assisted by the spring. The rod in the valve should be filled within 1/4" from the upper edge with oil which is approved as "Automatic Transmission Fluid, Type A".

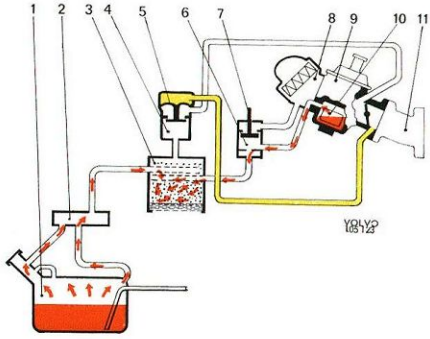



**Fig. 2-94. Gas evaporative control system with control rod (7) at idle**

1. Fuel tank
2. Expansion tank
3. Venting filter
4. Air valve
5. Diaphragm
6. Valve (hot start valve)
7. Control rod (connected to throttle)
8. Air cleaner
9. Carburetor
10. Floatchamber
11. Intake manifold

## GAS EVAPORATIVE CONTROL SYSTEM

Vehicles for the Canadian market are fitted with a gas evaporite control system which prevents fuel fumes from being released out into the atmosphere. Its function is outlined in Fig. 2-94 and Fig. 2-95.
Fuel fumes formed in the fuel tank, especially during warm weather, are led to the expansion tank (2) and from there to the venting filter (3) where the fumes are absorbed by active carbon. On the 140 model, the expansion tank is located in the luggage compartment, see Fig. 2-98. (On the 145, it is placed on the right-hand side in the cargo space.)The venting filter (Fig. 2-96) is located in the engine compartment on the right-hand side, see Fig. 2-99.
Fuel fumes from the floatchamber (10, Fig. 2-94) are led via the valve (6) to the venting filter when the engine has been switched off or during idling. Throttling shuts off the connection between the venting filter and the floatchamber so that the

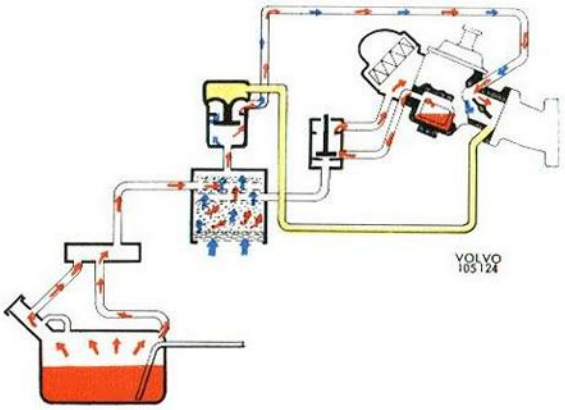



Fig. 2-95. Gas evaporative control system with control rod at running

fumes travel via the valve to the air cleaner. (Fig. 2-95).

The air valve (Fig. 2-97) controls the connection between the venting filter and the carburetor venturi. The space above the diaphragm (1) is connected by a line to the carburetor venturi on the side of the throttle facing the induction manifold, see Fig. 2-94.

The vacuum in the induction manifold depends on the engine load and speed.

At high vacuum, the vacuum valve is kept closed (Fig. 2-94). When the vacuum drops the valve opens and air is drawn through the cannister and vacuum valve to the carburetor venturi. Fuel fumes stored in the venting filter follow the air into the engine and take part in the combustion (Fig. 2-95).

The valve (6), which is known as the hot start valve, is to be found on all vehicles with twin carburetors. The difference between a valve used on a vehicle with or without a gas evaporative system is that in the latter case there is no hose connected to the outlet and the fumes are led directly out into the atmosphere when the engine is switched off or idling.

## HOT START VALVE

For the SU-carburetor, the hot start valve is described together with the carburetor.

The function of the hot start valve on the Stromberg carburetor is as follows:

During warm weather and when the engine is hot a great deal of fuel fumes develop in the floatchamber. These are vented through a channel to the air cleaner and result in the engine obtaining a somewhat "richer" fuel mixture. This makes it difficult to start the engine. To counteract this on B 20 B, the hot start valve is fitted to the connection between the floatchamber and air cleaner by means of hoses.

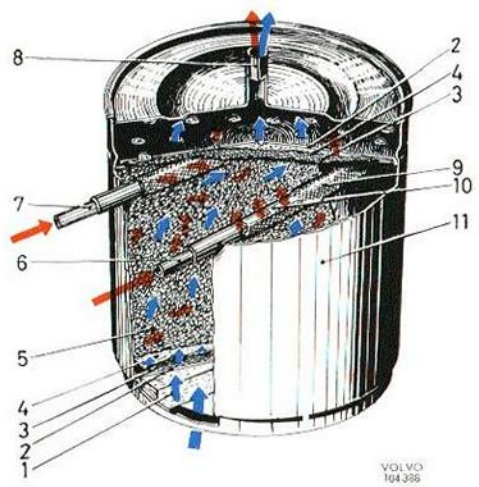



Fig. 2-96. Venting filter

1. Foam plastic filter (replace every 40 000 km =24 000 miles)
2. Plate (perforated)
3. Wire net (gauze)
4. Felt
5. Active carbon
6. Hose connection from expansion container
7. Hose connection from hot start valve
8. Connection to air valve
9. Wire net stocking
10. Perforated pipe
11. Cannister

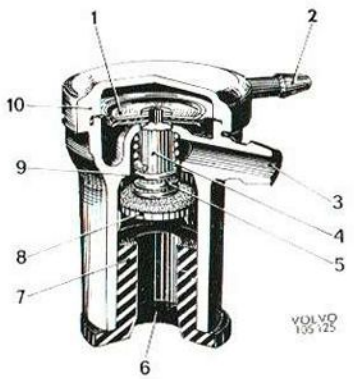



Fig. 2-97. Air valve

1. Diaphragm
2. Connection for hose to rear carburetor
3. Connection for hose to front carburetor
4. Valve rod
5. Thrust spring
6. Connection for venting filter
7. Rubber sleeve
8. Valve
9. Valve seat
10. Housing

When the throttle is at idling position, the lever (1, Fig. 2-101) presses against the valve control (2). The piston (14) is thereby lifted to its upper position

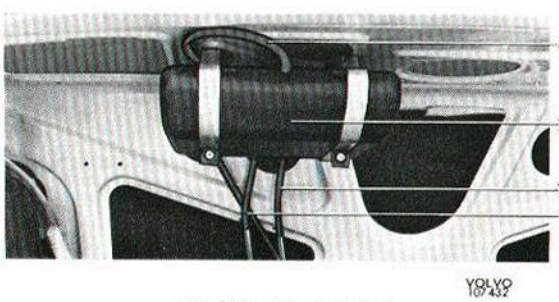



Fig. 2-98. Expansion tank

1. Hose to fuel filling pipe
2. Hose to fuel tank
3. Expansion tank
4. Hose to venting filter

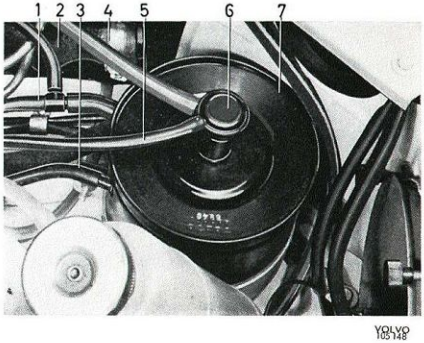



**Fig. 2-99. Venting filter, fitted**

1. Hose for rear carburetor hot start valve
2. Hose for front carburetor hot start valve
3. Hose from fuel tank via expansion tank
4. Hose for front carburetor positive vacuum connection
5. Hose for rear carburetor negative vacuum connection
6. Air valve
7. Venting filter

by the control rod (16). The connection between the floatchamber and air cleaner is closed and fuel fumes are led directly out into the atmosphere through the outlet (12).

When the accelerator pedal is depressed (see Fig. 2-101), the lever (1) releases the valve control (2) and the piston (14) is pressed by the spring (15) against its lower position. The outlet (12) is shut off, the fuel fumes are led into the air cleaner and, when the engine starts running, then through the carburetor and into the engine combustion chambers.

If it is to function properly, it is important that the hot start valve is accurately adjusted so that it has proper contact with the carburetor lever.

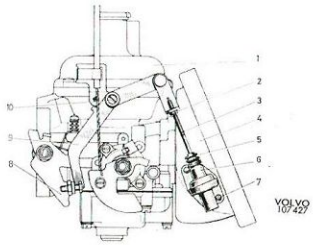



**Fig 2-100. Hot start valve on Zenith-Stromberg carburetor (B 20 B)**

1. Carburetor
2. Locknut
3. Control rod
4. Air cleaner, lower section
5. Rubber seal
6. Hot start valve
7. Attaching rivet
8. Throttle lever
9. Valve control
10. Screw for valve control

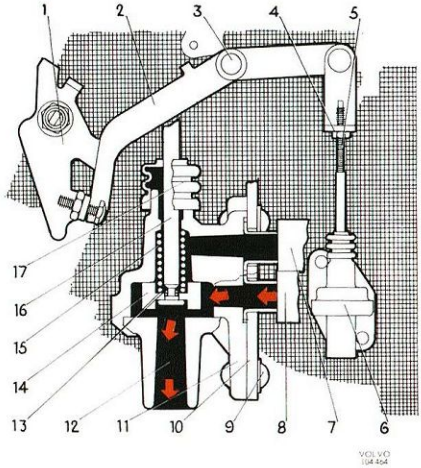



**Fig. 2-101. Hot start valve, function, idling (Zenith-Stromberg carburetor)**

1. Throttle lever
2. Valve control
3. Screw for valve control
4. Locknut
5. Control rod
6. Hot start valve
7. Outlet to air cleaner
8. Hose to floatchamber
9. Rivet
10. Air cleaner housing
12. Outlet to atmosphere
13. Rubber rings
14. Piston
15. Thrust spring
16. Control rod
17. Rubber seal

## EXHAUST GAS RECIRCULATION (EGR)

Vehicles for the Canadian market and with a B 20 B-engine are equipped with exhaust gas recirculation. This makes for cleaner exhaust gases when driving on half throttle.

The system consists of a recirculation line (2,

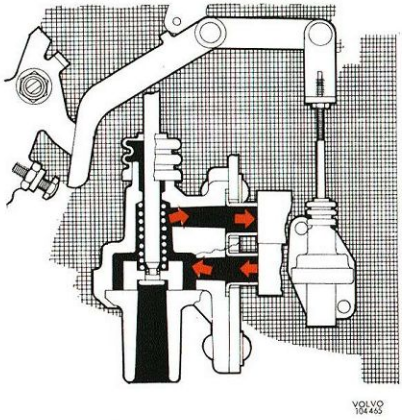



**Fig. 2-102. Hot start valve, function, driving (Zenith-Stromberg carburetor)**

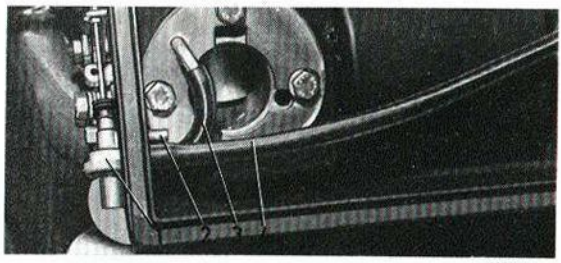


Fig. 2-103. Hose connections, Zenith-Stromberg

1. Hot start valve
2. Outlet to air cleaner
3. and 4. Hoses to carburetor floatchamber

Fig. 2-104) between the exhaust manifold and the intake manifold, and a vacuum-operated EGR valve (3) connected to the return channel. The system is operated by the control line (1) between the EGR valve and the carburetor venturi.

Exhaust gas recirculation takes place when the throttle flap is **between** the closed (idle) and the half-open position (full throttle).

When the throttle flap is closed, Fig. 2-106a, the opening for the control line on the EGR valve is in front of the air shutter. The pressure in the control line and also in the EGR valve vacuum chamber is then equal to atmospheric pressure. Since the pressure in the EGR valve reference chamber is always equal to atmospheric pressure, the same pressure exists on both sides of the diaphragm and this keeps the valve in a closed position under the force of the spring. In other words, there is no exhaust gas recirculation.

When the throttle flap is partly open, Fig. 2-106 b, the opening for the control line "moves" behind the air shutter. Behind the throttle flap there is partial vacuum which is transmitted to the vacuum chamber of the EGR valve. The atmospheric pressure in the EGR valve reference chamber now presses the diaphragm backwards so that the valve opens. Exhaust gas recirculation now takes place to the intake manifold and back into the cylinders.

With a fully open throttle flap, Fig. 2-106 c, there is atmospheric pressure in the intake manifold and

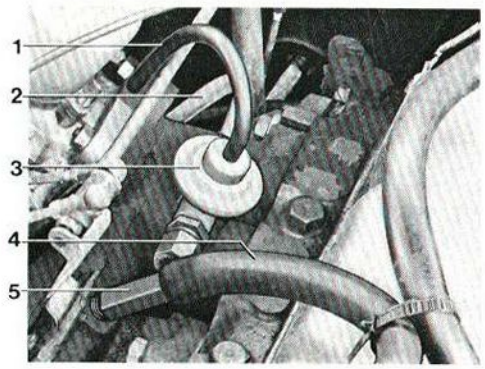


Fig. 2-104. EGR valve, fitted

1. EGR line
2. EGR line to exhaust manifold
3. EGR valve
4. Hose for crankcase ventilation
5. Nipple (T-nipple)

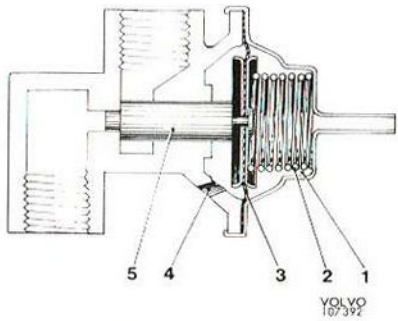


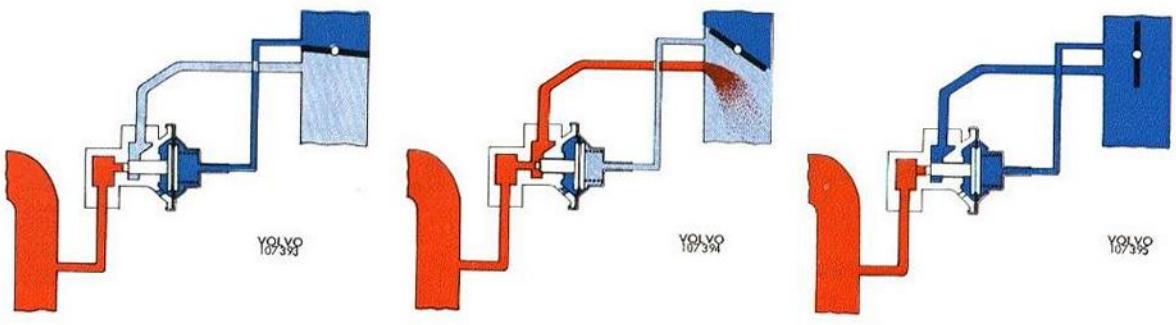
Fig. 2-105. EGR valve

1. Vacuum chamber
2. Return spring
3. Diaphragm
4. Reference chamber
5. Piston

this is transmitted to the vacuum chamber of the control valve. The pressure on both sides of the diaphragm is now equal so that the valve is closed by the spring. Exhaust gas recirculation has now stopped.

When adjusting the carburetors, it is particularly important that the synchronizing is done accurately in order to ensure the function of the exhaust gas recirculation.

The EGR system should be cleaned at certain intervals, see "Repair Instructions".



a b c

Fig. 2-106. EGR valve, principle function

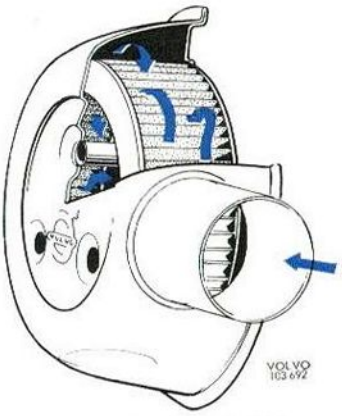



Fig. 2-107. Air cleaner B 20 A

## AIR CLEANER

The air cleaner functions both as a cleaner for the intake air and as an intake silencer.

The air cleaner (Fig. 2-107) on the B 20 A unit is replaced complete. Change it every 40 000 km (24 000 miles) or earlier if driving conditions require it.

The air cleaner (Fig. 2-108) on the B 20 B engine has a replaceable paper insert. Note that the insert for the SU-carburetors and the Stromberg carburetors differ from one another and must not be confused.

The engine is fitted with a **constant air temperature unit** for the air cleaner, see Fig. 2-109.

The constant air temperature unit consists of a flap housing (5), a hose (6) for cold air and heat-resistant hose (7) for warm air as well as a heater plate (8), which is secured to the exhaust pipe. The thermostat (2) fitted in the flap housing is inserted in the air cleaner housing and regulates the flap (4) by

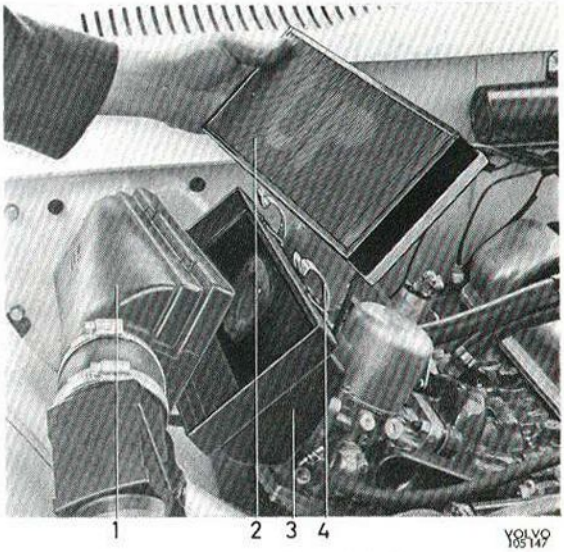



Fig. 2-108. Air cleaner B 20 B

1. Air cleaner housing, cover
2. Cleaner insert
3. Air cleaner housing, bottom section
4. Clamp

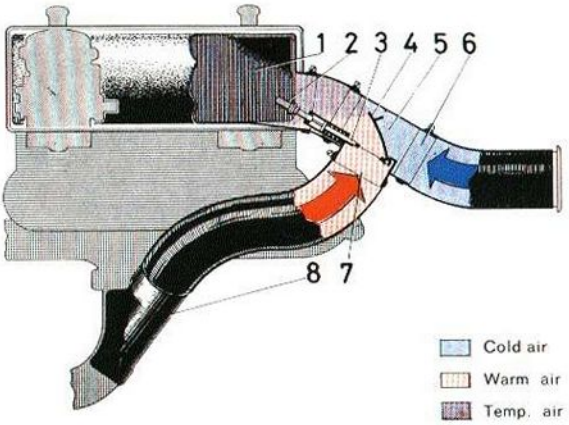



Fig. 2-109. Constant air temperature unit

1. Air cleaner
2. Thermostat
3. Flap control
4. Flap
5. Flap housing
6. Cold-air intake
7. Warm-air intake
8. Heater plate

means of the flap control (3). The warm air taken at the exhaust pipe and the cold air taken at the front of the vehicle are regulated by the flap, mixed. The temperature of the mixture then influences the thermostat. In this way, the air supplied to the carburetors is maintained at a constant temperature of approximately 90°F.

This device eliminates the formation of ice in the carburetor. It also ensures that the driving properties of the vehicle are independent of the temperature of the outside air.

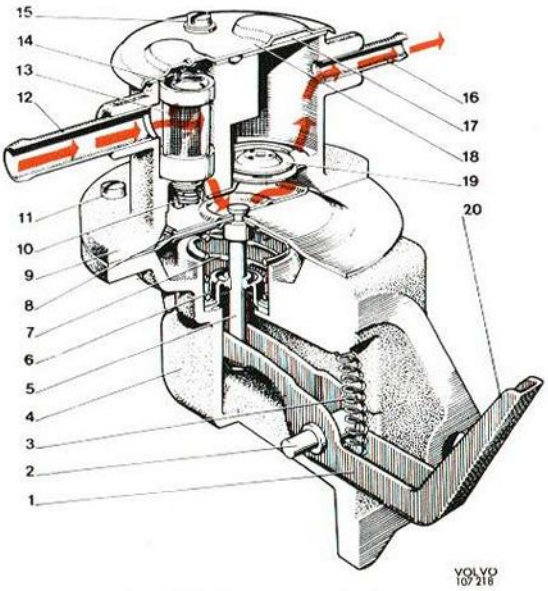



Fig. 2-110. Fuel pump, make S. E. V.

1. Rocker arm
2. Shaft
3. Spring
4. Lower pump body
5. Thrust rod
6. Seal
7. Spring
8. Diaphragm
9. Upper pump body
10. Inlet valve
11. Screw for body
12. Inlet
13. Filter
14. Spring
15. Screw for cover
16. Outlet
17. Seal
18. Cover
19. Outlet valve

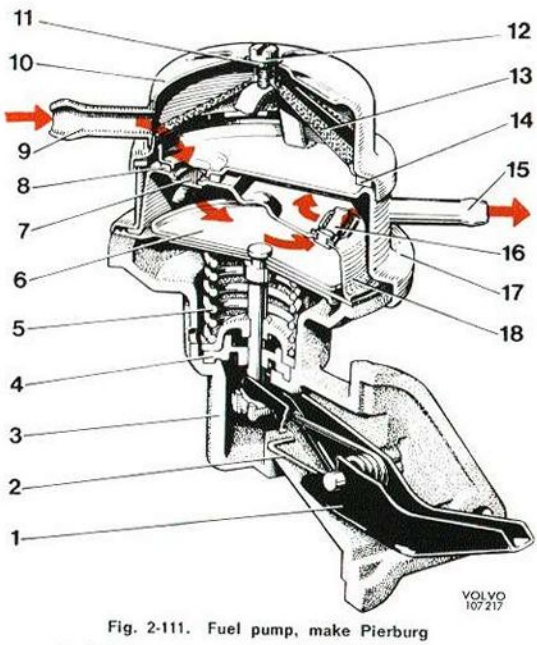



Fig. 2-111. Fuel pump, make Pierburg

1. Lever
2. Spring
3. Lower pump body
4. Seal
5. Spring
6. Diaphragm
7. Inlet valve
8. Sealing ring
9. Inlet
10. Cover
11. Washer
12. Screw
13. Filter
14. Sealing ring
15. Outlet
16. Outlet valve
17. Upper pump body
18. Valve housing

## FUEL PUMP

The fuel pump is of the diaphragm type and is driven by a cam on the camshaft. When the rocker arm in the pump is pressed upwards by the cam, the diaphragm is pulled downwards and fuel is drawn up to the pump. When the rocker arm returns, the diaphragm is pressed upwards by a spring (5, Fig. 2-111) and fuel is fed to the floatchamber in the carburetor. When the level in the floatchamber is sufficiently high, the float valve closes and the pressure in the delivery line rises until the pressure on the upper side of the pumping action ceases. The red arrows show the direction taken by the fuel.

Two alternative fuel pumps are used. One (Fig. 2-110) is of S.E.V. make and the other (Fig. 2-111) is produced by Pierburg.

For both the pumps, the filter (13, Figs. 2-110 and 2-111) should be cleaned after every 10 000 km (6 000 miles). No parts are stocked for these pumps. If the pumps are defective, they must be replaced by a new one, of make Pierburg. However, there is a filter kit for both the pumps when cleaning.

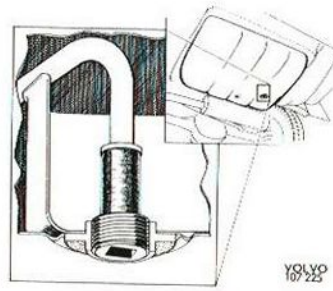



Fig. 2-112. Filter in fuel tank

## FILTER IN FUEL TANK

A filter is located in the suction line in the tank, see Fig. 2-112, and it prevents impurities from being sucked up from the tank into the fuel pump.

This filter should be cleaned at intervals of 40 000 km (24 000 miles).

# REPAIR INSTRUCTIONS

## ZENITH-STROMBERG CARBURETOR

The carburetor is specially set by the manufacturer and fine-adjusted with a CO-meter at the factory. **In order not to disturb the setting of the carburetor, it is absolutely essential that the following repair instructions are accurately followed when any work is to be done on the carburetor.**

### PERIODICAL CHECK

Every 10 000 km (6 000 miles) check that there is oil in the damper cylinder(s). The spindle in the piston should be filled to about a 1/4" from the upper edge with oil approved as "Automatic Transmission Fluid, Type A". See Fig. 2-110.

**Before any adjustment or repair to the carburetor is carried out, the following should be checked and, if necessary, remedied:**

Valve clearance, spark plugs, compression, ignition breaker (dwell angle) and ignition setting. Also check. That there is no air leakage on the intake side and that the air cleaner is not blocked. To be on the safe side, check also the flap function of the constant air temperature unit.

The function of the throttle control and throttle(s) should be checked as well.

### SETTING CARBURETOR

**The best setting of the carburetor is obtained by using a CO-meter**

However, the setting can be checked without the use of this meter, but if checking with either of these methods results in unsatisfactory running of

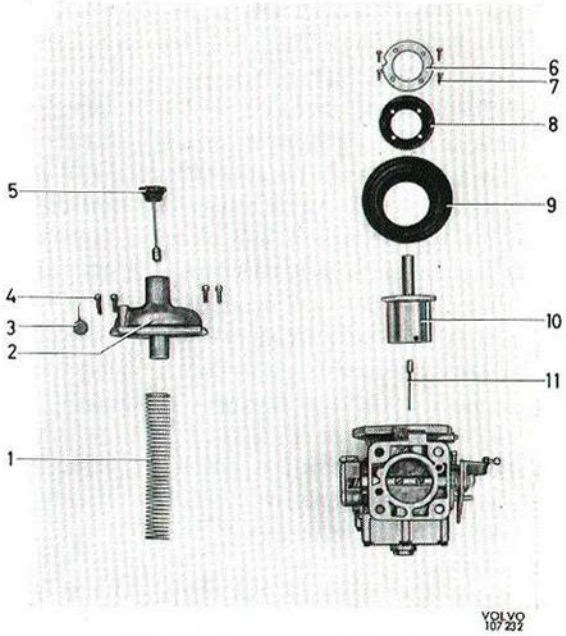



**Fig. 2-113. Upper section dismantled**

1. Spring
2. Suction chamber cover
3. Sealing plug
4. Screw
5. Hydraulic damper
6. Washer
7. Screw for diaphragm
8. Washer
9. Diaphragm
10. Air valve
11. Metering needle

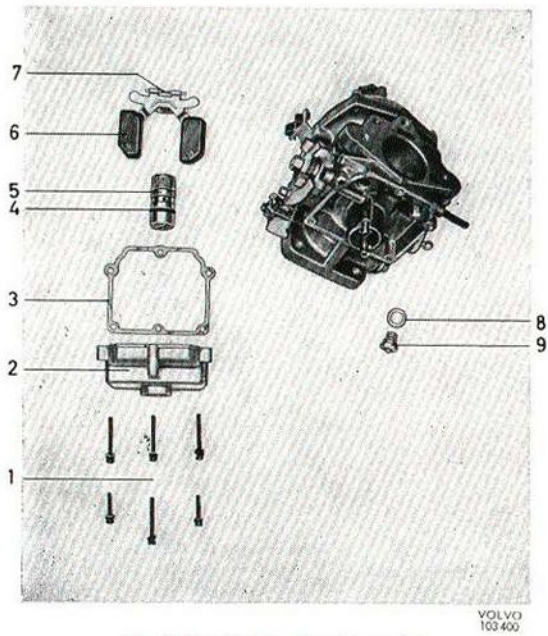



**Fig. 2-114. Floatchamber dismantled**

1. Screw for floatchamber
2. Floatchamber
3. Gasket
4. Rubber ring
5. Floatchamber plug
6. Float
7. Float pin
8. Washer
9. Float valve

the engine and it has been established that the fault is due to an "over-rich" carburetor or "too lean" fuel mixture, the carburetor nozzle should be adjusted by a special tool in accordance with Workshop Bulletin P-23-44.

Use a synchro test for synchronizing the carburetors on the B 20 B.

**SETTING WITHOUT CO-METER**

**B 20 A**

1. Check that there is oil in the damper cylinder. See under "Periodical Check" (page 2:42).
2. Connect at tachometer and run the engine warm at 25 r/s (1500 r/m) until the coolant thermostat opens. The setting should be made within about 10 minutes after the coolant thermostats has opened.
   (One way of finding this out is by feeling the radiator at the upper radiator hose which should start to get warm.)
3. Adjust the engine speed to 12 r/s (700 r/m) with the throttle stop screw (12, Fig. 2-69).
4. Adjust with the idle trimming screw (6, Fig. 2-70) so that the best idling speed is obtained.
5. Adjust the link rod. With the control against its stop on the manifold bracket, the link rod should be adjusted so that there is a clearance of about 0.1 mm (0.004") between the lever and the flange of the primary throttle spindle. See Fig. 2-117.
6. Setting the fast idle: Pull out the choke 20 mm (0.8"). Then adjust the fast idle screw (11, Fig. 2-69) to give an engine speed of 23—25 r/s (1400—1500 r/m).
7. Check that the cable (Fig. 2-128) is well stretched and, if necessary, adjust the cable sleeve adjustment (6).
   Right-hand steered vehicles:
   Adjust the length of the long vertical link (2, Fig.

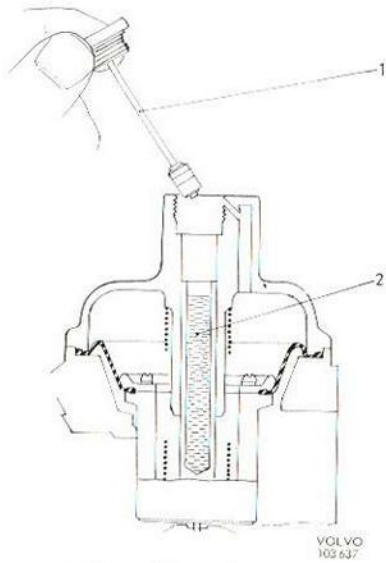



**Fig. 2-115. Checking the damper oil**

1. Damper piston
2. Oil approved as "Automatic Transmission Fluid, Type A"

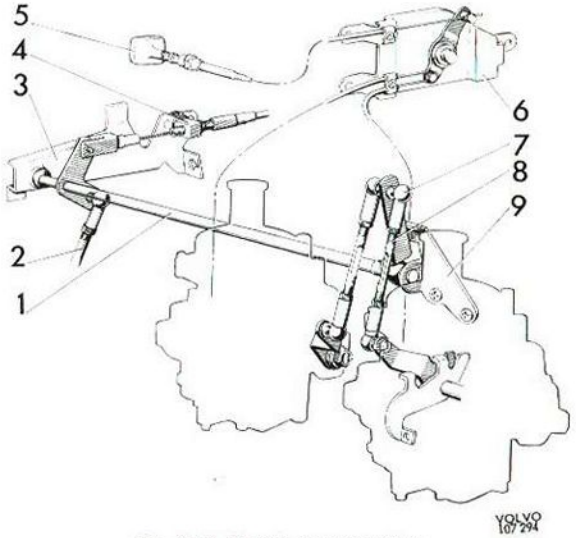



**Fig. 2-116. Throttle control, B 20 B**

1. Throttle control spindle
2. Link rod
3. Bracket (placed on dash)
4. Throttle cable (only vehicles with autom. transmission)
5. Choke control knob
6. Bracket for choke control (only twin carbs engines, plased on dash)
7. Ball joint
8. Link rod
9. Bracket (placed on manifold)

2-116) for the pedal so that there is a clearance of 1 mm (0.039") between the throttle lever lug and the full throttle stop on the carburetors, when the accelerator pedal is fully depressed.

8. Lubricate all ball joints.

**B 20 B**

1. Check that there is oil in the damper cylinders. See under "Periodical Check" (page 2:42).
2. Screw the idle trimming screw (6, Fig. 2-70) to its bottom position.
3. Connect up a tachometer and run the engine warm at 25 r/s (1500 r/m) until the coolant thermostat opens. The setting should be made within about 10 minutes after the coolant thermostat has opened.

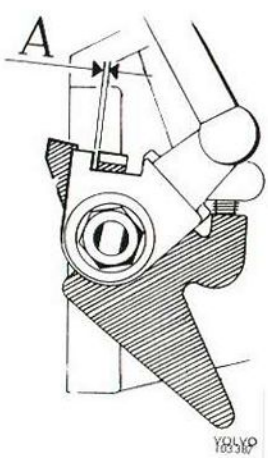



**Fig. 2-117. Setting the control**
A=0.1 mm (0.004")

(One way of finding this out is by feeling the radiator at the upper radiator hose which should start to get warm.)

4. Adjust the engine speed to 13 r/s (800 r/m) with the throttle stop screws (12, Fig. 2-69). The speed should be adjusted to 12 r/s (700 r/m) for a vehicle with automatic transmission.
5. Check with a syncro test that the stream of induction air to both carburetors is the same. Make sure that the syncro test is fitted so that its opening corresponds with the carburetor venturi. Turn the synchrotest throttling washer until a suitable register for its piston is achieved.
6. Adjust the idling screws until the synchro test shows the same register for both carburetors (adjust both screws so that the idling speed is withheld).
7. Adjust with the idle trimming screws (6, Fig. 2-70), so that the best idling speed is obtained. Screw **equally** for both carburettors.
8. Adjust the link rods. With the control against its stop on the manifold bracket, the link rods should be adjusted so that there is a clearance of about 0.1 mm (0.004") between the lever and the primary throttle spindle flange. See Fig. 2-117.
9. Adjust so that the valve control of the hot start valve is against the carburetor lever with the valve piston in the upper position and the throttle control at idle. (See Figs. 2-100, 2-101 and 2-102).
   Lubricate the contact surface with Molykote and check that the engine returns to idling speed after briefly revving-up several times.
10. Setting the fast idle: Pull out the choke control 20 mm (0.8"). Then adjust the fast idle screw (11, Fig. 2-69) to give an engine speed of 18—27 r/s (1100—1600 r/m).
11. Adjust the length of the long, vertical link (2, Fig. 2-16) for the pedal, so that there is a clearance of 1 mm (0.039") between the throttle lever lug and the full throttle stop on the carburetors, when the accelerator pedal is fully depressed.
12. Lubricate all ball joints.

## SETTING WITH CO-METER

**The setting should be made at a temperature of 60—80° F and must be made within 8 minutes after the coolant thermostat has opened. Warming-up should be done with a completely cold engine.**

When measuring with a CO-meter, it is important that the **carburetor temperature** is the correct one.

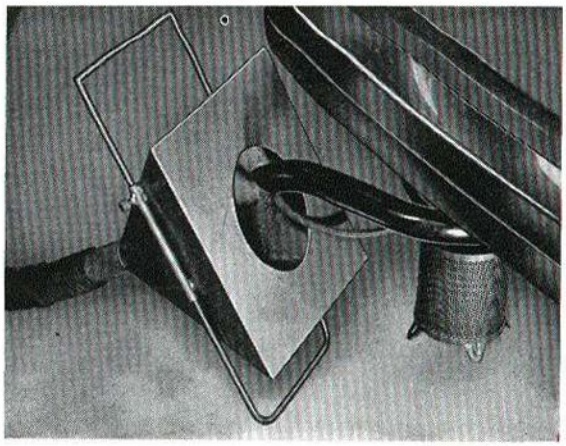



**Fig. 2-118. Funnel for exhaust evacution**

When the engine is idling, the floatchamber is exposed to heat radiation from the exhaust manifold while the flow of cold fuel through the floatchamber is small. The resultant rise in temperature causes an increase in the fuel flow through the jet due to the alternation in the viscosity and the increase in the CO-value. Racing the engine speed cools the carburetor to a certain extent due to the step up in the fuel flow. The temperature can be checked to make sure that it is not excessive by feeling the floatchamber with the hand. It should "feel cold", that is, it more or less should not exceed room temperature.

Before making a reading, rev up the engine so that the air valve takes up the proper position.

In order to be certain that the measured CO-value is correct, **measuring should be carried out within the time period mentioned above.**

There are a number of different types of CO-meters available which function with acceptable accuracy. The instructions on their use accompany each meter. Note that when connecting the hose for evacuating the exhaust gases, the hose must not be placed so that the exhaust gases are completely evacuated from the CO-meter connection to the exhaust manifold. A funnel, see Fig. 2-118, could suitably be used here. With the funnel installed, the suction at the connection would not be so great as to upset the measuring but sufficient to suck up the exhaust gases so that they do not fill the workshop.

When doing any measuring with the CO-meter, it is important that the exhaust pipe and silencer are in good condition, that is, they do not leak.

**B 20 A**

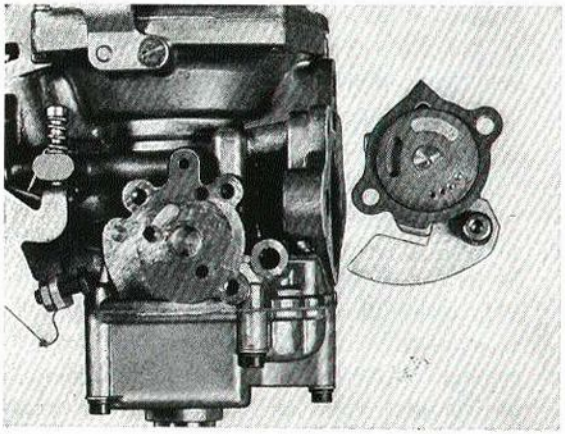
1. Check that there is oil in the damper cylinder. See under "Periodical Check" (page 2:42).
2. Connect at tachometer and run the engine warm at 25 r/s (1500 r/m) until the coolant thermostat opens. (One way of finding this out is by feeling the radiator at the upper radiator hose which should start to get warm.)
3. Adjust the engine speed to 12 r/s (700 r/m with the throttle stop screw (12, Fig. 2-69).
4. Connect a CO-meter and check that the CO-content is 2.5 %. With the help of the idle trimming screw (6, Fig. 2-70), the CO-content can be adjusted within small deviations. (If the CO-content is too high, check first the temperature compensator, see under the heading "Temperature Compensator".)
5. Adjust the link rod. With the control against its stop on the manifold bracket, the link rod should be adjusted so that there is a clearance of about 0.1 mm (0.004") between the lever and the flange of the primary throttle spindle. See Fig. 2-117.
6. Setting the fast idle: Pull out the choke control 20 mm (0.8"). Then adjust the fast idle screw (11, Fig. 2-69) to give an engine speed of 23—25 r/s (1400—1500 r/m).
7. Check that the cable (Fig. 2-128) is well stretched and, if necessary, adjust the cable sleeve adjustment (6).

   Right-hand steered vehicles:

   Adjust the length of the long vertical link (2, Fig. 2-116) for the pedal so that there is a clearance of 1 mm (0.039") between the throttle lever lug and the full throttle stop on the carburetors, when the accelerator pedal is fully depressed.
8. Lubricate all ball joints.

**B 20 B**

1. Check that there is oil in the damper cylinders. See under "Periodical Check" (page 2:42).
2. Screw the idle trimming screws (6, Fig. 2-70) to bottom position.
3. Connect at tachometer and run the engine warm at 25 r/s (1500 r/m) until the coolant thermostat opens. (One way of finding this out is by feeling the radiator at the upper radiator hose which should start to get warm.)
4. Adjust the engine speed to 13 r/s (800 r/m) with the throttle stop screws (12, Fig. 2-69). The speed should be adjusted to 12 r/s (700 r/m) for a vehicle with automatic transmission.
5. Check with a synchro test that the stream of induction air to both carburetors is the same. Make sure that the synchro test is fitted so that its opening corresponds with the throats of the carburetors. Turn the synchro test

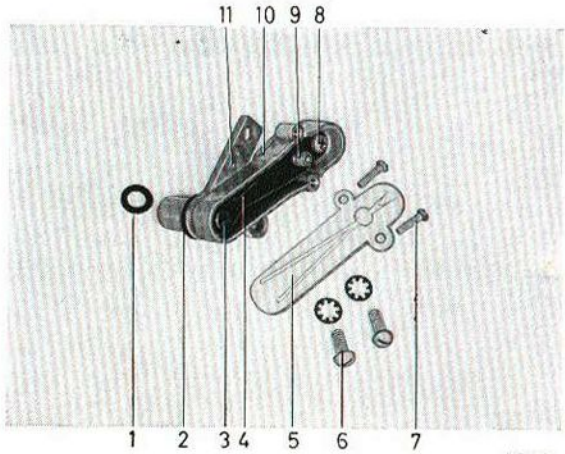


VOLVO 103402

Fig. 2-119. Cold start device

throttle washer until a suitable register for its piston is achieved.

6. Adjust the idling screws until the synchro test shows the same register for both carburetors (adjust both screws so that the idling speed is withheld).
7. Connect a CO-meter and check that the CO-content is 2.5 %. With the help of the idle trimming screw (6, Fig. 2-70) the CO-content can be adjusted within small deviations. Screw **equally** for both carburetors. (If the CO-content is too high, check first the temperature compensator, see under "Temperature Compensator".)
8. Adjust the link rods. With the control against its stop on the manifold bracket, the link rods should be adjusted so that there is a clearance of about 0.1 mm (0.004") between the lever and the flange of the primary throttle spindle. See Fig. 2-117.
9. Adjust so that the valve control of the hot start valve is against the carburetor lever with the valve piston in the upper position and the throttle control at idle. (See Figs. 2-100, 2-101 and 2-102.)
   Lubricate the contact surface with Molykote and check that the engine returns to idling speed after revving-up briefly several times.
10. Setting the fast idle: Pull out the choke control 20 mm (0.8").
    Then adjust the fast idle screw (11, Fig. 2-69) to give an engine speed of 18—26 r/s (1100—1600 r/m).
11. Adjust the length of the long, vertical link (2, Fig. 2-116) for the pedal, so that there is a clearance of 1 mm (0.039") between the throttle lever lug and the full throttle stop on the carburettors, when the accelerator pedal is fully depressed.
12. Lubricate all ball joints.




VOLVO 103731

Fig. 2-120. Temperature compensator

1. Rubber seal
2. Rubber seal
3. Valve
4. Bi-metal spring
5. Cover
6. Screw for temperature compensator
7. Screw for cover
8. Cross-slotted screw
9. Adjuster nut
10. Housing
11. Marking

## FAULTY CARBURETOR FUNCTION

1. Check to make sure that the reason for the fault in the function is not due to wrong damper oil or oil level, impurities in the floatchamber or a faulty float valve and float. See the respective headings.
2. Remove the air cleaner and check that the suction valve(s) operate easily and without jamming. (The damper piston(s) removed.) If this is not the case, remove the suction chamber cover and clean the pistons. At the same time, check to make sure the diaphragm is in good condition. Plug-seal after fitting.
   NOTE. If the metering needle must be released or moved, it should be adjusted, see under the heading "Replacing the metering needle". **A CO-meter is recommended for this purpose.**

## TEMPERATURE COMPENSATOR

3. Should there be a powerful drop in the idling speed during idling for a lengthy period, especially when the weather is warm, check the function of the temperature compensator by removing the plastic cover and pressing in the valve (3, Fig. 2-120). This should move under very light pressure and return to its position without jamming. This applies at a temperature above 85° F. The valve starts opening at 70°—77° F. Pressing the valve inwards deteriorates the quality of the idle. If the valve has a tendency to be stiff in operation or if the compensator is incorrectly adjusted, the latter should be replaced

complete. See under "Replacing temperature compensator".

For adjusting slacken one of the cross-slotted screws (8), for the bi-metal spring and center the valve so that its function will be as above. If necessary adjust as follows:

At 70°—77° F the valve should just start to open. In other words, the valve should be loose in its seat at this temperature.

When checking the setting, remove the temperature compensator from the carburetor and store it at a temperature of 70°—77° F until it has reached this temperature. Adjust with the nut (9) for the bi-metal spring.

## REMOVING CARBURETORS, B 20 B

(In principle, the same method is used as for the B 20 A.) Release the control for the hot-start valve and remove the air cleaner. Remove the link rod ball joints from the carburetors. Take off the fuel hoses, vacuum hose and choke wire.

Remove the nuts for the carburetors and take off the carburetors. Remove the protection plates and gaskets. Mask over the intake holes with tape.

## FITTING CARBURETORS, B 20 B

Clean the gasket surface. Fit the protection plates, new gaskets and then the carburetors. Connect the ball joints, fuel hoses, vacuum hose and choke wire. Make sure that the choke control on the dashboard is pushed in. Then secure the pull wire in the clamping screw of the rapid idle cam. After this clip on the outer sleeve of the pull wire.

Fit the air cleaner and connect the hose for the crankcase ventilation. Fit and adjust the control for the hot start valve. Adjust the carburetors, see under "Setting carburetors".

## CLEANING FLOATCHAMBER

The floatchamber is removed by unscrewing the floatchamber plug (5, Fig. 2-114) and the screws (1). Clean the gasket surface and fit a new rubber ring (4). Fit the floatchamber with a new gasket.

**Before tightening the floatchamber screws, fit the plug (5).**

## FLOAT LEVEL

Before checking the float level, remove the carburetor, invert it and take out the floatchamber.

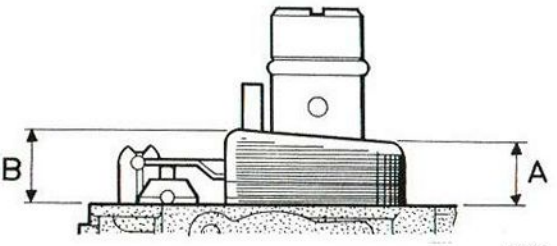



**Fig. 2-121. Float level**
A= 9—13 mm (1/2")
B=15—17 mm (5/8")

The float is removed by carefully breaking the float spindle from the bridge. The float is fitted with the sloping side facing away from the carburetor housing.

At the correct float level, the top point on the float should lie 15—17 mm (5/8") and the rear edge 9—13 mm (1/2") above the sealing surface (see Fig. 2-121). If the level is incorrect, adjust by bending the tag at the float valve.

**NOTE.** Do not bend the arm between the float and the pin.

## REPLACING DIAPHRAGM

1. Screw out the damper piston. Make line-up marks on the suction chamber cover and carburetor housing. Remove the seal plug, release the screws and take off the suction chamber cover. Remove the spring.
2. Pull up the air valve with diaphragm. Remove the diaphragm by unscrewing the four screws. Clean the air valve.

   **NOTE. Observe due care that the metering needle is not bent or moved from its position.**

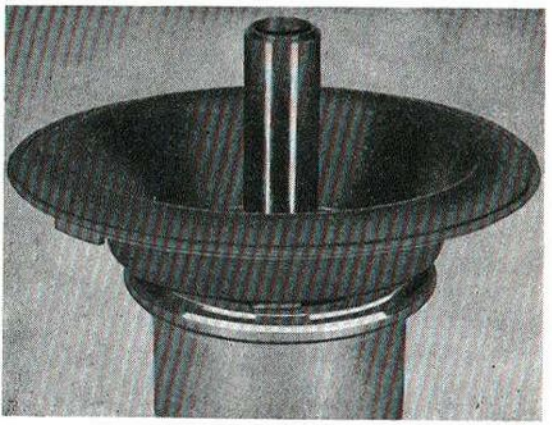



**Fig. 2-122. Diaphragm in air valve**

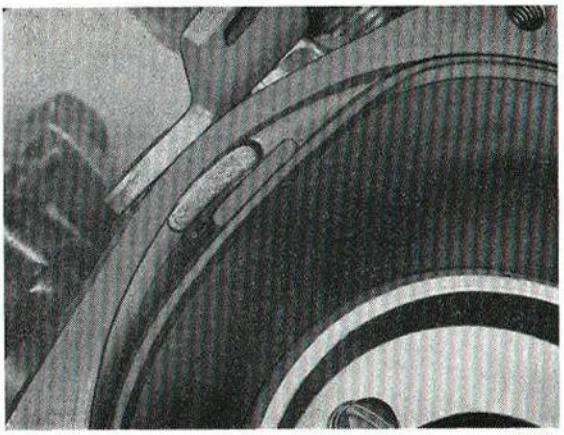


Fig. 2-123. Diaphragm in carburetor housing

3. Fit the new diaphragm, see Fig. 2-122. The rubber register should fit into the valve groove.
4. Move the air valve down and fit in the rubber register as shown in Fig. 2-123. Fit the cover and fill with damper oil.
5. Plug-seal the suction chamber cover.

## REPLACING TEMPERATURE COMPENSATOR

The temperature compensator is replaced complete. It is removed from the carburetor by unscrewing the screws (6, Fig. 2-120). Take out the old seal (1) from the carburetor and fit a new one. Place a new seal (2) on the temperature compensator and fit the compensator.

**NOTE.** The temperature compensator is marked "120°" for the B 20 A engine and "60°" for the B 20 B engine (see 11, Fig. 2-120).

## REPLACING METERING NEEDLE

**After replacing the metering needle, the following check with a CO-meter is recommended.**

If necessary the carburetor nozzle should be adjusted by a special tool in accordance with Workshop Bulletin P-23-44.

1. Remove the air valve from the carburetor and clean it.
2. Remove the needle by unscrewing the lock screw and pull the needle out with the spring suspension.
3. Before fitting the new needle, check the needle designation.
   For B 20 A: B1 CC
   For B 20 B: B1 BL
   The designation is punched on the needle and can be read by pulling the needle out of the spring suspension far enough to reveal the designation.

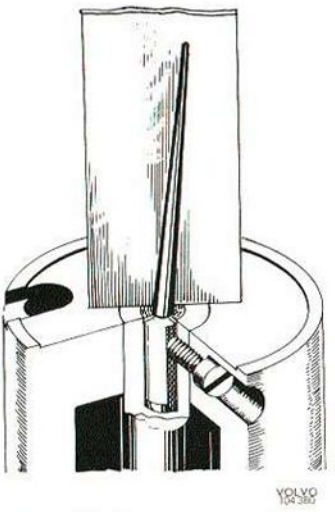


Fig. 2-124. Fitting the metering needle

4. Fit the needle with the spring suspension so that the flat surface faces the lock screw. The needle should incline from the holes in the air valve, i.e., in towards the air cleaner flange.
   The needle should be inserted so far that the plastic washer lies flush with the valve, see Fig. 2-124. Tighten the lock screw.
5. Fit the air valve in the carburetor. Plug-seal the suction chamber cover.


Fig. 2-125. Damper plunger clearance

## DAMPER DEVICE

If the engine does not react properly during acceleration, the reason may be a faulty clearance on the damper plunger, the axial clearance of which (see A, Fig. 2-125) should be 1.0—1.8 mm (0.04—0.07").

With any fault in the damper plunger change it complete.

If the damper device is to function correctly, then the level of the damper oil must be correct (see Fig. 2-115). The interval prescribed for the periodical check is 10 000 km (6 000 miles).

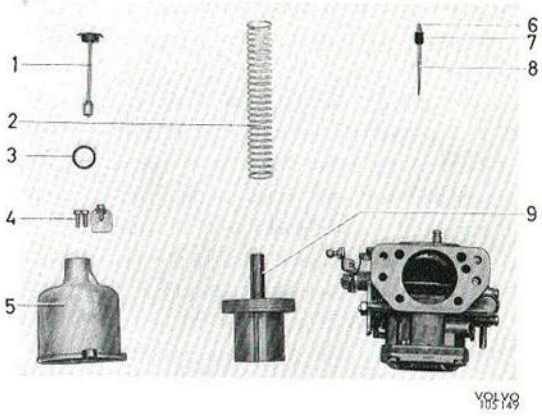



Fig. 2-126. Upper section disassembled

1. Hydraulic damper
2. Spring
3. Seal
4. Screw for suction chamber
5. Suction chamber
6. Spring
7. Sleeve
8. Metering needle
9. Air valve

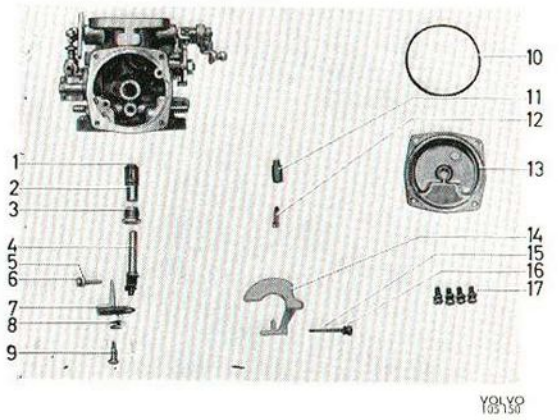



Fig. 2-127. Lower section disassembled

1. Seal
2. Jet sleeve
3. Locknut
4. Fuel jet
5. Rubber seal
6. Jet adjusting screw
7. Bi-metal assembly
8. Spring
9. Screw for bi-metal assembly
10. Rubber seal
11. Valve house
12. Float valve
13. Floatchamber cover
14. Float
15. Float shaft
16. Seal
17. Screws for floatchamber cover

## SU-CARBURETOR B 20 B

The carburetor is specially adjusted by the manufacturer and fine-adjusted with a CO (carbon monoxide) meter at the factory. **In order not to disturb the setting of the carburetor, it is absolutely essential that the following repair instructions are accurately followed when any work has to be done on the carburetor.**

### PERIODICAL CHECK

Every 10 000 km (6 000 miles) check that there is oil in the damper cylinders. The spindle in the piston should be filled to about 1/4" from the upper edge with oil approved as "**Automatic Transmission Fluid, Type A**", see Fig. 2-115.

**Before any adjustment or repair to the carburetor is carried out, the following should be checked and, if necessary, remedied:**

Valve clearance, spark plugs, compression, contact breaker (dwell angle) and ignition setting.

Also check that there is no air leakage on the intake side and that the air cleaner is not blocked.

To be on the safe side, check also the flap function of the constant air temperature unit.

The function of the throttle control and throttles should be checked as well. It should be noted here that, on vehicles for Canada, because of both the overrev valves, the engine drops its idling speed, after having been revved up, somewhat more slowly than the engine which does not have overrev valves.

Check that the control rod of the hot start valve does not prevent the return of the throttle to idling position.

At certain intervals, for example when changing the air cleaner, it is suitable to remove and carefully clean the suction chamber and air valve.

The floatchambers should be cleaned at the same time.

### ADJUSTING CARBURETOR

The best setting of the carburetor is obtained by using a CO-meter. However, the setting can be checked without the use of this meter.

Use a synchro test for synchronizing the carburetors. There are various makes of CO-meters in the market which give good results. Instructions for their use are supplied with the respective meter.

Note that when connecting the exhaust gas evacuation hose, it must not be placed so that the exhaust gases are completely drawn away from the CO-meter connection in the exhaust pipe. A funnel such as the one shown in Fig. 2-118 can suitably be used. With it the suction at the connection will not be so great as to disturb the measuring, but at the same time exhaust gases will be collected and prevented from coming out into the workshop.

When measuring with a CO-meter, it is important that the exhaust pipe and silencer are in good condition and do not leak.

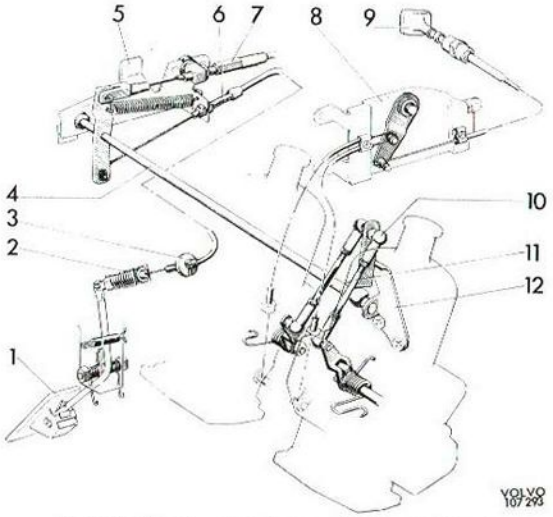



**Fig. 2-128. Throttle and choke control linkage, left-hand steered vehicle**

1. Accelerator pedal
2. Unloading spring
3. Wear washer (for attachment to firewall)
4. Throttle control shaft
5. Bracket (placed on firewall)
6. Adjuster sleeve for throttle control cable
7. Throttle cable (only vehicles with automatic transmission)
8. Bracket for choke control (only twin carb. engines. Placed on firewall)
9. Choke control knob
10. Ball joint
11. Link rod
12. Bracket (placed on manifold)

After each adjustment and before reading the CO-value, briefly rev up the engine so that the air valves are in their proper position.

Since the carburetors are fitted with temperature-controlled jets, the temperature of both the carburetors (floatchambers) should be about the same at the basic setting.

With temperature regulation, the carburetors are not so sensitive if the engine is allowed to idle for any length of time.

1. Remove the air cleaner.
2. Carry out the basic setting for the fuel jets:
   Lift the air valve and screw in the adjusting screw (6, Fig. 2-80) so that the upper edge of the fuel jet comes level with the bridge (9, Fig. 2-84).
   Then lower the jet by turning the adjusting screw 2 1/2 turns clockwise.
   This applies with a carburetor temperature of about 170° F. If the temperature is otherwise, compensation should be accordingly made.
   Turning the adjusting screw a 1/4 turn compensates for a temperature difference of about 70° F. If the temperature is higher than 70° F, screw the adjusting screw less than 2 1/2 turns, and at lower temperature more than 2 1/2 turns.
3. Check to make sure that there is oil in the damper cylinders. See under "Periodical Check".
4. Connect a speedometer (and a CO-meter). Run the engine warm at 25 r/s (1500 r/m) until the cooling water thermostat opens. (Feel the radiator with the hand at the upper radiator hose which should begin to get warm.)
5. Adjust the engine speed to 13 r/s (800 r/m) with the throttle stop screws (1, Fig. 2-83). The speed should be adjusted to 12 r/s (700 r/m) for a vehicle with automatic transmission.
6. Check with a synchro test that the stream of induction air to both carburetors is the same. Make sure that the synchro test is fitted so that its opening corresponds with the carburetor venturi. Turn the synchro test throttling washer until a suitable register for its piston is achieved.
7. Adjust the idling screws until the synchro test shows the same register for both carburetors (adjust both screws so that the idling speed is withheld).

8a. With CO-meter: Screw equally and simultaneously on both the adjusting screws (6, Fig. 2-80) so that the CO-value is 2.5 %. (Anti-clockwise screwing reduces the CO-content.) After each adjustment and before reading the Co-value, briefly rev up the engine so that the air valves are in their proper position.

b. Without CO-meter: Screw equally and simultaneously on both the adjusting screws (6, Fig. 2-80) so that maximum r/s is obtained. Then screw both equally anti-clockwise so that the speed just starts to drop (briefly race the engine a couple of times during adjustment).

9. Lift the air valve for one of the carburetors with the pin and check the fall off in engine speed. Repeat the procedure with the other carburetor.
10. If adjustment is correct, the fall off in speed should be approximately 2.5—4 r/s (150—250 r/m) in both cases.
    If the speed falls off too much when lifting, for example, the rear carburetor valve, adjust the front carburetor to a somewhat richer mixture (clockwise screwing).

11a. With CO-meter: Screw equally and simultaneously on both the adjusting screws so that the CO-value is 2.5 %.

b. Without CO-meter: If a carburetor has been adjusted to a richer mixture according to point 10, this can be remedied by screwing equally and simultaneously on both the adjusting screws (anti-clockwise) until there is a slight indication that the r/s is starting to drop.

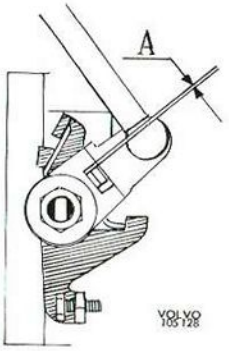



Fig. 2-129. Setting the control
A=0.1 mm (0.04")

12. Check and adjust if necessary the idling speed with the aid of the synchro test as per point 7.
13. Adjust the link rods. With the control against its stop on the manifold bracket, the link rods should be adjusted so that there is a clearance of about 0.1 mm (0.004") between the lever and the flange of the throttle spindle. See Fig. 2-129.
14. Adjust the hot start valve. With the control rods (Fig. 2-130) pressed down to the bottom position, the distance (A) between rod and adjusting screw should be max 1.0 mm (0.04"). (Check to make sure that the control rods move without jamming.)
15. Adjusting the rapid idle: Pull out the cold start control at the instrument panel 20 mm (0.8"). Then adjust the engine speed to 18—27 r/s (1100—1600 r/m). Screw equally on both fast idle stop screws.
16. Check that the cable (Fig. 2-128) is well-stretched and if necessary adjust with the cable sleeve adjustment (6).
17. Lubricate all ball joints.
18. Fit the air cleaners and test run the car. During test running, carry out a new "pin test" and any adjustment necessary. Fit the plastic plugs over the adjusting screws.

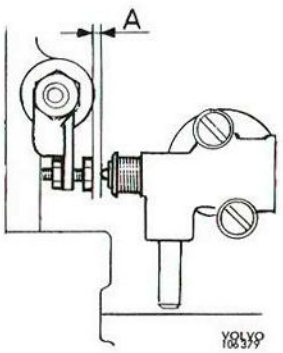



Fig. 2-130. Setting the hot start valve

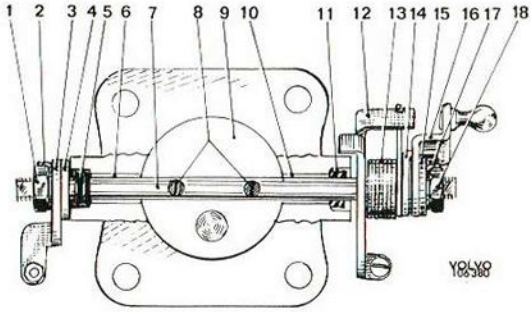



Fig. 2-131. Throttle spindle

1. Nut
2. Tab washer
3. Lever
4. Washer
5. Seal
6. Bush
7. Throttle spindle
8. Screw for throttle
9. Throttle
10. Bush
11. Seal
12. Lever
13. Return spring
14. Flange
15. Washer
16. Lever
17. Tab washer
18. Nut

## REMOVING CARBURETORS

Remove the air cleaner. Remove the link rod ball joints from the carburetors. Take off the fuel hoses, vacuum hoses, hose for hot-start valve and choke wires.

Remove the nuts for the carburetor and take off the carburetors. Remove the protection plates and gaskets. Mask over the intake holes with tape.

## INSTALLING CARBURETORS

Clean the gasket surface. Fit the protection plates, new gaskets and then the carburetors. Connect the ball joints, fuel hoses, vacuum hoses, hose for hot-start valve and choke wires. Make sure that the choke control on the dashboard is pushed in. Then secure the pull wire in the clamping screws of the rapid idle cam.

Fit the air cleaner and connect the hose for the crankcase ventilation. Adjust the carburetors, see under "Setting the carburetors".

## CLEANING FLOATCHAMBER

Remove the floatchamber by unscrewing the four screws (17, Fig. 2-127) for the cover. Use a new rubber ring (10) when fitting the cover. The cover should be fitted with the inside collar at the float valve.

## FLOAT LEVEL

To check the float level, remove the carburetor, turn it upside down and remove the floatchamber cover.

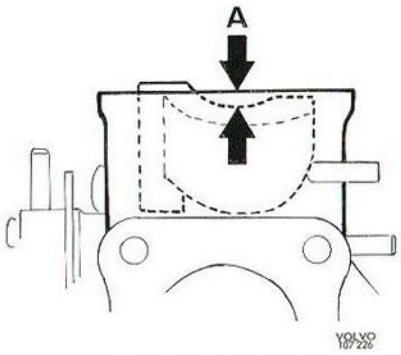



**Fig. 2-132. Float level**
A=0.5—1.5 mm (0.02—0.06")

At the correct float level, the measurement A (Fig. 2-132) between float and flange should be 0.5—1.5 mm (0.02—0.06").

The float has an adjustable metal tab.

The float is removed by screwing the float shaft out of the chamber.

Note when fitting that the float valve retainer should hook round the float tab (Fig. 2-134).

## FIT OF AIR VALVE

The fit can be checked by plugging the air holes in the valve with, for example, small corks. The damper plunger is fitted but not filled with oil. The air valve spring is not fitted. Normally the valve should sink to the bottom, from the position shown in Fig. 2-133 in about 5—7 seconds.

If the valve is worn, both valve and suction chamber should be replaced since they are matched together.

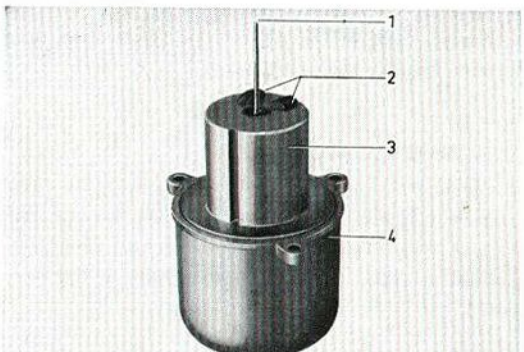



**Fig. 2-133. Air valve fit**

1. Metering needle
2. Plugs, e.g. rubber or cork
3. Air valve
4. Suction chamber

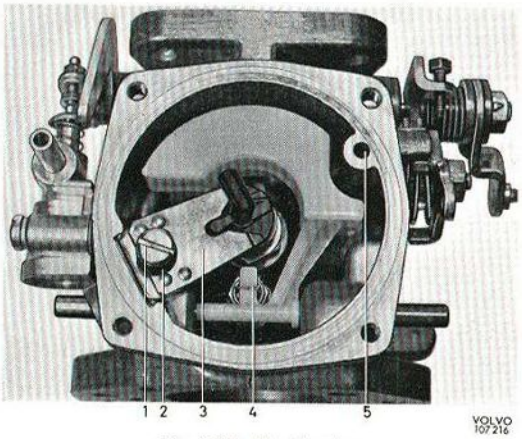



**Fig. 2-134. Floatchamber**

1. Screw for bi-metal assembly
2. Spring
3. Bi-metal assembly
4. Float valve retainer
5. Drilling to cold start valve

## REPLACING METERING NEEDLE AND FUEL JET

1. Remove the suction chamber and take out the air valve.
2. Remove the floatchamber cover.
   Undo the screw (1, Fig. 2-134) and lift the bi-metal spring out with the jet.
3. Unhook the jet from the bi-metal spring and hook on the new jet.
4. If the seal (1, Fig. 2-127) for the jet sleeve has to be replaced, this is done by undoing the locknut (3) and lifting out the jet sleeve. (First remove the float.)
5. Fit the jet in the sleeve and the bi-metal spring in position. Make sure that the slot on the lever fits on the adjusting screw pin. Fit the spring (8) and the screw (9).
   Note. Make sure that the correct jet is fitted in the right carburetor according to Fig. 2-136.
6. Screw on the adjusting screw so that the upper edge of the jet comes level with the bridge (9, Fig. 2-84). Then screw the adjusting screw 2 1/2 turns clockwise.
7. Fit the floatchamber cover with a new gasket.
8. Undo the lock screw in the air valve and pull out the metering needle with sleeve.
9. Fit the new metering needle in the air valve. The needle designation is BAZ (for Canadian market, BBB).
   **The needle should incline in the direction of the carburetor air cleaner flange.** This is obtained when the mark A, Fig. 2-135) on the sleeve points from the holes in the air valve. The mark shows where the pin, which presses over the needle, is located. The sleeve should lie level with the valve, see Fig. 2-135.
10. Fit the air valve and suction chamber.

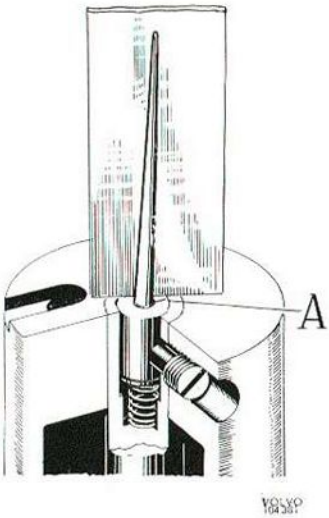
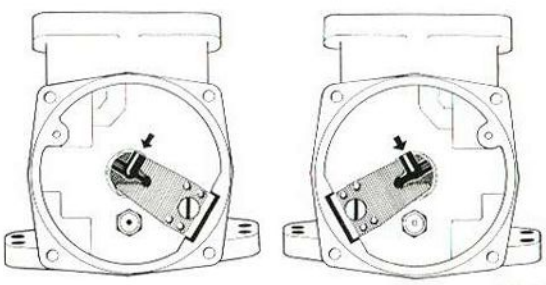



Fig. 2-135. Fitting metering needle

## COLD START DEVICE

### Replacing seals

1. Bend up the lock washer and remove the nut for the "channel disc" on the cold start device.
2. Disconnect the spring and remove the "channel disc". Remove the spring.
3. Undo the two screws and remove the spring retainer.
4. Pull out the cold start device from the carburetor housing. Press the spindle out of the cold start device housing. Remove the gasket (7, Fig. 2-137), the rubber ring (4) and the seal (6). Clean all parts. Blow clean all channels with an air line.
5. Fit a new rubber ring and seal. Oil the seals. Fit the spindle in the housing.
6. Place a new gasket on the housing and move the device into position in the carburetor housing so that recess is at the upper screw.
7. Fit the spring retainer and the screws. Place the return spring in position with the shorter wire end in the spring retainer slot.




A
Nozzle fitted in rear carburetor

B
Nozzle fitted in front carburetor

Fig. 2-136. Nozzle angle

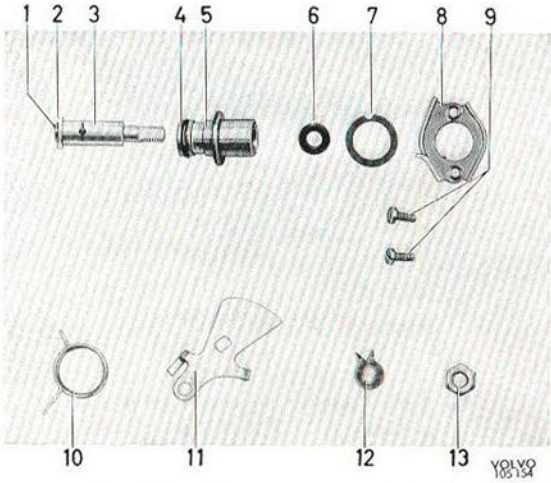



Fig. 2-137. Cold start device, disassembled

1. Circlip
2. Washer
3. Spindle
4. Rubber ring
5. House
6. Rubber seal for spindle
7. Gasket
8. Spring retainer
9. Screw for cold start device
10. Return spring
11. Fast idle screw
12. Tab washer
13. Nut

8. Hook the "channel disc" onto the spring end and place the disc on the spindle. Fit the lock washer and nut.

## HOT START VALVE

The hot start valve cannot be dissembled. Removal from the carburetor housing for cleaning is done by unscrewing the two screws. Clean all the channels with an air line. Check to make sure that no impurities prevent the valve disc from sealing. This can be done by blowing lightly with the mouth in the hose connection. Do this first with the control rod in the outer position, then pressed in and with a finger covering the hole (2, Fig. 2-138).

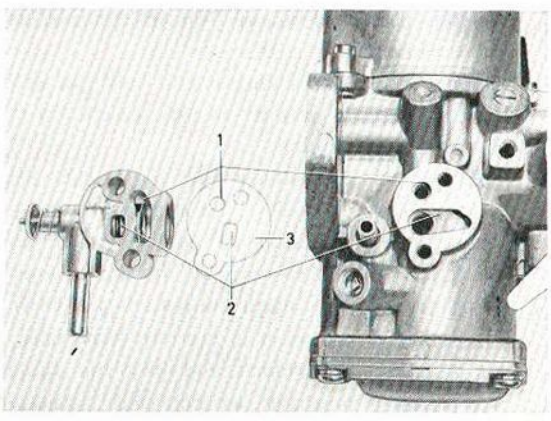



Fig. 2-138. Hot start valve removed

1. Channel, connected to air cleaner
2. Channel, connected to floatchamber
3. Gasket (in assembly position)

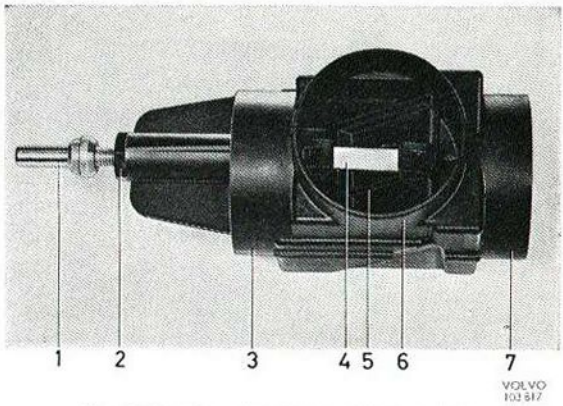



**Fig. 2-139. Constant air temperature device flap**

1. Thermostat
2. Lock
3. Air cleaner connection
4. Flap control
5. Flap
6. Warm air intake
7. Cold air intake

The valve will not seal against any high pressure. Also check that the control rod does not jam when moving.

Fit the valve with a new gasket. Make sure that the gasket faces in the proper direction.

### DAMPER DEVICE

If the engine does not react properly during acceleration, the reason may be a faulty clearance on the damper plunger, the axial clearance of which (see A, Fig. 2-125) should be 1.1—1.7 mm (0.04—0.07″). With any fault in the damper plunger, change it complete.

If the damper device is to function correctly, then the level of the damper oil must be correct (see Fig. 2-115). The interval prescribed for the periodical checks is 10 000 km (6 000 miles).

## REPLACING THROTTLE CABLE

1. Disconnect the cable end from the lever for the control rod.
2. Remove the cable sleeve from the bracket on the dashboard.
3. Remove the cable split pin and split pin bolt from the spring retainer at the attachment to the accelerator pedal.
4. Remove the cable sleeve from the attachment to the cowl and pull the cable through the hole.
5. Unhook the cable end from the spring retainer.
6. Hook the new cable onto the spring retainer.
7. Insert the cable through the hole in the cowl. Place the wear washer in position from inside the engine compartment and lock the cable sleeve by fitting the washer and nut and tightening up the nut from inside the car compartment.
8. Connect up the spring retainer to the pedal. Lock the split pin bolt with the split pin.

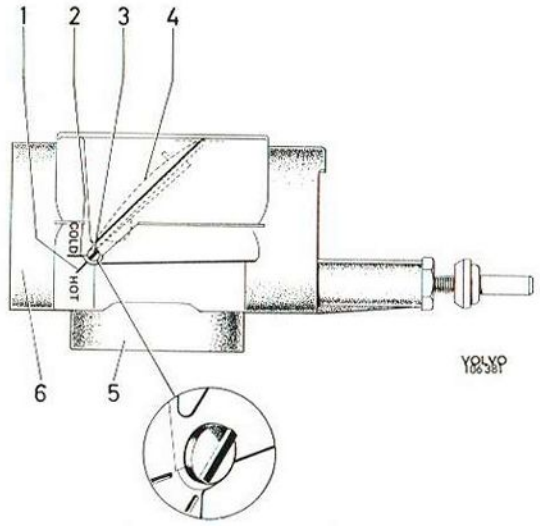



**Fig. 2-140. Checking flap function**

1. Hot=open for warm air
2. Cold=open for cold air
3. Tab
4. Shutter
5. Warm air intake
6. Cold air intake

9. Connect the end of the cable to the lever and the cable sleeve to the bracket on the cowl.
10. With the cable sleeve, adjust the cable so that it is properly stretched.

## FLAP HOUSING FOR CONSTANT AIR TEMPERATURE DEVICE

If the flap (5, Fig. 2-139) does not open, there will be too high a temperature for the intake air and this will have a negative effect on the engine.

The thermostat can be checked in lukewarm water. The flap should be closed for cold air at a temperature of 70—77° F and for warm air at 95—105° F. If correct function is not obtained, replace the flap housing with the thermostat complete.

The flap location can be checked with the flap housing fitted in position. A small tab on the flap spindle projects from both sides of the housing (see 3, Fig. 2-140). The longitudinal pin for these tabs conicides with that of the spindle and turns parallel with the spindle. In other words, the location of the flap can be seen at different temperatures by comparing the angle of a tab in relation to the marks (1) and (2). Cold=open for cold air. Hot=open for warm air.

When fitting the flap housing, note that the thermostat should be in the middle of the air flow and that the hose clamp screw should be on top of the flap.

## AIR CLEANER

The air cleaner on the B 20 A and the insert on the B 20 B should be changed every 40 000 km (25 000 miles) unless the driving conditions are severe, in which case replacement should take place more frequently.

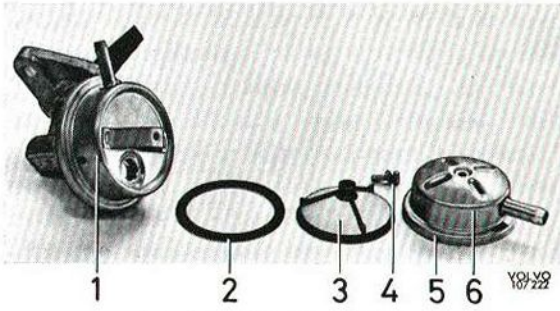



Fig. 2-142. Fuel pump, Pierburg

1. Profile
2. Seal
3. Filter
4. Screw for cover
5. Profile
6. Cover

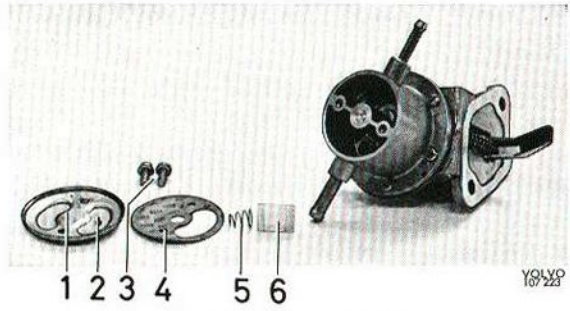



Fig. 2-143. Fuel pump, S.E.V.

1. Cover
2. Boss for centering spring (5)
3. Screw for cover
4. Seal
5. Spring
6. Filter

No cleaning of any kind should be done between the changes.

**On no condition must the insert be moistened or oiled.**

**A sign of a blocked air cleaner is increased fuel consumption.**

## FUEL PUMP

### PIERBURG

If the fuel pump is defective, replace it complete. There is a filter kit for cleaning it.

### Cleaning fuel pump

1. Remove the cover (6, Fig. 2-142), the filter (3) and the seal (2).
2. Clean the body and cover. Blow the filter clean or replace it.
3. Place the seal and filter on the body.
4. Fit the cover. Make sure that the profiles in the body and cover (see 1 and 5, Fig. 2-142) coincide.

## FUEL PUMP

### S. E. V.

If a S. E. V. fuel pump becomes defective, replace it complete with the Pierburg fuel pump. AB Volvo Parts stocks only the Pierburg type fuel pump. However, a filter kit is stocked for cleaning both the Pierburg pump and the S. E. V. pump.

### Cleaning fuel pump

1. Remove the cover (1, Fig. 2-143), the spring (5) and the seal (4).
2. Blow clean in the fuel pump body.
3. Remove the filter (6) and blow it clean or replace it.
4. Fit the filter. Place the seal in position with the open part over the filter. Place the spring (5) in position and fit the cover with the boss (2) facing the spring.

## FUEL FILTER IN TANK

The filter should be cleaned at intervals of 40 000 km (24 000 miles) for vehicles with carb. engines.

The filter is accessible after the bottom plug (see Fig. 2-145) has been screwed off.

When fitting the filter, check to make sure that the suction pipe is centered with the flange hole. Otherwise the filter can be pressed down at an angle when fitting the pipe or when fitting the bottom plug and at worse this could shut off the fuel supply.

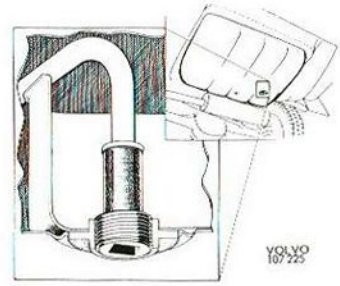



Fig. 2-144. Fuel filter in tank

## VENTING FILTER

The foam plastic filter (1, Fig. 2-96) should be changed every 40 000 km (24 000 miles). This is done by slackening the bracket screws, lifting up the venting filter and drawing out the foam plastic filter. Fitting is in reverse order.

## EXHAUST GAS RECIRCULATION (EGR)

The EGR lines and valve should be **cleaned** at intervals of 20 000 km (12 000 miles).

At every other cleaning, that is, every 40 000 km (24 000 miles) the EGR valve should be **replaced by a new one.**

When cleaning, remove the lines from their connections at the exhaust pipe and carburetor.

The intake manifold should only be cleaned when necessary. Remove the manifold to do this. The function of the EGR system is checked by connecting up the distributor vacuum hose to the EGR valve vacuum chamber with the engine at idle. This should cause the engine to stop or to run very unevenly. If this does not happen, check to make sure that the EGR pipe and the EGR line are not blocked. If this is not the case, in other words the EGR pipe and EGR line are without fault, replace the EGR valve with a new one.

## GROUP 24

# FUEL INJECTION ENGINES

## DESCRIPTION

The B 20 E engine is fitted with an electronically controlled fuel injection system. The system is made up of the following units:

Control unit, electric fuel pump, fuel filter, pressure regulator, injectors, cold start valve, inlet duct, throttle valve switch, auxiliary air regulator, temperature sensors (induction air and coolant), pressure sensor (for pressure in inlet duct), triggering contacts in ignition distributor, thermal timer and electronic control unit, see Figs. 2-145 and 2-146.

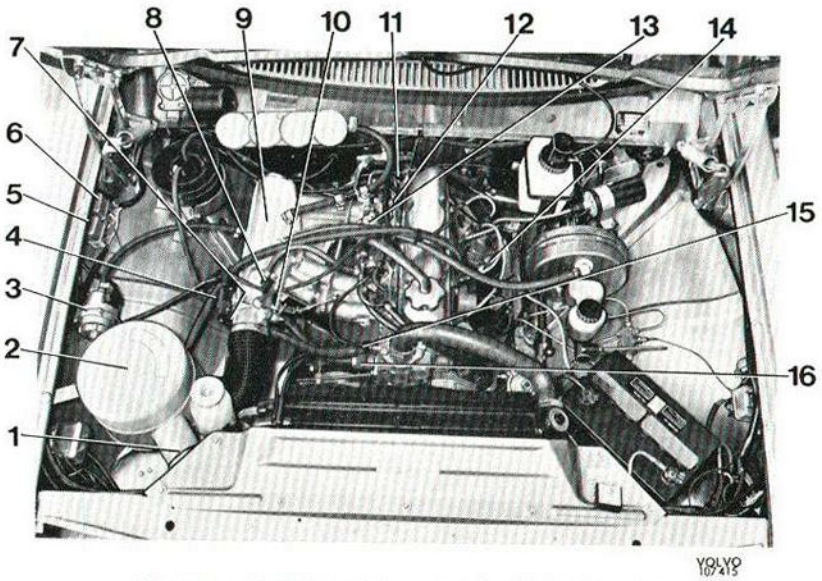



**Fig. 2-145. Electronically controlled fuel injection (B 20 E and F)**

1. Temperature sensor (induction air)
2. Air cleaner
3. Pressure sensor
4. Throttle switch
5. Pump relay
6. Main relay
7. Screw for adjusting idling (not visible)
8. Cold start valve
9. Inlet duct
10. Stop screw for throttle valve
11. Thermal timer
12. Injector
13. Pressure regulator
14. Triggering contacts
15. Temperature sensor (coolant)
16. Auxiliary air regulator

## FUNCTION

Fuel is drawn by the electric pump from the tank via the fuel line and through the filter from where it is conveyed under pressure into the fuel line to the injectors.

The pressure regulator, which is connected to the end of the pressure line, limits the fuel pressure to 2.1 kp/cm² (30 p s i). Excess fuel from the pressure regulator flows back to the tank through the return line. The electro-magnetic fuel injectors, which are mounted in the intake ports in the cylinder head, are connected to the fuel line.

The duration of injection for the injectors is governed basically by engine load and speed.

The pressure sensor senses the absolute pressure in the inlet duct and converts it to electrical impulses which are processed by the control unit. Since the pressure in the inlet duct is proportional to engine load, the control unit receives information concerning the engine load in this way.

The triggering contacts in the distributor provide the control unit with information about the engine speed.

The control unit processes this information and, by means of signals to the injectors, determines how long the injectors will be open in order to provide the right amount of fuel.

The opening time for the cold start valve, which

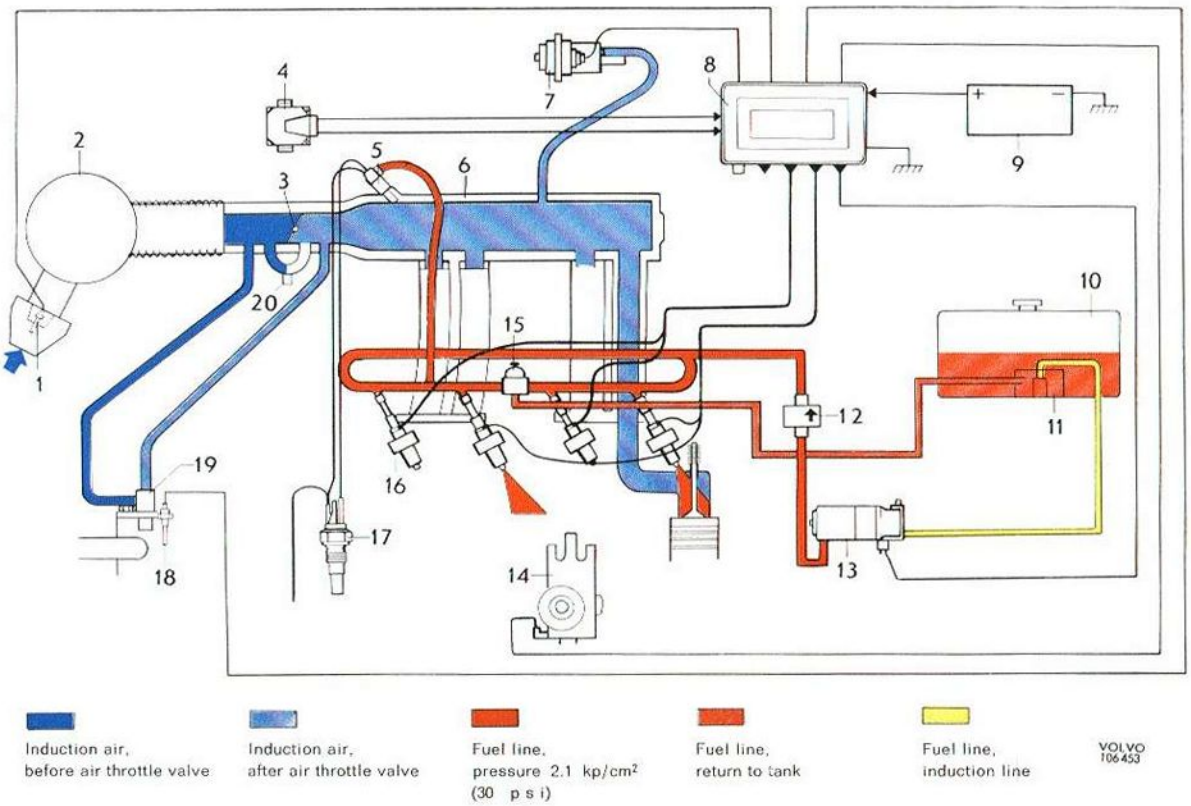



**Fig. 2-146. Fuel injection system, principle of operation**

1. Temperature sensor for induction air
2. Air cleaner
3. Throttle valve
4. Throttle valve switch
5. Cold start valve
6. Inlet duct
7. Pressure sensor
8. Control unit
9. Battery
10. Fuel tank
11. Fuel filter, suction line
12. Fuel filter, discharge line
13. Fuel pump
14. Distributor with triggering contacts
15. Pressure regulator
16. Injectors
17. Thermal timer
18. Temperature sensor for coolant
19. Auxiliary air regulator
20. Idling adjustment screw

reduces with increased engine temperature, is regulated by the thermal timer relay.

Over and above the basic fuel, extra fuel must be supplied to the engine for starting, running warm and acceleration. During cold starting, the engine is given extra fuel through the cold start valve on the inlet duct.

During warming-up the control unit receives information from the temperature sensor in the cooling water circuit and as a result permits the injectors to remain open for a little longer time. If the engine is to function as it should with the increased flow of fuel, more air is required. Extra air is obtained through the auxiliary air regulator which gradually closes as the engine temperature rises.

The electronic control unit receives impulses for additional fuel during acceleration from the throttle valve switch. When the accelerator pedal is depressed, impulses are released from the throttle switch to the control unit which issues orders to the injectors to inject a number of times between the ordinary injections. Depressing the accelerator pedal quickly would cause the duration of the injection to be longer than the ordinary injection time.

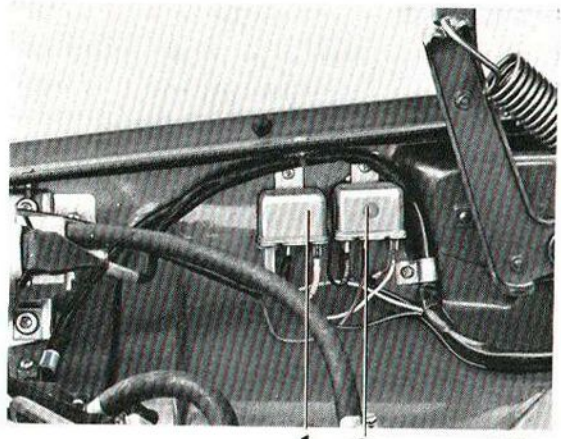



Fig. 2-148. Control relays
1. Pump relay
2. Main relay

## CONTROL UNIT

The control unit is located as shown in Fig. 2-147. Its function is to process the information from the various sensors and determine the opening interval for the injectors and when the fuel pump should start operating. The fuel pump is operated via a control relay located on the right wheel arch, see Fig. 2-148. Here, in the same place, the main relay feeding the control unit is also placed.

The main relay is provided with a diode in the control circuit to prevent the injection system from being engaged and consequently damaged, if the battery polarity is reversed.

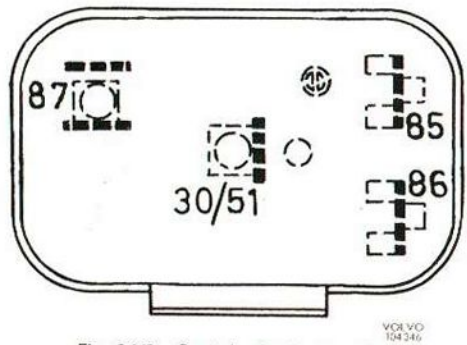



Fig. 2-149. Control relays' connections

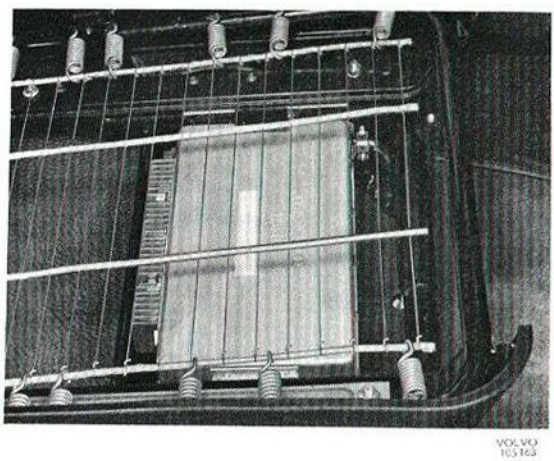



Fig. 2-147. Control unit, installed

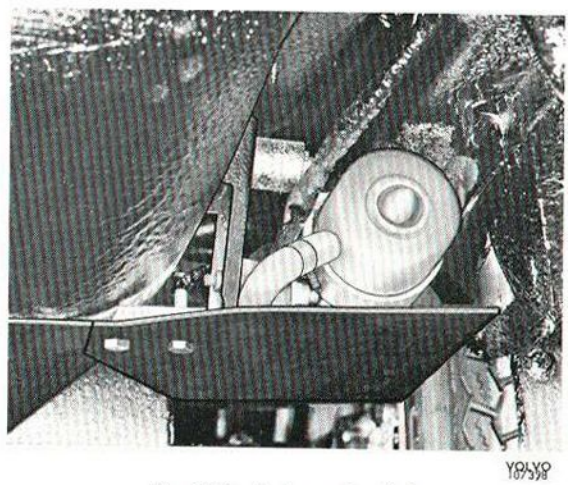



Fig. 2-150. Fuel pump, installed

The fuel pump is fitted under the vehicle to the right of the fuel tank, see Fig. 2-150.

The pump and pump motor are integrally built and connected up in such a way that they cannot be repaired but must be replaced if damaged. Fuel is sucked in at the front part of the pump and discharged at the rear end. With this arrangement the motor rotor and the electric brushes operate in the fuel. The pump is fitted with partly a built-in relief valve and partly a check valve. The relief valve opens if the pressure for some reason or other exceeds 4.5 kp/cm² (68 psi), which may be due to, for example, a fault in the pressure regulator, blockage in the fuel lines, etc. Fuel is pumped round in the pump without any further increase in pressure. The check valve shuts off when the pump pressure drops to 1.2 kp/cm² (16 psi) or lower, which means that the fuel in the line between pump and injectors will be under a pressure of 1.2 kp/cm² (16 psi) when the pump is not operating.

The pump runs for 1—2 seconds when the ignition is switched on. It operates thereafter only when the starter motor is engaged or when the engine is running.

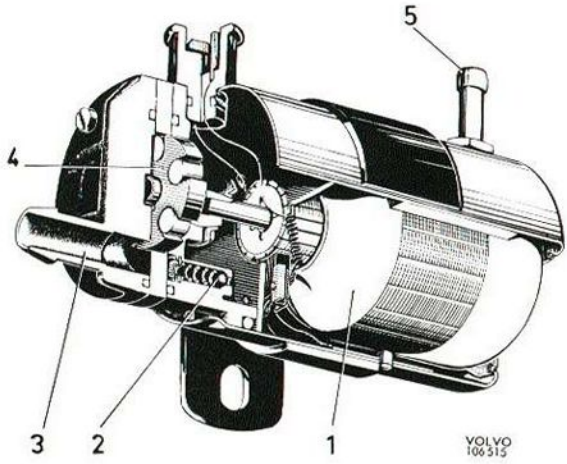



**Fig. 2-151. Fuel pump**

1. Rotor for elec. motor
2. Overflow valve
3. Inlet
4. Pump rotor
5. Outlet with non-return valve

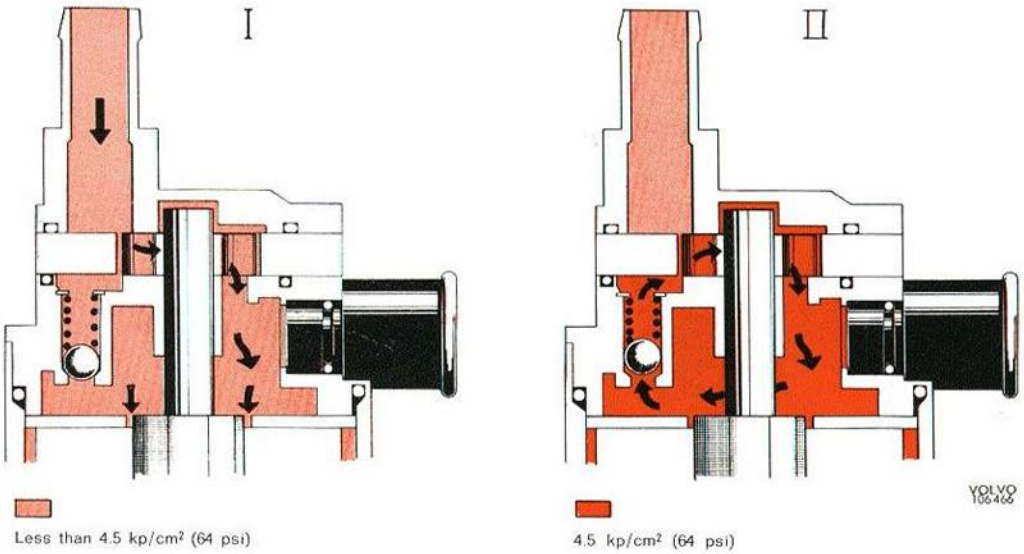



**Fig. 2-152. Overflow valve function**

I Overflow valve closed
II Overflow valve open


Fig. 2-153. Fuel filter, tank

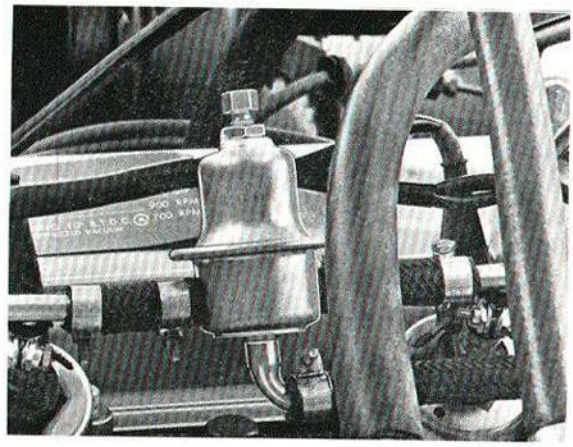



Fig. 2-155. Pressure regulator, installed

## FUEL FILTERS

The fuel system is provided with two fuel filters, one in the tank (suction line) and one after the fuel pump (discharge line).

## PRESSURE REGULATOR

The pressure regulator is located as shown in Fig. 2-155. It is connected to the distributing pipe, between the 2nd and 3rd injector. The pressure regulator is a fully mechanical regulator which controls the pressure in the fuel lines to 2.1 kp/cm² (30 psi). The pressure is adjusted with the help of the adjusting screw (4, Fig. 2-156).

When the pressure drops below 2.1 kp/cm² (30 psi), the valve (1, Fig. 2-156) closes. Once the pressure has exceeded 2.1 kp/cm² (30 psi) the valve opens and releases excess fuel into the return line to the tank.

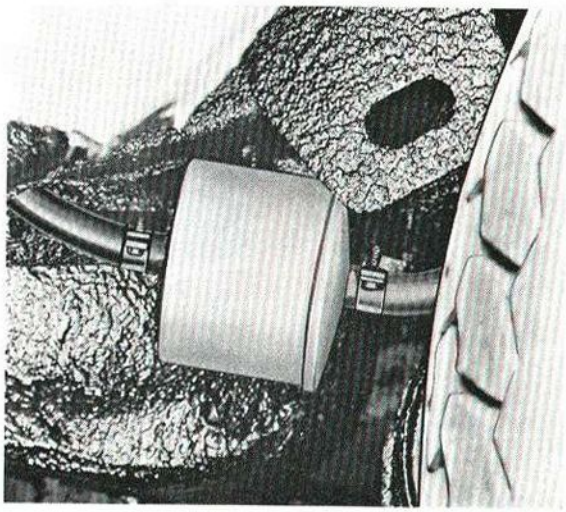



Fig. 2-154. Fuel filter

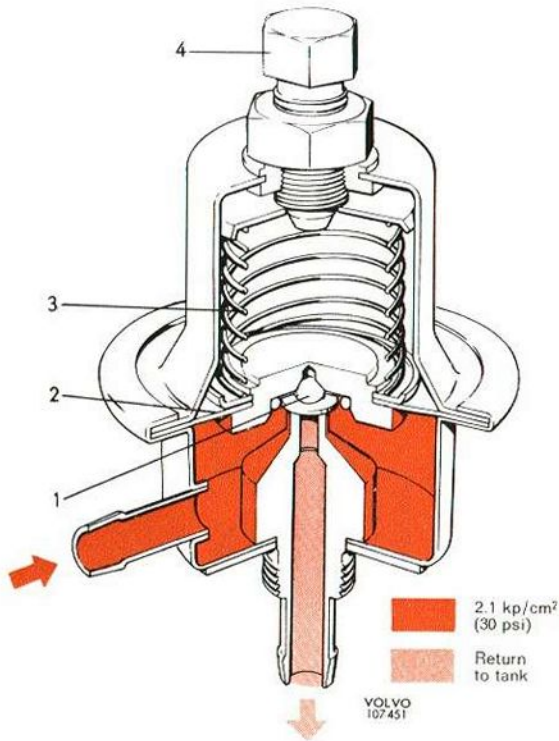



Fig. 2-156. Pressure regulator

1. Valve
2. Diaphragm
3. Spring
4. Adjusting screw

## INJECTORS

Fuel is injected into the intake ports in the cylinder head by four injectors, one for each port. The injectors are mounted in holders fitted on the cylinder head.

The injectors operate in two groups, that is, two and two. Injectors 1 and 3 inject simultaneously and 2 and 4 simultaneously.

The fuel is injected while the intake valves are still closed. This means that fuel is collected in the inlet duct until the intake valve opens.

The injector consists of a housing containing a sealing needle, magnetic winding and return spring, see Fig. 2-158. When the magnetic winding (2) is not in circuit, the return spring (3) presses the sealing needle (5) against a seat and this shuts off the supply of fuel.

As the magnetic winding receives current from the control unit, it attracts the rear section of the sealing needle (5), shaped as a magnetic armature, and this lifts the needle about 0.5 mm (0.02″) from the seat and permits fuel to pass. Since the needle and opening in the valve are accurately calibrated and the fuel pressure is constant, only the valve opening interval (2—10 milliseconds = 0.002—0.01 seconds) will determine the amount of fuel injected.

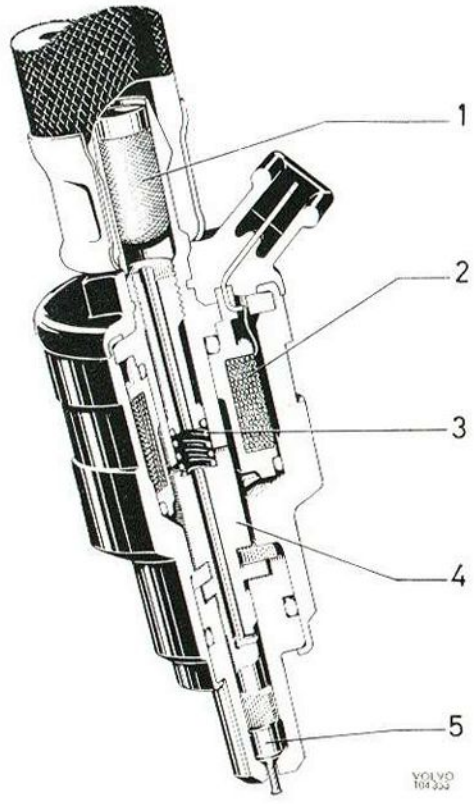



**Fig. 2-158. Injector**

1. Filter
2. Magnetic winding
3. Return spring
4. Magnetic armature
5. Sealing needle

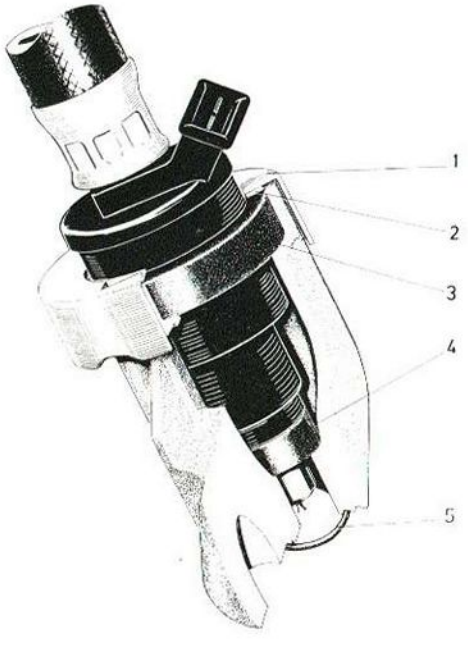



**Fig. 2-157. Injector with holder**

1. Circlip
2. Steel washer
3. Rubber seal
4. Rubber seal
5. O-ring

## COLD START VALVE

The cold start valve, which is mounted in the inlet duct after the air throttle, provides the engine with extra fuel during cold starting. The injection time is governed by the thermal timer, which registers the coolant temperature and cuts in current to the cold start valve. At —20°C (—4°F) and colder, the cold start valve provides extra fuel for 12 seconds, and at +35°C (95°F) the valve stops providing the engine with extra fuel at starting. The cold start valve will only inject when the starter motor is running. When the engine is running and the starter motor has been shut off before the injection interval governed by the thermal timer is completed, the cold start valve also ceases injecting fuel.

The cold start consists of a housing containing a magnetic winding and an armature together with return spring and packing. Its location can be seen from Fig. 2-159.

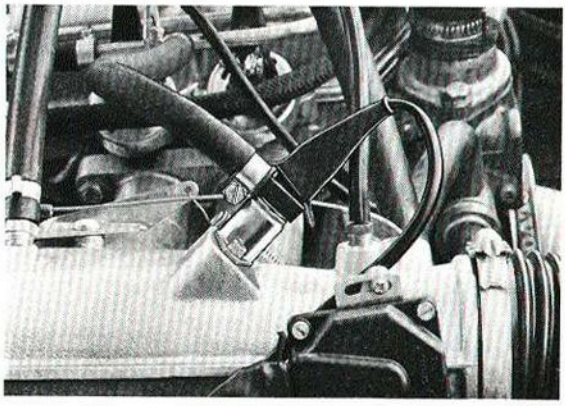



Fig. 2-159. Cold start valve, installed

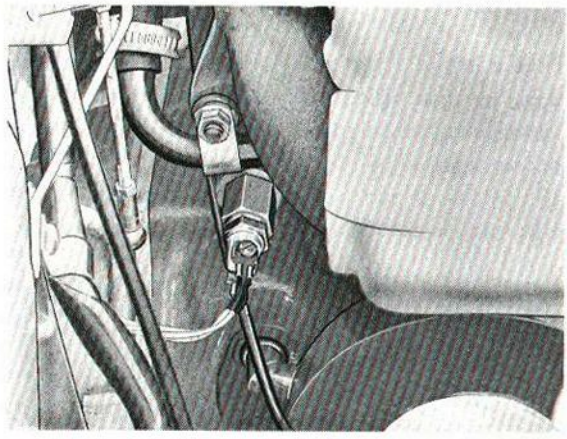



Fig. 2-161. Thermal timer, installed

When the magnetic winding (1, Fig. 2-160) is not in circuit, the packing (4) presses against the inlet of the armature (3), which in its turn is actuated by the return spring (2). This keeps the cold start valve closed. When the magnetic winding is fed from the thermal timer, the armature is drawn down and fuel is forced past the packing, through the cold start valve and into the inlet duct.

## THERMAL TIMER

When the engine is cold (below +35°C=95°F) the contacts (1, Fig. 2-162) are closed. When the starter motor is operating, current flows from it to the cold start valve and via cable (4) and contacts (1) to ground. Current at the same time flows from the starter motor via cable (3) and contacts (1) to ground. As long as the contacts (1) are closed and the starter motor engaged, the cold start valve will inject. Cable (3), however, heats up the bi-metal spring (2) which bends so that the contacts (1) open and current to the cold start valve is broken. The warming-up time will depend on engine temperature.

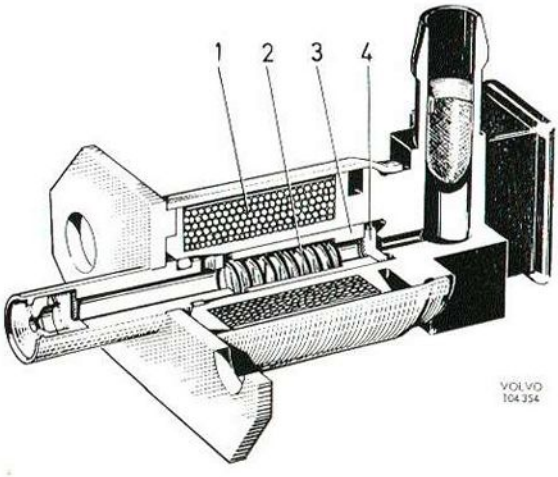



Fig. 2-160. Cold start valve

1. Magnetic winding
2. Return spring
3. Magnetic armature
4. Packing

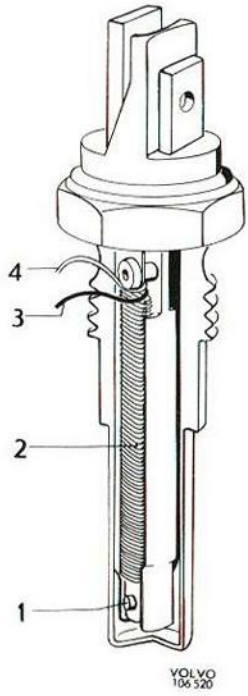



Fig. 2-162. Thermal timer

1. Contacts
2. Bi-metal spring
3. Cable
4. Cable

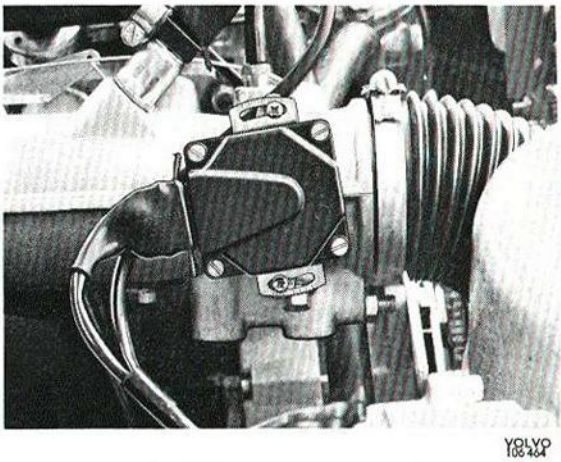


Fig. 2-163. Throttle valve switch

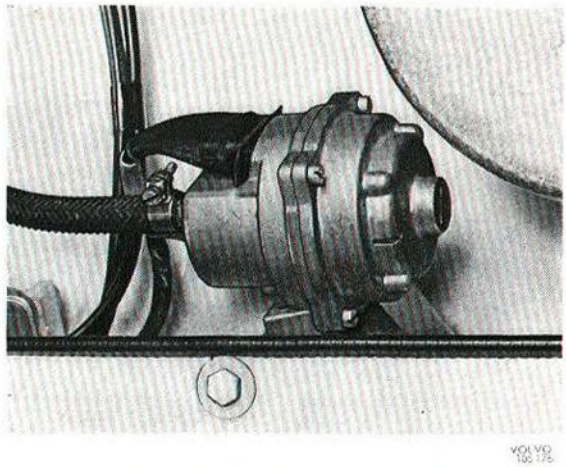


Fig. 2-165. Pressure sensor, installed

## THROTTLE VALVE SWITCH

The throttle valve switch is mounted on the inlet duct and is connected to the throttle shaft. It has two functions, to emit impulses to the control unit to increase the fuel supply during acceleration and, during idling or retardation, to engage the control unit's CO-potentiometer by which the CO-content can be regulated at idling.

During acceleration, the switches, 2. Fig. 2-164, are pressed together. This cuts in the circuit so that current flows from one switch to the other. As the switch contacts move across the zig-zag, the control unit receives impulses, their number and rapidity informing the control unit how much additional fuel is to be injected (that is, how many additional injections will take place and how much the injection interval has to be extended). Throttle reduction opens the switches (2, Fig. 2-164) to prevent the control unit from receiving impulses for "extra fuel" when the air throttle valve is closed. At idling or retardation, the switches (4, Fig. 2-164) close and the CO-potentiometer of the controll unit engages and this regulates the CO-content.

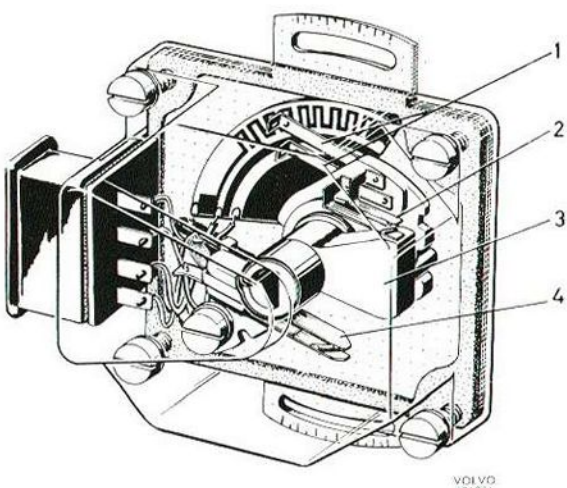



Fig. 2-164. Throttle valve switch

1. Slip switches
2. Switch pair for accelerator function
3. Connection with throttle spindle
4. Switch pair for CO-potentiometer

## PRESSURE SENSOR

The pressure sensor senses the pressure in the inlet duct and, by permitting pressure variations to influence the armature in the tranformer and so alter the transformer inductance, the pressure sensor informs the control unit about the load on the engine. The pressure sensor is located on the right wheel housing and is connected to the inlet duct by means of a hose, see Figs 2-165 and 2-166.

The pressure sensor, Fig. 2-166, is built into a light-alloy housing.

When the engine is switched off, atmospheric pressure exists on both sides of the diaphragm (8, Fig. 2-166) and the movable armature (11), which is suspended friction-free in both leaf springs (3 and 6) is pressed against the full-load stop (9) by the spring (2). Moreover, both the deflated diaphragm bellows (7) are pressed together, since they are influenced by atmospheric pressure. This permits the armature (11) to move further to the right. In this position with the armature at extreme right, the pressure sensor informs the control unit that maximum possible fuel can now be injected.

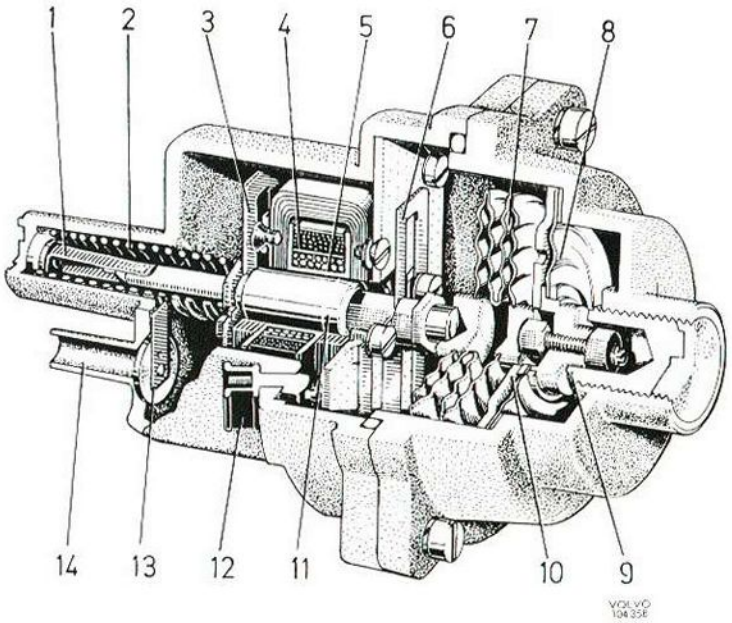



**Fig. 2-166. Pressure sensor**

1. Damping spring
2. Coil spring
3. Leaf spring (suspension)
4. Secondary winding
5. Primary winding
6. Leaf spring (suspension)
7. Diaphragm bellows
8. Diaphragm
9. Full-load stop
10. Part-load stop
11. Armature
12. Electrical connection
13. Valve
14. Hose connection

When the engine starts and the underpressure from the engine inlet duct influences the left-hand side of the diaphragm (8), atmospheric pressure forces the diaphragm over to the part-load stop (10). At the same time, the diaphragm bellows (7) expand since they are influenced by the underpressure inside the pressure sensor and they move the armature a bit to the left. Depending upon the pressure in the inlet duct (engine load) the armature adjusts itself to different positions during driving.

At full engine throttle, the pressure in the inlet duct will be almost equal to the atmospheric pressure, at which point the armature takes up the same position as when the engine starts.

The function of the valve (13) is to prevent pressure impulses in the inlet duct (from the piston movement) from being conveyed into the pressure sensor. This valve has a small hole which constricts the impulses. During sudden acceleration, when air will rush into the pressure sensor, the hole in the valve is insufficient to cope with this so that the entire valve is moved by spring pressure away from the opening and air is allowed to enter.

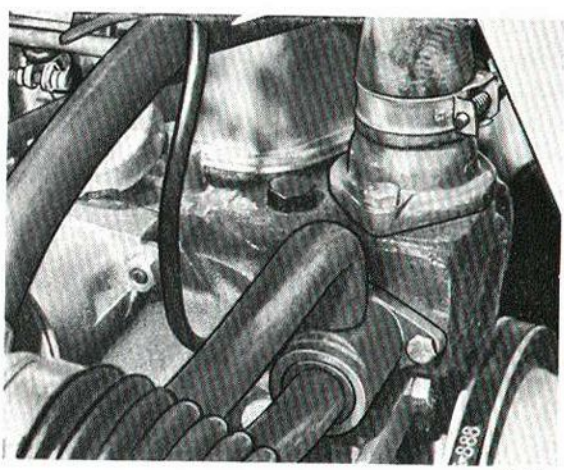



**Fig. 2-167. Auxiliary air regulator, installed**

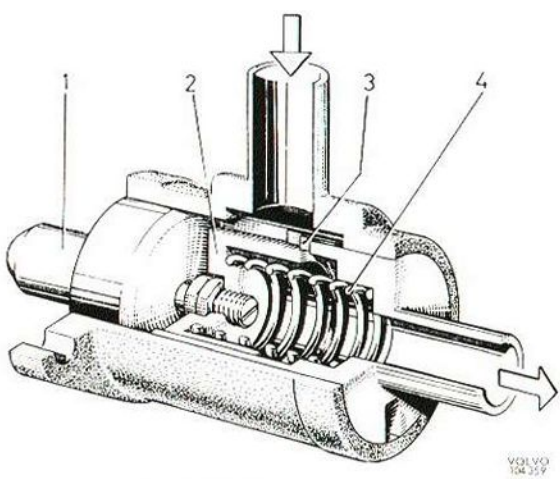


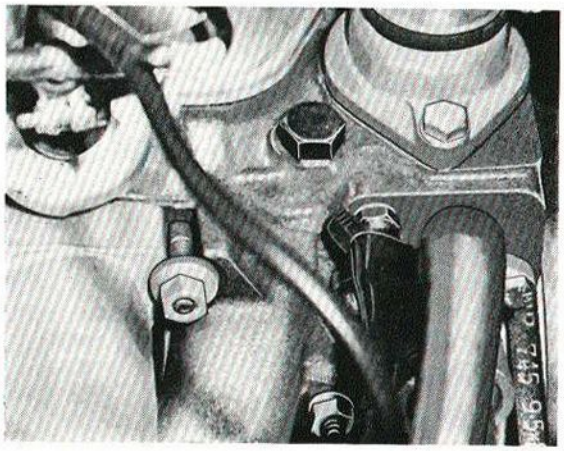

**Fig. 2-168. Auxiliary air regulator**

1. Capillary tube
2. Regulator slide
3. Auxiliary air pipe
4. Return spring

## AUXILIARY AIR REGULATOR

The auxiliary air regulator is placed at the front end of the cylinder head and has its capillary tube projecting into the coolant system, see Fig. 2-167. The regulator operating range is from —25° C (—13° F), fully open to +60° C (140° F), fully closed.

At cold start, the auxiliary air regulator opens (how much will depend on the temperature) and admits additional air into the inlet duct. Gradually, as the engine heats up, the capillary tube (1, Fig. 2-168) expands and presses back the regulator slide (2) which, at +60°C (140°F), completely shuts off the through-flow area.



VOLVO 104426

Fig. 2-170. Temperatur sensor for coolant

## TEMPERATURE SENSORS

The system is fitted with two temperature sensors, one for coolant and one for intake air.

The intake air temperature provides the control unit with information about the temperature of the intake air. At temperatures lower than +30°C (86°F) the injection interval increases slightly.

On the basis of the information supplied by the temperature sensor for the coolant, the control unit adapts the injection interval according to the temperature of the coolant.

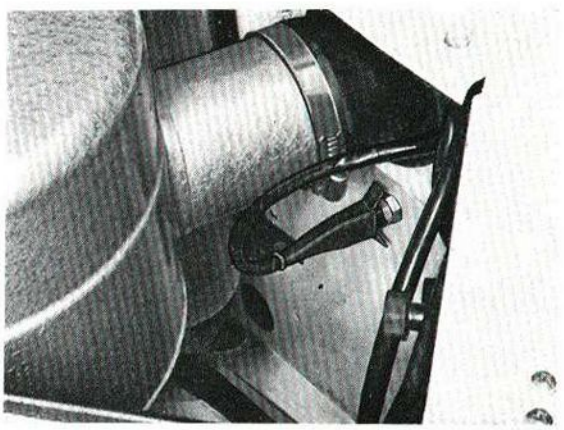
The coolant temperature sensor is located at the front end of the cylinder head, see Fig. 2-170, and the temperature sensor for the intake air in front of the air cleaner, see Fig. 2-169.

The part of the temperature sensor sensitive to temperature variation is a semi-conductor with negative temperature coefficient, that is, the resistance drops with increasing temperature. The resistance alters considerably between different temperatures. For example, the temperature sensor has at —20°C (—4°F) a resistance of 15 000 ohms, but at +60°C (140°F) only 600 ohms.

## INLET DUCT

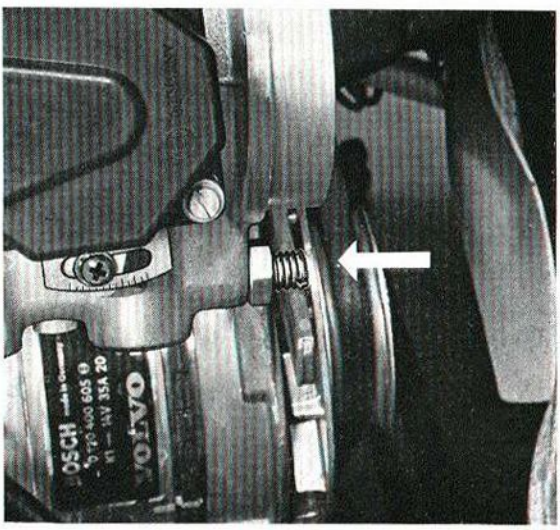
The inlet duct is of aluminium, and is cast in one piece. It consists of a common inlet duct from individual induction lead to each induction port in the cylinder head.

A throttle valve is mounted at the mouth of the common inlet duct. During idling, the throttle valve is completely closed. Air then flows in through a "by-pass" pipe under the throttle valve. Idling speed is adjusted by altering the cross-sectional area of the auxiliary air pipe by means of the idle adjustment screw, Fig. 2-171.



VOLVO 105175

Fig. 2-169. Temperature sensor for intake air




VOLVO 105173

Fig. 2-171. Screw for adjusting idling

## TRIGGERING CONTACTS

Below the centrifugal governor in the distributor there is a contact device with two triggering contacts, see Fig. 2-172.

The contacts are actuated by a cam on the distributor shaft.

The function of these contacts is to supply information to the control unit about engine speed to enable the control unit to determine partly when the injection should begin and partly the duration of the injection with the help of information from the pressure sensor.

## CABLE HARNESS

All electrical components in the electronic injection system are mounted in a special cable harness with numbered cables. The connections between the cable harness and components are of the so-called "Amp" plug type, which makes for good electrical contact as well as rapid removal and fitting of the various cables. The plugs are provided with grommets to ensure proper installation in the various components. Check that the grommet enters the cut-out on the control unit before pushing in the harness plug firmly. The connections are covered by rubber protectors which also serve for locking purposes. These protectors are removed by pulling the "tongues".

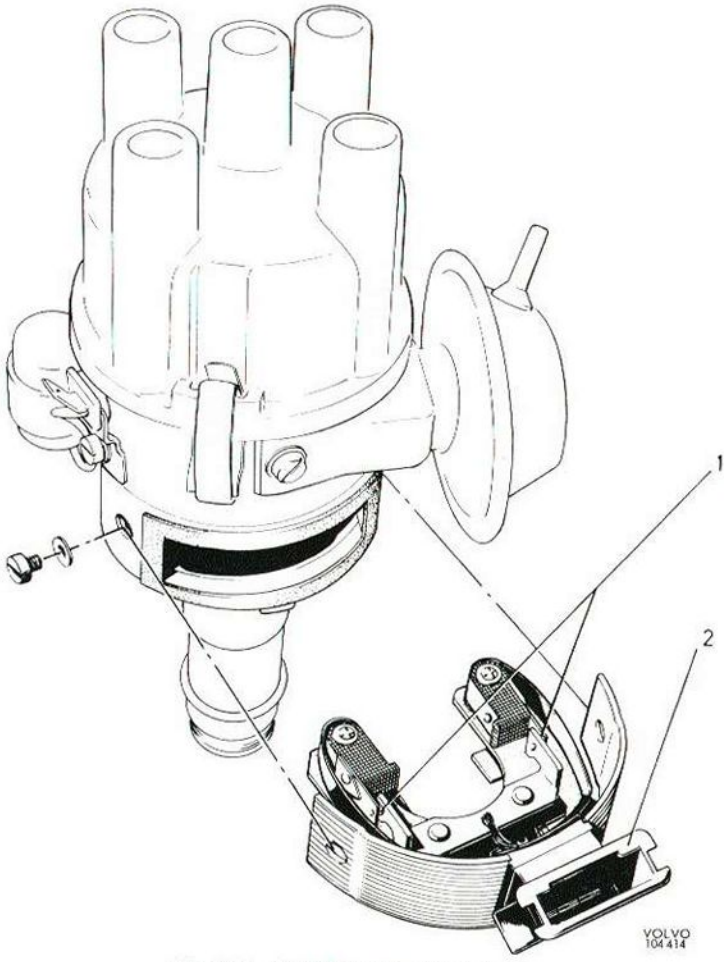



**Fig. 2-172. Distributor with contact device**

1. Triggering contacts
2. Electrical connection

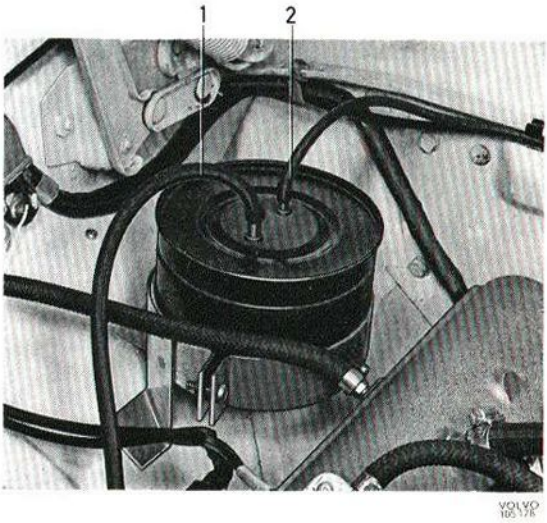



Fig. 2-173. Venting filter, fitted

1. Connection to inlet duct
2. Connection from expansion cannister

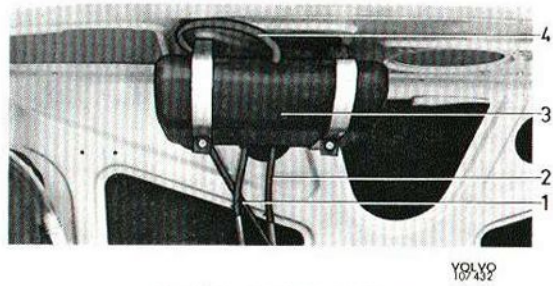



Fig. 2-175. Expansion container

1. Hose to fuel filling pipe
2. Hose to fuel tank
3. Expansion container
4. Hose to venting filter

## GAS EVAPORATIVE CONTROL SYSTEM

Vehicles intended for the U.S.A. market are fitted with a gas exaporative control system, which prevents gas fumes from being released into the atmosphere. The system consists of an expansion container and a venting filter, which is filled with active carbon. Also included are the connection hoses between the various components. The venting filter is located in the engine compartment on the right-hand side, see Figs. 2-173 and 2-174. The expansion container is placed in the luggage compartment, see Fig. 2-175.

Gas fumes forming in the hermetically sealed container, particularly during warm weather, are conveyed to the expansion container (2, Fig. 2-176) and from there to the venting filter (4) where they are mixed with the active carbon.

When the engine starts, air is drawn through the venting filter and into the engine via the inlet duct. Gas fumes stored in the active carbon are drawn by the air flow into the engine where they take part in the combustion.

The foam plastic filter at the bottom of the venting filter should be replaced after every 40 000 km (24 000 miles).

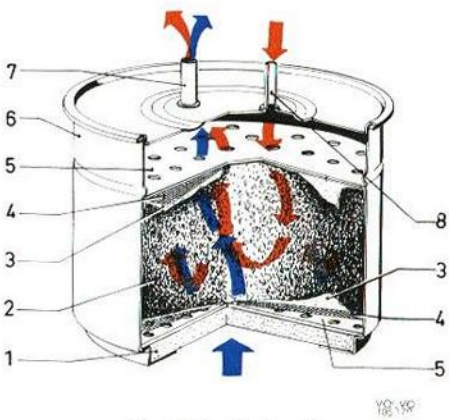



Fig. 2-174. Venting filter

1. Foam plastic filter
2. Active carbon
3. Felt
4. Wire gauze
5. Perforated plate
6. Cannister
7. Connection to inlet duct
8. Connection from expansion container

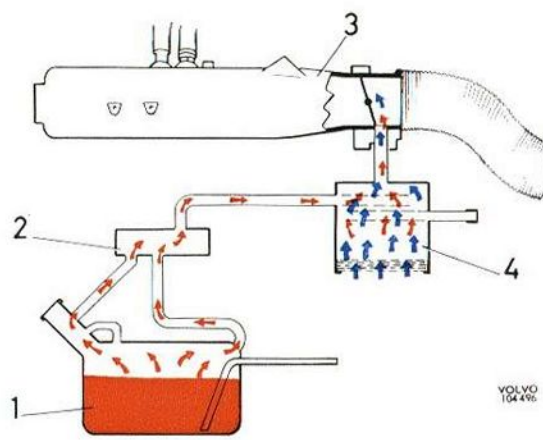



Fig. 2-176. Gas evaporative control system, principle

1. Fuel tank
2. Expansion container
3. Inlet duct
4. Venting filter

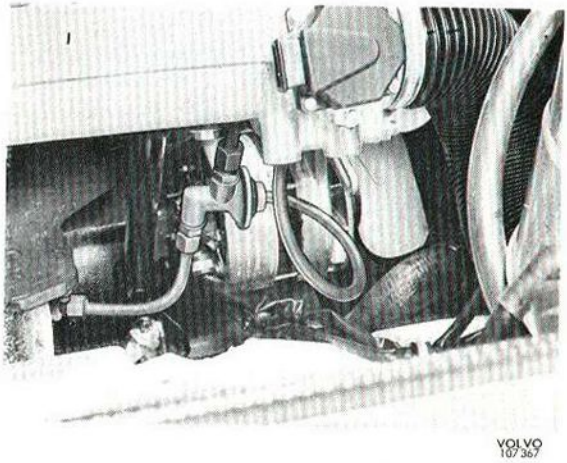



Fig. 2-177. EGR valve, installed

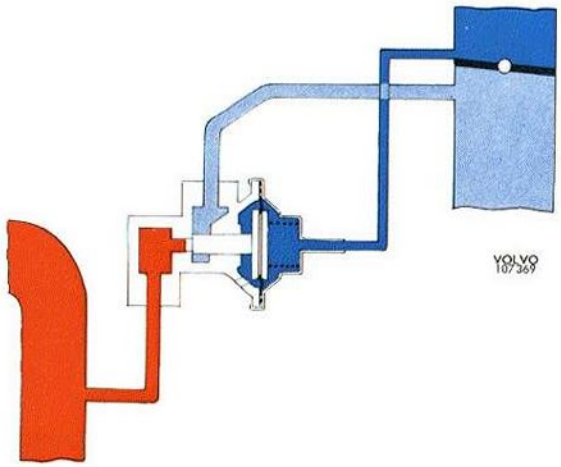



Fig. 2-179 a. Air shutter closed, no exhaust gas recirculation

## EXHAUST GAS RECIRCULATION (EGR)

Vehicles with a B 20 F-engine in combination with automatic transmission are equipped with exhaust gas recirculation. This makes for cleaner exhaust gases when driving on half throttle. The system consists of a recirculation channel and an EGR valve operated under a vacuum.

Exhaust gas recirculation takes place when the air shutter is **between** the closed position (idle) and the half-open position (full throttle).

When the air shutter is closed, Fig. 2-179 a, the opening for the EGR line on the EGR valve is in front of the air shutter. The pressure in the EGR line and also in the EGR valve vacuum chamber is then equal to atmospheric pressure. Since the pressure in the EGR valve reference chamber is always equal to atmospheric pressure, the same pressure exists on both sides of the diaphragm and this keeps the valve in a closed position under the force of the spring. In other words, there is no exhaust gas recirculation.

When the air shutter is partly open, Fig. 2-179 b, the opening for the EGR line "moves" behind the air shutter. Behind the air shutter there is partial vacuum which is transmitted to the vacuum chamber of the EGR valve. The atmosperic pressure in the EGR valve reference chamber now presses the diaphragm backwards so that the valve opens. Exhaust gas recirculation now takes place to the intake manifold and back into the cylinders.

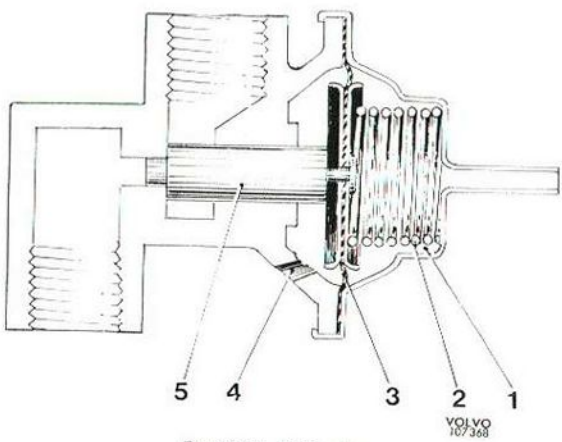



Fig. 2-178. EGR valve

1. Vacuum chamber
2. Return spring
3. Diaphragm
4. Reference chamber
5. Piston

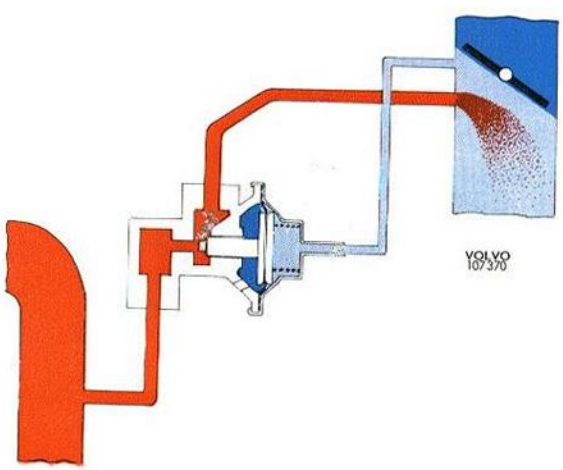



Fig. 2-179 b. Air shutter partly open, exhaust gas recirculation

With a fully open air shutter, Fig. 2-179 c, there is atmospheric pressure in the intake manifold and this is transmitted to the vacuum chamber of the EGR valve. The pressure on both sides of the diaphragm is now equal so that the valve is closed by the spring. Exhaust gas recirculation has now stopped.

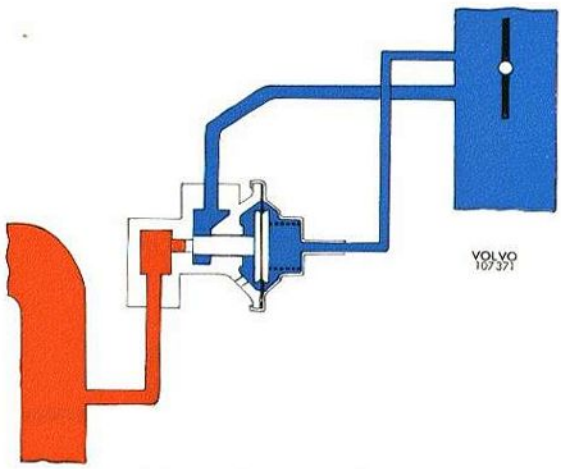



Fig. 2-179 c. Air shutter fully open, no exhaust gas recirculation

## CABLE HARNESS NUMBERING

| Cable No. | From | To |
|---|---|---|
| 1 | Control unit | Temperature sensor I (intake air) |
| 2 | Control unit | Cold start relay, terminal 85 |
| 3 | Control unit | Injector, cyl. 1 |
| 4 | Control unit | Injector, cyl. 3 |
| 5 | Control unit | Injector, cyl. 4 |
| 6 | Control unit | Injector, cyl. 2 |
| 7 | Control unit | Pressure sensor |
| 8 | Control unit | Pressure sensor |
| 9 | Control unit | Throttle valve switch |
| 10 | Control unit | Pressure sensor |
| 11 | Control unit | Ground |
| 12 | Control unit | Distributor (triggering contacts) |
| 13 | Control unit | Temperature sensor I (intake air) |
| 14 | Control unit | Throttle valve switch |
| 15 | Control unit | Pressure sensor |
| 16 | Control unit | Main relay, terminal 87 |
| 17 | Control unit | Throttle valve switch |
| 18 | Control unit | Starter motor, terminal 50 |
| 19 | Control unit | Pump relay, terminal 85 |
| 20 | Control unit | Throttle valve switch |
| 21 | Control unit | Ignition distributor (triggering contacts) |
| 22 | Control unit | Ignition distributor (triggering contacts) |
| 23 | Control unit | Temperature sensor II (coolant) |
| 24 | Control unit | Main relay, terminal 87 |
| 26 | Fuel injector, cyl. 1 | Ground |
| 27 | Fuel injector, cyl. 2 | Ground |
| 29 | Thermal timer, 6 terminal | Starter motor, terminal 50 |
| 30 | Fuel injector, cyl. 3 | Ground |
| 31 | Fuel injector, cyl. 4 | Ground |
| 32 | Temperature sensor II (coolant) | Ground |
| 33 | Cold start valve | Thermal timer, terminal W |
| 34 | Cold start valve | Thermal timer, terminal G |
| 35 | Fuel pump (—) | Ground |
| 36 | Fuel pump (+) | Connector |
| 37 | Connector | Pump relay, terminal 87 |
| 38 | Main relay, terminal 86 | Ignition coil, terminal 15 |

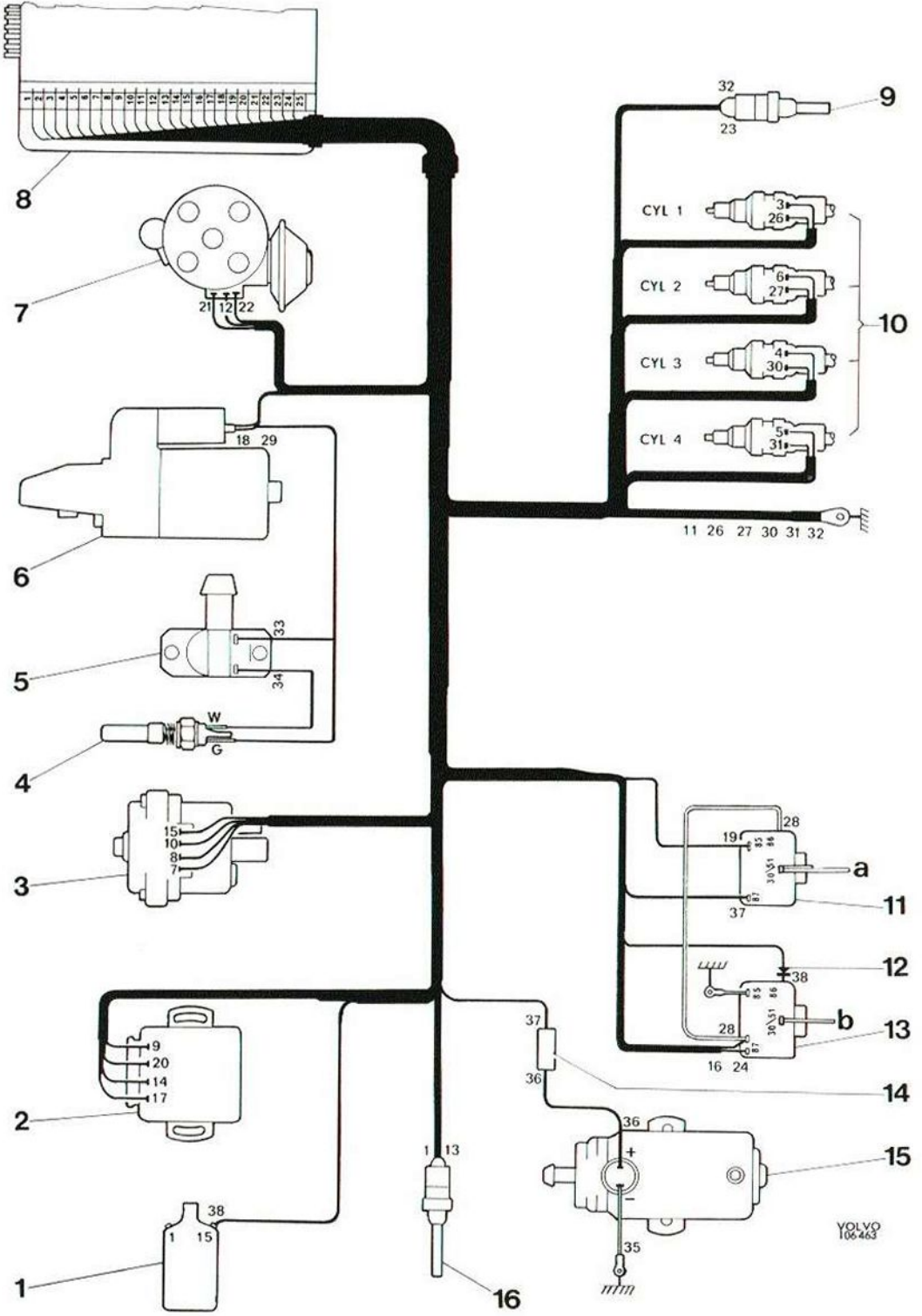



**Fig. 2-180. Cable harness**

1. Ignition coil
2. Throttle valve switch
3. Pressure sensor
4. Thermal timer
5. Cold start valve
6. Starter motor (terminal 50)
7. Distributor (triggering contacts)
8. Control unit
9. Coolant temperature sensor
10. Injectors
11. Pump relay
12. Diode (located in relay)
13. Main relay
14. Connector
15. Fuel pump
16. Temperature sensor for intake air
a. To fuse 1 (small fusebox)
b. To battery, B+

## SPECIAL INSTRUCTIONS FOR WORK ON VEHICLES WITH ELECTRONIC FUEL INJECTION

1. **Never** let the engine run without the battery being connected.
2. **Never** use a high speed battery charger as a aid in starting.
3. At least one battery lead should be disconnected when about to use a high speed charger to charge the battery in the vehicle.
4. On no account may the control unit overheat above 185°F. The control unit must not be connected up (the engine started) when the ambient temperature exceeds 185°F. (With paintwork, etc., when the vehicle is being stove-heated, it must not be driven out of the oven, but conveyed out. If there is risk of temperatures exceeding 185°F, the control unit must first be removed).
5. The ignition must be switched off before connecting up or disconnecting the control unit.
6. For all work with fuel lines, **great** care must be taken to make sure that no dirt enters the system. Even small dust particles can jam injectors.

## TESTING INJECTION EQUIPMENT WITH BOSCH TEST INSTRUMENT EFAW 228

1. Switch off the ignition.
2. Remove the control unit (see page 2-77).
   Connect the cable from test instrument to the cable harness in the vehicle, see Fig. 2-181.
3. Switch "A" on the instrument to position "Measuring circuit B".
4. Test as follows:
   (Note. When testing with the test instrument, the entire program should be carried out. Any faulty component should be replaced or adjusted before continuing the test. Extra starting button for operating the starter motor may not be connected until the test "Voltage III starter motor" has been carried out.)

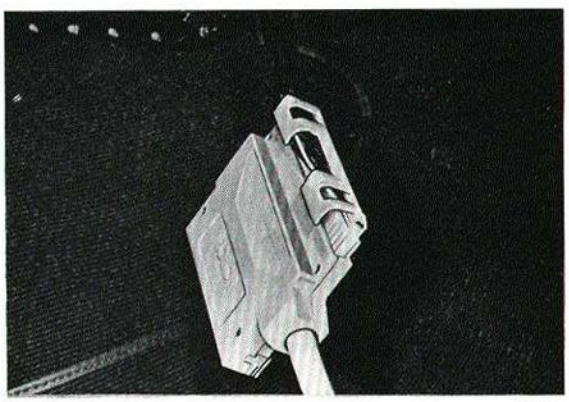



Fig. 2-181. Test instrument connected to cable harness

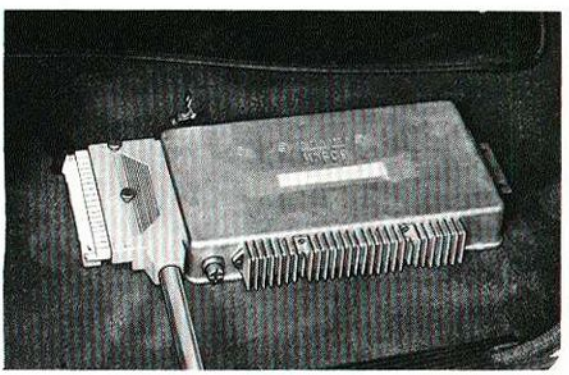
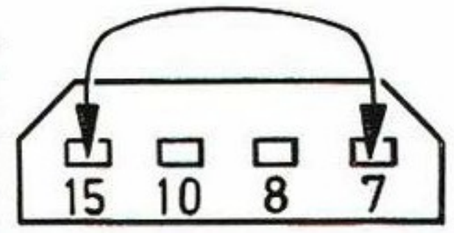
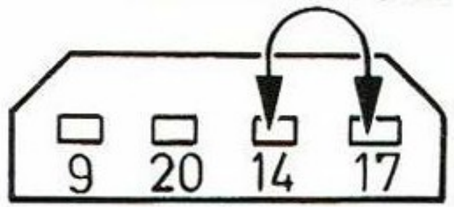


Fig. 2-182. Test instrument connected to cable harness

| Position of switch "B" | Operate | To measure | Indication (nominal value) | Deviation from nominal value. Possible faults and elimination |
|---|---|---|---|---|
| Voltage I | Switch on ignition | Voltage supply for the control unit | 11.0—12.5 (1.0—12.5 volt) | **No reading:**<br>1. Open circuit in cable 16, from terminal 87 on main relay to control unit.<br>2. Main relay inoperative. (Check for voltage at terminal 86. If none there, check cable 38 between terminals 86 and 15 on ignition coil. Check grounding from relay terminal 85 and cable 11 from control unit to ground. Check voltage at terminals 30/51. If there is no fault, change relay.)<br>**Voltage below 11 volt:**<br>1. Flat battery. (Check the battery voltage.)<br>2. Voltage drop in cables 16 or 11. Voltage drop in relay contacts. |
| Voltage II | | | 11.0—12.5 (11.0—12.5 volt) | As for "Voltage I". Also check cable 24. |
| Starting voltage | Operate starter for a short time | Voltage at terminal 50 of starter solenoid | 9.0—12.0 (9.0—12.0 volt) | **No voltage, starter operates:**<br>Open circuit in cable 18 from terminal 50 on starter motor to control unit.<br>**No voltage as above, starter does not operate:**<br>1. Ignition/starter switch defective.<br>2. Open circuit in cable between ignition and terminal 50 on starter.<br>**Voltage below 9.0 volt:**<br>1. Battery flat.<br>2. Voltage drop in cable from ignition/starter switch to terminal 50 on the starter solenoid too high.<br>3. Voltage drop in cable 18. |
| Adjustment "Ω", pressure sensor | | | | When full deflection on the instrument is not obtained the voltage of the vehicle battery is too low.<br>(See also test stage "Voltage I".) |
| | Push "ground" button | Resistance between pressure sensor windings and ground (short-circuit ground) | "∞" ("∞"Ω) | **Resistance "0":**<br>Short circuit to ground in cable or at pressure sensor. (Pull plug out of pressure sensor, alter reading "∞", replace sensor. If the reading remains an unchanged 0, there is fault in cable 7, 8 or -5.)<br>**Resistance between "0" and "∞":**<br>Damage to insulation. (Proceed as described above.) |

| Position of switch "B" | Operate | To measure | Indication (nominal value) | Deviation from nominal value. Possible faults and elimination |
|---|---|---|---|---|
| | Push "Primary" button | Resistance of primary windings of pressure sensor | 0.8—1.0 on the Ω scale (approx. 90 Ω) | **Resistance considerably smaller than nominal value:**<br>Damage to insulation. (Pull plug out of pressure sensor and if test instrument shows "∞", replace pressure sensor, otherwise cables 7 and 15.)<br><br>**Resistance considerably larger than nominal value:**<br>Voltage drop in cables or contacts.<br>(Check cables and contacts.)<br><br>**Resistance "0":**<br>Short circuit to ground, short circuit in secondary windings. (Pull plug out of pressure sensor and if test instrument shows "∞" replace pressure sensor, otherwise check cables 7 and 15.)<br><br>**Resistance "∞":**<br>Open circuit in sensor or cables. (Pull plug out of sensor. Bridge plug as shown in Illustration. If test instrument indicates 0, replace pressure sensor. If "∞" indicated, check cables 7 and 15.)<br>  |
| | Push in "Secondary" button | | 3—4 on Ω scale (approx. 350 Ω) | See under "Primary".<br>If needle of the test instrument shows "∞", connect terminals 8 and 10 in the plug instead of 7 and 15.) |
| Distributor contact I<br>Distributor contact II | Read off test instrument with switch in position I. Switch to position II. If the test instrument swings to 0 in the first position, it should now indicate ∞ and if the instrument shows ∞ in the first position, it should now indicate 0.<br>Switch to position I. Run the engine with short strokes on the starter motor until the instrument shows a reading opposite to the first reading. Switch to position II again and check to make sure that the reading changes. | Functioning of the triggering contacts in the distributor | 0 and "∞"<br>(0 and "∞"Ω) | **Resistance between 0 and "∞":**<br>Check terminal on distributor. Check cables 12, 21 and 22.<br>(If there is no fault in the terminal or cables change the contact insert in distributor.) |

| Position of switch "B" | Operate | To measure | Indication (nominal value) | Deviation from nominal value. Possible faults and elimination |
|---|---|---|---|---|
| Throttle valve switch I<br>Throttle valve switch II | Open and close throttle valve slowly | Impulses for extra fuel during acceleration | Instrument needle swings approx. 10 times between "0" and "∞" when the throttle valve opens.<br>(0 and "∞" Ω)<br>the instrument needle should indicate "∞" when the throttle closes | **Instrument needle shows "0" or swings when throttle valve closes:**<br>Faulty throttle valve switch, replace. |
| Throttle valve switch III | Check that throttle valve is closed | Functioning of the contacts in the throttle valve switch | 0<br>(0 Ω) | **Resistance "∞":**<br>Throttle valve switch incorrectly adjusted or damaged. Open circuit in cable to switch.<br>(Pull out plug and bridge as shown in Illustration. If the pointer swings to "0", there is no damage in the cables. Re-connect the switch.<br>Check setting of throttle valve switch acc. to page 2-80. Change switch if unable to be adjusted.)<br>  |
| | Open throttle valve approx. 1°. (Place a 0.50 mm = 0.02" feeler gauge between stop screw and stop on throttle spindle.) | | "∞"<br>("∞"Ω) | **Reading "0":**<br>Throttle valve switch incorrectly adjusted or damaged. Open circuit in cables. (Pull out plug. If reading swings to "∞", The cables are not damaged. Re-connect switch and check setting acc. to page 2-80. Replace throttle valve switch if unable to be adjusted.) |
| Temperature sensor I (intake air) | | Resistance in temperature sensor for intake air | 2—5<br>(300 Ω at +20°C = 68°F considerably dependent on temperature. Small reading at higher temperature). | **Resistance "∞":**<br>Open circuit. (Pull out plug and connect terminals. If reading swings to "0", change sensor, otherwise check cables 1 and 13.)<br>**Reading "0":**<br>Short circuit. Pull out plug. If reading is the same, check cables 1 and 13. If reading swings to "∞", change sensor.) |
| Temperature sensor II (cooling liquid) | | Resistance in temperature sensor for coolant | 0.5—3.5<br>(approx. 2.5 K Ω at +20°C = 68°F. Considerably dependent on temperature. Lower reading at higher temperature.) | See "Temperature sensor I".<br>Check cables 23 and 32. |

| | | | | |
|---|---|---|---|---|
| Valves | Adjust instrument to "∞" again (with switch "B" in position "valves")<br><br>Push buttons:<br><br>1 = injector for cyl. 1<br>2 = injector for cyl. 4<br>3 = injector for cyl. 2<br>4 = injector for cyl. 3 | Resistance of the windings in the injector with cable | 2—3<br>(2.4 Ω at 20°C = 68°F) | **Resistance "0":**<br>Short circuit in cables or injectors.<br>(Pull plug out of injector concerned and if test instrument shows "∞", exchange injector, otherwise replace cable harness.)<br>**Resistance "∞":**<br>Open circuit in cable or injector windings. (Remove plug from injector concerned, connect terminals in plug. If test instrument shows "0", the injector is defective; otherwise check the cables for the injector.)<br>**Resistance over "3":**<br>Ground cable from the injectors has a bad connection on the engine.<br>(Check ground cables for respective valves, 26, 27, 30 and 31.) |

Turn switch "A" to "Valve check". (Switch "B" position is of no importance here.)

| Position of switch "B" | Operate | To measure | Indication (nominal value) | Deviation from nominal value. Possible faults and elimination |
|---|---|---|---|---|
| Valve check | Connect pressure gauge to pressure regulator, see page 2:78<br>Press "Pump" button on the instrument | Pressure in fuel system | Nominal value<br>2.1 kp/cm²<br>(30 psi) | **No pressure build-up (pump does not start):**<br>Check if pump relay cuts in when "Pump" button is depressed.<br>Relay does not cut-in: Open circuit in cable 28, from main relay terminal 87 to pump relay terminal 86, resp. cable 19 from pump relay terminal 85 to control unit. (If the cables are not damaged, change the relay.)<br>Relay cuts-in: Open circuit in cables 27 and 36, from terminal 87 on pump relay to contact on pump or in cable 35, from contact to ground. Faulty pump. (Check cables, measure voltage at plug contact for pump. If voltage is 12 volts, change pump.)<br>**Pressure above or below 2.1 kp/cm² (30 psi):**<br>Pressure regulator incorrectly adjusted or damaged.<br>(Adjust or change regulator.) |
| Press in "Pump" button briefly | For leakage in fuel system (pressure side) | | Pressure may drop to approx. 1.2 kp/cm² (16 psi) when "pump" button is released. Pressure may then drop very slowly. | **Pressure drops rapidly below 1.2 kp/cm² (16 psi) when "Pump" button is released:**<br>Leakage in fuel system pressure side, pump-pressure regulator.<br>Run up pressure again. Place pinchers (2901) on fuel hose between distributor pipe and fuel pipe from pump. If pressure ceases to drop, fault is in pump or fuel line.<br>If pressure drops in spite of this, remove pinchers from hose, run up pressure again and place pinchers on hose between pressure gauge and pressure regulator (after having released "Pump" button).<br>If pressure does not drop more, then pressure regulator is faulty.<br>If pressure continues to drop, remove pinchers from hose. Run up pressure again and place pinchers on hose between distributing pipe and cold start valve.<br>If pressure ceases to drop, fault is in cold start valve. If pressure continues to drop, fault is in one of injectors, see below. |

| Position of switch "B" | Operate | To measure | Indication (nominal value) | Deviation from nominal value. Possible faults and elimination |
|---|---|---|---|---|
| | N.B. The following control should only be made when it is ascertained that there is a fault in one of the injectors. Remove the injectors, see page 2-79 Press in "Pump" button on the instrument and check the injectors for leakage. Then press in buttons 1, 2, 3 and 4, one after the other with the "Pump" button and check that the injectors open. Take care not to damage the injector needles. Collect the injected fuel to prevent it from making contact with a possibly hot exhaust manifold. | Function and leakage of the injectors | | The valve opening may be wet, but the injector must not leak more than 5 drops per minute at 2.1 kp/cm² (30 psi). |

| Position of switch "B" | Operate | To measure | Indication (nominal value) | Deviation from nominal value. Possible faults and elimination |
|---|---|---|---|---|

Switch off ignition. Connect control unit to other side of connection from instrument acc. to Fig. 2-182. Remove the pressure gauge. Fit the plug contacts on the distributor and coolant temperature sensor.

| | | | | |
|---|---|---|---|---|
| Distr. contact I<br>Distr. contact II | Start engine and let it run about 31.5 r/s (2000 r/m)<br>Switch over instrument to between Z-V contacts I and II | Functioning of the triggering contacts | Instrument pointer should swing to full reading and then to average value. On switching between ZV-contacts I and II, pointer may not move more than 2 fraction marks on voltage scale | **Feed reading deviates more than 2 fraction marks:**<br>(Replace contact kit in distributor.) |

Remove instrument and fit control unit.

If the engine does not function properly or not at all in spite of the fact that the above tests did not reveal fault, test with a new pressure sensor. If the engine still does not function, test with a new control unit.

Fig. 2-183. Removing control unit

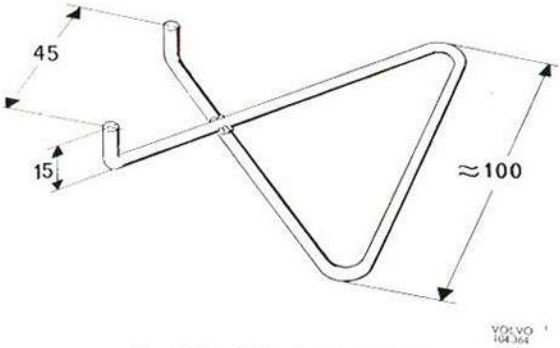



Fig. 2-185. Puller for plug contact
Material: 2 mm (5/64") welding wire

## CONTROL UNIT

### REMOVING

1. Move the right, front passenger seat to the rear stop position.
2. Remove the bolt between the tubular bend and link screw. Move the seat to the front stop position and fold it backwards, see Fig. 2-183.
3. Remove the control unit by unscrewing both the screws which secure the control unit in position.
4. Remove the screw for the cap holding the cable harness to the control unit, see Fig. 2-184.
5. Make a puller like the one shown in Fig. 2-185. Hook in this puller, see Fig. 2-186, and pull out the plug contact carefully.

### INSTALLING

1. Press the plug contact firmly into the control unit. Fit the plastic cover and cap.
2. Mount the control unit and fit the screws.
3. Fold back the seat and move it to the rear stop position.
4. Fit the bolt between the tubular bend and the link screw.

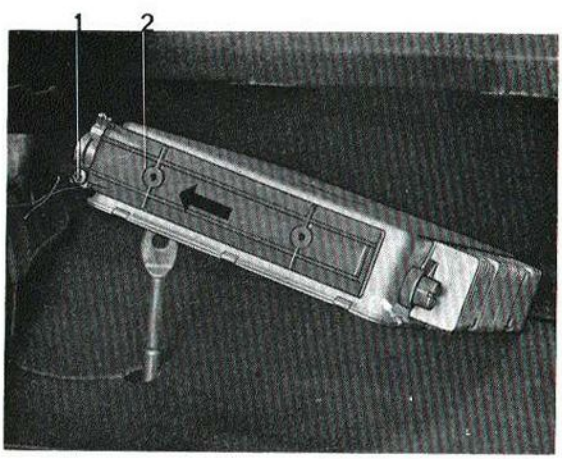



Fig. 2-184. Removing plastic cover
1. Cap screw 2. Plastic cover

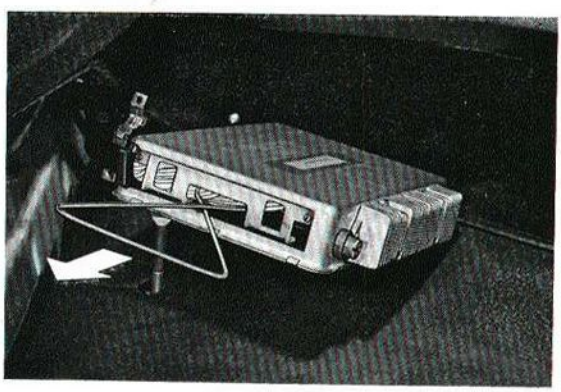


Fig. 2-186. Removing plug contact

## FUEL PUMP

### REPLACING

1. Remove the protective casing by unscrewing both the screws, see Fig. 2-187.
2. Disconnect the contact unit from the fuel pump and clean the pump hose connections.
3. Pinch the pump hoses with pinchers (2901). Slacken the hose clamps and remove the hoses, Fig. 2-187.
4. Remove the bolts securing the pump and take down the pump.
5. Fit the new pump.
6. Connect up the hoses to the pump and remove the pinchers.
7. Connect up the contact unit. Check to make sure the pump functions and that there is no leakage at the hose connections.
8. Fit the protective casing.

### CHECKING

The pump should be capable of delivering 1.67 $dm^3/s$ (0.36 Imp.galls. = 0.44 US galls./s) at a pressure of 2.1 $kp/cm^2$ (30 psi). At this load, current consumption should be 5.0 amps.

Note. The pump is pole-sensitive. Observe due care when testing a disconnected pump.

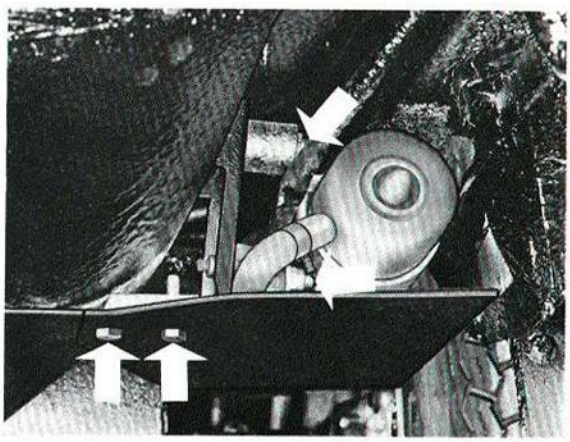



Fig. 2-187. Removing fuel pump

## FUEL FILTER

### REPLACING

1. Clean the filter hose connections.
2. Pinch the filter hoses with pinchers (2901). Release the hose clamps and remove the filter from the hoses, see Fig. 2-188.
   Note. Make sure that the new filter is fitted with the arrow pointing in the direction of fuel flow.
3. Fit the new filter and tighten the hose clamps. Remove the pinchers.
4. Check to make sure there is no leakage at the hose connections.

## PRESSURE REGULATOR

### REPLACING

1. Release the clamps at the hose connections for the pressure regulator.

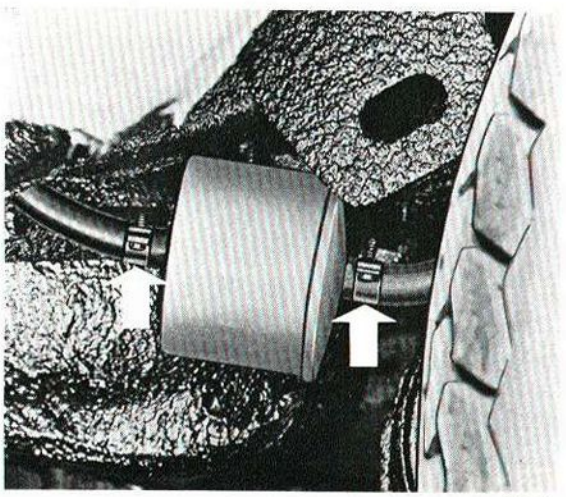



Fig. 2-188. Removing fuel filter

2. Remove the pressure regulator by disconnecting the hoses.
3. Fit the new pressure regulator and tighten the clamps.

### ADJUSTING

1. Remove the hose from the fuel pump at the distributor pipe and connect up the pressure gauge, see Fig. 2-189.
2. Run the fuel pump either by starting the engine or by connecting up test instrument Bosch EFAW 228.
3. Slacken the locknut and adjust the pressure to 2.1 kp/cm² (30 psi). (Replace regulator if pressure is incorrect.)
4. Disconnect the pressure gauge and connect the fuel hose to the distributor pipe.
   Check to make sure there is no leakage.

## INJECTORS

### REPLACING

1. Disconnect the hose clips for all injectors. Remove the hoses from the retainer at the thermostat housing. Disconnect the cable harness from the distributor pipe.
2. Remove the plug contact from the injector.
   Remove the distributor pipe.
3. Turn the lock ring, Fig. 2-190, anti-clockwise so that it loosens from the bayonet fitting.
   Pull out the injector.
4. Fit the new injector and lock it securely with the lock ring.
   Fit the distributor pipe.
   Fit the cable harness to the distributor pipe and secure the plug contact to the injector.
5. Fit the hoses to the thermostat housing.
   When removing all the injectors, for example, for the purpose of checking, the hose clips need not be removed since all the injectors and distributor pipe can be lifted up at the same time, see Fig. 2-191.
   Note. The rubber ring on the injector should be replaced each time the injector is removed.

### CHECKING

Measure the resistance between the terminal pins. It should be 2.40 ohms at +20°C (68°F).

NOTE. Never test an injector by connecting up 12 volts to the terminal. This would ruin the injector immediately since it only caters for a max. operating voltage of 3 volts.

Maximum leakage for the injectors is five drops per minute at 2.1 kp/cm² (30 psi).

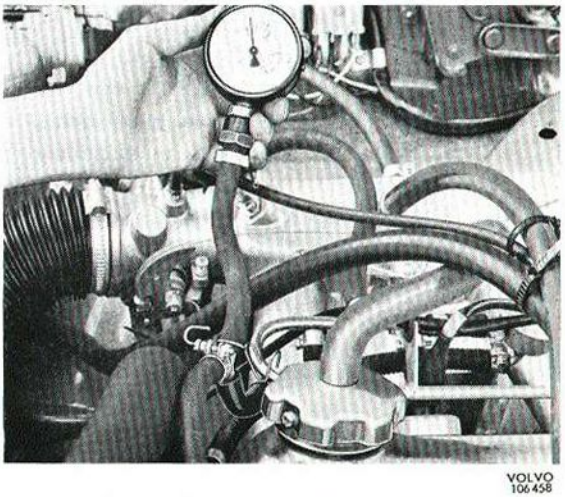



Fig. 2-189. Connecting pressure gauge

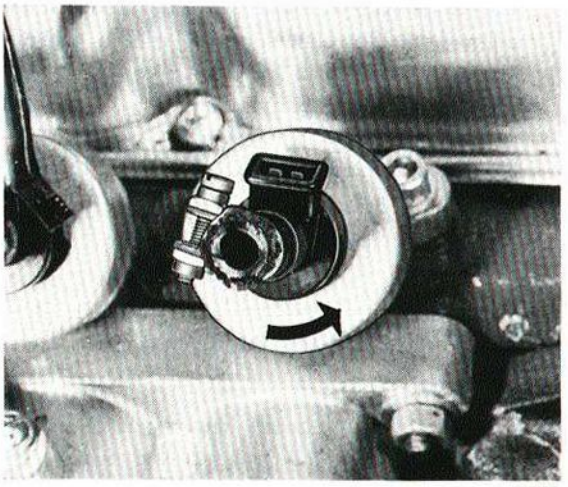
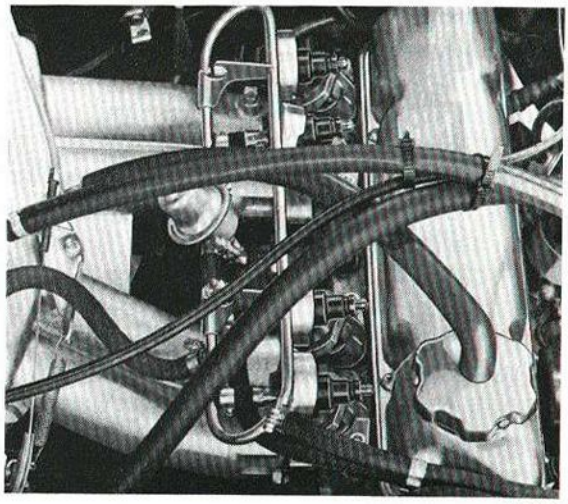
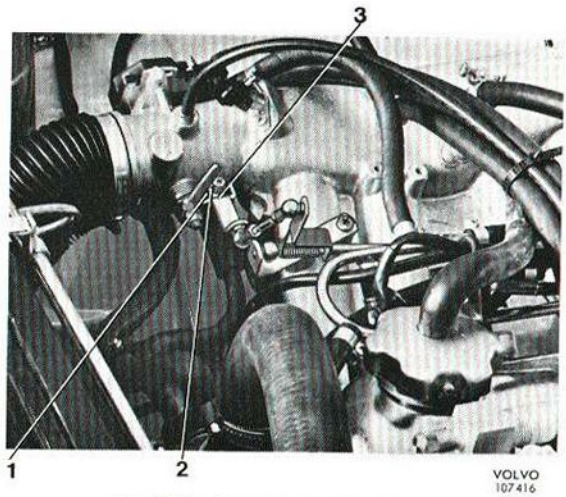



Fig. 2-190. Removing injector



VOLVO 106459

Fig. 2-191. Injectors removed for checking




VOLVO 107416

Fig. 2-192. Stop screw for throttle valve

1. Locknut
2. Stop screw
3. Stop on throttle valve spindle

## COLD START VALVE

### REPLACING

1. Remove the plug contact and the fuel hose from the valve.
2. Remove both the screws and lift off the valve. Fitting is in reverse order.

## THROTTLE VALVE

### ADJUSTING

1. Release the locknut for the throttle valve stop screw (1, Fig. 2-192), and back the screw a couple of threads so that it is not against the stop on the throttle valve shaft. Check to make sure that the valve is fully closed.
2. Screw in the stop screw until it touches the stop on the throttle valve shaft. Then screw in the screw 1/2 turn and tighten up the locknut. Check to make sure the throttle valve does not stick or jam in closed position.
3. Adjust the throttle valve switch.
   NOTE. Idle **must not** be adjusted with the stop screw.

## THROTTLE VALVE SWITCH

### REPLACING

1. Pull out the plug contact from the throttle valve switch. Remove the two screws holding the throttle valve switch to the intake duct. Pull the throttle valve switch straight out.
2. Press on the new throttle valve switch carefully. Fit the screw loosely. Connect the plug contact. Adjust the throttle valve switch according to below.

### ADJUSTING

1. Connect Bosch test instrument EFAW 228, see page 2.
2. Set switch "A" to position "Measuring" and switch "B" to position "Throttle valve switch III".
3. Slacken the screws in order to turn the throttle valve switch. Mark the inlet duct at the upper screw if there is not one there already.
4. Turn the throttle valve switch clockwise as far as it can go. Then turn it slowly anti-clockwise until the pointer on the instrument goes over from "∞" to "0".
   Then turn a further 1° (1/2 graduation mark on scale at upper attaching screw) and secure the throttle valve switch.
5. Check to make sure that the instrument pointer goes over to "∞" when the throttle valve opens about 1°. (Place a 0.50 mm = 0.02" feeler gauge between the stop screw and stop on the throttle valve spindle. Change to a 0.30 mm (0.014") feeler gauge, but the pointer should **not** swing to "∞".)

### CHECKING

Several components are connected up for the following checks, so that it is not possible to determine with certainty whether the fault is in the throttle switch if the checks are unsatisfactory.

1. Switch on the ignition. Open and close the throttle valve slowly. Clicking sounds should come from a group of injectors to indicate that extra fuel for acceleration has been injected.

## THERMAL TIMER

### REPLACING

1. Drain the coolant.
2. Disconnect the electric cables.
3. Unscrew and replace the thermal timer.
4. Re-connect the electric cables.
5. Fill with coolant.

## AIR CLEANER, 140

### REPLACING (every 40 000 km = 24 000 miles)

1. Turn the steering wheel to the right to full lock.
2. Disconnect and move to the one side the expansion bottle.
3. Disconnect the hose between the air intake and the air cleaner.
4. Remove the screws securing the cleaner and remove the cleaner.
5. Move the air intake over from the old cleaner to the new one.
6. Fit the new cleaner.
7. Connect the hose between the air intake and the cleaner.
8. Restore in position and screw tight the expansion bottle.

## TEMPERATURE SENSOR I (INDUCTION AIR)

### REPLACING

1. Pull out the four-way plug from the sensor.
2. Change the sensor. Do not tighten the new sensor too hard.
3. Re-fit the four-way plug.

### CHECKING

Measure the risistance between the terminal pins and compare with Fig. 2-193.

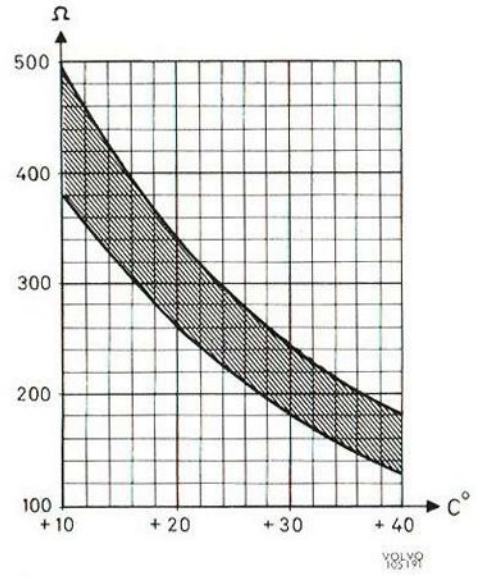



Fig. 2-193. Resistance in temperature sensor for induction air

## TEMPERATURE SENSOR II (COOLANT)

### REPLACING

1. Drain off the coolant.
2. Pull out the plug contact from the sensor. Screw out and replace the sensor. Do not forget the sealing ring.
3. Re-fit the plug contact and fill with coolant.

### CHECKING

1. Measure the resistance between the terminal pins and compare with Fig. 2-194.

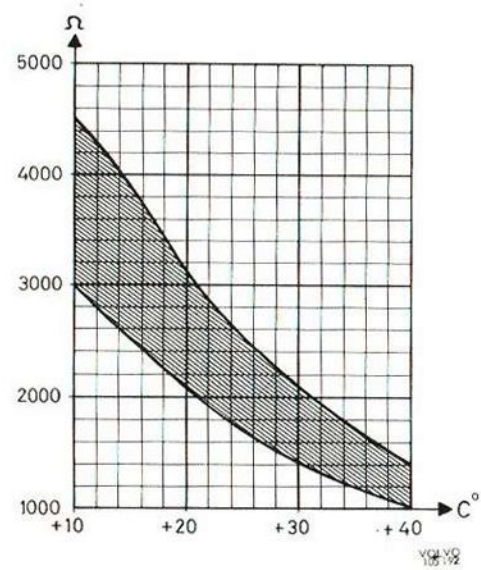



Fig. 2-194. Resistance in temperature sensor for coolant

## AUXILIARY AIR REGULATOR

### REPLACING

1. Drain off the coolant.
2. Remove the air hoses from the auxiliary air regulator. Unscrew the fixing screws and draw out the regulator.
3. Fit a new sealing ring and screw on the new regulator.
4. Re-fit the air hoses and fill with coolant.

### CHECKING

1. Run the engine warm (approx. 176° F). Read off the idling speed. After that pull off the hoses between the inlet duct and the auxiliary air regulator. Cover the hose opening with the hand.
2. Check that the speed does not drop noticeably in relation to the first reading.
3. If it does drop noticeably, there must be a leak in the auxiliary air regulator, which should be replaced.

## PRESSURE SENSOR

1. Pull out the four-way plug.
   Remove the hose from the pressure sensor.
2. Undo the three fixing screws holding the pressure sensor to the wheel housing.
3. Fit the new sensor on the wheel housing. Connect up the hose and re-fit the four-way plug. Note. Do not take off the protection over the hose connection until the hose has been re-fitted.

### CHECKING

Measure the resistance between the terminal points. The resistance should be approx. 90 ohms between 7 and 15 (primary winding).
Approx. 350 ohms between 8 and 10 (secondary winding).
All other combinations should give "∞" resistance.

## IGNITION DISTRIBUTOR TRIGGERING CONTACTS

### REPLACING

1. Remove the ignition distributor.
2. Undo the two screws securing the holder and pull out the holder.
3. Apply a little grease (Bosch Ft 1 v 4 or corresponding) to the fibre deflecting pieces of the ignition breaker lever on the new holder.
4. Check to make sure the rubber rings are not damaged, replace if necessary.
5. Fit the new holder in the distributor and secure it. (It is not possible to adjust the contacts.)
6. Fit the distributor and adjust the ignition.

## ADJUSTING THE IGNITION

1. Connect a rev. counter and stroboscope.
2. Remove the hose for the air cleaner at the inlet duct. Disconnect the hose for the distributor vacuum control from the inlet duct.
3. Start the engine. Fit the plastic cover, 999 2902, as shown in Fig. 2-195, and adjust down the speed to 12—13 r/s (700—800 r/m) by moving the bar across the hole in the plastic cover.
4. Adjust the ignition to 10° B.T.D.C. (For the adjustment, slacken the distributor housing and turn in the desired direction.)
5. Remove the plastic cover. Re-fit the hose on the vacuum governor. Re-fit the air cleaner hose.

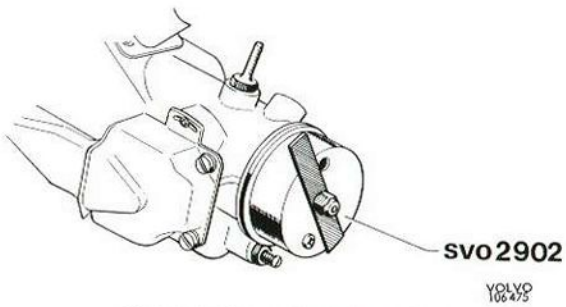



Fig. 2-195. Cover for ignition setting

## ADJUSTING THE IDLING

1. Run the engine until it is warm (approx. 176° F). Connect a rev. counter.
2. Remove the hose from the air cleaner at the inlet duct.
3. Check to ensure that the auxiliary air regulator is completely closed by pulling off the hose between the inlet duct and the regulator and by covering the opening with the hand. The speed must not differ much from the previous speed. (Engine insufficiently warm or auxiliary air regulator faulty.) Re-fit the hose.
4. Adjust the idling speed to 15 r/s (900 r/m by means of the idle adjuster screw. (If the speed cannot be lowered sufficiently, check the basic setting of the throttle valve, see Fig. 2-195.)
5. Re-fit the air cleaner hose.

## ADJUSTING THE CO-VALUE

This adjustment is done at idling speed and with warm engine (80° C=176° F).

1. Connect up a CO-meter.
2. Adjust the CO-value to 1—1.5 % (Automatic 0.5 —1.0 %) with the adjusting screw on the control unit.
   Turning the adjusting screw clockwise increases the CO-content.

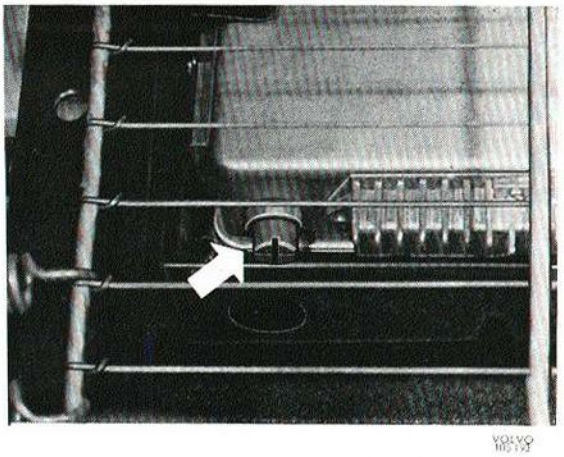


**Fig. 2-196. Adjusting the CO-valve**
Arrow=adjusting screw

## EXHAUST GAS RECIRCULATION (EGR)

The lines and valve should be **cleaned** at intervals of 20 000 km (12 000 miles).

At every other cleaning, that is, every 40 000 km (24 000 miles), the EGR valve should be **replaced by a new one.**

When cleaning, remove the lines from their connections at the exhaust pipe and carburetor.

The intake manfold should only be cleaned when necessary. Remove the manifold to do this. The function of the EGR system is checked by connecting up the distributor vacuum hose to the EGR valve vacuum chamber with the engine at idle. This should cause the engine to stop or to run very unevenly. If this does not happen, check to make sure that the EGR pipe and the EGR line are not blocked. If this is not the case, in other words the EGR pipe and EGR line are without fault, replace the EGR valve with a new one.

# COOLING SYSTEM

## DESCRIPTION

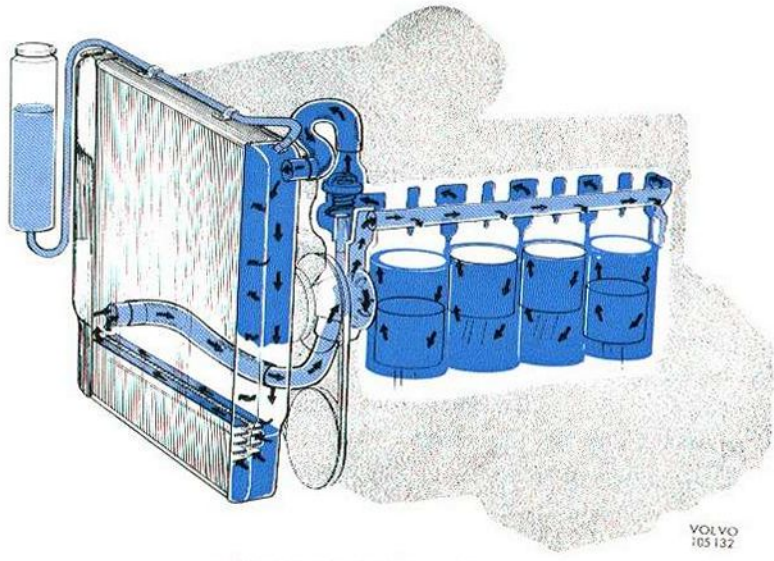



Fig. 2-197. Sealed type cooling system

### GENERAL

The engine is water-cooled and the cooling system is of the sealed type, see Fig. 2-197.

The fan is a fixed fan or a speed-regulated fan, a so-called viscous type (see Fig. 2-198).

The function of the viscous type is to ensure that the fan blades do not exceed a certain speed even if the engine speed is exceeded. See Fig. 2-198. The six fan blades are mounted asymmetrically to keep down the noise level. The fan coupling consists of the casing (11, Fig. 2-198) in which the fan blades (1) are secured with the bolt (2). The casing (11) has two halves which, however, cannot be separated for repairs, the fan coupling then being replaced complete. The hub (8) has a light fit on the water pump flange (6) and is locked by means of the center bolt (7). The hub is provided with a slip disc of friction material (9) surrounded by oil. During idling and at low speeds, slipping is insignificant, so that the fan provides an air current for good cooling. When the ingoing speed (that of the water pump) exceeds about 58 r/s (3500 r/m), slipping increases (see Fig. 2-206). With this arrangement the fan speed should never exceed about 0.4 r/s (25 r/m). The fan noise output would then be low compared with a fan which runs at the same

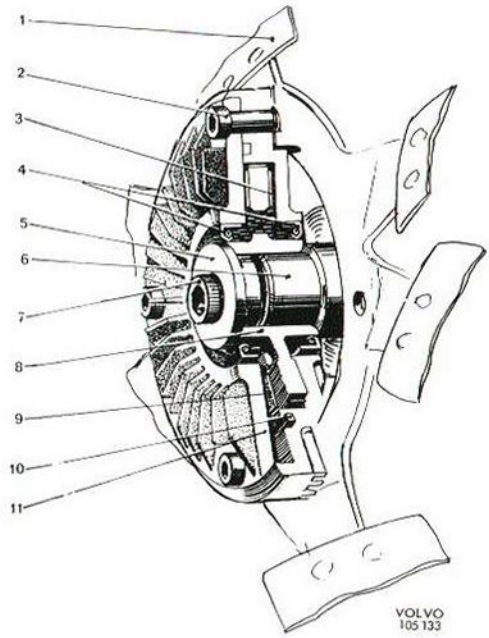



Fig. 2-198. Viscous fan

1. Fan blade
2. Bolt
3. Oil
4. Seals
5. Washer
6. Flange, water pump
7. Center bolt
8. Hub
9. Friction material
10. Rubber ring
11. Shroud casing

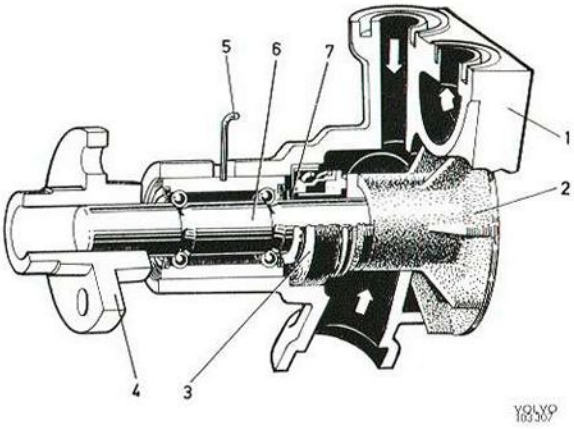



**Fig. 2-199. Water pump**

1. Housing
2. Impeller
3. Seal ring
4. Flange
5. Lock spring
6. Shaft with ball bearings (integral unit)
7. Wear ring

high speeds as the water pump. Compared with this latter type of fan, the output loss will be less for the viscous type fan. A centrifugal pump, Fig. 2-192, takes care of the coolant circulation and a twin operating thermostat provides rapid warming up of the engine and contributes to the engine maintaining the most suitable temperature under all operating conditions. The cooling system has a capacity of 10 litres (10 qts.). Of this quantity, 0.6 litre (0.6 qt.) fills the expansion tank at maximum level.

In order to achieve the desired effect with the sealed cooling system, it must be well filled and not leak. As coolant, a mixture consisting of 50 % ethylene gycol and 50 % water is used all year round. This mixture provides protection against frost down to minus 35° C (minus 32° F) and should be changed every other year, on which occasion the engine, radiator and expansion tank should be flushed with clean water.

If Volvo anti-freeze for cars is used (it has a red colour), it should not be mixed with other types of anti-freeze.

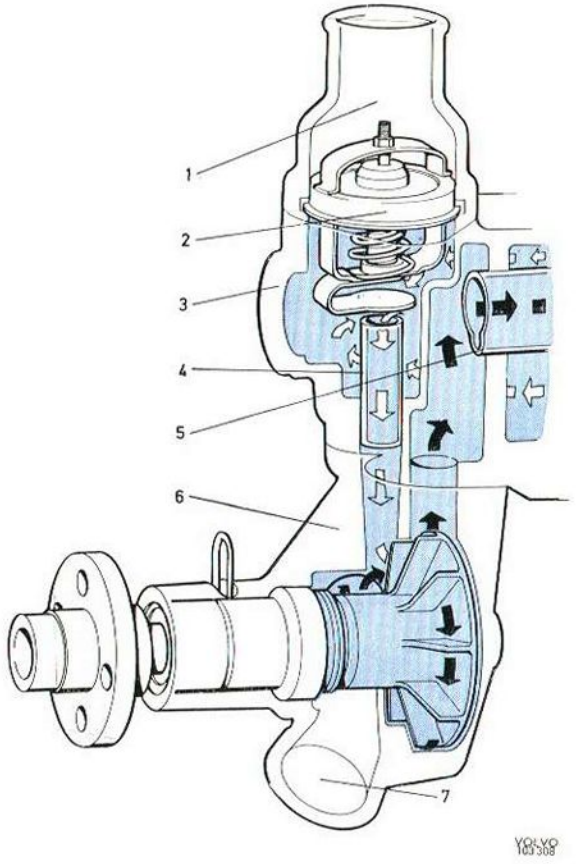



**Fig. 2-200. Coolant flow, thermostat closed**

1. To radiator
2. Thermostat
3. Cylinderhead
4. By-pass pipe
5. Distributor pipe
6. Water pump
7. From radiator

## COOLING SYSTEM INNER CIRCUIT (BY-PASS)

The cooling system consists of two circuits, an inner and an outer one. When the engine is warming up and in very cold weather when large quantities of heat are required for warming up the inside of the car, the coolant circulates almost exclusively through the inner circuit (the by-pass). This circuit covers the engine and car heater. The thermostat is closed, that is, the outlet to the radiator is shut off. The coolant passes through the thermostat by-pass to the distributor pipe (5, Fig. 2-200) in the cylinder head. This results in a uniform cooling of the warmest parts in the cylinder head. Even the parts around the spark plugs are also cold and thereby maintained at a constant temperature. The coolant surrounding the cylinder walls is circulated by means of thermo-syphon action.

## COOLANT SYSTEM OUTER CIRCUIT

When the coolant in the inner circuit reaches a suitable temperature for the engine, the thermostat begins to open, during which time the by-pass between the thermostat housing and the pump gradually closes, see Fig. 2-201.

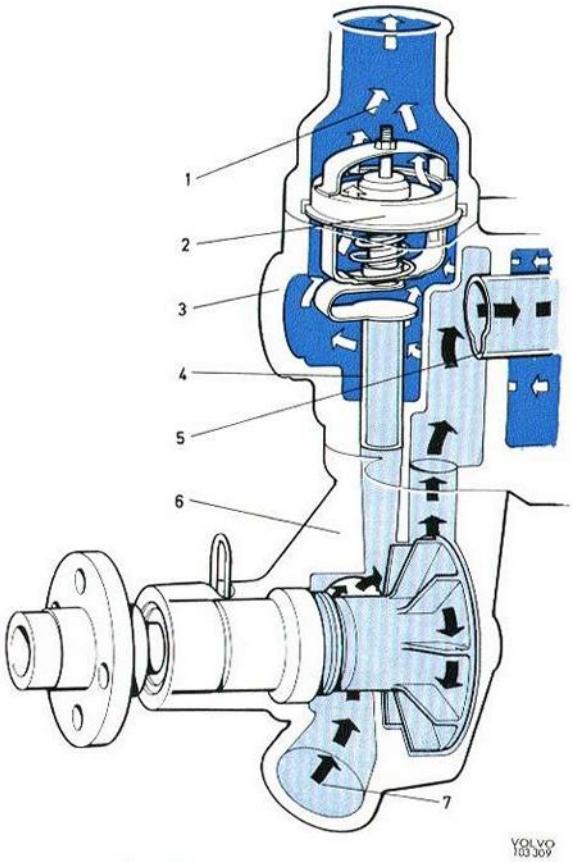



Fig. 2-201. Coolant flow, thermostat open
Concerning numbers above, see previous figure

Coolant flows from the engine into the upper part of the radiator is cooled and then sucked by the pump out from the lower part of the radiator from where it is conveyed into the engine through the distributing pipe.

An air cushion forms in the upper part of the expansion tank and permits the coolant to expand without involving any loss of coolant so that there is air suction at reduced temperature and volume. This arrangement ensures that the cooling system is always filled with coolant, thus minimizing the risk of corrosion. When the cooling system is being topped up, it will probably be difficult to prevent air from entering this system. The air, however, is subsequently separated and forced out into the expansion tank where it is replaced by coolant from this tank. It is, therefore, important to check the coolant level after the system has been emptied and filled with new coolant.

The expansion tank cap is provided with a valve which opens when the pressure in the system goes up to 0.7 atmospheric gauge. There is also a valve which opens when there is a partical vacuum in the system and admits air into the expansion tank.

# REPAIR INSTRUCTIONS

## RADIATOR
## TOPPING UP WITH COOLANT

Topping up with coolant, consisting of 50 % ethylene glycol and 50 % water (all year round) is done in the expansion tank, when the level has fallen to the "Min" mark.

NOTE. Never top up with water only.

## DRAINING COOLING SYSTEM

To drain the cooling system, semove the plug on the right side of the engine and remove the lower radiator hose. The expansion tank is emptied by first taking it off its mounting and holding it at a sufficient height so that the coolant runs into the radiator. Another way to empty the tank is to turn it upside down.

## FILLING EMPTY SYSTEM WITH COOLANT

Before filling, flush the cooling system with clean water. When filling with coolant, through the filler opening on top of the radiator, the heater control should be set at max. heat. Fill the radiator to the top and fit the cap. Fill also the expansion tank to the "Max" mark or to max. 30 mm (1 1/8") above this mark. Run the engine for several minutes at different speeds. If necessary, top up with more coolant and then fit the expansion tank cap. After driving for a short time, check the coolant level and top up with more coolant since it takes some time before the system is completely devoid of air.

## COOLING SYSTEM LEAKAGE CHECK

The cooling system is checked for leakage as follows: Connect a cooling system pressure tester to the hose between the expansion tank and radiator. Use a suitable T-nipple and two pieces of hoses. Carefully pump the pressure up to almost 0.7 kp/cm² (10 psi). Observe the pressure tester

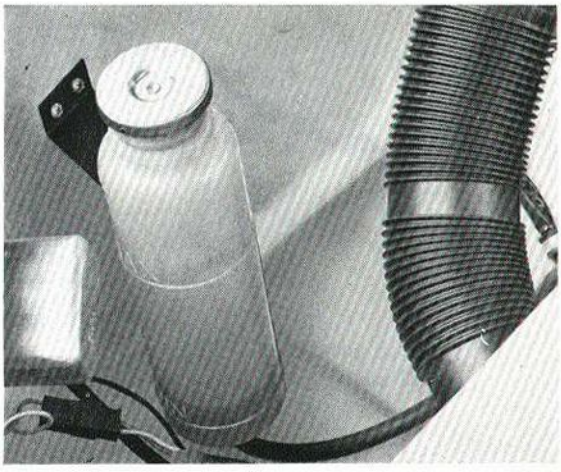


Fig. 2-202. Expansion tank

Fig. 2-203. Belt tensioner 2906

gauge. The pressure must not drop noticeably during 30 seconds. If it does, examine and remedy the leakage.

## REPLACING RADIATOR

1. Remove the radiator cap and drain the system of coolant by disconnecting the lower radiator hose.
2. Remove the expansion tank with hose and empty out the coolant. Remove the upper radiator hose.
3. Remove the bolts for the radiator (and fan casing). Lift off the radiator.
4. Place the radiator in position and tighten the bolts for the radiator.
5. Fit the radiator hoses as well as the expansion tank with hose.
6. Fill with coolant, see under "Filling empty system with coolant". Start the engine and check for leakage.

## REPLACING WATER PUMP

Remove the radiator according to the instructions given under "Replacing radiator" and screw off the water pump. Clean the sealing surfaces and refit the pump with new gasket. Make sure when fitting that the sealing rings on the upper side of the pump locate correctly. Also press the pump upwards against the cylinder head extension under the bolting, so that the sealing between the pump and cylinder head will be satisfactory. Make sure that the sealing rings at the water pipes are not damaged and press in the pipes thoroughly when attaching.

## THERMOSTAT

After being removed, the thermostat can be tested in a vessel containing heated water. The thermostat should open and close according to the values given in "Specifications". A faulty thermostat should be discarded. Use a new gasket when fitting the thermostat.

## TENSIONING THE PULLEY BELT

Belt tensioner 2906 can be suitably used for checking and adjusting the belt tension.

The gauge is placed on the belt as shown in the Fig. 2-203. The belt must lie in the fork on the thrust rod. Push the gauge down until both ends on the stop rule lie against the belt. In this position, read off the gauge. Fig. 2-204 shows the correct values. (See also the table.)

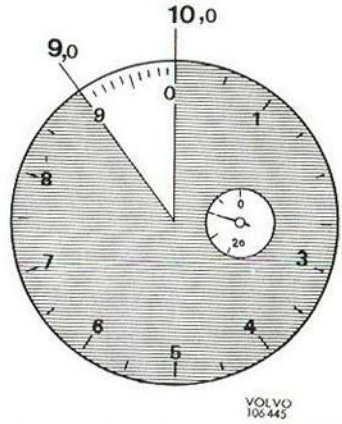



Fig. 2-204. Belt tensioning gauge values
See also the table

When adjusting the belt, use the upper, max. limiting value indicated, since the tensioning reduces somewhat after the engine has been turned over several times.

NOTE. The alternator must not be obliquely loaded. If an iron lever is used for adjusting, it should be placed between the engine and the **front end of the alternator.**

Note that if the lower alternator bolt is not slackened during adjustment, there will be heavy stresses on the drive end bearing shield.

On fitting a new belt, final tensioning should be carried out after driving for about 10 minutes. This will ensure a longer lifetime for the pulley belt.

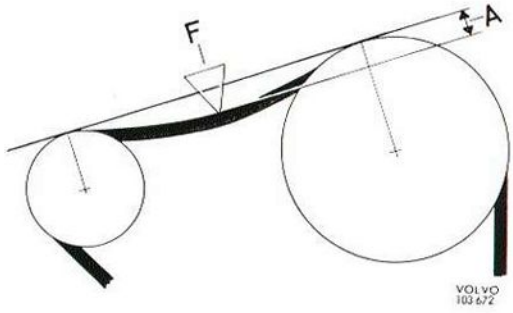



**Fig. 2-205. Fan belt tension**
F=See table A=10 mm (approx. 3/8")

## Without 2906

The pulley belt is tensioned so that it can be deflected 10 mm (approx. 3/8") with a force acc. to table applied to the belt midway between the water pump pulley and alternator pulley, see Fig. 2-205. The amount of force applied will depend on the location of the bolt in the oblong slot in the tensioner. With the bolt at the end of the slot (long belt), the force applied should be the lower value; and with the bolt at the beginning of the slot (short belt), a force of the higher value should be applied. If the bolt is located anywhere between these extremes, the force applied should be proportionally within the two limits given.

## FAN COUPLING

The fan coupling fuction can be checked with a stroboscope with variable blinking frequency. Make a mark on the fan and one on the water pump pulley. Find out the speed relationship between fan and pulley by means of the stroboscope. The fan speed should follow the speed of the water pump according to the curve given in Fig. 2-206.

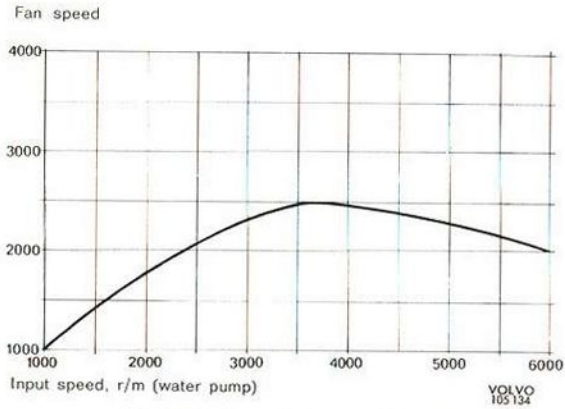



**Fig. 2-206. Curve for fan coupling slip**

Fan belt tensioning:

| | with 2906 | | | F |
|---|---|---|---|---|
| | A | B | C | N (lb) |
| Vehicle with l-h drive | 9.0—10.0 | 7.5—8.0 | 11.0 | 70—100 (15.5—22 ) |
| Vehicle with r-h drive | 7.2— 8.3 | 6.5—7.1 | 9.5 | 55— 70 (12 —15.5) |
| Vehicle with r-h drive and air conditioning | 9.0—10.0 | 8.8—9.3 | 11.0 | 85—100 (19 —22 ) |

A=Check value with belt tensioner gauge, 2906, new belt
B=With belt in outer position (stretched belt)
C=Value when fitting new belt
F=Depression force in N (lb) when depressing 10 mm (3/8") midway between pulleys.
(The lower value with belt in outer position, stretched.)

1. Water distribution pipe
2. Intake manifold
3. Seal ring
4. Exhaust valve
5. Fuel hose
6. Ventilation cover (oil filler cap)
7. Valve cotter
8. Inlet valve
9. Carburettor
10. Plug for damper piston
11. Upper valve washer
12. Valve spring
13. Valve guide
14. Rocker arm
15. Rocker arm shaft
16. Spring
17. Lower valve washer
18. Push rod
19. Bearing bracket
20. Rocker casing
21. Gasket
22. Cable terminal
23. Cylinder head
24. Vacuum line
25. Distributor
26. Valve tappet
27. Flywheel housing
28. Retainer
29. Cylinder block
30. Gear wheel
31. Circlip
32. Pilot bearing
33. Flywheel
34. Bush
35. Flange bearing shell
36. Sealing flange
37. Main bearing cap
38. Reinforcement
39. Sump
40. Gasket
41. Main bearing shell
42. Oil pump
43. Delivery pipe
44. Crankshaft
45. Camshaft
46. Piston
47. Piston rings
48. Connecting rod
49. Circlip
50. Gudgeon pin
51. Big-end bearing shell
52. Connecting rod bush
53. Thrust washer and spacer ring
54. Camshaft gear
55. Timing gear casing
56. Crankshaft gear
57. Hub
58. Washer
59. Belt pulley
60. Bolt
61. Fan
62. Key
63. Oil nozzle
64. Key
65. Lock washer (early production)
66. Cooling water inlet
67. Gasket
68. Water pump
69. Dynamo
70. Belt pulley
71. Gasket
72. Seal ring
73. Tensioner
74. Cylinder head gasket
75. Thermostat
76. Gasket
77. Cooling water outlet

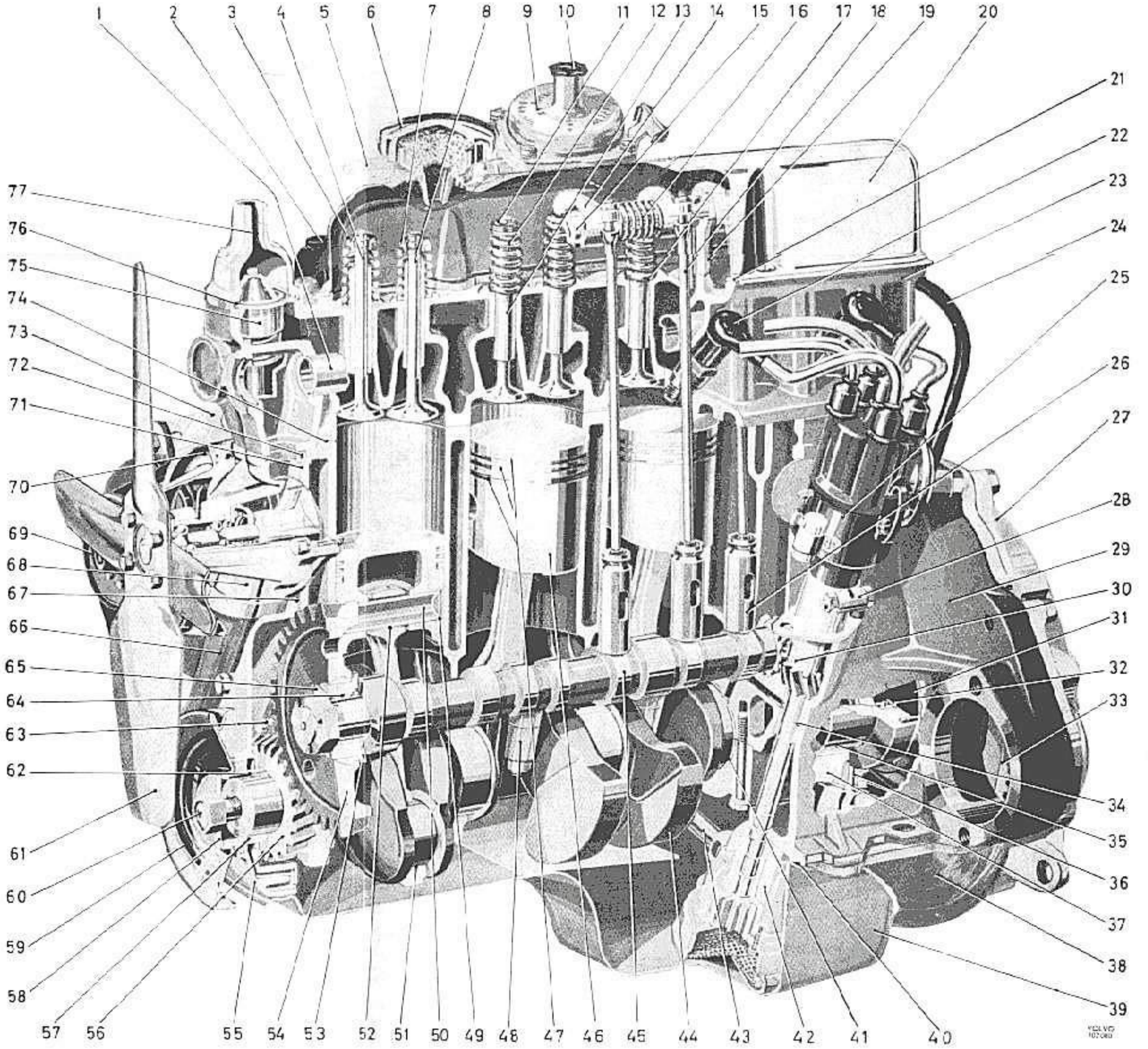
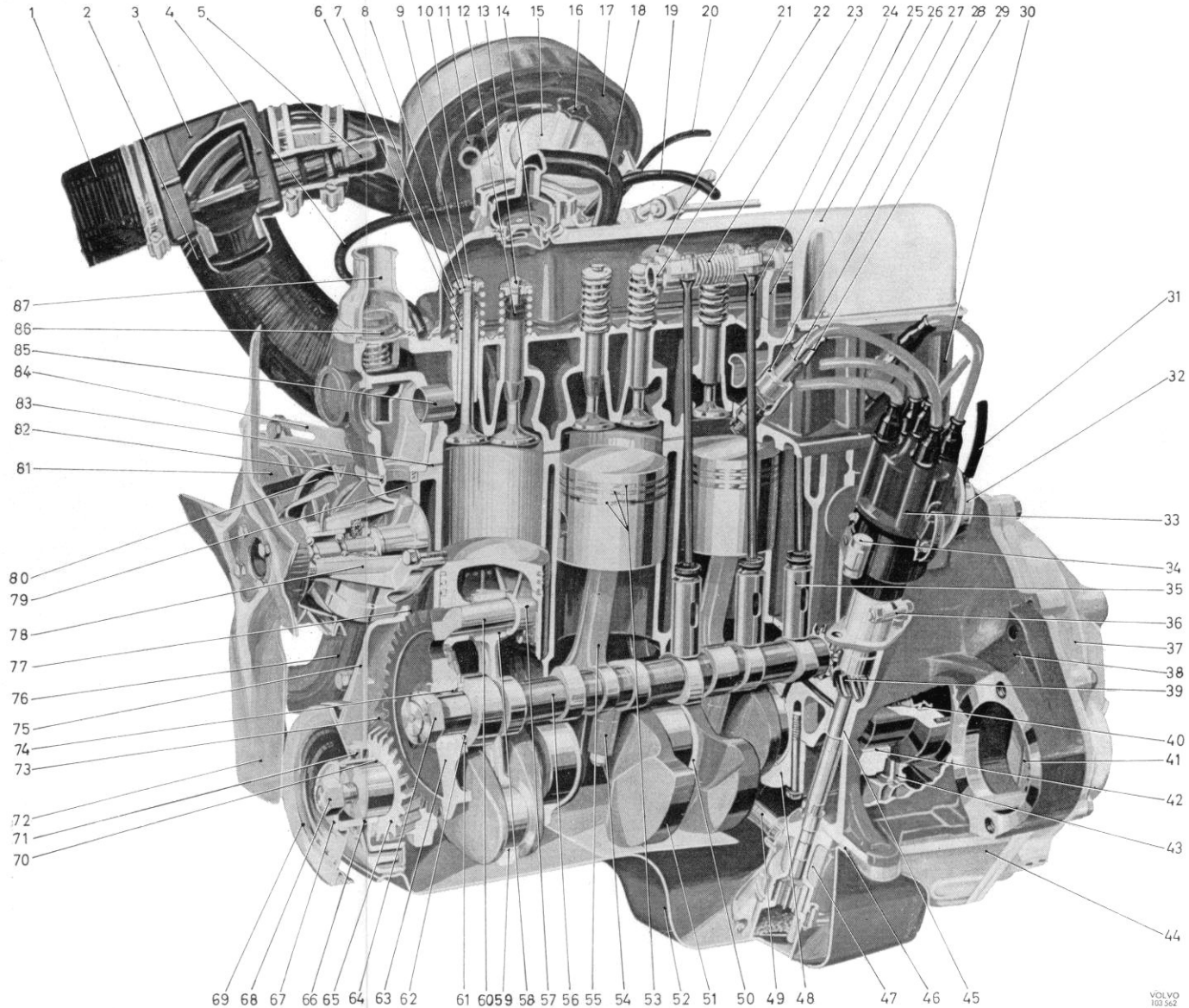



**Illustration A. Sectional view of B 18 A engine**

1. Cold-air hose
2. Warm-air hose
3. Flap, constant air temperature device
4. Fuel line
5. Thermostat
6. Valve guide
7. Valve spring
8. Washer
9. Valve collet
10. Exhaust valve
11. Connection for crankcase hose
12. Valve guide seal
13. Intake valve
14. Oil filler cap
15. Carburettor
16. Damping device
17. Air cleaner
18. Hose for crankcase gases
19. Vacuum hose for distributor
20. Choke wire
21. Rocker arm
22. Rocker arm shaft
23. Spring
24. Push rod
25. Bearing bracket
26. Rocker arm casing
27. Rubber seal
28. Cable terminal
29. Rubber seal
30. Cylinder head
31. Vacuum hose
32. Vacuum governor
33. Distributor
34. Condenser
35. Valve tappet
36. Retainer
37. Flywheel casing
38. Cylinder block
39. Gear wheel
40. Pilot bearing
41. Flywheel
42. Flange bearing shell
43. Sealing flange
44. Reinforcing bracket
45. Bush
46. Seal
47. Oil pump
48. Main bearing cap
49. Delivery pipe
50. Main bearing shell
51. Crankshaft
52. Sump
53. Piston rings
54. Connecting rod cap
55. Connecting rod
56. Camshaft
57. Piston
58. Bush
59. Big-end bearing shell
60. Gudgeon pin
61. Washer
62. Spacing ring
63. Camshaft gear
64. Nut
65. Crankshaft gear
66. Hub
67. Washer
68. Bolt
69. Pulley
70. Key
71. Seal
72. Fan
73. Oil nozzle
74. Key
75. Timing gear cover
76. Coolant inlet
77. Gasket
78. Water pump
79. Gasket
80. Pulley
81. Alternator
82. Sealing ring
83. Cylinder head gasket
84. Tensioner
85. Water distributing pipe
86. Thermostat
87. Coolant outlet



1 Cold-air
2 Warm-air inlet
3 Flap, constant air temperature device
4 Thermostat
5 Air cleaner insert
6 Air cleaner
7 Choke wire
8 Valve guide
9 Valve spring
10 Washer
11 Valve collet
12 Exhaust valve
13 Carburettor
14 Damping device
15 Hose connection for crankcase
16 Valve guide seal
17 Hose for floatchamber ventilation
18 Intake valve
19 Fuel hose
20 Hose connection for brake servo
21 Air cleaner hose for floatchamber ventilation
22 Clamp
23 Hose for crankcase gases
24 Choke wire
25 Rocker arm
26 Rocker arm shaft
27 Spring
28 Thrust rod
29 Bearing bracket
30 Rubber seal
31 Cable terminal
32 Rubber seal
33 Rocker arm casing
34 Cylinder head
35 Vacuum hose
36 Distributor
37 Vacuum governor
38 Flywheel casing
39 Condenser
40 Retainer
41 Valve tappet
42 Cylinder block
43 Gear wheel
44 Pilot bearing
45 Flywheel
46 Flange bearing shell
47 Sealing flange
48 Reinforcing bracket
49 Gasket
50 Sump
51 Oil pump
52 Main bearing cap
53 Crankshaft
54 Piston rings
55 Connecting rod
56 Connecting rod cap
57 Camshaft
58 Piston
59 Connecting rod bush
60 Big-end bearing shell
61 Gudgeon pin
62 Washer
63 Spacing ring
64 Camshaft gear
65 Key
66 Nut
67 Crankshaft gear
68 Hub
69 Washer
70 Bolt
71 Pulley
72 Key
73 Seal
74 Oil nozzle
75 Timing gear casing
76 Coolant inlet
77 Gasket
78 Water pump
79 Fan blade
80 Fan coupling
81 Gasket
82 Sealing ring
83 Pulley
84 Cylinder head gasket
85 Alternator
86 Tensioner
87 Water distributing pipe
88 Thermostat
89 Coolant outlet

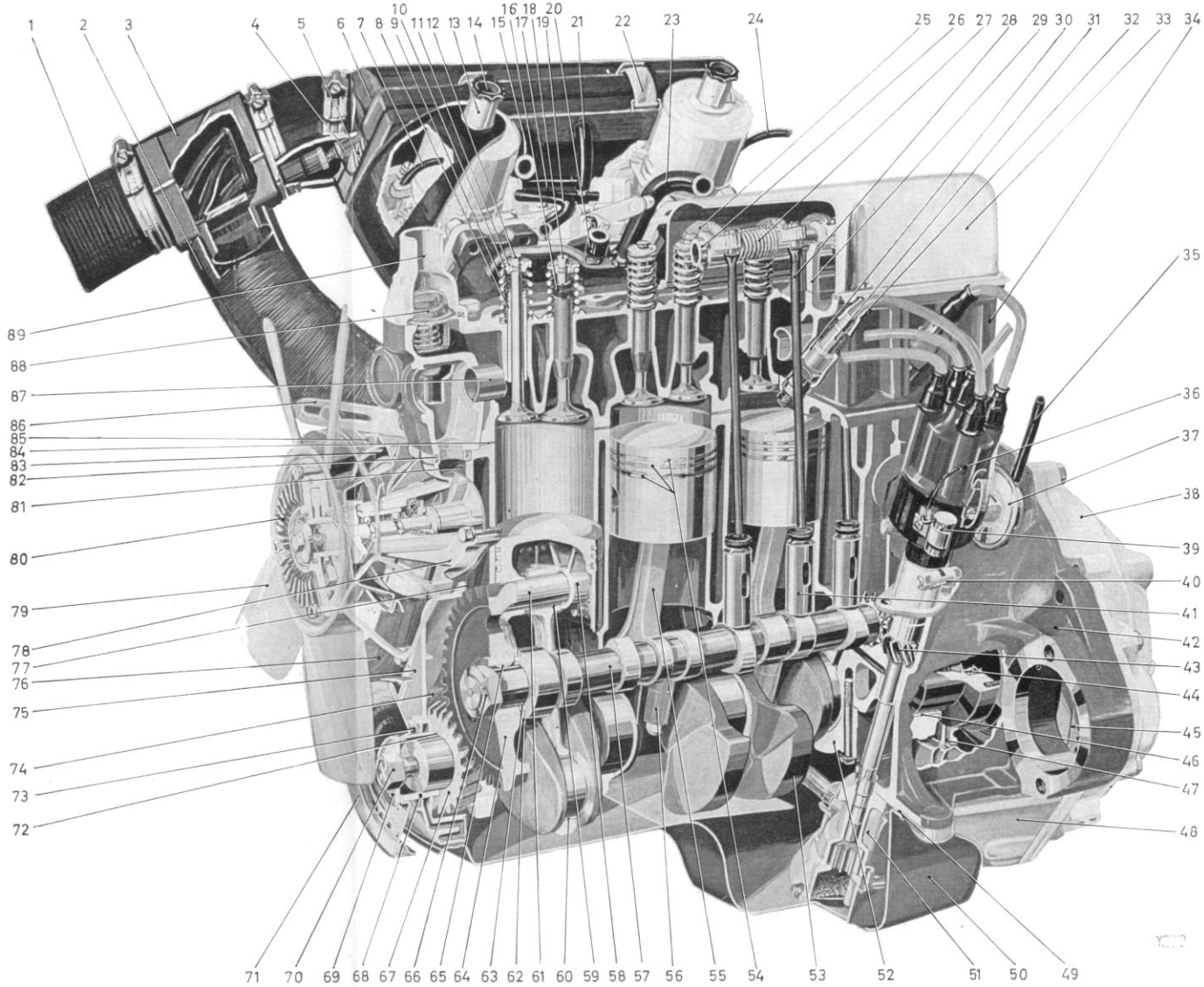



**Illustration B. B 20 B engine (with SU-carburettors)**

1. Inlet duct
2. Coolant outlet
3. Thermostat
4. Valve tappet
5. Valve spring
6. Washer
7. Valve collet
8. Exhaust valve
9. Valve tappet seal
10. Intake valve
11. Oil filler cap
12. Rocker arm
13. Rocker arm shaft
14. Spring
15. Push rod
16. Bearing bracket
17. Rocker arm casing
18. Rubber seal
20. Rubber seal
19. Rubber terminal
21. Cylinder head
22. Distributor
23. Vacuum governor
24. Condenser
25. Electrical conection
26. Flywheel casing
27. Cylinder block
28. Retainer
29. Gear wheel
30. Pilot bearing
31. Flywheel
32. Flange bearing shell
33. Sealing flange
34. Reinforcing bracket
35. Bush
36. Seal
37. Oil pump
38. Main bearing cap
39. Delivery pipe
40. Main bearing shell
41. Crankshaft
42. Piston rings
43. Connecting rod cap
44. Connecting rod
45. Camshaft
46. Connecting shell
47. Piston
48. Washer
49. Spacing ring
50. Camshaft gear
51. Crankshaft gear
52. Nut
53. Hub
54. Washer
55. Bolt
56. Pulley
57. Seal
58. Timing gear cover
59. Oil nozzle
60. Gudgeon pin
61. Fan
62. Bush
63. Coolant inlet
64. Flange
65. Intermediate piece
66. Screw
67. Washer
68. Fan coupling
69. Water pump
70. Sealing ring
71. Pulley
72. Bolt
73. Washer
74. Nut

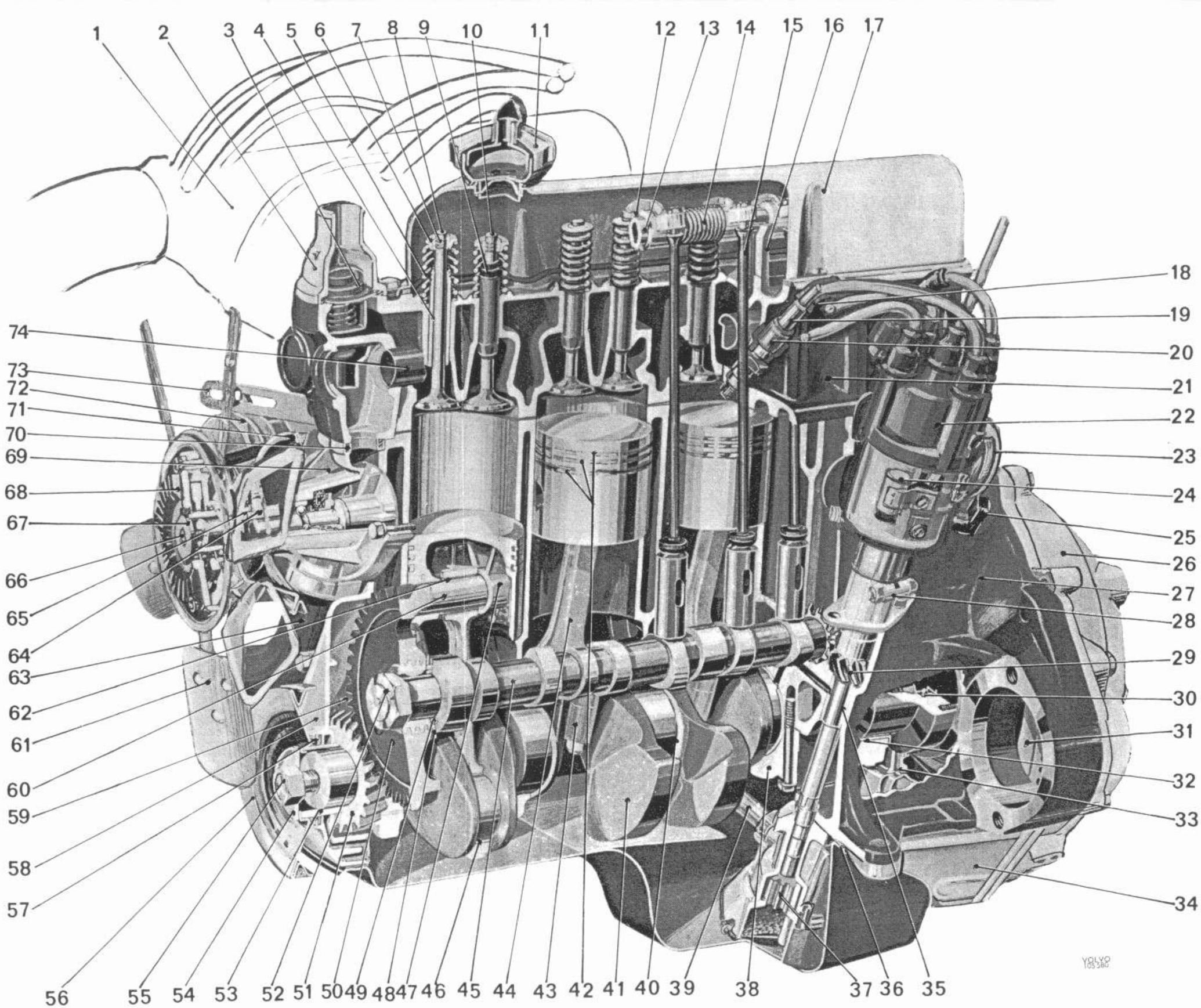



**Illustration 2-A. B 20 E engine**

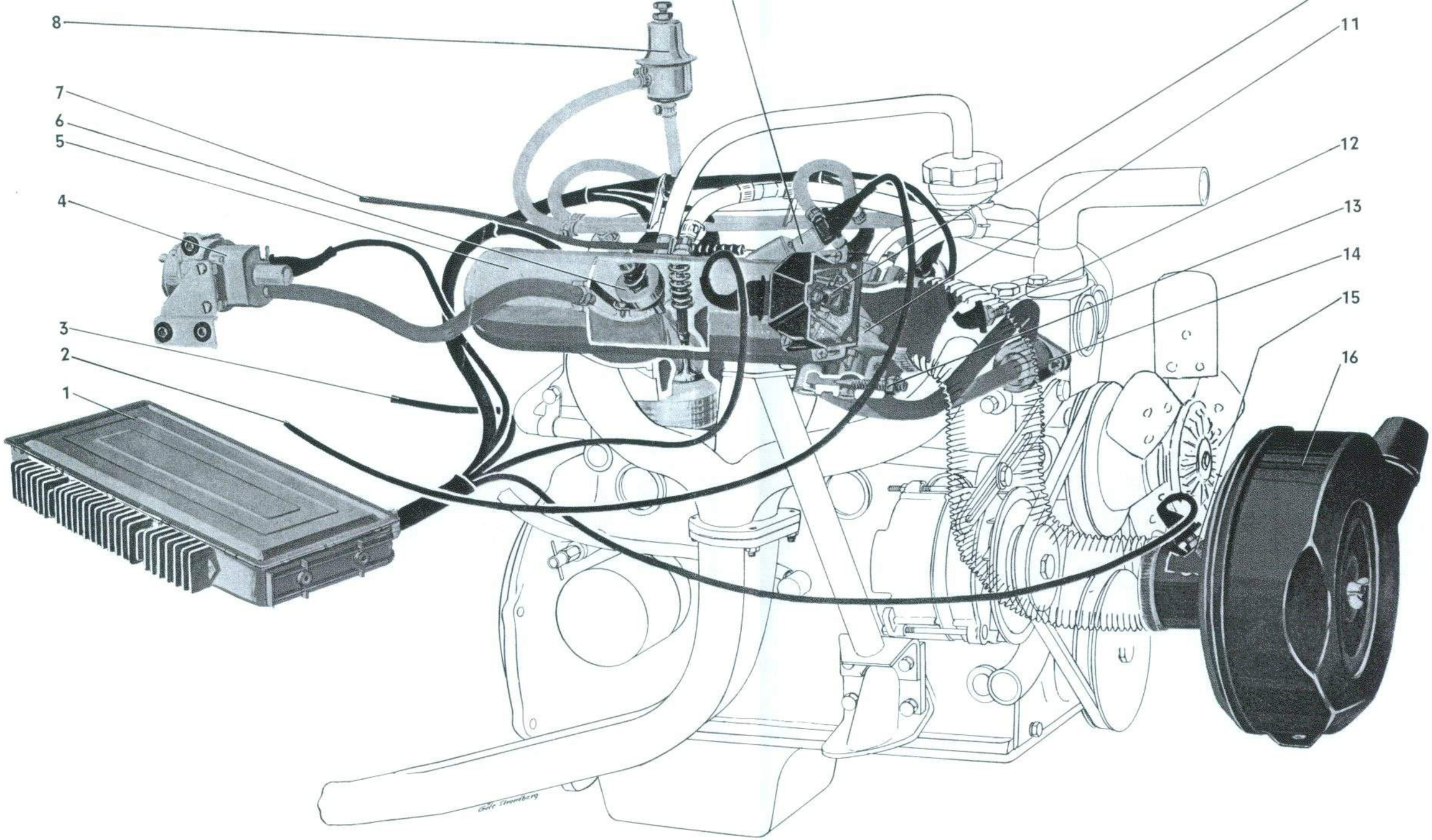



**Illustration 2-B. Fuel injection system**

1. Control unit
2. To cold start relay
3. To main relay
4. Pressure sensor
8. Pressure regulator
9. Cold start valve
10. Throttle switch
11. Throttle valve
14. Auxiliary air regulator
15. Temperature sensor for induction air
16. Air cleaner