SERVICE MANUAL

VOLVO
P 1800

Export Service Department

AKTIEBOLAGET
VOLVO
GOTEBORG SWEDEN

FOREWORD

This Manual contains instructions for the Volvo P 1800 sports car.

It is divided up into 12 parts in accordance with the register. The pages and illustrations in each part are numbered in such a way that the first number shows the part concerned while the remainder shows the number of the page in that particular section, for example, under the heading Transmission 3-1, 3-2 etc. A convenient way to find the particular section you are looking for is to bend the right side of the Manual so that the arrows on the register correspond to index marks on the first page of each section.

The various section are divided up as follows:

- Description
- Repair Instructions
- Fault Tracing
- Tools
- Specifications

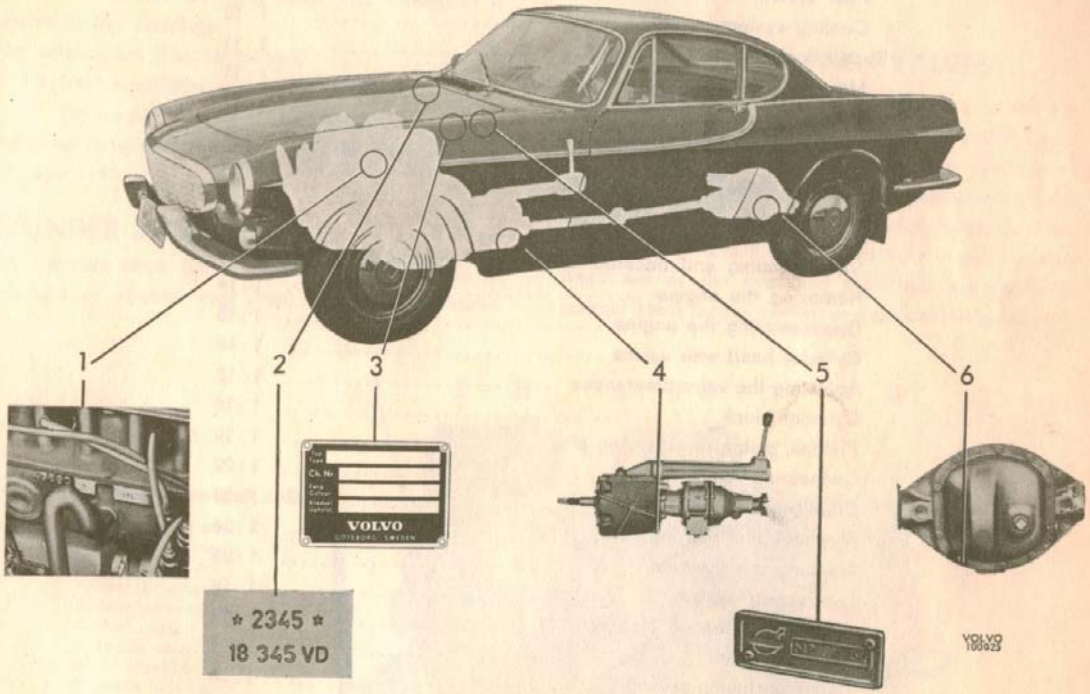
The instructions given in this book assume as a rule that special tools are used and are based on experience from time method studies. The same result can be obtained by several different working methods but if you follow the instructions in this book you will always get the quickest results.

AKTIEBOLAGET VOLVO
Göteborg – Sweden

TYPE DESIGNATIONS

This Service Manual deals with the Volvo P 1800 series having the following type designations and main data:

Type designation	Model	With effect from:	Chassis No.	Engine	Gearbox	Rear axle ratio	Remarks
P 1800	A	May 1961	1—6000	B 18 B early prod.	M 40 or M 41	4.56:1 or 4.10:1	Assembled in England
P 1800	B	April 1963	6001—8000	B 18 B late prod.	M 40 or M 41	4.56:1 or 4.10:1	Assembled in Sweden
P 1800 S	D	August 1963	8001—				



1) Engine type designation, serial number and part number.
2) The chassis number is stamped on the body above the battery bracket.
3) The chassis number and type designation of the car and the code number for colour and upholstery.
4) The gearbox type designation, serial number and part number.
5) Body number.
6) Rear axle plate showing number of teeth and reduction ratio is fixed on the lower part of the inspection cover.

GENERAL DATA

Weight	approx.	1210 kg (2670 lb.)
Axle pressure, front	„	630 kg (1390 lb.)
„ „ rear	„	570 kg (1260 lb.)
Wheelbase		2450 mm (96.46″)
Trackwidth		1315 mm (51.78″)
Overall length		4400 mm (173.23″)
Overall width		1700 mm (66.93″)
Overall height, unladen		1285 mm (50.59″)
Ground clearance, unladen		155 mm (6.10″)
Turning circle (measured on centers of tire treads)	approx.	9500 mm (31′2″)

PART 1

ENGINE

DESCRIPTION

GENERAL

The designation of the engine in the P 1800 is B 18 B. It is a four-cylinder, water-cooled, overhead-valve engine with twin horizontal carburetors.

There are separate inlet and exhaust ports in the cylinder head, one for each valve. The crankshaft is carried in five bearings.

The outputs are thus as follows:

B 18 B 100 b.h.p./5500 r.p.m. (SAE) early prod.
108 b.h.p./5800 r.p.m. (SAE) late prod.

For other detailed information, see the specifications on page 1:41.

CYLINDER BLOCK

The cylinder block (29, Illustration 1-A) is made in one unit of special cast iron. The cylinder bores which are surrounded by cooling water jackets, are machined directly in the block. The oil channels in the block are arranged in such a way that the oil cleaner, which is of the fullflow type, is connected directly to the oil cooler on one side of the block.

CYLINDER HEAD WITH VALVES

The cylinder head (23), which is attached to the top of the block by means of bolts, covers the upper part of the cylinders and forms the combustion chambers. The cylinder head also contains the inlet and exhaust ports as well as cooling water jackets. The valves (4 and 8, Illustration 1-A) in the cylinder head are of the overhead type and are made of special steel, being carried in replaceable guides.

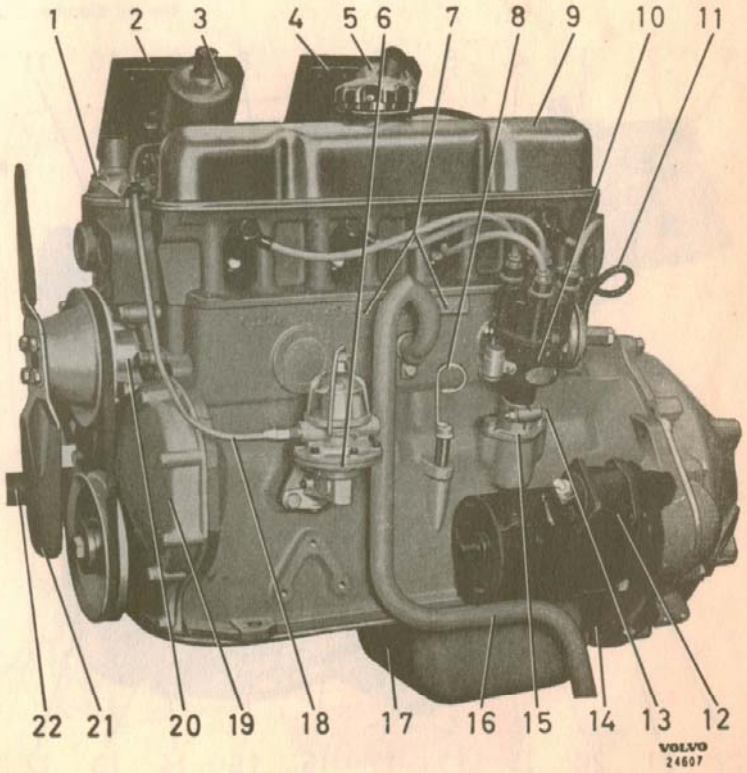


Fig. 1-1. The engine (left side)

1. Water outlet pipe
2. Front air cleaner
3. Front carburetor
4. Rear air cleaner
5. Rear carburetor
6. Fuel pump
7. Engine serial number
8. Oil dipstick
9. Rocker arm cover
10. Distributor
11. Vacuum line
12. Starter motor
13. Lock screw
14. Cover plate
15. Retainer
16. Breather pipe
17. Oil pan
18. Fuel pipe
19. Timing gear casing
20. Water pump
21. Fan
22. Water inlet pipe

1:1

CONTENTS

Part 1. Engine

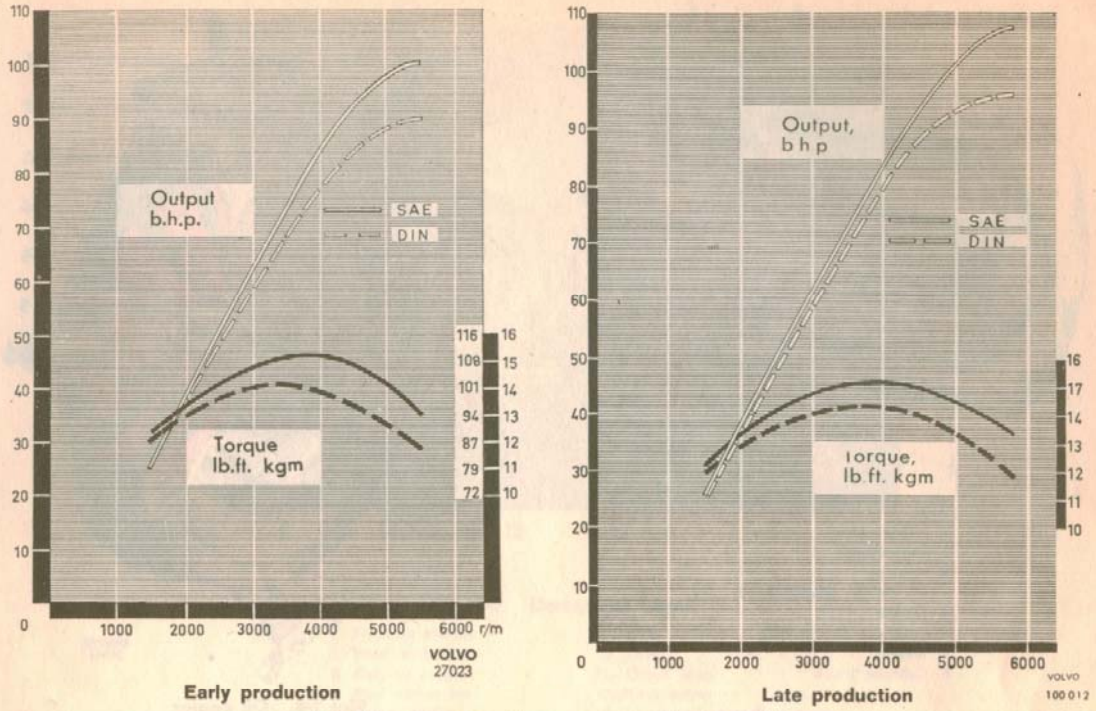


Fig. 1-3. Output and torque curves. Engine B 18 B

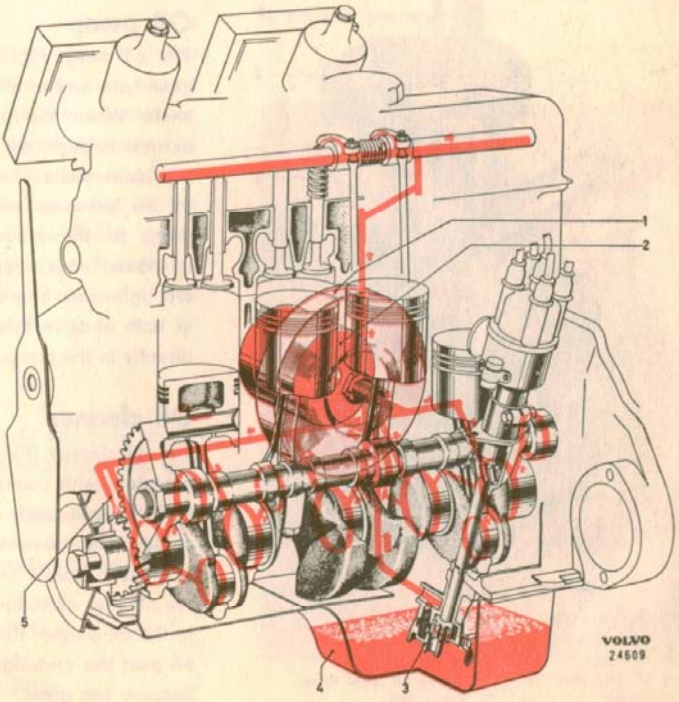


Fig. 1-4. The lubricating system

1. Oil cooler
2. Oil cleaner
3. Oil pump
4. Oil pan
5. Nozzle

CRANKSHAFT WITH BEARINGS

The crankshaft (44) is of forged steel and has ground and surface-hardened crankpins. It is carried in five main bearings, the rear of which also functions as an axial guide bearing. There are drillings through the crankshaft for the lubricating oil.

The bearing shells, which are replaceable, consist of steel-backed, indium-plated, lead-bronze bearing metal.

CAMSHAFT WITH VALVE LIFTERS

The camshaft (45) is made of special-alloy castiron and has surface-hardened cams. The camshaft is driven from the crankshaft by means of gears with a ratio of 1:2. Axial guidance is obtained by means of an axial washer on the front end of the shaft. The axial clearance is determined by a shim behind the camshaft gear.

The valve lifters (27) are influenced directly by the camshaft. They are located in ground holes in the block above the camshaft and transfer the movement to the valves through push rods and rocker arms. There are no inspection covers for the valve lifters since the valve lifters are accessible from the top after the cylinder head has been removed.

CONNECTING RODS, PISTONS AND PISTON RINGS

The connecting rods (48) are of drop-forged steel and are fitted at the top with finely-finished bushings which act as bearings for the piston pins. The connecting rod bearings on the crankshaft consist of precision-manufactured, replaceable bearing shells. The pistons (46) are made of light-alloy and each has two compression rings and one oil scraper ring. The upper compression ring on each piston is chromed to reduce cylinder wear.

The piston pins (50) are fully-floating in both the pistons and connecting rods. The axial movement of the piston pins is limited by the circlips in the piston pin holes.

LUBRICATING SYSTEM

The engine is lubricated by oil under pressure, see Fig. 1–4. The pressure is produced by a gear pump, driven from the camshaft and located under the crankshaft in the oil pan. The gears in the pump force the oil past the relief valve which is also located in the pump and then through the oil cooler, oil cleaner and so out through the drillings to the various lubricating points. All the oil which is forced out to the lubricating points thus first passes through the oil cleaner.

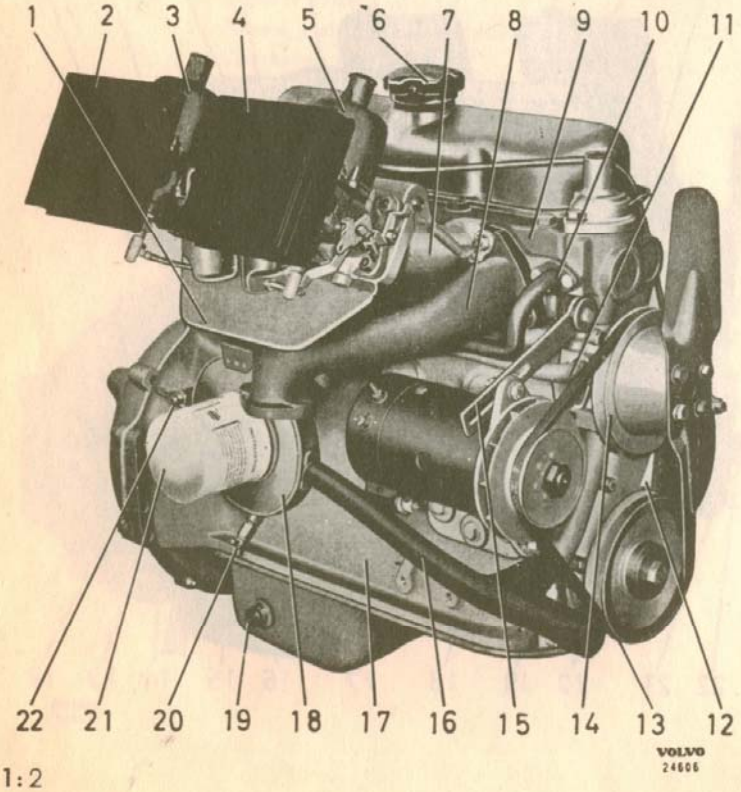


Fig. 1-2. The engine (right side)

1. Shield plate
2. Rear air cleaner
3. Rear carburetor
4. Front air cleaner
5. Front carburetor
6. Oil filler cap
7. Inlet manifold
8. Exhaust manifold
9. Cylinder head
10. Water pipe (to oil cooler)
11. Water pipe (from heater)
12. Setting marks
13. Pulley
14. Pulley
15. Belt tensioner
16. Water pipe
17. Cylinder block
18. Oil cooler
19. Plug for oil temperature gauge
20. Drain cock for water
21. Oil cleaner
22. Drain cock for water

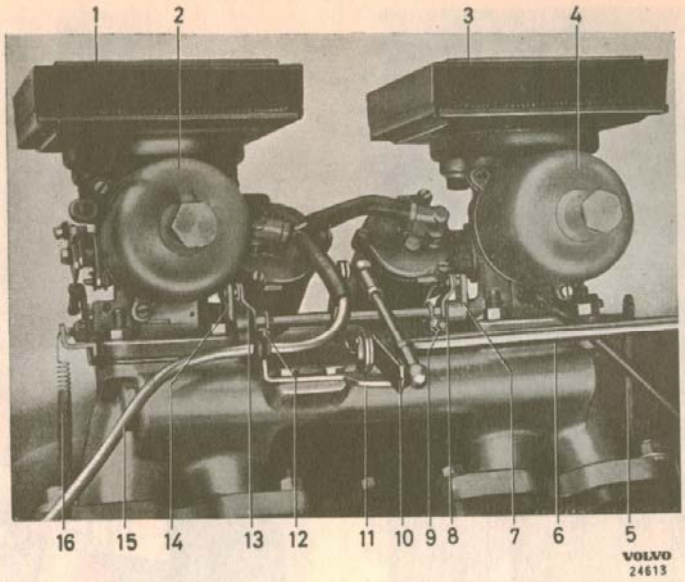


Fig. 1-8. Carburetor layout

1. Front air cleaner
2. Front carburetor
3. Rear air cleaner
4. Rear carburetor
5. Return spring
6. Control shaft
7. Lever on throttle spindle
8. Lever on intermediary shaft
9. Lock screw
10. Lever
11. Check stop
12. Lock screw
13. Lever on intermediary shaft
14. Lever on throttle spindle
15. Fuel pipe
16. Return spring

Oil cooler

The oil cooler (Fig. 1-6) is fitted between the oil cleaner and the cylinder block and consists of an inner part for the oil which is surrounded by a cooling jacket. The engine cooling water is taken through the cooling jacket. When the oil passes through the cooler on its way to the oil cleaner, part of the heat from the oil is conducted away by the cooling water. The cooling water cannot go the nearest way from the inlet (1) to the outlet (6) but is forced to circulate round the oil cooler by means of the stop plates (5). The oil is pressed through the pairs of disks one after the other due to the stop plates (4) and then passes out finally to the oil cleaner.

IGNITION SYSTEM

The distributor (25, Illustration 1-A) which is driven through a bevel gear from the camshaft is fitted with both centrifugal and vacuum governors. The direction of rotation is anti-clockwise and the order of firing is 1-3-4-2. See also Part 10.

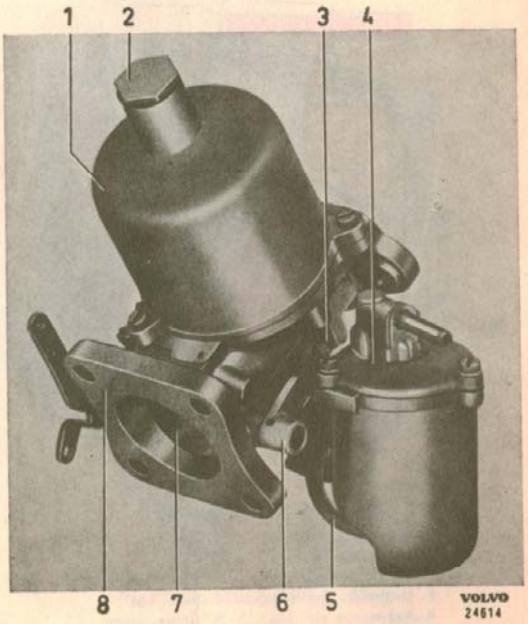


Fig. 1-9. Carburetor viewed from the left

1. Suction chamber
2. Screw for damping plunger
3. Lift pin
5. Fuel line
4. Float bowl cover
6. Lever
7. Throttle
8. Connecting flange

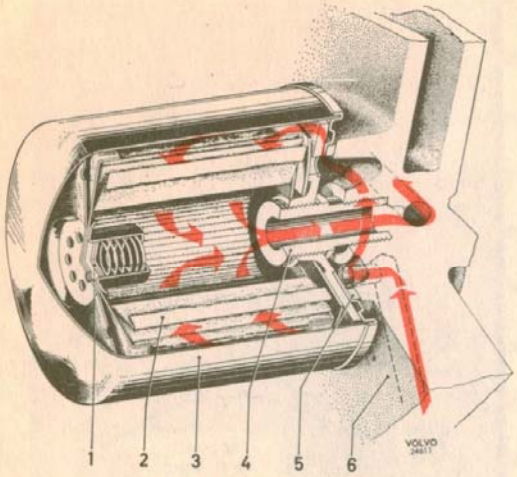


Fig. 1-5. Oil cleaner

1. Relief valve
2. Cartridge
3. Housing
   (cannot be disassembled)
4. Nipple
   (see also 10, Fig. 1-6)
5. Gasket
6. Cylinder block

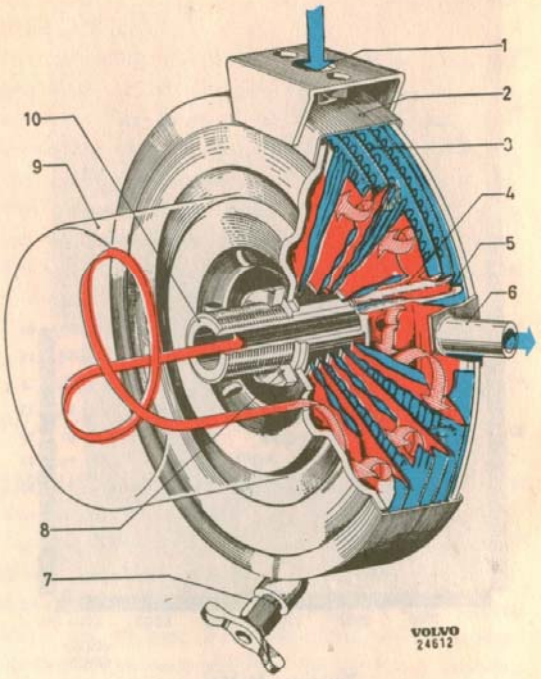


Fig. 1-6. Oil cooler

1. Cooling water inlet
2. Housing
3. Disks
4. Stop for oil
5. Stop for cooling water
6. Cooling water outlet
7. Drain cock for cooling water
8. Nut
9. Oil cleaner
10. Nipple

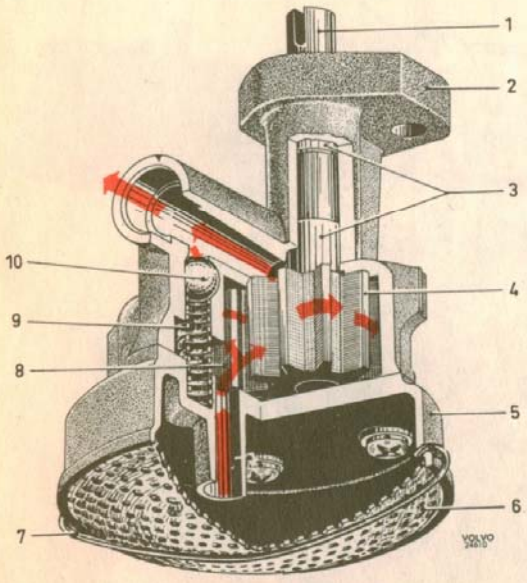


Fig. 1-7. Oil pump

1. Driving shaft
2. Pump housing
3. Bushings
4. Driving gear
5. Cover
6. Strainer
7. Bail
8. Driven gear
9. Spring for relief valve
10. Valve ball

Oil pump

The oil pump, Fig. 1-7 (41, Illustration 1-A) is of the gear type and is driven through gears from the camshaft. When the pump gears start rotating, oil is carried through the spaces between the teeth along the inner walls of the pump from the suction side to the pressure side. The pressure pipe from the pump to the block has no screw unions and is tensioned in position when the pump attaching bolts are tightened. There are seal rings of special rubber at both ends of this pipe. The relief valve is located directly in the pump.

Oil cleaner

The oil cleaner (Fig. 1-5) is manufactured in one unit complete with insert cartridge. The cleaner is of the fullflow type and is bolted directly onto the oil cooler. The oil which is forced out to the various lubricating points on the engine first passes through the cleaner cartridge which is made of special paper. In the oil cleaner there is a relief valve which releases oil past the cartridge if the resistance to flow should become too great.

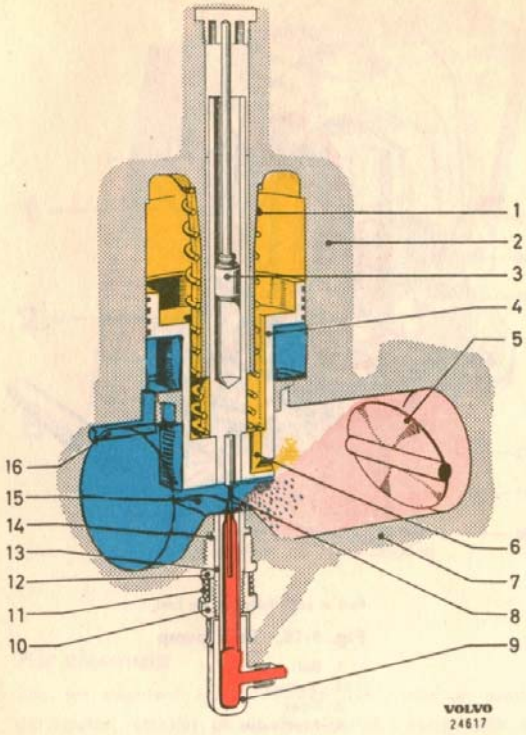


Fig. 1-13. Function of carburetor

Blue = atmospheric pressure
Yellow = vacuum
Red = fuel
Light red = fuel-air mixture

1. Spring
2. Suction chamber
3. Damping plunger
4. Piston in suction chamber
5. Throttle
6. Channel
7. Housing
8. Fuel needle
9. Jet
10. Adjuster nut
11. Lock spring
12. Lock nut
13. Jet sleeve
14. Washer
15. Bridge
16. Channel

by the float is fitted in the cover. Fuel is taken to the lower end of the jet through a flexible hose from the lower part of the float bowl (8, Fig. 1-11).

Cold Starting

When starting a cold engine, the fuel-air mixture can be made richer by lowering the jet, Fig. 1-12. The jet is influenced through a link system from the choke control on the instrument panel. Since the fuel needle is tapered, the fuel flow area is increased when the jet is lowered.

When the choke control is pulled out, the outer end of the lever (3) is pressed downwards and this influences the jet so that it is pushed down. The rapid idling screw is also influenced by the cam on the lever (2, Fig. 1-15) and the throttle opening is somewhat increased.

Operation

The stream of air which passes through the carburetor while it is operating increases in speed when it passes the constriction which is called the bridge (15). See Fig. 1-13.

Fuel is supplied to the air stream through the jet which terminates at the bridge.

The vertical position of the piston in the suction chamber is determined by the difference in pressure between the degree of vacuum in the carburetor and atmospheric pressure – the space above the piston is connected with the space between the throttle and the bridge – while the underside of the piston is influenced by atmospheric pressure. When loading increases, the degree of vacuum increases whereby the piston and the tapered fuel needle rise and permit an increased amount of fuel-air mixture to pass into the cylinders.

The amount of fuel and air supplied to the cylinders is thus dependent on the degree of vacuum in the throat of the carburetor and the carburetors thus work continuously over the whole range.

In order to prevent the piston in the suction chamber from moving too quickly, there is a damping plunger which runs in an oil-filled cylinder.

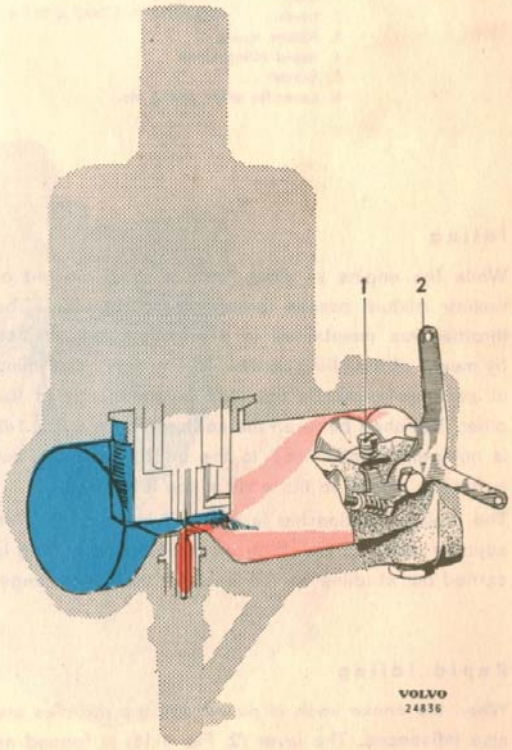


Fig. 1-14. Carburetor, idling

1. Idling screw
2. Lever for return spring

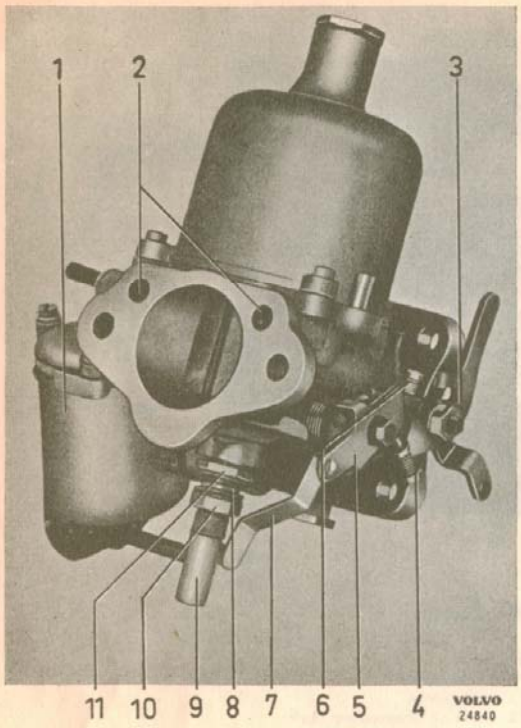


Fig. 1-10. Carburetor viewed from the right

1. Float bowl
2. Ventilation hole
3. Lever
4. Rapid idling screw
5. Lever
6. Idling screw
7. Link for jet
8. Spring
9. Jet
10. Adjuster nut.
11. Locknut

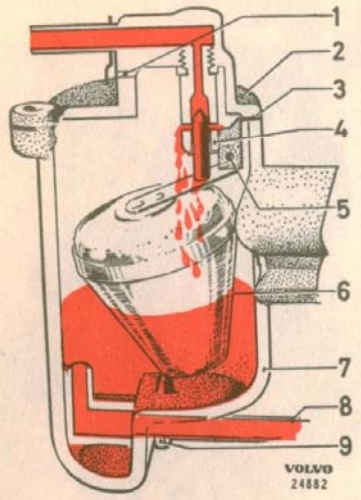


Fig. 1-11. Float system

1. Ventilation hole with protective washer
2. Float bowl cover
3. Gasket
4. Valve
5. Pin
6. Float
7. Float bowl
8. Fuel line
9. Screw union

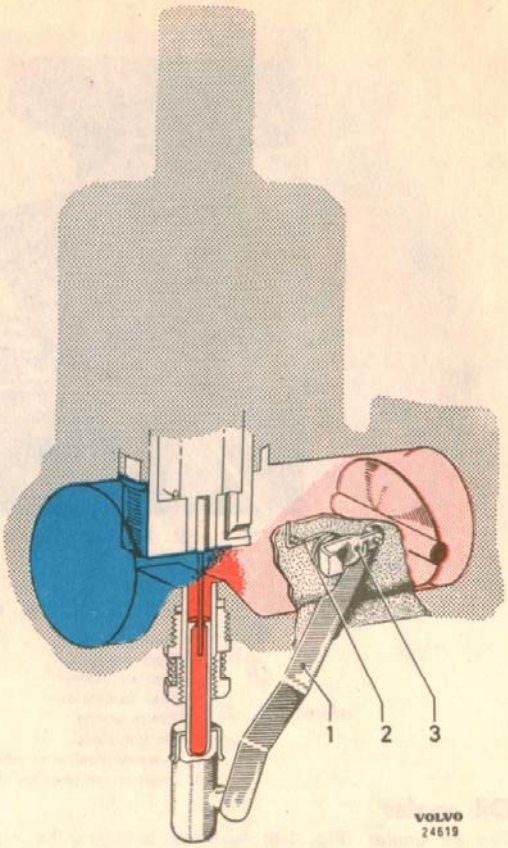


Fig. 1-12. Cold starting

1. Link 2. Return spring 3. Lever

FUEL SYSTEM

The fuel is sucked by a diaphragm type pump from the fuel tank through a filter and is then forced up to the float chambers in the carburetors. There are twin carburetors of the horizontal type. See Fig. 1-8, 1-9 and 1-10.

Carburetors

The twin carburetors, SU-HS 6 (2, Illustration 1-A) are of the horizontal type. Movement of the accelerator pedal is transmitted to the throttles on the carburetors by means of the shaft between the carburetors which is flexibly carried in the carburetor levers. For starting in cold weather, the fuel-air mixture is made richer by lowering the jets. This also causes rapid idling to occur. The various functions of the carburetors are as follows:

Float

The float bowl is screwed to the carburetor housing. See Fig. 1-10. The valve, which is opened or closed

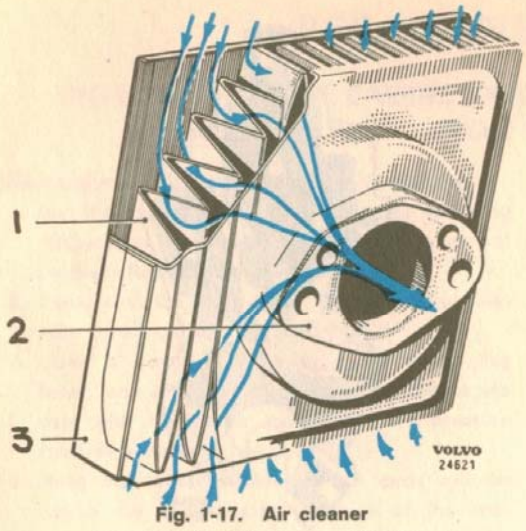


Fig. 1-17. Air cleaner

1. Cartridge (special paper), cannot be removed
2. Gasket
3. Housing

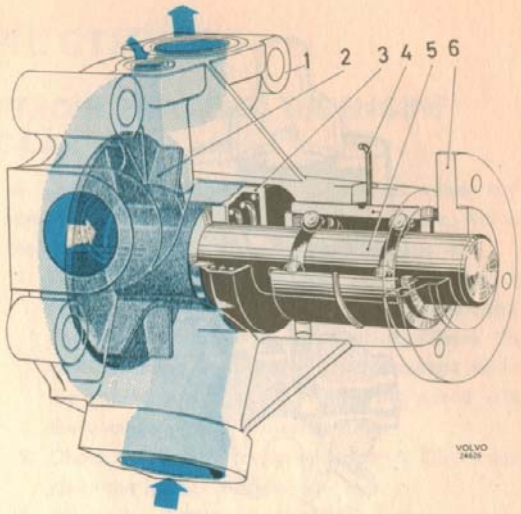


Fig. 1-18. Water pump

1. Housing
2. Impeller wheel
3. Seal
4. Lock spring
5. Shaft with ball bearing (1 unit)
6. Hub

Air cleaners

The air cleaners (1, Illustration 1-A), one on each carburetor, consist of a sheet-metal casing with a cartridge made of special paper. Dust and other impurities in the air are trapped when the air passes through the cleaners (see Fig. 1-17). The air cleaners require no maintainance and may not be oiled in. The complete air cleaners are replaced by new units after a certain mileage.

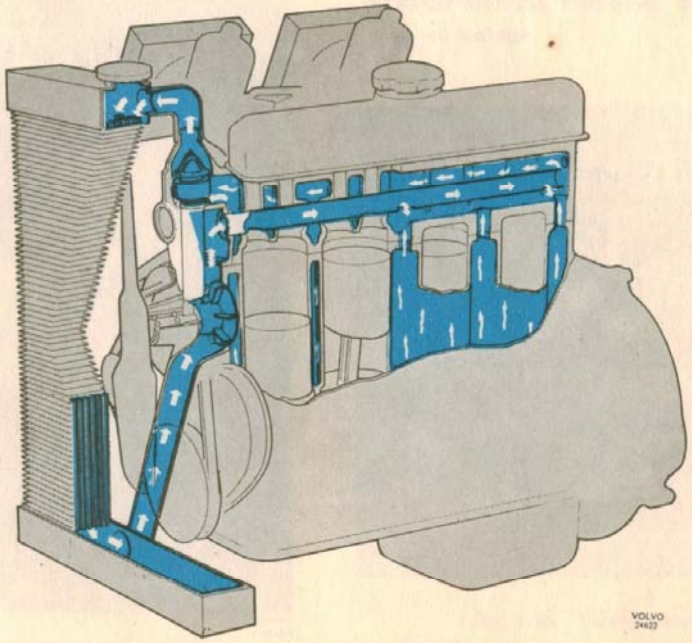


Fig. 1-19. Cooling system

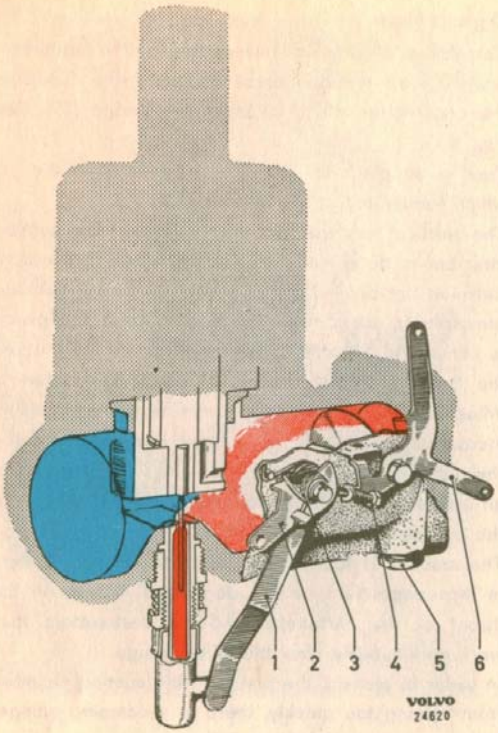
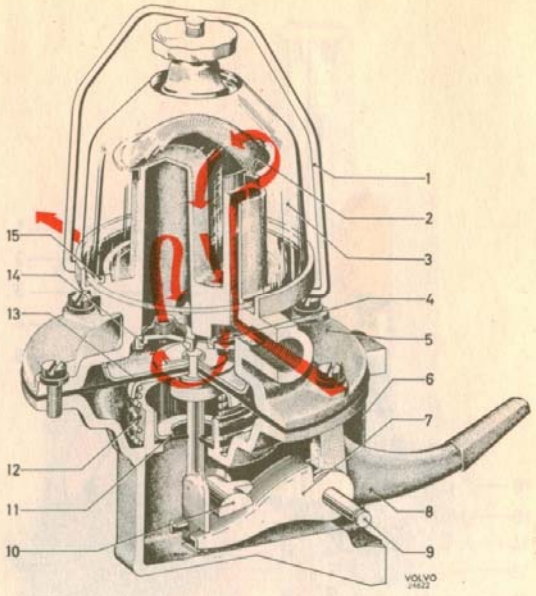


Fig. 1-15. Carburetor, rapid idling

1. Link
2. Lever
3. Return spring
4. Rapid idling screw
5. Screw
6. Lever for return spring etc.



Red = path followed by fuel

Fig. 1-16. Fuel pump

1. Bail
2. Strainer
3. Bowl
4. Inlet valve
5. Upper pump housing
6. Lower pump housing
7. Inner lever
8. Outer lever
9. Shaft
10. Check stop
11. Seal
12. Spring
13. Diaphragm
14. Outlet valve
15. Gasket

Idling

While the engine is idling, only a small amount of fuel-air mixture passes through the carburetors. The throttles are maintained in a slightly open position by means of the idling screws, (1, Fig. 1-14). The idling of each carburetor is adjusted independently of the other. The shaft between the carburetors, see Fig. 1-8, is not permanently fixed to the throttle spindles but is flexibly carried in the ends of the levers.

The fuel/air relationship is adjusted by means of the adjuster nuts (10, Fig. 1-13) on the jets and setting is carried out at idling for the whole of the speed range.

Rapid idling

When the choke knob is pulled out, the throttles are also influenced. The lever (2, Fig. 1-15) is formed as a cam at one end and this cam presses against the rapid idling screw (4) whereby the throttles are opened.

This means that the engine runs at a higher idling speed during the time the choke knob is pulled out.

Fuel pump

The fuel pump is of the diaphragm type and is driven by a cam on the camshaft. The pump is fitted with a disengaging device whereby it ceases to operate when there is a sufficiently high pressure in the float bowls. The design of the pump is shown in Fig. 1-16. The red arrows show the path followed by the fuel.

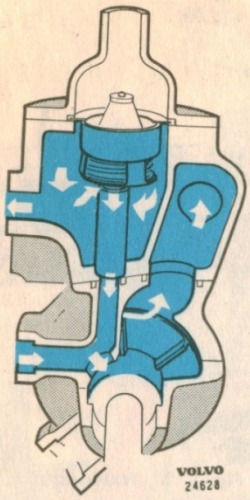


Fig. 1-20. Circulation of cooling water with thermostat closed

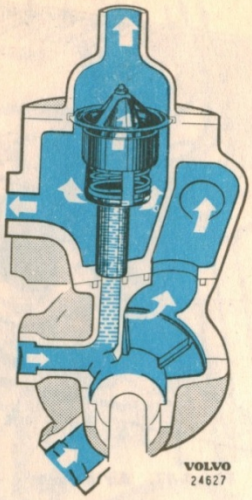


Fig. 1-21. Circulation of cooling water with thermostat open

COOLING SYSTEM

The cooling system, Fig. 1-19, is of the pressure type and is fitted with a circulating pump (Fig. 1-18).

While the engine is cold the cooling water only circulates through the engine itself through a by-pass (Fig. 1-20). When the engine warms up, the thermostat starts to open the outlet to the radiator (Fig. 1-21) whereby the spring-loaded plate on the underside of the thermostat closes the by-pass. Circulation is then regulated by the thermostat so that the engine operating temperature is maintained within the correct limits. A distribution tube in the cylinder head ensures that there is equal distribution of the cooling water though the warmest parts of the cylinder head. The cooling water round the walls of the cylinders circulates by the thermo-siphon principle.

WORK THAT CAN BE CARRIED OUT WITHOUT REMOVING THE ENGINE FROM THE CAR

Measuring the compression pressure

1. Run the engine until it obtains normal operating temperature. Check that the air cleaners are not blocked. Replace them if necessary.
2. Remove all the spark plugs. Depress the accelerator pedal and place a weight on it.
3. Insert a compression tester in the spark plug holes, one after the other, and turn the engine over with the starter motor until the pressure reaches a maximum value.
4. Note the pressure obtained on each cylinder unless the compression tester is of the self-registering type.
5. If low or uneven values are obtained, repeat the compression test after pouring a small quantity of thick oil into each cylinder. If the pressure is low in one of the cylinders, both with and without oil, this is a symptom of leaking valves. If the pressure is higher when the oil has been added, it is probable that the piston rings are worn.

Tuning up the engine

The engine should be tuned up at regular intervals if it is to produce the best results. Tuning up consists of adjusting all settings to the correct value and remedying small defect such as, for example, dirt in the sludge trap, deposits on the spark plugs, etc.

1. Run the engine warm and check (adjust if necessary) the dwell angle (contact breaker gap). Replace burnt contact breaker points. Check the ignition timing setting with a stroboscope while the engine is running at rapid idling speed with the vacuum governor disconnected.
2. Check the distributor gap and clean it. Check and clean the ignition cables.
3. Check the state of charge of the battery and the battery connections.
4. Clean the fuel pump sludge trap. Remove the float bowl covers from the carburetors and blow the housing clean. Remove and clean the plungers of the suction chambers and clean the chambers in white spirit. Re-assemble.
5. Check the air cleaners and replace if necessary.
6. Check the tightening torque of the cylinder head and the tightening of the inlet and exhaust manifolds. Check that there are no air leaks.
7. Remove and adjust the spark plugs or fit new spark plugs.
8. Check the compression on all the cylinders.
9. Adjust the valve clearances. Check that there is no oil leakage.

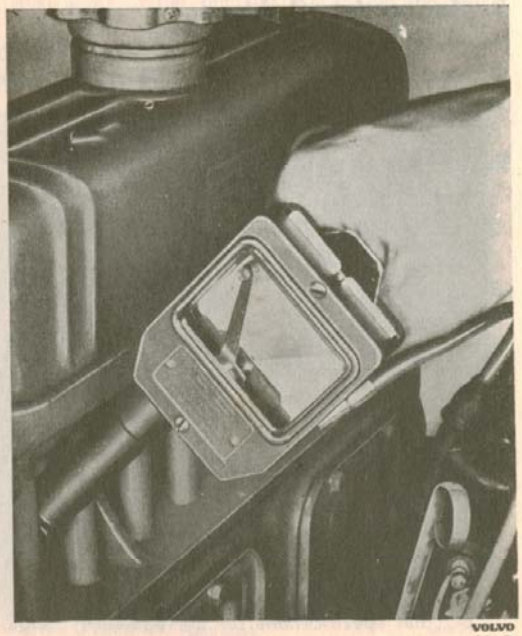


Fig. 1-22. Testing compression

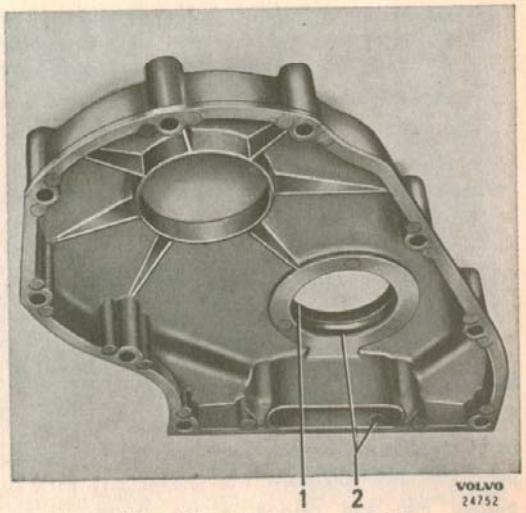


Fig. 1-23. Timing gear casing

1. Seal ring 2. Drain holes

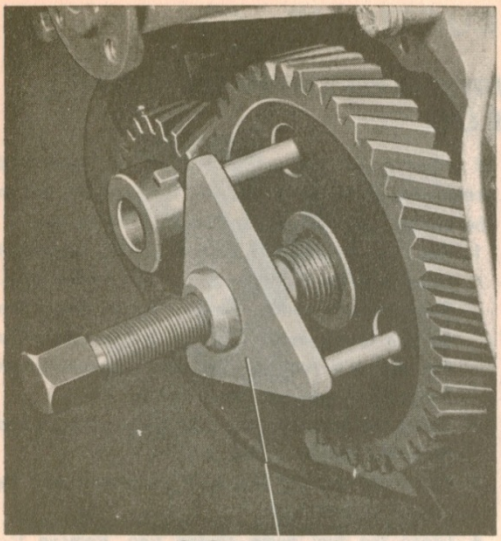


Fig. 1-24. Removing the camshaft gear

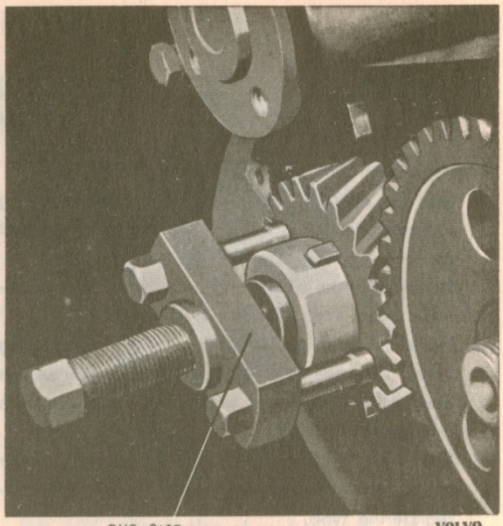


Fig. 1-25. Removing the crankshaft gear

10. Check and adjust when necessary the carburetor settings, see under the heading "Carburetor settings after assembly".

Replacing the cooling water pump

1. Drain off the cooling water.
2. Release the tension on the fan belt. Loosen both the water pipes.
3. Remove the fan and pulley, remove the pump.
4. Fitting is carried out in the reverse order but make sure that the seal rings on the top of the pump are correctly located. Also press the pump upwards against the extension of the cylinder head, for example, with two robust screwdrivers in front of and below the screw union so that the seal between the pump and the cylinder head is good.
5. Make sure that the seal rings on the water pipe are in good condition and push the pipes carefully in when attaching.
6. Fill up with cooling water. Test-run the engine and check that there is no leakage.

Replacing the carburetors

To replace one of the carburetors, both the carburetors must be removed and the attaching screws pulled off simultaneously. The intermediary shaft is pushed into and carried in the throttle levers. When fitting, put the intermediary shaft in position between the carburetors and then fit both carburetors at the same time. See also under the heading "Fuel system".

Replacing the oil cooler

To replace the oil cooler follow the instructions on page 1-24.

Replacing the oil cleaner

When replacing the oil cleaner, this being normally carried out after every 10 000 km (6000 miles), follow the instructions on page 24.

Replacing the timing gear casing

1. Release fan belt tension.
2. Remove the fan and the pulley on the water pump.
3. Remove the crankshaft pulley bolt. Remove the pulley.
4. Remove the timing gear casing. Loosen a couple of extra bolts for the oil pan and be careful to ensure that the oil pan gasket is not damaged.
5. Make sure that the drain holes (see Fig. 1-23) are not blocked in the new casing that is to be fitted.
6. Oil in the seal ring lightly and fit a new gasket.
7. Assemble the parts. Make sure that the casing is correctly centered. Tension the fan belt in accordance with the instructions on page 1-36.
   See the specifications for the tightening torque for the pulley bolt.

Replacing the timing gears

1. Drain off the cooling water and remove the hood and radiator.
2. Carry out the work described in points 1-4 in the previous section.
3. Remove the camshaft nut and pull off the camshaft gear by using tool SVO 2250, Fig. 1-24.
   The sleeve on the crankshaft is forced out with the help of a medium-sized sharp-ground screwdriver. The crankshaft gear is pulled off by using tool SVO 2405, Fig. 1-25.
4. Fit the crankshaft gear with SVO 2407. Fig. 1-26. Fit the camshaft gear with tool SVO 2408, Fig. 1-27. Do not push the shaft in so that the seal washer at the rear end of the camshaft is forced out. Check that the gears have the correct relationship according to the markings shown in Fig. 1-29. There are flats on tool SVO 2407 to turn the crankshaft.
5. Measure the tooth flank clearance, Fig. 1-28. Also measure the shaft end play, this being determined by the shim behind the camshaft gear. See the specifications for the measurement value. Fit the sleeve on the crankshaft.
6. Refit the other parts.

Valve-grinding and decarbonizing

1. Drain off the cooling water.
2. Disassemble the throttle control by loosening the ball joints, cotter pin and bracket on the inlet manifold. Loosen the choke control.

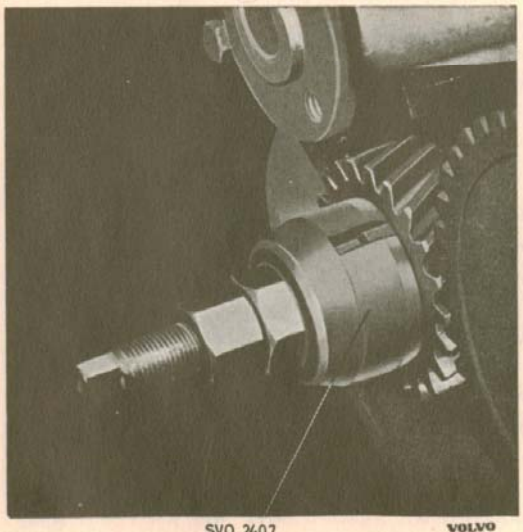


Fig. 1-26. Fitting the crankshaft gear

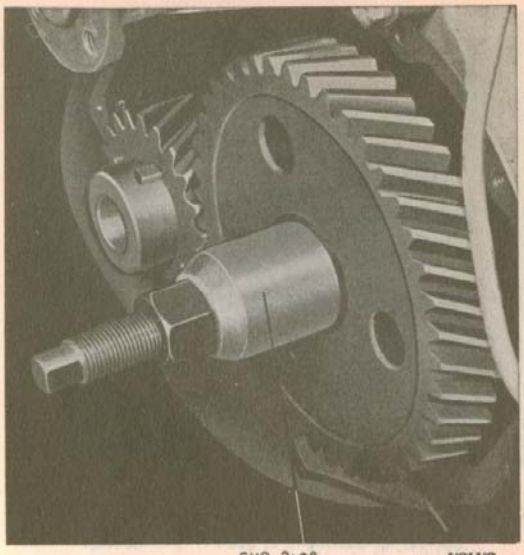


Fig. 1-27. Fitting the camshaft gear

3. Remove the carburetor. Both carburetors must be loosened and removed simultaneously since the intermediary shaft is carried and guided in the carburetor lever.
4. Disconnect the exhaust pipe from the exhaust manifold, disconnect the water hoses to the radiator and disconnect the other connections to the cylinder head.
5. Remove the rocker arm, rocker arm shaft and push rods.
6. Remove the cylinder head bolts, loosen the water

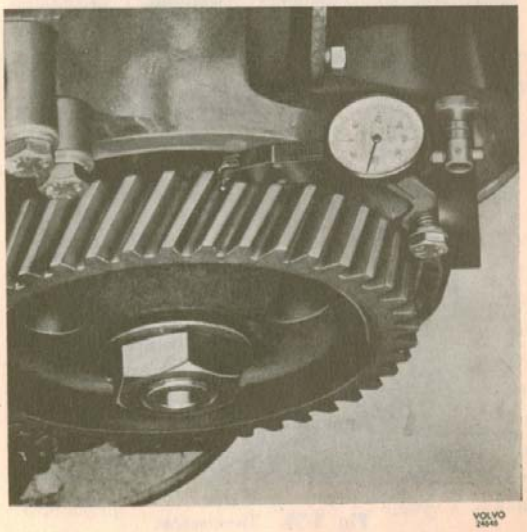


Fig. 1-28. Measuring tooth flank clearance

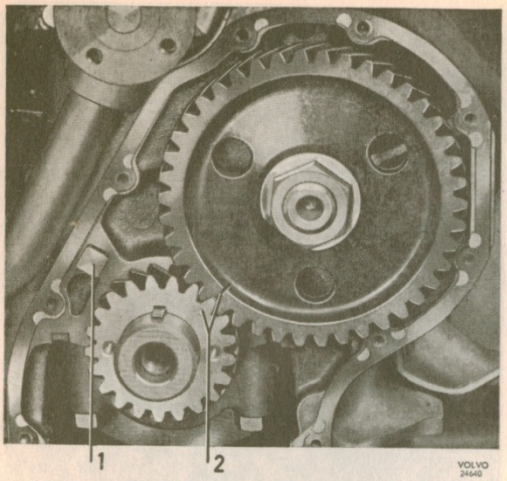


Fig. 1-29. Timing gear setting
1. Jet for lubrication of gears 2. Markings

pipe at the thermostat housing, loosen the attachment at the rear exhaust manifold bolt. Loosen the generator tensioner. Lift off the cylinder head.

7. Clean the piston crowns, combustion chambers, inlet and exhaust ports thoroughly. Do not use emery cloth since small particles can get between the pistons and the cylinder walls and cause damage.
8. Recondition the valve system according to the description under the heading "Cylinder head with valves".
9. Fit the valves. Fit a new cylinder head gasket and new seals for the water pump. Fit the cylinder head. See the specifications for the tightening order and tightening torque. Fit the other parts. Fill up with cooling water.
10. Adjust the valve clearances. Run the engine for a short while. Re-tighten the cylinder head and re-adjust the valve clearances.

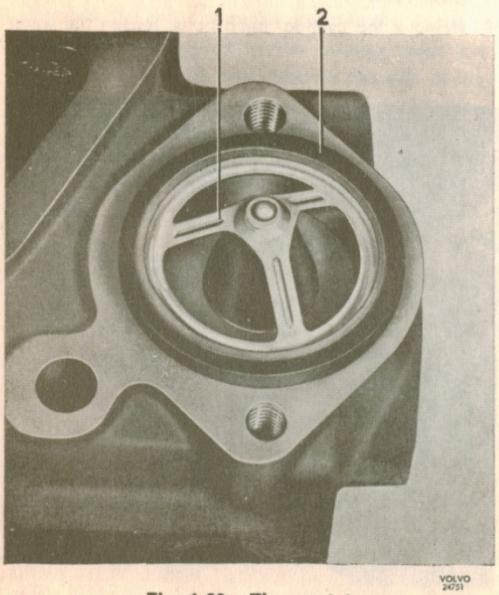


Fig. 1-30. Thermostat
1. Thermostat 2. Gasket

Replacing the thermostat

1. Drain off part of the cooling water.
2. Remove the bolts for the outlet pipe over the thermostat and turn up the pipe.
3. Replace the thermostat (1, Fig. 1-30). Use a new gasket.
4. Screw the pipe into position. Fill up with cooling water and check for leakage.

REMOVING THE ENGINE

1. Jack up the car about 30 cm (12″) over the floor and fit trestles under it.
   Drain off the cooling water and engine oil. Remove the positive pole from the battery.
2. Remove the hood and the radiator. Be careful not to damage the finish on the hood.
3. Remove the throttle control joints at the front and rear of the shaft between the engine and the body. Remove the cotter pin and washer and then pull out the shaft. Disconnect the vacuum tube at the front end of the inlet manifold and

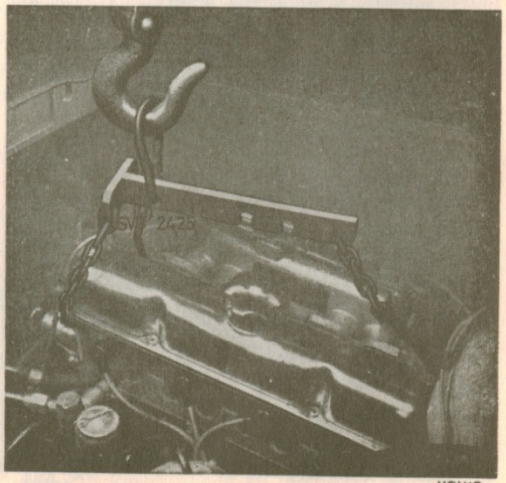


Fig. 1-31. Lifting out the engine

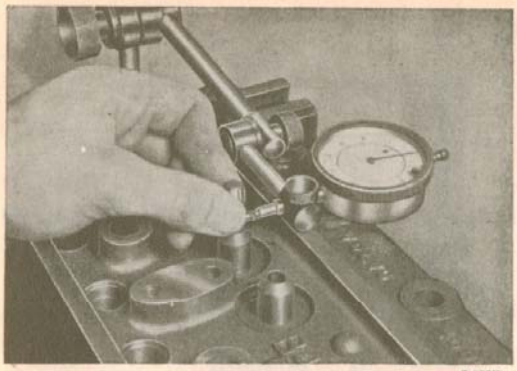


Fig. 1-32. Measuring clearance

disconnect the water pipe on the right-hand side of the thermostat housing.

Disconnect all connections round the rest of the engine. Remove the throttle control shaft behind the flywheel housing.

4. Loosen the exhaust pipe at the exhaust manifold and the attachment on the flywheel housing. Remove the nuts for the engine mounting blocks.
5. Remove the gearshift lever. Remove the control for the clutch and the cables for the overdrive.
6. Disconnect the forward propeller shaft joint. Place a jack under the transmission and raise the jack slightly. Remove the support cross-member.
7. Fit lifting tool SVO 2425 to the engine. Tighten the bolt on the tool in the hole at the front end of the cylinder head, locate the hooks under the manifold front and rear. See Fig. 1-31.
8. Lift the front end of the engine an inch or so to clear the engine mounting blocks. Lower the transmission but not more than necessary and pull the engine forwards at the same time as the front end is lifted. Lift out the engine by gradually raising the front end and lowering the rear end.

DISASSEMBLING THE ENGINE

After the engine has been lifted out of of the car, disassembly is carried out as shown below. (See under the headings concerned for the separate components).

1. Place the engine in a suitable stand. Check that the oil has been drained off.
2. Remove the starter motor and the cover plate on the lower front edge of the flywheel housing together with the transmission and then remove the clutch and flywheel.
3. Remove the rear sealing flange, the generator, the water pump and distributor, the rocker arm

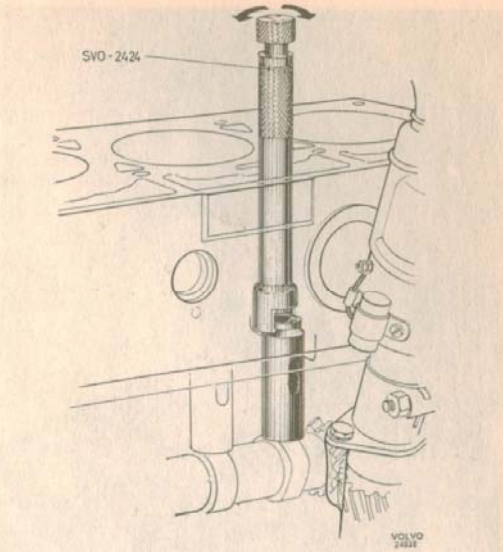


Fig. 1-33. Removing a valve lifter

cover, the rocker arms and the cylinder head. Remove the oil cleaner and oil cooler.

Remove the valve lifters with tool SVO 2424, see Fig. 1-33.

4. Remove the timing gear casing and the timing gears. See under the heading "Replacement of timing gears" for the tools concerned. Remove the camshaft.
5. Stand up the engine on its rear end on a bench. Place three wooden blocks under so that the crankshaft can rotate freely.

   Remove the oil pan, oil pump and connecting rods with pistons. Replace the bearing caps on their respective connecting rods.
6. Lay the engine with the bottom upwards and remove the crankshaft. Replace the bearing caps in their correct positions.

CLEANING

All the engine parts should be carefully cleaned after the engine has been disassembled. Parts made of steel or cast iron can be cleaned in a de-greasing tank with a lye solution. Light-alloy parts can easily be damaged by the lye and should therefore preferably be cleaned in white spirit. Never clean pistons and bearing shells in lye. Rinse the parts with warm water and blow them dry with compressed air after washing. Clean out the oil drillings particularly thoroughly. Clean them through by using a special brush and then blow them out with compressed air.

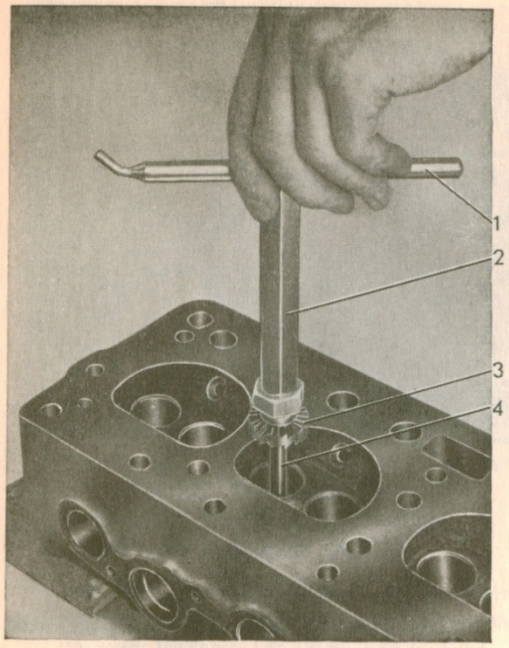


Fig. 1-34. Reaming a valve seat

All the seal plugs at the ends of the drillings in the cylinder block must be removed while cleaning is going on.

CYLINDER HEAD WITH VALVES

Disassembly

1. Remove the rubber seal. Remove the valve springs by first compressing them with a valve spring tool and then removing the valve keys and releasing the tool. Place the valves in order in a special stand.
2. Measure the clearance between the valve spindle and the valve guides as shown in Fig. 1-32. With a new valve this clearance should not exceed 0.15 mm (0.006″). Also check that the valves are not too worn. See under the headings "Valve system" and "Wear tolerances" in the specifications.

Fig. 1-35. Valve seat width
A = 1.5 mm (0.060″)

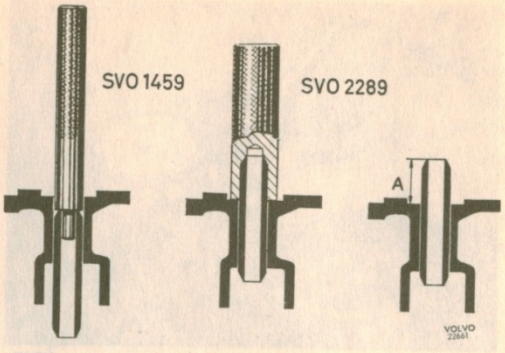


Fig. 1-36. Replacing valve guides
A = 21 mm (0.827″)

Cleaning

Clean the valves, combustion chambers and channels with rotating brushes to remove soot and combustion residues.

Grinding the valves and valve seats

1. Grind the valves in a valve-refacing machine after they have been cleaned. If the valves are very worn, fit new valves.
2. Grind the valve seats. Use an electrically driven valve-seat grinder or a hand reamer. A pilot spindle must first be fitted accurately before the work is started and worn valve guides should be replaced with new guides.
   Grind the seat until satisfactory sealing is obtained. The angle is 45° and the width of the valve seat should be 1.5 mm (0.060″), see "A", Fig. 1-35.
   If the valve seat width is too wide after grinding, it can be reduced from the inside with a grinding stone with an angle of 70° and from the outside with a 20° grinding stone.
3. Smear the valve seat surfaces with a thin layer of fine grinding compound and lap in the valves against their seats.
   Then clean the valves and seats and check for leakage.

Fig. 1-37. Spring testing

Replacing valve guides

1. Press out the old guides with the help of tool SVO 1459.
2. Press in the new guides by using tool SVO 2289, which presses them in to the correct depth. See Fig. 1-36.
3. Ream the new guides to the correct diameter with a suitable reamer so that the correct clearance is obtained, see the specifications.

Fig. 1-38. Replacing a rocker arm bushing

Fig. 1-39. Reaming a new bushing

Assembling

1. Check that the parts are in good condition and clean. Check that the springs hold the values shown in the specifications. See also Fig. 1-37.
2. Fit the valves in position. Fit the lower rubber washer, steel washer, valve spring, upper washer and valve cotter. Finally fit the rubber ring.

Replacing the rocker arm bushings and grinding the rocker arms

1. If wear is as much as 0.1 (0.004"), replace the rocker arm bushings. Use tool SVO 1867 to press out and press in the bushings. Then ream the bushings with a suitable reamer to an accurate fit on the shaft. The hole in the bushing should index with the hole in the rocker arm.
2. If necessary grind the thrust surface against the valve in a special machine.

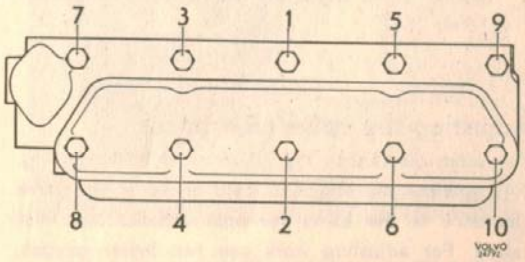


Fig. 1-40. Order of tightening for cylinder head bolts

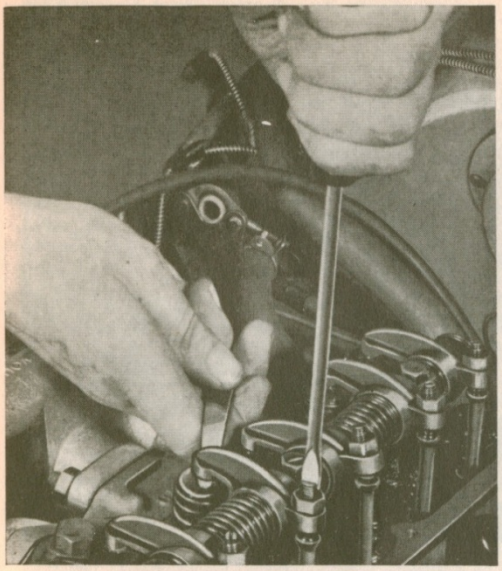


Fig. 1-41. Adjusting valve clearance

Fitting the cylinder head

1. Check that the cylinder head, cylinder block, pistons and cylinder bores are clean.
2. Check that the oil drillings to the rocker arm mechanism on the valve lifter side in the center of the block are clean. In the cylinder head, the oil goes up through the screw hole between the screw and the wall of the hole and then out through a diagonal drilling to the attaching screw for the rocker arm shaft and then up in the shaft.
3. Fit a new cylinder head gasket. Fit the cylinder head. Tighten the bolts in the right order and to the correct tightening torque. See Fig. 1-40 and the specifications.
4. Fit the rocker arm mechanism. Adjust the valve clearances. Fit the remaining parts.
5. Drive the car for a short distance. Retighten the cylinder head bolts and adjust the valve clearances.

Adjusting the valve clearances

The valve clearances are adjusted as shown in Fig. 1-41, whether the engine is cold or warm. The valve clearance is the same for both exhaust and inlet valves. For adjusting work use two feeler gauges, one 0.50 mm (0.02") and the other 0.55 mm (0.022").

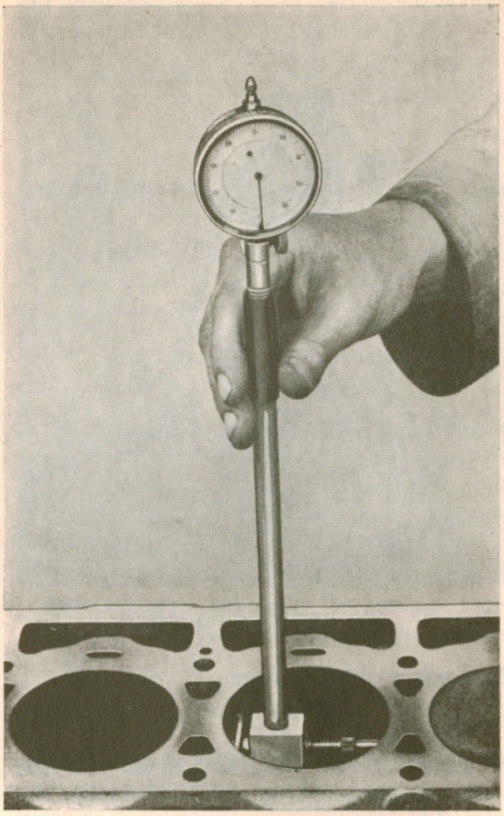


Fig. 1-42. Measuring the cylinder bore

The clearance is adjusted so that the 0.50 mm (0.02") gauge is easy to insert while the 0.55 mm (0.022") gauge will not go in.

If the engine has been diassembled, the valve clearances should be roughly adjusted before starting. The engine should then be turned over by hand by turning the fan. The spark plugs should be removed while this is done so that compression does not make the engine difficult to turn over.

CYLINDER BLOCK

Measuring the cylinder bores

The cylinder bores are measured by using a special gauge as shown in Fig. 1-42. There is a letter stamped on each cylinder bore showing its dimensions (only standard model), see specifications. See also Fig. 1-52. Carry out measurements at various depths and at various points around the circumference. See the specifications for the dimensions.

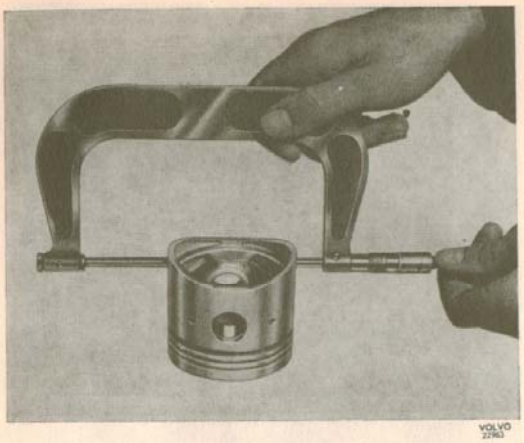


Fig. 1-43. Measuring a piston

Reboring the cylinders

The cylinders are rebored in a special machine and then they are honed to obtain a fine surface texture. The complete cylinder block should be washed before assembly in a de-greasing tank to remove all metallic residue and impurities.

See the specifications for the dimensions. See also the text under the heading. "Fit of pistons in cylinder bores".

PISTONS, PISTON RINGS, PISTON PINS

Measuring the pistons

The pistons are measured by means of a micrometer at right angles to the piston pin hole, 12.5 mm (0.490") from the lower edge, see Fig. 1-43. See the specifications for the dimensions.

Fit of pistons in cylinder bores

The fit of the pistons in the cylinder bores is checked without the pistons pins fitted. The clearance at right angles to the piston pin hole is measured with a feeler gauge 1/2" wide and 0.04 mm (0.0016") thick attached to a spring balance. The pull required should be 0.5–2 kg (1–4 1/2 lb.). This test should be repeated on several different diameters and at different depths.

The standard bore cylinders have a letter stamped on which shows the dimension and the piston in this particular cylinder should be marked with the same letter.

Fig. 1-44. Measuring the piston ring gap

Fig. 1-45. Piston ring clearance in groove

Piston ring fit

In a new or rebored cylinder

1. Push down the piston rings one after the other in the cylinder bore. Use a piston upside down so that the rings come into their correct position.
2. Measure the ring gap with a feeler gauge, Fig. 1-44. The gap should be 0.25–0.50 mm (0.01–

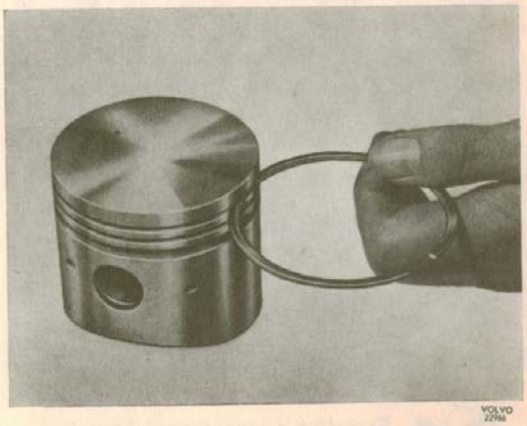


Fig. 1-46. Rolling the piston ring in the groove

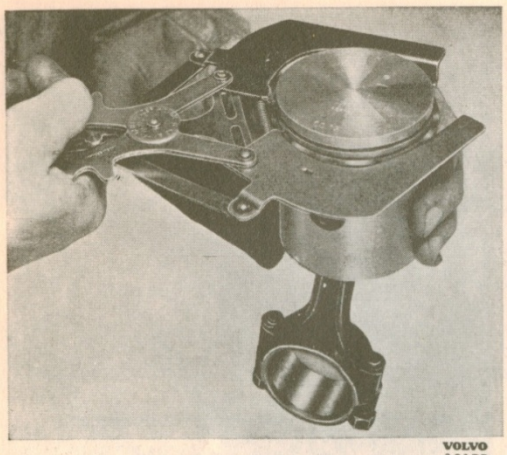


Fig. 1-47. Fitting the piston rings

0.020"). If necessary widen the gap by using a special file.

3. Check the piston rings in their respective ring grooves by rolling them in the groove, Fig. 1-46. Also measure the clearance at several points, Fig. 1-45. See the specifications for the dimenslons.

In a worn cylinder bore

When checking the fit of the rings in a worn cylinder bore, the rings must be tested at bottom dead center since it is there that the cylinder has the smallest bore.

Piston pins

The piston pins are available in three oversizes: 0.05 mm (0.002"), 0.10 mm (0.0040") and 0.20 mm (0.008")

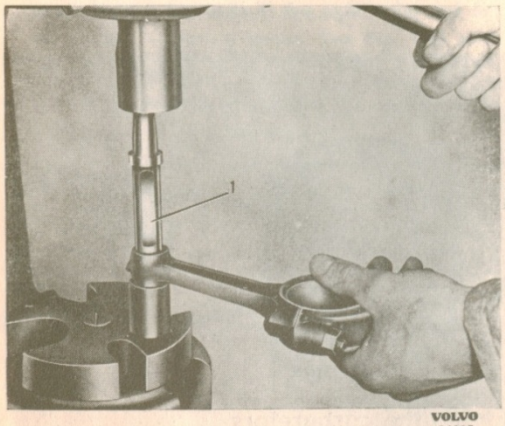


Fig. 1-48. Replacing a connecting rod bushing
1 = SVO 1867

Fig. 1-49. Piston pin fit

larger than the standard diameter 22.00 mm (0.866"). If the piston pin hole in the piston is worn so much that it is necessary to fit an oversize, first ream up the hole to the correct dimension. Use a reamer fitted

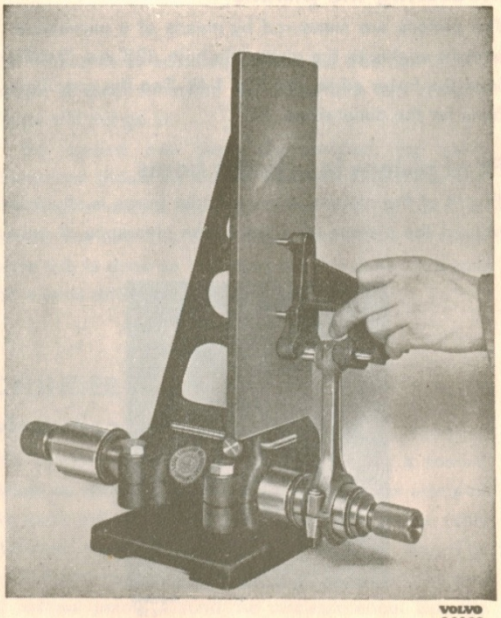


Fig. 1-50. Checking connecting rod alignment

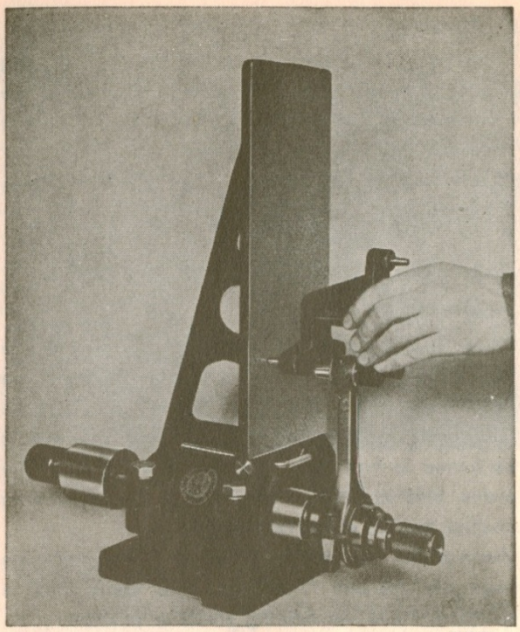


Fig. 1-51. Checking connecting rod alignment

with a guide and remove only a small quantity of material at a time.

The fit is correct when the piston pins can be pushed through the hole by hand and only light resistance felt.

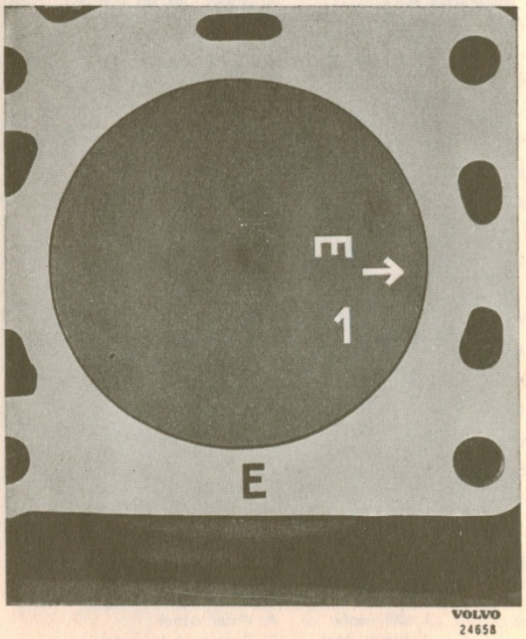


Fig. 1-52. Markings on piston and cylinder block

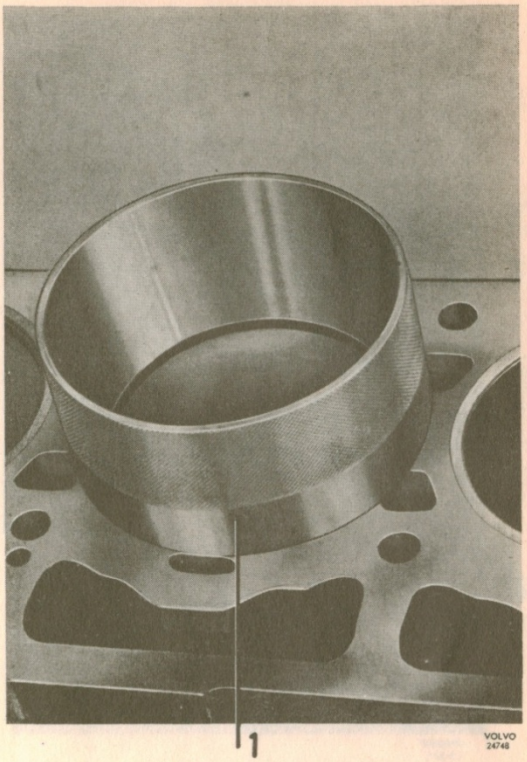


Fig. 1-53. Fitting a piston

1. Piston-inserting tool SVO 2176

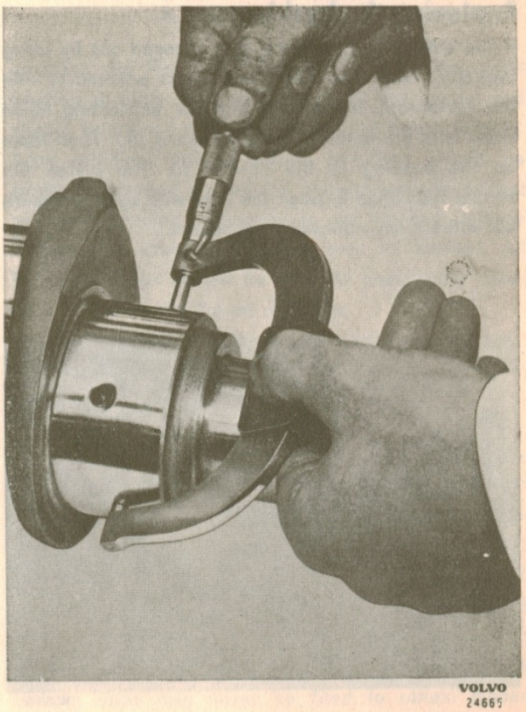


Fig. 1-54. Measuring the crankshaft

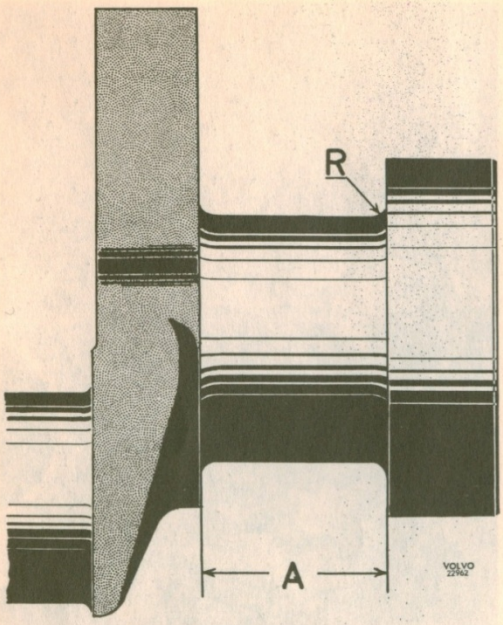


Fig. 1-55. Bearing journal
(R) for all bearing journals 2.0–2.5 mm (0.079"–0.098")
(A) width, dependent on size of journal

CONNECTING RODS

Replacing the bushings

If the old bushing is worn, it is pressed out by using tool SVO 1867 and a new bushing is pressed in with the same tool. Make sure that the lubricating holes index with the holes in the connecting rod. Then ream up the bushing to the correct fit. The piston pin should then slide through the hole with some pressure but without any noticeable looseness.

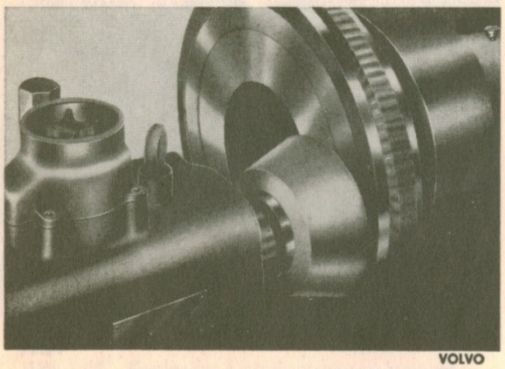


Fig. 1-56. Grinding the flywheel

Alignment

Check the connecting rods before fitting concerning alignment to make sure that they are straight, free from twist or S-distortion. If necessary, straighten them. See Fig. 1-50 and 1-51.

Always fit new nuts and bolts when reconditioning is carried out.

Assembling and fitting pistons and connecting rods

When assembling make sure that the pistons are turned the right way with the arrow on the top of the pistons facing the front of the engine, see Fig. 1-52. The number marking on the connecting rods should be turned to face away from the camshaft side. The piston pins are then fitted, the circlips placed in position and the piston rings fitted.

Use a piston ring tool for the rings. The compression rings are marked "TOP" and the upper ring is chromed. Place the bearing shells in position.

Turn the rings so that the ring gaps are not immediately under each other, then lubricate the piston and bearing surfaces.

Use the piston inserting tool SVO 2176, Fig. 1-53 when fitting the piston in the bore. Tighten the connecting rod bolts with a torque wrench, see the specifications for the tightening torques.

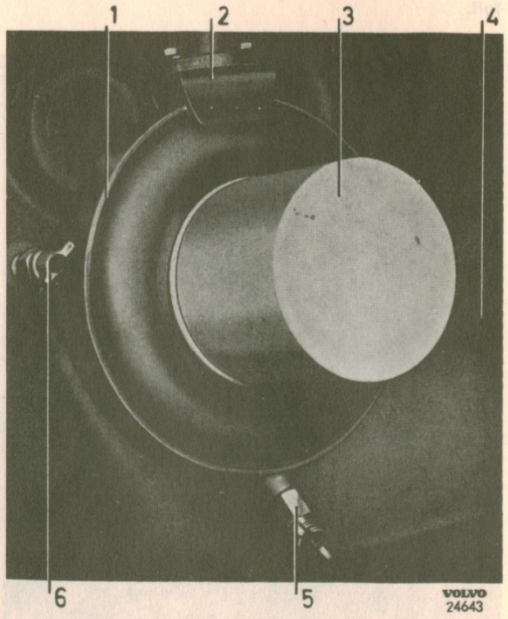


Fig. 1-57. Oil cleaner and oil cooler

1. Oil cooler
2. Water inlet
3. Oil cleaner
4. Water outlet
5. Drain cock for water
6. Drain cock for water

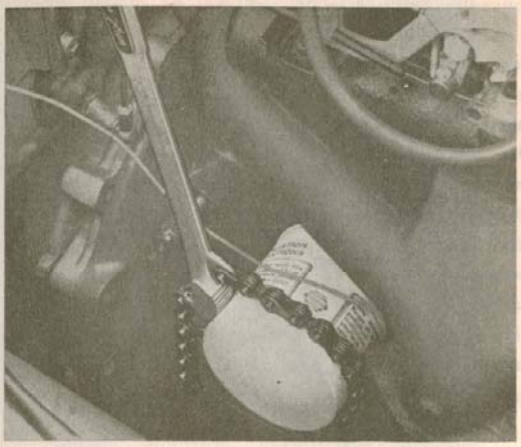


Fig. 1-58. Removing the oil cleaner

CRANKSHAFT

After cleaning the crankshaft, measure its journals with a micrometer. This measurement should be carried out at several points round the circumference and along the width. Out-of-roundness on the main bearing journals should not exceed 0.05 mm (0.002") and on the connecting rod bearing journals, 0.07 mm (0.003"). Taper should not be greater than 0.05 mm (0.002") for any of the journals. See Fig. 1-54.

If the measurement values obtained are in the neighborhood of or exceed the wear tolerances given above, the crankshaft should be ground to undersize. Suitable bearing shells are available in five undersizes. See the specifications for the dimensions. Check that the crankshaft is straight to within 0.05 mm (0.002") by using a dial indicator. Lay the crankshaft in two vee blocks and adjust a dial indicator against the center bearing journal. Then rotate the crankshaft. If necessary straighten the crankshaft in a press.

Grinding the crankshaft

Before the crankshaft is ground, its straightness should be checked as detailed above. Grinding is carried out in a special machine whereby the main and connecting rod bearing journals are ground to identical dimensions. These dimensions, which are given in the specifications, must be carefully followed to ensure that the correct bearing clearance is obtained with the precision bearing shells.

Scraping of the bearing shells or filing of the bearing caps is absolutely forbidden.

The fillet radius at the ends of the bearing journals should be 2.0–2.5 mm (0.079–0.098") for all the journals, see Fig. 1-55. The width (A) for the guide bearing is dependent on the size of the journal and should be ground to obtain the correct measurements. After grinding, the oil drilling openings should be carefully bevelled and all the bearing journals lapped with fine grinding compound to get the best surface texture. The crankshaft should then be washed. All the oil drillings should be cleaned particularly carefully to remove any traces of filings.

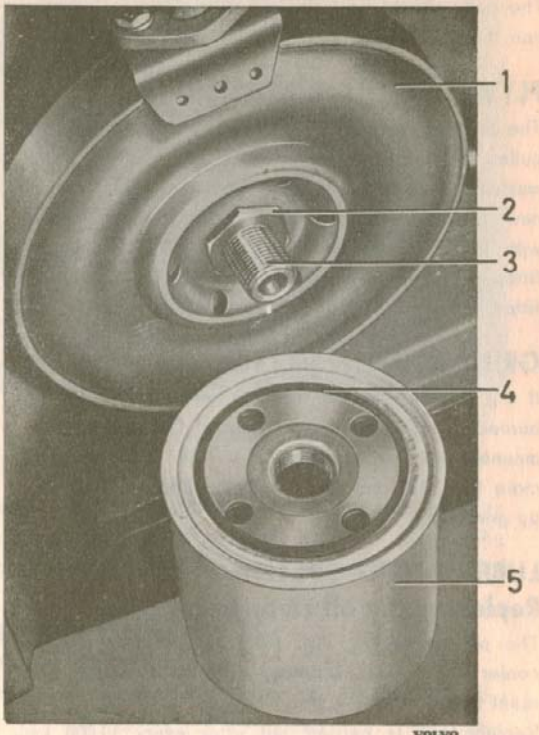


Fig. 1-59. Oil cleaner ready for fitting

1. Cooler
2. Nut
3. Nipple
4. Gasket
5. Cleaner

Main bearings and connecting rod bearings

Apart from the standard size, bearing shells are available in undersizes of 0.10", 0.020", 0.030", 0.040" and 0.050". The rear bearing shells are fitted with flanges and have a larger width relative to their size. If the crankshaft has been ground to the correct dimensions, the correct bearing clearance is obtained when the corresponding bearing shells are fitted. The bearing shells may not be scraped and the bearing caps may never be filed to obtain closer bearing clearance.

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

FLYWHEEL PILOT BEARING

The pilot bearing lock ring is removed, the bearing pulled out with tool SVO 4090 and checked after washing in white spirit. If the bearing is worn, fit a new bearing. Before re-fitting, pack the bearing with heat-resistant bearing grease. The bearing is fitted with tool SVO 1426 and the lock ring is then fitted.

GRINDING THE FLYWHEEL

If the wearing surface of the flywheel is uneven or burned, the surface can be ground flat in a saddle-mounted grinding machine. Fig. 1-56. Never remove more than 0.75 mm (0.030") of the original thickness by grinding.

LUBRICATING SYSTEM

Replacing the oil cleaner

The oil cleaner (3, Fig. 1-57) is bolted to the oil cooler in one unit together with the cartridge and relief valve.

Replacement is carried out after every 10 000 km (6000 miles) when the old oil cleaner is thrown away. In the case of a new or reconditioned engine, the oil cleaner is also changed for the first time after 5000 km (3000 miles) driving.

1. Remove the old oil cleaner with the help of a tool, as shown in Fig. 1-58.
2. Smear oil onto the rubber gasket on the new cleaner (4, Fig. 1-59) and make sure that the contact surface for the oil cleaner is free from dirt. If it is smeared with oil the gasket will slide better onto the sealing surface. Screw on the cleaner by hand until it just touches the oil cooler.
3. Tighten the oil cleaner a further half-turn but absolutely no more. Start the engine and check that the joints are not leaking. Top up with oil if necessary.

Oil pump with release valve

After the pump has been disassembled and cleaned, check that all the parts are in good condition. Check the spring for the relief valve (2, Fig. 1-60), see the specifications for the test standards.

Check that the tooth flank clearance is 0.15–0.35 mm (0.006–0.014"), see Fig. 1-61.

Measure the axial clearance, 0.02–0.10 mm (0.008–0.004"), see Fig. 1-62.

Fit a new cover or check that the old cover is not noticeably worn. A worn cover can be ground level. If the bushings or the shaft are worn, fit new units. Remember that the hole for the tubular pin in the driving gear may not be drilled right through since this would short-circuit the suction and pressure sides. The new bushings should be reamed after being pressed in. Use a reamer fitted with a guide.

Check that the seal rings on the ends of the pressure pipe are in good condition or fit new seals. The pressure pipe must be clamped in the holes properly, first in the oil pump and then the oil pump and the pipe together against the block. The pipe connecting flange should be flat against the block before being tightened.

Oil drillings

All the oil drillings must be cleaned particularly carefully to avoid damage to the bearings, bearing journals and other parts.

Before cleaning the cylinder block channels, remove the seal plugs and fit new plugs after cleaning them and blowing them dry.

Replacing the oil cooler

1. Drain off the engine cooling water.
2. Loosen the cooling water connections at the oil cooler. Remove the oil cleaner, see Fig. 1-58.
3. Remove the nut (2, Fig. 1-59) on the nipple for the oil cooler and pull out the cooler.
4. Fit the oil cooler in the reverse order. The O-ring against the block must be replaced if necessary and, should it be replaced, a new ring should be glued in the groove on the oil cooler before the oil cooler is fitted. Smear the groove with a thin layer of glue, resistant to oil at temperatures up to 140° C = 285° F (for example, Pliobond 20). Check during fitting that the oil cooler is in good top contact with the block all round when the nut has been tightened to a torque of 1 kgm (7 lb.ft.). The nut is finally tightened to a torque of 3–3.5 kgm (21–25 lb.ft).
5. Fit the oil cleaner, see under the heading "Replacing the oil cleaner".
6. Fill up with cooling water and engine oil if necessary.
7. Start the engine and check that there is no leakage.
8. If the nipple (3, Fig. 1-59) is replaced, the new nipple should be tightened to a torque of 4.5–5.5 kgm (32–40 lb.ft.).

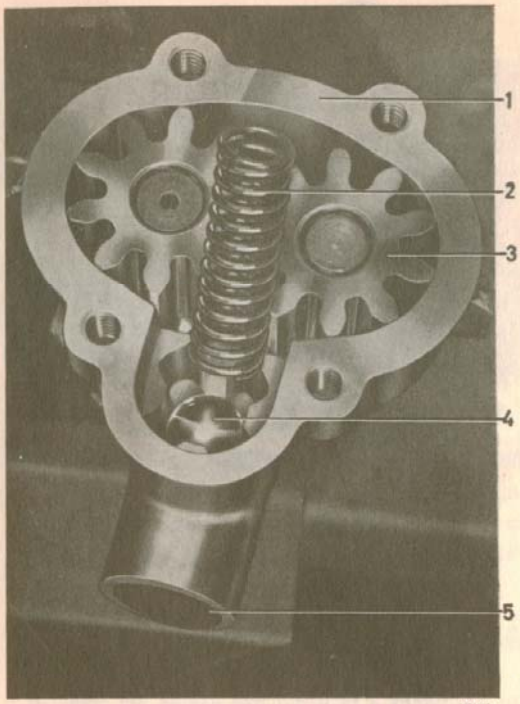


Fig. 1-60. Oil pump with relief valve

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

IGNITION SYSTEM

Fitting the distributor drive gear

When the engine is at TDC for ignition on number 1 cylinder, the drive gear for the oil pump and distributor is fitted. The small part of the groove is

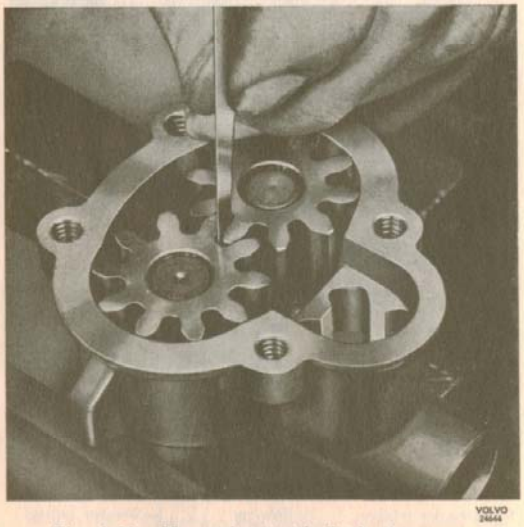


Fig. 1-61. Measuring tooth flank clearance

Fig. 1-62. Measuring axial clearance

turned diagonally upwards and to the rear, and the groove is placed at an angle of about 35° to the longitudinal axis of the engine, see A, Fig. 1-64.

Ignition timing setting

Basic setting

The basic setting when fitting the distributor on the engine is 5° before TDC (97 octane fuel). This setting is, however, only a rough setting which should be adjusted with a stroboscope before the car is driven.

1. Check that the engine is in the position for firing on cylinder number 1 and that the distributor drive gear is correctly fitted according to the description in the previous paragraph.
2. Turn the engine over so that the pointer at the front (Fig. 1-65) is opposite 5° before TDC. Fit the distributor but do not tighten it in position.
3. Connect up a small bulb (max. 2 W) as shown in Fig. 1-66 and connect up the current. Turn the distributor housing slowly in an anti-clockwise

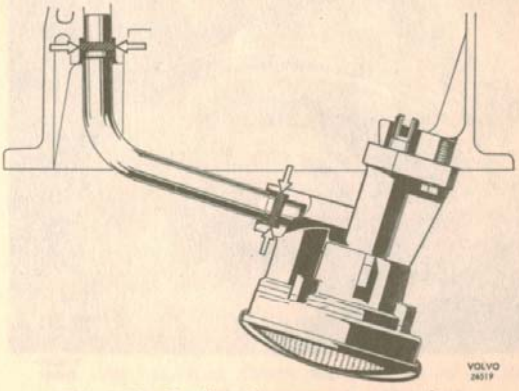


Fig. 1-63. Sealing rings on pressure pipe

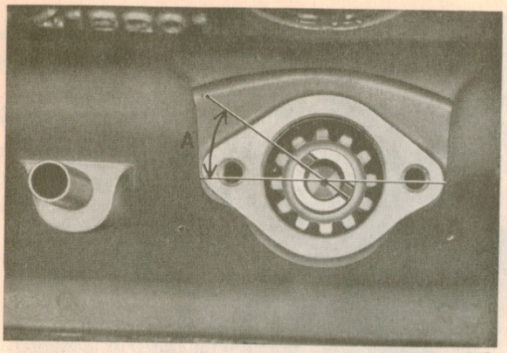


Fig. 1-64. The position of the distributor drive gear
A = 35°

direction past the contact breaker opening point for cylinder number 1, and then back again in a clockwise direction until the lamp just lights up. Tighten the distributor in this position. Make sure that the rotor is opposite the contact in the distributor cap which leads to number 1 cylinder, Fig. 1-68.

4. Fit the distributor cap and cables in order as shown in Fig. 1-68. The rotor rotates in an anti-clockwise direction.

Fine adjustment

Ignition timing setting should be carried out while the engine is running with the help of a control lamp (stroboscope) after the distributor has been removed, or otherwise when required. The basic setting as described above applies for assembly but the final adjustment is carried out while the engine is running.

1. Disconnect the vacuum governor by loosening its pipe at the distributor.

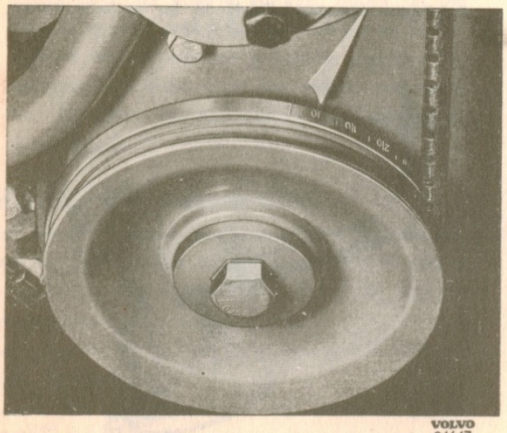


Fig. 1-65. Graduations for timing setting

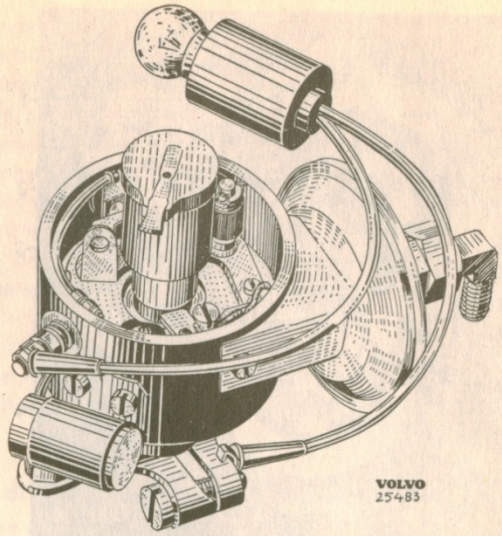


Fig. 1-66. Lamp connected up for basic ignition timing setting

2. Mark the crankshaft belt pulley with chalk within the graduations applying for the timing setting concerned. This facilitates adjustment since the setting range can be seen better.
   With 100 h.p. (SAE) B 18 B engines using 97 octane (Research Method) fuel, the setting should be 17–19° before T. D. C. This setting also

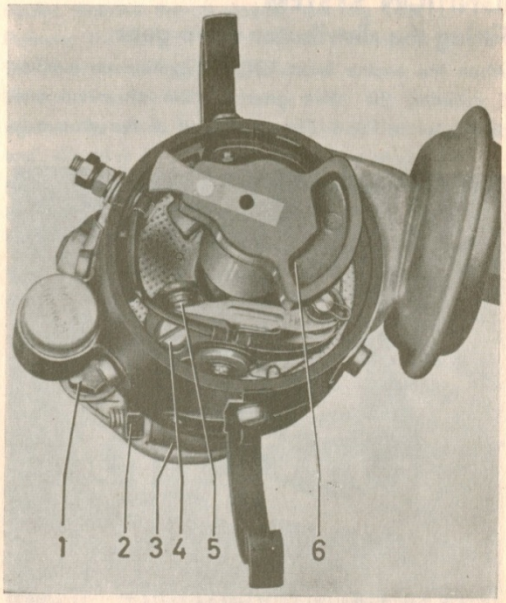


Fig. 1-67. Attachment of distributor

1. Screw for retainer
2. Clamp screw
3. Retainer
4. Lock screw
5. Breaker points
6. Rotor

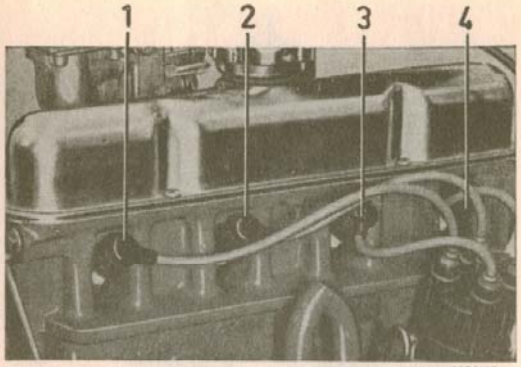


Fig. 1-68. Numbering of cables

applies for 108 h.p. (SAE) B 18 B engines using 100 octane (Research Method) fuel. If the latter engine type should be run on 97 octane (Research Method) fuel, the timing setting should be 14—19° before T. D. C.

3. Connect the lamp with the high tension cable to the spark plug in number 1 cylinder and the other two cables to the battery. See Fig. 1-69.
4. Start the engine and run it at a speed of 1500 r.p.m.

   Aim the lamp at the scale on the pulley and check that igniton occurs opposite the chalked mark mentioned in point 2 above.

   Keep your fingers away from the fan.

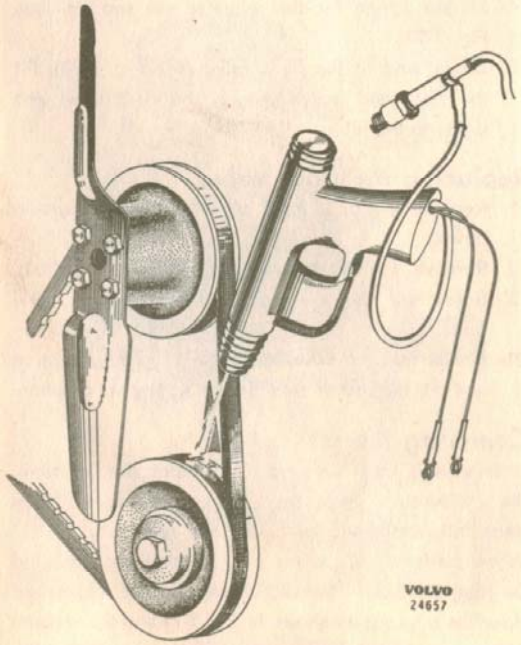


Fig. 1-69. Checking the ignition setting while the engine is running

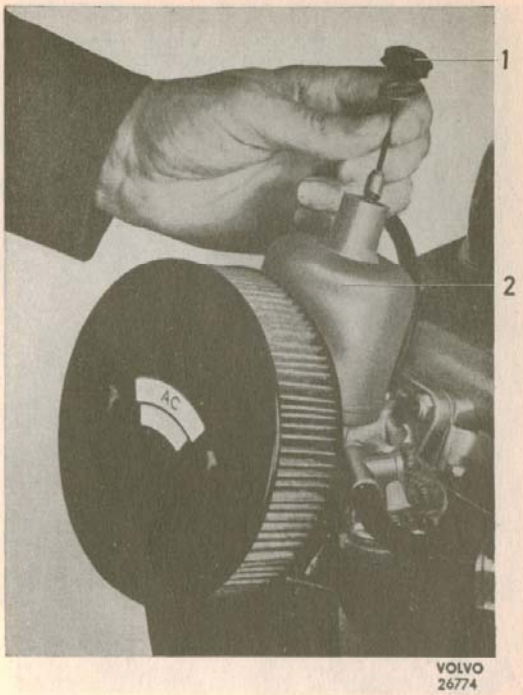


Fig. 1-70. Removing the damping plungers to fill oil in the damping cylinders

5. Adjust the setting if so required by turning the distributor after loosening its clamp screw.
6. Screw the distributor firmly into position and tighten up the vacuum pipe.

FUEL SYSTEM

Carburetors

Each time the car is given all-round lubrication, the oil level in the carburetor damping cylinders should be checked. If necessary top up with engine oil (SAE 20 but not multi-grade oil). See Fig. 1-70.

Do not add much oil, only the center spindle itself should be filled and not the part above this.

Removing the carburetors

(The carburetors should not be removed before this is absolutely necessary.)

Both the carburetors must be removed at the same time from the inlet manifold since the intermediary shaft is carried in the levers on the throttle spindles.

1. Remove the air cleaners, fuel pipes, vacuum pipe and controls from the carburetors.
2. Unscrew all the nuts retaining the carburetors on the inlet manifold.
3. Take off both the carburetors simultaneously from the inlet manifold. Cover the inlet holes in the manifold with masking tape.

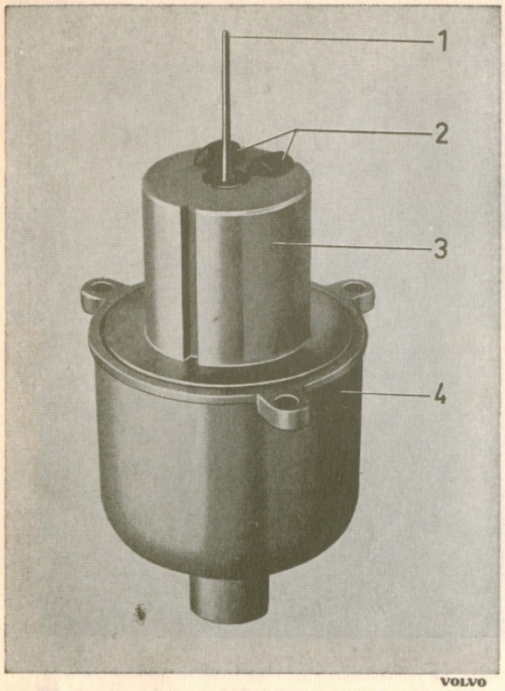


Fig. 1-71. Fit of piston in suction chamber
1. Fuel needle 2. Plugs 3. Vacuum piston 4. Suction chamber

Disassembling the carburetors

1. Remove the damping plungers and suction chamber with piston.
2. Unscrew the float bowl cover and lift it up. Then remove the housing.
3. Loosen the screws retaining the levers for the choke and rapid idling controls, pull these off and remove the jet.
   Remove the adjuster nut, the locknut and the jet sleeve.
4. Wash all the component parts in white spirit and blow dry with compressed air.
   The air cleaners must not be washed since they have paper inserts.

Inspection and assembly of carburetors

Check before assembling that all the parts are in good condition. The fit of the piston in the suction chamber is of high precision and its character may not be altered by means of filing or scraping. Small uneven points can be polished finely with fine grade emery cloth.

The fit can be tested by plugging the air holes in the piston, placing it in the suction chamber and holding the parts upside down. The damping plunger should be fitted but not filled with oil. The spring for the suction chamber piston should not be fitted. The piston should normally sink to the bottom from the position shown in Fig. 1-71 in 5-7 seconds.

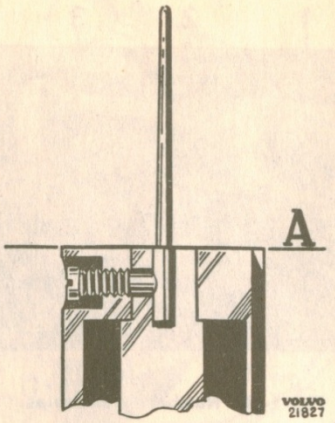


Fig. 1-72. Attachment of fuel needle
A = attaching level

1. Fit the fuel needle as shown in Fig. 1-72. Only the tapered part of the needle should be above the piston.
2. Fit the spring, washer and piston in the suction chamber and screw the suction chamber into the carburetor housing.
3. Fit the jet sleeve, locknut and adjusting nut, see Fig. 1-76. Slide in the jet and center it. See "Centering the jet".
4. Fit the spring for the adjuster nut and jet. See Fig. 1-73.
5. Check and fit the float valve (see Fig. 1-74). Fit the float and cover. Attach the float bowl and pipes to the jet.

Replacing the float valve

1. Remove the float bowl cover and turn it upside down.
2. Remove the float lever pin. Remove the float.
3. Screw out the valve and fit a new valve. Fit the float.
4. Check that the cover gasket is in good condition and fit the cover and screw tightly in position.

Centering the jet

It is usually only necessary to center the jet when the carburetors have been disassembled, or when parts influencing the jet have been replaced.

When centering is carried out, the carburetor should be disassembled. The carburetor in question is laid down on a bench as shown in Fig. 1-77 and the vacuum plunger is moved backwards and forwards with one finger towards the throttle flap by using light pressure.

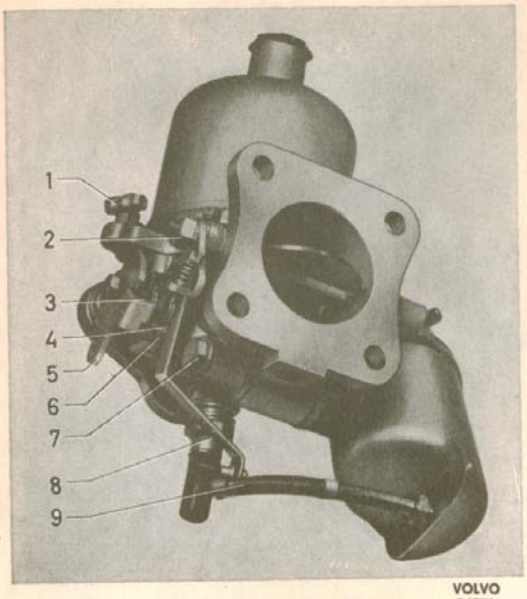


Fig. 1-73. Levers and springs

1. Attachment for choke control sleeve
2. Throttle spindle
3. Return spring
4. Return spring
5. Lever for rapid idling, etc.
6. Lever to lower jet
7. Screw for float bowl
8. Link to lower jet
9. Fuel line

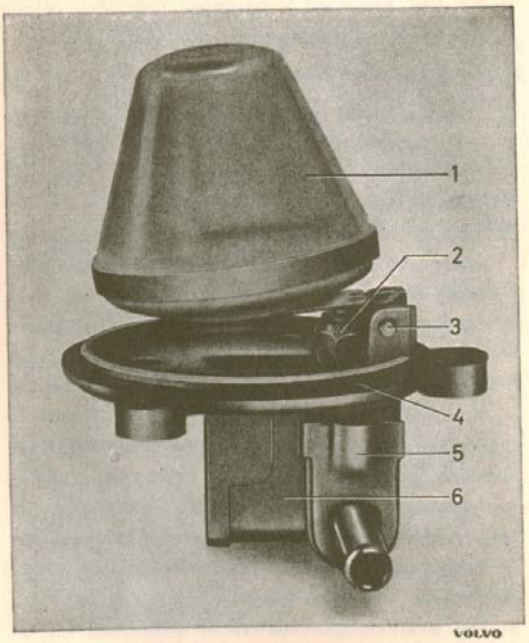


Fig. 1-74. Float

1. Float with arm
2. Float valve
3. Pin
4. Gasket
5. Air-venting washer
6. Cover

Fig. 1-75. Fitting the float bowl

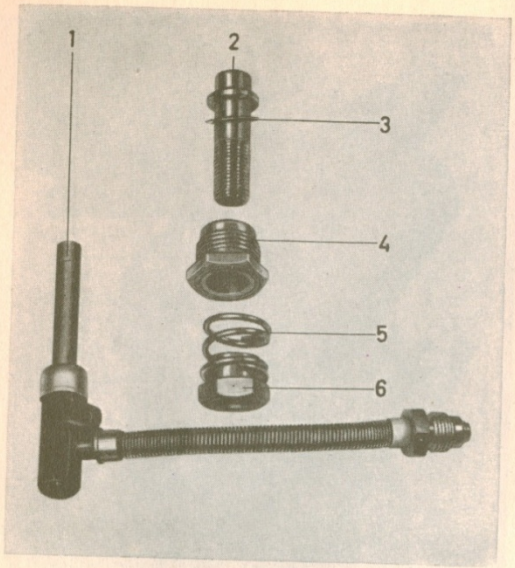
1. Cover 2. Gasket 3. Valve 4. Arm 5. Housing

This centers the jet correctly in relation to the position assumed by the vacuum plunger while the engine is running. The plunger is then pressed over towards the throttle flap due to the vacuum prevailing between the plunger and the throttle flap.

1. Remove the jet by removing the screw on the lower end of the link and the fuel line nipple.
2. Remove the adjuster nut (6) and the spring (5), Fig. 1-76. Loosen the locknut so that the sleeve can be moved.
3. Push the jet into position. Note that the fuel line of the jet should be at the same angle as it is when fitted. See Fig. 1-77.
4. Push up the jet against the jet sleeve and, at the same time, move the vacuum plunger backwards and forwards right down to the bridge by exerting light pressure against the trottle flap. Center the jet sleeve so that it does not prevent movement. Tight the lock nut (2) and then check that the plunger runs easily down to its loose position when the jet is held in the upper position as described in point 3 above.
5. Fit the parts which have been taken out. Make sure that the fuel line is not twisted when it is being attached to the float bowl.

Fitting the carburetors

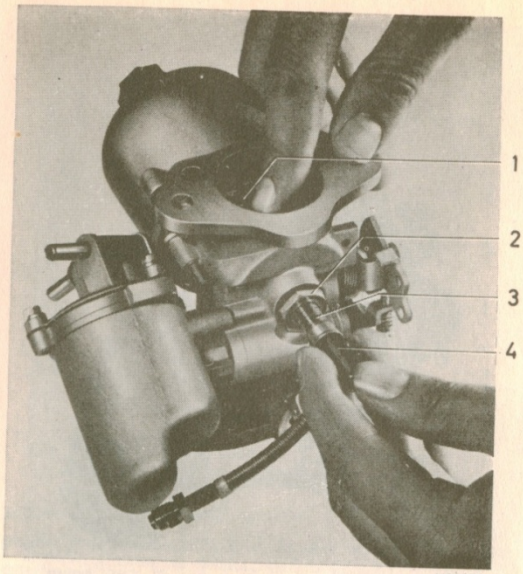
1. Remove the protective material over the inlet channels. Fit new gaskets.



VOLVO 26771

Fig. 1-76. The jet, disassembled

1. Jet with fuel line, complete
2. Jet sleeve
3. Washer
4. Locknut
5. Spring
6. Adjuster nut



VOLVO 26770

Fig. 1-77. Centering the jet

1. Lower part of vacuum plunger
2. Lock nut
3. Jet sleeve for jet

2. Move the intermediary shaft into its position between the carburetors, see Fig. 1-78. Make sure that the protective plate is in good condition and that the sealing surfaces are clean.
3. Fit the carburetors at the same time, with the intermediate shaft in position. Tighten the nuts and connect up the controls and lines.
4. Carry out necessary adjustment of carburetor settings, see "Carburetor settings after fitting".
5. Fit the air cleaners but make sure that the gaskets come into their correct positions. Fill up with SAE 20 engine oil (not multi-grade oil) in the damping cylinders if necessary.

Carburetor settings, after fitting (synchronization)

After the engine has been installed in the car and the carburetors have been fitted, they are adjusted in accordance with the following instructions. Check that oil and water has been added before the engine is started. If settings are carried out carefully, subsequent adjustment is very rarely needed.

At certain intervals, for example when changing the air cleaners, it is advisable to remove and thoroughly clean the suction chambers and vacuum plungers.

The float bowls should be cleaned at the same time. This can easily be carried out after the float bowl covers have been removed.

Synchronizing of the carburetors implies adjustment of the clearance on the intermediary shaft, adjustment of fuel/air mixture and idling as well as adjustment of the choke control and rapid idling.

Adjusting the clearance on the intermediary shaft

1. Insert a feeler gauge 0.5 mm thick at (A), Fig. 1-78, between the lever and its check stop. Screw out the idling screws (2, Fig. 1-79) so that the throttle flaps are completely closed.
2. Loosen the nuts (3 and 9, Fig. 1-78) and push the outer end of the levers (2, 8) on the intermediary shaft carefully downwards, so that the pins just contact the lower tooth on the throttle spindle levers, (1, 10). Note. Do not press so hard that the throttle flap is influenced. Only the clearance downwards at the pins should be eliminated. Tighten the nuts (3, 9) in this position. Note when tightening that the shaft end play is distributed equally in both directions and that there is a small axial clearance between the levers on the intermediary shaft and the throttle spindle levers.
3. Remove the feeler gauge. Then check by lifting the lever at "A" that both throttle flaps are influenced simultaneously. Also make sure that the intermediary shaft is free and can be moved slightly backwards and forwards. It must not be

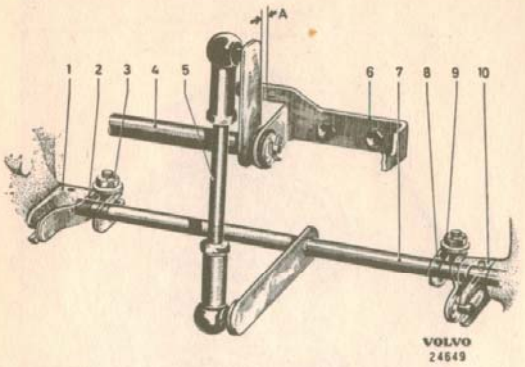


Fig. 1-78. Intermediary shaft and levers

A = clearance between stop and lever

1. Lever on throttle spindle
2. Lever on intermediary shaft
3. Locknut
4. Control shaft
5. Link
6. Bracket
7. Intermediary shaft
8. Lever on intermediary shaft
9. Locknut
10. Lever on throttle spindle

clamped by the levers (2, 8) being fitted too near the carburetors.

Adjustment of fuel/air mixture and idling

1. Roughly adjust the height of the jet by first screwing up adjuster nut (7, Fig. 1-79) to its upper position and then screwing it back one and a half turns. Adjust both carburetors in a similar way.
2. Turn the idling screws (2) so that they just touch the throttle levers while the throttle is closed. Then screw them down one half turn.
3. Top up with oil in the carburetor damping cylinders. Use SAE 20 engine oil, but not multi-grade oil. Only fill the center spindle of the vacuum plunger, not the part above this.
4. Start the engine. Adjust idling speed to 600—800 r.p.m. (B 18 B), 500—700 r.p.m. (B 18 D). Use the idling screws (2). Turn the screws so that the induction sound is equally strong on each carburetor. Run the engine warm.
5. Adjust the height of the jets (and thereby the fuel/air relationship) thoroughly, by turning the adjuster nut (7). The best position has been reached when the highest engine speed is obtained without altering the idling screw. When adjusting, screw the adjuster nut first slowly downwards (richer mixture) until the engine starts to run roughly and then slightly upwards (leaner mixture) so that the engine runs easily. Adjust the carburetors one at a time.

Fig. 1-79. Controls

1. Attachment for sleeve, choke control
2. Idling screw
3. Rapid idling screw
4. Lever
5. Lock screw for choke control
6. Locknut
7. Adjuster nut
8. Jet

6. Check and adjust idling speed with the idling screws. Remember to alter the setting equally on both carburetors.
7. Check that the fuel/air mixture is correct on both carburetors. First lift the plunger in one of the carburetors by using the pin beside the air intake and then do the same thing on the other carburetor. The engine should run equally unevenly in both cases. Engine speed should also fall off by about 200 r.p.m.

   If the engine should stall when one of the carburetor plungers is lifted, this usually depends on the fact that the mixture in the other carburetor is too lean. If the speed of the engine increases, the fuel/air mixture in the other carburetor is too rich. Adjust the settings carefully in both the last-mentioned cases.

Adjusting the choke control and rapid idling

The rapid idling adjustment described below is a normal setting. The setting can also be varied to suit varying requirements and temperatures. In the case of extremely cold weather, it may be advisable to adjust the rapid idling screw so that it comes into contact with the idling cam earlier than in the setting described below.

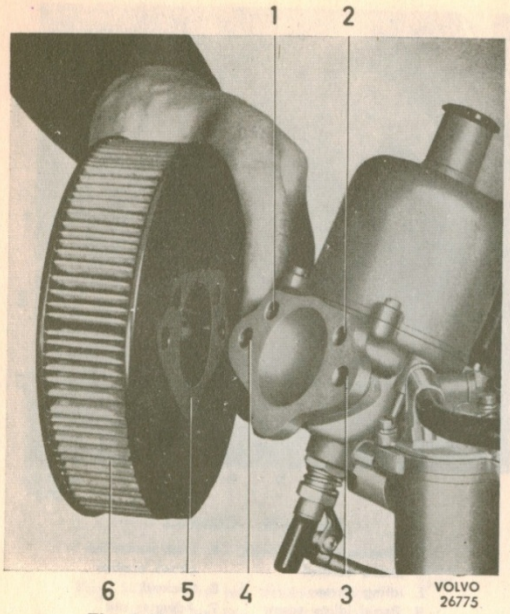


Fig. 1-80. Changing an air cleaner

1. Ventilation hole
2. Ventilation hole
3. Screw hole
4. Screw hole
5. Gasket
6. Air cleaner

Adjusting must always be carried out so that both carburetors are influenced to exactly the same amount by the controls.

1. Pull out the choke control on the instrument panel 15 mm (3/4″).
2. Loosen the screw (5, Fig. 1-79) for the control cable. Lift the lever so much that the jet just starts to go down.
3. Adjust the rapid idling screw (3) so that it just touches the rapid idling cam on the lever (4) when the jet starts to be influenced as described above. Tighten the lock screw for the control cable in this position.
4. Carefully adjust the other carburetor in the same way.
5. Check by pulling out the control that both carburetors are influenced to exactly the same extent. This is easiest to do if the control is pulled out about 20 mm (25/32″) and then watching the degree to which the jets go down.
   Adjust the settings if the jets do not go down by an equal amount.

Accelerator pedal adjustment

The length of the vertical push-rod from the control on the body should be adjusted so that there is a clearance of 1 mm (0.04″) between the lug on the throttle lever and the full throttle stop on the carburetor when the accelerator pedal is fully depressed. This means that when the accelerator pedal is fully depressed the loading exerted by the driver's foot will be taken up by the toe-plate without unnecessary loading of the carburetor linkage.

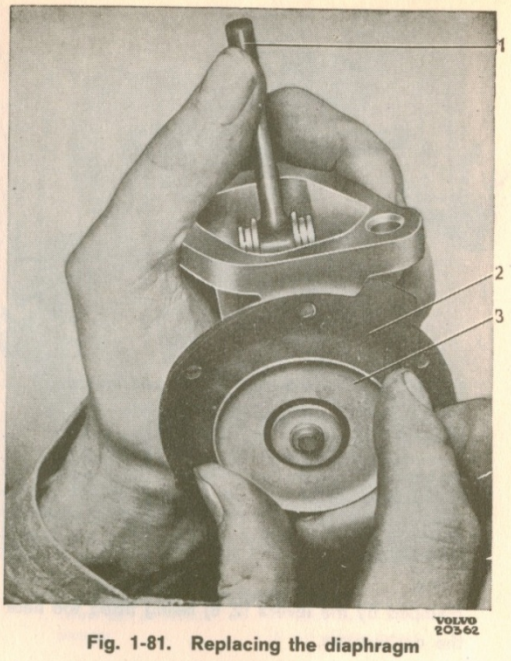


Fig. 1-81. Replacing the diaphragm

1. Lever
2. Diaphragm
3. Washer

Air cleaners

The only normal service procedure is to replace both the air cleaners after every 20 000 km (12 000 miles). The old air cleaners should be thrown away.

If the car is driven on dusty roads and in districts with particularly contaminated air, the cleaners should be changed more often, approx. after 10 000 km (6000 miles).

No cleaning of any sort should be carried out between these changes.

1. Remove the air cleaners by unscrewing the attaching screws.
2. Make sure that the gaskets are turned the right way, see Fig. 1-80, and fit the new air cleaners.

If the gasket is fitted wrongly, the ventilation holes for the suction chamber pistons are blocked and the carburetors cannot function properly. The car should not be driven without air cleaners fitted since the carburetors are dependent on the resistance to air flow through the carburetor cartridges.

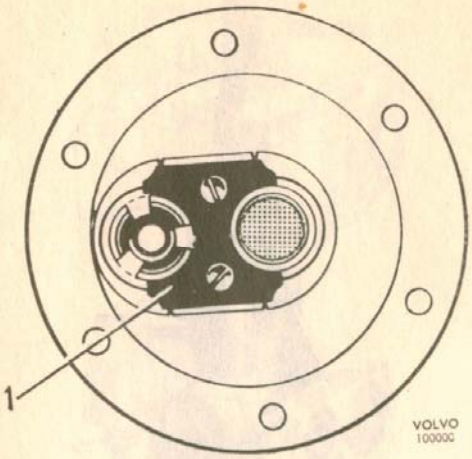


Fig. 1-82. Fuel pump early prod.
1. Retainer

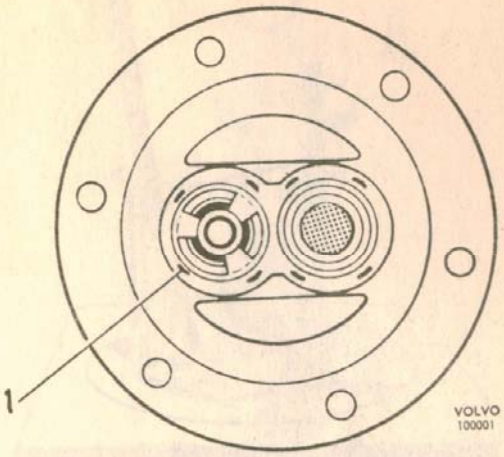


Fig. 1-84. Fuel pump late prod.
1. Upset material

Repairing the fuel pump

Before the pump is removed, it should be checked for pressure and capacity. If the values do not agree with those given in the specifications, the pump should be removed for repair, which most frequently involves replacing the diaphragm and/or valves.

Replacing the diaphragm

1. Dismantle the pump.
2. Hold the pump as shown in Fig. 1-81. Remove the old diaphragm by pressing it down and turning it a quarter of a turn.
3. Fit the new diaphragm by pressing down the rod and turning it a quarter of a turn.

Replacing the valves

Early production

1. Remove the screws which hold the upper and lower parts of the pump together.
2. Remove the valve retainer (1, Fig 1-82) and remove the valves and gasket.
3. Clean the valve recesses so that the valves come in the correct position when fitting.
4. Fit on a new gasket and new valves and screw up the retainer again.

Late production

1. Dismantle the pump.
2. Remove the old valves with a screwdriver or some other suitable tool.
3. Clean the valve recesses so that the new valves can be fitted correctly.
4. Place the new gaskets and valves in position.
5. Press down the valves to the correct position. A tube as shown in the figure 1-83 can be used for this.
6. Upset the material round each valve in four places, see Fig. 1-84, with a punch as shown in the figure 1-85.

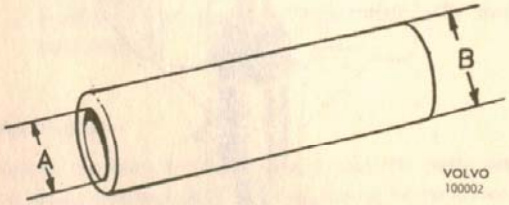


Fig. 1-83. Tube for fitting the valves

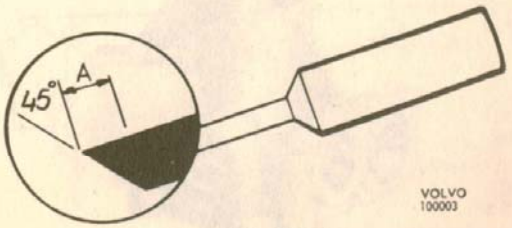


Fig. 1-85. Punch
A = 2.5 mm (3/32")

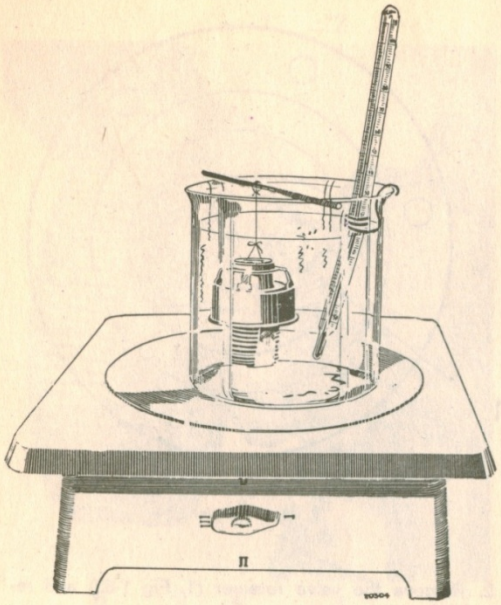


Fig. 1-86. Testing the thermostat

After the necessary repairs have been carried out to the fuel pump, it is assembled and tested and then fitted to the vehicle. Make sure that the lever comes in the correct position above the cam.

COOLING SYSTEM

During the cold season ethylene glycol should be mixed with the cooling water together with anti-corrosion agent in order to prevent the cooling system from freezing. See the specifications for the amounts required. Always use clean water (preferably rain water) together with anti-corrosion additive.
NOTE. The water pump is made of light-alloy.

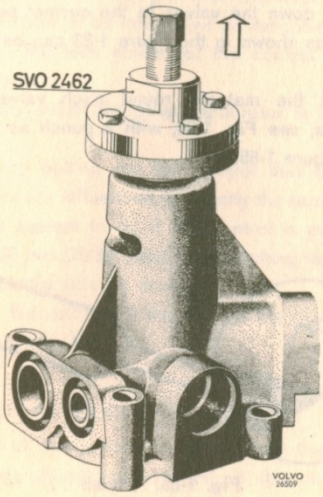


Fig. 1-87. Removing the hub

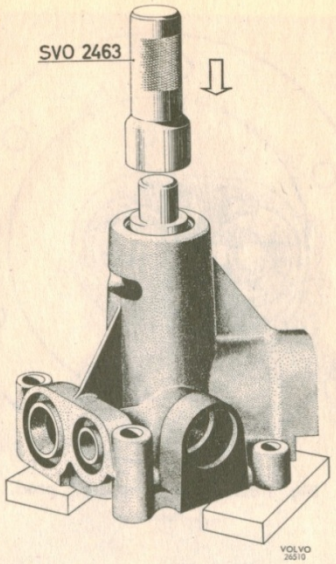


Fig. 1-88. Removing the shaft and impeller

Thermostat

The thermostat can be tested after it has been removed in a vessel full of water which is heated up. See Fig. 1-86.
The thermostat should open and close at the temperatures shown in the specifications.

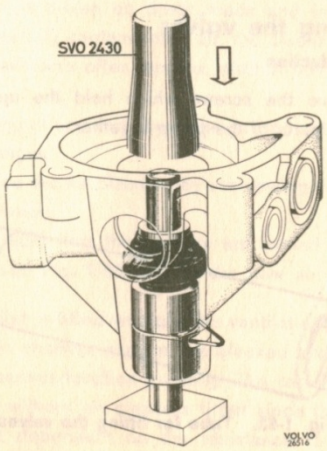


Fig. 1-89. Fitting the seal ring

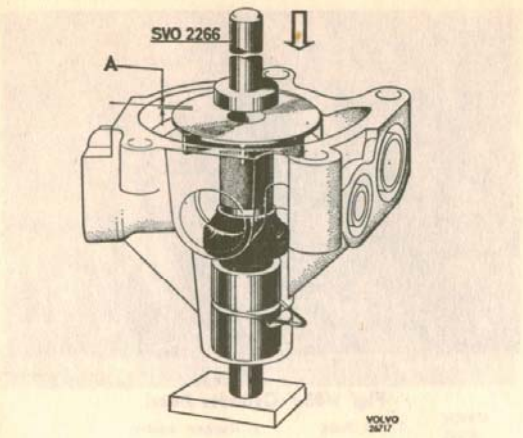


Fig. 1-90. Fitting the impeller
A = 0–0.016" (0–0.4 mm)

Reject a faulty thermostat. Use a new gasket when reassembling.

Water pump, reconditioning

Disassembly and inspection

1. Pull out the lock spring.
2. Fit puller SVO 2462 on the hub with the bolts for the pulley and pull off the hub. See Fig. 1-87.
3. Place the pump in a press. Fit tool SVO 2463 on the bearing outer race and press out the shaft, bearing and impeller. Fig. 1-88.
4. Inspect the impeller and the bearing. If the bearing is worn and feels loose or if it chafes, reject the shaft and bearing. (The shaft and bearing cannot be disassembled). If the bearing can still be used, it should not be warmed up or washed in fluid since the lubricant in it will then be ruined. If the impeller is removed it should be replaced by a new unit since there is almost always damage and excessive clearance. The seal ring should always be replaced by a new unit.
5. When disassembling the shaft and impeller, these units are separated by pressing the seal ring down and sliding the washer SVO 2429 in under the impeller. Then press out the shaft with tool SVO 2266.

Assembly

Check carefully before assembly that the parts are in good condition. The impeller sealing surface must be even and free from scratches. The bearing should run easily without chafing and should not be loose.

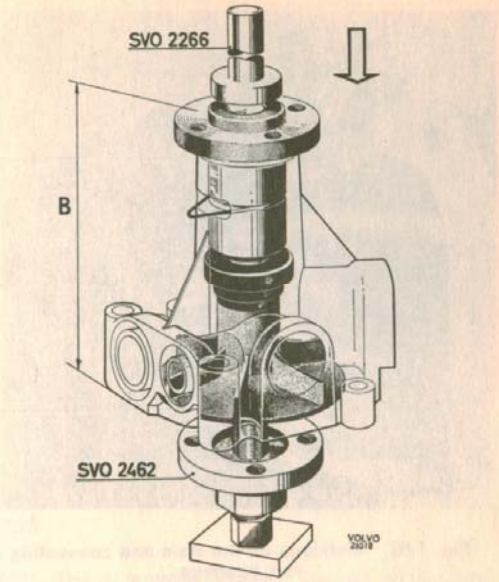


Fig. 1-91. Fitting the pulley
B = 4.134" ± 0.008" (105 ± 0.2 mm)

Replace damaged parts with new parts. The seal ring should always be replaced with a new unit.

1. Press down the shaft and the bearing in the housing by using tool SVO 2463 in a similar way to that shown in Fig. 1-88 so far that the lock wire can be inserted into its groove. Fit the lock wire.
2. Fit the seal ring with tool SVO 2430 as shown in Fig. 1-89. Smear the sealing surface against the impeller with molybdenum disulphide which has been stirred up in methylated spirit.
3. Press down the impeller with tool SVO 2266 so far that the impeller is level with or up to 0.016" (0.4 mm) below the pump housing surface. The lower end of the shaft should rest against a counterhold. See Fig. 1-90.
4. Turn the pump. Apply a counterhold under the end of the shaft in the impeller hole and press on the hub with tool SVO 2266. As counterhold use,

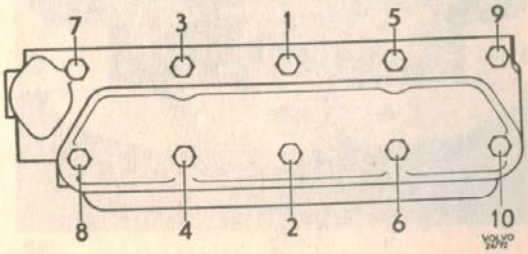


Fig. 1-92. The correct order to tighten the cylinder head bolts

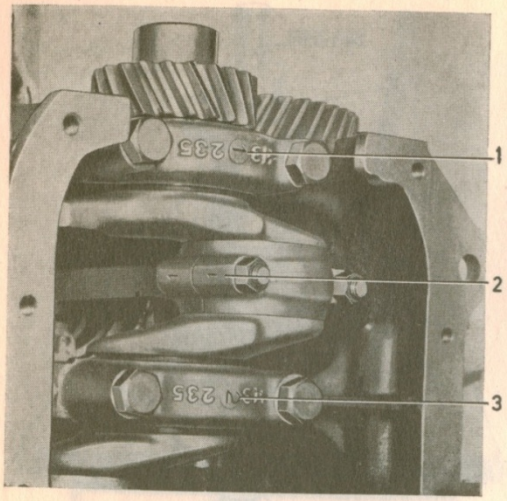


Fig. 1-93. Markings on the main and connecting rod bearings

1. Main bearing number 1 2. Connecting rod bearing number 1 3. Main bearing number 2

for example, puller SVO 2462 with the center bolt screwed in so that it supports against the shaft. Press carefully so far that the dimension B as shown in Fig. 1-91 is 4.134±0.008″ (105±0.2 mm).

5. Check that the pump can be turned by hand without excessively large resistance and that there is no chafing.

ASSEMBLING THE ENGINE

When assembling the engine follow the instructions for the parts concerned. The order of working will be in the reverse way to that carried out when disassembling. Check the marking on the bearings as shown in Fig. 1-93. The main bearings are marked 1–5, the connecting rod bearings 1–4, starting from the front.

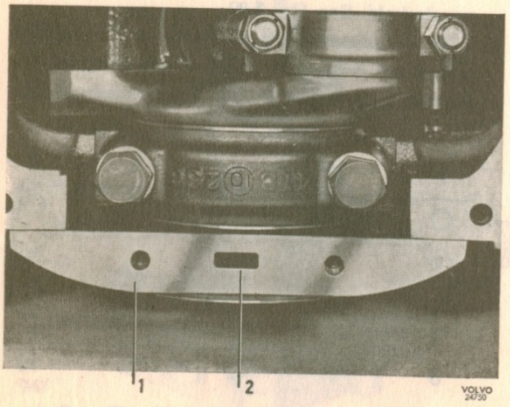


Fig. 1-94. Rear sealing flange

1. Flange 2. Drain hole

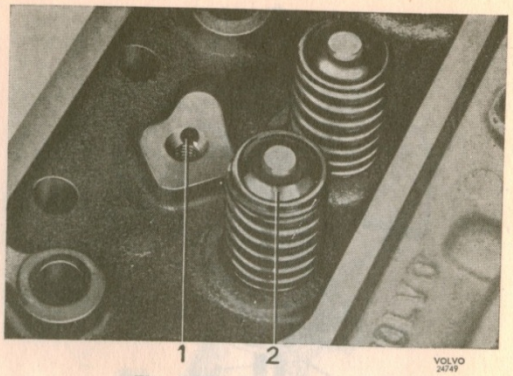


Fig. 1-95. Cylinder head

1. Oil hole 2. Rubber washer

Check that all component parts are clean and lubricate bearing surfaces with oil before assembling. Always use new gaskets and washers, cotter pins and lock washers. Shellac should not be used as sealing agent since it dries out and flakes off with the resultant risk that oil channels can be partially blocked.

Seals on the ends of the pressure pipes on the oil pump, as well as the pipes on and above the water pump, should be made of rubber. Make sure that these are in their correct positions and that the pipes are pressed in properly.

Make sure that the drain hole in the timing gear casing and the rear sealing flange (2, Fig. 1-94) are open and that the seals are in good condition. Make sure also that the timing gear casing and flange are well centered.

Fit new connecting rod nuts and bolts when reconditioning.

The cylinder head bolts must be tightened in a special order as shown in Fig. 1-92 in order to avoid unnecessary stresses. Check that the oil hole (1, Fig. 1-95) for the lubrication of the rocker arms is not blocked. The support bearing (5, Fig. 1-96) should be lubricated before fitting with heat-resistant bearing grease. The bearing is maintained in position by a lock ring (4).

The most important nuts and bolts should be tightened with a torque wrench, see the specifications for the correct tightening torque.

The fan belt should be tensioned so that the pulley starts to slip under a force of 6.5–8.5 kg (14 1/2–19 lb.) applied 150 mm (6″) from the hub center.

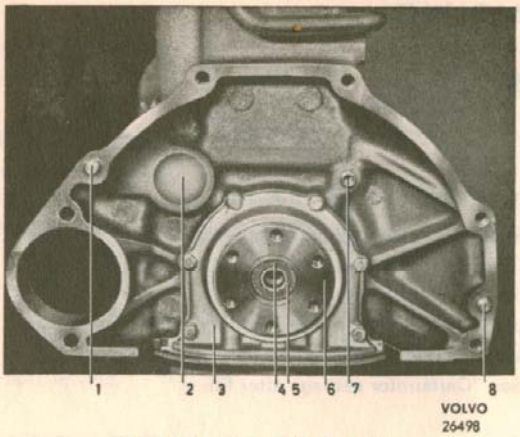


Fig. 1-96. Rear end of engine

A = 14.5 mm (9/16″)
B = 19 mm (3/4″)
1. Guide pin
2. Seal washer
3. Sealing flange
4. Lock ring
5. Support bearing
6. Crankshaft
7. Plug
8. Guide pin

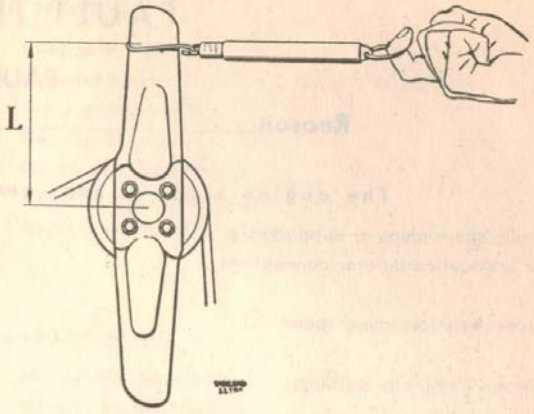


Fig. 1-97. Fan belt tension

L = 150 mm (6″)
Force applied = 6.5–8.5 kg (14 1/2–19 lb.)

Exert pressure in the direction of rotation of the engine and use a spring balance as shown in Fig. 1-97.

FITTING THE ENGINE IN THE CAR

Use the lifting tool SVO 2425 when fitting the engine in the car. The order of operations will be the reverse to that used when removing, see under heading "Removing the engine".

After all the component parts have been fitted, fill up with cooling water and oil.

Make sure that all the controls have been correctly connected, see the sections concerned.

When the fan blades are vertical, the clearance to the radiator straight up should be at least 15 mm (0.59″). The clearance between the fan blades and the radiator straight forward where it is nearest should not be less than 11 mm (0.43″).

Adjustment can be carried out by means of washers on the radiator mountings.

RUNNING IN

An engine that has been reconditioned either partly or completely must always be driven carefully during the first period, the running-in period. Do not run the engine at excessively high speeds but avoid running at very low speeds under loading.

Change the engine oil at closer intervals than usual. See the sections concerned in the instruction book.

If an engine test bench is available, it is a great advantage to run the engine in this if extensive reconditioning has been carried out.

FAULT TRACING

FAULTS

Reason	Remedy
The engine stops or runs very unevenly at idling speed	
Faulty spark plugs or suppressors.	Replace spark plugs and suppressors.
Air leaks at carburetor connections.	Check the tightness of the connections. Replace damaged gaskets.
Excessively low idling speed.	Increase the idling speed and check that the air intake sound is equally strong on both carburetors.
Uneven carburetor settings.	See "Carburetor settings after fitting".
The engine jerks (or coughs) during acceleration	
Dirty insulators on the spark plugs.	Clean the insulators.
Faulty spark plugs.	Check or replace spark plugs.
Dirty, faulty or moist distributor cap.	Remove and clean or replace the distributor cap.
Faulty or moist cables.	Check, clean or replace cables. See also Part 10.
Too little oil or too thin oil in the carburetor damping cylinders.	Fill with oil of the right grade and viscosity.
Dirt in the carburetors.	Remove the float bowl covers and clean the bowls.
Excessively lean fuel/air mixture.	Check the carburetor settings.
Faulty fuel pump supplying too little fuel.	Check the pressure and capacity of the fuel pump.
Weak engine output	
Air cleaners blocked.	Fit new air cleaners.
Poor quality fuel, too low octane value.	Check the fuel grade, use the correct fuel.
Faulty ignition timing setting.	Adjust the ignition timing setting during rapid idling with a stroboscope. See "Ignition timing setting".
Faulty and uneven adjustment of carburetors.	Check and adjust the carburetor setting. See "Carburetor setting after fitting".
Faulty valve clearances.	Check and adjust valve clearances.
Low compression on one cylinder.	Measure compression pressure. In the case of low values, remove the cylinder head for close investigation of engine.
Chafing piston.	Remove cylinder head for investigation.
Chafing wheel bearings or faultily adjusted brakes.	See Part 7.
Knocking from valve mechanism	
Excessively large valve clearances.	Adjust valve clearances.
Worn or damaged parts in valve mechanism.	Recondition or replace parts where required.
Heavy regular knocking sound, worse during loading	
Worn main and connecting rod bearings or worn pistons and piston pins.	Localise sound by short-circuiting spark plugs, one after the other. Then disassemble where necessary for an examination of bearings and pistons.

Oil pressure too low

Blocked oil cleaner.	Change air cleaner.
Faulty pressure gauge or piping.	Determine pressure with control gauge. Replace faulty gauge or pipe.
Faulty spring for release valve and/or worn pump.	Remove oil pump. Check spring and pump.
One or more bearings worn.	Examine and replace bearing shell.
Excessive wear in general.	Replace or recondition engine.

Excessive oil consumption

Hard driving.	No remedy necessary. Oil consumption can increase during very hard driving.
Leakage at joints.	Tighten bolts, replace damaged or poor gaskets at various points in engine.
Oil level too high.	Do not top up with oil until the level is almost down to the lower mark on the dipstick.
Worn valve guides.	Recondition valve system.
Worn piston rings.	Replace piston rings.

Fuel consumption excessive

Hard driving.	No remedy necessary. Normal during hard driving.
Blocked air cleaners.	Replace air cleaners.
Carburetors flooding.	Check or replace float valves. Also check pump pressure.
Faulty carburetor settings, fuel/air mixture too rich.	Adjust settings.
Poor suppressors on spark plugs, faulty contact on breaker points.	Replace spark plug suppressors. Adjust distributor.
Faulty cam dwell and ignition setting.	Adjust cam dwell and ignition setting. Use stroboscope for ignition settings.

Engine runs abnormally warm

Not enough cooling water.	Top up with cooling water.
Faulty gauge.	Check or replace gauge.
Fuel with excessively low octane rating (knocking).	Use fuel with correct octane rating.
Faulty thermostat.	Replace thermostat.
Faulty ignition setting.	Adjust ignition setting.
Faulty carburetor setting, (fuel/air mixture too lean).	Adjust carburetor settings.
Blocked cooling system.	Clean cooling system.
Fan belt insufficiently tensioned.	Adjust tension.

Cooling water losses

Hose junctions leaking.	Check or replace hoses and clips.
Faulty radiator cap.	Replace radiator cap.
Faulty cylinder head gasket, (oil in cooling water).	Replace cylinder head gasket.

TOOLS

The following special tools are needed for work on the engine.

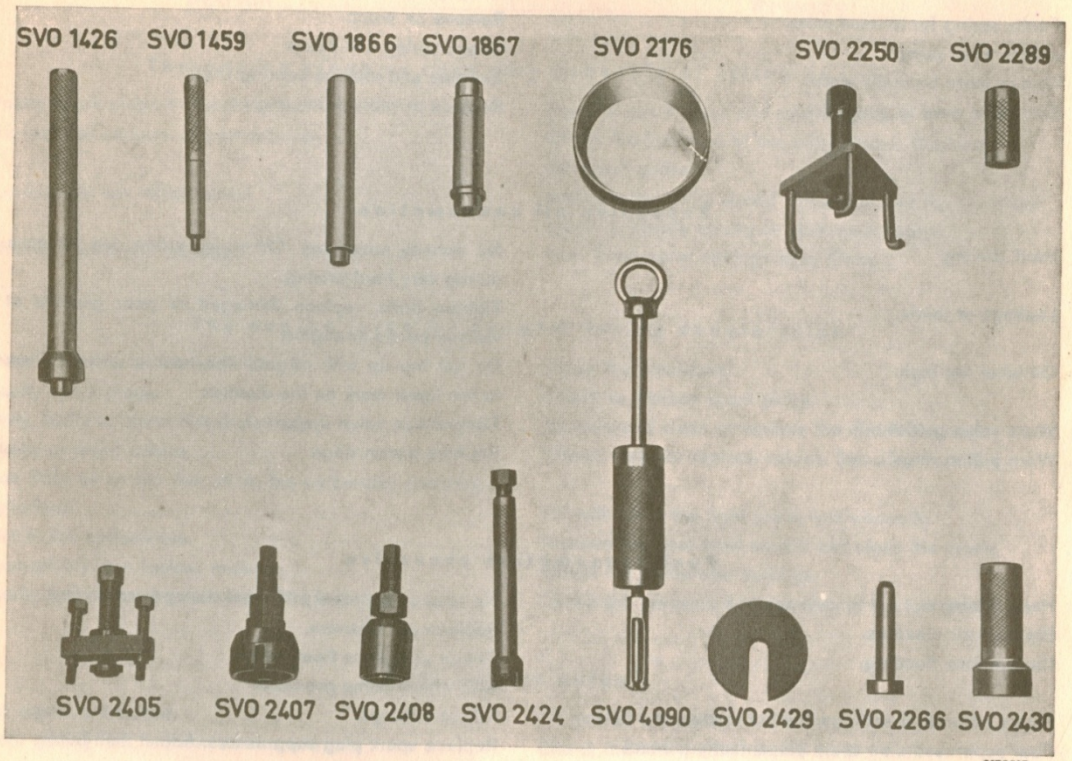


Fig. 1-98. Tools for engine

SVO 1426 Tool for removing pilot bearing
SVO 1459 Tool for removing valve guides
SVO 1866 Tool for removing and fitting piston pins
SVO 1867 Tool for removing and fitting bushings in rocker arms and connecting rods
SVO 2176 Tool for fitting piston rings (standard size)
SVO 2250 Puller for camshaft gear
SVO 2289 Tool for fitting valve guides
SVO 2405 Puller for crankshaft gear
SVO 2407 Press tool for fitting crankshaft gear
SVO 2408 Press tool for fitting camshaft gear
SVO 2424 Grip tool for removing and fitting valve lifters
SVO 4090 Puller for pilot bearing
SVO 2429 Press washer for removing impeller, water pump
SVO 2266 Tool for removing and fitting hub and impeller, water pump
SVO 2430 Tool for fitting seal, water pump

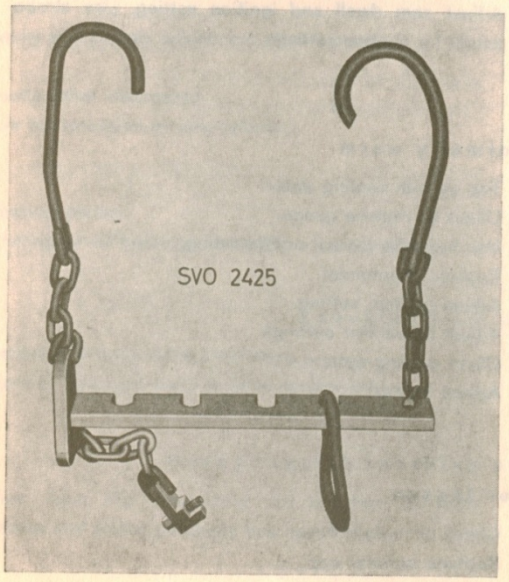


Fig. 1-99. Lifting tool for engine, SVO 2425

SPECIFICATIONS

GENERAL

Type designation	**B 18 B**
Output, b.h.p. at r.p.m. (SAE)	100/5500 (early prod.)
(DIN)	90/5500 (early prod.)
(SAE)	108/5800 (late prod.)
(DIN)	96/5600 (late prod.)
Max torque, kgm (lb.ft.) at r.p.m. (SAE)	15 (108)/4000 (early prod.)
(DIN)	14.5 (105)/3500 (early prod.)
(SAE)	15.2 (110)/4000 (late prod.)
(DIN)	14.3 (103)/3800 (late prod.)
Compression pressure (warm engine) when turned over with starter motor 200 r.p.m., kg/cm²	13–14
lb.sq.in.	184–200
Compression ratio	9.5:1 (early prod.)
	10.0:1 (late prod.)
Number of cylinders	4
Bore	84.14 mm (3.313")
Stroke	80 mm (3.15")
Displacement	1.78 liters (108.6 cu.in.)

CYLINDER BLOCK

Material	Special-alloy cast iron
Bore, standard	84.14 mm (3.313")
„ 0.020" oversize	84.65 mm (3.333")
„ 0.030" „	84.90 mm (3.343")
„ 0.040" „	85.16 mm (3.353")
„ 0.050" „	85.41 mm (3.363")

PISTONS

Material	Light-alloy
Weight	425±5 gm (15±0.18 oz.)
Permissible weight difference between pistons in same engine	10 gm (0.35 oz.)
Overall height	83.5 mm (3.29")
Height from piston pin center to piston crown	46 mm (1.81")
Piston clearance	0.03–0.05 mm (0.0012"–0.0020")
Diameter at right angles to piston pin at a point 12.5 mm (0.49") from lower edge of piston:	
Standard Class C	84.085 mm (3.314")
„ „ D	84.095 mm (3.3108")
„ „ E	84.145 mm (3.3112")
0.020" oversize	84.605±0.01 mm (3.3309±0.0004")
0.030" „	84.855±0.01 mm (3.3407±0.0004")
0.040" „	85.115±0.01 mm (3.3509±0.0004")
0.050" „	85.365±0.01 mm (3.3608±0.0004")

PISTON RINGS

Piston ring gap measured in ring opening	0.25–0.50 mm (0.001"–0.002")
Oversizes for piston rings	0.020" 0.040"
	0.030" 0.050"

Compression rings

Marked "TOP". Upper ring chromed	
Number of compression rings on each piston	2
Height	1.98 mm (0.078")
Piston ring clearance in groove	0.054–0.092 mm (0.021–0.0036")

Oil control rings

Number of oil control rings on each piston	1
Height	4.76 mm (0.187")
Piston ring clearance in groove	0.044–0.072 mm (0.0017–0.0028")

PISTON PINS

Fully floating. Circlips at both ends in piston

Fit:	
In connecting rod	Light push fit (accurate running fit)
In piston	Push fit (slide fit)
Diameter, standard	22.00 mm (0.866")
„ 0.05 oversize	22.05 mm (0.868")
„ 0.10 „	22.10 mm (0.870")
„ 0.20 „	22.20 mm (0.874")

CYLINDER HEAD

Height, measured from cylinder head contact surface to bolt head level	87 mm (3.42")
Distance from upper surface of cylinder head to upper end of overflow pipe (pipe located under thermostat)	33 mm (1.38")

CRANKSHAFT

Crankshaft axial clearance	0.017–0.108 mm (0.0007–0.0042")
Main bearings, radial clearance	0.038–0.089 mm (0.0015–0.0035")
Connecting rod bearings, radial clearance	0.039–0.081 mm (0.0015–0.0032")

Main bearings

Main bearing journals

Diameter, standard	63.441–63.454 mm (2.4977–2.4982")
„ undersize 0.010"	63.187–63.200 mm (2.4877–2.4882")
„ „ 0.020"	62.933–62.946 mm (2.4777–2.4782")
„ „ 0.030"	62.679–62.692 mm (2.4677–2.4682")
„ „ 0.040"	62.425–62.438 mm (2.4577–2.4582")
„ „ 0.050"	62.171–62.184 mm (2.4477–2.4482")
Width on crankshaft for flange bearing shell	
Standard	38.930–38.970 mm (1.5327–1.5343")
Oversize 1 (undersize shell 0.010")	39.031–39.072 mm (1.5366–1.5383")
„ 2 („ „ 0.020")	39.133–39.173 mm (1.5407–1.5422")
„ 3 („ „ 0.030")	39.235–39.275 mm (1.5447–1.5463")
„ 4 („ „ 0.040")	39.336–39.376 mm (1.5487–1.5502")
„ 5 („ „ 0.050")	39.438–39.478 mm (1.5527–1.5542")

Main bearing shells

Thickness, standard	1.979–1.985 mm (0.0779–0.0781")
undersize 0.010"	2.106–2.112 mm (0.0829–0.0831")
„ 0.020"	2.233–2.239 mm (0.0879–0.0881")
„ 0.030"	2.360–2.366 mm (0.0929–0.0931")
„ 0.040"	2.487–2.493 mm (0.0979–0.0981")
„ 0.050"	2.614–2.620 mm (0.1029–0.1031")

Connecting rod bearings

Connecting rod bearing journals

Bearing recess width	31.950–32.050 mm (1.2579–1.2620")
Diameter, standard	54.089–54.102 mm (2.1295–2.1300")
„ undersize 0.010"	53.835–53.848 mm (2.1195–2.1200")
„ „ 0.020"	53.581–53.594 mm (2.1095–2.1100")
„ „ 0.030"	53.327–53.340 mm (2.0995–2.1000")
„ „ 0.040"	53.073–53.086 mm (2.0895–2.0900")
„ „ 0.050"	52.819–52.832 mm (2.0795–2.0800")

Connecting rod bearing shells

Thickness, standard	1.833–1.841 mm (0.0722–0.0725")
undersize 0.010"	1.960–1.968 mm (0.0772–0.0775")
„ 0.020"	2.087–2.095 mm (0.0822–0.0825")
„ 0.030"	2.214–2.222 mm (0.0872–0.0875")
„ 0.040"	2.341–2.349 mm (0.0922–0.0925")
„ 0.050"	2.468–2.476 mm (0.0972–0.0975")

CONNECTING RODS

Axial clearance at crankshaft	0.15–0.35 mm (0.006–0.014")
Length, center–center	145±0.1 mm (5.709±0.004")
Maximum permissible weight difference between connecting rods in same engine	6 gm (0.21 oz.)

FLYWHEEL

Permissible runout. max.	0.20 mm (0.008")
Ring gear (bevel facing forward)	142 teeth

FLYWHEEL HOUSING

Max. tolerance, rear face	0.05 mm/100 mm diam. (0.002"/4" diam.)
Max. tolerance, rear guide	0.15 mm (0.006")

CAMSHAFT

Number of bearings	3
Front bearing journal, diameter	46.975–47.000 mm (1.8494–1.8503")
Center bearing journal, diameter	42.975–43.000 mm (1.8494–1.8503")
Rear bearing journal, diameter	36.975–37.000 mm (1.4557–1.4567")
Radial clearance	0.020– 0.075 mm (0.0008–0.0030")
Axial clearance	0.020– 0.060 mm (0.0008–0.0024")
Valve clearance for check of camshaft setting (cold engine)	1.15 mm (0.006")
B 18 B engine (100 b.h.p. SAE)	1.15 mm (0.045")
B 18 B engine (108 b.h.p. SAE)	1.45 mm (0.057")
The inlet valve should then open at	O° (TDC)

CAMSHAFT BEARING

Front bearing, diameter	47.020–47.050 mm (1.8512–1.8524")
Center bearing, diameter	43.025–43.050 mm (1.6939–1.6949")
Rear bearing, diameter	37.020–37.045 mm (1.4575–1.4585")

TIMING GEARS

Crankshaft gear, number of teeth	21
Camshaft gear (fiber), number of teeth	42
Tooth flank clearance	0.04–0.08 mm (0.0016–0.0032")

VALVES

Inlet

Valve disk diameter	40 mm (1.575")
Stem diameter	8.685–8.700 mm (0.3413–0.3485")
Valve seat angle	44.5°
Cylinder head seat angle	45°
Seat width in cylinder head	1.5 mm (0.060")
Clearance, warm or cold engine	0.50 mm (0.020")

Exhaust

Disk diameter	35 mm (1.50")
Stem diameter	8.645–8.660 mm (0.3403–0.3409")
Valve seat angle	44.5°
Cylinder head seat angle	45°
Seat width in cylinder head	1.5 mm (0.060")
Clearance, warm or cold engine	0.50 mm (0.020")

VALVE GUIDES

Length	63 mm (2.48")
Inner diameter	8.725–8.740 mm (0.3435–0.3441")
Height above cylinder head upper surface	21 mm (0.83")
Clearance, valve stem-guide, inlet valves	0.025–0.055 mm (0.0010–0.0021")
" " " " exhaust valves	0.065–0.095 mm (0.0025–0.0037")

VALVE SPRINGS

Length, unloaded	45 mm (1.77")
„ with a loading of 25.5±2 kg (56±4 1/2 lb.)	39 mm (1.54")
„ with a loading of 66±3.5 kg (145±8 lb.)	30.5 mm (1.20")

LUBRICATING SYSTEM

Oil capacity, including oil cleaner	3.75 liters (8 US pints = 6 1/2 Imp. pints)
Oil capacity, excluding oil cleaner	3.25 liters (7 US pints = 5 3/4 Imp. pints)
Oil pressure at 2000 r.p.m. (with new oil cleaner)	3.5–6.0 kg/cm² (50–85 lb./sq.in.)
Lubricant	Engine oil "Service MS"
„ viscosity below 0° C (32° F)	SAE 10 W
„ „ between 0° and +30° C (32° and +90° F)	SAE 20
„ „ over +30° C (90° F)	SAE 30
	or multi-grade oil SAE 10 W–30

Lubricating oil cleaner

Type	Fullflow oil cleaner
Make	Wix

Lubricating oil pump

Lubricating oil pump, type	Gear pump
„ „ „ number of teeth on each gear	10
„ „ „ axial clearance	0.02–0.10 mm (0.0008–0.0040")
„ „ „ radial clearance	0.08–0.14 mm (0.0032–0.0055")
„ „ „ tooth flank clearance	0.15–0.35 mm (0.0060–0.0140")

Relief valve spring (in oil pump)

Length, unloaded	31 mm (1.22")
„ , with a loading of 4.0±0.2 kg (9±1/2 lb.)	27.5 mm (1.08")
„ , „ „ „ „ 9.5±0.3 kg (21±3/4 lb.)	22.5 mm (0.089")

FUEL SYSTEM

Fuel pump

Fuel pump, type	AC diaphragm pump UG
Fuel pressure	min. 0.11 kg/cm² (1.5 lb/sq.in.) max. 0.18 kg/cm/ (2.5 lb./sq.in.)

Carburetors

Type	Horizontal carburetors
Make and designation	SU-HS 6
Number of carburetors	2
Size (air intake diameter)	44.5 mm (1 3/4")
Fuel needle, designation	TZ or ZH
Idling speed	600–800 r.p.m.
Oil for damping cylinders	SAE 20, engine oil (not multi-grade)

IGNITION SYSTEM

Voltage	12 volts
Order of firing	1-3-4-2
Ignition timing setting with stroboscope at 1500 r.p.m. Octane number by Research Method.	
Engine B 18 B (100 b.h.p. SAE), 97 octane	17–19° before TDC
Engine B 18 B (108 b.h.p. SAE), 97 octane	14–19° before TDC
100 octane	17–19° before TDC
Spark plugs	Bosch W 225 T1 or corresponding types
spark gap	0.7–0.8 mm (0.028–0.032")
tightening torque	3.8–4.5 kgm (28–32 lb.ft.)

Distributor

Type	Bosch
Designation	VJU 4 BL 33
Contact breaker point gap	0.4–0.5 mm (0.016"–0.020")
" " " pressure	0.5–0.6 kg (1–1 1/4 lb.)
Dwell angle	60±3°
Direction of rotation	Counter-clockwise

COOLING SYSTEM

Type	Pressure
Radiator cap valve opens at	0.23–0.30 kg/cm² (3–4.5 lb./sq.in.)
Capacity	9 liters (8 Imp. quarts=9 US quarts)
Fan belt, designation	HC 38×35"

Antifreeze

Amount of glycol for frost protection down to –10° C (14° F)	2 liters (4 US pints = 3 1/2 Imp. pints)
" " " " " " " " –20° C (–5° F)	3.25 liters (7 US pints = 5 3/4 Imp. pints)
" " " " " " " " –30° C (–22° F)	4.25 liters (9 US pints = 7 1/2 Imp. pints)
" " " " " " " " –40° C (–40° F)	5 liters (10 1/2 US pints = 8 3/4 Imp. pints)

Thermostat

Type	Fulton Sylphon 1–1700-D-3
Marked	170
Starts to open at	75–78° C (167–172° F)
Fully open at	89° C (192° F)

WEAR TOLERANCES

Cylinders

Rebore (if engine has abnormal oil consumption) when wear reaches	0.25 mm (0.010")

Crankshaft

Permissible out-of-roundness on main bearing journals, max.	0.05 mm (0.002")
Permissible out-of-roundness on connecting rod bearing journals, max.	0.07 mm (0.003")
Maximum axial clearance on crankshaft	0.15 mm (0.006")

Valves

Permissible clearance between valve stems and valve guides, max.	0.15 mm (0.006")
Valve stems, permissible wear, max.	0.02 mm (0.008")

Camshaft

Permissible out-of-roundness (with new bearings), max.	0.07 mm (0.003")
Bearings, permissible wear	0.02 mm (0.008")

Timing gears

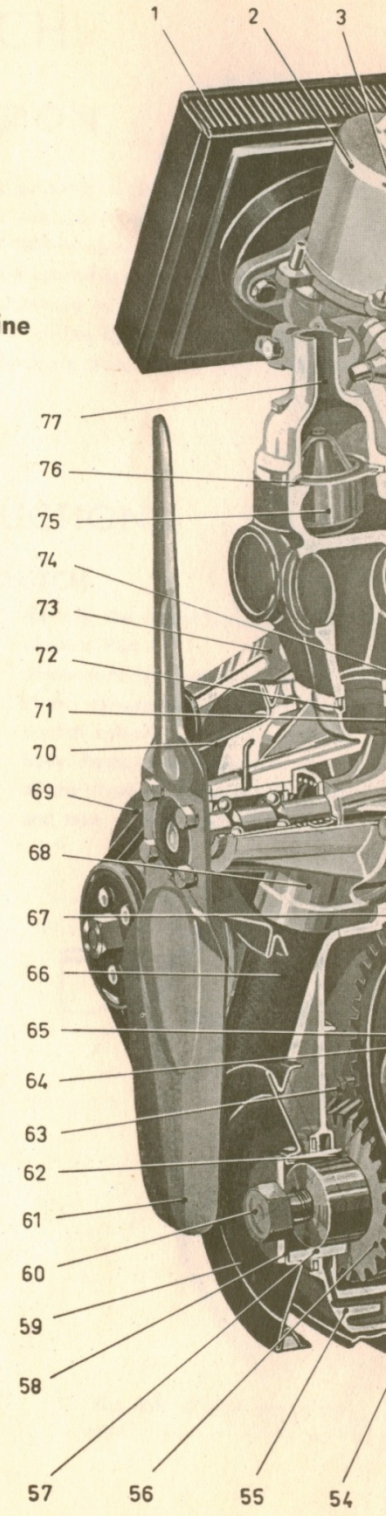
Permissible tooth flank clearance, max.	0.12 mm (0.005")

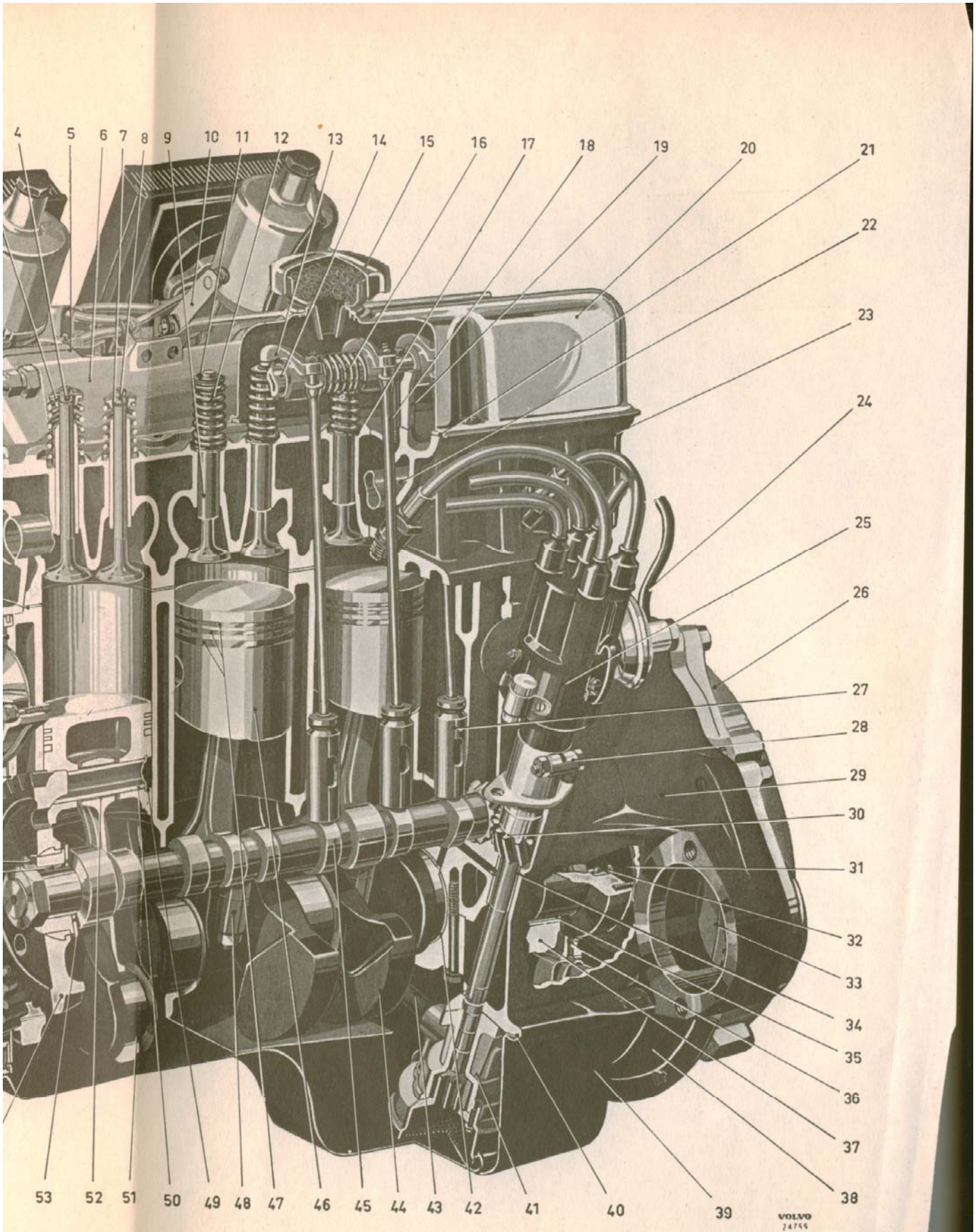
TIGHTENING TORQUES

	kgm	lb.ft.
Cylinder head	8.5–9.5	61–68
Main bearings	12–13	87–94
Connecting rod bearings	5.2–5.8	38–42
Flywheel	4.5–5.5	33–40
Nut for oil cooler	3.0–3.5	22–25
Spark plugs	3.8–4.5	28–32
Camshaft nut	13–15	94–108
Bolt for crankshaft pulley	7–8	50–58
Bolt for generator (3/8"–16)	3.5–4	25–29
Nipple for oil cooler and oil cleaner	4.5–5.5	33–40
Oil pan bolts	0.8–1.1	6–8

Illustration 1-A. Section through B 18 B engine

1. Front air cleaner
2. Front carburetor
3. Upper valve washer
4. Exhaust valve
5. Shield plate
6. Inlet manifold
7. Valve cotter
8. Inlet valve
9. Valve guide
10. Throttle control
11. Seal ring
12. Valve spring
13. Rocker arm
14. Rocker arm shaft
15. Breather (oil filler)
16. Spring
17. Lower valve washers (rubber and steel washers, rubber washer lowest)
18. Push rod
19. Bearing bracket
20. Rocker arm cover
21. Gasket
22. Water distributor tube
23. Cylinder head
24. Vacuum line
25. Distributor
26. Flywheel housing
27. Valve lifter
28. Retainer
29. Cylinder block
30. Gear
31. Lock ring
32. Pilot bearing
33. Flywheel
34. Bushing
35. Flange bearing shell
36. Sealing flange
37. Main bearing cap
38. Cover plate
39. Oil pan
40. Gasket
41. Oil pump
42. Main bearing shell
43. Oil pipe
44. Crankshaft
45. Camshaft
46. Piston
47. Piston rings
48. Connecting rod
49. Lock ring
50. Piston pin
51. Connecting rod bearing shell
52. Connecting rod bushing
53. Thrust washer and spacer
54. Camshaft gear
55. Timing gear casing
56. Crankshaft gear
57. Sleeve
58. Washer
59. Pulley
60. Bolt
61. Fan
62. Key
63. Oil jet
64. Key
65. Lock washer
66. Cooling water inlet
67. Gasket
68. Water pump
69. Generator
70. Pulley
71. Gasket
72. Seal
73. Tensioner
74. Cylinder head gasket
75. Thermostat
76. Gasket
77. Cooling water outlet

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PART 2

CLUTCH

DESCRIPTION

The clutch of the P 1800 is a single plate dry disk type of Borg and Beck manufacture. The pressure plate (22, Illustration II) is operated by means of three levers (31) which are actuated from the clutch pedal (18) through the hydraulic clutch control. The thrust required on the pressure plate is obtained from six strong pressure springs (24). The release bearing (25) is guided by a tubular extension on the bearing cover of the transmission input shaft. The clutch on the P 1800 is controlled hydraulically.

The control consists of a master cylinder (9) which is influenced by the clutch pedal and a control cylinder (41) on the flywheel housing (46) which operates the clutch via the clutch fork (33) and release bearing.

REPAIR INSTRUCTIONS

WORK WHICH CAN BE CARRIED OUT WITH THE CLUTCH FITTED

Adjusting the clutch release fork travel and clutch pedal play

In order to prevent the clutch from slipping, the clutch fork travel (A, Fig. 2-1) must be checked and if necessary adjusted every 3000 miles (5000 km). In the event of trouble arising with declutching, the clutch pedal play (A, Fig. 2-2) should also be checked.

The clutch fork travel is adjusted by means of the nuts (1, Fig. 2-1). These are adjusted so that the clutch fork travel is 0.12"–0.16" (3–4 mm).

The clutch pedal play should be 5 1/2" (140 mm) and is adjusted with the nut (1, Fig. 2-2).

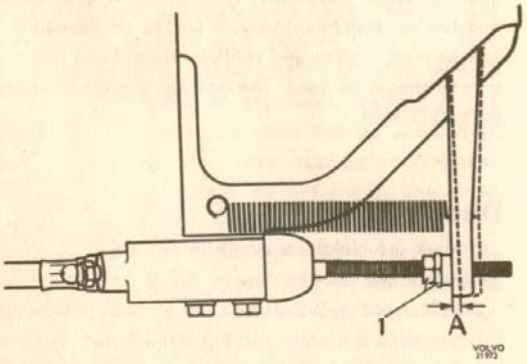


Fig. 2-1. Clutch fork travel

1. Adjusting nut A. 0.12" (3–4 mm)

CLUTCH

1. Remove the transmission. Follow the instructions given in Part 3.
2. Disconnect the return spring (34, Illustration II) at the release fork (33). Remove the bolt for the control cylinder (41). Tie up the cylinder to the body. Remove the plate from the lower front part of the flywheel housing (46). Remove the bolts and take off the flywheel housing.

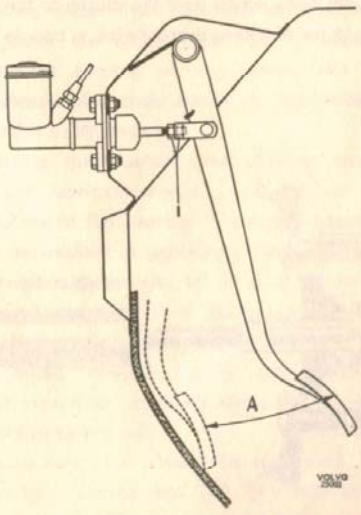


Fig. 2-2. Clutch pedal play

1. Adjusting nut A. 5 1/2" (140 mm)

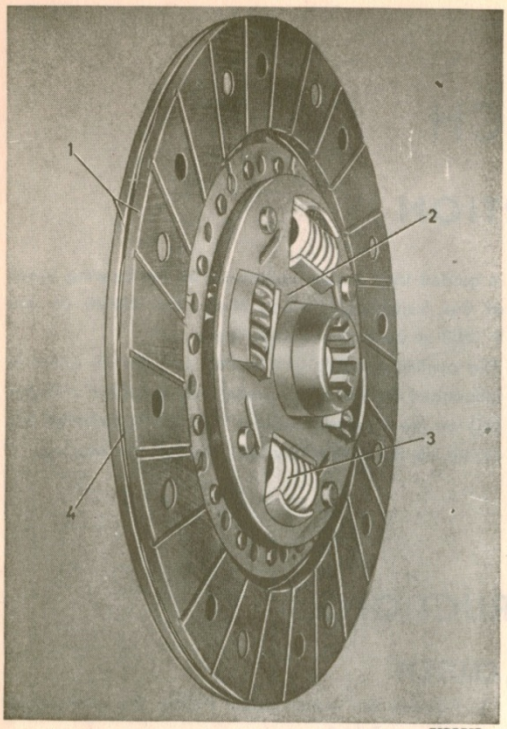


Fig. 2-3. Clutch plate

1. Facing 2. Hub 3. Spring 4. Disk

3. Remove the release bearing (25). Unscrew the bolt which holds the ball joint for the release fork. Remove the ball and fork.
4. The six bolts which hold the clutch to the flywheel should be slackened crosswise a couple of turns at a time to prevent breakage and should then be removed. Hold up the clutch so that it does not fall to the floor. Lift off the clutch and clutch plate (23).

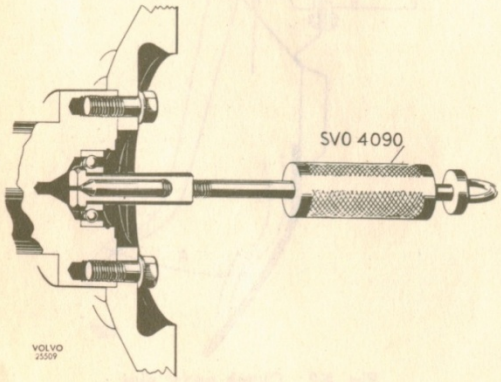


Fig. 2-4. Removing guide bearing

Replacing the clutch facings

1. Drill out the old rivets with a drill having the same diameter as the rivets, 9/64″ (3.5 mm) and remove the old facings.
2. Check the clutch plate. The indentations should be even. The clutch plate must not be warped. The springs and rivets in the hub should fit securely and not show any signs of looseness. The plate should slide easily on the main drive pinion without any play. Check to see that there are no cracks. If any of these defects are found the clutch plate should be replaced with a new one.
3. Rivet on the new facings (preferably in a rivet press). Note. The rivets should be inserted from the side on which the facing lies and riveted from the opposite direction against the disk. Use every other hole in the facing. After riveting, the facings should be spaced from each other as determined by the indentations in the disk. See Fig. 2-3. This is most important in order to achieve a smooth engagement when starting and driving.
   The clutch facings must be absolutely free from oil. Oil on the facings can cause the clutch to chatter or grab.

Input shaft guide bearing in the flywheel

The bearing is pulled out with puller SVO 4090 after the locking ring has been removed. See Fig. 2-4.
The bearing should be cleaned in gasoline. If the bearing, upon inspection, runs smoothly and evenly and has no significant play, it should be packed with ball bearing grease and refitted. Note. Heat-resistant grease should be used. The bearing is pressed in with drift SVO 1426.

Disassembling

1. Mark the clutch as shown in Fig. 2-5.
2. Place the packing blocks No. 0 on fixture SVO 2322, see Fig. 2-6. Place on the clutch, the 3-point supports, the arms and the three thrust rods, see Fig. 2-7. Place on the wrench and press down the clutch until the housing contacts the bottom plate.

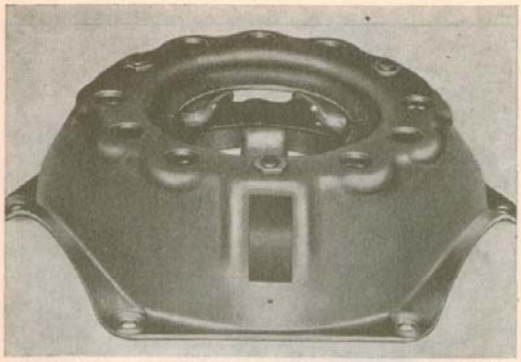


Fig. 2-5. Marking of clutch cover and pressure plate

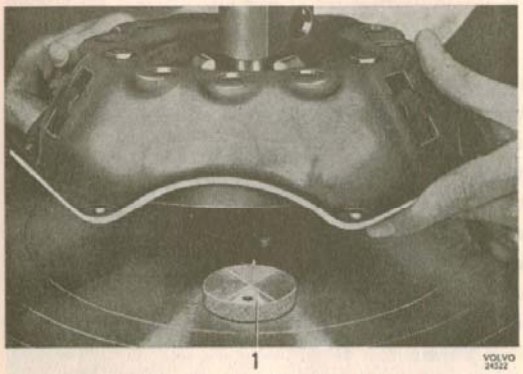


Fig. 2-6. Placing clutch in fixture, I

1. Packing block No. 0

3. Screw off the three adjusting nuts for the clutch release levers (31).
4. Screw up the wrench and remove the arms and thrust rods. Remove the clutch cover casing (21).
5. Remove the levers as shown in Fig. 2-8.

Inspection

Examine the pressure plate for warping. The pressure plate should be laid on a surface table and then tested with a feeler gauge 0.006″ (0.15 mm) thick. If this can be inserted at any point, warping is too great. The pressure plate must not be cracked or have a scored surface. There must be no scratches or other damage caused by the rivets. The same applies to the surface on the flywheel.

If the surfaces are blued or only lightly scored they can be reconditioned by grinding in a lathe with a saddle-mounted grinding machine, see Fig. 2-9. When carrying out this operation, not more than 0.03″ (0.75 mm) of material may be ground away. If the damage is deeper, the parts should be replaced.

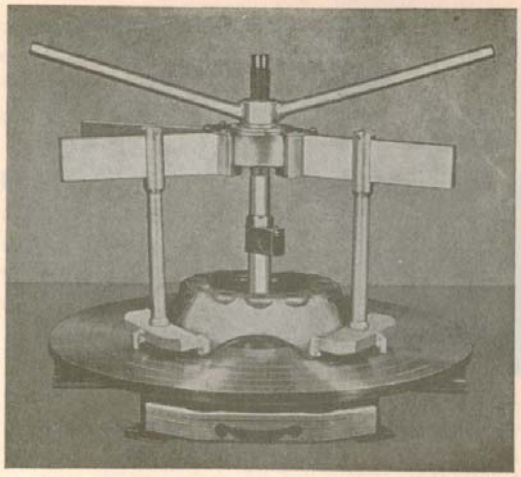


Fig. 2-7. Placing the clutch in the fixture, II

Fig. 2-8. Removing the levers

The pressure springs should have the prescribed length both loaded and unloaded, see the specifications.

The release bearing is checked by turning it round a few times under light pressure so that the balls rotate against the races. The bearing should turn easily without binding at any point. The release bearing should also slide easily on the guide extension from the transmission.

Note. During manufacture the release bearing is packed with lubricant which is intended to last the whole lifetime of the bearing. The bearing must therefore not be washed in gasoline or any other solvent, neither must it be warmed up to such an extent that the lubricant can run out. If the bearing is damaged or worn, it must be replaced by a new one. If it has become blued through having run round during driving, it should be replaced since the lubricant will have melted and run out.

The release fork joint should be examined. The ball must not be worn or dry. The ball cup should be intact and the locking ring securely in position so that the fork cannot jump off the ball. Replace all

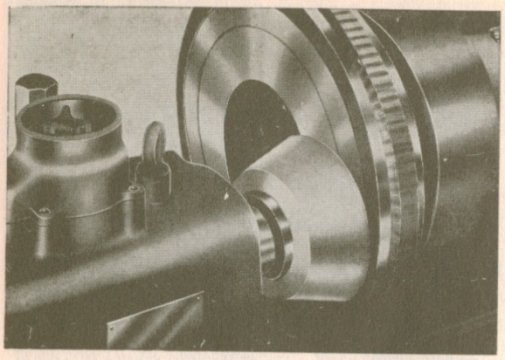


Fig. 2-9. Grinding the flywheel

parts which are worn or damaged. Lubricate the ball joint with grease when assembling.

Examine the clutch plate in accordance with point 2 under "Replacing the clutch facings".

Assembling

1. Place the pressure plate (22) on packing blocks no. 0 in fixture SVO 2322.
2. Lubricate the contact surfaces of the clutch levers (31) with oil. Lubricate sparingly so that no oil can run down into the clutch plate after fitting.
3. Fit the clutch levers as shown in Fig. 2-8.
4. Place the six pressure springs (24) in position. (The springs should be arranged so that black ones and unpainted ones come alternately on early prod. clutches. Late prod. clutches have only unpainted springs.)
5. Ensure that the three springs (1, Fig. 2-10) for the clutch levers are in position and place the clutch cover casing (21) over the six pressure springs in the position previously marked, Fig. 2-5.
6. Place on the 3-point support, arms, thrust rods and wrench. Press down the clutch cover casing until it contacts the bottom plate all round. Place the adjusting nuts on the eyebolts (32) and screw them on to full nut width. The clutch is now ready for adjusting.

Adjusting the clutch levers

This adjustment is carried out in fixture SVO 2322 with the help of the measuring gauge kept in the compartment. Fit the gauge and arm in the attachment on the spindle and set the gauge to measurement 41,5 (adjusting surface at upper edge of arm). The foot of the measuring gauge is ground with

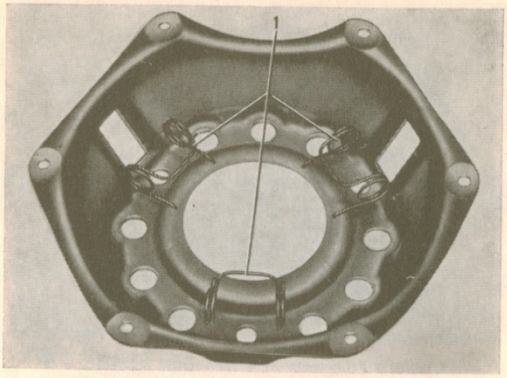


Fig. 2-10. Fitting the springs

1. Springs for clutch levers

tolerance positions corresponding to the mutual tolerance between the levers, see Fig. 2-11, and a side surface which is set parallel with the lever. Set the clutch lever to a height level with the maximum tolerance surface, see Fig. 2-12. The minimum tolerance surface must not then pass the edge of the clutch lever. Swing the arm when moving the measuring gauge over the clutch levers, see Fig. 2-13. After adjusting, carry out a further check on all the levers. Remove the measuring gauge and arm before releasing the clutch.

After all three levers have been adjusted, carry out a further check on all of them together. Then secure the adjusting nuts by means of center punch marks, see Fig. 2-14.

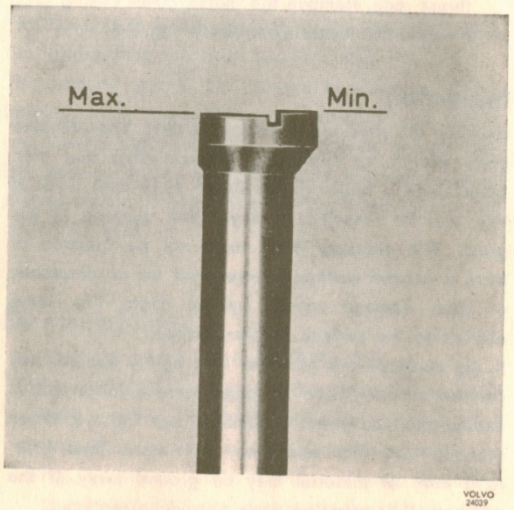


Fig. 2-11. Measuring gauge with tolerance positions

Dial indicating the flywheel

When checking to see that the flywheel is not warped, a dial indicator gauge is applied with the help of a magnetic attachment on the cylinder block. The measuring point of the indicator is directed onto the face of the flywheel near the outer diameter. The crankshaft is rotated and the variations read off. Maximum permissible warp is 0.008″ (0.20 mm).

Dial indicating the flywheel housing

The flywheel housing is measured with a dial indicator gauge applied to the flywheel by means of a magnetic attachment.

Measurement is carried out partly to check that the face of the housing attached to the transmission is at right-angles to the crankshaft with a permissible deviation of max. 0.002″ (0.05 mm) per 4″ (100 mm) diameter and partly that the hole is concentric with the axis of rotation of the crankshaft with a max. permissible deviation of 0.006″ (0.15 mm).

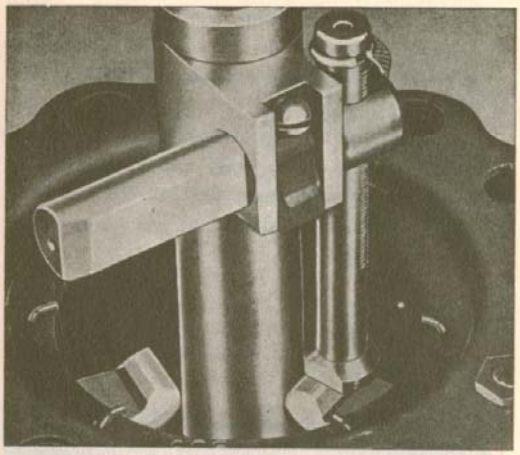


Fig. 2-12. Adjusting the clutch levers

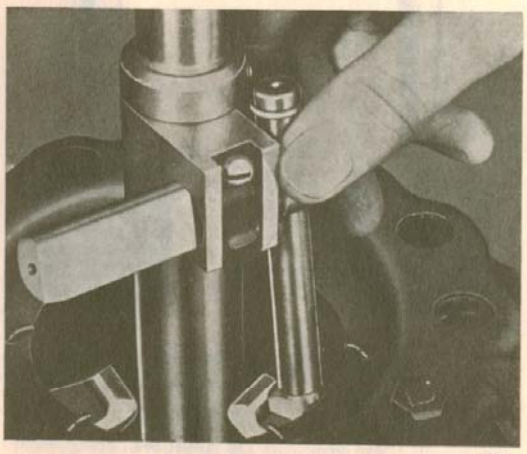


Fig. 2-13. Moving the measuring gauge

Fitting

Check before fitting that the clutch facings, flywheel and pressure plate are completely free from oil. Wash them with clean gasoline and dry off well with a clean piece of material.

1. Set up the clutch plate (23) (the highest side of the hub facing backwards) together with the clutch and insert the centering mandrel SVO 2484 so that the guide projection on this enters the guide bearing in the flywheel.
2. Place in the six bolts which retain the clutch and tighten them crosswise a couple of turns at a time. Remove the centering mandrel.
3. Fit the release fork (33) in the flywheel housing (46) and secure the joint ball with the bolt.
4. Fit the flywheel housing and release bearing (25).
5. Fit the control cylinder (41) and hook on the return spring (34).
6. Fit the transmission in accordance with the instructions given in Part 3.
7. Bolt the plate onto the lower front part of the flywheel housing.

CLUTCH CONTROL

Master cylinder

Removing

Remove the pipe (10, Illustration II) from the master cylinder (9). Remove the pedal bolt. Unscrew the bolts and lift off the cylinder.

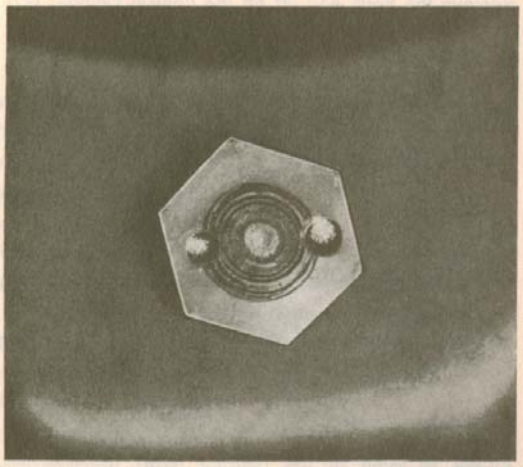


Fig. 2-14. Locking the adjusting nuts

Disassembling

1. Remove the cover and empty out the brake fluid.
2. Take off the rubber cover (16) and remove the locking ring (15). Take out the plunger (12) and the other parts from the cylinder.
3. Remove the retainer (3) for the non-return valve (8) from the plunger and separate the parts.

Inspection

Wash all parts in clean spirit and then check them for wear or other damage.
The cylinder must be carefully examined internally. There must be no grooves or scratches on the polished surface. Small scratches can be cleaned up with very fine emery cloth.

Assembling

1. Fit the packings on the plunger (12). Fit together the non-return valve (8), retainer (3), spring (5) and plunger.
2. Dip the plunger and non-return valve in brake fluid and fit them in the cylinders. Fit the thrust rod (17), washer (14) and locking ring (15). Place on the rubber cover (16).

Fitting

Fitting is done in the reverse order to removing. Fill up with brake fluid and bleed the system.

Control cylinder

Removing

Remove the pipe (10) from the hose (40). Remove the hose from the retainer. Unhook the return spring (34). Remove the bolts and lift off the control cylinder (41).

Disassembling

Remove the dust cover (38) and thrust rod (37). Remove the locking ring (39) and take out the plunger (45) and spring (42).

Assembling

Dip the plunger (45) and packing (44) in brake fluid and fit the packing on the plunger. Fit the spring (42) and plunger in the cylinder (41).
Fit the locking ring (39), thrust rod (37) and dust cover (38).

Fitting

Fitting is done in the reverse order to removing. Bleed the system and adjust the clutch travel.

Bleeding the hydraulic system

Check that the container is filled with brake fluid. Remove the rubber cap on the bleeding valve (43) on the control cylinder (41). Place a hose on the valve and immerse the other end of the hose in a container filled with brake fluid. Open the bleeding valve and depress the clutch pedal. Close the bleeding nipple while the pedal is fully depressed. Then release the pedal. Repeat this procedure until brake fluid free from air bubbles runs out. Fill the container with brake fluid up to the level mark (fluid level).

Renewing the pedal shaft

1. Remove the split pins and bolts in the pedals. Remove the return springs. Slacken the bolt and nut for the pedal shaft (8) Fig. 2-15. Remove the pedals (4, 9) and shaft.
2. Knock out the bushings (3) with a suitable drift. press in the new bushings.
3. Inspect the pedal shaft for wear. If it is abnormally worn, it should be replaced.
4. Lubricate the bushings in the pedal with a thin coating of ball bearing grease. Fit the spring and pedals on the pedal shaft and place them in position. Fit on the bolt and nut for the pedal shaft. Place in the pedal bolt and hook on the return spring.

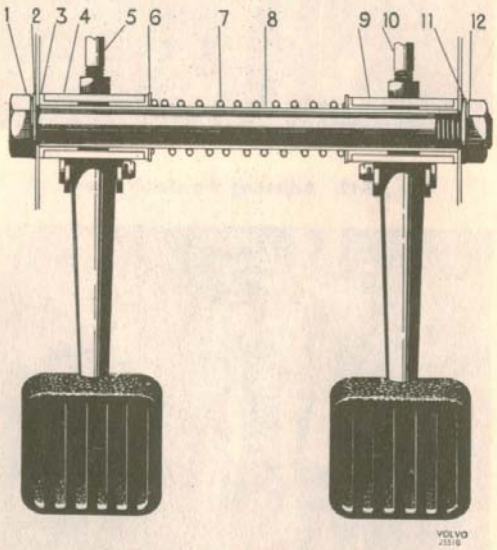


Fig. 2-15. Pedal shaft

1. Bolt
2. Waster
3. Nylon bushing
4. Clutch pedal
5. Thrust rod
6. Washer
7. Spring
8. Pedal shaft
9. Brake pedal
10. Thrust rod
11. Locking washer
12. Nut

FAULT TRACING

FAULT	
Reason	Remedy

The clutch grabs

Clutch wrongly adjusted.	Follow the instructions under "Adjusting the clutch levers" and "Adjusting the clutch release fork travel and clutch pedal play".
Clutch plate warped.	Fit new clutch plate.
Oil on the clutch facings, flywheel or pressure plate.	Replace the facings. Clean the flywheel and pressure plate with clean gasoline.
Clutch facings glazed on the surface.	Fit new clutch facings.
Clutch plate binds on the shaft.	Clean and lubricate the hub and shaft sparingly. File off any burr. (Replace the input shaft if necessary).
Surface of the pressure plate of flywheel is scratched, cracked or burnt.	Replace the pressure plate or flywheel (surfaces which are blued or only slightly scratched can be ground).
Engine loose in mountings.	Tighten the engine. Replace damaged engine mountings.
Clutch disk loose on the hub.	Fit new disk.
Clutch pedal binds.	Lubricate the pedal bushing.
Excessive play in the universal joint or rear axle gear.	Adjust or replace worn parts.

The clutch slips

Clutch wrongly adjusted.	Follow the instructions under "Adjusting the clutch release fork travel and clutch pedal play".
The clutch facings worn.	Fit new facings.
Clutch springs too weak or broken.	Check all the springs. Replace faulty springs with new ones.

The clutch does not disengage

Clutch wrongly adjusted.	Follow the instructions under "Adjusting the clutch release fork travel and clutch pedal play".
Faulty release bearing.	Fit new bearing.
Pressure plate cracked or warped.	Replace the pressure plate.
Clutch plate warped.	Fit new clutch plate.

Noisy clutch

Springs in the clutch plate hub broken or loose.	Replace clutch plate and facings.
Release bearing worn or dry.	Replace the bearing.
Bearing in the flywheel worn or not lubricated.	Replace or lubricate the bearing.
Clutch plate is loose at the hub.	Fit new clutch plate.
Broken clutch springs.	Replace the springs with new ones.

TOOLS

For carrying out repairs on the clutch the tools shown below (Fig. 2-17) are required together with clutch fixture SVO 2322. (Fig. 2-16).

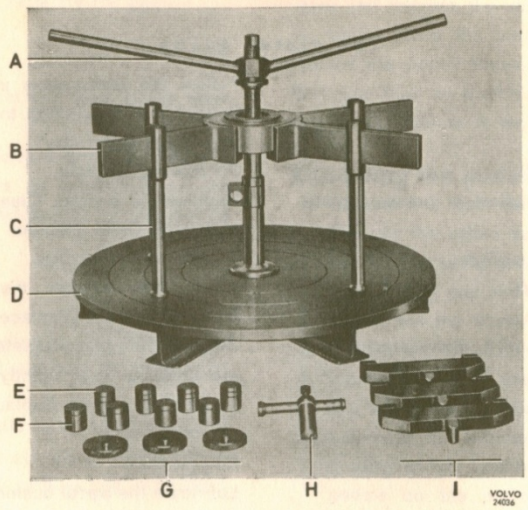


Fig. 2-16. Clutch fixture SVO 2322 with accessories

A. Wrench
B. Arm
C. Thrust rod
D. Bottom plate
E. Spacing block No. 2
F. Spacing block No. 1
G. Spacing block No. 0
H. Measuring gauge with holder
1. 3-point supports

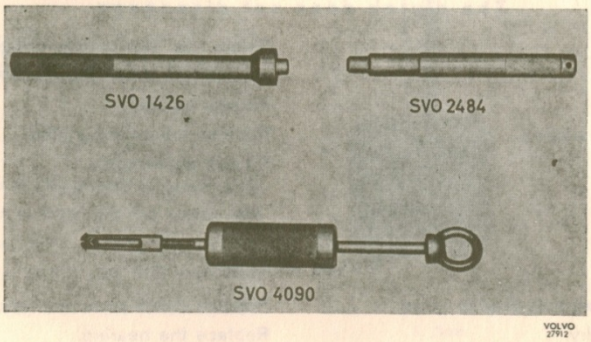


Fig. 2-17. Special tools

SVO 1426 Drift for support bearing in flywheel
SVO 2484 Mandrel for centering the clutch plate
SVO 4090 Puller for ball bearing in flywheel

SPECIFICATIONS

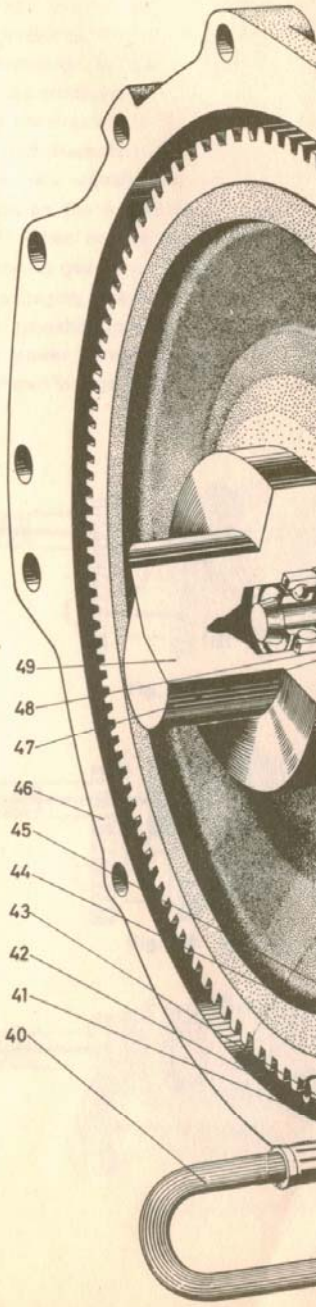
Clutch, type	Single dry plate
Size	8 1/2″ (215.9 mm)
Clutch friction surface, total	68.2 sq.in. (440 cm²)
Thickness of clutch plate when fitted	0.276–0.295″ (7.0–7.5 mm)
Clutch facing rivets:	
Number	16
Distance between the contact surface of the clutch levers for the release bearing and flywheel	1.8″ (46 mm)
Clutch springs:	
Early, prod.:	
Marking	Unpainted
Number	3
Length, loaded with 188–199 lb (85.5–90.5 kg)	1 1/2″ (38 mm)
Marking	Black
Number	3
Length, loaded with 224–235 lb (102–107 kg)	1 1/2″ (38 mm)
Late prod.:	
Marking	Unpainted
Number	6
Length, loaded with 188–199 lb (85.5–90.5 kg)	1 1/2″ (38 mm)
Adjustment of clutch levers:	
Setting 41.5 in clutch fixture SVO 2322, spacing block no. 0	
Clutch release fork travel	0.12″–0.16″ (3–4 mm)
Clutch pedal stroke	5 1/2″ (140 mm)

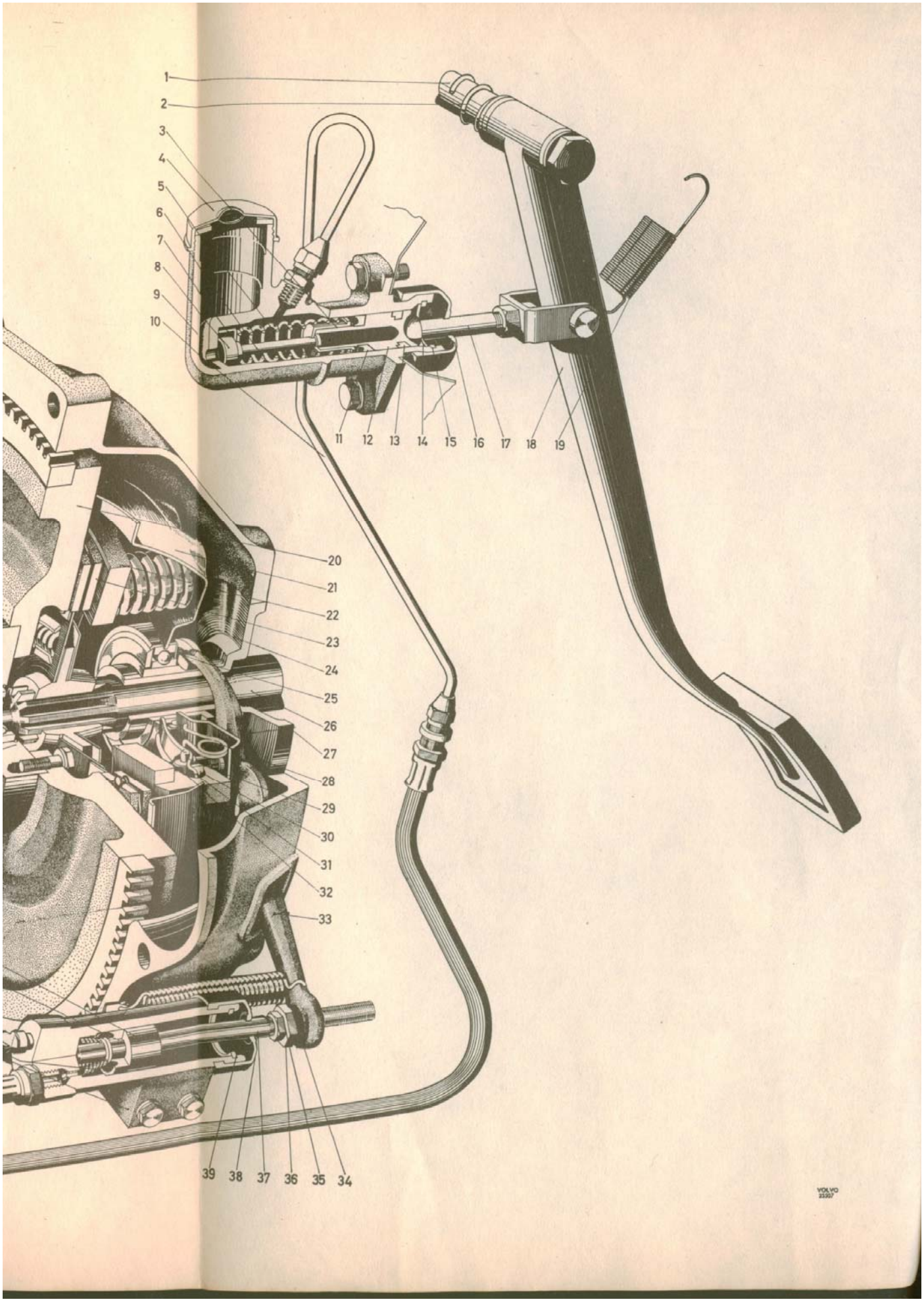
TIGHTENING TORQUES

	Lb.ft.	Kgm.
Nut on thrust rod, master cylinder	8–9	1.1–1.2
Bolt for joint ball	12–14	1.7–1.9

Illustration II. Clutch and clutch controls

1. Shaft
2. Spacing spring
3. Retainer
4. Cover
5. Spring
6. Thrust rod
7. Retainer
8. Non-return valve
9. Master cylinder
10. Pipe
11. Plunger packing
12. Plunger
13. Plunger packing
14. Washer
15. Locking ring
16. Rubber cover
17. Thrust rod
18. Pedal
19. Return spring
20. Flywheel
21. Clutch cover casing
22. Pressure plate
23. Clutch plate
24. Clutch spring
25. Clutch release bearing
26. Clutch disk shaft (input shaft, transmission)
27. Cover for clutch disk shaft
28. Spring
29. Shaft pin
30. Lip
31. Clutch release lever
32. Eyebolt
33. Clutch release fork
34. Return spring
35. Locknut
36. Adjusting nut
37. Thrust rod
38. Dust cover
39. Locking ring
40. Hose
41. Control cylinder
42. Spring
43. Bleeding nipple
44. Plunger packing
45. Plunger
46. Flywheel housing
47. Locking ring
48. Pilot bearing in crankshaft
49. Crankshaft

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PART 3 A

TRANSMISSION

DESCRIPTION

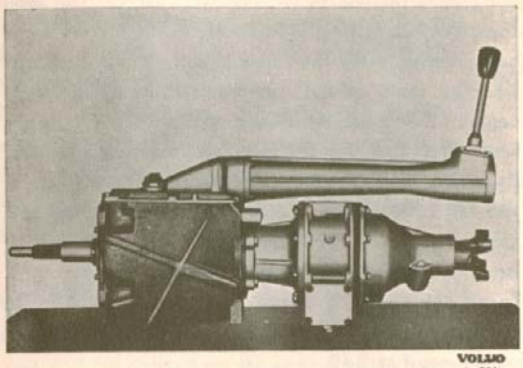


Fig. 3-1. Transmission (M 41), external view

The M 40 transmission (with overdrive = M 41) for the P 1800 is a four-speed transmission with all four speeds synchronised. It can also be provided with an overdrive connected to the fourth speed of the transmission so that a total of five forward speeds can be obtained.

The construction of the transmission is shown in Fig. 3-1 and illustration III-A. All gears except the reverse gears are spirally cut and in constant mesh. The gears on the mainshaft are carried on needle bearings. When one of the gears is engaged the corresponding gear is locked to the mainshaft by means of an engaging sleeve.

The gearshift lever positions are shown in Fig. 3-2. The power transmission path of the different speeds is shown in Figs. 3-3–3-7.

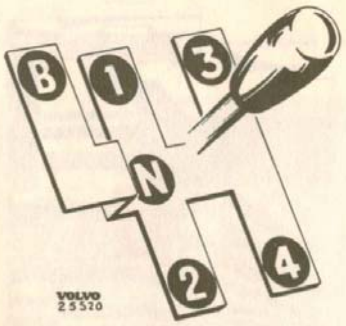


Fig. 3-2. Position of gears

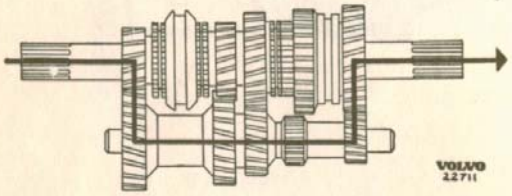


Fig. 3-3. 1st speed.

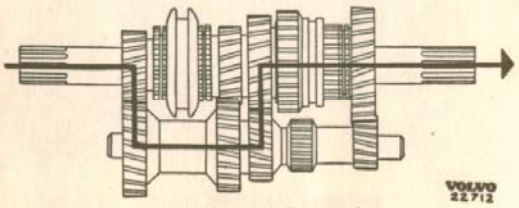


Fig. 3-4. 2nd speed

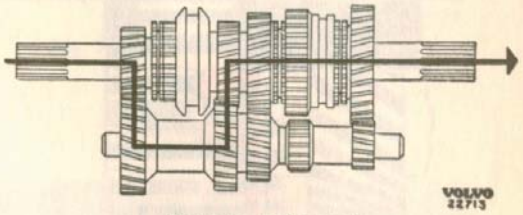


Fig. 3-5. 3rd speed

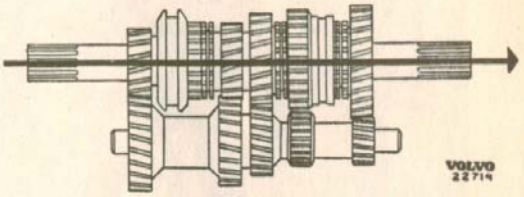


Fig. 3-6. 4th speed

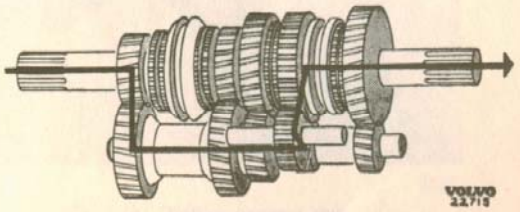


Fig. 3-7. Reverse

Fig. 3-8. Neutral position

1. Ring gear
2. Synchronizing cone
3. Engaging sleeve
4. Actuator
5. Synchronizing hub
6. Spring

The design and function of the synchronizing mechanism is shown in Figs. 3-8–3-10. When a gear is engaged, the engaging sleeve (3, Fig. 3-8) is pressed by the shift fork in the direction of the gear wheel concerned. The actuators (4) then press the synchronizing cone (2) against the cone on the ring gear (1). If the synchronizing mechanism and gear wheel have different speeds of rotation, the synchronizing cone will turn in relation to the engaging sleeve. The synchronizing cone is prevented by the actuators from being turned more than half a tooth width, see Fig. 3-9. The teeth of the synchronizing cone will then contact the engaging sleeve teeth at half a tooth width and thus prevent meshing from taking place. By means of friction between the synchronizing cone and the cone on the gear wheel, the gear wheel will assume the same speed of rotation as the synchronizing mechanism. When they have reached the same speed, the engaging sleeve causes the synchronizing cone to turn backwards and the gear can be engaged, see Fig. 3-10.

Fig. 3-9. Synchronizing

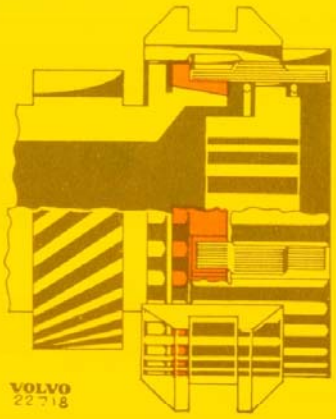


Fig. 3-10. Gear engaged

WORK WHICH CAN BE DONE WITH TRANSMISSION IN POSITION

Replacing sealing ring

1. Carry out points 1–4 under the heading "Removing" as far as necessary.
2. Unscrew the nut for the coupling (19, illustration III-A). Use key SVO 2409 as counterhold, see Fig. 3-11. Pull off the coupling with puller SVO 2262, see Fig. 3-12.
3. Pull out the old sealing ring (18) with puller SVO 4030, Fig. 1-13. Fit the new sealing ring with the help of drift SVO 2413, Fig. 3-14.
4. Press on the coupling with tool SVO 2304. Fig. 3-15. Fit the other parts.

REMOVING

1. Drain off the coolant. Slacken the upper radiator hose and the hoses from the engine to the heater. Remove the throttle control shaft and exhaust pipe at the exhaust manifold flange. Disconnect the battery cable.
2. Remove the rubber protector and gearshift lever.

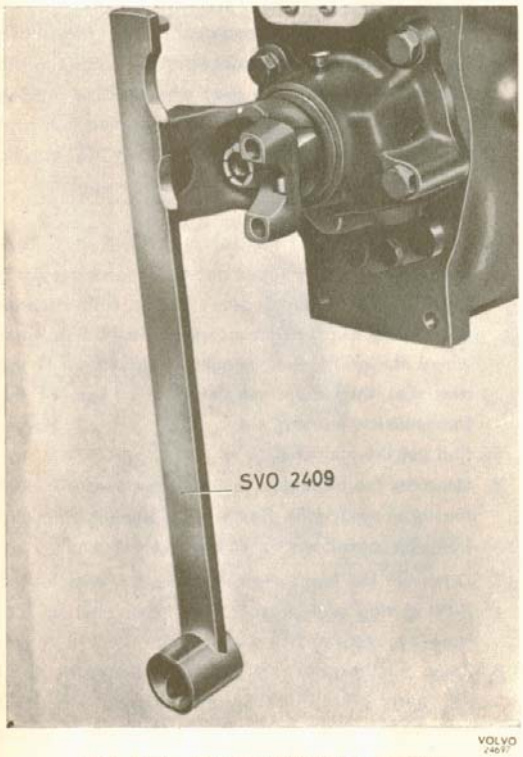


Fig. 3-11. Counterhold for coupling

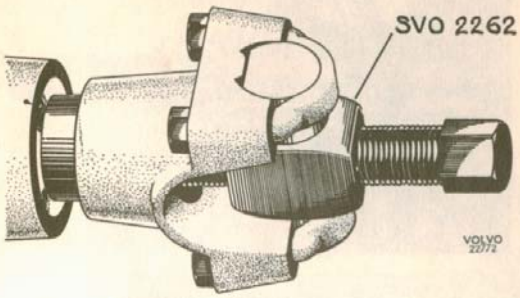


Fig. 3-12. Removing coupling

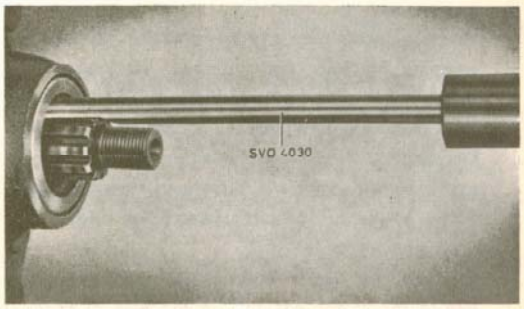


Fig. 3-13. Removing sealing ring

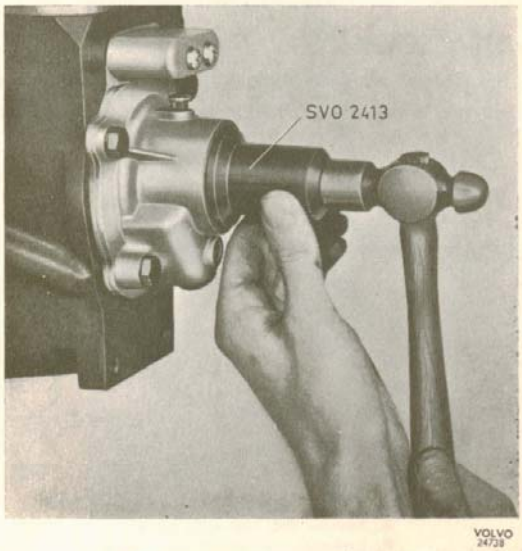


Fig. 3-14. Fitting sealing ring

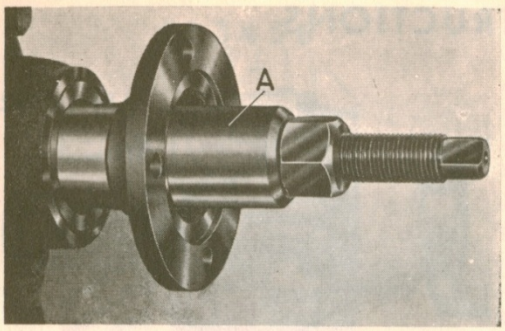


Fig. 3-15. Fitting coupling

3. Jack up the car and block up underneath. Drain the oil from the transmission. Remove the exhaust pipe from the attaching plate on the clutch casing.
4. Place a jack under the transmission to take the weight. Slacken and remove the supporting member beneath the transmission. Disconnect the front universal joint from the transmission coupling. Disconnect the speedometer cable. Disconnect any cables for the overdrive and reversing light. Place a wooden block between the engine and cowl and lower the jack.
5. Slacken the upper bolts which hold the gearbox to the clutch casing with the help of spanner SVO 2487 (3/8″ recessed hexagon) or SVO 2488 (8 mm recessed hexagon), see A, Fig. 3-16 and ball joint SVO 2427. Slacken the lower bolts with a standard hexagon spanner, preferably an extra long one. Pull out the gearbox to the rear.

DISASSEMBLING

The instructions given below apply for transmissions without overdrive. If the transmission is provided

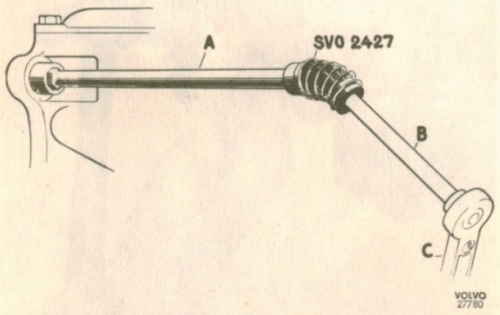


Fig. 3-16. Removing the upper gearbox bolts.

A. Spanner SVO 2487 or SVO 2488
B. Extension rod with 3/8″ square end
C. Ratchet handle

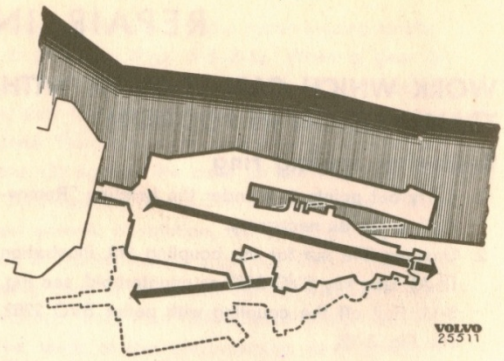


Fig. 3-17. Removing the transmission

with an overdrive, unscrew the bolts which hold the overdrive to the intermediate flange and then remove the overdrive. After this the instructions below apply with one or two small differences.

1. Fit together SVO 4109 and fixture SVO 2044 in a vice. Place the transmission in the fixture.
2. Slacken the bolts for the transmission cover (35, illustration III-A) and lift off the cover. Remove the springs (56) and interlock balls (57) for the shift rails.
3. Remove the casing (13) over the shift rails. Slacken the shift fork bolts. Move the shift fork (37) back to 1st speed position. Drive out the pin slightly (it must not foul 1st speed gear wheel). Then move the shift fork forward sufficiently to allow the pin to pass in front of the gear wheel. Drive out the pin. Slide out the shift rails. When doing this hold against the shift forks so that they do not lie obliquely and distort the rails. Remove the shift forks.
4. Unscrew the bolts for the rear cover (17). Turn the cover so that is does not lock the shafts (2, 5) for the intermediate gear wheels and reverse gear wheel (4, 6). Drive out the intermediate gear wheel shaft. The shaft should be driven out to the rear. Let the wheel fall into the bottom of the transmission housing.
5. Pull out the mainshaft.
6. Unscrew the bolts and remove the cover (67) over the input shaft (68). Remove the sealing ring (66) from the cover with a screwdriver or similar.
7. Drive out the input shaft. If necessary remove the locking ring and press off the ball bearing (64) from the input shaft.
8. Take out the idler gear wheel. Pull out the shaft (5) (early prod.) for the reverse gear wheel (6) with puller SVO 2301, Fig. 3-18. Take out the reverse gear wheel and lever (8).

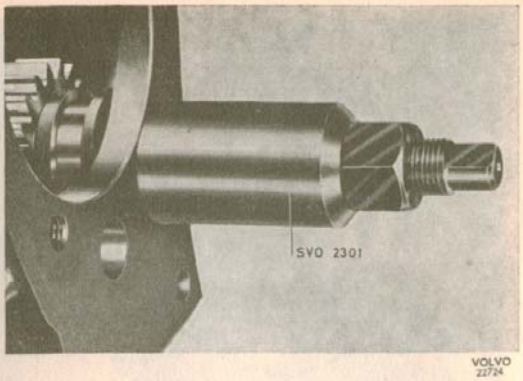


Fig. 3-18. Removing reverse shaft

9. On a reverse shaft with a turned groove (late production), puller SVO 2301 must be modified before use by providing the tongue on the spindle with a groove as shown in Fig. 3-19.

DISASSEMBLING MAINSHAFT

1A. Transmission without overdrive:
Unscrew the nut for the coupling. Use tool SVO 2409 as a counterhold on the coupling. Move the engaging sleeve (41) for 1st and 2nd speeds forwards. Place the shaft in a press and support under 1st speed gear wheel (10). Press out the shaft with a drift, Fig. 3-20.

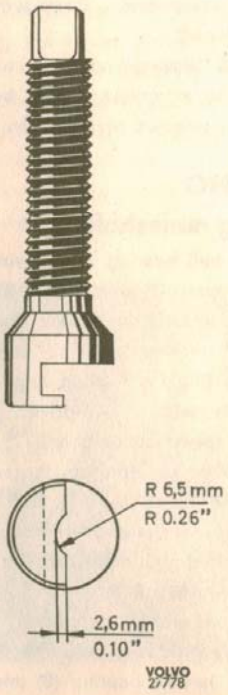


Fig. 3-19. Modifing puller SVO 2301

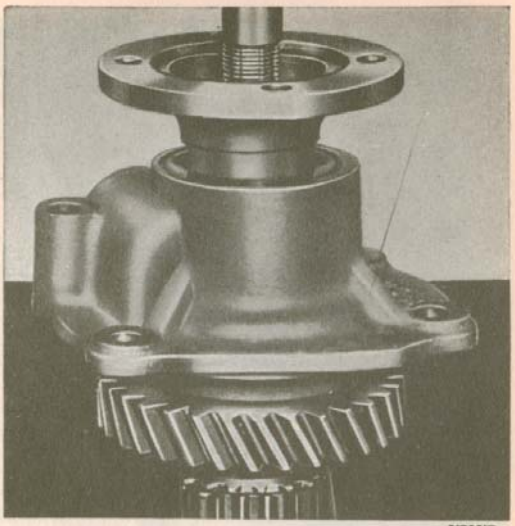


Fig. 3-20. Disassembling mainshaft, I

1B. Transmission with overdrive:
Remove the locking ring and press off the cam for the overdrive oil pump. Remove the locking ring for the mainshaft rear bearing. Slide the engaging sleeve (41) for 1st and 2nd speeds forwards. Place the shaft in a press and support under 1st speed gear wheel (10). Press out shaft, see Fig. 3-21.

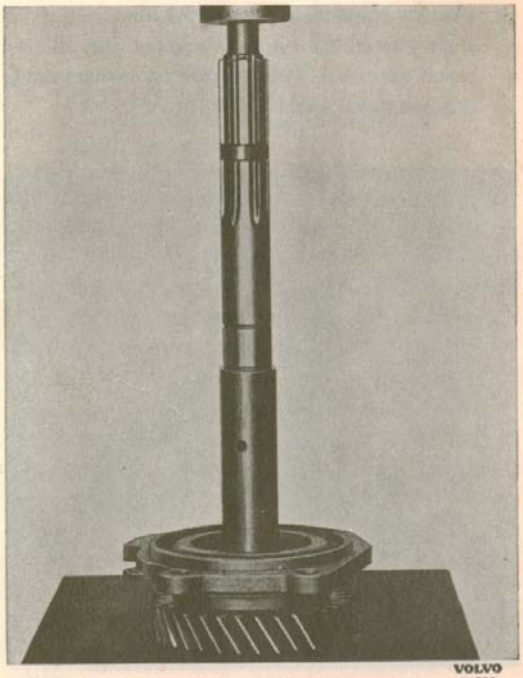


Fig. 3-21. Disassembling mainshaft, II

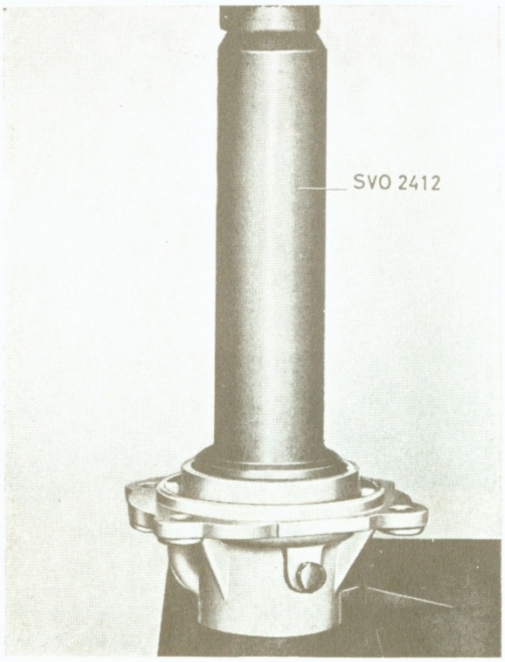


Fig. 3-22. Fitting ball bearing in rear cover

2. Remove the synchronizing cone, thrust washer, engaging sleeves, guides and springs from the shaft.
3. Remove the locking ring on the front end of the shaft. Pull off the synchronizing hub (53) and 3rd speed gear wheel (49). Remove the needle bearing (50) and thrust washer (48).

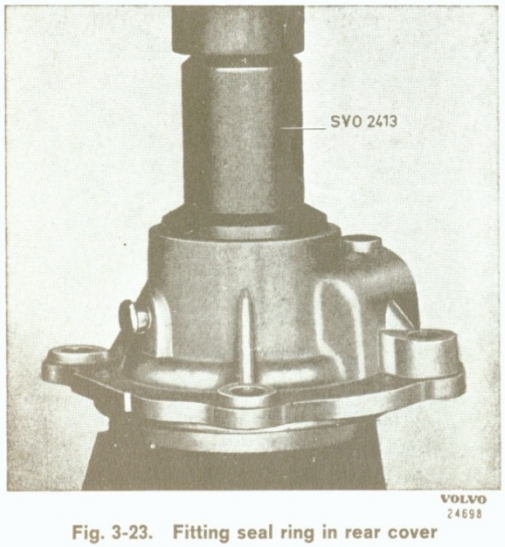


Fig. 3-23. Fitting seal ring in rear cover

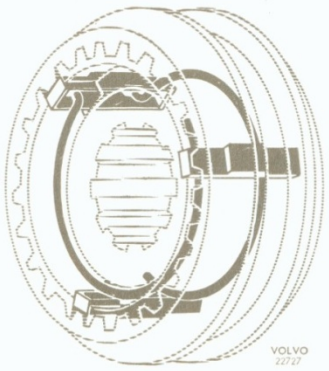


Fig. 3-24. Assembling synchronizing mechanism

4. Remove the locking ring (47) and then the thrust washer (46), 2nd speed gear wheel (45), needle bearing (44), synchronizing cone (42) and spring.
5. Remove the sealing ring (18) from the rear cover (17) and take out the speedometer gear (11). If necessary, remove the locking ring and press out the ball bearing (15).

INSPECTION

Check the gear wheels especially for cracks or chips in the teeth. Damaged or worn gears should be replaced.

Check the synchronizing cones and all the other synchronizing components. Damaged or worn parts should be replaced.

Check the ball bearings and needle bearings specially for scoring or cracks in the bearing races or on the balls or needles respectively.

ASSEMBLING

Assembling mainshaft

1. Press the ball bearing (15, illustration III-A) into the rear cover (17) with drift SVO 2412, Fig. 3-22 and fit the locking ring. There are different thicknesses of locking ring so select one which completely fills the locking ring groove.
2. Transmission without overdrive:
   Place the speedometer gear (11) on the bearing in the rear cover. Press in the sealing ring (18) with drift SVO 2413, see Fig. 3-23.
3. Fit the parts for 1st and 2nd speed synchronizing mechanism onto the mainshaft. Fit the spring rings correctly, see Fig. 3-24.

4A. Transmissions without overdrive:
   Fit the synchronizing cone for 1st speed gear wheel (10), needle bearing (9) and thrust washer (12). Place the rear cover on the shaft. Ensure

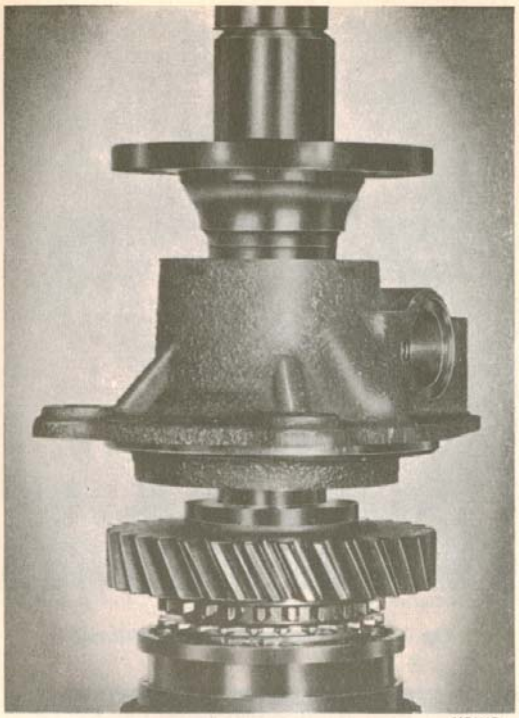


Fig. 3-25. Fitting rear cover

that the speedometer gear wheel is located correctly. Fit on the coupling (19). Use a sleeve which fits into the turned cavity in the coupling, press on the cover and coupling, see Fig. 3-25. Place on the washer and nuts for the coupling. Use tool SVO 2409 as a counterhold on the coupling and tighten the nut.

4B. Transmissions with overdrive:

Place the rear cover and ball bearing on a

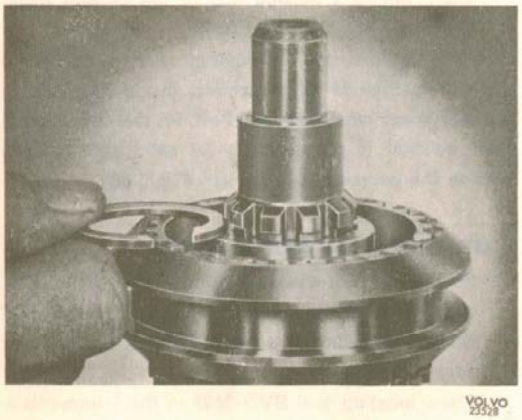


Fig. 3-26. Selecting a locking ring

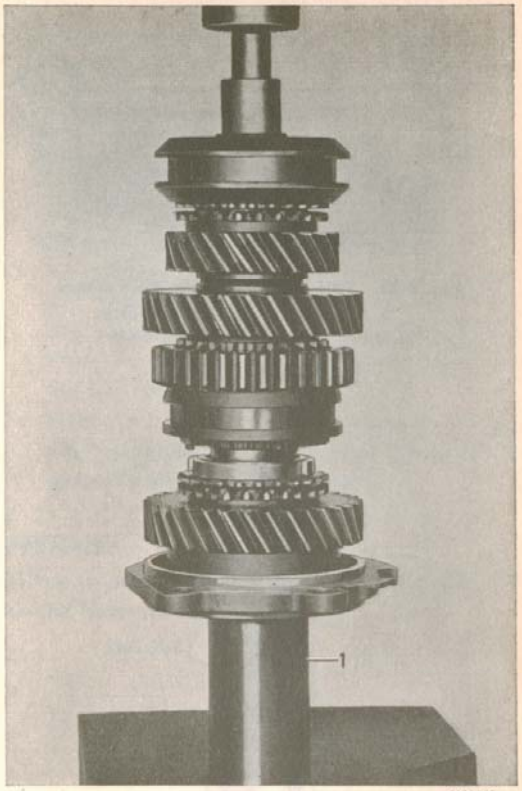


Fig. 3-27. Fitting rear cover, overdrive

1. Sleeve

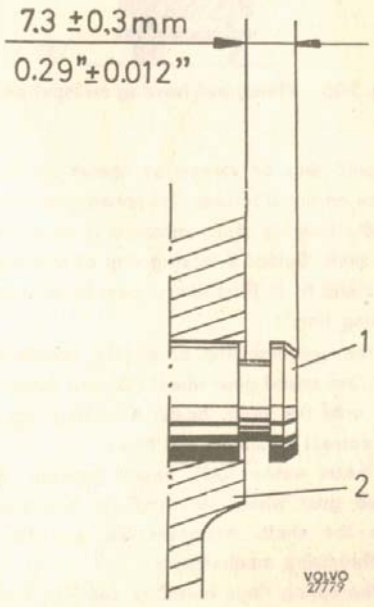


Fig. 3-28. Fitting the reverse shaft

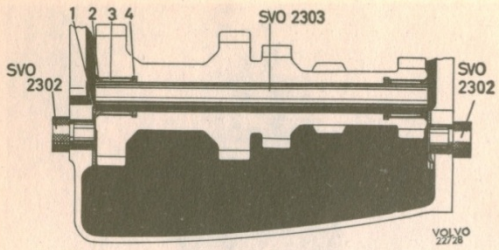


Fig. 3-29. Fitting intermediate gear wheel

1. Thrust washer
2. Spacing washer
3. Needle bearings
4. Spacing washer

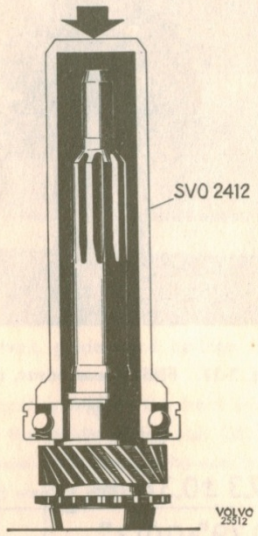


Fig. 3-30. Fitting ball bearing on input shaft

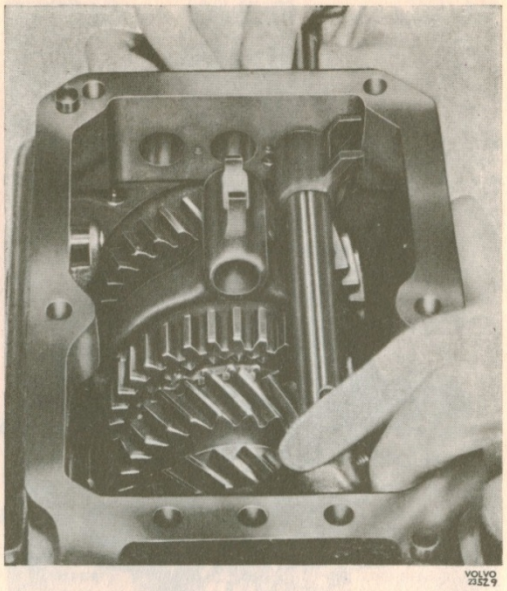


Fig. 3-31. Fitting the shift forks and rails

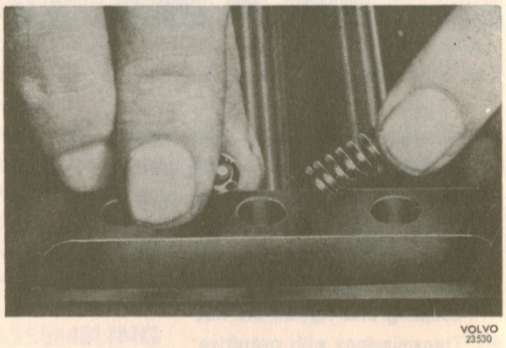


Fig. 3-32. Fitting interlock balls and springs

support ring or sleeve as shown in Fig. 3-27. Place on thrust washer, 1st speed gear wheel with needle bearing and sychronizing cone. Press in the shaft. Select a locking ring of suitable thickness and fit it. Fit the key, cam for oil pump and locking ring.

5. Fit the synchronizing cone (42), needle bearing (44), 2nd speed gear wheel (45) and thrust washer (46) onto the shaft. Select a locking ring (47) of the correct thickness and fit it.
6. Fit thrust washer (48), needle bearing (50), 3rd speed gear wheel (49) and synchronizing cone onto the shaft. Assemble 3rd and 4th speed synchronizing mechanisms.

   Fit the spring rings correctly, see Fig. 3-24. Then fit the synchronizing mechanism onto the mainshaft. Select a locking ring of the correct thickness, see Fig. 3-26, and fit it.

When fitting the late production reverse shaft into early production M 40 gearboxes, the locking tab on the rear cover must be ground off. Fit the new reverse shaft so that it projects 7.0–7.6 mm (0.276–0.300″) outside the gearbox housing, see Fig. 3-28.

Assembling the transmission

1. Fit the lever (8) and guide stud. Fit on the reverse gear wheel (6) and reverse shaft (5). Ensure that the groove in the reverse shaft (early prod.) faces correctly.
2. Place locating tool SVO 2303 in the intermediate gear wheel (4). Put in spacing washers (3, 69) and

needles (24 in each bearing). Use grease to hold the needles and washers in place.

3. Fix the washers (70) to the housing with grease and guide them into position with SVO 2302, see Fig. 3-29. Lay the intermediate gear in the bottom of the housing.
4. Press the bearing (64) onto the input shaft with the help of drift SVO 2412 see Fig. 3-30. Select a locking ring of suitable thickness and fit it. Place the 14 bearing rollers for the mainshaft in position on the input shaft. Use grease to keep the rollers in position. Press the input shaft into position in the housing. Press the sealing ring (66) into the cover (67) with drift SVO 2010. Then fit the cover over the input shaft.
5. Place the mainshaft in the housing. Turn the rear cover so that the countershaft can be fitted.
6. Turn the transmission upside down. Fit the countershaft (2) from the rear. Hold locating tool SVO 2303 with the hand. Ensure that the thrust washers do not fall down.

7A. Transmission without overdrive:
Turn the rear cover correctly so that it locks the reverse shaft. Fit the cover bolts.

7B. Transmission with overdrive:
Turn the rear cover correctly so that it locks the reverse shaft. Ensure that the cam for the overdrive oil pump faces upwards. Fit the intermediate flange and overdrive unit.

8. Fit shift rails and forks. Place both forks in position before fitting the rails, see Fig. 3-31. Move over the shift fork (37) to 1st speed position when fitting the pin. Use a new pin. Fit the cover over the shift rails.
9. Place the interlock balls and springs in position, Fig. 3-32. Fit the transmission cover. Check that all gears engage and disengage easily.

FITTING

Fitting is done in the reverse order to removing. Fill up the transmission with oil.

FAULT TRACING

FAULT	
Reason	Remedy
Gears difficult to engage	
Clutch does not release.	Adjust or repair the clutch. See Part 2.
Oil too thick.	Check that the correct oil is used.
Synchronizing device worn.	Replace the worn parts.
Bearing bushings or gear wheels worn.	Replace damaged or worn parts.
Shift rails or gear wheels bind.	Replace damaged or worn parts.
One of gears jumps out	
Worn bearings on shaft or gear wheels.	Fit new bearings or bushings.
Worn grooves in shift rails or weak springs.	Replace damaged or worn parts.
Badly worn gear wheels.	Replace the worn gear wheels.
Transmission fits obliquely on flywheel housing.	Check the flywheel housing with a dial indicator gauge and adjust if necessary (see Part 2). Clean the contact surfaces.
Support bearing in flywheel worn.	Replace the bearing.
Noise	
Oil level too low.	Fill up with the necessary quantity of oil.
Worn or damaged bearings on shafts and gear wheels.	Replace the bearings or bushings.
Badly worn gear wheels.	Replace the worn gear wheels.
Oil leakage	
Flange sealing surface worn.	Fit new flange and sealing ring.
Rear sealing ring and bearing worn.	Fit new bearing and new sealing ring.
Leakage between housing and rear cover.	Fit new paper gasket.
Leakage between housing and front bearing cover.	Fit new paper gasket. Clean out the return hole.
Front sealing ring worn.	Fit new sealing ring in the front bearing cover.
Leakage between housing and cover.	Fit new cork gasket.

TOOLS

The following special tools are required for carrying out repairs to the transmission.

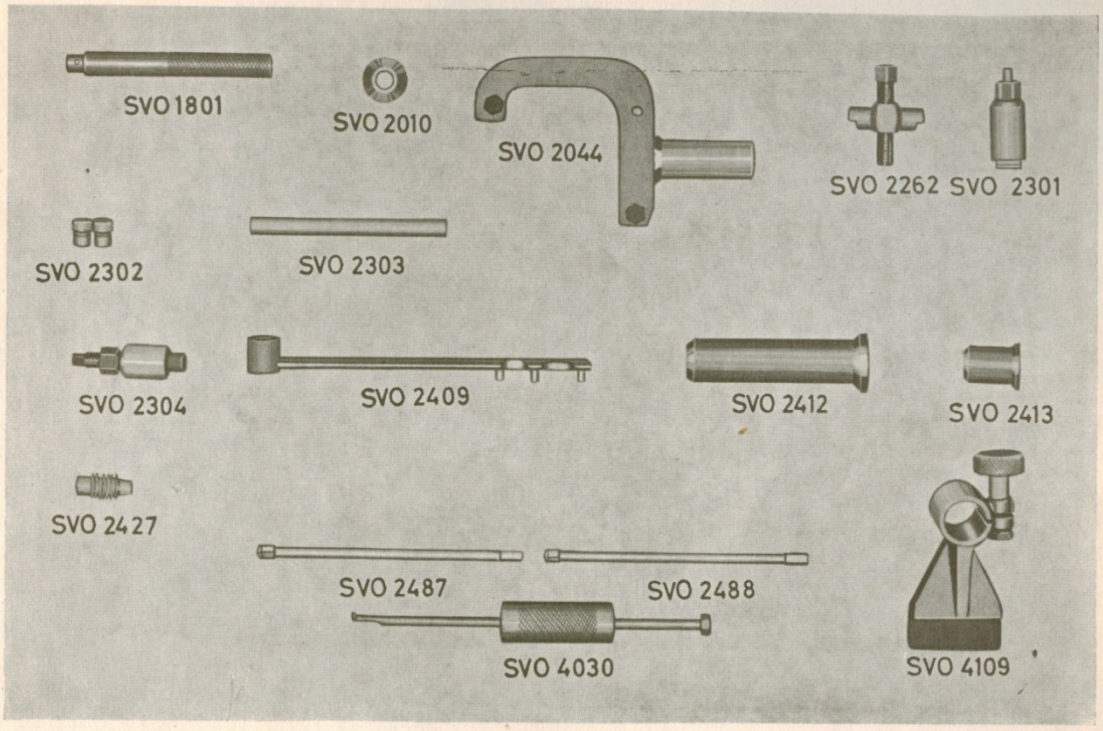


Fig. 3-33. Special tools

SVO 1801 Standard handle 18×200
SVO 2010 Fitting drift for sealing ring in input shaft cover
SVO 2044 Fixture for diassembling and assembling. Used together with SVO 4109
SVO 2262 Puller for coupling
SVO 2301 Puller for removing reverse shaft
SVO 2302 Drift for thrust washer. Used together with SVO 2303 when fitting intermediate gear wheel
SVO 2303 Drift for fitting intermediate gear wheel
SVO 2304 Press tool for fitting coupling
SVO 2409 Counterhold for coupling
SVO 2412 Fitting drift for bearings on input shaft and in rear cover
SVO 2413 Fitting drift for sealing ring in rear cover
SVO 2427 Ball joint for spanner SVO 2431
SVO 2487 3/8″ spanner for removing and fitting upper gearbox bolts.
SVO 2488 8 mm spanner for removing and fitting upper gearbox bolts. (Early production tools SVO 2431 and SVO 2432).
SVO 4030 Puller for sealing ring in rear cover
SVO 4109 Support for fixture SVO 2044

SPECIFICATIONS

Type designation	M 40
Gears ratios:	
1st speed	3.13: 1
2nd speed	1.99: 1
3rd speed	1.36: 1
4th speed	1: 1
Reverse	3.25: 1
Number of teeth on the different gears:	
Input shaft	19 teeth
Countershaft, drive gear	27 „
gear for 1st speed	15 „
gear for 2nd speed	20 „
gear for 3rd speed	23 „
gear for reverse	14 „
Mainshaft, gear for 1st speed	33 „
gear for 2nd speed	38 „
gear for 3rd speed	22 „
gear for reverse	32 „
Reverse gear	19 „
Lubricant, M 40 (without overdrive)	Transmission oil
viscosity	SAE 80
Oil capacity	1 1/2 US pints = 1 1/4 Imp. pints (0.75 liter)
Lubricant, M 41 (with overdrive)	Engine oil
viscosity	SAE 30
Oil capacity	3 3/4 US pints = 3 1/8 Imp. pints (1.8 liters)

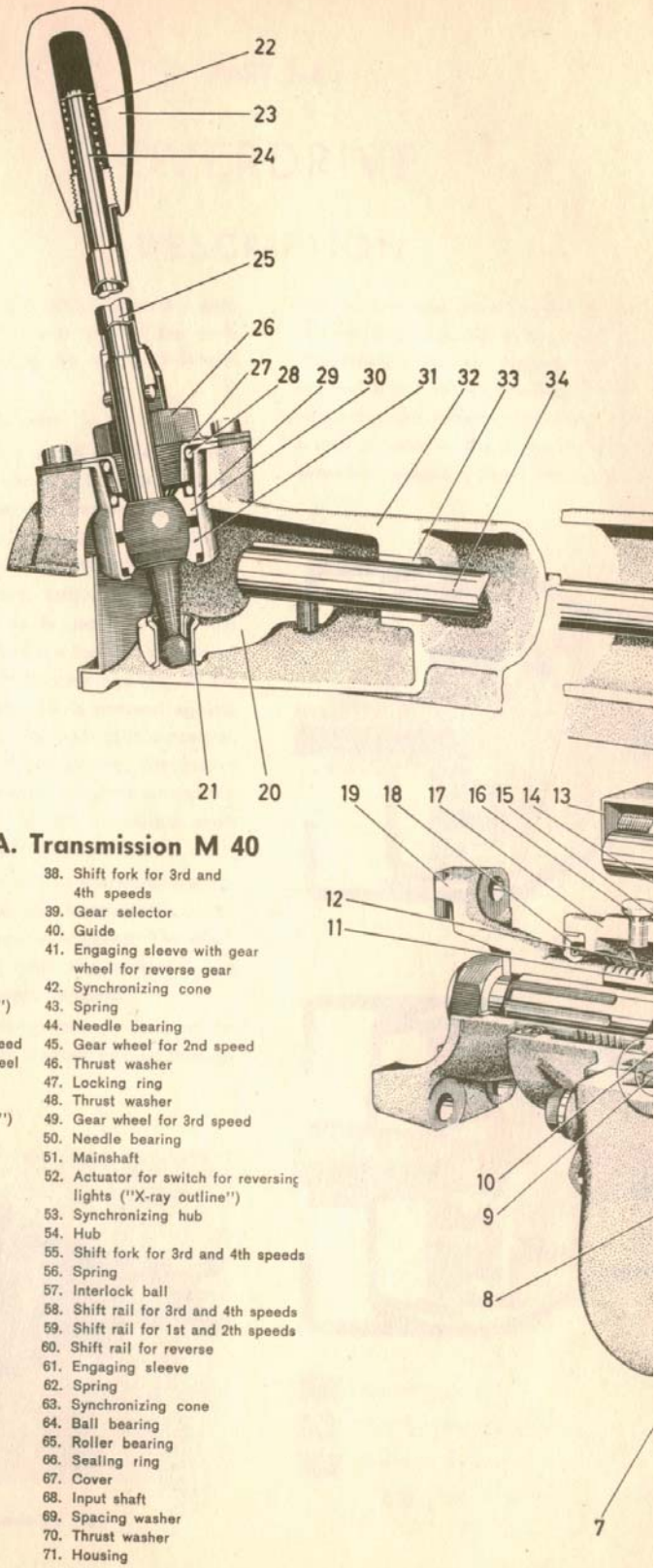
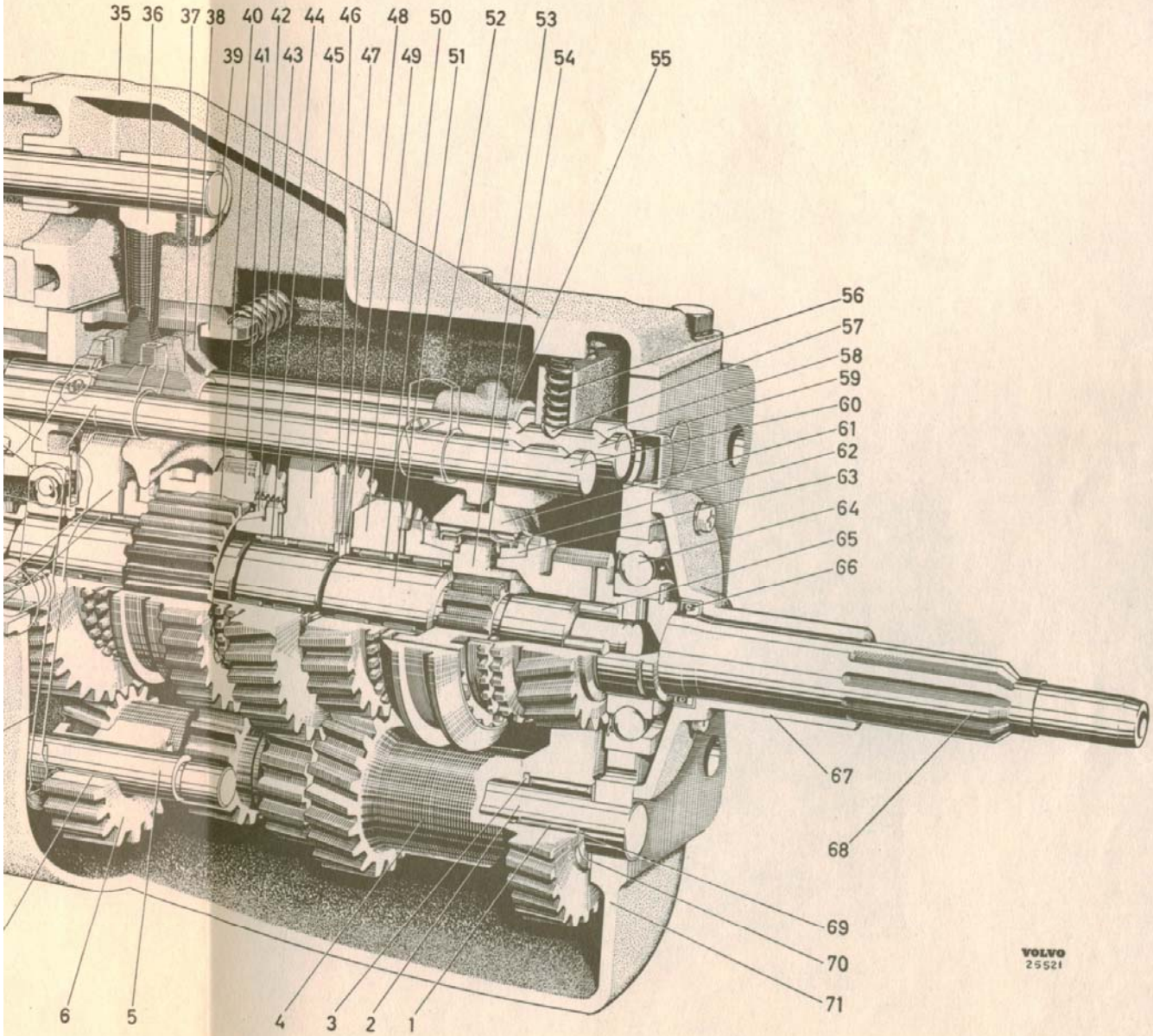


Illustration III-A. Transmission M 40

1. Needle bearing
2. Countershaft
3. Spacing washer
4. Intermediate gear
5. Reverse shaft
6. Reverse gear wheel
7. Bushing
8. Lever ("X-ray outline")
9. Needle bearing
10. Gear wheel for 1st speed
11. Speedometer gear wheel
12. Thrust washer
13. Casing
14. Guide ("X-ray outline")
15. Ball bearing
16. Air-venting nipple
17. Rear cover
18. Sealing ring
19. Coupling
20. Guide
21. Bushing
22. Spring
23. Gearshift lever knob
24. Gearshift lever
25. Sleeve
26. Reverse catch
27. Washer
28. Spring
29. Bearing retainer
30. Ball cup, upper
31. Ball cup, lower
32. Bearing sleeve
33. Bushing
34. Shaft
35. Cover
36. Gear shifter
37. Shift fork for 1st and 2nd speeds
38. Shift fork for 3rd and 4th speeds
39. Gear selector
40. Guide
41. Engaging sleeve with gear wheel for reverse gear
42. Synchronizing cone
43. Spring
44. Needle bearing
45. Gear wheel for 2nd speed
46. Thrust washer
47. Locking ring
48. Thrust washer
49. Gear wheel for 3rd speed
50. Needle bearing
51. Mainshaft
52. Actuator for switch for reversing lights ("X-ray outline")
53. Synchronizing hub
54. Hub
55. Shift fork for 3rd and 4th speeds
56. Spring
57. Interlock ball
58. Shift rail for 3rd and 4th speeds
59. Shift rail for 1st and 2th speeds
60. Shift rail for reverse
61. Engaging sleeve
62. Spring
63. Synchronizing cone
64. Ball bearing
65. Roller bearing
66. Sealing ring
67. Cover
68. Input shaft
69. Spacing washer
70. Thrust washer
71. Housing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PART 3-B

OVERDRIVE

DESCRIPTION

The overdrive on the P 1800 is of the planetary gear type and is attached to the rear end of the main transmission. The design is shown in Fig. 3-34 and illustration III-B.

The overdrive functions as follows:

In the direct gear position the clutch disk (41, illustration III-B) is in the position shown in I, Fig. 3-35. When driving forward, power from the transmission mainshaft (57) is transmitted through the free wheel (33, 34) to the overdrive output shaft (23). When reversing or using the engine as a brake, torque is transmitted through the clutch disk. This is possible since the clutch disk is pressed against the tapered portion of the output shaft by means of four springs (52). In the overdrive position the clutch disk is pressed against the brake drum (39), see II, Fig. 3-35. In this position the sun wheel is locked. When driving, the planet wheels (36) are therefore caused to rotate around the sun wheel (44). As a result of this the output shaft will rotate more quickly than the mainshaft.

Engagement of the overdrive is done electro-hydraulically. There is a contact on the transmission cover which cuts in when 4th speed is engaged. The overdrive can only be engaged when this contact is cut in, that is to say, with 4th speed engaged.

When engaging the overdrive a contact fitted on the instrument panel is operated. Current passes through this contact and goes via the contact on the transmission to a solenoid on the overdrive, see Fig. 3-36. The solenoid has two windings, a heavy control winding and a fine retaining winding. The control winding influences the solenoid armature in such a way that a control valve in the overdrive is opened. When the valve has opened, current through the control winding

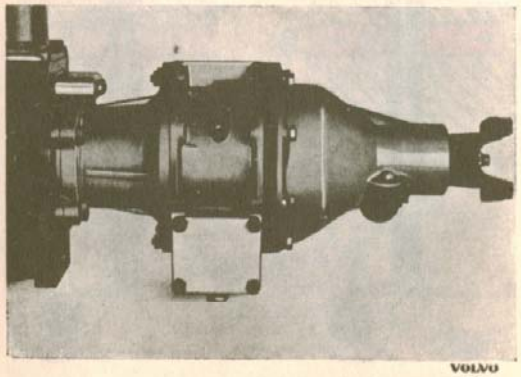


Fig. 3-34. Overdrive unit

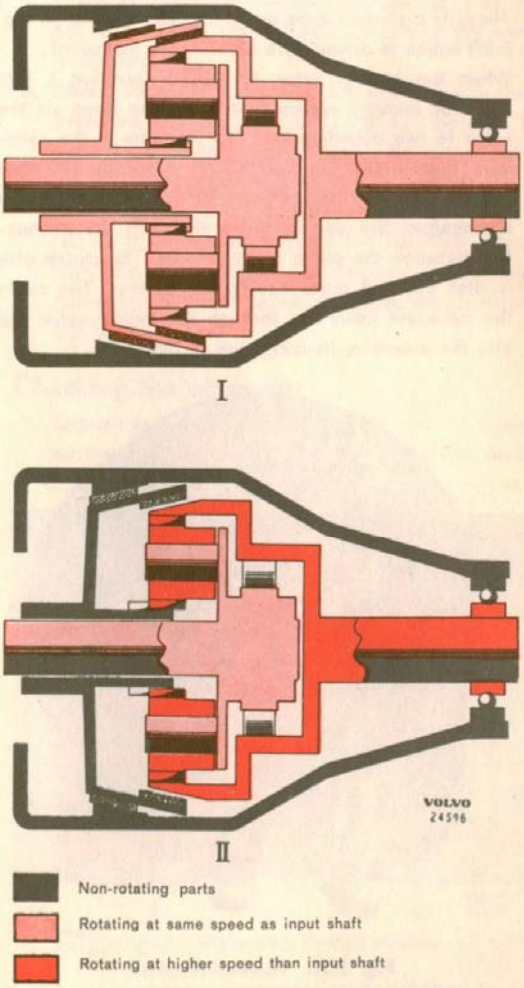


Fig. 3-35. Function of overdrive

I. Direct drive position II. Overdrive position

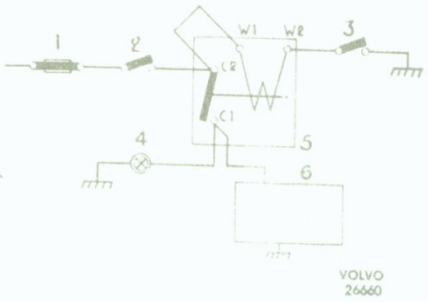


Fig. 3-36. Electrical wiring diagram

1. Fusebox
2. Switch on transmission
3. Switch on instrument panel
4. Control lamp for overdrive
5. Relay for overdrive
6. Solenoid on overdrive

Wire color on relay:
C_1. Yellow – purple
C_2. Yellow
W_1. Yellow
W_2. Yellow – green

is cut off. The valve is then held in the open position by the retaining winding.

There is a plunger type pump in the overdrive (4, Fig. 3-37) which is driven by a cam on the mainshaft.

When the control valve (6) opens (position I, Fig. 3-38), oil under pressure from the pump flows via the valve to two cylinders (1). The plungers in the cylinders then press the clutch disk forwards to make contact with the brake drum. When the overdrive is disengaged, the control valve shuts off the connection between the pump and cylinders. The clutch disk is then pressed rearwards by the springs. The oil in the cylinders flows out through the hollow valve rod into the overdrive housing, see II, Fig. 3-38.

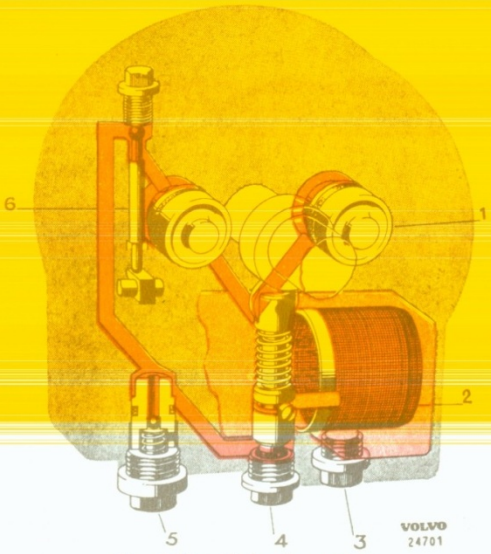


Fig. 3-37. Hydraulic system

1. Hydraulic cylinder and plunger
2. Oil strainer
3. Drain plug
4. Oil pump
5. Reducing valve
6. Control valve

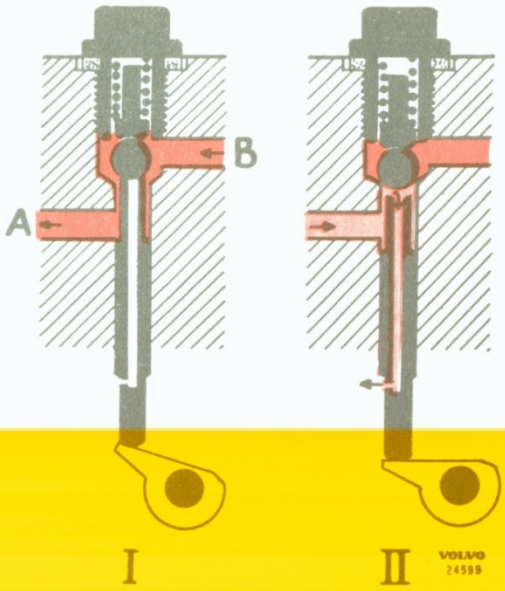


Fig. 3-38. Control valve, early prod.

I. Overdrive position
II. Moving over from overdrive to direct drive
A. To hydraulic cylinder B. From oil pump

On late production, Fig. 3-39, there is no pressure in the system even when the overdrive is disengaged. This has been done by lowering the channel from the oil pump so that it opens out below the valve ball. This permits the oil to by-pass the valve ball and flow through the drilled-out valve stem back to the gearbox housing. In order to facilitate oil circulation, the return hole in the valve stem has been made slightly larger than on the early production system.

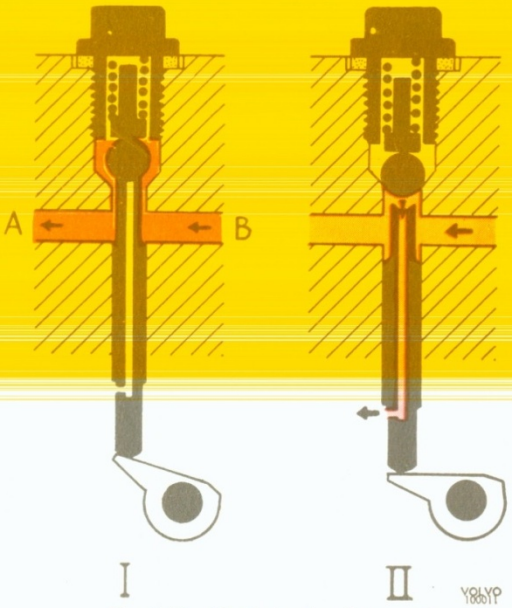


Fig. 3-39. Control valve, late prod.

For details, see under Fig. 3-38

WORK WHICH CAN BE CARRIED OUT WITH THE OVERDRIVE UNIT FITTED

Checking oil pressure

1. Engage and disengage the overdrive 10—12 times (with the engine stopped) in order to remove any residual oil pressure.
2. Remove the plug over the control valve and connect oil pressure gauge SVO 2415, see Fig. 3-40.
   NOTE. The spring (47, illustration III-B), stud (50) and ball (51) should remain in position.
3. Start and drive the car. (The test can also be done with the car jacked up). At a speed of 16.2—20.6 m.p.h. = 26—33 km.p.h. on the overdrive, the gauge should show a pressure of 470—540 lb./sq.in. (33—38 kg/cm²). If the gauge gives too low a reading, see "Fault tracing" concerning the reason and remedy.

Cleaning the oil strainer

The oil strainer should be cleaned at every oil change. First drain off the oil by removing the plug (3, Fig. 3-37, marked "Drain") under the oil strainer. Cleaning should then be done as follows:

1. Remove the cover (2) and take out the oil strainer (1), see Fig. 3-41. Clean the oil strainer in gasoline or white spirit. Blow dry with compressed air.
2. Check that the gasket (3) is intact and place it in position. Fit the oil strainer, new gasket (4) and cover.

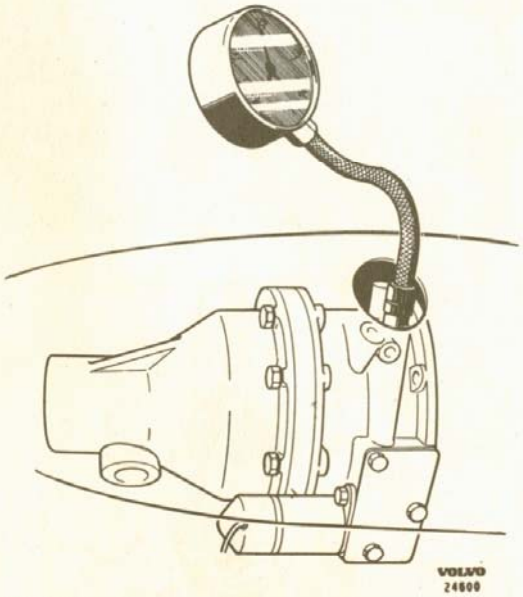


Fig. 3-40. Checking oil pressure with pressure gauge SVO 2415

Checking and adjusting the control valve

1. Jack up the car and place blocks under the front and rear axles.
2. Remove the cover over the control valve arm. Engage the overdrive (with the engine stopped and 4th speed engaged). If the control valve is correctly adjusted, it should be possible to push a 3/16" (4.75 mm) diameter pin through the hole in the arm and into the housing, see Fig. 3-42. If not, adjust until the correct position of the arm is obtained.
3. Check the current through the solenoid with the overdrive engaged. The current should be max. 1 amp. If the current is 18—20 amp., this means that the solenoid armature does not go in far enough to cut off the control current.
   NOTE. If the current through the solenoid is too high, the reason must be ascertained and the necessary measures taken, otherwise the solenoid can be destroyed.

Checking the oil pump

1. Engage and disengage the overdrive 10—12 times so that any residual oil pressure is removed. Jack

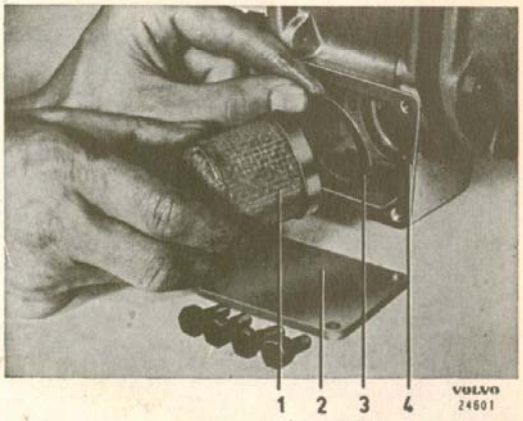


Fig. 3-41. Removing the oil strainer

1. Oil strainer
2. Cover
3. Gasket for oil strainer
4. Gasket for cover

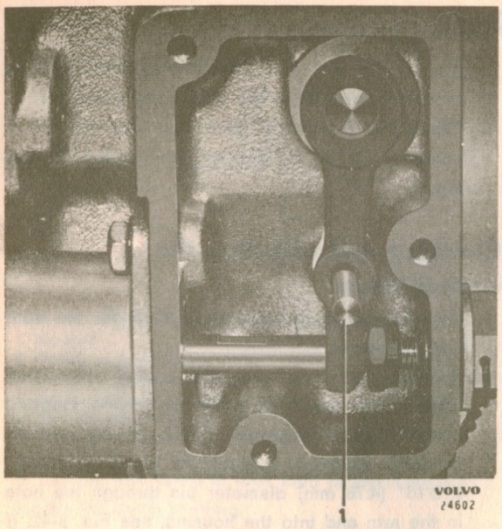


Fig. 3-42. Adjusting the control valve
1. Control gauge, diam. 3/16″ (4.75 mm)

up the car and place blocks under the front and rear axles. Remove the drain plug and let the oil run out into a container.

2. Remove the plug and take out the spring (8) and ball (6). Remove the valve seating (7) with key SVO 2419, see Fig. 3-43. Clean and check the parts.
3. Feel with a piece of wire or similar against the pump plunger that the pump works when the output shaft is rotated. The plunger stroke should be 0.126″ (3.2 mm). If the plunger stroke is shorter

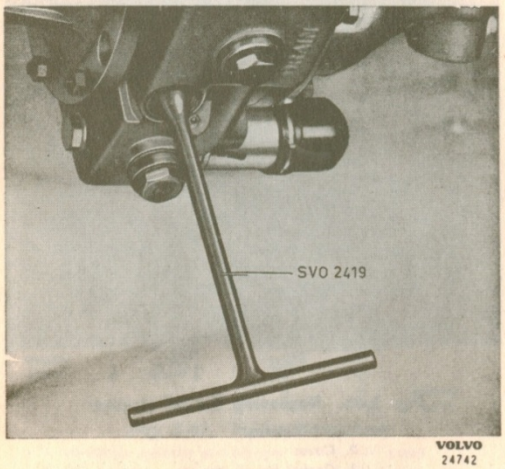


Fig. 3-43. Removing the valve seating, oil pump

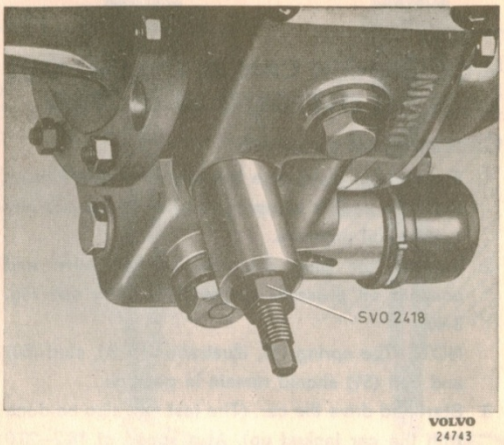


Fig. 3-44. Removing the oil pump

the pump must be removed and the reason ascertained.

4. The pump is removed in the following manner: Unscrew the bolt which holds the pump through the hole in the extension piece (56). Screw puller SVO 2418 into the place of the valve seating and pull out the pump, see Fig. 3-44.
   Disassemble and check the various parts of the pump.
5. The pump and pump valve are fitted in the reverse order to removing. Check that the gasket for the plug (4, Fig. 3-37) is intact. Fill up with oil.

Checking the reducing valve

1. Engage and disengage the overdrive 10–12 times so that any residual oil pressure is removed. Jack up the car and place blocks under the front and rear axles. Remove the drain plug and let the oil run out into a container.

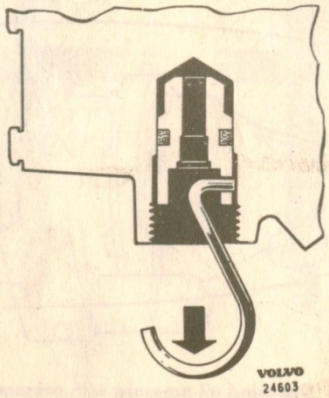


Fig. 3-45. Removing the valve seating, reducing valve

2. Remove the plug and take out the spring (11) and valve (12). Pull out the valve seating (10) with the help of a small hook, see Fig. 3-45.
3. Clean and check all parts throughly. Fit the parts in the reverse order to removing.

REMOVING THE OVERDRIVE

1. Carry out operations 1—4 according to "Removing the transmission". Also drain out the oil from the overdrive.
2. Disconnect the cable to the solenoid.
3. Unscrew the bolts which hold the overdrive unit to the intermediate flange and remove the overdrive unit.

DISASSEMBLING THE OVERDRIVE

The following section describes how the overdrive unit is completely disassembled. It is, however, seldom necessary to disassemble it completely. When carrying out disassembly, therefore, follow the appropriate parts of the instructions given below.

1. Remove the cover over the oil strainer and over the lever (13, illustration III-B) for the control valve. Remove the oil strainer. Unscrew the bolts and lift out the solenoid (17).
2. Bend down the locking plate, unscrew and remove the nuts for the plunger pressure plate (54). Remove the pressure plates. Pull out the plungers with the help of a pair of pliers, see Fig. 3-46.
3. Unscrew the nuts which hold together the brake drum (39), the front (46) and rear (20) housing halves. Slacken the nuts successively all round so that there is no oblique tension from the springs. Lift off the front housing half and brake drum.
4. Lift out the clutch disk (41) complete with thrust bearing and sun wheel. Remove the four springs and pressure plate. Remove the locking rings for the sun wheel (44) and bearing. Remove the sun wheel. Pull off the bearing from the clutch disk. Press out the bearing from the retainer.
5. Lift off the planet wheel (36) and carrier (43). Remove the locking pins (40) for the planet wheel shafts by first pressing them out with a drift or similar, see Fig. 3-47 and then removing them with a pair of pliers. If this is not possible, drill out the pins with a suitable drill. Press out the planet wheel shafts and remove the planet wheels.

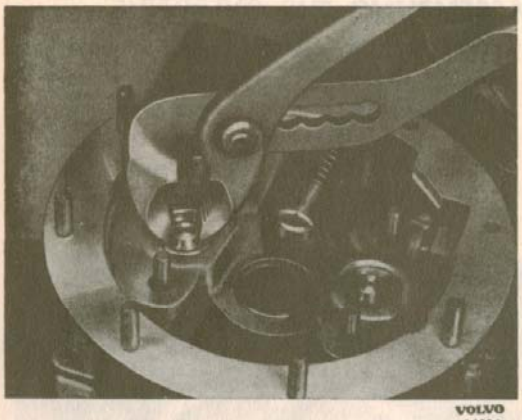


Fig. 3-46. Removing the plungers

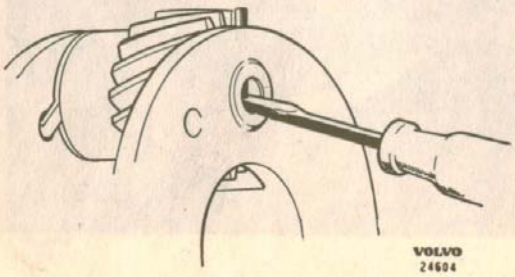


Fig. 3-47. Removing the locking pins in the planet wheels

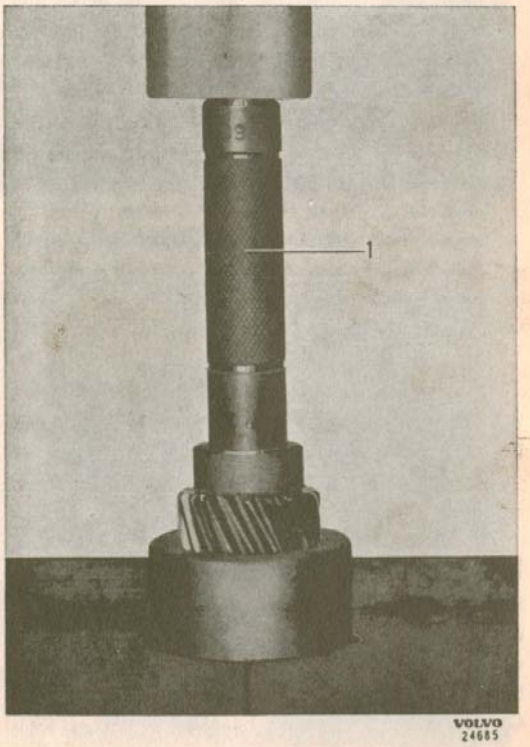


Fig. 3-48. Removing needle bearing in planet wheel

1. Drift SVO 2417

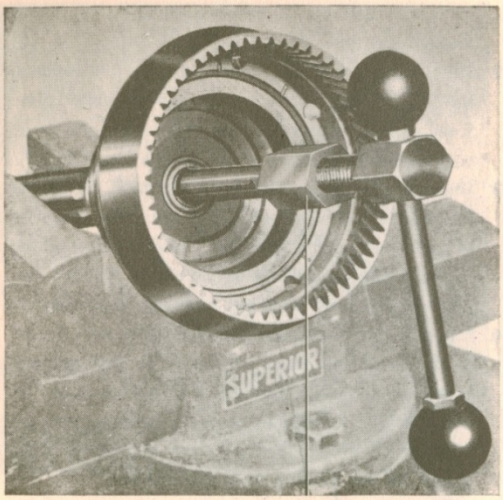


Fig. 3-49. Removing needle bearing, output shaft
1. Puller SVO 2423

The needle bearings in the planet wheels can be pressed out with drift SVO 2417, see Fig. 3-48.

6. Unscrew the bolt and pull out the bushing and small speedometer gear wheel. Unscrew the nut for the coupling (24). Pull off the coupling with puller SVO 2262. Place the housing in a press and press out the output shaft (23).
7. Remove the brass washer (35) which holds the free wheel on the output shaft. Lift out the free wheel parts. Remove the thrust washer (32). If necessary, pull out the needle bearing (31) in the output shaft with tool SVO 2423, see Fig. 3-49. Pull off the bearing on the output shaft preferably using a knife puller.
8. Remove the plugs and take out the parts for the control valve, reducing valve and outlet valve for the pump. Remove the locking screw and take out the oil pump. If the pump does not come out, remove the valve seating with key SVO 2419, see Fig. 3-43. Then pull the pump out with puller SVO 2418, see Fig. 3-44.

INSPECTING THE OVERDRIVE

Before inspecting wash all parts throughly in kerosene or white spirit. Then check all parts carefully for wear, cracks or other damage. Defective parts should be replaced.

Check the ball and needle bearings for cracks, wear or other damage to the balls, needles and races. Check the free wheel. Rollers and races must not be cracked or scored. Check that the outer race fits securely in the rear housing half.

Check the gear wheels. If the teeth on any gears should be damaged, they must be replaced.

Check that the facings on the clutch disk are not burnt or worn. Check that the springs are intact and have not become fatigued. Check the surface on the thrust bushings for the sun wheel in the front housing half. The bushing requires replacing only if the surface is deeply scratched.

Check the oil pump for damage on the pump plunger and roller.

Check that the plunger moves easily in the cylinder. Ensure that the plunger spring is not damaged. Check the valve seating and balls to make sure that they are not scratched and are free from burr.

Check the control valve for damage. Ensure that it moves easily in the bore in the front housing half. Check the reducing valve. NOTE. The reducing valve plunger and seating are machined together. If either part is damaged then both parts must be replaced. Check the cylinders of the control plungers for scratches and wear.

Make sure that the oil channels are clean.

ASSEMBLING THE OVERDRIVE

1. Place the front locking rings for the bearing (26) in the rear housing half. Press in the bearing with drift SVO 2413.
2. Press the guide bearing (31) for the transmission mainshaft in the output shaft (23) with drift SVO

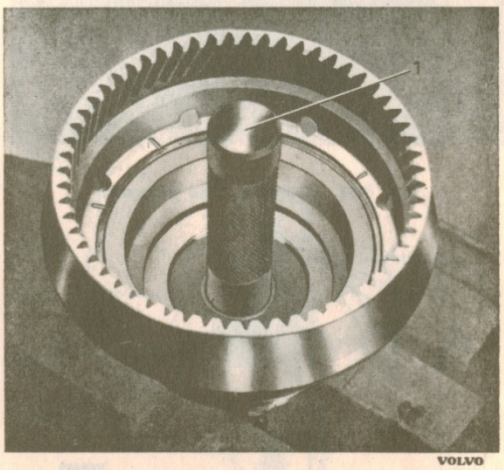


Fig. 3-50. Fitting needle bearing, output shaft
1. Drift SVO 2417

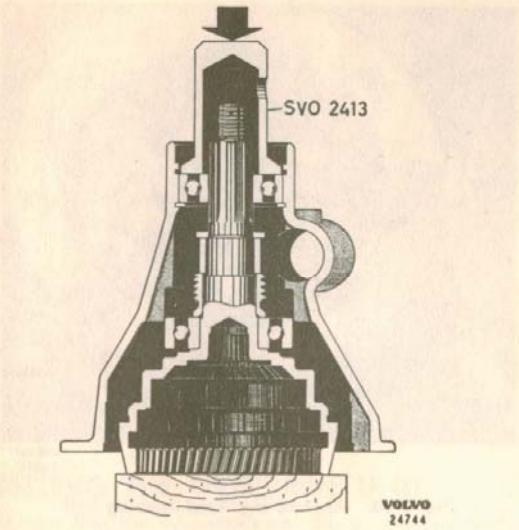


Fig. 3-51. Fitting output shaft

2417. Press the bearing on the output shaft with drift SVO 2412.

3. Support under the output shaft with a block of wood. Place on the speedometer gear (29), spacing sleeve (28) and thrust washer (27). Press on the rear housing half with drift SVO 2413, see Fig. 3-51. Place in the locking ring for the rear bearing. Press in the sealing ring (25) with drift SVO 2422. Press on the coupling (24) with a suitable sleeve or with press tool SVO 2421. Fit washer and nut. Tighten and lock the nut.
4. Assemble the free wheel hub (34), spring and roller retainer, see Fig. 3-52. Turn the roller retainer clockwise as far as it will go and lock it in this position with a key as shown in Fig. 3-53.

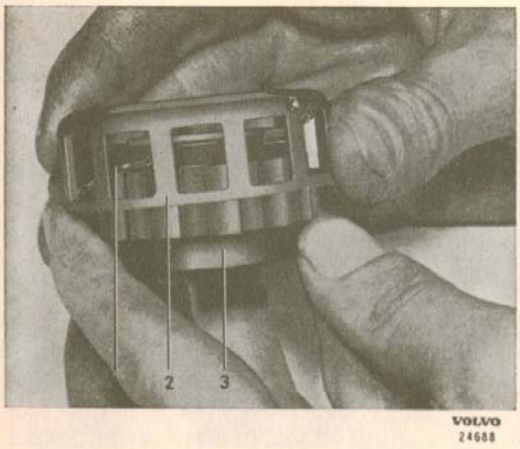


Fig. 3-52. Assembling the free wheel, I

1. Spring 2. Retainer 3. Free wheel hub

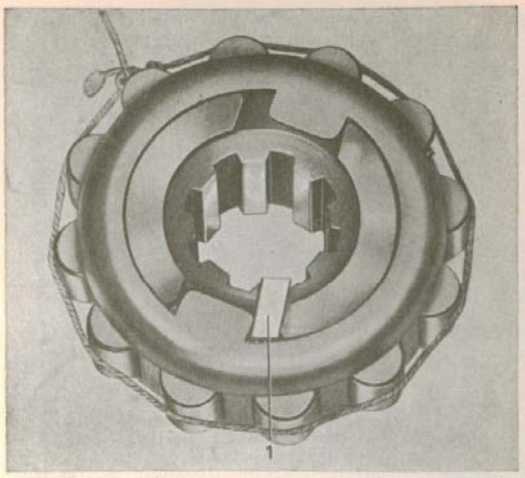


Fig. 3-53. Assembling the free wheel, II

1. Key

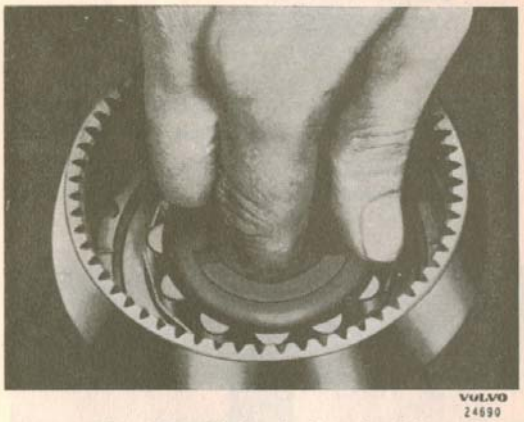


Fig. 3-54. Fitting the freewheel, I

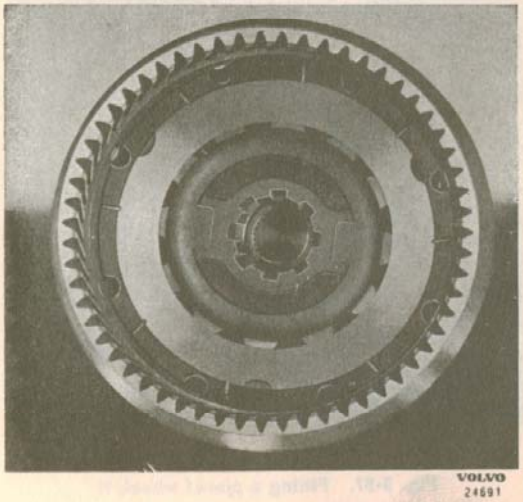


Fig. 3-55. Fitting the freewheel, II

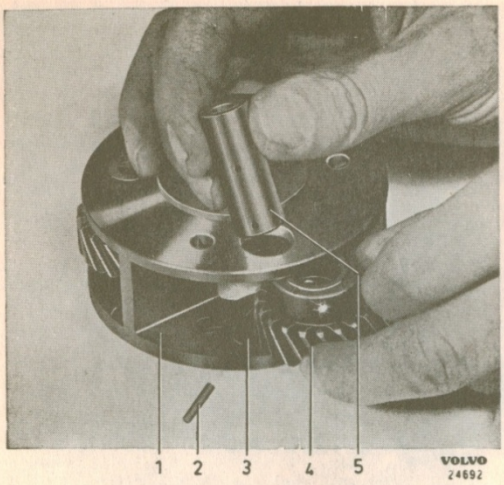


Fig. 3-56. Fitting a planet wheel, I

1. Planet wheel carrier
2. Locking pin
3. Thrust washer
4. Planet wheel
5. Shaft

Place in the rollers. Wind a piece of string or rubber band round the rollers. Fit the thrust washer and then the free wheel into position in the output shaft, see Fig. 3-54. Place in the brass

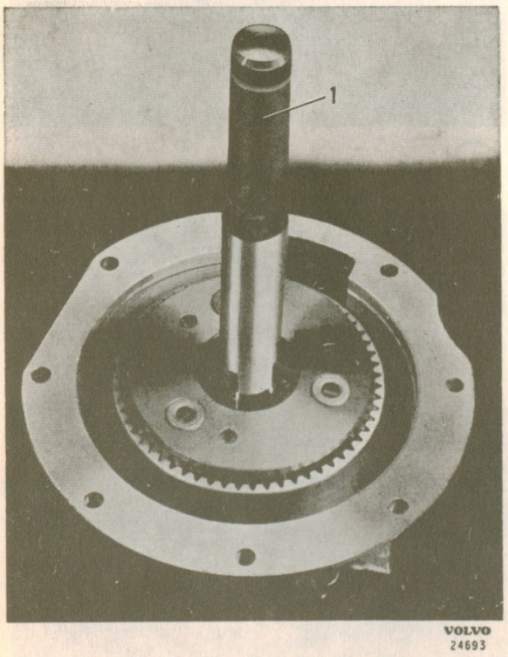


Fig. 3-57. Fitting a planet wheel, II

1. Centering mandrel SVO 2420

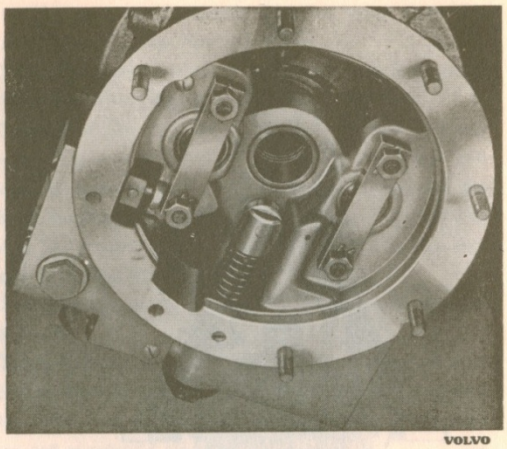


Fig. 3-58. Assembling front housing half

washer as shown in Fig. 3-55. The washer is secured with center punch or chisel marks.

5. Press the needle bearings (37) in the planet wheels (36) with drift SVO 2417. The bearings should lie slightly below the side surfaces of the wheels. Assemble the planet wheel carrier, shaft, washers and planet wheels, see Fig. 3-56. Guide the splines into the planet wheel carrier and free wheel hub with drift SVO 2420, see Fig. 3-57.
6. Fit the sun wheel (44) into the clutch disk (41). Fit bolts, thrust bearing and thrust bearing retainer. Fit the thrust bearing on the clutch disk.
7. Fit the plungers (14) in the front housing half. Assemble the clutch disk, brake drum (39), pressure springs (52), front housing half and pressure plates (48, 54) into one unit, see Fig. 3-58. When

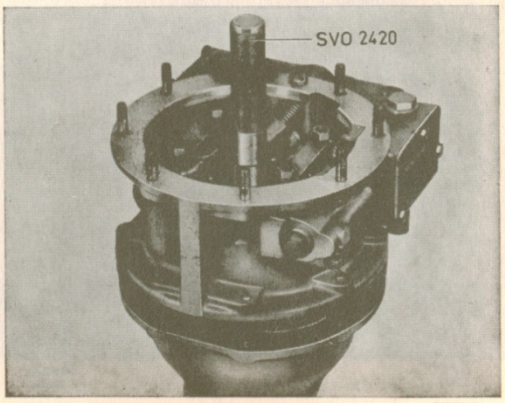


Fig. 3-59. Fitting front housing half

assembling, coat both sides of the brake drum with sealing compound.

8. Place the unit assembled as described in point 7 onto the rear housing half. Guide the splines in the planet wheel carrier and free wheel hub with mandrel SVO 2420, see Fig. 3-59. Place on washers and nuts. Tighten the nuts a little at a time until they are evenly tightened all round.
9. Fit the other parts in the reverse order to removing. Press in the solenoid armature as far as it will go and check that a 3/16″ (4.75 mm) diameter pin can be inserted through the hole in the lever and into the housing, see Fig. 3-60.

FITTING THE OVERDRIVE UNIT

Ensure that the oil pump cam (55) on the mainshaft faces upwards. Then fit the overdrive unit in the reverse order to removing. Fill up with oil.

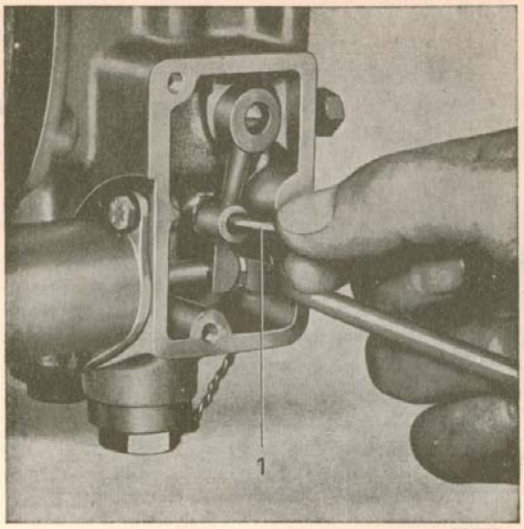


Fig. 3-60. Adjusting the control valve

1. Control gauge, 3/16″'' (4.75 mm) diameter

FAULT TRACING

FAULT	
Reason	**Remedy**
Overdrive does not engage	
Insufficient oil in the unit.	Fill up with oil to the level plug.
Control valve incorrectly adjusted.	Adjust the valve, see page 3:15.
Control valve leaks.	Check the control valve and replace faulty parts.
Oil pressure too low because of faulty reducing valve.	Check the valve and replace faulty parts.
Oil pressure too low because of blocked up oil strainer.	Clean the oil strainer.
Non-return valve at pump leaks.	Check the valve and replace faulty parts.
Broken pump plunger return spring.	Remove the pump and replace the plunger spring.
Solenoid not receiving current.	Check the parts in the circuit (see wiring diagram, Fig. 3-36 on page 3: 14).
Faulty solenoid.	Replace solenoid.
Overdrive does not disengage	
NOTE. This trouble must be attended to as soon as possible. The car must **not** be reversed with the overdrive engaged since this can cause damage.	
Faulty adjustment of control valve.	Adjust the valve, see page 3: 15.
Blocked oil channel in valve rod.	Remove the control valve. Take out and clean the valve rod.
Clutch slips in overdrive position	
Insufficient oil in the unit.	Fill up with oil to the level plug.
Worn or glazed clutch facings.	Disassemble the overdrive and replace the facings.
Oil pressure too low.	Check the oil pressure, see page 3: 15. See also under "Overdrive does not engage".
Clutch slips in direct position when reversing or when using engine as brake	
Worn or glazed clutch facings.	Disassemble the overdrive and replace the facings.
Blocked oil channel in valve rod.	Remove the control valve. Take out and clean the valve rod.
Spring pressure on the clutch too low.	Disassemble the overdrive and check the springs for the clutch drum. Replace faulty springs.
Fault tracing with pressure gauge SVO 2415	
Insufficient oil pressure on both direct drive and overdrive	
Oil level too low.	Fill up with oil to the level plug.
Oil strainer blocked up.	Clean the oil strainer.
Non-return valve leaks.	Check the valve and replace faulty parts.
Broken pump plunger return spring.	Remove the pump and replace the plunger spring.
Pump plunger binds.	Remove the pump. Clean and if necessary replace plunger and cylinder.
Faulty reducing valve.	Check the valve and replace faulty parts.

Oil pressure too low on direct drive

The control valve ball does not seal against the seating in the housing.	Check the control valve and replace faulty parts. If necessary, knock the ball lightly against the seating with the help of a brass or copper drift.

Oil pressure too low on overdrive

The control valve ball does not seal against the valve rod seating.	Remove and clean the ball and valve rod. Check and if necessary replace the parts.

TOOLS

The following special tools are required for work on the overdrive unit

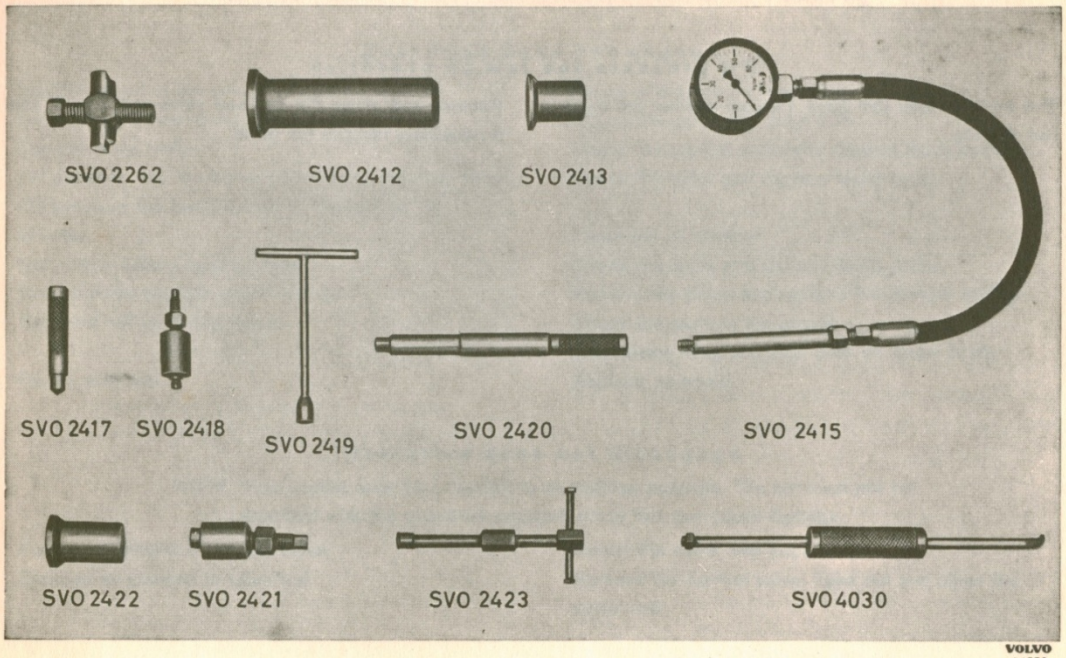
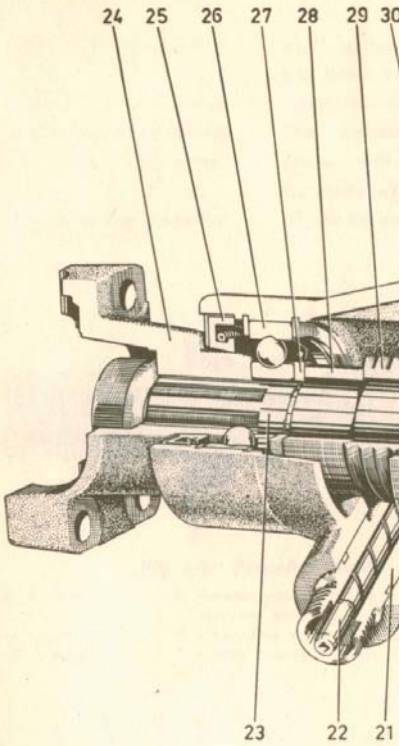


Fig. 3-61. Special tools

SVO 2262 Puller for coupling
SVO 2412 Drift for fitting front bearing on output shaft
SVO 2413 Drift for fitting rear bearing on output shaft
SVO 2415 Pressure gauge for checking oil pressure
SVO 2417 Drift for removing needle bearings in planet wheels and for fitting bearings in planet wheels and output shaft
SVO 2418 Puller for oil pump
SVO 2419 Key for valve seating, oil pump
SVO 2420 Centering mandrel for splines in planet wheel carrier and free wheel hub
SVO 2421 Press tool for fitting coupling
SVO 2422 Fitting tool for sealing ring, output shaft
SVO 2423 Puller for needle bearing in output shaft
SVO 4030 Puller for sealing ring, output shaft

SPECIFICATIONS

Gear ratio, overdrive	0.756: 1
Oil pump stroke	0.126″ (3.2 mm)
Clearance between the plunger and cylinder in oil pump	0.0002–0.0016″ (0.005–0.040 mm)
Oil pressure	470–540 lb/sq.in. (33–38 kg/cm²)
Lubricant	Engine oil
viscosity (all year round)	SAE 30
quality	For Service ML or higher
Oil capacity, transmission and overdrive	3 3/4 US pints = 3 1/8 Imp. pints (1.8 liters)



1. Roller
2. Pump plunger
3. Spring
4. Lever
5. Pump cylinder
6. Ball
7. Valve seating
8. Spring
9. Rubber ring
10. Reducing valve
11. Spring
12. Valve cone
13. Lever
14. Plunger
15. Armature for sol

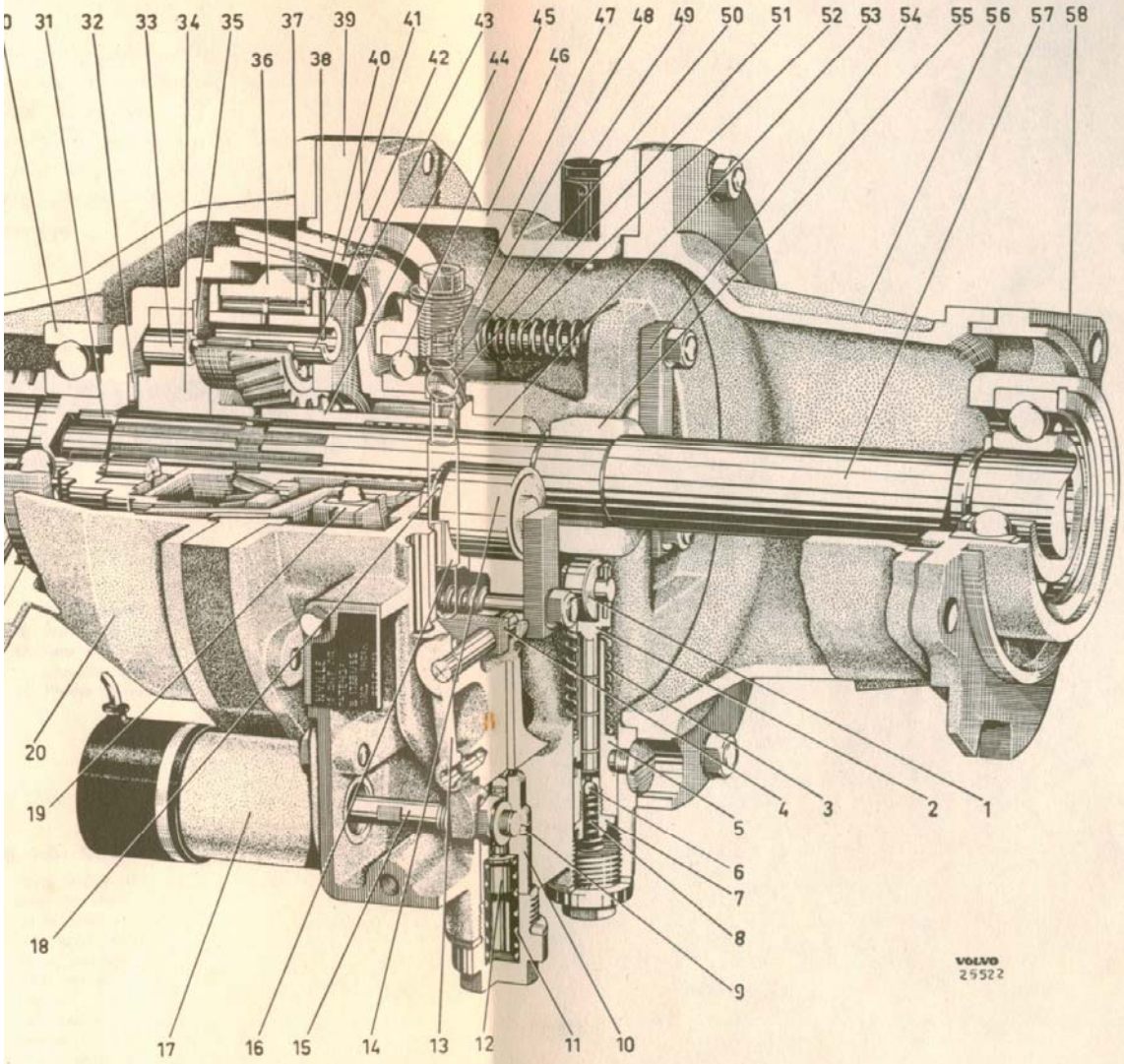


Illustration III-B. Overdrive unit

16. Valve rod ("X-Ray outline")
17. Solenoid
18. Plunger packing
19. Thrust bearing retainer
20. Housing, rear part
21. Bushing
22. Speedometer gear wheel, small
23. Output shaft
24. Coupling
25. Sealing ring
26. Ball bearing
27. Thrust washer
28. Spacing sleeve
29. Speedometer gear wheel, large
30. Ball bearing
31. Needle bearing
32. Thrust washer
33. Rollers for free wheel
34. Free wheel hub
35. Washer
36. Planet wheel
37. Needle bearing
38. Clutch facing
39. Brake drum
40. Locking pin
41. Clutch disk
42. Shaft
43. Planet wheel carrier
44. Sun wheel
45. Ball bearing
46. Housing, front part
47. Spring ("X-Ray outline")
48. Pressure plate
49. Air-venting nipple
50. Stud ("X-Ray outline")
51. Ball ("X-Ray outline")
52. Spring
53. Bushing
54. Pressure plate
55. Cam
56. Extension piece
57. Input shaft (transmission mainshaft)
58. Rear cover, transmission

PART 4

PROPELLER SHAFT

DESCRIPTION

The propeller shaft on the P 1800 is of the divided, tubular type, see Fig. 4-1.

The forward section of the propeller shaft terminates in a slip joint at the rear end. In this there is a spline shaft which also forms one of the yokes on the intermediate universal joint.

The rear end of the forward section of the propeller shaft is carried in a ball bearing see Fig. 4-2. The ball bearing is carried in a bearing housing which is rubber-mounted on two pins.

The propeller shaft is fitted with three universal joints. Each joint consists of a cross with four ground trunnions which are carried in the yokes by means of needle bearings.

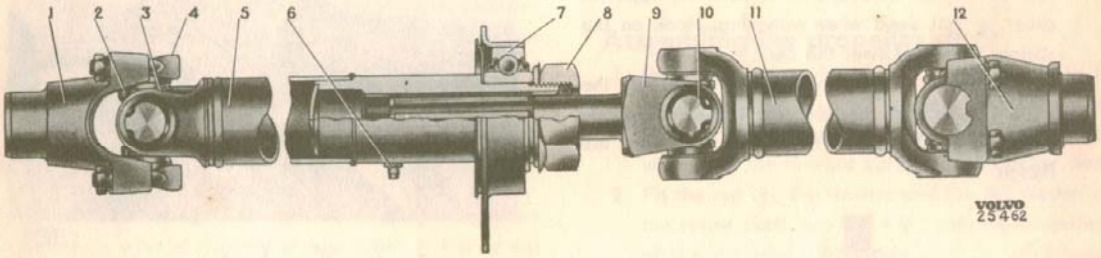


Fig. 4-1. Propeller Shaft

1. Flange on transmission
2. Universal joint
3. Lubricating nipple
4. Clamp
5. Forward section of propeller shaft
6. Lubricating nipple
7. Center bearing
8. Nut
9. Spline shaft
10. Snap ring
11. Rear section of propeller shaft
12. Flange on rear axle

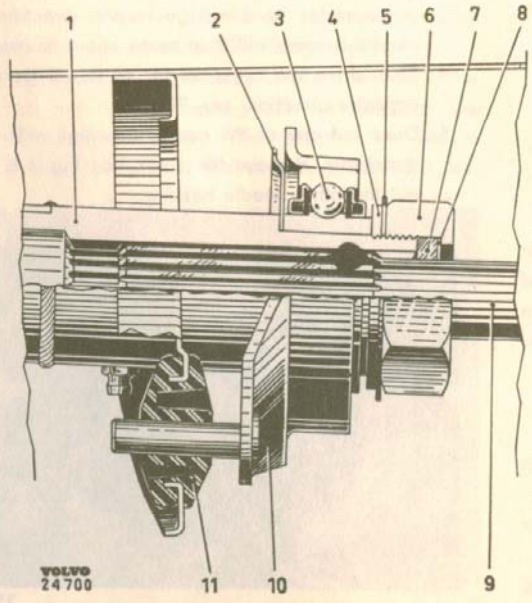


Fig. 4-2. Center Bearing

1. Front section of propeller shaft
2. Cover plate
3. Ball bearings
4. Thrust washer
5. Lock washer
6. Nut
7. Felt washer
8. Washer
9. Spline shaft
10. Retainer
11. Rubber bushing

REPLACING THE CENTER BEARING

1. Jack up the car and block up the front and rear axles. Loosen the clamps retaining the rear universal joint to the rear axle flange (12, Fig. 4-1). Release the lock washer and remove the nut (8). Pull out the propeller shaft to the rear.
2. Pull out the retainer with the center bearing (7) to the rear. Press the center bearing out of the retainer with a suitable tool. Press the new bearing into the retainer with the help of ring SVO 4801, see Fig. 4-3. If the diameter of the press tool is less than the hole in the ring, lay a plate (1, Fig. 4-3) over the ring.
3. Fit the retainer with the center bearing and the rear section of the propeller shaft in the opposite order to that used when removing. Hook on the springs if fitted. Lower the car.

   NOTE. When re-assembling make sure that the band (1, Fig. 4-9) on the rear universal joint is correctly positioned in the recess for it on the flange.

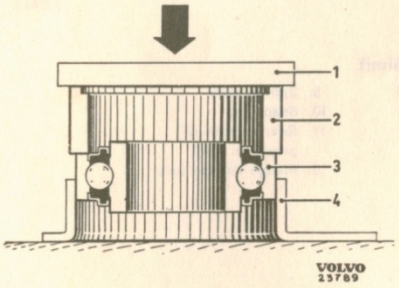


Fig. 4-3. Fitting the center bearing

1. Plate
2. Ring SVO 4081
3. Center bearing
4. Retainer

REMOVING

Jack up the car and block up the front and rear axles. Remove the clamps retaining the universal joints to the rear axle flange and the transmission flange. Loosen any springs fitted. Slide the propeller shaft to the rear and remove it.

DISASSEMBLING

1. Loosen the lock washer and remove the nut (8) for the center bearing (7). Remove the rear section of the propeller shaft. Remove the center bearing.
2. If necessary, press the center bearing out of the retainer with a suitable tool.

Disassembling the universal joints

The same disassembly principle is used on all the three universal joints. The only difference is that on the center universal joints, there are two yokes from which the cross is loosened.

1. Remove the snap rings (10) retaining the needle bearings in the yokes, see Fig. 4-4. Remove the lubricating nipple from the cross.
2. Set up the shaft in a vise, so that the universal joint is as near the vise as possible. Remember that the propeller shaft is in the form of a tube and can easily be deformed.
3. Use a hammer and a metal drift to drive the cross as far as it will go in one direction. The needle bearing will then come about halfway out.
4. Then drive the cross as far as it will go in the opposite direction, see Fig. 4-5.
5. Drive out one of the needle bearings with a thin metal tool. Remove the cross, see Fig. 4-6. Drive out the other needle bearing.

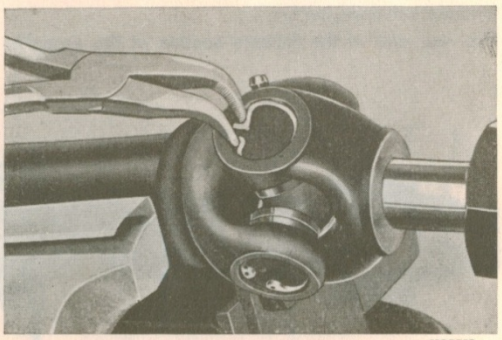


Fig. 4-4. Removing the snap rings

Rig. 4-5. Removing the cross

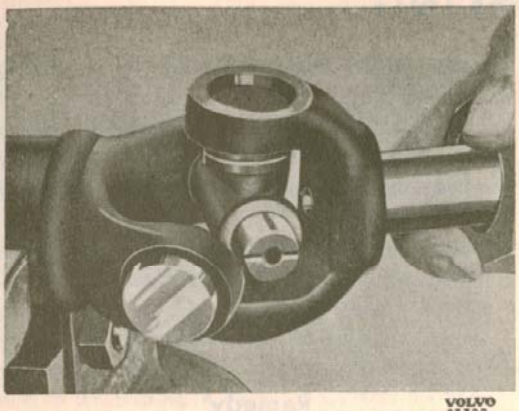


Fig. 4-6. Diassembling the cross

INSPECTION

Inspect the propeller shaft. Set the shaft up between centers and check it with an indicator along its entire length while it is rotating. If the run-out should exceed 0.25 mm (0.010″) then the shaft should be replaced. **NOTE. No attempt should be made to straighten a damaged propeller shaft – it should be replaced with a new shaft.**

Inspect the center bearing. The bearing should run smoothly without binding at any point. If this is not the case, fit a new bearing.

ASSEMBLING

Assembling the universal joints

1. Fit new cork washers on the joint cross trunnion. Fit the cross in the flange yoke in the same position as it was before being removed.
2. Move over the joint cross in one direction so far that the needle bearing can be fitted on the trunnion, se Fig. 4-7. Then press in the needle bearing so far that the snap ring can be fitted.

Fig. 4-7. Fitting the joint cross and needle bearing

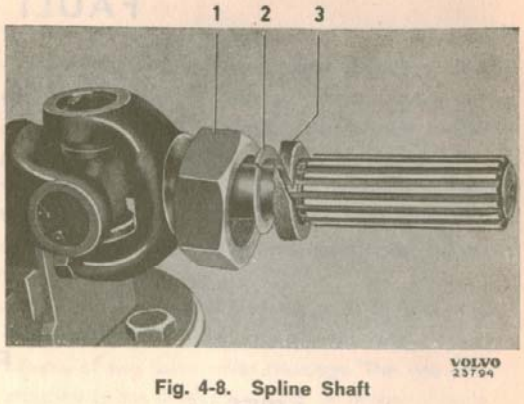


Fig. 4-8. Spline Shaft

1. Nut 2. Washer 3. Felt washer

3. Fit the other needle bearing and snap ring in the same way.

Assembling the propeller shaft

1. Press the center bearing (7) in the retainer by using the ring SVO 4081, see Fig. 4-3. Fit the cover plate, center bearing, thrust washer and lock washer on the forward part of the propeller shaft.
2. Fit the nut (8), the washer and the felt washer on the spline shaft, see Fig. 4-8. Lubricate the surface of the slip joint with a thin layer of mylobdenum disulphide. Fit together the forward and rear sections of the propeller shaft. NOTE. Make sure that the yoke on the forward section of the propeller shaft and the yoke on the spline shaft are correctly lined up, see Fig. 4-1.

FITTING

Fitting is carried out in the reverse order to that used when removing.

NOTE. When fitting be very careful to ensure that the bands on the forward and rear universal joints are correctly positioned in the recesses on the flanges in question, see Fig. 4-9. Tighten the nuts on the clamp to a torque of 1.4–1.65 kgm (10–12 lb.ft.).

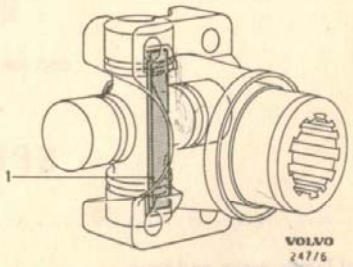


Fig. 4-9. Fitting the needle bearings

1. Metal band

FAULT TRACING

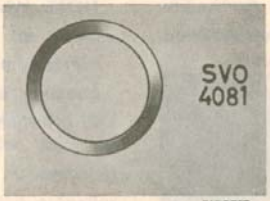
Trouble occurring in the propeller shaft and the universal joints usually consists of noise caused by vibration together with thumping or clicking sounds. No attempt should be made to repair or straighten a broken or damaged propeller shaft. A new propeller shaft should always be fitted. Vibration can depend on wear, insufficent lubrication or faulty assembly.

Vibration can be heard in the form of a growling noise which becomes louder as speed increases. If the universal joints are worn, there will be clearly audible clicking sounds if the car is driven slowly and the accelerator pedal is alternately depressed and released.

FAULT	
Cause	**Remedy**
Center bearing casing loose on locating pins.	Change the rubber bushings.
Center bearing dry or worn.	Replace the bearing.
Center bearing loose in casing.	Replace the bearing and bearing casing.
Needle bearings in universal joints dry or worn.	Lubricate with chassis grease or replace.
Metal band for needle bearings on forward or rear universal joints wrongly fitted.	Fit the band correctly. See Fig. 4-9.
Clamps on flange loose.	Replace the spring washers and tighten the nuts.
Propeller shaft bent.	Replace propeller shaft.
Clicking noise from propeller shaft depending on binding splines.	Disassemble and lubricate the slip joint with a thin coating of molybdenum disulphide.
Faulty assembly.	Study the instructions for assembly and fitting. Compare the relative positions of the universal joints with Fig. 4-1.

TOOLS

The following tools are used for repair work on the propeller shaft.



SVO 4081 Ring for fitting center bearing retainer

SPECIFICATIONS

Type	Tubular, divided, three universal joints, center bearing
Universal joints, make and type	Hardy-Spicer with needle bearings
Lubricant	Chassis grease

PART 5

REAR AXLE

DESCRIPTION

The rear axle on the P 1800 is carried in two support arms. The support arms are provided with two rubber bushings in which the rear axle housing is flexibly mounted. In order to take up the rear axle torque there are two torque rods attached to the body and levers on the housing. A track bar prevents the body and rear axle from moving sideways in relation to each other. The principle of the rear axle suspension is shown in Illustration V-A. The design of the rear axle is shown in Illustration V-B.

The rear axle is of the hypoid type, that is to say the drive pinion lies below the center of the ring gear. This means that the level of the propeller shaft can be lower and also permits greater stresses on the teeth of the pinion and ring gear. Apart from the pressure exerted against each other by the teeth in a gear system, there is also a wiping motion between the teeth in a hypoid gear system. This is why extra demands are made on the adhesion of the oil used. For this reason a special type of lubricating oil called hypoid oil which has outstandingly good adhesion is used. The use of the wrong type of oil can cause extremely rapid wear of the gears. The final drive assembly consists of the drive pinion, ring gear and differential gears.

The gear backlash and differential case bearing tension are adjusted by means of shims inside the differential case bearings.

The differential case and the ring gear are journaled in the drive pinion carrier and the rear axle housing by means of two taper roller bearings. The ring gear is attached to the differential case by means of bolts. The differential gears themselves in the differential case consist of two pinion gears on a short shaft and two side gears in which the axle shafts are carried by means of internal splines. The differential gears are journaled so that they can rotate and permit the axle shafts to rotate at different speeds when the car is being driven round curves. There is a washer under each of the differential gears and the drive pinion is carried in taper roller bearings. The axial location of the drive pinion relative to the ring gear is adjusted by means of shims under the outer race of the rear pinion bearing. The pinion bearings are adjusted by means of shims under the inner race of the front pinion bearing.

The outer end of each axle shaft is journaled in a taper roller bearing. Bearing clearance is adjusted by means of shims under the brake backing plates. Inside each of the axle shaft bearings there is an oil seal which, together with a felt ring outside each bearing, prevents oil from seeping out from the final drive onto the brake linings.

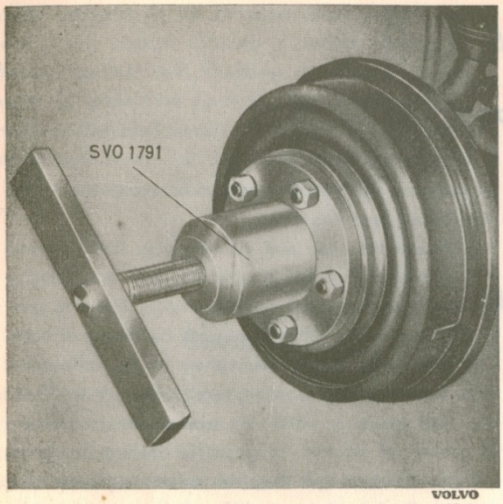


Fig. 5-1. Removing a wheel hub

WORK THAT CAN BE CARRIED OUT WITH THE REAR AXLE FITTED

Replacement of axle shaft oil seal

1. Remove the wheel and pull off the wheel hub, Fig. 5-1. Use puller SVO 1791. Remove the brake backing plate after having placed a wooden block under the brake pedal and loosened the brake line from the backing plate.
2. Pull out the axle shaft, Fig. 5-2. Use puller SVO 2204.
3. Pull out the oil seal by using tool SVO 4078, Fig. 5-3.
4. Drive in the new oil seal. Make sure it is correctly located. Use tools SVO 1801 and SVO 1803, Fig. 5-4.
5. Remove any oil and grease there may be on the brake backing plate. Replace brake linings if any oil or grease has come onto them.
6. Fit the axle shaft and brake backing plate with a new felt washer.
7. Check the axle shaft end play. See the instructions under the heading "Assembly".
8. Replace the draw key if it has been removed and then fit the hub and wheel.
9. Air-vent the brake lines and adjust the rear wheel brakes. Follow the instructions given in Part 7.
10. Check the oil level in the rear axle.

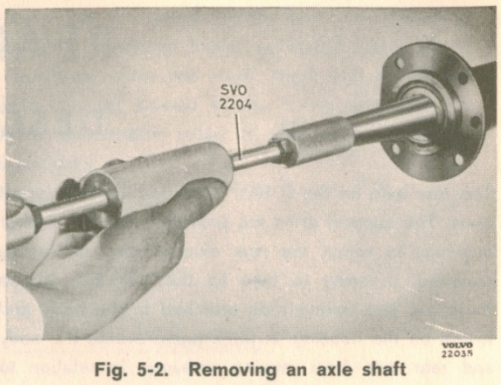
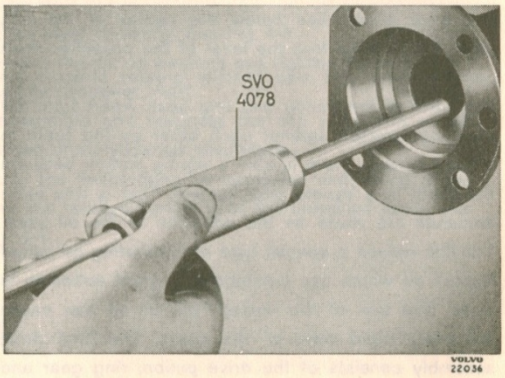


Fig. 5-2. Removing an axle shaft



Rig. 5-3. Removing an oil seal

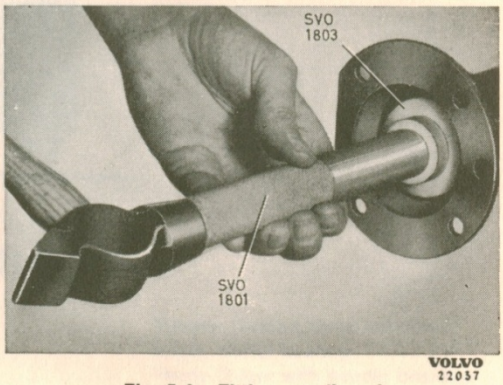


Fig. 5-4. Fitting an oil seal

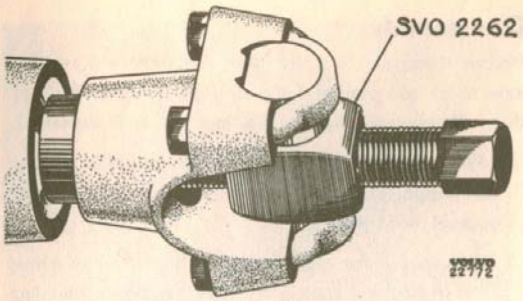


Fig. 5-5. Removing the flange

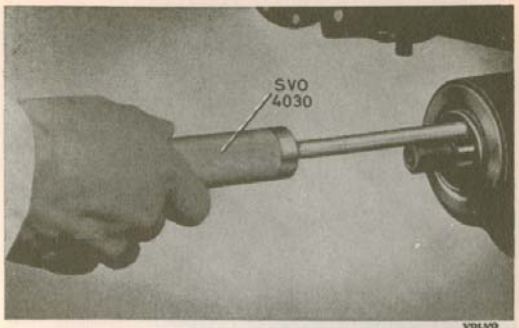


Fig. 5-6. Removing the oil seal

Replacing the drive pinion oil seal

1. Disconnect the rear section of the propeller shaft from the flange on the drive pinion. Check the looseness of the pinion in its bearing. If it is loose, this must be adjusted before fitting a new oil seal. See the instructions under the heading "Assembly".
2. Remove the flange nuts by using wrench SVO 2409 as holder. Pull off the flange with tool SVO 2262, see Fig. 5-5. Remove the old oil seal with SVO 4030, Fig. 5-6.
3. Fit a new paper washer and fit the new oil seal with tool SVO 2403, Fig. 5-7.
4. Press on the flange with the help of press tool SVO 1845, Fig. 5-8.
5. Refit the propeller shaft.

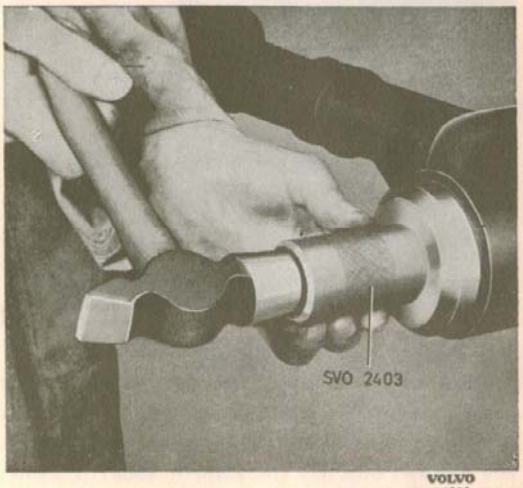


Fig. 5-7. Fitting the oil seal

Replacement of axle shaft and/or bearing

1. Remove the wheel and pull off the hub, Fig. 5-1. Use puller SVO 1791. Remove the brake backing plate after having placed a wooden block under the brake pedal and disconnected the brake line from the backing plate.
2. Pull out the axle shaft, Fig. 5-2. Use tool SVO 2204. Check or replace the oil seal.
3. Press off the bearing, see Fig. 5-9. Use tool SVO 1806 under the bearing. Fit the new bearing by using tool SVO 1805.
4. Fit the axle shaft, shims, and brake backing plate.
5. Check the axle shaft end play and adjust if necessary. Follow the instructions under the heading "Assembly".
6. Fit the draw key, hub and wheel.
7. Air-vent the brake lines and adjust the brakes. Follow the instructions given in Part 7.
8. Check the oil level in the rear axle.

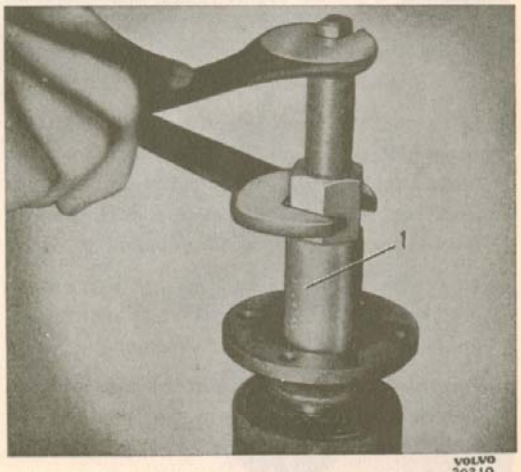


Fig. 5-8. Fitting the flange

1. Press tool SVO 1845

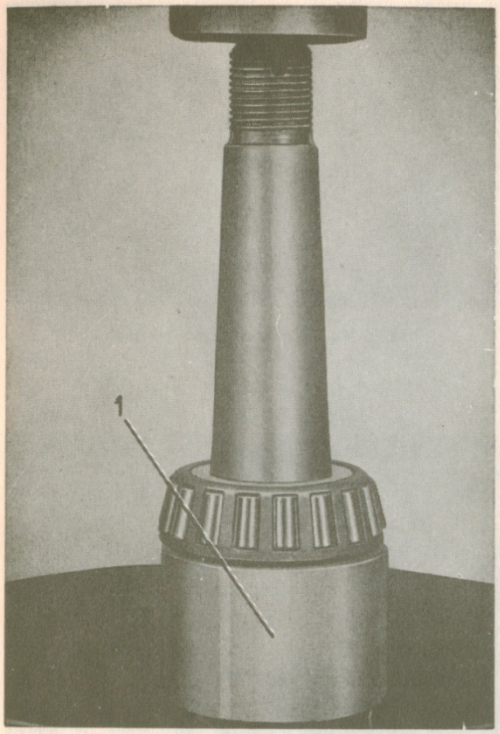


Fig. 5-9. Removing the axle shaft bearing
1. Tool SVO 1806

DISASSEMBLY

1. Remove the rear wheel nuts and the nuts from the axle shaft (13, Illustration V-B). Jack up the rear end of the car comparatively high by placing a jack under the rear axle. Fit blocks in front of the wheels. Place supports under the body in front of the rear wheels. Take off the rear wheels.
2. Disconnect the rear propeller shaft from the flange (22) on the pinion (28) and disconnect the brake line from the master cylinder to the rear axle level with the rear universal joint (place a wooden block under the brake pedal).
3. Loosen the track bar, shock absorbers and shock absorber straps from the rear axle. Disconnect the hand brake cables and the adjuster.
4. Remove the lever nuts. Lower the rear axle and remove the springs. Loosen the bolts for the torque rods and remove the rear axle.
5. Clean the rear axle externally and drain off the oil.

Disassembly

Before disassembling the rear axle measure up the axle shaft end play and the ring gear backlash since this enables any fault to be located and remedied.

1. Place the rear axle in a fixture or on a couple of supports of a suitable height. Remove the rear wheel hubs with puller SVO 1791, see Fig. 5-1.
2. Disconnect the brake lines on the axle from the brake backing plates. Remove the brake backing plates from the rear axle housing. Do not lose the shims.
3. Remove the axle shaft (13). Use puller SVO 2204, see Fig. 5-2. If necessary, press out the roller bearing (15) from the shaft. Use tool SVO 1806 as a support, see Fig. 5-9.
4. Remove the oil seals (14) with the help of puller SVO 4078, see Fig. 5-3.
5. Remove the inspection cover from the rear axle housing.
6. Check the aligning marks on the cap (2) and the carrier (21), see Fig. 5-10. If there are no markings or the markings are not easy to see, mark one side with a punch. Remove the cap.
7. Fit tool SVO 2394 in the holes in the drive pinion carrier as shown in Fig. 5-11. Fit an indicator so that the expansion of the drive pinion carrier can be read off. Tighten the tensioning screw so that the carrier is expanded not more than 0.3 mm (0.012″). Remove the indicator. Lift out the differential case with the ring gear.

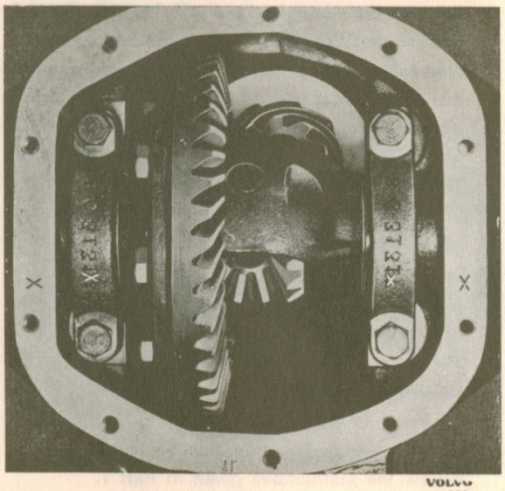


Fig. 5-10. Alignment markings on cap and carrier

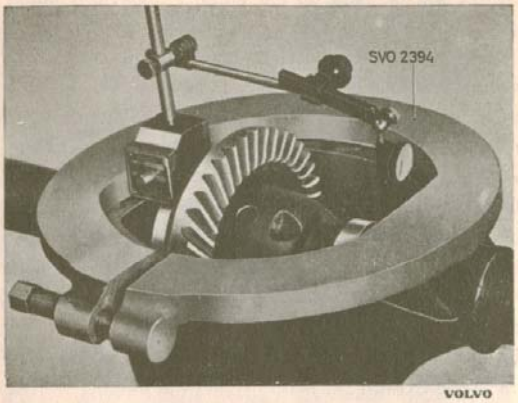


Fig. 5-11. Expanding the drive pinion carrier

8. Remove the nut for the flange (22). Use tool SVO 2409 as holder. Pull off the flange with puller SVO 2262, see Fig. 5-5. Press off the pinion (28).
9. Remove the oil seal (25) by using SVO 4030, see Fig. 5-6. Then remove the oil slinger (24) and the forward pinion bearing (27).
10. If necessary, drive out the bearing outer race, see Fig. 5-12. Use the standard handle SVO 1801 and tool SVO 4063 for the forward and SVO 4064 for the rear race. Do not lose the shims (30) under the rear ring.
11. If necessary pull off the rear bearing (29) from the pinion (28) by using puller SVO 2392, see Fig. 5-13. The puller is fitted in the following way: slide the puller down over the rollers and press down the lock ring. Then tighten the puller with the screw until the rollers are against both the edge on the inner race and the edge on the puller. Strike the lock ring with a hammer.

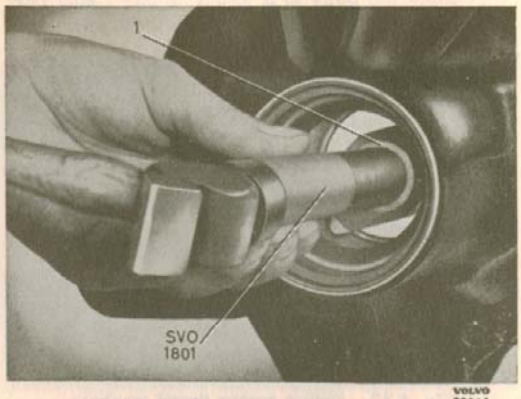


Fig. 5-12. Removing the bearing race

1. Drift, see text

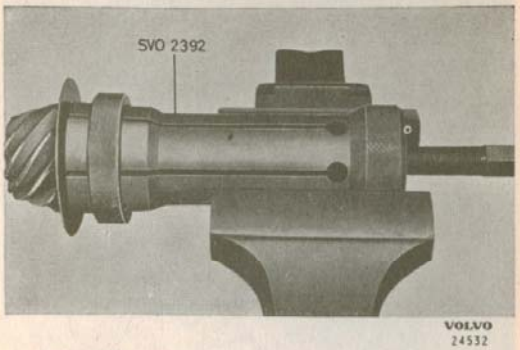


Fig. 5-13. Removing the rear pinion bearing

Disassembling the differential assembly

1. Loosen the bolts and remove the ring gear (9).
2. Drive out the lock pin (7), see Fig. 5-14 and then the shaft (10) for the differential gear. Take out the thrust block (12), the differential gears (6, 8) and the thrust washers (5, 11).
3. Pull off the differential case bearings (1) with puller SVO 4042, see Fig. 5-15. Do not lose the shims (3).

INSPECTION

The various component parts must be first thoroughly cleaned before they are inspected. Make a close examination of all bearing races and bearings. There should be no rough spots or damage on the races, rollers, or cages. Replace any damaged bearings and

Fig. 5-14. Removing the lock pin

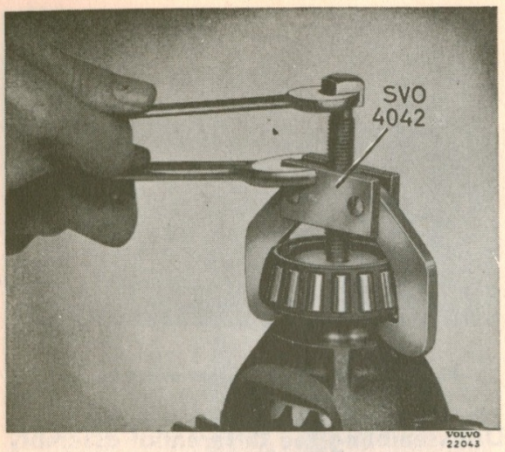


Fig. 5-15. Disassembling the differential case bearings

races. Make a close examination of the drive pinion and the ring gear to ensure that there is no damage on the teeth. Cracked teeth can cause small pieces to loosen while the car is being driven. These small pieces can then fall between the gears and cause extremely serious damage in the rear axle. If there is any damage or any cracks in the pinion or ring gear, both should be replaced. The reason for this is that the drive pinion and ring gear are only sold in pairs since they have been run in together in special machines to ensure the correct tooth contact and quiet operation.

The differential gears should also be examined for cracks and damage on the teeth. Fit the differential gears in a clean and dry condition in the differential case together with the shaft and thrust washers. This makes it very easy to detect looseness and wear. If there is looseness the parts concerned should be replaced. There should be no unevenness on the thrust washers.

Check to ensure that the cylindrical part of the flange in contact with the oil seal is not worn or scored. If this is the case, replace the flange and the oil seal. Inspect the axle shaft. A distorted or otherwise damaged axle shaft should be replaced.

Examine the oil seals and replace them if they are damaged or worn.

Make sure that the rear axle housing is free from cracks. Check that the brackets for the support arms and track bar are in good condition.

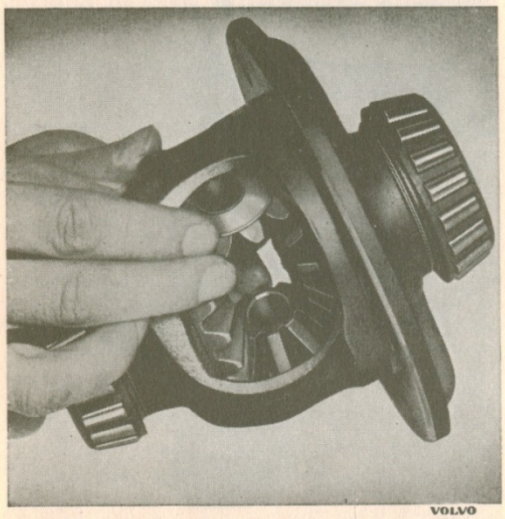


Fig. 5-16. Assembling the differential gears

Assembly

Assembling the differential unit

1. Place the differential side gears (6) with their thrust washer (5) in the differential case (4). Then "roll" in both the differential pinion gears (8) together with the domed thrust washers (11) (both gears at the same time), see Fig. 5-16.
2. Fit the thrust block (12) and drive in the shaft (10).
3. Check the differential unit. If there is any looseness, fit new thrust washers. The flat thrust washers (5) can be replaced with either oversize washers or spring thrust washers. Fit the spring thrust washers the right way round. The "back" should face the differential case, see Fig. 5-17. After checking and, if necessary replacing the washers, fit the lock pin (7).
4. Fit the ring gear (9). Make sure that the contact surfaces are clean and free from burr. Tighten the bolts to a torque of 5.5–7 kgm (40–50 lb.ft.).

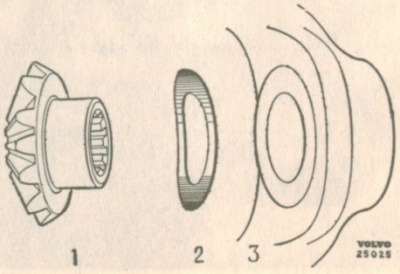


Fig. 5-17. Fitting spring thrust washers

1. Differential gear 2. Thrust washer 3. Differential case

Fig. 5-18. Fitting the differential case bearings

Assembling the final drive

1. Press on the differential case bearings (1) without shims. Use tool SVO 4112, see Fig. 5-18. Place the differential case with the ring gear and roller bearings in the housing. Measure the end play. The end play can be measured in two ways, either with a dial indicator or a feeler gauge. Whichever method is used, measurement must be carried out with a great deal of accuracy if good results are to be obtained.
   If a dial indicator is used, it is placed against the reverse side of the ring gear, see Fig. 5-19. The differential (remember this also includes the bearing outer races) is slid first one way and then the dial indicator is set to zero. Then the differential is slid the other way and the end play read off. If the feeler gauge system is to be used, use two gauges which are pushed down between one of the outer races and the bearing recess in the differential case. Add 0.2 mm (0.008") to the measurement obtained, this showing the total thickness of the shims to be used when assembly is carried out.
2. Fit the oil slinger washer (31) on the pinion (28). Press on the rear bearing (29) with tool SVO 2395, see Fig. 5-20.

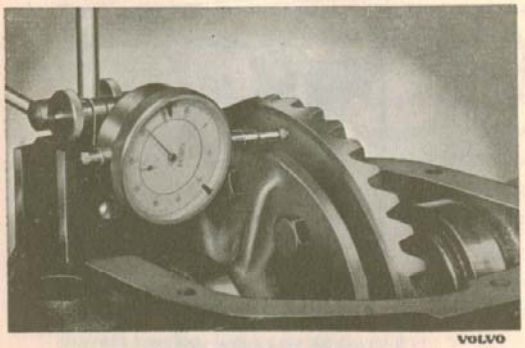


Fig. 5-19. Measuring the differential end play

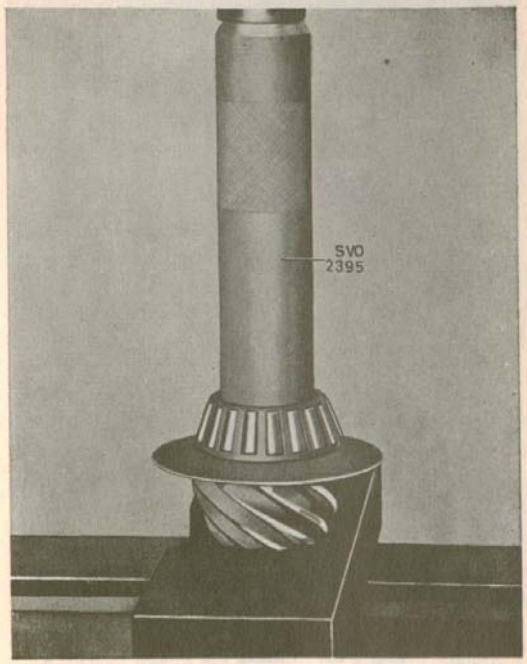


Fig. 5-20. Fitting the rear pinion bearing

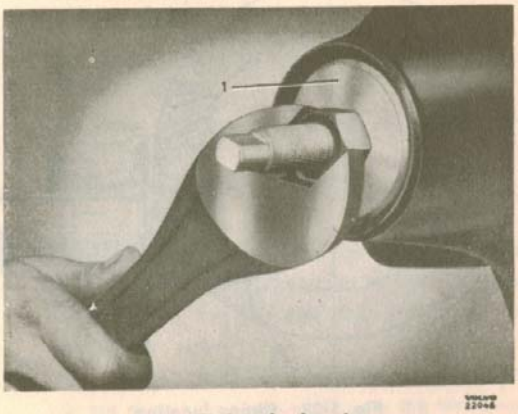


Fig. 5-21. Fitting the bearing races
1. Press tool SVO 4047

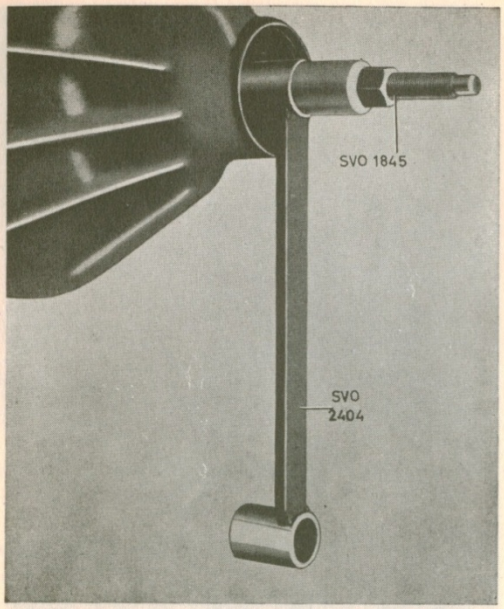


Fig. 5-22. Fitting the pinion

3. Replace the number of shims (30) for the rear pinion bearing outer race which were there before disassembly in the casing and then press in the outer races with the help of tool SVO 4047, see Fig. 5-21.
4. Place the pinion in the casing and fit the same number of shims (26) which were there when disassembling and then fit the forward pinion bearing (27). Fit the wrench SVO 2404 and the press tool SVO 1845 on the front end of the pinion and tighten in the pinion, see Fig. 5-22.

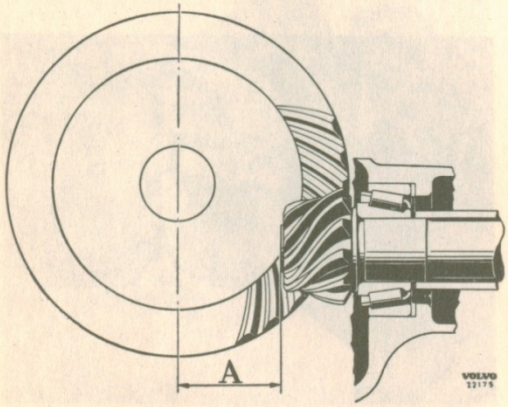


Fig. 5-23. Pinion location
A. Nominal measurement = 2.094″

5. Replace the press tool SVO 1845 with a washer and nut. Tighten the nut to a torque of 28–30 kgm. (200–220 lb.ft.) Then check the pinion bearing tension. It should be relatively easy to rotate the pinion (10–20 lb.in. = 11.–23 kgcm.). There should be no looseness. Bearing tension is adjusted by means of shims (26) on the forward pinion bearing.
6. There should be a certain nominal measurement (A, Fig. 5-23) to the center line of the ring gear. Due to tolerances in manufacture, however, there are deviations from this nominal measurement. The deviation is shown on the ground surface on the pinion by means of a figure with a plus or minus sign. If there is a plus sign in front of the figure, the nominal measurement is to be increased and in the case of a minus sign, the nominal measurement is to be decreased.
   The figure shown on the drive pinion is in thousandths of an inch.
   To check the location of the pinion, use a dial indicator, indicator retainer SVO 2284 and the measuring tool SVO 2393 which consists of two parts: a pinion gauge and an adjuster fixture. Checking is carried out in the following way:

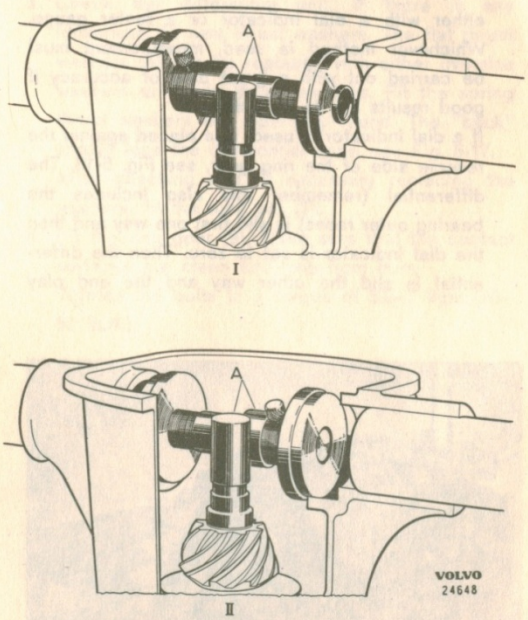


Fig. 5-24. Location of measuring tools
A. Measuring tool SVO 2393
I. Location, type Spicer mod. 23
II. Location, type Spicer mod. 27

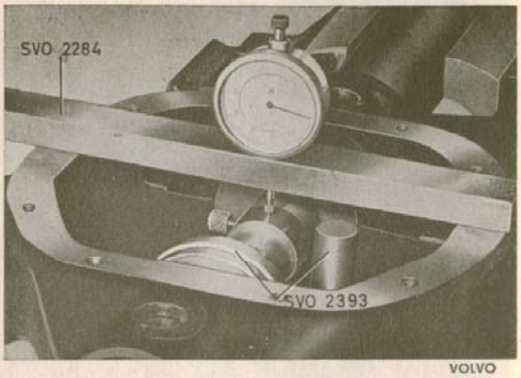


Fig. 5-25. Setting the indicator to zero

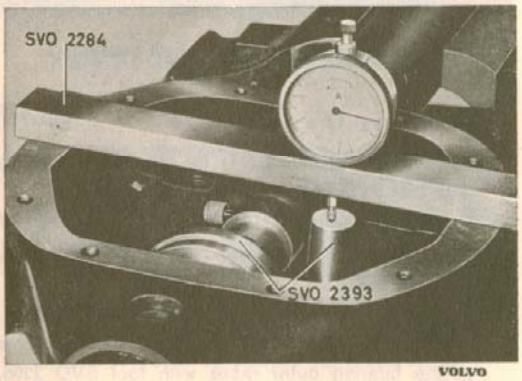


Fig. 5-26. Measuring the pinion location

Place the pinion gauge on the ground end surface of the pinion and place the adjuster fixture in the differential bearing recesses as shown at II, Fig. 5-24. Place the indicator retainer on the dry pinion carrier and zero the indicator against the adjuster fixture, Fig. 5-25.

Then move over the indicator retainer so that the indicator is against the pinion gauge, see Fig. 5-26. If the pinion is marked zero, the adjuster fixture and the pinion gauge should be at the same height. If it is marked – then the pinion gauge should be higher than the adjuster fixture and if it is marked + the pinion gauge should be lower than the adjuster fixture when adjustment is correct. Correction is carried out by adding or removing shims under the rear pinion bearing outer race. If the pinion bearing had the correct tension, just as many shims must be added or removed from the forward pinion bearing.

Conversion table for inches and millimeters	
inches	millimeters
0.001	0.025
0.002	0.051
0.003	0.076
0.004	0.102
0.005	0.127
0.006	0.152
0.007	0.178
0.008	0.203
0.009	0.229

Example. The pinion is marked + 2. The pinion gauge should then be 0.002″ under the adjuster fixture. Measurements show that the pinion gauge is 0.006″ above the adjuster fixture. The pinion must then be lowered 0.006″+0.002″ = 0.008″, so shims corresponding to this thickness (measured with a micrometer) are to be removed from under the rear pinion bearing outer race.

7. After adjusting the pinion location, check and adjust if necessary once again the pinion bearing tension.
8. Place the differential (without shims on the bearings) in the drive pinion carrier. Measure up the differential end play (the play between the pinion and the outer position of the differential). This can be measured either with an indicator against the reverse side of the ring gear or with two feeler gauges. Note the clearance obtained.
9. The clearance measured under point 8 above should be decreased by the backlash.

   Use here the average value (0.006″) of the backlash (0.004″–0.008″). An example. The measured clearance according to point 1 = 0.056″ plus tension 0.008″ = 0.064″.

   The measurement obtained according to point 8 above = 0.038″.

   Thickness of shims on ring gear side = 0.038″–0.006″ = 0.032″.

   Thickness of shims on opposite side = 0.064″–0.032″ = 0.032″.
10. Pull off the differential case bearings with puller SVO 4042. Fit shims according to the calculated values under the bearings and then press the bearings on again.
11. Fit tool SVO 2394, see Fig. 5-11 and an indicator on the drive pinion carrier. Tighten the tensioning screw so that the drive pinion carrier is expanded

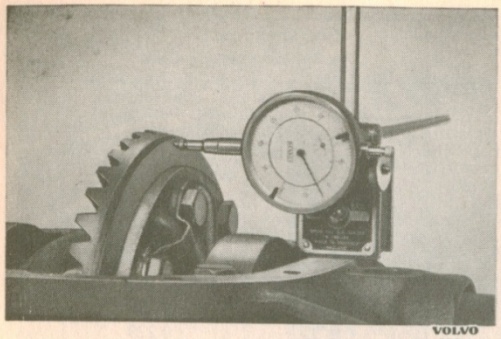


Fig. 5-27. Measuring the ring gear runout

by not more than 0.3 mm (0.012″). Remove the indicator. Fit in the differential with bearings. Then remove the tool SVO 2394.

12. Fit the caps (2) with bolts and tighten the bolts to a torque of 5.5–7 kgm (40–50 lb.ft.). Fit an indicator against the reverse side of the ring gear, Fig. 5-27. Rotate the ring gear and measure its runout. This should not exceed 0.08 mm (0.003″).
13. Measure the backlash as shown in Fig. 5-28. This should be 0.004″–0.008″.
14. Check the setting by marking the tooth contact as described under "Adjusting tooth contact".
15. When adjustment has been completed, remove the wrench SVO 2404.
16. Fit the oil slinger (24), the oil seal (25) and the paper washer. Use tool SVO 2403 for the oil seal. Then press on the flange (22) with the help of SVO 1845, see Fig. 5-8. Fit the washer and nut. Tighten the nut to a torque of 28–30 kgm (200–220 lb.ft.).
17. Fit the inspection cover and gasket.

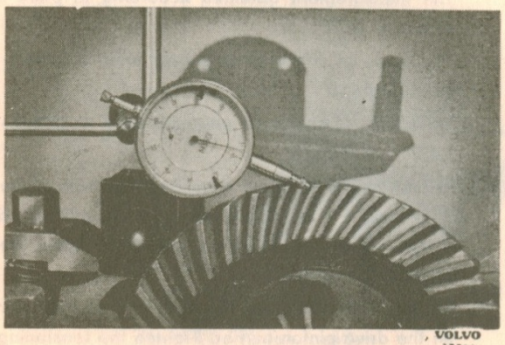


Fig. 5-28. Measuring the backlash

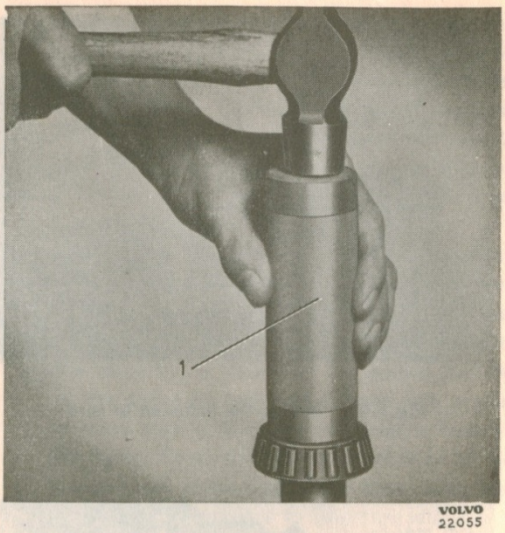


Fig. 5-29. Fitting the axle shaft bearings

1. Tool SVO 1805

Assembling the rear axle

1. Drive in the oil seals (14) for the axle shaft (13) with tool SVO 1803, see Fig. 5-4.
2. Drive the bearings (15) onto the axle shaft if they have been removed. Use tool SVO 1805, see Fig. 5-29.
3. Pack the bearings with heat-resistant grease. Fit the axle shaft in the rear axle housing. Drive in the bearing outer races with tool SVO 2205, see Fig. 5-30.
4. Fit the brake backing plates and the shims (16) as well as the retainer and felt seal (18), see Fig. 5-31.
   Check the axle shaft end play, see Fig. 5-32 and adjust if necessary. The end play should be 0.07–0.20 mm (0.003–0.008″).
5. Fit the brake lines, the hubs and brake drums.

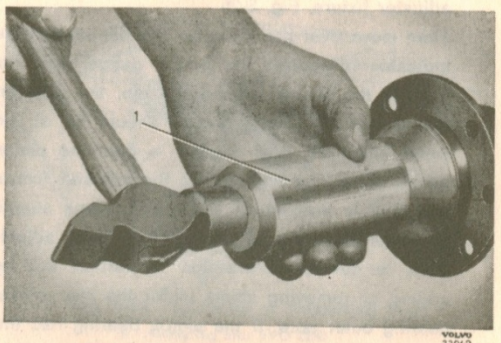


Fig. 5-30. Fitting the bearing race

1. Tool SVO 2205

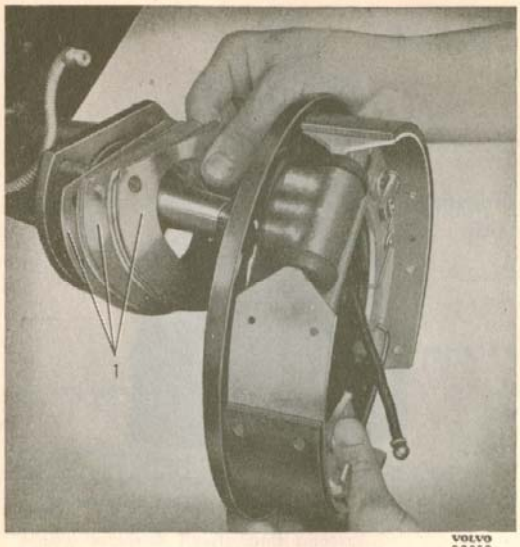


Fig. 5-31. Fitting the brake backing plate

Fitting

1. Lift up the rear axle and fit the torque rods. Slide the support arms into the retainers on the body and fit the rubber blocks, washers and nuts. Tighten the nuts a couple of turns to start with.
2. Fit the springs, retainers and rubber blocks in position. Lift up the rear axle with a jack. Tighten the support arm nuts. Fit the shock absorbers, shock absorbers straps and track bar.
3. Connect up the universal joint at the flange. Connect up the brake fluid hoses. Connect up the hand brake cables. Air-vent the brakes and adjust the hand brake. Fill up with oil.
   Use only hypoid oil.
4. Fit the wheels and wheel nuts. Lower the car and tighten the wheel nuts.

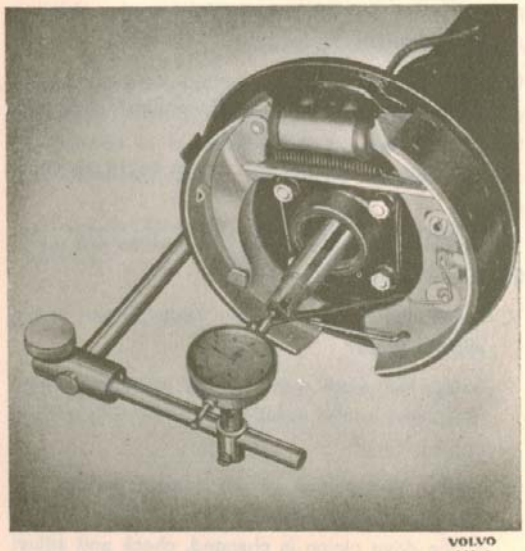


Fig. 5-32. Measuring the axle shaft end play

Adjusting tooth contact

When the rear axle is assembled it is extremely important to ensure that the ring gear and drive pinion are correctly fitted relative to each other. This does not concern only the clearance between the teeth but also the tooth contact. When the tooth contact is correct, the stresses to which the teeth are subjected when the car is driven are distributed over the greater part of the teeth surfaces. In this way tooth breakage is avoided as well as abnormally rapid wear of the gears. A further advantage is that the gears operate more quietly. The instructions given below can be used as a guide while this work is being carried out.

In order to describe tooth contact in a simple way the various parts of the gear teeth have been given special names. See Fig. 5-33 which shows one of the teeth on the ring gear.

NOTE. Adjustment is based on the contact obtained on the ring gear teeth.

The driving side is the side subject to pressure from the drive pinion when the car is driven forwards.

The reverse side is the subject to pressure when the car is reversed as well as when the engine is

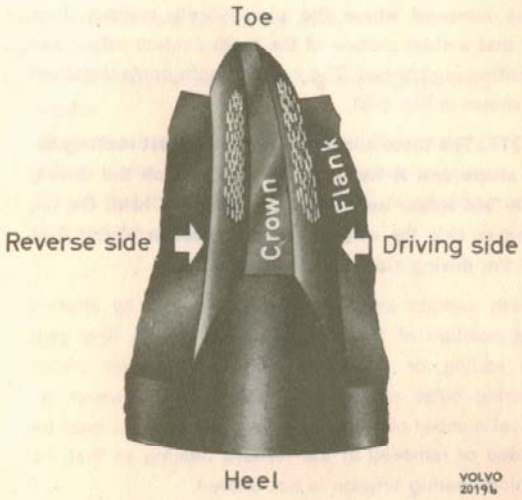


Fig. 5-33. Correct tooth contact pattern

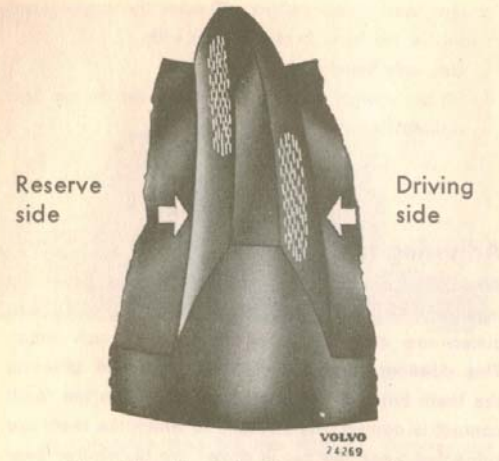


Fig. 5-34. Faulty tooth contact pattern

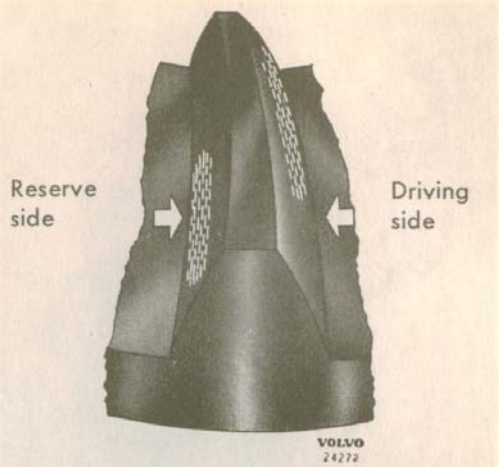


Fig. 5-35. Faulty tooth contact pattern

being used to brake the car when it is driven forwards.

The narrow end of the tooth is called the toe while the broad end is called the heel. The toe lies nearest the center while the heel is furthest out on the ring gear. In order to obtain a clear picture of tooth contact, the ring gear teeth are smeared on both sides with marking paint consisting of red lead mixed with engine oil. The marking paint must not be too thin since this can give a faulty result. All the teeth should be smeared with a thin coating of marking paint. The pinion is then rotated 10 to 12 times in both directions, at the same time as the ring gear is braked hard by using a wooden wedge or similar device. The marking paint on the ring gear teeth is thus removed where the pinion teeth contact them so that a clear picture of the tooth contact extent and position is obtained. The correct tooth contact pattern is shown in Fig. 5-33.

NOTE. The tooth contact pattern is almost rectangular in shape and is half-way up the tooth on the driving side but rather nearer the toe than the heel. On the reverse side the contact pattern is rather higher than on the driving side but otherwise similar.

Tooth contact adjustment is carried out by altering the position of the pinion relative to the ring gear by adding or removing shims at the rear pinion bearing outer race. At the same time, however, an equal number of shims of the same thickness must be added or removed at the forward bearing so that the pinion bearing tension is not altered.

Each time the position of the pinion is altered, the backlash must be adjusted and checked, see Fig. 5-28.

On a hypoid gear, the tooth contact pattern moves diagonally over the teeth and in a different direction on the driving and reverse side.

If the pinion is moved inwards, the contact pattern on the driving side moves from a high position at the heel, Fig. 5-34, to a low position at the toe, Fig. 5-35. On the reverse side, the tooth contact pattern moves at the same time from a high position at the toe. Fig. 5-34, to a low position at the heel, Fig. 5-35.

This means that the tooth contact pattern on the driving side moves in the same direction as the pinion. If the contact pattern is too far out towards the heel the pinion is moved inwards, and if the contact pattern is too far out towards the toe, the pinion is moved outwards.

When you consider that the contact pattern is correct on the driving side, look at the contact pattern on the reverse side. If the adjustment is correct, the contact patterns should be almost opposite each other.

The actual adjusting procedure is best carried out in the following way:

1. Adjust the backlash to the values shown in the specifications.
2. Smear the teeth with marking paint and rotate the pinion at the same time as the ring gear is braked.
3. Notice the position of the contact pattern and adjust as detailed above. Each time the position of the drive pinion is changed, check and adjust the backlash.

FAULT TRACING

The faults occurring in a rear axle become apparent as noise, overheating, leakage or axle shaft breakage. The noise usually encountered is a typical growling or whining sound.

FAULT	
Cause	**Remedy**
Noise possibly accompained by abnormally high temperature	
Wrong type of oil used in rear axle.	Drain off all the oil. Inspect the rear axle. Flush out the rear axle housing. Fill with hypoid oil.
Oil level too low.	Top up with oil.
Excessive bearing tension in final drive or on axle shaft.	Disassemble final drive (axle shaft) and re-adjust bearings.
Faulty backlash. Faulty tooth contact.	Disassemble final drive, adjust backlash and tooth contact in accordance with instructions.
Worn bearings.	Disassemble final drive, replace worn bearings.
Distorted rear axle housing.	Replace.
Twisted rear axle.	Replace.
Thumping sound in final drive when accelerating or decelerating	
First ensure that the sound does not depend on worn universal joints	
Worn shims on differential gears.	Fit new washers.
Differential gears or differential shaft worn.	Replace worn parts.
One of drive gears loose on hub.	Tighten loose nuts.
Worn spline on shaft or in gears.	Replace worn parts.
Leakage	
In case of leakage first check that the ventilation hole on the rear axle housing is not blocked	
Leakage at axle shaft, (oil on brake linings).	Replace oil seal inside bearing and replace felt washer.
Leakage at the pinion.	Replace oil seal and paper washer. If necessary adjust pinion bearing tension or replace bearing.
Leakage between rear axle housing and inspection cover.	Check that the sealing surfaces are clean and smooth, replace the gasket.

TOOLS

The following tools are required when carrying out repair work on the rear axle.

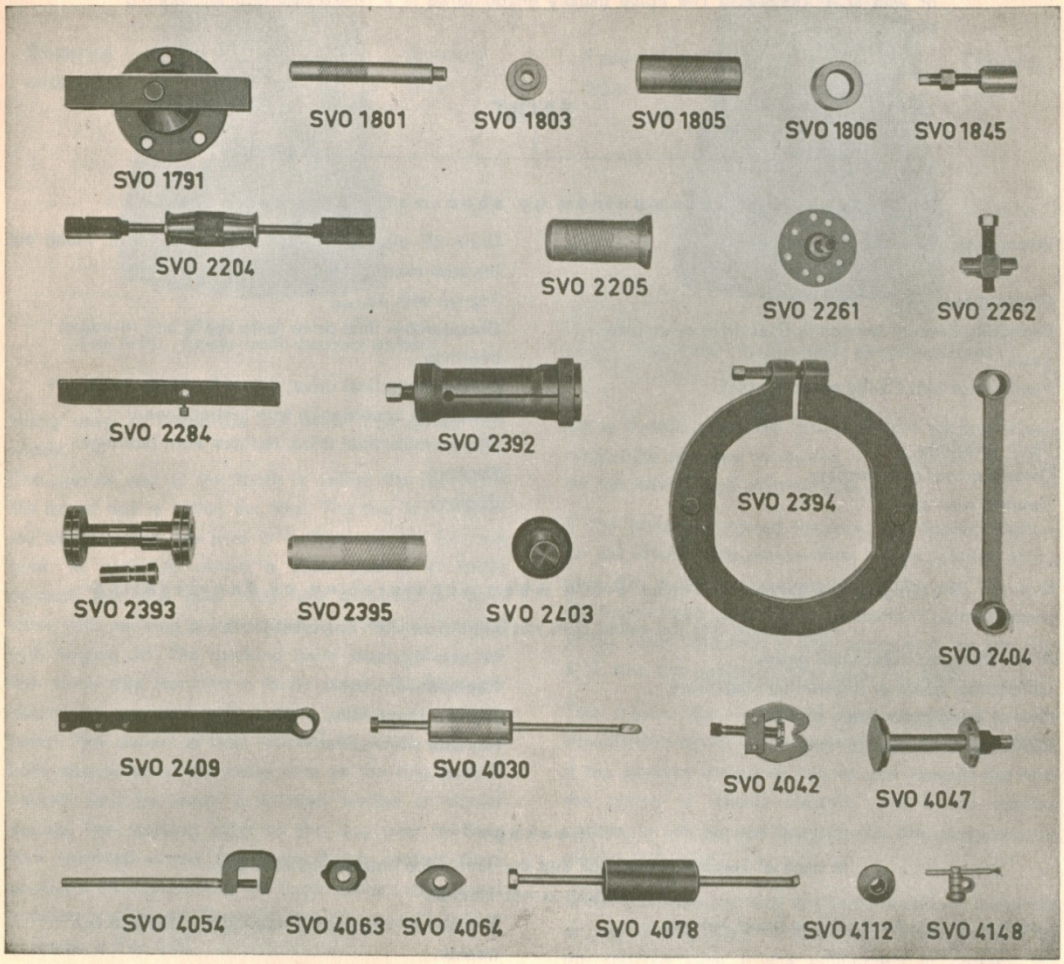


Fig. 5-36. Special tools

SVO 1791 Puller for wheel hubs
SVO 1801 Standard handle 18×200 mm
SVO 1803 Tool for fitting oil seals on axle shaft
SVO 1805 Sleeve for fitting axle shaft bearings
SVO 1806 Ring for disassembly of axle shaft bearings
SVO 1845 Press tool for fitting flange
SVO 2204 Puller for axle shaft
SVO 2205 Sleeve for fitting axle shaft bearing outer race
SVO 2261 Puller for flange, PV 544
SVO 2262 Puller for flange, P 1800
SVO 2284 Retainer for dial indicator
SVO 2392 Puller for rear pinion bearings
SVO 2393 Measuring tool for adjustment of pinion
SVO 2394 Expander tool for disassembly of differential
SVO 2395 Sleeve for assembly of rear pinion bearings
SVO 2403 Tool for fitting oil seal at flange
SVO 2404 Tool for fitting forward pinion bearings
SVO 2409 Holder for flange
SVO 4030 Puller for oil seal at flange
SVO 4042 Puller for differential case bearings
SVO 4047 Tool for fitting pinion bearing outer races
SVO 4054 Dial indicator attachment
SVO 4063 Tool for diassembling front pinion bearing outer race
SVO 4064 Tool for diassembling rear pinion bearing outer race
SVO 4078 Puller for oil seals on axle shaft
SVO 4112 Tool for assembly of differential case bearings
SVO 4148 Retainer for dial indicator

SPECIFICATIONS

Rear axle type	Semi-floating
Track width	1315 mm (51 49/64")
End play for axle shaft	0.01–0.20 mm (0.003–0.008")

FINAL DRIVE

Type	Spiral bevel (hypoid)
Ratio	4.56: 1 (9/41) or 4.1: 1 (10/41)
Runout, ring gear	max. 0.08 mm (0.003")
Backlash	0.10–0.20 mm (0.004"–0.008")
Pinion bearing tension, new bearings	11.5–23 kgcm (10–20 lb.in.)
Lubricant	Hypoid oil
Lubricant viscosity	SAE 80
Oil capacity	1.3 liters (2 1/4 Imp. pints = 2 3/4 US pints)

TIGHTENING TORQUES

	kgm	lb.ft.
Flange	28–30	200–220
Caps	5.5–7	40–50
Ring gear	5.5–7	40–50

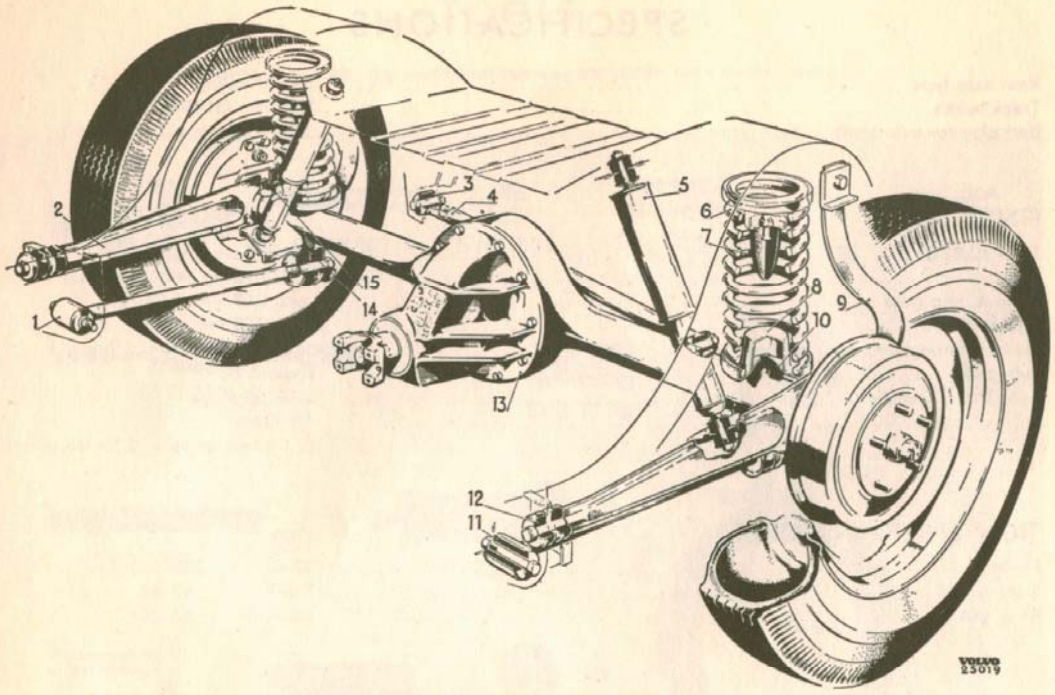
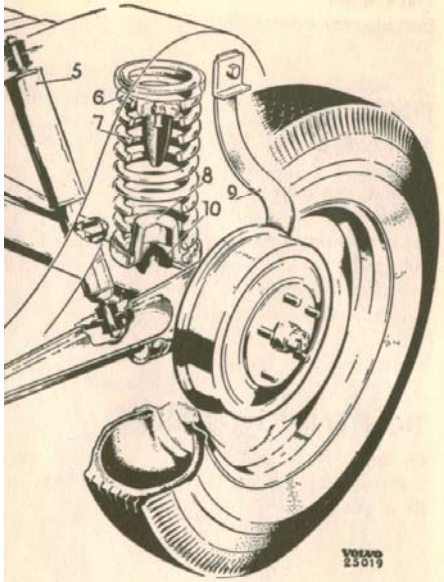


Illustration V-A. Rear suspension

1. Torque rod
2. Support arm
3. Rubber bushing for track bar
4. Track bar
5. Shock absorber
6. Spring
7. Rubber block
8. Spring retainer
9. Shock absorber strap
10. Rubber block
11. Rubber bushing for torque rod
12. Rubber bushing for support arm
13. Rear axle
14. Rubber bushing for torque rod
15. Rubber bushing for support arm



pension

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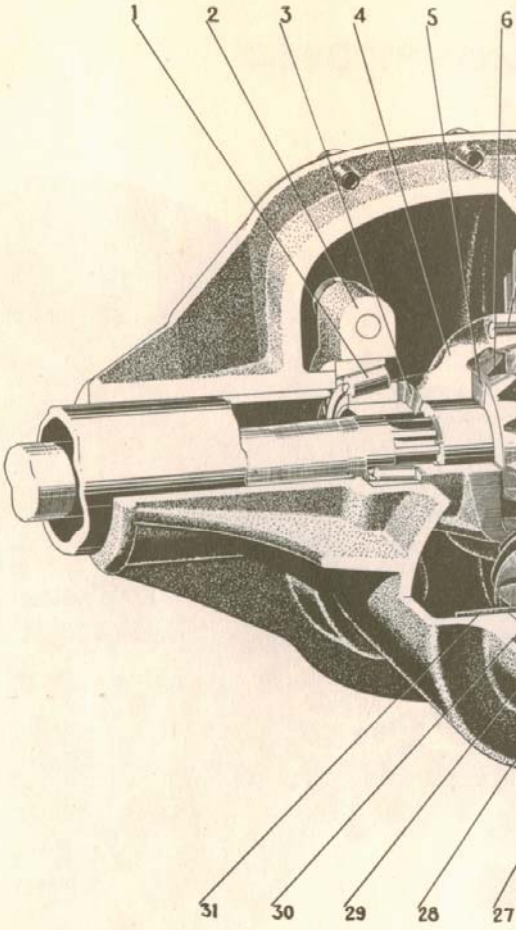

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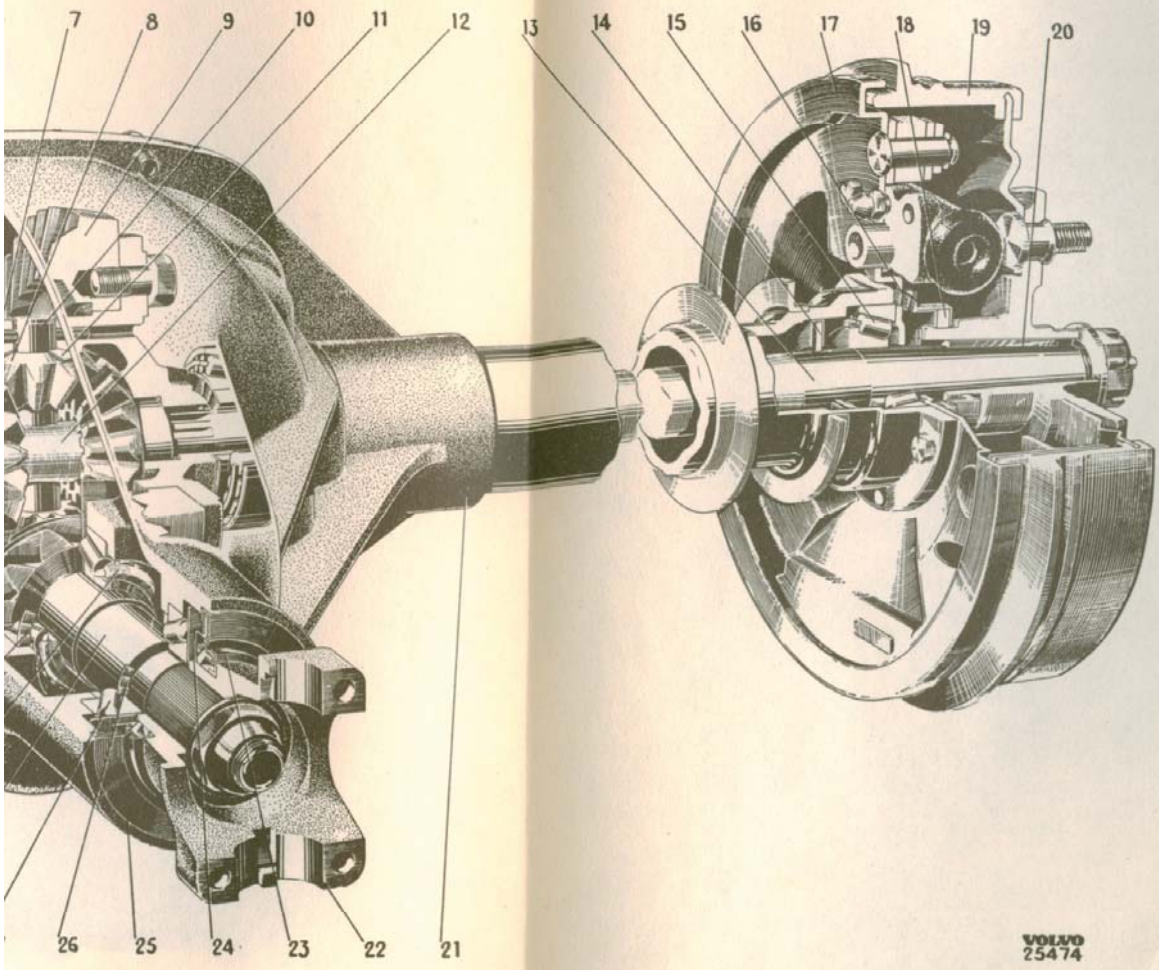


Illustration V-B. Rear axle, spicer mod. 27

'ferential case bearing
aring cap
ims
ferential case
ust washer
ferential side gear
k pin
ferential pinion gear
g gear
aft
rust washer, domed
12. Thrust block
13. Axle shaft
14. Oil seal
15. Roller bearing
16. Shims
17. Brake backing plate
18. Retainer with felt seal
19. Brake drum
20. Draw key
21. Drive pinion carrier
22. Flange
23. Dust cover plate
24. Oil slinger
25. Oil seal
26. Shims
27. Forward pinion bearing
28. Pinion
29. Rear pinion bearing
30. Shims
31. Oil slinger

PART 6

FRONT AXLE

DESCRIPTION

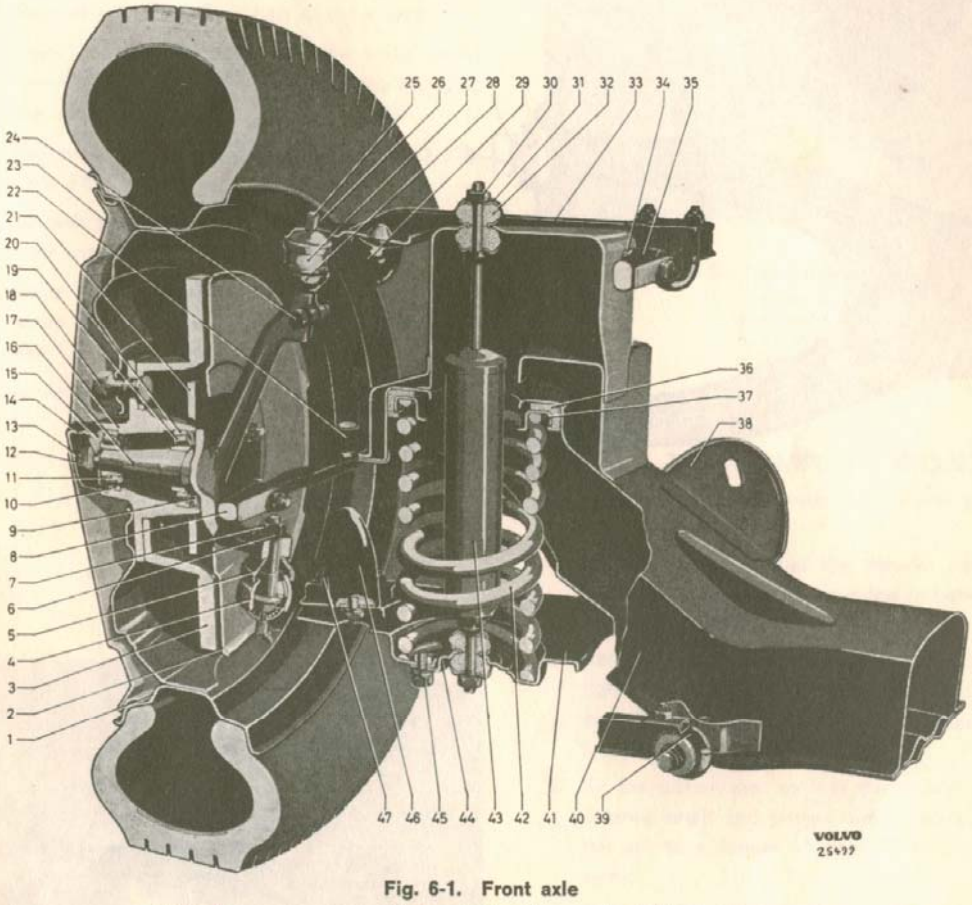


Fig. 6-1. Front axle

1. Wheel
2. Dust plate
3. Brake disk
4. Lower ball joint
5. Rubber seal
6. Castle nut
7. Split pin
8. Steering arm
9. Sealing ring
10. Outer ring, outer bearing
11. Outer roller bearing
12. Castle nut
13. Split pin
14. Grease cap
15. Washer
16. Steering knuckle
17. Hub
18. Wheel nut
19. Inner bearing
20. Outer ring, inner bearing
21. Retainer
22. Steering rod
23. Hub cap
24. Bolt
25. Grease nipple
26. Nut
27. Upper ball joint
28. Rubber seal
29. Rubber buffer
30. Nut
31. Washer
32. Rubber bushing
33. Upper control arm
34. Shim
35. Control arm shaft
36. Rubber insert
37. Washer
38. Engine mounting bracket
39. Inner attachment, lower control arm
40. Front axle member
41. Lower control arm
42. Front spring
43. Shock absorber
44. Washer
45. Bolt
46. Rubber buffer
47. Nut

The P 1800 has independent front wheel suspension. There is, therefore, no front axle as such, this being replaced by a robust box-section front axle member. This member is bolted to the front part of the self-supporting body. The wheel suspension and springs are fitted at the ends of this member. The design is shown in Fig. 6-1.

The steering knuckle (16) is flexibly attached to the upper and lower control arms (33 and 41 respectively) by means of ball joints (4 and 27 respectively). Movement at the inner attachments of the control arms is made through rubber bushings. Camber and caster are adjusted by means of shims at the upper control arm shaft and the front axle member and the side member respectively.

The front wheels are carried in taper roller bearings (11 and 19). In order to increase stability, the car is fitted with stabilizers which are attached to both the lower control arms and the body.

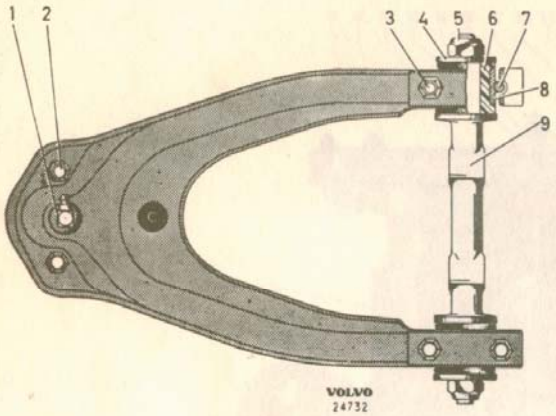


Fig. 6-2. Upper control arm

1. Grease nipple
2. Attaching nut for ball joint
3. Nut for clamp
4. Plain washer
5. Nut
6. Rubber bushing
7. Clamp
8. Sleeve
9. Upper control arm shaft

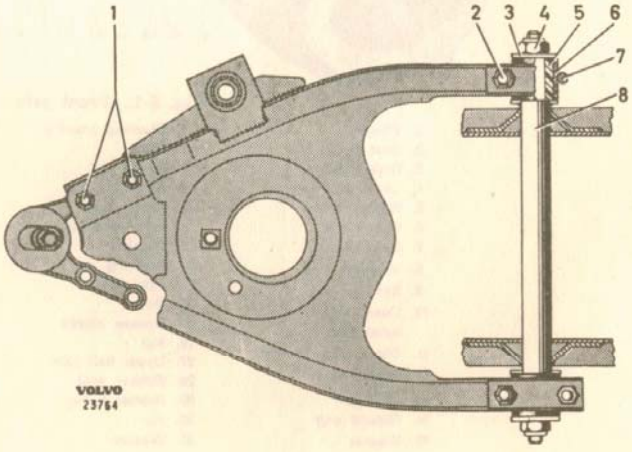


Fig. 6-3. Lower control arm

1. Attaching nuts for ball joint
2. Nut for clamp
3. Plain washer
4. Nut
5. Rubber bushing
6. Sleeve
7. Clamp
8. Lower control arm shaft

REMOVING THE COMPLETE FRONT END

1. Remove the hub caps and unscrew the wheel nuts.
2. Lift up the front end so that the wheels are clear of the ground. Place blocks under the body at the front jacking joints.
3. Remove the wheel nuts and lift off the wheels.
4. Support under the front part of the engine.
5. Place a block of wood under the brake pedal. Remove the brake lines from the body and plug the connections so that no dirt can enter.
6. Remove the pitman arm using puller SVO 2282 (Fig. 6-4).
7. Slacken the front engine mountings. Remove the idler arm bracket stabilizer from the body.
8. Place a jack under the front axle member. Unscrew the front axle member attaching bolts (2, 3 and 4, Fig. 6-5). Preserve the shims (1).
9. Lower the front axle member and pull it forwards.

Fig. 6-4. Removing the pitman arm

1. Attaching bolt for steering box

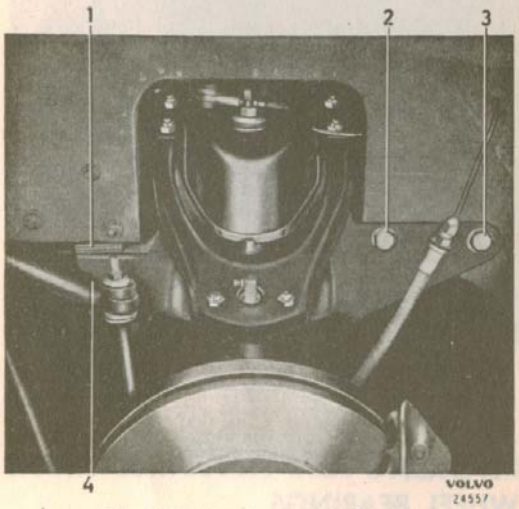


Fig. 6-5. Front axle attachment

1. Shim
2. Attaching bolt
3. Attaching bolt
4. Attaching bolt

FITTING THE COMPLETE FRONT END

1. Place the front axle member on a jack and move it under the car.
2. Raise the jack so that the member comes into the correct position. Place shims in between and tighten the bolts (2, 3 and 4, Fig. 6-5) properly.
3. Remove the support from under the engine and tighten the front engine mounting bolts.
4. Fit the idler arm bracket and stabilizer to the body.
5. Fit the pitman arm so that the markings on the steering shaft and pitman arm coincide. Tighten the nut to a torque of 100–120 lb.ft. (13.5–16.5 kgm).
6. Connect the brake leads and bleed the brake system, see Part 7.
7. Clean the contact surfaces between wheels and hubs, fit the wheels and tighten the nuts sufficiently so that the wheel cannot be displaced by the hub. Lower the car and tighten the wheel nuts. Tighten every other nut a little at a time until all of them are tightened to a torque of 70–100 lb.ft. (10–14 kgm). Fit the hub caps.
8. Check the wheel alignment. See "Wheel alignment".

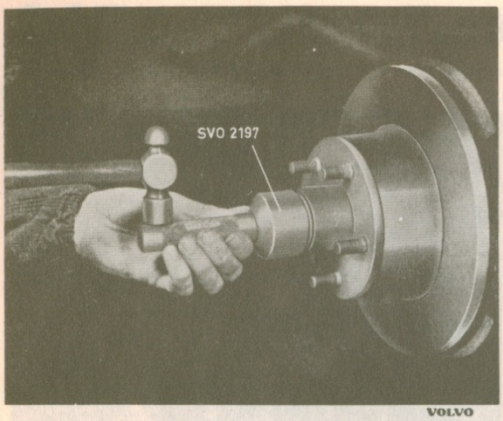


Fig. 6-6. Removing the grease cap

REPLACING AND ADJUSTING FRONT WHEEL BEARINGS

When adjusting the front wheel bearings, first remove the hub to inspect bearing races and rollers. Badly worn or scored bearings should be replaced. The procedure for replacing the bearings is described below. When only inspecting and adjusting, exclude the points which do not apply.

1. Remove the hub caps and loosen the wheel nuts slightly.

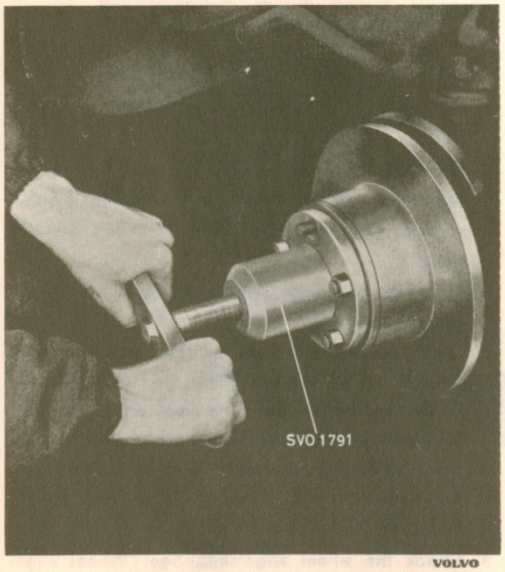


Fig. 6-7. Removing the hub

Fig. 6-8. Removing the inner bearing

2. Lift up the front end and block up under the lower control arms. Unscrew the wheel nuts and lift off the wheel.
3. Remove the brake line (3, Fig. 7-11) and plug the connections. Bend up the locking washer (5) and unscrew the attaching bolts (4 and 6). Remove the caliper (2) complete, Fig. 7-12.
4. Remove the grease cap with tool SVO 2197 (Fig. 6-6). Remove the split pin and castle nut. Pull off the hub with puller SVO 1791. (Fig. 6-7). Pull off the inner bearing from the steering knuckle spindle with puller SVO 1794 (Fig. 6-8) if the bearing remains in place.
5. Remove the bearing rings. Use drift SVO 1799

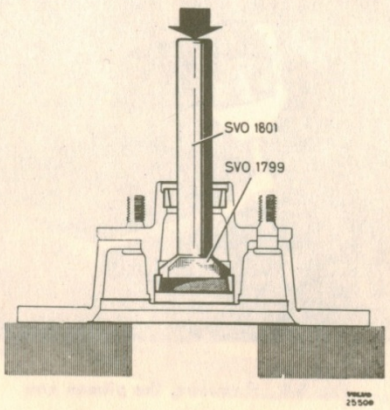


Fig. 6-9. Removing the inner bearing ring

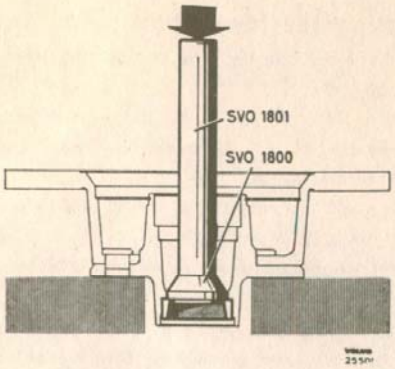


Fig. 6-10. Removing the outer bearing ring

(Fig. 6-9) for the inner bearing ring and drift SVO 1800 (Fig. 6-10) for the outer bearing ring together with the standard handle SVO 1801.

6. Clean the hub, brake disk and grease cap.
7. Press in the new bearing rings. In addition to the standard handle SVO 1801, drift SVO 1798 (Fig. 6-11) is used for the inner bearing ring and drift SVO 1797 (Fig. 6-12) for the outer bearing ring.
8. Fill grease into the bearings with the help of a pressure lubricator. If a lubricator is not available, pack in as much grease by hand as will fill up the space between the roller retainers and the bearing inner ring. Also smear grease on the outsides of the bearings and on the outer rings pressed in the hub. The recess in the hub is filled with grease all round up to the smallest diameter of the outer ring of the outer bearing, see Fig. 6-13.

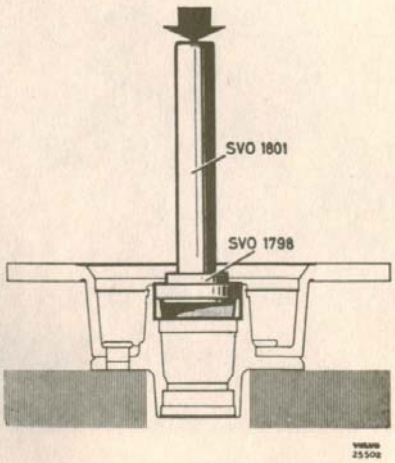


Fig. 6-11. Fitting inner bearing ring

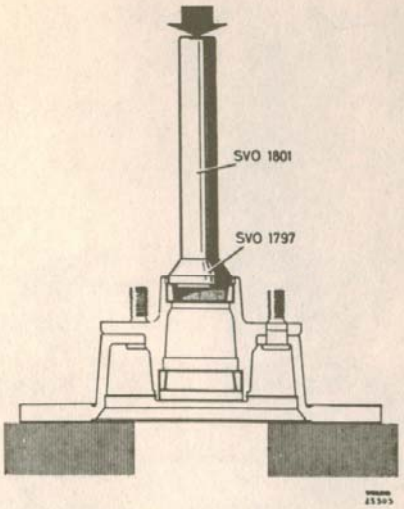


Fig. 6-12. Fitting outer bearing ring

Fit the inner bearing into position in the hub. Press in the sealing ring with drift SVO 1798 and standard handle SVO 1801 (Fig. 6-14).

9. Place the hub on the spindle. Fit the outer bearing, washer and castle nut.
10. The front wheel bearings are adjusted by first tightening the nuts with a torque wrench to a tightening torque of 50 lb.ft. (7 kgm). Then slacken the nut a third of a turn. If the recess in the nut does not coincide with the split pin hole in the spindle, slacken the nut further until the split pin can be fitted. Check that the wheel turns easily but without any looseness.
11. Fitt the grease cap half full with grease and fit it with drift SVO 2197.
12. Fit the caliper and lock the attaching bolts. Connect the brake line. Bleed the wheel unit cylinders, see Part 7.
    Clean the contact surfaces between the wheel and hub, fit the wheel and tighten the nuts

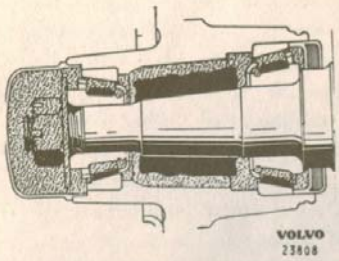


Fig. 6-13. Lubricating the front wheel bearings

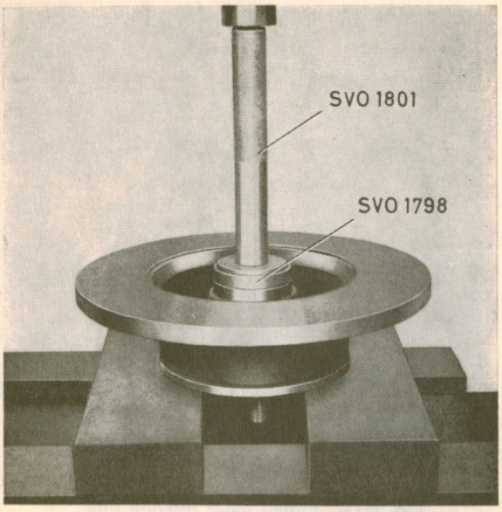


Fig. 6-14. Fitting the sealing ring

sufficiently so that the wheel cannot be displaced on the hub. Lower the car and tighten the wheel nuts. Tighten every other nut a little at a time until all of them are tightened to a torque of 70—100 lb.ft. (10—14 kgm). Fit the hub cap.

RECONDITIONING THE CONTROL ARM SYSTEM

The ball joints cannot be disassembled or adjusted so that when they are worn or damaged they must be replaced.

If the control arms have become distorted, they may only be reset to a small extent and then only in a cold condition. If when compared with a new part, the old one deviates considerably, it should be replaced.

Replacing the upper ball joint

1. Remove the hub cap and slacken the wheel nuts slightly.
2. Lift up the front end and place a block under the lower control arm. Unscrew the wheel nuts and take off the wheel.
3. Unscrew the nuts (26, Fig. 6-1) and remove the bolts. Lift the upper control arm (33).
4. Unscrew the nut and remove the bolt (24). Remove the upper ball joint (27) with sealing washer and rubber sleeve from the spindle.
5. Fitting is done in the reverse order. Fill grease between the rubber sleeve and the ball joint.

Replacing the lower ball joint

1. Remove the hub cap and slacken the wheel nuts slightly.
2. Lift up the front end and place a block under the lower control arm. Unscrew the wheel nuts and take off the wheel.
3. Screw off the nuts (47, Fig. 6-1) and remove the four bolts. Remove the split pin (7) and nut (6).
4. Disconnect the brake line from the retainer. Apply tool SVO 2281 to the spindle as shown in Fig. 6-15. The retainer for the brake line may have to be bent to the side slightly. Turn the nut of the tool untill the tool begins to tension. Turn the nut until the ball joint slackens, not, however, more than one and a half turns. If the ball joint fits so tightly that it does not slacken with this amount of turning, strike a few light blows with a hammer and counterhold on the spindle ball joint attachment.
5. Fitting is done in the reverse order. Tighten the castle nut to a torque of 35—40 lb.ft (4.8—5.5 kgm). Fill grease between the rubber sleeve and ball joint. Bleed the wheel unit cylinders if the brake lines have been removed. Check after fitting that the brake lines are well clear in all wheel positions. The brake line and control arm must not contact each other.

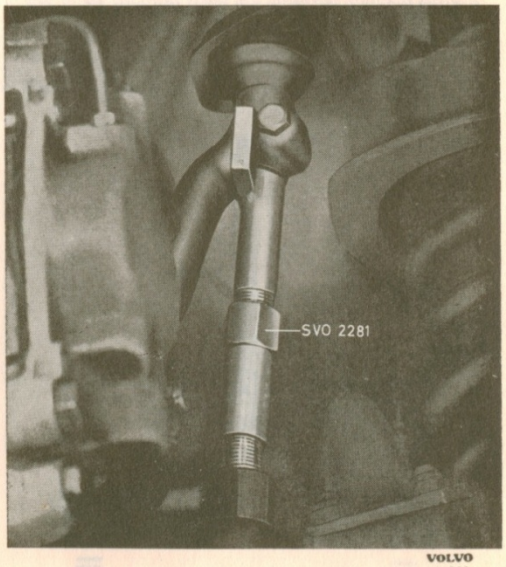


Fig. 6-15. Removing the lower ball joint

Replacing the upper control arm bushings

1. Remove the hub cap and slacken the wheel nuts slightly.
2. Lift up the front end and place a block under the lower control arm. Unscrew the wheel nuts and lift off the wheel.
3. Unscrew the nuts (3, Fig. 6-2) and remove the clamps (7).
4. Bend up the locking washer, unscrew the attaching bolts and remove the shaft (9). Preserve the shims.
5. Remove the nuts (5), washers (4) and bushings (6) together with the sleeves (8).
6. Fit the new rubber bushings (6) and sleeves (8) on the control arm shaft (9).

   Use soft soap as a lubricant to facilitate fitting the rubber bushings.

   Fit the washer (4) and tighten the nuts (5). Then fit the control arm with clamps loosely on both the bushings.
7. Place in the shims and secure the shaft (9) and control arm. Tighten the attaching bolts (2, Fig. 6-38) to a torque of 35–40 lb.ft. (4.8–5.5 kgm) and lock them with the locking plate (3).
8. Tighten the attaching nuts (3, Fig. 6-2) for the clamps to a torque of 15–17 lb.ft. (2.1–2.4 kgm). Fit the other parts in the reverse order to removing.
9. Check the wheel alignment, see under "Wheel alignment".

Replacing the upper control arm

1. Remove the hub caps and slacken the wheel nuts slightly.
2. Lift up the front end and place a block under the lower control arm. Unscrew the wheel nuts and lift off the wheel.
3. Unscrew the nuts (3, Fig. 6-2) and remove the clamps (7).
4. Remove the nuts (2) and attaching bolts for the upper ball joint and lift off the upper control arm.
5. Fitting is done in the reverse order to removing. Tighten the nuts (3, Fig. 6-2) for the clamps to a torque of 15–17 lb.ft. (2.1–2.4 kgm). Check the wheel alignment, see under "Wheel alignment".

Replacing the lower control arm bushings

1. Lift up the front end and place blocks under the axle member.
2. Unscrew the nuts (2, Fig. 6-3) and remove the clamps (7). Remove nuts (4) and washers (3).
3. Place a jack under the lower control arm inside the spring and lift it enough so that loading is removed from the bushings. Pull off the bushings (5) and sleeves (6).
4. Smear a little soft soap on the rubber bushings (5) and sleeves (6) and fit them onto the control arm shaft (8). Fit the washers (3) and tighten the nuts (4) well.
5. Lower the control arm and fit clamps (7) and nuts (2). Tighten the nuts to a torque of 15–17 lb.ft. (2.1–2.4 kgm).
6. Lower the car. Check the wheel alignment, see under "Wheel alignment".

Replacing the lower control arm

1. Remove the hub cap and slacken the wheel nuts slightly.
2. Lift up the front end and place blocks under the axle member. Unscrew the wheel nuts and lift off the wheel.
3. Remove the nuts (30, Fig. 6-1), washers (31) and rubber bushings (32). Remove the bolt (45) for the attaching washer (44). Remove the washer and shock absorber (43) downwards.
4. Place a jack under the lower control arm centrally under the spring. Raise the jack until the upper control arm rubber buffer (29) lifts.
5. Disconnect the stabilizer from the lower control arm. Remove the four attaching nuts (47) and disconnect the lower ball joint from the control arm.
6. Lower the jack slowly and remove the spring (42) when the control arm has come sufficiently far down.
7. Remove the nut and clamps at the inner attachment (39) after which the control arm can be lifted off.
8. Fitting is done in the reverse order. Tighten the nuts (2, Fig. 6-3) for the clamps to a torque of 15–17 lb.ft. (2.1–2.4 kgm). Check the wheel alignment, see under "Wheel alignment".

STEERING GEAR

DESCRIPTION

The arrangement of the steering gear on the Volvo P 1800 is shown in figures 6-16–6-19.

The movement of the steering wheel is transmitted to the wheels via the steering shaft (2), steering box mechanism (8), pitman arm (11), tie-rod (12), idler arm (15) with steering rods (7 and 17) and steering arms (5 and 18).

The steering box (Fig. 6-19) is of the "cam and roller" type. The early type idler arms (Fig. 6-17) are carried in needle bearings and the late type (Fig. 6-18) in bushings. The steering shaft is divided into two parts (2 and 6 respectively, Fig. 6-16) which are joined together by means of a coupling (3). The upper part of the steering shaft is carried in the jacket tube (1). The steering rod ball joints are lined with plastic which makes lubrication unnecessary.

The car has a turning circle of about 31'2" (9.5 metres). The number of steering wheel turns from lock to lock is 3 1/4.

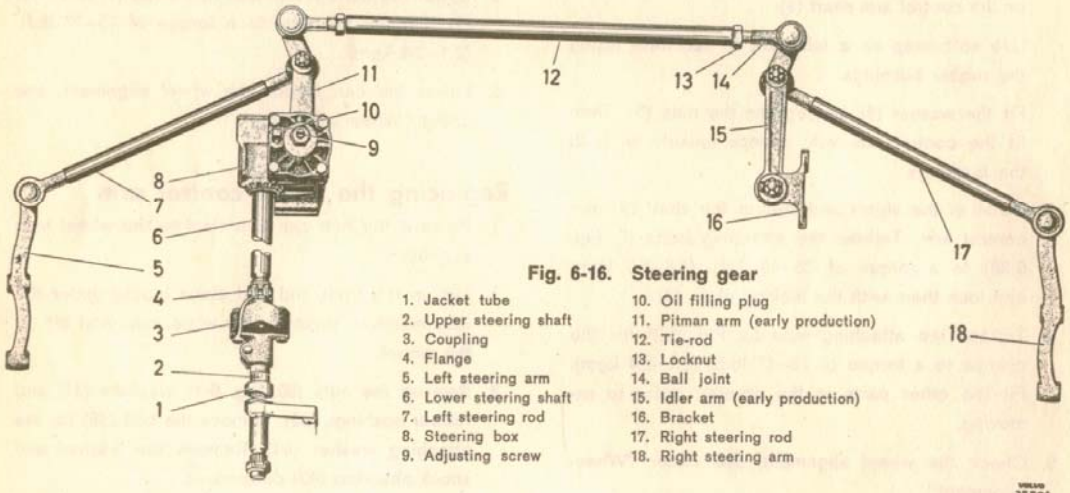


Fig. 6-16. Steering gear

1. Jacket tube
2. Upper steering shaft
3. Coupling
4. Flange
5. Left steering arm
6. Lower steering shaft
7. Left steering rod
8. Steering box
9. Adjusting screw
10. Oil filling plug
11. Pitman arm (early production)
12. Tie-rod
13. Locknut
14. Ball joint
15. Idler arm (early production)
16. Bracket
17. Right steering rod
18. Right steering arm

Fig. 6-17. Mounting of idler arm (early production)

1. Split pin
2. Nut
3. Plain washer
4. Vulcollan washer
5. Shims
6. Bracket for idler arm
7. Needle bearing
8. Seal ring
9. Vulcollan washer
10. Idler arm
11. Hole for steering rod

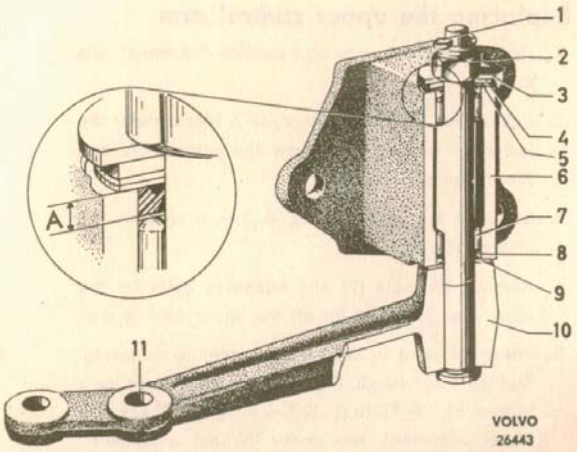
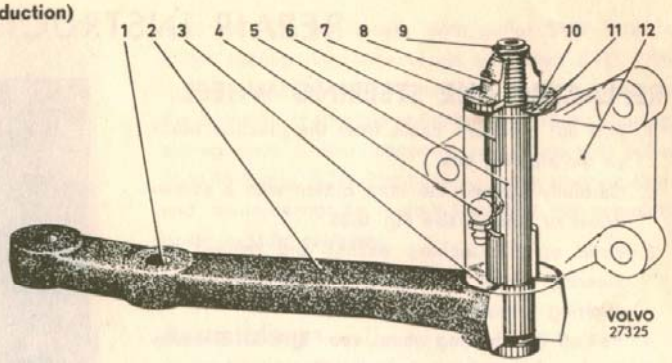


Fig. 6-18. Mounting of idler arm (late production)

1. Hole for steering rod
2. Idler arm
3. Vulcollan washer
4. Grease nipple
5. Shaft
6. Bushing
7. Washer
8. Nut
9. Locking ring
10. Vulcollan washer
11. Shims
12. Bracket



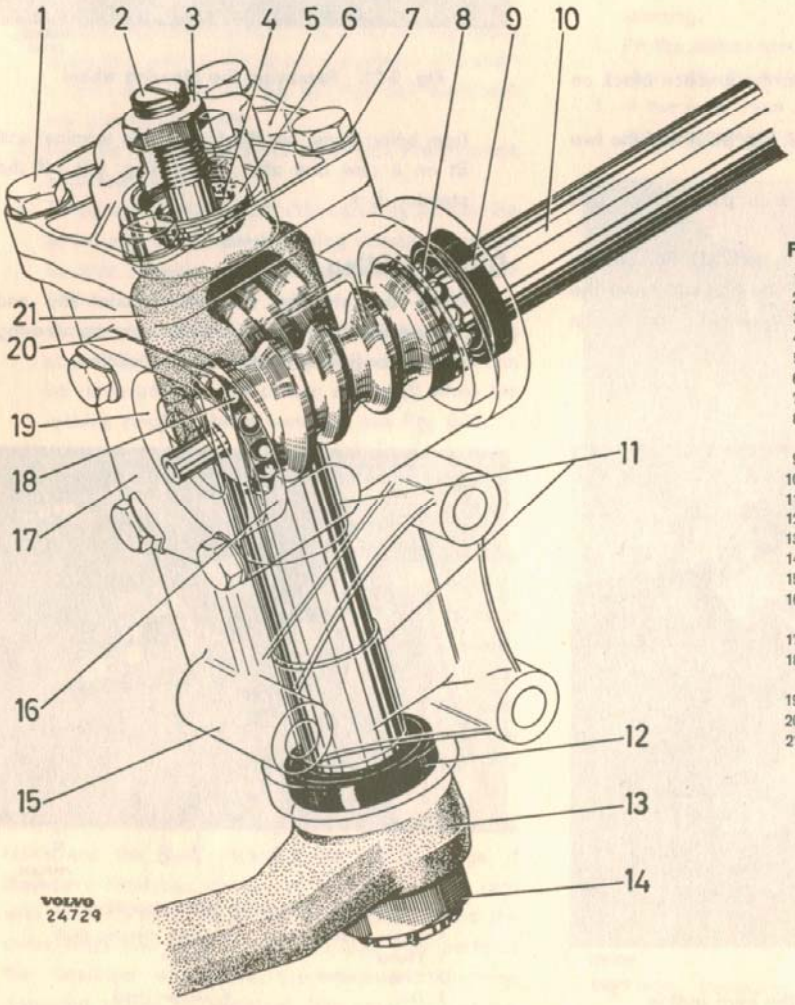


Fig. 6-19. Steering box

1. Bolt
2. Adjusting screw
3. Locknut
4. Washer
5. Cover
6. Locking ring
7. Tab washer
8. Steering shaft bearing (upper)
9. Steering shaft seal
10. Steering shaft
11. Pitman arm shaft bushings
12. Pitman arm shaft seal
13. Pitman arm
14. Nut
15. Steering box housing
16. Steering shaft lower bearing shell
17. End cover for steering shaft
18. Steering shaft bearing (lower)
19. Washer
20. Shim
21. Pitman arm shaft with roller

REPLACING THE STEERING WHEEL

1. Pull out the horn cable from the junction block on the steering box.
2. Carefully remove the horn button with a screwdriver or similar, see Fig. 6-20.
3. Bend up the locking washer and remove the steering wheel nut. Mark the position of the steering wheel.
4. Pull off the steering wheel, see Fig. 6-21. Unscrew the housing and hub from the steering wheel.
5. Fit the new steering wheel and other parts in the reverse order, observing the markings. Tighten the steering wheel nut to a torque of 20—30 lb.ft. (2.8—4.2 kgm) and then lock it.

Fig. 6-21. Removing the steering wheel

STEERING BOX

Removing

1. Pull out the horn lead from the junction block on the steering box.
2. Remove the ground lead (8, Fig. 6-22) and the two nuts (4 and 7).
3. Remove the pitman arm with puller SVO 2282 (Fig. 6-4).
4. Unscrew the three attaching bolts (1). Pull out the horn lead through the steering box and lower the steering shaft. If the cable terminal prevents this from being done, cut the lead at the terminal and fit on a new one after assembling. Lift off the steering box.

Disassembling

1. Wash the steering box clean externally and remove the flange (6, Fig. 6-22) from the steering shaft after having marked up its position.

Fig. 6-20. Removing the horn button

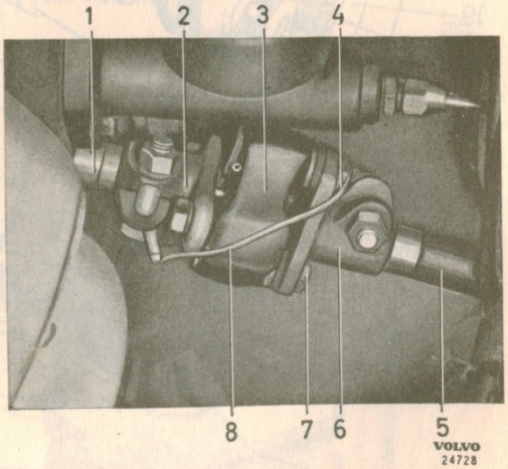


Fig. 6-22. Steering shaft coupling

1. Upper steering shaft
2. Flange
3. Coupling disk
4. Nut
5. Lower steering shaft
6. Flange
7. Nut
8. Ground lead

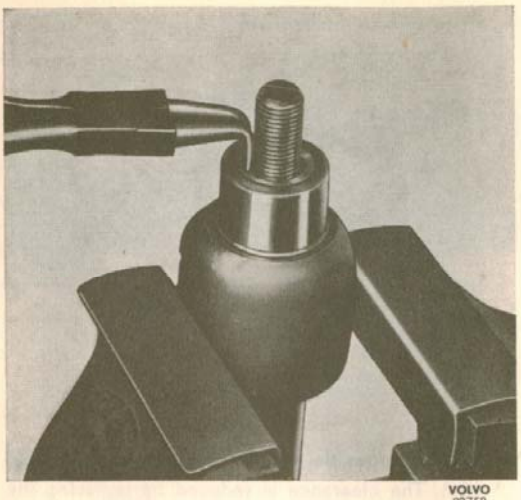


Fig. 6-23. Removing the adjusting screw

2. Remove the four bolts (1, Fig. 6-19) for the upper cover (5), pull up the cover and pitman arm shaft a little and drain off the oil. Pull out the cover and pitman arm shaft.
3. Remove the bolts and end cover (17). Preserve the adjusting shims (20).
4. Strike the steering shaft (10) carefully so that the outer race of the lower bearing comes out of the housing. Remove the steering shaft (10) with cam and bearings.
5. Slacken the locknut (3) and unscrew the adjusting screw (2) from the cover. The adjusting screw can be removed from the pitman arm shaft when the locking ring has been removed, see Fig. 6-23.

Inspection

Clean all parts in white spirit. Examine the sealing ring. If any of these show the least sign of wear or damage, they should be replaced. Removing is done with the help of puller SVO 4030 or with a screwdriver. Check the pitman arm shaft. The roller must not be scratched, scored or badly worn on the contact surfaces neither must it be loose in the pitman arm shaft. If so, or if the pitman arm shaft shows signs of other damage, replace it.

Examine the contact surfaces of the cam with the roller and the inner races of the ball bearings. If there are scratches, scoring or heavy wear, the cam with steering shaft should be replaced. Examine the outer rings and balls of the bearings. Any parts of the bearings which are scratched or otherwise damaged should be replaced. The outer ring of the upper bearing is removed with puller SVO 1819 or, if the sealing ring is removed, with drift SVO 1708. Examine whether the pitman arm shaft is loose in the bushings. If so replace the bushings in the housing, pulling them in their respective directions with puller SVO 1819 (Fig. 6-24). The bushing in the steering shaft end cover cannot be removed so that the complete cover must be replaced.

Assembling

1. Press in the pitman arm shaft bushings from their respective directions with drift SVO 2228 and standard handle SVO 1801, see Fig. 6-25. Ream the bushings with reamer SVO 2225. Use guide SVO 2254 which is fitted onto the housing with two bolts, see Fig. 6-26. Carefully clean out all metal chippings from the steering box after reaming.
2. Fit the pitman arm shaft sealing rings and steering shaft with the help of drift SVO 2227.
3. If the outer race of the upper bearing has been removed, press it in with a suitable drift. Press it

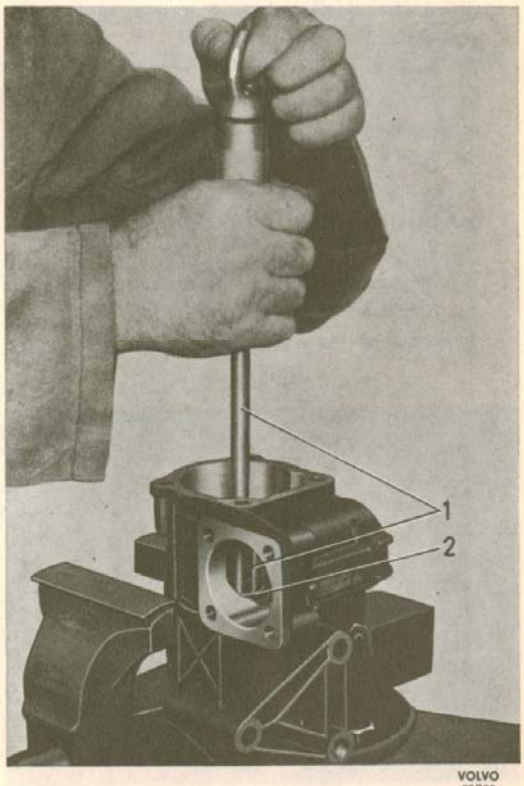


Fig. 6-24. Removing the pitman arm shaft bushings
1. SVO 1819 2. Pitman arm shaft bushing

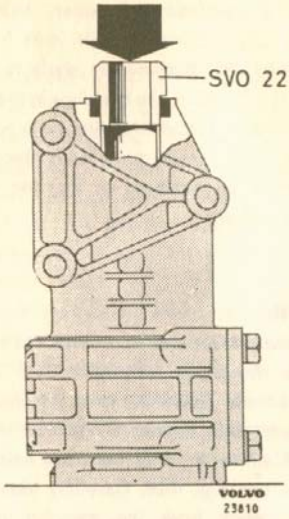


Fig. 6-25. Fitting the pitman arm shaft bushing

in so that it lies flush against the shoulder in the housing.

4. Fit the steering shaft with bearings in the housing carefully so that the sealing ring is not damaged. Clamp the steering box in a vice so that the steering shaft comes horizontal.
   Fit the steering shaft end cover and washer together with shims of the same thickness as were there previously. Tighten the cover, checking all the time that the steering shaft turns easily but without any looseness. At correct bearing adjustment a torque of 0.87–2.18 lb.in. (1–2.5 kg.cm.) is required to turn the steering shaft.
5. Fit the adjusting screw, washer and locking ring on the pitman arm shaft, see Fig. 6-27. The axial clearance of the adjusting screw should be as small as possible and not more than 0.002" (0.05 mm). The clearance is reduced by replacing the washer (2) with a thicker one. The adjusting screw should be easy to turn after fitting.
6. Apply sleeve SVO 2199 as shown in Fig. 6-28 and fit the pitman arm shaft in the steering box. Lubricate the adjusting screw in the pitman arm shaft with a few drops of oil.
7. Fit the cover and gasket over the pitman arm shaft. Screw in the adjusting screw far enough so that the pitman arm shaft is not gripped when the attaching bolts are tightened.
8. Set the steering wheel in the central position. Screw in the adjusting screw so far that a noticeable resistance is felt when turning the steering wheel either side of the central position.
   Place a spring balance at a distance of 8.3" (210 mm) from the center line of the shaft. The spring balance can also be placed on a lever fixture fitted to the steering shaft, see Fig. 6-29. Screw back the adiusting screw so that the spring balance gives a reading of 14–25 oz. (0.4–0.7 kg) when the steering shaft is pulled over the central position. The turning movement should be done at right-angles to the steering shaft (Fig. 6-29) and the steering box should be clamped so that the steering shaft is vertical when measuring. When

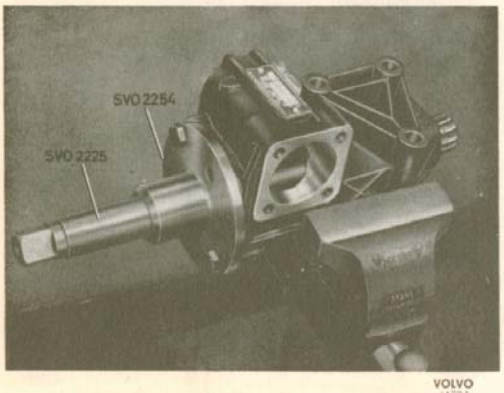


Fig. 6-26. Reaming the pitman arm shaft bushings

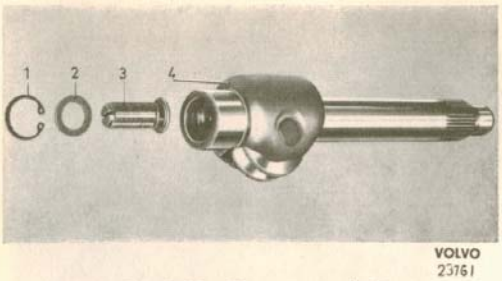


Fig. 6-27. Pitman arm shaft

1. Locking ring
2. Washer
3. Adjusting screw
4. Pitman arm shaft with roller

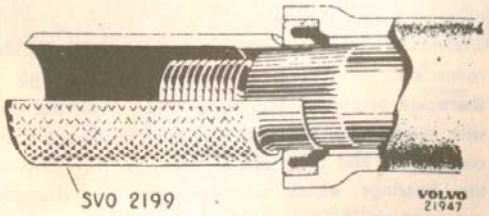


Fig. 6-28. Fitting the pitman arm shaft

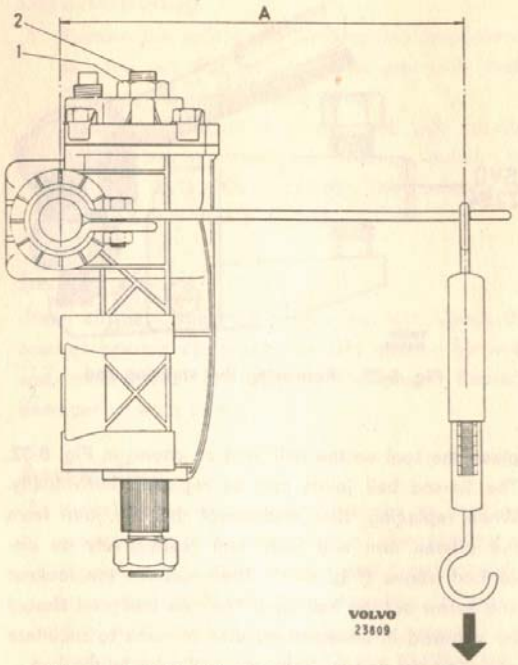


Fig. 6-29. Checking the bearing adjustment

"A" = 8.3" (210 mm)

1. Locknut 2. Adjusting screw

the correct adjustment has been obtained, the adjusting screw is locked with the stop nut. Repeat the test after the stop nut has been tightened.

9. Fit the flange on the steering shaft in the same position it had before removing.
10. Fill up the steering box with 3/8 Imp. pint = 1/2 U.S. pint (0.25 litre) of hypoid oil SAE 90. At permanent temperatures below –5° F (–20°C), however, use SAE 80.

Fitting

1. Insert the horn lead, which runs through the lower steering shaft, through the steering box, using a piece of wire if necessary. Place the steering box in position and fit on all attaching bolts, washers and nuts which have been removed.
2. Fit the flange to the coupling disk, see Fig. 6-22. Do not forget the ground lead.
3. Adjust the position of the steering box so that there is the least possible tension on the coupling disk. Tighten the steering box attaching nuts.
4. Fit the pitman arm so that the mark on the pitman arm shaft coincides with the mark on the pitman arm.
5. Check that the spokes of the steering wheel are horizontal when the wheels face directly forward. If not, remove the steering wheel and alter its position. See under "Replacing the steering wheel". Connect the horn lead.

REPLACING THE JACKET TUBE AND JACKET TUBE BEARINGS

1. Remove the steering wheel, see under "Replacing the steering wheel".
2. Unscrew the bolts (3, Fig. 6-30) for the lower

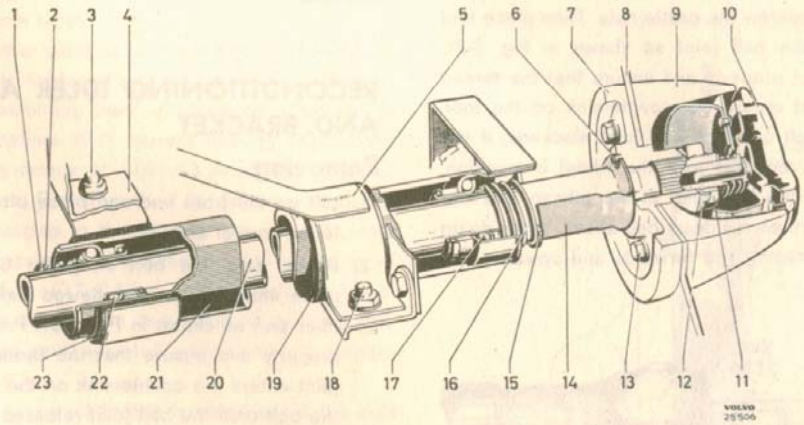


Fig. 6-30. Journaling of steering shaft

1. Locking ring
2. Spring
3. Bolt
4. Lower attachment
5. Upper attachment
6. Guide pin
7. Steering wheel hub
8. Steering wheel
9. Housing
10. Horn button
11. Steering wheel nut
12. Locking washer
13. Bolt
14. Actuator
15. Washer
16. Spring
17. Upper bearing
18. Bolt
19. Rubber bushing
20. Steering shaft
21. Jacket tube
22. Lower bearing
23. Rubber bushing

attachment and the bolts (18) for the upper attachment. Pull up the jacket tube (21) slightly and remove the traffic indicator switch and lever, see Part 10. Then pull off the jacket tube from the steering shaft (20).

3. If only the bearings (17 and 22) in the jacket tube are to be replaced, first knock out the old ones with the help of a suitable punch or pull them out with a puller. The new bearings should then be pressed into the jacket tube carefully.
4. Check that the rubber bushings (19 and 23) for the jacket tube attachment are intact and that the locking ring (1) is located in its groove. Then fit the jacket tube and other parts in the reverse order to removing and as shown in Fig. 6-30. Tighten the steering wheel nut to a torque of 20–30 lb.ft. (2.8–4.2 kgm) and do not forget to lock it.

RECONDITIONING STEERING ROD AND TIE ROD

The steering rod and tie-rod must not be straightened. If they are bent or damaged in any other way, they must be replaced.

The ball joints cannot be disassembled or adjusted so that when they become worn or damaged they must be replaced.

The steering rod ball joints are made integral with the steering rod so that the complete steering rod must be replaced. When removing, first take out the split pins and unscrew the castle nuts. Then place tool SVO 2294 on the ball joint as shown in Fig. 6-31. Press in the tool properly and ensure that the thread on the ball joint enters the countersink on the tool. Screw in the bolt until the ball joint slackens. If the steering rod is removed with the wheel in position, first disconnect the ball joint at the pitman arm and idler arm respectively as described above. When doing this, turn the steering rod forwards and upwards and

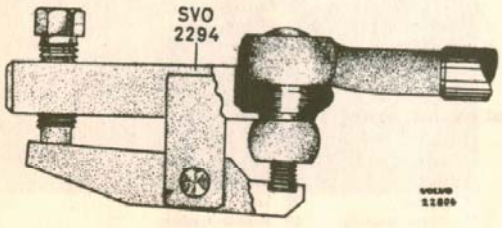


Fig. 6-31. Removing the ball joint

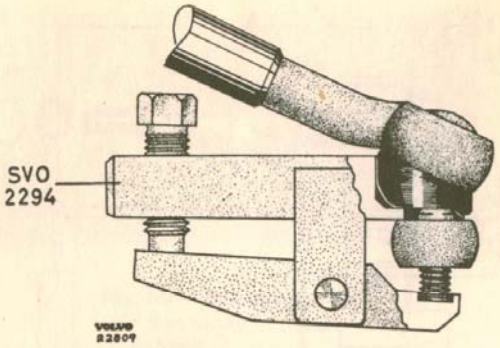


Fig. 6-32. Removing the steering rod

place the tool on the ball joint as shown in Fig. 6-32. The tie-rod ball joints can be replaced individually. When replacing, first disconnect the ball joint from the pitman arm and idler arm respectively as described above (Fig. 6-31). Then slacken the locknut and screw out the ball joint. The new ball joint should be screwed in an equal number of turns to facilitate adjusting the toe-in. Lock the ball joint to the rod.

When replacing the ball joint rubber covers, these should be filled with grease.

When fitting the ball joint to the arm, turn the ball stud so that the split pin hole is across the longitudinal direction of the rod. Tighten the castle nut to a torque of 23–27 lb.ft. (3.2–3.7 kgm) and lock it with a split pin.

After having carried out reconditioning work on steering rods and ball joints, toe-in should always be checked.

RECONDITIONING IDLER ARM AND BRACKET

Removing

1. Lift up the front end and place blocks under the lower control arm.
2. Screw back the bolt on puller SVO 2294 and place the tool on the tie-rod ball joint at the idler arm as shown in Fig. 6-31. Press in the tool properly and ensure that the thread on the ball joint enters the countersink on the tool. Screw in the bolt until the ball joint releases from the idler arm.
3. Remove the steering rod from the idler arm in a corresponding manner.
4. Remove the three bracket attaching bolts and lift off the bracket with idler arm.

Disassembling

1. Remove the split pin or locking ring respectively and the nut. Pull out the idler arm with shaft. Preserve the washers and shims.
2. Clamp the bracket in a vice and pull out the needle bearings with a bearing puller, for example, SVO 4090 (Fig. 6-33). The bushings are removed with drift SVO 2498.

Inspection

Clean all parts free from grease and dirt. Check the bracket bearing seatings, idler arm bearing surfaces and other parts for wear and damage. Replace damaged or worn parts.

Assembling

1. Press in the new needle bearings or bushings respectively. In the case of type I idler arm mounting (early production without seal rings), pressing in is done flush with the outer side. On type II (Fig. 6-17), the needle bearings are pressed in so that measurement A is 3.2–3.5 mm (0.126–0.138″). The sealing rings are fitted in these spaces with the lip turned outwards. On type III (Fig. 6-18) the bushings are pressed in 0.3–0.5 mm (0.012–0.020″) inside the outer face with the help of drift SVO 2498 (Fig. 6-34). Check the fit of the shaft in the bearings. The shaft should turn easily but without any play. On type III the bushings are reamed with reamer SVO 4153.
2. Fill the bearings and the space between them with chassis grease. Also lubricate the vulcollan washers on both sides.
3. Fit the other parts as shown in Figs. 6-18 and 6-19. The nut is tightened to a torque of 50 lb.ft. (7 kgm).
4. After assembling there must be no looseness in the journaling. With correct bearing adjustment, a turning torque of 13.0±4.3 lb.in. (15±5 kgcm.) is required. For example, if the idler arm is pulled at right-angles in the hole for the rod (the inner hole), a spring balance should give a reading of 24.5–45.5 oz. (0.7–1.3 kg). If the check should not give this result, the journaling should be disassembled and adjusted with shims of suitable thickness.

   When the correct torque is obtained, fit the split pin or locking ring respectively.

Fitting

Fit the bracket in position and tighten the attaching bolts properly. Fit the steering rod in the inner hole of the idler arm and the tie-rod in the outer hole. Tighten the castle nuts to a torque of 23–27 lb.ft. (3.2–3.7 kgm) and lock them with split pins.

Fig. 6-33. Removing needle bearing

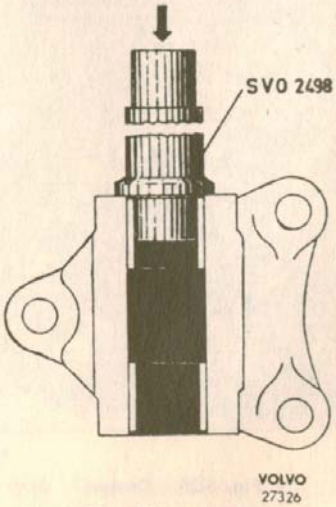


Fig. 6-34. Fitting the bushings

WHEEL ALIGNMENT

If the car is to have good steering properties and minimum tire wear, the front wheels must have certain pre-determined settings. These are known as wheel alignment and include caster, camber, king-pin inclination, toe-out and toe-in.

Caster

Caster usually refers to the longitudinal (forwards or backwards) inclination of the king-pin. On this car, which does not have a king-pin, camber consists of the deviation from the vertical of a center line through the ball joints (A, Fig. 6-35).

Camber causes the wheels to maintain a straight-forward position and so to facilitate steering.

Camber

This refers to the inward or outward inclination of the wheel. Camber is reckoned to be posivite if the wheel is inclined outwards (see Fig. 6-36) and negative if the wheel inclines inwards. Faulty camber causes uneven tire wear.

King-pin inclination

This refers to the inward inclination of the king-pin. Since this car does not have a king-pin, inclination is reckoned to be the deviation from the vertical of a center line through the ball joints. (B, Fig. 6-36).

King-pin inclination means that the center line of the king-pin and the wheel approach each other towards the road surface. The wheel is thus easier to turn. King-pin inclination also influences the tendency of the wheels to remain in a straight-forward position since the car is lifted slightly when the steering wheel is turned.

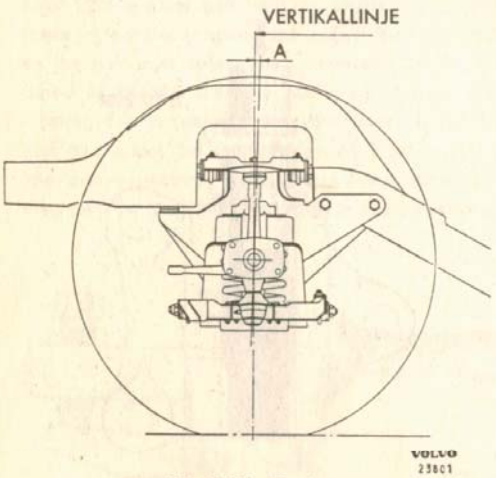


Fig. 6-35. Caster

Vertikallinje = Vertical line

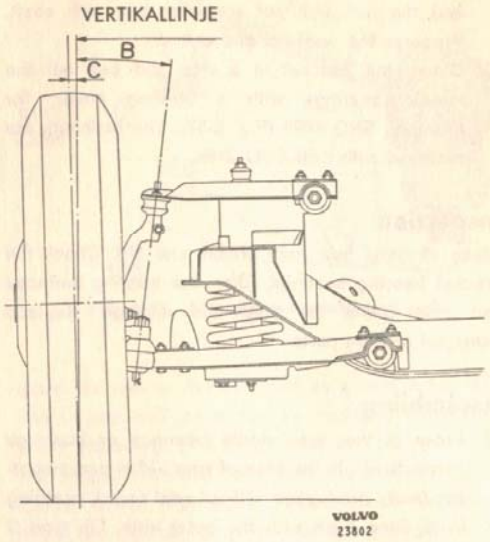


Fig. 6-36. Camber and king-pin inclination

Vertikallinje = Vertical line

Toe-out

When driving round a curve, the wheels will have different radii of rotation. In order for them to have the same pivoting center and, as a result of this, have minimum tire wear, the front wheels must be turned to different extents. This relationship, the toe-out, is determined by the construction of the steering rods and steering arms. See Fig. 6-37.

Toe-in

The difference in the distances (A and B, Fig. 6-37) between the wheels measured at hub level across the front and rear of the tires, is called toe-in. The purpose of toe-in is to reduce tire wear.

MEASURING AND ADJUSTING WHEEL ALIGNMENT

Wheel alignment is measured by means of special instruments of which many different types are available. For this reason, no general instructions concern-

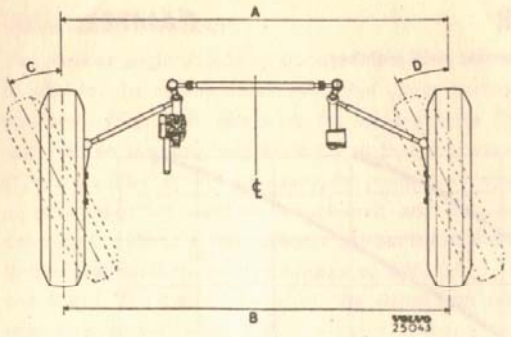


Fig. 6-37. Toe-out

ing procedure are given. Camber is measured directly, with the wheels in the straight-forward position. Caster and king-pin inclination cannot be measured directly. Instead, measurements are carried out of the angular differences on the instrument when the wheels are turned from 20° outwards to 20° inwards.

When carrying out wheel alignment measurements, always follow the instructions given with the individual instruments being used.

Precautions to be taken before adjusting wheel alignment

When checking wheel alignment, the car must be standing on an absolutely flat and level surface. In addition, the following checks should be carried out and any defects remedied.

1. Check the tire pressure on all wheels.
2. Check that the front wheel tires are worn down equally on both sides. If not, change them round with the rear wheels or spare wheel.
3. Check that the wheels do not have a greater run-out than 0.1" (2.5 mm).
4. Check that there is no excessive play in the wheel bearings, ball joints, control arms or steering mechanism.
5. Check that there is no visible damage on springs, steering rods or control arms.
6. Ensure that the car has normal equipment (oil, water, gasoline and tools) but is otherwise unloaded.

Adjusting caster

Caster should be 0° to +1°. If it is the same on both sides but of the wrong value, this is adjusted by means of shims (1, Fig. 6-5) between the front axle member and side member. When carrying out adjustment, the front end is lifted and blocks placed under the body at the jacking points. When the front axle member attaching bolts (2, 3 and 4) have been slackened, a sufficient number of shims are added or removed as may be necessary to obtain the correct caster. Tighten the attaching bolts before making a new measurement.

Shims for adjusting caster (front axle member – side member) are available in thicknesses of 2 and 3 mm. The amount by which caster can be adjusted by these shims is shown in Fig. 6-37. NOTE. The same amount of alteration must be done on both sides in order to avoid extra strain on the front axle member.

When caster is different on the right and left-hand side, adjustment is done at the upper control arm shaft (Fig. 6-38). Bend up the locking plate (3) and slacken the attaching bolts (2) so that the shims (1) can be lifted up. These shims are available in thicknesses of 0.15, 0.5, 1, 3 and 6 mm. The amount by which these alter the caster is shown in Fig. 6-39. The same amount of alteration is obtained if one shim is removed from one of the attaching bolts or if it is added to the other. In both cases the camber is altered slightly and the procedure therefore partly depends on how much it is desired to alter this. Always tighten the attaching bolts before making new measurements. When the correct caster is obtained, the attaching bolts are locked with a locking plate (3).

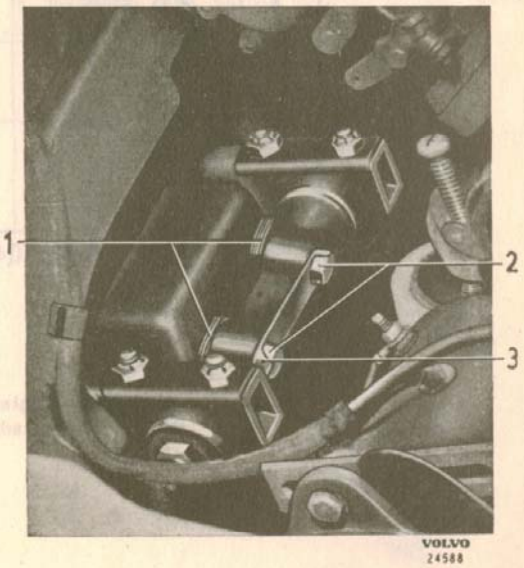


Fig. 6-38. Upper control arm attachment

1. Shims 2. Attaching bolts 3. Locking plate

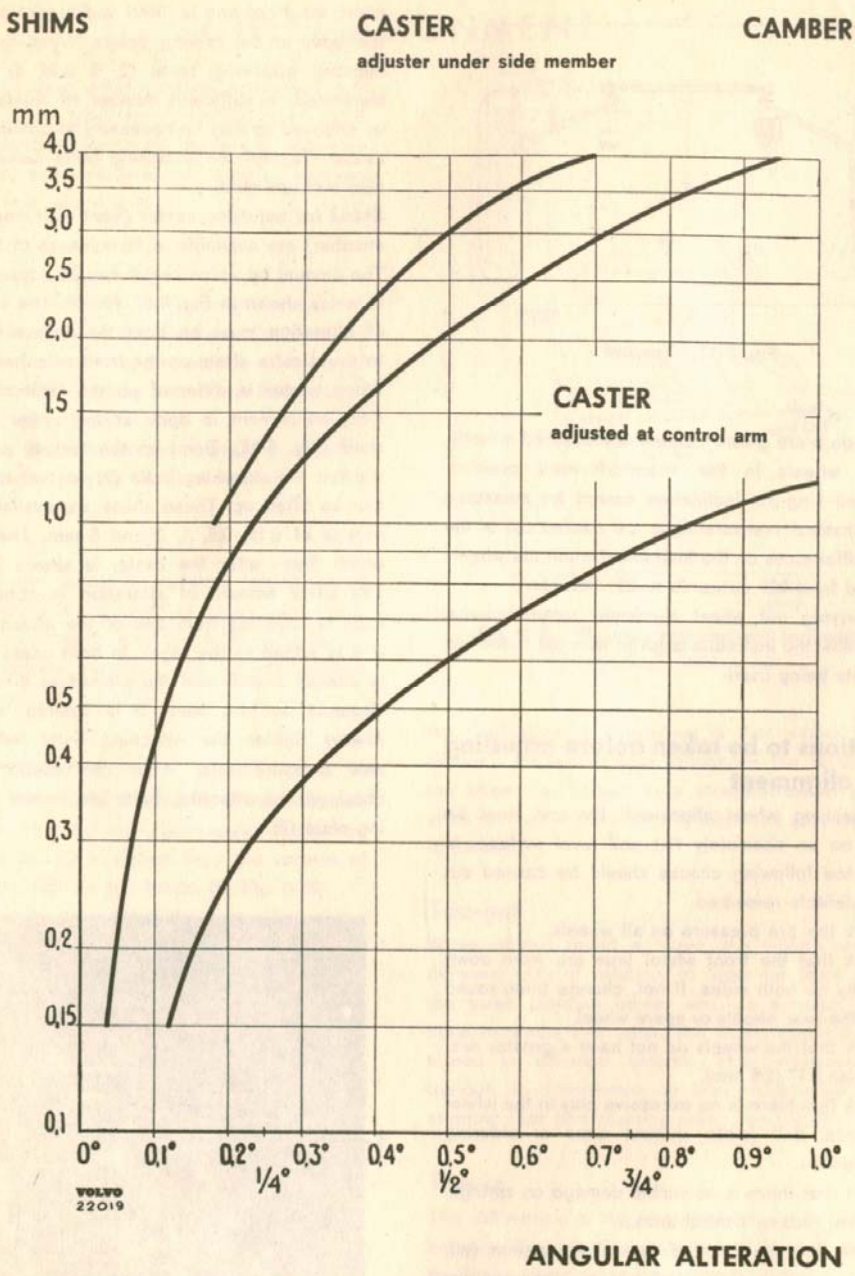


Fig. 6-39. Diagram for camber and caster adjustments

Adjusting camber

The camber angle should be 0° to +1/2°. The camber is adjusted by means of shims at the upper control arm shaft (Fig. 6-38). Bend up the locking plate (3) and slacken the attaching bolts (2) so that the shims (1) can be lifted up. By increasing the number of shims a more negative camber is obtained and by decreasing the shims a more positive camber is obtained. Shims are available in thicknesses of 0.15, 0.5, 1, 3 and 6 mm. The amount by which the shims alter the camber is shown in Fig. 6-39.

NOTE. Shims of the same thickness must be added or removed at both attaching bolts, as otherwise the caster may be altered.

After adjusting, tighten the attaching bolts and recheck the camber. When the correct camber has been obtained, lock the bolts with the locking plate (3).

Checking king-pin inclination

The king-pin inclination, which on this car corresponds to the inclination of the center line through the ball joints, should be 8° at a camber of 0°.

Checking toe-out

1. Place the front wheels of the car on turnables and ensure that the wheels are in the straightforward position. When the car is placed on the turntables they should be set to zero and locked.
2. Turn the wheels to the left until the right-hand wheel is turned 20° inwards. The left-hand turntable scale should then read 22.5±1°.
3. Turn the wheels in the other direction and read off the turning angle in a corresponding manner to that described above.
4. It is not possible to adjust toe-out and if it is faulty, the steering arms and steering rods should be checked and replaced if found to be damaged.

Adjusting steering lock

The amount by which the wheels can be turned outwards is limited by means of stop screws at the pitman arm and idler arm (Fig. 6-40). Adjustment is carried out as follows:

1. Turn the left-hand wheel inwards (as though for taking a right-hand curve) as far as possible. Check that the distance between the tire and stabilizer (measurement A, Fig. 6-41) is 0.59" (15 mm). If not, slacken the locknut (3, Fig. 6-40) for the idler arm stop screw (2) and turn this until the correct value is obtained. Then lock the stop screw.
2. Repeat the procedure with the right-hand wheel and stop screw at the pitman arm.

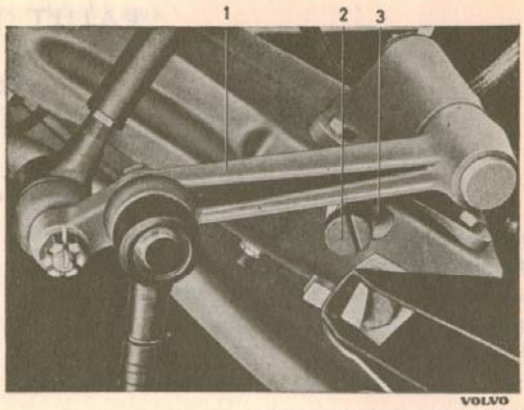


Fig. 6-40. Adjusting steering lock
1. Idler arm 2. Stop screw 3. Locknut

Adjusting toe-in

Toe-in should be 0–0.16" (0–4 mm). This is adjusted by slackening the tie-rod locking nut (13, Fig. 6-16) and turning the rod (12) in the desired direction. By turning the tie-rod the same way as the normal direction of rotation of the wheels, the distance between the tires at the front is decreased, that is to say, toe-in is increased. After having obtained correct toe-in, tighten the locknut.

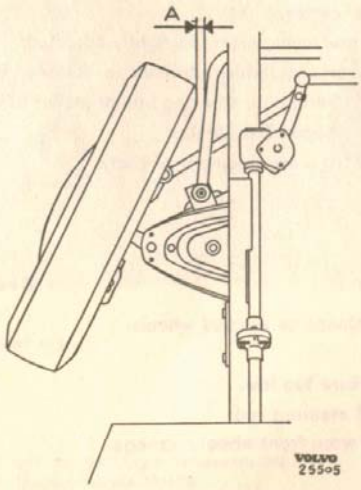


Fig. 6-41. Steering lock measurement
A = 0.59" (15 mm)

FAULT TRACING

FAULT	
Cause	**Remedy**
The car wanders	
Incorrect caster.	Check and adjust caster.
Excessive or insufficient play in the steering box mechanism.	Adjust the steering box mechanism.
Steering rod ball joints worn or too tight.	Check the ball joints and replace any which are worn.
Toe-in faulty.	Check and adjust toe-in.
Tires too soft.	Replace the tires.
Play in rear wheel suspension.	Replace the necessary parts (see Part 5).
The car pulls to one side	
Low or uneven tire pressure.	Check and adjust tire pressure (see Part 8).
Front springs sag or are of different heights.	Remove and check the springs (see Part 9).
A roller bearing is excessively tight.	Check the bearings. Replace damaged bearing and adjust according to the instructions on page 6-4.
Faulty tracking.	Check-measure the body and straighten if necessary (see Parts 11 and 9 respectively).
Brakes dragging.	Adjust the brakes (see Part 7).
Bent steering rod.	Replace damaged steering rod.
Incorrect camber.	Check and adjust camber.
Hard or stiff steering	
Tire pressure too low.	Adjust tire pressure.
Front end in need of lubrication.	Lubricate the front end.
Excessive caster.	Adjust the caster.
Steering box mechanism too tightly adjusted.	Adjust the steering box mechanism.
Too little or unsuitable lubricant in the steering box.	Top up or change the oil as required.
Damaged bearings in steering box or jacket tube.	Replace damaged bearings.
Tight or damaged ball joints.	Replace the ball joints.
Damaged front axle member or body.	Straighten or replace damaged parts.
Front wheel shimmy	
Out-of-balance or warped wheels.	Balance and if necessary true-up the wheels (see Part 8).
Tire pressure too low.	Adjust the tire pressure (see Part 8).
Damaged steering rod.	Replace the damaged rod.
Loose or worn front wheel bearings.	Remove wheel and hub. Examine bearing races. If any part is damaged, the whole bearing should be replaced.
Faulty wheel alignment.	Adjust wheel alignment.

Steering shock or kickback

Excessive play in the steering box mechanism.	Adjust or if necessary recondition the steering box mechanism.
Unsuitable or too little lubricant in the steering box.	Check the oil. Concerning this, see specifications.
Play in the front wheel bearings.	See under the heading "Front wheel bearings".
Play in steering rod ball joints.	Replace loose ball joints.
Pitman arm wrongly fitted.	Adjust position of pitman arm.
Out-of-balance or warped wheels.	Balance the wheels and true them up if necessary.
Loose steering wheel or steering box mechanism.	Tighten the steering wheel or steering box mechanism.
Play in idler arm.	Tighten or if necessary replace bushings.
Bushings in shock absorber attachments worn or attachments loose.	Replace necessary parts.
Shock absorbers not functioning.	Replace shock absorbers.

TOOLS

The following special tools are required for repairs to the front axle and steering gear

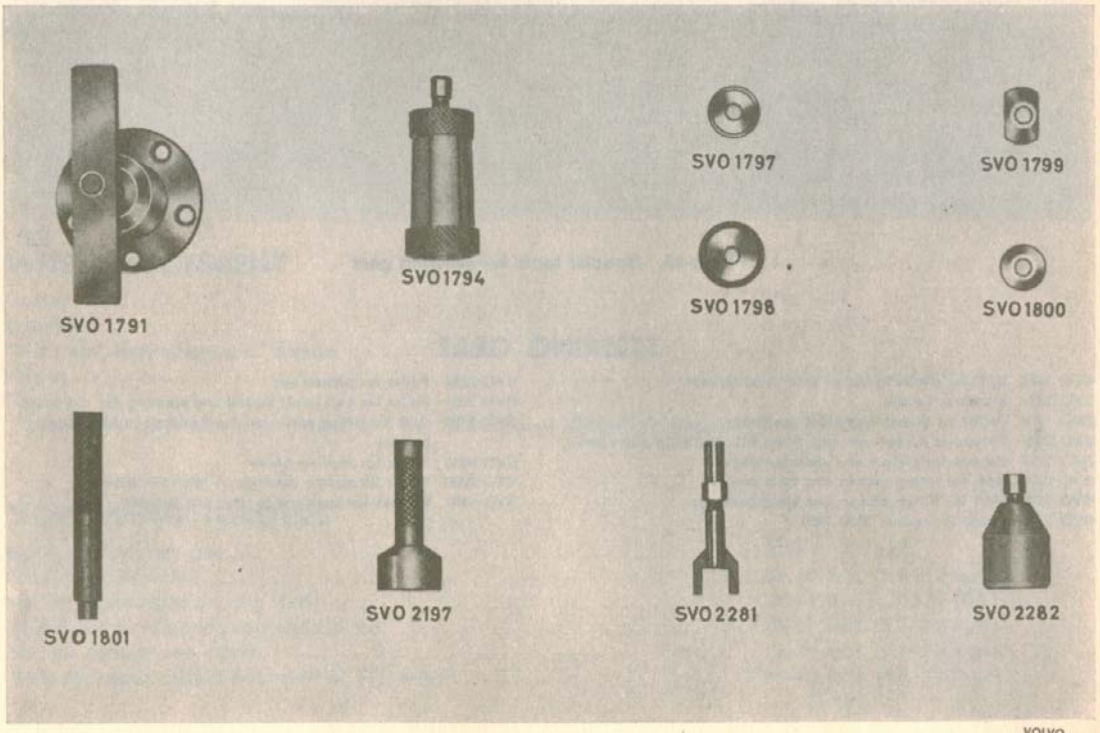


Fig. 6-42. Special tools for front axle

FRONT AXLE

SVO 1791	Puller for wheel hub
SVO 1794	Puller for inner ring, inner wheel bearing
SVO 1797	Drift for fitting outer bearing ring
SVO 1798	Drift for fitting inner bearing ring and seal in hub
SVO 1799	Drift for removing inner bearing ring
SVO 1800	Drift for removing outer bearing ring
SVO 1801	Standard handle 18×200
SVO 2197	Drift for fitting and removing grease cap
SVO 2281	Tool for removing lower ball joint, control arm
SVO 2282	Puller for pitman arm

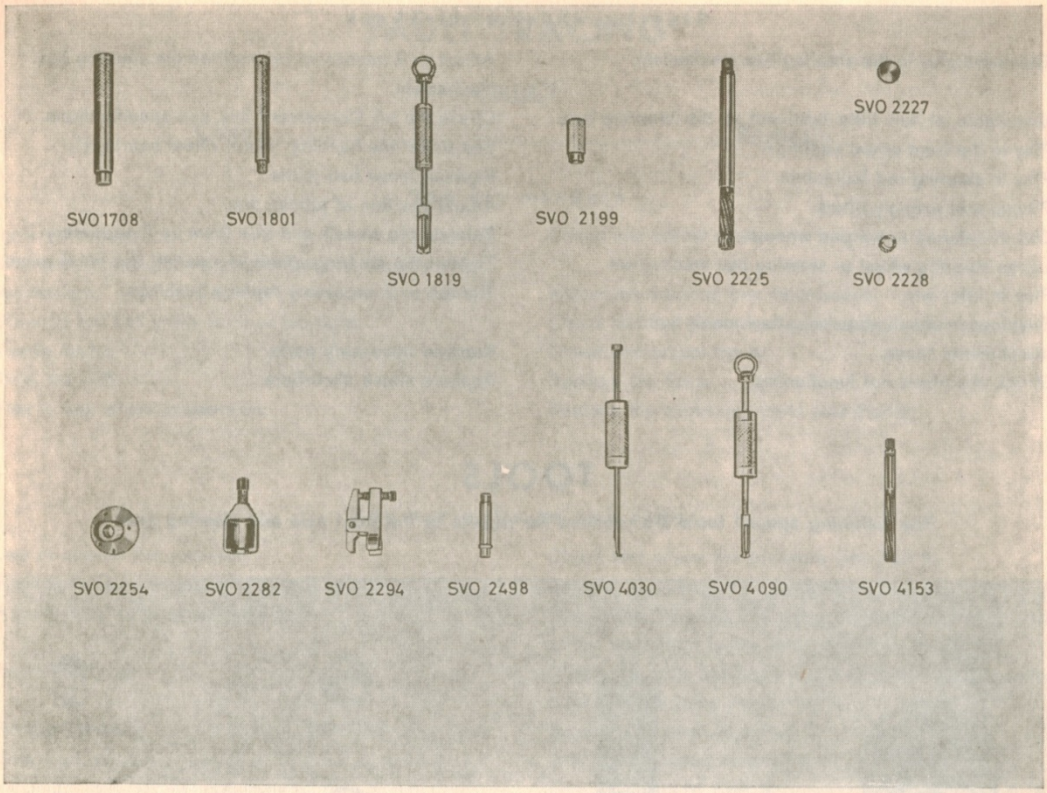


Fig. 6-43. Special tools for steering gear

STEERING GEAR

SVO 1708 Drift for removing upper outer bearing race
SVO 1801 Standard handle
SVO 1819 Puller for pitman arm shaft bushings
SVO 2199 Protective sleeve for seal when fitting pitman arm shaft
SVO 2225 Reamer for pitman arm shaft bushings
SVO 2227 Drift for fitting pitman arm shaft seals
SVO 2228 Drift for fitting pitman arm shaft bushings
SVO 2254 Guide for reamer SVO 2225
SVO 2282 Puller for pitman arm
SVO 2294 Puller for ball joint, tie-rod and steering rod
SVO 2498 Drift for fitting and removing bushings in idler arm bracket
SVO 4030 Puller for stuffing boxes
SVO 4090 Puller for needle bearings in idler arm bracket
SVO 4153 Reamer for bushings in idler arm bracket

SPECIFICATIONS

FRONT AXLE

Shims for front axle member	Thickness = 2 mm
	Thickness = 3 mm
Shims for upper control arms	Thickness = 0.15 mm
	Thickness = 0.5 mm
	Thickness = 1 mm
	Thickness = 3 mm
	Thickness = 6 mm

STEERING GEAR

Steering wheel diameter	16" (406.4) mm)
Numbers of turns (from lock to lock)	3 1/4
Steering mechanism, type	Gemmer, "cam and roller"
ratio	15.5: 1
Shims for steering worm bearings	Thickness = 0.10 mm
	Thickness = 0.12 mm
	Thickness = 0.15 mm
	Thickness = 0.30 mm
Washers between adjusting screw and pitman arm shaft (in stages of 0.05 mm)	Thickness = 2.20–2.45 mm
Lubricant for steering box	Hypoid oil SAE 90
Oil capacity	1/2 US pint = 3/8 Imp. pint (0.2 liter)
Idler arm:	
Necessary turning torque	8.7–17.4 lb.in. (10–20 kgcm)
Shims	Thickness = 0.1 mm
	Thickness = 0.35 mm

WHEEL ALIGNMENT

Caster	0 to +1°
Camber	0 to +1/2°
"King pin" inclination at 0° camber	8°
Toe-in	0 to 5/32" (0 to 4 mm)
Toe-out:	
When the outer wheel is turned 20°, the inner wheel should be turned	21.5 to 23.5°

TIGHTENING TORQUES

Nyloc nut for idler arm	50 lb.ft. (7 kgm)
Steering wheel nut	20–30 lb.ft. (2.8–4.2 kgm)
Nut for pitman arm (14, Fig. 6-19)	100–120 lb.ft. (13.5–16.5 kgm)
Castle nut for steering rod and tie-rod	23–27 lb.ft. (3.2–3.7 kgm)
Nut for control arm clamp	15–17 lb.ft. (2.1–2.4 kgm)
Bolts for upper control arm shaft (2, Fig. 6-38)	35–40 lb.ft. (4.8–5.5 kgm)

PART 7

BRAKES

DESCRIPTION

The P 1800 is equipped with two brake systems independent of each other. One of these, the footbrake, is controlled by a brake pedal and operates on all four wheels through a hydraulic system. The other brake system, the handbrake, is operated by means of a brake lever and influences both the rear wheels mechanically.

FOOTBRAKE

The design of the footbrake is shown in Figs. 7-1—7-5. The front wheel brake units are of the disk brake type. The disks (14, Fig. 7-1) are of steel and are attached to the hubs with which they rotate. A retainer (13) is fitted at each steering knuckle for the wheel unit cylinders and brake blocks, known as calipers. In addition, protective covers for the brake disks are also fitted on the steering knuckles. The brake blocks (9, Fig. 7-3) are provided with cast-in facings. When braking, one of the facings is pressed against the inner side of the brake disk by a large hydraulic plunger (10) and the other against the outer side by two smaller plungers (2). When braking ceases, the facings are moved back just enough so that they are always at a certain minimum distance from the brake disk. This means that the front wheel brake units are self-adjusting.

The rear wheel brakes are of the drum type. The upper end of the brake shoes rests against a double-acting wheel unit cylinder (9, Fig. 7-1) and the lower end against an adjusting device (10).

When the brake pedal (7, Fig. 7-1) is depressed this influences the plunger in the master cylinder (5) by means of a thrust rod (6). The hydraulic pressure in the master cylinder then rises and is transmitted through the brake fluid to the servo-brake cylinder

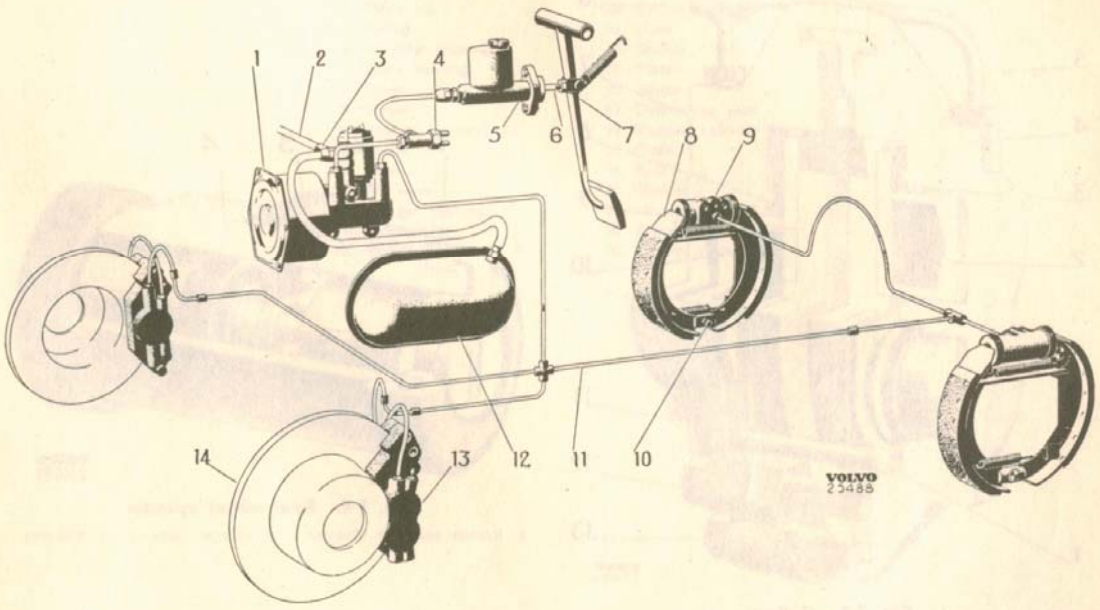


Fig. 7-1. Footbrake system

1. Servo-brake cylinder
2. Vacuum line from engine
3. Non-return valve
4. Brake contact
5. Master cylinder
6. Thrust rod
7. Brake pedal
8. Brake shoe
9. Wheel unit cylinder
10. Adjusting screw
11. Brake line
12. Vacuum tank (early prod.)
13. Caliper
14. Brake disk

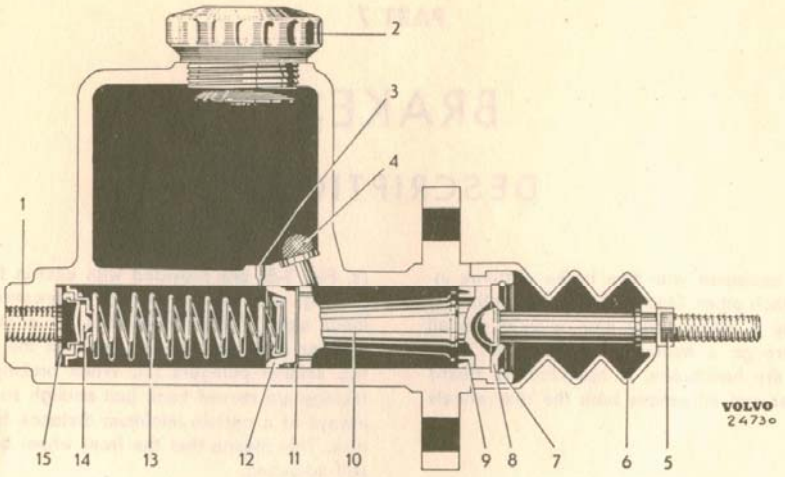


Fig. 7-2. Master cylinder

1. Connection for brake line
2. Plug
3. Equalising hole
4. Strainer
5. Thrust rod
6. Rubber cover
7. Lock ring
8. Stop washer
9. Packing
10. Plunger
11. Washer
12. Packing
13. Spring
14. Valve
15. Washer

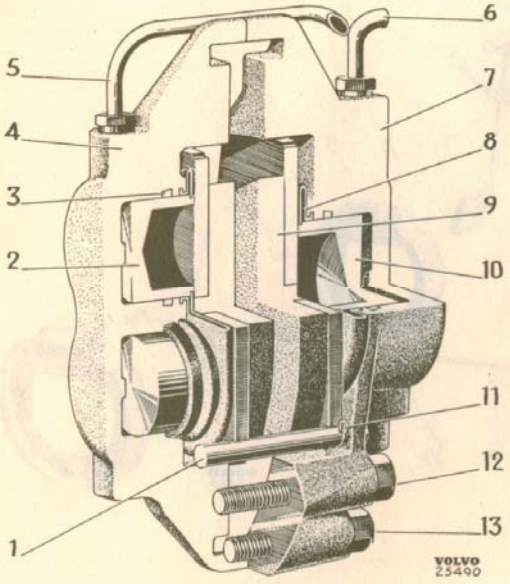


Fig. 7-3. Caliper

1. Guide pin
2. Outer plunger
3. Sealing ring
4. Outer housing
5. Connecting line
6. Brake line
7. Inner housing
8. Rubber cover
9. Brake block
10. Inner plunger
11. Locking clip
12. Bolt
13. Bolt

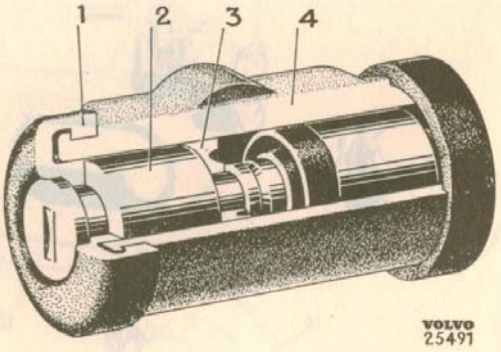


Fig. 7-4. Rear wheel cylinder

1. Rubber seal
2. Plunger
3. Plunger packing
4. Housing

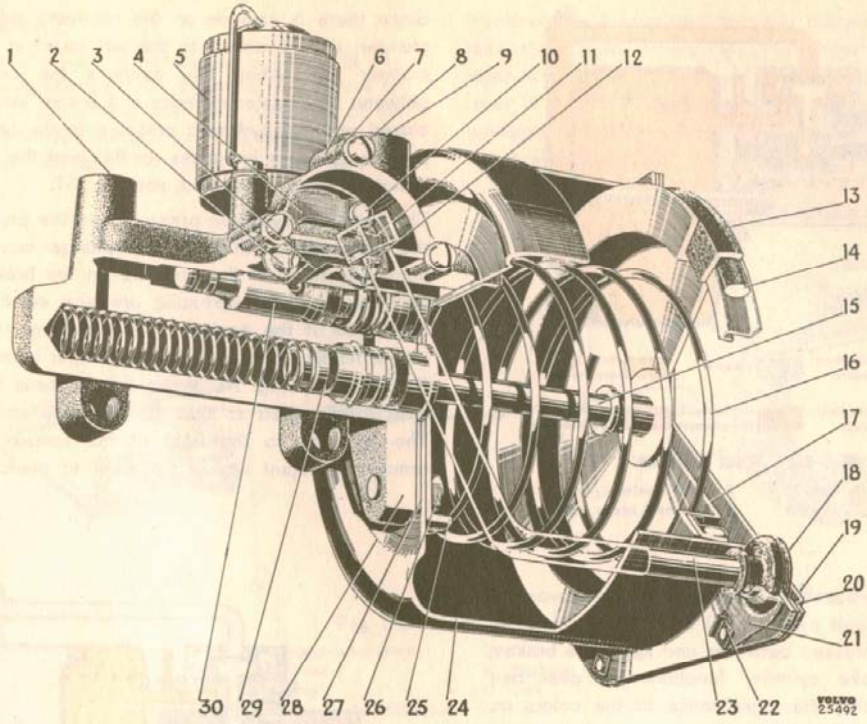


Fig. 7-5. Servo-brake cylinder

1. Connection for brake line
2. Air valve
3. Valve arm
4. Spring
5. Air filter housing
6. Valve housing
7. Cover
8. Screw
9. Vacuum connection
10. Screw
11. Yoke
12. Air valve
13. Plunger packing
14. Rubber ring
15. Plunger rod
16. Return spring
17. Plunger
18. Rubber bushing
19. Cover
20. Gasket
21. Plate
22. Screw
23. Connecting pipe
24. Vacuum cylinder
25. Plate
26. Bolt
27. Gasket
28. Housing
29. Plunger
30. Control plunger

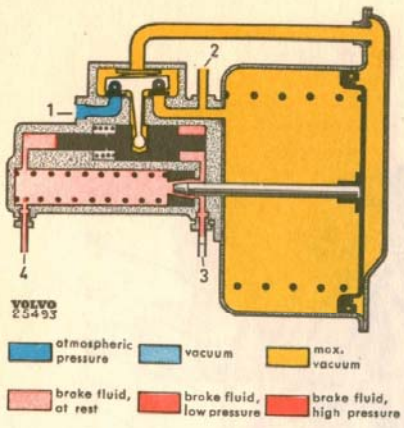


Fig. 7-6. Rest position

1. From air filter
2. From vacuum tank
3. From master cylinder
4. To wheel brake units

(1) where it is boosted. The pressure then moves out to the wheel unit cylinders (9 and 13) in which the plungers are pressed outwards and apply the brakes. The servo-brake cylinder functions as described below. Regarding the significance of the colors on the figures, see Fig. 7-6.

When the system is at rest (Fig. 7-6) the control plunger is kept pressed to the right so that the air valve remains closed and the vacuum valve open. The same vacuum therefore exists on both sides of the vacuum plunger which is kept pressed to the right by the return spring. When the pressure in the master cylinder rises, the hydraulic pressure in the servo-brake cylinder also rises to the same extent. Since the right-hand pressure surface of the control plunger is larger than the left, the plunger is moved to the left. When this happens the valve arm also moves, the vacuum valve closes, the air valve opens and air flows into the right side of the vacuum plunger.

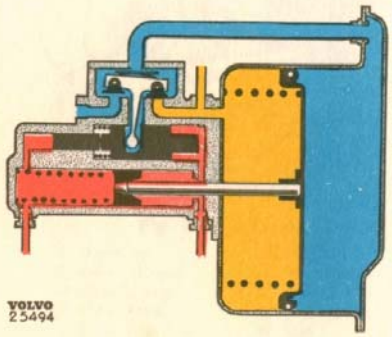


Fig. 7-7. Applying brakes

Since there is vacuum on the left-hand side of the plunger, this is moved to the left together with the plunger rod. When this happens the connection between the master cylinder and brake lines is first closed and the hydraulic pressure to the left of the pressure plunger increases. In this way the outgoing brake pressure is boosted, see Fig. 7-7.

The outgoing hydraulic pressure and the pressure on the left-hand side of the control plunger increases as more air enters. If the pressure on the brake pedal, and therefore the hydraulic pressure on the large, right side of the control plunger remains unaltered, this is finally overcome and the plunger is pressed to the right, see Fig. 7-8. When this happens the valve arm is influenced so that the air valve also closes. The pressure to the right of the vacuum plunger remains constant and is not able to overcome the

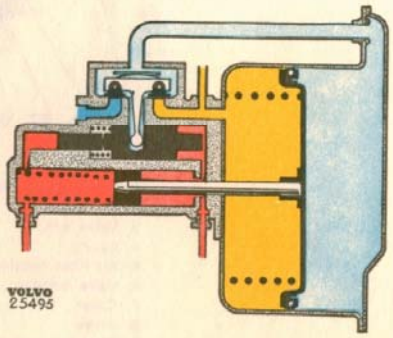


Fig. 7-8. Constant braking

hydraulic resistance in the pressure cylinder. The moving parts of the servo-brake cylinder therefore remain in this position and constant braking is obtained as long as the same pressure is maintained on the pedal.

If the pressure on the pedal is decreased, the hydraulic pressure on the right-hand side of the control plunger is also decreased and the plunger is moved further to the right. The valve arm is then turned so that the vacuum valve opens. The spaces on both sides of the vacuum plunger thus have a free passage between each other, the pressure equalizes and the plunger is moved to the right by spring pressure. The pressure of the plunger rod on the hydraulic plunger decreases and this plunger is pressed back to the right so that the outgoing brake pressure decreases. If the pedal is released completely, all the parts of the servo-brake cylinder will return to the rest position and the brakes will disengage.

HANDBRAKE

The arrangement of the handbrake is shown in Fig. 7-9. The handbrake lever (5) is placed in the floor on the outside of the driving seat. The movement of the lever is transmitted via pull-rod (20), shaft (21) with lever and pull-rod (2) to the clevis (4). From here the movement is transmitted through cables (8) to the rear wheel brake levers (14). The upper end of this lever is attached to the rear brake shoe. When the lever is pulled forwards the shoes (16) are pressed outwards with the help of the link (13) so that the handbrake is applied.

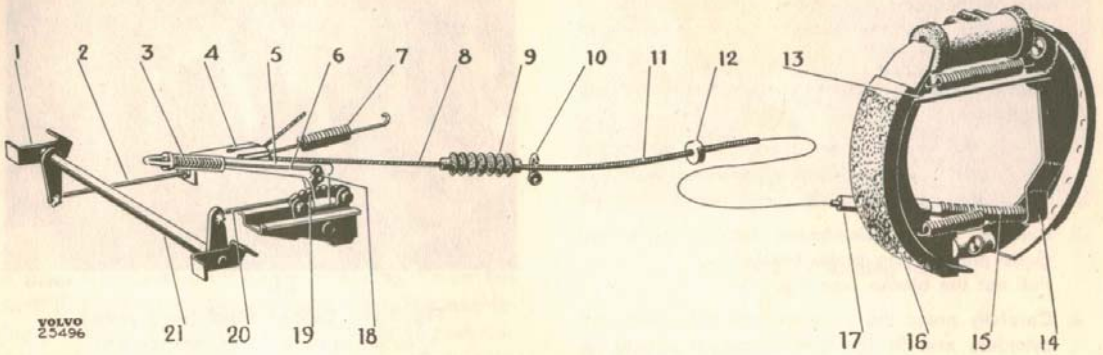


Fig. 7-9. Handbrake

1. Support attachment
2. Pull-rod
3. Spring
4. Clevis (early production)
5. Handbrake lever
6. Thrust rod
7. Return spring
8. Handbrake cable
9. Rubber cover
10. Attachment for outer casing
11. Outer casing
12. Bushing
13. Link
14. Lever
15. Return spring
16. Brake shoe
17. Sleeve
18. Pawl
19. Toothed segment
20. Pull-rod
21. Shaft

FOOTBRAKE

Front wheel brake units

Replacing brake blocks

The brake blocks should be replaced when about 1/8″ (3 mm) of the facing thickness remains. Under no circumstances may the facings be worn down to below 1/16″ (1.5 mm).

1. Remove the hub cap and slacken the wheel nuts slightly.
2. Lift up the front end and place blocks under the lower control arms. Unscrew the wheel nuts and lift off the wheel.
3. Remove the hairpin-shaped locking clips and guide pins for the brake blocks.
   Pull out the blocks, see Fig. 7-10.
4. Carefully press the plungers into the wheel unit cylinders and fit the new blocks. It should be noted that the brake fluid level in the master cylinder will then rise and may possibly overflow. Refit guide pins and locking clips.
5. **Depress the brake pedal several times and check that the movement feels normal.**

   As a rule air-venting need not be carried out after replacing the brake blocks.
6. Lift on the wheel after having cleaned the contact surfaces between the wheel and hub free from sand and dirt and tighten the nuts sufficiently so that the wheel cannot be displaced on the hub. Lower the car and tighten the wheel nuts. Tighten every other nut at little at a time until all are tightened to a torque of 70—100 lb.ft. (10—14 kgm). Fit the hub cap.

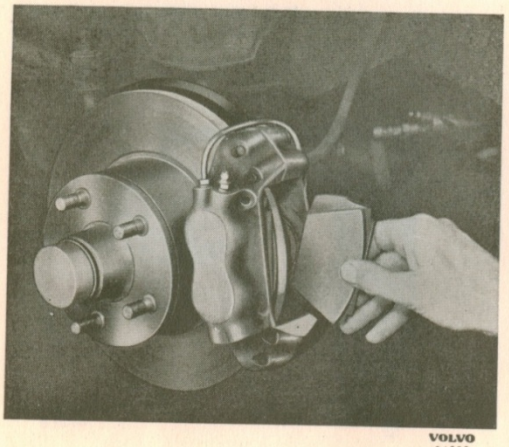


Fig. 7-10. Fitting the brake blocks

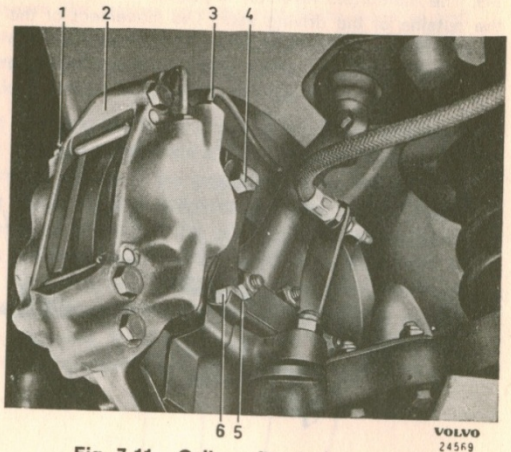


Fig. 7-11. Caliper, fitted (early prod.)

1. Air venting nipple
2. Caliper
3. Brake line
4. Attaching bolt
5. Locking washer
6. Attaching bolt

Reconditioning wheel unit cylinders

Removing

1. Remove the wheel, see operations 1—2 under "Replacing the brake blocks".
2. Clean the caliper externally.
3. Disconnect the brake line (3, Fig. 7-11) and plug the connection. Make sure that no brake fluid runs onto the brake disk or blocks. Bend up the locking washer (5) and unscrew the attaching bolts (4 and 6). Lift off the caliper (2) complete, see Fig. 7-12.

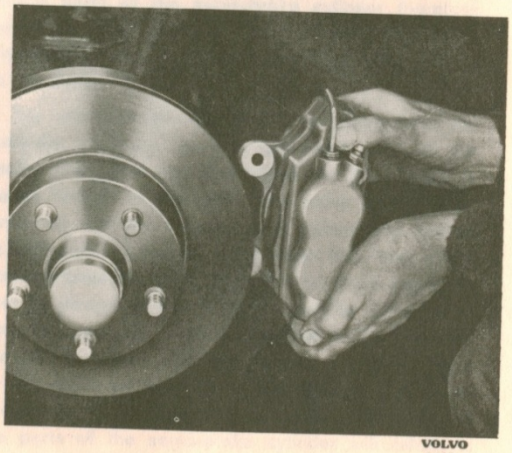


Fig. 7-12. Removing the caliper

Disassembling

1. Remove the hairpin-shaped locking clips (11, Fig. 7-3) and guide pins (1). Pull out the brake blocks (9).
2. Remove the plungers and pull off the rubber cover (8).
3. Remove the sealing rings (3) from the cylinders with the help of a blunt tool. Be careful to ensure that the edges of the grooves are not damaged.

Inspection

Before inspection wash all parts in methylated spirits. Plungers and cylinders should be examined very carefully. There must be no scoring, scratches or rust on the polished surface. Damaged plungers should be replaced. Minor damage in the cylinder can as a rule be eliminated by means of honing. To do this both sides of the caliper are taken apart. The machining procedure varies with different tools so that it is not possible to give a general description. Follow the manufacturer's instructions. Clean the cylinders carefully after honing and check that the channels are free.

Assembling

1. Coat the working surfaces of plungers and cylinders with brake fluid.
2. Fit new sealing rings (3, Fig. 7-3) in the cylinders. Place the rubber covers (8) in position and ensure that they enter the cylinder grooves.
3. Fit the plungers with the closed end first. Press the plungers in fully and see that the rubber covers come into the plunger grooves.
4. Place the brake blocks (9) in position. If the two halves of the caliper have been disassembled, assemble these. Tighten the inner large attaching bolts (12) to a torque of 45–50 lb.ft. (6.2–7 kgm) and the outer smaller ones (13) to 25–30 lb.ft. (3.5–4.2 kgm). Fit guide pins and locking clips.

Fitting

Check that the contact surfaces of the caliper and retainer are clean and undamaged since it is of vital importance that the caliper takes up the correct position in relation to the brake disk. Fit the caliper see Fig. 7-11.

Check that the brake disk can run freely between the brake plates. Place on locking washer (5) and tighten the attaching bolts (4 and 6) and lock them. Connect the brake line (3) and air-vent the wheel unit cylinders. Fit the wheel, see operation 6 under "Replacing the brake blocks".

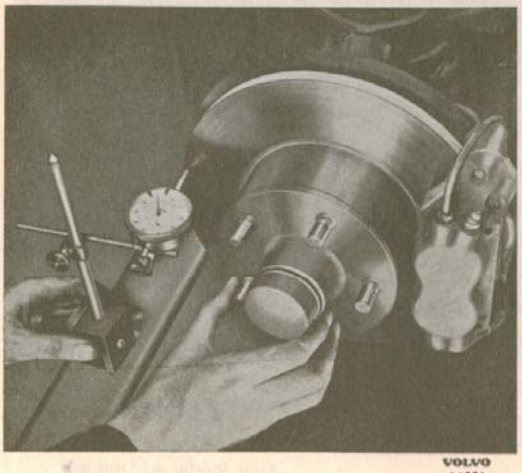


Fig. 7-13. Checking run-out

Brake disk

The brake disk should be examined as regards the friction surface, run-out and thickness. There must be no rust or scratches on the friction surface. Run-out must not exceed 0.004″ (0.1 mm) and is measured as shown in Fig. 7-13. Check first that the wheel bearings are correctly adjusted and that the disk fits securely on the hub. The thickness should not vary more than 0.0012″ (0.03 mm) when the disc is rotated one turn, since this can cause a vibrating brake pedal.

The brake disk can be reconditioned by precision turning or precision grinding. Machining should be done together with the hub. The thickness of the disk after machining must not be less than 0.48″ (12.2 mm) and surface texture should be max. 3μ at a random diameter and max. 5μ measured radially. After reconditioning, the disk should not throw more than 0.004″ (0.10 mm) and its thickness must not vary more than 0.0012″ (0.03 mm).

If the brake disk cannot be reconditioned as described above, or if it is cracked or damaged, it should be replaced together with the hub. Regarding procedure for this, see under "Replacing or adjusting front wheel bearings", Part 6.

When replacing the wheel studs, the old stud is pressed out after which an oversize stud is fitted. Before the stud can be pressed through the hole in the brake disc, this must be drilled out to 0.653–0.661″ (16.6–16.8 mm).

Rear wheel brake units

Disassembling

1. Remove the hub cap and split pin in the drive shaft. Slacken the castle nut and wheel nuts

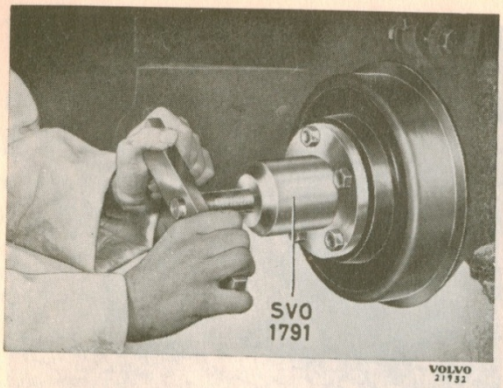


Fig. 7-14. Removing the hub

slightly. Jack up the car and place blocks under the rear axle. Remove the wheel.

2. Release the handbrake. Pull off the hub with tool SVO 1791, see Fig. 7-14.
3. Place clamp SVO 4074 over the wheel unit cylinder so that the plungers cannot be pressed out. Remove the upper return spring with the help of a pair of brake spring pliers. Pull down the front shoe into the groove on the brake backing plate, hold against the guide pin on the back side of the backing plate and turn and then remove the locking clamp. Lift out the shoe, see Fig. 7-15.
4. Remove the rear shoe in a corresponding manner and disconnect it from the handbrake cable. Unhook the return spring and if necessary the handbrake link.
5. Screw in the adjusting screw slightly. Remove the adjusting plungers, see Fig. 7-16.

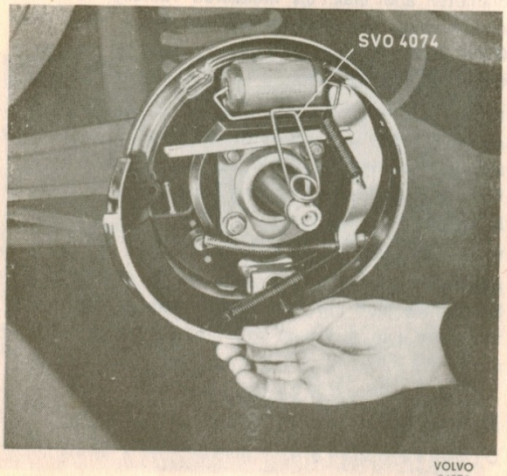


Fig. 7-15. Removing brake shoes

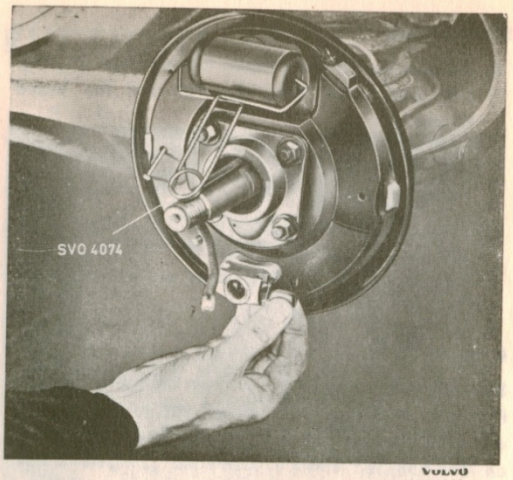


Fig. 7-16. Removing adjusting plunger

Replacing brake linings

The brake linings should be replaced at the latest when they have been worn down level with the rivet heads.

1. Press out the rivets with the drift provided for the purpose in the rivet press. Then wash the shoes clean and dry them.
2. Rivet on the ready-made original linings. The front lining is placed towards the lower end of the shoe and the rear lining towards the upper end, see Fig. 7-18.

   Use rivets as shown in the specifications and a rivet press with suitable drift. Begin riveting from the center and continue outwards to the ends. Check after riveting that the brake lining beds down properly along its entire length.
3. In order to obtain best results, the linings should be ground in a special grinding machine. Check that the lining has a radius of 0.008–0.016″ (0.2–0.4 mm) less than that of the brake drum.

Reconditioning wheel unit cylinder

Loosen the clip, pull off the rubber seals (1, Fig. 7-4) and take out the plungers (2) with packings (3). Wash all parts in methylated spirits.

Carefully examine the cylinder internally. There must be no scoring, scratches or rust on the polished surface. Such damage can be eliminated by honing the cylinder. The procedure for doing this varies with different machines so that the respective manufacturer's instructions should be followed. Clean the cylinder carefully after honing when the air-venting nipple should be removed.

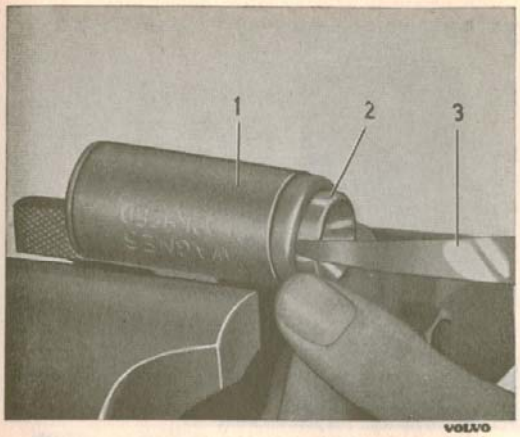


Fig. 7-17. Checking clearance

1. Wheel unit cylinder 2. Plunger 3. Feeler gauge

The clearance between the plunger and cylinder must not exceed 0.01″ (0.25 mm) and is measured as shown in Fig. 7-17. If the clearance exceeds 0.01″ (0.25 mm), test with a new plunger. If this does not help, the wheel unit cylinder must be replaced.

Examine packings and other parts for wear and damage. Damaged or worn parts should be replaced. Assemble the parts in the reverse order to disassembling. When doing so, dip plungers and packings in brake fluid. The location of the parts is shown in Fig. 7-4.

Brake drums

The friction surface and radial throw of the brake drums should be checked. Radial throw must not exceed 0.006″ (0.15 mm). If the friction surface is concave, scratched or cracked, the brake drum should be replaced. Rust spots and minor scratches can, however, be polished out or ground away in a machine.

Assembling

1. Screw back the adjusting screw and fit the adjusting screws after having cleaned them and coated them lightly with heat-resistant grease. Check that the plungers move easily.
2. Fit the lever on the rear brake shoe. Hook on the handbrake cable and return springs. Place the shoe in position and fit the guide pin and locking clip. Ensure that the head of the guide pin comes into the countersink of the clip.
3. Place the handbrake link into position ensuring that it is turned correctly. Hook on the lower return spring and fit the front brake shoe with guide pin and locking clip. Hook on the upper return spring with brake spring pliers. Remove SVO 4074. Fit the spring clip (5, Fig. 7-18).
4. Check that springs and locking washers are properly in position and that the linings are free from burr, grease and dirt.
5. Check that the key fits properly in the drive shaft and fit the hub with brake drum. Place on the washer and tighten the castle nut. If the wheel unit cylinder has been removed, this should be air-vented, see under "Air-venting the hydraulic system". Lift on the wheel after having cleaned the contact surfaces between wheel and hub free from sand and dirt, and tighten up the nuts sufficiently so that the wheel cannot be displaced on the hub. Adjust the brake, see under "Adjusting the wheel brake units". Lower the vehicle and tighten the wheel nuts.

   Tighten every other nut at little at a time until all are tightened to a torque of 70–100 lb.ft. (10–14 kgm). Tighten the castle nut properly and lock it with a split pin. Fit the hub cap.

NOTE Fouling of the servo cylinder air filter, as well as brake lining wear, depends to a large extent on the number of brakings. As a rule, therefore it is advisable to change the air filter element in connection with replacing the rear wheel brake linings.

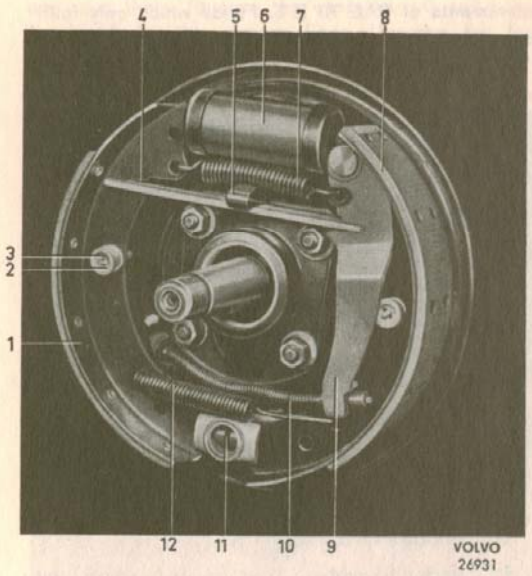


Fig. 7-18. Rear wheel brake unit

1. Front brake shoe
2. Locking washer
3. Guide pin
4. Link
5. Spring clip
6. Wheel unit cylinder
7. Upper return spring
8. Rear brake shoe
9. Lever
10. Return spring for lever
11. Adjusting device
12. Lower return spring

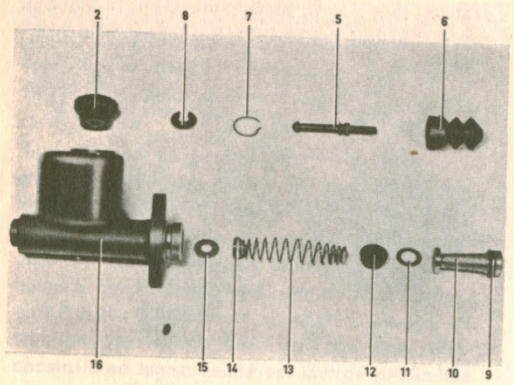


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Fig. 7-19. Master cylinder

2. Plug
5. Thrust rod
6. Rubber cover
7. Locking ring
8. Stop washer
9. Packing
10. Plunger
11. Washer
12. Packing
13. Spring
14. Valve
15. Washer
16. Cylinder housing

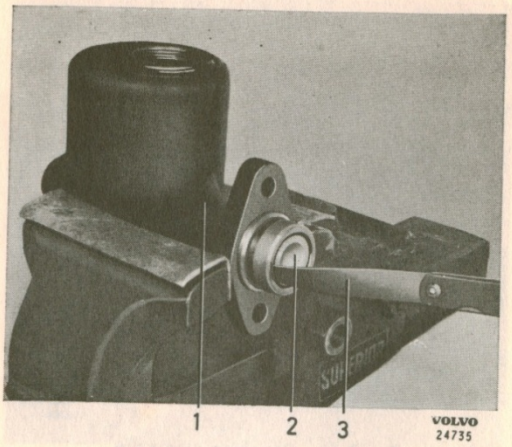

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Fig. 7-20. Checking the clearance

1. Master cylinder 2. Plunger 3. Feeler gauge

Master cylinder

Observe the greatest possible care when working on the hydraulic system. Wash the hands with soap and water before cleaning the internal parts. These should be cleaned with methylated spirits. Gasoline, kerosene or spirit containing bensol must not be used.

Fill up with first-class brake fluid which fulfils the requirements of SAE 70 R 3. Fluids which only fulfil the requirements of SAE 70 R 1 or what is known as HD quality, should not be used. Avoid spilling brake fluid on the paintwork as this can cause damage.

Removing

1. Remove the split pin and bolt for brake pedal. Unhook the return spring. Remove the rubber cover.
2. Disconnect the connection for the brake line. Remove the two attaching bolts for the master cylinder. Pull out the master cylinder carefully. Avoid spilling brake fluid on the paintwork as it will cause damage.

Disassembling

1. Unscrew the plug (2, Fig. 7-2 and 7-19) and empty out the brake fluid.
2. Pull back the rubber cover (6) and remove the locking ring (7), washer (8) and thrust rod (5). Shake out all parts from the cylinder.

Inspection

Before inspection all parts of the master cylinder should be washed in methylated spirits.

Examine the cylinder carefully internally. There must be no scoring, scratches or rust on the polished surface. Such damage can as a rule be eliminated by honing the cylinders. The procedure for doing this varies with different makes of tool so that a general description cannot be given. Therefore follow the manufacturer's instructions. Clean the cylinder carefully after honing and check that the holes are free. The clearance between plunger and cylinder must not exceed 0.008″ (0.20 mm) and is measured as shown in Fig. 7-20. If the clearance exceeds 0.008″ (0.20 mm),

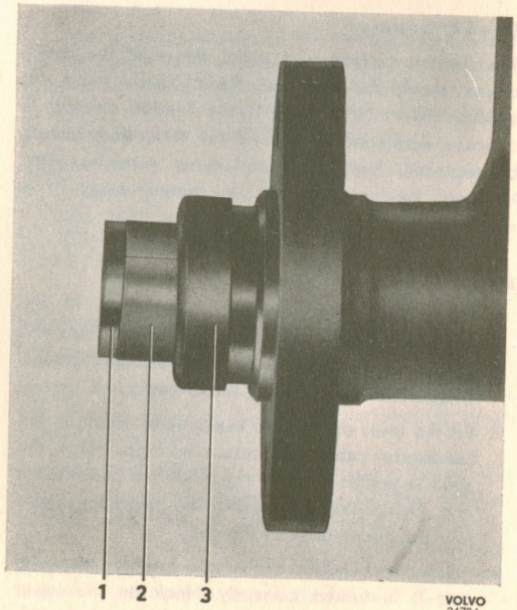

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Fig. 7-21. Fitting the plunger

1. Plunger 2. Brass foil 3. Master cylinder

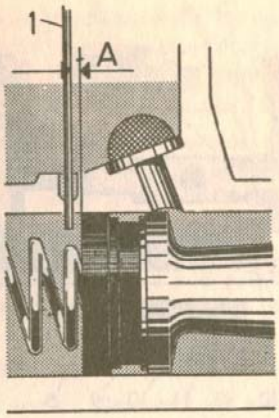

Fig. 7-22. Checking aqualizing hole

1. 0.020″ (0.5 mm) wire A = approx. 0.020″ (0.5 mm)

test with a new plunger. If this does not help, the master cylinder must be replaced.

Examine packings, valves and other parts for wear and damage. Damaged or worn parts should be replaced.

Assembling

1. Fit the washer (15, Fig. 7-19) in the bottom of the cylinder.
2. Place the packing (12) on the spring guide. Dip the packing in brake fluid and fit it together with the spring and valve. Place the washer (11) in the cylinder.
3. Pull the packing (9) on the plunger and turn it as shown in the figure. Dip the plunger in brake fluid and fit it. Be careful to ensure that the packing (9) is not damaged. Preferably use a piece of brass foil shaped like a tube as a guide for the packing, see Fig. 7-21. Compress the spring and fit thrust rod (5), washer (8) and locking ring (7).
4. Check that the equalizing hole is free by inserting a 0.02″ (0.5 mm) wire through the hole, see Fig. 7-22. It should then be possible to press the plunger in approx. 0.020″ (0.5 mm) before the wire gets caught. Be careful to ensure that the packing is not damaged. Check also that there is clearance for the thrust rod (5).
5. Fit the rubber cover (6).

Fitting

Fitting is done in the reverse order to removing. Do not forget the split pin in the pedal bolt. Fill up with brake fluid and air-vent according to the instructions given under "Air-venting the brake system".

Fig. 7-23. Servo-brake cylinder fitted

1. Non-return valve
2. Banjo screw
3. Outgoing brake line
4. Container
5. Brake line from master cylinder
6. Brake contact
7. Bracket
8. Vacuum lines
9. Ingoing brake line
10. Servo-brake cylinder

Servo-brake cylinder

Removing

Disconnect the hydraulic lines (3, 5 and 9, Fig. 7-23) and plug them. Remove the container (4) and banjo screw (2) for the vacuum lines. Unscrew the four attaching bolts for the bracket (7) and lift up the

Fig. 7-24. Removing the servo-cylinder

servo-brake cylinder complete with bracket, see Fig. 7-24. Remove the three attaching bolts and separate the servo-brake cylinder from the bracket.

Disassembling

1. Remove the air filter from the servo-brake cylinder.
2. Unscrew the screws (22, Fig. 7-5) when the cover (19) will be lifted off by the spring-loaded plunger. Remove cover, gasket (20), plunger (17) and return spring (16). Unscrew the three bolts (26) and remove the cylinder (24) from the housing (28).
3. Remove the cover (7) from the valve housing (6). Unscrew the screws (10) and lift out the yoke (11), spring (4) and valve arm (3).
4. Remove the gasket (27) and strike the housing against a wooden object so that the plug (2, Fig. 7-25) falls out. Remove the control plunger (7).
5. Remove the sleeve (17), packing (16) and spacing sleeve (15). Remove the locking ring (14) with a pair of suitable pliers and lift out the other parts.

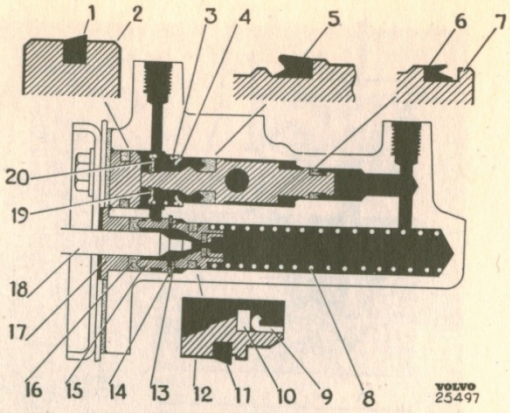

Fig. 7-25. Hydraulic control parts

1. Packing
2. Plug
3. Spring
4. Washer
5. Packing
6. Packing
7. Control plunger
8. Spring
9. Sleeve
10. Packing
11. Packing
12. Plunger
13. Washer
14. Locking ring
15. Spacing sleeve
16. Packing
17. Sleeve
18. Plunger rod
19. Locking ring
20. Washer

Inspection

Before inspection all parts should be washed in clean spirit. Place the cleaned parts on a clean cloth and observe the utmost cleanliness when continuing the work.

Inspect all parts for wear and other damage. All packings and any damaged or worn parts should be replaced. If the plunger rod is damaged, the complete vacuum plunger should be replaced.

Assembling

1. Take a new plunger (12, Fig. 7-25) with inner packing (10) fitted. Fit the plunger packing (11) and turn it as shown in the figure. Place the spring (8) on the plunger. Dip the plunger in brake fluid and insert the unit into the cylinder. Fit the washer (13) and press it in so that a new locking ring (14) can be fitted. Place the packing (16) on the spacing sleeve (15) and fit in. Place the sleeve (17) in position.
2. Place the packings (5 and 6) onto the control plunger and turn them as shown in the figure. Fit washers, spring (3) and locking ring (19).

   Dip the plunger in brake fluid and fit it as shown in Fig. 7-25. Turn the plunger so that the valve arm (3, Fig. 7-5) can be fitted in its hole.
3. Fit the valves (2 and 12, Fig. 7-5) onto the valve arm (3) and place the unit in position in the housing. Fit the spring (4), yoke (11), washers and screws (10). Test the function by pressing the control plunger (30) backwards and forwards (Fig. 7-26) when the valve should close and open respectively. In the normal position the valve nearest the flange should be open and the other one closed. Fit the packing and cover (7) with vacuum line. A suitable tightening torque for the bolts is 2–3 lb.ft. (0.3–0.4 kgm).
4. Place the packing (1) on the plug (2) and fit it so that the packing flange comes inwards, see Fig. 7-25. Let the plug project about 1/16″ (1–2 mm) outside the flange. Place the plate (21, Fig. 7-5) onto the vacuum line and the new gasket (27),

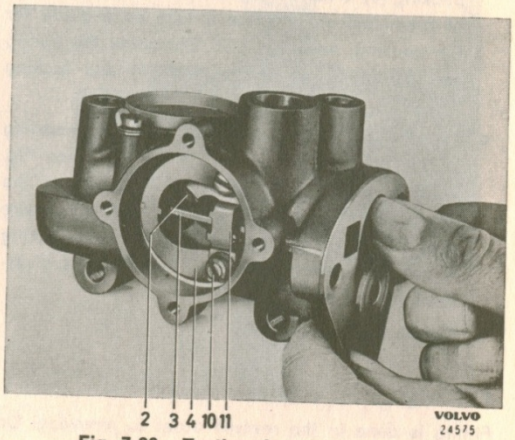

Fig. 7-26. Testing the control device

2. Air valve
3. Valve arm
4. Spring
10. Screw
11. Yoke

cylinder (24) and plate (25) into their positions and insert the connecting pipe (23) through the rubber bushing (18). Tighten the three bolts (26) to a torque of 10–12 lb.ft. (1.4–1.8 kgm).

5. Check that the vacuum cylinder (24) is still clean internally. Plate the return spring (16) in position. Fit the vacuum plunger (17) complete with new rubber ring (14) and insert the plunger rod (15) carefully into the bushing. No lubrication should be done. Place on a new gasket (20) and bolt on the cover (19) and plate (21). A suitable tightening torque for the bolt is 2–3 lb.ft. (0.3–0.4 kgm).
6. Fit a new air filter insert and place on the cover and yoke.

Testing

After assembling, the servo-brake cylinder should be tested. This can be done in a test-bench as shown in Fig. 7-27. Testing should preferably be carried out as follows:

1. Connect the vacuum line (7) to the servo-brake cylinder hydraulic inlet. When doing this, brake fluid should naturally be emptied from the cylinder. Plug the hydraulic outlet. Start the vacuum pump and open the vacuum valve (11). When a vacuum of 10.7 lb.sq/in. (0.75 kg/cm²) has been reached (Gauge 1), close the valve (11). The servo-brake cylinder should maintain a vacuum of at least 10 lb/sq.in. (0.7 kg/cm²) for five seconds. Then disconnect the vacuum line and open the hydraulic outlet.
2. Connect the line (9) to the servo-brake cylinder hydraulic inlet. Close the shut-off valve (3) and open the inlet valve (13). Check through the sight glass (6) that there is sufficient brake fluid for air-venting. Operate the pump (15) until brake fluid begins to run out of the servo-brake cylinder hydraulic outlet.
3. Connect the line (10) to the outlet and the vacuum line (7) to the vacuum connection, see Fig. 7-27. Open the valve (11) so that the gauge (1) shows 10.7 lb/sq.in. (0.75 kg/cm²). Check that the shut-off valve (3) is closed and that the valves (13 and 14) are open. Pump up the ingoing hydraulic pressure until the gauge (4) shows 498 lb/sq.in. (35 kg/cm²). The outgoing hydraulic pressure (Gauge 5) should then show at least 950 lb/sq.in. (67 kg/cm²). Then open the shut-off valve (3) when the gauges (4 and 5) should immediately return to zero. Repeat this test operation a few times.
4. Remove the servo-brake cylinder air filter and plug the air intake hole. Set in 10.7 lb/sq.in. (0.75 kg/cm²) vacuum (Gauge 1). Shut the valve (3) and open the valves (13 and 14). Pump up the ingoing hydraulic pressure to a value exceeding 50 lb/sq.in. (3.5 kg/cm²). The ingoing and outgoing pressure should then be equal (Gauges 4 and 5). After the test, open the shut-off valve (3), remove the plug and refit the air filter.
5. Check that the gauge (1) shows 10.7 lb/sq.in. (0.75 kg/cm²) vacuum. Close the valve (3) and check that the valves (13 and 14) are open. Pump up the ingoing pressure to 35.6 lb/sq.in. (2.5 kg/cm²) (Gauge 4). The outgoing pressure (Gauge 5) should then show at least 50 lb/sq.in. (3.5 kg/cm²). Open the shut-off valve (3).
6. Set in 10.7 lb/sq.in. (0.75 kg/cm²) vacuum on the gauge (1). Then close the vacuum valve (11). After a period of 1 minute 40 seconds the vacuum should not decrease more than so that the gauge (1) shows 5.7 lb/sq.in. (0.4 kg/cm²). After the test disconnect vacuum line (7) from the servo-brake cylinder.

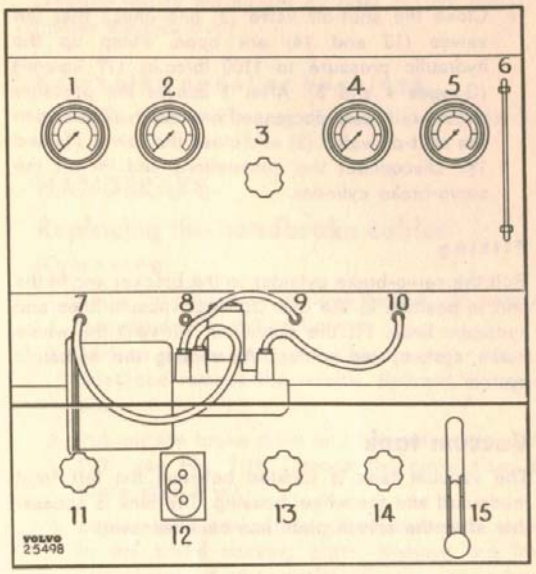

Fig. 7-27. Connections for testing

1. Gauge for constant vacuum
2. Gauge for control vacuum
3. Hydraulic shut-off valve
4. Gauge for hydraulic inlet pressure
5. Gauge for hydraulic outlet pressure
6. Sight glass
7. Connection for constant vacuum
8. Connection for control vacuum
9. Connection for hydraulic inlet
10. Connection for hydraulic outlet
11. Vacuum valve
13. Hydraulic inlet valve
14. Hydraulic outlet valve
15. Hydraulic pump

7. Close the shut-off valve (3) and check that the valves (13 and 14) are open. Pump up the hydraulic pressure to 1100 lb/sq.in. (77 kg/cm²) (Gauges 4 and 5). After 1 minute the pressure should not have decreased noticeably. Then open the shut-off valve (3) and close the valves (14 and 13). Disconnect the connections and lift off the servo-brake cylinder.

Fitting

Bolt the servo-brake cylinder to the bracket and fit the unit in position in the car. Connect vacuum lines and hydraulic lines. Fit the container. Air-vent the whole brake system, see under "Air-venting the hydraulic system".

Vaccum tank

The vacuum tank is located between the left front mudguard and the wheel housing. The tank is accessible after the splash plate has been removed.

Brakes lines

The brake lines should be flushed through in conjunction with complete reconditioning of the hydraulic system.

The lines are disconnected at the wheel cylinders one by one and flushed with clean spirit. Flushing should preferably be done by filling the master cylinder with spirit and then carrying out repeated brake movements with the pedal. When the master cylinder has been reconditioned, it is filled with brake fluid after which the lines are flushed free from spirit. All spirit must be throughly removed from the brake lines othervise gas bubbles can arise in the system causing spongy pedal action. With leakage or when the effect is such that leakage can be suspected, the damaged line should be replaced. This is preferably done in accordance with the instructions given below.

Note that the pipes on the early production type are tapered in a special way differing from those on our other cars. Therefore use only original spare parts intended for this car.

On late production (with effect from chassis number 7000) the brake lines are double-flanged in the same way as on our other vehicles. When making any replacement, therefore, check that the correct type of brake pipe is obtained.

1. Remove the damaged brake line.
2. Take a complete new brake line, blow it clean internally and fit it.

   Make sure that the brake line lies in such a position that it cannot chafe while driving. Particularly important points are where the pipes pass the rear spring attachments on the rear axle, where the pipe must not come nearer than 3/8" (10 mm), and where they pass the support arms.
3. Air-vent the hydraulic system.

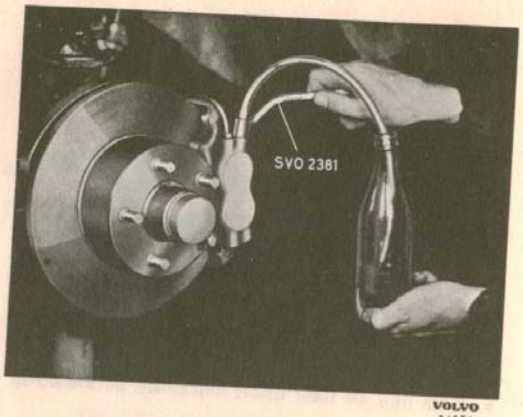

Fig. 7-28. Air-venting (early prod.)

Air-venting the hydraulic system

A sign that there is air in the system is that the brake pedal can be depressed without any appreciable resistance, or if it feels spongy.

When any part of the system has been removed, air-venting must be carried out. Air can also enter the system if there is too small a quantity of brake fluid in the reservoir. If, for example, only one wheel unit cylinder has been removed, it is usually sufficient to air-vent this only. If, on the other hand, the master cylinder or lines from this have been removed, the whole brake system must be air-vented.

When air-venting or other similar work is being carried out, no brake fluid may be permitted to run onto the brake disk or blocks.

Air-venting the whole brake system is done as follows:

1. Clean round the filling cover on the master cylinder. Unscrew the cover and if necessary top up with brake fluid. Use only first-class brake fluid fulfilling the requirements of SAE 70 R 3. Fluid which only fulfills the requirements of SAE 70 R 1 or HD quality, should not be used. Disconnect the servo-brake cylinder by screwing out the banjo screw (2, Fig. 7-23).
2. Clean the air-venting nipple. Fit on the wrench SVO 2381 with a hose on the air-venting nipple and let the other end of the hose hang down in the fluid in a collecting vessel, see Fig. 7-28.
3. Open the nipple and have somebody press down the brake pedal slowly. Close the nipple before releasing the pedal. Repeat this procedure as long as there are air bubbles in the fluid running out.
4. Air-vent the remaining wheels in the same manner. Between each operation, check that there is sufficient brake fluid in the reservoir.

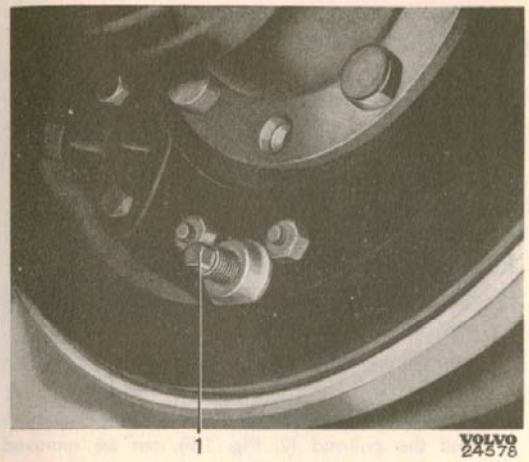

Fig. 7-29. Adjusting device for rear wheel brake unit
1. Adjusting screw

5. Connect the vacuum lines by screwing in the banjo screw.

Adjusting the footbrake

The front wheel disk brakes are designed so that the linings are always at a certain minimum distance from the brake disk regardless of wear. The front wheel brakes are therefore self-adjusting and no manual adjustment of the position of the brake plates needs to be carried out.

When the brake pedal can be depressed too far down towards the floorboards this usually means that the rear wheel brake linings are worn and that the brake shoes require adjusting. If it is suspected that the linings are worn, the brake drum should be removed for checking this. The adjusting device permits adjustments even if the linings are worn down to the rivets and such wear can lead to the rivets damaging the brake drums. The linings should be inspected regularly every 6 000 miles (10 000 km). Adjusting is done as follows:

1. Lift up the rear end and place blocks under the rear axle. Release the handbrake.
2. Turn the adjusting screw (1, Fig. 7-29) clockwise until the brake drum locks. Then turn back the screw until the drum can rotate freely.
3. Adjust the other rear wheel in the same manner. Lower the car.

Brake pedal

Adjusting position of brake pedal

When the brake pedal is released it takes up the same position as the clutch pedal. The position is adjusted by slackening the lock nut and turning the pressure rod to the master cylinder. Do not forget to tighten the lock nut.

Replacing pedal or bushings

See under "Reconditioning the pedal shaft", Part 2.

HANDBRAKE

Replacing the handbrake cables

Removing

1. Apply the handbrake, remove the hub cap, slacken the wheel nuts and castle nut.
2. Jack up the rear end, place blocks under the rear axles and remove the wheels. Release the handbrake.
3. Pull off the brake drum and hub with puller SVO 1791, see Fig. 7-14. Unhook the cable from the brake shoe lever.
4. Loosen the screws at the cable sleeve attachment in the brake backing plate. Remove the front attachment of the cable sleeve with support rubber. Unhook the cable from the clevis and pull the cable forwards.

Fitting

1. Place the rubber support on the cable sleeve. Insert the cable into the brake backing plate and hook it onto the lever.
2. Hook the cable onto the clevis.
3. Tighten the bolt in the brake backing plate. Fit the cable sleeve front attachment and ensure that the clamp enters the groove on the sleeve. If necessary, slacken the adjusting nut. Fit the support rubber in its bracket.
4. Fit on the hub with brake drum and wheels.

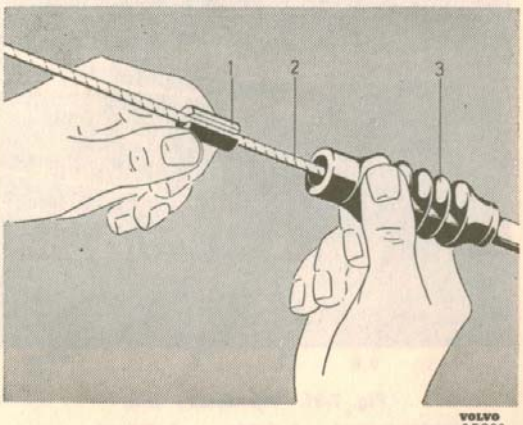

Fig. 7-30. Fitting the rubber cover
1. Sealing plug 2. Cable 3. Rubber cover

Tighten the castle nut and wheel nuts sufficiently for the drum and wheel to position correctly.

5. Adjust the handbrake. Lower the car and tighten the wheel nuts to a torque of 70—100 lb.ft. (10—14 kgm). Tighten and lock the castle nuts. Fit on the hub cap.

Replacing the rubber cover

If the handbrake cable rubber cover has been damaged for any reason, it must be replaced, as otherwise water and dirt can penetrate and cause the brake to rust on.

For this replacement there is a special rubber cover available with sealing plugs (part nos. 86850 and 86851 respectively). When replacing, the pull-rod is removed from the lever and the cable unhooked from the clevis. Cut off the old cover and fit on the new one. Hook on the cable to the clevis and refit the pull-rod. Fit the slotted sealing plug (1, Fig. 7-30) on the cable (2) and press it into the rubber cover (3).

Replacing the brake lever or ratchet part

1. Release the handbrake and remove the protective cover over the segment.
2. Remove the split pin and washer at the shaft lever (6, Fig. 7-31). Turn the pull-rod (7) so that it can be removed from the handbrake lever. Remove the ratchet segment (1).
3. Unscrew the bolts for the support attachment (8) and drive out the stud and attachment. Lift off the lever (3).
4. Unscrew the locking screw and remove the yoke (5) and button (4). Take out the spring from the lever. Remove the rivet (2) and take out the thrust rod (6, Fig. 7-9) and pawl (18).
5. Fit the new parts in the reverse order. Ensure that the rivet is secure but without interfering with the movement of the pawl. Lubricate the bushings with a thin coating of ball-bearing grease. Do not forget to lock the pull-rod.

Replacing the handbrake shaft

1. Lift up the rear end and place blocks under the rear axle.
2. Release the handbrake and disconnect the pull-rod (7, Fig. 7-31) from the shaft lever (6).
3. Remove the split pin and stretch the cables so that the pull-rod (2, Fig. 7-9) can be removed from the shaft lever. Remove the support attachment and lift off the shaft (21).
4. Lubricate the bushings in the new shaft with a thin coating of ball bearing grease. Check that the studs of the support attachments are undamaged. Fit the shaft in the reverse order to removing.

Adjusting the handbrake

The handbrake should give full brake effect at the fourth-fifth notch. If not, the handbrake should be adjusted. Before adjusting, make sure that the trouble is not in the wheel brake units. The rear wheel brakes should therefore first be adjusted, see "Adjusting the footbrake". The handbrake is adjusted by moving the clevis on the pull-rod, see Fig. 7-32. Tighten the nuts well after adjusting.

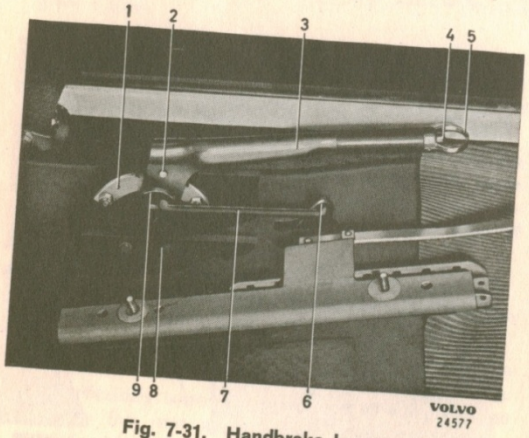

Fig. 7-31. Handbrake lever

1. Ratchet segment
2. Rivet
3. Handbrake lever
4. Button
5. Yoke
6. Lever
7. Pull-rod
8. Support attachment
9. Lever

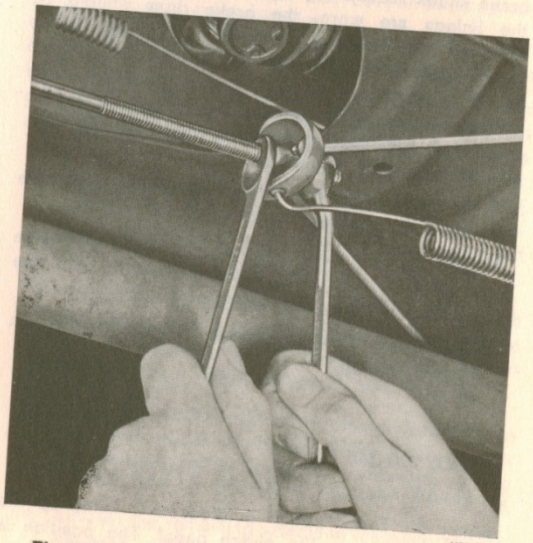

Fig. 7-32. Adjusting the handbrake (late prod.)

FAULT TRACING

FAULT	
Reason	Remedy
No or poor braking effect	
Too little brake fluid in the system.	Fill up with brake fluid. Check for leakage. Air-vent the system.
Air in the hydraulic system.	Air-vent the system.
Leakage in the hydraulic system.	Check and repair the leakage. Air-vent the system.
Defective master cylinder.	Replace the master cylinder.
Brakes wrongly adjusted.	Adjust the brakes.
Unsuitable brake linings.	Replace with original brake linings.
Grease or oil on the brake linings.	Replace the brake linings. Check the sealing ring.
The car pulls to one side when braking	
Grease or oil on one of the brake linings.	Replace the linings. Check the sealing ring.
Unevenly adjusted brakes.	Adjust the brakes.
Out-of-round or uneven brake drum.	Replace or grind the drum.
Defective wheel unit cylinder.	Recondition the wheel unit cylinder.
Excessive play in the wheel bearings of faulty wheel alignment.	Adjust the front end.
Uneven tire pressure.	Adjust the tire pressure.
Unevenly worn tires.	See Part 8.
The brakes bind	
Brakes wrongly adjusted.	Adjust the brakes.
Moisture on the brake linings.	Brake repeatedly until the fault disappears.
Excessive play in wheel bearings.	Adjust the bearings.
Brake linings worn out.	Replace the linings.
Brake linings glazed owing to contamination with oil.	Replace the linings and repair the leakage.
Damaged or loose brake linings.	Replace the linings.
Loose brake backing plate or retainer.	Tighten the brake backing plate or retainer.
Out-of-round brake drum.	Replace or grind the drum.
Broken return spring.	Replace the spring.
Brake drag on one of the front wheels	
Brakes wrongly adjusted.	Adjust the brakes.
Broken return spring.	Replace the return spring.
Handbrake cable chafing.	Lubricate or replace the handbrake cable.
Brake line to the wheel blocked or damaged.	Clean or replace the line.
In extremely cold weather: poor quality brake fluid.	Change the brake fluid.
Brake drag on one of the front wheels	
Brake line to the wheel blocked or damaged.	Clean or replace the line.
Plungers binding.	Recondtion the wheel unit cylinders.
In extremely cold weather: poor quality brake fluid.	Change the brake fluid.
Noisy brakes	
Brake linings worn out.	Replace the linings.
Dirt in the brake drums.	Clean the drums and linings.
Brake drums vibrate.	Fit damping springs on the outside of the drums.

TOOLS

The following special tools are used for repairs to the brake system.

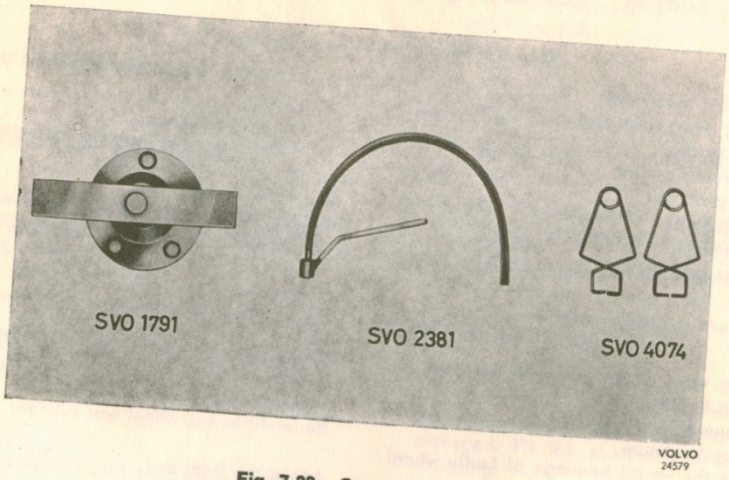

Fig. 7-33. Special tools

SVO 1791 Puller for hub
SVO 2381 Wrench for air-venting nipple
SVO 4074 Spring clips for wheel unit cylinder

SPECIFICATIONS

FRONT WHEEL BRAKES

Type	Disk brakes
Brake disk:	
External diameter	10.86″ (276.5 mm)
Thickness, new	0.500–0.504″ (12.7–12.8 mm)
reconditioned	Min. 0.480″ (12.2 mm)
Run-out	Max. 0.004″ (0.1 mm)
Brake linings:	
Number per wheel	2
Thickness	0.421″ (10.7 mm)
Effective area per wheel	14.3 sq.in. (92.5 cm²)
Wheel unit cylinders:	
Number per wheel	3
Diameter, inner cylinders	2 1/8″ (53.98 mm)
outer cylinders	1 1/2″ (38.1 mm)
Tightening torque, inner bolts (12, Fig. 7-3)	45–50 lb.ft. (6.2–7 kgm)
outer bolts, (13, Fig. 7-3)	25–30 lb.ft. (3.5–4.2 kgm)

REAR WHEELS BRAKES

Type	Drum brakes
Brake drums:	
Diameter	9″ (228.6 mm)
Radial throw	Max. 0.006″ (0.15 mm)
Brake linings:	
Width	2″ (50.8 mm)
Thickness	3/16″ (4.76 mm)
Length	8.66″ (220 mm)
Effective area per wheel	34.56 sq.in. (223 cm²)
Rivets for brake linings, size	11/64×7/64″ (6.7×4.4 mm)
number per shoe	10
Wheel unit cylinder:	
Internal diameter	7/8″ (22.23 mm)
Clearance between plunger and cylinder	Max. 0.010″ (0.25 mm)

MASTER CYLINDER

Internal diameter	7/8″ (22.23 mm)
Clearance between plunger and cylinder	Max. 0.008″ (0.20 mm)

BRAKE LINES

External diameter	3/16″
Length, master cylinder – branch-off, left-hand drive	11 1/2″ (292 mm)
branch-off – servo-brake cylinder	10″ (254 mm)
servo-brake cylinder – branch-off	31 1/2″ (800 mm)
branch-off – right-hand brake hose	30 3/4″ (781 mm)
branch-off – left-hand brake hose	18 3/4″ (476 mm)
brake hose – wheel unit cylinder	10″ (254 mm)
branch-off – rear axle	83 1/2″ (2120 mm)
branch-off – right-hand rear wheel	40 1/2″ (1054 mm)
branch-off – left-hand rear wheel	21″ (534 mm)

SERVO-BRAKE CYLINDER

Make and designation	Girling AHV 550 MK 2
Diameter of vacuum cylinder	5 1/2″ (139.7 mm)
Test values at a vacuum of 10 lb/sq.in. (0.7 kg/cm²)	
Outgoing hydraulic pressure at an ingoing pressure of 35.6 lb/sq.in. (2.5 kg/cm²)	Min. 50 lb/sq.in. (3.5 kg/cm²)
Outgoing hydraulic pressure at an ingoing pressure of 50 lb/sq.in. (3.5 kg/cm²)	Min. 95 lb/sq.in. (6.7 kg/cm²)
Tightening torque, bolts for valve housing cover	2–3 lb.ft. (0.3–0.4 kgm)
bolts for vacuum cylinder	10–12 lb.ft. (1.4–1.8 kgm)
bolts for vacuum cylinder cover	2–3 lb.ft. (0.3–0.4 kgm)

PART 8

WHEELS

The following instructions apply when only the car tool kit is available. If wheel changing is to be carried out in a workshop, a heavier jack is used as well as a cross-type wheel nut wrench and a torque wrench whereby the instructions below must be modified.

Fig. 8-1. Remove hub cap

Fig. 8-2. Loosen wheel nuts

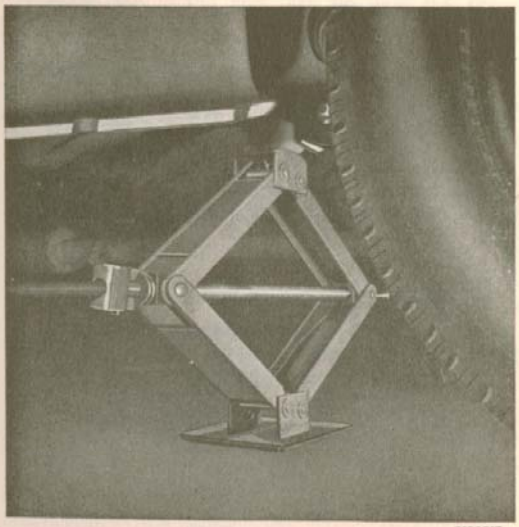

Fig. 8-3. Fit jack in recess

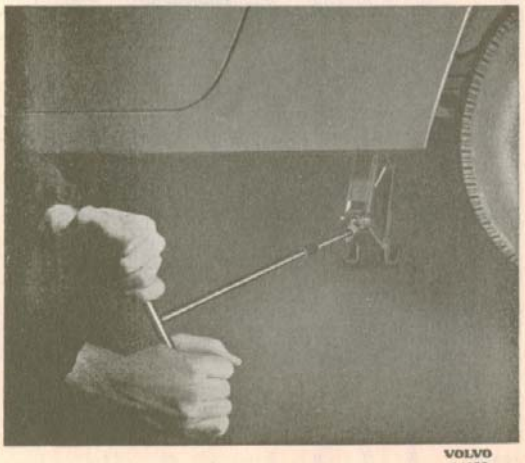

Fig. 8-4. Lift car with jack

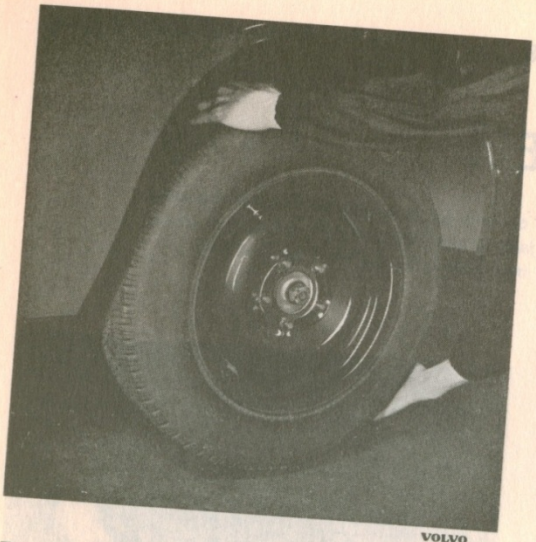

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Fig. 8-5. Remove wheel nuts and lift off wheel, taking care to avoid damage to wheel studs

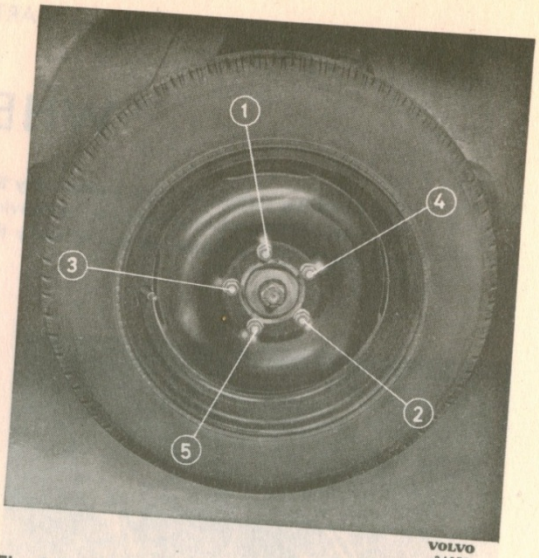

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Fig. 8-6. Lift on the new wheel after cleaning the contact surface between the wheel and the hub. Tighten the nuts so that the wheel is firmly on the hub. Lower the car and tighten the wheel nuts. Tighten each nut a little at a time until they are all tightened to a torque of 70–100 lb.ft. (10–14 kgm)

REPLACING WHEEL STUDS

When replacing wheel studs, press out the old stud and then fit an oversize stud. Before pressing the stud through the hole in the brake disk, this hole must be drilled out to 16.6–16.8 mm (0.65–0.66″).

SPECIFICATIONS

WHEELS

Size	2 1/2 J×15 L
Number of wheel nuts	5
Max. permissible eccentricity	0.071″ (1.08 mm)
Max. permissible run-out	0.071″ (1.08 mm)
Max. permissible out-of-balance (complete wheel)	0.87 lb.in. (900 gcm)
Wheel revolutions per mile	approx. 840
Wheel nut tightening torque	70–100 lb.ft. (10–14 kgm)

TIRES

Type	Braced tread with inner tube
Size	165 mm – 15″
Rolling radius	11.97″ (304 mm)
Air pressure (cold tires), front	26 lb/sq.in. (1.8 kg/cm²)
rear	28 lb/sq.in. (2.0 kg/cm²)

PART 9

SPRINGS

DESCRIPTION

The Volvo P 1800 is fitted with coil springs front and rear. There is individual wheel suspension.

The upper ends of the front springs are seated in housings in the front cross-member while the lower ends are carried in the lower control arms which are fitted between the front-member and the lower ball joint on each side.

The upper ends of the rear springs are carried in housings in the body while the lower ends of the springs are seated on the rear axle. The car is also fitted with a stabilizer. This consists of a torsion spring in front of the front suspension cross-member across the car.

REPAIR INSTRUCTIONS

FRONT SPRINGS

Removing

1. Remove the hub cap and loosen the wheel nuts.
2. Jack up the front end of the car and block up the front cross-member.
3. Remove the wheel nuts and lift off the wheel.
4. Remove the shock absorber nuts and washers and take off the outer rubber bushings (3, Fig. 9-1 and 1, Fig. 9-2). Remove the bolts (4, Fig. 9-2) for the attaching plate (3) and pull this together with the shock absorber downwards.
5. Place a jack under the lower control arm directly under the spring and jack up until the upper control arm rubber bumper lifts.
6. Disconnect the stabilizer bar from the lower control arm. Remove the nut (12, Fig. 9-1) for the lower ball joint.
7. Lower the jack slowly and remove the spring when the control arm has come down far enough. If the lower ball joint does not loosen when the jack is lowered, use tool SVO 2281.

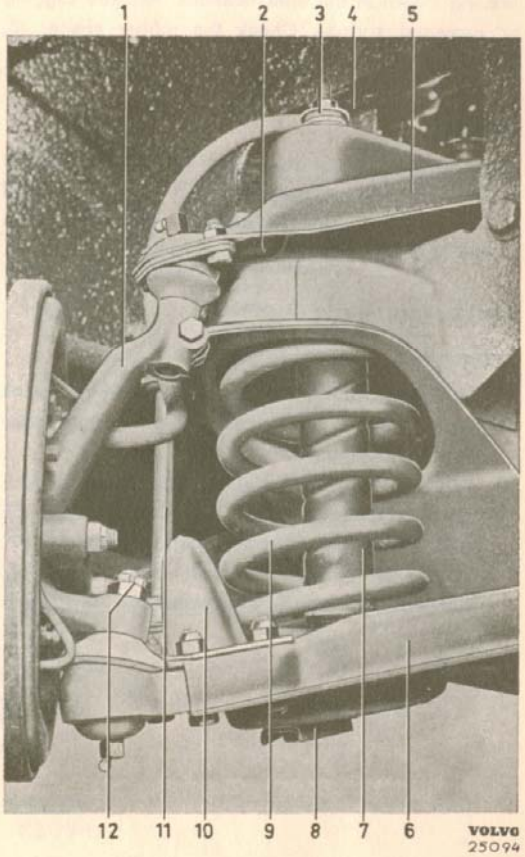


Fig. 9-1. Front spring and shock absorber

1. Steering knuckle
2. Upper rubber bumper
3. Rubber bushing
4. Washer
5. Upper control arm
6. Lower control arm
7. Shock absorber
8. Attaching plate
9. Spring
10. Lower rubber bumper
11. Stabilizer bar
12. Nut for lower ball joint

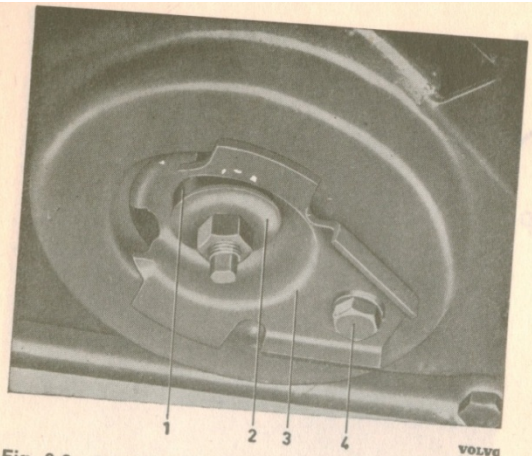


Fig. 9-2. Lower attachment for front shock absorber

1. Rubber bushing
2. Washer for rubber bushing
3. Attaching plate
4. Bolt

Check measuring

Check the spring before fitting it. Compress the spring fully and then check its length under the loading shown in the specifications. Replace sagging or damaged springs. Check the rubber spacer (5, Fig. 9-4).

Fitting

Place the rubber spacer (5, Fig. 9-4) and washer (6) in position in the spring seating in the member and fit the spring in reverse order to that used when removing.

REAR SPRINGS

Removing

1. Loosen the wheel nuts on the rear wheels. Jack up the rear end of the car and put blocks under the rear jacking points.
2. Remove the wheels and release the handbrake.
3. Place a jack under the rear axle housing and jack it up until the shock absorber bands slacken.
4. Loosen the lower shock absorber attachment (Fig. 9-6) and the upper attachment for the shock absorber band (4, Fig. 9-3) on both sides. Slacken the front support arm attachment slightly.
5. Lower the rear axle until the spring is free and then remove the spring and spacer.

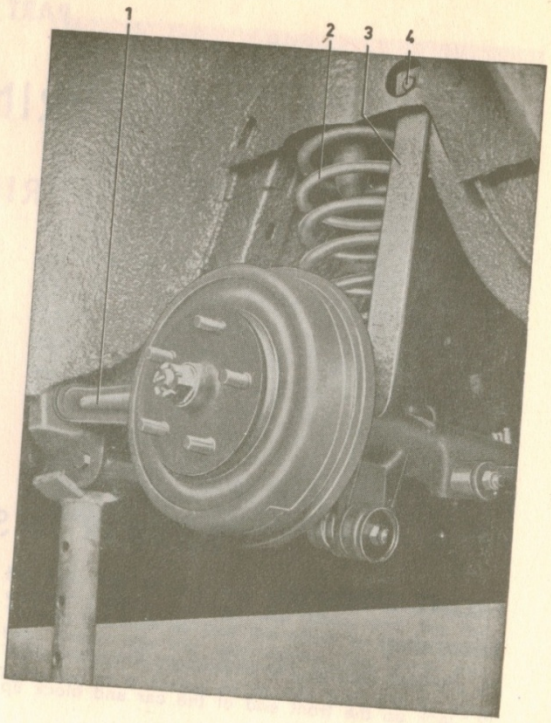


Fig. 9-3. Rear spring

1. Support arm
2. Spring
3. Shock absorber band
4. Attachment for shock absorber band

Check measuring

See under the heading. "Check measuring" for the front springs.

Fitting

Fitting is carried out in the reverse order to that used in removing. Make sure that the rubber pad (7, Fig. 9-5) and the rubber spacer (4) come in the correct position.

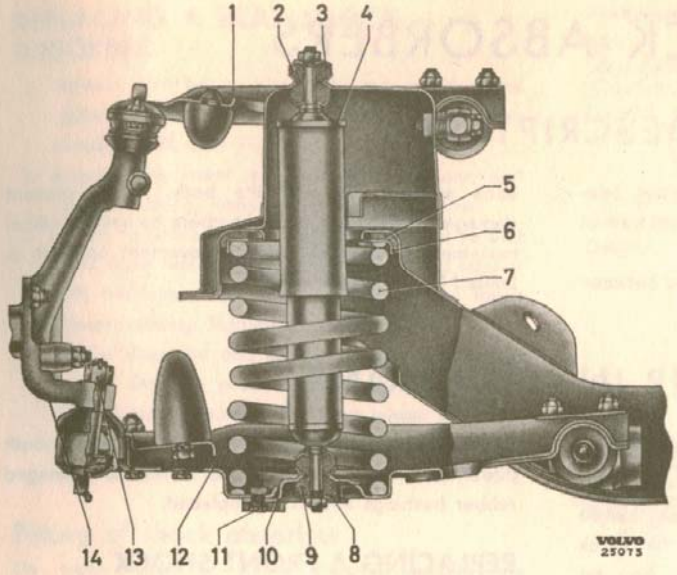


Fig. 9-4. Front spring and shock absorber

1. Upper control arm
2. Rubber bushing
3. Washer
4. Shock absorber
5. Rubber spacer
6. Washer
7. Spring
8. Washer
9. Rubber bushing
10. Attaching plate
11. Bolt
12. Lower control arm
13. Nut
14. Steering knuckle

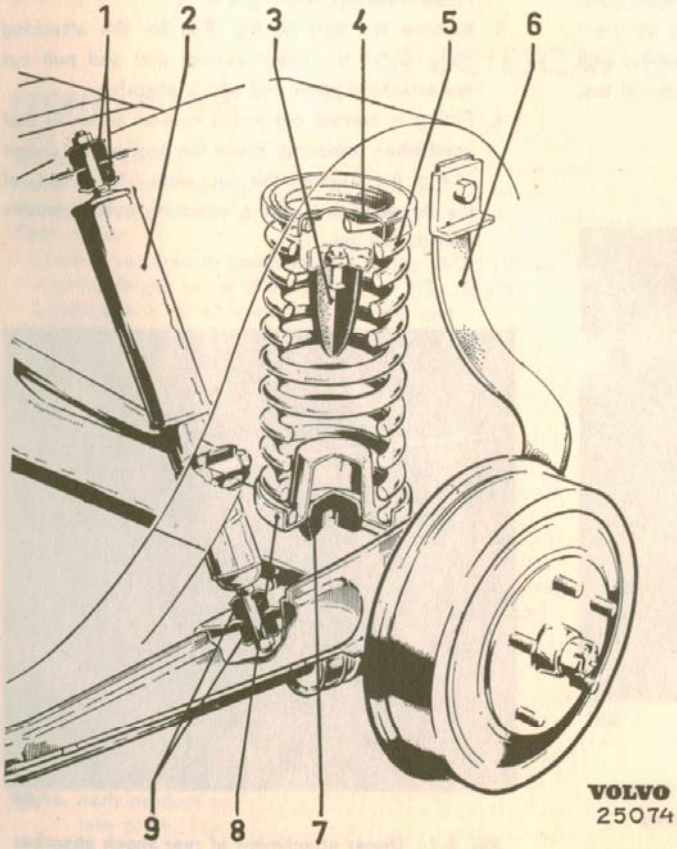


Fig. 9-5. Rear spring and shock absorber

1. Rubber bushings for upper shock absorber attachment
2. Shock absorber
3. Rubber bumper
4. Rubber spacer
5. Spring
6. Shock absorber band
7. Rubber pad
8. Spring retainer
9. Rubber bushings for lower shock absorber attachment

SHOCK ABSORBERS

DESCRIPTION

The shock absorbers are of the double-acting telescopic type. They require no maintenance and cannot be disassembled.

Shock absorbers bands (3, Fig. 9-3) are fitted between each support arm and the body. These prevent damage to the rear shock absorbers by limiting wheel movement downwards. Wheel movement upwards is limited by the rubber buffers.

REPAIR INSTRUCTIONS

CHECKING THE SHOCK ABSORBERS

A simple way of checking the condition of the shock absorbers is to rock the car up and down, and then to release it so that the damping effect of the shock absorbers can be observed. Testing can also be carried out by driving the car on a bumpy road surface. If the shock absorber has been removed from the car, the lower attachment should be tightly clamped in a position similar to that when it is fitted on the car. If it is quickly pulled out and then compressed, it is possible to judge whether it is functioning properly. The damping effect can, however, only be determined definitely with the help of special test devices.

Shock absorbers that do not function properly in both directions should be replaced. Worn or damaged rubber bushings should be replaced.

REPLACING A FRONT SHOCK ABSORBER

1. Remove the upper attaching nut, the washer (4, Fig. 9-1) and rubber bushing (3).
2. Remove the lower attaching nut, washers, and rubber bushing. See Fig. 9-2.
3. Remove the bolt (4, Fig. 9-2) for the attaching plate (3) in the lower control arm and pull out the attaching plate and shock absorber.
4. Fitting is carried out in the reverse order to that used when removing. Place the washers as shown in Fig. 9-4. Tighten the nuts until 1/8″ (3 mm) of the threaded end of the attaching bolt protrudes outside the nut.

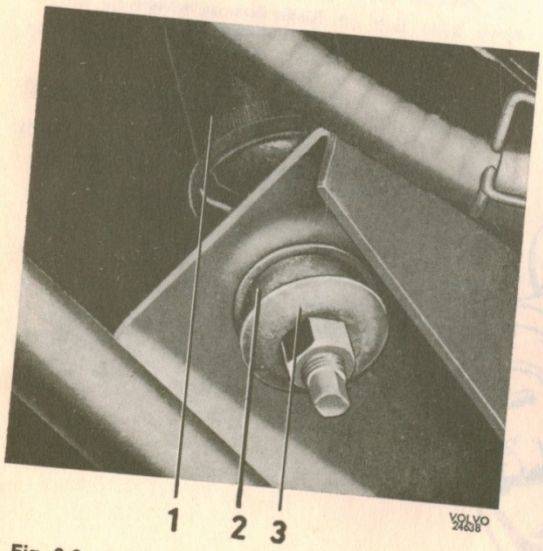


Fig. 9-6. Lower attachment of rear shock absorber

1. Shock absorber
2. Lower rubber bushing
3. Lower washer

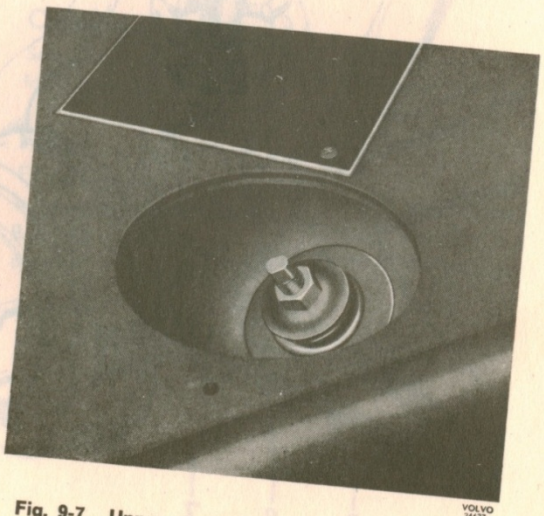


Fig. 9-7. Upper attachment of rear shock absorber

REPLACING A REAR SHOCK ABSORBER

1. Remove the upper attaching, nut, washer and rubber bushing through the hole in the rear window shelf. See Fig. 9-7.
2. Remove the lower attaching nut, washers, and rubber bushing. Remove the shock absorber.
3. Fitting is carried out in the reverse order to that used when removing. See Fig. 9-5. Fit the washer with the larger hole on the inside of the lower rubber bushing. Tighten the nuts until 1/8″ (3 mm) of the threaded end of the attaching bolt protrudes. On late production shock absorbers of Gabriel manufacture, which have longer attaching bolts (52 mm = 2 1/16″), the above-mentioned measurement should, however, be 11 mm (7/16″).

Fitting of shock absorber

On some types of shock absorber attachments the retaining nut is screwed directly on the shock absorber rod. Since the degree of tightening of this nut can vary with the vehicle type and shock absorber type, the following information is given for these shock absorbers which occur on the P 1800-series.

Shock absorber type	Position	Measurement		Fitted as shown
Early prod. (Chassis No. 1-2443)		III, Fig. 9–8C in inches	(mm)	Fig. 9–8 A and B
Gabriel, type I	Front	1.732″	(44)	A
type II	„	2.047″	(52)	B
type I	Rear	1.732″	(44)	A
type II	„	2.047″	(52)	B
Late prod. (Chassis No. 2443–)				
Delco,	Front	1.732″	(44)	A
	Rear	1.732″	(44)	A

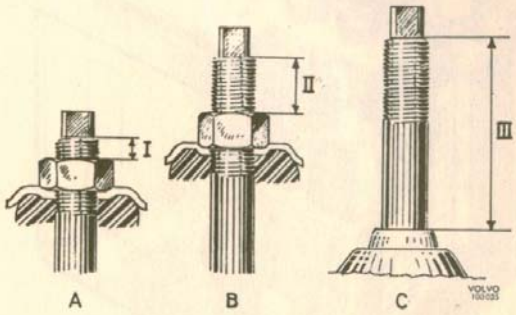


Fig. 9-8. Fitting of shock absorbers

A. I=0.118″ (3 mm)

B. II=0.433″ (11 mm)

C. The distance varies according to the type of shock absorbers, see list above.

SPECIFICATIONS

FRONT SPRINGS

Type	Coil springs
Material thickness	0.55–0.563″ (14.1–14.3 mm)
Outer diameter of spring	4.76–4.82″ (21–122.5 mm)
Total number of coils	8.7
Test values:	
Loading required to compress the spring 25/64″ (10 mm) (measured within a spring length range of 6 3/4–8 1/2″ = 175–215 mm)	105 1/2–114 1/2 lb. (47.8–51.8 kg)
Loading for a spring length of 7.68″ (195 mm):	
Yellow marking	1062–1082 lb. (481–491 kg)
Blue marking	1082–1104 lb. (491–501 kg)
Red marking	1104–1126 lb. (501–511 kg)

REAR SPRINGS

Type	Coil springs
Material thickness	0.441–0.449″ (11.2–11.4 mm)
Outer diameter of spring	4.57–4.63″ (116–117.5 mm)
Total number of coils	10.7
Test values:	
Loading required to compress the spring 25/64″ (10 mm) (measured within a spring length range of 8 3/4–10 1/2″ = 225–265 mm)	35.5–38.9 lb. (16.1–17.7 kg)
Length when fully compressed	4.65″ (118 mm)
Loading for a spring length of 9.64″ (245 mm):	
Yellow marking	504–515 lb. (229–234 kg)
Blue marking	515–526 lb. (234–239 kg)
Red marking	526–537 lb. (239–244 kg)

SHOCK ABSORBERS

Make, early production	Gabriel
late production	Delco

PART 10

ELECTRICAL SYSTEM

DESCRIPTION

The electrical system of the Volvo P 1800 is a 12-volt system. The equipment can be grouped into the following main parts: battery, generator, charging control, starter motor, ignition system, lighting and signal devices and instruments.

BATTERY

The battery is located on a shelf to the right on the front side of the bulkhead. It is a 12-volt lead battery consisting of 6 cells. The battery has a capacity of 57 ampere hours.

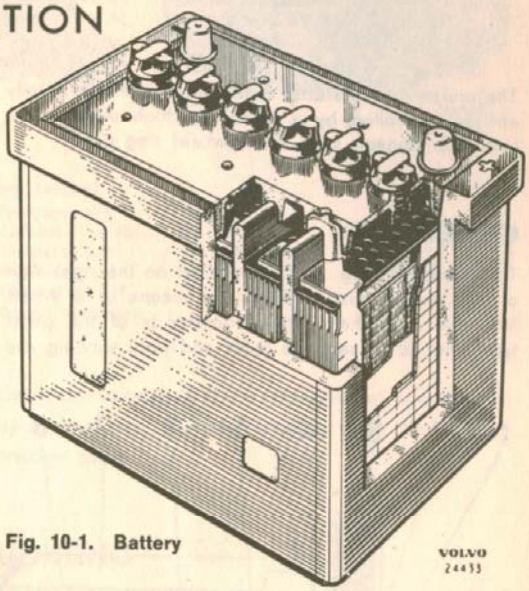


Fig. 10-1. Battery

VOLVO 24433

STARTER MOTOR

The starter motor, Fig. 10-2, is fitted on the flywheel housing on the left side of the engine. It consists of a 4-pole series motor.

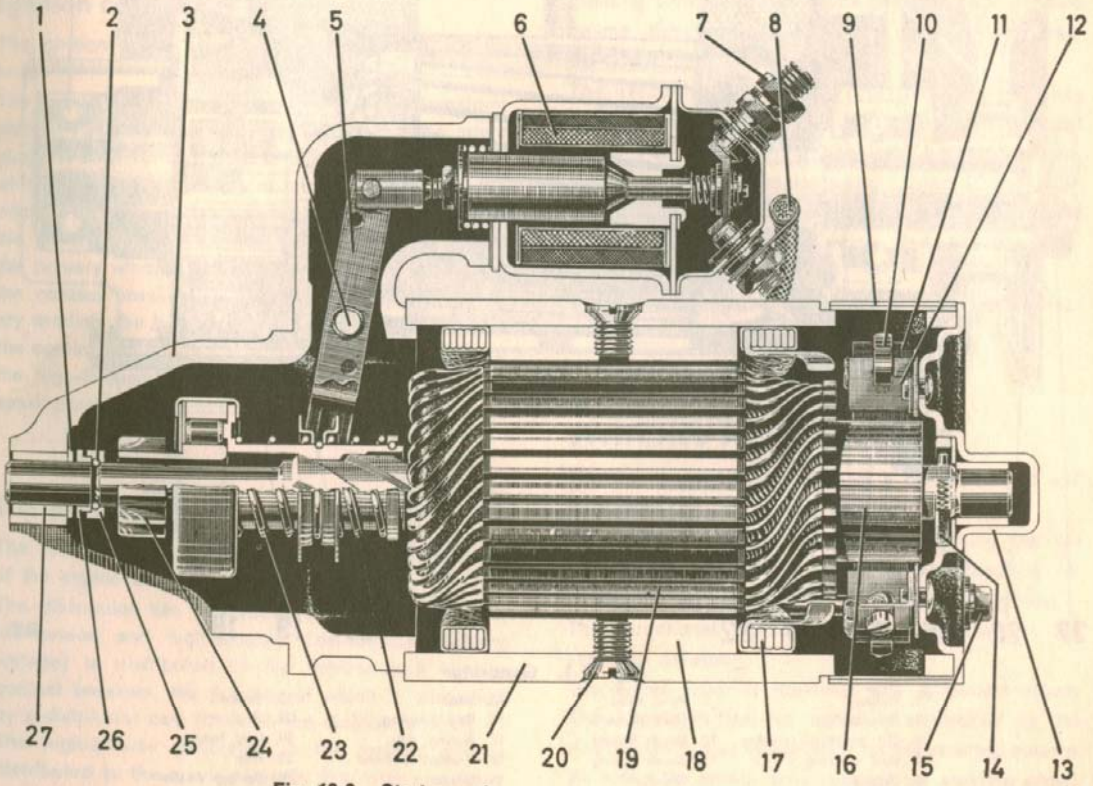


Fig. 10-2. Starter motor

VOLVO 26555

Fig. 10-2. Starter motor

1. Adjuster washer
2. Lock ring
3. End head
4. Shaft
5. Connecting arm
6. Solenoid switch
7. Terminal bolt
8. Lead
9. Protective band
10. Brush spring
11. Brush
12. Brush holder
13. End head
14. Rotor brake
15. Bolt
16. Commutator
17. Field winding
18. Pole shoe
19. Rotor
20. Pole screw
21. Stator
22. Spring
23. Spring
24. Pinion
25. Washer
26. Washer
27. Bushing

The pinion on the starter motor rotor can slide axially and is controlled by a solenoid which enables the pinion to engage with the flywheel ring gear.

GENERATOR

The generator, Fig. 10-3, is located on the right side of the engine and is driven by means of a V-belt from the crankshaft. The generator is of the shunt type, that is to say, the rotor and field winding are connected in parallel. The charging output of the generator is regulated by a charging control.

Charging control

The charging control, Fig. 10-4, is fitted on the left wheel housing. The charging control is of the variometer type, that is to say, the current output is limited by means of a variometer. In addition to the variometer, the charging control also has a reverse current relay and voltage control.

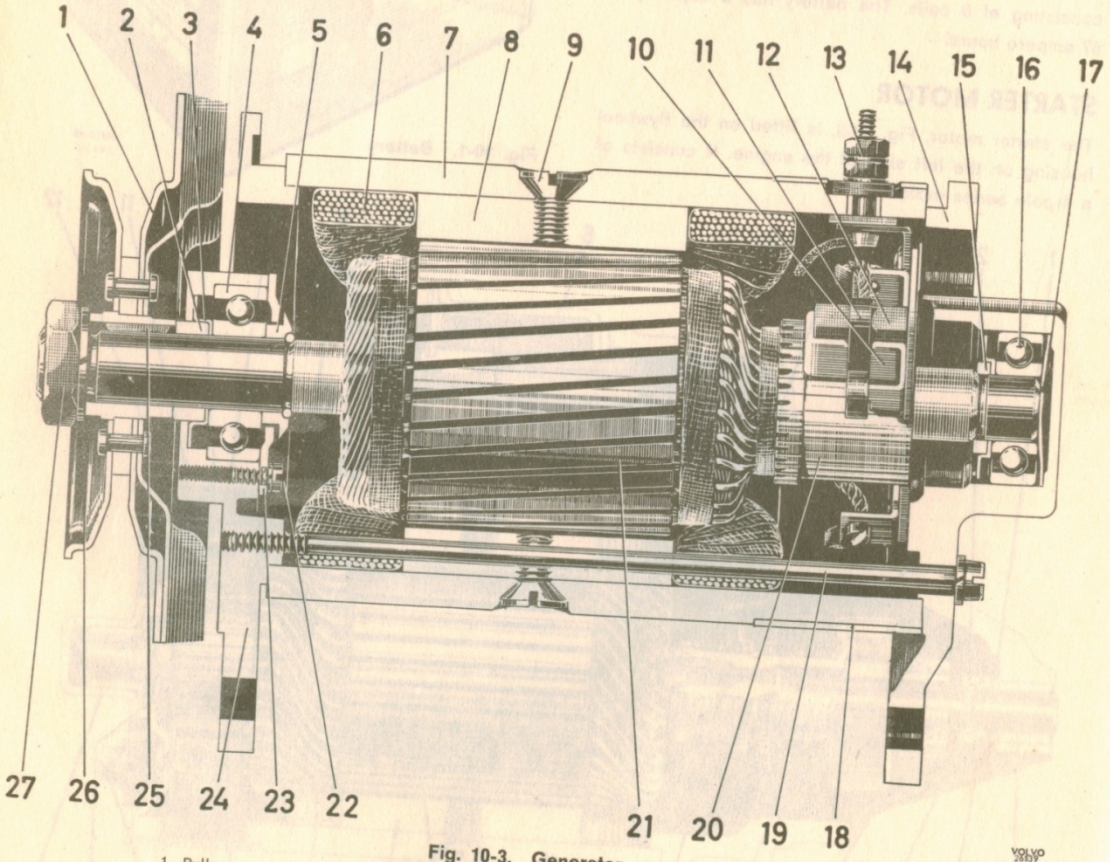


Fig. 10-3. Generator

1. Pulley
2. Spacer
3. Oil protector washer
4. Ball bearing
5. Spacer
6. Field winding
7. Stator
8. Pole shoe
9. Pole screw
10. Brush holder
11. Brush spring
12. Brush
13. Terminal screw
14. End head
15. Seal
16. Ball bearing
17. Spring ring
18. Protective band
19. Screw
20. Commutator
21. Rotor
22. Screw
23. Seal
24. End head
25. Key
26. Spring washer
27. Nut

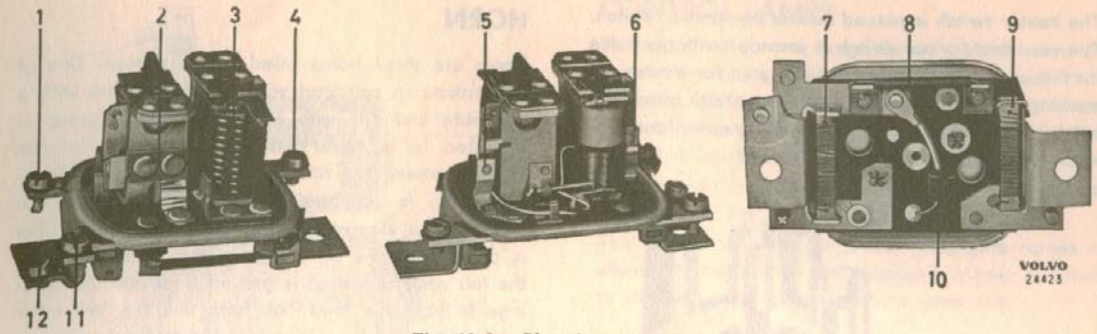


Fig. 10-4. Charging control

1. Terminal, DF
2. Voltage control
3. Cut-in relay
4. Terminal, B+
5. Cut-in contact
6. Control contact
7. Resistance w R
8. Variometer resistance
9. Resistance a R
10. Variometer
11. Terminal D+, 61
12. Ground connection

IGNITION SYSTEM

The ignition system is of the battery ignition type. This consists of the following main parts: ignition coil, distributor, ignition leads and spark plugs.

Ignition coil

The ignition coil is fitted on the left side of the bulkhead.

The purpose of the ignition coil is to transform battery voltage to high-tension voltage for the spark plugs. It consists of a core of laminated plate around which is coiled a winding of heavy copper wire, the primary winding, and a winding of fine copper wire, the secondary winding. The first-mentioned winding, the primary winding, operates at battery voltage from the contact breakers in the distributor. The secondary winding, the high-tension winding, is connected to the center terminal on the distributor cover. From here the high-tension current is distributed to the engine spark plugs.

The distributor

The distributor, Fig. 10-5, is placed on the left side of the engine and driven from the camshaft.

The distributor has two separate electrical circuits, low-tension and high-tension. Low-tension (battery voltage) is distributed to the ignition coil by the contact breakers, the function of which is controlled by a distributor cam fitted on the distributor shaft.

The high-tension generated in the ignition coil is distributed to the spark plugs by the rotor arm fitted on the distributor camshaft. The adjustment of the distributor in relation to the engine speed is controlled by a centrifugal governor located under the contact breaker plate.

LIGHTING

Lighting consists of headlights giving full and dimmed beams, directional flashers and parking lights, rear lights and number plate lighting.

The headlights are fitted in the front fenders. They are operated by a light switch fitted on the instrument panel. Full and dimmed headlight beams are controlled by a foot dimmer switch fitted in the floor. The parking lights are placed under the headlights and contain bulbs for parking and directional indicators.

The rear lights have two bulbs for rear light, directional indicators and stop light.

SWITCHES AND CONTROLS

The lighting control consists of a combined pull and turn switch.

The pulling function is used for switching the car lighting on and off and the turning function for controlling the strength of the instrument lighting.

The directional indicator switch is placed on the steering column.

The switch lever is provided with automatic return. The headlight flashing signal is controlled by the directional flasher switch lever on the steering column. By lifting the switch lever towards the steering wheel, full headlight beams are engaged.

The heater switch is placed beside the ignition switch. The windshield wiper switch is provided with positions for full speed and half speed and also for windshield washing. The windshield wipers operate when the button is pulled out. The windshield washer functions when the button is turned to the right.

HORN

There are three horns fitted in two groups. One of the groups in provided with two horns, one with a low note and one with a high note. This group is operated by a horn button in the center of the steering wheel. The other group consisting of a loud-tone horn is operated by a spring-loaded switch lever on the steering column. When the horn button is pressed in, the winding in a horn relay (fitted on the left wheel housing) is grounded so that the windings in both the loud-tone horn and the two other horns are grounded. Current is fed to the horns over a fuse.

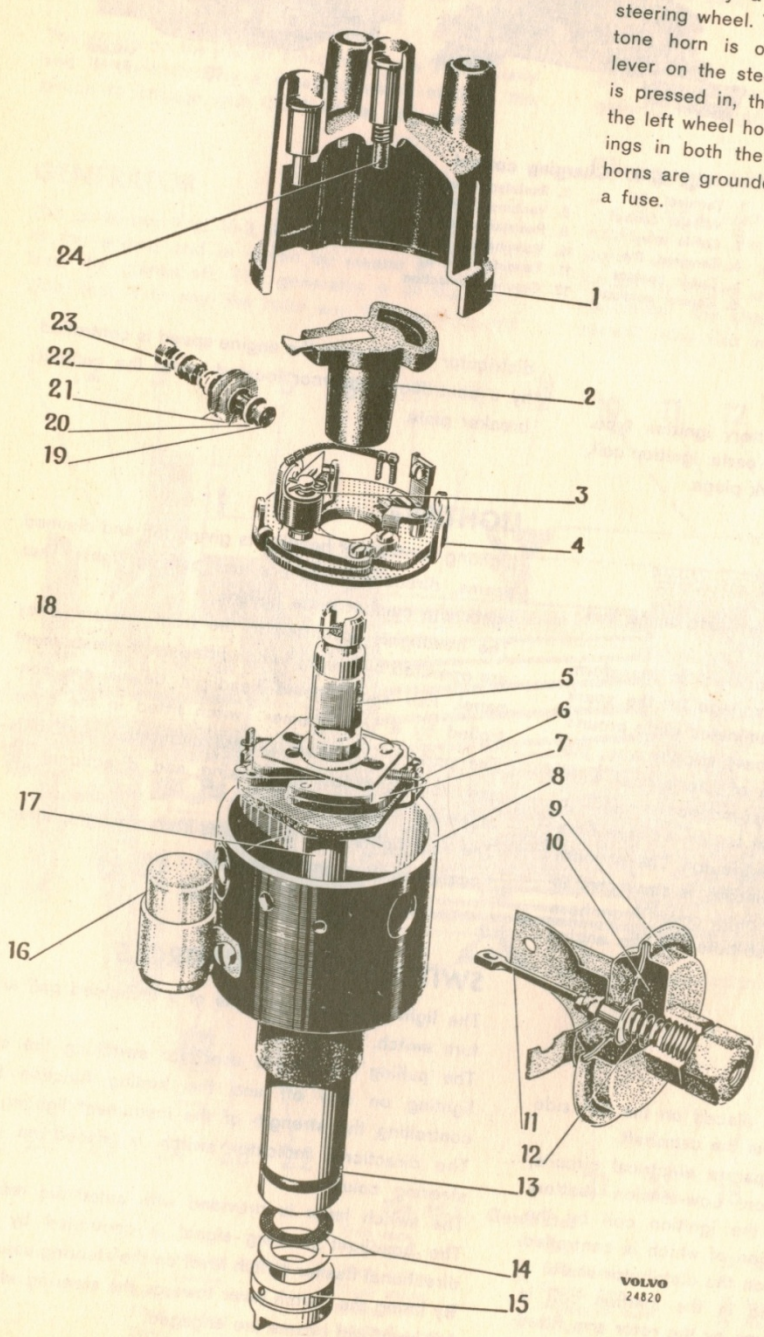


Fig. 10-5. Distributor

1. Cover
2. Rotor arm
3. Contact breaker points
4. Contact breaker plate
5. Contact breaker cam
6. Spring
7. Governor weight
8. Distributor housing
9. Vacuum regulator
10. Diaphragm
11. Link rod
12. Spring
13. Rubber seal
14. Washers
15. Collar
16. Condenser
17. Distribution shaft
18. Felt packing
19. Screw
20. Flat washer
21. Insulating washers
22. Spring washer
23. Nut
24. Brush

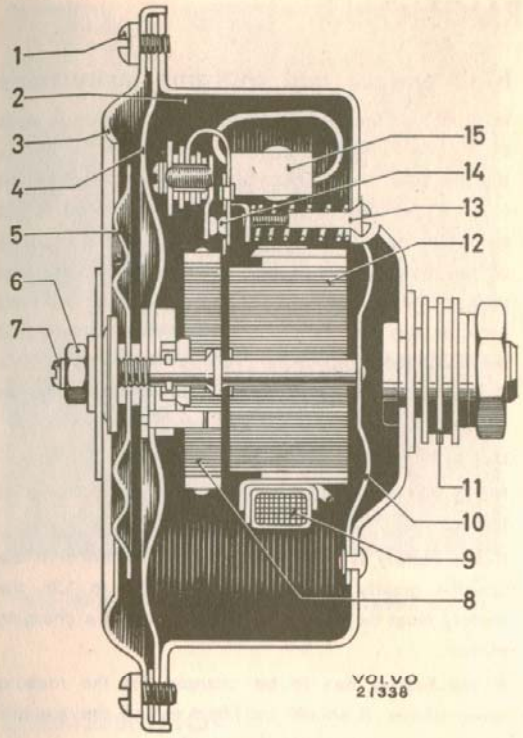


Fig. 10-6. Horn

1. Cover
2. Screw
3. Housing
4. Condenser
5. Cut-out
6. Adjusting screw for cut-out
7. Attachment
8. Leaf spring
9. Iron core
10. Magnetic winding
11. Armature plate
12. Diaphragm
13. Vibration plate
14. Adjusting screw
15. Lock nut

CONTROL LAMPS

The charging control lamp should be out when the engine is running. This shows that the generator is charging the battery. If the lamp lights, this indicates a fault in the generator. At low engine speed (idling speed) it is normal for the lamp to light.

The control lamp for the directional flashers blinks when one of the flashers is engaged.

The control lamp for full-beam headlights comes on when full headlights are engaged. When switching to dimmed headlights, the lamp goes out.

WINDSHIELD WIPER

The windshield wipers are driven by an electric motor. The motor operates the wiper blades through a gear housing and linkage system. The motor has two speeds.

FUSES

The fuses are placed beside the charging control on the left wheel housing.

The fuses consist of melt-wires fitted in glass tubes. The wiring diagram shows how the fuses are connected and what leads and components they protect.

Fig. 10-7. Windshield wiper

BATTERY

Removing

1. Remove the cable terminals from the battery terminal studs.

   Use a puller if the terminals are stuck on the studs.

2. Slacken the nuts on the attaching bar and lift out the battery.

3. Brush off the battery with a brush and wash it with clean lukewarm water.

4. Clean the battery shelf and cable terminals. Use a special steel brush for the cable terminals.

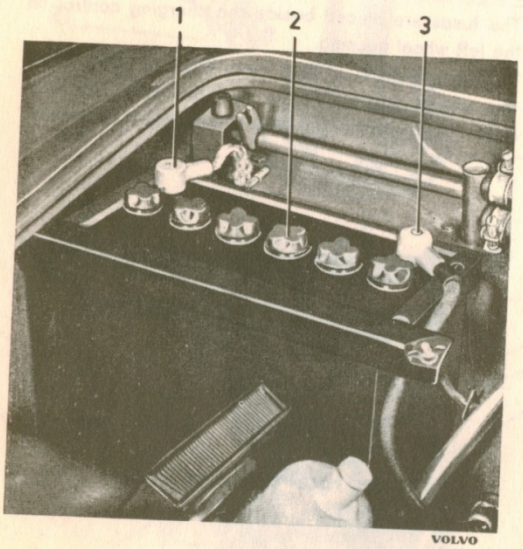


Fig. 10-8. Battery

1. Ground lead 2. Fitting plug 3. Lead to starter motor

Fitting

1. Place the battery in position. See that it is fitted the right way. Fix the battery with the attaching bar and nuts.

2. Tighten the cable terminals onto the terminal studs. The battery negative terminal stud should be grounded.

3. Coat the cable terminals and terminal studs with vaseline.

Maintenance and charging instructions

In order for the battery to function properly it must be in good condition. The first condition for this is that the fluid level is maintained at the correct height above the plates. If the fluid level is allowed to fall below the upper edge of the plates, the full capacity of the battery cannot be obtained since only that part of the plates surrounded by fluid can be used for charging and discharging. Therefore ensure that the level comes up to the plate A shown in Fig. 10-9. If the level is too low, top up with **distilled** water as necessary.

Use a filling flask as shown in Fig. 10-9.

NOTE. On no account must battery acid be used for this topping up.

If the battery is in a discharged condition or if the specific gravity of the fluid has fallen to 1.23, the battery must be taken out and charged at a charging station.

If the battery has to be charged for the reasons given above, it should be lifted out of the car and washed externally with clean water.

Only direct-current must be used for charging. Alternating-current will destroy the battery.

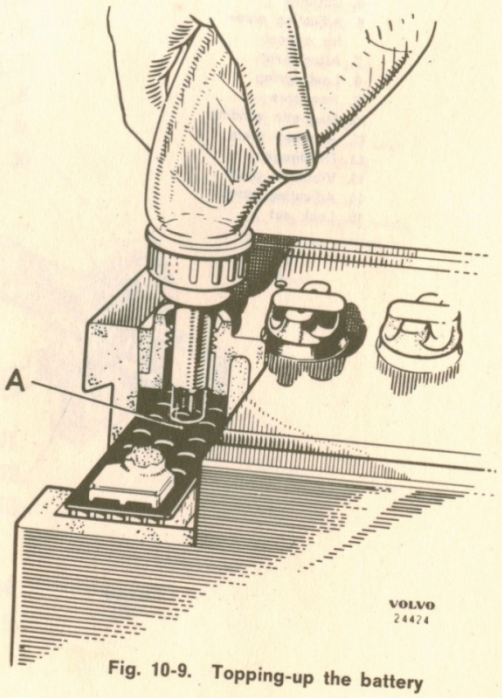


Fig. 10-9. Topping-up the battery

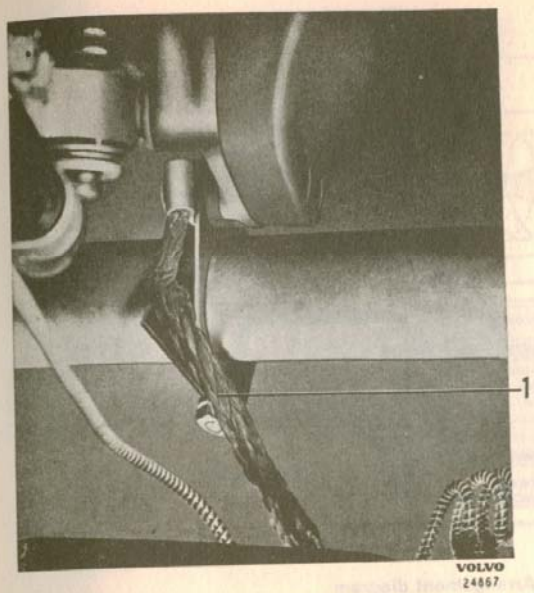


Fig. 10-10. Placing ground lead between engine and body
1. Ground lead

STARTER MOTOR

Removing

1. Remove the cable terminal from the negative terminal stud of the battery.
2. Remove the leads from the starter motor solenoid.
3. Remove the bolts that hold the starter motor to the flywheel housing and remove same.
4. Wipe off the starter motor externally with a piece of cloth moistened in gasoline.

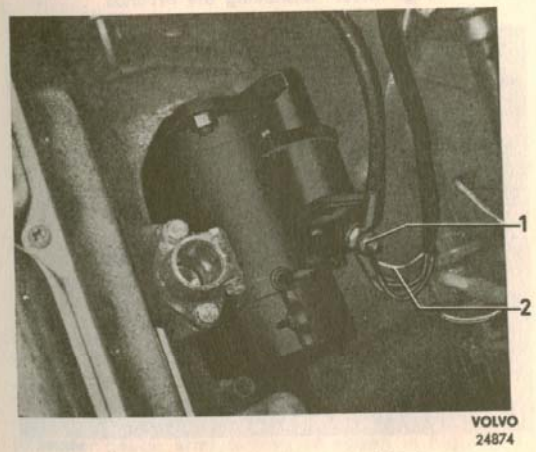


Fig. 10-11. Starter motor fitted
1. Battery lead 2. Control lead

Fitting

Fitting is carried out in the reverse order to removing. Tighten the bolts evely but not too tightly. Connect the leads carefully.

Measures before disassembling

If the starter motor shows signs of not functioning satisfactorily or perhaps not working at all, make sure first that it is not the battery, lead, starter contact or solenoid causing the trouble. If the fault is localised to the starter motor, remove same.

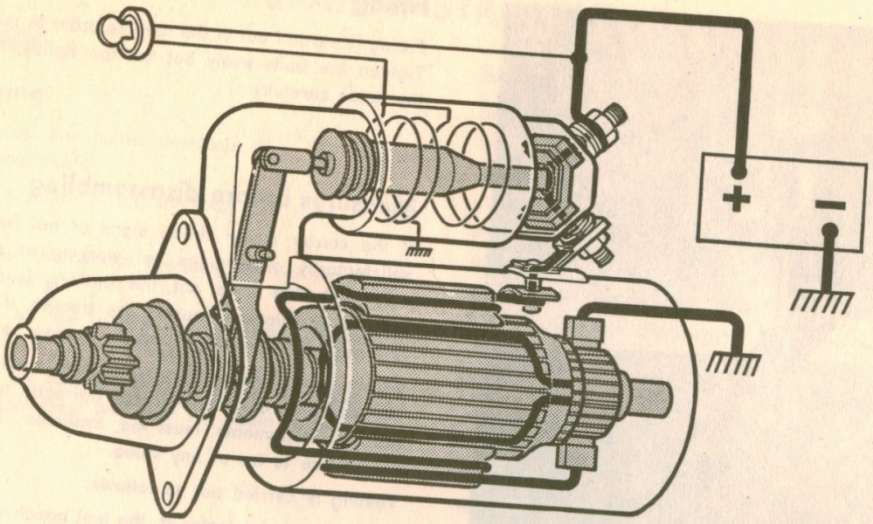
Before disassembling begins, we would point out the importance of carrying out tests correctly. In addition, reliable instruments must be available if the test results are to be of any value.

Testing is carried out as follows:

Place the starter motor on the test bench and remove the protecting band.

Connect the starter motor to the correct voltage. The starter motor housing is connected with the negative terminal. If the starter motor functions without any sign of short-circuiting or stiffness when current is connected, continue testing. Connect in a voltmeter and ammeter to a shunt of 500 amps. Hold a revolution counter against the shaft end of the rotor. Connect current and read off voltage, current value and speed. In addition, watch the brushes and commutator. Note the values and observations. Compare the values with those given in the specifications for an unloaded starter motor. The following reasons can now be established:

1. Low speed and low current strength.	Excessive resistance caused by dirty commutator, worn brushes or insufficient spring pressure.
2. Low speed and high current strength.	Short-circuiting in the field windings. The rotor drags against the pole shoes because of worn bearings or bent rotor shaft.
3. Excessive sparking, low rotation.	Insufficient spring pressure because of worn brushes or fatigued brush springs. Short-circuiting or partial breakage in rotor winding.
4. Excessive movement of brushes.	Insufficient spring pressure or out-of-round commutator.



VOLVO 21527

Fig. 10-12. Starter motor. Arrangement diagram

Dissassembling the starter motor

Disassembling the starter motor for overhaul (cleaning and lubricating) or repair is done as follows:

1. Remove the protecting band.
2. Lift the brush springs and pull up the brushes, Fig. 10-13.
3. Mark the position of the front and rear end heads in relation to the housing.
4. Remove the bolts which hold the 3 above-mentioned main parts of the starter together. Lift off the rear end head with rotor brake together with housing after the lead between the solenoid and housing has been disconnected.
5. Lift out the rotor with pinion housing, Fig. 10-14. This can be done after the pivot bolt for the solenoid engaging fork has been unscrewed.
6. Remove the stop washers on the rotor shaft. The thin washers (axial adjusting washers) and washer (3, Fig. 10-15) are removed by being pulled straight off the shaft. The thick washer (1, Fig. 10-15) should be knocked in 3/16–5/16″ (5–8 mm) on the shaft so that the lock ring (2, Fig. 10-15) can be removed, after which the washer is pulled off the shaft.
7. Remove the rotor brake from the rear end head.
8. Blow all dust and dirt from the starter motor housing with field winding and rotor. Clean off with a piece of cloth moistened with gasoline. Note. Blended gasoline, such as, for example, bentyl, must not be used since this can dissolve the insulation.

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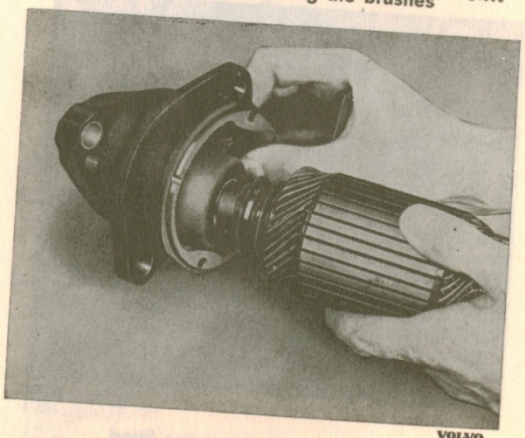
Fig. 10-13. Removing the brushes



VOLVO 24801

Fig. 10-14. Removing the pinion and rotor

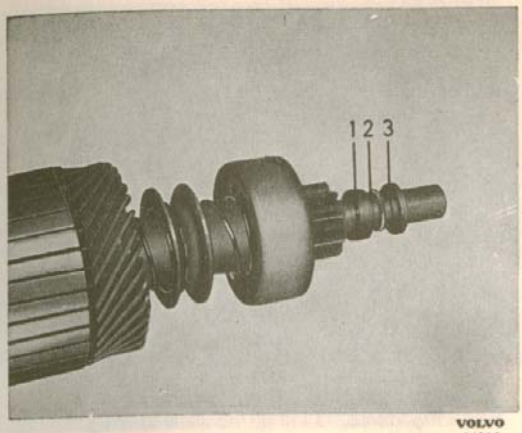


Fig. 10-15. Pinion, locking ring and nut
1. Stop ring, inner 2. Locking ring 3. Stop ring, outer

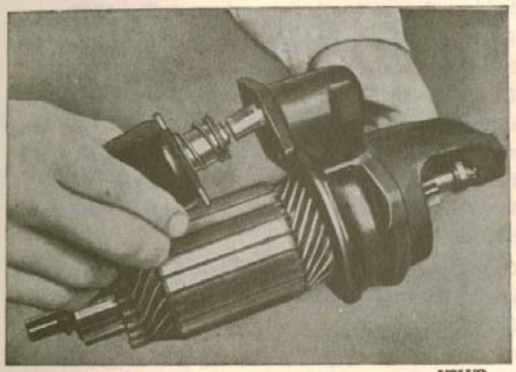


Fig. 10-16. Removing the solenoid

Inspection

Examine the rotor for mechanical damage. This can consist of a bent or worn shaft, scratched commutator and damaged winding.

If the rotor shaft is bent or worn, the rotor should be replaced. The shaft should only be straightened in exceptional circumstances. This should be done in a press.

If the commutator is scratched or unevenly worn, it should be turned, see Fig. 10-17. When doing this a special chuck should be used, see Fig. Take small cuts each time so that no more material is removed than is absolutely necessary. Large cuts can cause damage to the insulation and disks.

The commutator should be checked with a dial indicator gauge after turning as shown in Fig. 10-18. Radial throw must not exceed 0.003″ (0.08 mm). The insultation between the disks should be milled down

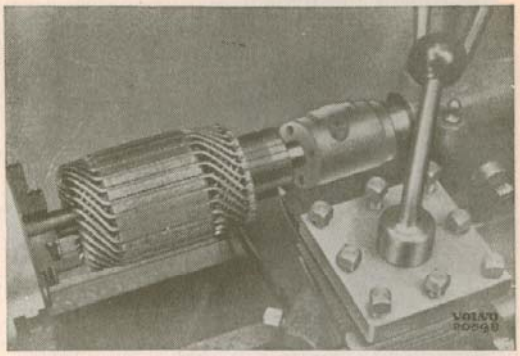


Fig. 10-17. Lathe-turning the commutator

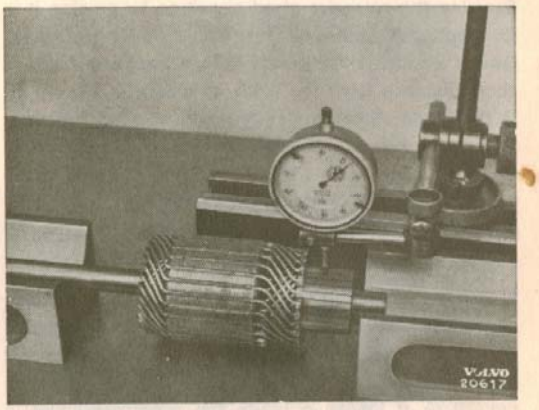


Fig. 10-18. Dial-indicating the rotor

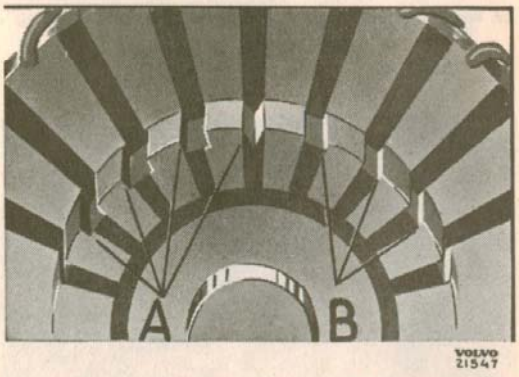


Fig. 10-19. A. Incorrect milling B. Correct milling

1/16″ (0.4 mm) under the disk surface. See Figs 10-19 and 10-20. This work should be carried out in a special apparatus or if one of these is not available, with a ground-off hacksaw blade.

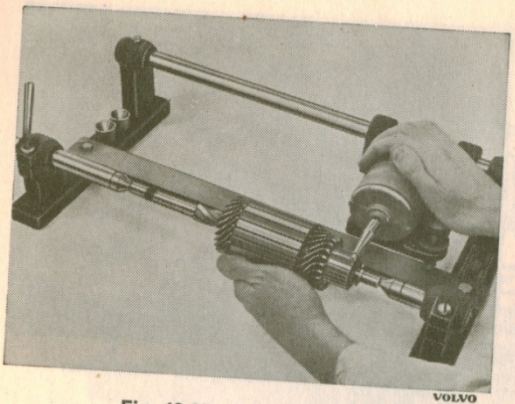


Fig. 10-20. Milling grooves

Examine the rotor for short-circuiting by placing it in an apparatus intended for this purpose (growler). Switch on the current and hold a hacksaw blade a short distance from the rotor as shown in Fig. 10-21. If the blade vibrates in any position when the rotor is turned, this can depend on one of the following reasons: shorting to the rotor frame, shorting in the commutator or between the windings.

Shorting to the rotor frame is tested with the help of probes and test lamp.

Examine the housing and field winding for damage caused by the rotor. Check that the field winding is not shorted to ground by connecting the contact points to the housing and field winding as shown in Fig. 10-22. If the lamp lights, the winding or inlet in the housing is damaged. Ensure that the brushes do not lie against the housing. Remove the inlet in the housing and check again. If the lamp still lights this shows that the field is grounded. The winding must be removed. See under "Replacing the field winding".

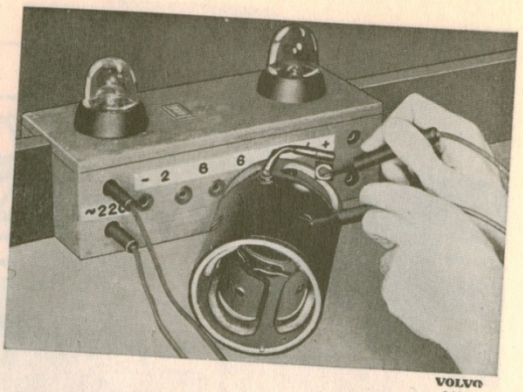


Fig. 10-22. Testing the field winding

Check the bearing end head with brush retainer. If any parts are damaged or excessively worn, they must be replaced. Bearing clearance must not exceed 0.005″ (0.12 mm). Check that both positive brush holders do not touch the end head, Fig. 10-23.

Brushes that are damaged, scratched or more than half-worn must be replaced.

Check spring pressure by means of a spring balance inserted in the spring, see Fig. 10-24. The force necessary to lift the spring from the brush should be between the values given in the specifications. If there is any deviation from the values, replace the springs concerned.

Check the pinion housing. Check the bearing on the shaft. Bearing clearance must not exceed 0.005″ (0.12 mm).

Inspect the other parts and replace any which are damaged or worn. Locking rings should always be replaced with new ones since they may have been damaged or lost their tension when being removed.

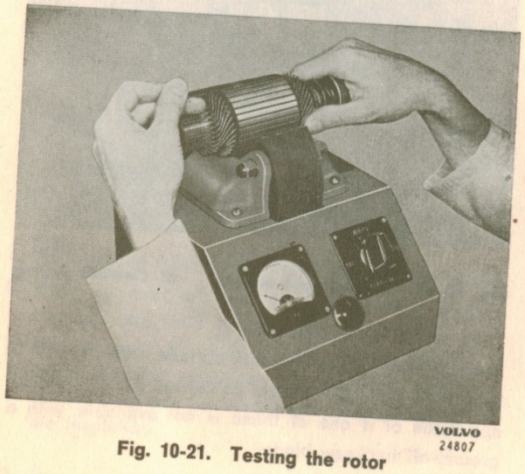


Fig. 10-21. Testing the rotor

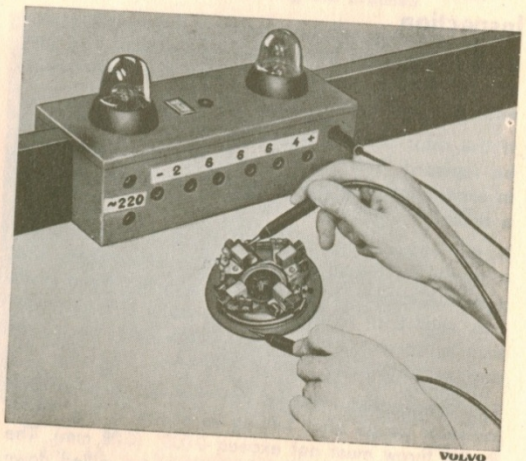


Fig. 10-23. Testing the brush retainer

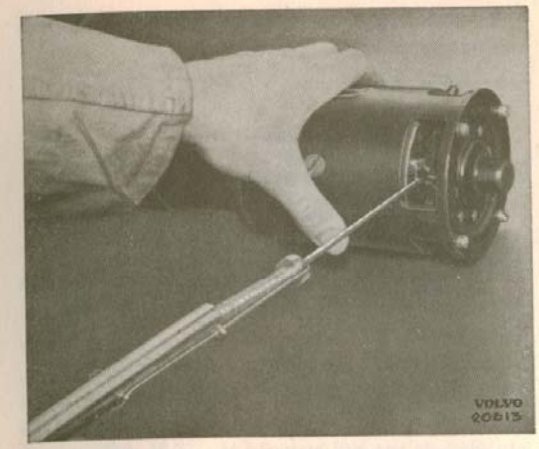


Fig. 10-24. Checking brush spring tension

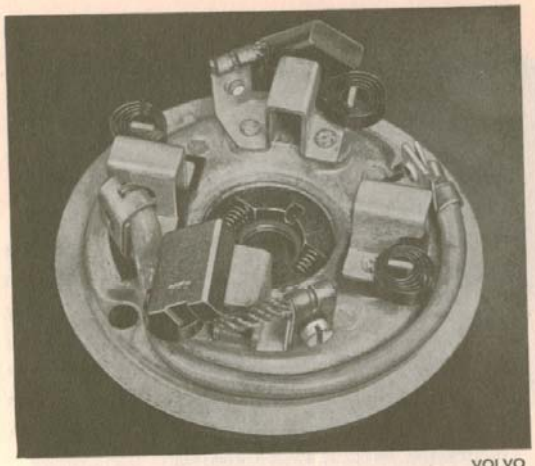


Fig. 10-26. End head

Assembling the starter motor

1. Fit the rotor brake in the rear end head, see Fig. 10-25, and the lead between the positive brushes as shown in Fig. 10-26.
2. Fit the starter pinion on the rotor shaft, then put on washers and locking ring as shown in the Fig. Lubricate the rotor shaft as shown in the instructions in Fig. 10-31.
3. Assemble the rotor and pinion housing and place the engaging arm in position round the starter pinion. Then fit the solenoid lever on the pinion housing and place in the pivot bolt.
   Lubricate the starter pinion and engaging arm with heat-resisting ball bearing grease.
5. Place the housing on the rotor; fit it into the end head following guide pins or marking. Place the rear end head on the rear shaft end of the rotor and bolt it in the correct position with the through-running bolts. Turn the rotor and check that it

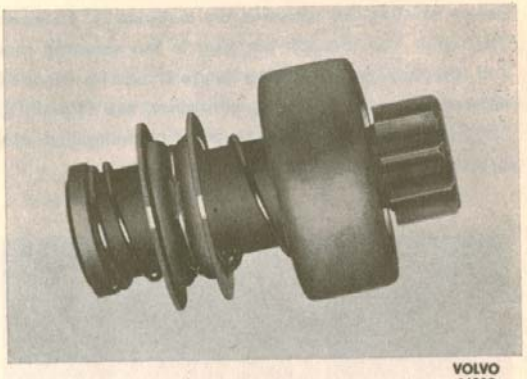


Fig. 10-27. Starter pinion

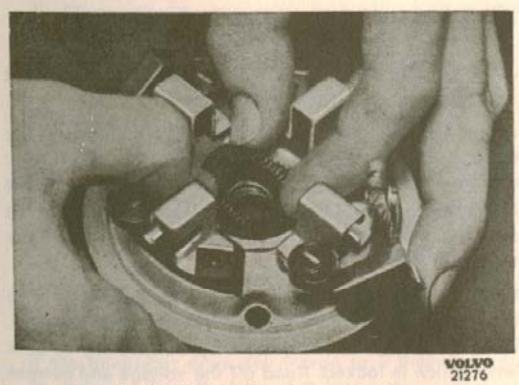


Fig. 10-25. Fitting the rotor brake

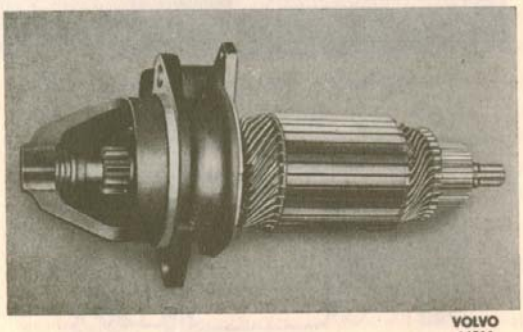


Fig. 10-28. Rotor and starter pinion fitted

runs easily. Measure the axial clearance and compare with the specifications. Lubricate the shaft end and bushing.

6. Fit the brushes.

Solenoid

If the solenoid does not work, first check that the battery is in good condition. If there is no fault with the battery, connect a lead between the battery positive terminal and the contact screw of the solenoid control lead. If the solenoid still does not connect in the starter pinion and main current, remove it from the starter motor. If it engages, on the other hand, examine the ignition switch and leads.

When the solenoid has been removed it should be cleaned. Then press in its armature several times and test again by connecting it to a battery. If it still does not function, check the coil, when the values in the specifications should apply. A faulty solenoid should be replaced with a new one.

Before refitting the solenoid, the distance "a" between the center line through the stud in the solenoid fork and solenoid lever attaching flange should be checked when the iron core is fully withdrawn, see Fig. 10-30. After adjusting this distance and tightening the lock nut, recheck the distance "a".

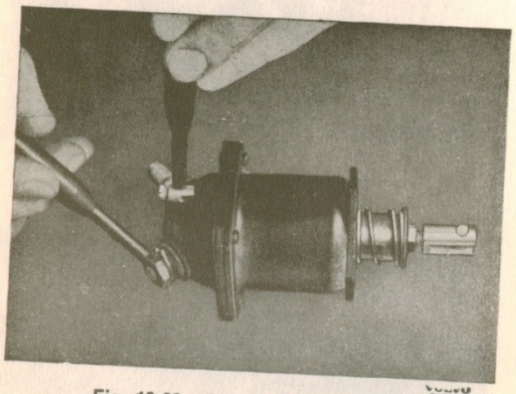


Fig. 10-29. Testing the solenoid

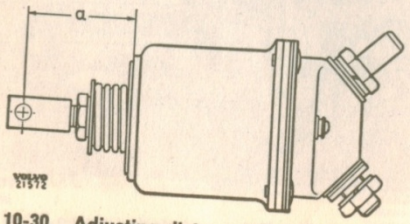


Fig. 10-30. Adjusting distance for the solenoid fork

The nut and fork stud should then be locked with sealing compound.

Concerning the distance "a", see specifications.

Replacing the brushes

If the brushes are damaged or more than half-worn, they must be replaced.

When replacing the brushes the starter motor must be removed from the car and cleaned externally.

Brushes should be changed with the starter motor assembled. The lead from the brush is unscrewed, the brush spring lifted with a hook and the brush then lifted up from its retainer. The new brush is slid into the retainer and screwed in.

Replacing the field winding

1. If the starter motor is not disassembled, do so. Follow the instructions under the heading "Disassembling".
2. Lay the housing in a V-block as shown in Fig. 10-45. Place a screwdriver in the drill chuck. Press down with the handle at the same time as turning the screwdriver. The scews are usually very tight. Therefore make sure that the screwdriver fits well into the screw slot and is sufficiently wide.
3. When the screws have been removed, lift off the housing. Screw out the screws with an ordinary screwdriver. Remove the field coil inlet in the housing and then lift out the winding and pole shoes.
4. Place the pole shoes in the new field winding and screw them on to the housing. Use the same method as when removing them.
5. Solder the field coil at the inlet in the housing.
6. Fit together the other parts of the starter motor. See under "Assembling".

Testing the starter motor

After the starter motor has been assembled it should be tested before fitting into the car.

Carry out the mechanical tests first. Measure the friction torque of the rotor brake, the free-wheel moment of the pinion, the brush spring tension and the rotor axial clearance if these have not been checked previously. After these tests, carry out the electrical tests.

First test the starter motor unloaded according to the values given in the specifications. After this test, lock the starter motor pinion by connecting it to a lever which is locked. Read off the voltage and current according to the specifications.

Lubricating scheme for starter motor

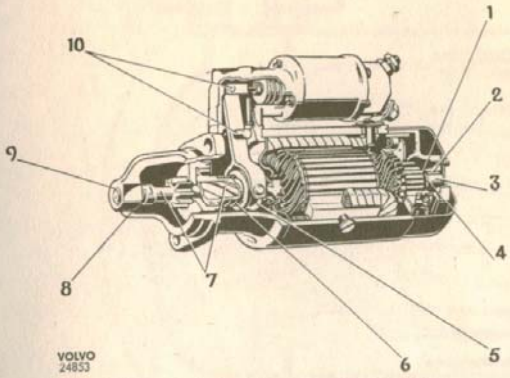


Fig. 10-31. Lubricating the starter motor

Use Bosch lubricant (or corresponding) as shown by the designations given below

1. Ft 1 v 8. Lubricate the rotor springs lightly
2. Ol 1 v 13. Lay the bushing in oil for 0.5 hour before fitting
3. Ft 1 8 8. Lubricate the adjusting washers and shaft ends lightly
4. Ft 1 v 8. Coat the rotor brake liberally with grease
5. Ft 1 v 8. Coat the groove liberally with grease
6. Ft 1 v 8. Lubricate the flange sleeve and coil spring lightly
7. Ft 1 v 8. Lubricate the shaft end guides lightly
8. Ft 1 v 8. Lubricate the adjusting washers lightly
9. Ol 1 v 13. Lay the bushing in oil 0.5 hour before fitting
10. Ft 1 v 8. Lubricate the studs and their positions lightly

GENERATOR

Removing

1. Remove the cable terminal from the battery negative terminal.
2. Remove the leads from the generator.
3. Disconnect the tensioning stay for the V-belt and lift off the V-belt.
4. Remove the two bolts holding the generator to the engine and remove it.
5. Clean off the generator externally with a piece of cloth moistened in gasoline.

Fitting

Fitting is carried out in the reverse order to removing. The attaching bolts should be secured with tab washers or castle nuts and split pins.

Measures before removing and disassembling

If the generator does not charge or if there is reason to believe that it does not generate a sufficient

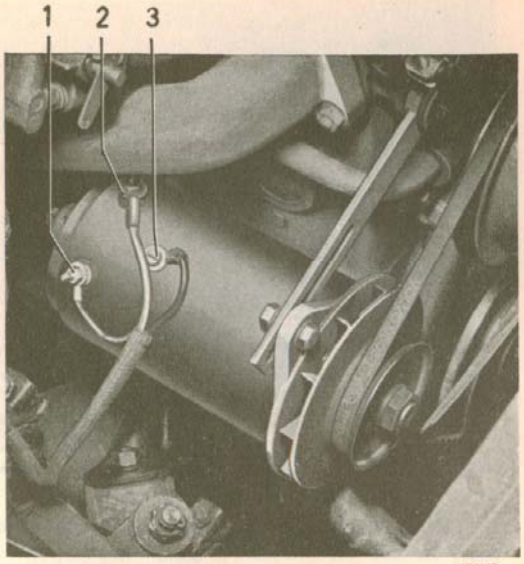


Fig. 10-32. Generator connections
1. Generator, DF 2. Generator, D+ 3. Ground leads

quantity of current or gives too high an output or voltage, it must be ascertained whether the fault is in the generator itself or if the charging control and cables are faulty.

First check that the connection from the battery to the relay terminal marked 51 B+ is intact. This is done with a voltmeter. The voltmeter is connected between the relay terminal B (51 B+) and the chassis. The voltage must not be less than battery voltage. If the voltmeter gives a poor reading, leads and contact points must be examined. If the voltmeter gives no reading at all, this indicates a breakage in the system. If there is no fault, the following test should be done on the generator. Disconnect the leads on the generator. The field terminal (small screw) is connected with a lead to the generator frame, voltmeter connected in between the generator current terminal (large screw) and generator frame. The engine is started and run from idling speed up to about 2000 r.p.m. while the voltmeter is being watched. The voltage should increase in step with the engine speed. Then return to idling speed and disconnect the ground connection of the field. The voltmeter should then return to zero. If it does not do so, the field is grounded inside the generator so that the control organ of the charging control will not function, with the result that the generator will burn out.

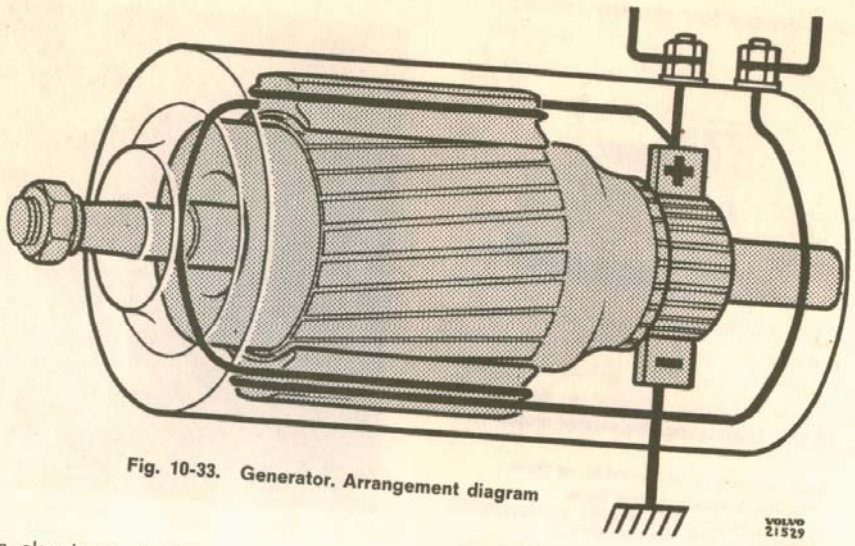


Fig. 10-33. Generator. Arrangement diagram

The test can also be carried out as follows. Disconnect the generator leads at the charging control. Ground the field lead, increase engine speed gradually at the same time bringing the other lead from the generator in contact a few times with the charging control frame. Heavy sparking should occur when contact is made between the leads and charging control frame.

If no sparks are seen or if the voltmeter does not give a reading, the generator is faulty and must be removed.

Then break connection between the charging control frame and field lead, bring the main lead in contact again with the charging control frame and no sparks must now be seen. If sparking occurs, the field is grounded inside the generator.

Inspecting the generator

After removing, the generator should be cleaned externally with gasoline or similar. The protecting band for the brushes should be removed and the generator placed on a test bench. The testing to be carried out is designed to establish the type of fault in the generator and it is very important that the testing should be done correctly and with reliable instruments.

The generator field terminal is connected to the generator frame and this is connected to the battery negative terminal. The battery positive terminal is connected in series with an ammeter to the generator output terminal.

The generator should now run as motor at a low and even speed. If not, see the following fault tracing scheme.

Current low, rotor stationary.	Brushes worn or stuck in retainer and do not reach down to the commutator.
Current low, rotor rotating slowly.	Poor contact between brushes and commutator. Breakage in rotor winding.
Current high, rotor stationary.	Short-circuit in rotor. Breakage or short-circuit in field. A bearing has seized.
Current high, rotor rotating.	Scratched or burnt commutator. Bearings binding. Excessive brush spring pressure.
Excessive movement of brushes and heavy sparking.	Out-of-round or burnt commutator. Damaged brushes.

Disassembling

Disassembling the generator for overhaul (cleaning and lubricating) is done as follows:

1. Remove the protecting band if this has been fitted again after testing.
2. Disconnect the brush leads. Lift up the pressure arms or springs for the brushes with a hook and pull up the brushes, see Fig. 10-34.

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Fig. 10-34. Removing the brushes

3. Remove the bolts which hold the generator housing and end heads together. When doing so, first release the connecting bar as shown in Fig. 10-35.
4. Take off the rear end head with brush retainer.
5. Lift the rotor from the housing.
6. Place the rotor in a vice but do not grip too tightly (use copper jaws). Undo the nut for the belt pulley and pull off same. Use a tool as shown in Fig. 10-36. Remove the Woodruff key.
7. Remove the front end head from the rotor.
8. Pull off the ball bearings with a standard puller.
9. Blow the generator housing and field winding together with rotor free from dust and dirt. Clean with a linen rag moistened in gasoline.

   Note. Blended gasoline, for example, bentyl, must not be used since it dissolves the shellac. Wash the other parts, except the brushes, in clean gasoline.

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Fig. 10-35. Removing the connecting bar

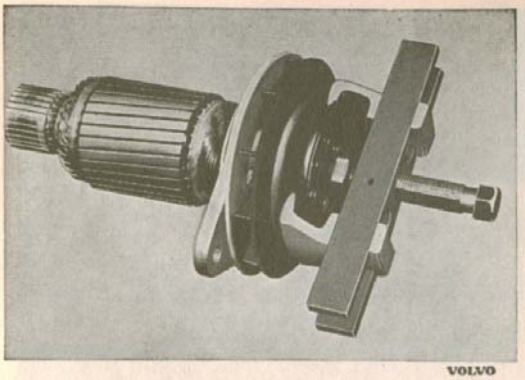

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Fig. 10-36. Removing the belt pulley

Inspection

Examine the rotor for mechanical damage. This can consist of a bent or worn shaft, scratched commutator and damaged or loose rotor winding.

A shaft which is only slightly bent can be straightened in a press but it is not recommended. Preferably replace the whole rotor.

If the commutator is scratched or unevenly worn, it should be lathe-turned. When turning, a special chuck should be used. In addition, the greatest care must be observed. Take small cuts every time so that no more material than is absolutely necessary is removed. If too large cuts are taken, this can damage the insula-

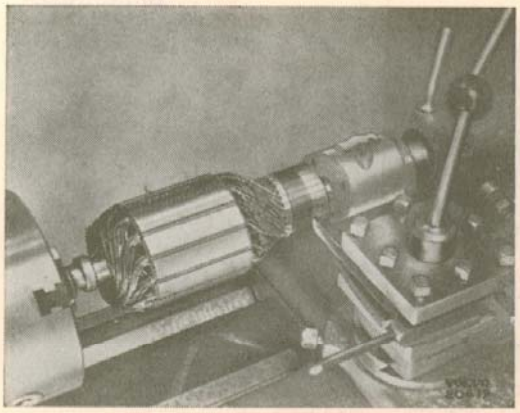

Fig. 10-37. Turning the commutator

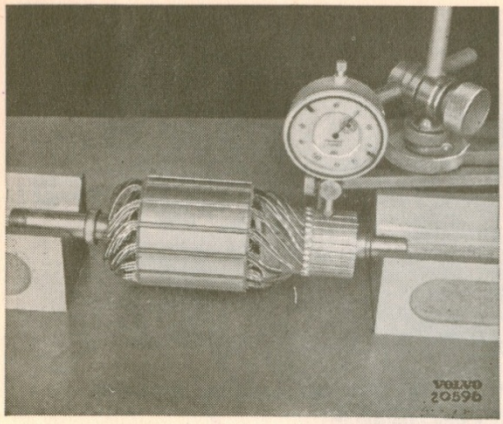

Fig. 10-38. Dial indicating the commutator

tion and disks. Ensure that no object comes in contact with the rotor or winding during turning.

After turning, the commutator should be measured with a dial indicator gauge as shown in Fig. 10-38. Out-of-roundness must not exceed 0.0005″ (0.013 mm). The insulation between the disks should be milled down 1/32″ (0.8–1.0 mm) under the disk surface, see Fig. 10-39. This should be done in a special apparatus but if one of these is not available, with a ground-off hacksaw blade.

Examine the rotor both before and after turning by placing it in a special test apparatus (growler). Switch on and hold a hacksaw blade a short distance from the rotor, see Fig. 10-40. If the blade vibrates in any position when the rotor is turned round, one of the following faults can be the reason: short-circuiting to the rotor frame, short-circuit in the commutator or windings.

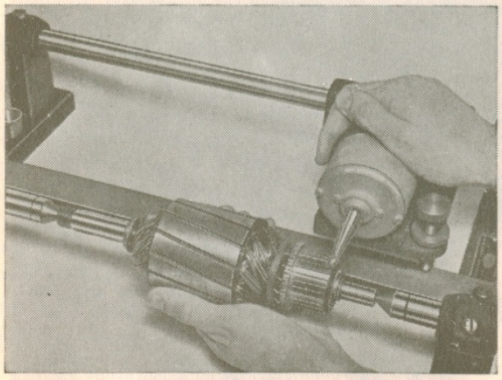

Fig. 10-39. Milling the grooves

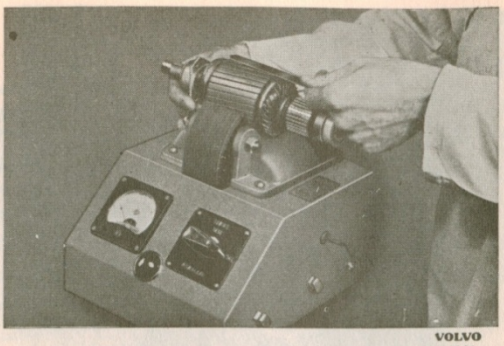

Fig. 10-40. Testing the rotor

Short-circuiting between the windings can be measured by holding the resistance fork against the commutator as shown in Fig. 10-41. Switch on and adjust the rheostat while turning the rotor backwards and forwards until the highest reading is obtained on the meter. Turn the rotor (the fork must be held still) so that the next pair of disks comes opposite the forks and hold it against these. If there is no fault, the reading should be the same and also for the other disks. A rotor winding with short-circuiting between the winding coils shows a low reading and a broken winding, no reading at all.

Short-circuiting to the rotor body is checked with the help of test probes and test lamps. See Fig. 10-42. Examine the housing and field winding for damage

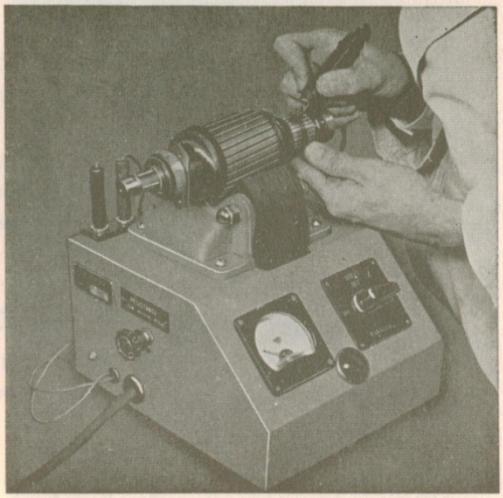

Fig. 10-41. Measuring the rotor

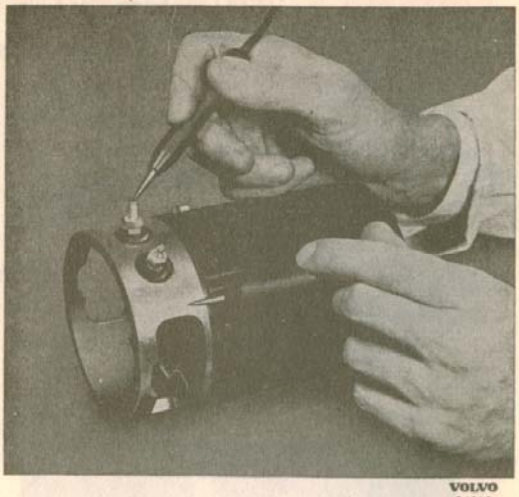

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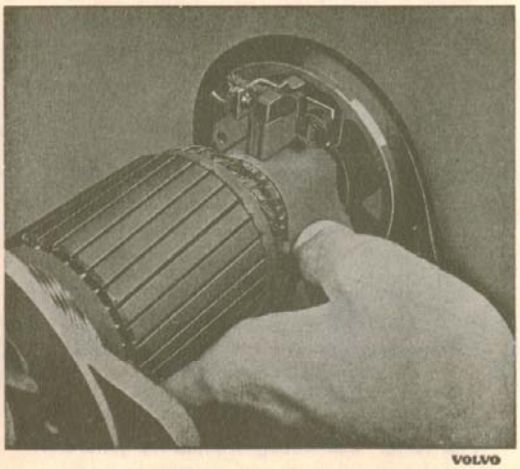
Fig. 10-42. Testing the stator

that could have been caused by the rotor. Test that the field winding is not grounded by connecting the contact points to field terminal and housing. If the lamp lights, there is leakage between the field winding and housing.

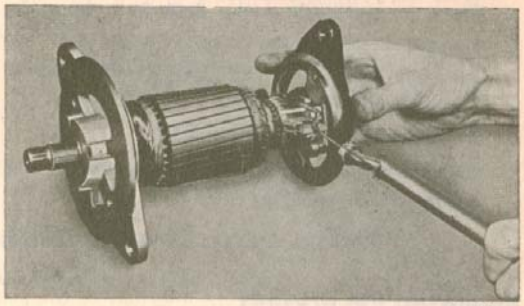
Ensure that the cable from the field winding to the positive brush holder does not touch the housing. Screw out the field inlet and test again. If the lamp still lights, the field winding is in contact with the housing. If so, the winding must be removed. See under "Replacing the field winding".

Internal faults in the field coils are determined by measuring the current consumption of the coils. This is done with an ohmmeter or volt-ammeter. If a volt-ammeter is used, convert according to Ohms law. Examine the rear end head brush retainer.



VOLVO 24855

Fig. 10-43. Clearing the brushes



VOLVO 24860

Fig. 10-44. Measuring brush pressure

If any parts are damaged, they should be replaced with new ones. Check that there is no leakage between the positive brush holder (insulated) and end head.

Brushes that are damaged or worn down more than half should be replaced. Brushes which are scratched or make bad contact with the commutator can be cleaned with sandpaper grade 00 or 000. See Fig. 10-43.

Check brush spring tension by fitting the end head on the rotor and connecting a spring balance to the flexible arm or spring, see Fig. 10-44. The force necessary to lift the arm or spring should agree with that given in the specifications. If there are deviations from these values, the spring must be replaced.

Check the bearings. The ball bearings should rotate freely without any noticeable play. Damaged or worn bearings should be replaced.

Assembling

1. Fit the stop ring and sleeve, where these exist, on the shaft.
2. Place the inner cover with any felt ring on the shaft. Lubricate the bearing with heat-resisting ball bearing grease and then fit it.
3. Place the front end head on the shaft and bearing. Place any outer cover with felt ring beside the end head and bolt the end head and cover together.
4. Drive in the key and press on the belt pulley. Place the rotor in a vice. Do not tighten too hard otherwise the rotor may be deformed. Fit spring washer and nut.
5. Insert the rotor into the housing and ensure that the guide pin locates correctly.

6. Place the end head on the shaft, fit in the guide pin and screw in the 2 bolts which hold the generator housing and end heads together. Check that the rotor turns easily. Fit the brushes into the holders in the rear end head.
7. Connect the terminal tab for output current to the positive brush, see Fig. 10-35.

Replacing the brushes

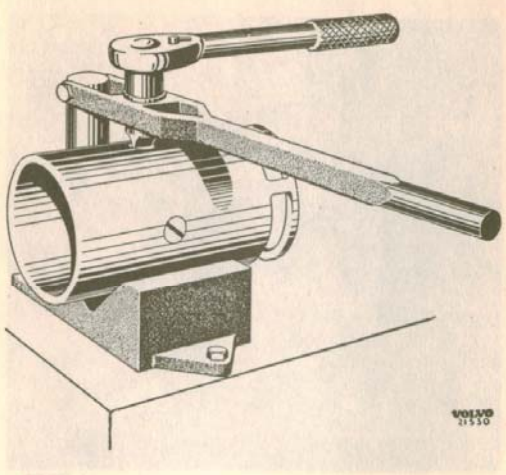
If the brushes are worn down more than half-way or damaged, they must be replaced. A symptom of this is that the generator ceases to charge. Remove the protecting band and examine the brushes and commutator. If it can be seen that the above fault is the reason for charging not taking place, the generator must be removed.

Wash carefully and wipe the generator externally with a piece of rag moistened in gasoline.

Remove the brushes by undoing the connections on the brush holders, lifting up the brush springs and pulling up the brush with a pair of pliers, see Fig. 10-34. If the commutator is scratched or unevenly worn, the generator must be disassembled and the commutator lathe-turned. See further under "Disassembling, inspection and assembling". Place in the correct type brushes and fit the protecting band. If there are test devices available, it is wise to test the generator before refitting it in the car. See further under "Testing the generator".

Replacing the field winding

1. If the generator is not disassembled, proceed in accordance with points 1 to 5 under the heading "Disassembling".
2. Place the generator housing in a V-block as shown in Fig. 10-45. Press downwards at the same time as turning the screwdriver. The screws are usually very tight. Therefore ensure that the screwdriver fits properly into the groove in the head of the screw and is sufficiently wide. When both screws have been removed, lift the housing out of the way. Screw out the screws with a screwdriver. Remove the cable inlet in the housing and lift out the windings and pole shoes.
4. Fit the new field winding into the housing. Follow the same procedure as when removing the screws.
5. Connect the cables at the inlet in the housing. Check for grounding.



6. Assemble the other parts of the generator. See under the heading "Assembling".

Testing the generator

Before the generator is refitted into the car it should be tested. Place the generator on a test bench and connect a volt-ammeter.

Run the generator as motor for a short while. Ensure that the generator has the right polarity, negative to ground. Check that current consumption for the generator is normal and that it runs evenly and silently, etc. Then start the drive motor, check its direction of rotation, and check that the generator gives the necessary voltage at the speeds stated in the specifications. Check that there is no sparking on the commutator and that the brushes do not jump.

Lubricating scheme for generator

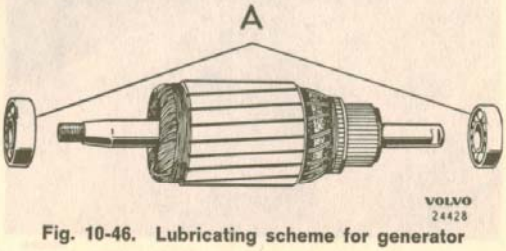


Fig. 10-46. Lubricating scheme for generator

A. Bearing lubricated with grease, Bosch Ft 1 v 22 or corresponding

CHARGING CONTROL

Removing

1. Disconnect the lead on the charging control.
2. Remove the charging control from the plate on the wheel housing.
3. Clean the charging control externally.

Fitting

1. If the charging control has been replaced, check that the new one is of the right type.

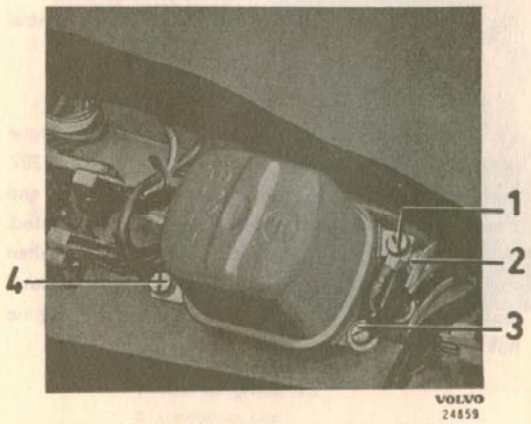


Fig. 10-47. Charging control terminals

1. Generator D+, 61
2. Ground lead
3. Generator field, DF
4. Battery, B+

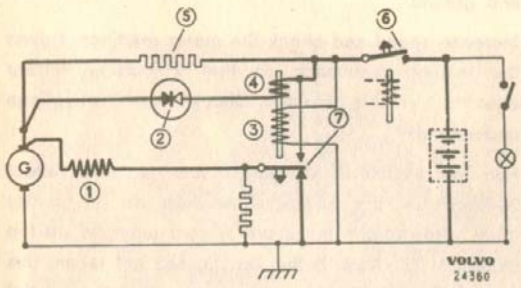


Fig. 10-48. Wiring diagram for charging control

1. Field winding
2. Variometer
3. Voltage winding
4. Current winding
5. Variometer resistance
6. Cut-in contacts
7. Control contacts

2. Screw the charging control onto the plate on the wheel housing.
3. Connect the leads. The leads are connected as shown in the Fig. 10-47 or according to the wiring diagram, illustration 10-1.

Adjusting the charging control

Reverse current relay

Cut-in voltage

Connect a voltmeter over D+ on the control and generator frame. Start the engine and increase speed gradually while watching the voltmeter. The reading should at first increase and then fall to 0.1—0.2 volts when the reverse current relay cuts in and thereafter remain stationary. The voltage which the voltmeter comes up to before this happens is the cut-in voltage. This is checked with the specifications after which any necessary adjustments are made.

Adjusting is carried out by increasing or decreasing the spring pressure influencing the relay armature. If the spring pressure is decreased, cut-in voltage decreases and vice versa.

Preliminary adjusting is shown in Fig. 10-49 and final adjusting in Fig. 10-50.

Reverse current

An ammeter is connected in series with B+ on the charging control and lead to the battery. The generator speed is increased until the ammeter shows

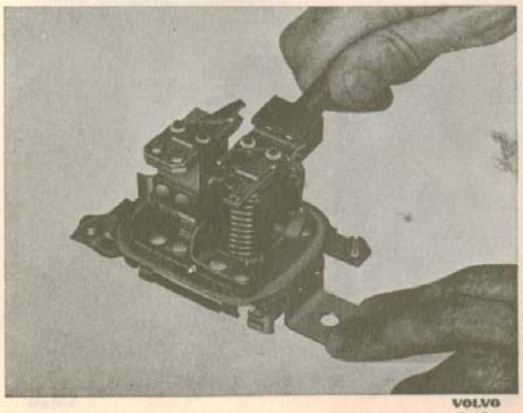


Fig. 10-49. Adjusting cut-in voltage

charging. The speed is then decreased slowly. The ammeter needle goes to zero and then over to discharge. It then returns suddenly to zero. The reverse current is read off at the turning point before the needle returns to zero. The relay has cut out when the needle returns to the zero position. The reverse current should be between the values given in the specifications.

If the reverse current is too low, the curve in the contact spring should be lessened by bending the contact yoke for the cut-in contact. It may be necessary to file off the pole pin slightly. If the reverse current is too high, the curve of the contact spring must be increased. Check the cut-in contact gap and adjust it if necessary. After adjustment, recheck the cut-in voltage.

Voltage control

Break the connection B+ on the voltage control. Connect a voltmeter between B+ and the voltage control frame and increase the generator speed gradually.

As soon as voltage control has begun, that is to say, when the voltage does not rise any more, the control voltage should be read off. Adjustment of the voltage control is done by bending the support tab for the spring tongue as shown in Fig. 10-50 so that the spring tongue is completely relieved. Preliminary adjustment is then done by bending the relay elbow as shown in Fig. 10-51. If the elbow is bent downwards, voltage is increased and vice versa.

Preliminary adjustment should be about 1–2 volts lower than final adjustment. This is done by bending

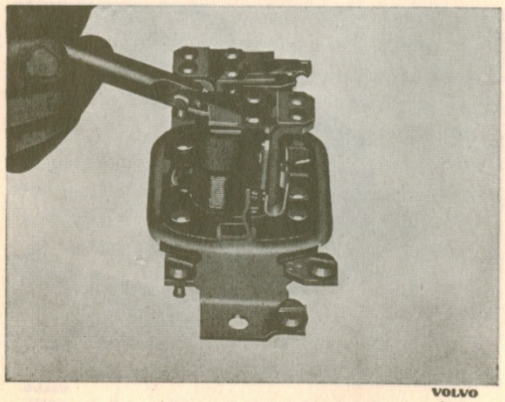


Fig. 10-50. Final adjustment of voltage control

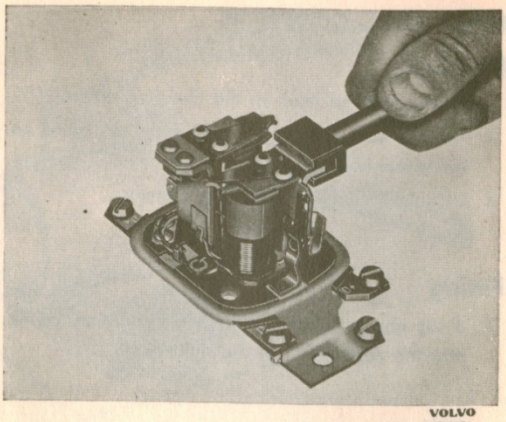


Fig. 10-51. Preliminary adjustment of voltage control

the support tab upwards so that the spring tongue is tensioned, see Fig. 10-50. Special Bosch tool V 397. Increase and decrease the speed a few times and check that the voltage control is correctly adjusted. NOTE. This adjustment must be carried out when the generator has attained full operating temperature, that is to say, at least 12 minutes after the engine has been started from cold.

Checking the variode (cold generator)

Connect an ammeter between B+ and the live lead and connect an adjustable loading resistance of suitable size between the ammeter battery side and ground. In addition, connect a voltmeter between B+ and ground.

Increase speed and check the meter readings. Adjust the loading resistance so that a loading current equal to 1 max. is obtained. Check the control voltage under load.

Run the engine at the above loading. After about 2–3 minutes, the current value must not be greater than 2/3rds of the maximum current stamped on the generator (1 max.). If the loading has not fallen, this indicates a fault in the variometer so that the control must be replaced.

Since the generator output is very high, this puts great demands on the condition and tension of the drive belt. Before starting work on the charging control and generator, therefore, always check that the belt is correctly tensioned.

DISTRIBUTOR

Removing

1. Lift off the distributor cap.
2. Mark the rotor arm position on the distributor housing.
3. Disconnect the primary lead 1, Fig. 10-52.
4. Unscrew the screw (4, Fig. 10-52) on the control arm and lift up the distributor.

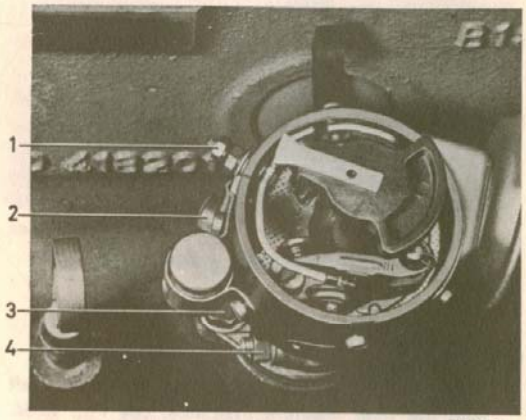


Fig. 10-52. Distributor, fitted

1. Lead for ignition coil
2. Lubricating cup
3. Screw for attaching distributor
4. Adjusting screw

Fitting

Fitting is done in the reverse order to removing. If the engine has not been turned while the distributor has been removed, fit it in accordance with the marking under point 2 above.

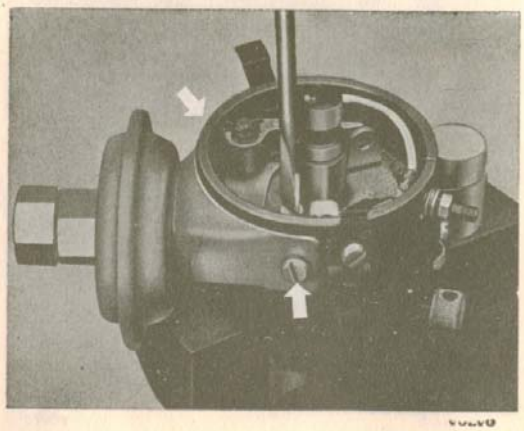


Fig. 10-53. Removing the vacuum regulator

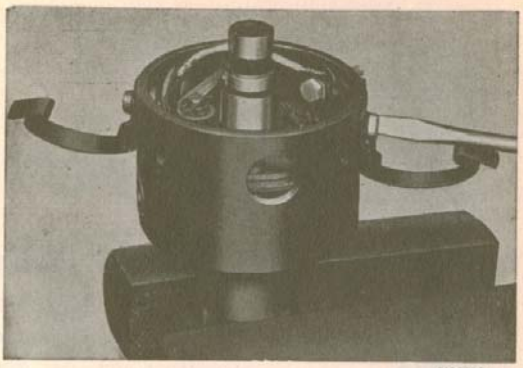


Fig. 10-54. Removing the contact breaker plate

Adjusting the ignition

Concerning adjusting the ignition, see Part 1, Engine.

Disassembling the distributor

1. Pull off the rotor arm.
2. Disconnect the vacuum regulator by unscrewing the screws as shown in Fig. 10-53 and then lifting it off.
3. Remove the primary terminal screw with washers.
4. Remove the contact breaker plate. This is done by unscrewing the two screws which hold the distributor cap retainers. Fig. 10-54.

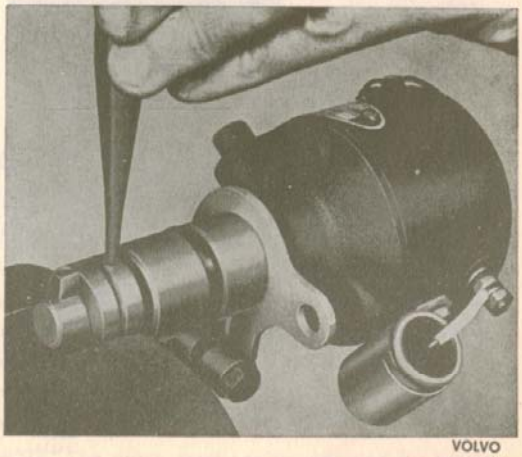


Fig. 10-55. Removing the collar

5. Lift the stop spring (locking spring) and knock out the pin for the collar and pull it off. Mark the position of the collar in relation to the shaft. Fig. 10-55.
6. Lift up the distributor shaft.
7. Release the locking springs and springs between the centrifugal regulator and breaker camshaft and lift up same.
8. Wash all parts in gasoline and lay them out for inspection.

Inspection

Distributor plate

1. The contact breaker points should be smooth and even at the contact surfaces. They should be of a gray color. Replace oxidised or burnt contacts. After a long period of running the points can become worn and the springs fatigued so that the contacts should be replaced.
2. There must be no play or wear on the contact plate causing loose particles.

Distributor shaft

1. The clearance between the distributor shaft and breaker camshaft must not exceed 0.004″ (0.1 mm).
2. The cams on the breaker camshaft must not be scored or worn as this will cause alternation in the closing angle.
3. The holes in the centrifugal regulator weights must not be oval or otherwise deformed. The fiber washers, Fig. 10-56, must be intact.
4. The springs for the above-mentioned regulator must not be deformed or damaged.

Distributor housing

1. The clearance between the distributor housing and shaft should not exceed 0.008″ (0.2 mm). If the clearance is greater than this, replace the bushings, and if this is not sufficient, replace the shaft.
2. The insulation washers for the primary terminal must not be cracked or soaked with oil as this can cause current leakage.
3. The capacitor should be checked with a direct-current glow-lamp or with a capacitor bridge. When testing with glow-lamp at room temperature, there should be no discharging and when testing with the capacitor warmed to 140–160° F (60–70° C), a maximum of 15 discharges per minute can be accepted.

Assembling

1. Place the Resitex washer on the distributor shaft and the fiber washers over this, see Fig. 10-56. Lubricate and place the centrifugal regulator weights in position. Place on the locking springs. Concerning lubricating, see Fig. 10-60.
2. Lubricate and fit the breaker camshaft and put on the springs, see Fig. 10-57.
3. Lubricate the distributor shaft and place it in the distributor housing. Check that the axial adjusting

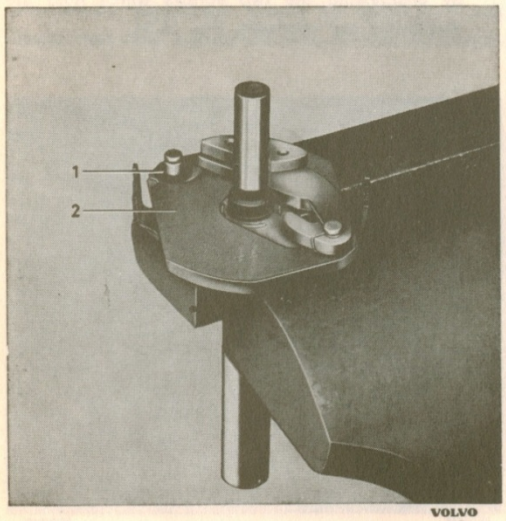


Fig. 10-56. Plate with fiber washers
1. Fiber washer 2. Resitex plate

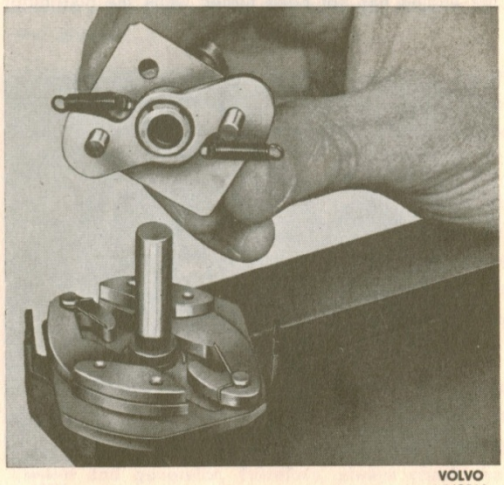


Fig. 10-57. Fitting the contact breaker camshaft

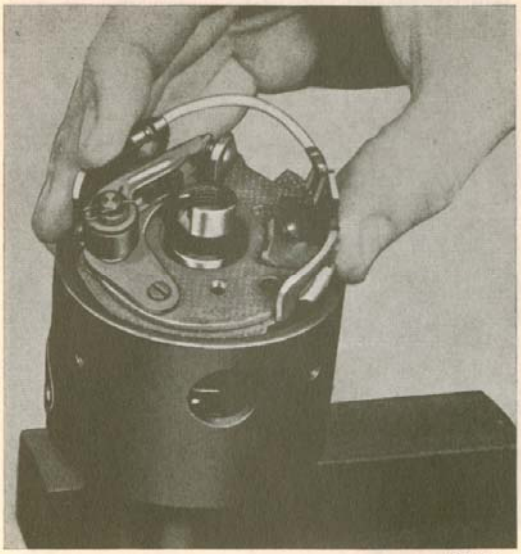


Fig. 10-58. Fitting the contact breaker plate

washers are located correctly. The fiber washer should contact the inside of the distributor. The steel washers should contact the collar.

Fit the contact breaker plate and springs, see Fig. 10-58.

4. Fit the primary terminal and connect this to the contact breakers and capacitor.
5. If the contact breakers have been replaced, ensure that the new ones come at the correct height and that they are level with each other. Levelling adjustment is done with a contracting tool (for example, Bosch EFAW 57 or similar). Only the fixed contact may be bent as shown in Fig. 10-59. Adjust the gap and check contact pressure.

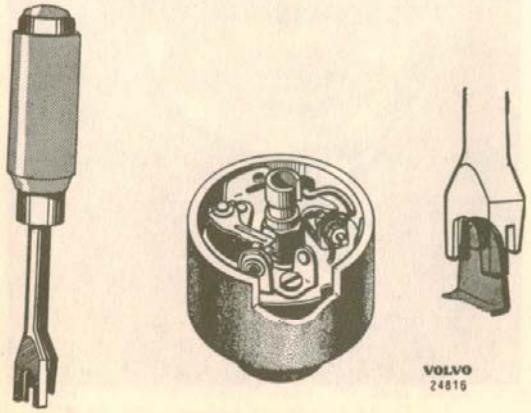


Fig. 10-59. Adjusting contact gap

6. Fit the vacuum regulator.
7. Fit the collar, check axial clearance. The fiber washer should lie against the distributor housing and the steel washer (steel washers) against the collar. The axial clearance should be min. 0.004″ (0.1 mm), max. 0.008″ (0.2 mm).

Testing the distributor

The distributor should be tested in a distributor testbench (synchrograph) or in an electrical testbench with necessary accessories.

1. Set up the distributor according to the instructions applying for the distributor testbench concerned.
2. Run the distributor in the normal direction of rotation and adjust the closing angle of the contact breakers in accordance with the specifications.
3. Run the distributor and adjust the setting disk so that the spark comes opposite 0° at a speed when the centrifugal regulator has not begun to take effect. Increase the speed gradually and read off the values at the prescribed revolutions. Newly lubricated distributors should first be run at maximum speed a few times. Permissible tolerance for the centrifugal regulator is ±1°.
4. Run the distributor at low speed (about 200 r.p.m.) and set the adjusting disk so that the spark occurs at 0°. Increase the vacuum and read off the ignition setting. Increase the vacuum successively and check that the whole range of adjustment agrees. Then test vacuum control in a decreasing direction by lowering the vacuum and reading off the values. The difference between increasing and decreasing values must not exceed 1.5°. If so, there is a fault in the contact breaker plate, pull-rod or vacuum regulator.

Adjusting the ignition curve
(Centrifugal regulator)

The curve is adjusted by tensioning the centrifugal regulator springs. To do this the shaft must be lifted up from the distributor housing and the screws on the underside of the collar loosened. If the collar is turned against the direction of rotation, the springs are tensioned, that is to say, ignition is retarded and optimum control is reached later.

NOTE. The curve must not be adjusted by bending the spring yoke.

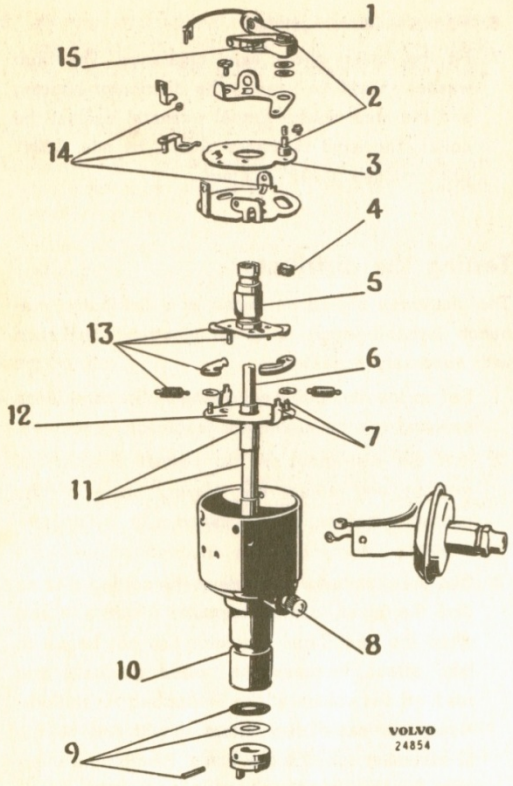


Fig. 10-60. Lubricating scheme for distributor
(Bosch lubricant or corresponding)

1. Lubricate the spring sparingly with Ft 1 v 4 grease
2. Lubricate the bushing and studs with Ft 1 v 22 grease
3. Oil the sliding surfaces of the contact breaker plate with Ol 1 v 2 oil
4. Soak the lubricating felt with Ol 1 v 2 oil
5. Lubricate the cam with a thin layer Ft 1 v 4 grease
6. Lubricate the shaft stud lightly with Ft 1 v 8 grease and Ol 1 v 2 oil
7. Lubricate bearing studs and spring attachments with Ft 1 v 8 grease
8. Fill the oil cup while turning the shaft. Use Ol 1 v 13 oil
9. Lubricate washers and pins before filling with Ol 1 v 13 oil
10. Soak the lubricating felt between the bushings with Ol 1 v 13 oil
11. Lubricate the shaft and fiber washers with grease and oil Ft 1 v 22 and Ol 1 v 13
12. Lubricate the regulator plate with Ol 1 v 22 oil
13. Lubricate contact surfaces, plate studs, etc., with Ft 1 v 8 grease
14. Lubricate the bearing studs, ball, guide lip and their contact surfaces with plenty of grease Ft 1 v 22
15. Put a small quantity of grease on the rivet side of the lifting lip, Ft 1 v 4

HEADLIGHTS

Replacing the headlights

The following section describes how the headlights should be removed from the car and disassembled. For partial disassembly, follow the instructions given in the appropriate points.

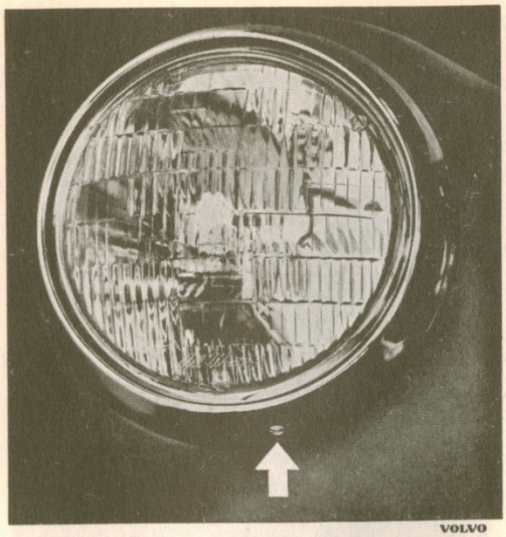


Fig. 10-61. Removing the headlight rim

1. Remove the headlight rim as shown in Fig. 10-61.
2. Unscrew the screws indicated by the arrows and turn the headlight ring to the left and remove same, see Fig. 10-62.
3. Lift out the insert.
4. Pull off the coupling contact from the bulb or headlight insert, see Fig. 10-63.
5. Unhook the spring and lift out the bowl.
6. Unscrew the four screws which hold the casing to the mudguard and remove same.

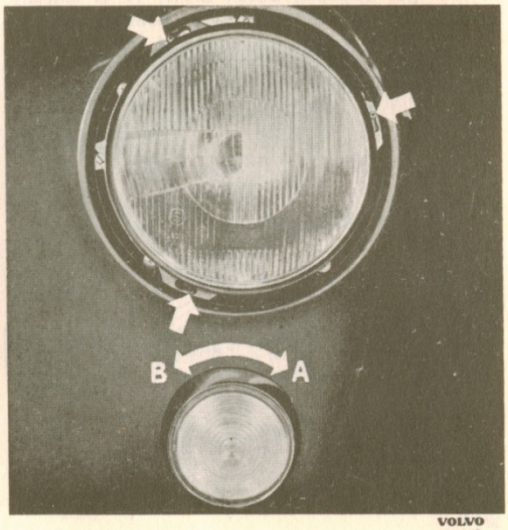


Fig. 10-62. Removing the headlight inner ring

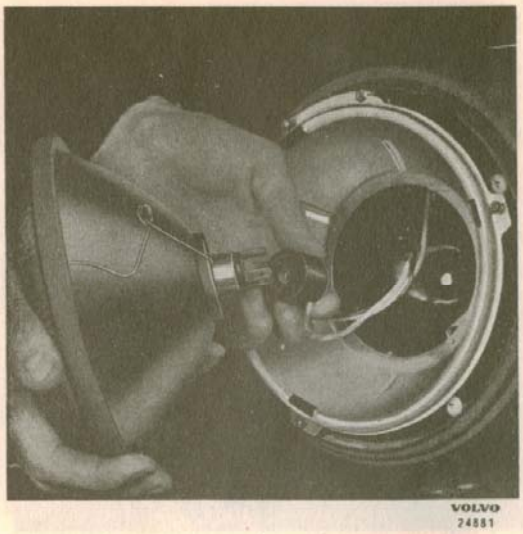


Fig. 10-63. Fitting the coupling contacts

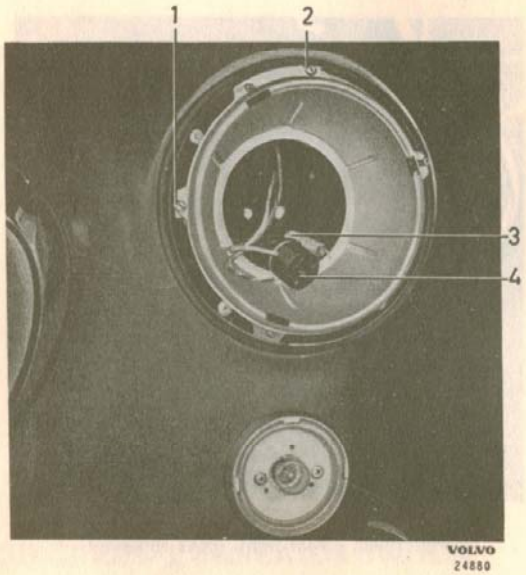


Fig. 10-64. Headlight bowl

1. Adjusting screw
2. Adjusting screw
3. Spring
4. Coupling contact

Replacing the bulbs

1. Carry out points 1–4 under the heading "Replacing the headlights".
2. Remove the spring which holds the bulb holder to the insert and lift out the bulb holder, Fig. 10-65, then remove the old bulb.

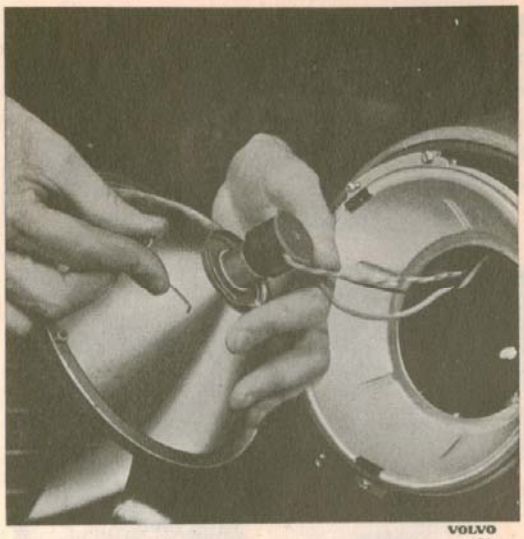


Fig. 10-65. Removing the bulb holder

3. Fit the new bulb. This should be done as shown in Fig. 10-66. Do not touch the bulb itself with the fingers but only pull out the bulb socket from the carton far enough for the bulb to be fitted.
4. Fitting is done in the reverse order to removing.

Adjusting the headlights

From a traffic safety point of view it is of great importance that the headlights are adjusted in accordance with existing regulations.
This is done by turning the two screws as shown in Fig. 10-64.

FLASHER AND PARKING LIGHT

The glass is removed by turning to the left. The lamp is removed by unscrewing the two screws beside the bulb, see Fig. 10-64.

Fig. 10-66. Fitting the bulb

NUMBER PLATE LIGHT

The number plate light can be replaced from the inside of the luggage compartment. To do this, unscrew the nuts as shown in Fig. 10-67. The bulb can be replaced by removing the bulb holder as shown in Fig. 10-67.

Fig. 10-67. Number plate light, removing the bulb

REAR LIGHT

Replacing the rear light

1. Unscrew the four screws which hold the glass, see Fig. 10-68.
2. Unscrew the two screws which hold the rear light housing to the body, see Fig. 10-69. The nuts are accessible from inside the luggage compartment.
3. Disconnect the leads at the connecting pieces, see Fig. 10-70.

Fitting is done in the reverse order. When fitting, ensure that good sealing is obtained between the body and the rear light and that good grounding is obtained.

INSTRUMENTS AND INTERIOR LIGHTING

The instrument lighting consists of six bulbs attached to the instruments and accessible from the backside of the instrument panel.

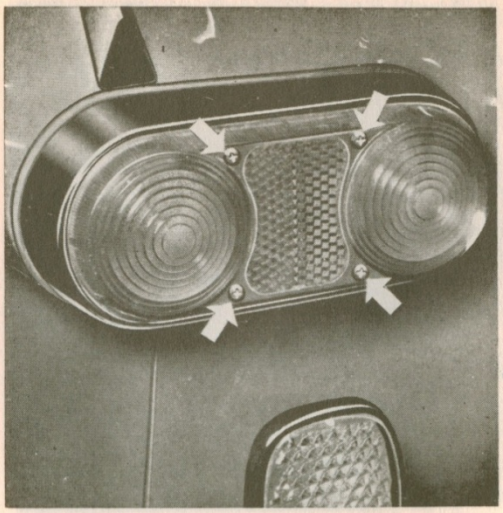


Fig. 10-68. Rear light

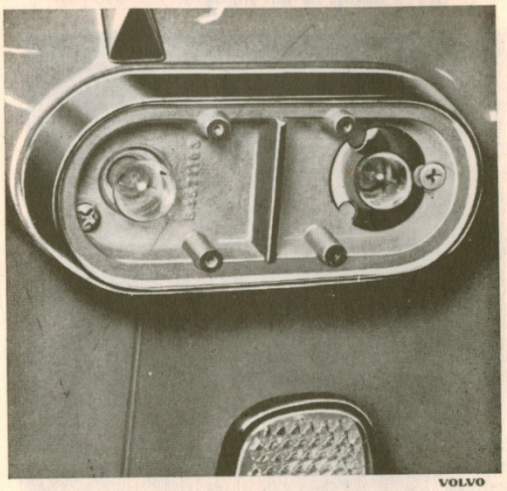


Fig. 10-69. Rear light, glass removed

The control lamps are also fitted in the instrument panel. All control lamps are accessible for replacement from the backside of the instrument panel.

Interior lighting consists of two lamps placed at the rear next to the rear window. The bulbs are accessible after the glasses have been removed. These are removed by pulling straight out.

LIGHTING SWITCH

The pull switch for lighting has three positions: off, parking and full and dimmed headlights.

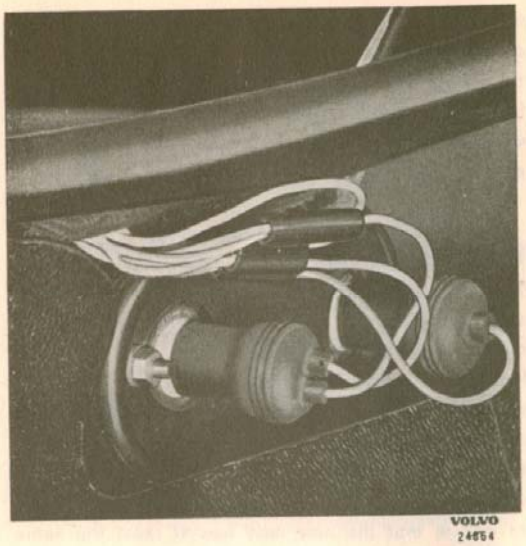


Fig. 10-70. Rear light coupling contacts

The switch can be removed from the instrument panel as follows:

1. Disconnect the ground lead from the battery.
2. The pull button is removed by pressing in the locking pin with a suitable tool after which the button can be pulled out. Fig. 10-71.
3. The switch is removed by unscrewing the nut with a suitable tool as shown in Fig. 10-72.
4. The switch can then be removed rearwards and downwards.
5. Mark the leads and disconnect them.

DIRECTIONAL INDICATOR SWITCH

1. Remove the steering wheel in accordance with the instructions in Part 6.
2. Unscrew the screws which hold the switch casing, see Fig. 10-73.
3. Unscrew the jacket tube screws and pull this up so that switch screws are accessible.
4. Unscrew the two screws which hold the switch to the jacket tube.

   The position of the switch is adjusted by turning the jacket tube. Concerning the attachment of this, see Part 6.

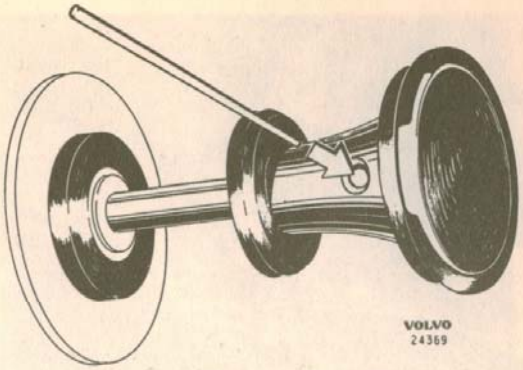


Fig. 10-71. Removing the pull button

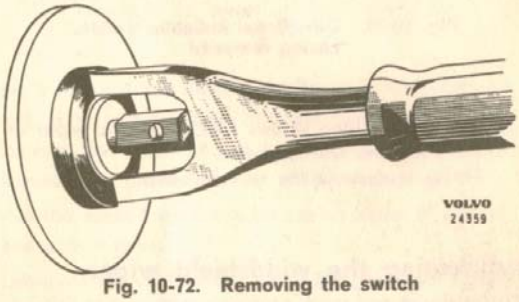


Fig. 10-72. Removing the switch

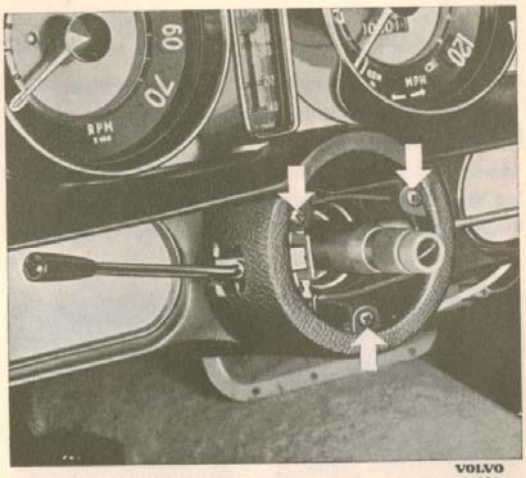


Fig. 10-73. Removing the switch casing

WINDSHIELD WIPER

Removing and fitting

1. Pull off the wiper arms.
2. Unscrew the two nuts and remove the washer and seal. Disconnect the leads.

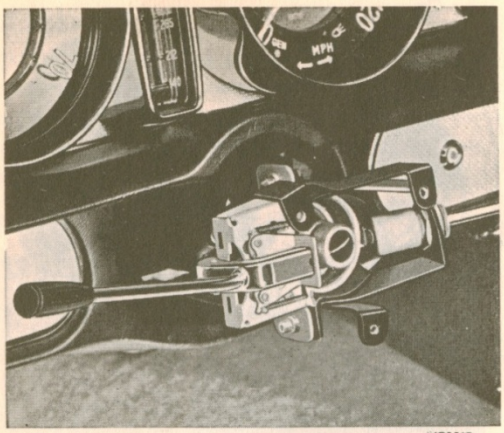


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Fig. 10-74. Directional indicator switch, casing removed

3. Unscrew the two screws which hold the wiper to the body and remove same.
   Fitting is done in the reverse order.

Lubricating the windshield wiper

The bushings and tooth segments in the wiper linkage system are lubricated during assembly. It is not necessary to lubricate the link arms or gearing after a certain time and this need only be done in connection with reconditioning.

FUSES

The fuses are placed as shown in Fig. 10-75. Concerning the position of the fuses in the wiring circuit, see the wiring diagram. When replacing fuse boxes and similar, the whole plate with fuse boxes, charging control and overdrive relay can be removed from the car as shown in Fig. 10-75. The melt-fuses in the fuse boxes should be replaced when damaged. Fuses must never be repaired or replaced with nails, pieces of wire or similar.

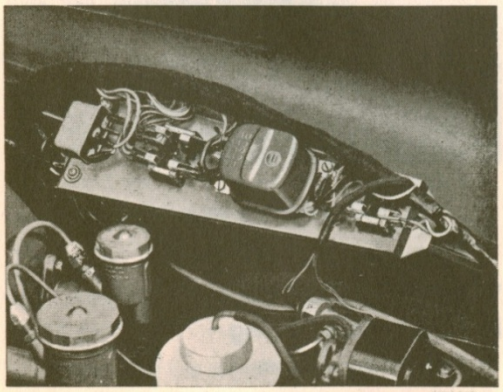

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Fig. 10-75. Location of fuses

ELECTRICAL LEADS

The wiring diagram shows how the electrical leads connect the various components and also shows the marking and cross-sectional area of the leads. The leads are of different colors to facilitate fitting and fault tracing. When fault tracing, it is important to carry this out following the wiring diagram. If there should be a breakage or grounding in a lead, it should be replaced. When doing so it is important to ensure that the new lead has at least the same cross-sectional area as the old one. Too small an area can lead to overloading and dangerous heating up of the lead.

HORN

There are three horn units which are spring-mounted and attached to the front cross-member. When removing, the hood must first be taken off.

When replacing the horn lead through the jacket tube, attach a piece of wire or similar to faciliate pulling down the new lead.

The horn switch on the side of the jacket tube is accessible after the steering wheel has been removed, the jacket tube screws removed and the tube pulled up as shown in Fig. 10-74. The steering shaft is divided and fitted with a rubber coupling disk in the middle. A ground connection is fitted over the coupling disk. When repairing and adjusting, ensure that this fits securely and gives good contact.

INSTRUMENTS

All instruments are fitted to the instrument panel with clips and screws.

Before carrying out work on the instruments, one of the battery leads should be disconnected from the battery.

Speedometer

If the speedometer does not give a reading but the mileometer functions and vice verse, the fault is in the instrument, so that it should be removed and sent to

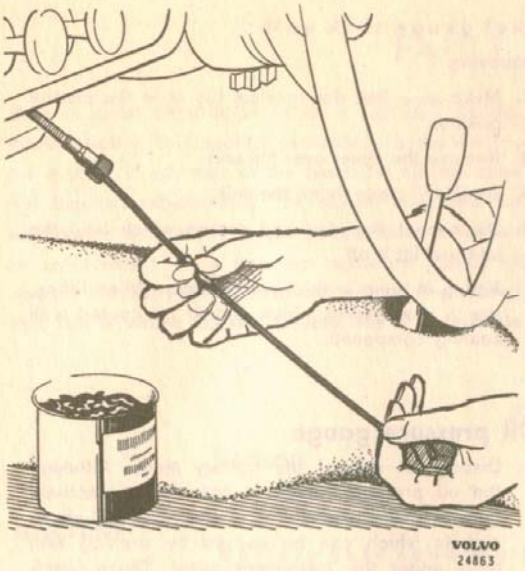

Fig. 10-76. Lubricating the speedometer cable

an instrument repair shop. If the instrument gives neither a speed nor mileage reading or if the needle is unsteady, the driving cable should be removed since this is probably broken or binding in the outer casing.

Speedometer cable

Lubricating

It is important that the cable must not be lubricated in such a manner that oil can penetrate up into the instrument and damage it. During servicing, therefore, it is unsuitable to lubricate the cable with oil. Instead the cable should be lubricated as follows: Remove the cable from the speedometer.

Pull the cable from the outer casing about 8″ (20 cm) and wipe it clean.

Lubricate the cable with Castrol LM grease or corresponding and slide it back into the outer casing again, see Fig. 10-76.

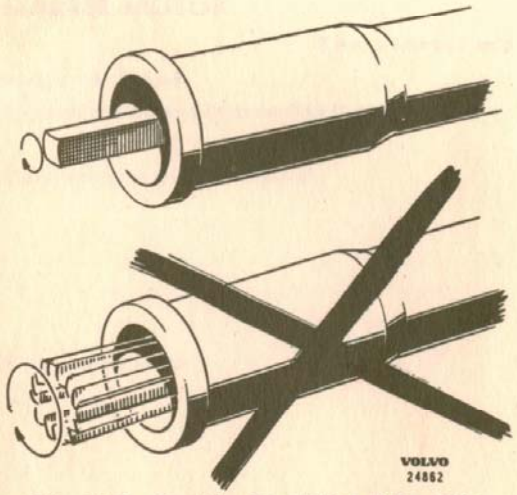

Fig. 10-77. Checking the rotation of the cable

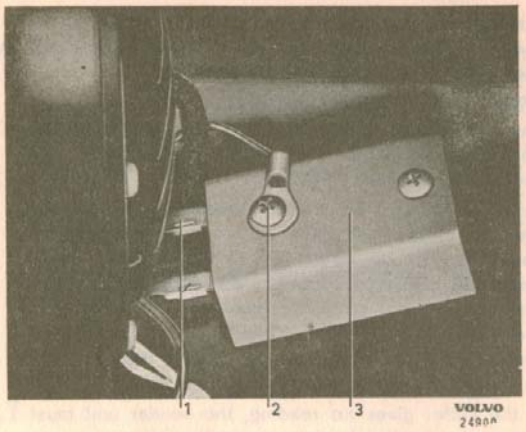

Fig. 10-78. Revolution counter sender
1. Terminals 2. Ground lead 3. Sender unit

Checking the cable

If the cable has been replaced, the bending radii must be checked. There must be no bend in the cable for at least 2″ (50 mm) from the connection at the transmission and instrument repectively. The minimum permissible bending radius of the cable must not be less than 6″ (15 cm). If any bending radius is less than 6″ (15 cm) this may cause the needle to vibrate. The cable should run concentrically in the outer casing and checking is carried out by rotating the cable as shown in Fig. 10-77.

Revolution counter

The revolution counter on the instrument panel is fed from a transistorised sender type Scinenta VM-1 A which, by means of the breaker impulses in the ignition coil, produces current proportional to the engine speed. The sender is molded in synthetic resin and is therefore almost entirely insensitive to mechanical stresses and reasonable temperature variations.

The sender unit is placed in the air intake in front of the radiator, see Fig. 10-78.

Because of the sensitivity of the transistors for battery polarity, faulty connection of the sender will result in it being destroyed immediately.

When connecting the sender, therefore, great care must be taken to ensure that the terminals are connected correctly. This applies particularly to the terminal pin marked "M".

In the event of a fault in the revolution counter, the function of the instrument dial can be checked by connecting an ammeter for 10 milliamps or more (max. 100 milliamps) between the chassis (negative) and the terminal pin "M", (positive). At 2800 r.p.m. the meter should show 10 milliamps. The internal resistance of the ammeter must be less than 70 ohms at the measuring range concerned.

If the meter gives no reading, the sender unit must be replaced after having ascertained that there is no fault in the leads.

Concerning data, see the specifications.
Connecting:

"M" to positive terminal of instrument.
"+" to ignition switch
"B" to breaker contact

The short lead is grounded.

Fuel gauge

The fuel gauge is removed as follows:

1. Disconnect one of the battery leads.
2. Remove the bulb holders for the instrument lighting.
3. Undo the clamps which hold the instrument and lift it down.
4. Disconnect the leads from the instrument. Mark the leads since any confusion when fitting can ruin the instrument.

Fuel gauge tank unit

Removing

1. Make sure that the ignition key is in the neutral position.
2. Remove the cover over the unit.
3. Blow well clean round the unit.
4. Disconnect the lead and screws which hold the unit and lift it off.

   Fitting is done in the reverse order. When fitting, use a new gasket which should be coated with sealing compound.

Oil pressure gauge

1. Disconnect one of the battery leads. Although the oil pressure gauge is not of the electrical type, this recommendation is given to avoid short-circuits which can be caused by working with tools under the instrument panel. These short-circuits can be both severe and expensive to repair.
2. Disconnect the pipe on the oil pressure gauge.
3. Release the clamps which hold the instrument and lift it down.

   Fitting is done in the reverse order. Do not forget to connect the oil pipe before starting the engine.

Water and oil temperature gauges

The fuel levels must be lowered before the respective sensitive heads can be removed. As in the case above, disconnect one of the battery leads before starting work under the instrument panel. The pipe leads to the sensitivie heads must be handled with care and sharp bends, etc. must be avoided.

FAULT TRACING

It is of great importance to carry out fault tracing systematically. This applies particularly to the electrical system. If any part of the electrical system does not function satisfactorily, the reason must first be established before any measures are taken for repair or replacement. It is thus not sufficient merely to replace the faulty part (instrument) without first testing that this is where the real trouble lies. It is possible that the fault may be due to outside elements. The procedure for fault-tracing should therefore be:

1. Establish which part is faulty.
2. Establish the reason for the occurrence of the fault.
3. Repair or replace the part concerned.

FAULT	
Reason	**Remedy**

BATTERY

Battery gets abnormally warm or gases excessively

Insufficient charging from generator.	Adjust the charging control.
Fluid level in battery too low.	Top-up with distilled water.
Loose or corroded connections.	Clean the cable terminals and tighten them carefully
Short-circuit in brake contact.	Replace the brake contact.
Internal short-circuit in battery.	Indicated by the fact that the specific gravity of the acid does not rise during continued charging. Replace the battery.

The battery is discharged or does not maintain charging

Excessive charging from generator.	Adjust the charging control.
Fluid level too low.	Top-up with distilled water.
Battery has been badly charged.	Have the battery charged.
Internal short-circuit.	Replace the battery.

STARTER MOTOR

The starter motor does not work

Battery discharged.	Examine the battery. Charge or replace battery.
Bad connections and/or grounding to chassis.	Check the connections at the battery, starter motor and starter relay or solenoid.
Faulty solenoid or starter contact.	Press the starter contact and check that the solenoid engages. If it does not do so, check that current is received from the starter contact when this is in the starting position. See also under "Faulty starter motor". A faulty solenoid or starter contact should be replaced.
Faulty starter motor.	Test by disconnecting the battery lead from the solenoid and holding it against the terminal on the starter motor itself. If the starter motor does not function, remove it for testing and repair. Do not hold the lead in place for more than a few seconds if the starter motor does not work.

Starter motor has poor output

Battery in poor condition.	Test and charge up if necessary.
Excessive resistance in the starter motor circuit.	Examine all terminals on leads to the starter motor and leads between the motor and chassis. Make sure that the contact surfaces are clean, that all cable terminals are properly soldered and tighten the leads well.
Bad contact in solenoid.	Compare the starter motor output with and without the solenoid by disconnecting the lead on the solenoid and holding it directly on the starter motor output stud. Replace a faulty solenoid.
Faulty starter motor.	Remove and test the starter motor.

Starter motor spins without engaging in the flywheel

Ring gear on flywheel damaged.	Remove the housing under the flywheel. See Part 1. Replace a damaged ring gear.
Starter pinion damaged.	Remove the starter motor and replace damaged parts.
Starter pinion and/or engaging device damaged.	Remove the starter motor and replace damaged parts.

GENERATOR AND CHARGING CONTROL

Insufficient or no charging with discharged battery

Bad contact or damaged leads.	Inspect all leads between the generator, charging control and battery for loose contacts, broken leads, poor insulation, corrosion and grounding.
Worn out or insufficiently tensioned fan belt.	Replace or tension the fan belt.
Faulty generator.	Disconnect the lead for rotor current and the lead to the battery from the charging control and connect an ammeter in series with these. Start the engine and let it run at idling speed. Connect the terminal for field current to the generator housing. If the ammeter now, and at increased speed, gives insufficient reading, the generator should be removed for examination and repair. NOTE. Never run the generator with the above-mentioned connection at such a high speed that maximum current output is exceeded.
Faulty charging control.	Test and adjust charging control. See under the heading "Charging control".

Excessive charging with fully charged battery

Faulty generator	Let the generator run at about half charge. Disconnect the field lead from the charging control. If charging does not fall to zero, also disconnect the field lead from the generator. If charging falls to zero, examine the lead as otherwise the generator is faulty so that it should be removed for repair.
Excessive resistance at chassis connection points.	Examine the chassis connection at the generator, charging control and battery.
Faulty charging control.	Test and adjust the charging control. Proceed in accordance with directions given under heading "Charging control".

SPECIFICATIONS

BATTERY

Type	Lucas B T 29 A
Grounded	Negative terminal
System voltage	12 volts
Battery capacity, standard	57 amp. hr.
Electrolyte specific gravity, fully charged battery	1.275–1.285
Electrolyte specific gravity when re-charging is necessary	1.230

IGNITION SYSTEM

Voltage	12 volts
Order of firing	1–3–4–2
Ignition timing setting with stroboscope at 1500 r.p.m. Octane number, Research Method.	
Engine B 18 B (100 b.h.p. SAE), 97 octane	17–19° before TDC
Engine B 18 B (108 b.h.p. SAE), 97 octane	14–19° before TDC
100 octane	17–19° before TDC
Spark plugs	Bosch W 225 T1 or corresponding types
spark gap	0.7–0.8 mm (0.028–0.032″)
tightening torque	3.8–4.5 kgm (28–32 lb.ft.)

DISTRIBUTOR

Type	VJU 4 BL 33

Test values

Direction of rotation	Anti-clockwise			
Ignition setting curves:				
Centrifugal regulator:				
Crankshaft degrees	0	10	20	22±3
Crankshaft r.p.m.	750–1050	1300–1850	2300–2900	2800–3300
Breaker contact, gap	0.016–0.020″ (0.4–0.5 mm)			
Breaker contact, contact pressure	0.9–1.1 lb. (0.4–0.5 kg)			
Closing angle	60°			

GENERATOR

Type	Bosch LJ/GG 240 12/2400 AR 7
System voltage	12 volts
Rated output	240 watt
Maximum current (continuous)	30 amp.
Grounded	Negative terminal
Direction of rotation	Clockwise
Reduction ratio, engine-generator	1.8: 1
Brushes, designation	WSK 43 L 1
number	2
contact pressure	16–21 oz. (450–600 grammes)

Test values

Field winding resistance	4.8+0.50 ohms
Charging, cold generator, 240 W	2300 r.p.m.
Charging, warm generator, 240 W	2500 r.p.m.
Rated voltage, speed, unloaded	1700 r.p.m.

Charging control

Type	Bosch RS/VA 240/12/2
Equalising resistance aR	15.5–16.5 ohms
Control resistance wR	8–9 ohms

Test values

Reverse current relay:	
Adjusted for cutting-in at	12.1–12.8 volts
at reverse current	2.0–7.5 amp
Voltage control:	
control voltage, idling, adjusted to	13.9–14.8 volts
loaded	12.9–14.1 volts
Load current:	
Cold generator and regulator	45 amp
Warm generator and regulator	30 amp

STARTER MOTOR

Type	Bosch EGD 1/12 AR 37
System voltage	12 volts
Grounded	Negative terminal
Direction of rotation	Clockwise
Output	approx. 0.9 h.p. at 15° F (–10° C) approx. 1.2 h.p. at 70° F (+20° C)
Number of teeth on pinion	9
Modulus	2.11
Brushes, designation	DSK 35/5
number	4

Test valeus

Mechanical:	
Axial clearance of rotor	0.004–0.012" (0.1–0.3 mm)
Brush spring tension	1.76–1.98 lb. (800–900 grammes)
Distance from pinion to ring gear	0.098–0.118" (2.5–3 mm)
Friction torque of rotor brake	2.6–4.34 lb.in. (3–5 kg/cm)
Pinion free-wheel torque	1.13–1.56 (1.3–1.8 kg/cm)
Tooth flank clearance	0.014–0.023" (0.35–0.6 mm)
Electrical:	
Starter motor unloaded:	
11.5 volt and 40–60 amp.	5500–7500 r.p.m.
Starter motor loaded:	
10 volts and 200 amp.	1100–1300 r.p.m.
Starter motor locked:	
(r.p.m. = 0)	400–450 amp. 8 volt
Solenoid:	
Cut-in voltage	Max. 7 volt
Setting measurement "a" (see Fig. 10-29)	1.268±0.004" (32.2±0.1 mm)

FUSES

Fuse boxes under hood on left wheel housing, 3 fuses rated 35 amp.

REVOLUTION COUNTER

Range	0–7000 r.p.m.
Corresponding current in instrumental dial	0–25.0 milliamps.
Internal resistance in instrument dial	75 ohms, max.
Maximum operating temperature for sender	160° F (70° C)

BULBS

	Strength	Number
Headlight bulbs	45/40 W	2
Lamp for number plate lighting	6 W	2
Rear lights/flashers	20/5 W	2
Stop lights	20 W	2
Instrument lighting	2.4 W	6
Flashers and parking lights	20/5 W	2
Map-reading light	6 W	1
Roof light	5 W	2
Control light for directional flashers	2.4 W	1
Control light for headlights	2.4 W	1
Control light for charging	2.4 W	1
Control light for overdrive	2.4 W	1

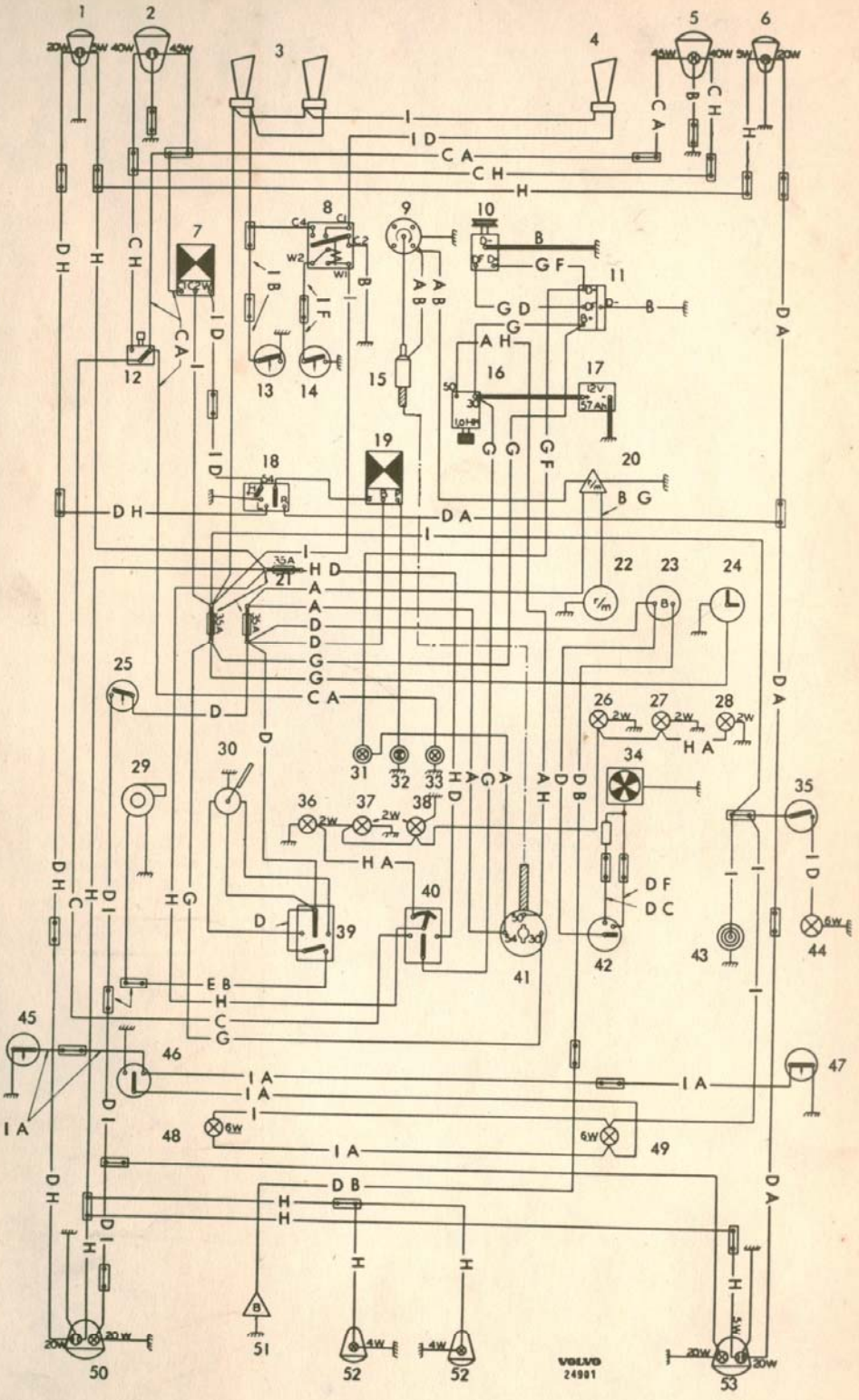
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Illustration 10—1. Wiring Diagram

1. Flasher and parking light, left
2. Headlight, left
3. Horn
4. Loud tone horn
5. Headlight, right
6. Flasher and parking light, right
7. Relay for headlight flasher
8. Horn relay
9. Distributor
10. Generator
11. Charging control
12. Foot dimmer switch
13. Horn button
14. Lever for loud tone horn
15. Ignition coil
16. Starter motor
17. Battery
18. Directional indicator switch
19. Flasher impulse unit, directional indicators
20. Revolution counter sender
21. Fuses
22. Revolution counter
23. Fuel gauge
24. Clock
25. Brake contact
26. Instrument lighting
27. Instrument lighting
28. Instrument lighting
29. Windshield washer
30. Windshield wipers
31. Warning lamp, charging
32. Warning lamp, directional indicators
33. Warning lamp, full headlights
34. Heater
35. Switch, map-reading light
36. Instrument lighting
37. Instrument lighting
38. Instrument lighting
39. Controls for windshield wipers and windshield washers
40. Lighting controls
41. Ignition switch
42. Heater controls
43. Cigarette lighter
44. Map-reading light
45. Door contact
46. Switch for roof light
47. Door contact
48. Roof light
49. Roof light
50. Rear light, left
51. Fuel gauge sender
52. Number plate lighting
53. Rear light, right

A = White
B = Black
C = Blue
D = Green
E = Light green
F = Yellow
G = Brown
H = Red
I = Purple

PART 11

BODY

DESCRIPTION

The Volvo P 1800 has an integral body so that there is no independent chassis frame. The body is made up of a number of pressed steel plates. Each plate forms a part of the supporting construction. The main parts of the body can be divided up into the following groups: floor section, side sections, rear section, front section, roof, front fenders, doors, luggage compartment and hood.

The floor section consists of front and rear floor plates with inner bottom rails, front and rear cross-members, side members, tunnel, bulkhead, front wheel housings and front side plates. The floor plates are spot-welded to the rear seat support. Four brackets are fitted to the front cross-member and these serve as attachments for the front seat slide rails. The tunnel, which accomodates the propeller shaft, is spot-welded to the floor plates. On each underside of the rear floor plate there is a longitudinal reinforcement and a number of cross-members between these. One of the cross-members is provided with an attaching device for the rear axle track rod. There is a flanged hole in the rear floor plate for attaching the fuel tank, the top side of which forms part of the floor in the luggage compartment.

The bulkhead forms the front transverse wall of the body and is shaped with welded ends. The two front side members protrude from the front floor. At the front they are joined together with a cross-member and at the rear they are connected to the front cross-member under the front seat. From the upper corner of the bulkhead – front pillar there are upper reinforcing members. These are spot-welded to the front pillar, front side plates and wheel housing plates. The front axle member and bumper support bars are attached to the side members.

The roof section consists of a number of plates. The roof plates form the upper part of the cowl, windshield opening and the roof itself.

The front fenders and front end and hood comprise the front section. The front section is welded to the upper side member, front cross-member and front pillar. The front fenders are welded to the wheel housing plates. The front end forms the front part of the front section together with the air intake to the radiator. The hood is pivoted on two hinges. In the closed position the hood is secured by a hood lock fitted to the bulkhead. The lever for the hood lock is located to the left under the instrument panel inside the car.

The doors are made up of an inner and outer plate which are beaded and spot-welded together. The hinges are fitted on the inner plate. The doors are adjustable longitudinally, vertically and laterally.

The door locks are fitted to the doors with screws. The press button of the outside door handle influences a lever which in turn releases a rotating toothed roller (locking plunger). The inside door handle is fitted to the remote control which is attached to the inside door plate with screws. The handle transmits the action to the toothed roller by means of a linkage system. The locking device is fitted in the press button on the door handle.

The window lifts are of the lift arm and toothed segment type. When the window handle is turned, two parallel lift arms, one of them attached to a toothed segment, move the window to the required position.

The luggage compartment is built up of an inner and outer plate. There is a locking device fitted at the lower edge of the luggage compartment lid. Hinges are fitted at the upper edge of the lid. The hinges are bolted to the body. The luggage compartment lid is balanced with torsion rods. The lock shackle for the luggage compartment lid is fitted on the body. The lid is opened by pressing in the lock button. The bumpers are fitted to four support bars. The front support bars are fitted to the front side members. The rear support bars are fitted to the rear side members.

FRONT SECTION

The front fenders and front end are welded together and also welded to the upper and lower longitudinal members, bulkhead and radiator air intake.

HOOD AND HOOD LOCK

The hood is removed by unscrewing the two nuts on the hinges.

The hook lock is fitted to the bulkhead and controlled by a lever from the driving seat. The downward tension of the hood is adjusted partly by screwing the rubber stop up or down and partly by placing packing pieces under the lock hook on the hood. The lock shackles are bolted to the rear corner of the hood and lubricated with paraffin (paraffin wax) when adjusting.

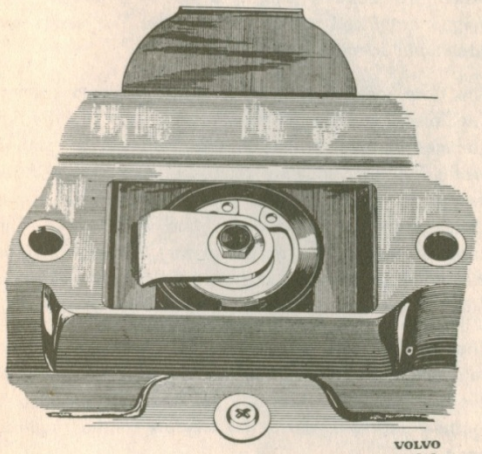


Fig. 11-1. Attachment of lock in luggage compartment lid

LUGGAGE COMPARTMENT LID

The luggage compartment lid is suspended on two hinges which are bolted to the inner plate of the lid and to the plate under the rear window.

The holes in the hinge part attached to the luggage compartment lid are oval, permitting longitudinal adjustment.

The lid is balanced with torsion stays. The locking device is attached to the lid with a screw and locking plate as shown in Fig. 11-1.

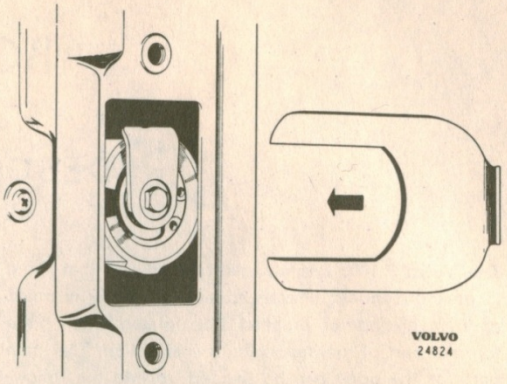


Fig. 11-2. Removing the lock from the luggage compartment lid

The lock is released by pressing in the lockable press button. The lock shackle on the lower edge of the body is adjustable to permit variation of the downward tension of the luggage compartment lid.

When removing the lock, the locking piece and X-headed screw are removed as shown in Fig. 11-2, after which the lock unit can be lifted out. The lock unit can be disassembled as shown in Fig. 11-3. When fitting, ensure that the rubber seal round the lock press button and the gasket which seals against the body are intact and seal properly.

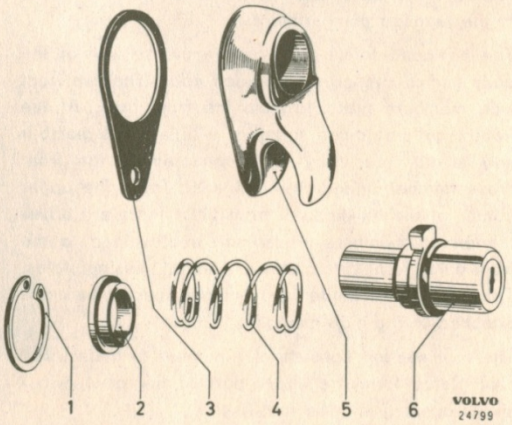


Fig. 11-3. Lock unit dissembled

1. Locking ring
2. Washer
3. Gasket
4. Spring
5. Handle
6. Press button with lock

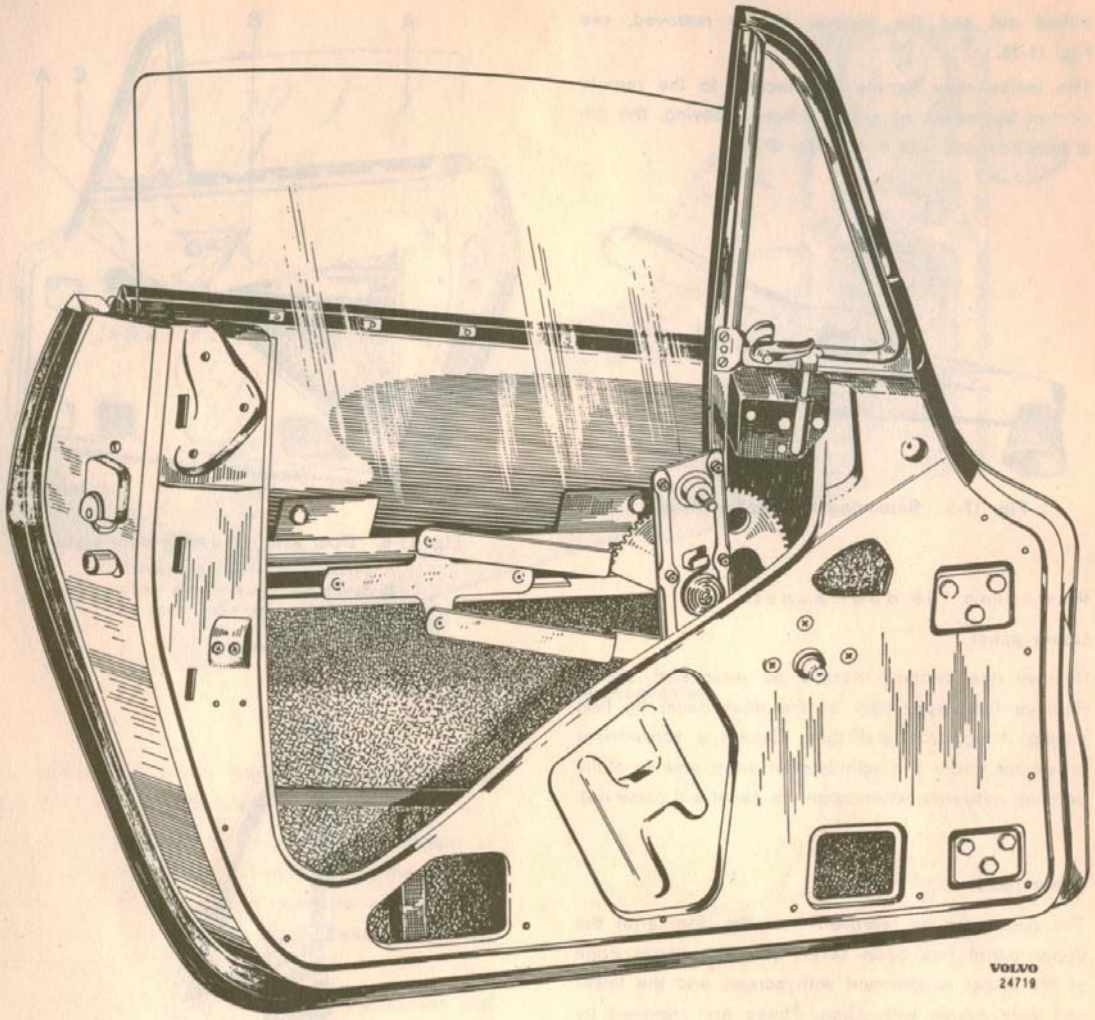


Fig. 11-4. Door

DOORS

Removing door

The door, Fig. 11-4, can be removed with or without the hinges fitted. If the door is removed with the hinges remaining in the body, the door stop need not be removed. When removing, take off the inner door handle and window winding handle with door panel in accordance with the instructions under the heading "Removing door handle and panel". If the door is removed with hinges attached, that is to say the door is taken off at the body attachment, the door stop must be disassembled. This is done by knocking or drilling out the guide pin. The hinges are accessible after the inside panel has been removed.

Adjusting

The door is adjustable longitudinally and vertically by the holes for the bolts through the body being made larger than the diameter of the bolts. The door is adjusted laterally by means of packing pieces.

Removing door handle and panel

Window handle and door handle

The window handle is attached with a spring clip. The clip is removed by means of a hook inserted between the door panel and window handle washer so that the hook grips the clip after which it can be

pulled out and the window handle removed, see Fig. 11-15.

The inside door handle is attached to the remote control by means of a pin. When removing, the pin is knocked out with a suitable drift.

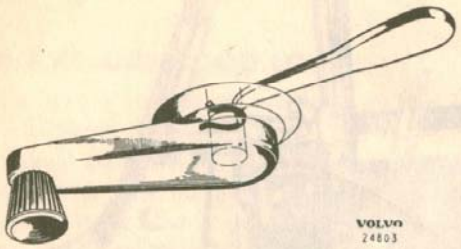


Fig. 11-5. Removing the window handle

Removing the door panels

Upper panel

Remove the window handle as described above. Remove the upper part of the door panel by first pulling it upwards and then placing a screwdriver or similar under the upholstered edge and carefully bending outwards, whereupon the panel will come out.

Lower panel

The panel can be removed from the door after the upper panel has been taken out. The upper edge of the panel is attached with screws and the lower and side edges with clips. These are removed by bending outwards.

Ventilation windows

The ventilation window is attached by means of two screws to the upper door plate and with a loose plate on the front edge of the door. When removing, take off the window handle, upper door panel and plate on the front edge of the door and then unscrew the two screws on the upper inner door plate, Fig. 11-6, after which the ventilation window can be lifted up. The back edge of the ventilation window forms a guide for the main window. The end of the guide rests against a fixing catch attached to the door. When fitting, ensure that this catch locates in the guide. The catch is adjustable. The stiffness of the ventilation window in the open position can be adjusted by tightening the two screws (1) in Fig. 11-7.

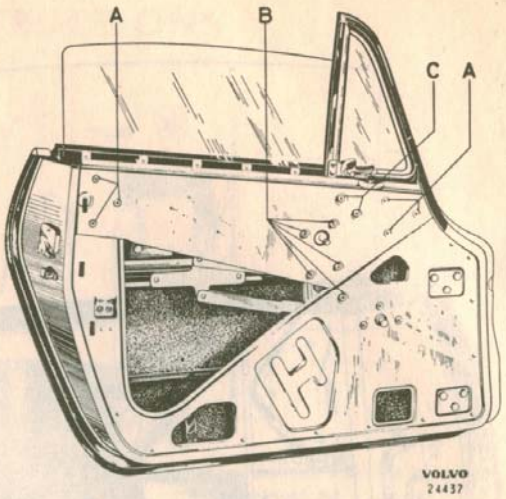


Fig. 11-6. Door with removable door plate

A. Screws for removable door plate
B. Screws for window winding mechanism
C. Screws for ventilation window

Fig. 11-7. Ventilation window

1. Adjusting screws

Main windows

The window winding mechanism, Fig. 11-8, is attached partly to the upper removable inner door plate and partly to the fixed inner plate.

When removing, detach the upper removable plate where it is fitted to the door and to the window, see Fig. 11-6, together with the ventilation window. Then unscrew the screw in the fixed lower inner plate on

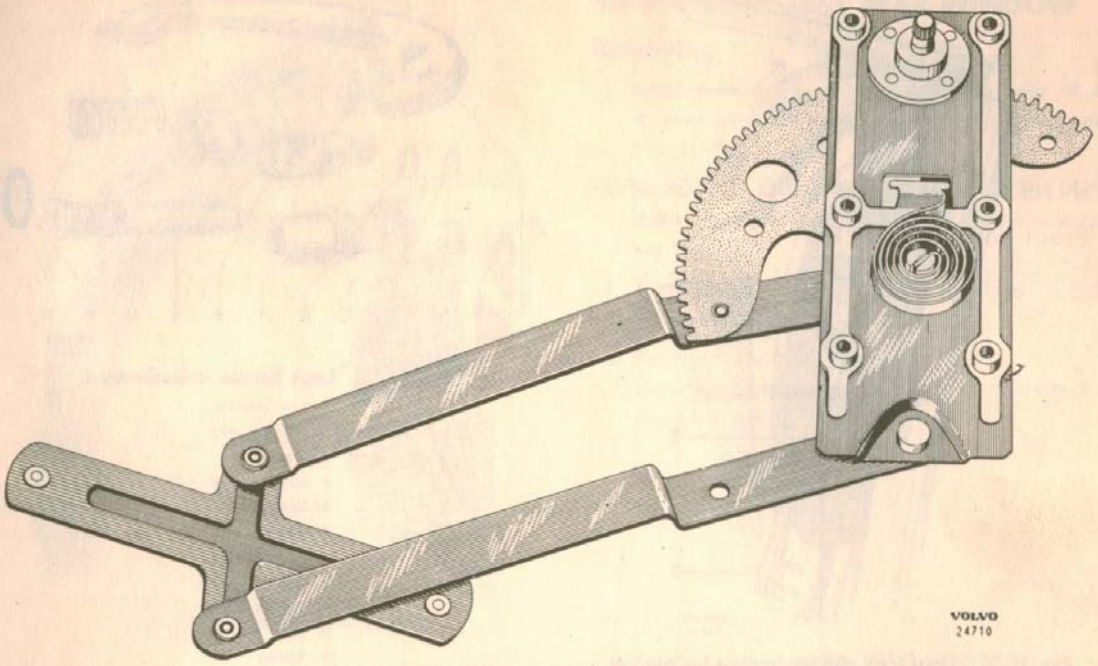


Fig. 11-8. Window winding mechanism

the door, after which the window with winding mechanism can be lifted up.

The glass is attached to the slide rail by means of bolts and rubber washers. When replacing the window, make sure that the rubber washers are in good condition and that the bolts are tightened sufficiently hard, see Fig. 11-9.

The toothed segment of the winding mechanism and the slide rail on the glass are lubricated with grease. The rear guide strip of the winding mechanism is adjustable as far as the contact of the glass against the sealing strip is concerned, see Fig. 11-10. The guide strip on the rear edge of the door can be removed after the upper outer trim molding has been taken off.

Door lock, lock handle and remote control

Door lock

The door lock is attached to the rear edge of the door with bolts. When removing the door lock, these bolts are removed together with the link arms to the outer, lockable door handle and remote control. The door lock is lubricated with silicon grease.

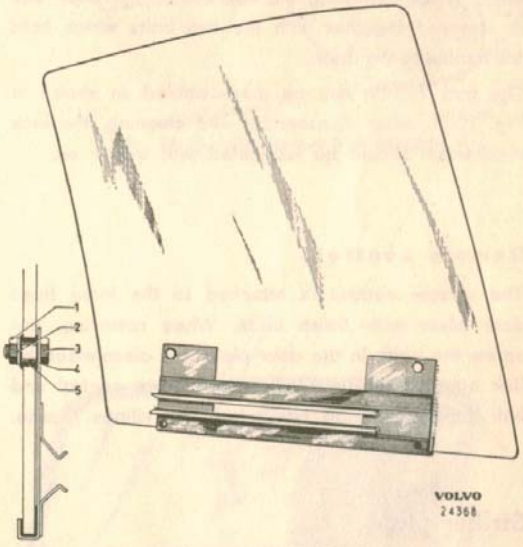


Fig. 11-9. Window

1. Nut
2. Washer
3. Bolt
4. Bushing
5. Rubber bushing

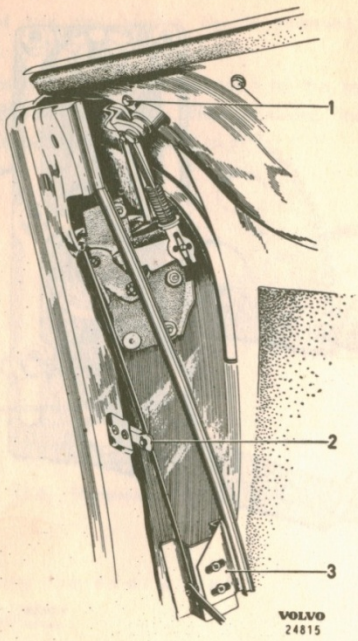


Fig. 11-10. Door lock and guide strip for window

1. Screws for door handle 2. Support 3. Adjusting screws

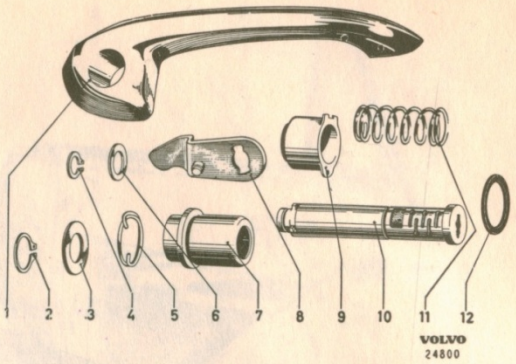


Fig. 11-11. Lock handle disassembled

1. Lock handle
2. Locking ring
3. Washer
4. Locking ring
5. Spring
6. Washer
7. Press button
8. Control lever
9. Bottom plate
10. Lock cylinder
11. Spring
12. Sealing ring

Lock handle

The lock handle is attached to the door with two bolts. When removing, the link arm to the door lock is removed together with the two bolts which hold the handle to the door.

The lock handle can be disassembled as shown in Fig. 11-11. After disassembly and cleaning, the lock mechanism should be lubricated with silicon oil.

Remote control

The remote control is attached to the inner fixed door plate with three bolts. When removing, unscrew the bolts in the door plate and disconnect the link arm to the door lock. The remote control and link arms should be lubricated with silicon grease.

Striker plate

The striker plate, Fig. 11-12, is made of steel. It is fitted with floating nuts and adjustable by the holes in the body being made larger than the diameter of the attaching screws. The striker plate should be lubricated with paraffin, (paraffin wax).

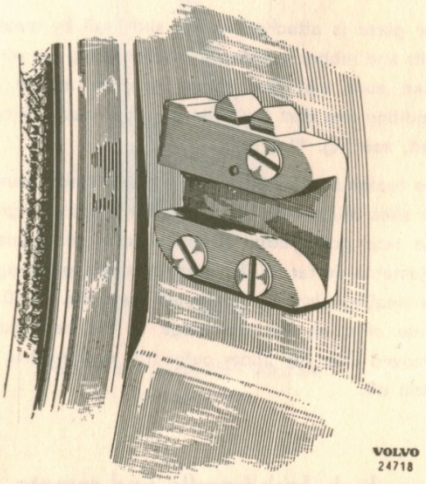


Fig. 11-12. Striker plate

Sealing strips for door

The sealing strip is attached with clips to the door frame, see Fig. 11-13. When fitting a new strip, this should be knocked well in over the plate edge.

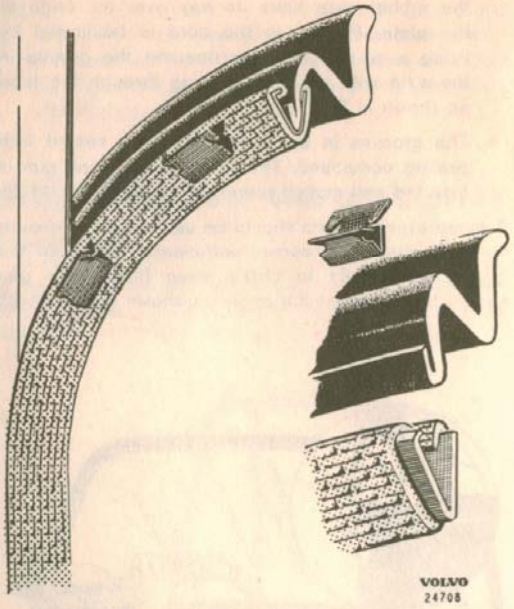


Fig. 11-13. Fitting sealing strip

HEADLINING

The headling, Fig. 11-14, is stretched over a ribbed frame and attached with four screws and clips. When removing, first take out the interior lights and sun visors after which the two screws under the sun visor attachments are removed. Then carefully remove the side upholstery at the interior lights after which the two rear screws are accessible. The headlining is then bent carefully down with the help of a suitable tool.

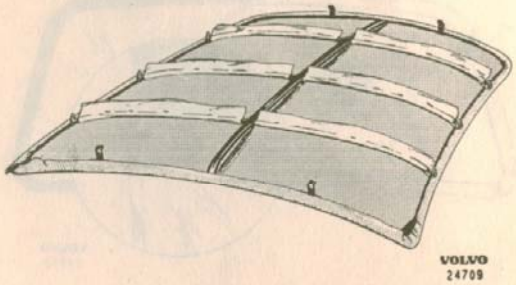


Fig. 11-14. Headlining

WINDSHIELD AND REAR WINDOW

Removing

1. Remove the trim molding with the help of a wooden putty knife and lift off the molding, see Fig. 11-15.
2. Remove the rubber strip adhesive from the body and window glass with the help of the putty knife, see Fig. 11-16.
3. Take hold of the rubber strip as shown in Fig. 11-17 and pull it off.
4. Remove the window glass.
   Clean the parts which are to be refitted to the car. Use white spirit.

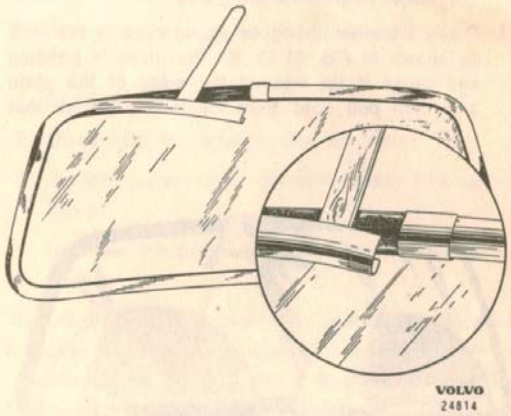


Fig. 11-15. Removing trim molding

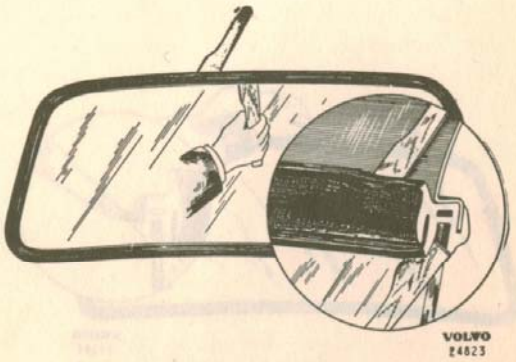


Fig. 11-16. Removing rubber strip

Fig. 11-17. Removing window

Fitting

1. Check that the windshield opening is not distorted by holding a glass pressed against the opening. The glass should lie flush on the plate all round. The edge of the plate must be adjusted if there is any unevenness or distortion.
2. Place the glass on a blanket or similar and fit the rubber strip round the glass.
3. Press a leather thong or strong cord in the strip as shown in Fig. 11-18. Fit the glass in position and press it up against the edge of the plate and then pull cord from inside the car so that the rubber strip finds its way over the edge of the plate. Placing in the cord is facilitated by using a narrow tube for opening the groove in the strip with the cord running through the tube as shown in Fig. 11-19.
4. The grooves in the rubber strip are sealed with sealing compound. The sealing compound gun is inserted and moved round as shown in Fig. 11-20.

A compressed air gun should be used partly to ensure that the compound comes sufficiently deeply in the groove and partly to obtain even filling. The gun should be moved at the angle as shown in Fig. 11-20.

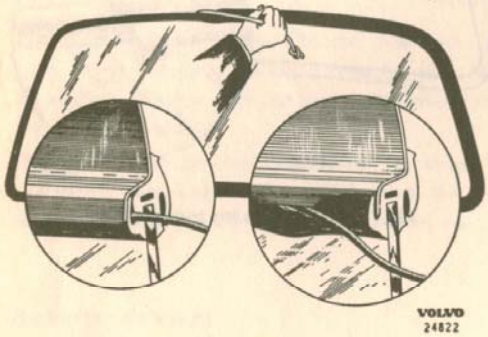


Fig. 11-18. Fitting the sealing strip

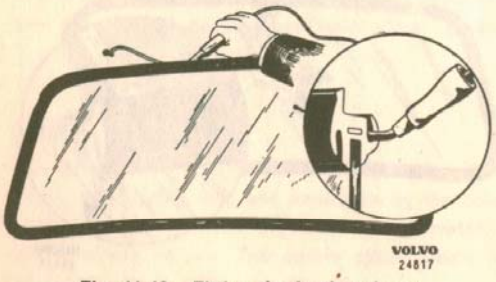


Fig. 11-19. Fitting the leather thong

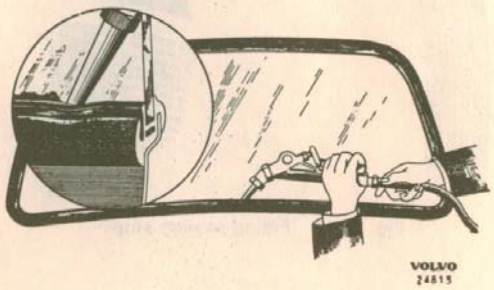


Fig. 11-20. Applying sealing compound to the window

Fitting trim moldings

1. Place a thong or cord in the groove of the rubber strip in the same way as when fitting the glass, see Fig. 11-18. It is assumed that the glass is fitted to the body.
2. The lap of the trim molding is then pressed down into the groove of the rubber strip after which the thong is pulled out. The lap of the rubber strip then finds its way up over the trim molding, see Fig. 11-21.

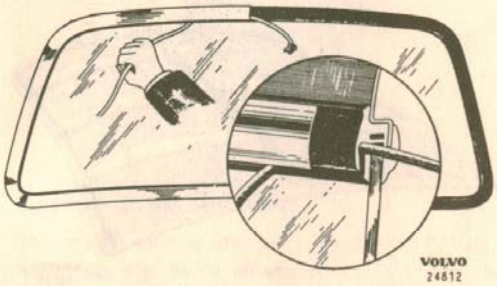


Fig. 11-21. Fitting trim molding

3. The joining pieces on the trim moldings are slid along the strips and preferably placed on one of the strips before fitting is started, after which the joining piece is pushed down over the joint when the strips are in place.

INTERIOR FITTINGS AND UPHOLSTERY

Front seats

The front seat is built up on a tubular frame as shown in Fig. 11-22. The seat is bolted to the upper slide rails. The lower slide rails are bolted to the floor.

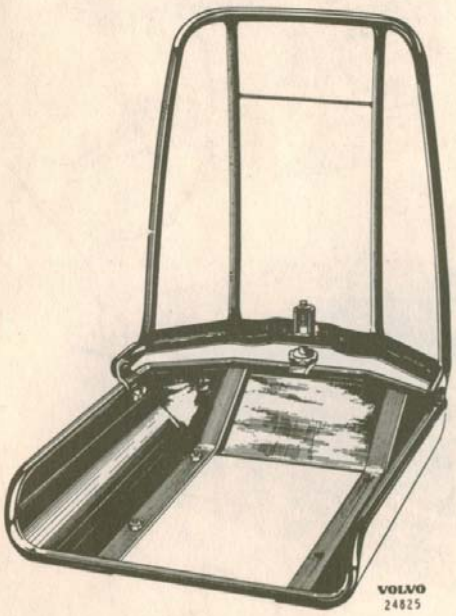


Fig. 11-22. Seat

The slide rails and catches should be lubricated when necessary with paraffin and oil. The padding consists of foam rubber.

Bulkhead and floor

The sides of the bulkhead are lined with cardboard panels. The bulkhead is covered with felt matting and woven plastic. At the front the floor is covered with a rubber mat and at the rear with a shaped textile mat.

CAR HEATER

The heater, Fig. 11-23, consists of a turbine housing with fan motor and turbine, cell system, distribution housing with shutter, thermostat and controls.

The heater is removed and fitted as a complete unit as follows:

1. Drain off the coolant.
2. Disconnect the leads to the fan motor.
3. Remove water hoses, defroster hoses and control wires.
4. Unscrew the bolts which hold the heater to the body.

The fan motor is provided with self-lubricating bushings. Lubricating is done in connection with reconditioning of the fan motor. The cell system can be removed after both the casing halves have been disassembled.

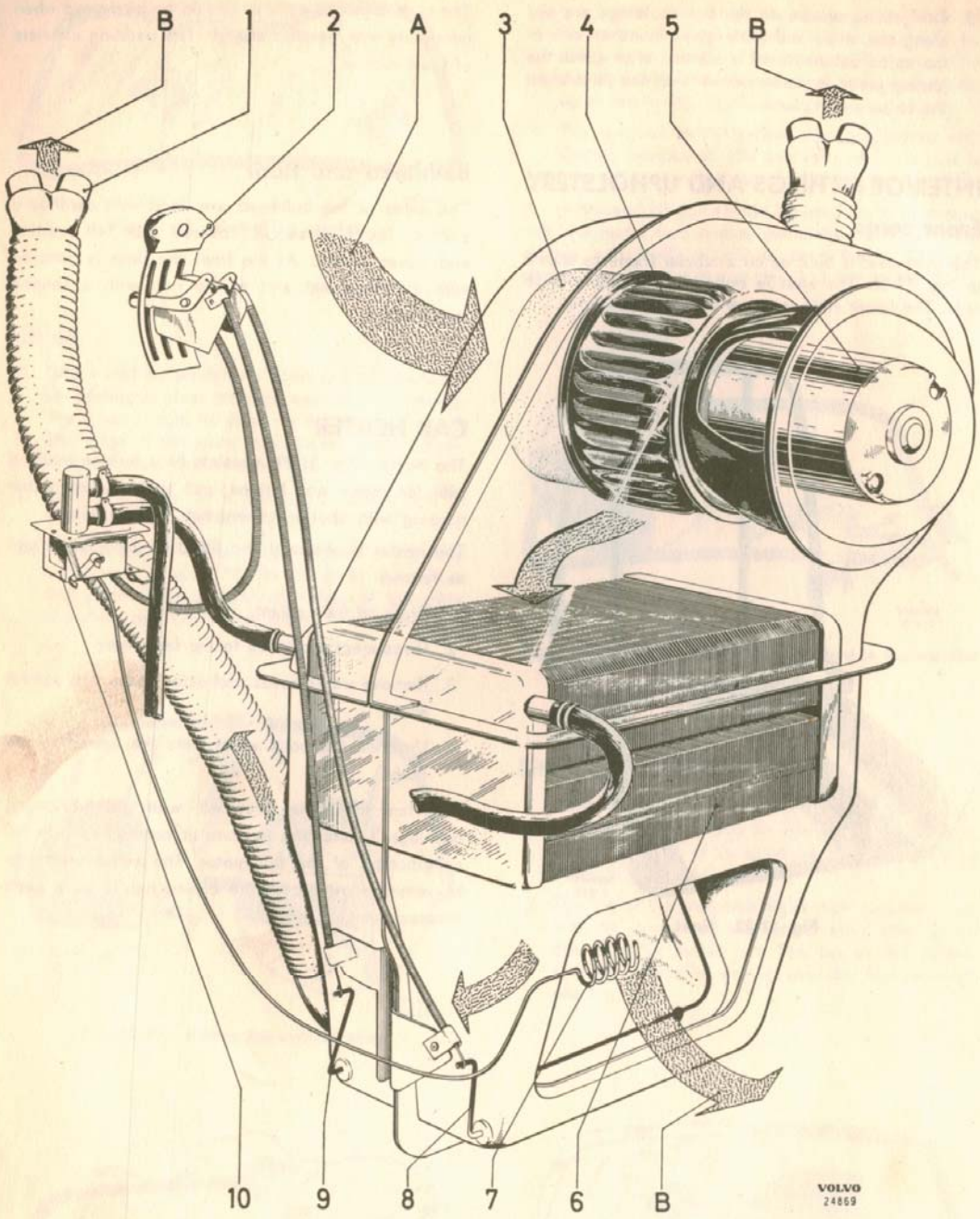
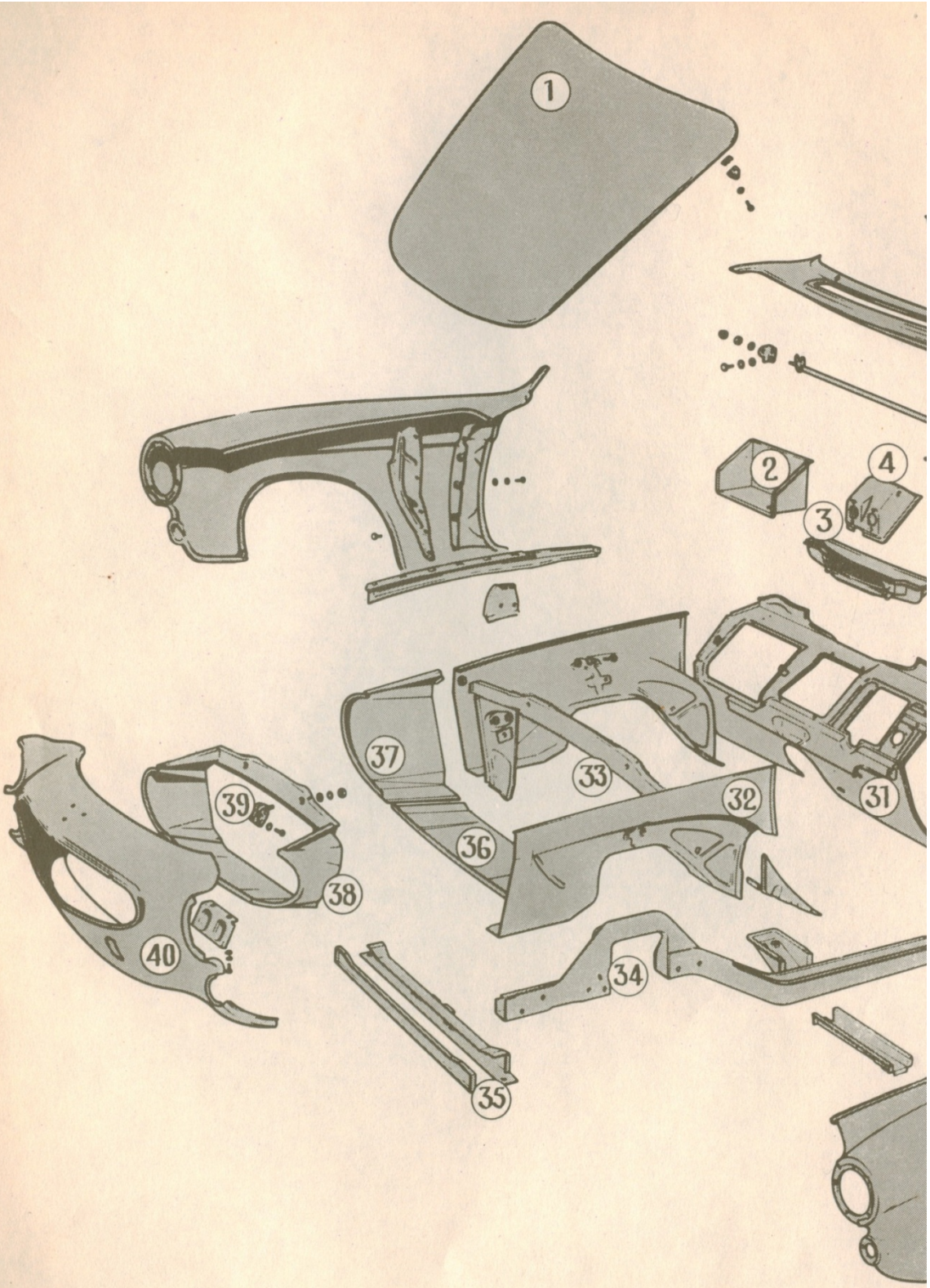


Fig. 11-23. Heater

1. Defroster nozzle
2. Controls
3. Air intake
4. Turbine
5. Electric motor
6. Cell system
7. Sensitive head
8. Air shutter
9. Defroster shutter
10. Thermostat

A. Incoming air
B. Outgoing air



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1. Hood
2. Battery box
3. Air intake
4. Pedal cover
5. Hood lock
6. Tunnel
7. Roof plate
8. Rear quarter section
9. Seat support
10. Back plate
11. Rear floor plate
12. Luggage compartment lid
13. Luggage compartment lid lock
14. Hinge
15. Torsion spring

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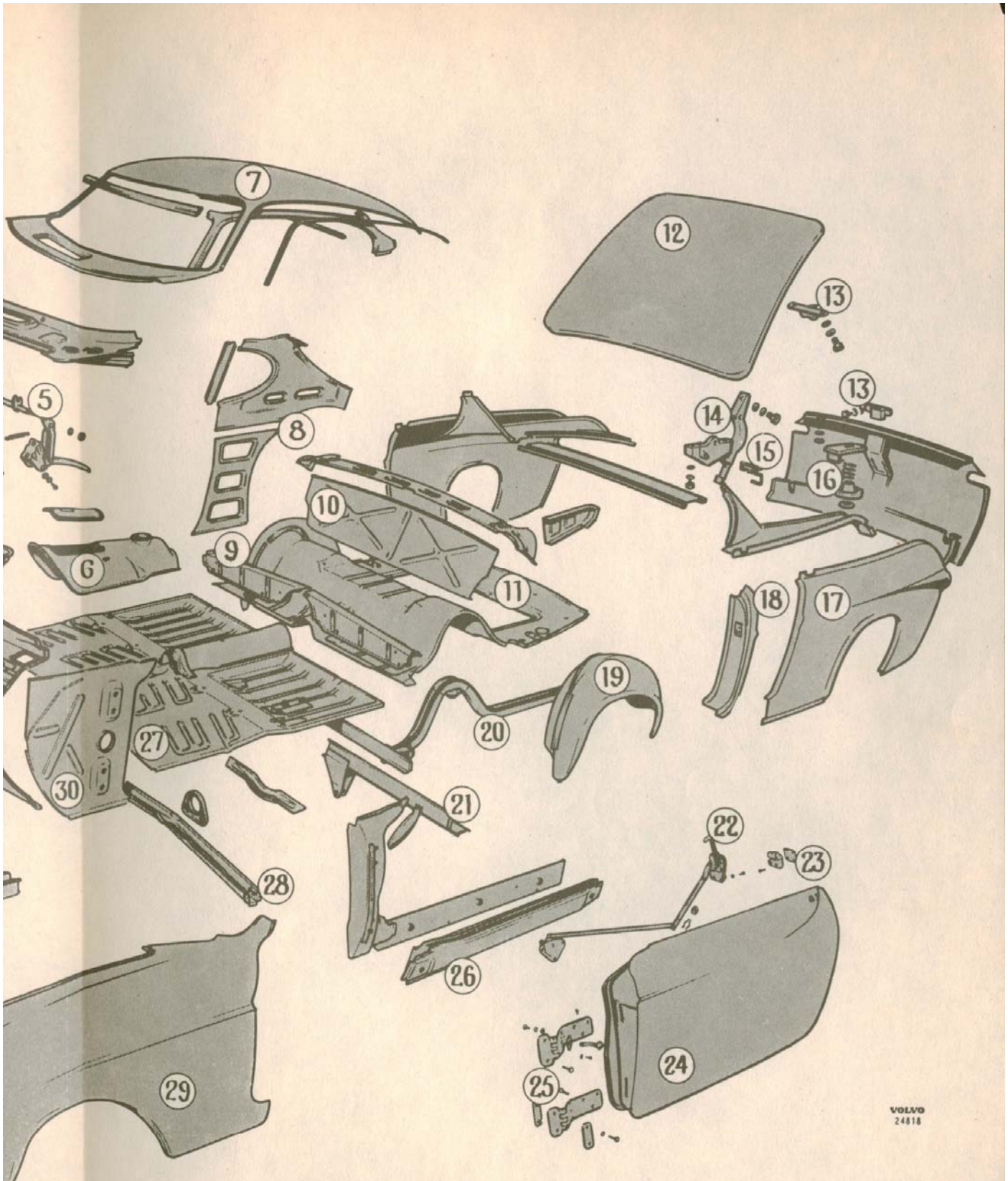

ustration XI. Body

6. Fuel filling cap
7. Rear fender
8. Door pillar
9. Wheel housing
0. Side member, rear
1. Cross-member, rear
2. Lock mechanism
3. Striker plate
24. Door
25. Hinge
26. Bottom rail
27. Front floor plate
28. Cross-member, front
29. Front fender
30. End plate
31. Bulkhead
32. Wheel housing plate
33. Cross-member, front, upper
34. Side member, front
35. Cross-member, front, lower
36. Radiator air scoop, bottom
37. Radiator air scoop, side
38. Radiator air scoop
39. Hood hinge
40. Front section

PART 12

LUBRICATION

INSTRUCTIONS FOR OIL CHANGING

ENGINE

During the six summer months and on cars principially used for long-distance driving, the oil in the engine should be changed every 3000 miles (5000 km). During the six winter months, the oil should be changed every 1500 miles (2500 km), particularly on cars principally used for short journeys. In addition, on new cars the oil should be changed after the first 600 miles (1000 km).

The oil should be drained immediately after driving whilst the engine is still warm. There is a plug for draining the oil, Fig. 12-1. After all the oil has run out, check the washer and screw in and tighten the plug. Oil is filled in through the rocker arm casing after the filler cap has been removed.

The engine oil used should be of quality corresponding to the requirements of "For Service MS". Concerning viscosities, see "Specifications". The oil change quantity is 7 US pints = 5 3/4 Imp. pints (3.25 liters). When changing the oil cleaner, fill in a further 1 US pint = 7/8 Imp. pint (0.5 liters).

Each time the oil is changed, the oil level in the carburetor damping cylinder must be checked. This is done by removing the nut and damping plunger, see Fig. 12-2. There should be so much oil there that the centre spindle but not the part above it is full when the plunger is fitted. If there is not sufficient oil, top up with SAE 20 engine oil (not multigrade oil).

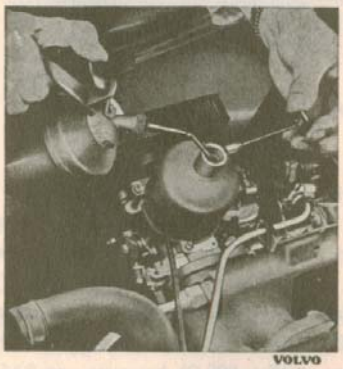

Fig. 12-2. Filling oil into the center spindle

TRANSMISSION

The oil should be changed every 12 500 miles (20 000 km). In the case of a new or reconditioned transmission, the oil should also be changed after the first 3000 miles (5000 km).

The old oil should be drained out immediately after driving whilst it is still warm. Open the plugs 1 and 2, Fig. 12-3. On transmissions with overdrive, also open the drain plug (Fig. 12-4) and clean the oil strainer, see page 12-4.

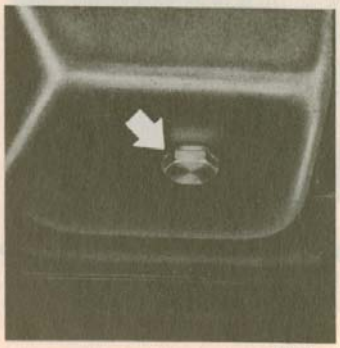

Fig. 12-1. Drain plug on engine

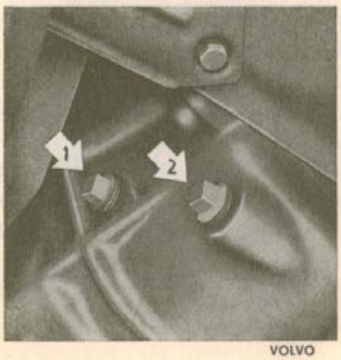

Fig. 12-3. Transmission

1. Filling plug 2. Drain plug

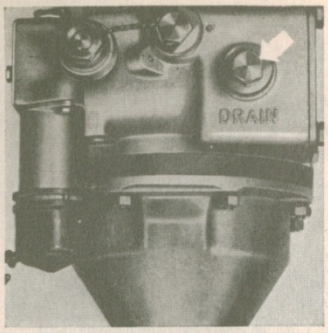

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Fig. 12-4. Drain plug on overdrive

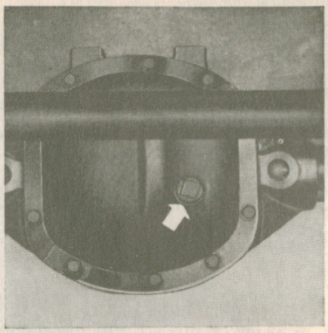

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Fig. 12-5. Filling plug on rear axle

Fill up with new oil after having screwed in and tightened the drain plug. Oil should reach up to the filling hole (1, Fig. 12-3). Screw in and tighten filling plug.

For transmission without overdrive, use transmission oil SAE 90 all the year round. At permanent temperatures below –5° F (–20° C), however, use SAE 80. The oil change quantity is 1 1/2 US pints = 1 1/4 Imp. pints (0.75 liter). For transmissions with overdrive, use engine oil "For Service ML" or higher having a viscosity of SAE 30 all the year round. The oil change quantity in this case is 3 7/8 US pints = 3 1/4 Imp. pints (1.8 liters).

REAR AXLE

With a new or reconditioned rear axle oil should be changed after the first 3000 miles (5000 km). After this the oil need only be changed in connection with reconditioning.

The oil should be drained off immediately after driving while it is still warm. Since the rear axle does not have a drain plug, the cover must be removed for the oil to run out. When doing this, great care must be taken to see that no dirt gets into the gears. Check that the cover gasket is not damaged; if so, replace it.

Fill up with new oil to the edge of the filling hole (Fig. 12-5). Screw in and tighten the plug.

Use hypoid oil SAE 90 all the year round. At permanent temperatures below –5° F (–20° C), however, use SAE 80. The oil change quantity is 2 3/4 US pints = 2 1/4 Imp. pints (1.3 liters).

STEERING GEAR

The oil in the steering gear box normally only needs replacing in connection with reconditioning. If for any reason the oil must be replaced with the steering gear fitted, the old oil must be sucked up with a suitable appliance, for example, a tube with a sucking device which is inserted through the filling hole.

Oil is filled in through the filling hole after the plug has been removed, Fig. 12-6. The oil should reach up to the filling hole. Screw in and tighten the plug. Hypoid oil SAE 90 is used for the steering box. At permanent temperatures below –5° F (–20° C), however, use SAE 80. The oil capacity of the steering box is 1/2 US pint = 3/8 Imp. pint (0.2 liter).

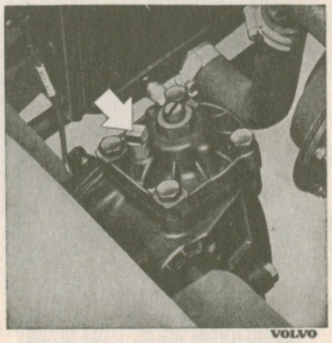

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Fig. 12-6. Filling plug on steering box

Fig. 12-7. Removing the oil cleaner

Fig. 12-9. Oil filling cap

REPLACING THE ENGINE OIL CLEANER

The complete oil cleaner should be replaced every 6000 miles (10 000 km). With a new or reconditioned engine it should, in addition, be replaced after the first 3000 miles (5000 km).

1. Clean the parts around the oil cleaner so that no dirt can enter the lubricating system when it is removed.
2. Slacken the oil cleaner anti-clockwise with the help of a tool, see Fig. 12-7. Unscrew the cleaner and collect up the oil running out.
3. Moisten the gasket on the new cleaner with oil. Screw in the oil cleaner by hand until it just begins to seal. Then tighten it a further 1/2 turn but no further.
4. Start the engine and check that there is no leakage. Top up with oil if necessary. It is normally necessary to add about 1 pint (0.5 liter) of oil.

REPLACING AIR CLEANERS

The complete air cleaners should be replaced every 12 500 miles (20 000 km). Unscrew the attaching bolts and lift off the cleaner, see Fig. 12-8. When fitting the new cleaner, check that the gasket is undamaged and that it faces as shown in the figure.

CLEANING THE FILLING CAP

In order for crankcase ventilation to be satisfactory, the filter in the oil filling cap should be removed and cleaned every 6000 miles (10 000 km). Remove the cap, unscrew the three screws and lift off the head, see Fig. 12-9. Clean the filter in gasoline, let it dry and moisten it with thin oil. Before fitting the cover, check and replace the gasket if necessary.

Fig. 12-8. Removing air cleaner

1. Air cleaner 2. Gasket

Fig. 12-10. Distributor

1. Lubricating cup 2. Cam 3. Felt wick

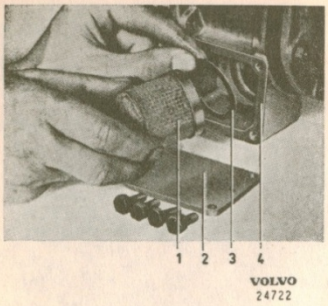


Fig. 12-11. Removing the overdrive oil strainer

1. Oil strainer
2. Cover
3. Gasket for oil strainer
4. Gasket for cover

LUBRICATING THE DISTRIBUTOR

The distributor should be lubricated every 6000 miles (10 000 km).

Lubricate the felt wick (3 Fig. 12-10) under the rotor arm with a few drops of light engine oil. Fill the lubricating cup (1) with light engine oil. In addition, lubricate the contact surface of the cam (2) with a very thin layer of vaseline.

CLEANING THE OVERDRIVE OIL STRAINER

The oil strainer should be cleaned at every oil change. After the oil has been drained out through the plug (Fig. 12-4), cleaning should be done as follows:

1. Remove the cover (2, Fig. 12-11) and take out the oil strainer (1).
2. Clean the oil strainer in gasoline or white spirit. Blow dry with compressed air.
3. Check that the gasket (3) is in good condition and place it in position. Fit the oil strainer, a new gasket (4) and cover.

Fig. 12-12. Lubricating the handbrake cable

Fig. 12-13. Lubricating the speedometer drive cable

LUBRICATING THE HANDBRAKE CABLES

The handbrake cables should be lubricated twice a year. Remove the front and rear attachments for the outer casing and move this backwards and forwards while smearing graphite grease on the cable, see Fig. 12-12.

LUBRICATING THE SPEEDOMETER DRIVE CABLE

The drive cable should be lubricated about every 12 500 miles (20 000 km) or once a year. It is important that the drive cable should not be lubricated in such a manner that lubricant can penetrate up into the instrument and impair its function. Oil is therefore unsuitable for this purpose. Lubricating should be carried out as follows.

Disconnect the drive cable from the speedometer and pull it out of the outer casing about 8″ (20 cm), see Fig. 12-13. Clean the cable and lubricate it with a thin layer of Castrol LM grease or corresponding. Slide back the cable into the outer casing and fit it to the speedometer.

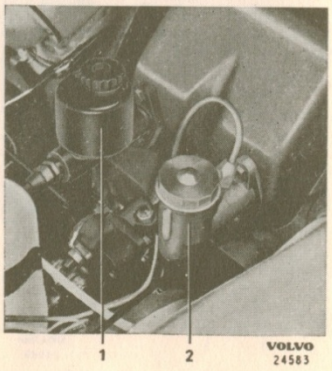


Fig. 12-14. Brake fluid containers

1. Brake
2. Clutch

LUBRICATING THE WINDSHIELD WIPERS

The windshield wiper gear housing and output shaft together with drive mechanism should be lubricated with grease in connection with reconditioning. The shaft for the wiper arms should be lubricated with light engine oil every 3000 miles (5000 km).

CHECKING THE BRAKE FLUID LEVEL

Every 3000 miles (5000 km) check that the fluid level in both the containers (Fig. 12-14) reaches up to about 3/4" (15–20 mm) under the edge of the filling aperture. Top up as necessary with first-class brake fluid fulfilling the requirements of SAE 70 R 3. Brake fluids which only fulfil the requirements of SAE 70 R 1 or HD grade should not be used. Avoid spilling brake fluid on the paintwork as this can cause damage.

LUBRICATING THE WHEEL BEARINGS

The wheel bearings should be removed after every 40 000 km (25 000 miles) or at least every other year for cleaning and greasing. Removal is carried out in accordance with the instructions in the Service Manual, Parts 6 and 5 respectively.

After the bearings and seal rings have been removed, the hub and grease cap should be thoroughly cleaned. Make sure that all the old grease inside the hub is removed. Compressed air can be used for rough cleaning of the bearings. The bearing components are then washed in white spirit or a similar solvent and then allowed to dry. Drying should not be done with compressed air since the air often contains moisture and particles of dust. Accessible bearing components should be dried off with linen or cotton cloth (not cotton waste). A new bearing in an unbroken packing should not be cleaned.

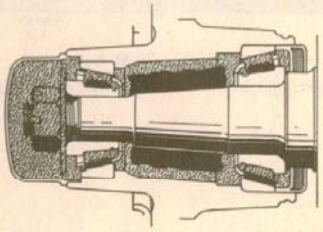


Fig. 12-15. Greasing the hub

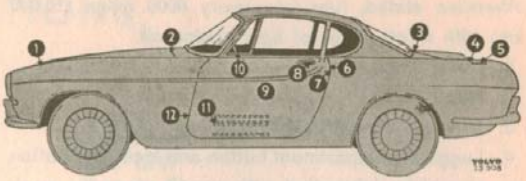


Fig. 12-16. Lubricating points on the bodywork

Inspect all parts carefully after cleaning. If there are any signs of damage, rust or blueing on the bearing races or rollers, replace the bearing. If the outer or inner races are loose in their recesses, test with a new race. If the looseness does not disappear, the hub or axle in question must be replaced. Replace seal rings if they are worn or damaged.

Use only a top quality multi-purpose grease with a lithium base for the lubrication of wheel bearings. Do not mix up different makes of grease. A greasing machine should be used for the effective grease-packing of the wheel bearings. Follow the instructions supplied by the manufacturers. If no greasing machine is available, pack the bearings by hand with as much grease as there is room for between the roller cage and the inner race. Also apply grease to the outside of the rollers and cages. The space between the outer and inner bearings in the front wheel hub should be filled with grease as shown in Fig. 24. Assembly is carried out in accordance with the instructions in Part 6 and Part 5 respectively.

LUBRICATING THE BODYWORK

In order to avoid rattles and unnecessary wear, the bodywork must be lubricated at the points listed below. See Fig. 12-16 concerning the numbers. Unless

Fig. 12-17. Gasoline filling cap

1. Hinge (light oil) 2. Lock (silicon oil)

otherwise stated, lubricate every 6000 miles (10 000 km) with a few drops of light engine oil.

1. Hood hinge.
2. Hood lock.
3. Luggage compartment hinge.
4. Luggage compartment button and lock. The button should be lubricated with paraffin (paraffin wax). The lock is lubricated through the keyhole with silicon oil.
5. Gasoline filling cap, see Fig. 12-17.
6. Latch, se Fig. 12-18.
7. Door lock, see Fig. 12-19.
8. Door buttons and locks. Concerning lubricant, see point 4.
9. Remote control, link, lock and window lift. Accessible after the door upholstery panel has been removed, see Part 11. Lubricating need only be carried out about every 12 500 miles (20 000 km) or once a year. Guide rails and pulleys should be lubricated with silicon grease.
10. Ventilation window locks and hinges.
11. Front seat slide rails and catches, see Fig. 12-20.
12. Door hinges, see Fig. 12-21.

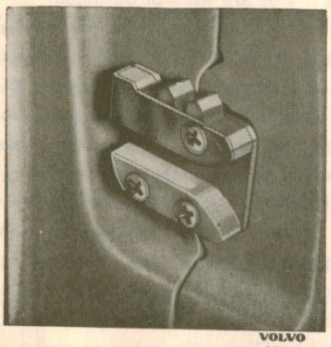


Fig. 12-18. Latch

Lubricate with paraffin (paraffin wax)

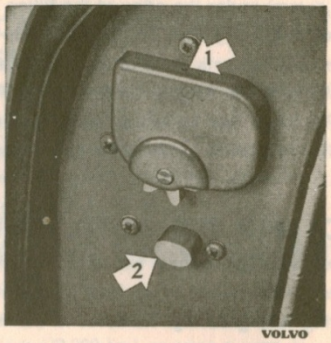


Fig. 12-19. Door lock

1. Lubrication hole for lock (silicon oil)
2. Door guide, paraffin (paraffin wax)

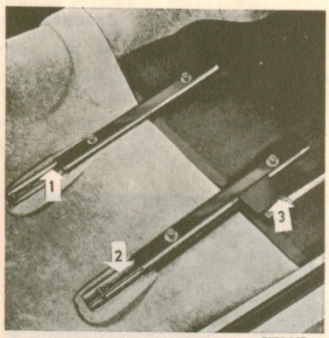


Fig. 12-20. Seat slide rails

1 and 2. Slide rail, paraffin (paraffin wax) 3. Catch (light oil)

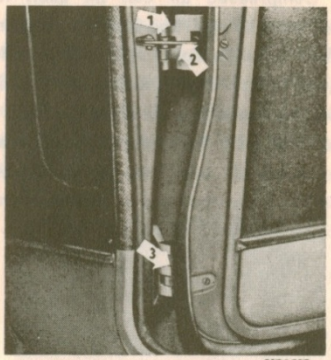


Fig. 12-21. Door hinge

1 and 3. Hinge (light oil) 2. Door stop, paraffin (paraffin wax)

SPECIFICATIONS

ENGINE

Lubricant type	Engine oil
quality	Service MS
viscosity, below 32° F (0° C)	SAE 10 W
above 32° F (0° C)	SAE 20
alternatively, all year round	Multigrade oil SAE 10 W–30
Oil change quantity, without oil cleaner	7 US pints = 5 3/4 Imp. pints (3.25 liters)
with oil cleaner	8 US pints = 6 1/2 Imp. pints (3.75 liters)

TRANSMISSION WITHOUT OVERDRIVE

Lubricant type	Transmission oil
viscosity	SAE 90
continuosly below 32° F (0° C)	SAE 80
Oil change quantity	1 1/2 US pints = 1 1/4 Imp. pints (0.75 liter)

TRANSMISSION WITH OVERDRIVE

Lubricant type	Engine oil
quality	Service ML or higher
viscosity, all year round	SAE 30
Oil change quantity	3 3/4 US pints = 3 1/8 Imp. pints (1.8 liters)

REAR AXLE

Lubricant type	Hypoid oil
viscosity	SAE 90
continuosly below 32° F (0° C)	SAE 80
Oil change quantity	2 3/4 US pints = 2 1/4 Imp. pints (1.3 liters)

STEERING GEAR

Lubricant type	Hypoid oil
viscosity	SAE 90
continuosly below 32° F (0° C)	SAE 80
Oil capacity	1/2 US pint = 3/8 Imp. pint (0.25 liter)

DIRECTIONS FOR LUBRICATING CHART

SYMBOLS

Engine oil "For Service MS"
Viscosity,
temperatures below 32° F (0° C) SAE 10W
between 32–90° F
(0–30° C) SAE 20
above 90°F (32°C) SAE 30
alternatively, all year round multi-grade oil ..... SAE 10W-30

Hypoid oil SAE 90

Chassis lubricant

Light engine oil

Brake fluid

Lubricant, see respective note

OIL CHANGE QUANTITIES

Engine,	
without oil cleaner	7 US pints = 5 3/4 Imp. pints (3.25 litres)
with oil cleaner	8 US pints = 6 1/2 Imp. pints (3.75 liters)
Transmission,	
without overdrive	1 1/2 US pints = 1 1/4 Imp. pints (0.75 liter)
with overdrive	3 3/4 US pints = 3 1/8 Imp. pints (1.8 liters)
Rear axle	2 3/4 US pints = 2 1/4 Imp. pints (1.3 liters)
Steering gear	1/2 US pint = 3/8 Imp. pint (0.2 liter)

OTHER LUBRICATING POINTS

In addition to the points shown on the lubricating chart, the chassis should be lubricated once or twice a year at all joints for the throttle control, handbrake, pedal linkage and similar.

NOTES

Note 1. Check the oil level in the steering box, see further page 12-2.

Note 2. After every 40 000 km (25 000 miles) or at least every other year, the front wheel bearings should be disassembled and thoroughly cleaned before being packed with a top quality multi-purpose grease with a lithium base, see page 12-5.

Note 3. On a certain series of cars the upper ball joint (1, Fig. 12-22) is of a type that does not require to be lubricated and therefore does not have a lubricating nipple.

Note 4. Check the fluid level, see under "Checking the brake fluid level", page 12-5.

Note 5. The speedometer drive cable should be lubricated every 12 500 miles (20 000 km) or once a year, see page 12-4.

Note 6. After every 40 000 km (25 000 miles) or at least every other year, the rear wheel bearings should be disassembled and cleaned before being packed with a top quality multi-purpose grease with a lithium base, see page 12-5.

Note 7. The handbrake cables should be lubricated twice a year, see page 12-4.

Note 8. Check the oil level at least every fortnight. The engine oil should be changed at the intervals stated in the instructions on page 12-1 and in addition during spring and fall. The oil cleaner should be replaced and the oil filling cap should be cleaned every 6000 miles (10 000 km) and the air cleaners should be replaced every 12 500 miles (20 000 km), see page 12-3.

Note 9. See under "Lubricating the distributor", page 12-4.

Note 10. Check the oil level every 3000 miles (5000 km) and change the oil every 12 500 miles (20 000 km), see further page 12-1.

Note 11. Check the oil level every 3000 miles (5000 km), see further page 12-2.

EXPLANATORY FIGURES

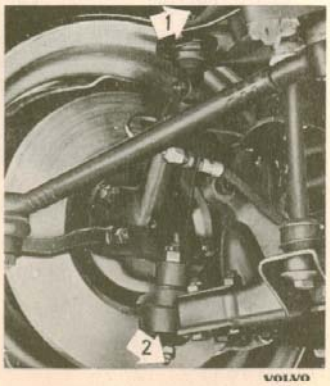


Fig. 12-22. Ball joint
1. Upper ball joint 2. Lower ball joint

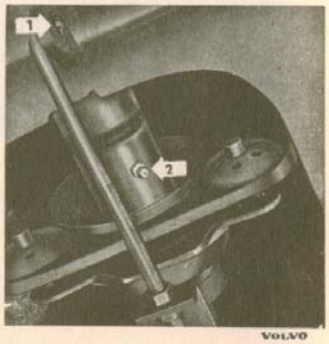
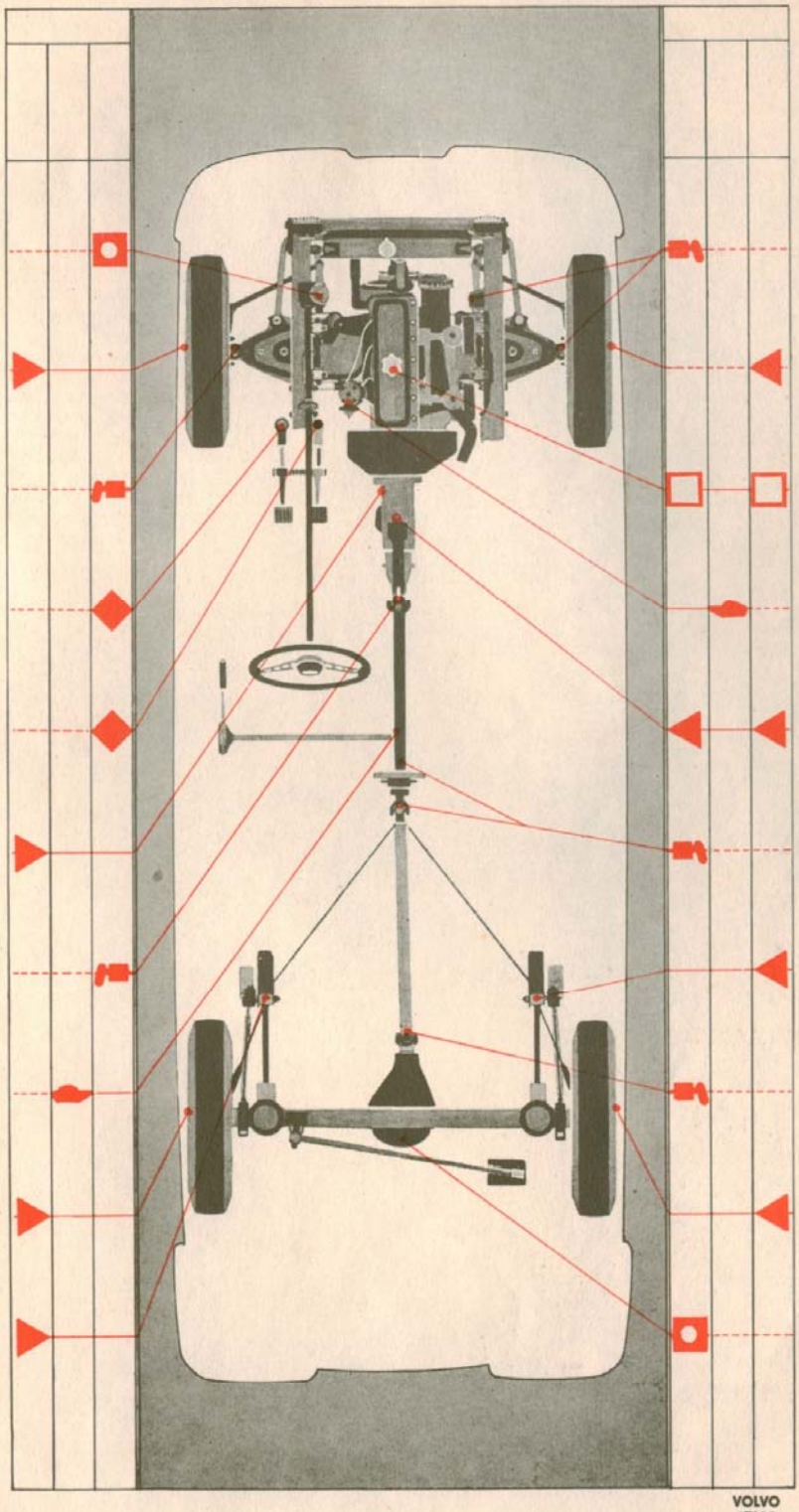


Fig. 12-23. Propeller shaft and handbrake
1. Handbrake pull-rod 2. Spline shaft

LUBRICATING CHART P 1800



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