Service Manual

Volvo 164 1975

VOLVO

Service Manual VOLVO 164 1975

FOREWORD

This Manual contains Service Procedures for the Volvo 164, 1975 model from chassis No. 132567.
The book is divided into 9 sections as indicated by the register opposite. The pages and figure illustrations in each part are numbered in such a way that the first group shows the number of the part concerned while the second group shows the number of the page or figure illustration in that particular section, for example, under the heading "Electrical system and instruments"; 3–1, 3–2, etc. A convenient way of finding the particular section you are looking for is to bend the right side of the Manual back so that the arrows in the register point to the index marks on the first page of each section.

The various sections are divided up as follows:

- Tools
- General Information
- Service Procedures

The specifications are to be found in Section 0, General. The instructions given in this book generally assume that special tools are used and are based on experience gained from method studies.
Similar results may be obtained with other working methods, but we are convinced that by following the instructions given in this Manual you will always achieve the best results in the shortest possible time.

AB VOLVO
Göteborg · Sweden

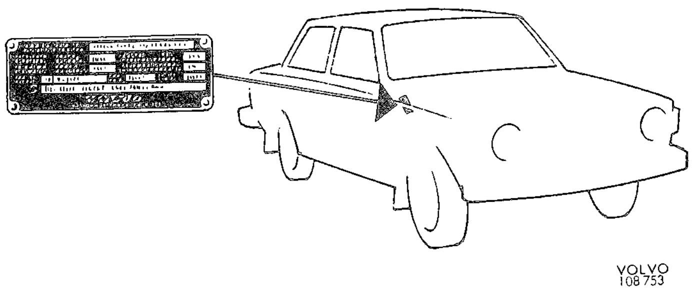
Section 0

GENERAL

TYPE DESIGNATIONS

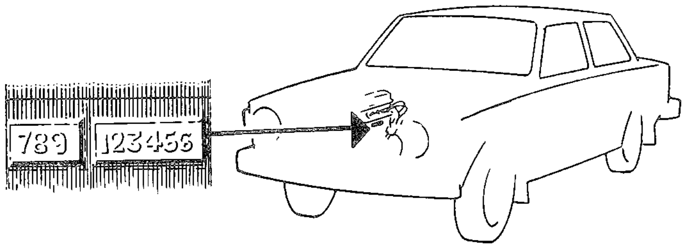
MODEL PLATE
Vehicle:
Type and Designation
Chassis No
Weight Specifications
Color Code
Upholstery code

Location:
Right side wheel housing



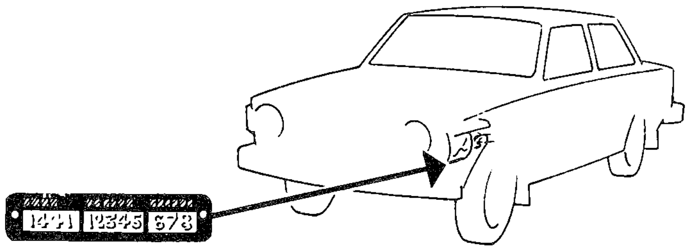
ENGINE
Type, P/N and Serial No.

Location:
Stamped on the engine left side



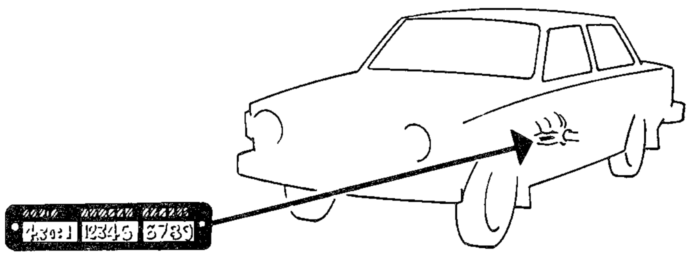
TRANSMISSION
Type and Designation P/N and Serial No

Location:
On the transmission underside (M410) or on the left side (BW35)



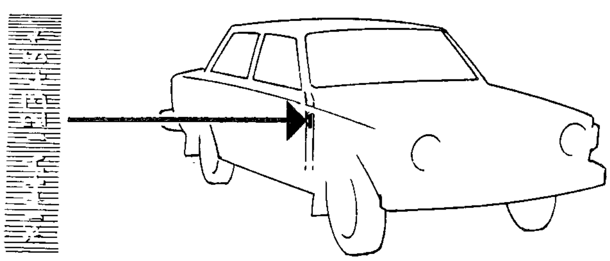
FINAL GEAR
Ratio, P/N and Serial No

Location:
On the left side of the final gear housing



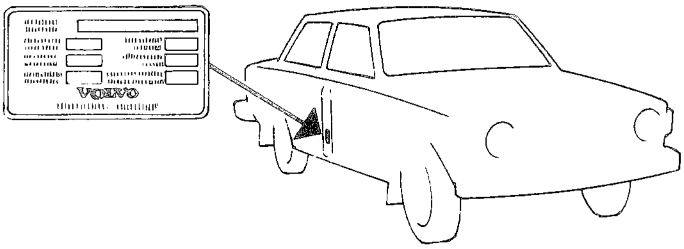
TYPE, MODEL YEAR DESIGNATION, CHASSIS NO.

Location:
Stamped on the right front door post. Vehicles intended for USA are provided with a Chassis No. Plate also on the left windshield pillar.



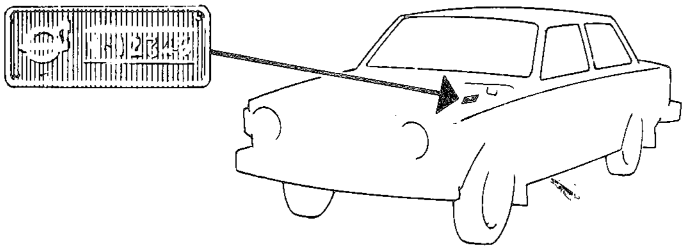
SERVICE PLATE
Introduced Nov. 1973
Chassis No, Codes for brakes, clutch etc.

Location:
The pillar behind right front door



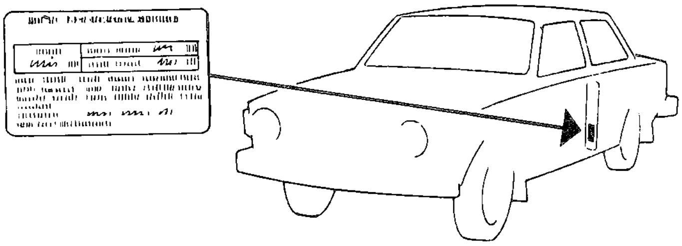
BODY NO.

Location:
On the left side of the firewall in the engine compartment



CHASSIS NO. AND WEIGHT SPECIFICATIONS

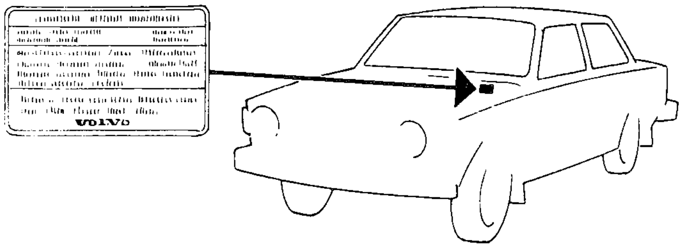
Location:
The pillar behind left front door



VEHICLE EMISSION CONTROL INFORMATION

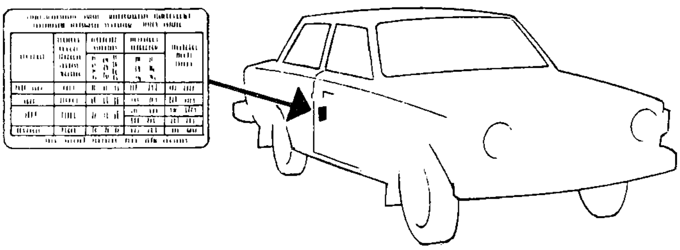
Location:
On the left side of the firewall in the engine compartment

For California there is also a label with Emission Control Information on the rear window



TIRE PRESSURES

Location:
rear front door jam.



SPECIFICATIONS

DIMENSIONS AND WEIGHTS

Length	4870 mm (192")
Width	1710 mm (67.3")
Height	1450 mm (56.8")
Wheelbase	2720 mm (107.0")
Ground clearance	180 mm (7.0")
Track, front	1350 mm (53.2")
rear	1350 mm (53.2")
Turning circle	10.3 m (33.8 ft.)
Curb weight approx.	1400–1430 kg (3080–3150 lb.)

LUBRICATION

ENGINE

Lubricant, type	Engine oil
grade	Service SD, SE and CC (MS)
viscosity, summer (above −12°C = +10°F)	Multigrade Oil SAE 20 W-40 or 20 W-50
winter (below −12°C = +10°F)	Multigrade Oil SAE 10 W-30
continuous temp. below −18°C = 0°F)	Multigrade Oil SAE 5 W-20
Oil capacity, excluding oil filter	5.2 liters (5.5 US Qts.)
including oil filter	6.0 liters (6.3 US Qts.)
Oil for carburetor damping cylinder	Automatic Transmission Fluid

TRANSMISSION WITH OVERDRIVE

Lubricant, type	Engine oil
grade	Service MS
viscosity, all year round	SAE 30
alternative	Multigrade Oil SAE 20 W-40
Oil capacity	1.4 liters (1.5 US Qts.)

AUTOMATIC TRANSMISSION

Lubricant	Automatic Transmission Fluid, Type F
Normal operating temp. of oil	100–115°C (212–239°F)
Oil capacity	8.2 liters (8.6 US Qts.)

FINAL GEAR

Lubricant, type, without limited slip	Oil ac. to API-GL-5 (MIL-L-2105 B)
with limited slip	Oil ac. to API-GL-5 (MIL-L-2105 B), provided with additive for limited slip differential
viscosity, above −10°C (14°F)	SAE 90
below −10°C (14°F)	SAE 80
Oil capacity	1.6 liters (1.7 US Qts.)

POWER STEERING

Lubricant	Automatic Transmission Fluid, Type A, F or Dexron
Oil capacity approx.	1.2 liters (1.3 US Qts.)

ENGINE

GENERAL

Type, designation	B 30 F
Output, hp at rpm	SAE J 245 138/5500
Output, kW at r/s	SAE J 245 101/92
Max. torque, $\frac{kpm}{lbft}$ at rpm	SAE J 245 $\frac{21.5}{154}$/3500
Max. torque, Nm at r/s	SAE J 245 209/58

Compression pressure (warm engine) when turned over with starter motor, 4.2–5.0 r/s (250–300 rpm)	9–11 kp/cm² (128–156 psi)
Compression ratio	8.7:1
Number of cylinders	6
Bore	88.9 mm (3.50")
Stroke	80 mm (3.15")
Displacement	2.98 dm³
Weight, including electrical equipment and gearbox	241 kg (530 lb)
Weight excluding gearbox, starter motor, oil and water	192 kg (422 lb)

CYLINDER BLOCK

Material	Special alloy cast iron
Bore, standard	88.91–88.92 mm (3.504–3.5008")
oversize 0.015"	89.295 mm (3.5155")
0.030"	89.675 mm (3.5305")

PISTONS

Material	Light alloy
Weight, standard	507±5 grammes (17.75±0.18 0z.)
Permissible weight deviation between pistons in same engine	10 grammes (0.35 oz.)
Height, total	71 mm (2.79")
Height from piston center to piston crown	46 mm (1.81")
Piston clearance	0.01–0.03 mm (0.0004–0.0012")

PISTON RINGS

Piston ring gap, measured in ring opening	0.40–0.55 mm (0.016–0.022")
Oversize on piston rings	0.015", 0.030"

COMPRESSION RINGS

Upper ring chromed.

Number on each piston	2
Height	1.98 mm (0.078")
Compression ring clearance in groove	0.040–0.072 mm (0.0016–0.0028")

OIL OIL SCRAPER RINGS

Number on each piston	1
Height	4.74 mm (0.186")
Scraper ring clearance in groove	0.040–0.072 mm (0.0016–0.0028")

GUDGEON PINS

Floating fit. Circlips at both ends in piston.

Fit:

In connecting rod	Close running fit
In piston	Push fit
Diameter, standard	24.00 mm (0.945")
oversizes 0.05"	24.05 mm (0.947")

CYLINDER HEAD

Height, measured from cylinder head contact face to face for bolt heads	87.0 mm (3.425″)
Cylinder head gasket, thickness standard, unloaded	1.2 mm (0.047″)
loaded	1.0 mm (0.039″)
Distance from top side of head to overflow pipe upper end (pipe placed under thermostat)	35 mm (1.38″)

CRANKSHAFT

Crankshaft, end float	0.047–0.137 mm (0.0019–0.0054″)
Main bearings, radial clearance	0.028–0.083 mm (0.0011–0.0033″)
Big-end bearings, radial clearance	0.029–0.071 mm (0.0012–0.0028″)

MAIN BEARINGS

Main bearing journals

Diameter, standard	63.451–63.464 mm (2.4981–2.4986″)
undersize 0.010″	63.197–63.210 mm (2.4881–2.4886″)
0.020″	62.943–62.956 mm (2.4781–2.4786″)
Width on crankshaft for pilot bearing shell	
Standard	38.960–39.000 mm (1.5338–1.5354″)
Oversize 1 (undersize shell 0.010″)	39.061–39.101 mm (1.5378–1.5394″)
Oversize 2 (undersize shell 0.020″)	39.163–39.203 mm (1.5419–1.5434″)

BIG-END BEARINGS

Big-end bearing journals

Width of bearing recess	29.95–30.5 mm (1.1779–1.1830″)
Diameter, standard	53.987–54.000 mm (2.1255–2.1260)″)
undersize 0.010″	53.733–53.746 mm (2.1155–2.1160″)
0.020–	53.479–53.492 mm (2.1055–2.1060″)

CONNECTING RODS

End float on crankshaft	0.15–0.35 mm (0.006–0.014″)
Length, center-center	145 ± 0.1 mm (5.71 ± 0.004″)
Max. permissible weight deviation between connectings rods in same engine	10 grammes (0.35 oz.)

FLYWHEEL

Permissible axial throw, max.	0.05 mm (0.002″) at a diameter of 150 mm (5.9″)
Ring gear (chamfer forwards)	153 teeth

CAMSHAFT

Marking	C
Max. lift height of cam	6.7 mm (0.264″)
Number of bearings	4
Journal, diameter	46.975–47.000 mm (1.8494–1.8504″)
Radial clearance	0.020–0.075 mm (0.0008–0.0030″)
End float	0.020–0.060 mm (0.0008–0.0024″)
Valve clearance for control of camshaft setting (cold engine)	1.45 mm (0.057″)
Inlet valve should then open at	0° (TDC)

CAMSHAFT BEARING

Bearing diameter	47.020–47.050 mm (1.8512–1.8524″)

TIMING GEARS

Crankshaft drive, number of teeth	21
Crankshaft gear (fibre), number of teeth	42
Backlash	0.04–0.08 mm (0.0016–0.0032″)
End float, camshaft	0.02–0.06 mm (0.0008–0.0024″)

VALVE SYSTEM

VALVES

Inlet

Disc diameter	44 mm (1.732")
Stem diameter	7.955–7.970 mm (0.3132–0.3138")
Valve face angle	44.5°
Valve seat angle	45°
Seat width in cylinder head	2 mm (0.08")
Clearance, both hot and cold engine	0.50–0.55 mm (0.020–0.022")

Exhaust

Disc diameter	35 mm (1.378")
Stem diameter	7.925–7.940 mm (0.3120–0.3126")
Valve face angle	44.5°
Valve seat angle	45°
Seat width in cylinder head	2 mm (0.08")
Clearance, both hot and cold engine	0.50–0.55 mm (0.020–0.022")

VALVE GUIDES

Length, inlet valve	52 mm (2.047")
exhaust valve	59 mm (2.323")
Inner diameter	8.000–8.022 mm (0.3150–0.3158")
Height above upper face of cylinder head	17.5 mm (0.689")
Clearance, valve stem-valve guide, inlet valve	0.030–0.067 mm (0.0012–0.0026")
exhaust valve	0.060–0.097 mm (0.0024–0.0038")

VALVE SPRINGS

Length, unloaded, approx.	46 mm (1.81")
with a loading of 295±23 N (65±5 lb)	40 mm (1.57")
with a loading of 825±43 N (181.5±9.5 lb)	30 mm (1.18")

LUBRICATING SYSTEM

Oil capacity, including oil filter	6.0 liters (6.3 US Qts.)
excluding oil filter	5.2 liters (5.5 Qts.)
Oil pressure at 33.3 r/s (2000 rpm) (with hot engine and new oil filter)	2.5–6.0 kp/cm² (36–85 psi)

OIL FILTER

Type	Full-flow type

OIL PUMP

Oil pump, type	Gear
number of teeth on each gear wheel	9
end float	0.02–0.10 mm (0.0008–0.0039")
radial clearance	0.08–0.14 mm (o.oo32–0.0055")
backlash	0.15–0.35 mm (0.0060–0.0140")

RELIEF VALVE SPRING (IN OIL PUMP)

Length, unloaded ... approx.	39.0 mm (1.54")
loaded with 50±4 N (11.0±8.8 lb)	26.25 mm (1.03")
70±8 N (15.4±1.7 lb)	21.0 mm (0.83")

FUEL SYSTEM

FUEL FILTER

Type	Paper filter
Changing intervals	20 000 km (12 000 miles)

FUEL PUMP

Type	Rotor pump
Capacity	100 liters/h at 2 kp/cm² (26 US gals/h at 28 psi)
Current consumption	5 amps
Relief valve opens	approx. 4.5 kp/cm² (64 psi)

PRESSURE REGULATOR

Setting value	2.1 ± 0.1 kp/cm² (30 ± 1.4 psi)

injectors

Resistance in magnetic winding	2.4 ohms at +20°C (68°F)

COLD-START VALVE

Resistance in magnetic winding	4.2 ohms at +20°C (68°F)

AUXILIARY AIR REGULATOR

Fully open at	−25°C (−13°F)
Fully closed at	+60°C (140°F)

TEMPERATURE SENSOR I (INTAKE AIR)

Resistance	approx. 300 ohms at +20°C (68°F)

TEMPERATURE SENSOR II (COOLANT)

Resistance	approx. 2500 ohms at +20°C (68°F)

PRESSURE SENSOR

Resistance in primary winding (stops 7 and 15)	approx. 90 ohms
Resistance in secondary winding (stops 8 and 10)	approx. 350 ohms

CO-TEST

Hot engine, idling speed	1 − 1.5 % (Automatic 0.5 − 1.0 %)

VENTING FILTER

Type	Foam plastic filter
Changing intervals	40 000 km (25 000 miles)

AIR CLEANER

Type	Paper insert
Changing intervals	40 000 km (25 000 miles)

COOLING SYSTEM

Type	Sealed system
Radiator cap valve opens at	0.7 kp/cm² (10.0 psi)
Capacity	approx 12.4 liters (13.0 US Qts.) (expansion tank of which 1.5 liters (1.5 US Qts.)
Fan belt, designation	HC-38-888

Fan belt tensioning: Depression force 75 − 110 N (16.5 − 24 lb) when depressing 5 − 10 mm (3/16 − 3/8") midway between pulleys.

THERMOSTAT

Type	Wax
Marked	82°
Begins to open at	81–83°C (177–182°F)
Fully open at	90°C (194°F)

TIGHTENING TORQUES

	Nm	Lb.ft.
Cylinder head (oiled screws	90	65
Main bearings	120–130	87–94
Big-end bearings	70–78	51–57
Flywheel	65–70	47–51
Spark plugs	35–40	25–30
Camshaft nut	130–150	94–108
Bolt for crankshaft belt pulley	70–80	51–58
Nipple for oil filter	45–55	32–40
Sump bolts	8–11	6–8
Intake and exhaust manifold	18–22	13–16
Alternator bolt (1/2″)	71–86	50–60

WEAR TOLERANCES

CYLINDERS

To be rebored when wear amounts to (if engine has abnormal oil consumption)	0.25 mm (0.010″)

CRANKSHAFT

Permissible out-of-round on main bearing journals, max.	0.05 mm (0.0020″)
Permissible out-of-round on big-end bearing journals, max.	0.07 mm (0.0028″)
Crankshaft end float, max.	0.15 mm (0.0060″)

VALVES

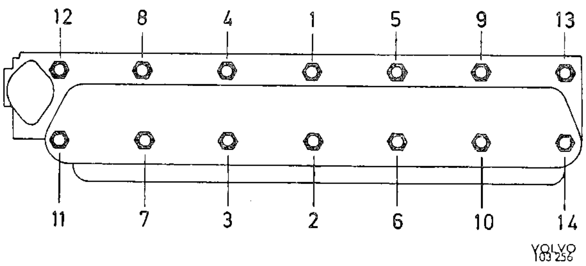
Permissible clearance between valve stems and valve guides, max.	0.15 mm (0.0060″)
Valve stems, permissible wear, max.	0.02 mm (0.0008″)

CAMSHAFT

Permissible out-of-round (with new bearings) max.	0.07 mm (0.0028″)
Bearings, permissible wear	0.02 mm (0.0008″)

timing gears

Permissible backlash, max.	0.12 mm (0.0048″)



Tightening sequence for cylinder head bolts (tightened in 3 stages). 1st stage: 40 Nm (29 lbft) 2nd stage: 80 Nm (58 lbft) 3rd stage: after driving the car for 10 minutes, 90 Nm (65 lbft).

ELECTRICAL SYSTEM

BATTERY

Type	Tudor 6 Ex 4 F
Grounded	Negative terminal
System Voltage	12 V
Battery, capacity	60 Ah
Specific gravity of electrolyte:	
Fully charged battery	1.28
When recharging is necessary	1.21
Recommended charging current	5.5 A

ALTERNATOR

Type	S.E.V. Motorola 14 V-34833
Output	770 W
Max. amperage	55 A
Max. speed	250 r/s (15 000 rpm)
Direction of rotation	Optional
Ratio, engine-alternator	1÷2
Brushes, minimum length	5 mm (0.20")
Tightening torques:	
Attaching screws	2.8–3.0 Nm (2.0–2.2 lbft)
Pulley nut	40 Nm (29 lbft)

TEST VALUES

Field winding resistance	3.7 ohms
Voltage drop across insulation diode	0.8–0.9 V
Rated test	48 A (min. at 50 r/s [3000 rpm] and approx. 14 V)

VOLTAGE REGULATOR

Type	S.E.V. Motorola 14 V-33544
Control voltage, cold regulator	13.1–14.4 V
after running 45 minutes	13.85–14.25 V

STARTER MOTOR

Type	Bosch GF 12 V 1 PS
Voltage	12 V
Grounded	Negative terminal
Direction of rotation	Clockwise
Output	Approx. 736 W (1 hp)
Brushes, number	4

TEST VALUES

Mechanical

Rotor end float	0.05–0.3 mm (0.002–0.012")
Brush spring tension	11.5–13 N (2.53–2.86 lb)
Distance from pinion to ring gear	1.2–4.4 mm (0.047–0.173")
Frictional torque of rotor brake	0.25–0.40 Nm (2.17–3.81 lbin)
Pinion idling torque	0.13–0.45 Nm (1.13–1.56 lbin)
Backlash	0.35–0.45 mm (0.14–0.018")
Minimum diameter of commutator	33 mm (1.3")
Minimum length of elec. brushes	14 mm (0.6")

Electrical

Unloaded starter motor:	
12.0 V and 40−50 A	115−135 r/s (6900−8100 rpm)
Loaded starter motor:	
9 V and 185−200 A	17.6−22.5 r/s (1050−1350 rpm)
Locked starter motor:	
6 Vand 300−350 A	0 r/s

CONTROL SOLENOID

Cut-in voltage	Min. 8 V

IGNITION SYSTEM

Firing order	1-5-3-6-2-4
Ignition timing (at 10.0−13.3 r/s [600−800 rpm] with vacuum governor disconnected)	10° before TDC
Spark plugs type	Bosch 225 WT 35 (B 30 F: W200 T 35)
thread	14 mm (1/2″)
spark plug gap	0.7−0.8 mm (0.028″−0.032″)
tightening torque	35−40 Nm (25.3−29.0 lbft)
Pre-engaging resistance to ignition coil	0.9 ± 0.05 ohm

DISTRIBUTOR

Type	Bosch PGFUX 6
Direction of rotation	Anti-clockwise

Centrifugal governor:

Advance range, total	10.5 ± 1° (distr. graduation)
Advance begins at	7.50−9.83 r/s (450−590 rpm) (distr.)
Values, 5°	12.33−15.00 r/s (740−900 rpm) (distr.)
9°	17.50−22.50 r/s (1050−1350 rpm) (distr.)
Advance finishes at	26.66 r/s (1600 rpm) (distr.)

Negative control

Drop, total	5.0 ± 1.0 (distr. graduation)
Drop begins at	30−110 mm (1.2−4.3″) Hg
Drop 2°	60−120 mm (2.5−4.7″) Hg
Drop finishes at	130 mm (5.1″) Hg

LAMP BULBS

	Watts	Socket	Number
Headlights	60/55	P 43 t-38	2
Parking Lights, front	5 (4 cp)	Ba 15 s	2
rear	5 (4 cp)	Ba 15 s	2
Turn Signals	32 CP	Ba 15 s	4
Brakes Stop Lights	25 (32 cp)	Ba 15 s	2
Back-up Lights	15 (32 cp)	Ba 15 s	2
License Plate Light	5	SV 8.5	2
Side Marker Lights	4	Ba 9 s	4
Interior Light	10	SV 8.5	1
Glove Locker Light	2	Ba 9 S	1
Engine and Luggage Compartments	18	SV 8.5	2
Instrument Panel Light	3	W 2.2 d	2
Control Panel Lighting	1.2	W 1.8 d	3
Shift Positions Light, Autom. Transm.	1.2	W 1.8 d	1
Lighting, heater controls, clock	2	Ba 7 s	1
Warning Light, instrument panel	1.2	W 1.8 d	5
Warning Light, overdrive	1.2	W 1.8 d	1
Warning Light, elec. heated rear window	1.2	W 1.8 d	1
Warning Light, safety belt	1.2	W 1.8 d	1
Emergency Warning Flashers	1.2	W 1.8 d	1

FUSES

	Number
Rated current 16 A	2
Rated current 8 A	4
Rated current 5 A	6
Rated current 8 A (foglights)	2

ELECTRICALLY HEATED REAR WINDOW

Output .... Approx.150 W

INSTRUMENTS

SPEEDOMETER GEARS

Tire 175 SR 15

Gearbox	Final drive red. ratio	Small S-gear		Large S-gear		Ratio	Error %
		Part No.	Teeth	Part No.	Teeth		
M 400	3.73:1	380168	18	381033	6	3.00:1	+0.8
M 410	3.73:1	380754	18	380682	6	3.00:1	+0.8
BW 35	3.31:1	380164	16	381033	6	2.66:1	+0.6
M 400	3.54:1	380166	17	381033	6	2.83:1	+1.3
M 410	3.54:1	380913	17	380682	6	2.83:1	+1.3
BW 35	3.54:1	380166	17	381033	6	2.83:1	+1.3

The percentage error in the above table is calculated for a rolling radius of 318 mm (12.5"), which is the value of the figure established by AB Volvo for tires at a vehicle speed of about 80 kmph (50 mph).

Number of speedometer cable revolutions per km (mile) registered: 617 (990).

POWER TRANSMISSION, REAR AXLE

CLUTCH

Clutch, type and size .... Single, 2 1/2", dry-plate, diaphragm spring
Disc .... 9 1/2"
Clutch friction area, total .... 540 cm^2 (83.7 sq.in.)
Release lever play, vehicle with left-hand steering .... 4–5 mm (0.16–0.20")
vehicle with right-hand steering .... 2.5–3.5 mm (0.10–0.14")

GEARBOX

Type designation M410
Reduction ratios:
1st speed 3.54:1
2nd speed 2.12:1
3rd speed 1.34:1
4th speed 1:1
Overdrive 0.797:1
Reverse 3.54:1
Oil pressure, direct drive .... Approx. 1.5 kp/cm^2 (21 psi)
overdrive .... 32–35 kp/cm^2 (455–500 psi)
Nut for driving flange .... 165–180 Nm (lbft)
Lubricant, ... Engine oil
viscosity .... SAE 30 or SAE 20 W-40
Oil capacity, gearbox and overdrive .... approx. 1.4 liters (1.5 US Qts.)

AUTOMATIC TRANSMISSION

Make and type	Borg-Warner, type 35
Type designation	319
Colour of type plate	Grass green
Reduction ratios:	
1st gear	2.39:1
2nd gear	1.45:1
3rd gear	1:1
Reverse	2.09:1
Number of teeth, front sun gear	32
rear sun gear	28
planet gear, short	16
planet gear, long	17
ring gear	67
Size of converter	11" (28 cm)
Torque ratio in converter	2:1–1:1
Normal stall speed, B 30 A	35.0 r/s (2100 rpm)
B 30 E	38.3 r/s (2300 rpm)
B 30 F	36.7 r/s (2200 rpm)

Weights:	kg	lb
Gearbox	37.2	82
Converter case	7	3.2
Converter	30	13.6
Total, without fluid	119	54.0
Weight of fluid	17	7.7
Total, with fluid	136	61.7

Fluid, type	Automatic Transmission Fluid, Type F
Fluid capacity	8.2 liters 8.6 US Qts.
Normal operating temperature of fluid	approx. 110–115°C (212–240°F)

Approximative shift speeds

Throttle position	1–2		2–3		3–2		3–1	
	kmph	mph	kmph	mph	kmph	mph	kmph	mph
Full throttle	54	34	97	60	–	–	–	–
Kick-down	65	40	125	78	110	70	max 49	30

SPRINGS FOR CONTROL SYSTEM

Spring	Approximate length		Effective number of turns	Wire diameter	
1–2 shift valve	27.8 mm	1.094"	13 1/2	0.61 mm	0.024"
Primary regulator valve	74.7 mm	2.941"	14	1.42 mm	0.056"
Servo orifice control valve	25.5 mm	1.005"	17	0.61 mm	0.024"
Modulator valve	27.2 mm	1.069"	19	0.71 mm	0.028"
Secondary regulator valve	65.9 mm	2.593"	18	1.42 mm	0.056"
2–3 shift valve (inner spring)	40.0 mm	1.59"	22 1/2	0.91 mm	0.036"
Throttle valve (inner spring)	20.5 mm	0.807"	28	0.46 mm	0.018"
Throttle valve (outer spring)	29.8–30.1 mm	1.174–1.185"	19 1/2	0.81 mm	0.032"
Fast 3–2 shift check valve	16.5 mm	0.650"	16	0.18 mm	0.007"

TIGHTENING TORQUES

Application	Nm	Lb.ft.
Torque converter – drive plate	35–41	25–30
Transmission case – converter housing	11–18	8–13
Extension housing – transmission case	41–76	30–55
Oil pan – transmission case	11–18	8–13
Front servo – transmission case	11–18	8–13
Rear servo – transmission case	18–37	13–27
Pump adaptor – front pump body	24–30	17–22
Slotted screws	3–4	2–3

Pump adaptor — transmission case	11—26	8—18.5
Oil deflector flange — transmission case	6—10	4—7
Center support — transmission case	14—25	10—18
Outer lever — manual valve shaft	10—12	7—9
Pressure point	6—7	4—5
Oil pan drain plug	12—17	9—12
Oil tube collector — lower body	2.5—3.5	1.7—2.5
Governor line plate — lower body	2.5—3.5	1.7—2.5
Lower body end plate — lower body	2.5—3.5	1.7—2.5
Upper body end plate front or rear — upper body	2.5—3.5	1.7—2.5
Upper body — lower body	2.5—3.5	1.7—2.5
Valve bodies assembly — transmission case	6—12	4.5—9
Front pump strainer — lower body	2.5—3.5	1.7—2.5
Downshift valve cam bracket — valve body	2.5—5	1.7—3.5

Governor

Governor body — retainer	6—7	4—5
Cover plate — governor body	2.5—5.5	1.7—4.0

Brake band adjustment

Adjusting screw locking nut, rear servo — case	41—55	30—40

Special threaded parts

Start inhibitor switch locknut	6—8	4—6
Downshift valve cable adaptor — transmission case	11—12	8—9
Coupling flange — driven shaft	48—69	35—50
Nipple for oil cooler connection	7—10	5—7
Nut for nipple	14—17	10—12

PROPELLER SHAFT

Type	Tubular, divided, three universal joints, support bearings
Universal joints	Fitted with needle bearings
Lubricant, sliding joint (when assembling)	Molybdenum disulphide chassis grease
universal joint	Subsequent adding not required

REAR AXLE

Rear axle, type	Semi-floating
Track	1350 mm (53.15″)

FINAL DRIVE

Type	Spiral bevel (hypoid)
Reduction ratio	3.31:1, 3.54:1 or 3.73:1
Backlash	0.12—0.18 mm (0.0048—0.0071″)
Pre-loading on pinion bearings, new bearings	150—350 Ncm (11.0—25.0 lbin)
run-in bearings	60—110 Ncm (5.21—9.55 lbin)
Pre-loading on differential bearings	0.13—0.20 mm (0.005—0.008″)
Lubricant, type, without limited slip differential	Oil according to MIL-L-2105 B
with limited slip differential	Oil according to MIL-L-2105 B, provided with additive for limited slip differential
viscosity, above −10°C (14°F)	SAE 90
below −10°C (14°F)	SAE 80
Oil capacity	1.6 liters (1.7 US QTS.)

TIGHTENING TORQUES	Nm	Lb.ft.
Flange	240—300	175—200
Caps	50—70	35—50
Crown wheel	65—90	45—65

BRAKES

FRONT WHEEL BRAKES

Type	Disc brakes
Brake discs:	
Outside diameter	272.2 mm (10.7")
Thickness, new	24 mm (1")
reconditioned	Min. 22.8 mm (0.9")
Warp	Max. 0.10 mm (0.004")
Brake linings:	
Number per wheel	2
Thickness, new	10 mm (0.394")
Effective area	145 cm² (22.5 sq.in.)
Wheel unit cylinders:	
Number per wheel	4
Area per wheel	40.68 cm² (6.30 sq.in.)

REAR WHEEL BRAKES

Type	Disc brakes
Brake discs:	
Outside diameter	295.5 mm (11.63")
Thickness, new	9.6 mm (0.378")
reconditioned	8.4 mm (0.331")
Warp	max. 0.15 mm (0.006")
Brake linings:	
Number per wheel	2
Thickness, new	10 mm (0.394")
Effective area	105 cm² (16.3 sq.in.)
Wheel unit cylinders:	
Number per wheel	2
Area per wheel	22.66 cm² (3.51 sq.in.)

MASTER CYLINDER

Nominal diameter	22.2 mm (7/8")
Bore	Max. 22.40 mm (0.882")
Piston diameter	Min. 22.05 mm (0.868")

BRAKE LINE

Outer diameter	3/16"

BRAKE VALVE

Make	Ate
Operating pressure	34±2 kp/cm² (484±28 psi)

POWER CYLINDER

Make	Ate
Designation	Bremsgerät T 51

VACUUM PUMP

Designation	Pierburg PE 15634
Test values:	
At engine speed 67 r/s (4000 rpm)	
The pump should give an underpressur of	Min. 70 kPa (0.7 kp/cm²=10 psi)

PARKING BRAKE

Brake drum:	
Diameter	Max. 178.33 mm (7.0")
Radial throw	Max. 0.15 mm (0.006")
Out-of-round	Max. 0.2 mm (0.008")
Brake linings, effective area	175 cm² (27 sq.in.)

TIGHTENING TORQUES

	Nm	Lb.ft.
Attaching bolts, front brake caliper	90–100	65–70
Attaching bolts, rear brake caliper	60–70	45–50
Wheel nuts	100–140	70–100
Stop screw, master culinder	5–8	3.6–5.8
Attaching nuts, master cylinder	12–15	9–11
Bleeder nipples	2–3.5	1.2–2.5
Brake hoses	16–20	12–15
Warning valve, switch	14–20	10–15
Brake pipes	11–15	8–11

FRONT END AND STEERING GEAR

WHEEL ALIGNMENT (UNLOADED VEHICLE)

Caster	+1.5 to +2.5°
Camber	0 to +0.5°
King pin inclination at a camber of 0°	7.5°
Toe-in	2 to 5 mm (0.08 to 0.20")
Turning angles: at a 20° turn of the outer wheel the inner wheel should be turned 21.5° to 23.5°.	
Shims, thickness	0.15 mm (0.006") 0.50 mm (0.020") 1.0 mm (0.039") 3.0 mm (0.118") 6.0 mm (0.236")

POWER STEERING

Steering wheel diameter	423 mm (16.6")
Number of turns from stop to stop in vehicle	3.7
Steering gear:	
Make and type	ZF, ball-nut
Reduction ratio	15.7:1
Bearings for steering spindle:	
Needle diameter, part numbers 681358	1.992–1.994 mm (0.0784–0.0785")
681357	1.994–1.996 mm (0.0785–0.0786")
681356	1.996–1.998 mm (0.0786–0.0787")
681355	1.998–2.000 mm (0.0787–0.0790")
Bearing sleeve, ext. diameter, alt.	28.0 and 28.15 mm (1.102–1.108")
Washer for axial bearings, thickness, alt.	1.9–2.4 mm (0.075–0.095") in steps of 0.1 mm (0.004")
Gasket at worm, thickness, alt.	1.7 and 1.8 mm (0.067–0.071")
Balls, piston–worm, number	23
diameter, alt.	6.989 mm (0.2752") 6.996 mm (0.2754") 7.000 mm (0.2756") 7.008 mm (0.2760") 7.012 mm (0.2761")
Washer for adjuster screw, thickness, alt.	2.15–2.45 mm (0.085–0.096") th.diff. 0.05 mm (0.002")
Power pump:	
Make and type	Zf, vane pump
Max. pressure	75±5 kp/cm² (1066±71 psi)
Theoretical capacity at 8.3 r/s (500 r/m)	6.65 liters/m (7 US Qts.)
Min. capacity, 8.3 r/s (500 r/m) 50 kp/cm² (711 psi), 80°C (176°F)	4.5 liters/m (4.7 US Qts.)
Regulated capacity	5–8 liters/m (5.3–8.4 US Qts.)
Drive	Belt
Ratio, engine–pump	1:1
Oil type	Oil approved as "Automatic Transmission Fluid, Type A, F or Dexron"
Oil changing quantity	Approx. 1.2 liters (1.3 US Qts.)

TIGHTENING TORQUES

	Nm	Lb.ft.
Attaching bolt for upper control arm shaft	55–70	40–50
Nut for steering wheel	30–40	20–30
Nuts, engine mountings	210–250	15–20
Nuts, steering knuckle	70	50
Bolts, upper control arm bushes	40–50	30–35
Nuts, lower control arm shaft	55–70	40–50
Nut, upper ball joint	85–100	60–70
Nut, lower ball joint	100–120	70–90
Steering wheel nut	28–40	20–30
Bolt, flange steering gear	35–40	25–30
Mechanical steering gear:		
Bolt, upper cover	17–21	12–15
Power steering gear:		
Bolt, valve housing	34	25
Bolt, upper cover	31	22
Nut, adjuster screw	25	18
Nut, pitman arm	170–200	125–145
Attaching nut, steering gear and idler arm bracket	35–40	255–305
Lock nut, tie-rod	75–90	55–65
Nut, ball joint in steering rod and tie-rod	48–62	35–45
Wheel stud nut	100–140	70–100
Nut for pitman arm	175–200	125–145
Lock nut for tie rod	75–90	55–65

SUSPENSION, WHEELS

SPRINGS

FRONT

Type	Coil springs
Wire diameter	16.7 mm=.657″
Outer diameter	126.7 mm=4.99″
Springing coils	8.4
Test datas:	
Loading for a compression of 10 mm (25/64″)	898 N=201 lb
Length, fully compressed	135.3 mm=5.33″
Load	7239–7730 N=740–790 kp =1628–1738 lb
at spring length	202.4 mm=7.968″

REAR

Type	Coil springs
Wire diameter	12,7 mm=0.50″
Outer diameter	129.4 mm=5.09″
Springing coils	8
Test datas:	
Loading for a compression of 10 mm (25/64″)	203 N=45.5 lbs
Length, fully compressed	120 mm=4.72″
Load	2380–2520 N=535–565 lbs
at spring length	285 mm=11.2″

SHOCK ABSORBERS

Type	Double-acting, hydraulic, telescopic
Total length:	
front shock absorbers, compressed	approx. 223 mm (8.78″)
unloaded	approx. 340 mm (13.39″)
rear shock absorbers, compressed	approx. 279 mm (10.98″)
unloaded	approx. 443 mm (17.44″)

WHEELS

WHEEL RIMS

Designations	5.5 J×15 L
Type	Disc
Wheel offset	25 mm (1")
Radial throw	max. 1.6 mm (0.063")
Warp	max. 1.6 mm (0.063")
Imbalance, complete wheel	0.09 Nm (7.8 lb.in.)
Tightening torque for wheel nuts	100–140 Nm (72–101 lb.ft.)

TYRES

Type	Tubeless
Size	165 HR 15, 175 SR 15, 175 HR 15

AIR CONDITIONING SYSTEM

Refrigerant, type	Freon 12 (dichlorodifluoromethane)
Compressor, type	York A 209
number of cylinders	2
max. speed	100 r/s (6000 r/m)
lubricating oil capacity	0.3 liter (0.32 Qt.)
lubricating oil, type	Refrigerant compressor oil e.g.: SUNISO 5, BP ENERGOL LPT 100, SHELL CLAVUS 33, TEXACO CAPPELLA E 500
Compressor clutch, type	Electro-magnetic
Compressor belt size	HC 50×1475
System pressure at approx. 30°C (86°F)*	
low-pressure side	1–3 kp/cm² (14–40 psi)
high-pressure side	10–15 kp/cm² (140–220 psi)

TIGHTENING TORQUES	Nm	Lb.ft.
Unions, expansion valve equalizing tube	20	15
expansion valve	50	35
expansion valve hose	42	30
evaporator hose	42	30
condenser	42	30
compressor	42	30
receiver dryer	30	22
Compressor, top cover	20–30	15–22
bottom cover	20–30	15–22
rear bearing housing	20	15
connecting rod bolts	20	15
oil plug	5	4
Compressor clutch centre bolt	25–30	18–22

* These figures are valid only if the car is driven, or a suitable fan is used to force cooling air through the condenser and the radiator (equal to driving conditions).

Section 1

SERVICING AND MAINTENANCE

CONTENTS

LUBRICATION

OIL LEVEL CHECKS AND OIL CHANGES

ENGINE

The oil level is checked with the dipstick, see Fig. 1-1. Oil and oil filter cartridge are first time replaced at the 1 500 mile inspection. Subsequent oil changes are made with 7 500 mile intervals or **at least twice a year.** However, under adverse conditions, like hot ambient temperatures, trailer pulling, hill climbing, driving long distances at high speeds, extended periods of idling or low speed operation, short trip operation at freezing temperatures require oil changes more frequently (every three months). The oil should be drained off immediately after the car has been driven and while the engine is still warm. For this, use the oil drain plug, see Fig. 1-2. When all the oil has run out, check the washer and screw the plug tightly into position again. Oil is added through the valve cover after removing the filler cap. Oil with grade designation API "For Service SD, SE and CC" is used for the engine. The previous designation "For Service MS" can also be used. Concerning viscosity, select a multigrade oil according to the following table:

Temperature range	Viscosity
SUMMER (above −12°C=+10°F)	20 W - 40 or 20 W - 50
WINTER (below −12°C=+10°S)	10 W - 30

At very low temperature (below −18°C=0°F) or when cold-starting difficulties are anticipated, multi-grade oil SAE 5 W - 20 is recommended. This oil should not be used when the temperature is continuously above 0°C (32°F). The quantity of oil changed is 5.2 liters (5.5 US Qts). The corresponding quantity when the oil filter is included is 6.0 liters (6.3 US Qts).

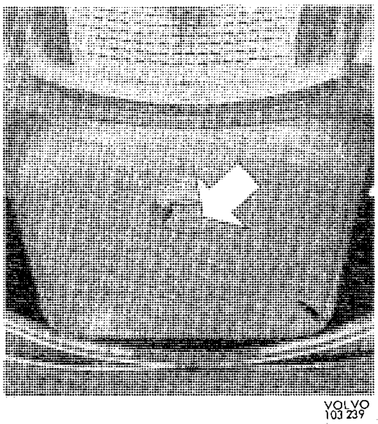


Fig. 1-2. Drain plug on sump

MECHANICAL TRANSMISSION (WITH OVERDRIVE)

To check the oil level, remove the filler plug (1, Fig. 1-3) and then check to see that the oil reaches up to the hole for the plug.

In the case of a new or reconditioned transmission, the oil should be changed after the first 1 500 miles. The oil should subsequently be changed after every 30 000 miles.

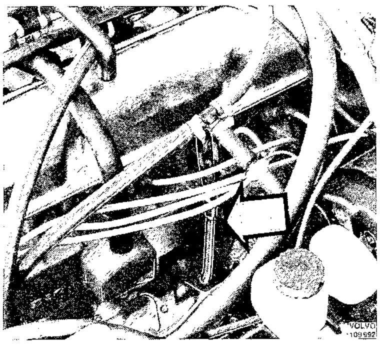


Fig. 1-1. Oil dipstick

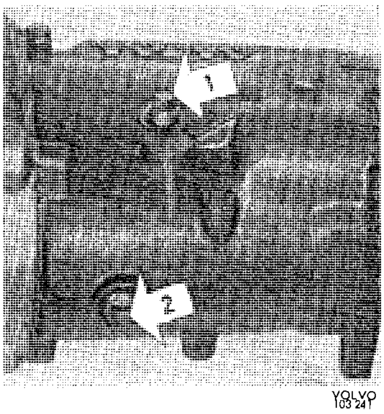


Fig. 1-3. Gearbox
1. Filler plug 2. Drain plug

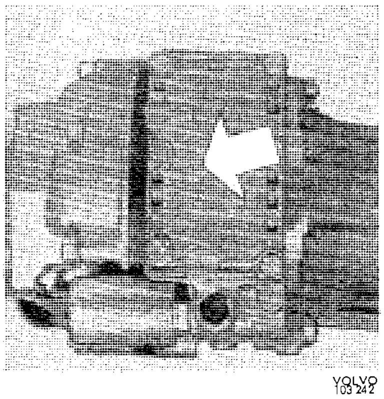


Fig. 1-4. Overdrive

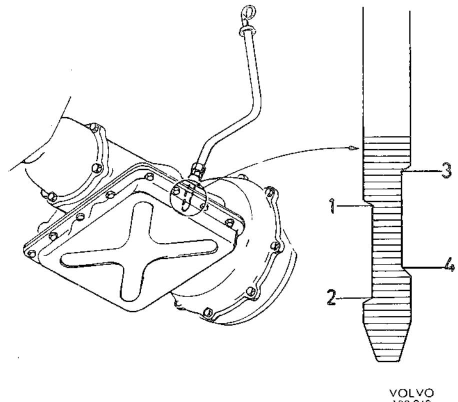


Fig. 1-5. Checking the oil level
1. Max. oil level, cold transmission
2. Min. oil level, cold transmission
3. Max. oil level, warm transmission
4. Min. oil level, warm transmission

The oil should be drained off immediately after the car has been driven and while the oil is still warm. To do this remove the plugs marked 1 and 2 in Fig. 1-3 as well as the cover for the oil strainer, see Fig. 1-4. Also clean the oil strainer as indicated in group 43 B.
Re-fit the drain plugs and bolt on the cover securely. Fill with new oil. Fill slowly to enable the oil to run over into the overdrive. The oil should reach up to the filler hole (1, Fig. 1-3). Screw tight the filler plug. For a gearbox with overdrive, engine oil with viscosity SAE 30 is used all the year round. As an alternative, multigrade oil SAE 20 W-40 can be used. The oil changing quantity is 1.4 liters (1.5 US Qts).

AUTOMATIC TRANSMISSION

Normally oil changing only needs to be carried out when the transmission is reconditioned. The oil level, on the other hand, should be checked after every 7 500 miles.
The vehicle should stand level. Move the selector lever to position "P" and let the engine run at idling speed. Wipe off the dipstick with a nylon cloth, paper, etc. Do not use waste or fluffy rags. Insert the dipstick, pull it up and check the oil level. See Fig. 1-5. **NOTE. There are different levels for a warm or cold transmission.** For a warm transmission, which is the case after driving 5—7 miles, the upper section applies (3 and 4, fig. 1-5). The lower section (1 and 2, Fig. 1-5) applies to a transmission. The text on the dipstick will also remind you of this.
If necessary, fill up with oil until the level reaches the "Max" mark. Do not fill above this mark, as this can cause the transmission to become overheated. The difference between the "Min and Max" marks is about 0.5 liter (0.5 Qt.). For topping-up, use Automatic Transmission Fluid, Type F, that is, a fluid meeting Ford specification H2C 33F.
Frequent filling up of the transmission indicates leakage which must be put right immediately.

FINAL DRIVE

To check the oil level, remove the filler plug (1, ig. 1-6) and then check to ensure that the oil reahces up to the hole for the plug.
With a new or reconditioned final drive, the oil should be changed after the first 1 500 miles. Oil changing should therefore be carried out only when overhauling is being done.

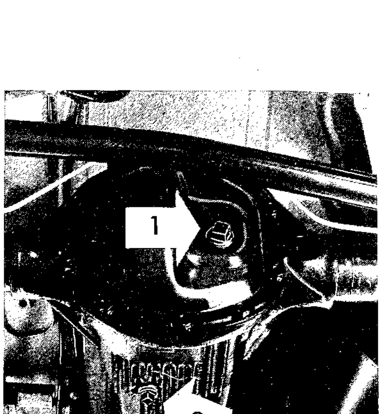


Fig. 1-6. Final drive
1. Filler plug 2. Drain plug

The oil should preferably be changed immediately after the vehicle has been driven and while the oil is still warm. When draining the oil, remove the plugs marked 1 and 2 in Fig. 1-6.

Clean the magnetic plug (2) well. It is of great importance for the lifetime o the final drive that particles and other impurities accumulated during the running-in are removed.

After the drain plug or cover has been re-sitted, fill with new oil. The oil should reach up to the filler hole and the oil capacity is about 1.6 liters (1.7 US Qts.). For changing the oil in the final drive oil which meets the requirements API-GL-5 (MIL-L-2105 B), SAE 90, is used.

A final drive fitted with a limited slip differential is filled at the factory with a transmission oil which meets the requirements API-GL-5 (MIL-L-2105 B) provided with an additive for final drives with limited slip differential. For subsequent topping-up and when changing, oil is according API-GL-5 (MIL-L-2105 B) having the above-mentioned additive. The oil level should be checked and the oil changed at the same intervals and in the same way as for a final drive without a limited slip.

POWER STEERING

CHECK OIL LEVEL

The oil level should be check every 7 500 miles. First check the level with the engine standing to check possible oil loss. The oil level should then lie about 5–10 mm (5/8") above the level mark. If the level is lower than this, fill with oil with the engine standing to eliminate the risk of air being sucked in. Start the engine and re-check the oil level, which should now have fallen to the level mark, see Fig. 1-7. When the engine has stopped, the level should rise to about 5–10 mm (5/8") above the mark.

Use Automatic Transmission Fluid (type A, F or Dexron).

OIL CHANGING

Normally the oil should be changed in connection with replacement of the power steering components, see Part 6 of this Service Manual. On this occasion, the filter in the oil container should also be changed.

CHECKING BRAKE FLUID LEVEL

This check can be made without taking off the cap. (See Fig. 1-8.) If the check is carried out in connection with a visit to a workshop, the level should be attended to if it is lower than the "Max" mark. Under no circumstances may the level be below the "Min" mark.

If necessary, top up with first-class brake luid which meets the requirements according to DOT 3 or DOT 4. Brake fluid with designation SAE J 1703 can also be used. Clean the brake fluid container cap before removal and observe maximum cleanliness when filling with oil. Avoid spilling brake fluid on to the paintwork since this will damage it. Check to make sure that the vent-hole in the cap is not blocked.

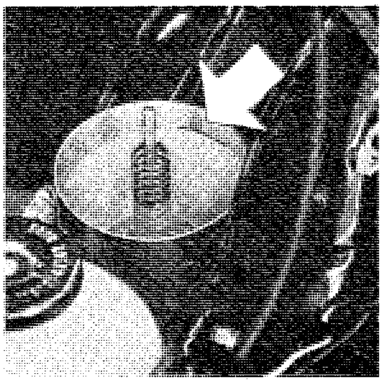


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Fig. 1-7. Oil level

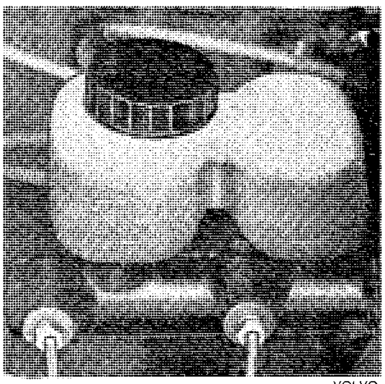

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Fig. 1-8. Brake fluid container

INSTRUCTIONS FOR LUBRICATING

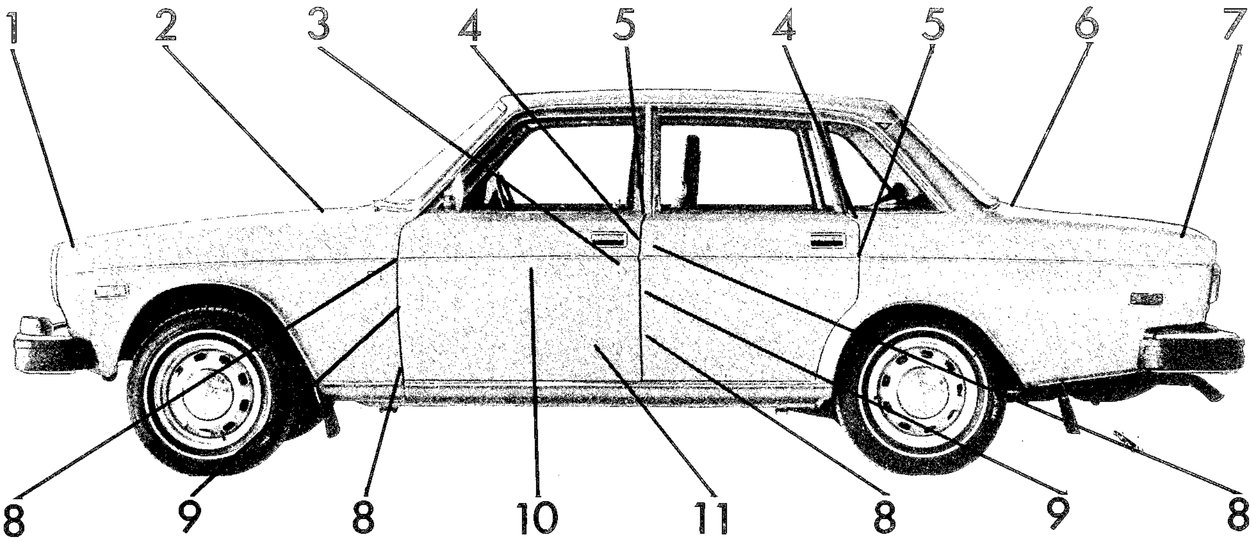


Fig. 1-9. Lubricating points on body

No.	Lubricating point	Lubricant
1	Hood catch	Paraffin wax
2	Hood hinges	Oil
3	Key holes	Lock oil
4	Striker plate	See Fig. 1-11
5	Outer sliding surface of door lock	Paraffin wax
6	Trunk lid hinges	Oil
7	Trunk lid lock	Oil
	Trunk key hole	Lock oil
8	Door hinges	Grease
9	Door stops	Paraffin wax
10	Window winders	Oil and grease
	Locks	Silicon grease
	(Accessible after door upholstery panels have been removed.)	
11	Front seat runners and catches	Parafin wax and oil

BODY

To avoid squeaking and unnecessary wear, the body should be lubricated as described. Nos. 2, 6, 8 and 9 of the lubricating scheme should be lubricated approx. every 7 500 miles and other parts of the body about once a year. Moreover, during winter the door and luggage compartment lid locks should be lubricated with a suitable lock oil which would prevent them from freezing up.

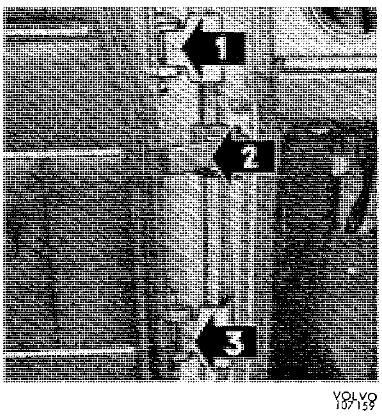


Fig. 1-10. Hinges
1. Hinges, grease
2. Door stop, paraffin wax
3. Hinges, grease

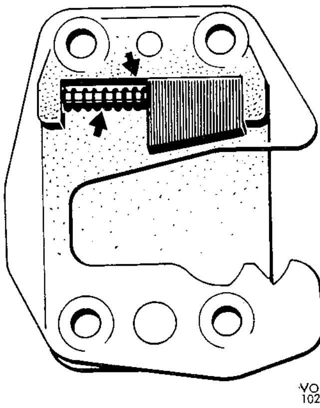


Fig. 1-11. Striker plate
Inner sliding surfaces, spring and pin are lubricated with molybdenum disulphide grease

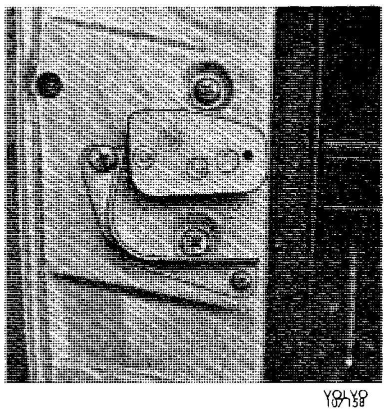


Fig. 1-12. Door lock with guide plate
Apply paraffin wax

CHECKS WHEN FILLING TANK

The following should be carried out when filling the tank

1. Check to make sure that the oil level in the engine is between the "Max" and "Min" marks on the dipstick (see Fig. 1-13).
2. Without removing the cap, check that the level in the brake fluid container is above the "Min" mark (see Fig. 1-14).
3. Check that the coolant level is between the "Max" and "Min" marks on the expansion tank (see Fig. 1-15).
4. Check that the fluid container for the windscreen washer is filled (see Fig. 1-16).

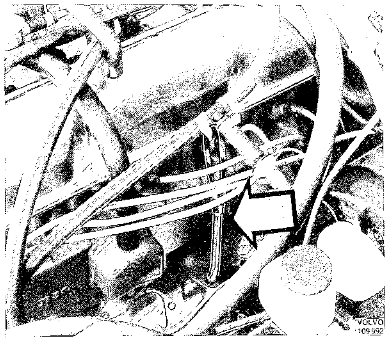


Fig. 1-13. Oil dipstick

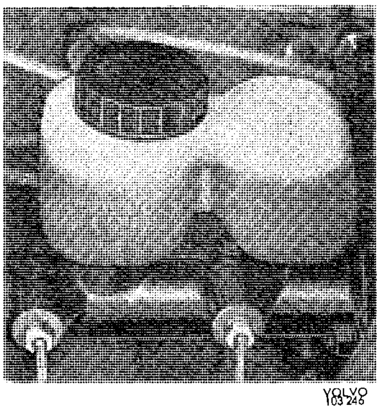


Fig. 1-14. Brake fluid container

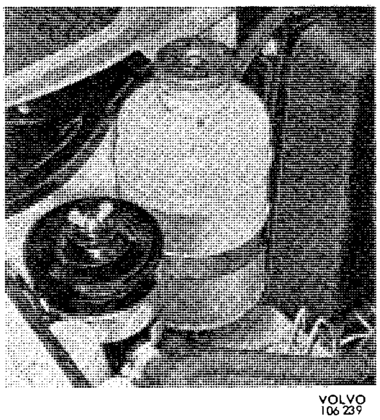


Fig. 1-15. Expansion tank

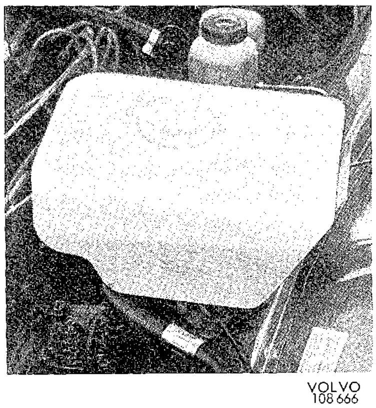


Fig. 1-16. Windshield fluid container

The following should be carried out every other week

1. Check that the electrolyte level in the battery is about 5 mm (3/16") above the plate (Fig. 1-17). If necessary fill with **distilled** water. Also check that the battery and battery terminals are secure.
2. Check to make sure that the pressure in the tyres correspond to the following values:

Tire size	Recommended tire infl. pressure cold tires, psi (kp/cm²)				Max. permitt. inflation pressure psi (kp/cm²)
	1–3 persons		Full load		
	Front	Rear	Front	Rear	
175 R 15	25 (1.7)	26 (1.8)	26 (1.8)	30 (2.1)	36 (2.5)

For driving at speeds above 75 mph for one hour or more, inflation pressure must be increased 4 psi (0.3 kp/cm²).

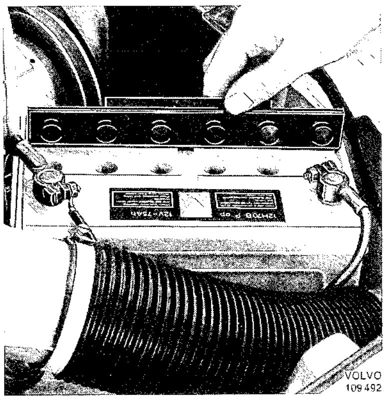


Fig. 1-17. Battery

INSTRUCTIONS FOR LUBRICATING CHART

SYMBOLS

Engine oil
Grade: "For API Service SE
Viscosity: See page 1·1

Final drive oil
Grade: API-GL-5 (MIL-L-2105 B)
Viscosity SAE 90
below −10°C (14°F) SAE 80
Concerning lubricant for final drive with limited slip differential, see page 1 : 3

lubricant, see respective note.

light engine oil

Brake fluid
Grade: DOT 3 or DOT 4

OIL CHANGING QUANTITIES

Engine, oil changing quantity	approx. 5.2 liters (5.5 US QTS.)
including oil filter	approx. 6.0 liters (6.3 US Qts.)
Mechanical transmission with overdrive	approx. 1.4 liters (1.5 US QTS.)
Automatic transmission	approx. 8.2 liters (8.6 US Qts.)
Final drive	approx. 1.6 liters (1.7 US Qts.)
Power steering	approx. 1.2 liters (1.3 US Qts.)

OTHER LUBRICATING POINTS

In addition to the points indicated in the lubricating chart, the chassis should be greased about once a year at all the joints for the throttle control linkage, parking brake, pedal linkages etc. Certain checks should also be carried out when filling the tank, see page 1 : 5.

Note 1. In connection with such workshop operations involving uncovering the wheel bearings, the bearings should be removed, cleaned, and then lubricated with high class durable grease according to the instructions in Groups 46 and 77 respectively. Subsequent filling or replacement of grease in addition to the above should not take place.

Note 2. Check the oil level. See page 1 : 3.

Note 3. Check the brake fluid level and, for vehicles with right-hand steering, also the clutch fluid level. See page 1 : 3.

Note 4. Every 7 500 miles check that the oil reaches up to the filler plug. After every 30 000 miles the oil should be changed (mechanical transmission). N.B. The grade of oil to be used depends on the type of gearbox, see pages 1 : 1 and 1 : 2. Lubricate the felt wick under the rotor.

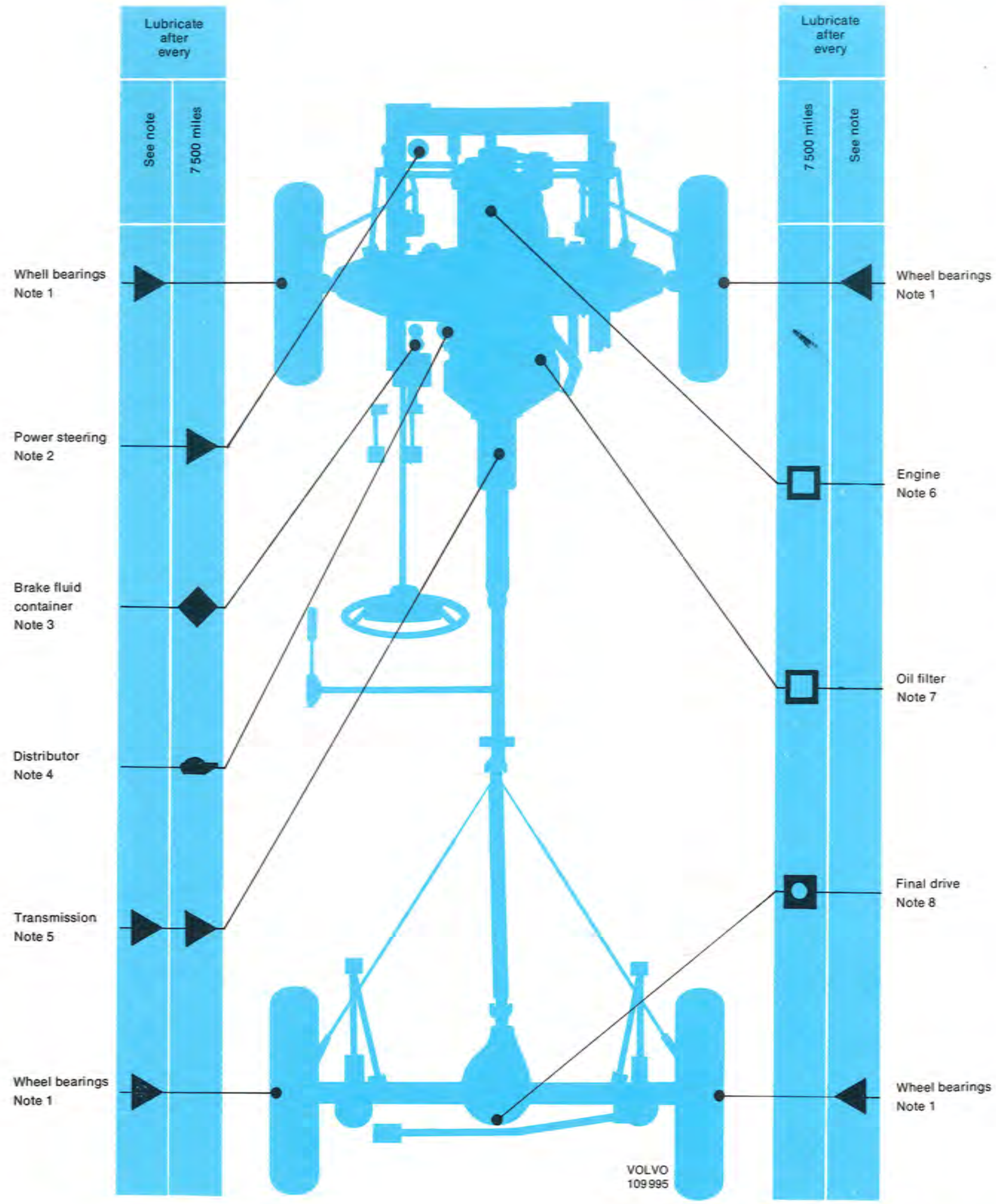
Note 5. Check every 7 500 miles that the oil reaches up to the filler plug. Concerning oil change, see page 1−2.
OBSERVE. The type of transmission will decide the type of lubricant to be used.

Note 6. Check the oil level when filling the tank. Change the oil according to the instructions on page 1 : 1.

Note 7. Change the oil filter completely according to the instructions in Section 2.

Note 8. Every 7 500 miles check that the oil reaches up to the filler plug.

LUBRICATING CHART 164



Section 2

ENGINE

CONTENTS

TOOLS

The numbers for the special tools are preceded by 999 or SVO
(e.g. 9992837 or SVO 2837)

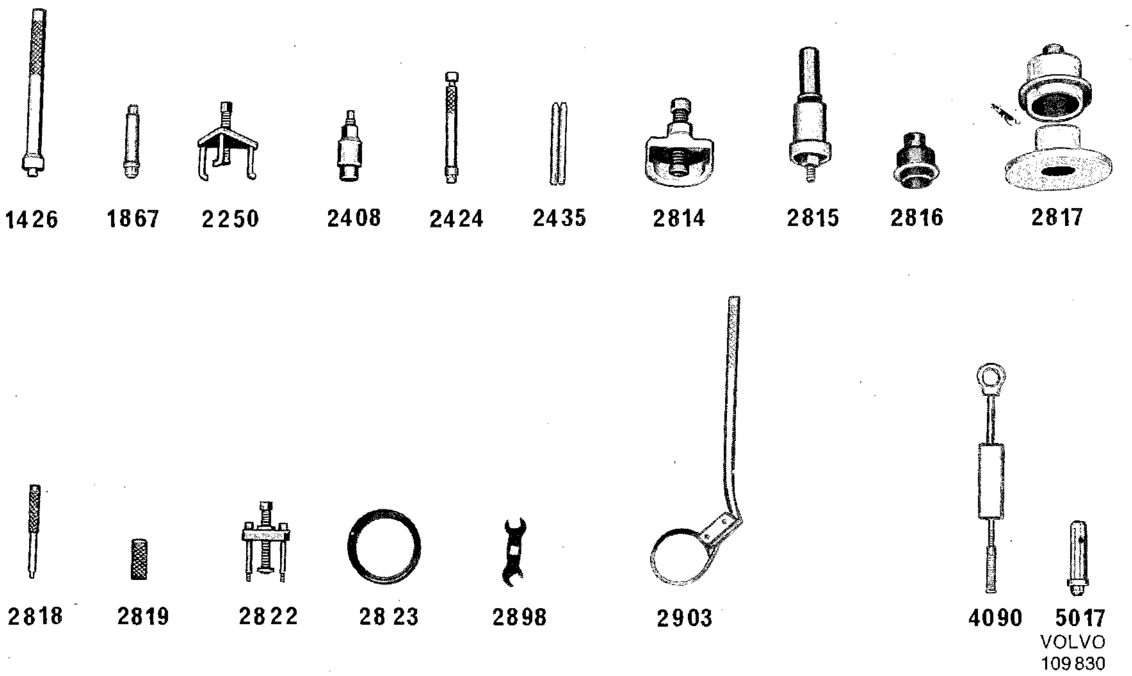


Fig. 2-1. Tools for engine

999 (SVO)

1426	Drift for installing pilot bearing in flywheel (crankshaft)
1867	Drift for removing and fitting bushing in rocker arm
2250	Puller for camshaft gear
2408	Press tool for installing camshaft gear
2424	Grip tool for removing and installing valve tappets
2435	Guide pins (2) for installing cylinder head
2814	Puller for polygon hub
2815	Press tool for installing crankshaft drive and polygon hub
2816	Drift for installing crankshaft oil seal on engine front end
2817	Drift for installing crankshaft oil seal on engine rear end
2818	Drift for removing valve guide
2819	Drift for installing valve guide
2822	Puller for crankshaft drive
2823	Ring for installing standard piston
2898	Spanner for re-tightening cylinder head bolts
2903	Spanner for removing oil cleaner
4090	Puller for crankshaft pilot bearing
5017	Drift for removing and connecting rod bushing

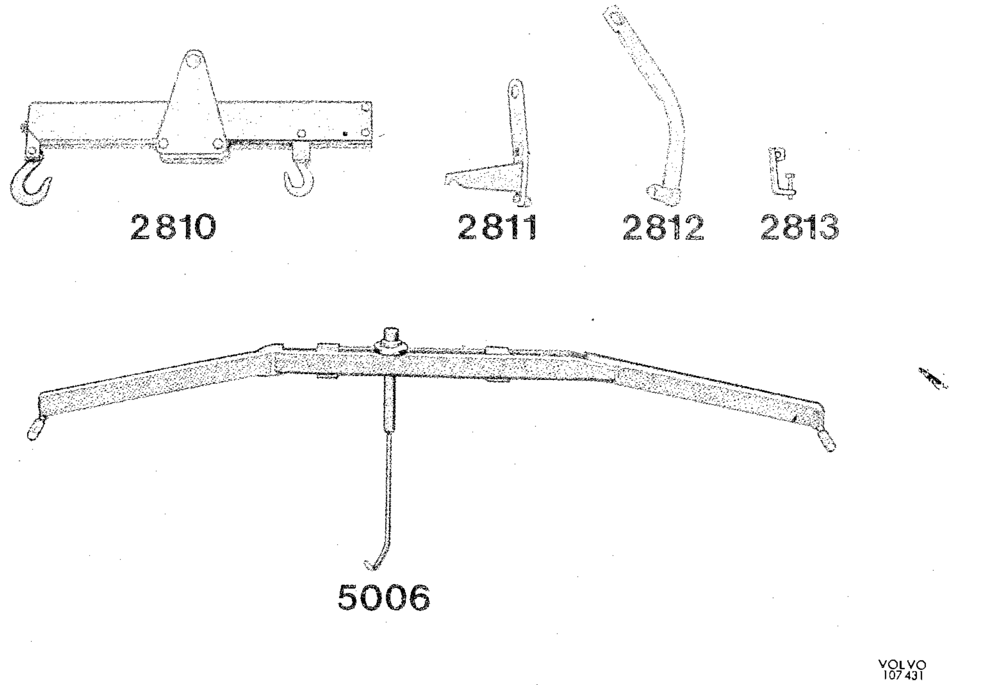


Fig. 2-2. Tools for removing engine

999 (SVO)
- 2810 Beam for lifting out and installing engine. Used together with tools SVO 2811 and SVO 2812.
- 2811 Lifting lug for attaching lifting beam 2810 or 2727 in engine front end
- 2812 Lifting arm for attaching lifting beam 2810 in rear end of engine

999 (SVO)
- 2813 Support for lifting arm SVO 2811 for lifting engine with cylinder head removed
- 5006 Tool for lifting engine front or rear end to remove oil sump and gearbox resp.

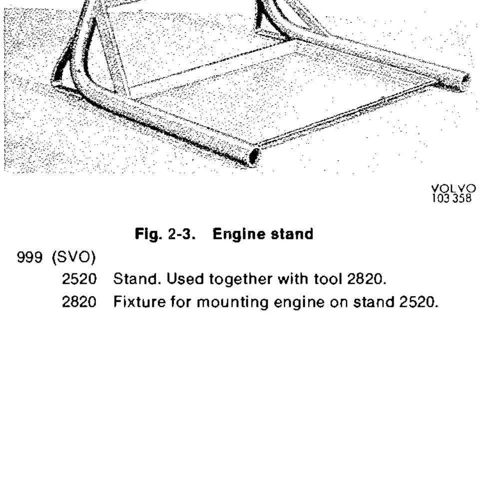


Fig. 2-3. Engine stand

999 (SVO)
- 2520 Stand. Used together with tool 2820.
- 2820 Fixture for mounting engine on stand 2520.

GENERAL

GENERAL INFORMATION

The B 30 engine (Figs. 2-4 and 2-5) is an in-line six-cylinder, water-cooled overhead-valve unit. The seven-bearing crankshaft has a flywheel damper mounted on its front end. The engine is also fitted with an air preheater and has positive crankcase ventilation. The fan is of the slip-coupling type.

The B 30 F is equipped with an electronic fuel injection system.

The output figures for the engines are given in Fig. 2-6.

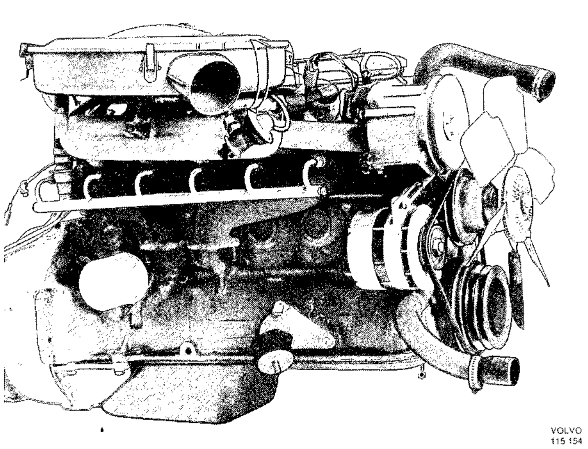


Fig. 2-4. Engine viewed from left

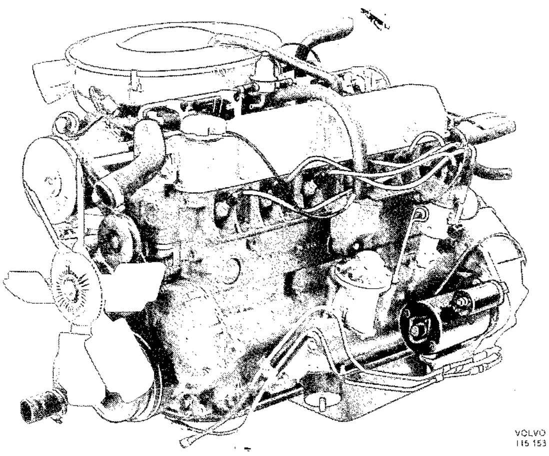


Fig. 2-5. Engine viewed from right

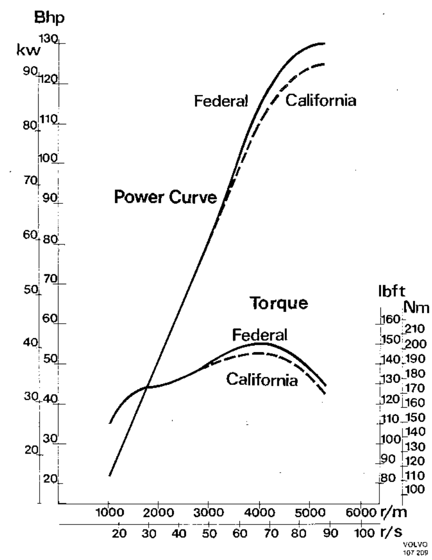


Fig. 2-6. Output and torque curves

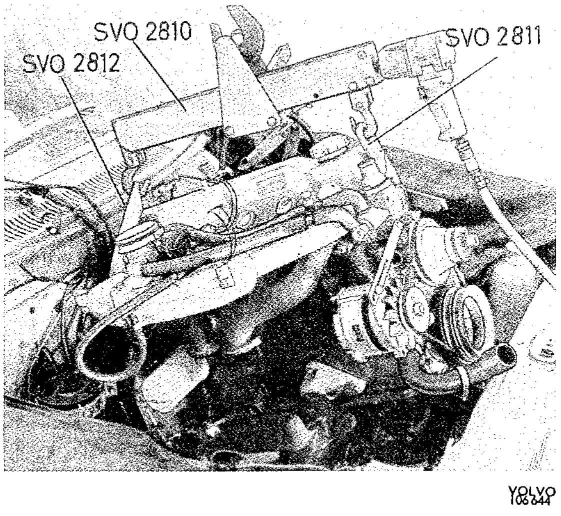


Fig. 2-7. Lifting engine

REMOVING ENGINE

1. On vehicle with manual transmission: Remove the gear shift lever.
2. Remove the hood and then the battery. Empty the coolant.
3. Remove the air cleaner.
4. Remove the contacts for the following: Cold start valve, throttle switch, temperature sensor for coolant and injectors.
   Disconnect the cable loom from its attachment to the distribution pipe and place it on the cowl.
5. Remove the electric cables from the oil pressure and temperature sensors.
6. Remove the following from the inlet duct: Pressure sensor hose, vacuum hose for ignition distributor, hose for power brake and crankcase ventilation hose which comes from the oil trap.
7. Remove the throttle cable from the control arm and the bracket on the inlet duct. (On vehicles with automatic transmission also the throttle cable.)
8. Remove the electric cables from the alternator.
9. Remove the electric cables from the ignition coil and remove the coil.
10. Remove the contact from the impulse contact on the ignition distributor and the electric cables from the starter motor.
11. Disconnect the battery lead from the clamp and place it on the battery shelf.
12. On vehicles with automatic transmission: Divide the cable loom for the start inhibitor contact in the joining piece at the left side member.
13. Remove the vacuum hose from the ignition distributor.
14. Remove the hoses for the fuel pipes in the joint on the left side member.
15. Remove the brackets for the fuel pipes from the left engine attachment and the cylinder head.
16. Remove the hose for the cold start valve from the distribution pipe.
17. Remove the injectors with distribution pipe and fuel hoses. Fit masking caps and protection plugs.
18. Remove the hoses for the heater element from the engine.
19. With automatic transmission: Remove the attaching bolts for the clamp on the transmission oil filling pipe.
20. Remove the water return pipe and place it down against the oil filter.
21. With automatic transmission: Divide the oil cooling hoses for the transmission in the joint under the pulley.
22. Remove the radiator hoses from the radiator.
23. Remove the radiator, fan shroud and fan.
24. Lift out the water return pipe.
25. Remove the power pump for the steering gear and place it on the wheel housing.
26. Fit lifting lug 2811 to the front end of the engine and arm 2812 to the rear of the engine.
    Prop up under the vehicle.
27. Remove the nuts for the front engine mountings, also the nut for the front exhaust pipe flange.
28. Place lifting beam 2810 in an engine hoist and place the beam eyelets in the lifting lugs. Adjust the block and tackle to its rear position and hoist to off-load the engine.
29. Remove, from underneath the vehicle, the nuts for the exhaust pipe flange, also the clamp at the gearbox.
30. Remove the ground lead from the engine. With manual transmission: Remove the electric cables from the transmission and overdrive. With automatic transmission: Remove the ground lead from the start inhibitor contact.
31. Remove the member and the rear engine attachment. Remove the propeller shaft from the gearbox.
32. Remove the speedometer cable from the transmission. With manual transmission: Remove the clutch wire pin from the lever and the clutch wire sleeve from the clutch casing.
    With automatic transmission: Remove the control rod from the lever for the selector lever.
33. Raise the engine by means of the hoist, adjust the block and tackle and lift out the engine.

INSTALLING ENGINE

1. Fit lifting lug 2811 to the front of the engine and lifting lug 2812 to the rear end of the engine. Fit lifting beam 2810 and hoist the engine into position by means of the engine hoist.
2. Adjust the block and tackle to the rear position. Raise the hoist until the clutch casing touches the tunnel.
3. Vehicle with manual transmission: Fit the clutch wire sleeve and connect the wire to the lever. Vehicle with automatic transmission: Fit the control rod to the lever for the gear selector lever. Connect the speedometer hose. Fit the propeller shaft.
4. Fit the rear engine mounting loose to the transmission Place the other bolts in position and tighten the member to the body.
5. Remove the engine hoist. Fit the exhaust pipe to the manifold and the exhaust pipe clamp to the gearbox. Secure the rear engine mounting.
6. Connect the ground lead between engine and body: With manual transmission: Connect the electric cables to the transmission and overdrive. With automatic transmission: Connect the ground cable to the start inhibitor contact.
7. Fit the nuts for the front engine mounting blocks.
8. Lower the vehicle and remove the lifting lugs.
9. Fit the power pump.
10. With automatic transmission: Fit the clamp for the oil filling pipe to the transmission.
11. Fit the water return pipe and connect the hoses to engine and pipe.
12. Fit the fan, radiator and fan shroud. Connect the radiator hoses. With automatic transmission: Connect pipes and hoses to the oil cooler.
13. Place the injectors in position and fit them with the distribution pipe and fuel hoses.
14. Fit the brackets for the fuel pipes on the cylinder head and engine mounting and connect the fuel pipes together in the joint at the left side member.
15. Connect the vacuum hose for the ignition distributor.
16. With automatic transmission: Connect the cable loom to the start inhibitor contact.
17. Fit the clamp for the battery lead to the starter motor. Connect the electric cables to the starter motor and for the triggering contact on the ignition distributor.
18. Fit the ignition coil and connect the electric cables for it. Connect the alternator cables.
19. Fit the accelerator cable and for vehicles with automatic transmission also the throttle cable.
20. Connect the hoses for the oil trap, power brake cylinder, ignition distributor and pressure sensor to the inlet duct.
21. Connect the electric cables to the temperature and oil pressure sensors.
22. Place the cable loom on the brackets for the distribution pipe. Connect the contacts to the injectors, temperature sensor for coolant, throttle valve switch and cold start valve.
23. Fit the air cleaner.
24. Check and fill with oil, also coolant.
25. Fit the battery and hood.
26. With manual transmission: Fit the gear lever.
27. Carry out function and leakage checks.

OIL PAN

Because much time can be spared by being able to remove the oil pan without lifting out the engine when doing certain types of work on the engine, the following working method has been evolved:

REMOVING

1. Place lifting tool 5006 as shown in Fig. 2-8. Hook the lift hook round the alternator tensioning bar, next to the engine block. Raise the front end of the engine to off-load the engine mountings. Remove the oil dipstick.
2. Jack up the vehicle under the front attachments. Drain off the engine oil. Remove the lower nuts for the engine mountings.
3. Place a workshop jack under the front axle member. Remove the rear bolts of the front axle member and fit instead two auxiliary bolts (UNC $^{1}/_{2}$-13×114). Remove the front bolts for the front axle member. Lower and remove the jack so that the front axle member hangs on the auxiliary bolts.
4. Remove the reinforcing bracket (at the flywheel cover). Unscrew the bolts for the oil sump and lift down the sump.
5. Remove the old gasket and clean the contact surfaces of the cylinder block and oil pan.

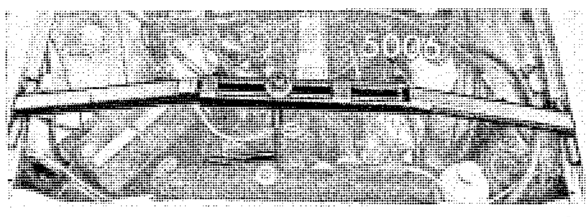


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Fig. 2-8. Lifting tool 5006

INSTALLING

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

ENGINE

GENERAL INFORMATION

CYLINDER BLOCK

The cylinder block is made of special cast iron and is cast in a single unit. The cylinder bores, which are surrounded by cooling jackets, are machined directly in the block. The oilways in the block are arranged so that the oil filter, which is of the full-flow type, is directly attached to the right-hand side of the block.

CYLINDER HEAD AND VALVES

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

The valves which are fitted suspended in the cylinder head, are made of special steel and are carried in replaceable guides. The valve stems are chromed.

The valve collet is provided with three lands and the valve with corresponding grooves, which hold the valve but also make suitable rotation possible. (Compare with Fig. 2-19.)

The valves are provided with valve guide rubber seals, which are mounted on the guides.

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

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

The difference in compression between the various engines is due to the cylinder heads having different heights and the gaskets different thicknesses (see "Specifications").

CRANKSHAFT AND BEARINGS

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

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

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

CAMSHAFT AND VALVE TAPPETS

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

CONNECTING RODS, PISTONS AND PISTON RINGS

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

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

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

FLYWHEEL DAMPER

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

INTAKE AND EXHAUST MANIFOLDS

The inlet duct for the B 30 F engines is of light-alloy and designed for electronic fuel injection.

The exhaust pipes consist of two separate cast iron pipes each of which serves three cylinders.

POSITIVE CRANKCASE VENTILATION

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

Between the oil trap (6, 2-9) and the intake manifold there is a hose (3). It is connected to the intake manfold by means of a calibrated nipple (1). This nipple should be cleaned every 20 000 km (12 000 miles). Between the rocker arm casing and air cleaner there is a hose (2) connected for the fresh-air supply. At the connection to the rocker arm casing there is a flame arrester (4), which consists of a metal filter. The partial vacuum which arises in the intake manifold when the engine is driven, brings about partial vacuum in the crankcase through the hose (3).

Fresh air is supplied to the rocker arm casing through the air cleaner via the hose (2). A plate in the rocker arm casing (see Fig. 2-9) ensures that the fresh air circulates sufficiently in order to mix with the crankcase gases.

As the fresh air supply passes through the carburetor air cleaner, impurities are prevented from getting into the engine. Where there is a high or medium degree of partial vacuum in the crankcase (intake manifold), which happens during idling and when operating under a light load, the system functions as described above. When the partial vacuum in the crankcase is less than that in the air cleaner, which occurs at full load and/or with large flow quantities, no fresh air is supplied. Instead, the flow in the connection between the rocker arm casing and air cleaner reverses and the crankcase gases go both ways, partly through the hose (3) and partly through the air cleaner and carburetor to the intake manifold. In this way, the crankcase ventilation system can deal with relatively large quantities of crankcase gases without any escaping into the atmosphere.

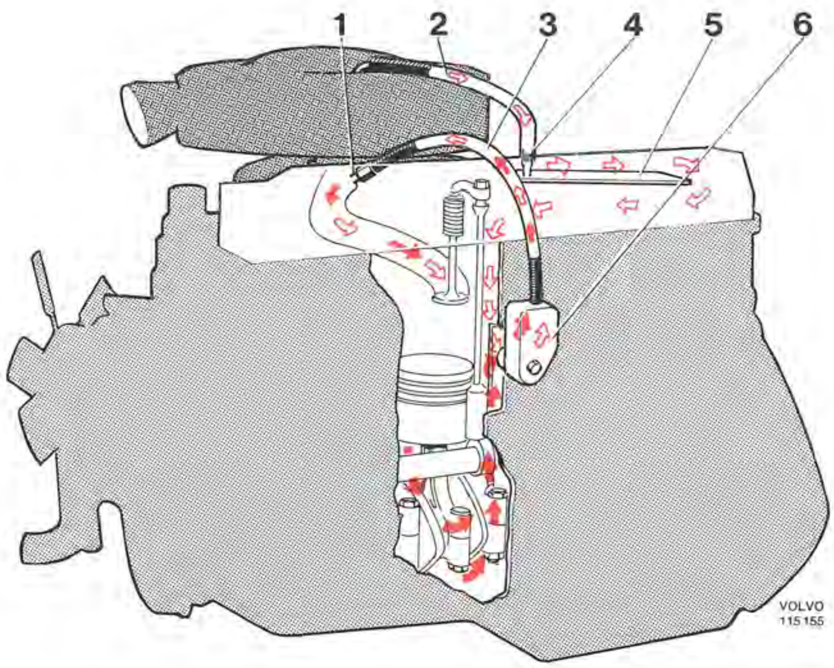


Fig. 2-9. Positive crankcase ventilation

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

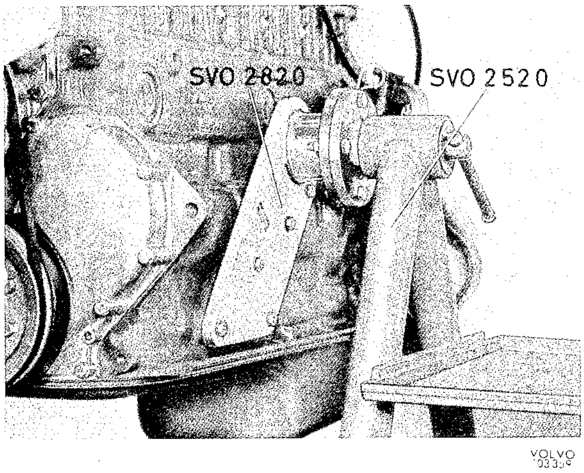


Fig. 2-10. Engine on stand

DISASSEMBLING ENGINE

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

1. Place the engine on stand 2520 with fixture 2820. See Fig. 2-10. Check to make sure the oil has been drained off.
2. Remove the starter motor and reinforcing plate on the lower front edge of the flywheel housing. Remove the flywheel housing together with the gearbox. Then remove the clutch and flywheel.
3. Remove the alternator, water pump, distributor, valve cover, rocker arms and oil filter. Remove the manifolds with carburetors. Take off the cylinder head. Remove the valve tappets with tool 2424, see Fig. 2-11.
4. Remove the timing gear casing and the timing gears. Concerning the tools for this purpose, see under the heading "Replacing timing gears". Remove the camshaft and then the oil nozzle.
5. Decarbonize the top of the cylinders. Remove the oil pan, rear sealing flange, oil pump and connecting rods with pistons. Replace the caps correctly on the respective connecting rods.
6. Invert and turn the engine. Remove the crankshaft. Place the caps correctly in their respective positions.

CLEANING

After disassembling, wash the parts thoroughly. Parts made of steel or cast iron can be washed in a degreasing tank with a caustic soda solution. Light-alloy parts can, however, be damaged by caustic soda so that they should preferably be cleaned with white spirit. Pistons and bearing shells mut never be washed in caustic soda. Rinse the parts with warm water and blow them dry with com-

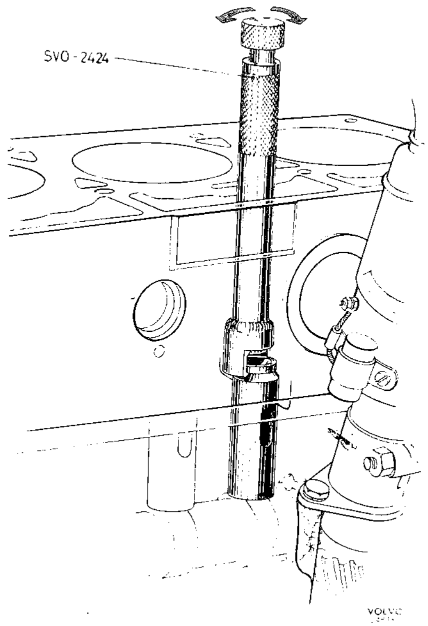


Fig. 2-11. Removing valve tappet

pressed air after washing. Clean the oilways with particular thoroughness. All sealing plugs at the oilway openings in the cylinder block must be removed druing the cleaning process.

ASSEMBLING ENGINE

When assembling the engine, follow the instructions for the components concerned. Check the marking of the bearings according to Fig. 2-12. The main bearings are marked 1-7, and the big-end bearings 1-6, counting from the front.

Check that all parts are clean and lubricate sliding surfaces with oil before assembling. Always use new gaskets, split pins and lock washers. No adhesive should

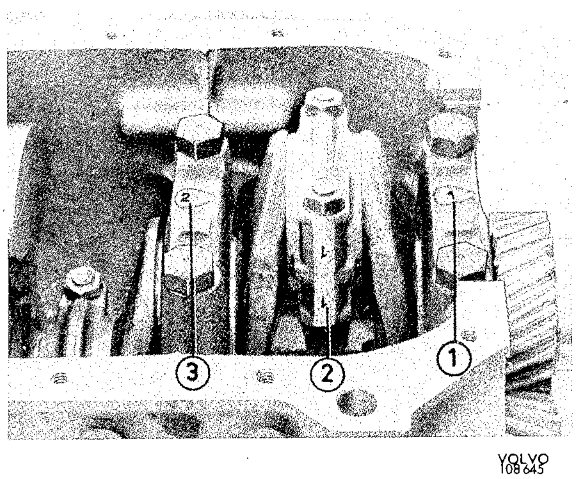


Fig. 2-12. Marking main and big-end bearings
1. Main bearing No. 1 2. Big-end bearing No. 1
3. Main bearing No. 2

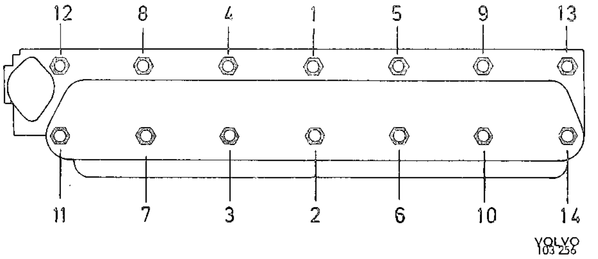


Fig. 2-13. Tigtening sequence for cylinder head bolts
To be tightened in three stages
1st stage: 40 Nm (29 lbft) 2nd stage: 80 Nm (58 lbft)
3rd stage: 90 Nm (65 lbft)

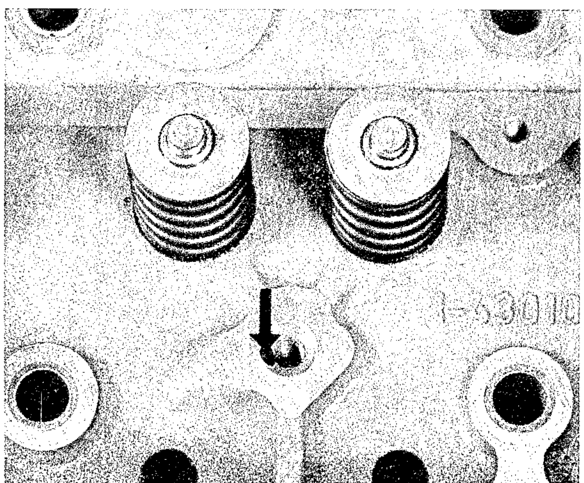
be used on the gaskets. Sealing at the ends of both the oil pump delivery pipe and the water pump pipes is provided by rubber rings. These rings, which seal radially, are made of special rubber with very close tolerances. Only genuine Volvo parts should be used. Fitting is facilitated by coating the rings with soapy water. Slip the rings on the pipes and then press them into their correct positions before finally tightening the attaching screws. The oil pump flange should lie flush against the cylinder block before tightening. Crankshaft seals at the front and rear ends respectively are installed according to the instructions given on page 2 : 15.

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

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

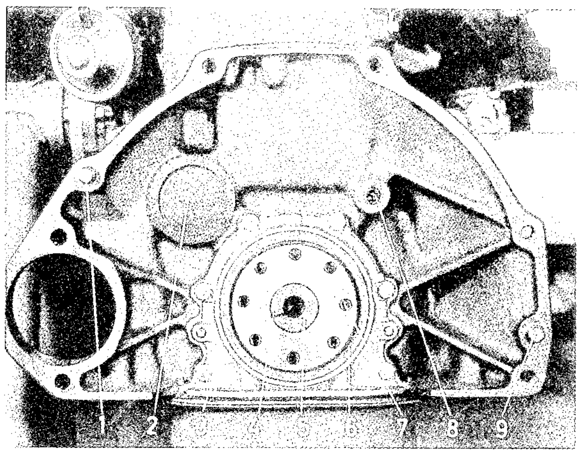
The cylinder head is fitted with the help of dowels 2435. The bolts must be tightened in a certain sequence, see Fig. 2-13, to avoid unnecessary stresses. The bolts should be tightened in two stages and final-tightened after running the engine warm. Check that the oil hole (Fig. 2-14) for lubricating the rocker arms is not blocked.

The pilot bearing (5, Fig. 2-15) should be lubricated before fitting with heat-resistant ball bearing grease. The bearing and protecting washer are held in position by a circlip (4). The most important bolts and nuts should be tightened with a torque wrench, see "Tightening Torques" in the "Specifications".



VOLVO 103364

Fig. 2-14. Oil hole in cylinder head



VOLVO 108725

Fig. 2-15. Rear end of engine

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

VALVE GRINDING AND DECARBONIZING

REMOVING CYLINDER HEAD

1. Remove the lower radiator hose and drain off the coolant.
2. Disconnect the battery lead from the battery and the attachment to the cylinder head.
3. Remove the air cleaner.
4. Remove the following from the inlet duct: Pressure sensor hose, for power brake and crankcase ventilation as well as the vacuum hose for the igniton distributor.
5. Remove the contacts for the throttle valve switch, cold start valve, thermal timer contact, tempeature sensor for coolant and injectors.
   Remove the cable loom.
6. Remove the temperature sensor for the coolant.
7. Remove the throttle cable from the control shaft. Remove the link rod and the control bracket from the inlet duct.
8. Remove the flange bolts for the exhaust manifold.
9. Remove the fuel hoses from the distribution pipe.
10. Remove the upper radiator hose. Remove .the tensioning iron for the alternator from the cylinder head.
11. Remove the ignition cables from the spark plugs. Remove the hose to the car heater from the heat control valve.
12. Remove the valve cover and take out the rocker arm mechanism and the push rods.

13. Remove the bolts for the cylinder head and take off the head. Remove the inlet and exhaust pipes from the cylinder head.
14. Remove the cylinder head gasket, the flange gaskets and the sealing rings for the water pump. Clean the contact surfaces.
15. Recondition the valve system according to the description given under the heading "Cylinder head and valves".

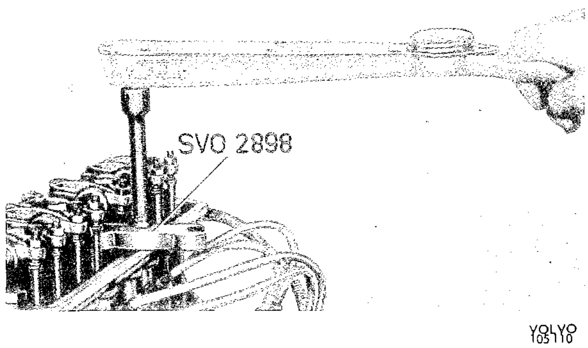


Fig. 2-16. Re-tightening cylinder head bolts

FITTING CYLINDER HEAD

1. Fit the inlet and exhaust pipes to the cylinder head.
2. Place the cylinder head gasket in position with "TOP" facing upwards. (Wide edge faces upwards.) Place the sealing rings for the water pump in position. Fit guides 2435.
3. Check that the oil hole (Fig. 2-14) in the cylinder head for the rocker arm mechanism is not blocked.
4. Place the cylinder head in position. Fit the bolts and remove the dowels. The cylinder head bolts should be tightened in three stages, 1st stage: 40 Nm (29 lbft), 2nd stage: 80 Nm (58 lbft) and the third stage, 90 Nm (65 lbft) after running the engine warm according to point 17. The bolts should be tightened in the sequence shown in Fig. 2-13.
5. Fit the push rods and rocker arm mechanism.
6. Adjust the valves to a clearance of 0.55–0.60 mm (0.022–0.024"). Note that these values are not final.
7. Fit the valve cover.
8. Install the spark plugs and connect up the ignition cables.
   Fit the hose to the heater control valve.
9. Connect the battery lead to the attachment on the cylinder head. Fit the fuel hoses to the distribution pipe. Connect up the radiator hose.
10. Fit the tensioning bar for the alternator and check the tension on the fan belt.
11. Place the gaksets in position and connect the exhaust pipe to the manifold.
12. Place the cable loom in position and connect it to the cables for the injectors, temperature sensor for coolant, thermal timer contact, cold start valve and throttle valve switch.
13. Fit the contact for the coolant temperature sensor.
14. Connect the hoses for the ignition distributor, crankcase ventilation, brake servo and pressure sensor to the inlet duct.
15. Fit the control bracket and the control to the inlet duct. Fit the link rod and the throttle cable.
16. Fit the air cleaner, connect the battery lead to the battery. Fill with coolant.
17. Start the engine and carry out a function check. Run the engine for 10 minutes (preferably under load).
18. Remove the air cleaner and valve cover
19. Tighten the cylinder head bolts in the proper order to 90 Nm (65 lbft). Use spanner 2898 for this purpose.
20. Check and if necessary adjust the valve clearance to 0.50–0.55 mm (0.020–0.022"). Fit the rocker arm cover and the air cleaner. Carry out a function check.

CYLINDER HEAD AND VALVES

DISASSEMBLING

1. Remove the valve springs by first compressing them with valve pliers and then by removing the valve collets, after which the pliers are released. Place the valves in order in a valve rack. Remove the valve guide seals.
2. Measure the clearance between the stem and the guide. The clearance with a new valve must not exceed 0.15 mm (0.006"). Also check that the valves are not excessively worn. See "Specifications" under the headings "Valve System" and "Wear Tolerances".

CLEANING

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

GRINDING VALVES AND VALVE SEATS

1. Grind the valves in a machine after they have been cleaned. Fit new valves if the old ones are excessively worn.
2. Grind the valve seats. Use an electrically driven grinder or a hand milling cutter. A pilot spindle must be carefully fitted before work is started and any worn guides must be replaced with new ones. The seat should be ground until a good sealing surface is obtained. The angle is 45° and the width of the sealing surface is approx. 2 mm (0.08"), see "A", Fig. 2-17. If the sealing surface is too wide after grinding, it can be reduced by using a 70° grinding stone from the inside and a 20° grinding stone from the outside.

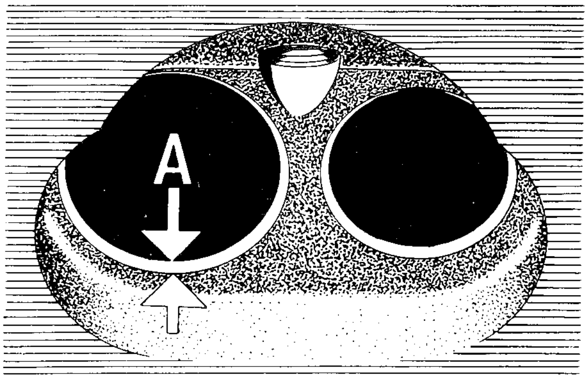


Fig. 2-17. Valve seat width A=2 mm (0.08")

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

REPLACING VALVE GUIDES

1. Press out the old guides with tool 2818.
2. Press in the new guides using drift 2819, which gives the correct pressing-in depth. See Fig. 2-18.
3. Check that the guides are free from burr and that the valves move easily in them.

ASSEMBLING

1. Check that the parts are in good condition and clean them. Test the springs to ensure that they maintain the values given in the "Specifications".

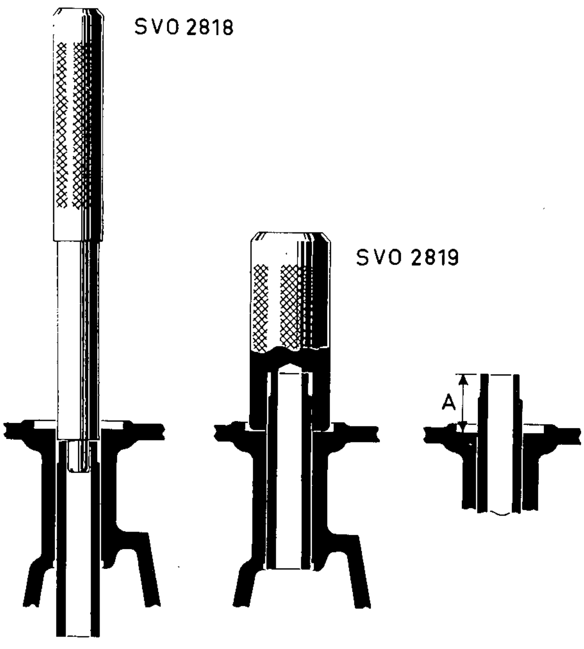


Fig. 2-18. Replacing valve guides
A=17.5 mm (0.689")

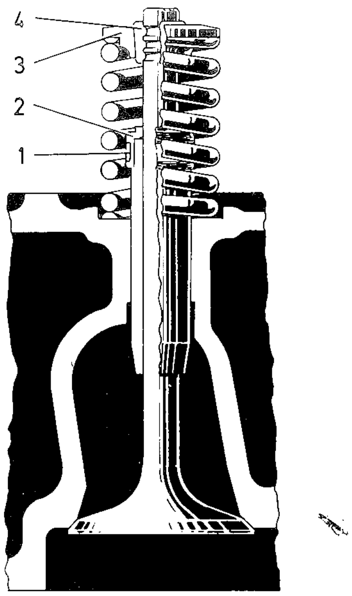


Fig. 2-19. Valve collet and valve guide seal
1. Metal ring
2. Rubber seal
3. Washer
4. Valve collet

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

REPLACING ROCKER ARM BUSHINGS AND GRINDING ROCKER ARMS

1. If wear amounts to 0.1 mm (0.004") replace the rocker arm bushing. Use tool 1867 for pressing the bushing out and in, see Fig. 2-20. Then ream the bushing with a suitable reamer until an accurate fit on the shaft is obtained. The hole in the bushing should coincide with the hole in the rocker arm.
2. If necessary, grind the pressure pad of the rocker arm in a special machine.

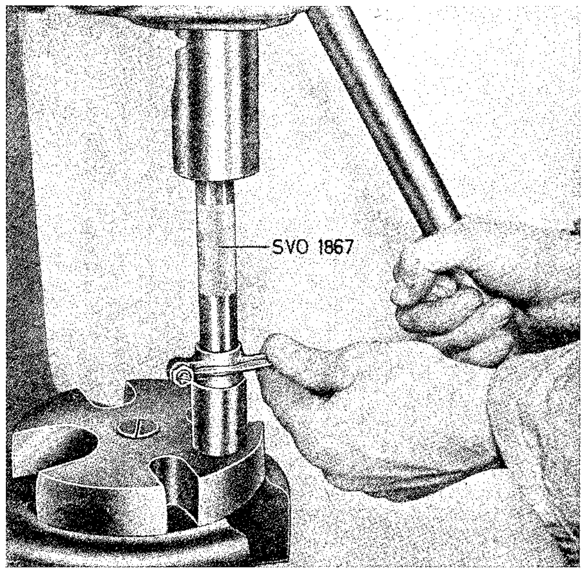


Fig. 2-20. Replacing bushing in rocker arm

ADJUSTING VALVE CLEARANCE

The valve clearance can be adjusted satisfactorily with the engine switched off, irrespective of whether the engine is cold or warm. The clearance is the same for both the inlet and exhaust valves. When adjusting, use two feeler gauges, one "Go" 0.50 mm (0.020") thick and the other "No-Go" 0.55 mm (0.022") thick. The clearance is adjusted so that the thinnest gauge can be inserted easily while the thicker one must not enter.

Turn over the crankshaft until No. 1 comes to firing position. No. 6 rocker arms "balance". The pulley mark is at 0. Adjust No. 1 valve clearance.

Turn over the crankshaft until No. 2 rocker arms "balance". Adjust No. 5 clearance.

When No. 4 rocker arms "balance" – adjust No. 3 clearance.

When No. 1 rocker arms "balance" – adjust No. 6 clearance.

When No. 5 rocker arms "balance" – adjust No. 2 clearance.

When No. 3 rocker arms "balance" – adjust No. 4 clearance.

("Balance" = the intake rocker arm has just closed and the exhaust rocker arm just starts to open.)

CYLINDER BLOCK

MEASURING CYLINDER BORES

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

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

PISTONS, PISTON RINGS AND PISTON PINS

MEASURING PISTONS

The pistons are measured with a micrometer at right angles to the piston pin hole 7 mm (0.28") from the lower edge.

FIT OF PISTONS IN CYLINDERS

The piston fit in the respective cylinders is tested without the piston rings being fitted. The clearance at right angles to the piston pin hole is measured with a feeler gauge 1/2" wide and 0.05 mm (0.0020") thick attached to a spring balance. The force applied should be 1 N (2.2 lb). This gives the average value for piston clearance. When the above-mentioned force is applied, the piston clearance obtained is equal to the thickness of the feeler gauge used. Feeler gauges which are 0.04 mm (0.0016") or 0.06 mm (0.0024") thick can, therefore, also be used. The test is carried out at several different depths.

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

PISTON RING FIT

In a new or re-bored cylinder

1. Push down the piston rings one after another in the cylinder bore. Use a reversed piston to ensure that the rings come into the correct position.
2. Measure the ring gap with a feeler gauge. The gap should be 0.40–0.55 mm (0.016–0.022"). If necessary, the gap can be increased with the help of a special file.
3. Check the piston rings in their respecitve grooves by rolling them in the groove. Also measure the clearance at a few points. See "Specifications" for the proper measurements.

In a worn cylinder bore

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

ASSEMBLING AND FITTING PISTON AND CONNECTING ROD

When assembling, make sure that the piston is turned correctly so that the slot on top of the piston faces forwards as shown in Fig. 2-21. If the piston is turned the wrong way, this will cause a loud noise. The number marking on the connecting rod should be turned to face away from the camshaft side. The gudgeon pin is then fitted, the circlip placed in position and the piston rings fitted.

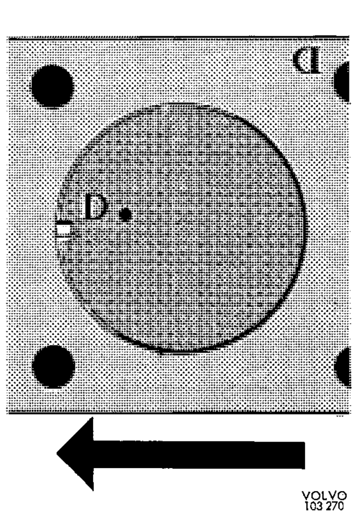


Fig. 2-21. Marking on pistons and cylinder block

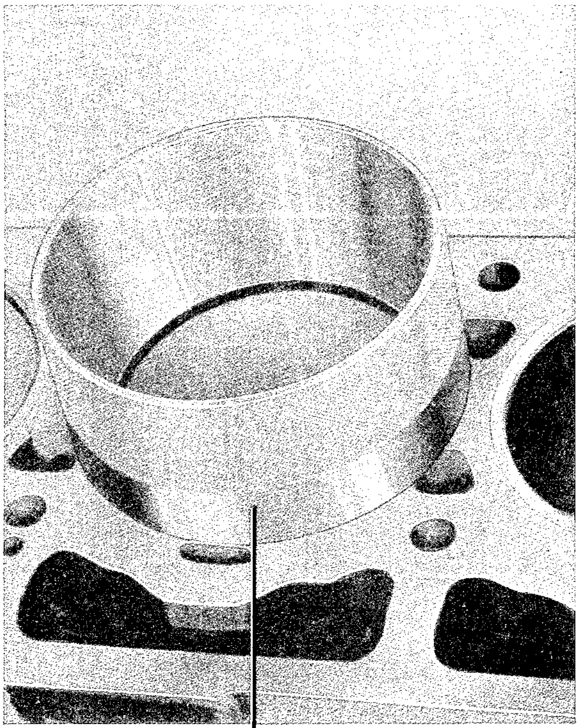


Fig. 2-22. Fitting piston
1. Fitting ring 2923

Use piston ring grips when fitting the rings. The upper ring on each piston is chromed. Place the bearing shells in position.
Turn the rings so that the gaps do not come directly under one another. Then lubricate the piston and bearing surfaces.
Use fitting ring 2923, see Fig. 2-22, when fitting the piston in the cylinder bore. Tighten the connecting rod bolts with a torque wrench, see "Specifications" for the correct tightening torque.

PISTON PINS

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

CONNECTING RODS

REPLACING BUSHINGS

If the old bushing in a connecting rod is worn, press it out by using drift 5017 and press in a new bushing with the same tool, see Fig. 2-23. Make sure that the lubricating holes index with the holes in the connecting rod. Then

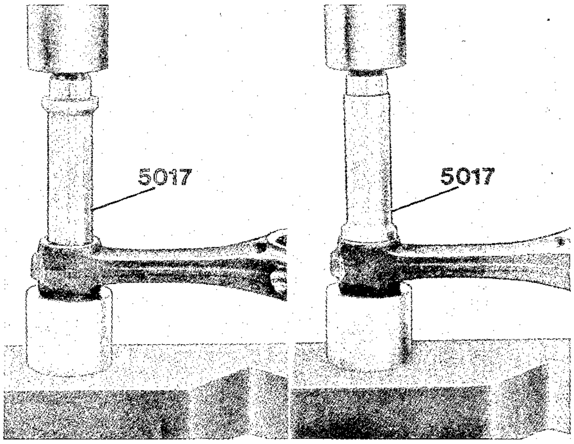


Fig. 2-23. Replacing bushing in connecting rod

ream the bushing to the correct fit. The piston pin should slide through the hole under light thumb pressure without any noticeable looseness.

STRAIGHTENING

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

CRANKSHAFT

After the crankshaft has been cleaned, its journals must be measured with a micrometer. Measuring should be carried out at several points round the circumference and along the longitudinal axis of each journal. Out-of-roundness on the main bearing journal should not exceed 0.05 mm (0.002"), and 0.07 mm (0.003") on the big-end bearing journals.
Taper should not exceed 0.05 mm (0.002") on any of the journals.
If the values obtained are close to or exceed the wear limit mentioned above, the crankshaft should be ground to undersize. Suitable bearing shells are available in five undersizes. The measurements are in the "Specifications".
Check that the crankshaft is straight to within 0.05 mm (0.002") by using a dial gauge. The crankshaft is placed on two V-blocks and a dial gauge placed against the center bearing journal after which the crankshaft is rotated. If necessary, straighten the crankshaft in a press.

GRINDING CRANKSHAFT

Before the crankshaft is ground, check to ensure that it is straight, this being done as described above. Grinding is carried out in a special machine whereby the main bearing journals and the big-end bearing journals are

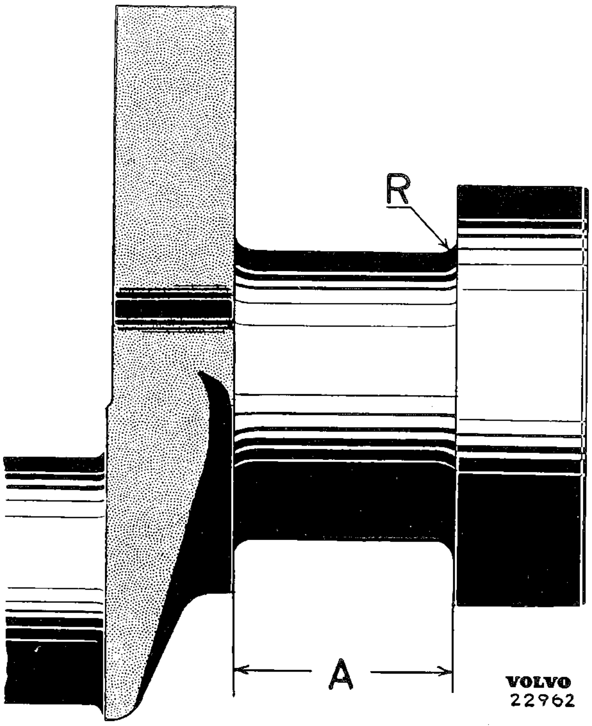


Fig. 2-24. Bearing journal

ground to identical measurements. These measurements, which are given in the "Specifications", must be carefully followed in order to ensure correct clearance with ready-machined bearing shells.

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

The fillets at the ends of the journals should have a radius of 2.0–2.5 mm (0.080–0.100") on all journals, see Fig. 2-33. The width measurement (A) for the pilot bearing depends on the size of the journals and should be ground in order to obtain the correct measurement. After grinding has been completed, all the burr should be carefully removed from the oilway openings and all the journals lapped with a fine grinding paste to the finest possible surface finish. The crankshaft should then be washed. All the oilways should be cleaned with particular thoroughness in order to remove any metal chippings and grinding residue.

BEARING SHELLS

In addition to standard sizes, bearing shells are available in undersizes of 0.010" and 0.020". The rear main bearing shells are provided with flanges and have a larger width relative to their size. If the crankshaft has been ground to the correct measurement, the right bearing clearance is automatically obtained when the bearing shell concerned is fitted. The bearing shells must not be shaved and the caps must never be filed in order to obtain a closer bearing fit.

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

GRINDING FLYWHEEL

If the wear surface of the flywheel is unveven or burnt, the surface can be ground in a saddle-mounted grinding machine. Not more than 0.75 mm (0.03") of the original thickness must be ground off.

PILOT BEARING FOR CLUTCH SHAFT

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

REPLACING CRANKSHAFT REAR OIL SEAL

1. After having removed the transmission, clutch and flywheel from the engine, remove the two bolts for the oil sump in the sealing flange. Slacken one of the two bolts on each side so that oil sump pressure on the sealing flange will not be so great. Remove the sealing flange.
2. Press out the seal with the help of the drift for tool 2817, Use a suitable cushion for the sealing flange to prevent it from being damaged.
3. Press in the sealing ring with tool 2817, see Fig. 2-25. NOTE. First inspect the wear surface of the crankshaft. The sealing ring can be fitted in three positions with tool 2817, see Fig. 2-25. With a new crankshaft or a crankshaft with approved wear surface, fit the seal in its outer position (fully screwed in center bolt). With the wear mark on the crankshaft, fit the crankshaft with the center bolt screwed out a couple of turns or completely.
4. Fit the sealing flange, its sealing surface being well cleaned, and a new gasket. (Oil first the sealing ring.)

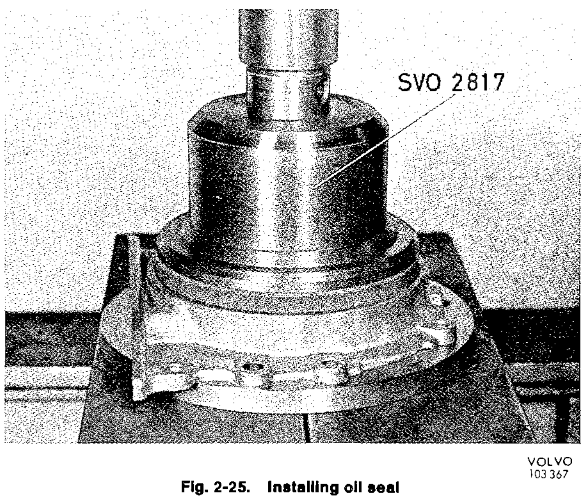


Fig. 2-25. Installing oil seal

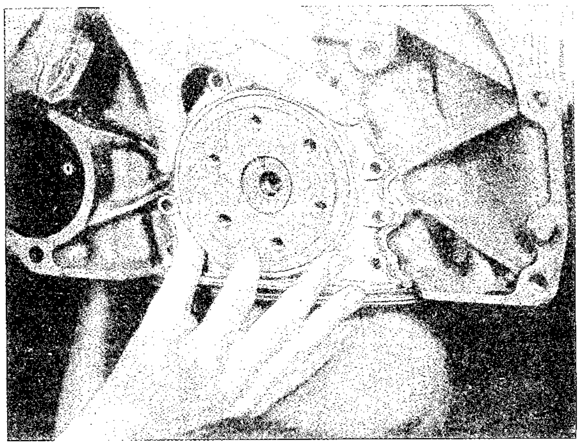


Fig. 2-26. Flange installation

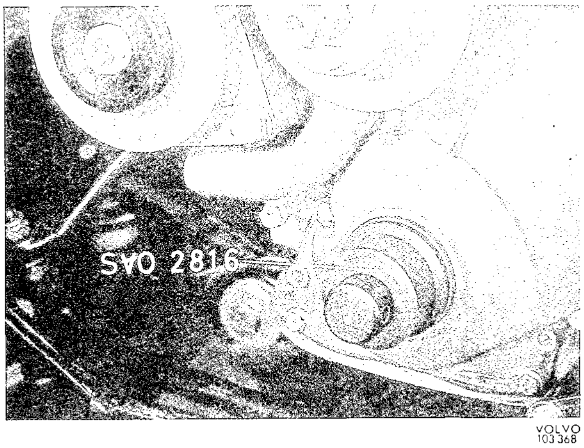


Fig. 2-28. Installing oil seal

The sealing flange should be mounted on the crankshaft carefully, see Fig. 2-26. Use your finger to fit on the sealing lip.

REPLACING OIL SEAL IN TIMING GEAR COVER

1. Empty the coolant from the system and remove the radiator and radiator grille.
2. Release the fan belt. Unscrew the bolts for the pulley and the flywheel damper and remove the bolts.
3. Remove the center bolt and take off the polygon hub with puller 2814, see Fig. 2-27. (First check to see whether it is possible to pull off the polygon hub by hand.)
4. Remove the oil seal. Lubricate the sealing lip on the new seal and fit the seal with drift 2816, see Fig. 2-28. NOTE. First inspect the wear surface of the polygon hub. The oil seal can be fitted in three positions with tool 2816. With a new polygon hub, the center bolt of the tool should be screwed in fully, see Fig. 2-29. In this position, the seal will be fitted in its outer position (position 1). With a wear mark on the polygon hub, fit the seal in position 2 ($1^1/_4$ turns of center bolt screwed out). With two wear marks on the hub, fit the sealing in position 3 (center bolt screwed out fully). With three wear marks, the polygon hub should be replaced with a new one.
5. Fit the polygon hub with tool 2815, see Fig. 2-30.

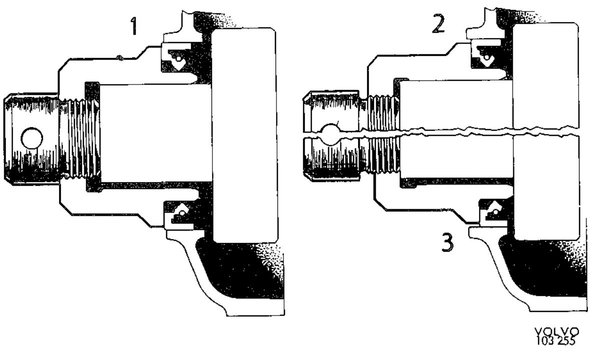


Fig. 2-29. Center spindle position on 2816

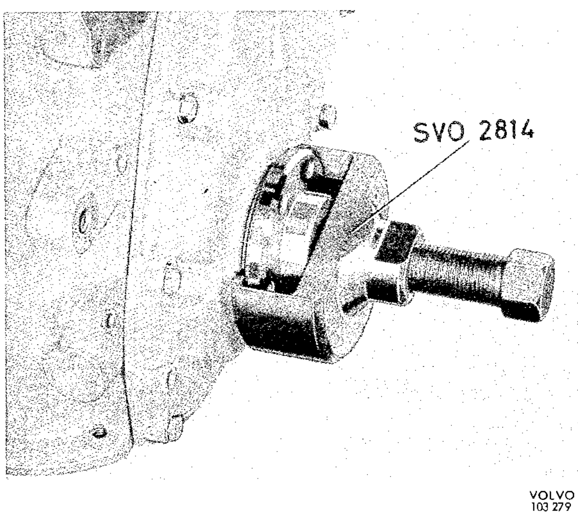


Fig. 2-27. Removing polygon hub

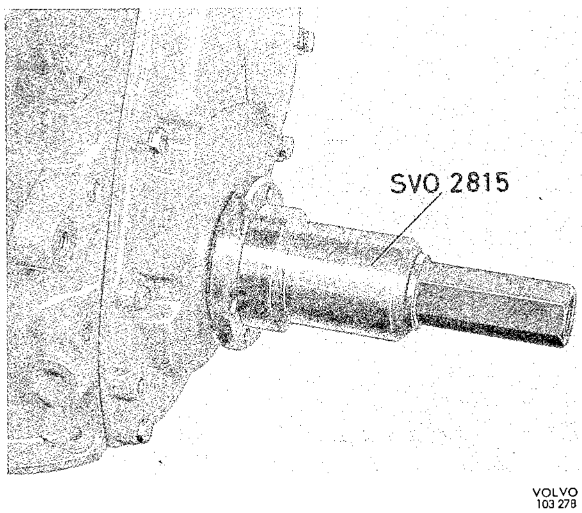


Fig. 2-30. Installing polygon hub

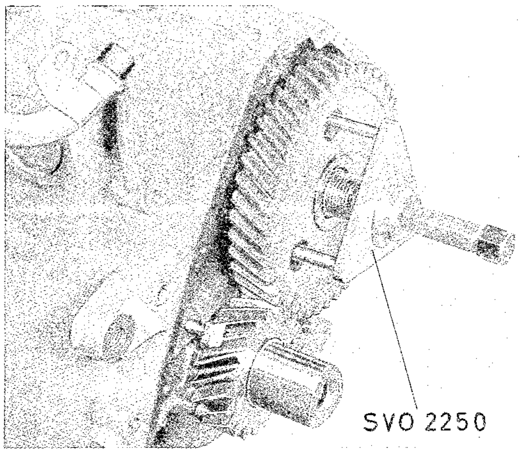


Fig. 2-31. Removing camshaft gear

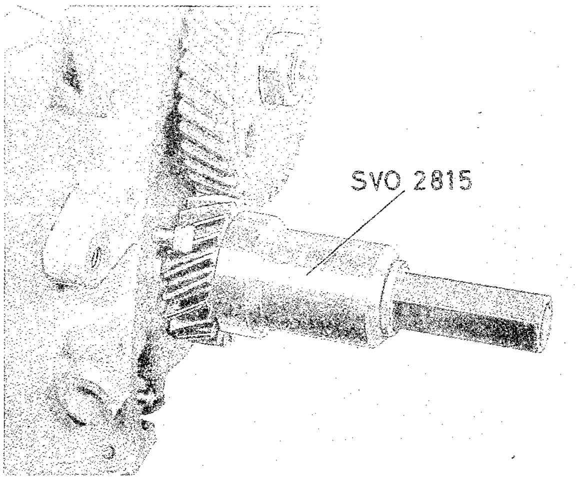


Fig. 2-33. Installing crankshaft gear

Before fitting, the sliding surfaces of the polygon hub should be greased. **Note the marking,** that is, the center punch marks on the crankshaft end and polygon hub. Fit the center bolt and tighten it to a torque of 70–80 Nm (7–8 kpm=50–57 lbft).

6. Fit the flywheel damper and pulley. Since the bolt holes are not located symmetrically, fitting can only be done in one position.
7. Fit the fan belt. The pulley belt should be tensioned according to the instructions given in Group 26 "Tensioning pulley belt".
   Fit the radiator.

REPLACING TIMING GEARS

1. Empty the coolant from the system and remove the radiator and radiator grille. Remove the fan belt and fan.
2. Carry out operations 2–3 from the previous section.
3. Remove the timing casing. Slacken a couple of bolts extra for the oil sump and observe due care that the sump gasket is not damaged.
4. Remove the camshaft nut and pull off the camshaft gear with puller 2250, see Fig. 2-31.
5. Pull off the crankshaft gear with puller 2822, see Fig. 2-32.
   Screw out the oil nozzle, blow it clean and re-fit it, see Fig. 2-35. The gears are lubricated from this nozzle.
6. Re-fit the crankshaft gear with tool 2815, see Fig. 2-33.
7. Re-fit the camshaft gear with tool SVO 2408, see Fig. 2-34. Both gear wheels should take up the correct position relative to each other, see Fig. 2-35. When the timing gear drive markings are opposite each other, then the piston for No. 6 cylinder is at top dead center, firing position. Do not press the camshaft backwards so that the sealing washer at the rear end loosens. Fit the nut and tighten it to a torque of 130–150 Nm (13–15 kpm=94–108 lbft). The measuring values for the tooth flank clearance and the camshaft axle clearance, which

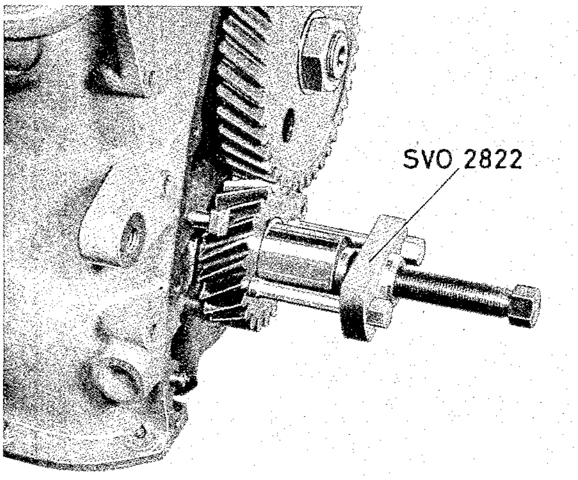


Fig. 2-32. Removing crankshaft gear

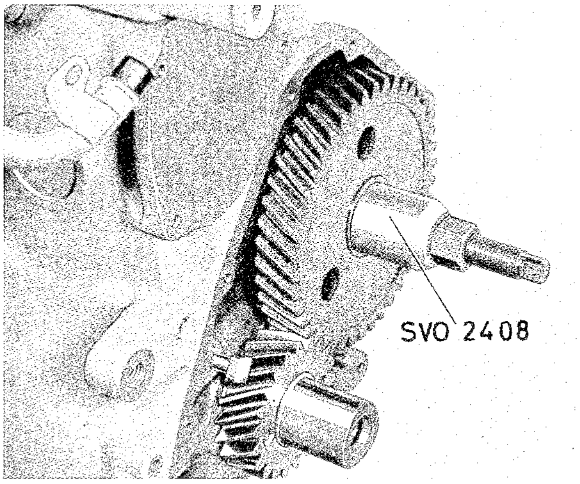


Fig. 2-34. Installing camshaft gear

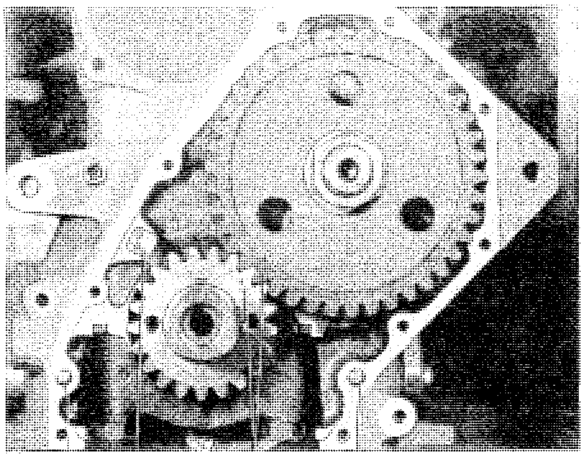


Fig. 2-35. Markings on timing gears
1 Oil nozzle 2. Markings 3. Dowel pins

is determined by the spacing ring behind the camshaft gear, are given in the "Specifications".

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

POSITIVE CRANKCASE VENTILATION

OVERHAUL

At intervals of 20 000 km (12 000 miles), the nipple (1, Fig. 2-9), the hoses and flame arrester (4) should be removed and cleaned. At the same time check the hoses and replace those in poor condition.

LUBRICATING SYSTEM

GENERAL INFORMATION

The engine has a force-feed lubricating system, see Fig. 2-36. Pressure is provided by a gear pump driven from the camshaft and fitted under the crankshaft in the sump. The gear pump forces oil past the relief valve, which is also fitted on the pump, through the oil filter and then through oilways out to the various lubricating points. All the oil supplied in the lubricating points, therefore, first passes through the oil filter.

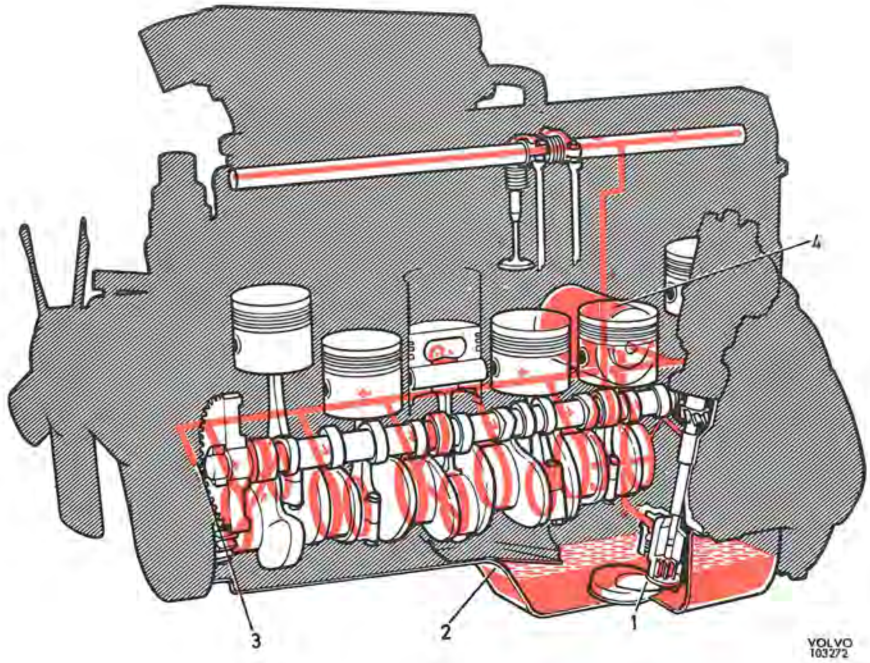


Fig. 2-36. Lubricating system
1. Oil pump
2. Sump
3. Nozzle
4. Oil filter

OIL PUMP, RELIEF VALVE

The oil pump, see Fig. 2-37, is of the gear type and is driven through a gear train from the camshaft. The delivery pipe from the pump to the cylinder block does not have screw unions and is, therefore, automatically tightened in position when the attaching bolts for the pump are tightened. At each end of the pipe there are sealing rings made of special rubber. The relief valve is fitted directly on the pump and consists of a spring-loaded ball. The ball has a cylindrical guide with a stop at the end position and, therefore, operates flexibly. Even at idling speed there is a certain amount of overflow, so that the oil pressure is then relatively low.

OIL FILTER

The oil filter (see Fig. 2-38), which is manufactured as a single unit complete with element, is of the full-flow type and is screwed directly onto the cylinder block. The oil which is fed out to the various lubricating points in the engine first passes through the oil filter element which is made of special paper. In the oil filter there is a by-pass valve which allows the oil to by-pass the element if resistance to flow should become excessive. When replacing the filter, discard the old one completely and fit the new one.

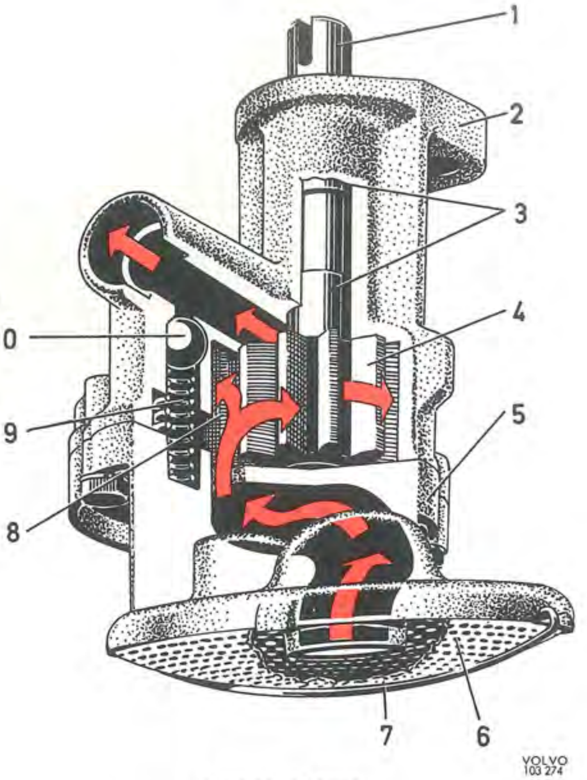


Fig. 2-37. Oil pump

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

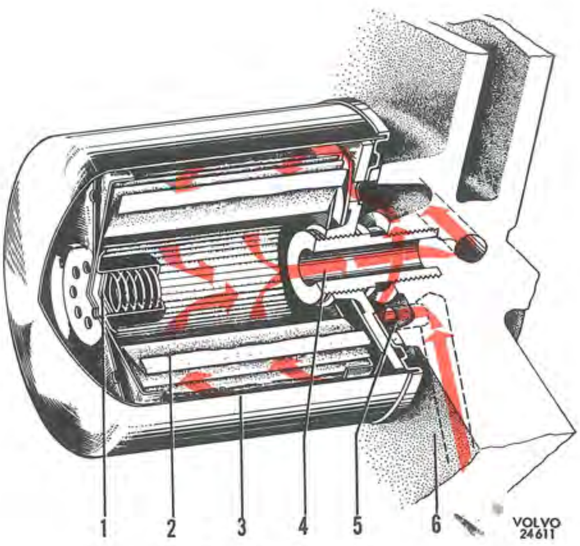


Fig. 2-47. Oil filter

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

SERVICE PROCEDURES

Fig. 2-39. Removing oil filter

REPLACING OIL FILTER

Together with the element and relief valve, the oil filter (see Fig. 2-28) is screwed as a complete unit onto a nipple fitted in the cylinder block.

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

1. Remove the old filter with the help of chain tongs, 2903. see Fig. 2-39.
2. Coat the rubber gakset (1, Fig. 2-40) of the new filter with oil and make sure that the contact surface for the oil filter is free from dirt. By smearing it with oil, the gasket slides into better contact with the sealing surface. Screw on the filter by hand unit it just touches the cylinder block.
3. Continue to screw on the oil filter a further half turn by hand. **Chain tongs must not be used for fitting.** Start the enigne and check that there is no leakage at the joint. Fill up with oil if necessary.

Fig. 2-40. Oil filter ready for installing
1. Gasket (oiled) 2. Filter

OIL PUMP AND RELIEF VALVE

After the pump has been disassembled and cleaned, check that all the parts are in good condition. Test the relief valve spring (2, Fig. 2-41), see "Specifications" for the values concerned.

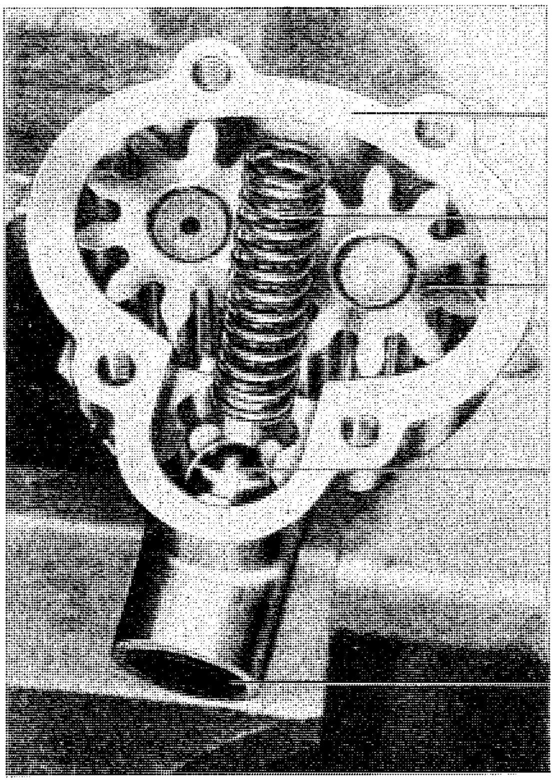


Fig. 2-41. Oil pump

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

Check that the tooth flank clearance is 0.15–0.35 mm (0.006–0.014"), see Fig. 2-43.
Measure the end float, 0.02–0.10 mm (0.0008–0.0040"), with a feeler gauge and a new cover or the old one if not noticeably worn. If the bushings or shaft are worn, replace them with new ones. Note that the driving shaft with gear is replaced as a single unit. The new bushings should be reamed after pressing in with a reamer provided with a pilot guide.
The seals at the ends of the delivery pipe are made of special rubber and are manufactured to very close tolerances, see Fig. 2-44. Use only genuine Volvo parts.
The delivery pipe must be clamped into its correct position first in the oil pump and then the oil pump and pipe together clamped against the block. The pump connecting flange should lie flush against the block before being tightened. Before fitting the rubber rings on the pipe, apply soapy water since this enables the pipe to take up its position more easily. Tap lightly on the pipe with a soft mallet if necessary.

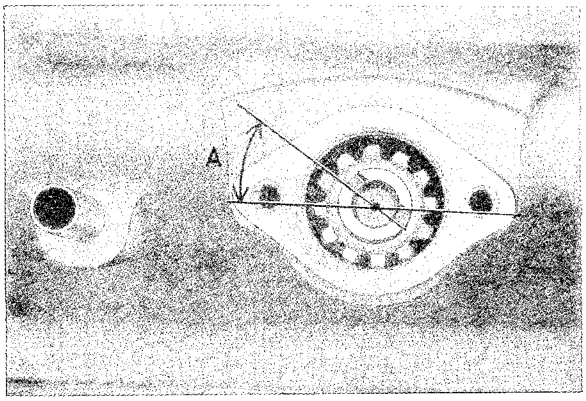


Fig. 2-42. Distributor drive position
A=approx. 35°

OILWAYS

Before being fitted, all the oilways must be cleaned very thoroughly to avoid damage to the bearings, bearing journals and other components.
To clean the cylinder block oilways, remove the sealing plugs. After cleaning and drying with compressed air, fit new plugs.

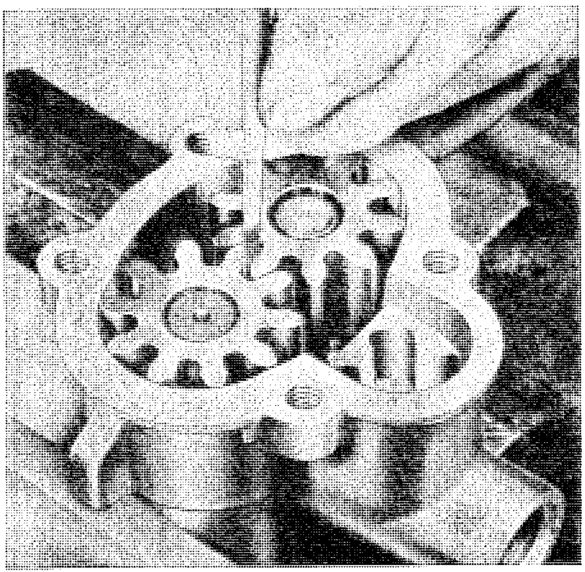


Fig. 2-43. Measuring tooth flank clearance

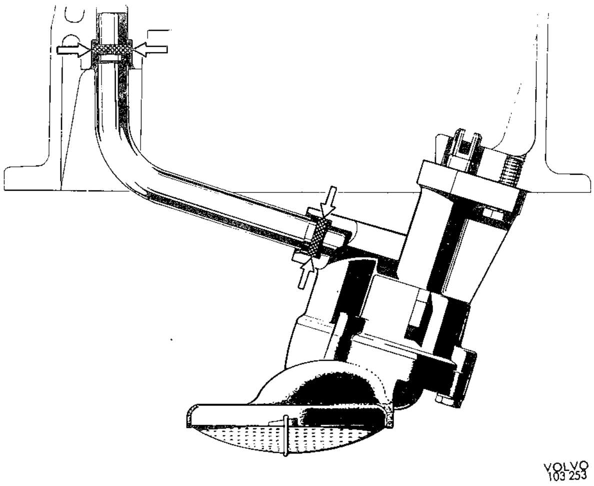


Fig. 2-44. Delivery pipe sealings

FITTING OIL PUMP

When No. 1 cylinder is at top dead center, fit the oil pump drive and distributor. The small part at the groove is turned obliquely upwards-backwards and the groove set at an angle of 35° to the longitudinal axis of the engine, see Fig. 2-42 (A). Make sure that the shaft goes down into its groove in the pump shaft.

(NOTE. When the timing gear marks are opposite each other, then the piston for No. 6 cylinder is at top dead center, firing position.)

FUEL SYSTEM

FUEL INJECTION ENGINES

GENERAL INFORMATION

The B 30 E and B 30 F engines are fitted with an electronically controlled fuel injection system.
The system is made of the following units: Fuel filter, electric fuel pump, control pressure regulator, injectors, cold start injector, intake manifold, throttle valve switch, auxiliary air valve, temperature sensors (for induction air and coolant), pressure sensor (for pressure in intake manifold) and triggering contacts in ignition distributor, also the electronic control unit. In addition, there is a mechanical thermal timer for regulating the cold start valve. See Fig. 2-45.

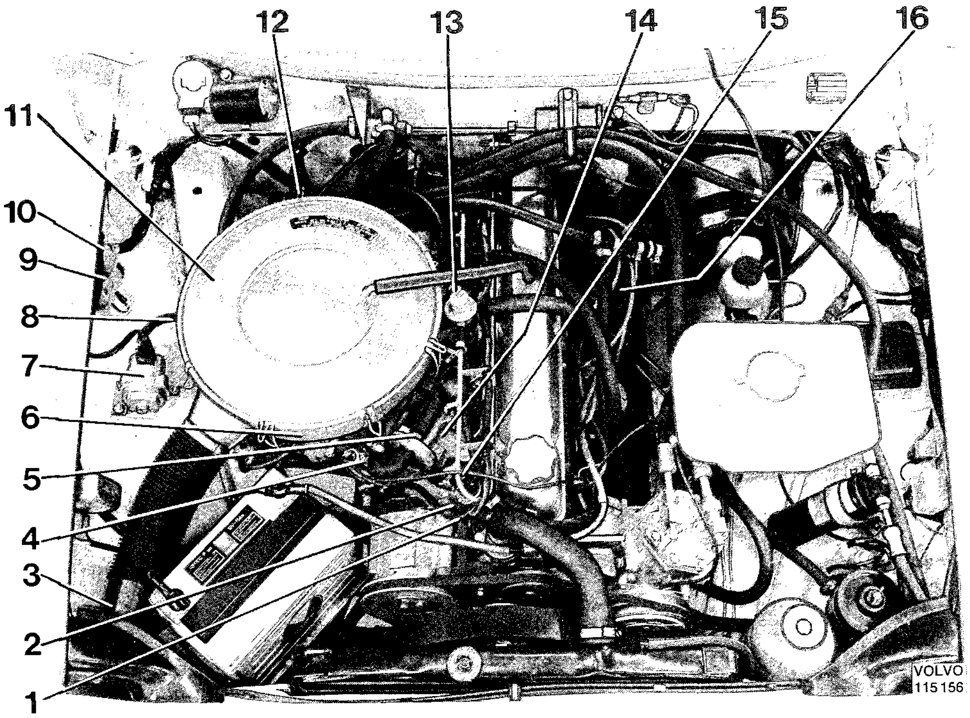


Fig. 2-45. Electronically controlled fuel injection (B 30 E and F)

1. Thermal time switch
2. Temperature sensor, coolant
3. Temperature sensor, induction air
4. Idle adjustment screw
5. Auxiliary air valve
6. Throttle valve switch
7. Pressure sensor
8. Cold start injector
9. Pump relay
10. Main relay
11. Air cleaner
12. Stop screw for throttle valve
13. Control pressure regulator
14. Intake manifold
15. Injector
16. Triggering contacts

FUNCTION

Fuel is drawn by the electric fuel pump from the tank via the fuel line and through the filter. From here it passes into the fuel pressure line to the injectors.

The control pressure regulator limits the fuel pressure in the fuel line to 2.1 kp/cm² (30 psi). From the intake ports regulator excess fuel flows back to the tank through the return line. The electro-magnetic fuel injectors are mounted in the intake ports in the cylinder head and are connected to the fuel line.

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

The pressure sensor senses the absolute pressure in the intake manifold and converts this to electric impulses which are computerized by the control unit. Since the pressure in the intake manifold is proportional to the engine load, the control unit receives in this way information concerning engine load.

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

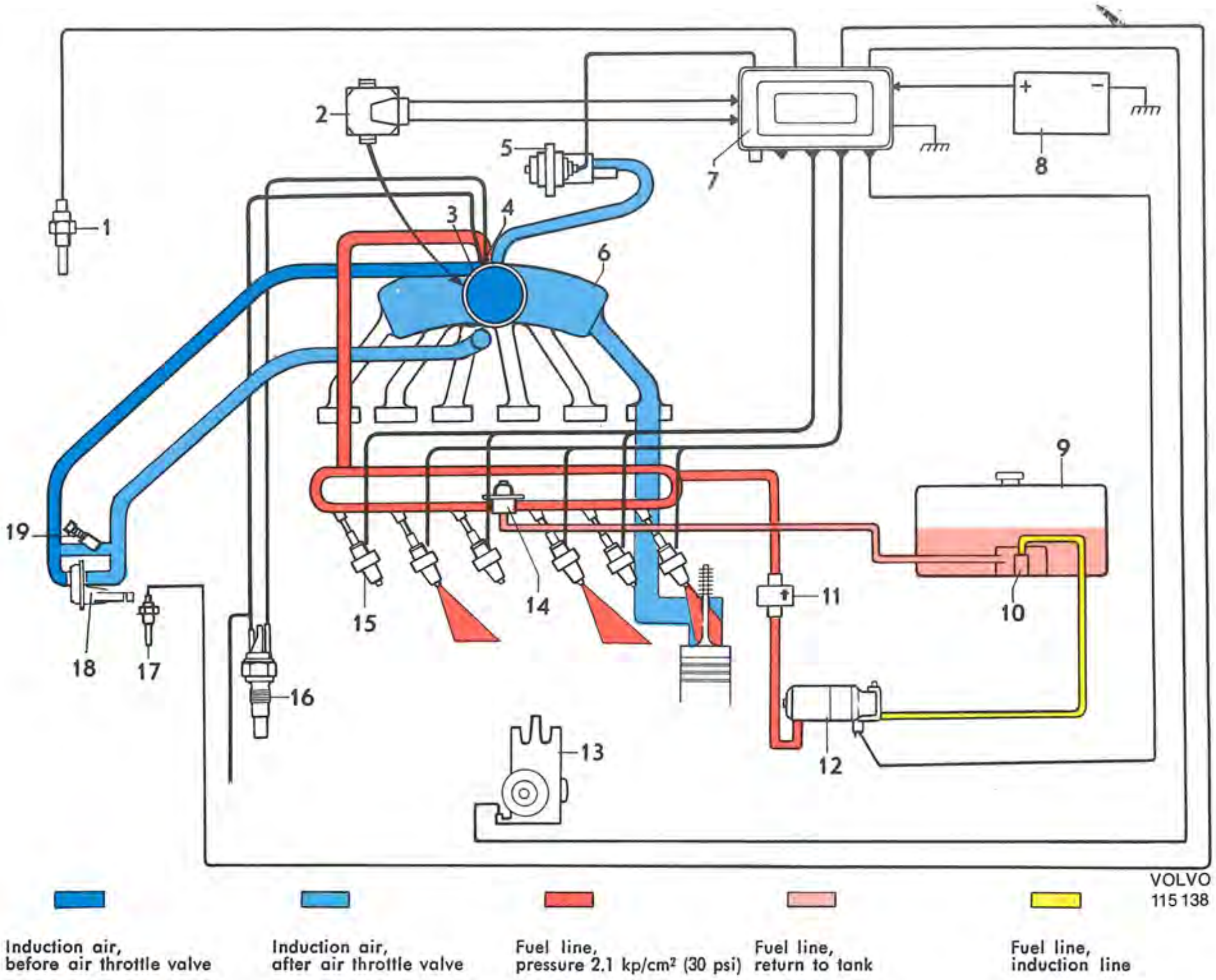


Fig. 2-46. Fuel injection system, principle of operation

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

The control unit processes this information and determines how long the injectors shall remain open in order to provide the right amount of fuel.
In addition to the basic amount of fuel, extra fuel must be supplied to the engine when starting, running warm and during acceleration. At cold start, the engine is supplied with extra fuel through the cold start valve on the inlet duct.
The opening interval for the cold start valve, which reduces with increased engine temperature, is regulated by the thermal time switch.
During warm running, the control unit gets information from the temperature sensor for the coolant and accordingly allows the injectors to remain open a little longer. But, if the engine is to run properly with the increased fuel, extra air is required. This is supplied by means of the auxiliary air valve which gradually closes as the engine temperature rises.
The electronic control unit receives impulses for additional fuel during acceleration from the throttle valve switch. When the accelerator pedal is depressed, impulses are released from the throttle valve switch to the control unit which gives orders to the injectors to inject a number of times between the ordinary injections. If the accelerator pedal is depressed quickly, the duration of injection will also be longer than the ordinary injection time.

CONTROL UNIT AND RELAYS

The location of the control unit can be seen from Fig. 2-47. It processes the information from the various sensors and determines the opening interval for the injectors, if and for how long the cold start valve should be open and when the fuel pump should start operating. The fuel pump is operated via a control relay (pump relay) located on the right wheel housing.

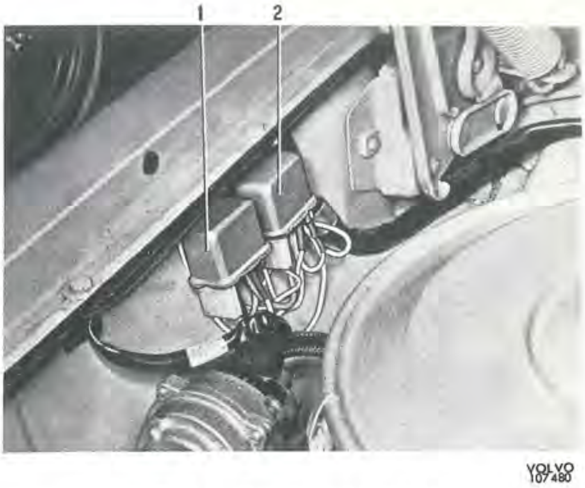


Fig. 2-48. Control relays, installed
1. Pump relay 2. Main relay

The main relay, placed next to the pump relay, feeds the control unit with current.
The fuel pump is fitted under the vehicle to the left of the fuel tank, see Fig. 2-50.
The pump and pump motor are integrally built and connected up in such a way that they cannot be repaired but must be replaced if damaged. Fuel is sucked in at the front part of the pump and discharged at the rear end. With this arrangement the motor rotor and the electric brushes operate in the fuel. The pump is fitted with partly a built-in relief valve and partly a check valve. The relief valve opens if the pressure for some reason or other exceeds 4.5 kp/cm² (68 psi), which may be due to, for example, a fault in the pressure regultor, blockage in the fuel lines, etc. Fuel is pumped round in the pump without any further increase in pressure. The check valve shuts off when the pump pressure drops to 1.2 kp/cm² (16 psi) or lower, which means that the fuel in the line between pump and injectors will be under a pressure of 1.2 kp/cm² (16 psi) when the pump is not operating.

Fig. 2-47. Control unit, installed

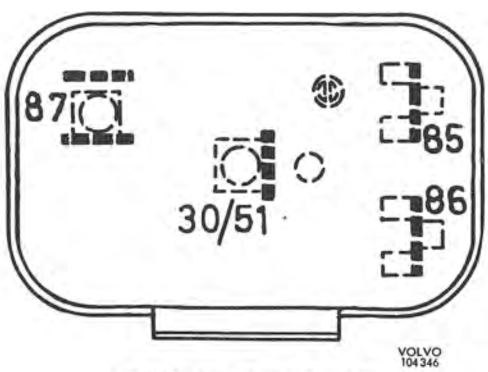


Fig. 2-49. Control relay terminals

Fig. 2-50. Fuel pump installed

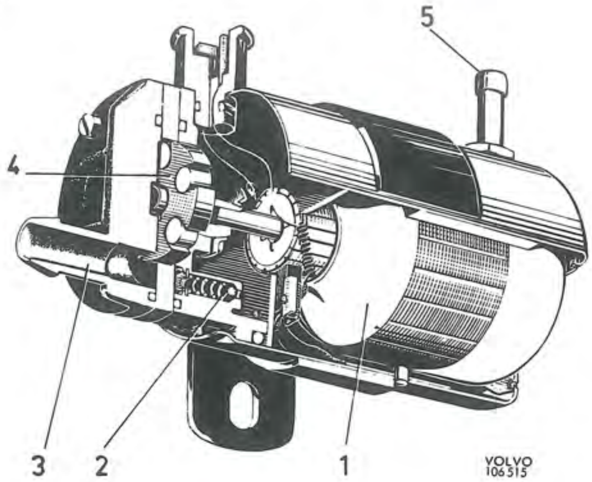


Fig. 2-51. Fuel pump
1. Rotor for elec. motor
2. Overflow valve
3. Inlet
4. Pump rotor
5. Outlet with non-return valve

The pump runs only 1–2 seconds when the ignition is swithced on. This is to prevent the engine from being filled with petrol by a leaking cold start valve or injector. The pump only works when the starter motor engages or when the engine is running.

FUEL FILTER

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

PRESSURE REGULATOR

The location of the pressure regulator is shown in Fig. 2-56. It is connected to the distribution pipe. The pressure regulator is a fully mechanical unit which regulates the pressure in the fuel lines to 2.1 kp/cm² (30 psi).

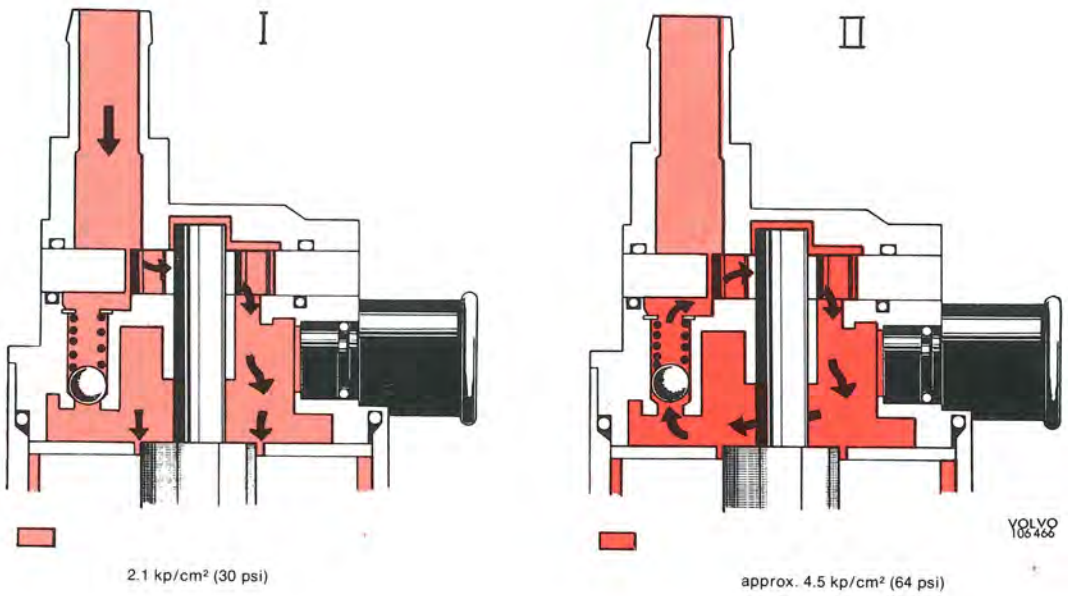


Fig. 2-52. Relief valve function

I Valve closed

II Valve open

Fig. 2-53. Fuel filter, tank

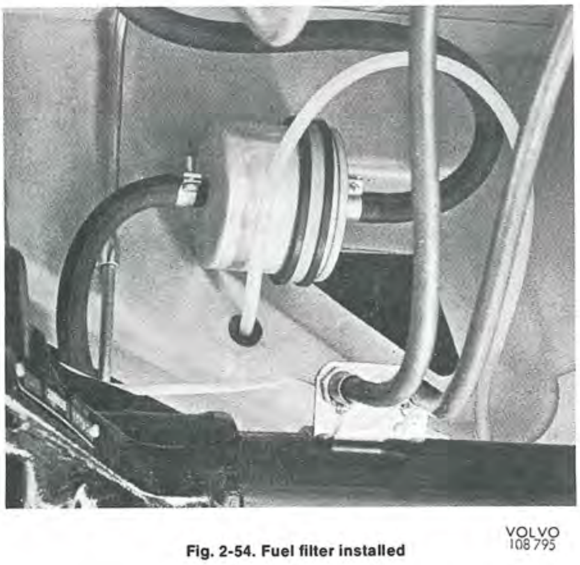


Fig. 2-54. Fuel filter installed

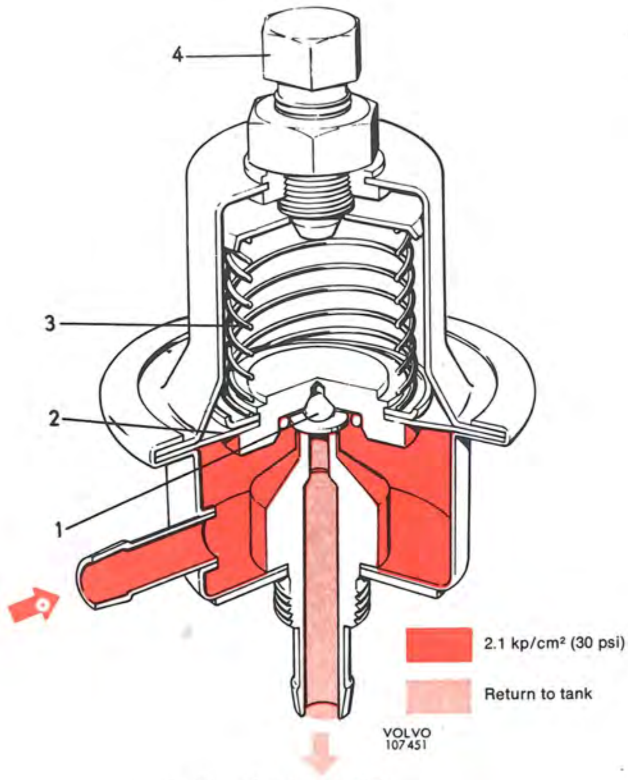


Fig. 2-55. Pressure regulator

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

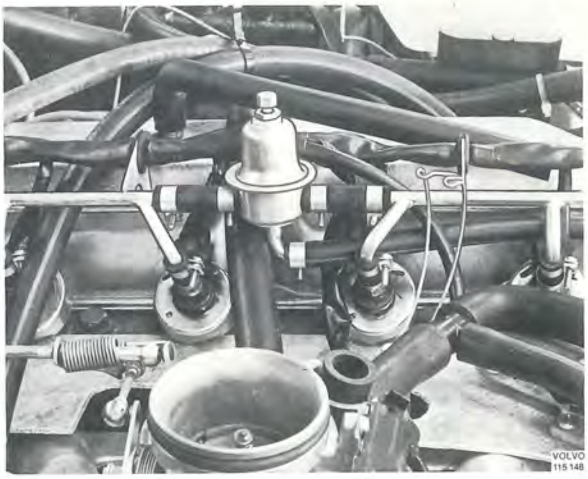


Fig. 2-56. Pressure regulator, installed

When pressure is lower than 2.1 kp/cm² (30 psi) the valve (1, Fig. 2-60) is closed. When the pressure exceeds 2.1 kp/cm² (30 psi) the valve opens and releases excess fuel into the return line to the tank.

INJECTORS

Fuel is injected into the intake ports in the cylinder head by six injectors, one for each port. The injectors are mounted in holders which sit in the cylinder head.

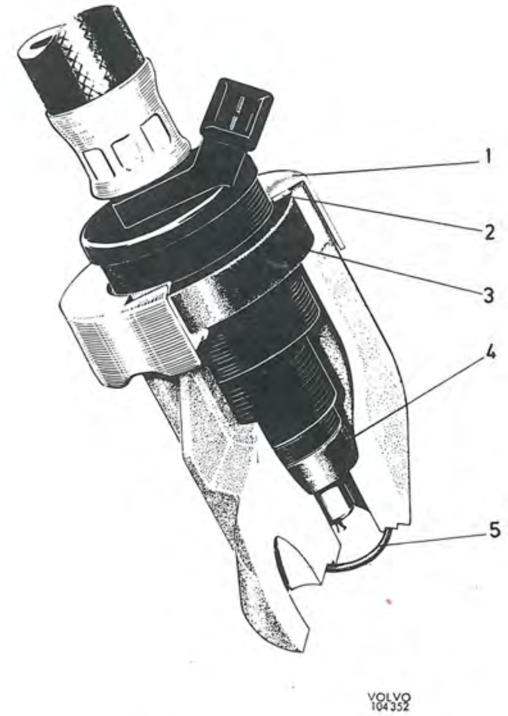


Fig. 2-57. Injector with holder

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

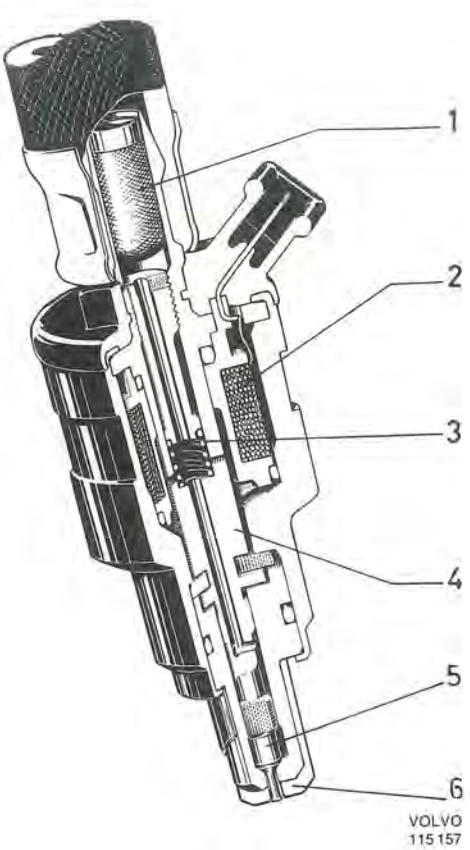


Fig. 2-58. Injector
1. Filter
2. Magnetic winding
3. Return spring
4. Magnetic armature
5. Sealing needle
6. Protective sleeve

The injectors inject in two groups, that is, three and three. Injectors 1,5 and 3 inject at the same time, while 6, 2 and 4 inject together.

The injector consists of a housing containing a sealing needle magnetic winding and return spring, see Fig. 2-58. When the magnetic winding (2) is not in circuit, the return spring (3) presses the sealing needle (5) against a seat and this closes off the supply of fuel.

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

COLD START VALVE

The cold start valve, which is installed in the inlet after the air throttle, provides the engine with extra fuel during cold starting. The injection time is regulated by the thermal timer, which registers the coolant temperature and determines the injection interval in relation to the temperature. At −20°C (−4°) and colder, the cold start valve provides extra fuel for 12 seconds. At +35°C (95°F) the cold start valve stops giving the engine extra fuel at starting.

The cold start valve only injects when the starter motor is running. When the engine is running and the starter motor has been shut off before the injection interval governed by the control unit is completed, the cold start valve also ceases injecting fuel.

The cold start valve consists of a housing in which a magnetic winding and an armature are housed together with a return spring and packing, see Fig. 2-59. When the magnetic winding (1) is not in circuit, the packing (4) presses against the inlet for the armature (3) which in its turn is actuated by the return spring (2). This keeps the cold start valve closed.

When the magnetic winding is fed from the control unit via a control relay, the armature is drawn down and fuel is pressed past the packing, through the cold start valve and into the inlet duct.

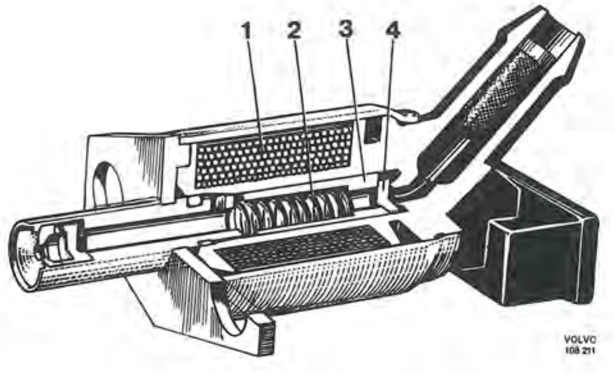


Fig. 2-59. Cold start valve
1. Magnetic winding
2. Return spring
3. Magnetic armature
4. Packing

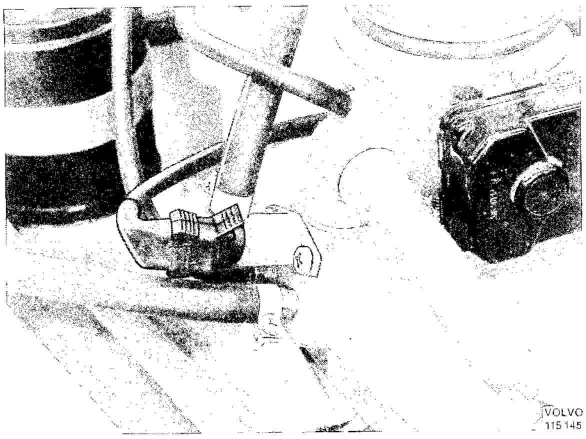


Fig. 2-60. Cold start valve, installed

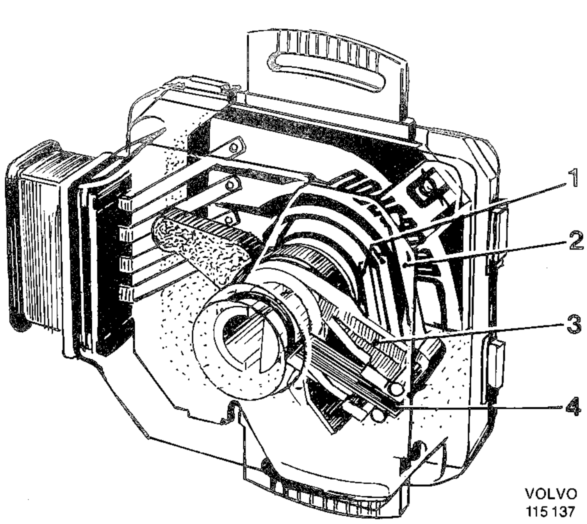


Fig. 2-62. Throttle valve switch

1. Slip contacts
2. Switch pair for acceleration function
3. Connection with throttle spindle
4. Switch pair for fuel shut-off function

THROTTLE VALVE SWITCH

The throttle valve switch is installed in the inlet duct and is connected by means of the throttle shaft. The switch sends impulses to the control unit to increase fuel with acceleration.

During acceleration, the switches (2, Fig. 2-62) are pressed together. This cuts in the circuit so that current can flow from one switch to the other.

When the slip contacts move over the zig-zag, the control unit receives impulses. Depending upon the number of impulses and their rapidity, the control unit determines how much additional fuel will be injected (that is, how many additional injections will take place and how much the injection interval will be extended). Throttle reduction opens the switches (2) to prevent the control unit from receiving impulses for "extra fuel" when the air throttle valve is closed.

PRESSURE SENSOR

The pressure sensor senses the pressure in the inlet duct and by permitting pressure variations to influence the armature in a transformer, thus altering the transformer inductance, the pressure sensor informs the control unit about the engine load.

The pressure sensor is located on the right wheel housing and is connected to the inlet duct by means of a hose, see Fig. 2-63.

The pressure sensor, Fig. 2-64, is built into a housing of light-alloy.

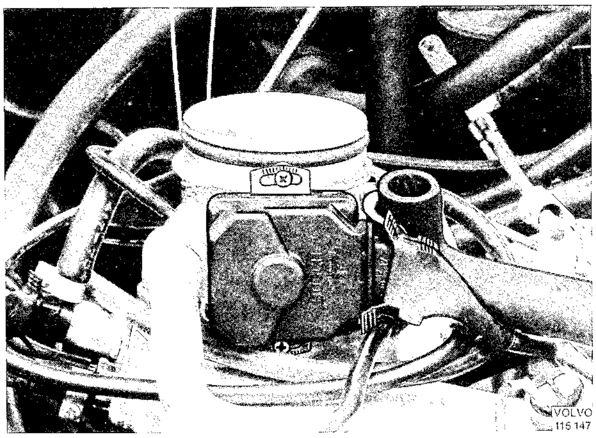


Fig. 2-61. Throttle valve switch installed

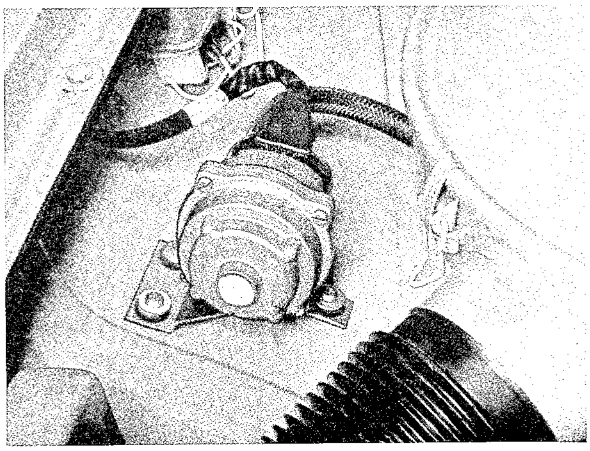


Fig. 2-63. Pressure sensor installed

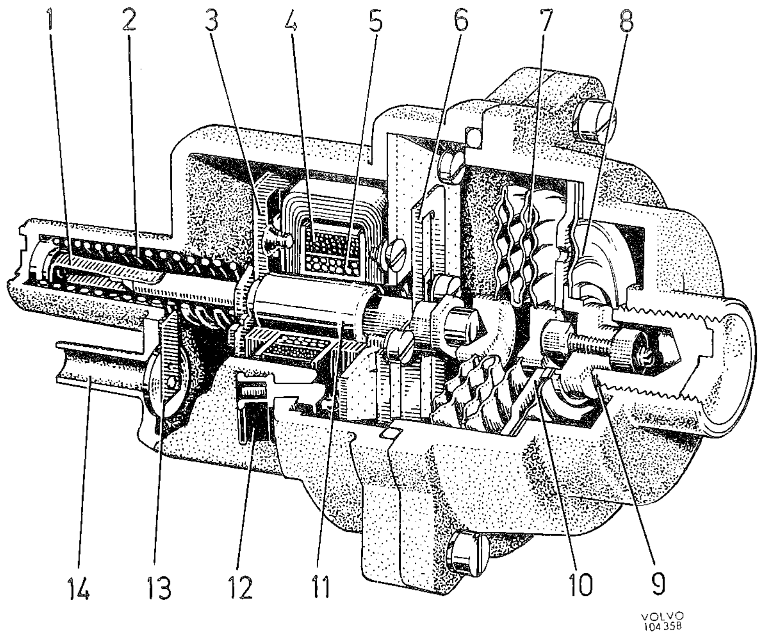


Fig. 2-64. Pressure sensor
1. Damping spring
2. Coil spring
3. Leaf spring (suspension)
4. Secondary winding
5. Primary winding
6. Leaf spring (suspension)
7. Diaphragm bellows
8. Diaphragm
9. Full-load stop
10. Part-load stop
11. Armature
12. Electrical connection
13. Valve
14. Hose connection

When the engine is switched off, atmospheric pressure exists on both sides of the diaphragm (8) and the movable armature (11), which is suspended friction-free in both leaf springs (3 and 6), is pressed against the full-load stop (9) by the spring (2). Moreover, both the deflated diaphragm bellows (7) are pressed together, since they are influenced by atmospheric pressure. This permits the armature (11) to move itself further to the right. With the armature at the extreme right, the pressure sensor informs the control unit that maximum possible fuel can now be injected. When the engine starts and the underpressure from the engine intake duct influences the left-hand side of the diaphragm (8), atmospheric pressure forces the diaphragm over to the part-load stop (10). At the same time, the diaphragm bellows (7) expand since they are influenced by the underpressure inside the pressure sensor and they move the armature a bit to the left. Depending upon the pressure in the inlet duct (engine load) the armature adjusts itself to different positions during driving.

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

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

THE AUXILIARY AIR VALVE

sits on the intake manifold and, like the idle adjustment screw, is connected to a by-pass line over the throttle valve.

When the engine is cold, the bi-metal spring 3 presses on the auxiliary air valve 2 so that the air duct is held open. When the starter motor is operating and the engine has started, current flows through the electric cable 1, which heats up the bi-metal spring. When the bi-metal spring is heated up, it bends away from the valve, which then closes off the duct, with the help of the coil spring (4).

During cold starting and warm running, the auxiliary air valve is open so that the engine gets more air and thus runs at a higher idling speed.

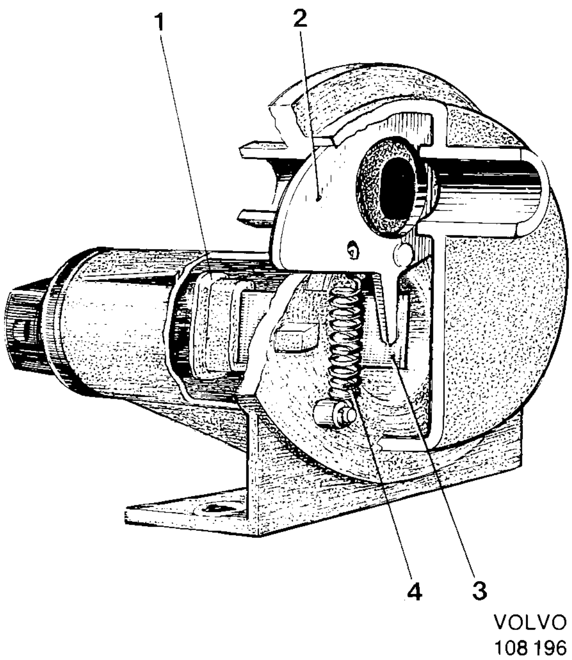


Fig. 2-65. Auxiliary air valve

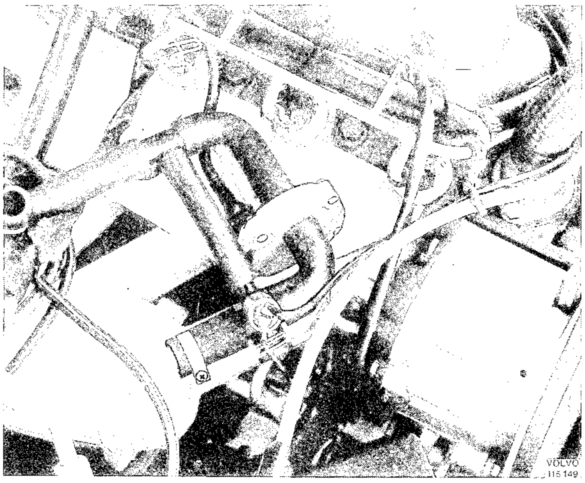


Fig. 2-66. Auxiliary air valve installed

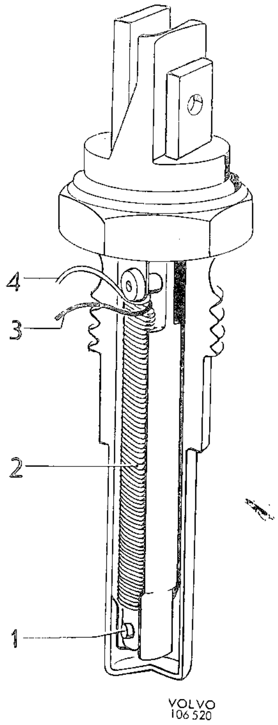


Fig. 2-68. Thermal time switch
1. Contacts
2. Bi-metal spring
3. Cable
4. Cable

THERMAL TIME SWITCH

The thermal time switch regulates the injection interval for the cold start valve. With a cold engine (below +35°C =95°), the contacts (1) are closed. When the starter motor operates, current then flows from it to the cold start valve and via the cable (3) and contacts (1) to ground. At the same time a current flows from the starter motor via the cable (4) and the contacts (1) to ground. As long as the contacts (1) are closed and the starter motor engaged, the cold start valve will inject. When current flows through the cable (3), this heats up the bi-metal spring (2) which bends and causes the contacts (1) to open. The cold start valve will now stop injecting. The heating-up time for the bi-metal spring, and thereby the injection interval for the cold start valve, varies with engine temperature.

TEMPERATURE SENSORS

The system is equpped with two temperature sensors, one for coolant and one for intake air. The temperature sensor for the coolant provides the control unit with information about the coolant temperature so that the control unit can adapt the injection interval.
The temperature sensor for the intake air provides the control unit with information about the temperature of the intake air so that the control unit can increase the injection

Fig. 2-67. Thermal time switch installed

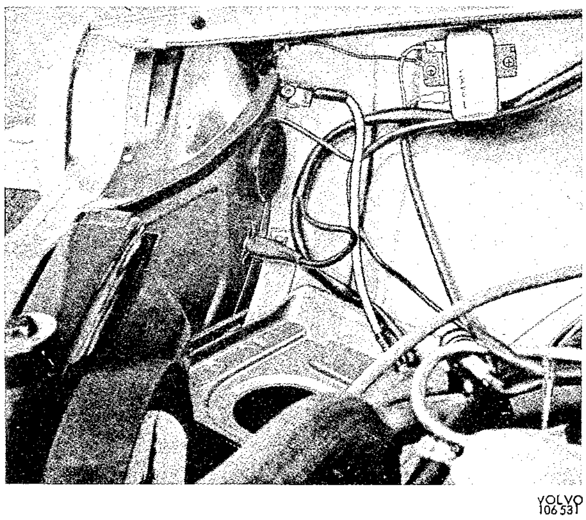


Fig. 2-69. Temperature sensor for intake air, installed

Fig. 2-70. Temperature sensor for coolant, installed

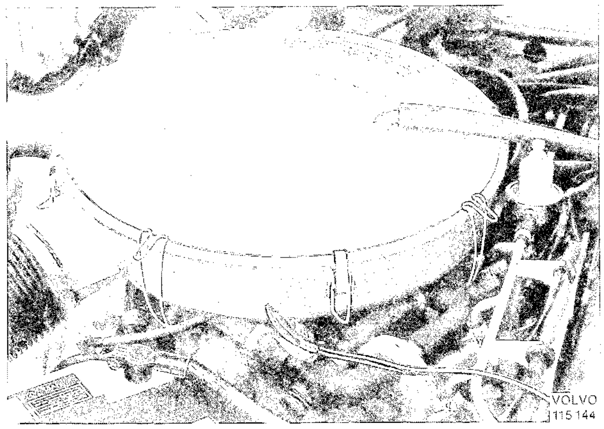


Fig. 2-71. Air cleaner, installed

quantity somewhat at low intake air temperature. Compensation ceases when the temperature of the intake air is greater than +30°C (86°F).

The temperature sensor for the coolant is located at the front of the cylinder head, see Fig. 2-70, and the temperature sensor for the induction air in front of the battery, see Fig. 2-69.

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

AIR CLEANER

The air cleaner is placed above the intake manifold, see Fig. 2-71, and is of the paper type. It should be replaced after every 40 000 km (24 000 miles).

INTAKE MANIFOLD

The intake manifold is of aluminium, cast in one piece. It consists of a common intake manifold from which individual induction pipes lead to each intake port in the cylinder head.

A throttle valve is mounted at the mouth of the common intake manifold. During idling, the throttle valve is completely closed and the engine receives air through a by-pass line from the top side of the throttle valve to its bottom side. Idling speed is adjusted by altering the cross-sectional area of the auxiliary air pipe by means of the idle adjusting screw placed in the line, see Fig. 2-72.

TRIGGERING CONTACTS

Below the centrifugal governor in the distributor there is a contact device with two triggering contacts, see Fig. 2-73.

The contacts are actuated by a cam on the distributor shaft. The function of these contacts is to supply information to the control unit about engine speed so as to enable the control unit to determine, partly when the injection should begin, and partly the duration of the injection with the help of the information from the pressure sensor.

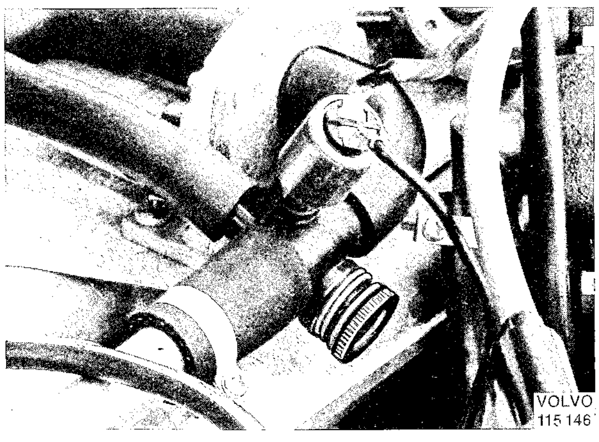


Fig. 2-72. Idle adjustment screw

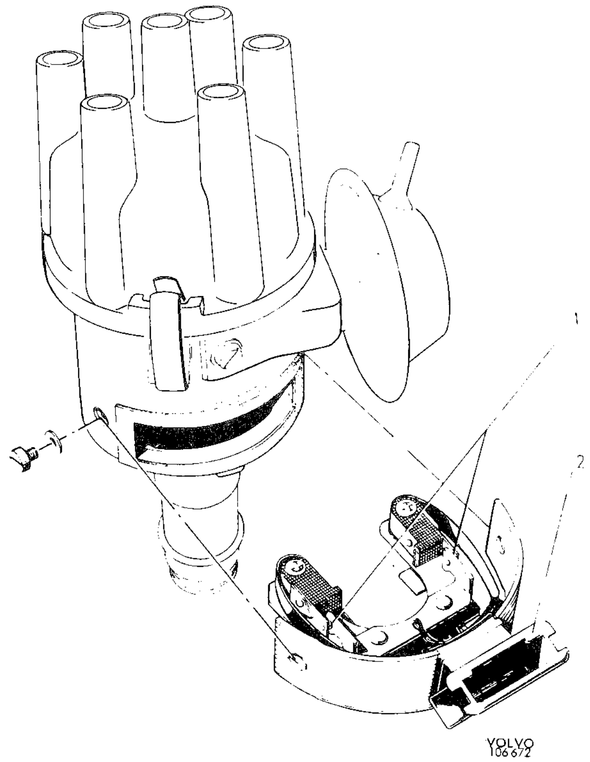


Fig. 2-73. Distributor with control device
1. Triggering contacts 2. Electrical connection

CABLE LOOM

All electrical components in the electronic injection system are mounted in a special cable loom with numbered cables, see next page, Fig. 2-74. The connections between the cable loom and components are of the so-called "Amp" plug type, which makes for good electrical contact as well as rapid removal and fitting of the various components. The plugs are provided with grommets to ensure proper installation in the various components. Check that the grommet enters the cut-out on the control unit by pushing in the loom plug securely. The connections are covered by rubber protectors which also serve for locking purposes. These protectors are removed by pulling the "tongues".

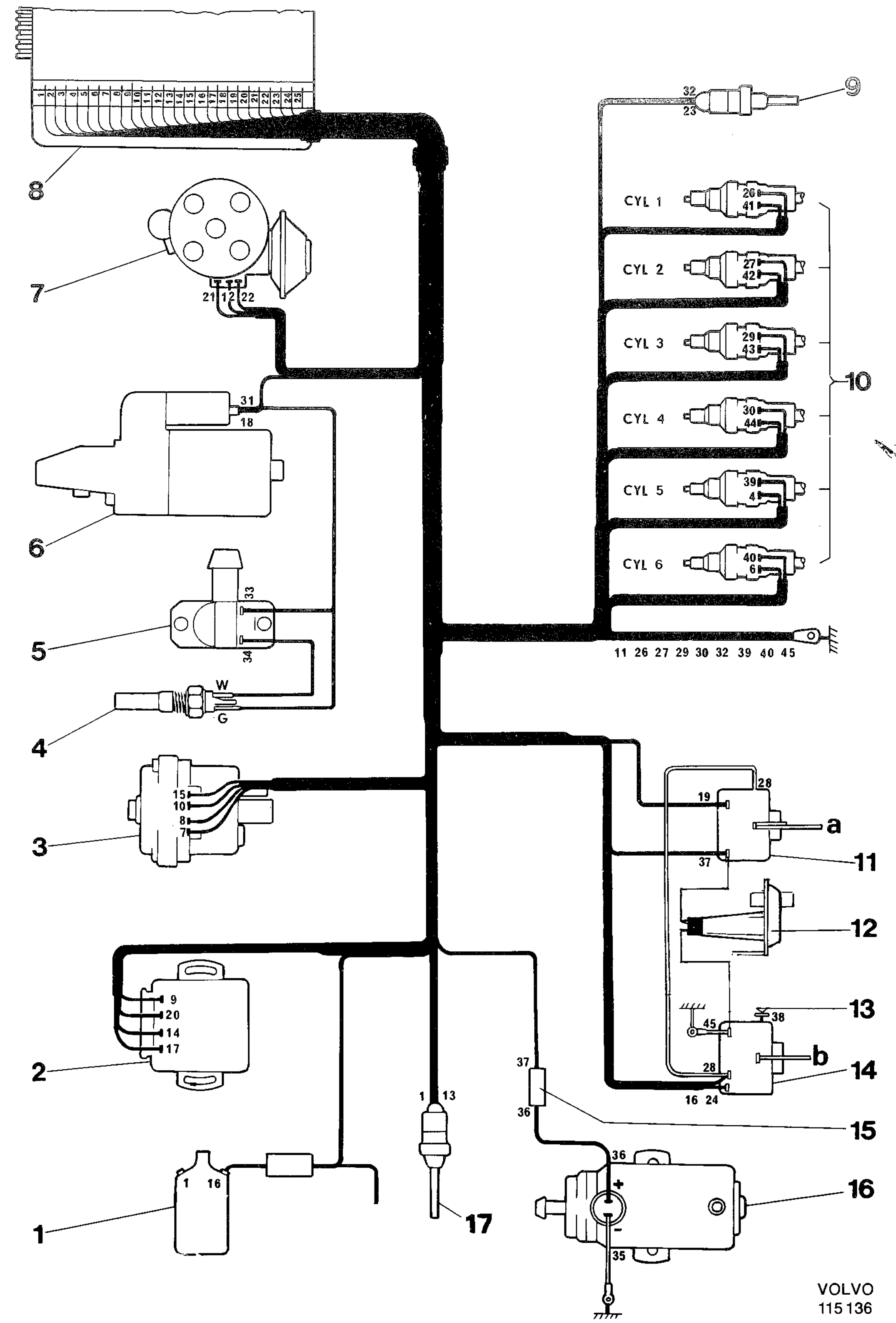


Fig. 2-74. Cable loom

1. Igniton coil (term. 16)
2. Throttle valve switch
3. Pressure sensor
4. Thermal time switch
5. Cold start valve
6. Starter motor (term. 50)
7. Distributor (triggering contacts)
8. Control unit
9. Temperature sensor for coolant
10. Injectors
11. Pump relay
12. Auxiliary air valve
13. Diode (located in relay)
14. Main relay
15. Connector
16. Fuel pump
17. Temperature sensor for induction air

a. To fuse 1 (small fuse box)
b. To battery, B+

CABLE LOOM NUMBERING

Cable No. From	To
1 Control unit	Temperature sensor I (induction air)
3 Control unit	Injector cyl. 1
5 Control unit	Injector cyl. 2
3 Control unit	Injector cyl. 3
5 Control unit	Injector cyl. 4
4 Control unit	Injector cyl. 5
6 Control unit	Injector cyl. 6
7 Control unit	Pressure sensor
8 Control unit	Pressure sensor
9 Control unit	Throttle valve switch
10 Control unit	Pressure sensor
11 Control unit	Ground
12 Control unit	Distributor (Triggering contacts)
13 Control unit	Temperature sensor I (Induction air)
14 Control unit	Throttle valve switch
15 Control unit	Pressure sensor
16 Control unit	Main relay, terminal 87
17 Control unit	Throttle valve switch
18 Control unit	Starter motor, terminal 50
19 Control unit	Pump relay, terminal 85
20 Control unit	Throttle valve switch
21 Control unit	Distributor (Triggering contacts)
22 Control unit	Distributor (Triggering contacts)
23 Control unit	Temperature sensor II (Coolant)
24 Control unit	Main relay, terminal 87
26 Injector, cyl. 1	Ground
27 Injector, cyl. 2	Ground
29 Injector, cyl. 3	Ground
30 Injector, cyl. 4	Ground
39 Injector, cyl. 5	Ground
40 Injector, cyl. 6	Ground
32 Temperature sensor II	Ground
35 Fuel pump (−)	Ground
36 Fuel pump (+)	Connector
37 Connector	Pump relay, terminal 87
38 Main relay, terminal 86	Ignition
45 Main relay, terminal 85	Pre-engaging resistance
28 Main relay, terminal 87	Ground
31 Thermal time switch	Pump relay, terminal 30 Starter motor 50

FUEL TANK

Fig. 2-75 shows the layout of the tank which holds 60 liters (16 US gals.) and is fitted with a built-in plastic expansion tank (10) for 5 liters (5 qts.). The expansion tank has an equalizing hole on top and an inlet hole underneath, dimensioned for slow filling.

When the fuel tank is full, there is air in the expansion tank to cope with fuel expansion caused by increase in temperature.

The tank is provided with a baffle can (11). Fuel is taken from it via the filter (12).

The filter (12) is accessible for cleaning after the plug underneath the tank has been removed. The filter should be cleaned every 20 000 km (12 000 miles).

The tank is fitted with a breather pipe (8) and equalizing hose (9).

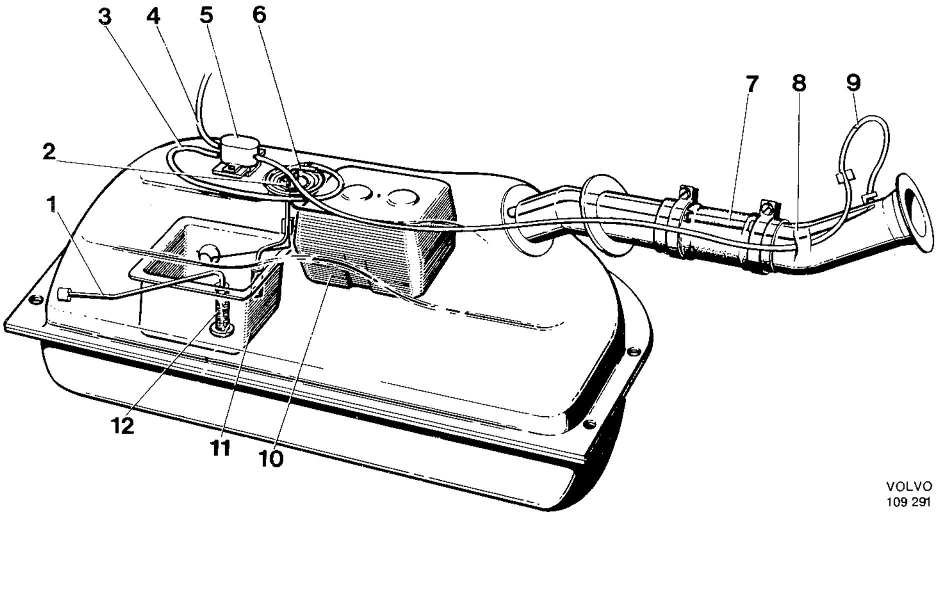


Fig. 2-75. Fuel tank
1. Fuel output
2. Level sender unit
3. Hose connecting tank and equalizing valve
4. Venting filter hose
5. Equalizing valve
6. Connection for return line
7. Hose
8. Breather pipe
9. Equalizing nose
10. Expansion tank
11. Baffle can
12. Fuel filter

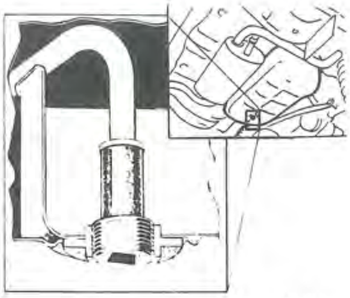


Fig. 2-76. Filter in fuel tank

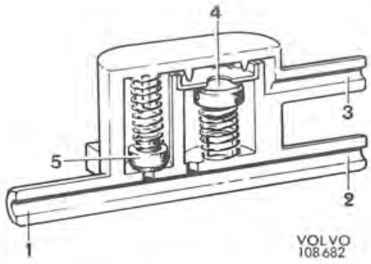


Fig. 2-78. Equalizing valve (on fuel tank)

1. Hose to filler neck
2. Hose to tank (fuel gauge sender)
3. Hose to venting filter
4. Underpressure valve
5. Overpressure valve

The equalizing hose is connected to an equalizing valve (5). A hose (3) from the tank is also connected to this valve. From the valve a hose (4) runs to the venting filter in the engine compartment at the front.

Concerning the function of the equalizing valve, see under "Gas evaporative system"

FILTER IN FUEL TANK

Clean the tank filter every 20 000 km (12 000 miles). The filter is accessible after the bottom plug (see Fig. 2-76) has been screwed out.

When installing the filter, check to make sure that the suction pipe is centered in the flange hole. If this is not done, the filter can be incorrectly installed in the pipe and the bottom plug come askew, this causing at worst fuel blockage.

GAS EVAPORATIVE EMISSION CONTROL SYSTEM

The cars are fitted with a gas evaporative emission control system that prevents gas fumes from being released into the atmosphere.

Fig. 2-77. Venting filter, fitted

The system consists of a venting filter with an air valve (Fig. 2-77), an equalizing valve (Fig. 2-78) and hoses that connect the various components.

An expansion tank (2, Fig. 2-79) in the fuel evaporative emission control system absorbs any fuel expansion caused by temperature with a full tank.

Fig. 2-79 shows how the system functions in principle. Fuel fumes in the fuel tank, particularly during warm weather, are conveyed through hoses to the equalizing valve (3, see red arrow).

The balance valve (3) consists of an overpressure valve (4) and an underpressure valve (5). When pressure rises above 0.05 – 0.2 kp/cm² (0.7 – 2.8 psi), the valve (5) opens and the fuel fumes go to the venting filter where they are absorbed by active carbon.

The equalizing valve prevents fuel, for example when taking a bend, from running up the hose to the venting filter. The function of the valve (5) is such that it opens when the vacuum in the tank exceeds 0.1 – 0.2 kp/cm² (1.4 – 2.8 psi), the valve (5) opens and air goes via the venting filter to the tank.

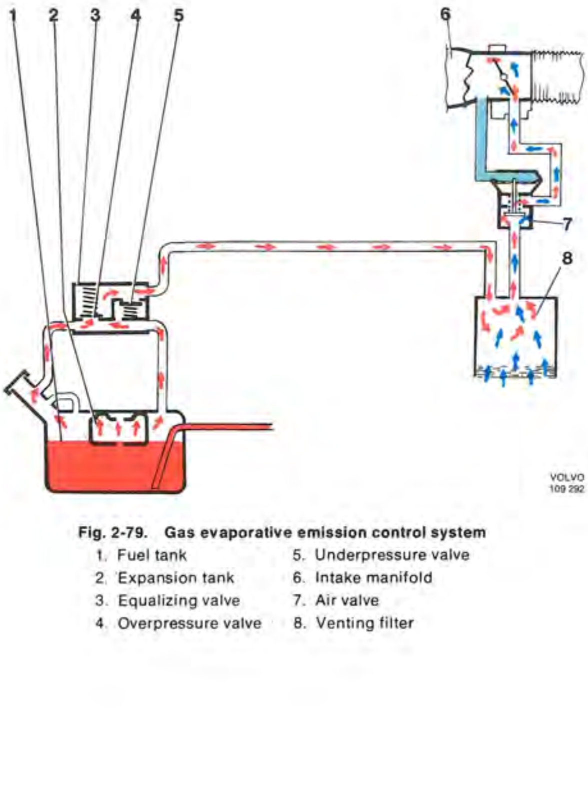


Fig. 2-79. Gas evaporative emission control system

1. Fuel tank
2. Expansion tank
3. Equalizing valve
4. Overpressure valve
5. Underpressure valve
6. Intake manifold
7. Air valve
8. Venting filter

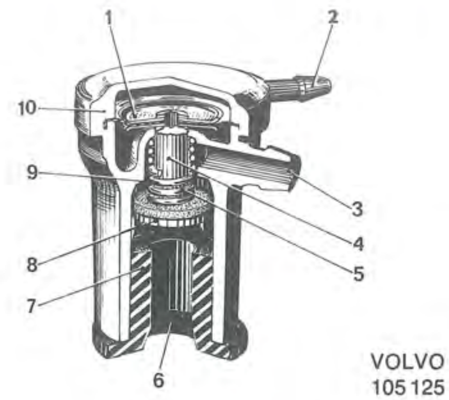


Fig. 2-80. Air valve

1. Diaphragm
2. Connection for vacuum hose to intake manifold
3. Connection for fuel fumer hose to intake manifold
4. Valve rod
5. Thrust spring
6. Connection for venting filter
7. Rubber sleeve
8. Valve
9. Valve seat
10. Housing

The air valve (Fig. 2-80) controls the connection between the venting filter and the carburetor venturi. The space above the diaphragm (1) is connected by a line to the intake manifold, see Fig. 2-79.

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

At high vacuum, the air valve is kept closed. When the vacuum drops the valve opens and air is drawn through the venting filter and vacuum valve to the carburetor venturi. Fuel fumes stored in the venting filter follow the air into the engine and take part in the combustion (fig. 2-79).

Exhaust gas recirculation (EGR)

Vehicles with a B 30 F-engine in combination with automatic transmission are equipped with an EGR system. This makes for cleaner exhaust gases when driving on half throttle. The system consists of a recirculation channel and an EGR valve operated under vacuum.

Fig. 2-81. EGR valve, installed

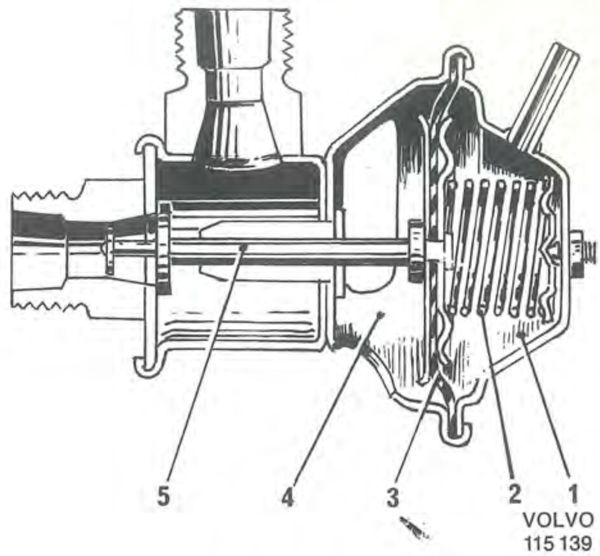


Fig. 2-82. EGR valve

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

Function

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

When the air shutter is closed, Fig. 2-83, the opening for the EGR line on the EGR valve is in front of the air shutter. The pressure in the EGR line and also in the EGR valve vacuum chamber is then equal to atmospheric pressure. Since the pressure in the EGR valve reference chamber is always equal to atmospheric pressure, the same pressure exists on both sides of the diaphragm and this keeps the valve in a closed position under the force of the spring. In orhter words, there is no exhaust gas recirculation. When

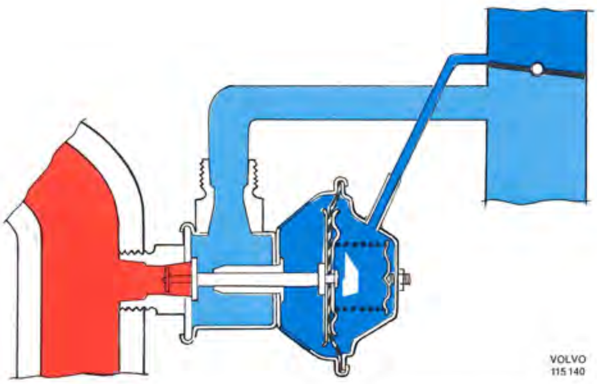


Fig. 2-83. Air shutter closed, no exhaust gas recirculation

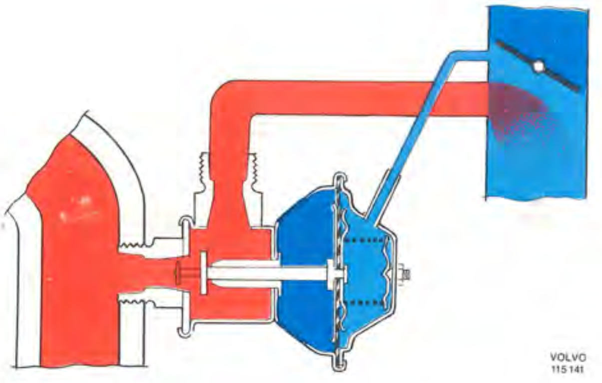


Fig. 2-84. Air shutter partly open, exhaust gas recirculation

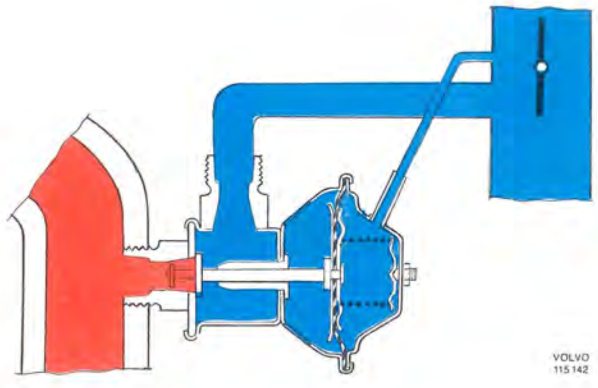


Fig. 2-85. Air shutter fully open, no exhaust gas recirculation

the air shutter is partly open, Fig. 2-84 the opening for the EGR line "moves" behind the air shutter. Behind the air shutter there is partial vacuum which is transmitted to the vacuum chamber of the EGR valve. The atmospheric pressure in the EGR valve reference chamber now presses the diaphragm backwards so that the valve opens. Exhaust gas recirculation now takes place to the intake manifold and back into the cylinders.

With a fully open air shutter, Fig. 2-85, there is atmospheric pressure in the intake manifold and this is transmitted to the vacuum chamber of the control valve. The pressure on both sides of the diaphragm is now equal so that the valve is closed by the spring. Exhaust gas recirculation has now stopped.

SERVICE PROCEDURES

SPECIAL INSTRUCTIONS FOR WORKING ON VEHICLES WITH ELECTRONIC FUEL INJECTION

1. **Never** let the engine run without the battery connected.
2. **Never** use a high speed battery charger as a starting aid.
3. When using a high speed charger to charge the battery in the vehicle, the battery should be disconnected from the rest of the electrical system.
4. The control unit may not overheat above +85°C (185°F). The control unit must not be connected up (the engine started) when the ambient temperature exceeds +70°C (158°F). (With paintwork on the body, etc., when the vehicle is being stove-heated, it must not be driven out of the oven, it must be conveyed out. If there is risk of temperature exceeding +85°C (185°F), the control unit must first be removed.)
5. The ignition must be switched off before connecting up or disconnecting the control unit.
6. For all work with fuel lines, great care **must** be taken to ensure that no dirt enters the system. Even tiny dust particles can jam injectors.

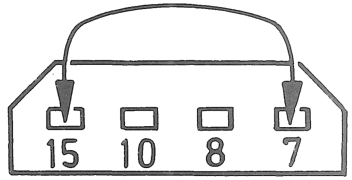
TESTING OF INJECTION EQUIPMENT WITH BOSCH TEST INSTRUMENT EFAW 228

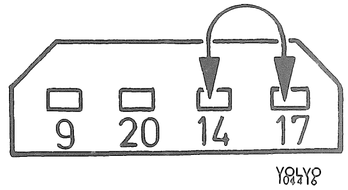
1. Switch off the ignition.
2. Remove control unit (see page 2 : 45).
   Connect the cable from the test instrument to the cable harness in the vehicle, see Fig. 2-86.
3. Turn switch "A" on the instrument to position "Measuring circuit B".
4. Test as follows:
   (NOTE. When testing with the test instrument, the entire program should be carried out. Any faulty component should be replaced or adjusted before continuing the test. Extra starting button for operating the starter motor may not be connected until the test "Voltage III starter motor" has been carried out.)

Fig. 2-86. Test instrument connected to cable loom

Fig. 2-87. Test instrument connected to cable loom

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

Position of switch "B"	Operate	To measure	Indication (nominal value)	Deviation from nominal value. Possible faults and elimination
	Push "Primary" button	Resistance of primary windings of pressure sensor	0.5—1 on the Ω scale (approx. 90 Ω)	**Resistance considerably smaller than nominal value:** Damage to insulation. (Pull plug out of pressure sensor and if test instrument shows "∞", replace pressure sensor, otherwise cables 7 and 15.) **Resistance considerably larger than nominal value:** Voltage drop in cables or contacts. (Check cables and contacts.) **Resistance "0":** Short circuit to ground, short circuit in secondary windings. (Pull plug out of pressure sensor and if test instrument shows "∞" replace pressure sensor, otherwise check cables 7 and 15.) **Resistance "∞":** Open circuit in sensor or cables. (Pull plug out of sensor. Bridge plug as shown in Illustration. If test instrument indicates 0, replace pressure sensor. If "∞" indicated, check cables 7 and 15.) 
	Push in "Secondary" button		3—4 on Ω scale (approx. 350 Ω)	See under "Primary". If needle of the test instrument shows "∞", connect terminals 8 and 10 in the plug instead of 7 and 15.)
Distributor contact I Distributor contact II	**Read off test instrument with switch in position I. Switch to position II. If the test instrument swings to 0 in the first position, it should now indicate ∞ and if the instrument shows ∞ in the first position, it should now indicate 0. Switch to position I. Run the engine with short strokes on the starter motor until the instrument shows a reading opposite to the first reading. Switch to position II again and check to make sure that the reading changes.**	Functioning of the triggering contacts in the distributor	0 and "∞" (0 and "∞" Ω)	**Resistance between 0 and "∞":** Check terminal on distributor. Check cables 12, 21 and 22. (If there is no fault in the terminal or cables change the contact insert in distributor.)

Position of switch "B"	Operate	To measure	Indication (nominal value)	Deviation from nominal value. Possible faults and elimination
Throttle valve switch I	Open and close throttle valve slowly	Impulses for extra fuel during acceleration	Instrument needle swings approx. 10 times between "0" and "∞" when the throttle valve opens. (0 and "∞" Ω) The instrument needle should indicate "∞" when the throttle closes.	**Instrument needle shows "0" or swings when throttle valve closes:** Faulty throttle valve switch, replace.
Throttle valve switch II				
Throttle valve switch III	Check that throttle valve is closed	Functioning of the contacts in the throttle valve switch	0 (0 Ω)	**Resistance "∞":** Throttle valve switch incorrectly adjusted or damaged. Open circuit in cable to switch. (Pull out plug and bridge as shown in Illustration. If the pointer swings to "0", there is no damage in the cables. Reconnect the switch. Check setting of throttle valve switch acc. to page 2 : 48. Change switch if unable to be adjusted.) 
	Open throttle valve approx 1°, (Place a 0.50 mm=0.02" feeler gauge between stop screw and stop on throttle spindle.)		"∞" ("∞" Ω)	**Reading "0":** Throttle valve switch incorrectly adjusted or damaged. Open circuit in cables. (Pull out plug. If reading swings to "∞", the cables are not damaged. Re-connect switch and check setting acc. to page 2 : 48. Replace throttle valve switch if unable to be adjusted.)
Temperature sensor I (intake air)		Resistance in temperature sensor for intake air	2—5 (300 Ω at +20° C= 68° F considerably dependent on temperature. Small reading at higher temperature.)	**Resistance "∞":** Open circuit. (Pull out plug and connect terminals. If reading swing to "0", change sensor, otherwise check cables 1 and 13.) **Reading "0":** Short circuit. Pull out plug. If reading is the same, check cables 1 and 13. If reading swings to "∞", change sensor.)
Temperature sensor II (cooling liquid)		Resistance in temperature sensor for coolant	0.5—3.5 (approx. 2.5 K Ω at +20° C=68° F. Considerably dependent on temperature. Lower reading at higher temperature.)	See "Temperature sensor I". Check cables 23 and 32.

Position of switch "B"	Operate	To measure	Indication (nominal value)	Deviation from nominal value. Possible faults and elimination
Valves	Adjust instrument to "∞" again (with switch "B" in position "valves") Push buttons: 1=injector for cyl. 1/3 2=injector for cyl. 2/4 3=injector for cyl. 6 4=injector for cyl. 5	Resistance of the windings in the injector with cable	1—2 (1—1.5 Ω) 3—4 (2—3 Ω) 2—3 (2.4 Ω at 20° C=68° F)	**Resistance "0":** Short circuit in cables or injectors. (Pull plug out of injector concerned and if test instrument shows "∞", exchange injector, otherwise replace cable harness.) **Resistance "∞":** Open circuit in cable or injector windings. (Remove plug from injector concerned, connect terminals in plug. If test instrument shows "0", the injector is defective; otherwise check the cables for the injector.) **Resistance over "1.5" and "3":** Ground cable from the injectors has a bad connection on the engine. (Check ground cables for respective valves, 26, 27, 29, 30, 39 and 40.)

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

Position of switch "A"	Operate	To measure	Indication (nominal value)	Deviation from nominal value. Possible faults and elimination
Valve check	Connect pressure gauge to pressure regulator, see page 2 : 47 Press "Pump" button on the instrument	Pressure in fuel system	Nominal value 2.0—2.2 kp/cm² (28—31 psi)	**No pressure build-up (pump does not start):** Check if pump relay cuts in when "Pump" button is depressed. Relay does not cut-in: Open circuit in cable 28, from main relay terminal 87 to pump relay terminals 86, resp. cable 19 from pump relay terminal 85 to control unit. (If the cables are not damaged, change the relay.) Relay cuts-in: Open circuit in cables 27 and 36, from terminal 87 on pump relay to contact on pump or in cable 35, from contact to ground. Faulty pump. (Check cables, measure voltage at plug contact for pump. If voltage is 12 volts, change pump.) **Pressure above or below 2.1 kp/cm² (30 psi):** Pressure regulator incorrectly adjusted or damaged. (Adjust or change regulator.)
	NOTE. The following control should only be made when it is ascertained that there is a fault in one of the injectors. Remove the injectors, see page 2 : 47 Press in "Pump" button on the instrument and check the injectors for leakage.	Function and leakage of the injectors		The valve opening may be wet, but the injector must not leak more than 5 drops per minute at 2.1 kp/cm² (30 psi).

Position of switch "A"	Operate	To measure	Indication (nominal value)	Deviation from nominal value. Possible faults and elimination
	Then press in buttons 1, 2, 3 and 4, one after the other with the "Pump" button and check that the injectors open. Take care not to damage the injector needles. Collect the injected fuel to prevent it from making contact with a possibly hot exhaust manifold.			

Switch off ignition. Connect control unit to other side of connection from instrument acc. to Fig. 2 : 45. Remove the pressure gauge. Fit the plug contacts on the distributor and coolant temperature sensor.

Distr. contact I Distr. contact II	Start engine and let it run about 33.3 r/s (2000 r/m) Switch over instrument to between Z-V contacts I and II	Functioning of the triggering contacts	Instrument pointer should swing to full reading and then to average value. On switching between ZV-contacts I and II, pointer may not move more than 2 fraction marks on voltage scale	**Feed reading deviates more than 2 fraction marks:** (Replace contact kit in distributor.)

Remove instrument and fit control unit.

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

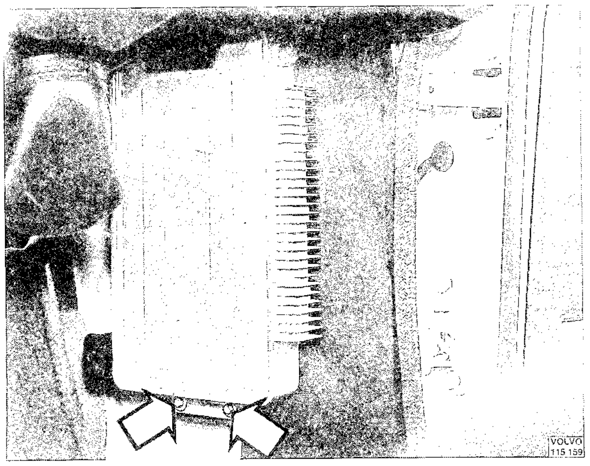


Fig. 2-88. Removing control unit

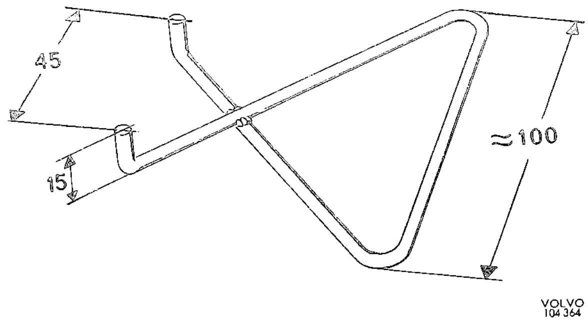


Fig. 2-90. Puller for plug contact
Material: 2 mm (5/65") welding wire

CONTROL UNIT

REMOVING

1. Move the right seat to its rear stop position.
2. Remove the bolt between the tubular bend and the link screw. Move the seat to the front stop position and fold it backwards, see Fig. 2-88.
3. Unscrew the two attaching screws and lift out the control unit.
4. Unscrew the screw for the cap holding the cable loom to the control unit, see Fig. 2-89.
5. Make a puller as shown in Fig. 2-90. Hook in the puller, see Fig. 2-91, and pull out the plug contact carefully.

INSTALLING

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

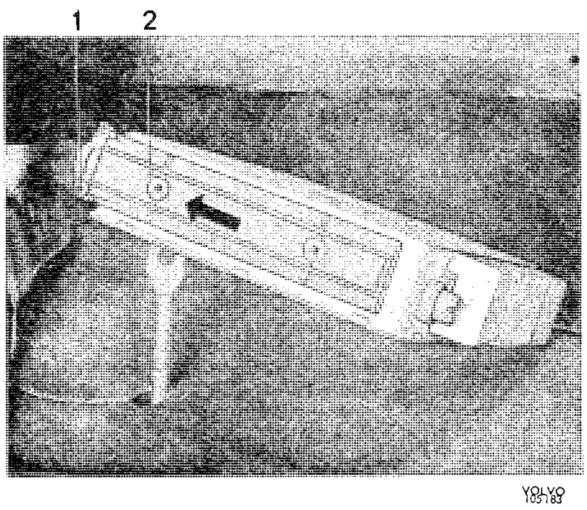


Fig. 2-89. Removing plastic cover
1. Cap screw
2. Plastic cover

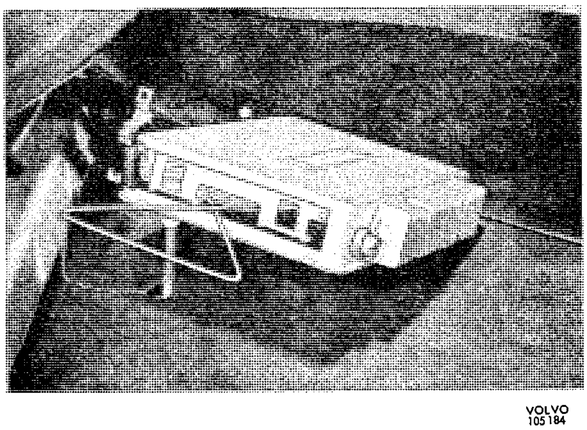


Fig. 2-91. Removing plug contact

FUEL PUMP

REPLACING

1. Disconnect the ground cable from the battery.
2. Clean the hose connections at the fuel pump.
3. Pinch the suction and discharge hoses with pinchers (999 2901).
4. Remove the hoses from the fuel pump.
5. Remove the fuel pump from the fuel tank.
6. Disconnect the electric cables from the fuel pump.
7. Remove the rubber pads from the fuel pump.
8. Fit the rubber pads on the fuel pump.
9. Connect up the electric cables to the fuel pump.
10. Fit the fuel pump on the fuel tank.
11. Fit the hoses on the fuel pump.
12. Remove the hose pinchers.
13. Connect up the ground cable to the battery.

CHECKING

The pump should deliver 100 dm^3/h (26.4 US gal./h) at a pressure of 2.1 kp/cm^2 (30 psi). At this load, current consumption should be 5 amps.

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

FUEL FILTER

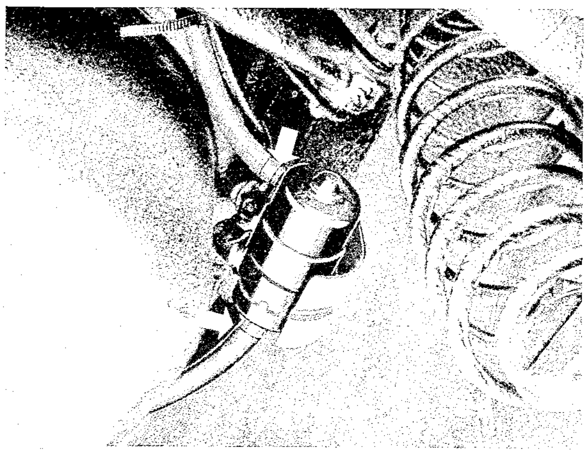
REPLACING (Every 20 000 km=12 000 miles)

1. Clean the filter hose connections.
2. Pinch the filter hoses with pinchers (2901). Release the hose clamps and remove the filter from the hoses, see Fig. 2-93. Remove the filter from the body by slackening the clamp.
   NOTE. Make sure that the new filter is fitted with the arrow pointing in the direction of fuel flow.
3. Fit the new filter and tighten the hose clamps. Remove the pinchers.
4. Check to make sure there is no leakage at the hose connections.

PRESSURE REGULATOR

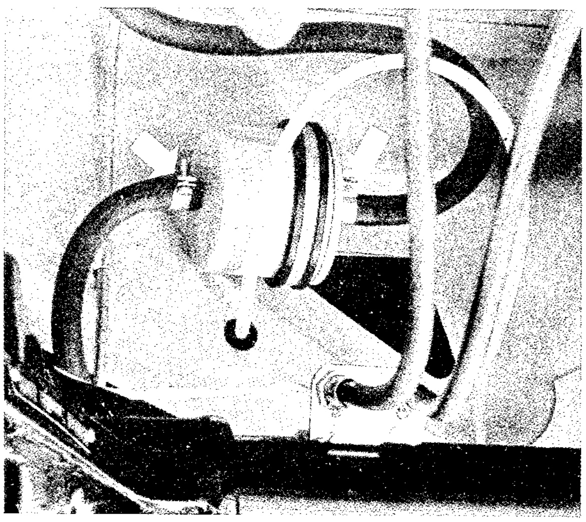
REPLACING

1. Disconnect the three hose connections to the pressure regulator. See Fig. 2-94.
2. Remove the pressure regulator.
3. Install the new regulator.
4. Tighten the three hose connections.
5. Check for leakage.



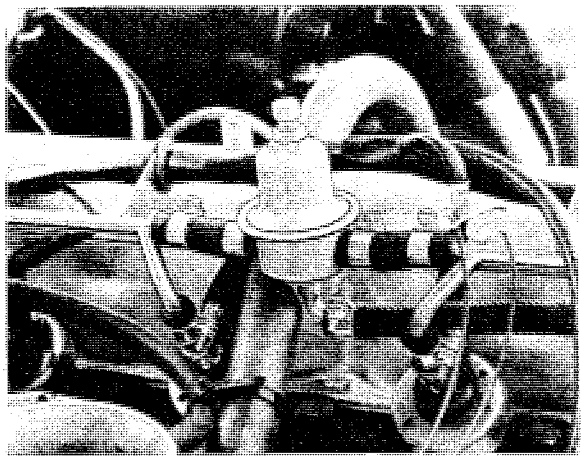
VOLVO
108 794

Fig. 2-92. Removing fuel pump



VOLVO
108 796

Fig. 2-93. Removing fuel filter

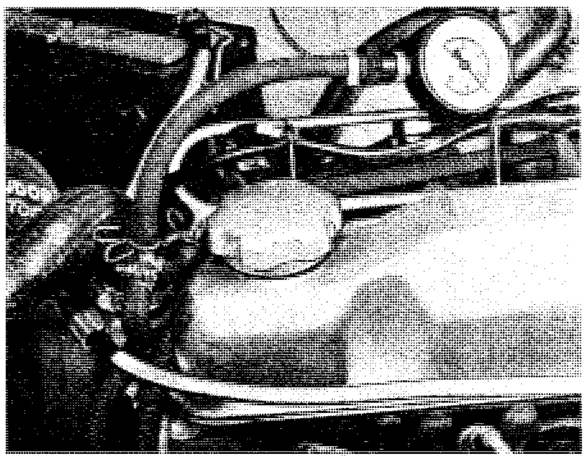


VOLVO
106 646

Fig. 2-94. Replacing pressure regulator

ADJUSTING

1. Slacken the hose clamp and remove the hose from the header pipe.
2. Connect up a pressure gauge according to Fig. 2-95.
3. Run the fuel pump, either by starting the engine or by connecting up test instrument Bosch EFAW 228 and operating the pump with this instrument.
4. Slacken the lock nut and adjust the pressure to 2.1 kp/cm² (30 psi). (Replace regulator if pressure is not correct.)
5. Remove the pressure gauge.
6. Connect the hose to the header pipe and tighten the hose clamp.



VOLVO
106 532

Fig. 2-95. Connecting pressure gauge

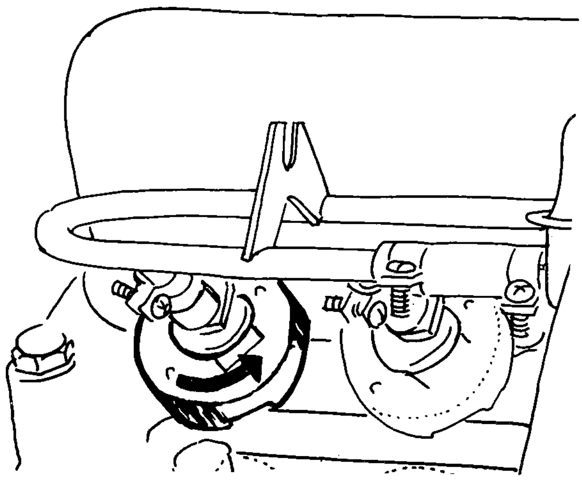
INJECTORS

REPLACING

1. Remove the air cleaner.
2. Remove the vacuum hose to the servo and the hose from the inlet duct to the oil trap.
3. Remove the plug contacts from the injectors and the throttle valve switch. Disconnect and lift out of the way the cable harness from the header pipe.
4. Disconnect the hose to the header pipe and from the pressure regulator, also the hoses between header pipe.
5. Remove the injector by turning the lock ring, see Fig. 2-96, anti-clockwise so that it loosens from the bayonet fitting. Pull up the injector.
6. Move over the sealing ring, washers, bayonet fitting. NOTE. The small rubber seal on the injector should be replaced each time the injector is removed.
   Installing is in reverse order, that is from 5 to 1.

CHECKING

Measure the resistance between the terminal pins. The resistance should be 2.40 ohms at +20°C (68°F).
NOTE. Never test an injector by connecting up 12 volts to the terminal. The injector will be ruined immediately since it caters for a max. operating voltage of 3 volts. Maximum leakage for the injectors is two drops per minute at 2.1 kp/cm² (30 psi).



VOLVO
115 143

Fig. 2-96. Removing injector

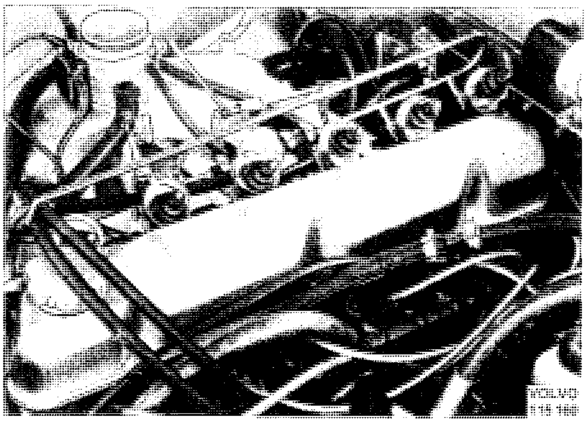


Fig. 2-97. Injectors removed for checking

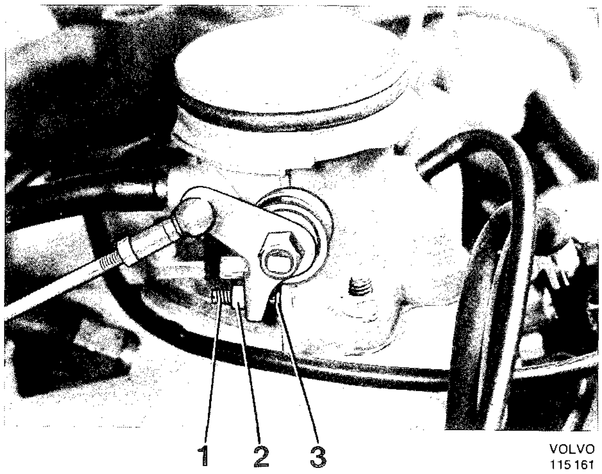


Fig. 2-98. Stop screw for throttle valve
1. Stop screw
2. Lock nut
3. Stop on valve spindle

COLD START VALVE

REPLACING

1. Remove the air cleaner.
2. Apply pinchers (2901) and pinch the hose for the cold start valve.
3. Remove the plug contact and the fuel hose from the valve.
4. Unscrew both screws securing the cold start valve and remove the valve.
5. Place the new cold start valve with packing in position and screw it on securely.
6. Connect the fuel hose and fit the plug contact to the valve.
7. Remove the pinchers.
8. Fit the air cleaner.

THROTTLE VALVE

ADJUSTING

1. Release the lock nut for the stop screw (2, Fig. 2-98) for the throttle valve switch and screw out the screw a couple of turns so that it does not lie against the stop on the throttle valve spindle. Check to make sure that the switch is fully closed.
2. Screw in the stop screw until it touches the stop on the switch spindle. Then screw it in 1 turn and tighten the lock nut. Check that the throttle valve switch does not jam or seize in the closed position.
3. Adjust the throttle valve switch as indicated under "Adjusting".
   NOTE. The stop screw must **not** be used for adjusting idle.

THROTTLE VALVE SWITCH

REPLACING

1. Remove the air cleaner.
2. Pull out the plug contact from the throttle valve switch.
3. Remove both the screws securing the throttle valve switch to the inlet duct. Pull the throttle valve switch straight out.
4. Press on the new switch carefully. Re-fit the screws but do not tighten them. Connect the plug contact. Adjust throttle valve switch according to below.
5. Fit the air cleaner.

ADJUSTING

1. Connect Bosch test instrument EFAW 228 according to page 2 : 57.
2. Set switch "A" to position "Measuring" and switch "B" to position "Throttle valve switch III".
3. Slacken the screws in order to turn the throttle valve switch. Make a mark on the inlet duct at the upper screw if there is not one there already.
4. Turn the throttle valve switch clockwise as far as possible. Then turn it slowly counter-clockwise until the pointer on the instrument goes over from "∞" to "0". Then turn a further 1° (1/2 graduation mark on the scale at the upper attaching screw) and secure the throttle valve switch.
5. Check to make sure that the instrument pointer goes over to "∞" when the throttle valve opens about 1°. (Place a 0.50 mm=0.02" feeler gauge between the stop screw and stop on the throttle valve spindle. Change to a 0.30 mm=0.012" feeler gauge. The pointer should **not** then swing over to "∞".)

CHECKING

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

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

TEMPERATURE SENSOR I (INDUCTION AIR)

1. Remove the right drip protection.
2. Remove the air hose from the right side plate.
3. Pull out the plug contact from the temperature sensor.
4. Remove the temperature sensor.
   Installing is in reverse order, that is, from 4 to 1.

CHECKING

Measure the resistance between the terminal pins and compare with the table in Fig. 2-99.

AUXILIARY AIR REGULATOR

REPLACING

1. Drain the coolant from the engine block.
2. Disconnect the hoses from the auxiliary air regulator.
3. Remove the auxiliary air regulator (Inhex $^3/_{16}$).
4. Place the packing in position and install the new regulator.
5. Fit the hoses.
6. Close the drain cock and fill with coolant.

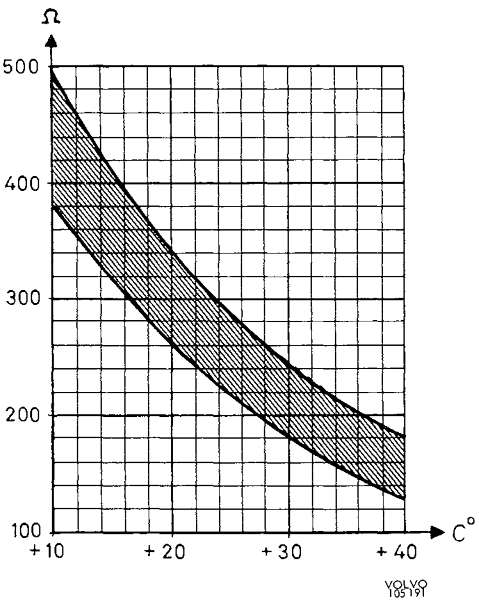
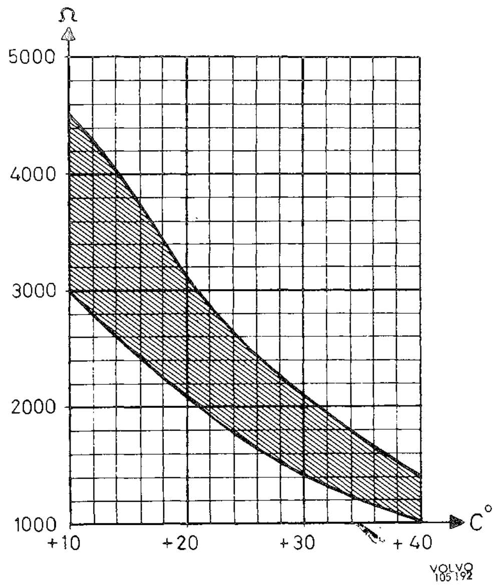


Fig. 2-99. Resistance in temperature sensor for induction air



Firg. 2-100. Resistance in temperature sensor for coolant

TEMPERATURE SENSOR II (COOLANT)

REPLACING

1. Pull out the plug contact from the sensor.
2. Remove the temperature sensor. NOTE. To avoid losses, the new temperature sensor, provided with packing, should be ready for installing.
3. Install the new temperature sensor.
4. Re-fit the plug contact.

CHECKING

Measure the resistance between the terminal pins and compare with the table in Fig. 2-100.

PRESSURE SENSOR

REPLACING

1. Disconnect the hose and remove the plug contact from the sensor. Remove the sensor.
2. Move the bracket from the old to the new sensor.
3. Installing is in reverse order, that is, from 2 to 1.

CHECKING

Measure the resistance between the terminal pins.

The resistance should be approx. 90 ohms between 7 and 15 (primary winding).

Approx. 350 ohms between 8 and 10 (secondary winding).

All other combinations should give "∞" resistance.

IGNITION DISTRIBUTOR TRIGGERING CONTACTS

REPLACING

1. Remove the distributor.
2. Clean the outside of the distributor.
3. Remove both the screws. Pull out the insert.
4. Lubricate the fibre tabs on the new insert with grease (Bosch Ft 1 v 4 or corresponding).
5. Check to make sure that the packing is not damaged if it is not to be replaced.
6. Fit the contact insert.
7. Fit the distributor and adjust the ignition.

AIR CLEANER

REMOVING

1. Disconnect the hoses from the rocker arm casing and side plate.
2. Release the tensioning clamps from the air cleaner.
3. Lift off the air cleaner.
4. Check the rubber sealing.
   Installing is in reverse order to removing.

ADJUSTING IGNITION

1. Connect a rev counter and stroboscope.
2. Remove the hose for air cleaner at the inlet duct. Disconnect the hose to the distributor vacuum governor from the inlet duct.
3. Start the engine and adjust down the speed to 11.7–13.3 r/s (700–800 r/m).
4. Set the firing to 10° BTDC. (When adjusting, disconnect the distributor housing and turn it in the desired direction.)
5. Re-fit the hose from the vacuum governor.

ADJUSTING IDLING

1. Run the engine until it is warm (approx. 80°C=176°F). Connect a rev counter.
2. Check to make sure that the auxiliary air regulator is completely closed by pulling off the hose between the inlet duct and the regulator and by covering the opening with the hand. The speed must not differ much from the previous speed. (Engine insufficiently warm or auxiliary air regulator faulty, if there is much difference in speed.) Re-fit the hose.

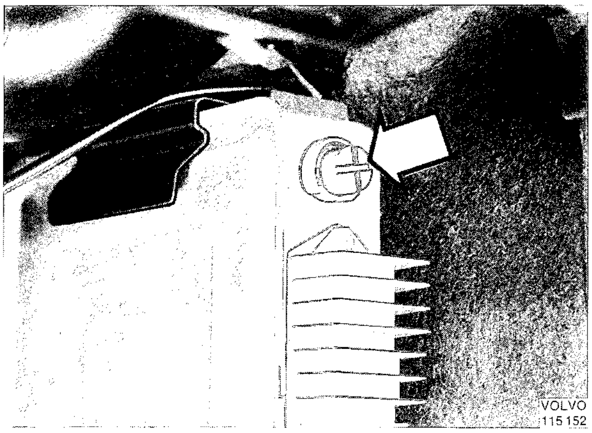


Fig. 2-101. Adjusting CO-value

3. Adjust the idling speed to 15 r/s (900 r/m) (for vehicles with automatic transmission, 13.3 r/s = 800 r/m) by means of the idle adjustment screw. (If the speed cannot be lowered sufficiently, check the basic setting of the throttle valve, see page 2 : 48).
4. Fit the hose from the air cleaner.

ADJUSTING CO-VALUE

Adjusting is at idling speed and with the engine warm (80°C=176°F).

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

EXHAUST GAS RECIRCULATION SYSTEM

CHECKING THE EGR VALVE

The EGR valve should be checked and cleaned every 24 000 km (15 000 miles). An Odo-meter is placed under the dashboard and connected to the mileometer. Its function is to remind the driver that it is time to check and clean the EGR valve. When the above mileage has been reached, the contacts in the Odo-meter close and this lights up a warning lamp in the combined instrument. When servicing the EGR, the warning lamp should be out and the Odo-meter zero-set. This is done by removing the cover on the reverse side of the Odo-meter and by pressing in the white plastic bar in the bottom.

The intake manifold should only be cleaned when necessary. To do this, first remove the manifold. The

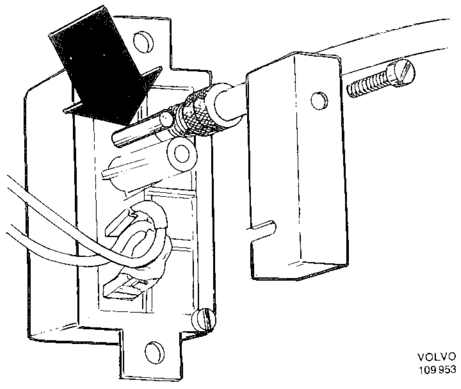


Fig. 2-102. Odo-meter

function of the EGR system can be checked by connecting the vacuum hose of the distributor to the EGR valve vacuum chamber and with the engine on idle. The engine should stop or run unevenly. If this does not happen, check to make sure that the return pipe and the EGR line are not blocked. If the return pipe and EGR line are without fault, change the EGR valve for a new one. The EGR valve should always be replaced after every 48 000 km (30 000 miles).

When servicing the EGR, the warning lamp should be out and the Odo-meter zero-set. This is done be removing the cover on the reverse side of the Odo-meter and by pressing in the white plastic bar in the bottom.

INTAKE AND EXHAUST SYSTEM

GENERAL INFORMATION

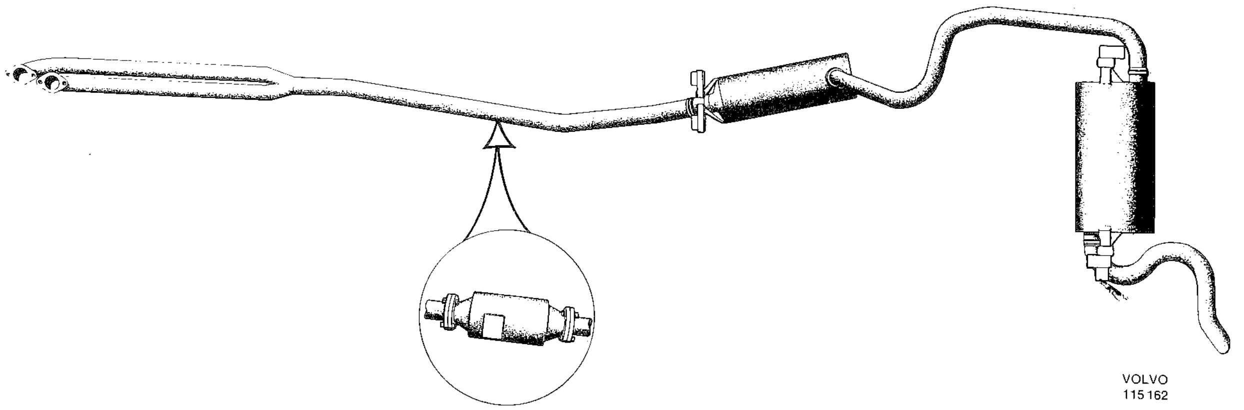


Fig. 2-103. Exhaust system B 30 E/F

INTAKE AND EXHAUST MANIFOLDS

The inlet manifold is of light-alloy and designed for electronic fuel injection.
The exhaust pipe system consists of two separate cast iron pipes each of which serves three cylinders.

MUFFLER AND MANIFOLD PIPES

The exhaust system is made up of a twin leading pipe, a catalytic converter, a leading muffler, intermediate pipe, rear muffler (resonator) and rear pipe. The leading pipes are bolted to the exhaust manifold pipes by studs and nuts. There are two types of pipe joints; **early prod.:** one where the joints are clamped by means of conventional screw clamps; **late prod.:** and the other where the joints, intermediate pipe—rear muffler and rear muffler—rear pipe are hydraulicly clamped. The leading pipe is suspended to the transmission to reduce stresses in the manifold. The leading muffler is suspended at its front end by means of two rubber rings and the rear muffler is held in position by means of a rubber shackle, one at each end.
The vehicles are equipped with an Exhaust Gas Recirculation system (EGR). For information and service procedures on this system, see pages 2 : 50 and 2 : 57 respectively.

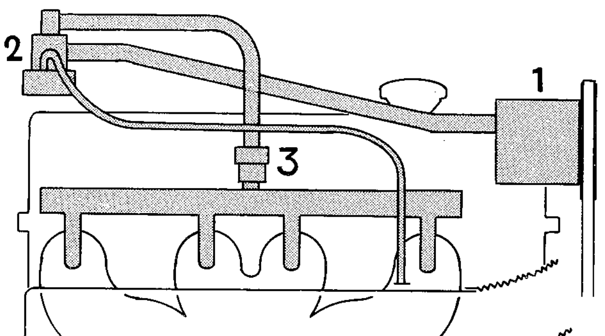


Fig. 2-104

AIR INJECTION REACTOR

This exhaust emission system consists of an air pump (1), a diverter valve (2), a backfiring valve (3) and an air manifold (4).
These components are connected to each other by means of rubber hoses.

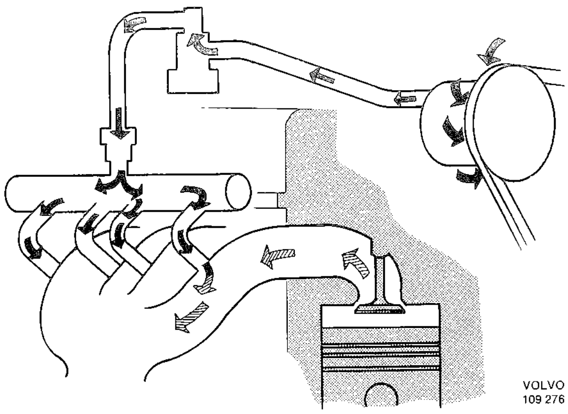


Fig. 2-105

When the engine is running, air is pumped from the air pump to the diverter valve, the backfiring valve and the air manifold into the branches of the exhaust manifold.

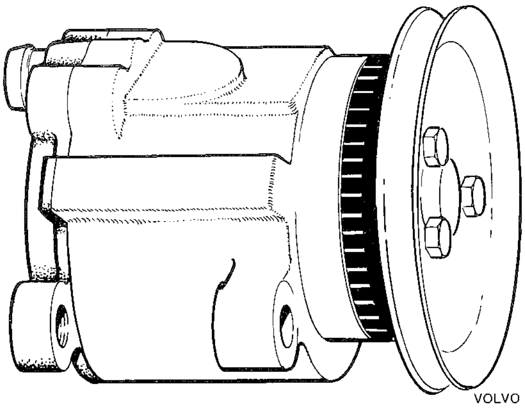


Fig. 2-106

The air pump, a so-called displacement pump, is of the vane type and is driven from the engine with the help of a belt. The pump is lubricated for life and **must not** be lubricated.

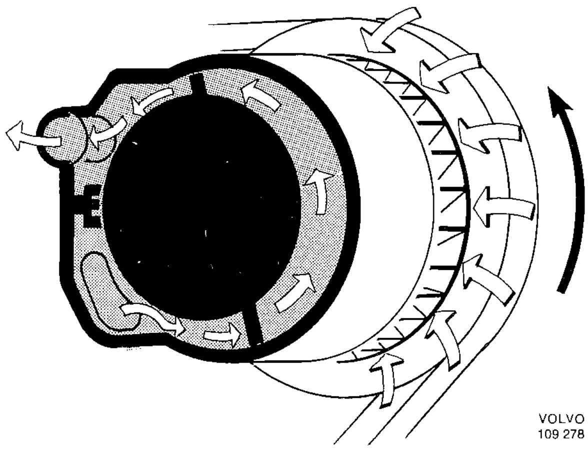


Fig. 2-107

The pump takes in air via a centrifugal filter fan which separates the larger impurities from the air.
The cleaned air is compressed by the vane pump and discharged through the outlet in the rear end of the pump housing.

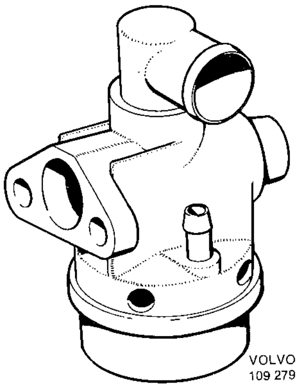


Fig. 2-108

The diverter valve is located on the firewall. It closes the air discharge to the air manifold at the beginning of a deceleration. It also limits the maximum air pressure in the air line between the valve and air pump.

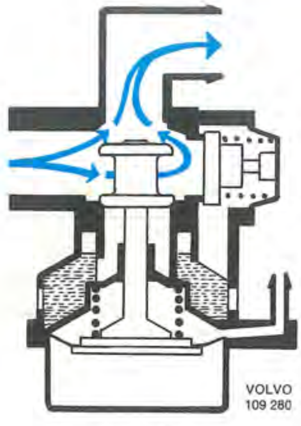


Fig. 2-109

Normally the diverter valve works in this position, that is, it diverts air from the air pump to the backfiring valve and exhaust manifold.

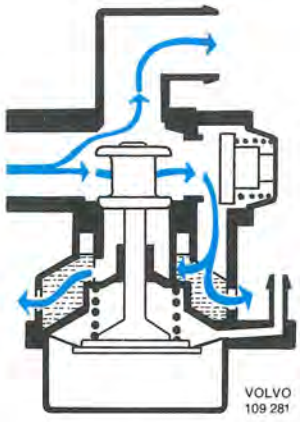


Fig. 2-110

At a certain backpressure at the valve outlet (1), the valve (2) opens and the surplus air is exhausted to the atmosphere.

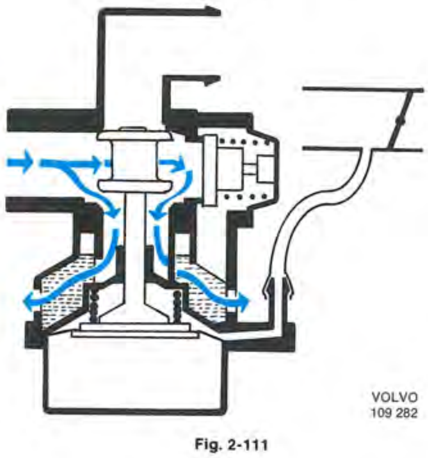


Fig. 2-111

During deceleration, the valve closes with the help of the vacuum formed in the intake manifold since air injected at this time would cause backfiring. When a sharp rise in vacuum is sensed, the diverter valve exhausts the air pump output into the atmosphere for a few seconds.

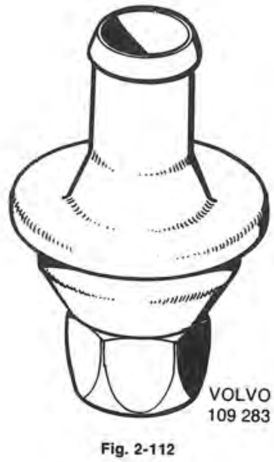


Fig. 2-112

The backfiring valve is mounted on the air manifold.

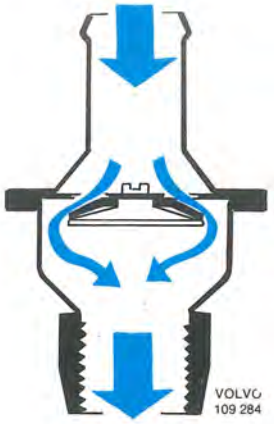


Fig. 2-113

Under normal operating conditions, air flows as shown in the adjacent illustration between the metallic disc (1), and the rubber disc (2).

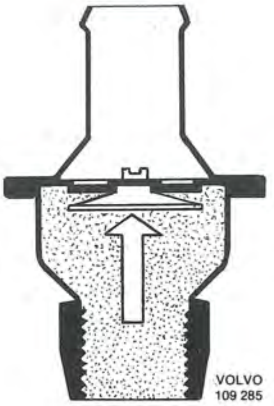


Fig. 2-114

If exhaust gases flow towards the backfiring valve, for example, when air charging ceases, the holes in the metallic disc are closed by the rubber disc.
This prevents gases from reversing and thus damage to the components.

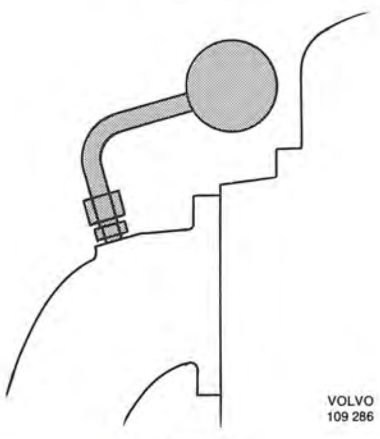


Fig. 2-115

From the backfiring valve the air goes through the air manifold to the exhaust manifold.

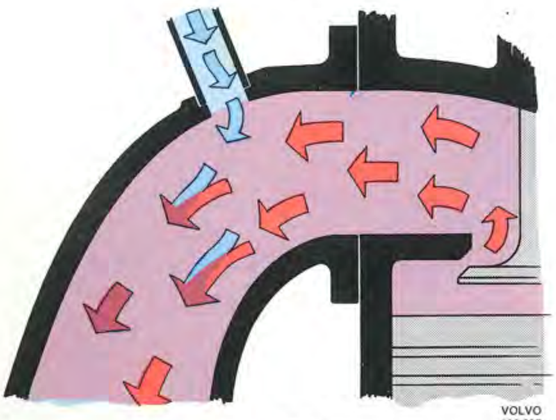


Fig. 2-116

When air flows into the exhaust manifold, the oxygen, blue arrows, react with the unburnt hydro carbons and carbon monoxide, red arrows, which results in carbon dioxide and steam.
Some rests of oxygen and exhaust emissions will yet always persist.

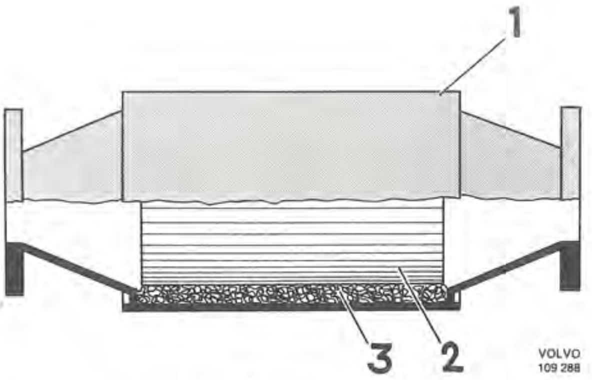


Fig. 2-117

CATALYTIC CONVERTER

The catalytic converter is fitted under the vehicle in front of the muffler. It is designed to take care of the exhaust emissions not taken care of by the air injection reactor. The converter consists of a stainless steel cover (1), which encloses a ceramic material (2), through which the exhaust gases flow.

Between the steel cover and the ceramic insert is steel wool which protects the insert against shocks and allows heat expansion.

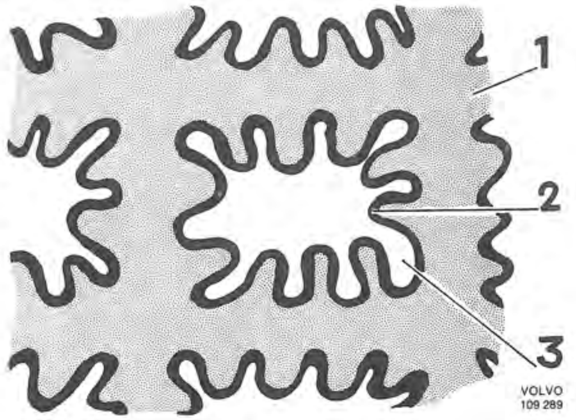


Fig. 2-118

The ceramic material consists of a ceramic core (1), coated with a very thin layer of platinum-palladium (2). These metals are catalysts. In other words they facilitate combustion without being burned up themselves.

The exhaust gases flow through the channel (3), the walls of which are designed to provide the greatest possible reaction surface and thereby maximum cleaning of the exhaust gases.

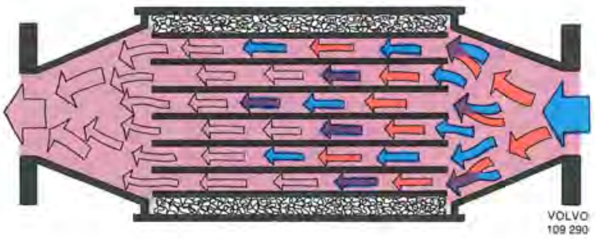


Fig. 2-119

Dirty exhaust gases and oxygen flow into the catalytic converter and are burned by the platinum-palladium layer so that very little dirty gas is finally exhausted.

SERVICE PROCEDURES

EXHAUST MANIFOLD GASKET REPLACEMENT

1. Disconnect the ground battery cable.
2. Remove the air cleaner.
3. Remove the throttle control, all hoses and electrical cables from the intake manifold.
4. (F-engine). Remove the battery. Disconnect the EGR-valve from the upper pipe. Remove the lower pipe with the EGR-valve.
5. Remove the manifold nuts and lift off the intake manifold.
6. Remove the clamp fixing the exhaust pipes to the gearbox.
7. Pull out the exhaust manifold from the cylinder head in order to get out the manifold gasket.
8. Remove the manifold gasket and clean the contact surfaces on the manifold and cylinder head.

9. Place the new manifold gasket on the cylinder head studs.
10. Fit the exhaust manifold in position. Place the intake manifold against the cylinder head, fit the manifold nuts and tighten to a torque of 18–22 Nm (1.8–2.2 kpm=13–16 lbft).
11. Fit the clamp fixing the exhaust pipes to the transmission.
12. Fit the EGR-valve with the lower pipe on the exhaust pipe but wihtout tightening up. Screw tight the EGR-valve to the upper pipe. Tighten the nut on the lower pipe.
13. Fit the throttle control, all hoses and electrical cables to the intake manifold.
14. Fit the air cleaner and the ground battery cable.

REPLACEMENT OF COMPLETE EXHAUST SYSTEM

B 30 F has a double leading exhaust pipe, otherwise the following applies.

1. Release the clamps on the leading muffler.
2. Pull off the intermediate pipe from the leading muffler.
3. Remove the rubber rings suspending the leading muffler. Use, for example, a screwdriver and lever the rubber rings off their brackets.
4. Pull off the leading muffler from the leading pipe.
5. Remove the rubber shackles suspending the rear muffler and lift down as a unit the intermediate pipe, rear muffler and rear pipe.
6. a. (Carburetor engine.) Remove the preheating plate.
6. b. (Injection engine.) Remove the air cleaner and battery. Disconnect the vacuum hose from the EGR-valve. Remove the lower pipe and nipple with washer from the exhasut pipe.
7. Unscrew the flange nuts and clamps securing the leading pipe to the transmission attachment.
8. "Manipulate" down the leading pipe.
9. Hang up a new flange gasket on the manifold. Fix the leading pipe with clamp to the transmission attachment.
10. Fit the flange nuts.
11. a. (Carburetor engine.) Fit the preheating plate.
11. b. (Injection engine.) Fit the nipple and washer onto the exhaust manifold. Fit the lower pipe and EGR-valve to the lower pipe without tightening up. Screw tight the EGR-valve to the upper pipe. Tighten up both nuts on the lower pipe, starting with the one at the EGR-valve. Fit the vacuum hose on the EGR-valve. Fit the vacuum hose on the EGR-valve. Fit the battery and the air cleaner.
12. Tighten up the clamp securing the leading pipe to the transmission attachment.
13. Hang the clamp up on the leading pipe and insert the leading muffler into the leading pipe. The pipe ends should be stuck in about 40 mm (1/2").
14. Fit the rubber rings for the leading muffler. Use, for example, a screwdriver and lever the rubber rings over the brackets.
15. Place the rubber shackle for the rear muffler on the underbody brackets.
16. Hang the clamps on the muffler and insert the rear pipe into the muffler about 40 mm (1/2"). NOTE! Rear mufflers with part Nos. 461356 and 460981, are marked "IN", where they are connected to the intermediate pipe.
17. Insert the intermediate pipe to the rear muffler about 40 mm (1/2"). Lift up the entire unit intermediate pipe, rear muffler, rear pipe and suspend the muffler on the rubber shackles.
18. Hang up the clamp on the leading muffler and fit the intermediate pipe on to the leading muffler.
19. Adjust the location of the rear muffler. This is done by turning the rear muffler and by moving the leading muffler on the leading pipe.
   The suspension pins or the rear muffler should be vertical to the body pins. The muffler should incline forwards (lower at the front than at the rear) 15° in relation to the horizontal, see Fig. 2-120.
20. Tighten up all clamps; the clamps should be exactly over the jointed sections.

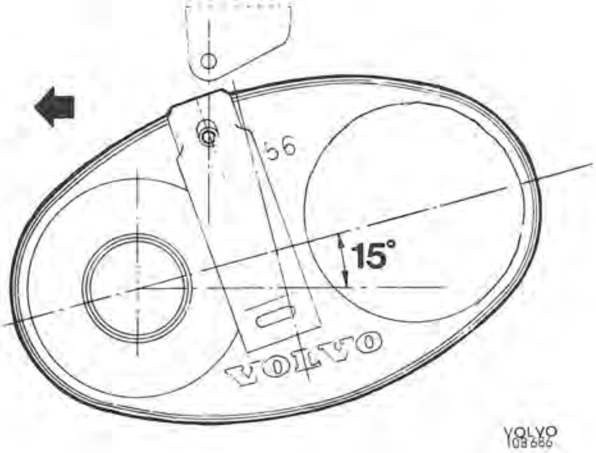


Fig. 2-120. Fit rear exhaust muffler
The arrow points forwards in the vehicle

GROUP 26

COOLING SYSTEM

GENERAL INFORMATION

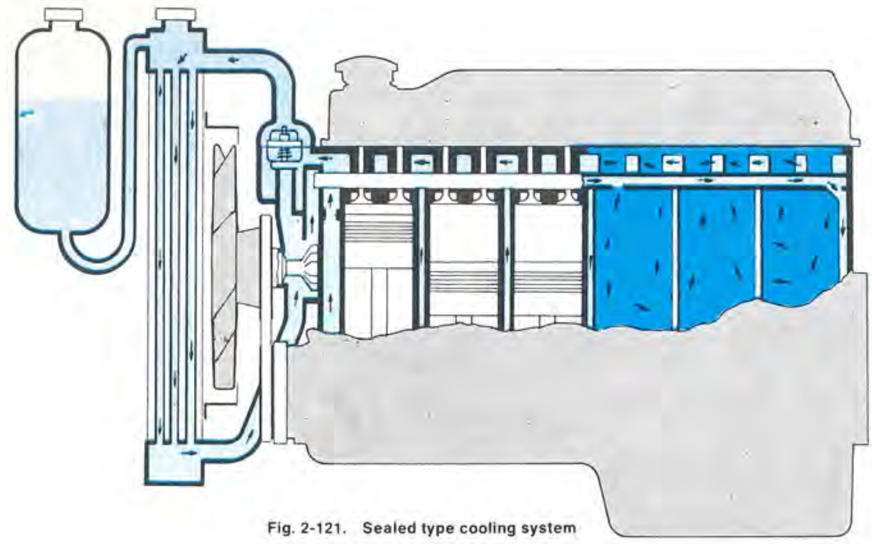


Fig. 2-121. Sealed type cooling system

GENERAL

The engine is water-cooled and the cooling system is of the sealed type, see Fig. 2-121. A fan cover mounted on the radiator improves the cooling function of the fan. The fan is speed-regulated, a so-called slip-coupling type (see Fig. 2-122), the function of which is to ensure that the fan blades do not exceed a certain speed even if the engine speed is exceeded. See Fig. 2-128. The six fan blades are mounted asymmetrically to keep down the noise level. The fan coupling consists of the casing (11, Fig. 2-122) in which the fan blades (1) are secured with the bolt (2). The casing (11) has two halves which, however, cannot be separated for repairs, the fan coupling then being replaced complete. The hub (8) has a light fit on the water pump flange (6) and is locked by means of the center bolt (7). The hub is provided with a slip disc of friction material (9) surrounded by oil. During idling and at low speeds, the slipping is insignificant, so that the fan provides an air current for satisfactory cooling. When the ingoing speed (that of the water pump) exceeds about 58 r/s (3 500 r/m), the slipping increases (see Fig. 2-128). With this arrangement, the fan speed should never exceed about 41.7 r/s (2 500 r/m). The fan noise output would then be low compared with a fan which runs at the same high speeds as the water pump. Compared with this latter type of fan, the output loss will be less for the slip-coupling type fan. A centrifugal pump, Fig. 2-123, takes care of the coolant circulation and a twin operating thermostat provides rapid warming up of the engine and contributes to the

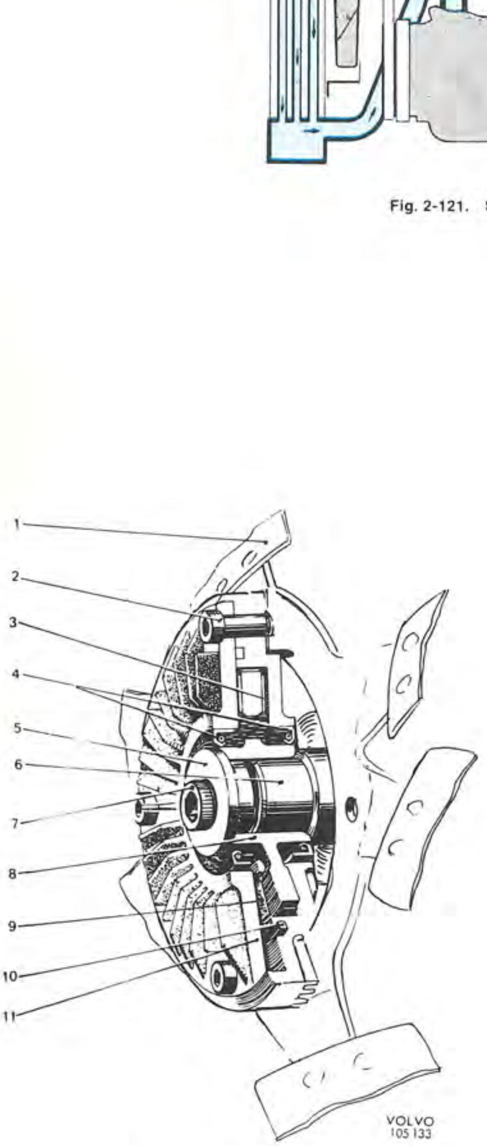


Fig. 2-122. Fan coupling

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

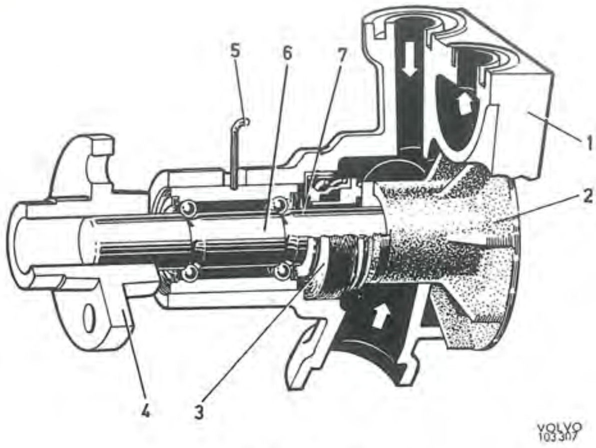


Fig. 2-123. Water pump

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

engine maintainting the most suitable temperature under all operating conditions.

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

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

COOLING SYSTEM INNER CIRCUIT (BY-PASS)

The cooling system consists of two circuits, an inner and an outer one. When the engine is warming up and in very cold weather when large quantities of heat are required for warming up the inside of the car, the coolant circulates almost exclusively through the inner circuit (the by-pass). This circuit covers the engine and car heater. The thermostat is closed, that is, the outlet to the radiator is shut off. The coolant passes through the thermostat by-pass to the distributing pipe (5, Fig. 2-124) in the cylinder head. This results in a uniform cooling of the warmest parts in the cylinder head. Even the parts around the spark plugs are also cold and thereby maintained at a constant temperature. The coolant surrounding the cylinder walls is circulated by means of thermo-syphon action.

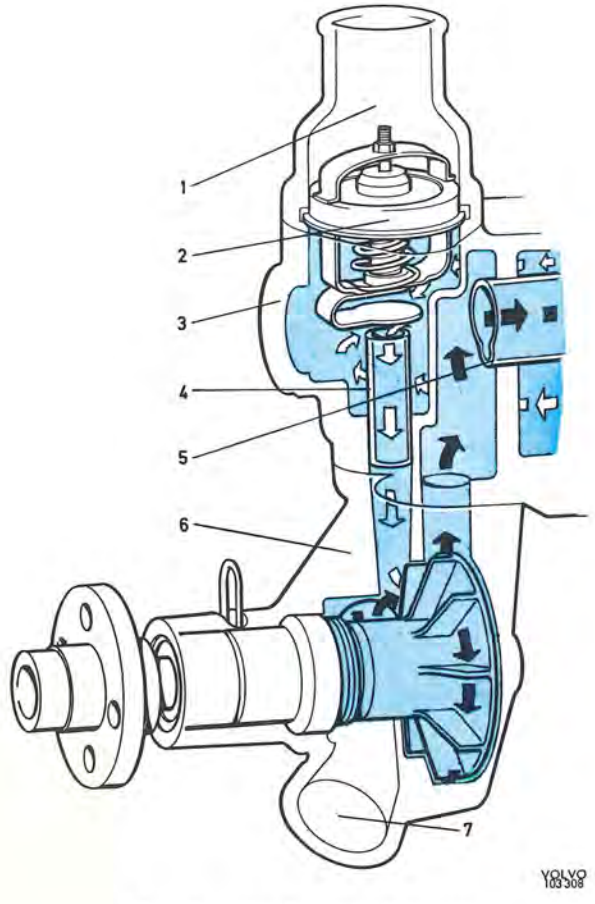


Fig. 2-124. Coolant flow, thermostat closed

1. To radiator
2. Thermostat
3. Cylinder head
4. By-pass pipe
5. Distributing pipe
6. Water pump
7. From radiator

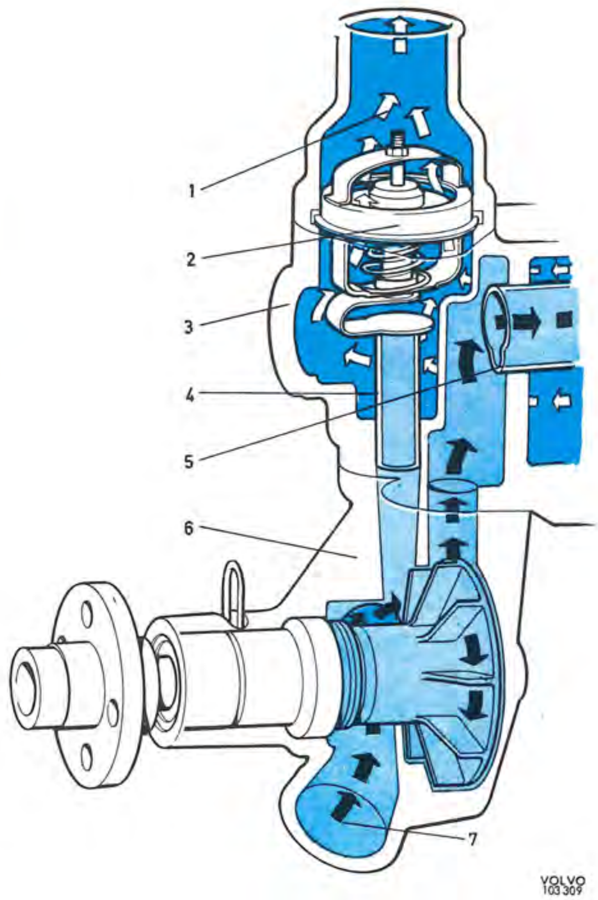


Fig. 2-125. Coolant flow, thermostat open

Concerning numbers above, see previous figure

COOLANT SYSTEM OUTER CIRCUIT

When the coolant in the inner circuit reaches a suitable temperature for the engine, the thermostat begins to open during which time the by-pass between the thermostat housing and the pump is gradually closed, see Fig. 2-125. Coolant flows from the engine into the upper part of the radiator, is cooled and then sucked by the pump out from the lower part of the radiator from where it is conveyed into the engine through the distributing pipe.

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

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

SERVICE PROCEDURES

TOPPING UP WITH COOLANT

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

NOTE. Never top up with water only.

DRAINING COOLING SYSTEM

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

FILLING EMPTY SYSTEM WITH COOLANT

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

COOLING SYSTEM LEAKAGE CHECK

The cooling system is checked for leakage as follows: Connect a cooling system pressure tester to the hose between the expansion tank and radiator. Use a suitable T-nipple and two pieces of hoses for this purpose. Carefully pump the pressure up to almost 0.7 kp/cm² (10 psi). Observe the pressure gauge. The pressure must not drop noticeably during 30 seconds. If it does, check and put right any leakage.

THERMOSTAT

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

Fig. 2-126. Expansion tank

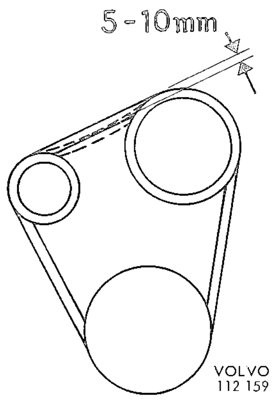


Fig. 2-127. Fan belt tension

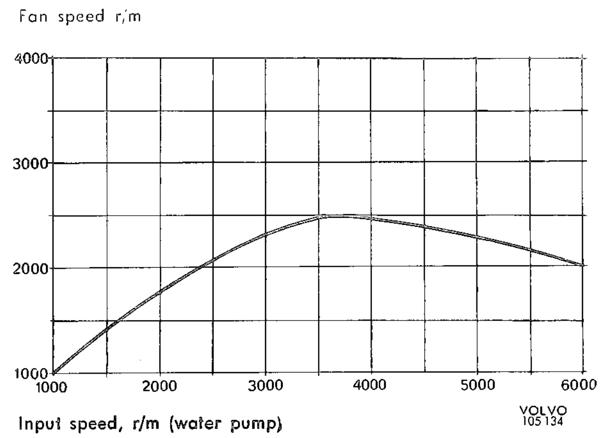


Fig. 2-128. Curve for fan coupling slip

REPLACING RADIATOR

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

REPLACING WATER PUMP

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

TENSIONING PULLEY BELT

WITHOUT 2906

The pulley belt is tensioned so that it can be deflected 5—10 mm (approx 3/8") with thumb pressure applied to the belt midway between the water pump pulley and alternator pulley, see Fig. 2-127.

FAN COUPLING

The fan coupling function can be checked with a stroboscope with variable blinking frequency. Make a mark on the fan and one on the water pump pulley. Find out the speed relationship between fan and pulley by means of the stroboscope. The fan speed should follow the speed of the water pump according to the curve given in Fig. 2-127.

Section 3

ELECTRICAL SYSTEM AND INSTRUMENTS

CONTENTS

GROUP 30

GENERAL

The electrical system is designed for a voltage of 12 V. The equipment can be divided up into the following main parts: Battery, alternator and voltage regulator, starter motor, ignition system, lighting, remaining electrical standard equipment and instruments.

GROUP 31

BATTERY

GENERAL INFORMATION

The battery, Fig. 3-1, is placed on a shelf to the right of the radiator. The battery is a 12 V lead battery with a capacity of 60 Ah and with the negative pole stud-grounded.

SERVICE PROCEDURES

REMOVAL

1. Remove the cable terminals from the battery terminal studs. Use a puller if the cable terminals are stuck to the terminal studs.
2. Remove the securing bar and lift up the battery.
3. Clean the battery with a brush and rinse it with clean tepid water.
4. Clean the battery shelf and cable terminals. Use a special steel brush or pliers for the cable terminals.

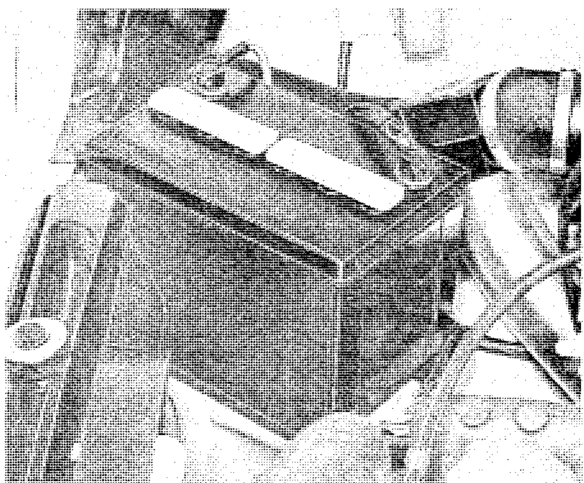
INSTALLATION

1. Place the battery in position.
2. Install the securing bar and secure the battery.
3. Tighten the cable terminals on to the terminal studs. Coat the cable terminals and terminal studs with vaseline.

SERVICE

In order for the battery to function satisfactorily, the acid must be maintained at the prescribed level. Make sure that the level is about 5 mm ($^3/_{16}$") above the plates. If the level is too low, fill up with **distilled** water as necessary. Ensure also that the battery is thoroughly secure and the cable terminals firmly in position.

The cable terminal studs should be coated with a thin layer of vaseline to prevent oxidation.



VOLVO
105433

Fig. 3-1. Battery

ALTERNATOR

GENERAL INFORMATION

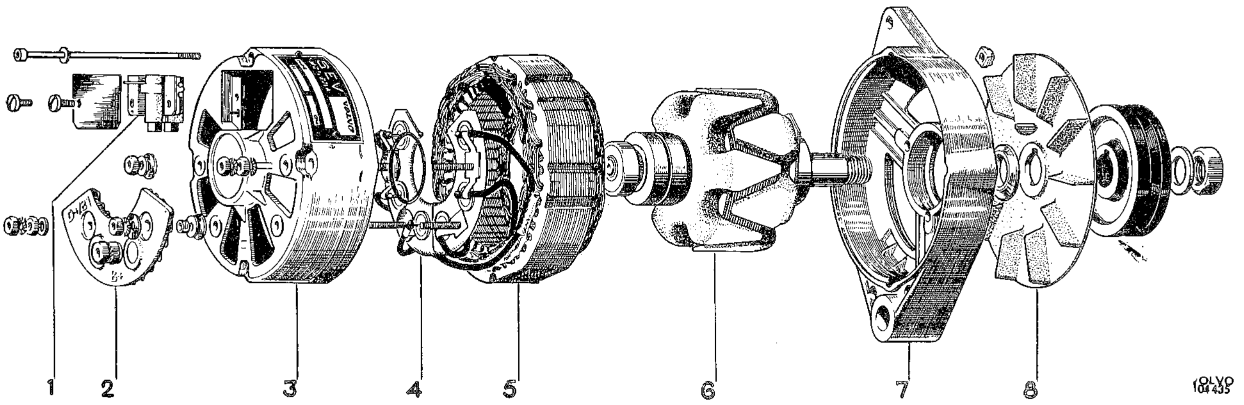


Fig. 3-2. Exploded view of alternator

1. Brush holder
2. Magnetizing diodes with holder
3. Slip ring and shield
4. Rectifier (silicon diodes)
5. Stator
6. Rotor
7. Drive end shield
8. Fan

The alternator is a three-phase, deltaconnected alternator unit which is located on the right-hand side of the engine and is driven by a V-belt from a pulley on the crankshaft. The alternator has a rectifier built into the slip ring end shield. This rectifier consists of six silicon diodes. The alternator has a rotating field (rotor) and stationary generating windings (stator).

The rotor is of the claw-pole type with the field windings fed over the slip rings. The construction of the rotor has made it possible for the alternator to have a max. speed of 250 r/s (15 000 r/m).

The magnetizing diodes (2, Fig. 3-2), which are placed on the outside of the alternator, have two functions: They prevent the battery from discharging through the regulator and alternator field, and they provide a simple means of operating the charging warning lamp.

The alternator is self-limiting (max. 55 amps.) and for this reason a simple voltage regulator can be used with only voltage control.

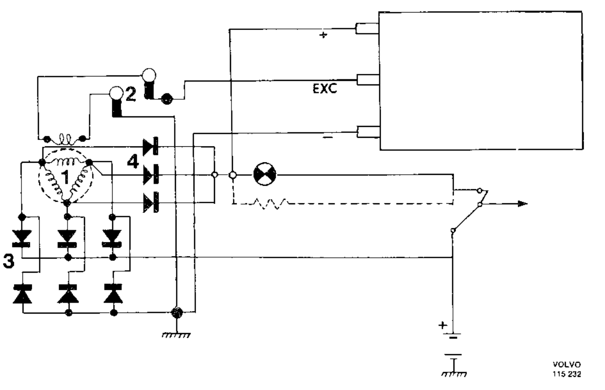


Fig. 3-3. Alternator inner circuit

1. Stator
2. Slip ring and brush holder
3. Rectifier diodes
4. Magnetizing diodes

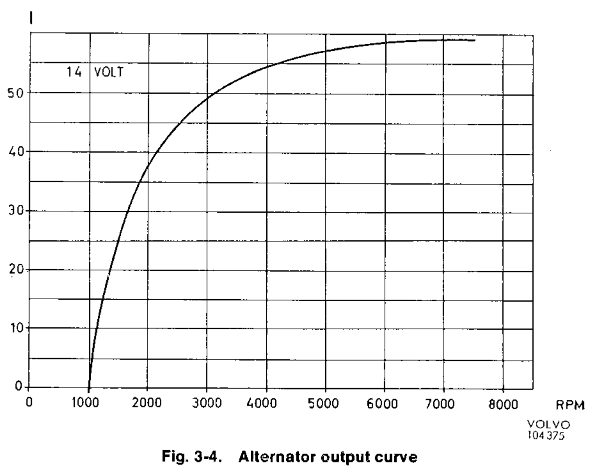


Fig. 3-4. Alternator output curve

SERVICE PROCEDURES

SPECIAL INSTRUCTIONS FOR WORK ON ALTERNATOR EQUIPMENT

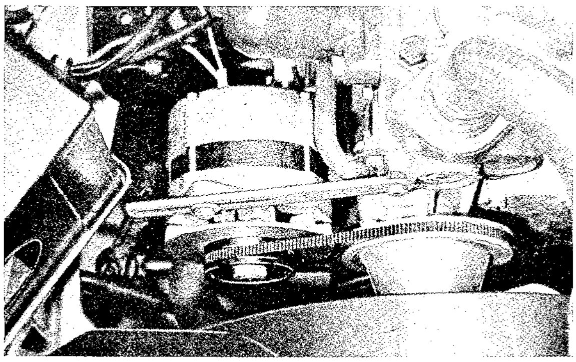
1. When replacing or fitting the battery, make sure that the new battery is connected with the correct polarity.
2. Never run the alterantor with the main circuit broken. The battery and/or alternator and regulator leads must never be disconnected while the engine is running.
3. No attempt should be made to polarize the alternator since this is not necessary.
4. When charging the battery while installed in the vehicle, the negative battery lead should be disconnected.
5. A rapid charger should not be used as a help in starting.
6. When using an extra battery as an aid in starting, always connect it in parallel.
7. When carrying out any electric welding on the vehicle disconnect the negative battery lead as well as all the alternator leads. The welding unit should always be connected as near as possible to where the welding is to be carried out.

REMOVING ALTERNATOR

1. Disconnect the negative lead to the battery.
2. Disconnect the leads to the alternator.
3. Remove the bolt for the adjusting bar.
4. Remove the bolt holding the alternator to the engine block.
5. Remove the fan belt and lift the alternator forwards.

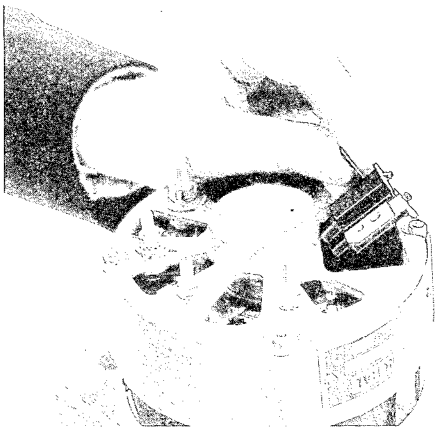
DISASSEMBLING ALTERNATOR

1. Release the two screws holding the brush holder. Pull out the brush holder.
2. Remove the nut and washer. Lift off the pulley, fan, key and spacer washer.
3. Remove the nuts and washers on terminal 61.
4. Mark the drive end shield, stator and slip ring end shield to avoid confusion when assembling. Remove the four attaching screws.
5. Remove the stator and slip ring end shield with the help of two screwdrivers, which are inserted in two of the sockets between the stator and drive end shield, see Fig. 3-7.
   NOTE. The screwdrivers may not be inserted deeper than 2 mm (just over $^{1}/_{16}''$), otherwise the stator may be damaged.
6. Release the three screws holding the support plate of the drive end bearing. Release the bearing by knocking the end of the shaft against a piece of wood, see Fig. 3-8.
7. Remove the nuts and washers for the diode-holders.
8. Remove the stator and diode holders for the slip ring end shield.



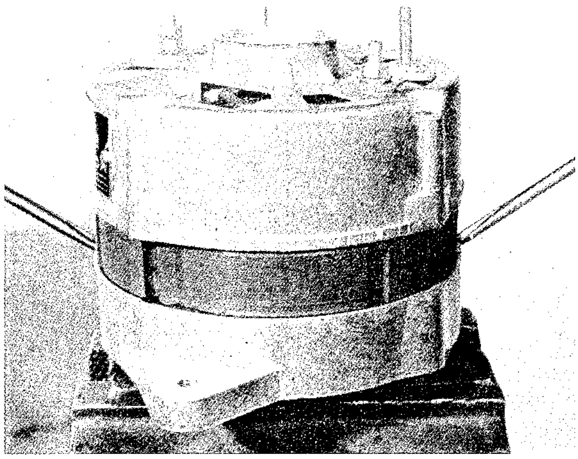
VOLVO
104 469

Fig. 3-5. Alternator installed



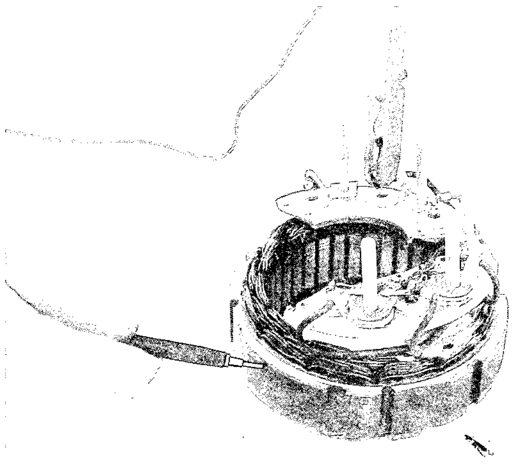
VOLVO
115 218

Fig. 3-6. Removing brush holder



VOLVO
104 471

Fig. 3-7. Disassembling alternator



VOLVO
115 219

Fig. 3-9. Checking stator

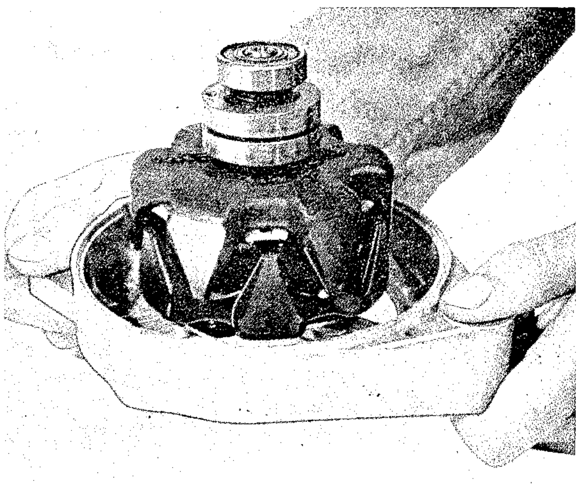
CHECKING DISASSEMBLED ALTERNATOR

STATOR

Check the stator for any short-circuiting. If one or several of the coils are burnt, there must be a shortcircuit in the stator. Connect a test lamp (12 V. 2–5 W) between the stator plates and a terminal on the stator, see Fig. 3-9.
If the lamp lights, the isolation between the stator winding and the stator plates must be burnt out, in which case the stator should be replaced.
NOTE. Only a 12 V. 2–5 W test lamp may be used; 110 or 220 V, D.C. or A.C. lamps may NOT be used. This applies to all the alternator components.
Check the diodes with a diode tester, see Fig. 3-10. If any of the rectifier diodes is faulty, the entire diode holder (with three diodes) must be replaced. If any of the magnetizing diodes is faulty, replace the holder, complete with magnetizing diodes.
If a diode tester is not available, the diodes should be soldered loose (see page 3 : 5) and tested with an ohmmeter. The diodes should have high resistance in reverse direction and low resistance in the flow direction.

ROTOR

Check to make sure that the slip rings are not dirty or burnt.
Check the winding for breakage or damaged isolation. Measure the resistance between the slip rings, see Fig. 3-12. At 25°C (77°F) the resistance should be 3.7 ohms.



VOLVO
104 472

Fig. 3-8. Removing drive end shield

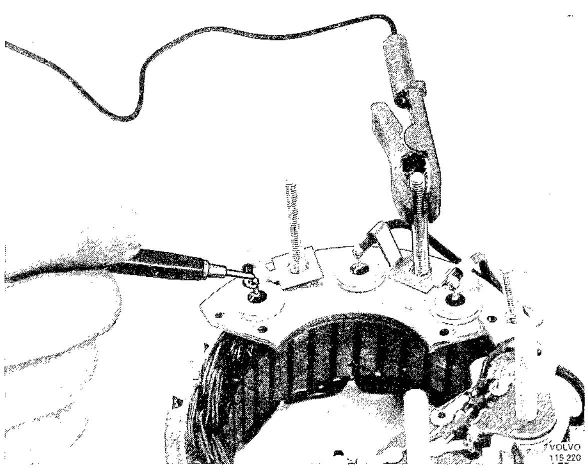


Fig. 3-10. Checking diodes

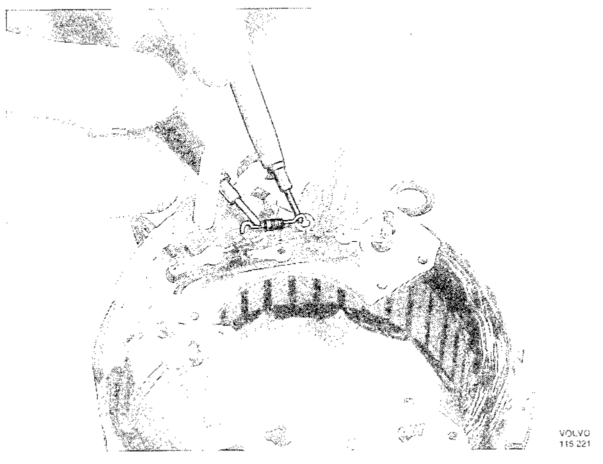


Fig. 3-11. Checking magnetizing diodes

If the slip rings are dirty, clean them carefully with a cloth moistened in trichloroethylene. The slip rings can also be polished with fine sand paper.
If the winding is faulty, the entire rotor must be replaced.
Check the bearings. (The bearings should always be replaced when the alternator has been disassembled.)

BRUSH HOLDER

Connect a test lamp between the brushes. The lamp must not light.
Connect the test lamp between the DF-terminal and "+" brush. The lamp should give a steady light even if the brush or the terminal cable is moved see Fig. 3-13.
Connect the test lamp between the brush holder frame

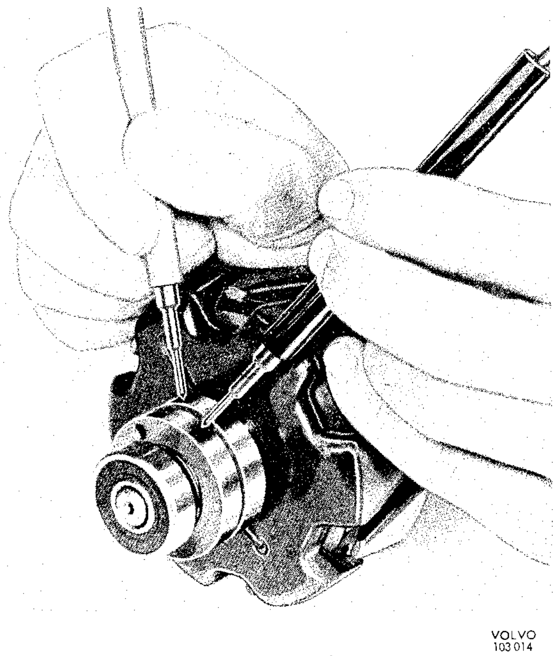


Fig. 3-12. Check-measuring rotor

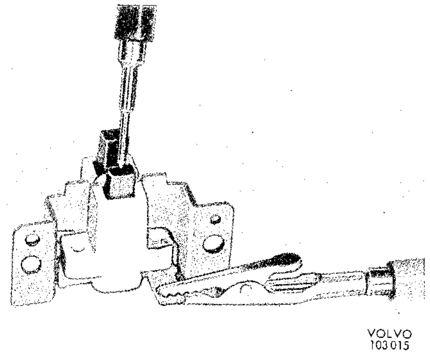


Fig. 3-13. Checking brush holder

"−" brush. The lamp should give a steady light even if the brush or the terminal lead is moved.
If the brush holder does not meet the above requirements or if the brush length is less than 5 mm (approx. 3/16"), then replace the brush holder.
The brush length is measured between the brush contact surface and holder, with the brush resting against the spring, see Fig. 3-14.

REPLACING RECTIFIER DIODES

1. Mark the leads connecting the stator to the diodes. Solder loose the leads.
2. Place the new diode holder in exactly the same position occupied by the old one. Hold the outgoing diode lead with a pair of flat pliers. (This is to conduct the heat from the soldering point so as not to damage the new diode.)
3. Solder on the diodes, see Fig. 3-15.
   NOTE. The complete "+" or "−" diode holder must be replaced even if only one diode is faulty.

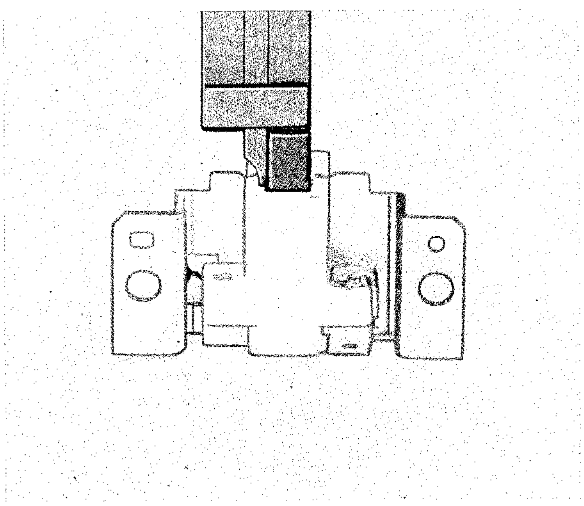


Fig. 3-14. Measuring brush length

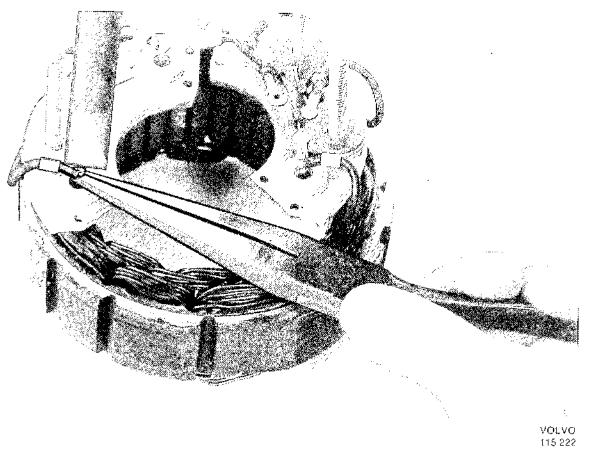


Fig. 3-15. Soldering on diodes

Use a well-heated soldering iron, minimum 100 W for the soldering.
Never change places for the two diode holders. The **positive diode holder** is isolated from the frame by means of isolation washers and sleeves and its diodes are marked in **red.**
The **negative diode holder** is not isolated and its diodes are marked in **black.**

REPLACING BEARINGS

DRIVE END SHIELD BEARING

Removal

1. Place the rotor in a vise with soft jaws.
2. Pull the bearing off with a claw puller, see Fig. 3-16.

Installation

1. Place the support plate on the rotor shaft with the three elevations facing the rotor winding.
2. Press the bearing in with the help of a tubular sleeve which presses on the bearing inner ring, see Fig. 3-17.

SLIP RING END BEARING

Removal

1. Place the rotor in a vise with soft jaws.
2. Pull the bearing off with a claw puller.

Installation

1. Press the bearing on with a tubular sleeve which presses on the bearing inner ring.

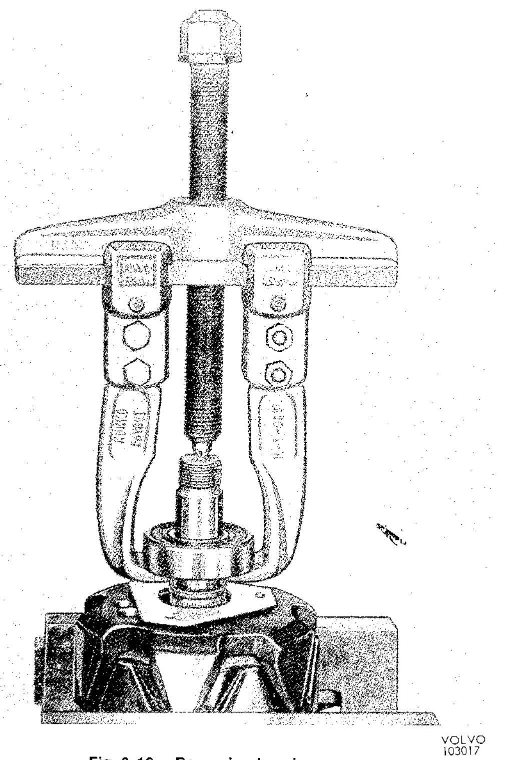


Fig. 3-16. Removing bearing

REPLACING SLIP RING END SHIELD O-RING

1. Remove the O-ring with a steel blade with rounded edges (for example, a feeler gauge), see Fig. 3-18.
2. Wash the groove clean.
   Check that the hole in the bearing shield is not blocked.
3. Fit a new O-ring.
   Lubricate the O-ring and the hole with mineral oil or similar.

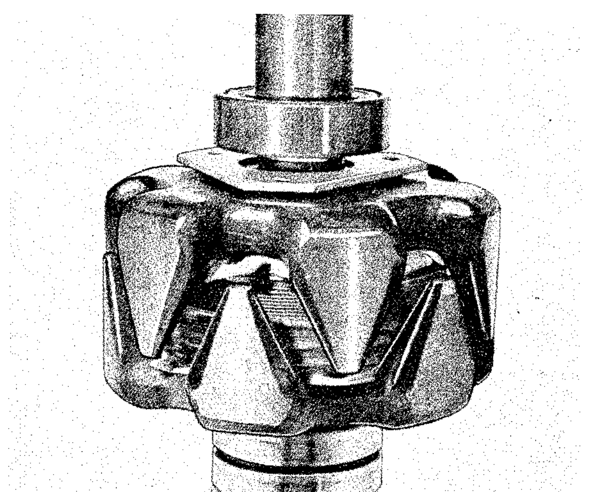


Fig. 3-17. Installing bearing

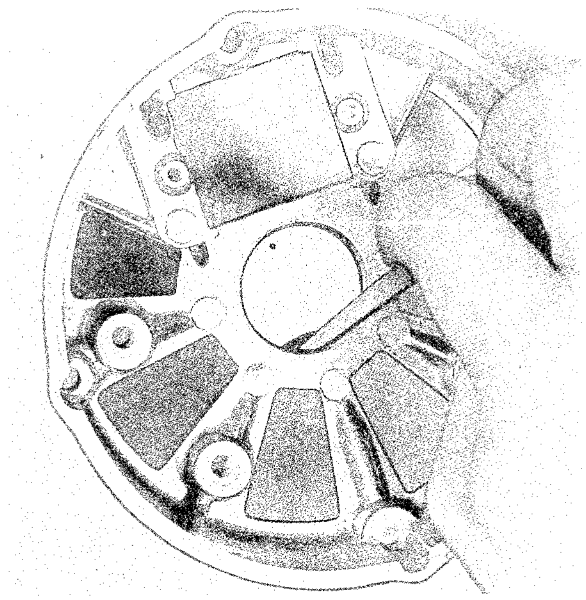


Fig. 3-18. Removing O-ring

The O-ring should be replaced each time the alternator has been disassembled.

ASSEMBLING ALTERNATOR

1. Fit the stator and the diode holders in the slip ring end shield. (Do not forget the isolation washers for the positive diode holder). Fit the nuts and washers on the negative diode holder screws.
2. Press the rotor into the drive end shield. Fit the three screws for the drive bearing support plate.
3. Fit together the rotor and stator sections.
4. Fit the attaching screws. Tightening torque 2.8–3.0 Nm (0.28–0.30 kpm=2.0–2.2 lbft).
5. Fit the brush holder.

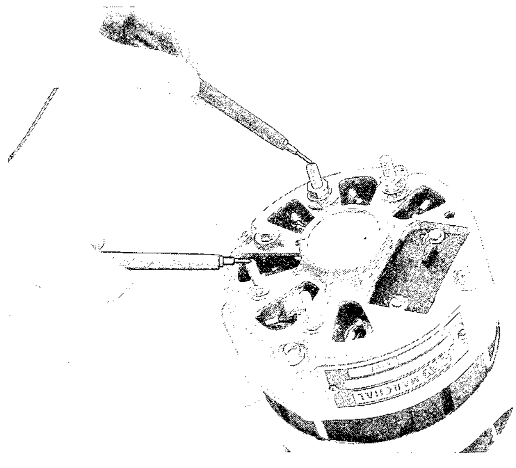


Fig. 3-19. Checking alternator

6. Fit the spacer washer, key, fan, pulley, washer and nut. Tightening torque 40 Nm (4 kpm=29.0 lbft).
7. Connect a test lamp between B+ and the alternator frame. Switch the terminals. The lamp should light only in one direction, see Fig. 3-19. After any repairs, the alternator should be test-run in a test bench.

INSTALLING ALTERNATOR

1. Place the alternator in position while fitting on the fan belt at the same time.
2. Fit the attaching bolts and tensioning iron without tightening up the bolts. Adjust the belt tension (see Section 2, Engine, Group 25) and secure the alternator. NOTE. Force may only be applied to the front end of the alternator when adjusting the belt tension. Fit the leads to the alternator.
4. Fit the battery lead.

VOLTAGE REGULATOR

GENERAL INFORMATION

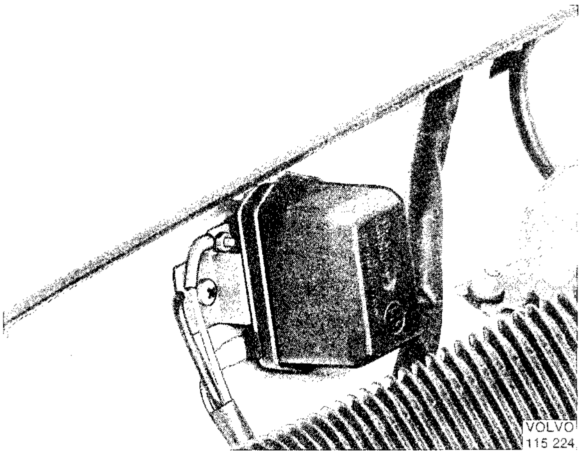


Fig. 3-20. Voltage regulator fitted

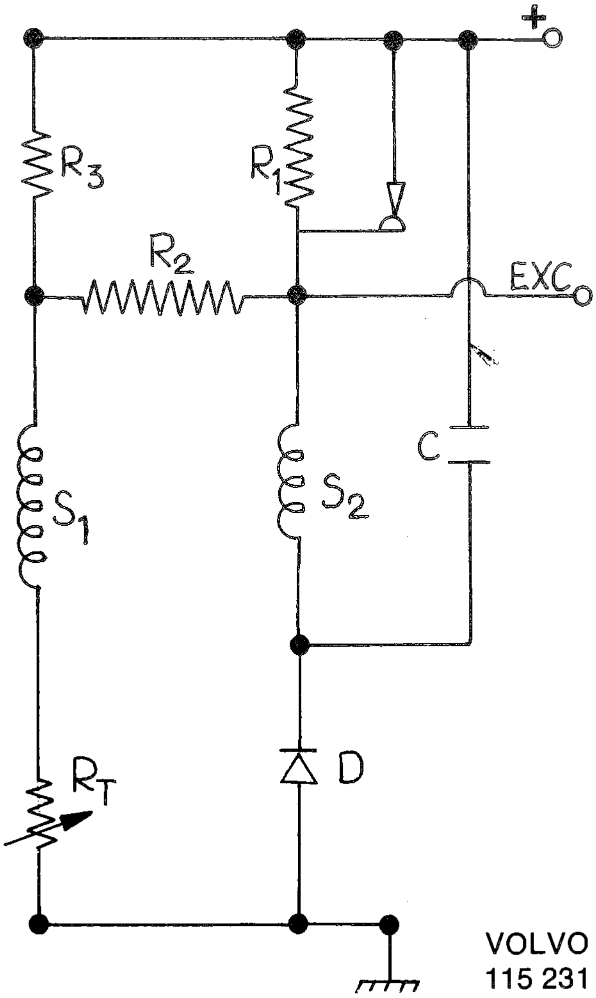


Fig. 3-21. Inner wiring of regulator

S1 Voltage winding
S2 Acceleration winding
R1 Regulator resistances (2) 10>±10 %
R2 Damping resistance 30>±10 %
R3 Compensation resistance (adapted to RT during manufacture)
RT Compensation thermistor approx. 4 > at 25°C (77°F)

The regulator, Fig. 3-20, is a twin contact regulator with a fixed upper contact, a movable contact and a fixed lower one. The movable contact is attached to an armature which is actuated by a voltage coil. The regulator also houses four resistors and one thermistor.

FUNCTION

When the ignition key is switched on, current flows through the charging warning lamp to +(61) on the regulator. It is then conducted via the regulator through the field winding to earth.

When the alternator starts rotating, alternating current is formed in the stator. This alternating current is rectified by the silicon diodes and the direct current produced is re-fed via the regulator to the field winding until the regulating voltage has been reached. When the regulating voltage has been reached the armature is attracted by the coil. This causes the contacts to open and the field current must pass the resistances R1, Fig. 3-21.

If in spite of this, the voltage rises, the armature is drawn further down and the movable contact meets the lower contact so that the field winding is earthed at both ends, this causing the voltage to drop rapidly. The cycle is repeated continuously so that the voltage is maintained constant.

TEST OF ALTERNATOR AND VOLTAGE REGULATOR

GENERAL

Fixed clamps should be used for all testing of the alternator equipment. So-called crocodile clamps should not be used as they have a certain tendency to loosen. A loose lead can result in the alternator and regulator being damaged. When about to connect up instruments, disconnect the battery first.

ALTERNATOR CIRCUIT TEST

Before carrying out any tests on the alternator or regulator in the vehicle check the battery and vehicle wiring system for damaged leads or insulation, loose or corroded lead terminals and poor earthing. **Check the fan belt** (see Section 2, Engine, Group 26). Any of the above faults must be remedied before the electrical checks can be started.

BATTERY TEST

Test the battery with a hydrometer and battery tester. If the battery is not fully charged, remove it from the car and charge it or replace it with a new one if necessary. A fully charged battery which is otherwise in good condition should always be used when testing.

VOLTAGE DROP TEST

This test is made to check the leads between the alternator and the battery and also the battery earth lead. The test should be carried out with a fully charged battery in good condition. The battery terminals should be well cleaned and tightened. Load the alternator with about 10 amps., meausre with a suitable voltmeter the voltage between the positive pole of the battery and B+ on the alternator. If the voltage at this test exceeds 0.3 volt, there is a fault in the lead or contact, which must be remedied immediately. After repairing the leads or contacts, measure the voltage drop between the negative pole of the battery and the alternator terminal D−. Here the voltage drop must not exceed 0.2 volt. If the voltage drop exceeds 0.2 volt, check the battery earth lead, the alternator contact with the engine and the engine contact with the chassis. After making the necessary repairs measure again.

ALTERNATOR TEST

(On a test bench or in the vehicle.)

Connect up the alternator as shown in Fig. 3-22. Check that the current through the field winding (ammeter C) is 3−3.5 amps. (If the current is not the correct one, then check the brush holder and field winding.) Run the alternator to a speed of 50 r/s (3000 r/m). Engine speed 25 r/s (1500 r/m).

The alternator should then produce at least 48 amps at 14 volts. (A further load may be connected up in order to maintain the voltage at 14 volts.) This applies to a warm alternator and an ambient temperature of 25°C (77°F).

Measure the voltage at B+ and 61 when the alternator charges.

The voltage should be 0.8−0.9 volt more than at terminal 61, otherwise the isolation diode is faulty and should be replaced.

VOLTAGE REGULATOR TEST

(On a test bench or in the vehicle.)

Connect up the alternator and regulator as shown in Fig. 3-23. Run the alternator at about a speed of 83 r/s (5000 r/m) engine speed 42 r/s (2500 r/m) for 15 seconds. Then read off the voltage on the voltmeter. With no load on the alternator, the voltmeter should read 13.1−14.4 volts with the regulator ambient temperature at 25°C (77°F).

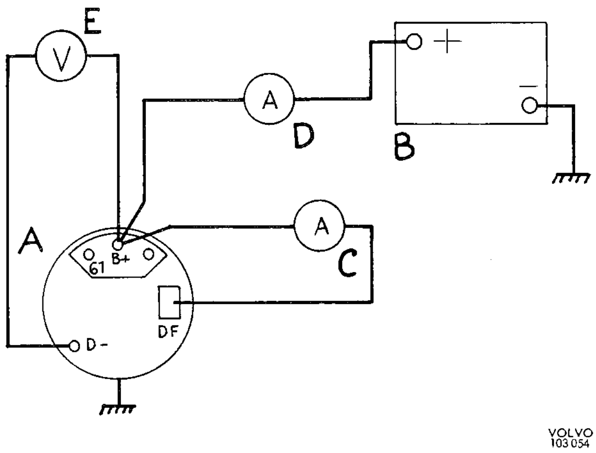


Fig. 3-22. Wiring diagram for testing alternator

A Alternator
B Battery 60 Ah
C Ammeter 0−10 amps.
D Ammeter 0−50 amps.
E Voltmeter 0−20 volts

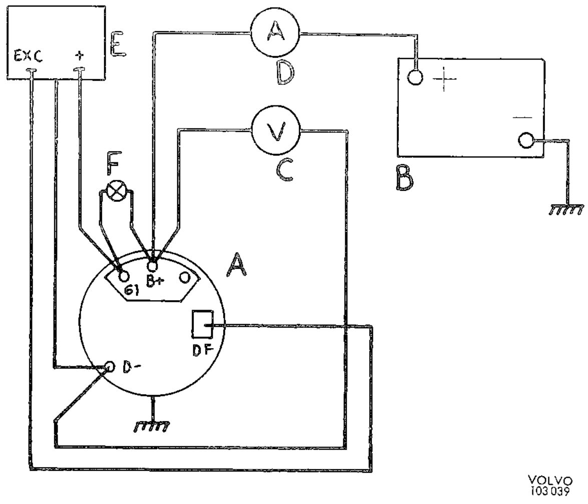


Fig. 3-23. Wiring diagram for testing voltage regulator

A Alternator
B Battery 60 Ah
Voltmeter 0–20 amps.
D Ammeter 0–50 amps.
E Voltage regulator
F Warning lamp 12 volts. 2 watts

Load the alternator with 10–15 amps, for example, full-beam headlights, and read off the voltage. The voltage should also lie on this occasion between 13.1–14.4 volts. For ambient temperatures other than 25°C (77°F), see the diagram in Fig. 3-24.

If the voltage is outside the tolerance limits, the regulator should be replaced.

If the voltage regulator is to be tested more accurately, install it in the vehicle which should then be driven for about 45 minutes at a speed above 50 kmph (30 mph).

The reason for the driving is to enable the regulator to obtain the correct working temperature.

NOTE. The vehicle must be driven. It is not sufficient just to have the engine idling.

Immediately after, or preferably during driving, measure the voltage between B+ and D– on the alternator. The engine should be turning over at about 25 r/s (1500 r/m),

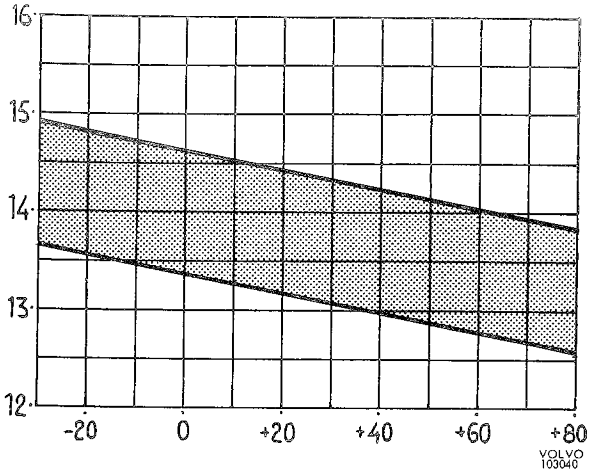


Fig. 3-24. Voltage-temperature diagram for cold voltage regulator

50 r/s (3000 alternator r/m) when the measuring is being carried out. When the regulator ambient temperature is about 25°C (77°F) the voltage should be 13.85–14.25 volts. For other ambient temperatures, see Fig. 3-25.

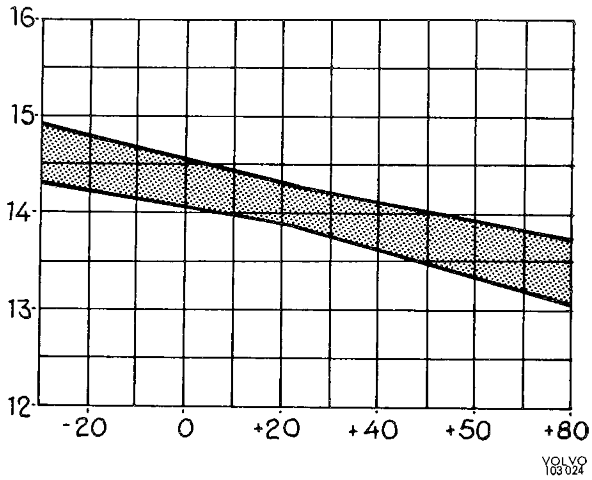


Fig. 3-25. Voltage-temperature diagram for warm voltage regulator

SERVICE DIAGNOSIS

CONDITION	POSSIBLE CAUSE
Alternator does not charge.	Worn or insufficiently tensioned fan belt. Breakage in charging circuit. Worn brushes. Breakage in rotor winding. Breakage in magnetizing diodes. Defective regulator.
Charging weak or irregular.	Worn or insufficnelty tensioned fan belt. Intermittent breakage in charging circuit. Worn brushes. Breakage or short-circuiting in one or several rectifier diodes. (Breakage in a diode reduces the charging current about 5 amps. Short-circuiting in a diode limits the alternator charging current to 7–8 amps and causes a rumbling sound in the alternator.) Rotor partly shorted. Stator broken or shorted. Defective regulator.
Too high charging.	Defective regulator. Defective terminals on regulator or alternator. Magnetizing diodes shorted.
Noise in alternator.	Worn fan belt. Loose pulley. Worn bearings. One or several rectifier diodes shorted. Alternator pulley incorrectly aligned in relation to the crankshaft pulley.
Charging warning lamp glows.	Voltage drop in fuse box.

STARTER MOTOR

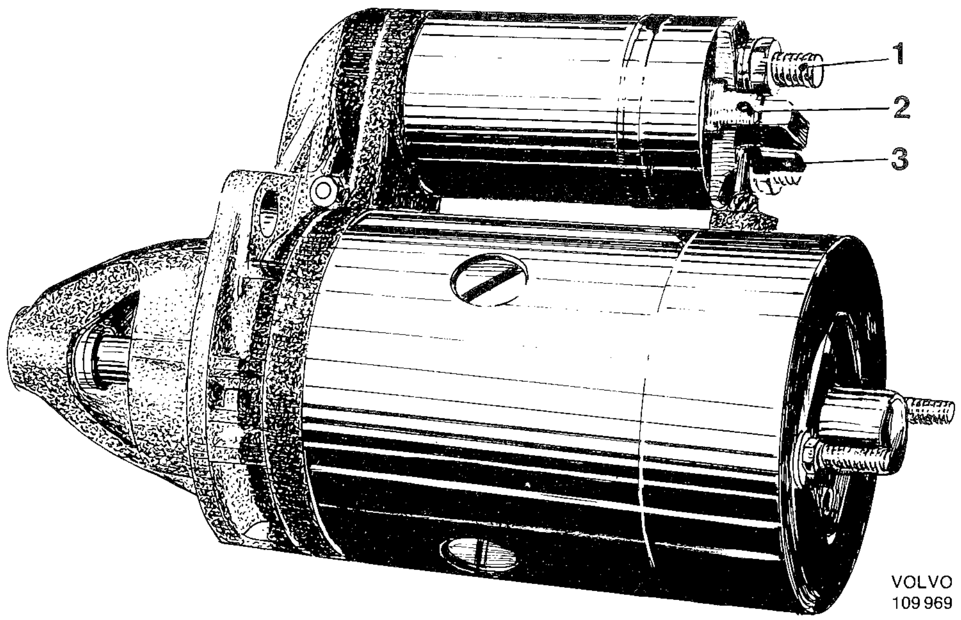


Fig. 3-26. Starter motor
1. + from battery
2. Terminal 16 (to ignition coil terminal 15)
3. Terminal 50 (to ignition switch)

GENERAL INFORMATION

The starter motor is mounted on the flywheel housing on the left-hand side of the engine. It consists of a four-pole series-wound motor. The starter motor rotor shaft pinion moves axially to engage with the flywheel ring gear. The pinion is controlled by a solenoid.
Turning the ignition key to the starting position cuts in the solenoid, causing the armature in the solenoid to be drawn in and the starter pinion to engage the ring gear on the engine flywheel.
When the armature has moved a certain distance, the contacts for the main current close and the starter motor starts running.

SERVICE PROCEDURES

For those who so wish, Bosch supplies the following special tools:

EF 2722	Sleeve and drift for fitting circlip
EFAL 3	Smoothing drift
EF 2649/1	Smoothing drift
EF 2649	Drift for fitting bushing

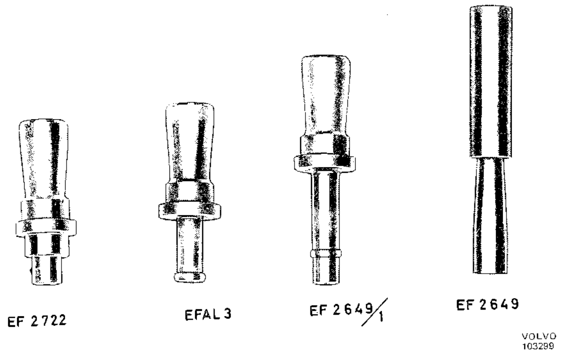


Fig. 3-27

REMOVING THE STARTER MOTOR

Disconnect the battery ground cable.

Disconnect the three leads from the starter motor.

Remove the bolts holding the starter motor to the timing gear housing and lift off the starter motor.

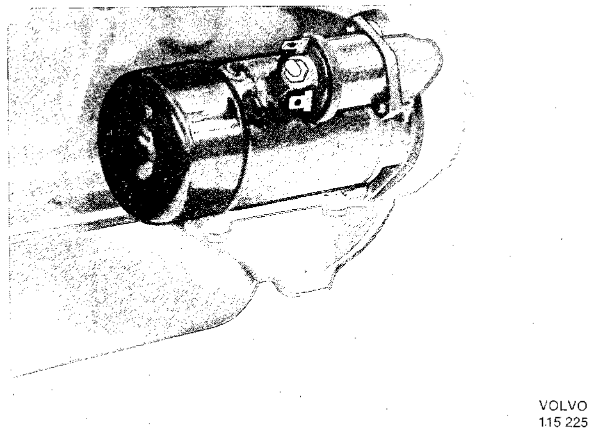


Fig. 3-28

STARTER MOTOR DISASSEMBLY

Unscrew both the screws securing the small cover on the front end of the shaft.

Remove the cover.

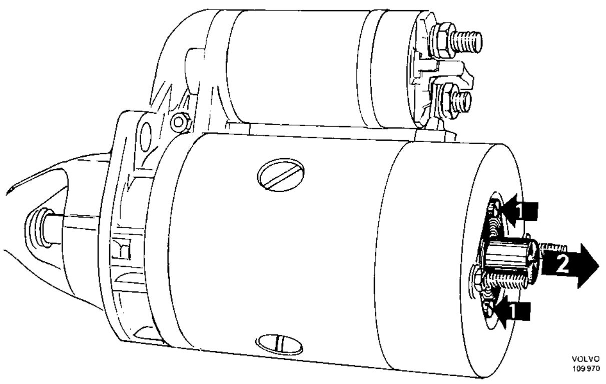


Fig. 3-29

Lift off the lock washer and adjusting washers.

Remove the two bolts holding the commutator end frame.

Remove the frame.

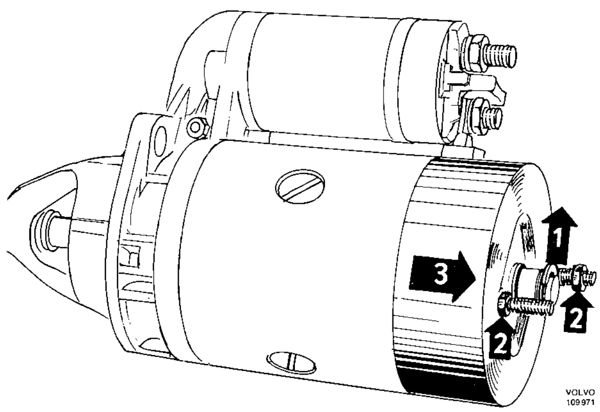


Fig. 3-30

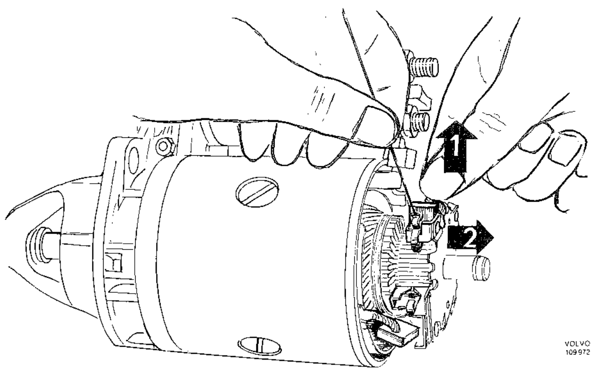


Fig. 3-31

Lift up the brushes and holders.

Remove the brush bridge from the rotor shaft.

When the bridge is removed, the negative brushes also follow, but the positive brushes will remain in the field winding.

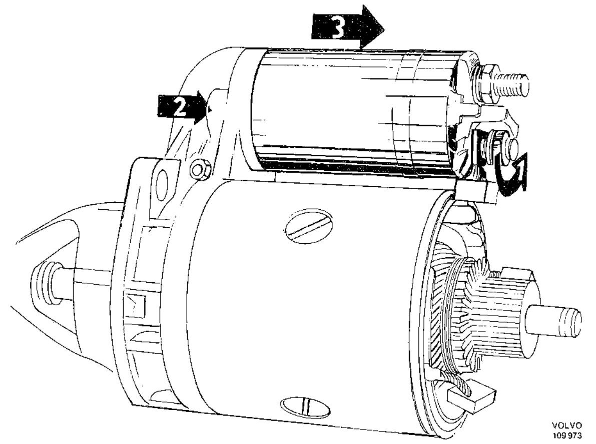


Fig. 3-32

Remove the nut holding the field terminal connection to the control solenoid.

Remove the screws securing the solenoid to the drive end frame.

Remove the solenoid.

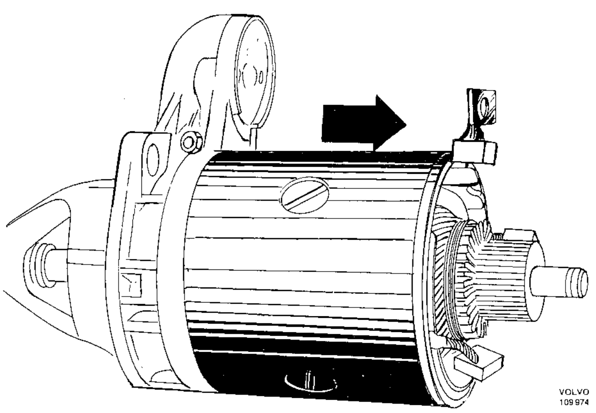


Fig. 3-33

Remove the stator from the drive end frame.

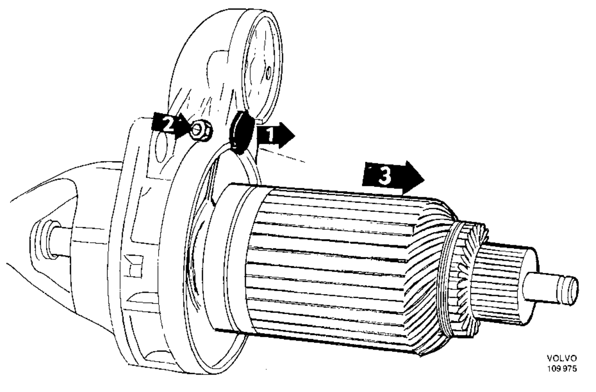


Fig. 3-34

Remove the rubber washer and metal washer.

Remove the screw on which the shift lever is carried.

Lift the armature with pinion and lever out of the drive end frame.

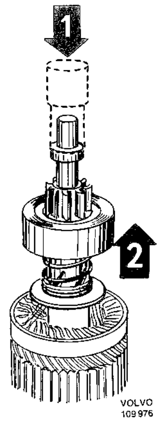


Fig. 3-35

Knock back the stop washer with the help of a suitable sleeve. Remove the snap ring, stop washer and armature shaft.

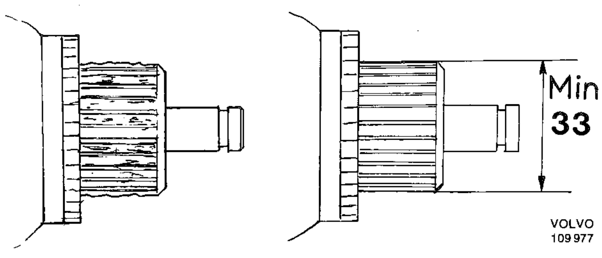


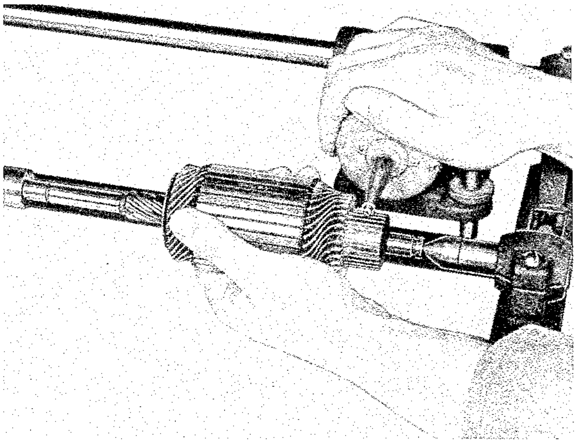
Fig. 3-36

INSPECTION

Examine the armature for mechanical damage. If the armature shaft is bent or worn, the armature should be replaced.

If the commutator is scored or unevenly worn, it should be turned.

The commutator diameter must not be less than 33 mm (1.3″). After turning, the commutator should be checked with a micrometer. A radial throw of up to 0.08 mm (0.003″) is permitted.

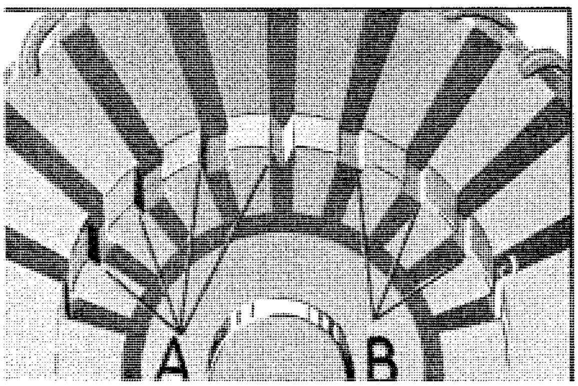


VOLVO 103354

Fig. 3-37

The isolation between the laminations should be milled down to 0.4 mm (0.016″) below the surface of the laminations.

This work is carried out in a special apparatus, or if such is not available, with a ground-off hacksaw blade.



VOLVO 21547

Fig. 3-38

A. Incorrectly milled.
B. Correctly milled.

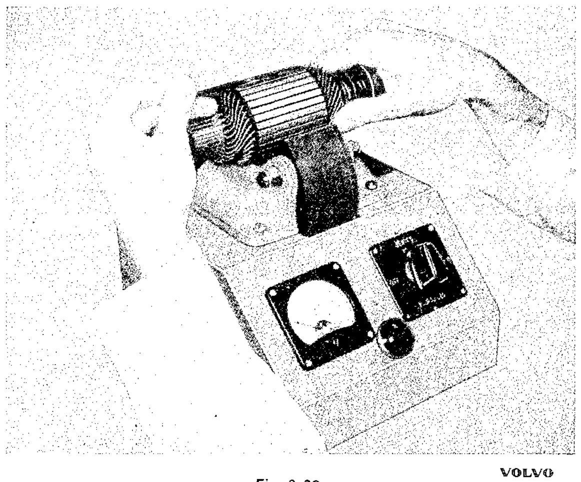


Fig. 3-39 VOLVO 24807

Examine the armature for shorts by placing it in a growler. Switch on and hold a hacksaw blade a few mm from the armature.

If the blade vibrates in any position when the armature is rotated, one of the following faults can be the reason: Shorting through the armature frame, shorting in the commutator or between the windings.

A shorted armature should be replaced by a new one.

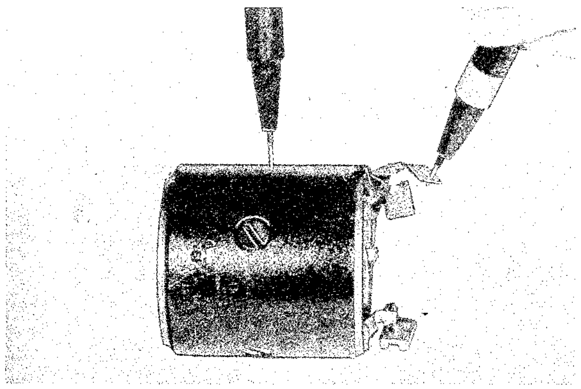


Fig. 3-40 VOLVO 103306

Check the pole housing with 40 volts A.C.

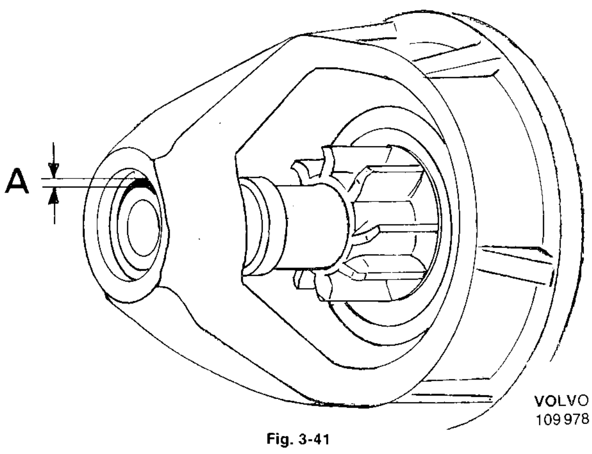


Fig. 3-41 VOLVO 109978

Examine the drive end frame and brush holders.

If damaged of excessively worn, they must be replaced.

A bearing clearance "A" between the shaft and bushing of up to 0.12 mm (0.005") may be considered permissible. Examine the other parts and replace any that are damaged or worn. The snap ring should always be replaced with a new one, since it may have been damaged or lost its tension when being removed.

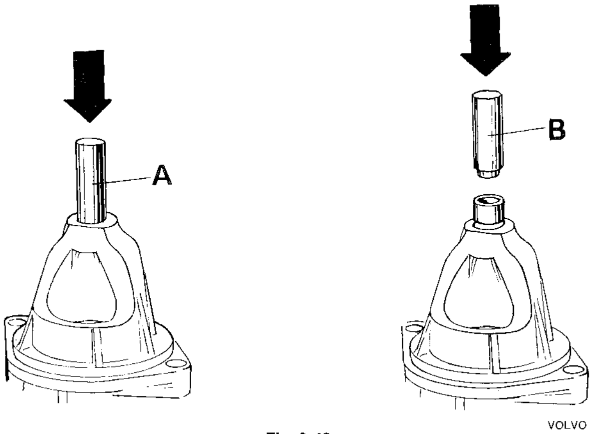


Fig. 3-42 VOLVO 109979

REPLACEMENT OF SELF-LUBRICATING BUSHINGS

(Starter motor disassembled.)

Before the new bushings are installed, they should be immersed in oil (Bosch 01 1 V 13 or corresponding) for at least 1/2 hour. Otherwise they will wear rapidly and at worst seize.

The bushings are supplied with correct fit and should not be machined otherwise the pores may become blocked and deteriorate the self-lubrication.

Drive out the worn bushings with a suitable tool, A.

Clean the hole for the bushings and cut away any burr. Press in the new bushings with a suitable drift, B.

REPLACEMENT OF FIELD COILS

(Starter motor disassembled.)

Mark the poles and pole housing in a suitable manner so that they are re-fitted in the same position.

Place the stator in the rotating clamping block* (Bosch EFAW 9 or corresponding) and remove the pole screws. Remove the stator from the rotating clamping block and remove the pole shoes and field coils.

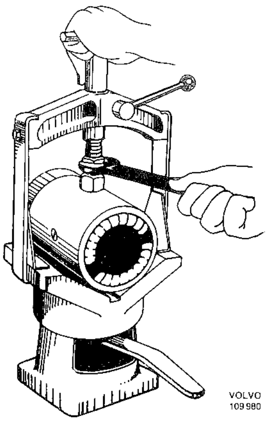


Fig. 3-43

Push in the new field coils and pole shoes into the stator. Before installing the field coils, warm them slightly. Make sure the pole shoes are located according to the marks.

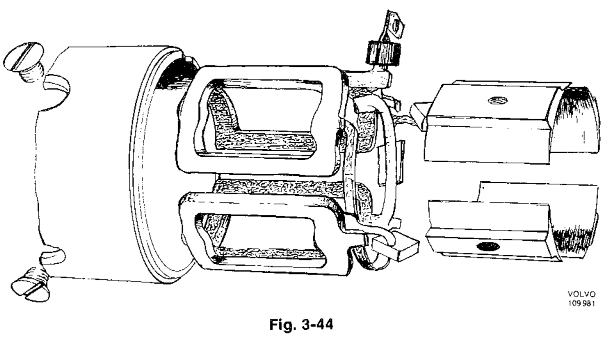


Fig. 3-44

Press in a suitable drift and place the stator in the rotating clamping block.

Tighten up the pole shoes.

Force out the press drift with a drift press.

Check the installed field coils for breakage and shorts.

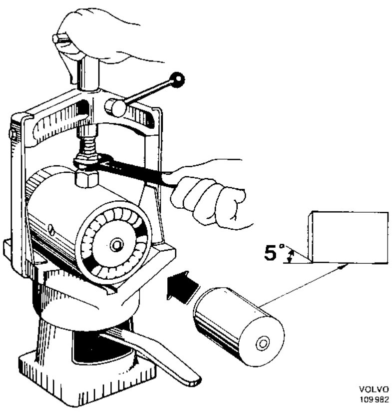


Fig. 3-45

REPLACEMENT OF BRUSHES

(Alternator removed.)

Brushes worn down less than 14 mm (approx. 1/2") should be replaced with new ones. Replacement is as follows:

1. Carry out steps 1 to 5 under "Disassembling alternator".
2. Heat the brushes loose from their respective attachments on the brush holder and field coils.
   This can be done rapidly with the help of a properly heated soldering iron.
3. Solder well the new brushes with a properly heated soldering iron.

The solder must not run down onto the brush wires, since this will impede the movement of the brushes in the brush holders.

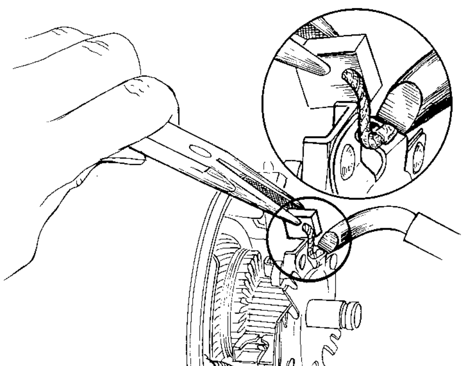


Fig. 3-46

STARTER MOTOR ASSEMBLY

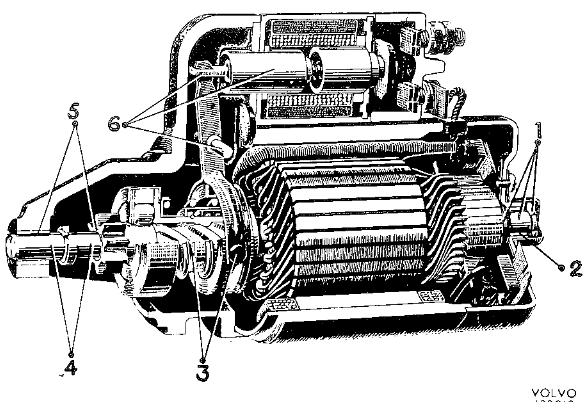


Fig. 3-47

Lubricate the parts of the starter motor according to the Fig. Use Bosch lubricant (or equivalent) in accordance with the following directions:

1. Ft 2 V 3 Place a thin layer of grease on the isolation washers, the shaft end, the adjusting washers and lock washer.
2. Ol 1 V 13 Place the bushing in oil for 1/2 hour before installation.
3. Ft 2 V 3 Apply plenty of grease to the armature thread and the engaging lever groove.
4. Ft 2 V 3 Place a thin layer of grease on the armature shaft.
5. Ol 1 V 13 Place the bushings in oil for 1/2 hour before installation.
6. Ft 2 V 3 Lubricate the engaging lever joints and the iron core of the solenoid with a thin layer of grease.

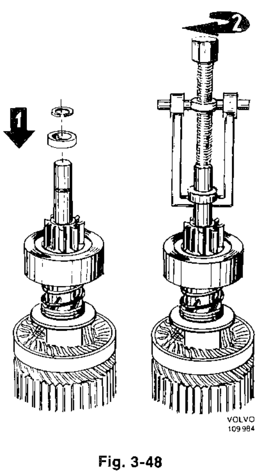


Fig. 3-48

Install the starter pinion, the stop washer and snap ring. Pull the stop washer into position with a suitable puller.

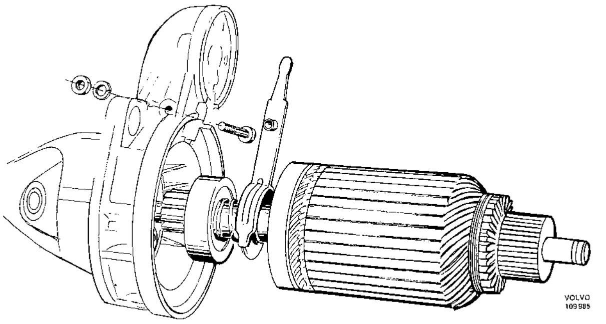


Fig. 3-49

Install the engaging arm on the starter pinion.
Install the armature in the drive end frame.
Install the screw for the engaging arm.

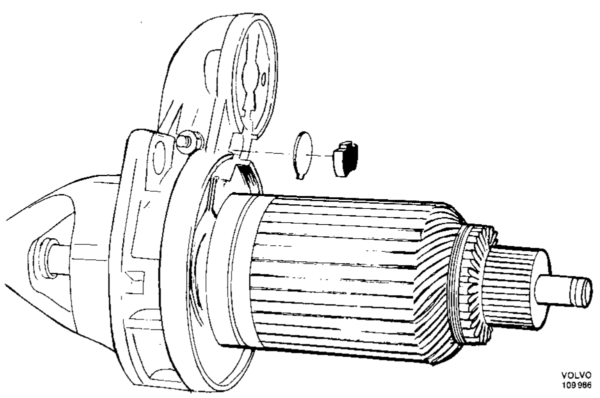


Fig. 3-50

Install the metal washer and rubber washer on the drive end frame.

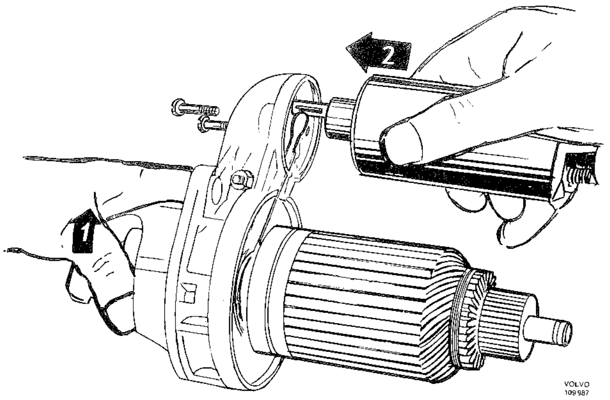


Fig. 3-51

Install the solenoid.

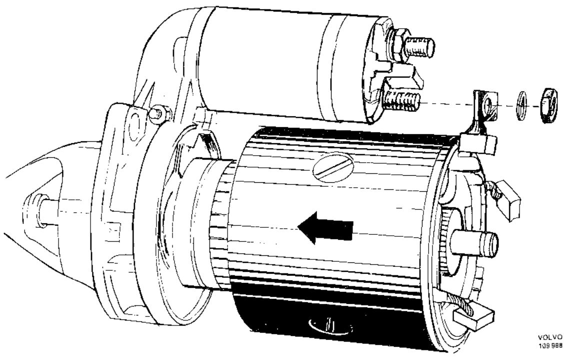


Fig. 3-52

Install the pole housing.

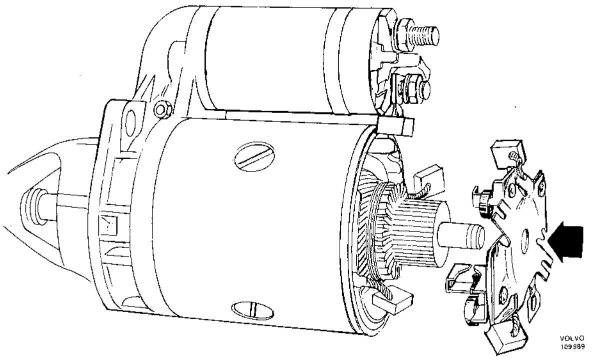


Fig. 3-53

Place the brush bridge in position.

Install the brushes.

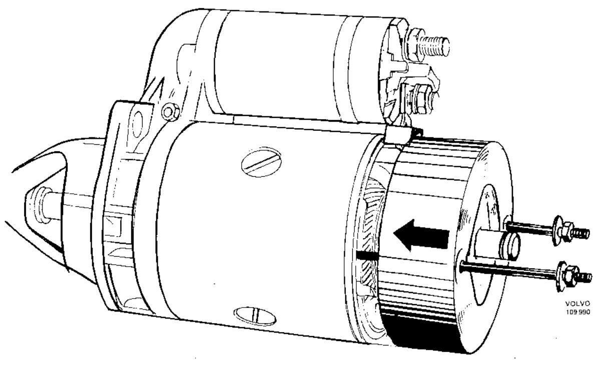


Fig. 3-54

Install the commutator bearing frame.

Screw the starter motor together with the two long bolts.

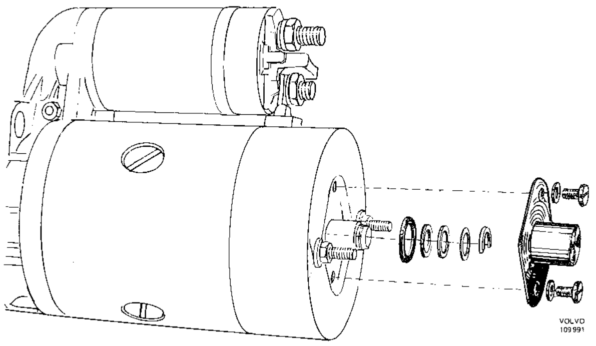


Fig. 3-55

Install the adjusting washers and the snap ring on the shaft end. Check that the armature axial clearance is 0.05–0.3 mm (0.002–0.012"). If necessary adjust with a suitable number of washers until the clearance is correct.
Screw tight the small casting over the shaft end.

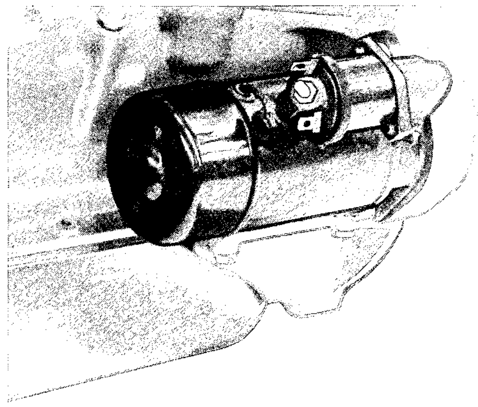


Fig. 3-56

INSTALLATION OF STARTER MOTOR

Connect the electric cables to the starter motor.
Connect the ground cable to the battery.
Check the function by starting the motor.

GROUP 34

IGNITION SYSTEM

GENERAL INFORMATION

The ignition system is of the battery ignition type. It consists of the following main parts:
Ignition coil with advance engaging resistor, distributor, ignition leads and spark plugs.

IGNITION COIL

The ignition coil and advance engaging resistor are fitted on the bulkhead. In order to make sure that a completely satisfactory spark is obtained at high speeds, an ignition coil is fitted which is designed for a voltage lower than 12 volts. An advance engaging resistor is connected in series with the ignition coil for the purpose of lowering the voltage to the right value.
In order to raise the ingition voltage at the moment starting takes place, the advance engaging resistor is by-passed when the starter motor is engaged. The ignition coil is activated directly by the battery voltage via a contact on the starter motor (see wiring diagram). The advance engaging resistance has a resistance of 0.9 ohm.

DISTRIBUTOR

The distributor is mounted on the left-hand side of the engine, and is driven from the camshaft. The setting of the distributor in relation to engine speed is regulated by a centrifugal governor. Adjustment in relation to loading is controlled by a vacuum regulator mounted outside the distributor.

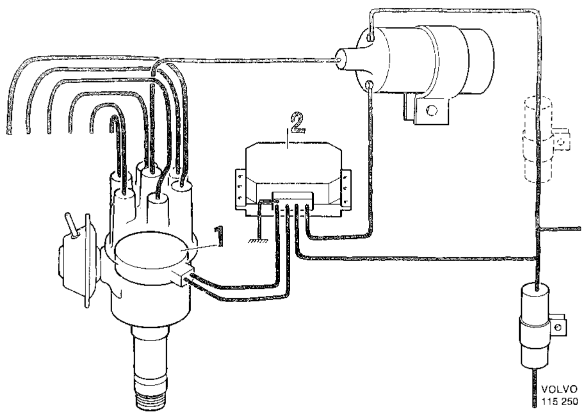


Fig. 3-57

BREAKERLESS SOLID STATE IGNITION SYSTEM

SUMMARY

The breakerless solid state ignition system differs from the conventional ignition system chiefly in two points:

1. The breaker points in the ignition distributor have been replaced by an induction type **impulse sender.**
2. An **electronic module** has been added. It is wired between the distributor and ignition coil. Its function is to amplify the impulses before sending them on to the ignition coil.

Otherwise the design and function are the same as for a conventional ignition system.

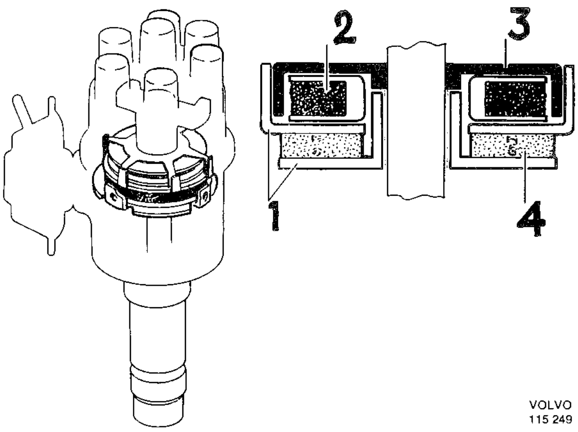


Fig. 3-58

SPECIFIC FUNCTION INFORMATION

(Contains only those differences compared with a conventional ignition system.)

IMPULSE SENDER

It is located in the distributor where the breaker points used to be.

Instead of closing and opening an electric circuit, the impulse sender functions as a small generator and consists of:

stator (1)
coil (magnetic pick-up) (2)
armature (rotor) (3)
permanent magnet (4)

The stator, coil and permanent magnet are connected to the ignition distributor housing while the armature is connected to the distributor shaft and rotates with it.

The stator and armature have as many pole teeth as the engine has cylinders.

The permanent magnet generates a magnetic field which goes through the stator. When the pole teeth are opposite each other, the magnetic circuit is closed, and opens when the pole teeth are separated. In other words, the armature closes and opens the magnetic field while it is rotating. This induces current pulses in the distributor coil (magnetic pick-up).

Vacuum and centrifugal control of the timing are similar to that in a conventional distributor.

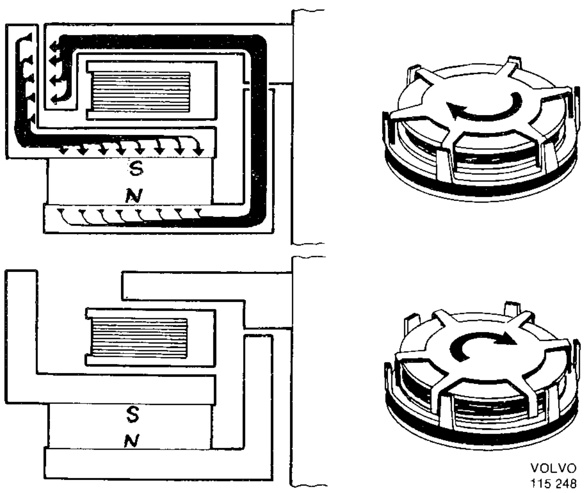


Fig. 3-59

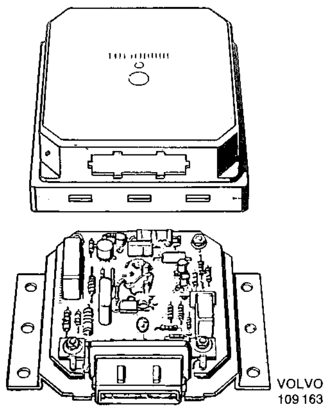


Fig. 3-60

The electronic module is a solid state design with transistors. It amplifies the impulses from the impulse sender and also controls the dwell angle.

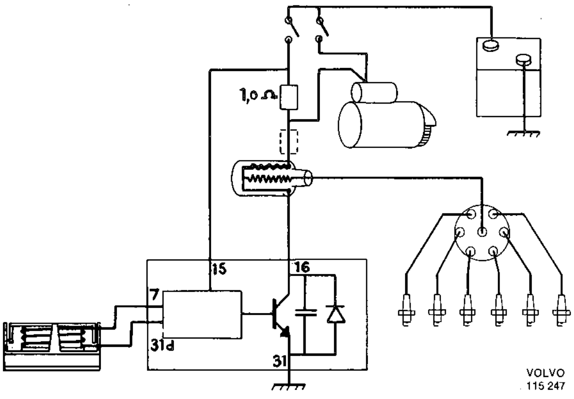


Fig. 3-61

Impulses received from the coil (magnetic pick-up) in the distributor are converted and reinforced in the electronic module and govern the output transistor which in turn controls the ignition coil primary circuit.
When the pole teeth are in front of each other, the module output transistor breaks the primary circuit and induces secondary voltage in the coil to fire the spark plugs.
In other words, the pole teeth have a function similar to that of the cam lobes in a conventional distributor.
The ignition coil has been specifically designed for the breakerless solid state ignition system.

SERVICE PROCEDURES DISTRIBUTOR

REPLACING IMPULSE SENDER (B 21 E)
Removal

Unclasp the lock clasps and remove cap, rotor and dust cover.

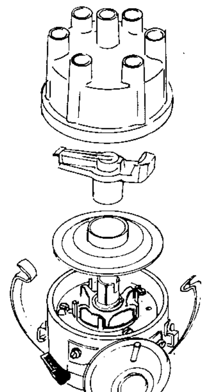


Fig. 3-62

Undo the screws for the vacuum unit and lock clasps and remove these.
The screws must always accompany the component they belong to since they are of different length and if improperly placed can project and damage moving parts.

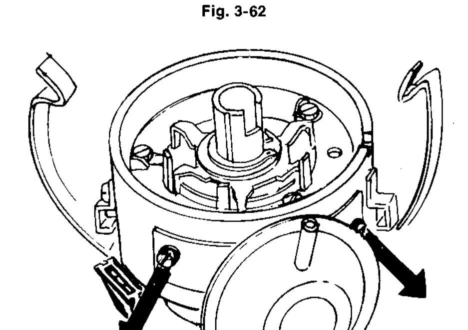


Fig. 3-63

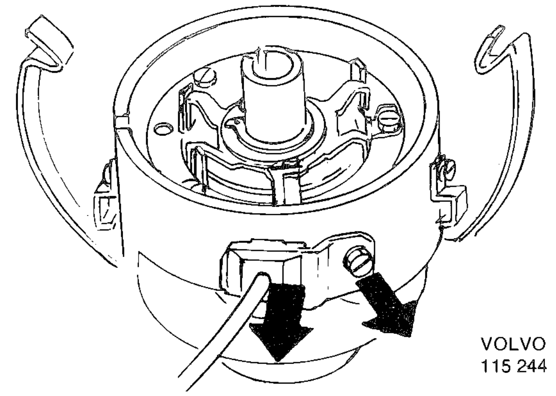


Fig. 3-64

Remove the screws securing the contact. Remove the contact by pulling it carefully straight out.

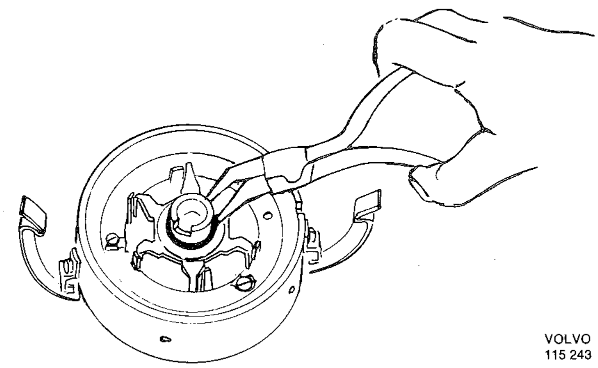


Fig. 3-65

Remove the snap ring with snap ring pliers. Then lift off the shims under the snap ring.

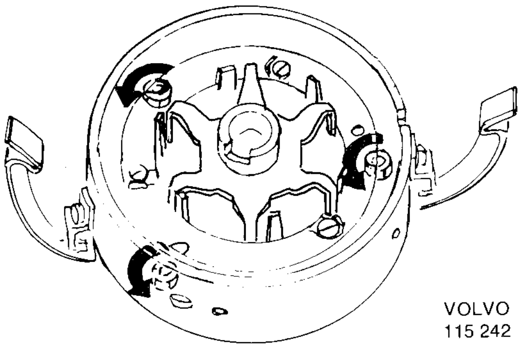


Fig. 3-66

Remove the screws retaining the impulse sender plate.

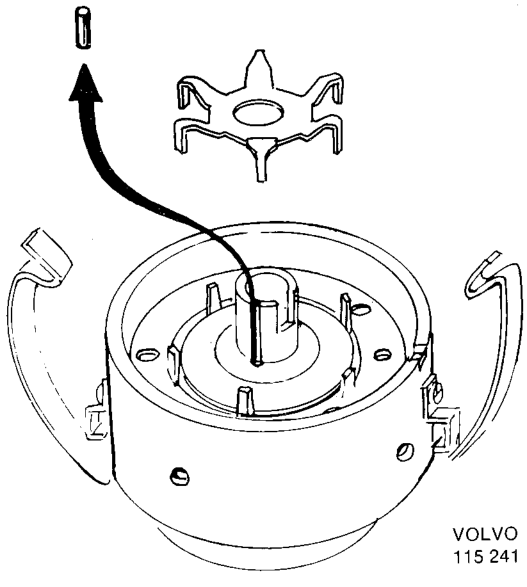


Fig. 3-67

Lift off the armature and the small lock pin.

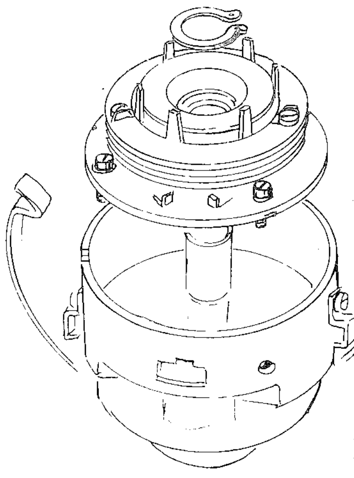


Fig. 3-68

Remove the snap ring with snap ring pliers. Lift up the impulse sender plate.

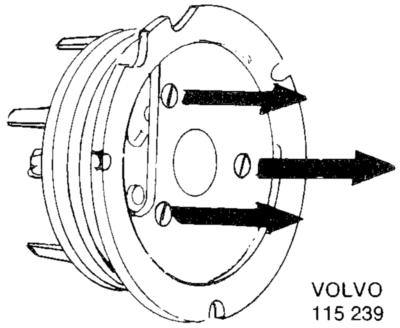


Fig. 3-69

Remove the three screws and replace the impulse sender.

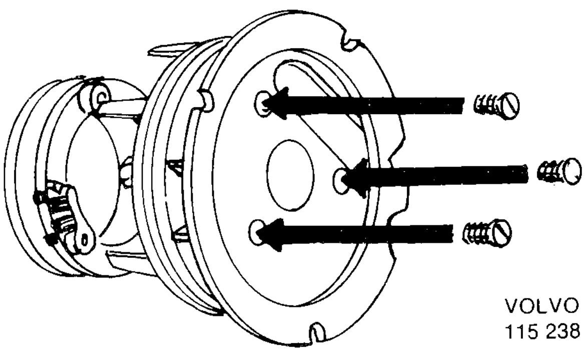


Fig. 3-70

Installation

Fit the impulse sender on the impulse sender plate by placing the connector pins opposite and above the attaching lug for the impulse sender plate.

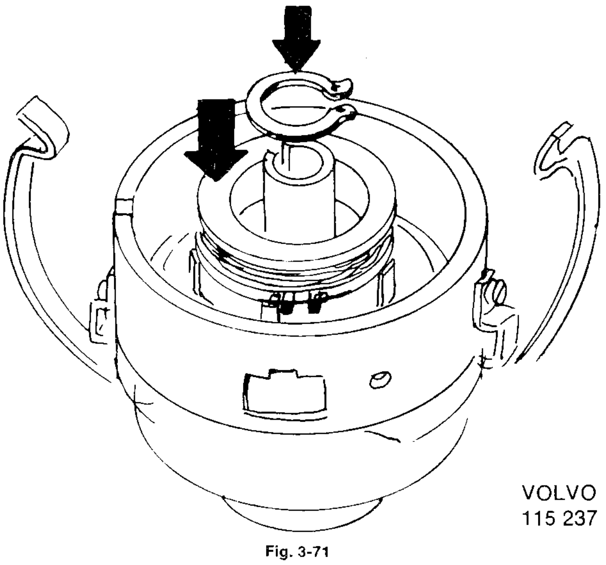


Fig. 3-71

Install the impulse sender plate and secure it with the two screws.

Install the snap ring.

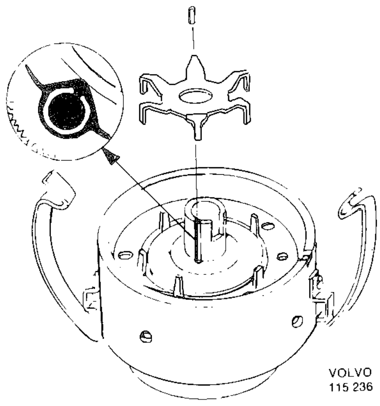


Fig. 3-72

Install the armature so that the slot comes opposite the ridge on the distributor shaft.
Fit the lock pin so that the slot faces the ridge on the distributor shaft.
Otherwise the lock pin may be sheared off.

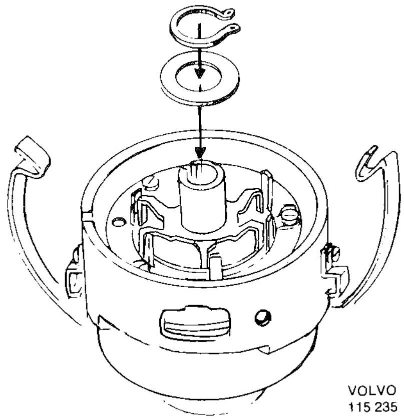


Fig. 3-73

Install the shims and snap ring.

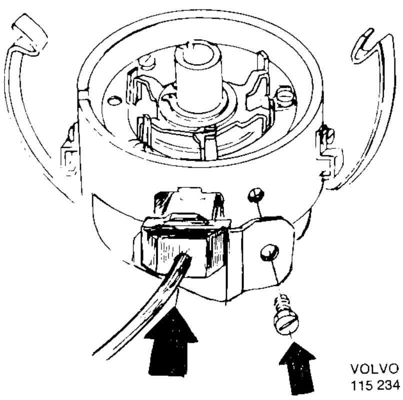


Fig. 3-74

Connect up the contact and secure it with the screw.

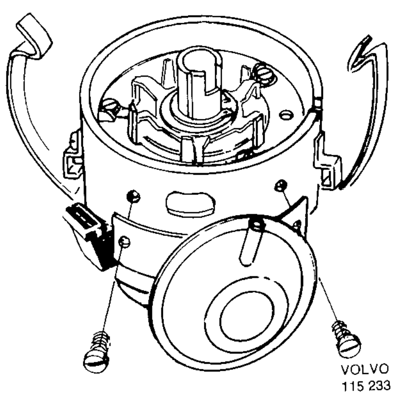


Fig. 3-75

Install the clasps and vacuum unit.

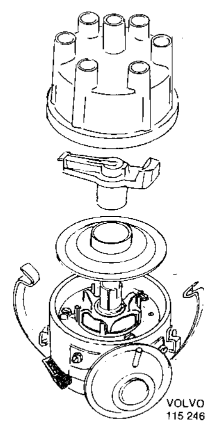


Fig. 3-76.

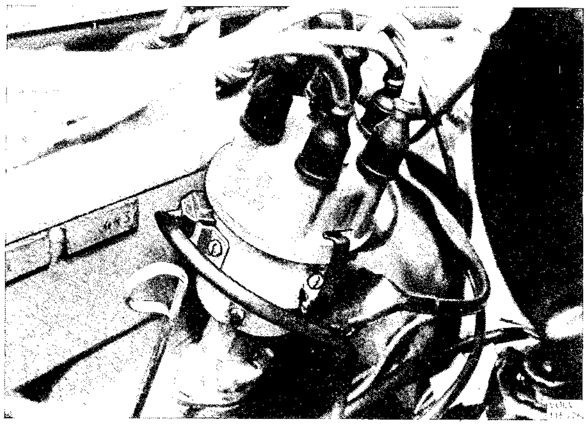


Fig. 3-77. Removing distributor

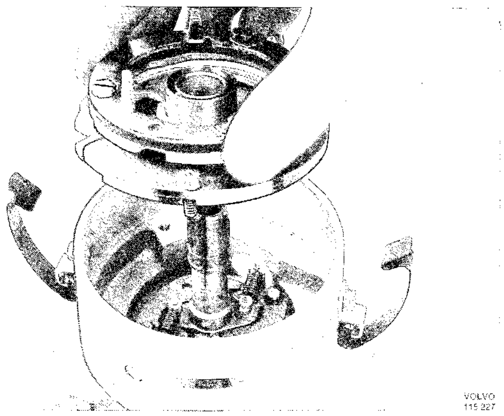


Fig. 3-78. Removing impulse sender

Fig. 3-79. Removing triggering contacts

Install the dust cover, rotor and cap.

REMOVAL

1. Disconnect the ignition high tension leads from the distributor cap.
2. Disconnect the plug contact from the triggering contacts and the cable to the impulse sender at the contact.
3. Remove the vacuum hose from the vacuum regulator.
4. Release the attaching screw and pull up the distributor.

DISASSEMBLY

1. Remove impulse sender.
2. Disconnect the springs to the centrifugal governor and mark up where the drive shaft is located in relation to the distributor shaft. Secure the drive shaft in a vise with soft jaws, see Fig. 3-80.
   Carefully tap on the distributor housing with a plastic mallet until the circlip releases.
3. Remove the triggering contacts, see Fig. 3-79.

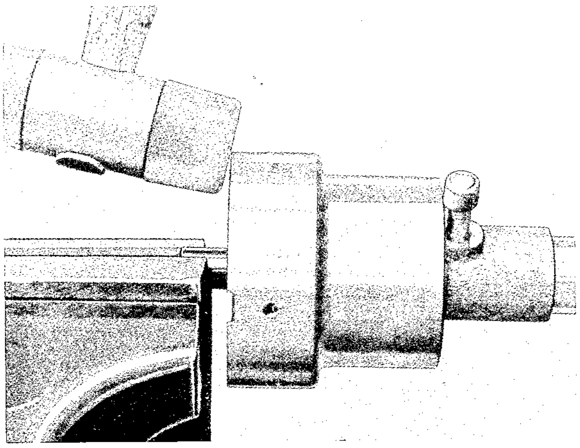


Fig. 3-80. Removing circlip VOLVO 106480

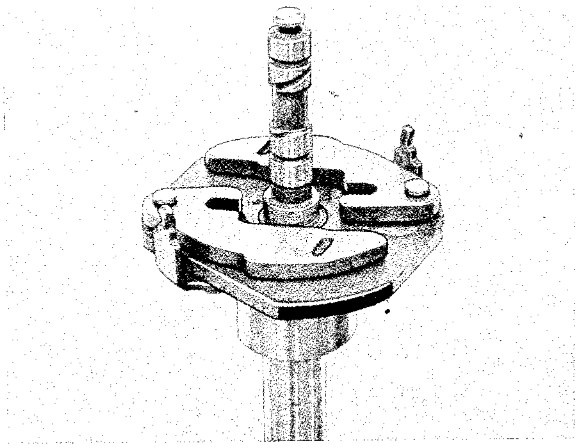


Fig. 3-81. Distributor shaft with centrifugal weights VOLVO 105626

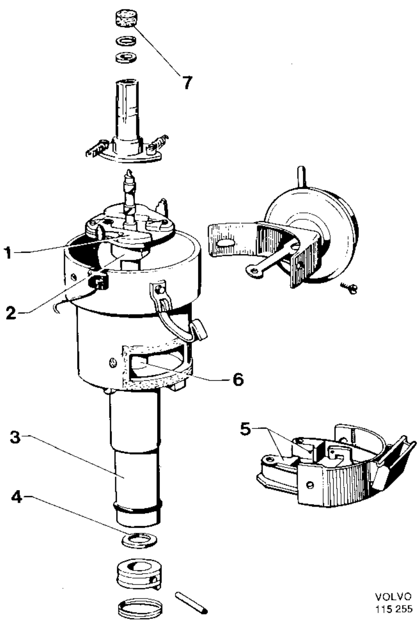


Fig. 3-82. Lubricating chart for distributor

1.	Ft 2 v 3.	Grease the weights.
2.	Ft 1 v 4.	Place a light layer on the breaker cam.
3.	Ol 1 v 13.	Place the brushes in oil for at least 1/2 hour before fitting. Soak the lubr. felt in oil.
4.	Ft 2 v 3.	Grease the washers.
5.	Ft 1 v 4.	Place a little grease on the fiber tabs.
6.	Ol 1 v 13.	Oil the shaft before fitting.
7.	Ol 1 v 13.	Soak the lubr. felt in oil.

4. Remove the resilient ring and mark up the location of the flange in relation to the distributor shaft. Knock out the pin. Take off the flange and pull up the distributor shaft. Check to make sure that no washers are lost.
5. Remove the lock springs for the centrifugal weights and take off the weights.

INSPECTING

Distributor shaft

The clearance between the distributor shaft and ignition breaker cam may not exceed 0.1 mm (0.004").

The holes in the centrifugal governor weights may not be oval or deformed in any other way.

The springs for the weights may not be deformed or damaged.

Distributor housing

The clearance between the distributor housing and shaft may not exceed 0.2 mm (0.008"). If the clearance is excessive, replace the bushings and, if this is still not sufficient, the shaft.

1. Lubricate the parts of the distributor according to the instructions given in Fig. 3-82.
   Assembling is in reverse order to disassembling.

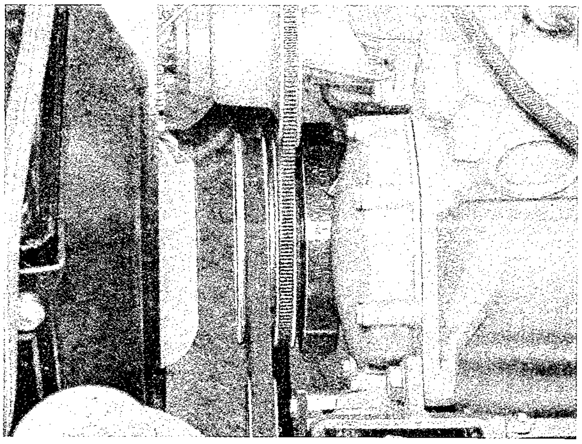


Fig. 3-83. Flywheel damper with graduation for ignition setting

INSTALLATION

1. Place the distributor in position.
2. Press the distributor downwards while turning the distributor arm at the same time. When the distributor goes down about 5 mm (3/16") and it is no longer possible to turn the distributor arm, the driving collar of the distributor is then in the slot on the distributor drive.
3. Turn the distributor housing so that it takes up the same position it had before removal.
4. Connect the cable to the impulse sender contact. Connect the plug contact for the triggering contact. Connect the ignition high tension leads.
5. Start the engine and set the ignition. (If the engine does not start, turn the distributor housing until it does so.)

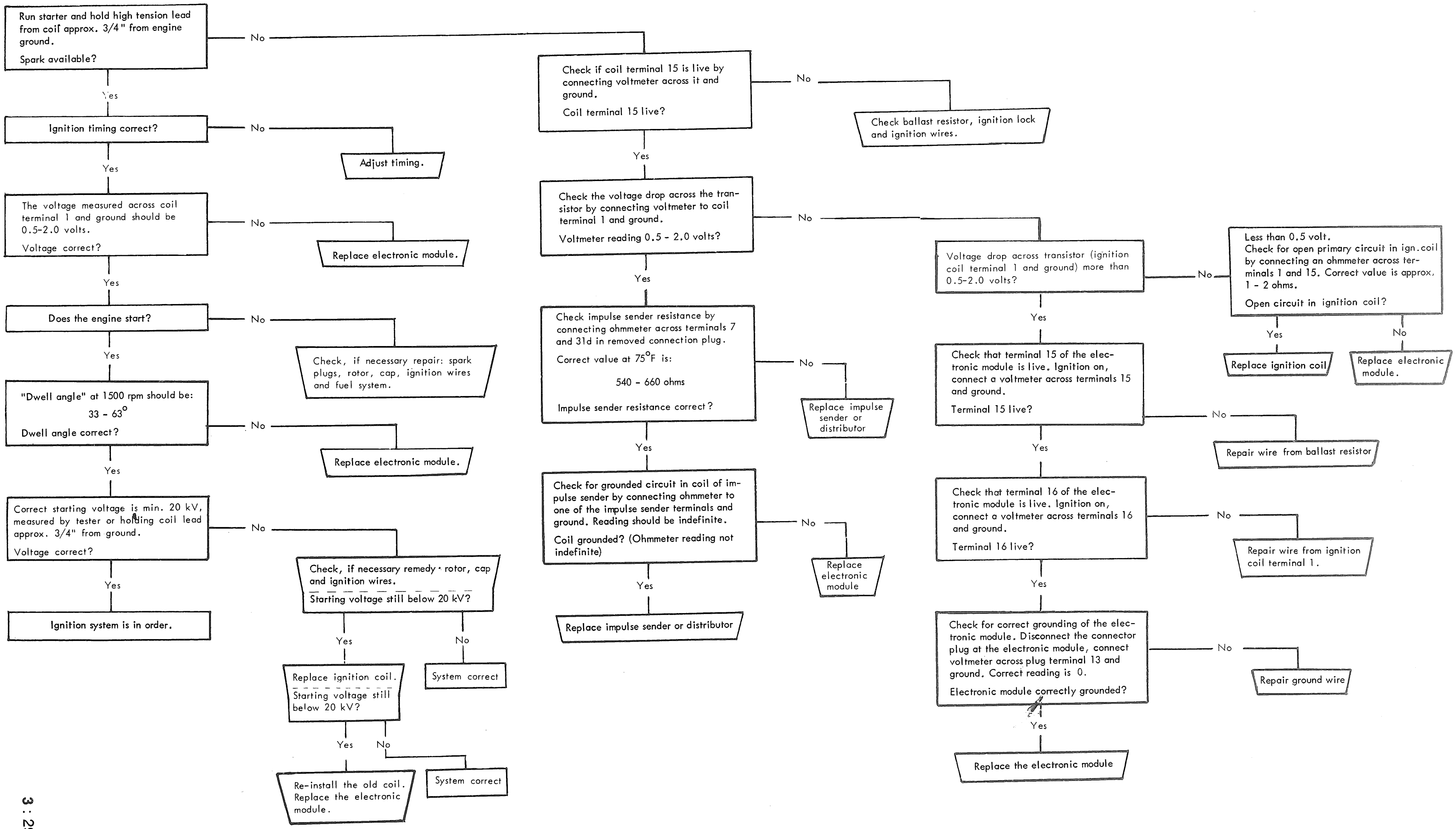
IGNITION SETTING

Ignition setting should always be carried out while the engine is running and with the help of a Stroboscope.

1. Clean the flywheel damper so that the graduation marks are visible, see Fig. 3-83.
2. Remove the hoses from the vacuum regulator. (The hose for the intake manifold should be shut off by, for example, bending it or by sealing it with a suitable plug, so that the engine does not draw in unwanted air.)
3. Connect the Stroboscope to No. 1 cylinder spark plug and to the battery.
4. Start the engine and run it at the r/m given in the "Specifications". Use a tachometer for this purpose. Point the ignition setting lamp at the graduation on the flywheel damper. Slacken the distributor attaching bolt and turn the distributor until the firing position agrees with that given in the "Specifications". Tighten securely the distributor and check that the firing position and speed have not been altered.
5. Remove the Stroboscope and re-fit the hoses on the vacuum regulator.

CHECK OF BREAKERLESS IGNITION SYSTEM

START HERE



LIGHTING

GENERAL INFORMATION

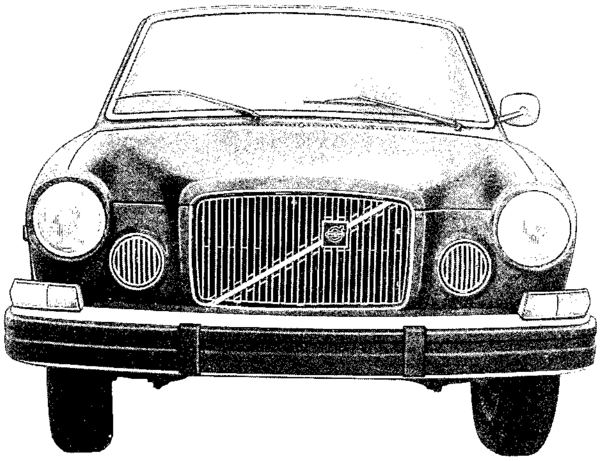


Fig. 3-84. Headlights

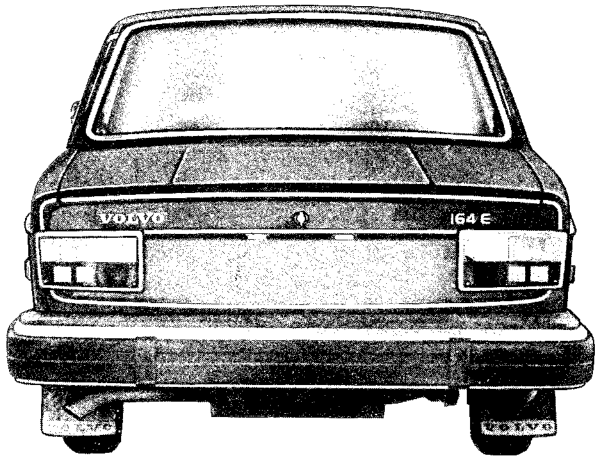


Fig. 3-85. Rear light

The lighting consists of two upper and lower beam headlights with Sealed-Beam inserts, parking lights, tail lights, license plate lights and side marker lights.
The headlights are fitted in the mudguards, see Fig. 3-84. Extra lights can be installed in these recesses merely by removing these covers.
Switching between upper and lower beams is done by moving the turn signal lever towards the steering wheel. A relay makes the lighting. Up front the parking lights are integrally built with the turn signals and are mounted on the front bumper at the corners.
The tail lighs are provided with separate bulbs for rear lights, stop lights, back-up lights and turn signals, see Fig. 3-85.

SERVICE PROCEDURES

HEADLIGHTS

REPLACING HEADLIGHT INSERT

1. Remove the screw and take off the plastic cover over the space behind the headlight, see Fig. 3-88.
2. Remove the connecting contact by pulling it straight backwards.
3. Remove the outer rim by pulling it upwards-forwards, see Fig. 3-89.
4. Release the screws for the inner rim a couple of turns, see Fig. 3-90, turn the rim and lift it off together with the headlight insert.

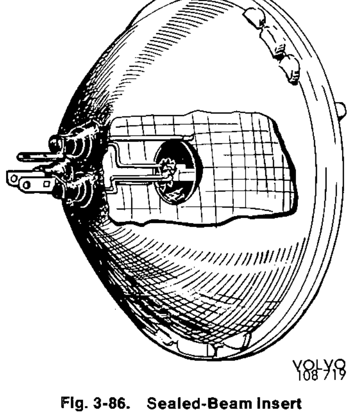


Fig. 3-86. Sealed-Beam Insert

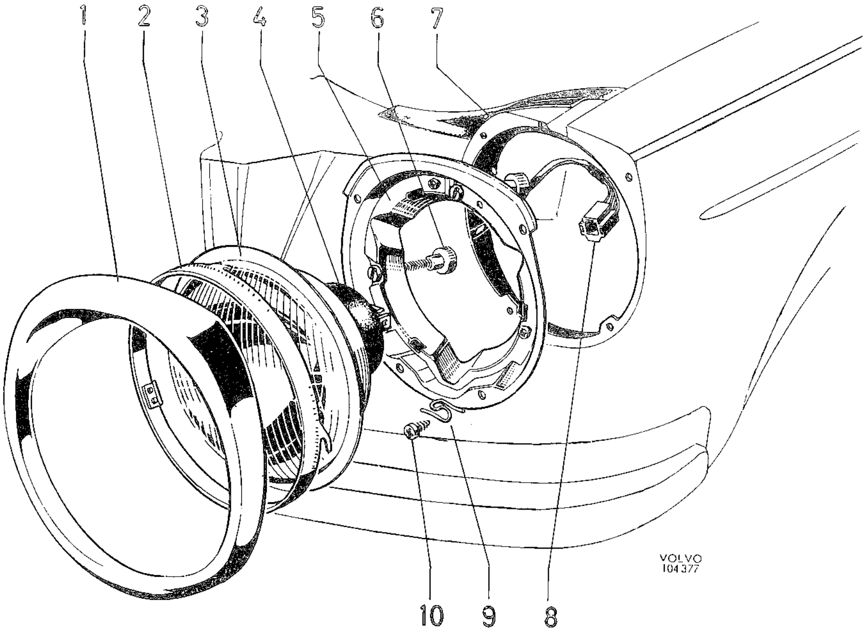


Fig. 3-87. Headlight
1. Outer rim
2. Inner rim
3. Headlight insert
4. Rubber cover
5. Holder unit
6. Adjusting knob
7. Plastic cover
8. Connector
9. Spring wire holder
10. Attaching screw

5. Remove the rubber cover from the old insert and fit it on the new one.
6. Fit the insert and inner rim. Fit the outer rim by hooking the lower section in the spring wire holders, then lift the rim straight up and hook it on securely.
7. Adjust the light according to current legislation. Adjustment is made by means of the two adjusting screws, see Fig. 3-87. Use approved light adjusting equipment.
8. Fit the plastic cover over the space behind the headlight.

CHECKING AND ADJUSTING HEADLIGHTS

The condition of the glass, reflector and bulb of the headlight should be checked. If the glass is damaged by flying gravel, cracked or in any other way defective, the insert

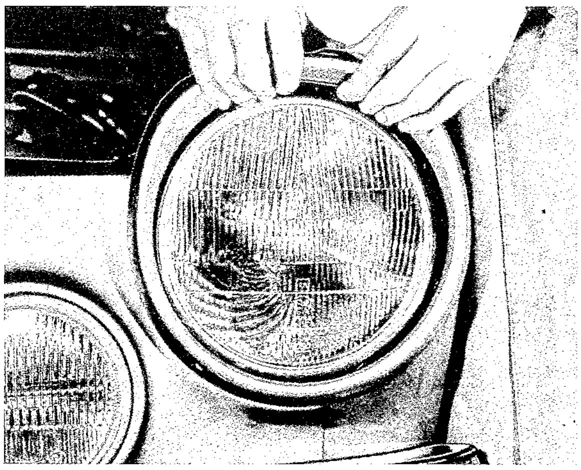


Fig. 3-89. Removing outer rim

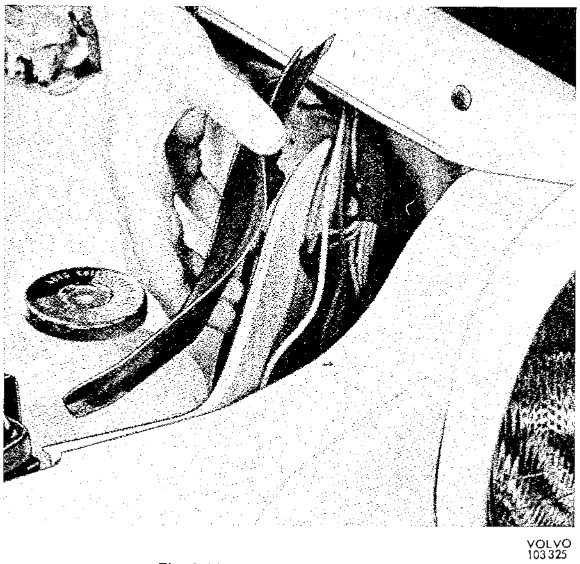


Fig. 3-88. Removing plastic cover

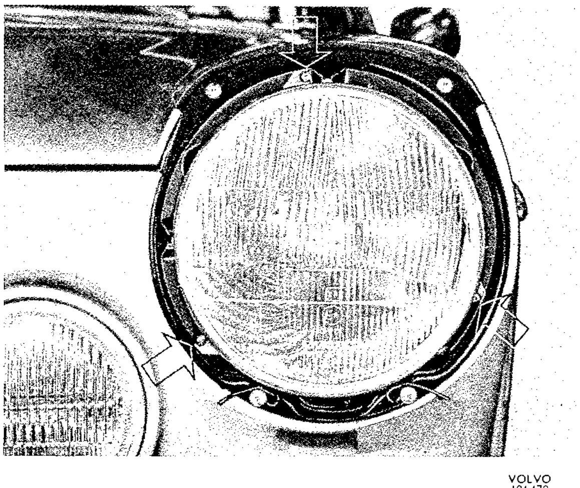


Fig. 3-90. Screws for inner rim

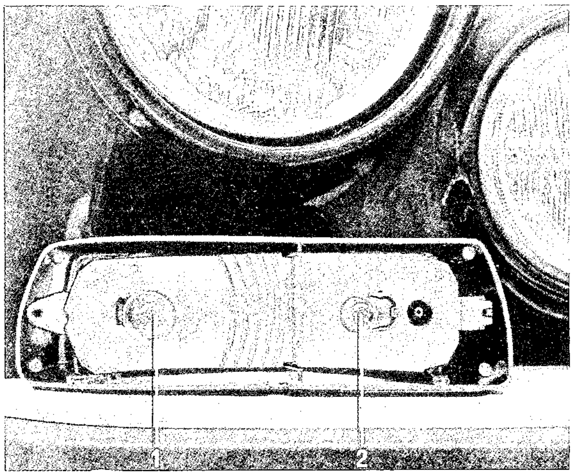


Fig. 3-91. Parking and turn signal light
1. Bulb for turn signal 2. Bulb for parking light

should be replaced. Glass which has become "sand-blasted" by flying stones, etc., will considerably reduce the lighting effect and can give rise to dazzling, irregular beams, etc.

If the reflector is dull, buckled or damaged in any other way, the insert should be replaced. The inside of the bulb must not be oxidized to a black or brown color. The lighting effect normally deteriorates to such an extent that the bulbs should be replaced after 100—200 hours of operation.

The voltage at the bulb with the headlights switched on and the engine running at charging speed should be at least 12.5 volts if sufficient lighting strength is to be produced.

The headlights should be adjusted according to current legislation. Approved adjusting equipment should be used for this purpose.

Adjustment is made by varying the two adjusting knobs

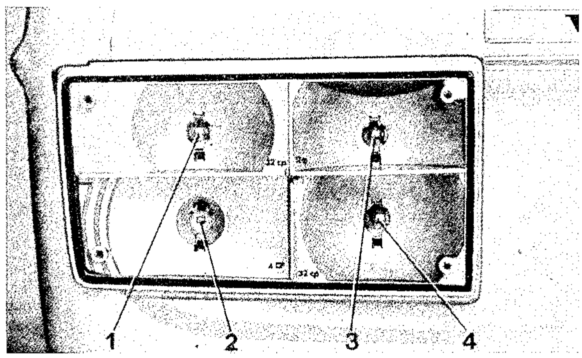


Fig. 3-92. Bulb location
1. Turn signal light 3. Reversing light
2. Tail light 4. Brake light

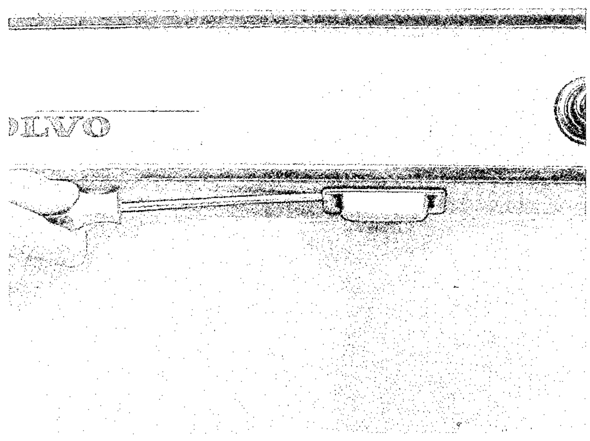


Fig. 3-93. Removing license plate light

behind the headlight, see Fig. 3-87. The upper knob adjusts the headlight vertically and the knob at the side adjusts the headlight laterally.

CHECKING

See "Checking and adjusting headlights".

PARKING LIGHTS AND TURN SIGNALS

REPLACING BULB

1. Remove the screws holding the glass and lift off the glass.
2. Replace the damaged bulb.
   NOTE. Do not touch the new bulb globe with your fingers.
3. Fit the glass and the screws. Check that the sealing is fitted correctly.

TAIL LIGHTS

REPLACING BULBS

1. Unscrew the four attaching screws for the lamp glass and remove the glass.
2. Replace the bulb, see Fig. 3-92.
3. Re-fit the glass.

TAIL LIGHT

The tail light is replaced as a complete unit.

1. Remove the spare wheel (left-hand side).
2. Remove the protective cardboard.
3. Mark up the cables and disconnect them.
4. Remove the attaching screws. A suitable tool for this is an 8 mm (5/16") screwdriver.
5. Lift off the tail light.
6. Installing is in reverse order to removal.
7. Check to make sure that the tail light functions properly.

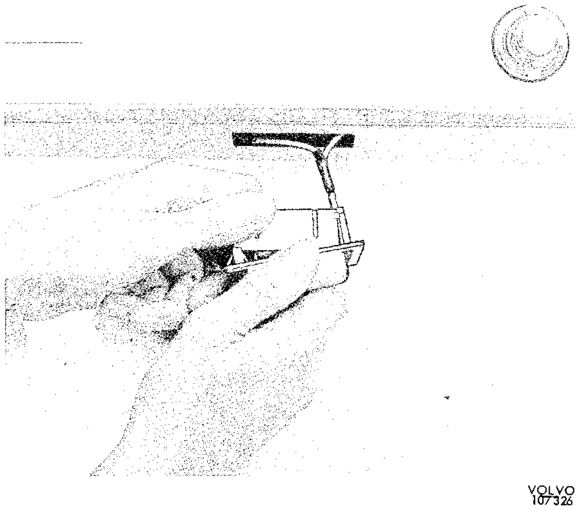


Fig. 3-94. Disassembling license plate light

LICENSE PLATE LIGHT

REPLACING BULB

1. Remove the license plate light with the help of a cross-head screwdriver according to Fig. 3-93.
2. Disconnect the electric cable from the plate.
3. Disassemble the plate according to Fig. 3-94.
4. Replace the bulb.
5. Re-connect the electric cable to the plate.
6. Install the plate by pressing it firmly into its recess.

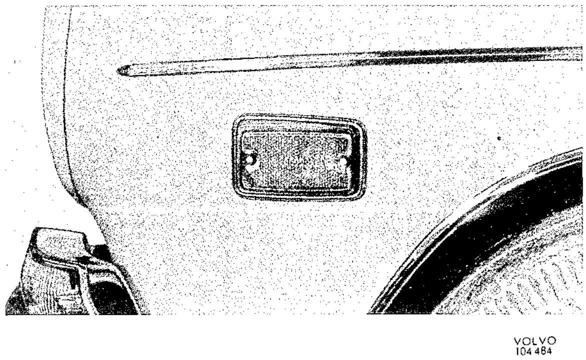


Fig. 3-95. Side marker light

SIDE MARKER LIGHTS

Two side marker lights are placed on each side of the car, one in front and one in rear.

To replace the bulb, take off the glass. The glass is fitted on the body by two screws.

OTHER ELECTRICAL STANDARD EQUIPMENT

GENERAL INFORMATION

TURN INDICATORS

The turn indicator system consists of an electronic flasher relay, turn indicator switch, flash lamps on the front mudugards and bulbs in the tail lights. The turn signal lever is located under the plastic casing on the left-hand side of the steering column, see Fig. 3-97. It switches on the right or left in two stages. Stage one is used when changing a lane and stage two when changing direction. The switch has automatic return to neutral. The turn indicator panel light is wired in parallel across the switch. The turn indicators can also be used as emergency warning flashers, which are switched on by the emergency warning flasher switch on the control panel. The flasher function is governed by the flasher on the reverse side of the control panel, see Fig. 3-96. The steering wheel lock is equipped with a reminder buzzer which buzzes when the driver's door is open and the ignition key is in the ignition switch, in other words, if the steering wheel is not locked.

IGNITION SWITCH

The ignition switch is integrally built with the steering wheel lock. The switch has four positions:

0. Complete electrical system disocnnected and steering wheel locked.
1. Current to fuse box (Intermediate position).
2. Same as position 1 but also current to igniton coil (Driving position).
3. Same as position 2 but also current to starter motor solenoid (Starting position). When the ignition key is released in position 3, it returns automatically to position 2.

HORNS

The horns are located to the left of the radiator behind the grille.
One of the horns has a low frequency and the other a high frequency.
The horn pad mounted in the steering wheel operates the horns.

FUSES

The fuses are in a fuse box, which is located next to the left fresh-air vent. The fuses are accessible when the cover is removed.

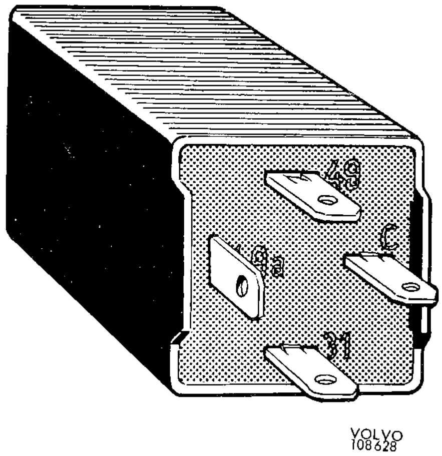


Fig. 3-96. Flasher

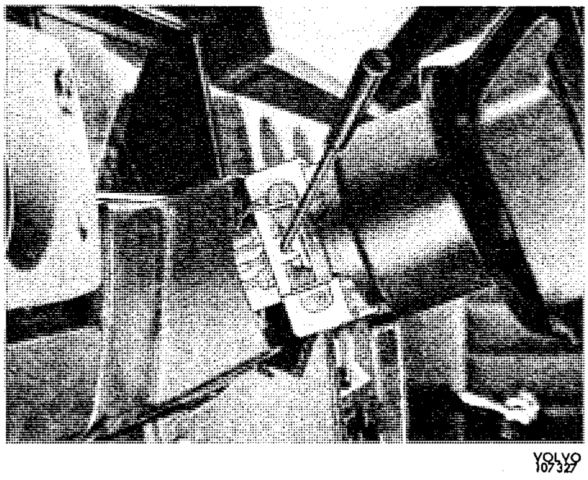


Fig. 3-97. Turn signal lever

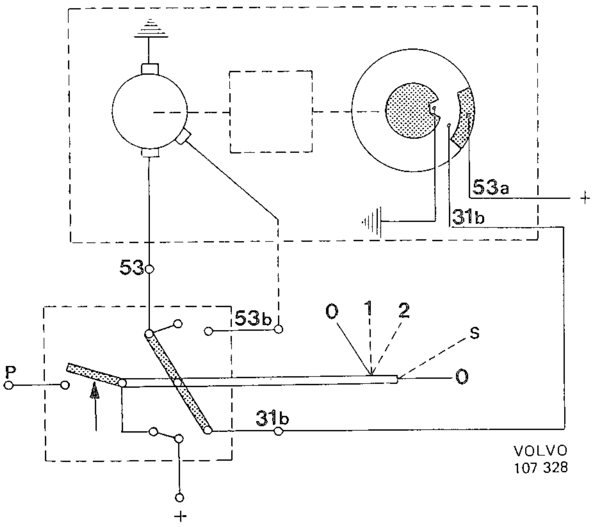


Fig. 3-98. Wiring diagram for windshield wiper motor, Electrolux

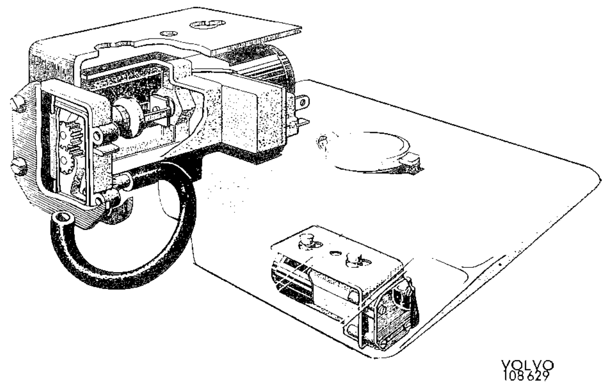


Fig. 3-100. Windshield washer

WINDSHIELD WIPERS

The windshield wipers are driven by an electric motor. The motor is connected to the wipers by a combined cable and linkage system. It has a permanently magnetized field and three brushes, one a minus brush and the other two plus burshes. The plus brushes are connected one at a time so that the engine has two different speeds, 0.57± 0.07 r/s (34±4 rpm) and 0.92±0.8 r/s (55±5 rpm). The function of the parking switch, which is built into the gear housing, is to return the wiper blades to a suitable, predetermined, parking position, see Figs. 3-98 and 3-99 irrespective of where the wiper is switched off.

WINDSHIELD WASHER

The windshield washer, see Fig. 3-100, which is located on the left wheel housing, is driven by an electric motor. Motor and pump are placed on the underside of the washer container. The pump is of the gear type, see Fig. 3-100.

Wipers and washers are operated by the same switch lever, located on the steering column.

SWITCHES

The switches for the flashers, electrically heated rear window, are of the toggle type and are located on the control panel. Also located on the control panel is a rheostat for the instrument panel light.

INTERIOR LIGHT

The interior light consists of a lamp located in the middle of the roof. It is switched on by a switch built into the light. The switch has three positions. In its first position, the light is switched off completely, in the second position the light is on when any of the front doors is opened, and in the third position the light is on continuously.

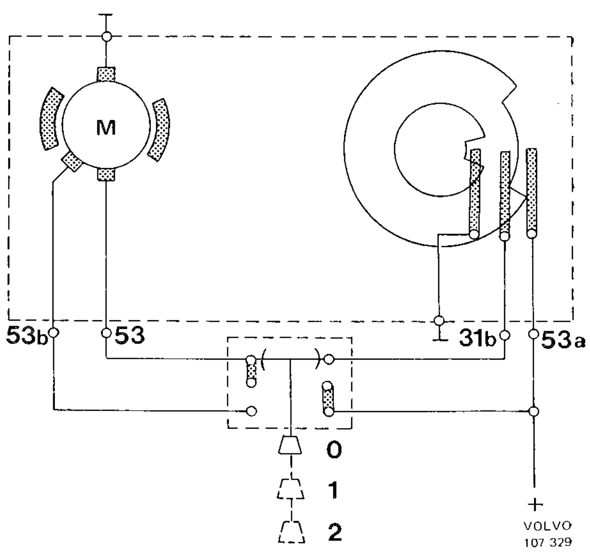


Fig. 3-99. Wiring diagram for windshield wiper motor, SWF

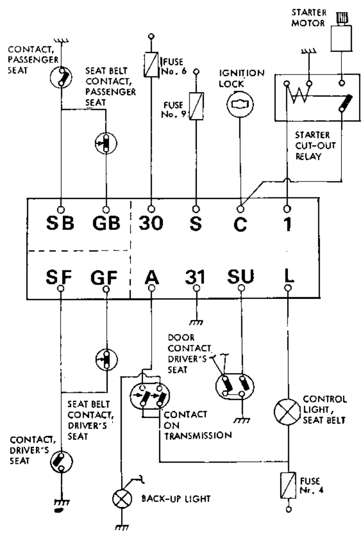


Fig. 3-101. Interlock Control System, wiring diagram

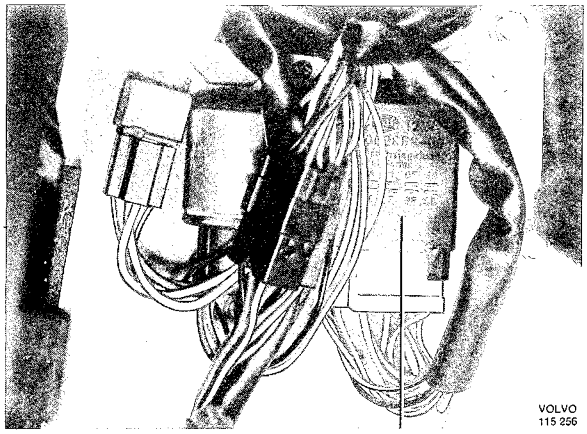


Fig. 3-102. Interlock Control Unit (1)

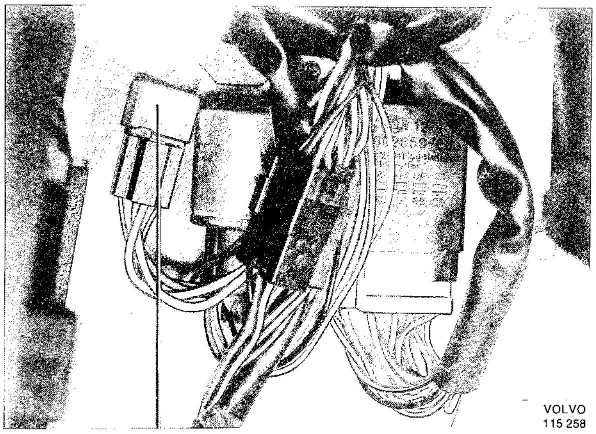


Fig. 3-104. Starter Cut-Out Relay (1)

SEAT/IGNITION INTERLOCK SYSTEM GENERAL

The purpose of the Seat/Ignition Interlock System is to prevent starting the engine if the driver's seat or the passenger's seat is occupied but the appropriate seat belt is not fastened.

The Ignition Interlock Device consists of:

SEAT CONTACTS, one for each seat, which indicate if the seat is occupied. The circuit is closed when the seat is occupied.

BELT CONTACTS, which indicate if the belt is connected. The circuit is opened when the belt is fastened.

INTERLOCK CONTROL UNIT (Logic Unit), which switches on or off the Starter Cut-Out Relay, according to the indications of the above switches.

STARTER CUT-OUT RELAY, which is governed from the Interlock Control Unit and consequently opens or closes the circuit from the ignition switch to the starter. The Interlock Control Unit incorporates also:

buzzer and **"fasten seat belt" control light** and the warning fucntion "Ignition key left in the lock".

FUNCTION

The driver's seat and the passenger's seat each have one set of contacts and belt contacts. These sets are independent.

A relay in the Interlock Control Unit is governed by the indications from the driver's side and the passenger's side. When the seat belt is used correctly, the relay closes the circuit from "C" to "1" (relay rest position), and the engine can be started. See Fig. 3-101, pos. 1.

If the starter circuit has been cut out (seat and belt contacts incorrectly sequenced or misconnected) the driver is warned by the buzzer and the "Fasten Seat Belt" warning light when the ignition key is turned to the "Starting" position or the gear shift is in a forward position.

In order to prevent the cut-out and warning system to function if the seat intermittently is unoccupied (for instance at a road bump), there is a delay mechanism which cuts in the fucntion only when the seat has been occupied for more than 20 seconds.

If the relay has functioned, the seat belt has to be disconnected and re-fastened.

The engine can be started:

1. If the seat first is occupied (loaded).
2. If the seat first is occupied and the seat belt thereafter fastened.

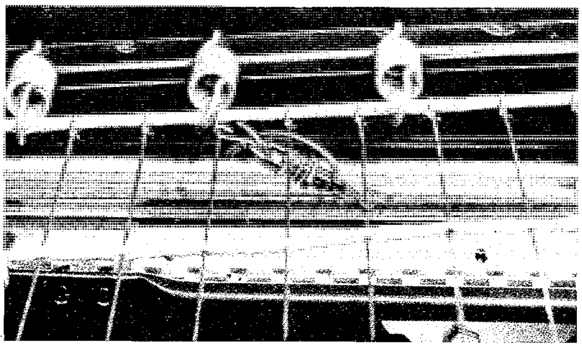


Fig. 3-103. Seat contact

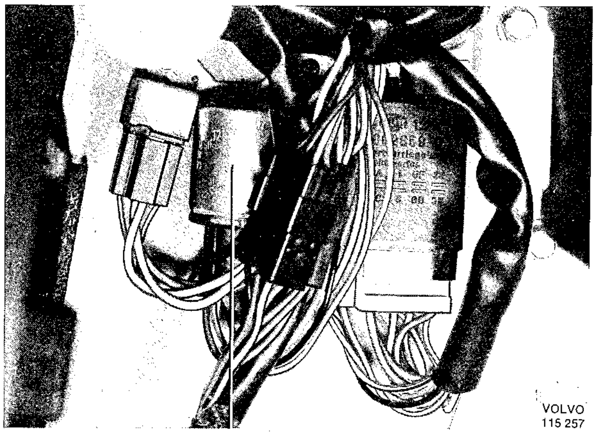


Fig. 3-105. Reed Relay

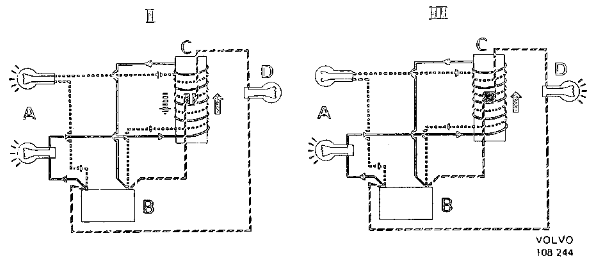


Fig. 3-106. Bulb Integrity Sensor, function

BRAKE LIGHT SWITCH

The brake light switch is located on the pedal carrier under the dashboard. It is operated mechanically by the brake pedal.

CONTROL RELAYS

The cars in the 164-series are as standard equipped with one control relay for switching between upper and lower beams.
Vehicles with automatic transmission are equipped with a control relay for the back-up lights.

BULB INTEGRITY SENSOR

The Bulb Integrity Sensor system consists of a Reed relay and a warning light. It indicates if any of the bulbs for lower beam, tail light or stop light are out of order.
The indication is that the warning light comes on. The Reed relay is located to the left under the dash board, see Fig. 3-105, and the warning light is located in the combination instrument.
The Reed relay consists of a contact set, surrounded by three coil sets (one for lower beams, one for tail lights, one for stop light).

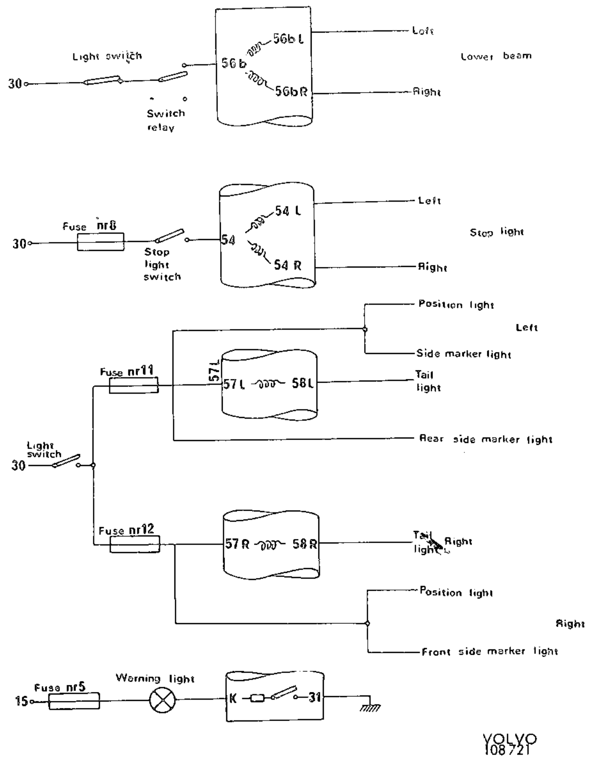
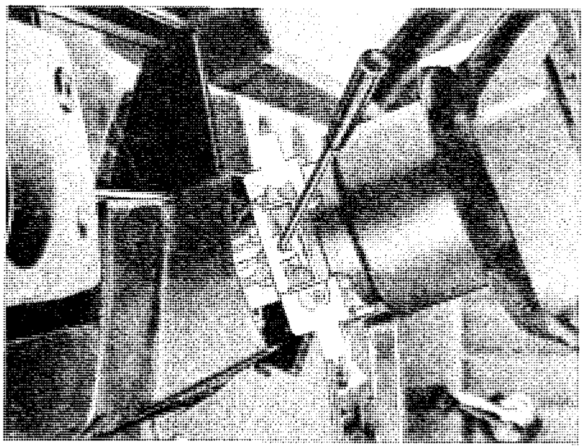


Fig. 3-107. Bulb Integrity Sensor, wiring diagram

Each coil set has two coils, one for the left bulb, one for the right bulb. The two coils develop counteracting magnetic fields.

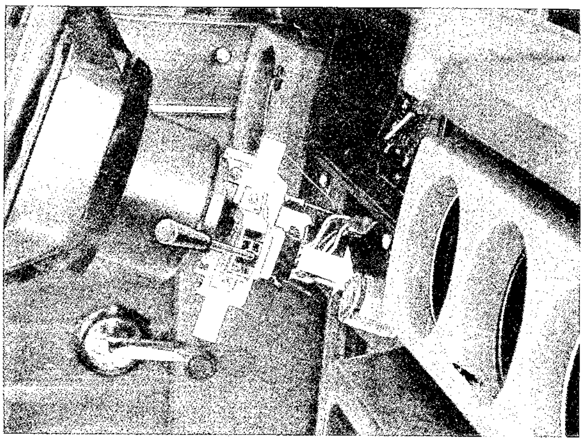
FUNCTION

When current flows through both coils in the coil set, which means that the bulbs on both sides are functioning, the two coils develop counteracting magnetic fields that cancel out each other and prevent the contacts from joining, see I Fig. 3-106. But if current flowing through one of the coils ceases (the bulb is not functioning), the contacts are actuated and the warning light comes on, see II in Fig. 3-106.



VOLVO 107331

Fig. 3-108. Lever for flashers



VOLVO 107332

Fig. 3-109. Lever for windshield wipers

REPLACING LEVERS FOR TURN INDICATORS AND WINDSHIELD WIPERS

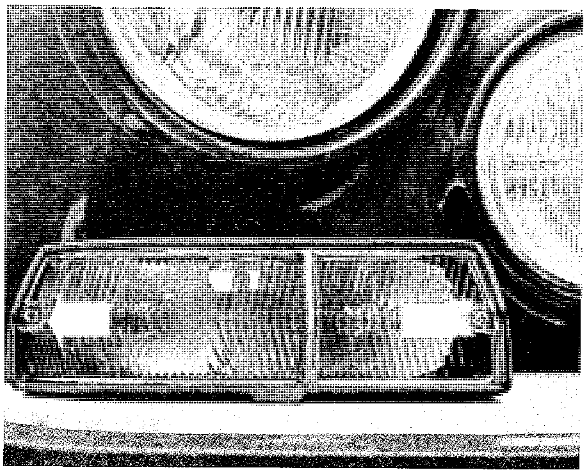
1. Remove the casings over the steering column.
2. Remove the screws for the lever.
3. Connect the electric wires to the new lever.
4. Install the new lever and check its function.
5. Restore.

REMOVING HORN CONTACT BAR

1. Remove the impact guard (1, Fig. 3-111). (Carefully lever it loose with the help of a screwdriver.)
2. Disconnect the electric cable (4, Fig. 3-111) from the contact bar (3, Fig. 3-111).
3. Remove the four attaching screws (2, Fig. 3-111) for the contact bar and lift off the bar. Installation of the contact bar is in reverse order to removal. After installation, check the flasher function.

REPLACING FLASHER LIGHTS

1. Remove the electric cable from the cable loom in engine compartment.
2. Remove the light glass, see Fig. 3-110.
3. Remove the housing from the fender. Pull out the electric cable with its grommet.
4. Install the new electric cable with grommet and install the housing.
5. Install the bulb connecting the electric cable to the harness.
6. Check the flasher function and install the lens.



VOLVO 108759

Fig. 3-110. Removing flasher light glass

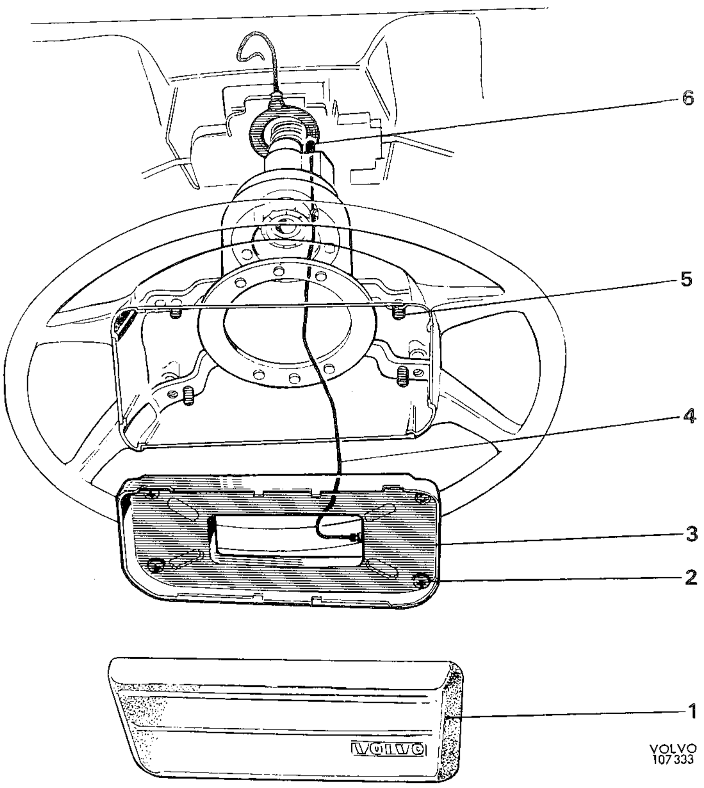


Fig. 3-111. Contact bar
1. Impact guard
2. Attaching screw
3. Contact bar
4. Electric cable
5. Contact pin
6. Slip contact

REMOVING WIPER MOTOR

1. Remove the drive link from the lever on the wiper motor after having first removed the lock device, see Fig. 3-113.
2. Remove the contact from the wiper motor.
3. Remove the three attaching screws (Fig. 3-114). Lift out the wiper motor.

When replacing a wiper motor, transfer the lever, rubber seal, damper rubber and spacer sleeves to the new wiper motor.

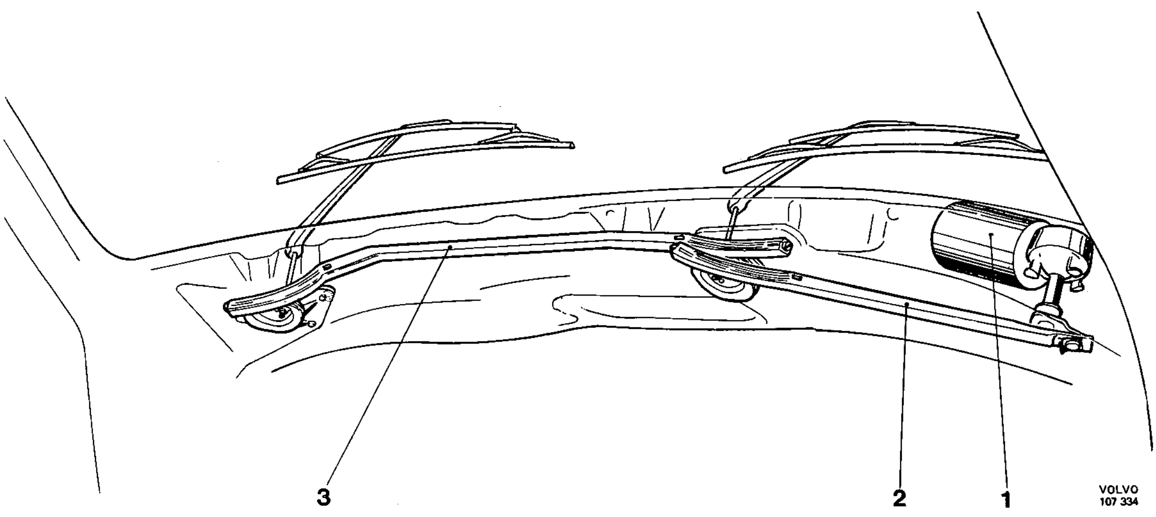


Fig. 3-112. Windshield wiper unit
1. Wiper motor 2. Drive link 3. Parallel drive link

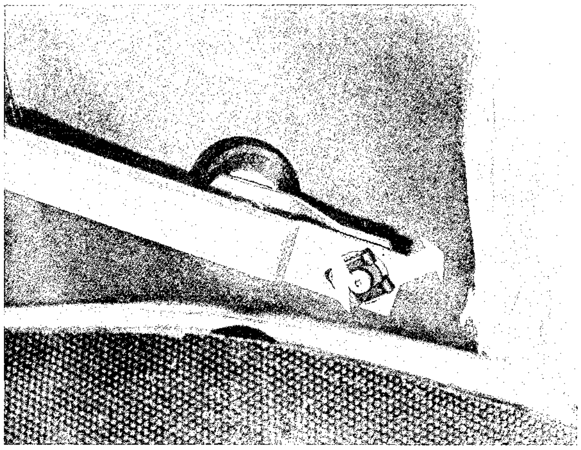


Fig. 3-113. Removing lock

INSTALLING WIPER MOTOR

1. Place the wiper motor in position and install the attaching screws, see Fig. 3-114.
2. Connect up the contact to the wiper motor.
3. Install the drive link to the lever on the wiper motor.
4. Check the wiper function.

REMOVING DRIVE LINK

1. Remove the glove box.
2. Remove the right defroster nozzle.
3. Remove the drive link for the wiper motor lever and unscrew the nut for the cable stretcher.
   Lift off the drive link.

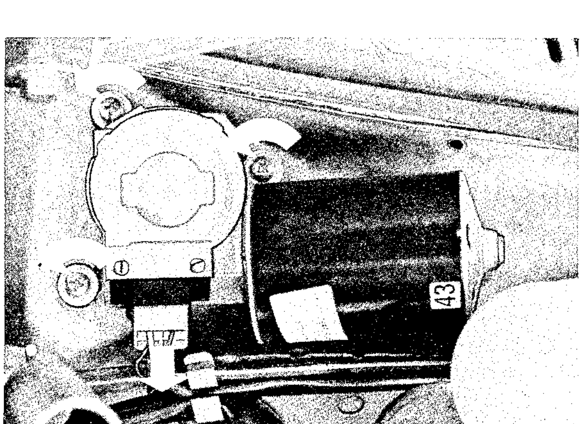


Fig. 3-114. Removing windshield wiper motor

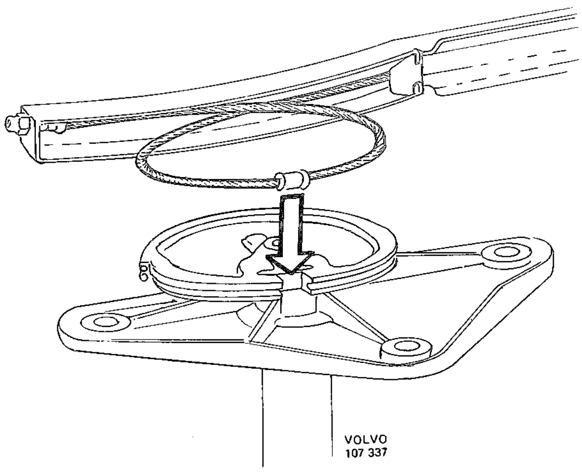


Fig. 3-115. Installing cable for drive link and parallel drive link, left-hand side

INSTALLING DRIVE LINK

1. Place the cable's flange nipple in the segment recess and then lever the cable over the segment, see Fig. 3-115. This work should be done with the greatest care in order not to score the segment or damage it in any other way, as this would lead to disturbance in operation.
2. Install the connecting rod for the wiper motor lever. Thereafter tension the cable.
3. Check to make sure the wipers are functioning properly.
4. Install the defroster nozzle and glove box.

REPLACING CABLE

1. Remove the drive link and the parallel drive link.
2. Bend up the lock washer with the help of a screwdriver, and remove the washer. Remove the old cable.
3. Check to make sure the wipers are functioning properly.
4. Re-install the cable stretcher in the drive link. The nut should be screwed on only a couple of threads.
5. Install the drive link and parallel drive link.

REMOVING PARALLEL DRIVE LINK

Left-hand side

1. Remove the defroster hose.
2. Remove the air duct between the defroster nozzle and the air vent in the dashboard.
3. Remove the nut for the cable stretcher and disconnect the cable from the segment.

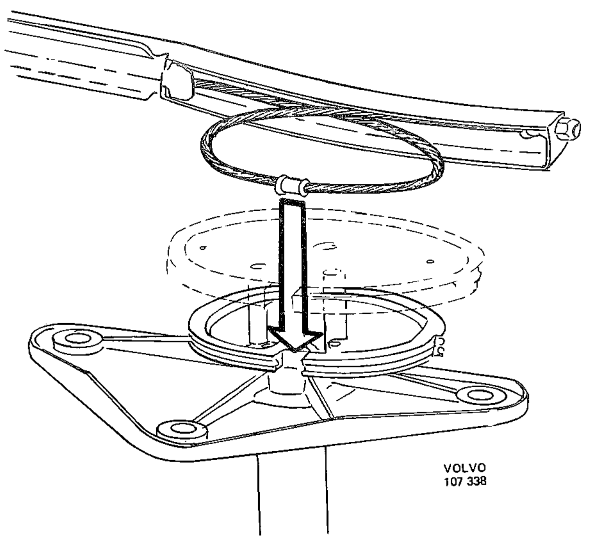


Fig. 3-116. **Installing cable for parallel drive link, right-hand side**

Right-hand side

1. Remove the side panel and defroster hose.
2. Remove glove box and right-hand defroster nozzle.
3. Disconnect the drive link and remove it.
4. Remove the nut for the cable stretcher and disconnect the cable from the segment.
5. Lift forward the parallel drive link.

INSTALLING PARALLEL DRIVE LINK

Left-hand side

1. Place the cable's flange nipple in the large segment recess and thereafter, prise the cable over the segment, see Fig. 3-115. Great care should be observed when doing this in order not to score the segment or damage it in any other way, otherwise this might lead to disturbances in operation.

Right-hand side

1. Place the cable's flange nipple in the small segment recess and thereafter prise the cable over the inner segment, see Fig. 3-116. Great care should be observed when doing this work so as not to score the segment or damage it in any other way, as this should lead to disturbance in operation. Tension the cable.
2. Place the drive link cable's flange nipple in the front segment recess and thereaefter prise the cable over the segment, see Fig. 3-115.
   Attach the drive link to the lever on the wiper motor. Tension the cable.
3. Check the wiper function.
4. Install the defroster hoses and the side panel.
5. Install the defroster nozzle and the glove box.

REPLACING WIPER ARM BEARING

1. Remove the wiper arm.
2. Remove the drive link and parallel drive link.
3. Remove the attaching screws and lift off the wiper arm bearing.
4. Transfer the seal to the new wiper arm bearing. A worn or deformed seal should be replaced by a new one.
5. Install the wiper arm.
6. Check the wiper function.

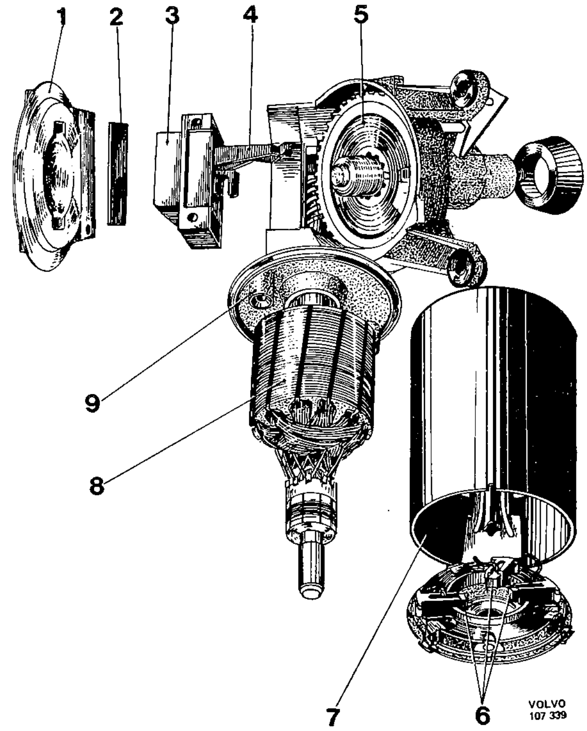


Fig. 3-117. **Windshield wiper motor, Electrolux**

1. Cover
2. Packing
3. Connection contact
4. Contacts
5. Gear with contact bar
6. Electric brushes
7. Stator
8. Rotor
9. End

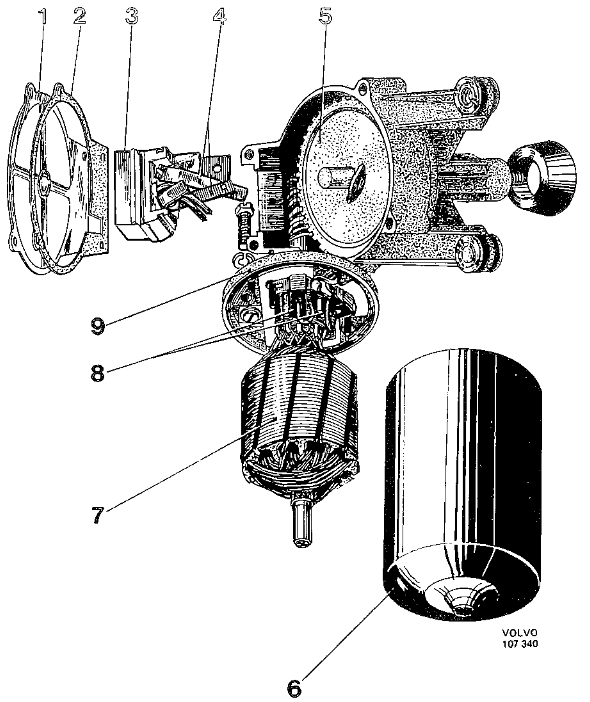


Fig. 3-118. Windshield wiper motor, SWF

1. Cover
2. Packing
3. Connection contact
4. Contacts
5. Gear with breakers
6. Stator
7. Rotor
8. Electric brushes
9. End

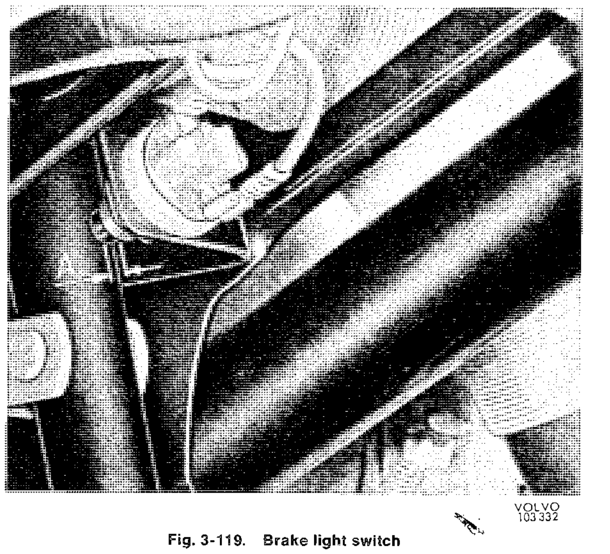


Fig. 3-119. Brake light switch

REPLACING INTERIOR LIGHT BULB

Pull down the glass at the short side opposite the switch. Pull out the bulb. The glass is re-fitted by hooking it securely at the side where the switch is situated and then pressing in the glass firmly.

REPLACING BRAKE LIGHT SWITCH

When replacing the brake light switch, make sure that the new switch is adjusted correctly so that it functions satisfactorily. The distance between the brake pedal released and the threaded bronze hub on the switch should be 4±2 mm (0.16±0.08") (A. Fig. 3-119). If the distance must be adjusted, release the attaching screw for the bracket and move the bracket until the correct distance is obtained.

REPLACING IGNITION SWITCH

1. Remove the contact by pulling it straight forwards.
2. Undo both the attaching screws with a screwdriver.
3. Lift out the ignition switch.

Installing of the ignition switch is in reverse order to removal.

REPLACING SWITCHES ON CONTROL PANEL

1. Disconnect the ground cable from the battery.
2. Unscrew the control panel and lift up from the bottom until the contacts are accessible.
3. Disconnect the contact harness from the switch.
4. Remove the switch by first pressing in the lock springs and then pressing the switch out of the panel, see Fig. 3-120.

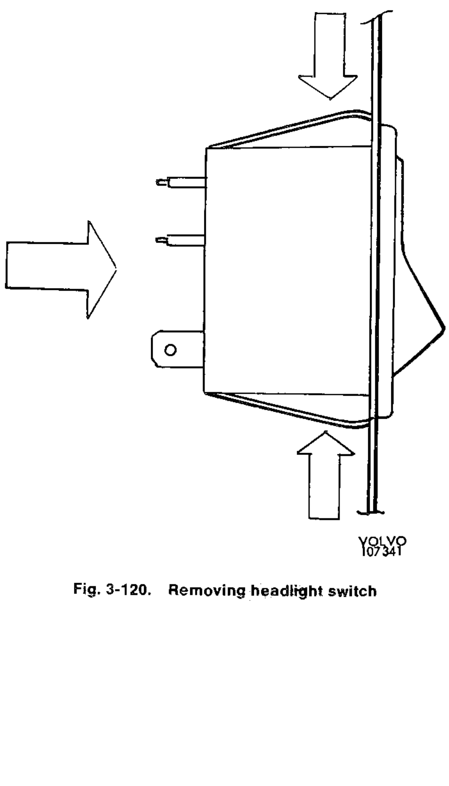


Fig. 3-120. Removing headlight switch

REPLACING HEADLIGHT SWITCH

1. Remove the switch knob.
2. Pull out the choke. (Does not apply to injection engines.)
3. Remove the impact guard by pulling it straight back.
4. Remove the nut for the switch with a suitable tool.
5. Remove the switch and transfer electric cables to the new switch.

Installation is in reverse order to removal.

BULB INTEGRITY SENSOR, CHECK

NOTE: The Bulb Integrity Sensor warning light may come on if current to the bulbs is distorted, e.g., a bulb is out of order. A short indication may sometimes occur, when the headlight is switched on, depending on variations in "starting" time for the bulbs.

1. Switch on the ignition.
   The warning light should come on.
   If the warning light does not come on, it is defective.
2. Start the engine.
   The warning light should go out.
   The Bulb Integrity warning light and the charging control light light simultaneously: the alternator does not function.
   The Bulb Integrity warning light is on after the charging control light has gone out: the Bulb Integrity Sensor is defective.
   NOTE: The light switch should be pushed in and the brake pedal not actuated during the test.
3. Switch on the headlight, lower beam.
   The warning light should be out.
   The Bulb Integrity warning light is on, but all bulbs for lower beam, parking light, tail light etc are functioning: the Bulb Integrity Sensor is defective.
4. Switch off the headlight lower beam.
5. Remove one of the fuses No. 11 or 12.
   The warning light should come on, if not, the Bulb Integrity Sensor is defective.
   Re-connect the fuse.
6. Switch off the light.
7. Depress the brake pedal.
   The warning light should be out. If it comes on and both brake lights function, it is defective.
8. Switch off the ignition.

BULB INTEGRITY SENSOR, REPLACEMENT

1. Disconnect the connector at the Sensor Unit.
2. Remove the sensor Unit.
3. Install the replacement Sensor Unit.
4. Re-connect the connector to the Sensor Unit.
5. Check the function of the replacement unit.

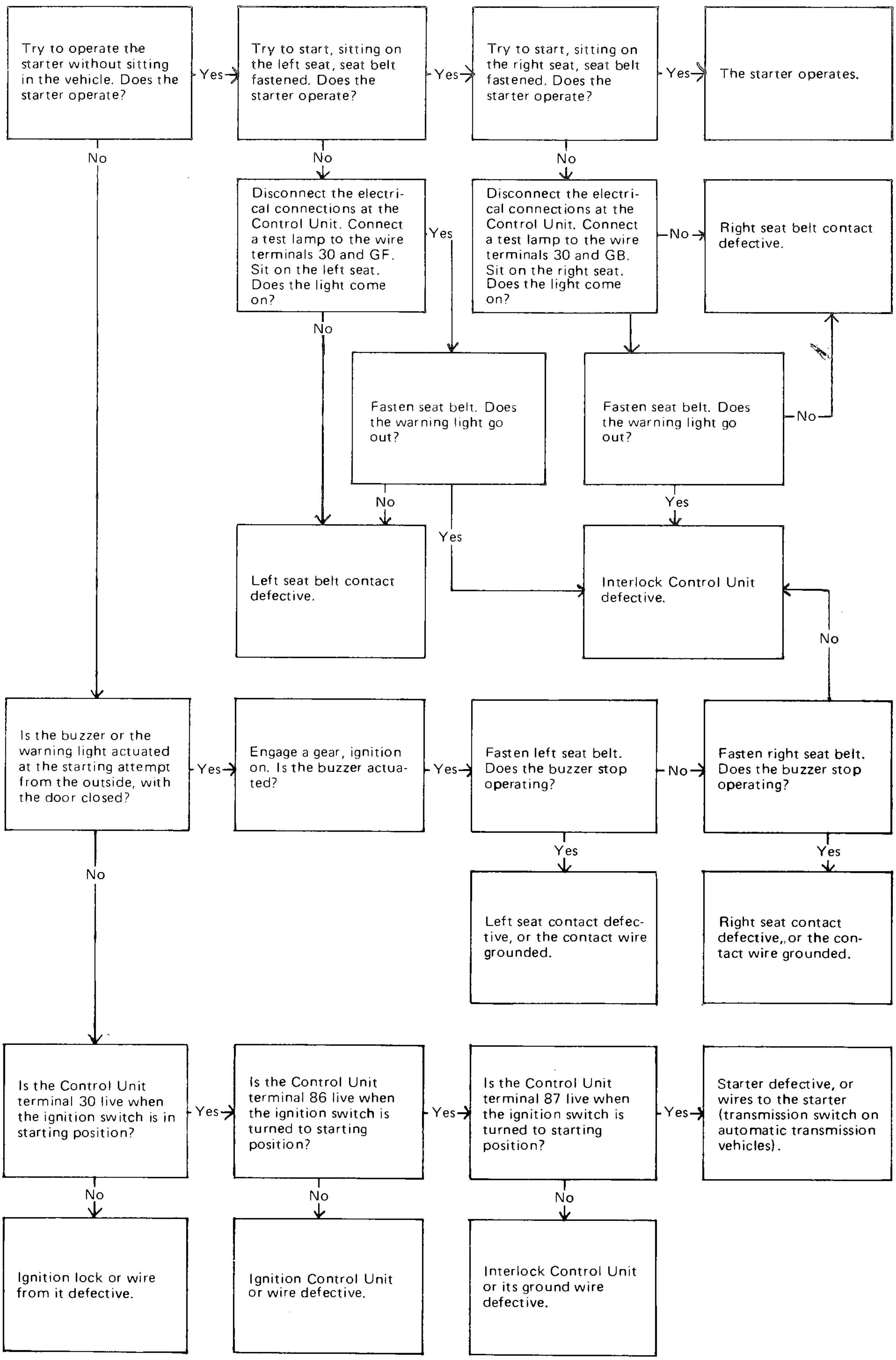
INTERLOCK CONTROL UNIT, REPLACEMENT

1. Disconnec the electrical connections at the unit.
2. Remove the control unit.
3. Install the replacement unit.
4. Test the unit, as follows:
   a. Get seated.
      Move the gear lever to "Neutral" position.
      Turn the ignition switch to starting positon.
      The starter should fail to operate.
   b. Fasten the seat belt.
      Turn the ignition switch to starting position.
      The starter should operate.
      Switch off the ignition.
      Disconnect the seat belt and leave the vehicle.

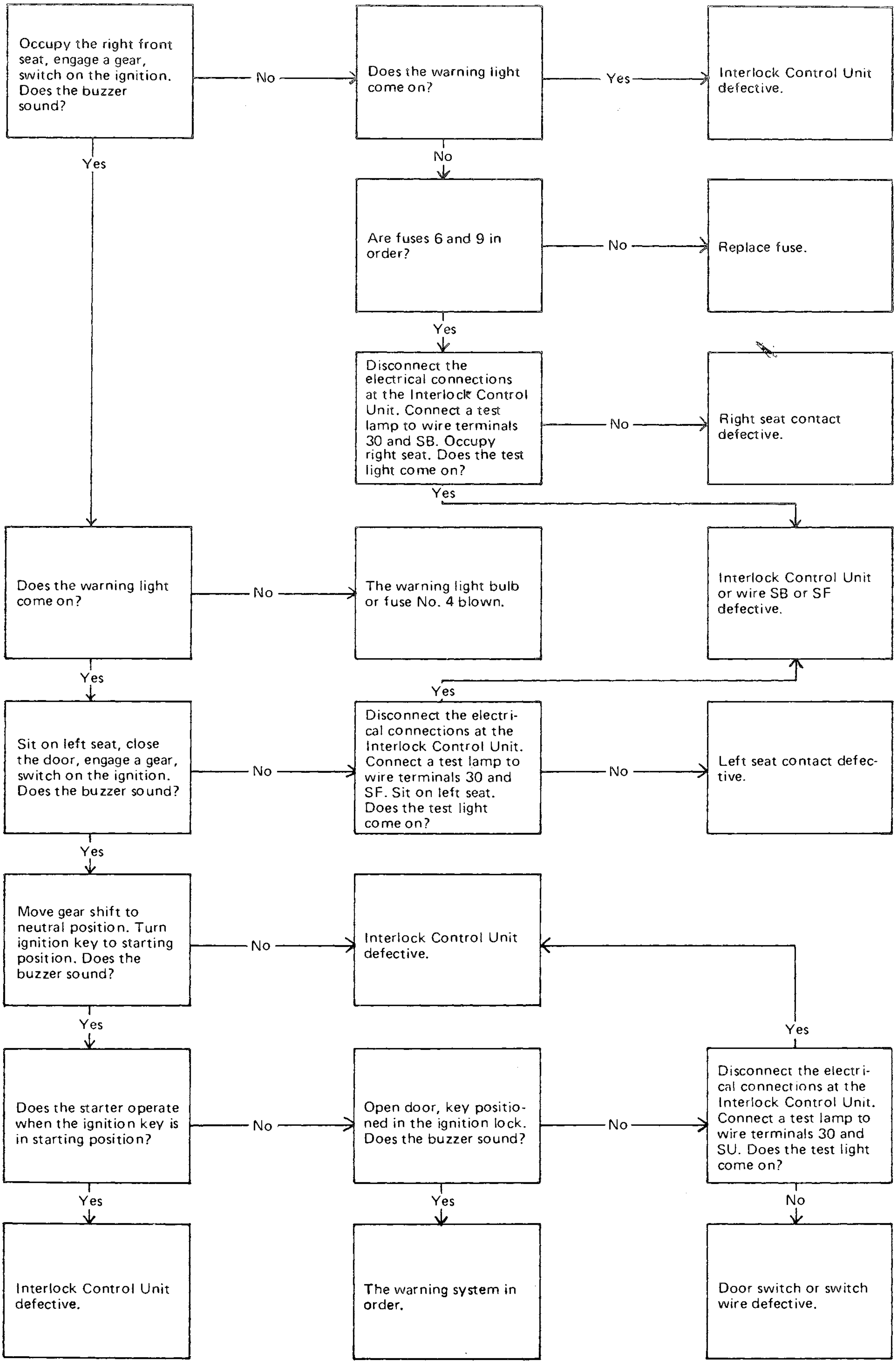
SERVICE DIAGNOSIS

Concerning Service Diagnosis on the Seat/Ignition Interlock System, see pages 3 : 44–3 : 46.

THE STARTER DOES NOT OPERATE



WARNING SYSTEM DOES NOT FUNCTION



WARNING SYSTEM OPERATES CONTINUOUSLY

Try to start without sitting in the seat. Does the starter operate?

No → See condition "Starter does not operate".

Yes → Interlock Control Unit defective.

INSTRUMENTS
TOOLS

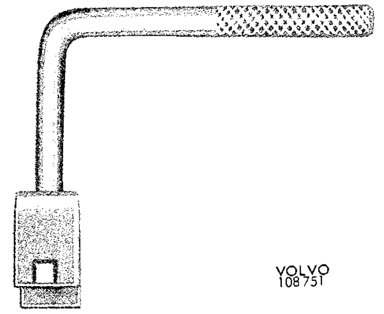


Fig. 3-121. Special tool for removing and installing tank fittings

The numbers for the special tools may now be preceded by SVO or 999, e.g.,
SVO 1801 or 999 1801

GENERAL INFORMATION

The instrumentation consists of a combined instrument, see Figs. 3-122 and 3-123. It comprises a speedometer, trip meter, tachometer (certain models), temperature gauge, fuel gauge, warning lamps for parking brake, brake circuit failure, oil pressure, battery charging, choke, bulb integrity sensor and overdrive.

Also connected to the combined instrument is a voltage regulator which maintains the feed voltage constant for the instrumentation.

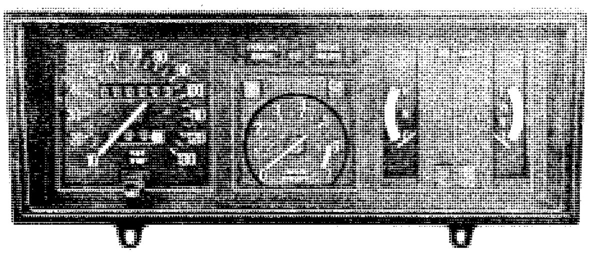


Fig. 3-122. Combined instrument, front side

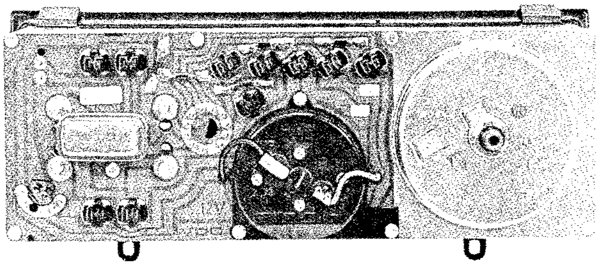


Fig. 3-123. Combined instrument, reverse side

SPEEDOMETER AND ODOMETER

The speedometer and odometer are integrally built and are driven by a drive line from a worm on the transmission output shaft.

The speedometer is of the eddy current type and mainly consists of a permanent magnet, a mounting disc and a rotor drum. The rotor drum is linked by a shaft to the gauge pointer. The shaft is also provided with a balance spring.

The odometer has a number of gears and registers up to 1 million km (600 000 miles). It is also provided with a trip meter. The ratio of the odometer is so chosen that the drive line should rotate 640 times in order for the gauge to register 1 km.

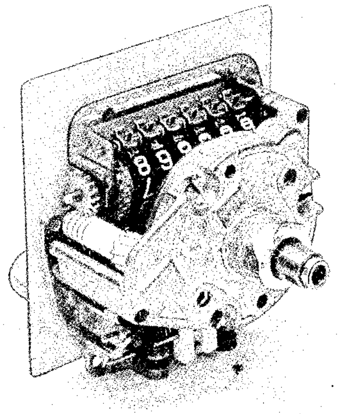


Fig. 3-124. Speedometer and mileometer

When the vehicle starts running, the drive line and the permanent magnet connected to the drive line rotate. This generates a rotating magnetic field, which gives rise to ecdy currents in the rotor drum. The rotating effect which the magnetic field as well as the induced eddy currents have on the rotor drum increases with increased speed on the permanent magnet. The rotation of the rotor drum is counteracted by the balance spring, this giving a proportional reading of the pointer to the magnetic rotation.

TACHOMETER

The tachometer consits partly of a transistorized registration and amplifier unit and partly of a rotational coil system.

The registration part senses, through a sender line, the pulse frequency of the ignition coil. The amplifier part amplifies and conducts the pulses to the rotational coil system.

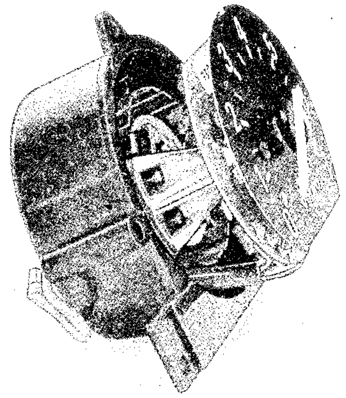


Fig. 3-125. Tachometer

The rotational coil system consists of an annular shaped permanent magnet round which a coil is fitted. The coil is movable the length of the magnet and is linked to a shaft to which the rev counter gauge pointer is fitted. When pulses from the amplifier are conducted through the coil, this forms a magnetic flow which coils the length of the permanent magnet. The rotational force is proportional to the current flow through the coil.

TEMPERATURE GAUGE, COOLANT

The temperature gauge is of the bi-metal type and consists of a sensor and registering instrument. The sensor is mounted on the engine and senses the coolant temperature. The registering instrument is included in the combined instrument.

Fig. 3-126. Temperature gauge

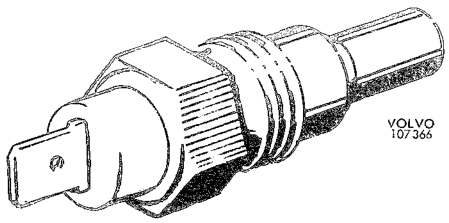


Fig. 3-127. Sensor for temperature gauge

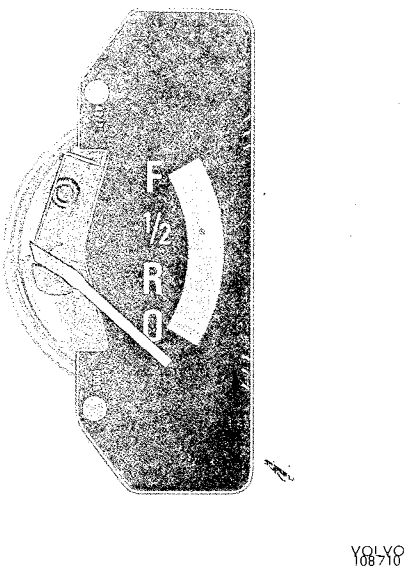


Fig. 3-129. Fuel gauge

The sensor, which is of the semi-conductive type, has a negative temperature coefficient, which means that its resistance drops in proportion to increased temperature. The registering instrument consists of a bi-metal spring connected to a pointer. A resistance wire, connected in series with the voltage stabilizer and sensor, is wound round the bi-metal spring.
When the ignition is switched on, current flows from the voltage stabilizer through the resistance wire and the sensor to ground. When current passes the resistance wire, it heats up the metal spring and this causes the pointer to indicate on the gauge. The volume of the current passing through the resistance wire in inverse proportion to the resistance of the sensor, and for this reason the gauge reading increases with increased engine temperature.

FUEL GAUGE

The fuel gauge consists of a sender and indicating instrument. The sender in the fuel tank consists of a moving resistance, a lever and a float. The indicating instrument is of the same type as for the temperature gauge.
The function is exactly the same as for the temperature gauge, apart from the fact that the sender is mechanical. The amount of sender resistance engaged will depend on the amount of fuel in the tank and thereby the location of the float. In other words, an empty tank results in large sender resistance while a full tank produces minimum sender resistance. This has a corresponding effect on the indicating instrument.

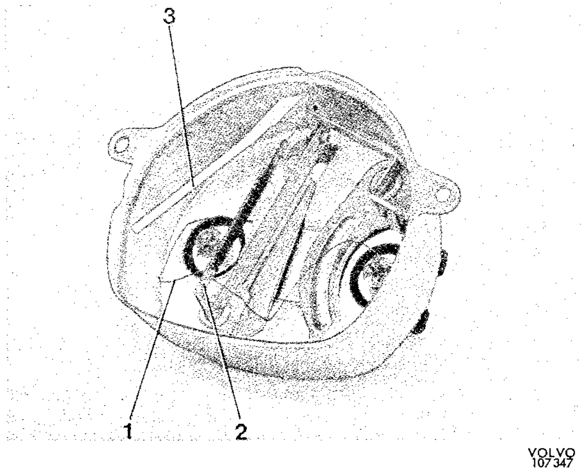


Fig. 3-128. Registering instrument, disassembled
1. Resistance wire 2. Bi-metal spring 3. Pointer

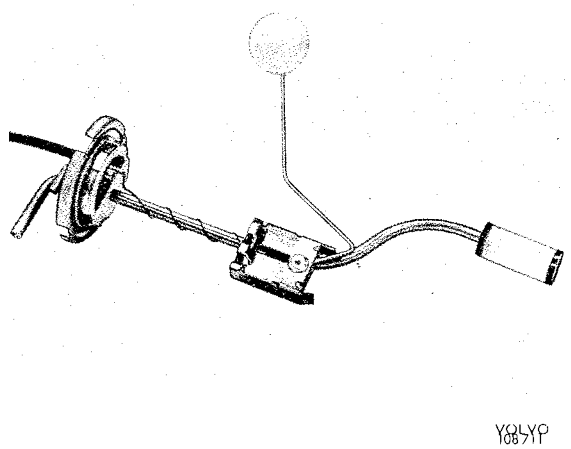


Fig. 3-130. Sender for fuel gauge

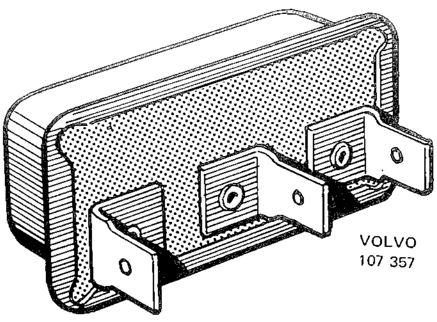


Fig. 3-131. Voltage stabilizer

VOLTAGE STABILIZER

The temperature and fuel gauges are powered by a voltage of 10 volts and are fed through a voltage stabilizer. This stabilizer contains a bi-metal spring and a contact breaker. When the ignition is switched on, current flows through the stabilizer and out to the instruments. This heats the stabilizer bi-metal spring which bends and thus breaks the circuit. As the spring cools down, it returns to its original position and the circuit is closed again. This cycle is repeated continuously. A regulated effect corresponding to a constant voltage of approx. 10 volts is thereby obtained. The breaking and making of the circuit is not visible on the instruments due to their inertia. The stabilizer is mounted on the reverse side of the combined instrument.

WARNING/CONTROL LAMPS

PARKING BRAKE

The parking brake warning lamp receives current via the ignition switch. When the parking brake is applied, the warning lamp is grounded by the switch, Fig. 3-132, and this switches on the warning lamp which remains lighted as long as the parking brake is on.

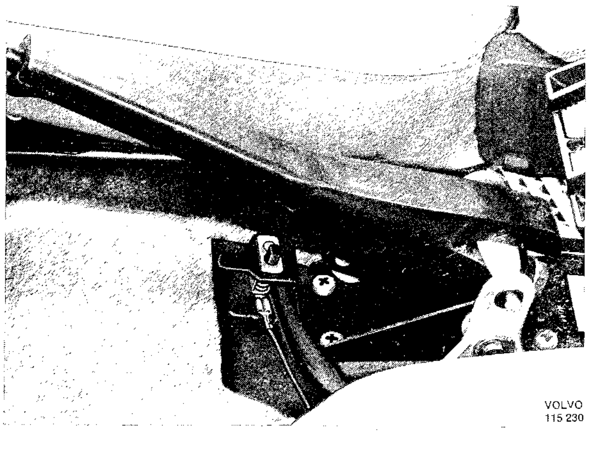


Fig. 3-132. Switch for parking brake control

BRAKE CIRCUIT FAILURE

Should a fault arise in any of the two circuits of the hydraulic brake system, so that there is a pressure difference between the circuits of more than 8–10 kp/cm² (114–142 psi) when the brakes are applied, this actuates the warning valve, Fig. 3-133 and the warning lamp goes on. The warning lamp remains lighted until the fault in the brake system has been corrected and the warning valve re-set. Re-setting the warning valve, see Section 5, Brakes, Group 52.

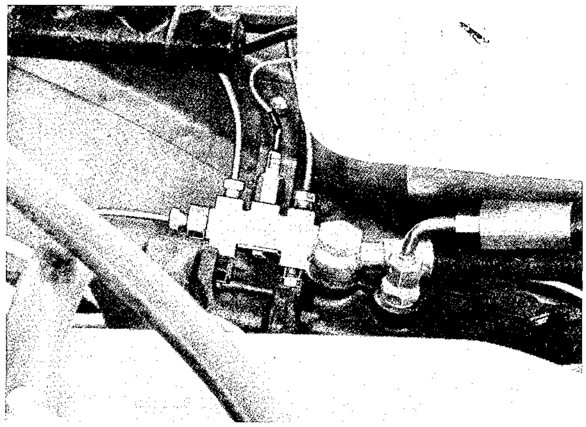


Fig. 3-133. Warning valve

BATTERY CHARGING

The battery charging warning lamp is connected to the alternator. It lights up when the alternator voltage is lower than the battery voltage. As the alternator voltage rises and commences to charge the battery, the warning lamp goes out, thus indicating that the alternator is charging.

TURN INDICATORS

The warning lamp for the turn indicators flashes when the signal is engaged. It is wired across the switch for the indicators.

FULL-BEAM HEALDIGHTS

The control light for the headlight upper beams comes on simultaneously with the full-beam headlights. It is wired parallel with the headlights at the relay.

OIL PRESSURE

The warning lamp for the oil pressure receives current via the ignition switch and is grounded through a pressure sensitive valve on the engine. With the engine running and at normal pressure, the connection between this lamp and ground (through the engine) is open. When the oil pressure drops below a pre-determined value, the pressure sensitive valve closes the circuit and the warning lamp lights.

CONTROL PANEL

The control panel contains a rheostat for the instrument panel lighting, cigarette lighter and switch with built-in warning lamp for the electrically heated rear window and emergency warning flashers.

The control panel also contains the controls for the heating unit as well as a reminder lamp for the seat belts.

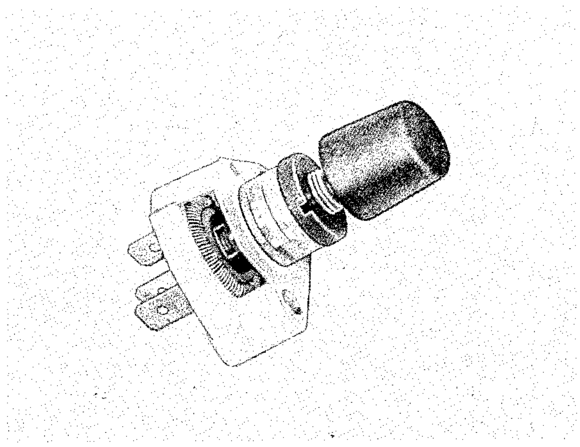


Fig. 3-134. Rheostat for instrument light

OVERDRIVE

The control light for the overdrive is connected between the switch for the overdrive and ground, and thus lights when the overdrive is engaged.

CHOKE

When the engine is choked, a contact in the choke control cuts in the circuit and this grounds the warning lamp, which lights.

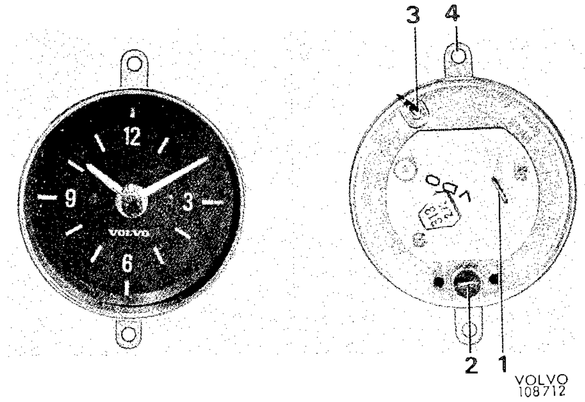


Fig. 3-135. Electric clock, front and reverse
1. Battery connection
2. Bulb
3. Battery connection
4. Attaching screws

CLOCK

The clock, Fig. 3-135, is electrically driven and is located above the control panel.

SERVICE PROCEDURES

For all work under the dashboard, the battery ground cable should be disconnected to avoid any short-circuiting.

REMOVING COMBINED INSTRUMENT

1. Remove the casings over the steering column.
2. Remove the attaching screws for the bracket and allow it to drop down towards the steering column. The combined instrument's attaching screws can now be removed.
3. Disconnect the speedometer cable from the instrument.
4. Take hold of the reverse side of the speedometer gauge with the hand and press the instrument upwards—inwards until the snap lock in the upper edge of the instrument releases.
5. Lift forward the instrument and disconnect the connection from its reverse side. (On vehicles with tachometer, the tachometer cable should also be disconnected.)

REMOVING WARNING LAMPS

1. The lamps are mounted in holders which are removed by pushing in their attaching hooks and then pulling the holder straight out.
2. The bulbs are released from their sockets by pulling them straight out.

REMOVING TACHOMETER OR GUARD COVER

1. Remove the combined instrument.
2. Remove the three screws.
3. Lift off the tachometer or the guard cover carefully in order not to damage the pole connections.

REMOVING SPEEDOMETER UNIT

1. Remove the combined instrument.
2. Remove the rev counter or guard cover.
3. Unscrew the three remaining screws.
4. Lift off the speedometer carefully in order not to damage it.

REMOVING VOLTAGE STABILIZER

The voltage stabilizer is removed by pulling it straight up so that the three connection pins release from their retainers.

REMOVING CABLE PLATE

1. Remove the combined instrument.
2. Remove the rev counter or guard cover.
3. Remove the speedometer.
4. Remove the three remaining screws.
5. Carefully lift up the cable plate so that the temperature gauge or fuel gauge is not damaged.

REMOVING TEMPERATURE GAUGE AND FUEL GAUGE

1. Remove the tachometer or guard cover.
2. Remove the speedometer.
3. Remove the contact device.
4. Remove both the nuts on the reverse side of the contact device.
5. Lift out the gauge.

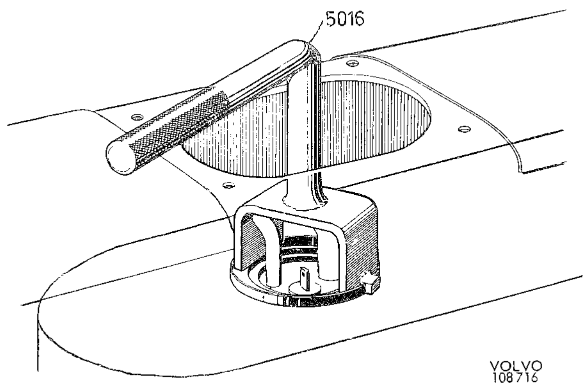


Fig. 3-136. Tool for removing sender for fuel gauge

The components in the combined instrument are installed in reverse order to removal.

REMOVING FUEL GAUGE SENDER

The sender, which is located in the fuel tank, is held in position with a bayonet fixture. When removing, use tool 5016 see Fig. 3-136.

REPLACING TEMPERATURE GAUGE SENSOR

1. Drain some of the coolant, about 2 dm^3 (2 qts).
2. Disconnect the electric cable from the sensor.
3. Remove the sensor and replace it with a new one.
4. Install the new sensor and connect the electric wire.
5. Fill coolant.

REMOVING CLOCK

1. Remove the impact pad.
2. Remove the control panel attaching screws.
3. Lift forward the panel sufficiently to get at the reverse side of the clock.
4. Disconnect the electric cable from the clock.
5. Remove the clock's two attaching screws and lift forward the clock.

Installation is in reverse order to removal.

TESTING SPEEDOMETER AND ODOMETER

If the speedometer or odometer is not functioning, the reason may be due to a fault in the instrument or speedometer cable or the worm gear, which is located on the transmission for driving the cable. In order to decide which component is faulty, check the following: If the speedometer functions while the odometer does not, or vice-versa, then the instrument is defective and should be replaced. No attempt should be made to repair the instrument.

When both the speedometer and odometer stop functioning, the fault is probably in the speedometer cable or the worm gear. Disconnect the speedometer cable from the instrument and see if it can be rotated. If it can, this means that it has broken from the worm gear. Check the cable and the drive at the transmission.

Check to see whether the drive couplings can rotate easily. If they jam, the instrument should also be replaced.

The speedometer can be checked by running it at different speeds. The following values should then apply:

Speed of drive couplings			
8.35	16.70	29.20	r/s
(500)	(1000)	(1750)	(rpm)
Speedometer reading			
33±2.5	63±2.5	108.5±2.5	mph

TESTING SPEEDOMETER CABLE

It is most important that the speedometer cable is correctly fitted if the speedometer is to function without trouble. It is vitally important that the cable is given a smooth bend. At no point must the radius of a bend be less than 100 mm (4"). If it is less than this, vibration and noise can occur in the instrument. The drive couplings must run true in the outer caisng of the cable. This is checked with the cable rotating.

TESTING TEMPERATURE GAUGE

If the temperature gauge is faulty, the faulty component (sensor, indicating instrument or voltage regulator) must first be traced and then the fault remedied. In order to trace the faulty component, two or possibly three resistors are required, one or two at 40 ohms and one at 282 ohms. Trouble-shoot as follows:

First disconnect the electric cable from the temperature sensor and then connect up the 282 ohm resistor between cable and ground.

First disconnect the electric cable from the temperature sensor and then connect up the 282 ohm resistor between cable and ground.

With the ignition switched on, the pointer on the indicating instrument should be at the beginning of the green field (50°C=122°F). Instead of the 282 ohm resistor, then connect the 40 ohm resistor. The pointer on the indicating instrument should be at the beginning of the red field (120°C=248°F). With correct indicating instrument function, the sensor is defective and should be replaced by a new one.

NOTE: The sensor cable must never be wired directly to ground since it would overheat and ruin the instrument.

If the instrument gives incorrect reading, the fault is either in the indicating instrument or the voltage regulator.

In order to decide where the fault lies, disconnect the fuel gauge sender wire from the sender and connect a resistance of 40 ohms between wire and ground.

If the fuel gauge now shows a full tank, the fault must be in the indicating instrument of the temperature gauge, which must be replaced. If, on the other hand, the temperature gauge and fuel gauge give the same, but incorrect, reading, then the voltage regulator must be defective and should be replaced.

TESTING REMOVED TEMPERATURE GAUGE SENSOR

The sensor is checked by heating it up and then reading resistance and temperature. The following values should be obtained if the sensor is without fault:

(NOTE: The resistances may deviate ±10 %.)

Temperature	50	100	120	°C
	(122)	(212)	(248)	°F
Resistance	282	60	40	ohms

TESTING FUEL GAUGE

The fuel gauge is checked in the same way as the temperature gauge.

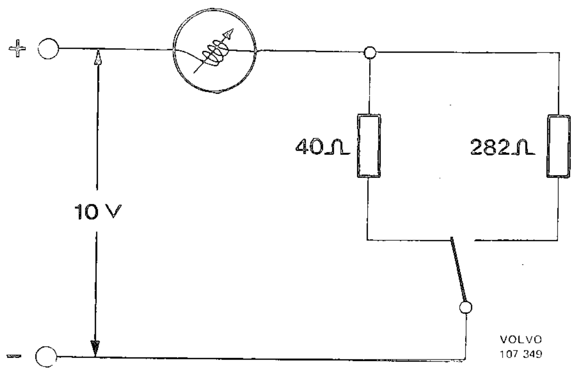


Fig. 3-137. Wiring diagram for checking temperature gauge or fuel gauge indicating instrument

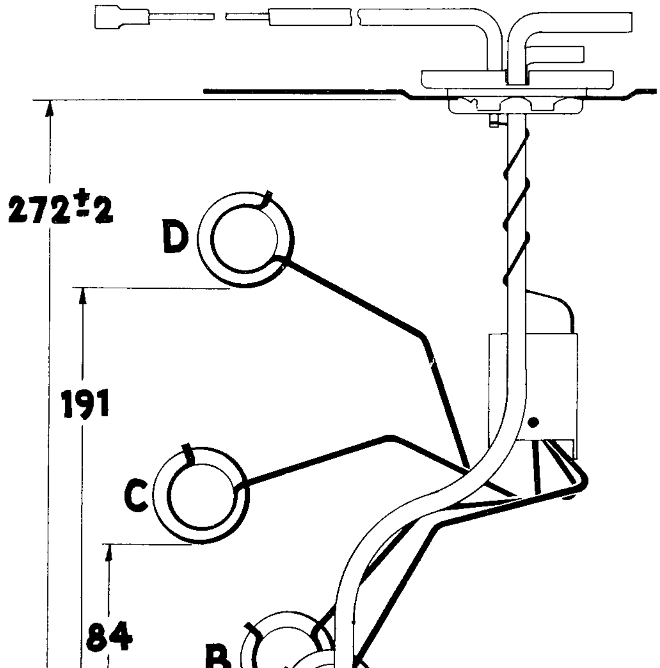
TESTING REMOVED FUEL GAUGE SENDER

The sender is checked with an ohmmeter which is wired between the contact unit for the electric cable and ground. The following resistance values should be obtained if the sender is functioning correctly:

Regarding various positions of the float, see Fig. 3-138. Its measurement indications indicate the number of mm the float should be lifted from its bottom position.

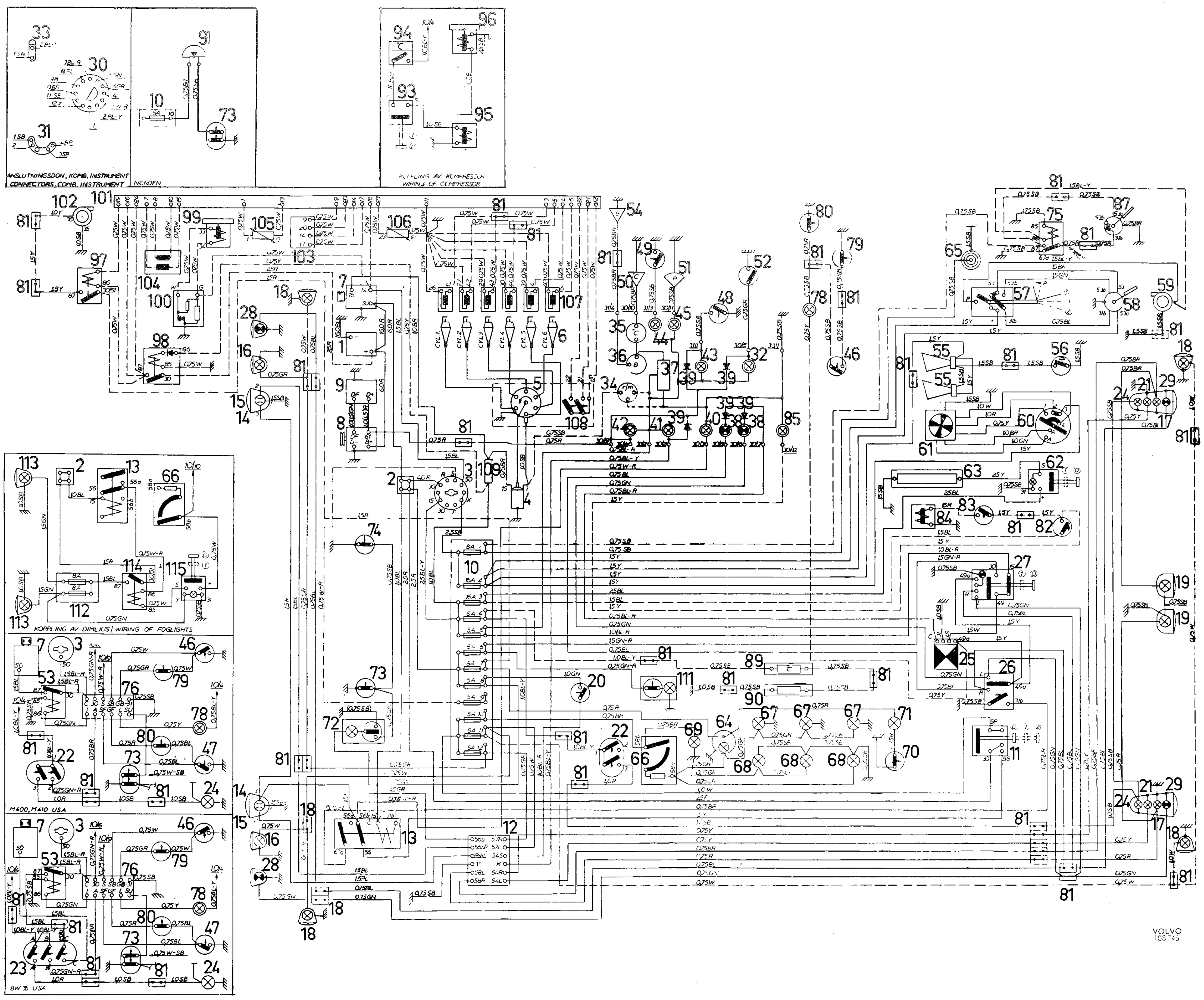
TESTING REMOVED VOLTAGE STABILIZER

The function of the voltage stabilizer is checked with an adjustable bimetal instrument. The instrument is wired in series with a resistance of about 60 ohms and a constant D.C. voltage of 10 volts. The indicating instrument should be read off. The constant D.C. voltage is thereafter replaced by a 12 volt battery (check that the voltage is really 12 volts) and the voltage stabilizer. The indicating instrument should give a similar reading. During the test, the stabilizer should have the same position as it had in the vehicle. A damaged stabilizer is replaced by a new one, although it can of course be repaired, but this is pointless both from an economic and reliability point of view.



Position	Resistance in ohms		
A	282±48	C	98±14
B	223±26,5	D	40± 5

Fig. 3-138. Checking fuel gauge sender



Pos Unit

1. Battery, RV
2. Connection plate
3. Ignition switch
4. Ignition coil
5. Distributor, Firing order 1-5-3-6-2-4
6. Spark plugs
7. Starter motor, 800W
8. Alternator, 760 W
9. Voltage regulator
10. Fuse box
11. Light switch
12. Bulb integrity sensor
13. Step relay for upper and lower beams and headlight flasher, 1.25 A
14. Upper beam, 45 W
15. Lower beam, 40 W
16. Position lamp, 5 W
17. Tail lamp, 5 W
18. Side marker lamp, 3 W
19. License plate lamp, 5 W
20. Stop light switch
21. Stop lamp, 32 cp
22. Conn at instrument
23. Contact on transmission BW 35
24. Back-up lamp, 32 cp
25. Flasher unit
26. Turn indicator lever
27. Hazard warning signal switch
28. Front turn signal lamp, 32 cp
29. Rear turn signal lamp, 32 cp
30. Conn at instrument
31. Conn at instrument
32. Brake failure pilot lamp, 1.2 W
33. Conn at instrument
34. Tachometer
35. Thermometer
36. Fuel meter
37. Voltage stabilizer
38. Turn signal light pilot lamp, 1.2 W
39. Diode
40. Upper beam pilot lamp, 1.2 W
41. Bulb integrity sensor, 1.2 W
42. Charging pilot lamp, 1.2 W
43. Parking brake pilot lamp, 1.2 W
44. Choke pilot lamp, 1.2 W
45. Oil pressure pilot lamp, 1.2 W
46. Contact, passenger's seat
47. Contact, driver's seat
48. Parking brake contact
49. Luggage comp. light, 15 W
50. Temperature gauge
51. Oil pressure guard
52. Brake failure contact
53. Starter cut-out relay
54. Fuel level gauge
55. Horn, 7.5 A
56. Horn ring
57. Windsheild wipe/wash switch
58. Windshield wiper, 3.5 A
59. Windshield washer, 2.6 A
60. Fan switch
61. Fan, 170 W
62. El heated rear window switch
63. El heated rear window, 200 W
64. Clock
65. Cigar lighter, 7 A
66. Instrument lighting rheostat
67. Instrument lighting, 2 W
68. Control panel lighting, 1.2 W
69. Gear selector lighting, 1.2 W
70. Glove box contact
71. Glove box lamp, 2 W
72. Interior lamp, 10 W
73. Door contact, driver's side
74. Door contact, passenger's side
75. EGR/CAT Warning lamp, 1.2 W
76. Belt interlock unit
77. EGR/CAT Warning contact
78. Safety belt pilot lamp, 1.2 W
79. Safety belt contact, pass.seat
80. Safety belt contact, driver's seat
81. Junction
82. Overdrive lever M 410
83. Overdrive contact on transmission M 410
84. Overdrive solenoid on transmission M 410
85. Over-drive pilot lamp, 1.2 W
86. Buckle lighting, 1.2 W
87. Relay for window lifts
88. Supplementary air valve
89. Heating element with thermostat, drivers' seat
90. Heating element, driver's seat, 30 W
91. Switch for window lift r.h.
92. Switch for window lift l.h.
93. Switch for compressor
94. Thermostat
95. Solenoid on compressor, 3.9 A
96. Solenoid valve
97. Relay for fuel pump
98. Main relay, fuel injection
99. Starting valve
100. Temperatur-time contact
101. Injection control unit
102. Fuel pump, 6.5 A
103. Flop valve contact
104. Pressure sensor
105. Temperature sensor I
106. Temperature sensor II
107. Injection valves
108. Release contact
109. Resistor, 0.9
110. Rear ash tray lighting, 1.2 W
111. Engine comp. lighting, 18 W
112. Motor for window lift r.h., 5 A
113. Motor for window lift l.h., 5 A
114. Ignition control unit
115. Relay for headlamp wiper
116. Headlamp wiper
117. Contact on transmission M 410
118. Relay for back-up lamp
119. Relay for AC

Illustration 3-A. Wiring diagram 164

Section 4

POWER TRANSMISSION
REAR AXLE

CONTENTS

GROUP 41

CLUTCH

TOOLS

The following tools are used for clutch work.

The numbers for the special tools are preceded by 999 or SVO, e.g., 999 2824 or SVO 2824.

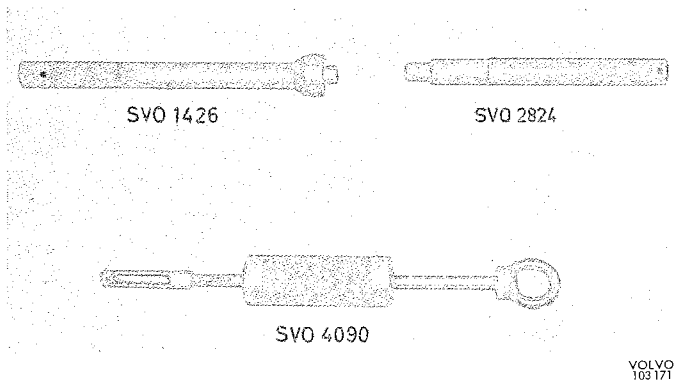


Fig. 4-1. Special tools
999 (SVO) 1426 Drift for pilot bearing in flywheel
999 (SVO) 2824 Mandrel for centering clutch plate
999 (SVO) 4090 Puller for ball bearing in flywheel

GENERAL INFORMATION

The clutch is of the diaphragm spring type. It consists mainly of a pressure plate, diaphragm spring and a sheet-metal casing. The diaphragm spring has a double function, that of a clutch lever when declutching and a pressure spring when engaging.

The clutch operation takes place by means of the clutch pedal, and on left-hand steered vehicles its movements are transferred to the clutch via a wire, a lever and a release bearing. On right-hand steered vehicles, the movements are transmitted with the help of a hydraulic control.

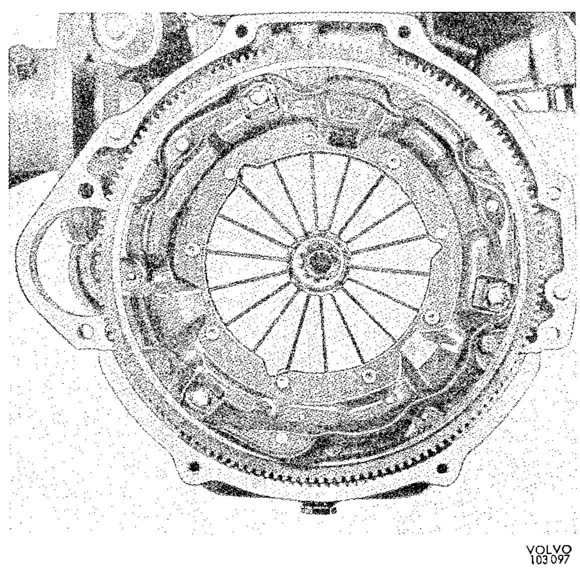


Fig. 4-2. Clutch

SERVICE PROCEDURES

CLUTCH WORK IN VEHICLE

ADJUSTING CLUTCH PEDAL PLAY

Correct clutch pedal play is obtained by adjusting the release lever so that on left-hand steered vehicles a play of 4–5 mm (0.16–0.20"), A in Fig. 4-3, is obtained. Play is adjusted by unscrewing or screwing the fork (3) on the clutch wire. If this adjustment is insufficient, for example, because of replacement of the clutch wire, the sleeve attachment to the clutch casing is moved by means of the nuts (1).

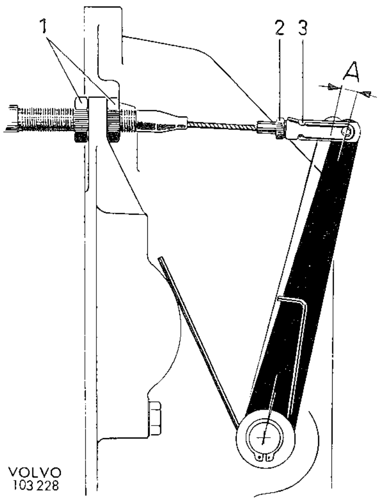


Fig. 4-3. Release lever play
A=4–5 mm (0.16–0.20")
1. Adjusting nuts 2. Lock nut 3. Fork

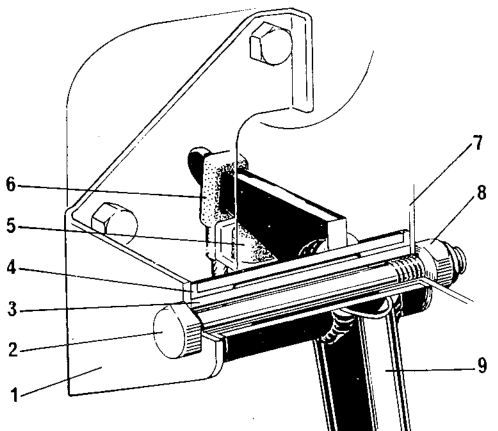


Fig. 4-4. Pedal carrier

1. Stop bracket
2. Bolt
3. Pedal shaft
4. Bushing
5. Rubber stop
6. Clutch wire
7. Bracket
8. Nut
9. Clutch pedal

CLUTCH WIRE REPLACEMENT

1. Unhook the release fork. Disconnect the wire from the lever.
2. Unscrew the rear nut and remove the wire sleeve from the clutch casing.
3. Disconnect the wire from the clutch pedal. Unscrew the nut for the wire sleeve and remove the wire.
4. Install the new wire in reverse order to removal. Adjust the pedal play.

CLUTCH PEDAL OR BUSHING REPLACEMENT

The description given below covers the replacement of the pedal and/or the bushings.

1. Slacken the nut and remove the bolt. Disconnect the pedal from the wire and remove the pedal.
2. Take out the tubular shaft. Drive out the bushings with a suitable drift.
3. Install the new bushings. Lubricate them with grease. Fit the tubular shaft.
4. Place the return spring on the bearing sleeve of the pedal. Move the pedal into position and attach it to the wire. Install the bolt which holds the pedal.

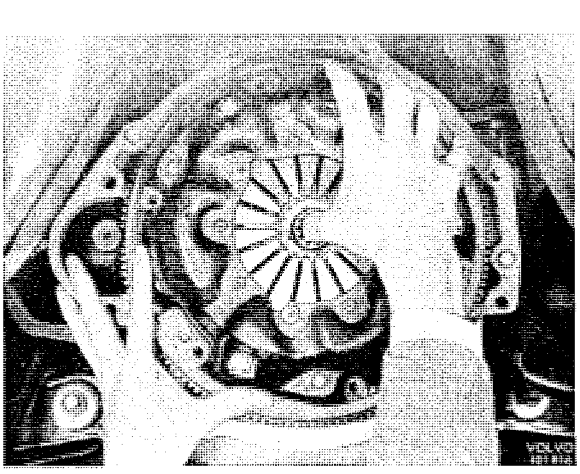


Fig. 4-5. Clutch removal

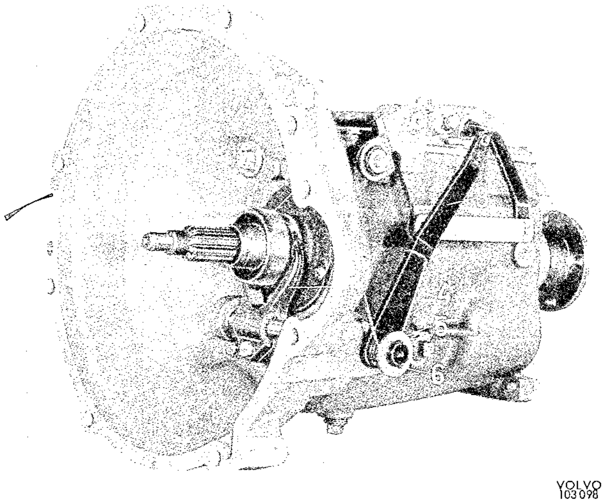


Fig. 4-6. Release components

1. Release bearing
2. Release fork
3. Release shaft and lever
4. Return spring
5. Washer
6. Snap ring

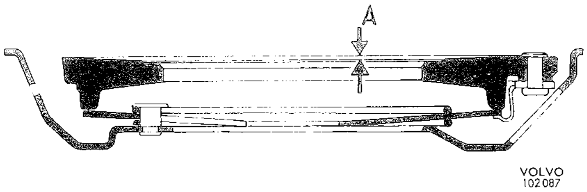


Fig. 4-7. Checking curvature of pressure plate

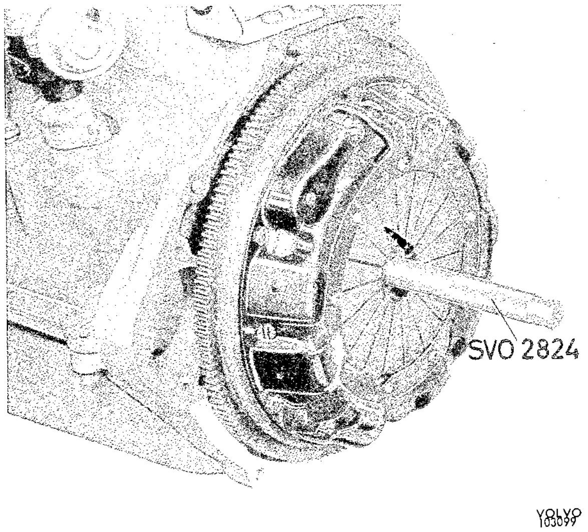


Fig. 4-8. Clutch installation

CLUTCH REMOVAL

1. Remove the transmission according to the instructions in Group 43.
2. Slacken the bolts holding the clutch to the flywheel by loosening them crosswise a couple of turns at a time to prevent warping. Remove the clutch and clutch plate.

SERVICING RELEASE COMPONENTS

1. Remove the bolt in the release fork. Take out the release bearing. Pull out the release shaft.
2. Drive out the old bushings with a suitable drift. Press in the new bushings.
3. Coat a thin layer of grease on the sleeve of the release bearing and then install the bearing in position.
4. Hold the release fork in its place and insert the release shaft.

SERVICING CLUTCH SHAFT PILOT BEARING

1. Remove the circlip for the bearing. Pull out the bearing with puller 4090.
2. Pack the bearing with heat-resistant grease. Then install it with the help of drift 1426. Install the snap ring.

INSPECTION

Check the clutch thoroughly. The pressure plate should be checked for heat damage, cracks, scoring or other damage to the friction surface. Check the curvature of the pressure plate with a 240 mm (9.45") long steel ruler, which is placed diagonally over the friction surface of the pressure plate. Then measure the distance between the straight edge of the ruler and the inner diameter of the pressure plate. This measurement must not exceed a maximum of 0.03 mm (0.0012"), see A fig. 4-7.There must be no "crowning", that is, clearance between the straight edge of the ruler and the outer diameter of the pressure plate. The check should be carried out at several points.

INSTALLATION

Before installation, check that the clutch facings, the flywheel and the pressure plate are completely free from oil. Wash them with gasoline and wipe off with a clean piece of cloth.

1. Set up the clutch plate (the longest side of the hub facing backwards) together with the clutch against the flywheel and insert the centering mandrel 2824 so that the guide iournal on this centers the pilot bearing in the flywheel, see Fig. 4-8.
2. Place in the six bolts which hold the clutch and tighten them crosswise a couple of turns at a time. Remove the centering mandrel.
3. Install the transmission according to the instructions given in Group 43. Adjust the clutch pedal play.

GROUP 43 A

TRANSMISSION

TOOLS

The following special tools are required for transmission repairs:
The numbers for the special tools are preceded by 999 or SVO, e.g., 999 2825 or SVO 2825.

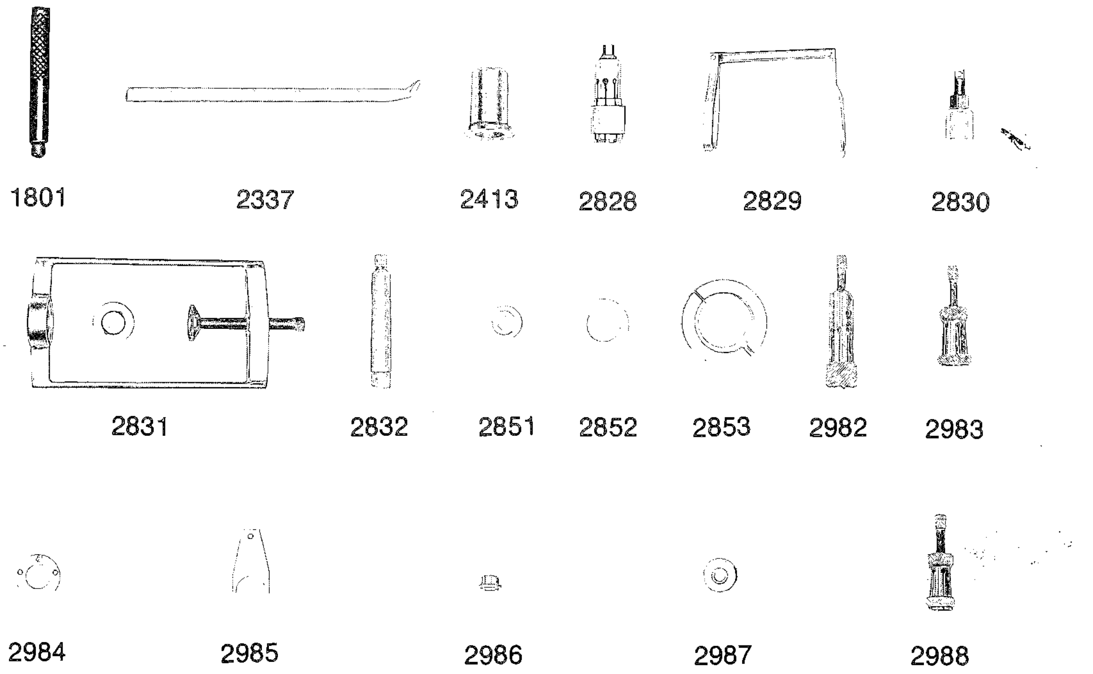


Fig. 4-9. Special tools

999 (SVO)

1801 Standard handle 18×200 mm
2337 Drift for removing oil seal in cover for input shaft
2413 Drift for removing outer ring for front bearing for intermediate shaft
2520 Stand, see Fig. 4-10. Used togheter with fixture 2825
2825 Fixture for holding transmission. Used together with stand 2520
2828 Puller for rear bearing on main shaft. Used together with 2832
2829 Device for lifting and installing the main shaft in gearbox
2830 Puller for reverse shaft
2831 Press tool for installing bearing on intermediate shaft and rear bearing on main shaft
2832 Puller for rear bearing on main shaft. Used together with 2828
2833 Fixture for transmission. Used on garage jack when removing and fitting transmission, see Fig. 4-12
2851 Drift for installing oil seal in cover for input shaft
2852 Cushioning ring for installing bearing on input shaft and synchronizers on main shaft
2853 Ring for disassembling main shaft
2982 Puller for input shaft ball bearing
2983 Puller for rear bearing inner ring on intermediate shaft
2984 Measuring stand for measuring intermediate shaft axial clearance
2985 Counterhold for output shaft
2986 Drift for installing rear bearing inner ring on intermediate shaft
2987 Drift for installing front bearing inner ring on intermediate shaft
2988 Puller for front bearing inner ring on intermediate shaft

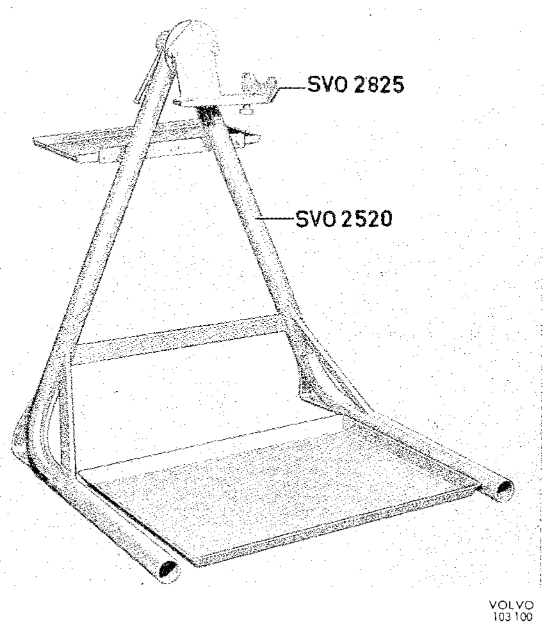


Fig. 4-10. Stand 2520 with fixture 2825

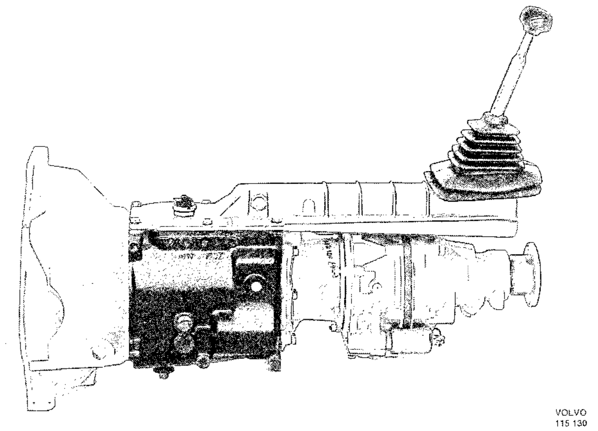


Fig. 4-11. Gearbox M410

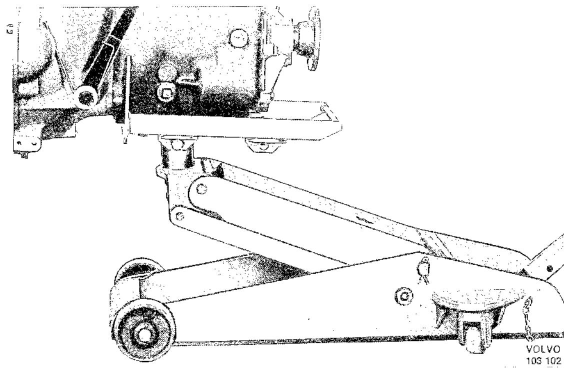


Fig. 4-12. Fixture for removing gearbox

GENERAL INFORMATION

(For transmission with overdrive, see also Group 43 B, Overdrive)

The transmission is four-speed and fully synchronized. Its design and construction are shown in Fig. 4-11 and Illustration 4 B. All gears except reverse are in constant mesh with one another. For this reason, the main shaft gear is journaled with needle bearings. When a gear is engaged, the corresponding gear wheel is connected to the mainshaft by means of an engaging sleeve.

SERVICE PROCEDURES

TRANSMISSION REMOVAL

1. Jack up the vehicle and place props underneath. Remove the oil from the gearbox.
2. Remove the gear lever. Disconnect the following: The upper anchorage bolts for the radiator, the nuts for the exhaust manifold flange, the battery lead, the throttle shaft and clutch wire from the flywheel casing.
3. Replace the lift plate on a jack with fixture SVO 2833. The pin in the fixture should be placed in the rear position. Support under the transmission with the fixture and then remove the support beam under the transmission.
   Disconnect the bracket for the exhaust pipe. Disconnect the speedometer cable. Disconnect the propeller shaft.
4. Place a wooden block between the engine and firewall and lower the jack until the engine is against the block. Disconnect the electric cables from the contact on the transmission.
5. Slacken the bolts in the clutch casing. Pull the transmission rearwards and then lower it, see Fig. 4-12.

TRANSMISSION DISASSEMBLY

1. Fit fixture 2825 in stand 2520, see Fig. 4-10. Secure the transmission in the fixture. The bolt for securing the transmission to the fixture is fitted in the transmission drainage hole.
2. Release the bolts and lift off the transmission cover. Remove the springs and interlock balls for the selector forks.
3. Remove the nuts securing the overdrive to the intermediate flange. Remove the overdrive.
4. Unscrew the bolts for the selector forks. Push the selector rails backwards and drive out the tensioning pin in the flange of the selector rails. Push out the selector rails. When doing this, hold the selector forks so that they do not come askew and jam on the rails. Remove the selector forks.

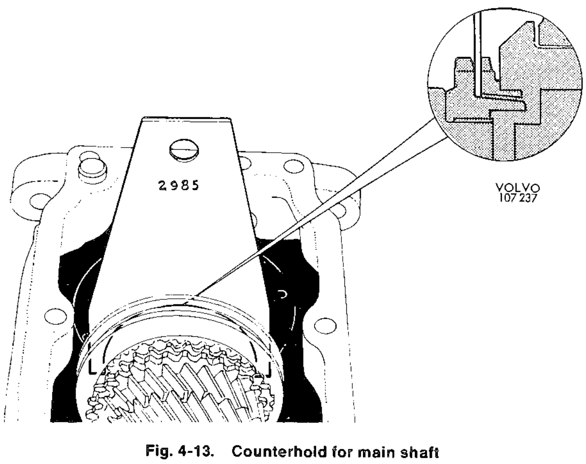


Fig. 4-13. Counterhold for main shaft

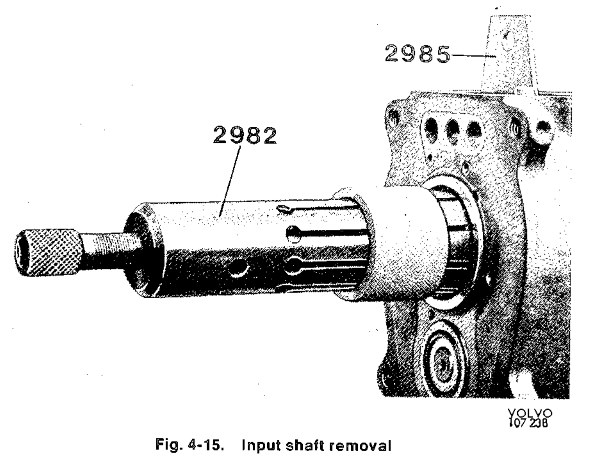


Fig. 4-15. Input shaft removal

5. Place counterhold 2895 between the input shaft and the front synchronizing, see Fig. 4-13. Remove the bolt in 2828 and replace with tool 2832. Pull off the mainshaft rear bearing with pullers 2828 and 2832, see Fig. 4-14.
6. Remove the release bearing. Release the bolts and remove the cover for the input shaft. Then release the bolts for the clutch casing and remove the casing.
7. Remove the circlip and pull off the bearing for the input shaft with puller 2982, see Fig. 4-15. Remove counterhold 2985.
8. Turn the transmission upside down. Carefully drive the intermediate shaft forwards with a metal drift in the center hole until the front gear wheel goes against the end of the housing. Thereafter drive the intermediate shaft backwards until the rear bearing outer ring releases. NOTE. The intermediate shaft may catch in the boss for the reverse shaft, in which case it should be pressed to the one side.
9. Restore the transmission to its normal position. Pull out the input shaft and remove the synchronizing. Remove the thrust washer from the rear end of the mainshaft. Fit lift tool 2829 onto the mainshaft. Push the engaging sleeve for 1st-2nd speeds backwards. Lift up the mainshaft according to Fig. 4-16.
10. Hoist the intermediate shaft. Drive out the outer ring for the intermediate shaft front bearing with drift 2413. Pull off the inner rings for the intermediate shaft bearing with pullers 2983 (rear bearing, see Fig. 4-17) and 2988 (front bearing).
11. Pull out the reverse shaft with puller 2830, see Fig. 4-18, and take out the reverse gear.
12. Drive out the sealing ring from the front cover with drift 2337 and from the rear cover with drift 2413.

MAINSHAFT DISASSEMBLY

1. Remove the lifting tool and then 1st speed gear wheel, the needle bearing and the synchronizing cone.
2. Remove the engaging sleeves and the flanges for the synchronizers. Remove the circlips for the synchronizing hub.
3. Fit tool 2853 on to the mainshaft. Place the shaft in a press and support it with the tool as shown in Fig.

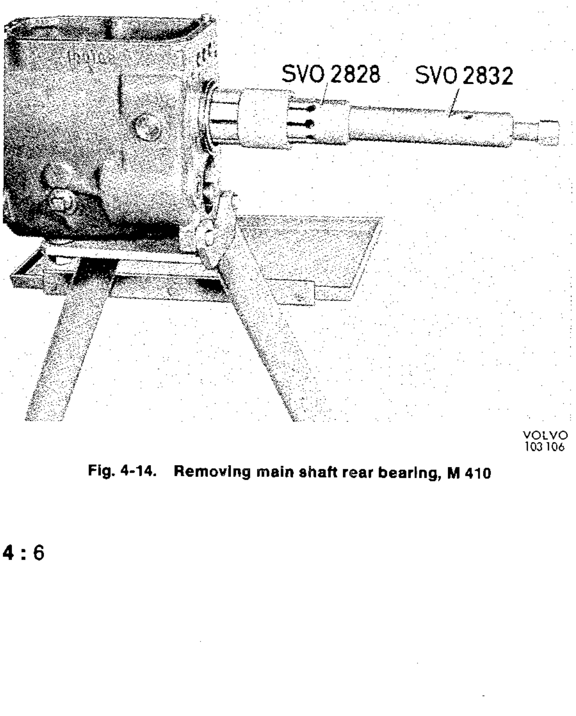


Fig. 4-14. Removing main shaft rear bearing, M 410

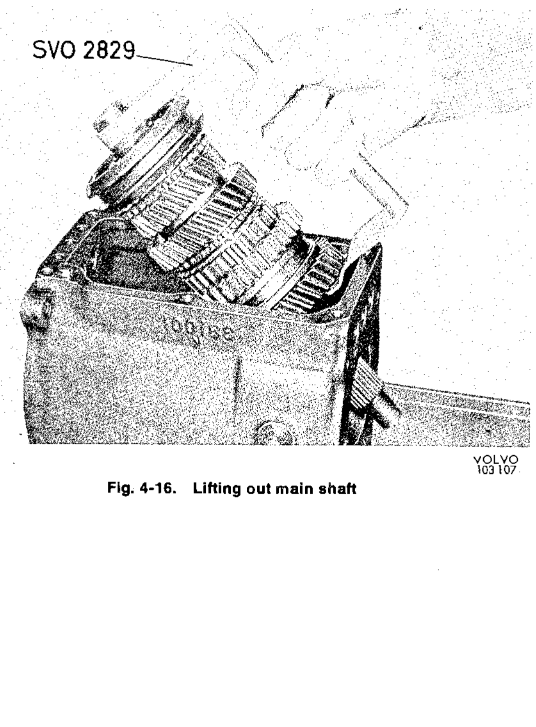


Fig. 4-16. Lifting out main shaft

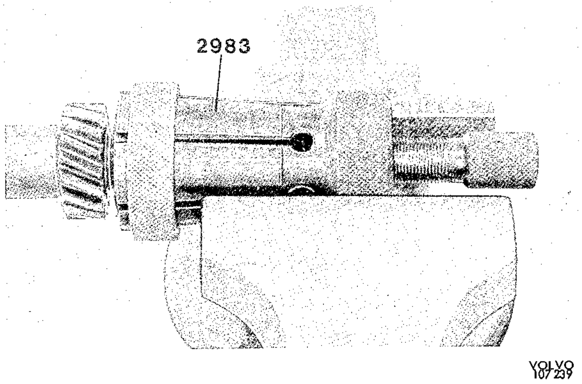


Fig. 4-17. Rear inner ring removal

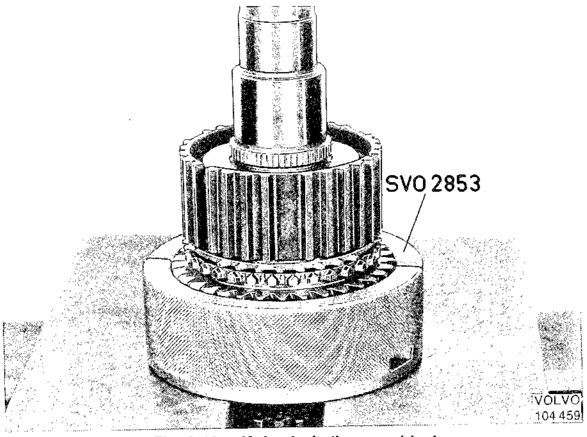


Fig. 4-19. Main shaft disassembly, I

4-19. Press off 2nd speed gear wheel and 1st and 2nd speed synchronizing hub.

4. Revert the shaft and place it in the press as shown in Fig. 4-20. Press off 3rd speed gear wheel and 4th speed synchronizing hub.

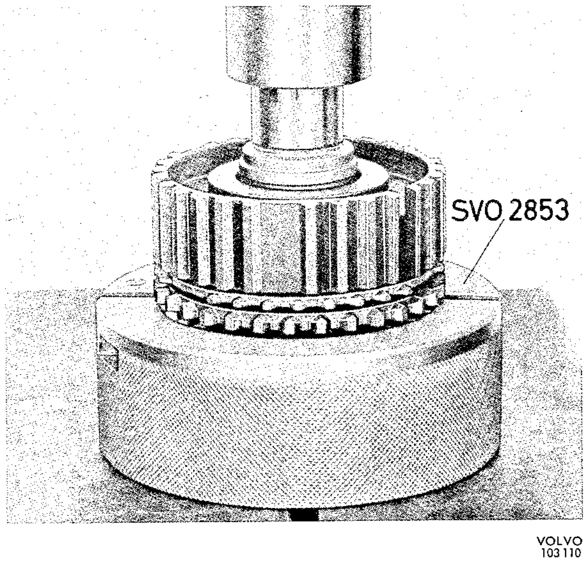


Fig. 4-20. Main shaft disassembly, II

INSPECTION

Aster the dismantling, clean all the parts in white spirit and check for wear or other damage.

Examine the gear wheels particularly for cracks or scoring on the teeth surfaces. Damaged or worn gear wheels should be replaced.

Examine the synchronizing cones, also the other parts of the synchronizing devices. Damaged or worn parts should be replaced.

Examine the ball bearings especially for scoring or cracks in the bearing races or on the balls.

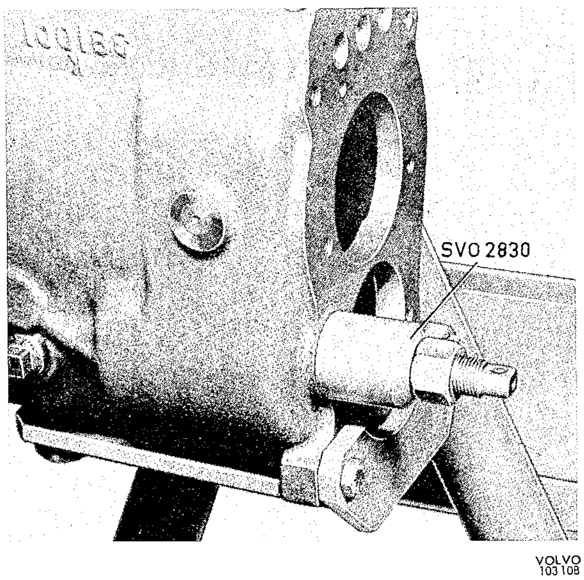


Fig. 4-18. Reverse shaft removal

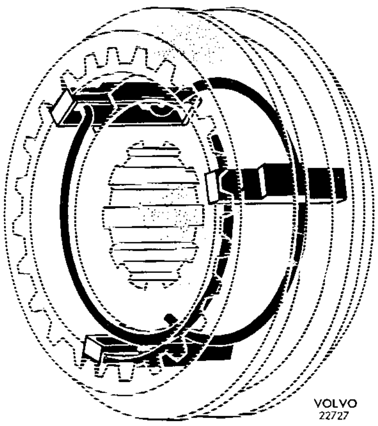


Fig. 4-21. Synchronizer assembly

ASSEMBLY

MAIN SHAFT ASSEMBLY

1. Assemble 1st-2nd and 3rd-4th speed synchronizers. Fit the snap rings correctly, see Fig. 4-21. Place the resilient ring in the hub for 3rd – 4th synchronizers, see Fig. 4-22.
2. Center the resilient ring (Fig. 4-22) with the help of a small screwdriver. Place 3rd synchronizing cone in the synchronizing. Make sure that the flanges fit properly in the grooves in the synchronizing cone. Assemble the synchronizing and 3rd speed gear. Turn the gear wheel to make it easier for the resilient ring to be fitted on.
3. Place ring 2852 in a press and fit on the synchronizing and the gear wheel. Fit the needle bearing and press in the mainshaft, see Fig. 4-23. When doing this, turn the 3rd speed gear wheel in order to check that this gear as well as the needle bearing fit correctly. Try out a circlip which fills the groove well and fit the circlip.
4. Place 1st-2nd speed synchronizer, synchronizing cone, 2nd speed gear wheel and needle beraing on ring 2852. Make sure that the gear ring on the engaging sleeve comes forwards and that the flanges fit correctly in the grooves of the synchronizing cone. Press in the mainshaft, see Fig. 4-23. When doing this, turn the 2nd speed gear wheel to prevent it from fastening. Try out a circlip which fits well into the groove on the shaft and fit the circlip.
5. Fit 1st speed gear wheel with needle bearing and synchronizing cone on the mainshaft. Fit on lifting tool 2829.

TRANSMISSION ASSEMBLY

1. Press the sealing rings in the front cover with drift 2851 + 1801. Press the ball bearing on the input shaft with the help of the cushioning ring 2852 and drift 2851, see Fig. 4-24.
   NOTE. The ball holder should be faced inwards. Test a circlip which fits well in the groove and fit it. Press the rear bearing inner ring onto the intermediate shaft with drift 2986, see Fig. 4-25.

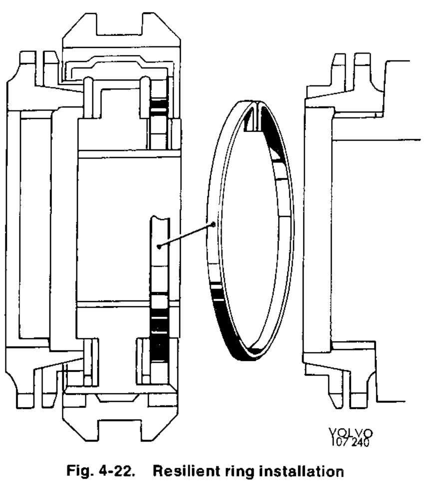


Fig. 4-22. Resilient ring installation

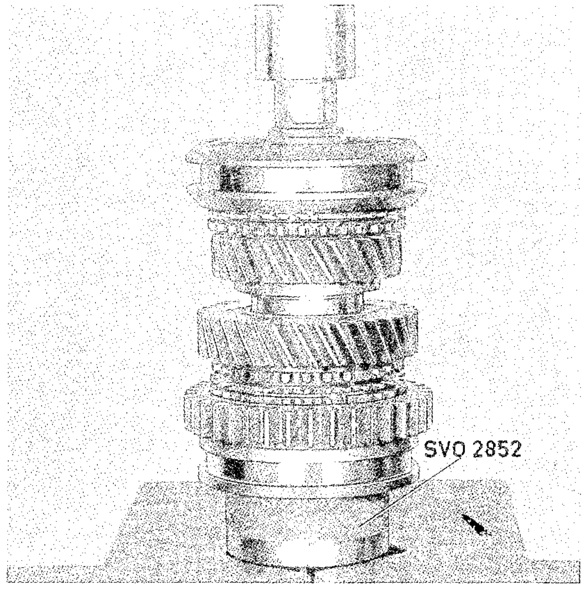


Fig. 4-23. Synchronizer installation

2. Place the gear lever for the reverse shaft onto the bearing pin in the transmission housing. Fit the reverse gear and the reverse gear shaft. The reverse gear shaft should lie level with the housing or a maximum 0.2 mm (0.08") underneath.
3. Place the intermediate shaft in the bottom of the transmission housing. Place the mainshaft in the housing. Remove lifting tool 2829 and fit the thrust washers onto the mainshaft.
4. Fit the rear ball bearing onto the mainshaft. NOTE. The ball holder should be faced inwards. Fit press tool 2831 over the bearing and the mainshaft as shown in Fig. 4-26. Press the bearing onto the shaft. If the bearing does not locate in the housing, the spindle on tool 2831 can be screwed out and a flat iron piece placed between this and the front end of the housing. The bearing can then be pressed into position with the tool.

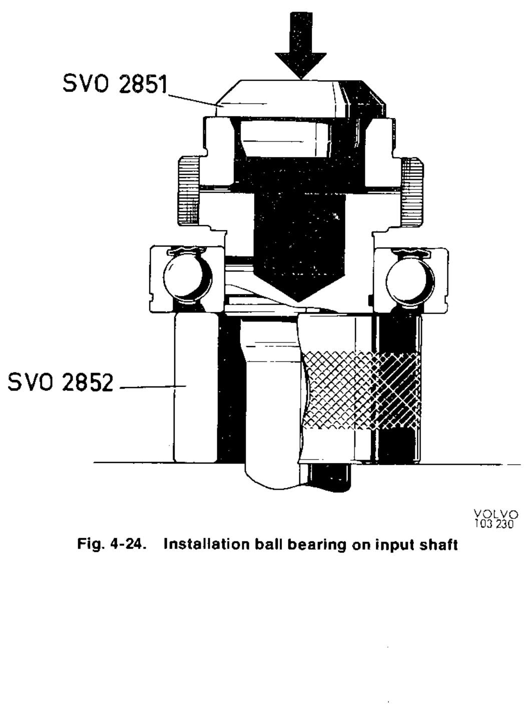


Fig. 4-24. Installation ball bearing on input shaft

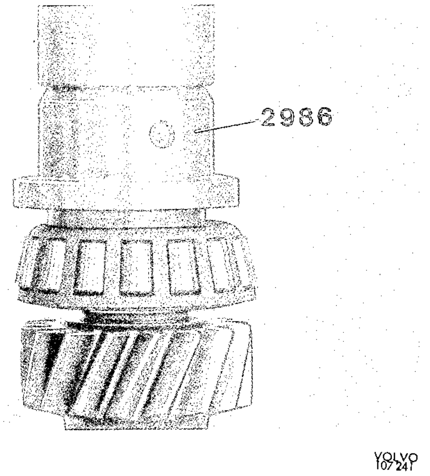


Fig. 4-25. Rear inner ring installation

5. Fit the needle bearing in the input shaft. Install the loose synchronizing cone in the synchronizer for the 3rd–4th speeds. Place it correctly so that the flanges take up in their grooves. Push the input shaft into the housing and onto the pin of the mainshaft.
6. Turn the transmission upside down. Press the front bearing inner ring onto the intermediate shaft with 2831, 2986 and 2987, see Fig. 4-27. Drive in the outer rings until they are about 3 mm (0.12") above the face.
7. Turn the transmission with the front end upwards and fit the engaging casing and the front cover with gaskets.
8. Turn the transmission with the rear end upwards. Fit the gasket and place a 0.7 mm (0.028") shim on the rear bearing outer ring. Fix the measuring stand 2984 with two bolts as shown in Fig. 4-28. Mark up and place the dial indicator with the measuring point facing the inner ring.

   NOTE. When reading off the dial indicator, the measuring point should always be pointing to the same point on the inner ring.
9. Press down the intermediate shaft with, for example, a crosshead screwdriver in the center hole, and rotate it at the same time by rotating the mainshaft

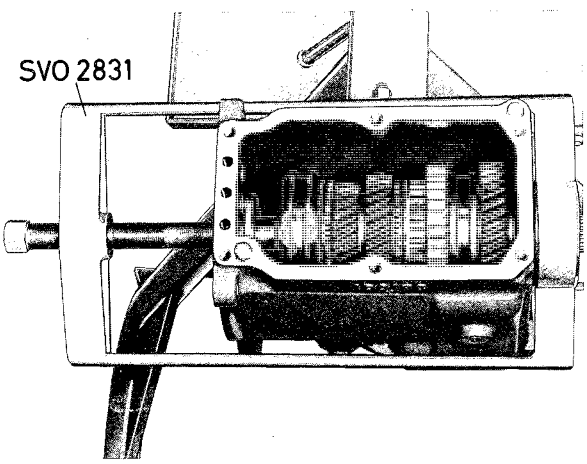


Fig. 4-26. Mainshaft rear bearing installation

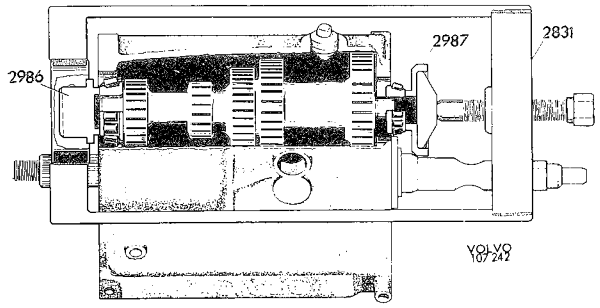


Fig. 4-27. Front inner ring installation

with the reverse gear engaged. Zero-set the dial indicator when the intermediate shaft no longer goes down.

10. Press the intermediate shaft upwards with a screwdriver through the level hole on the housing and rotate it at the same time. Read off the dial indicator when the pointer has stopped at its highest position.
11. Measure up shims with thickness equal to the measured clearance less 0.06 mm (0.0024"). Remove the measuring stand, insert shims (the thickest should be against the rear cover), re-fit the measuring stand and check-measure the clearance, which should be between 0.03–0.10 mm (0.0012–0.004").
12. Fit selector forks, flanges and selector rails. Make sure that the flange for the reverse gear fits correctly in the gear lever. Fit the bolts and tensioning pins. Use new pins.
13. Install the intermediate flange with new gasket. When installing, compress the gakset and give the intermediate shaft the correct clearance, 0.20–0.25 mm (0.008–0.010").
14. Install the overdrive.
15. Place the interlocking balls and springs in position. Fit the transmission cover with gasket. Fit the release bearing and the small speedometer gear.

INSTALLATION

Installing of the transmission is in reverse order to removal. Fill with oil.

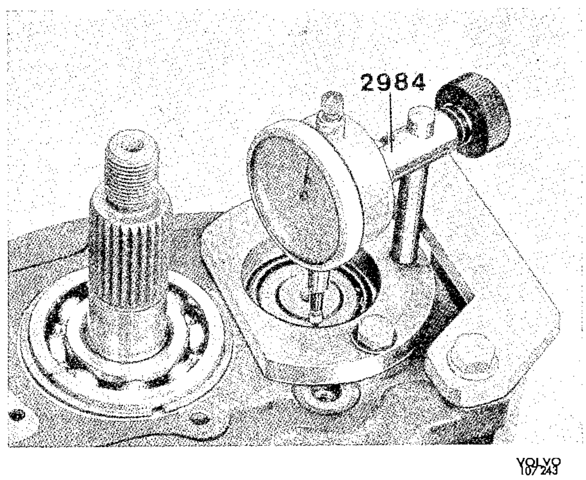


Fig. 4-28. Axial clearance measurement

OVERDRIVE

TOOLS

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

The numbers for the special tools are preceded by 999 or SVO, e.g, 999 2834 or SVO 2834.

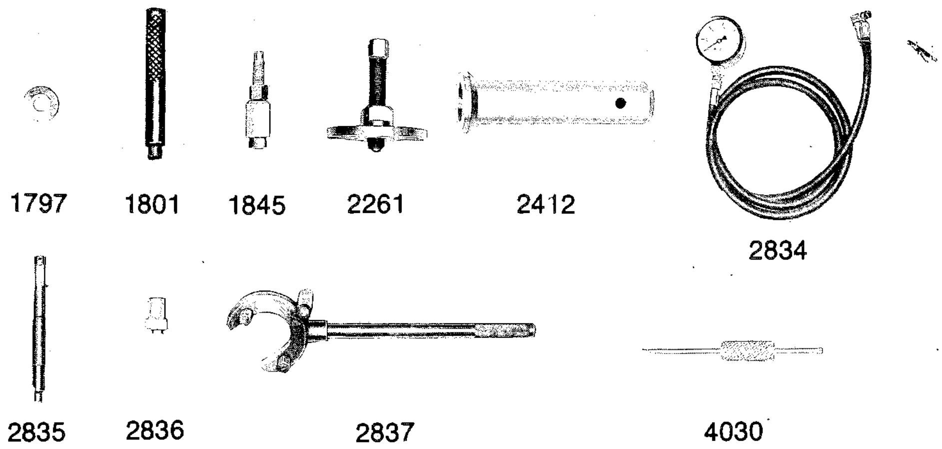


Fig. 2-29. Special tools

999 (SVO)

1797	Drift for removing rear bearing, output shaft
1801	Standard handle
1845	Press tool for fitting flange
2261	Puller for flange
2412	Sleeve drift for fitting front and rear bearings on output shaft and oil seal at flange
2834	Pressure gauge for checking oil pressure
2835	Centering mandrel for splines in planet carrier and one-way clutch
2836	Socket for removing and fitting plugs for fine filter, oil pump and relief valve
2837	Counterhold for flange
4030	Puller for oil seal at flange

GENERAL INFORMATION

The overdrive unit is of the epicyclic type and is attached to the rear end of the transmission. Its design and construction are shown in Figs. 4-35, 4-43 and Illustration 4-C. The working principle of the overdrive is as follows:

DIRECT DRIVE POSITION

When traveling forwards the power is transmitted from the transmission mainshaft through the uni-directional clutch to the output shaft of the overdrive. At the same time the clutch sliding member (position I, Fig. 4-30) is pressed by four springs against the tapered part of the output shaft. When reversing or when the engine acts as a brake, the torque is transmitted through the clutch sliding member.

OVERDRIVE POSITION

In the overdrive position the clutch sliding member is pressed against the brake ring (see II, Fig. 4-30) with the help of the pistons (27, Fig. 4-37) in the hydraulic cylinders. This also locks the sun wheel. Since the planet gear retainers are linked to the mainshaft through the splines, the planet gears are forced to rotate around the sun wheel. As a result of this, the output shaft will rotate at a higher speed than the mainshaft.

ELECTRICAL SYSTEM

The overdrive is engaged by electro-hydraulic means. On the transmission cover there is a contact which cuts in when 4th speed is engaged. Thus the overdrive can only be engaged when this speed is engaged. It is switched on by means of a switch placed underneath the steering wheel. This switch closes the circuit via the switch on the transmission to a solenoid on the overdrive. The solenoid armature is thus moved and this operates the control valve to the position for overdrive.

HYDRAULIC SYSTEM

The hydraulic system consists of the following main parts: Pre-filter, plunger pump, fine filter, hydraulic cylinders and plungers, relief valve and a control valve which is operated by the solenoid.

The relief valve has a special construction with a hydraulic piston and three different springs. It has three different functions: It must maintain a low pressure in the system with direct drive, a high pressure with overdrive, and also provide smooth changing when shifting from overdrive to direct drive and vice versa. Its function is described in more detail below.

The oil flow with direct drive is shown in Fig. 4-34.

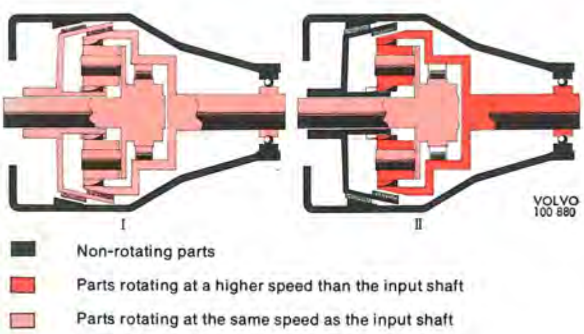


Fig. 4-30. Working principle of overdrive
I. Direct drive position
II. Overdrive position

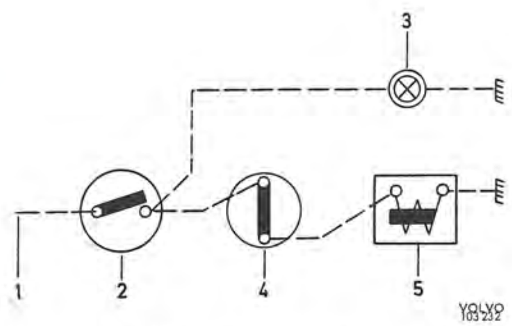


Fig. 4-31. Electrical circuit diagram
1. Lead from fuse box
2. Switch for overdrive
3. Indicator lamp for overdrive
4. Switch on gearbox
5. Solenoid on overdrive

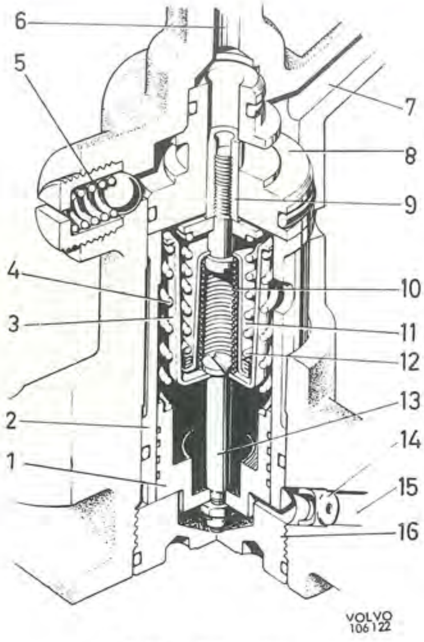


Fig. 4-32. Relief valve

1. O-ring
2. Cylinder
3. Large piston unit
4. Spring
5. Valve ball
6. Channel for oil pump
7. Channel to main shaft
8. Relief valve body
9. Relief valve spindle
10. Residual spring
11. Relief valve spring cup
12. Relief valve spring
13. Dashpot spindle
14. Orifice nozzle
15. Drilling from operating valve
16. Dashpot plug

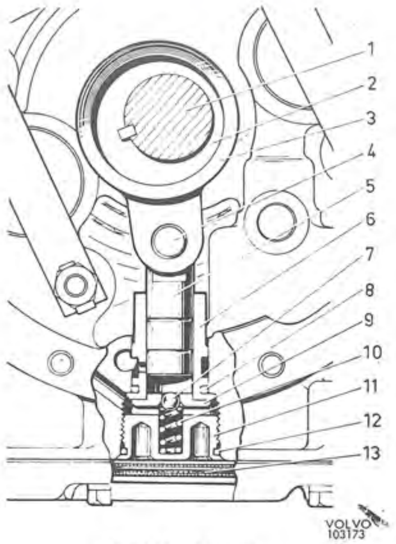


Fig. 4-33. Oil pump

1. Main shaft
2. Eccentric
3. Connecting rod
4. Gudgeon pin
5. Piston
6. Cylinder
7. Ball
8. O-ring
9. Valve seat
10. Spring
11. Plug
12. O-ring
13. Pre-filter

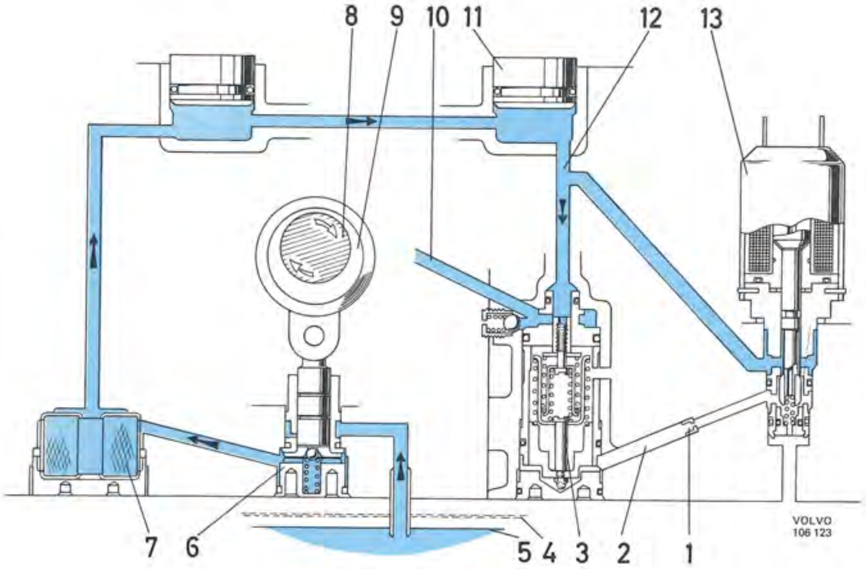


Fig. 4-34. Function with direct drive

1. Nozzle
2. Channel, control valve-relief valve
3. Relief valve
4. Pre-filter
5. Oil sump
6. Oil pump
7. Fine filter
8. Gearbox main shaft
9. Eccentric
10. Channel, relief valve main shaft
11. Piston
12. Channel, oil pump–hydraulic cylinder–control and relief valves
13. Control valve and solenoid

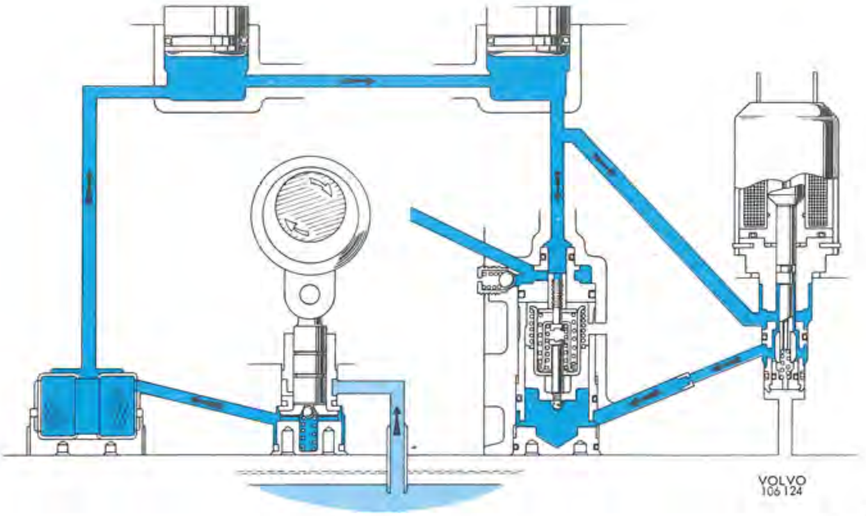


Fig. 4-35. Overdirve in function

The oil is drawn through the pre-filter by the plunger pump and is conveyed under pressure through the fine filter. From here the oil flows further through the hydraulic cylinders to the relief and control valves. The control valve closes and the large piston of the relief valve is in its lower position. This off-loads the springs so that only a low pressure is required to press down the small piston of the relief valve. Oil then flows past the small piston out into the channel to the mainshaft.

When the overdrive engages, the control valve is displaced and oil flows through the oilway and operates the large piston of the relief valve. This is then moved upwards and causes the springs to tension. The more the springs tension the greater the force is required to press down the small piston, this causing the hydraulic pressure to rise. The pistons are thereby displaced in the hydraulic cylinders, the clutch sliding member is pulled forwards and contact made with the brake ring.

With disengagement of the overdrive, the connection between channels 12 and 2 closes. The connection between channel 2 and the sump then opens. This permits oil under the large piston of the relief valve to flow out into the sump, the pressure in the system drops and direct drive is engaged. Because of the orifice nozzle in the channel and owing to a suitable balancing of the spring force, a certain time passes for the piston of the relief valve to move from one outer position to the other. This time is so adapted that a smooth engagement occurs without any slipping of gears.

Oil passing the small piston of the relief valve is conveyed through the channel and a drilling in the mainshaft to the uni-directional clutch and the needle bearing shaft. Thereafter the oil is caught up by a plate and lead via the planet gear back to the gearbox housing, see Fig. 4-36.

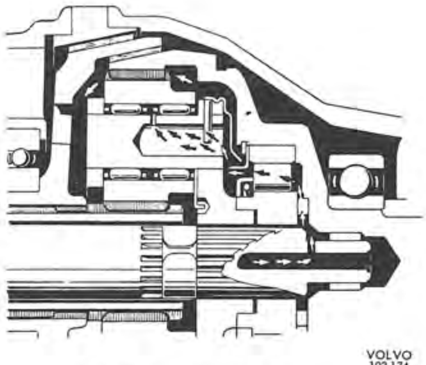


Fig. 4-36. Lubricating system

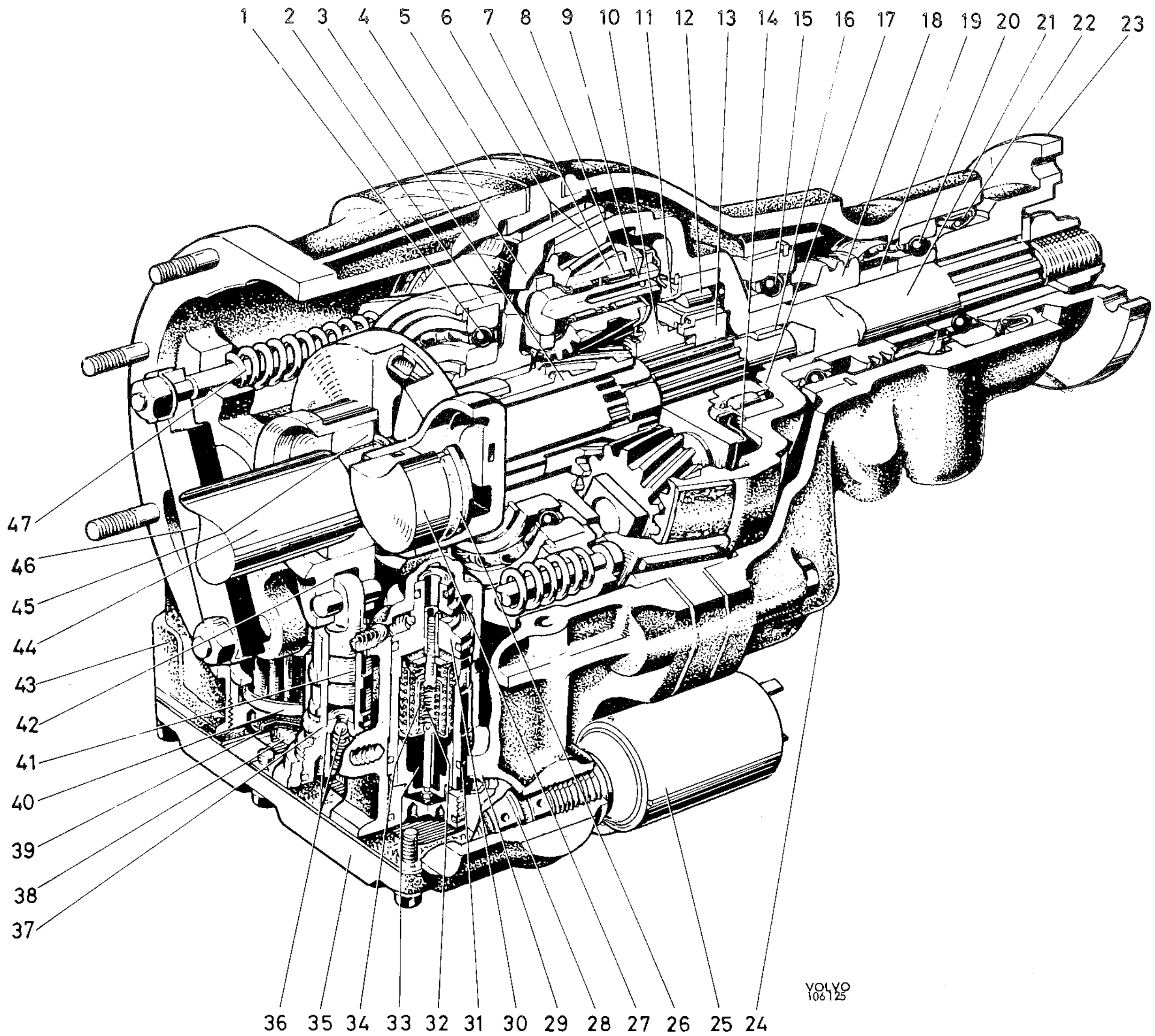


Fig. 4-37. Overdrive

1. Output shaft support bearing
2. Thrust bearing retainer
3. Sun wheel
4. Clutch sliding member
5. Brake ring
6. Clutch member outer lining
7. Planet gear
8. Needle bearing
9. Shaft
10. Planet carrier
11. Oil thrower
12. One-way clutch rollers
13. One-way clutch
14. Oil trap
15. Ball bearing
16. Bushing
17. Thrust washer
18. Speedometer driving gear
19. Spacer
20. Ball bearing
21. Output shaft
22. Oil seal
23. Coupling flange
24. Rear casing
25. Solenoid
26. Piston seal
27. Piston
28. Operating valve
29. Orifice nozzle
30. Cylinder top
31. Cylinder
32. Spring
33. Large piston
34. Small piston
35. Base plate
36. Check valve for oil pump
37. Pump cylinder
38. Magnet
39. Pre-filter
40. Fine filter
41. Pump plunger
42. Connecting rod
43. Front casing
44. Input shaft (transmission main shaft)
45. Eccentric
46. Bridge piece
47. Spring

WORK ON OVERDRIVE IN VEHICLE

REPLACING OIL SEAL

1. Carry out where applicable operations 1–6 under the heading "Removal".
2. Release the nut for the flange. Pull off the flange with puller 2261, see Fig. 4-38.
3. Pull out the old seal with puller 5069. Fit the new oil seal with the help of sleeve 2412.
4. Press on the flange with tool 1845, see Fig. 4-39. Fit the other parts.

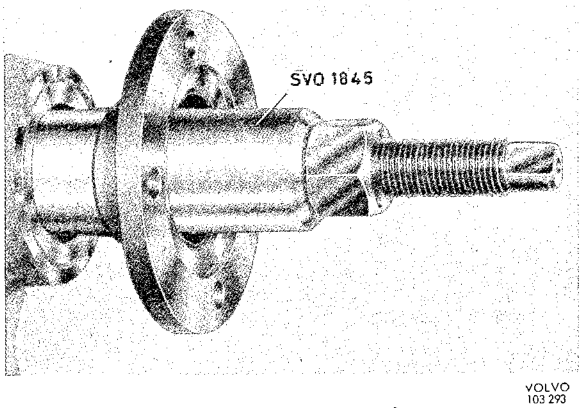


Fig. 4-39. Fitting flange

CHECKING OIL PRESSURE

The oil pressure can be suitably checked when driving on test rollers or on a motorway. The check can also be made with the vehicle jacked up but this should be avoided for reasons of safety.

Checking is as follows:

1. Remove the plug under the operation valve and connect the pressure gauge 2834, see Fig. 4-40.
2. Read off the pressure when driving on direct drive at about 40 kmph (25 mph). The pressure should then be about 1.5 kp/cm² (21 psi).
3. Engage the overdrive and check that the pressure rises to 32–35 kp/cm² (455–500 psi).
4. Disengage the overdrive and check the time for the pressure to drop to 1.5 kp/cm² (21 psi). The time must not exceed 3 seconds.

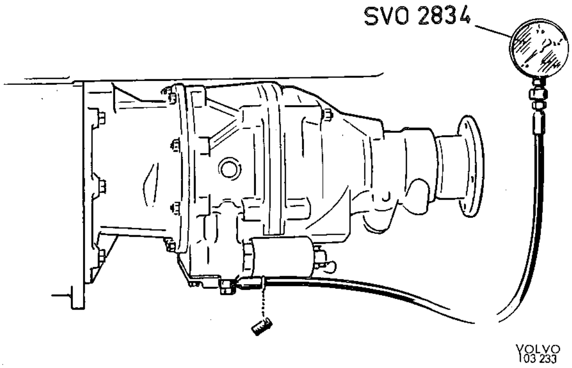


Fig. 4-40. Oil pressure check

SOLENOID AND OPERATING VALVE REPLACEMENT

The solenoid and operating valve are integrally built as one unit, which is replaced complete. For removal and installation, use a 25 mm (1") fixed spanner. Use a new seal and O-rings when fitting. The tightening torque should be 42–55 Nm (4.2–5.5 kpm=30–40 lbft).

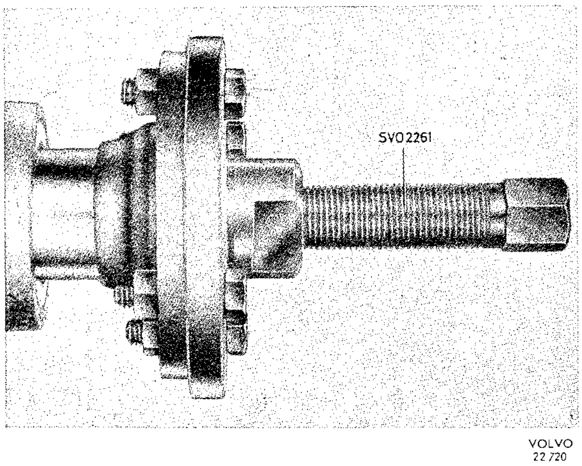


Fig. 4-38. Removing flange

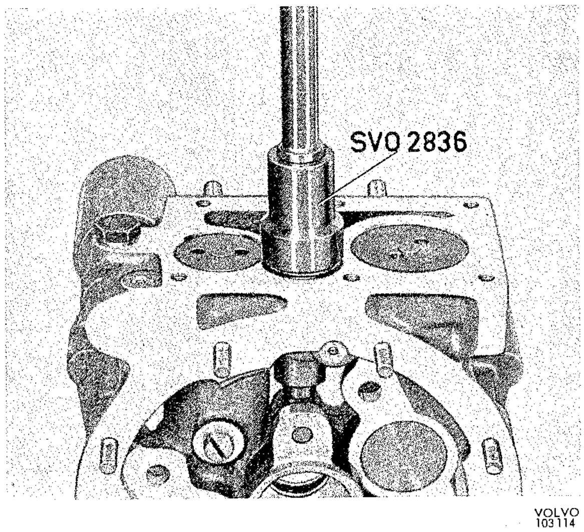


Fig. 4-41. Plug removal

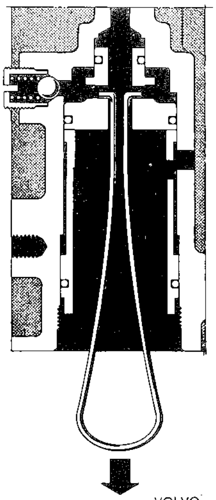


Fig. 4-42. Relief valve removal

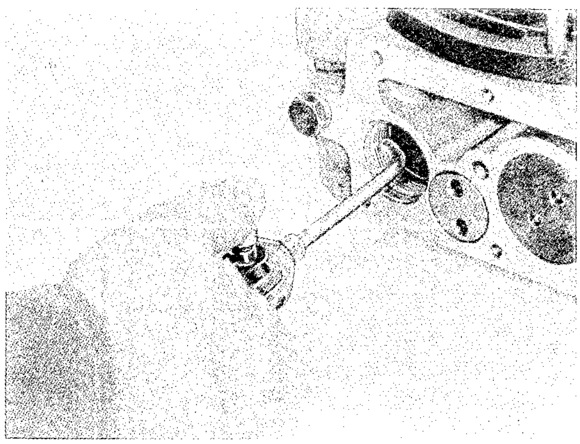


Fig. 4-43. Blowing orifice nozzle clean

RELIEF VALVE CHECK AND REPLACEMENT

1. Remove the base plate and the pre-filter. Collect the oil in an oil container. Warning. If the vehicle has been driven recently, the oil may be hot and scald if it comes into contact with your skin.
2. Remove the plug under the relief valve with tool 2836, see Fig. 4-41. Pull out the large piston of the relief valve, then the spring and spring retainer. Even the low-pressure spring will also be included in the removal. Then pull out the small piston with its spring and spring retainer, also the cylinder and end washer. Use a pair of pliers with narrow jaws for the piston unit and a loop, see Fig. 4-42, for the cylinder and washer.
3. Wash all the parts in alcohol or solvent and blow them dry with compressed air. Check them carefully for wear and damage. The pistons should run easily in their cylinders. Faulty parts must be replaced. NOTE. The following units are available as spare parts: End washer, cylinder, the small piston, adjuster washer, low-pressure spring, large piston, plug and the O-rings.
4. Before fitting the parts of the relief valve, it may be suitable to blow the orifice nozzle clean with compressed air, see Fig. 4-43.
5. Install the new O-rings on the end washer, cylinder and plug. Lubricate the parts with oil. Then install them in the following order: End washer, cylinder, small piston, low-pressure spring, large piston and plug. Tighten the plug to a torque of 22 Nm (2.2 kpm=16 lbft).
6. Install the pre-filter and base plate with a new gasket. Make sure that the magnet is in position on the base plate. Fill with oil.

CLEANING ORIFICE NOZZLE

The orifice nozzle is accessible after the cylinder of the relief valve has been removed according to above. Blow the orifice nozzle clean with compressed air, see Fig. 4-43.

CHECK VALVE TEST AND REPLACEMENT

1. Remove the base plate and pre-filter. Collect the oil in an oil container. Warning. If the vehicle has been recently driven, the oil may be hot and scald if contact is made with your skin.
2. Remove the plug with tool 2836. Take off the non-return valve spring, non-return ball and non-return body.
3. Clean all the parts in alcohol or solvent and blow them dry with compressed air. Check the parts for damage and wear. Replace faulty parts.
4. Install a new O-ring on to the plug and then re-fit the non-return body, ball, spring and plug. Tighten the plug to a torque of 22 Nm (2.2 kpm=16 lbft).
5. Re-install the pre-filter and base plate together with a new gasket. Do not forget the magnet on the bottom plate. Fill with oil.

FILTER CLEANING

1. Remove the base plate and the pre-filter. Collect the oil in an oil container. Warning. If the vehicle has been recently driven, the oil may be hot and scald if contact is made with your skin.
2. Remove the plug and take out the seal and fine filter, see Fig. 4-44.

3. Clean all the parts in alcohol or solvent. Then blow them dry with compressed air.
4. Fit the fine filter, a new seal and the plug. Tighten the plug to a torque of 22 Nm (2.2 kpm=16 lbft).
5. Re-fit the pre-filter and the base plate with a new gasket. Make sure that the magnet is in position on the base plate. Fill with oil.

OVERDRIVE REMOVAL

To facilitate removal, the vehicle should first be driven with the overdrive engaged and then with it disengaged **with the clutch pedal depressed.** The last-mentioned is important in order to avoid torsional tensions in the shaft between the planet carrier and one-way clutch. Any stresses will disappear even if oil with pressure of 20–25 kp/cm^2 (284–335 psi) is connected to the output at the operating valve. The overdrive is engaged and disengaged with this pressure.

Removal:

1. Carry out operations 1–4 under "Removal" in Group 43 a.
2. Disconnect the cables to the solenoid.
3. Unscrew the bolts holding the overdrive unit to the intermediate flange. Pull the overdrive straight out backwards until it goes free from the transmission main shaft.

OVERDRIVE DISASSEMBLY

Maximum cleanliness must be observed when working with the overdrive unit. Before the disassembly, clean the outside of the unit thoroughly. Then first disassemble the main parts as follows:

1. Place the overdrive vertically in a vise provided with copper jaws. Remove the solenoid and operating valve.
2. Bend down the locking tab, unscrew and remove the nuts for the piston bridge pieces. Remove the bridge pieces.
3. Unscrew the nuts holding the brake ring, front and rear casing. Loosen the nuts successively all round in order to avoid any distortion from the springs. Lift off the front casing and brake ring, see Fig. 4-45.
4. Tap loose the brake ring from the front casing with the help of a copper drift and hammer.
5. Remove the springs for the clutch sliding member. Lift out the clutch sliding member complete with thrust bearing and sun wheel.
6. Lift out the planet gear carrier complete.

FRONT CASING REMOVAL

1. Place the casing with the front side downwards on a bench. Connect compressed air to the hole for the opening valve and blow out the pistons.
2. Disconnect the base plate and remove the pre-filter. Then remove the plugs and take out the parts for the respective fine filter, relief valve and pump check valve. See also under the heading "Work on overdrive in vehicle".
3. Press down and pull out the pump cylinder. Then take out the connecting rod and pump plunger.

CLUTCH UNIT DISASSEMBLY

1. Remove the circlip for the sun wheel. Pull out the sun wheel backwards.
2. Remove the inner circlip for the bearing. Hold the bearing body and tap loose the clutch sliding member with a rubber mallet.
3. Remove the outer circlip and press the bearing out of the bearing housing.

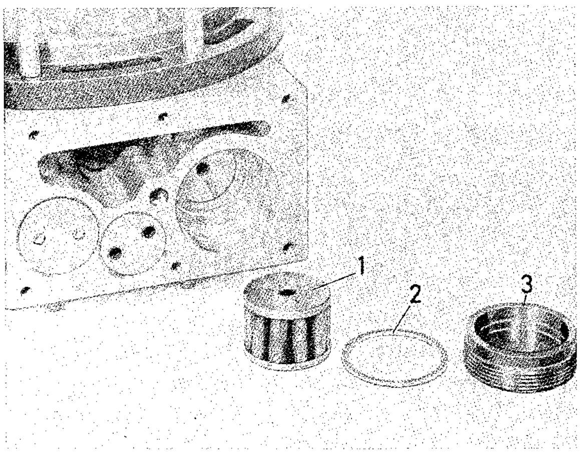


Fig. 4-44. Fine filter
1. Filter 2. Seal 3. Plug

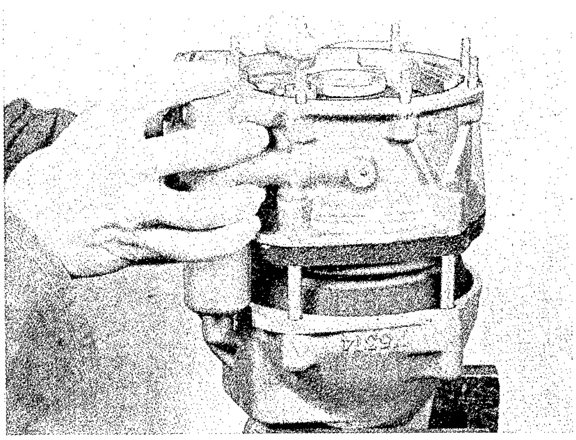


Fig. 4-45. Overdrive disassembly

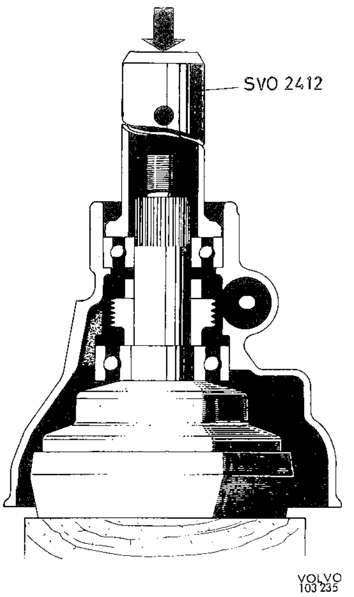


Fig. 4-46. Output shaft installation

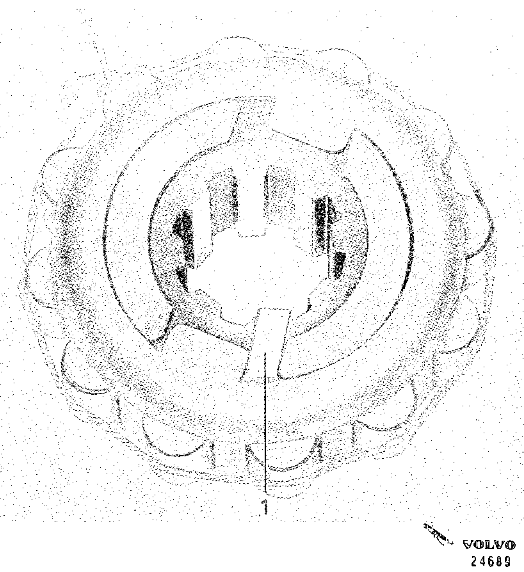


Fig. 4-48. One-way clutch assemlby, II
1. Key

REAR CASING DISASSEMBLY

1. Remove the bolt and pull out the retainer, the bushing and the speedometer pinion.
2. Remove the nut and pull off the flange with puller 2261 Place the housing in a press and press out the output shaft.
3. Remove the spacer, the speedometer driving gear. Pull out the bearing on the output shaft, suitably with a so-called knife extractor. The rear bearing and oil seal are pressed out of the housing with drift 1797 and handle 1801.
4. Remove the snap ring and the oil thrower, which hold the one-way clutch on the output shaft. Lift out the snap ring clutch ocmponents. Remove the thrust washer.

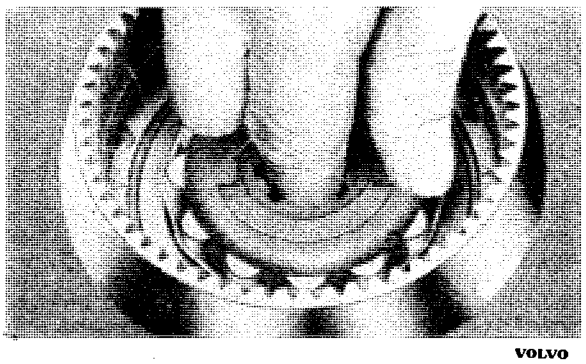


Fig. 4-47. One-way clutch assemlby, I
1. Spring 2. Cage 3. One-way clutch hub

OVERDRIVE INSPECTION

Before inspecting, clean all the parts in alcohol or solvent and then blow them dry with compressed air. Pay particular attention to the cleaning of the filters and all the oilways. Check that the orifice nozzle in the channel between the relief and operating valves is clean. If it is not possible to blow the nozzle clean, it can be cleaned with a pointed wooden stick or suchlike. Hard objects must not be used since these can alter the graduation.

Check also that the groove inside the ring gear on the output shaft is properly cleaned. Dirt collects here due to the centrifugal force. After cleaning, check all the parts carefully for wear, cracks or other damage. Pay particular attention to the following:

Check the solenoid with the help of a 12 volt battery and an ammeter. Current consumption should be about 2 ampères. Check the movement of the valve during engagement and disengagement.

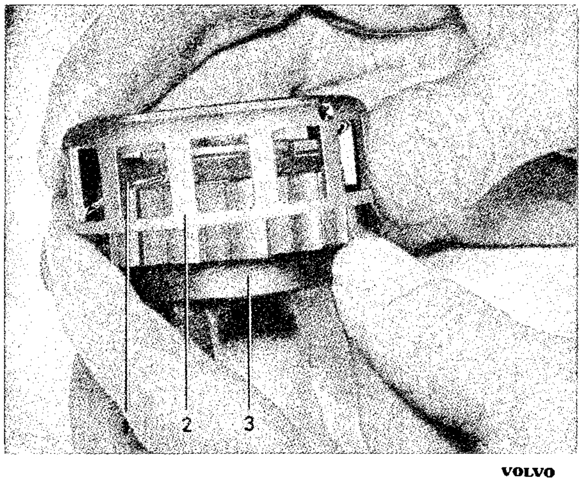


Fig. 4-49. One-way clutch installation

Check to make sure that the filters are not damaged. Also check the pistons of the hydraulic system for abrasion and wear. Check the valves for wear. Make sure that all the springs are not damaged. Check all the gears and ball bearings for cracks and wear. Make sure that the bushing on the sun wheel is not worn. With replacement, change the sun wheel complete with bushing. The bushing must be concentric with the gear wheel, and this is difficult to bring about outside a workshop.
Check the brake ring for abrasion, cracks or wear.Check to make sure that the linings on the clutch sliding member are not burnt or worn.

OVERDRIVE ASSEMBLY

Use new gaskets, O-rings, lock washer and seals when assembling. Observe maximum cleanliness since the hydraulic system is sensitive to impurities.

REAR CASING ASSEMBLY

1. Press the front bearing to the output shaft with drift 2412.
2. Press the rear bearing on to the rear casing section with drift 2412.
3. Place a wooden block under the output as support. Fit the speedometer driving gear and spacer. Press on the rear casing with drift 2412, see Fig. 4-46.
4. Press in the oil seal with drift 2412. Fit the coupling flange, the washer and nut. Tighten the nut to a torque of 110–140 Nm (11–14 kpm=80–100 lbft).
5. Assemble the one-way clutch, spring and roller cage, see Fig. 4-47. Turn the roller cage clockwise as far as it will go and lock it in this position with a key as shown in Fig. 4-48. Place in the rollers. Tie a piece of rubber band or string round the rollers.
6. Install the thrust washer and then the one-way clutch in position on the output shaft, see Fig. 4-49. Fit the oil thrower and install the snap ring, see Fig. 4-50.
7. Install the speedometer pinion and bushing. Fit the retainer and bolt.
8. Place the planet carrier complete with planet gear in position on the output shaft. Guide up the splines into the planet carrier and one-way clutch with drift 2835, Fig. 4-51.

CLUTCH UNIT ASSEMBLY

1. Press the ball bearing into the retainer and fit the snap ring.
2. Install the bolts on the bearing retainer. Then press the bearing with retainer on to the clutch sliding member. Install the snap ring.
3. Install the sun wheel on to the clutch sliding member. Fit the circlip.
4. Install the clutch unit in position on the output shaft. Install the four thrust springs on to the bolts.

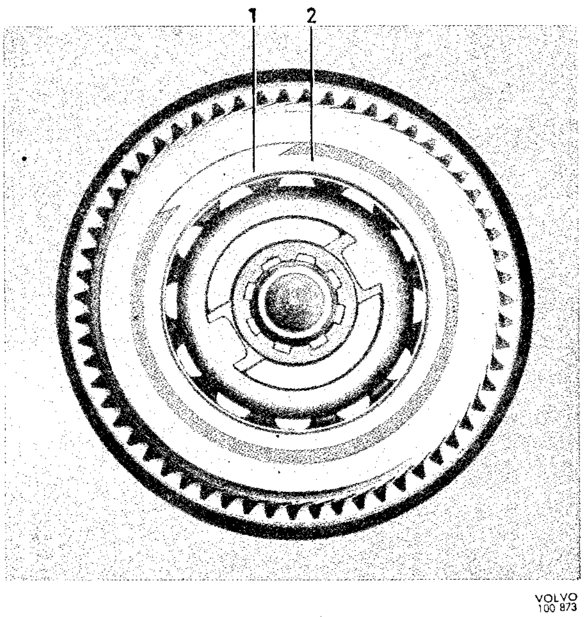


Fig. 4-50. Oil thrower installation
1. Oil thrower plate 2. Snap ring

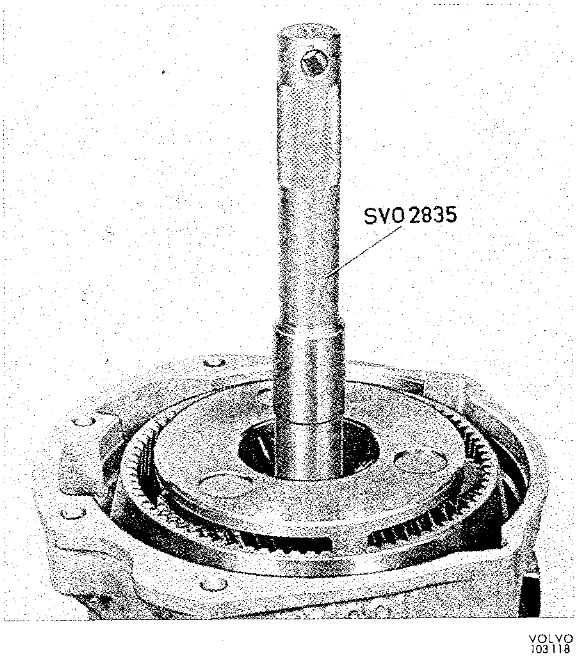


Fig. 4-51. Planet gear installation

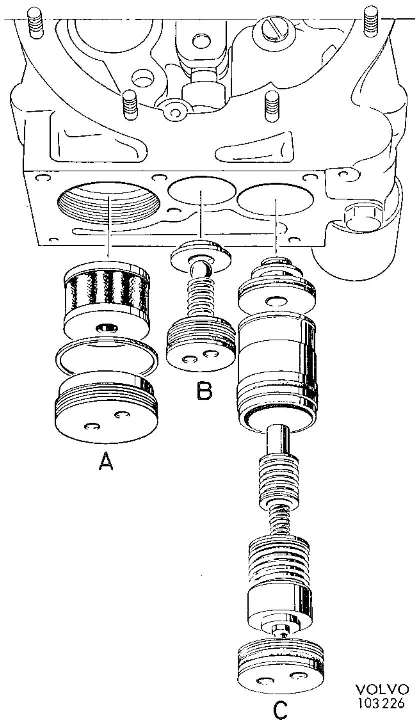


Fig. 4-52. Fine filter, oil pump check valve and relief valve installation

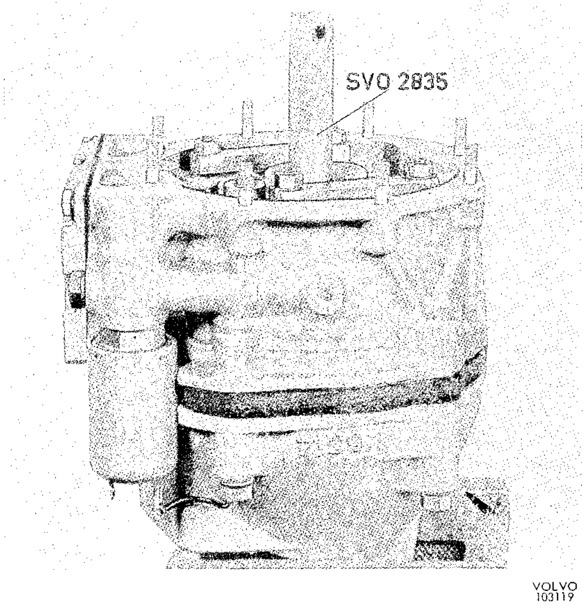


Fig. 4-53. Front casing installation

FRONT CASING ASSEMBLY INSTALLATION

1. Install the fine filter. Also install the relief valve parts in the following order: End washer, cylinder, small piston, low-pressure spring, large piston and plug, see 4-52.
2. Place the connecting rod and pump plunger in position in the casing. Then push in the cylinder. After that install the non-return body, non-return ball, spring and plug.
3. Tighten the plugs for the fine filter, relief valve and pump check valve with torque wrench and tool 2836. The tightening torque is 22 Nm (2.2 kpm=16 lbft). Install the pre-filter, magnet, gasket and base plate.
4. Install the operating pistons in their cylinders.
5. Install the brake ring on the front casing. Place the front casing on the rear one. Fit washers and nuts, see Fig. 4-53. Note that both the copper washers should be fitted on the upper bolts. Tighten the bolts a little at a time until they are tightened evenly all around.
6. Install both the thrust washers. Tighten and lock the nuts. Fit the operating valve and solenoid.

INSTALLING OVERDRIVE

Installing the overdrive is in reverse order to removal. Fill with oil. Check the oil in the gearbox after the vehicle has been driven 10—15 km (6—9 miles).

GROUP 44

AUTOMATIC TRANSMISSION

TOOLS

The following special tools are required for work on the automatic transmission.

The numbers for the special tools are preceded by 999 or SVO, e.g., 999 2837 or SVO 2837.

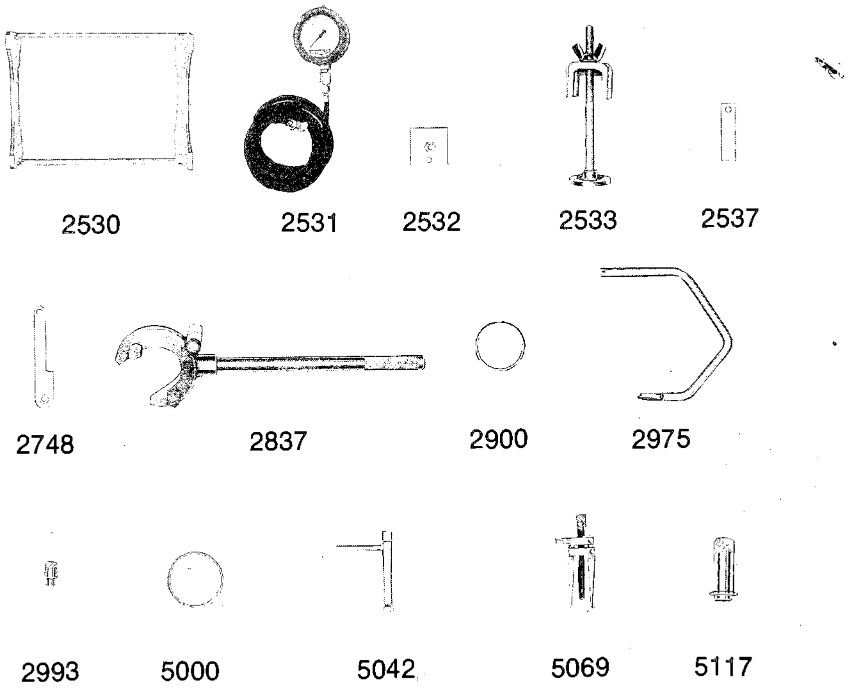


Fig. 4-54. Special tools

999 (SVO)
- 2530 Fixture for disassembling and assembling the transmission.
- 2531 Pressure gauge complete with hose and connection for checking the oil pressure.
- 2532 Attaching plate for magnetic holder when measuring end float of input shaft.
- 2533 Press tool for compressing rear clutch when removing and fitting the snap ring.
- 2537 Spacer for adjusting front brake band.
- 2746 Transmission fixture when removing and fitting, see Fig. 4-72.
- 2748 Wrench for adjusting front brake band.
- 2837 Counterhold for flange
- 2900 Ring for installation of piston in front clutch.

999 (SVO)
- 2975 Spanner for contact for starter inhibitor, etc.
- 2993 Guide for installation of piston in front clutch.
- 5000 Ring for installation of piston in rear clutch.

Instead of bench rack 2530, the following can be used for disassembling and assemlbing, see Fig. 4-73:

999 (SVO)
- 2520 Stand
- 2934 Fixture
- 5042 Tool for adjusting rear brake band
- 5069 Puller for oil seal at flange.
- 5117 Sleeve drift for installation of seal in pump housing.

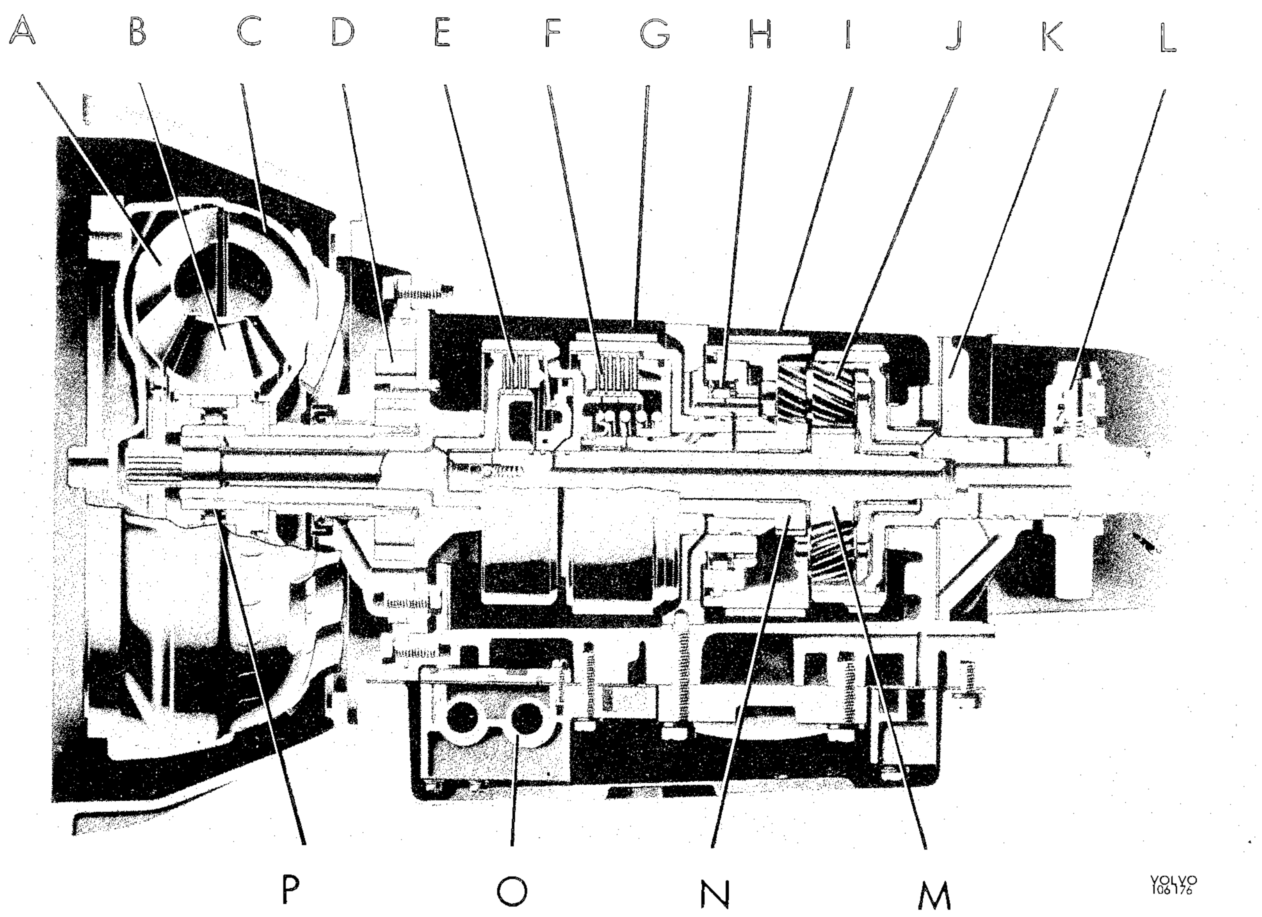


Fig. 4-55. Sectioned view of transmission

A. Turbine
B. Stator
C. Impeller and cover
D. Pump
E. Front clutch
F. Rear clutch
G. Front brake band
H. One-way clutch in gearbox
I. Rear brake band
J. Planetary gear set
K. Oil deflector flange
L. Governor
M. Forward sun gear
N. Reverse sun gear
O. Control system
P. One-way clutch in converter

GENERAL INFORMATION

The Volvo automatic transmission for cars is of Borg-Warner manufacture, type 35. If consists of two main components:

1. A three-element hydrokinetic torque converter coupling capable of torque multiplication at an infinitely variable rate between 2:1 and 1:1.
2. A hydraulically operated transmission comprising a planetary gear set with a valve system which automatically selects a suitable gear in relation to the speed of the car and position of the accelerator pedal.
   There is also a selector lever with positions "P", "R", "N", "D", "2" and "1", see Fig. 4-57.

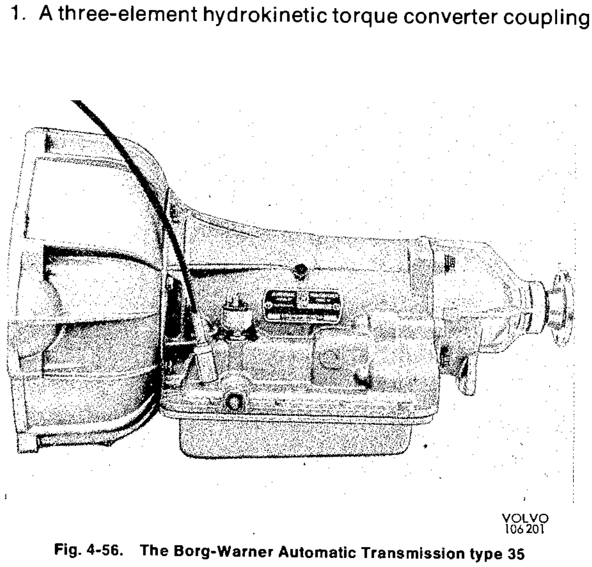


Fig. 4-56. The Borg-Warner Automatic Transmission type 35

TORQUE CONVERTER

The torque converter serves both as a clutch and as an extra (hydraulic) gear between the engine and transmission. It provides a means of obtaining smooth application of engine power to the driving wheels and additional engine torque multiplication to the 1st and 2nd gears of the gearbox. The converter also provides extreme low-speed flexibility when the gearbox is in 3rd gear and, due to the ability of multiplying engine torque, it provides

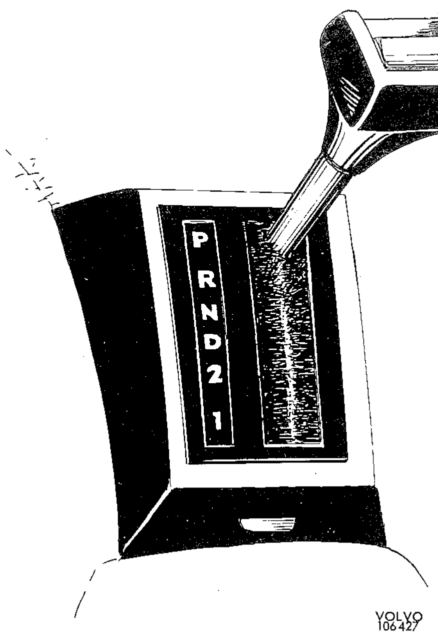


Fig. 4-57. Selector lever positions

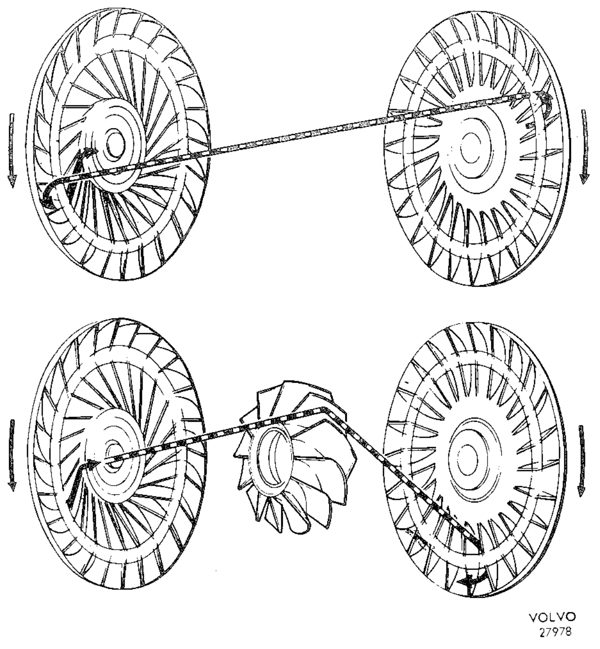


Fig. 4-59. Function of converter

good acceleration from very low road speed without having to resort to a downshift in the transmission.

The converter consists of three main components—an impeller connected to the engine crankshaft, a turbine connected to the input shaft of the transmission, and a stator mounted on a sprag-type one-way clutch support on a fixed hub projecting from the transmission case.

The converter functions as follows:

The impeller is rotated by the engine and converts the engine power into hydrokinetic energy. The fluid flows from the impeller vanes to the turbine vanes and returns to the impeller through the stator vanes, see Fig. 4-59. The curvature of the various vanes is so designed that when a speed differential exists between the impeller and the turbine, the angle of the fluid flow from the turbine is changed by the stator vanes in such a way that the discharge of fluid from the stator assists in driving the impeller. Under such conditions, torque multiplication occurs and varies from 2:1 when the turbine is stalled (i.e. when, with any of the driving ranges selected, the vehicle is held stationary and the engine is operating at maximum throttle opening) to 1 : 1 when the turbine reaches a speed approximately 90 % of that of the impeller. When this speed differential between the impeller and turbine is achieved, the fluid flow angle from the turbine is such that the stator is driven in the same direction as the turbine and the impeller. Under these circumstances, the converter becomes a fluid flywheel or coupling and there is no torque multiplication.

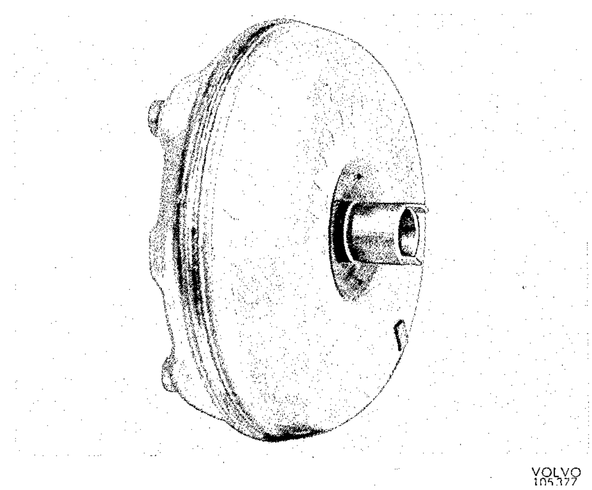


Fig. 4-58. The converter

TRANSMISSION

The transmission consists of a mechanical power transmission system—planetary gear, two clutches, two brake bands and a one-way clutch—and a hydraulic system—front and rear pump, centrifugal governor and a control valve system which regulates the fluid pressure and directs the fluid to the various transmission components.

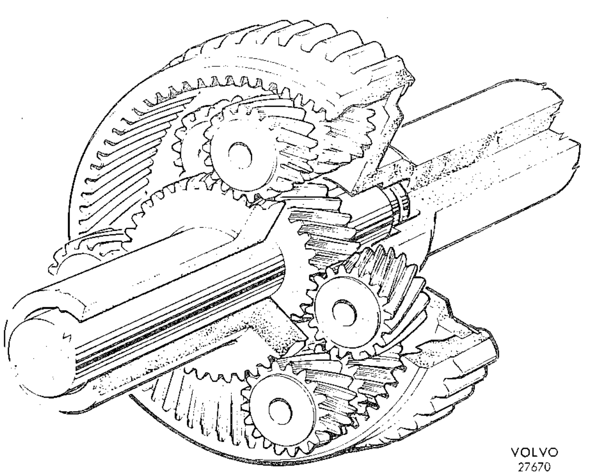


Fig. 4-60. Planetary gear

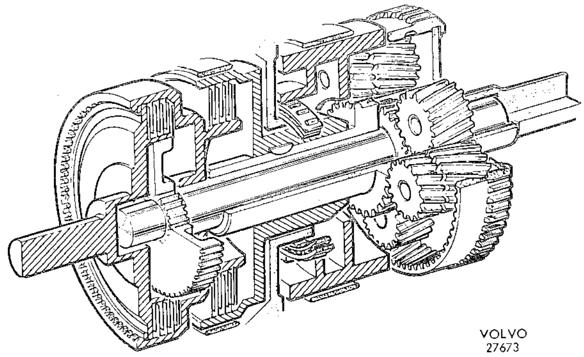


Fig. 4-61. Planetary gear, clutches and brake bands

MECHANICAL POWER TRANSMISSION SYSTEM

PLANETARY GEAR

The planetary gear set consists of two sun gears, two sets of pinions, a pinion carrier and a ring gear, see Fig. 4-60. Helical involute tooth forms are used throughout. In all forward gears, power enters through the forward sun gear; in reverse, power enters through the reverse sun gear. Power leaves the gear set by the ring gear. The pinions are used to transmit power from the sun gears to the ring gear. In reverse, a single set of pinions is used which causes the ring gear to rotate in the opposite direction to the sun gear. In forward gears, a double set of pinions is used to cause the ring gear to rotate in the same direction as the sun gear. The carrier locates the pinions in their correct positons relative to the two sun gears and the ring gear (and also forms a reaction member in certain conditions). The various mechanical ratios of the gear set are obtained by the engagement of hydraulically operated multi-disc clutches and brake bands.

CLUTCHES

The clutches, see Fig. 4-61, consist of multi-disc units operated by hydraulic pistons. In all forward gears the front clutch connects the converter to the forward sun gear; for reverse, the rear clutch connects the converter to the reverse sun gear.

BRAKE BANDS

Brake bands, operated by hydraulic servos, hold elements of the gear set stationary to effect an output speed reduction and a torque increase. In "lockup", the rear band holds the pinion carrier stationary and provides the 1st gear ratio of 2.39:1 and, in reverse, a ratio of 2.09:1. The front band holds the reverse sun gear stationary to provide the 2nd gear ratio of 1.45:1.

ONE-WAY CLUTCH

In the drive position "D", a one-way clutch is used in place of the rear band to prevent the pinion carrier from turning opposite to engine rotation, thus also providing a 1st gear ratio of 2.39:1. This one-way clutch, allowing the transmission to freewheel in 1st gear, provides smooth ratio changes from 1st to 2nd and vice versa.

OIL COOLER

The automatic transmission is connected to an oil cooler. This is housed in the bottom tank of the engine radiator and is connected as shown in Fig. 4-63. The oil cooler is connected to the nipples (Fig. 4-62) on the right-hand side of the transmission.

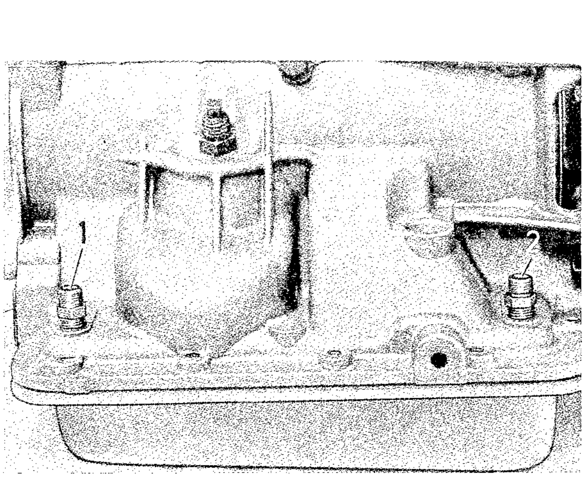


Fig. 4-62. Oil cooler connection
1. and 2. Connection nipples for oil cooler

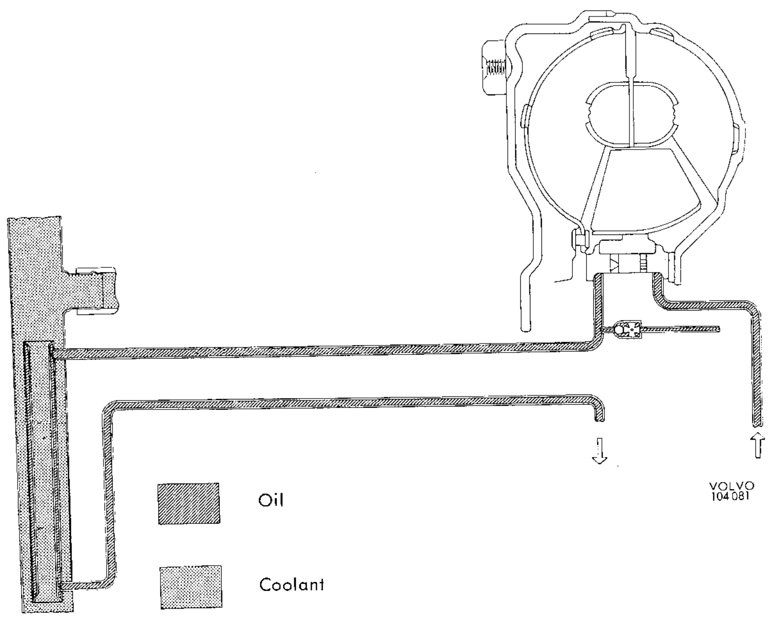


Fig. 4-63. Oil cooler operation

SERVICE PROCEDURES

When carrying out any work on the vehicle, the selector lever should be in position "P".
Provided the transmission is operating satisfactorily, the car may be towed in position "N", on condition that the transmission is properly adjusted and the fluid level is correct. **If the transmission is inoperative, the propeller shaft should be disconnected before starting towing.**
The control system of the automatic transmission is manufactured with the same degree of precision and accurate fits as the injection equipment of a Diesel engine. Fluid circulates through the converter, transmission and control system. **It is therefore necessary to observe the utmost cleanliness when carrying out any work on the transmission.**

WORK ON TRANSMISSION IN VEHICLE

FLUID LEVEL CHECK

Normally oil changing is only required when the transmission has been reconditioned. However, the oil level should be checked every 10 000 km (6 000 miles). When checking the oil level, the car should be on a level surface. Move the selector to position "P" and let the engine idle. The filling pipe with dipstick is located in front of the bulkhead on the right-hand side of the engine. Pull up the dipstick, and wipe it with nylon cloth, paper or chamois leather. Fluffy rags must not be used. Insert the dipstick, then pull it up and note the oil level, see Fig. 4-64. **NOTE. There are different oil level marks for a warm or cold transmission.** When the transmission is warm, after the car has been driven about 8–10 km (5–7 miles), the upper area (3 to 4, Fig. 4-64) applies. The lower area (1 to 2) applies when the transmission is cold. The text on the dipstick also mentions this difference.
If necessary, top up with oil to the "Max" mark. Do not exceed this mark, otherwise the transmission can become overheated. The difference between the "Min" and "Max" mark is about 1 pint (0.5 liter). Use an oil which is approved as "Automatic Transmission Fluid, Type F".
If topping up with oil is required often, there must be leakage, which should be attended to immediately.

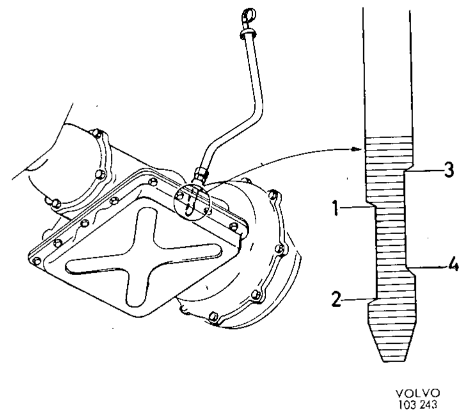


Fig. 4-64. Oil level check
1. Max. oil level, cold transmission
2. Min. oil level, cold transmission
3. Max. oil level, transmission run warm
4. Min. oil level, transmission run warm

VALVE BODIES ASSEMBLY, REMOVAL AND INSTALLATION

1. Jack up and put the vehicle on stands. Drain off the oil into a vessel which is absolutely clean. See Fig. 4-71. NOTE. The oil may be very hot and cause burns if contact is made with the skin.
2. Release the bolts for the oil sump and remove the sump. Carefully remove the oil pipes (Fig. 4-74).
3. Release the throttle cable from the cam. Remove the three bolts, see Fig. 4-75, which secure the control system to the transmission casing. Remove the valve bodies assembly straight downwards so that it releases from the oil pipes at the front end.
4. Make sure that the oil pipes are in position on the front pump body. Place the valve bodies assembly in position and secure it with the three bolts, see Fig. 4-75.
5. Fit the throttle cable to the cam. Mount the oil pipes as shown in Fig. 4-74. Check that the magnetic element lies in the oil pan and fit the pan. Use a new gasket. Coat the threads on the oil drain plug with sealing fluid 277 961 and then fit the plug.
6. Lower the vehicle, fill with oil.

SELECTOR CONTROLS ADJUSTMENT

1. Place the lever in the second position from the front (position "2"). Also place selector lever in position "2".
2. Adjust the length of the shift rod so that there is a small gap (min. 1 mm=0.04", see B, Fig. 4-65) between the selector lever inhibitor and inhibitor plate when the rod is connected to the lever on the transmission.
3. Move the selector lever to position "D" and check that the gap to the gate is about the same as in position "2". Adjust if necessary.

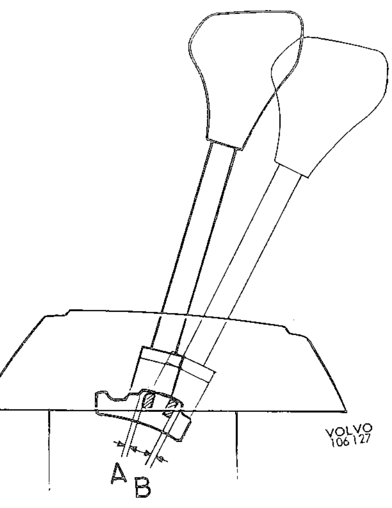


Fig. 4-65. Adjusting selector controls
A=B

4. Tighten the lock nut.
5. Check that the gaps (A and B) remain in positions "D" and "2" after the lever has been moved to positions "P" and "1". Check also that the output shaft is locked with the selector lever in position "P".

THROTTLE CABLE ADJUSTMENT

Correct adjustment of this cable is most important for satisfactory operation of the transmission. There are three different methods. **Adjust first in accordance with A, see**

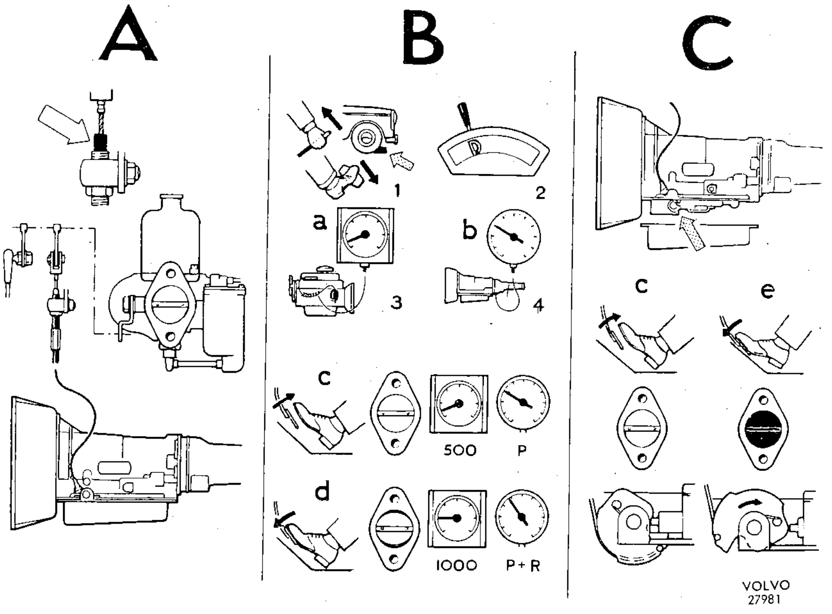


Fig. 4-66. Throttle cable adjustment
A. Adjusting cable stop
B. Adjusting with tachometer and pressure gauge
   1. Chock the wheels and apply the brakes
   2. Select position "D"
   3. Connect a revolution counter (a)
   4. Connect a pressure gauge (b)
   c. Measure pressure (P) at 8.3 r/s (500 rpm)
   d. Measure pressure (P+R) at 16.6 r/s (1000 rpm)
   R. Should be 1.8−2.1 kp/cm² 25−30 psi
C. Adjust the cam in transmission
   c. Accelerator pedal in idling position
   e. Accelerator pedal fully depressed

Fig. 4-66. Method B is to be applied if the transmission is not functioning satisfactorily, and method C when replacing the cable.

A. 1. Check that engine idling speed is correctly adjusted and that the inner cable and outer cable are correctly attached.
   2. Screw up the threaded sleeve until it almost lies against the stop (for vehicles with single carburetor), and 1/32" (1 mm) from the stop for vehicles with twin carburetors, the stop being crimped on to the cable.
   3. With the accelerator pedal fully depressed, check that:
      a. the carburetor lever is at the full open stop.
      b. the line pressure at converter stall speed amounts to at least 11 kp/cm² (160 psi).

B. If the cable stop has been damaged or moved, the cable must be adjusted as follows:
   1. Connect a tachometer to the engine and pressure gauge to the transmission as shown in Fig. 4-67.
   2. Block the wheels and apply the brakes. Start the engine and move the lever to "D". Read off the pressure at 8.3 and 16.6 r/s (500 and 1000 rpm). At 16.6 r/s (1000 rpm) the gauge to the transmission as shown in Fig. 4-67, pressure should be 1.8–2.1 kp/cm² (25–30 psi) higher than at 8.3 r/s (500 rpm). If the pressure rise is less than 1.8 kp/cm² (25 psi), the effective length of the outer cable should be increased by means of the adjuster. Conversely, if the rise is more than 2.1 kp/cm² (30 psi) the effective length of the outer cable should be decreased.

NOTE. On vehicles with an exhaust emission control system it may be more suitable to measure the pressure at 11.3 and 20 r/s (700 and 1200 rpm). The pressure increase also in this case should be 1.8–2.1 kp/cm² (25–30 psi).

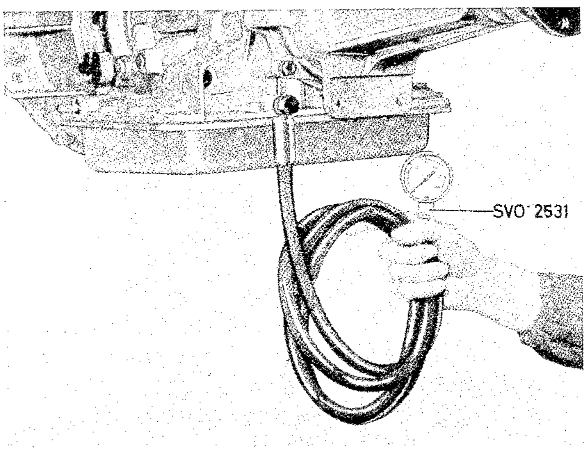


Fig. 4-67. Connecting pressure gauge

C. If a new cable has to be fitted, the transmission oil pan must be removed. In this event it is often simpler to adjust the cable by observing the movement of the cam in relation to accelerator pedal movement as follows:
   1. With the accelerator pedal fully released and the carburetor lever at the idling stop, the heel of the cam should contact the full diameter of the downshift valve, with all the slack of the inner cable taken up.
   2. With the accelerator pedal fully depressed and the carburetor lever at the full open stop, the constant radius area of the cam should be the point of contact with the downshift valve.

Note: 1. The cable is pre-lubricated with silicon or molybdenum disulphide lubricant and must not be oiled.
   2. Ensure at all times that the outer cable is correctly located in the adjuster.

STARTER INHIBITOR SWITCH REPLACEMENT

1. Disconnect the electric cables from the contact. Release the contact with spanner 2975 and unscrew it.
2. Install a new gasket (A, Fig. 4-68) onto the contact. Screw in the contact and tighten it to a torque of 8–11 Nm (0.8–1.1 kpm=6–8 lbft) with spanner 2975. Connect up the electric cables.
3. Check that the engine can be started only in positions "P" and "N", that the reversing light goes on in position "R" and that the belt reminder functions.

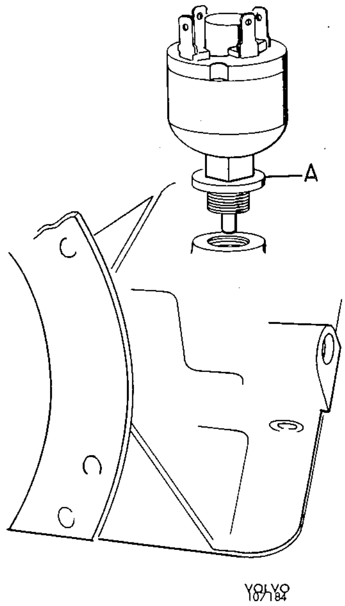


Fig. 4-68. Fitting starter inhibitor switch
A. Packing

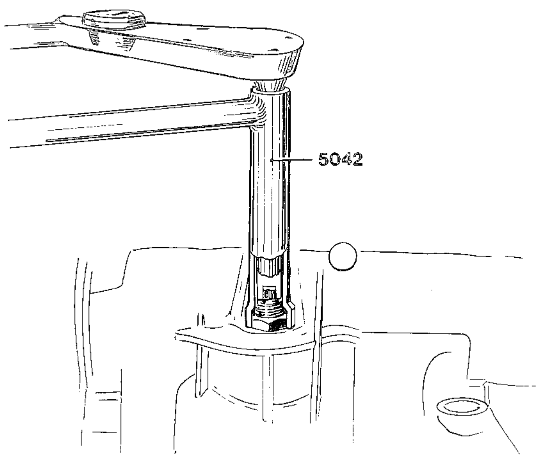


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Fig. 4-69. Rear brake band adjustment

REAR BRAKE BAND ADJUSTMENT

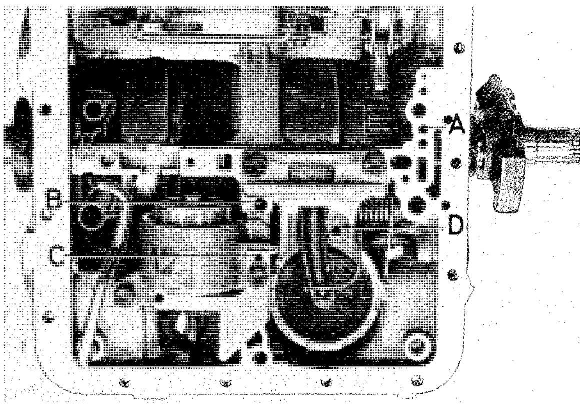
When adjusting this band in the car, a hole has been introduced in the body tunnel, which is accessible after the mats have been moved to one side, the air duct removed and the rubber cover taken off. Otherwise adjusting is carried out as follows:

1. Connect a torque wrench to the inner sleeve on tool 5042 and install the tool on the screw and nut as shown in Fig. 4-69.
2. Slacken the lock nut for the adjusting screw. Tighten the screw to 14 Nm (1.4 kpm=10 lbft). Back off the adjusting screw one turn.
3. Tighten the lock nut and fit any parts which have been removed.

AIR PRESSURE TESTS

Air pressure checks can be made on the transmission assembly to determine whether the clutches and brake bands are operating. These checks can be made with the transmission in the car or on the bench. In either event, drain the fluid from the transmission and remove the oil pan as well as the valve bodies assembly with oil tubes. The air used must be clean and dry.

If the clutch and bands operate satisfactorily with air pressure, faulty operation of the transmission must be due to malfunction of the hydraulic control system. The valve bodies assembly must then be disassembled, cleaned, inspected and re-assembled.



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Sig. 4-70. Functioning test with compressed air
A. Front clutch (5)
B. Rear clutch (15)
C. Front servo application
D. Rear servo

FRONT CLUTCH AND GOVERNOR FEED "A"

Apply air pressure to the passage (5) of the transmission case rear wall, see Fig. 4-70. Listen for a thump, indicating that the clutch is functioning. On the bench, also verify by rotating the input shaft with air pressure applied.

If the extension housing has been removed, rotate the output shaft so that the governor weight will be at the bottom of the assembly. Verify that the weight moves inwards with air pressure applied.

REAR CLUTCH "B"

Apply air pressure to the passage (15) of the transmission case web. On the bench, verify by turning the input shaft that the clutch is functioning. Keep air pressure applied for several seconds to check for leaks. Then listen for a thump indicating that the clutch is releasing when the air pressure is removed.

FRONT SERVO "C"

Apply air pressure to the hole immediately adjacent to the rear retaining bolt. Observe the movement of the piston pin.

REAR SERVO "D"

Apply air pressure to the hole on the servo body. Observe the movement of the servo lever.

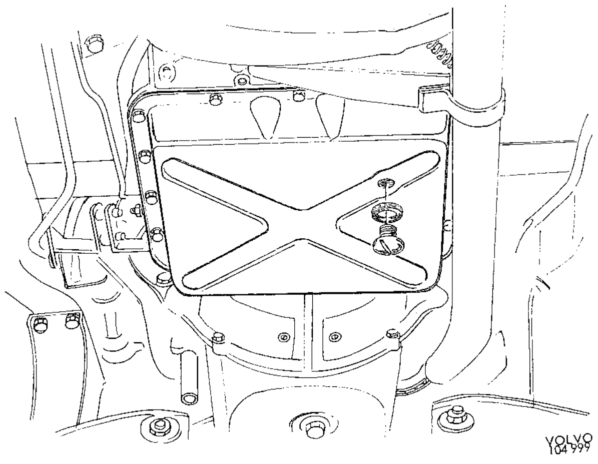

Fig. 4-71. Oil drain plug

AUTOMATIC TRANSMISSION REMOVAL

1. Take up the oil dipstick and remove the clamp for the filler pipe. Remove the bracket and the throttle cable from the dashboard and throttle control respectively. Disconnect the exhaust pipe at the flange. Jack up the car and place props under the front and rear axles.
2. Remove the cover plate under the transmission. Drain the oil into a clean container, see Fig. 4-71. **NOTE. The oil may be very hot and scald if contact is made with the skin.**
3. Disconnect the propeller shaft from the gearbox flange. Disconnect the controls from the selector shaft lever as well as the reinforcing bracket under the oil pan.
4. Unscrew the attaching bolts for the converter. With a spanner on the crankshaft pulley bolt turn the crankshaft forwards. The spanner is also used as a counterhold.
5. Replace the lift plate on a jack with fixture 2746. Support under the gearbox with the jack, see Fig. 4-72.
6. Unscrew the nut for the rear engine mounting and remove the cross-member. Disconnect the brackets for the exhaust pipe and the rear engine mounting. Remove the speedometer cable from the transmission. Release the oil filler pipe.
7. Place a wooden block between the engine and firewall and then lower the jack until the engine is against the block. Observe due care with the battery lead. If any tensions arises, release the lead clamp.
8. Disconnect the electric cables from the starter inhibitor. Unscrew the attaching bolts for the converter casing. Pull the transmission backwards and release the guide pin on the converter at the same time. Lower and remove the transmission.

DISASSEMBLY

As a general rule it is advisable to disassemble only those components requiring attention as indicated by road-testing or fault-tracing procedure.

Prior to the removal of any components, the outside of the transmission must be thoroughly washed down with white spirit. A high standard of cleanliness is required when handling or storing components.

When disassembling, the transmission should be inverted and placed on the bench cradle or in the fixture 2934 as shown in Fig. 4-73, and special tools used as shown in the service tool list. Treat the various components with great care, particularly light-alloy parts. When the transmission is to be completely disasselbmed, follow the procedure below.

1. Remove the six bolts and withdraw the converter housing.
2. Unscrew the "Wedglok" screw for the drive flange on the output shaft. Pull out the drive flange and catch the $^3/_8$" flat washer. Loosen and withdraw the rear housing. Remove the speedometer gear.
3. Unscrew the bolts for the oil pan and remove this. Lever out carefully the oil tubes B—E shown in Fig. 4-74.

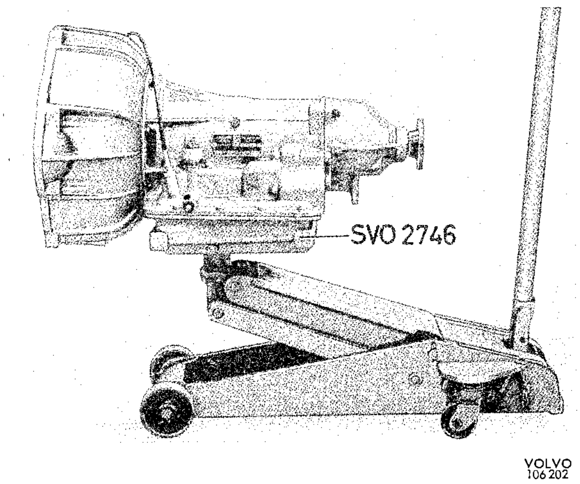

Fig. 4-72. Fixture for transmission

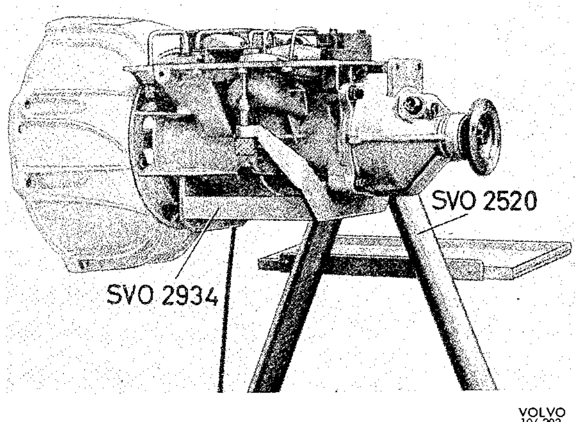

Fig. 4-73. Transmission in fixture

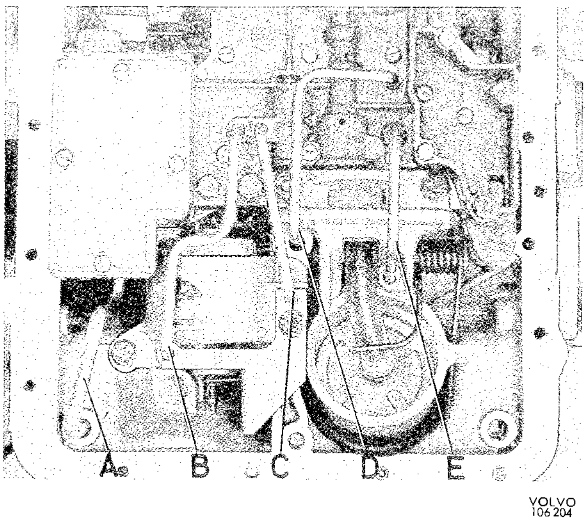

Fig. 4-74. **Oil tubes**
A. Converter outlet
B. Front servo release
C. Front servo apply
D. Rear clutch
E. Rear servo

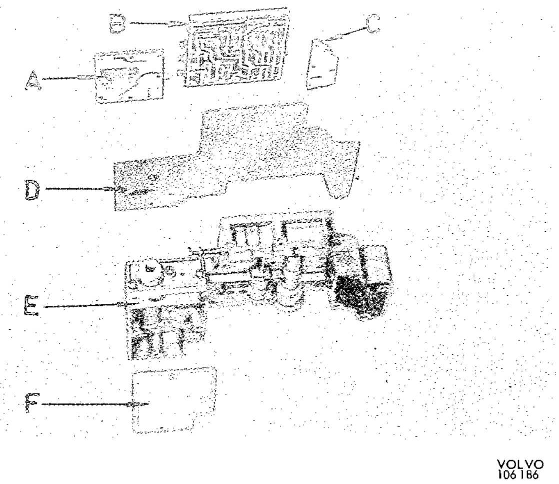

Fig. 4-76. **Main components of valve bodies assembly**
A. Oil tube collector
B. Upper valve body
C. Governor line plate
D. Separating plate
E. Lower valve body
F. Pump strainer

VALVE BODIES ASSEMBLY

Work on the whole assembly should preferably be carried out in a diesel test-room or in a room with equal standards of cleanliness.

4. Disconnect the downshift valve cable from the downshift valve cam. Unscrew the three screws which retain the valve bodies assembly to the transmission housing, see Fig. 4-75. Lift the valve bodies assembly straight up so that it releases from the oil tubes at the front end.
5. Unscrew the two screws for the bracket of the downshift valve cam.
6. Remove the strainer for the oil pump.
7. Unscrew from above the screws which retain the upper valve body. Turn the valve bodies assembly round and unscrew the other six screws from underneath.
8. Unscrew the eight screws which retain the oil tube collector.
9. Unscrew the four screws which retain the governor line plate. Note that two screws are under one of the strainers.
10. Remove the separating plate and then the check valves for the fast 3-2, see Fig. 4-77. Withdraw the manual control valve, see "A", Fig. 4-78.
11. Remove the stops for the throttle valve and the return spring. Then withdraw the downshift valve, spring and throttle valve, see "B", Fig. 4-78.
12. Remove the dowel pin which retains the plug for the modulator valve. Then remove the plug, valve, plunger and spring.

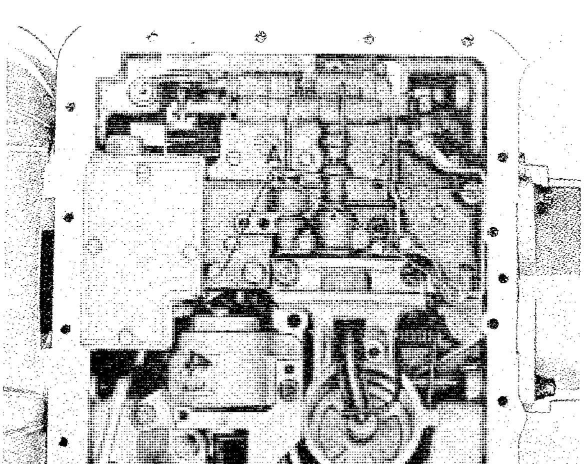

Fig. 4-75. **Valve bodies assembly**
A. Attaching screws

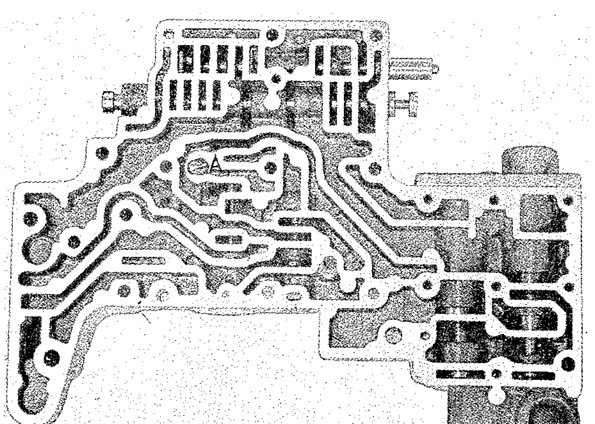

Fig. 4-77. **Check valves in lower valve body**
A. Check valve for fast 3-2

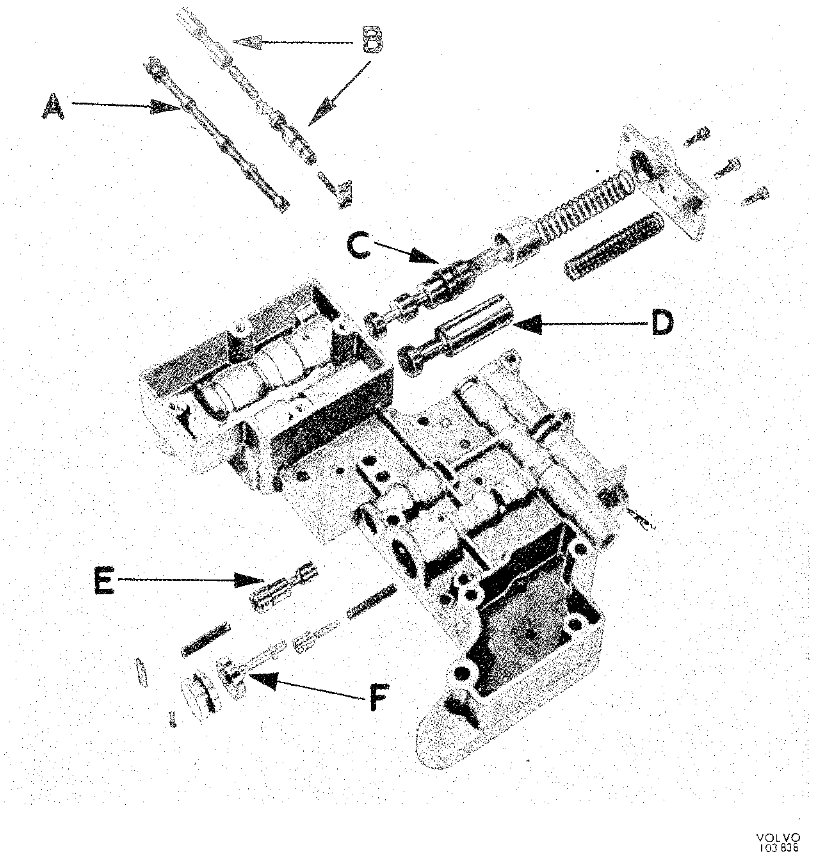

Fig. 4-78. Lower valve body
A. Manual control valve
B. Downshift and throttle valve
C. Primary regulator valve
D. Secondary regulator valve
E. Servo orifice control valve
F. Modulator valve

13. Remove the stop for the servo orifice control valve and then the spring and valve.
14. From the manual valve side of the lower valve body, remove the following components: three screws, lower body end plate, primary regulator spring, primary regulator valve sleeve, primary regulator valve, secondary regulator valve spring and secondary regulator valve.
15. Remove the six screws and end plate from the upper valve body, see Fig. 4-79. Remove the following parts from the rear end of the body: shift valve 2−3, inner spring and plunger together with shift valve 1−2. The spring and plunger for shift valve 1−2 are removed in the other direction.

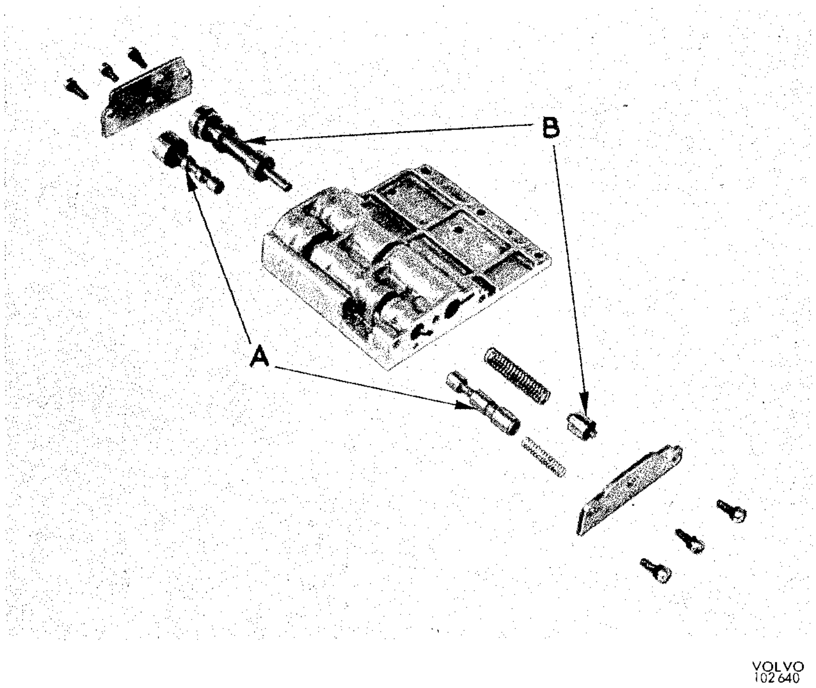

Fig. 4-79. Upper valve body
A. 1−2 shift valve and plunger
B. 2−3 shift valve and plunger

FRONT AND REAR SERVOS

16. Remove the two screws which retain the front servo to the body, withdraw the servo and the strut for the band.
17. Remove the snap ring in the servo with a small screwdriver. Take out the piston and separate the various parts. Drive out the slotted spring pin and lever pivot pin if necessary.
18. Unscrew the two screws which retain the rear servo and withdraw this and the strut.
19. Unhook the spring. Drive out the pivot pin and remove the lever. Pull out the piston.

PUMP ASSEMBLY

20. Remove the oil tubes in the housing. In case of difficulty pull them out with needle-nose pliers as shown in Fig. 4-80.
21. Set up the dial indicator gauge as shown in Fig. 4-81 with plate 2532 and magnetic attachment. Place the point of the gauge against the shaft end, move the shafts and gears backwards and forwards and read off the end float. This should be 0.25–0.75 mm (0.010–0.030"). Note the amount of play.
22. Unscrew the six bolts which retain the pump to the body. Withdraw the pump and remove the gasket. Push the shaft inwards when withdrawing the pump, see Fig. 4-82.
23. Unscrew the five hexagon bolts and the slotted screw. Separate the pump body, gears and other parts, see Fig. 4-83.

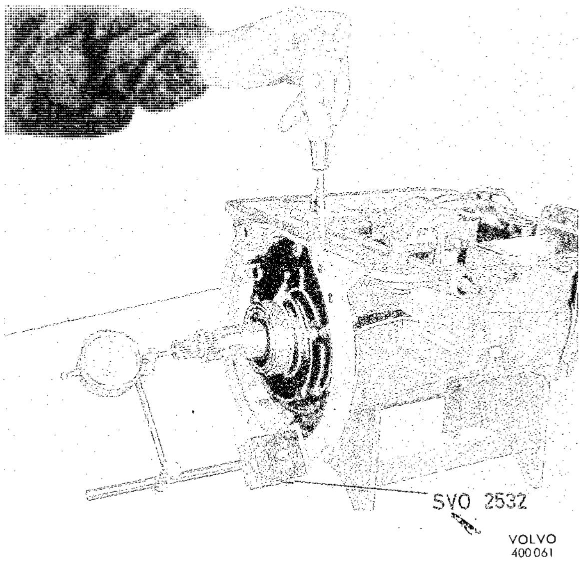

Fig. 4-81. End float check

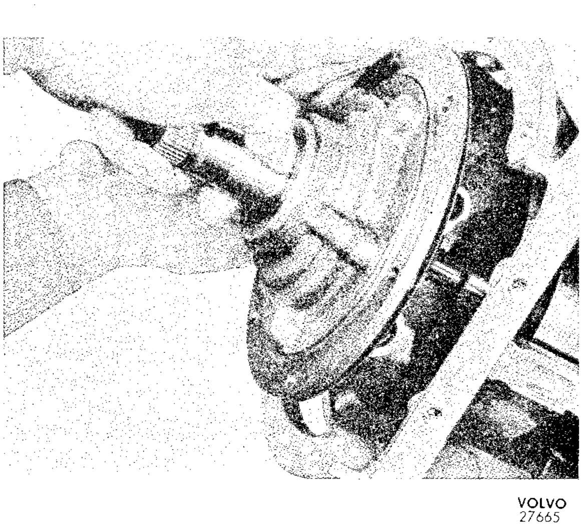

Fig. 4-82. Pump removal

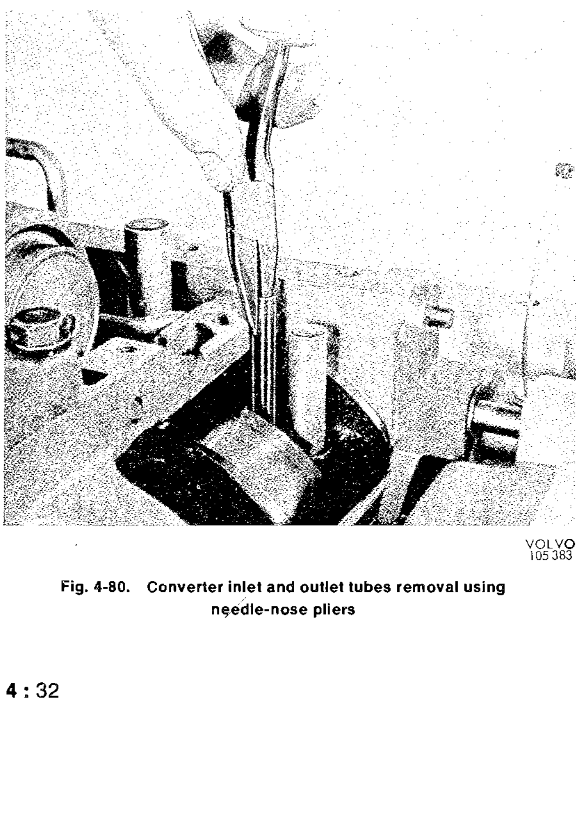

Fig. 4-80. Converter inlet and outlet tubes removal using needle-nose pliers

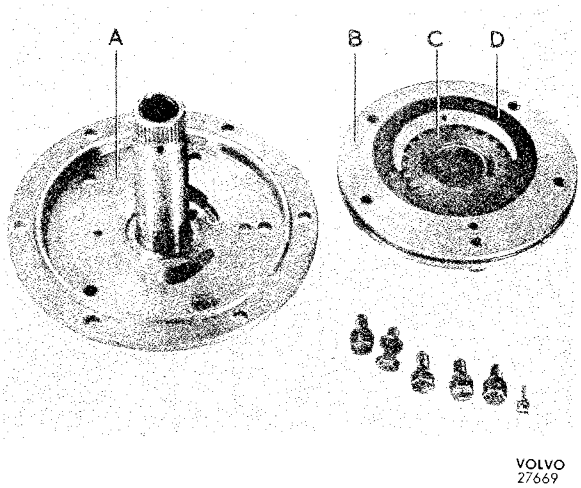

Fig. 4-83. Converter support separated from pump
A. Pump adapter and converter support assembly
B. Body and bushing assembly
C. Driving gear
D. Driven gear

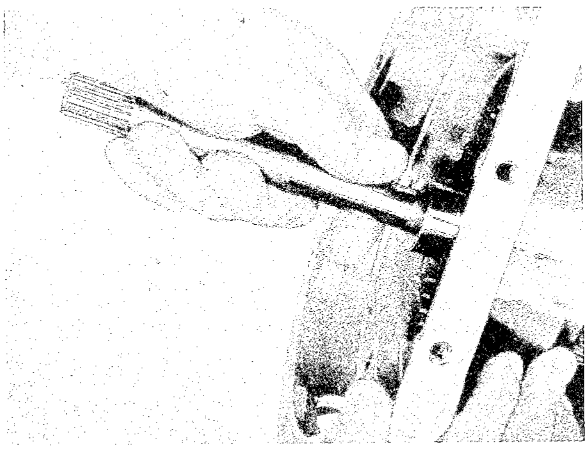

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Fig. 4-84. Front clutch assembly removal

FRONT CLUTCH ASSEMBLY

24. Withdraw the front clutch assembly and input shaft complete, see Fig. 4-84. Take care of the thrust washers. Take out the front brake band.
25. Remove the snap ring with a screwdriver. Withdraw the input shaft. Take out the inner and outer plates and the clutch hub.
26. Remove the snap ring, spring, and piston. If the piston is tight, lay the clutch body with the opening downwards on a bench and blow out the piston with compressed air.

REAR CLUTCH ASSEMBLY

27. Withdraw the rear clutch assembly together with the forward sun gear shaft, see Fig. 4-85.
28. Remove the two oil rings at the front of the shaft. Then withdraw the shaft. Take care of the two needle thrust bearings.
29. Remove the three oil rings from the clutch body hub.

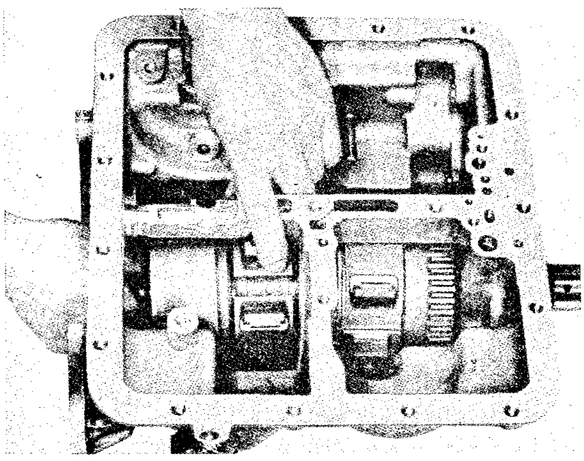

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Fig. 4-85. Withdrawing rear clutch and forward sun gear group

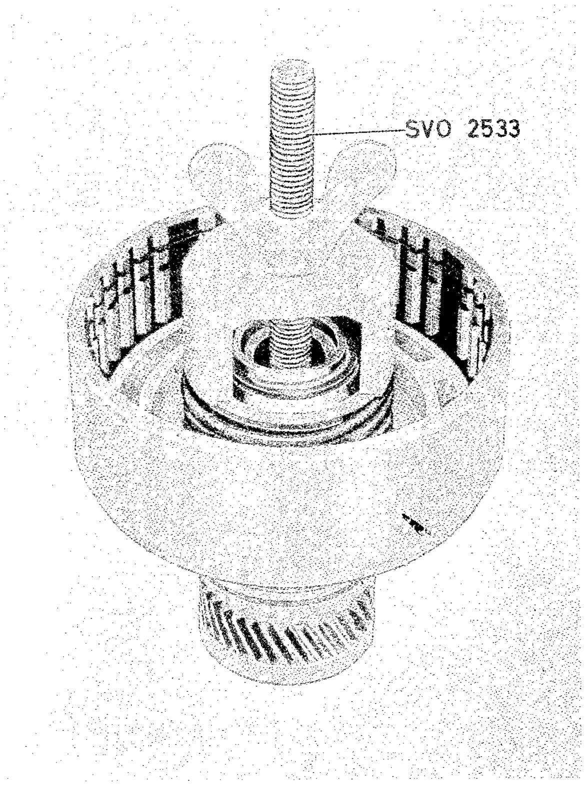

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Fig. 4-86. Rear clutch disassembly

30. Remove the snap ring and take out the pressure plate, inner and outer plates.
31. Place special tools 2533 on the clutch as shown in Fig. 4-86. Tighten the wing nut until the snap ring releases. Remove the snap ring and screw back the wing nut. Remove the special tool, then the retainer and spring. Withdraw the piston. If necessary blow out the piston with compressed air.

CENTER SUPPORT AND PLANET GEARS

32. From the outside of the transmission case remove the two center support screws, see Fig. 4-87. Remove the

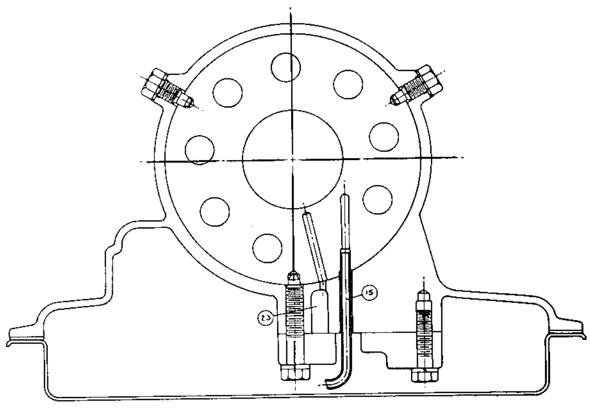

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Fig. 4-87. Center support, retention and passages

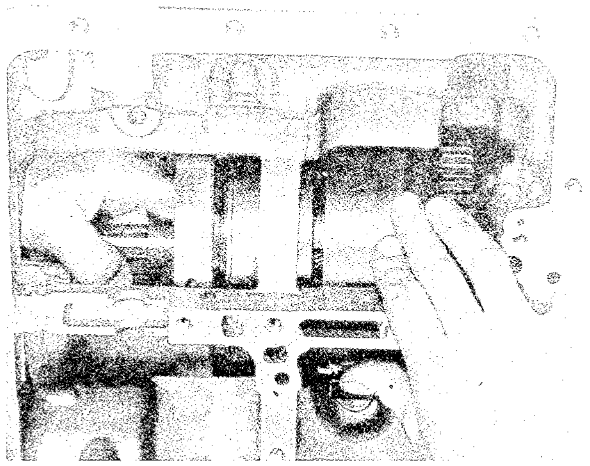

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Fig. 4-88. Center support and planet gears removal

center support and planet gears, see Fig. 4-88. Take out the rear brake band. Separate the center support, one-way clutch and planet gears. Remove the snap ring and the outer race of the one-way clutch.

GOVERNOR

33. Unscrew the bolt and pull the governor off the shaft, see Fig. 4-89.
34. Press the valve assembly together and remove the clip. Remove the other parts.

OIL DEFLECTOR FLANGE

35. Unscrew the five slotted screws. Withdraw the oil deflector flange.

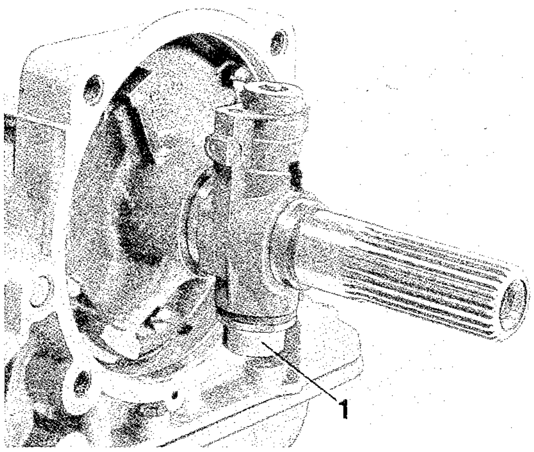

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Fig. 4-89. Governor removal
1. Bolt

36. Remove the three oil sealing rings from the driven shaft.

DRIVEN SHAFT

37. Withdraw the driven shaft. Remove the thrust wahser. If necessary remove the snap ring and separate the ring gear from the driven shaft.

SHAFT, PARKING PAWL AND LEVERS

38. Remove the locking clips. Push the inner lever manual valve lever in the shaft and remove the lock pin. Separate the varous parts. The lower shaft for the parking inhibitor can be pulled out with a magnet or shaken out. If the control shaft has to be removed, drive out the lock pin in the housing.
39. The throttle cable and other parts in the body are removed as necessary.

INSPECTION

After cleaning, all parts should be thoroughly checked for wear or other damage.
Check that the white metal bushing for the driven shaft and the pins for the parking pawl linkage are firmly secured in the case. If they are loose, the case must be replaced.
Check the thrust washers and needle bearings for wear and any seizing. If the end-float is within the permissible limits, it can be taken for granted that the thrust washers are not worn.
Check the gears for wear, seizing or tooth fractures. Also check that the pinions in the planet gear pinion carrier run easily on the needle bearings.
Check the brake band and discs for wear, overheating or other damage.

ASSEMBLY

The utmost cleanliness must be observed when assembling the transmission.
Before assembling, all parts must be carefully washed in white spirit.
Use new gaskets when assembling. Lubricate the parts with "Automatic Transmission Fluid Type F".
Tighten all bolts with a torque wrench in accordance with the torque chart in the "Specifications". Use sealing compound 277961 on the threads of the inhibitor switch, the pressure point plug and the oil drain. Locking fluid Loctite CV or corresponding is used for the flange bolt, and Loctite AV for the nipples for the oil cooler connections. Note: Items not described in this section are assembled in the reverse order to disassembling.

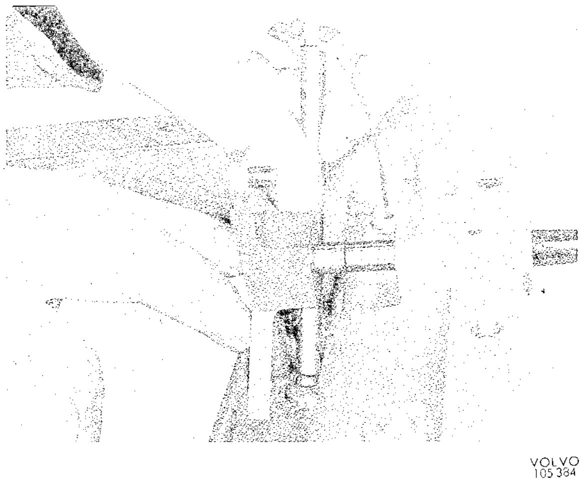


Fig. 4-90. Location of manual valve lever on detent ball spring

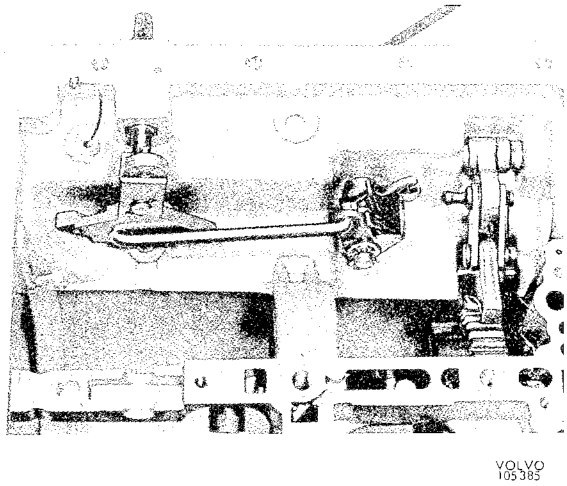


Fig. 4-91. Parking pawl and linkage installed

TRANSMISSION CASE, SHAFT, PARKING PAWL AND LEVERS

1. The transmission case is inverted on the bench cradle or in the fixture.
2. Assemble the shaft, parking pawl and levers in the reverse order to disassembling. Make sure that the springs for the levers are correctly fitted, see Fig. 4-91. Fitting the detent ball is facilitated by pressing down the ball using a short length of tubing as shown in Fig. 4-90.

DRIVEN SHAFT

3. The thrust washer for driven shaft, see Fig. 4-92, is stuck onto the transmission case with vaseline. The driven shaft complete with ring gear is then installed into the transmission case.

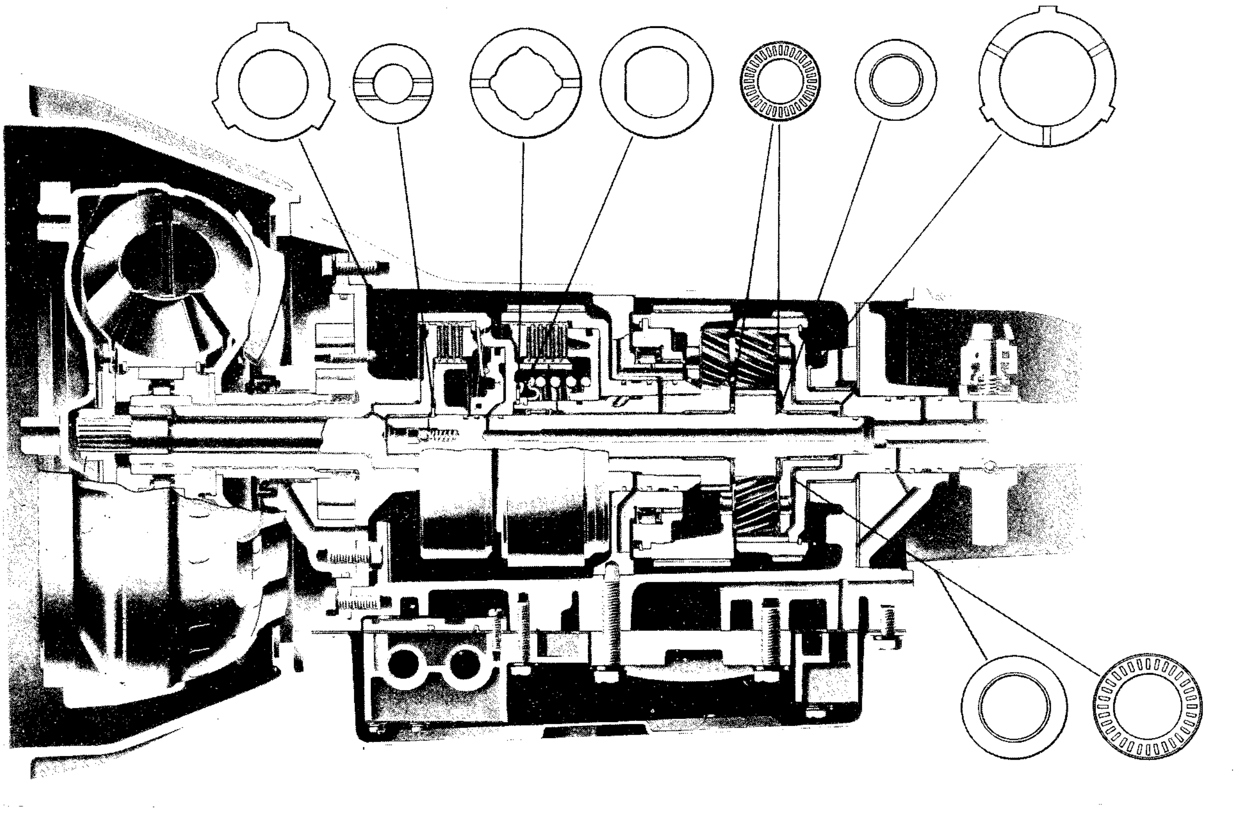


Fig. 4-92. Locacion of thrust washers

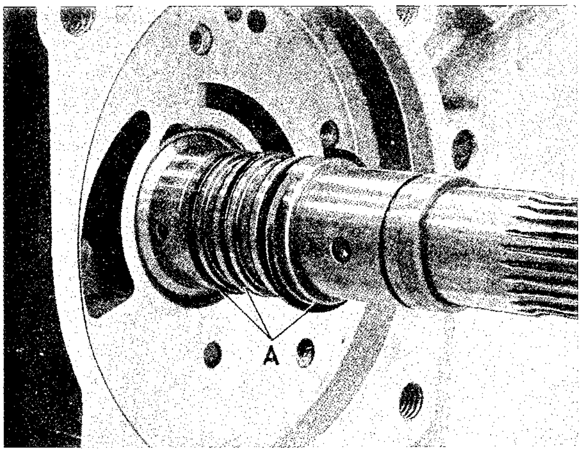


Fig. 4-93. Driven shaft oil rings installed
A. Oil rings

OIL DEFLECTOR FLANGE

4. Install the three oil sealing rings on the shaft, see Fig. 4-93. Exercise care when doing this as the oil sealing rings are very fragile. Stand the box on its front end and support under the shaft. Center the oil rings. The oil deflector flange is then fitted.

GOVERNOR

5. Push the governor onto the shaft as shown in Fig. 4-96. Make sure that the pin on the bolt enters the recess on the shaft, tighten the bolt to a torque of 20–25 Nm (2.0–2.5 kpm=15–18 lbft). This tightening torque should not be exceeded.
NOTE. It is not certain that the resilient washer will be fully compressed when tightening the bolt.

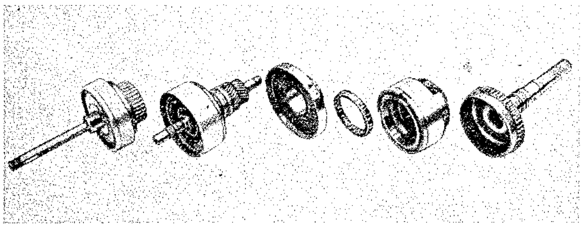


Fig. 4-94. Gear train components

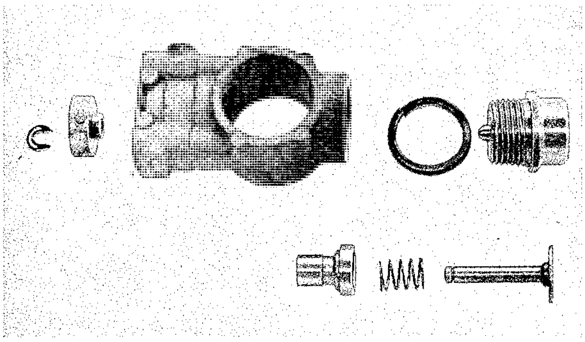


Fig. 4-95. Governor assembly disassembled

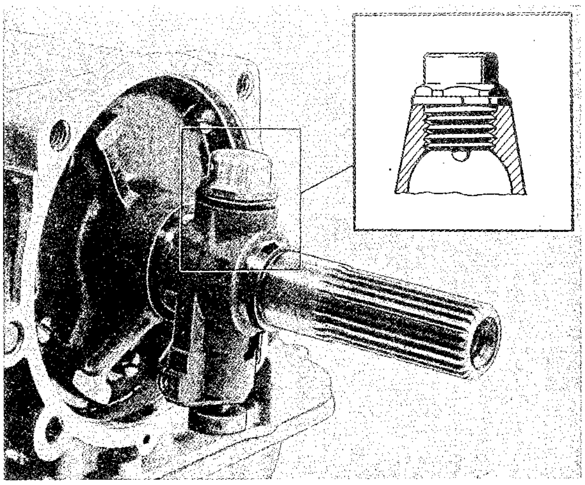
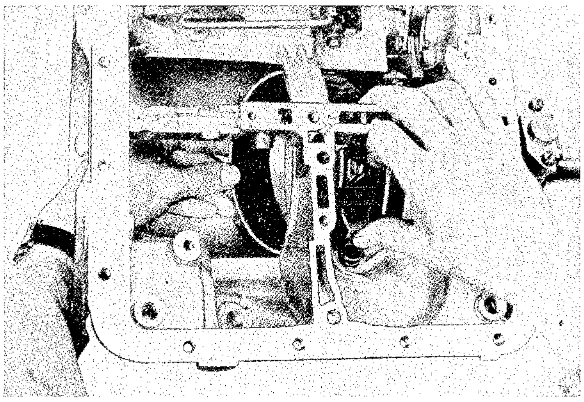


Fig. 4-96. Governor and driven shaft

REAR BRAKE BAND AND SERVO

6. Place the rear brake band in position in the case, see Fig. 4-97. Then fit the rear servo assembly. Tighten only the rear (short) servo screw since the long one also locates the center support.



Eig. 4-97. Installing rear brake band

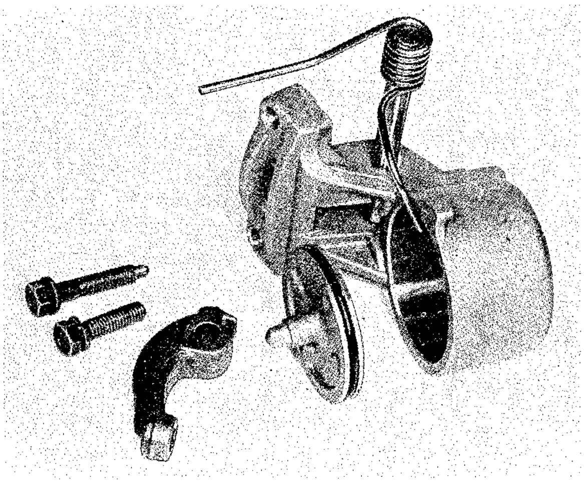


Fig. 4-98. Rear servo assembly disassembled

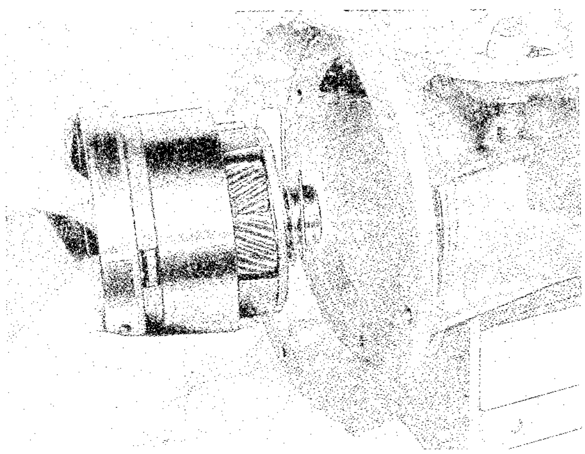


Fig. 4-99. Installation of center support and planet gears with needle thrust bearing and plate washer

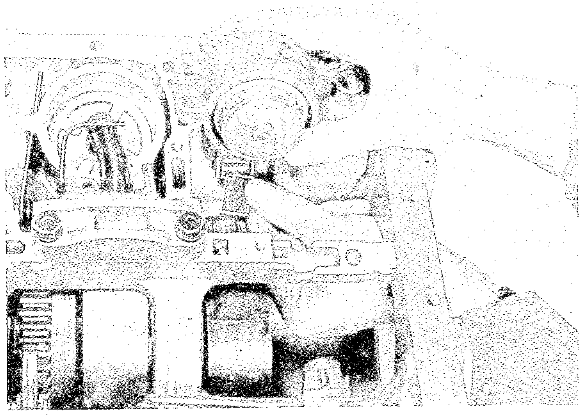


Fig. 4-100. Installation of front servo and strut

PLANET GEAR AND CENTER SUPPORT

7. Assemble the planet gear, one-way clutch and center support, see Fig. 4-99. Stick the thrust plate and needle thrust bearing to the planet cover with vaseline.
8. Turn the fluid passage holes in the center support upwards and fit the assembled unit into the transmission case. (Note that the holes point downwards when the transmission is turned the right way up, see Fig. 4-87.)
9. Fit the two center support screws from outside. Remember that the lock washers also serve as sealing washers so that the flat surface should face inwards. Then tighten the servo screw locating the support.

FRONT BRAKE BAND AND SERVO

10. Place the front brake band in position, see Fig. 4-100. Stick the strut to the servo lever with vaseline.
 Fit the servo. The shorter bolt is fitted at the front. Make sure that the servo strut is correctly engaged with the slot in the brake band.
 The cam for self-adjsutment is fitted later.

REAR CLUTCH

11. Fit the sealing rings for the piston. Use fitting ring 5000 and fit the piston in the clutch case, see Fig. 4-103.
12. Fit the spring, spring seat and snap ring using special tool 2533, which is used when disassembling, see Fig. 4-86.
13. Install the clutch plates. Note that the outer plates are coned and that all the plates should be fitted with the

Fig. 4-101. Front servo assembly disassembled

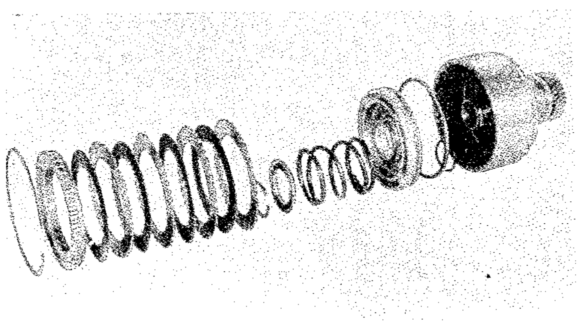


Fig. 4-102. Rear clutch disassembled

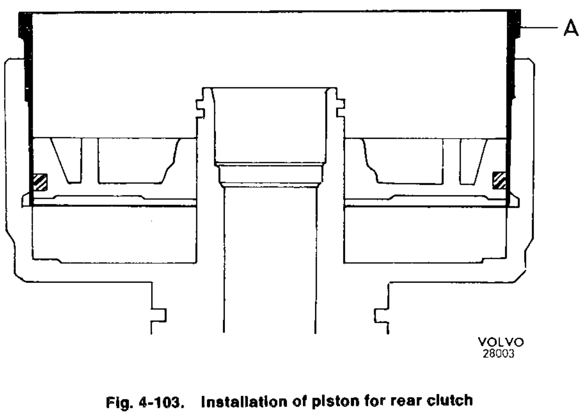


Fig. 4-103. Installation of piston for rear clutch
A. Fitting ring 5000

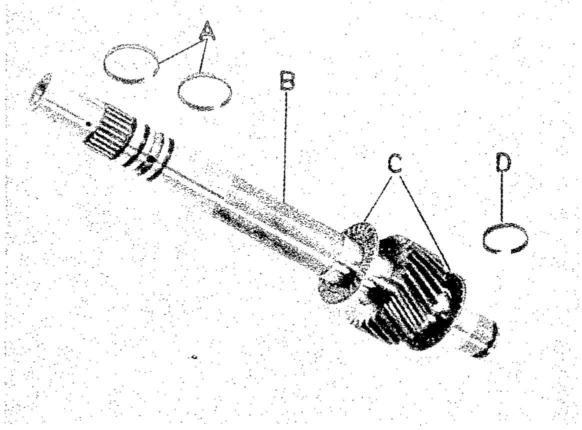


Fig. 4-104. Forward sun gear components
A. Oil sealing rings, front clutch
B. Forward sun gear assembly
C. Needle thrust washers
D. Oil sealing ring, governor feed

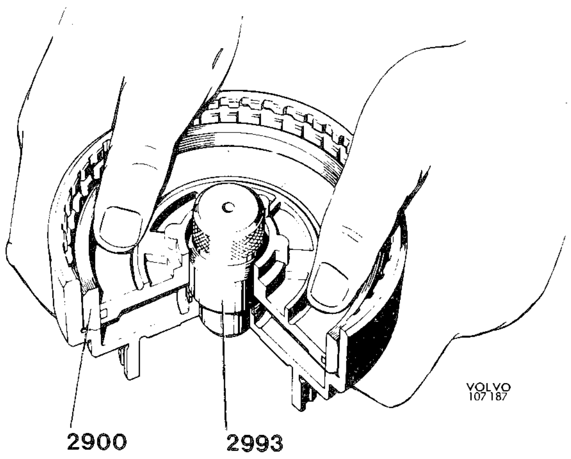


Fig. 4-107. Installing piston for front clutch

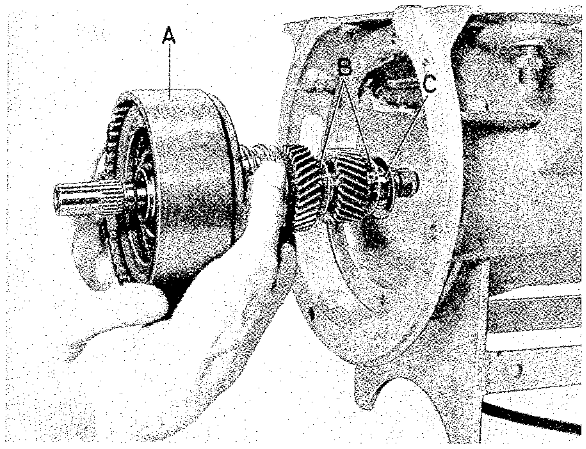


Fig. 4-105. Installing gear clutch and forward sun gear group
A. Rear clutch
B. Neędle thrust bearings
C. Thrust washer plate

cone facing in the same direction. Begin with an outer plate and then fit inner and outer plates alternately. Fit the pressure plate and snap ring.

14. Place the front needle thrust bering on the rear sun gear shaft. Fit the shaft in the rear clutch assembly. Install the oil sealing rings, see Fig. 4-104.
15. Install the rear needle thrust beraing and fit the clutch in the gearbox as shown in Fig. 4-105.

FRONT CLUTCH

16. Place the guide 2993 in the clutch housing. Fit the sealing ring on the piston and the O-ring in the drum. Place the piston in installing ring 2900. Press it down until it is level with the lower edge of the ring. Place the piston over the guide in the clutch housing as shown in Fig. 4-107. Take hold of the housing with the hands and press down the piston with the thumbs. Remove the tools. Fit the spring with the dished side facing rear. Put on the snap ring.

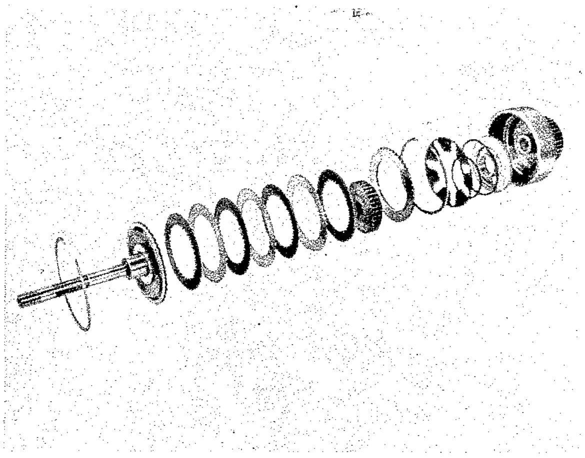


Fig. 4-106. Front clutch disassembled

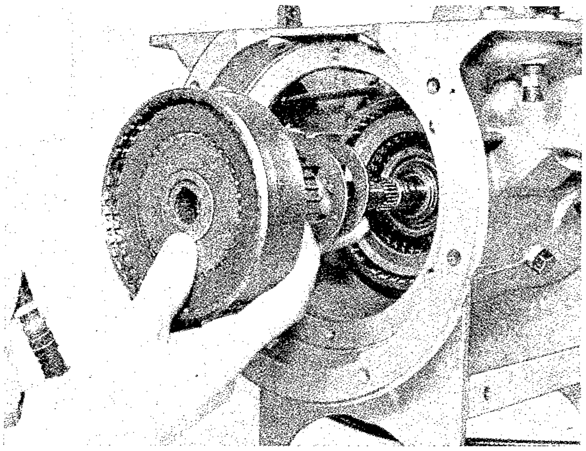


Fig. 4-108. Installation sequence, front clutch cylinder thrust and backing washers

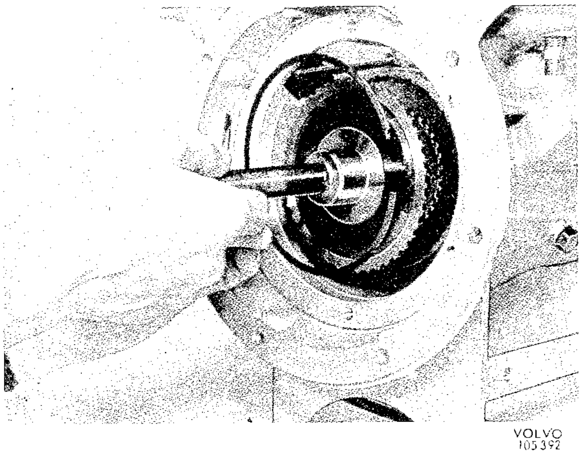


Fig. 4-109. Installation sequence, front clutch snap ring, input shaft and thrust washer

17. Install the clutch assembly with its two different thrust washers in the gearbox, see Fig. 4-108. Be careful not to damage the oil sealing rings. For identifying the thrust washers, see Fig. 4-92.
18. Fit the pressure plate, inner and outer plates, and hub. Fit the thrust washer for the clutch hub and input shaft into the front clutch, see Fig. 4-109. Fit the snap ring.

The front and rear clutches can also be installed in the gearbox as an assembly. In this case they are first assembled individually. The rear clutch is then stood straight up, the thrust washer for the clutch hub centred, both the rear thrust washers placed on, and after this the rear clutch and sun gear are assembled with the front clutch.

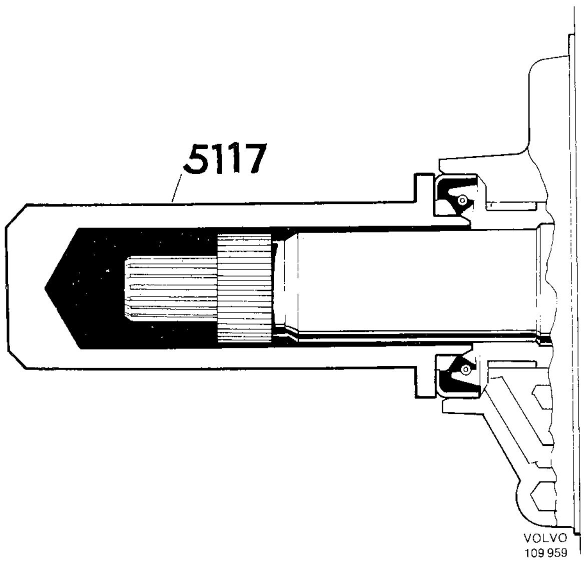


Fig. 4-110. Installation of sealing ring in pump

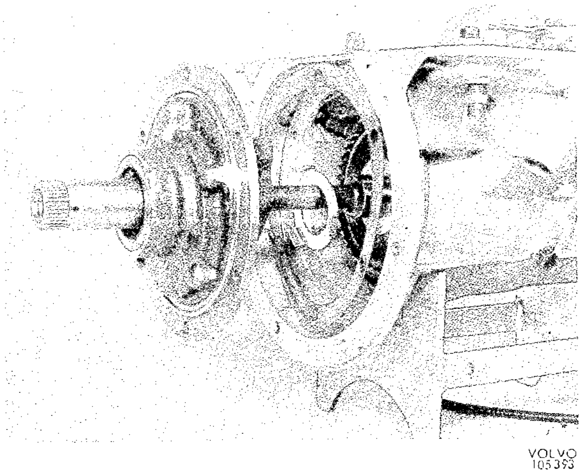


Fig. 4-111. Installation sequence, front pump assembly thrust washer and gasket

PUMP

19. Fit the sealing ring in the pump housing with the sleeve drift 5117, see Fig. 4-110.
20. Fit the O-ring on the pump body, then assemble the pump in the reverse order to dismantling.
21. Stick on the thrust washer with vaseline and then fit the pump with a new gasket on the transmission case, see Fig. 4-111. Re-check the end float in accordance with point 21, page 4 : 32.

EXTENSION HOUSING

22. Place the speedometer gear correctly on the driven shaft as shown in Fig. 4-112. Fit the extension housing with a new gasket and fit the drive flange with washer and nut.

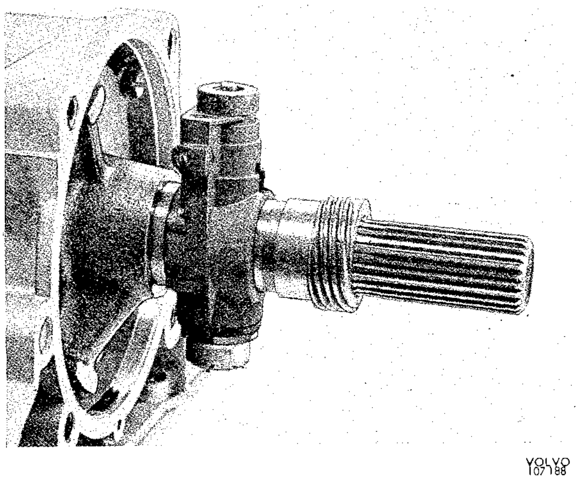


Fig. 4-112. Installing speedometer gear

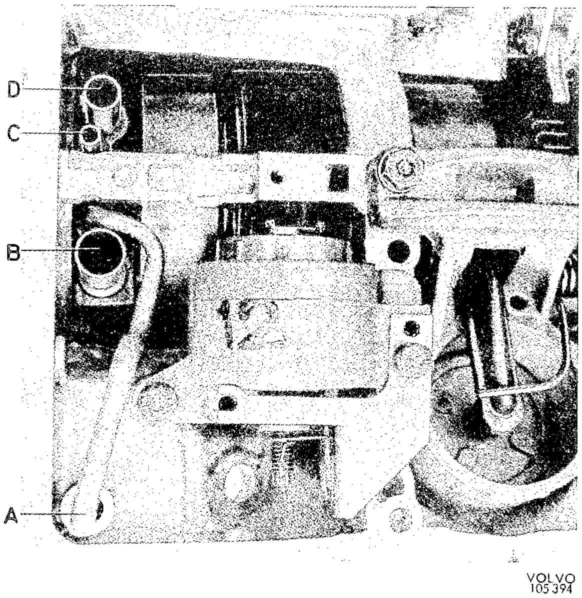


Fig. 4-113. Location of oil tubes, front of gearbox
A. Converter outlet C. Converter inlet
B. Pump inlet D. Pump outlet

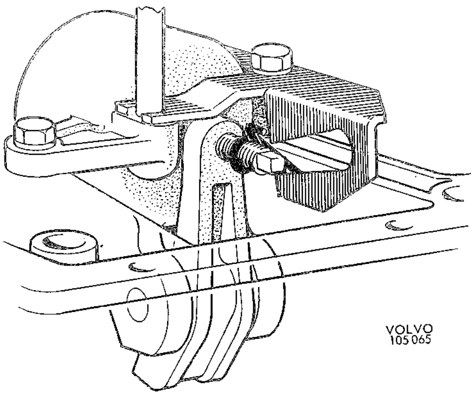


Fig. 4-115. Self-adjusting spring bolt cam

VALVE BODIES ASSEMBLY

23. When assembling, all the component parts which have been dismantled should be thoroughly cleaned and lubricated with oil approved as "Automatic Transmission Fluid, Type A" prior to reassembling in the reverse order to disassembling. Line up the component parts of the valve bodies assembly by using two of the retaining bolts. Check the free movement of all valves in their bores. Check that the strainers are flat so that they make a complete seal when screwed down. Tighten the screws to the specified torque.
24. Fit the oil tubes for the pump and converter on the pump body, see Fig. 4-113. Do not forget the O-ring for the pump inlet tube.
25. Fit the valve bodies assembly onto the gearbox. Connect the throttle cable.

MISCELLANEOUS

26. Place the spacer bar 2537 between the bolt and cylinder, see Fig. 4-114. Tighten the bolt with torque wrench 2748 until the ratchet handle clicks out. This should be at a torque of 115 Ncm (10 lbin).
27. Adjust the location of the spring on the adjusting screw. It should be 1—2 threads from the lever. Remove the torque wrench and spacer block. Fit the cam. The long end of the spring sticks into the cam, see Fig. 4-115.

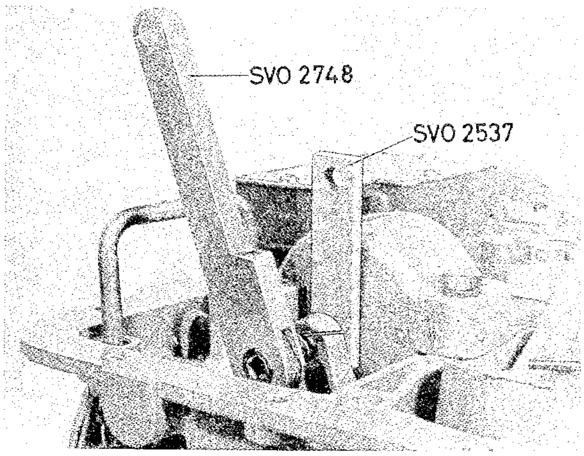


Fig. 4-114. Front brake band adjustment

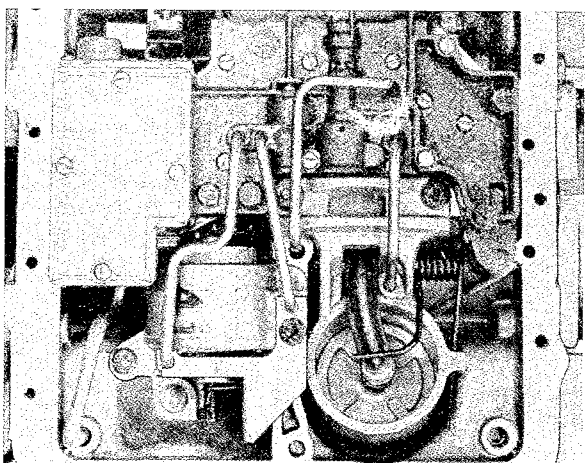


Fig. 4-116. Retention of front and rear pump strainers

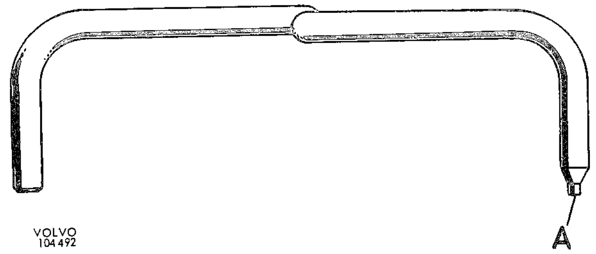


Fig. 4-117. Oil tube for valve bodies system, vehicle with B 30 E and F engines

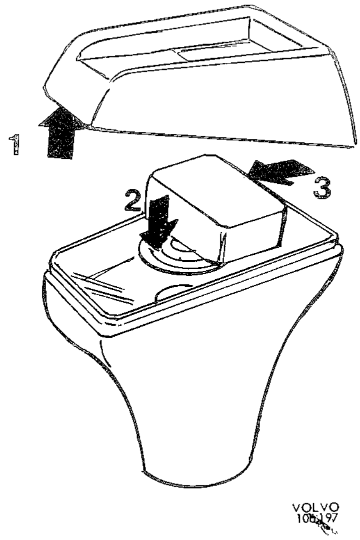


Fig. 4-119. Disassembling knob

28. Fit the four oil tubes according to Fig. 4-116. Note that the oil tube for releasing the front control cylinder is shaped like (A, Fig. 4-117). This end is fitted in the valve bodies system.
29. Adjsut the brake bands, see "Adjusting rear brake band" on page 4 : 28. Fit the starter inhibitor switch, see "Replacing starter inhibitor switch" on page 4 : 27.
30. Place the magnetic piece in the oil pan. Fit the oil pan with a new gasket.

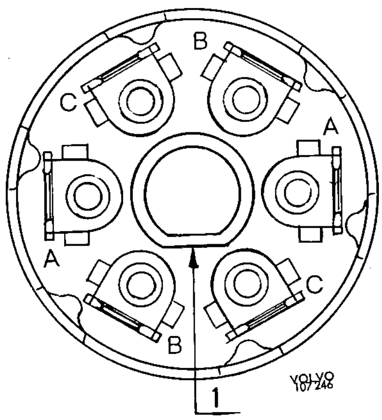


Fig. 4-118. Contact on autom. trans.
1. Flat surface on center pin
A. Connection pin for reversing lights
B. Connection pin for seat belt reminder
C. Connection pin for starter inhibitor

INSTALLATION

The converter, converter housing and gearbox are fitted in the reverse order to removal. Connect the leads for the starter inhibitor switch, reversing light, and belt reminder correctly, see wiring diagram in Section 3 and Fig. 4-118.

SELECTOR CONTROLS

REMOVAL AND DISASSEMBLY

1. Move selector control to "P" position. Prop up under the vehicle. Remove the shift rod (15) from the selector lever (12) on the selector lever housing (10, Fig. 4-120).
2. With the help of a knife lever up at the front edge the cap (1) on the selector lever knob (see Fig. 4-119). Press down the spring washer (3) and push the button (20) forwards so that it releases from the push rod. Remove the washer and spring (4) and pull up the lower part of the selector lever knob (2).
3. Unscrew the retaining screws and lift off the shift positions console (7). Remove the bulb holder for the shift positions lamp (8). Unscrew and lift up the selector lever housing.
4. Release the nut and remove the lever (12). Remove the screws and take the bracket (17) off the selector lever housing (10).
5. Knock up the tubular studs. Remove the push rod (5) and inhibitor (19). Drive out the shaft (11). Release the screws from the gate (9). Drive out the bushings from the bracket (17).

ASSEMBLY AND INSTALLATION

1. Press the bushings into the bracket and screw tight the gate.
   Grease the slide surfaces on the bushings, inhibitor and lower part of the push rod.
2. Assemble the selector lever and bracket and press in the shaft. Lock it with the tubular stud.
3. Fit the push rod and inhibitor. Drive in the tubular stud. Assemble the selector lever housing and shift positions console.
4. Grease the seal. Fit it together with the washer and lever on the shaft.
5. Adjust the sealing strip round the tunnel opening. Fit the complete selector lever housing. Note that the ground cable for the shift positions console lamp should be connected to one of the screws. Fit the lamp socket and then the console for the shift positions.
6. Fit the lower part of the selector lever knob. Put on the washer and spring. Press down the washer and fit the button. Snap the selector lever knob cap into position. Set the selector lever to position "P".
7. If the shift rod has been disassembled, its length should be 390 mm ($15^{3}/_{8}$") from the center to the center for the bolts. Grease the bushings and then connect the shift rod to the levers. Make sure that the shift rod lug comes on the outside of the lever on the selector lever housing.
8. Check the gap for selector gating in positions "D" and "2". The gaps (A and B, Fig. 4-65) should be the same in both shift positions (min. 1 mm=0.04"). Adjust if necessary. Check that there is still the same gap after the selector lever has been shifted to positions "1" and "P". Also check that the output shaft is locked with the lever in position "P".
9. Lower the vehicle.

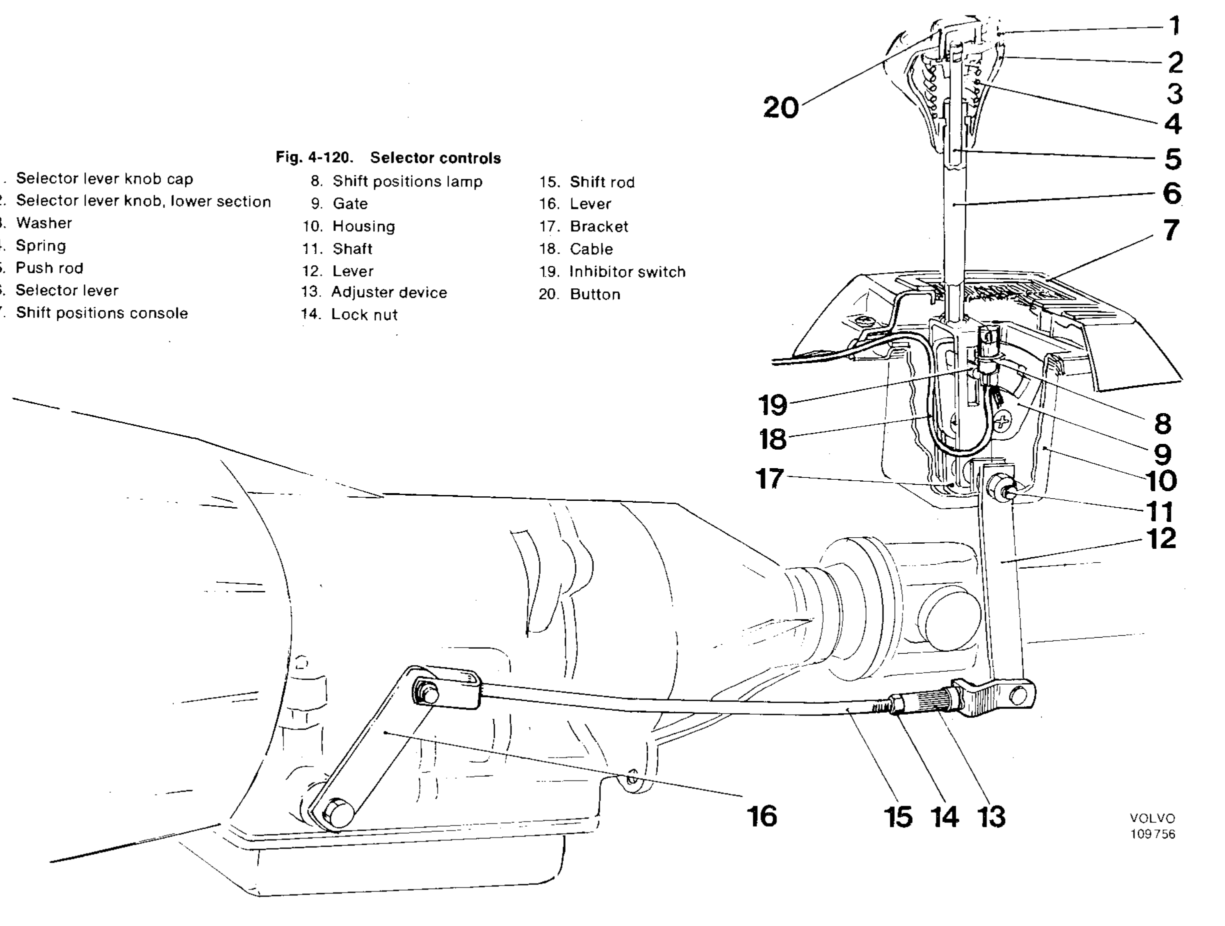


Fig. 4-120. Selector controls

1. Selector lever knob cap
2. Selector lever knob, lower section
3. Washer
4. Spring
5. Push rod
6. Selector lever
7. Shift positions console
8. Shift positions lamp
9. Gate
10. Housing
11. Shaft
12. Lever
13. Adjuster device
14. Lock nut
15. Shift rod
16. Lever
17. Bracket
18. Cable
19. Inhibitor switch
20. Button

SERVICE DIAGNOSIS

ROAD-TEST

(Used together with the service diagnosis chart).

It is important to gain as much information as possible as to the precise nature of any fault. If possible, go out in the car with the customer and get him to demonstrate the fault. In all cases, the following road-test procedure should be carried out completely as there may be more than one fault.

TEST NO.

1. Check that the starter only operates with the selector in "P" and "N" and that the reversing light operates only in "R".
2. Apply the brakes and, with the engine running at normal idling speed, select "N–D", "N–2", and "N–R". Transmission engagement should be felt in each position selected.
3. Check the converter stall speed with the transmission in "1" and "R". Check for slip or clutch squawk.
   Note. Do not stall for longer than 10 seconds or the transmission will overheat.
4. With the transmission at normal running temperature, select "D". Release the brakes and accelerate with minimum throttle opening. Check for 1–2 and 2–3 shifts. Note. At minimum throttle openings, the shifts may be difficult to detect. Confirmation that the transmission is in 3rd gear may be obtained by selecting "2" or "1", when a 3–2 downshift should be felt.
5. a. Stop and restart using full throttle acceleration. Check for 1–2 and 2–3 shifts according to the shift speed table in the "Specifications".
   b. At 40 kmph (25 mph) in 3rd gear, depress the accelerator to full throttle position. The car should downshift to 2nd gear. Repeat at 65 kmph (40 mph). The car should accelerate in 3rd gear and should not downshift to 2nd.
   c. At 50 kmph (30 mph) in 3rd gear, depress the accelerator to the kick-down position. The transmission should downshift to 2nd gear.
   d. At 25 kmph (15 mph) in 3rd gear, depress the accelerator to the kick-down position. The transmission should downshift to 1st gear.
6. a. Stop and restart using forced throttle acceleration. Check for 1–2 and 2–3 shifts according to the shift speed table in the "Specifications".
   b. At 65 kmph (40 mph) in 3rd gear, release the accelerator and select "1". Check for 3–2 downshift and engine braking. Check for roll-out 2–1 downshift at about 8 kmph (5 mph) and engine braking.
7. Stop, and with "1" still engaged, release brakes and, using full throttle, accelerate to 30 kmph (20 mph). Check for no slip or clutch squawk and no upshifts.
8. Stop and select "R". Release brakes and reverse using full throttle if possible. Check for no slip or clutch squawk.
9. Stop on the brakes facing downhill and select "P". Release the brakes and check that the parking pawl will hold the car. Re-apply the brakes before disengaging the parking pawl. Repeat with the car facing uphill. Check that the selector is trapped by the gate in "P".

TROUBLE SHOOTING

(To be used in conjuction with road-test.)

TEST	FAULT	ACTION
1.	Starter will not operate in "P" or "N"	19
	Starter operates in all selector positions	20
2.	Excessive bump on engagement of "D", "2", "1" or "R"	4, 3
3.	If stall speed higher than specified:	
	a. with slip and squawk in '1"	1, 2, 3, 13, 11
	b. with slip and squawk in "R"	1, 2, 3, 13, 12
	If stall speed lower than specified, check engine performance	
	If stall speed more than 10 r/s (600 r/m) lower than specified	21
4.	No drive in "D" (if normal in "1", omit 11 and 13; if no drive in "D", "2", "1" or "R", add 17)	1, 2, 3, 13, 11, 16
	Delayed or no 1–2 shift	3, 14, 13, 5, 6
	Slip on 1–2 shift	2, 3, 5, 6, 7, 13
	Delayed or no 2–3 shift. (If normal in "R", omit 12)	3, 14, 13, 5, 6, 12
	Slip or engine run-up on 2–3 shift	2, 3, 5, 13, 12
	Bumpy gear shifts	3
	Drag in "D 2" and "D 3"	8
	Drag on 2–3 shift	5, 6
5 a.	Slip and squawk or judder on fullt throttle take-off in "D"	1, 2, 3, 13, 11
	Loss of performance and overheating in "D 3" (seized stator)	21
	Continue as for test 4 above	
b.	Transmission downshifts too easily	3
c, d.	Transmission will not downshift	3, 13, 14
6 a.	As test 6a above	1, 5, 6, 7, 12
b.	No 3–2 downshift or engine braking	1, 5, 6, 7, 12
	No 2–1 downshift or engine braking	8, 9, 10
7.	Slip and squawk or judder on take-off in "1"	1, 2, 3, 13, 11
	Transmission upshifts	1
8.	Slip and squawk or judder on take-off in "R"	1, 2, 3, 13, 12
	Slip but no judder on take-off in "R" (if engine braking available in "1", 1st gear omit 8, 9, 10)	1, 2, 3, 8, 9, 10
	Drag in "R"	5
	No drive in "R" (if engine braking available in "1", 1st gear, omit 8, 9, 10)	1, 2, 3, 8, 13, 9, 10, 12
9.	No park	1, 15
Mis-	Screech or whine, increasing with engine speed	17
cell-	Grinding or grating noise from gearbox	18
aneous	Knocking noise from torque converter area	22
	At high speeds in "D 3", transmission downshifts to "D 2" and immediately back to "D 3"	12

ACTION

1. Check manual linkage adjustment.
2. Check fluid level.
3. Check adjustment of downshift valve cable using line pressure gauge and tachometer.
4. Reduce engine idling speed.
5. Check front band adjustment.
6. Check front servo seals and tubes for leakage.
7. Check front band for wear.
8. Check rear band adjustment.
9. Check rear servo seal and fit of tubes.
10. Check rear band for wear.
11. Examine front clutch and seals, also front sun gear shaft sealing rings. Verify that cup plug in driven shaft is not leaking or dislodged.
12. Examine rear clutch, check valve, and seals. Check fit of tubes.
13. Strip valve bodies and clean.
14. Strip governor valve and clean.
15. Examine parking pawl, gear and internal linkage.
16. Examine one-way clutch.
17. Strip and examine front pump and drive fingers.
18. Strip and examine gear train.
19. Adjust starter inhibitor switch inwards.
20. Adjust starter inhibitor switch outwards.
21. Replace torque converter.
22. Examine torque converter drive plate for cracks or fracture.

CONVERTER SERVICE DIAGNOSIS

The converter housing is welded together and cannot therefore be repaired but must be replaced in the event of defects. There is no drain plug since fluid changes do not occur and fluid filling is done through the transmission. The stall speed means the speed obtained at full throttle on the engine with the lock-up engaged but with the car stationary. Check that the transmission has the correct running temperature and that the fluid level is correct before the stall speed test. The test must not take place longer than ten seconds, otherwise the transmission will overheat.

Fault-tracing on the converter is carried out as follows:

1. If the general performance of the vehicle is below standard, check the converter stall speed with a accurate tachometer by applying maximum pressure on the footbrake pedal, selecting "Lock-up" and fully depressing the accelerator. If the stall speed is up to 5 r/s (300 rpm) below that specified, the engine is not developing its full power.
2. Inability to start on steep gradients combined with poor acceleration from rest indicates that the converter stator one-way clutch is slipping or that the stator support is fractured. This condition permits the stator to rotate in an opposite direction to the turbine and torque multiplication cannot occur. Check the stall speed and, if it is more than 10 r/s (600 rpm) below that specified, the converter assembly must be replaced.
3. Below standard acceleration in 3rd gear above 50 kmph (30 mph) combined with a substantially reduced maximum speed indicates that the stator one-way clutch has locked in the engaged condition. The stator will then not rotate with the turbine and impeller, therefore the fluid flywheel phase of the converter performance cannot occur. This condition will also be indicated by excessive overheating of the transmission, although the stall speed will remain as specified. In this case the converter assembly must be replaced.
4. Stall speed which is higher than that specified, indicates that the converter is not receiving its required fluid supply or that slip is occurring in the clutches of the automatic transmission.

PROPELLER SHAFT

TOOLS

The numbers for the special tools are preceded by 999 or SVO, e.g., 999 2846 or SVO 2846.

999 (SVO) 2846 Special socket for propeller shaft bolts

GENERAL INFORMATION

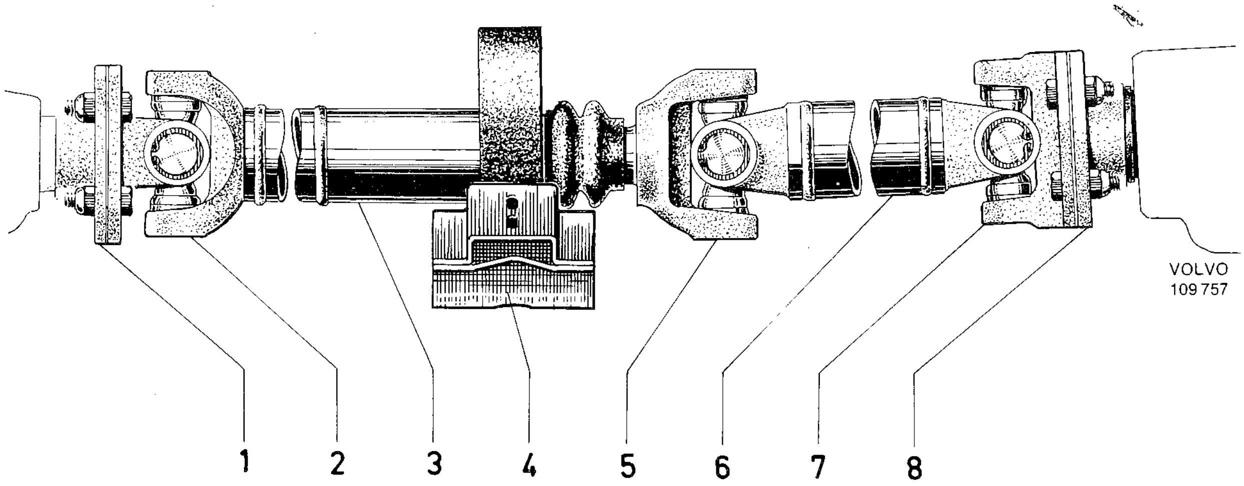


Fig. 4-121. Propeller shaft with support bearing

1. Flange on gearbox
2. Front universal joint
3. Front section of propeller shaft
4. Support bearing
5. Intermediate universal joint
6. Rear propeller shaft
7. Rear universal joint
8. Flange on rear axle

The propeller shaft is of the divided, tubular type, see Fig. 4-121. The rear end of the front section of the propeller shaft is in the form of a splined sleeve. In this there is a splined shaft which also forms one of the yokes on the intermediate universal joint. The rear end of the front section of the propeller shaft is carried in a ball bearing. The ball bearing is contained in a rubber bearing housing, which is attached to the propeller shaft tunnel with a cover, see Fig. 4-122. The propeller shaft is fitted with three universal joints. Each joint consists of a spider with four ground trunnions carried in flange yokes by means of needle bearings.

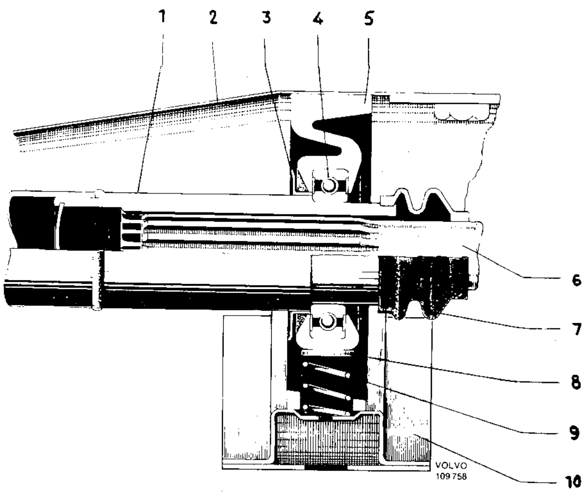


Fig. 4-122. Support bearing

1. Front section of propeller shaft
2. Floor tunnel
3. Dust cover
4. Ball bearing
5. Rubber housing
6. Rear section of propeller shaft
7. Rubber cover
8. Washer
9. Suspension spring
10. Cover

SERVICE PROCEDURES

SUPPORT BEARING REPLACEMENT

1. Jack up the vehicle. Slacken the propeller shaft from the rear axle flange. Bend back the lock washer and unscrew the nut at the sliding joint. Pull out the propeller shaft to the rear.
2. Loosen the cover for the support bearing. Pull off the support bearing complete.
3. Press the old bearing out of the rubber housing. Fit the new bearing.
4. Fit the support bearing and the other parts in the reverse order to removal. If the splined joint appears dry, lubricate it with grease mixed with molybdenum disulphide.

REMOVAL

Jack up the vehicle. Slacken the propeller shaft from the gearbox and rear axle flanges. The bolts can be loosened by an air impact wrench and special socket 2846, see Fig. 4-123. Loosen the cover for the support bearing and take down the propeller shaft complete.

DISASSEMBLY

PROPELLER SHAFT DISASSEMBLY

1. Bend back the lock washer and unscrew the nut for the support beraing. Remove the rear section of the propeller shaft. Pull off the support bearing.
2. Remove the support beraing from the housing.

UNIVERSAL JOINTS DISASSEMBLY

1. Remove the snap rings securing the needle bearings in the yokes, see Fig. 4-124.
2. Secure the shaft in a vise so that the universal joint comes as near as possible to the vise jaws. Remember that the propeller shaft is tubular and can easily be deformed.
3. With a hammer and metal punch drive the spider as far as it will go in one direction. The needle bearing will then come about half way out.
4. Then drive the spider as far as it will go in the opposite direction, see Fig. 4-125.
5. Drive out one of the needle bearings with a thin metal punch. Remove the spider, see Fig. 4-126. Drive out the other needle beraing.

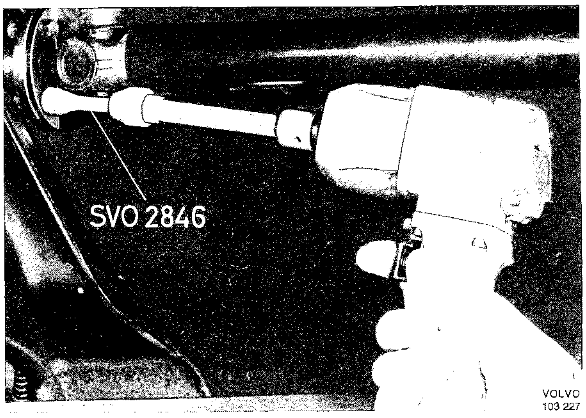


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Fig. 4-123. Removal of bolts

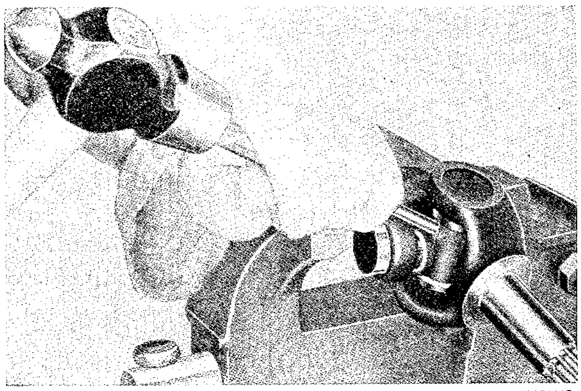
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Fig. 4-125. Removal of spider, I

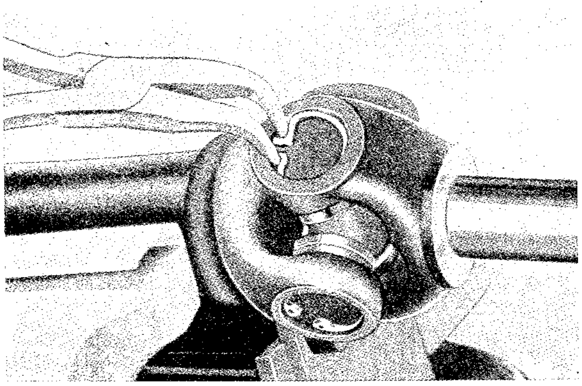
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Fig. 4-124. Removal of snap ring

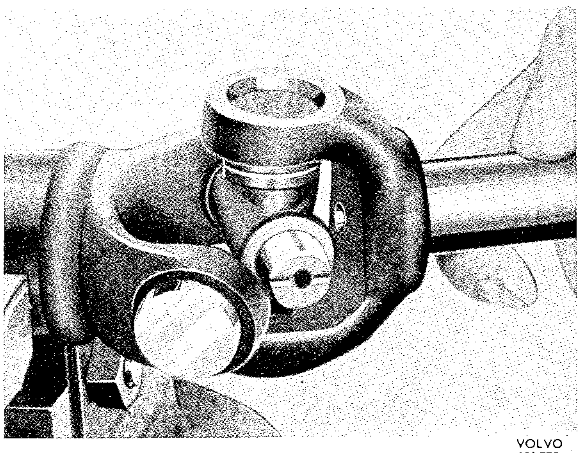
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Fig. 4-126. Removal of spider, II

INSPECTION

It is extremely important to ensure that the propeller shaft is straight. Since even minor damage on a propeller shaft can cause vibration, the inspection must be very thorough. The shaft should be set up between centers and checked along its entire length with an indicator gauge while it is rotating. If it is out-of-true more than 0.25 mm (0.010"), the shaft must be replaced. **NOTE. No attempt should be made to straighten a damaged propeller shaft—discard and replace with a new one.**

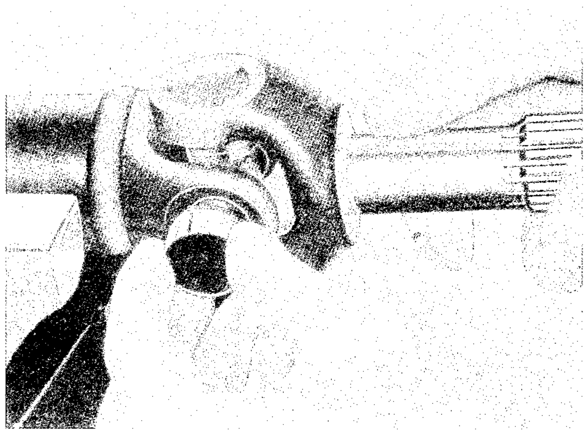
Examine the support beraing by pressing the beraing races against each other by hand and turning them in opposite directions. The bearing should run easily without binding at any point. If it does not, scrap the bearing and replace it with a new one.

Check needle bearings and spiders. Worn or damaged parts should be replaced.

ASSEMBLY

UNIVERSAL JOINTS ASSEMBLY

1. When fitting the old neelde bearings, check that they are filled with grease and that the rubber seals are not damaged. New bearings should be half-filled with grease.
2. Insert the spider in the flange yoke. Push the spider over in one direction so far that the needle bearing can be fitted on to the trunnion, see Fig. 4-127. Then press the needle bering in so far that the snap ring can be fitted. Use a drift having a diameter slightly less than that of the needle bearing sleeve.



VOLVO
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Fig. 4-127. Installing spider

3. Fit the other needle bearing and snap ring as above. The fitting of the spider in the other yoke should also be carried out in the same way as described in operation 2.

INSTALLATION

Installation is in reverse order to removal.

REAR AXLE
TOOLS

The numbers for the special tools are preceded by 999 or SVO, e.g., 999 2844 or SVO 2844.

The following tools are used for work on the rear axle.

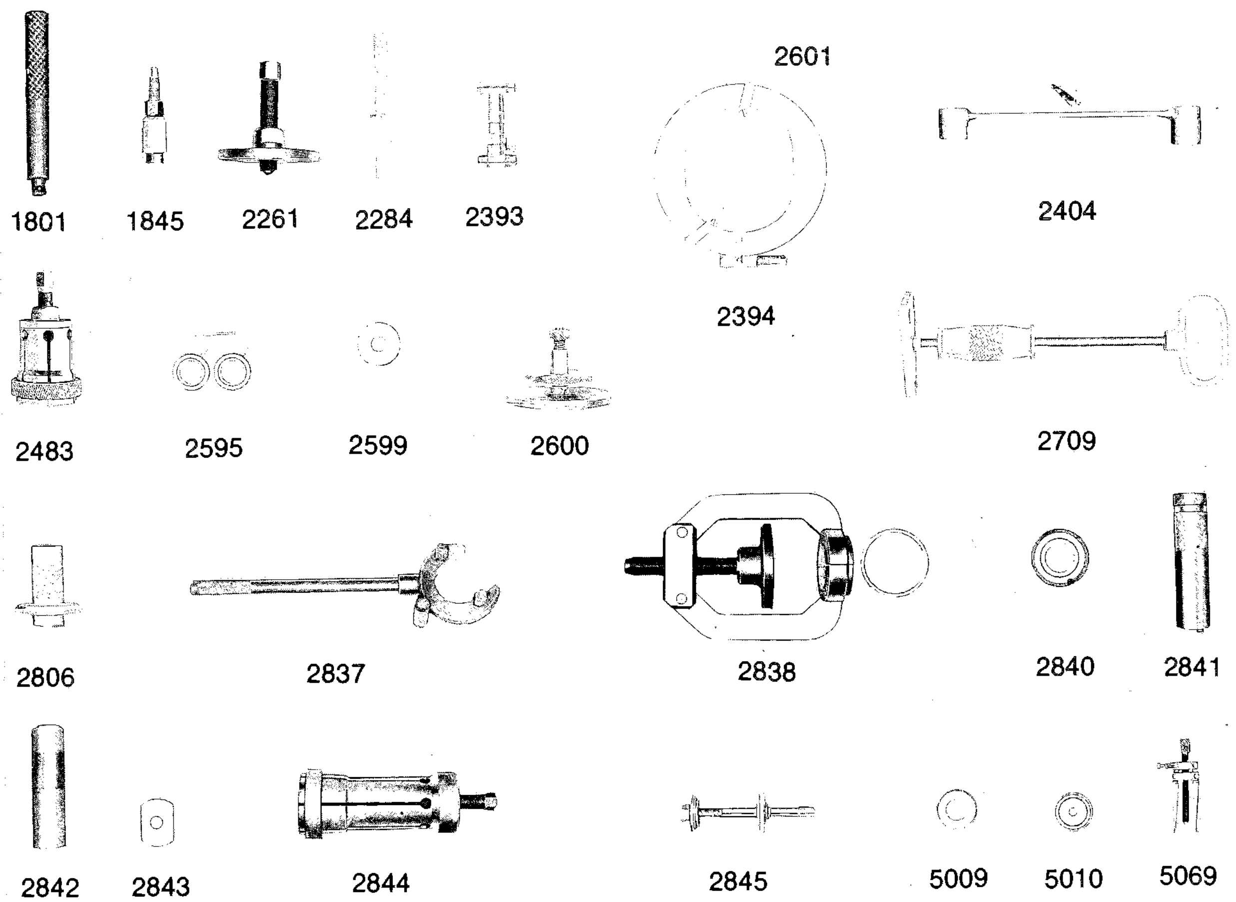

Fig. 4-128. Special tools for rear axle

999 (SVO)

1801 Standard handle 18×200 mm
1845 Press tool for fitting flange
2261 Puller for flange
2284 Retainer for dial indicator for final drive adjustment
2393 Measruing tool for pinion adjustment
2394 Expander tool used for removing and fitting differential
2404 Tool for fitting front pinion bearing. Used also when checking tooth mesh
2483 Puller for differential carrier bearings
2520 Stand, see Fig. 4-129
2522 Fixture for rear axle (used together with stand SVO 2520 for work on the final drive)
2595 Adjusting rings for differential
2599 Drift for removing outer ring, front pinion bearing
2600 Measuring fixture for adjusting rings
2601 Holder for expander tool 2394 (fitted on tool)
2709 Puller for drive shaft

999 (SVO)

2714 Fixture for rear axle, used on garage jack for removing and fitting rear axle, see Fig. 4-161
2806 Tool for fitting oil seal at flange
2837 Counterhold for flange
2838 Press tool for removing and fitting bearing and lock ring on drive shaft
2840 Adjusting ring for pinion
2841 Box spanner for adjusting ring 2840
2842 Sleeve for fitting inner ring, rear pinion bearing
2843 Drift for removing outer ring, rear pinion bearing
2844 Puller for rear pinion bearing
2845 Press tool for fitting outer ring, pinion bearing
5009 Drift for fitting inner sealing ring for drive shaft bearing
5010 Ring for fitting bearing and lock ring on drive shaft. Used together with 2838
5011 Levers for 2838
5069 Puller for oil seal at flange

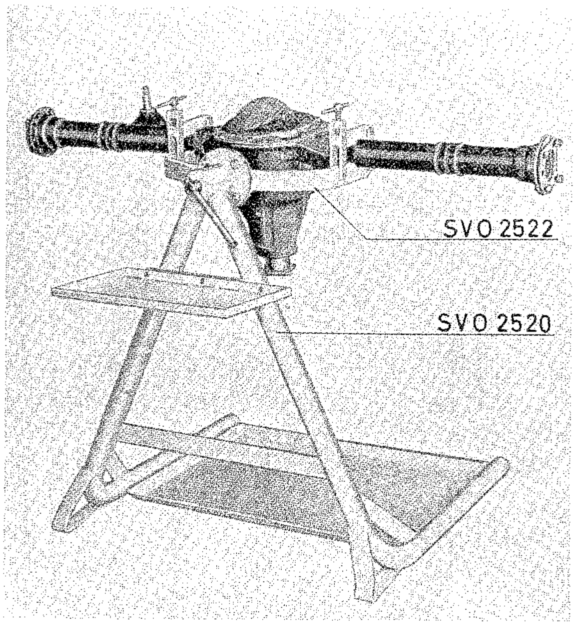

Fig. 4-129. Stand and fixture for rear axle

GENERAL INFORMATION

The rear axle is carried in two support arms. The support arms are provided with a couple of robust bushings and are attached to the body. The rear axle housing is attached to the support arms with levers. In order to take up the rear axle torque, there are two torque rods attached to the drive shaft tubular covers and to the body. A track bar prevents the body and rear axle from moving sideways in relation to each other. The design of the rear axle is shown in Illustration 4 E.

The final drive is of the hypoid type, that is to say, the drive pinion lies below the center of the crown wheel. It consists of the drive pinion, ring gear and differential gear. The gear backlash and differential carrier bearing tension are adjusted by means of shims inside the differential carrier bearings.

The differential carrier and the ring gear are journaled in the final drive housing by means of two taper roller bearings. The ring gear is bolted to the differential carrier. The differential gears themselves in the differential carrier consist of two bevel pinions on a trunnion and two side gears in which drive shafts are carried by means of internal splines. The differential gears are journaled so that they can rotate and permit the drive shafts to rotate at different speeds when the car is being driven round bends. There is a thrust washer under each of the differential gears.

The drive pinion is carried in taper roller bearings. The axial location of the drive pinion relative to the crown wheel is adjusted by means of shims under the outer race of the rear pinion bearings. Application of the pinion bearings is by means of shims under the front pinion bearing inner ring. The outer end of each drive shaft is journaled in a taper roller bearing. Bearing clearance is not adjustable but is determined by the construction of the bearing, see Fig. 4-130. There are oil seals on both sides of the drive shaft bearings.

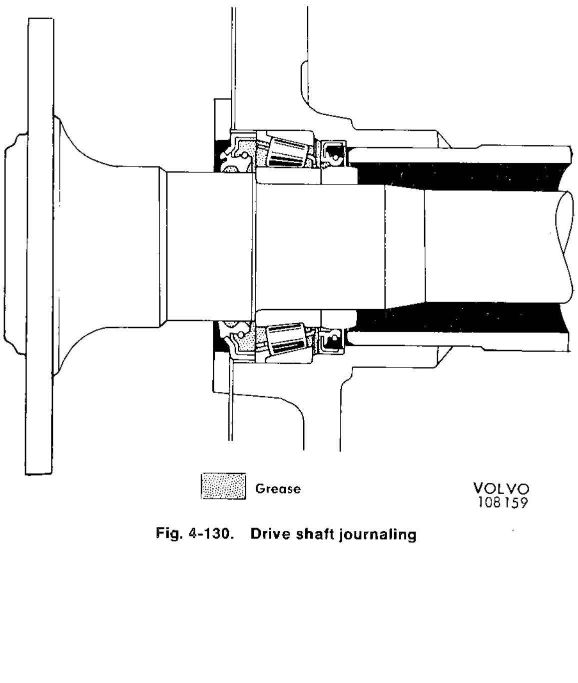

Fig. 4-130. Drive shaft journaling

WORK ON REAR AXLE IN VEHICLE

REPLACING BEARINGS AND DRIVE SHAFT OIL SEALS

1. Jack up the vehicle and put stands under the rear axle. Remove the wheels.
2. Disconnect the brake pipe from the brake caliper. Slacken the bolts for the brake disc and remove the disc.
3. Slacken the bolts for the thrust washer. These are slackened through the holes in the drive shaft flange. Pull out the drive shaft with puller 2709, see Fig. 4-131.
4. Pull out the inner sealing ring with puller 4030 or lever it out with a strong chisel.
5. Secure press tool 2838 in a vise. Secure the drive shaft to the spindle plate. Screw in the spindle so that the tool arms can be placed against the bearing, see Fig. 4-132. Screw out the spindle and press off the bearing and lock ring. Discard the lock ring.
   Remove the oil seal.
6. Fill the space between the seal lips on the new oil seal with grease. Then place it on the drive shaft. Fit the bearing and a new lock ring. Turn the bearing correctly, see Fig. 4-130.
   NOTE. Always use a new lock ring.
   Place fitting ring 5010 against the bearing and the lock ring. Close the tool arms and lock them round the fitting ring, see Fig. 4-133. Press on the bearing and lock ring by screwing in the spindle.
7. Drive in the inner sealing ring with drift 5009 and handle 1801 The drift is so designed that it will install the ring in its correct position, see Fig. 4-134.
8. Pack the bearing with durable grease. Also fill the space between the sealing rings and between the sealing ring lips on the outer ring with grease, see Fig. 4-130. Then fit the drive shaft. Tighten the bolts for the thrust washer to a torque of 50 Nm (5 kpm=36 lbft). Fit the brake disc and brake caliper. Connect the brake line. Bleed and adjust the brakes, see Section 5.
9. Install the wheels and wheel nuts. Lower the vehicle. Tighten the wheel nuts.

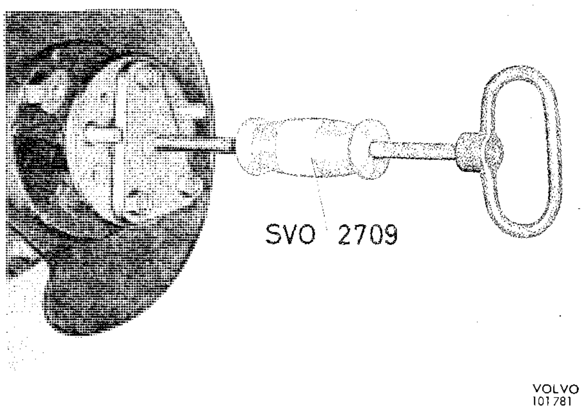

Fig. 4-131. Drive shaft removal

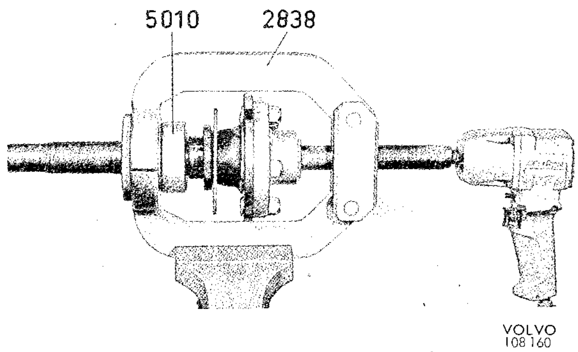

Fig. 4-133. Drive shaft bearing installation

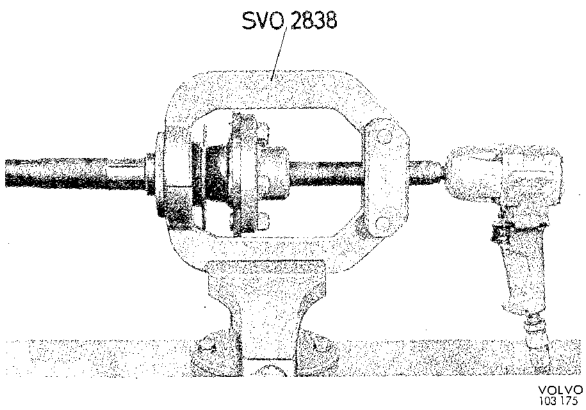

Fig. 4-132. Drive shaft bearing removal

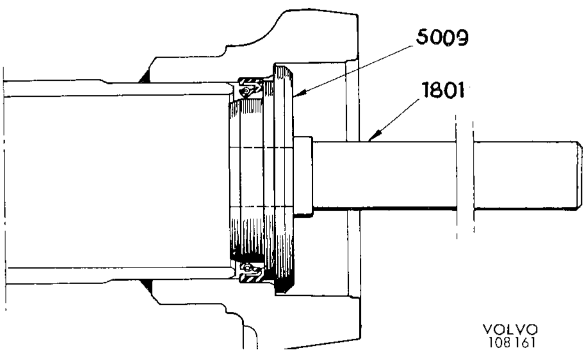

Fig. 4-134. Inner sealing ring installation

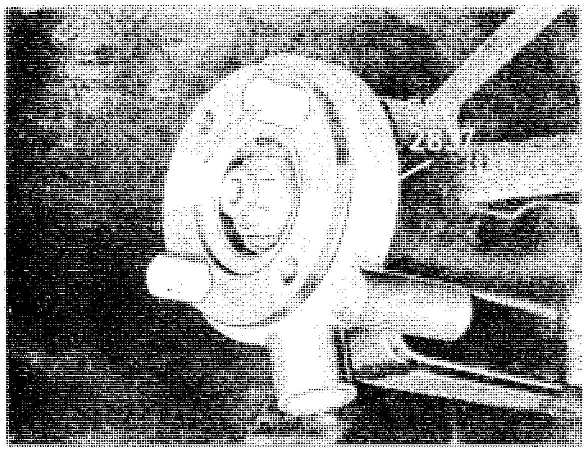

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Fig. 4-135. Counterhold for flange

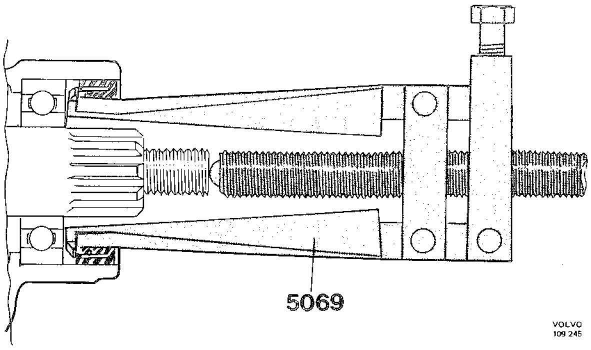

Fig. 4-137. Oil seal removal

PINION OIL SEAL REPLACEMENT

1. Disconnect the rear section of the propeller shaft from the flange on the pinion. Check for looseness of the pinion in its bearings. If there is looseness, this must be remedied before a new oil seal can be fitted. See the instructions under the heading "Assembling".
2. Remove the nut for the flange. Use for this purpose tool 2837, see Fig. 4-135. Pull the flange off with puller 2261, see Fig. 4-136. Pull out the old oil seal with puller 5069, see Fig. 4-137.
3. Fit the new oil seal with tool SVO 2806. When fitting the oil seal, lubricate the seal lips with grease. At the same time grease the spring coil. See Fig. 4-138. This is to prevent the spring coil from jumping out during fitting.
4. Press on the flange with the help of press tool 1845, see Fig. 4-139. Fit the washer and nut. Tighten the nut to a torque of 240–300 Nm (24–30 kpm=180–220 lbft).
5. Connect the propeller shaft section.

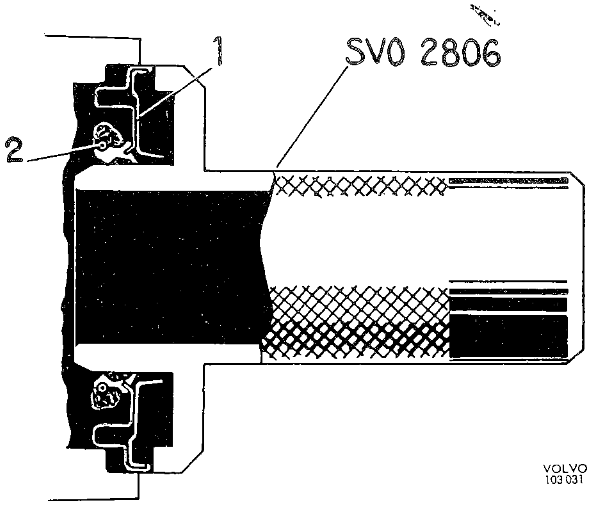

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Fig. 4-138. Installation of oil seal
1. Oil seal
2. Spring coil with grease coating

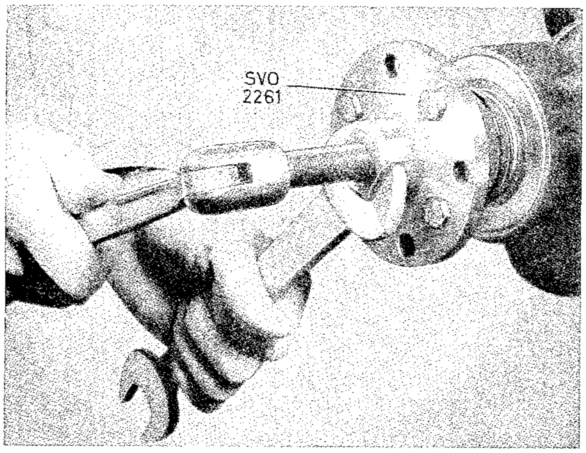

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Fig. 4-136. Flange removal

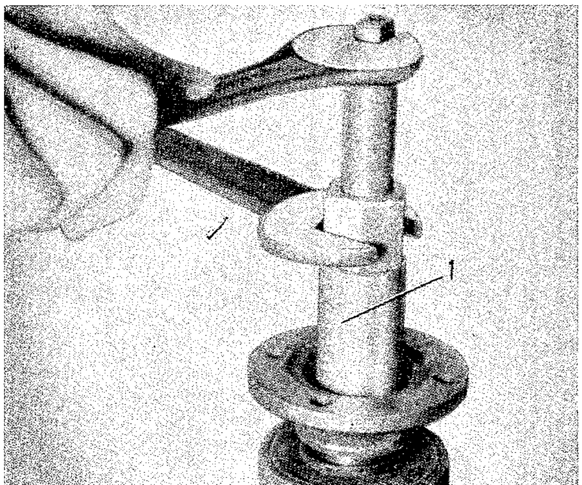

Fig. 4-139. Installation of flange
1. Press tool 1845

REMOVING REAR AXLE

1. Remove the rear wheel nuts. Place stands under the front end. Place fixture 2714 on a jack and lift the rear axle. See also Fig. 4-161. Place stands in front of the rear jack attachments, see Fig. 4-140, and then lower the jack slightly. Note that the stands must not be placed at a point further than the dash line indicated in the Figure. Remove the rear wheels.
2. Loosen the upper attaching bolts for the shock absorbers.
3. Remove the brake pipes from the rear axles and the attaching bolts for the calipers.
4. Hang up the brake caliper with steel wire on the upper shock absorber attachments so that no sharp bends are made on the brake pipes.
5. Remove the brake drums.
6. Unhook the springs with spring pliers and remove the brake shoes.
7. Press out the pin securing the brake wires to the levers.
8. Remove the bolts and pull out the wires and plastic tubes with rubber seals. Remove the springs securing the wires to the rear axle.
9. Remove the propeller shaft from the flange on the pinion.
10. Disconnect the panhard rod from the bracket on the rear axle housing.
11. Disconnect the springs from the trailing arms. Lower the rear axle and remove the springs.
12. Loosen the bolts holding the rear axle housing to the trailer arms and torque rod.
13. Lower the jack and pull the rear axle out from the rear.

DISASSEMBLING REAR AXLE

1. Place the rear axle in fixture 2522, see Fig. 4-129. The rear axle is placed with the underside of the drive facing inwards to the fixture support, when the pinion is pointing downwards. Remove the brake pipes.
2. Release the bolts for the brake backing plates and brake shoe retainers. They are slackened through the holes in the drive shaft flanges. Pull out the drive shafts with puller 2709, see Fig. 4-131.
3. Remove the inspection cover.
4. If the final drive is being reconditioned because of noise, the mesh pattern should be checked before disassembling takes place, as this might assist in locating the fault. Before carrying this out, clean the teeth so that no misleading mesh pattern is obtained.
5. Check the alignment markings on the cap and carrier, see Fig. 4-141. If there are no markings, or if they are difficult to see, mark one side with a punch. Remove the caps.
6. Fit tool 2394 in the holes in the drive pinion carrier as shown in Fig. 4-142. Fit the tool with retainers 2601. Tension the tool until it fits exactly in the holes in the carrier. Then tension the bolt a further 3—3½ turns. Lift out the differential carrier with ring gear. Tool 2337 can be used for this purpose.
7. Turn the final drive and let the oil run out into a container. Use tool 2837 as a counterhold for this purpose, see Fig. 4-135. Pull off the flange with puller 2261, see Fig. 4-136. Press out the pinion.
8. Drive out the front pinion bearing, the washer and the oil seal with standard handle 1801 and drift 2599.

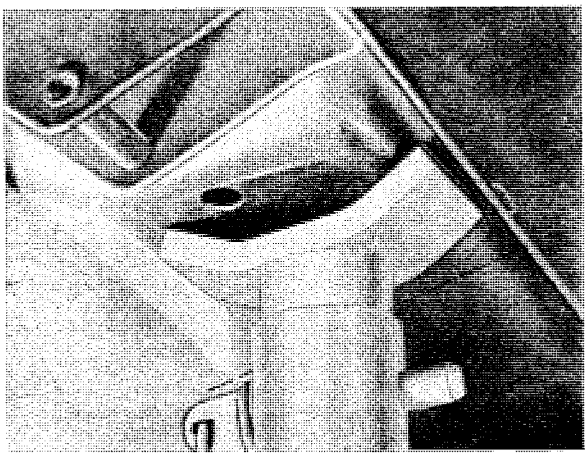

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Fig. 4-140. Locating rear axle stand

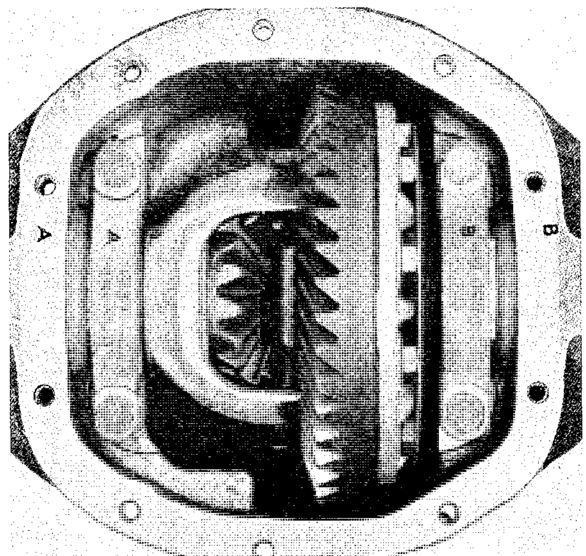

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Fig. 4-141. Alignment marking on cap and carrier

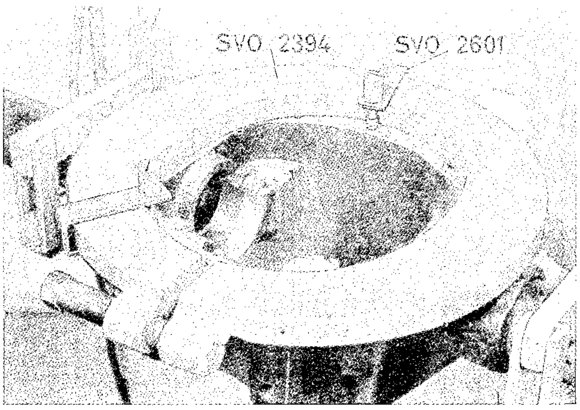


Fig. 4-142. **Expanding drive pinion carrier**

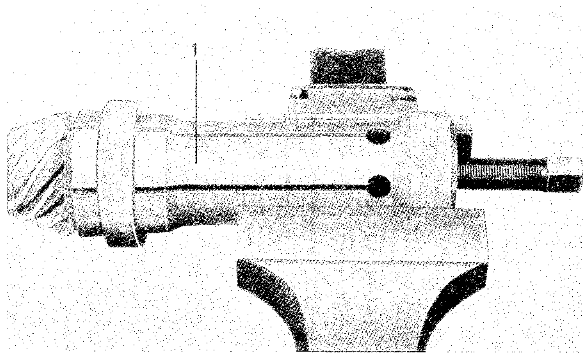


Fig. 4-144. **Rear pinion bearing removal**
1. Puller 2844

9. If necessary, drive out the rear bearing outer ring out of position, see Fig. 4-143. Use standard handle 1801 and drift 2843.
10. Clean the gasket. File off all burr from the surface on which the indicator retainer 2284 is to slide.
11. If necessary, pull off the rear bearing from the pinion with puller 2844, see Fig. 4-144. The puller is fitted in the following way (see Fig. 4-145). Move the puller down over the rollers and press down the lock ring. Then pull up the puller with the bolt until the rollers lie flush with the edge of the inner race and the edge on the puller. Tap out the lock ring with a hammer.

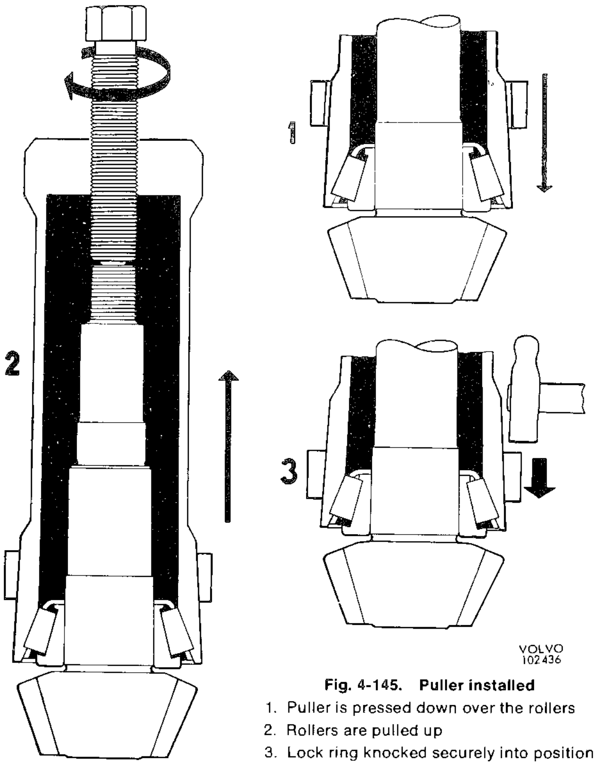


Fig. 4-145. Puller installed
1. Puller is pressed down over the rollers
2. Rollers are pulled up
3. Lock ring knocked securely into position

DIFFERENTIAL DISASSEMBLY

1. Pull off the differential carrier bearings with puller 2483, see Fig. 4-147. Take care of the shims.
2. Remove the lock plate for the crown wheel bolts. Release the ring gear bolts and remove the crown wheel. Discard the bolts.
3. Drive out the lock pin, see Fig. 4-146, and then the shaft for the differential gears. Take out the differential gears and the thrust washers.

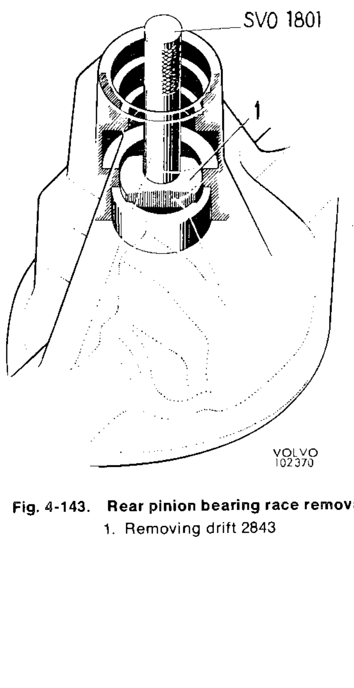


Fig. 4-143. **Rear pinion bearing race removal**
1. Removing drift 2843

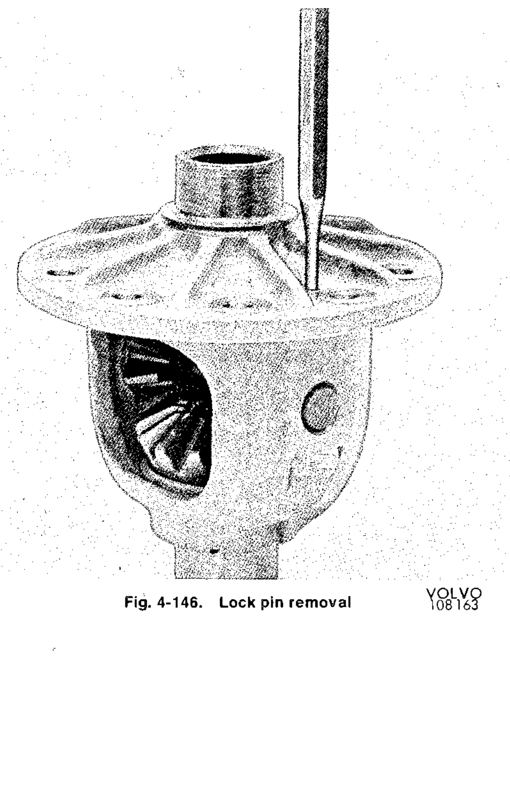


Fig. 4-146. **Lock pin removal**

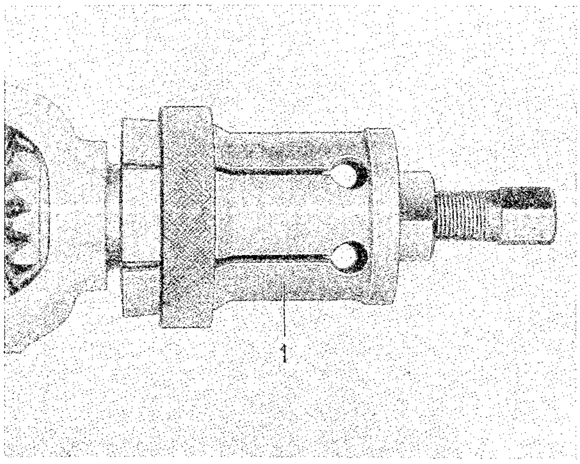


Fig. 4-147. **Removal of differential carrier bearings**
1. Puller 2483

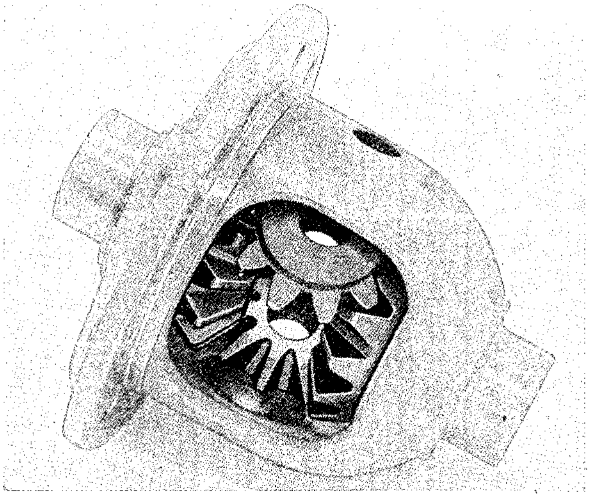


Fig. 4-148: **Differential gear installation**

REAR AXLE INSPECTION

First clean all the parts thoroughly. Check the bearing races and bearings. The races, rollers or roller retainers must not be scratched or damaged. All damaged bearings and bearing races should be replaced.

Note that both parts of the outer ring for the drive shaft bearings are stuck together with new bearings. This adhesion may loosen after driving for some time, but it does not influence the usability of the bearing. Check both the pinion drive and crown wheel carefully for damage to the teeth. The most damage is seizing gear teeth. This is caused by incorrect running-in, wrong oil, insufficient tooth flank or faulty tooth contact. If the cause of the seizing is not remedied at an early stage, the entire gear wheel can be damaged.

The differential gears should also be examined for damage to the teeth. They should be fitted in a clean and dry condition in the differential carrier together with the shaft and thrust washers. Play should then be checked **by means of marking blue behind both the differential side gears.** If the play exceeds 0.15 mm (0.006"), when the gears have been rotated to maximum play, replace with thicker washers. These are available in seven thicknesses from 0.74 mm (0.029") to 0.98 mm (0.039") with a difference of 0.04 mm (0.0016") between each.

Check also to see whether the cylindrical part of the flange which goes into the oil seal is worn or scratched. If this is the case, replace the flange together with the oil seal.

The pinion nut is provided with a slit for locking. In time this slit loses its locking effectiveness. For this reason, the nut should be replaced if it has been removed a couple of times. The washer under the nut should also be replaced if it has become deformed. Check the oil seals and replace them if they are damaged or worn.

Make sure that there are no cracks in the rear casing. Check that the brackets for the support arms and track rod are intact.

Inspect the drive shafts. Drive shafts which are warped or damaged in any other way should be replaced with new ones.

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

Check the rear axle casing for cracks. Check that the brackets for the support arms and track rod are not damaged.

ASSEMBLY

Observe greatest cleanliness when assembling and adjusting final drives. Dirt in a taper roller bearing can result in completely inaccurate measurements.

If a bearing is measured for clearance or pre-load, it should be oiled and rotated several turns under load.

DIFFERENTIAL ASSEMBLY

1. Place the differential side gears and the thrust washers in the differential carrier. Then "roll" in the differential pinions both simultaneously with the dished thrust washers, see Fig. 4-148. Drive in the shaft.
2. Check the differential. If the gear play has not been determined, check it according to the instructions given under the heading "Inspection". If oversize spacer washers are installed, the play can be checked by turning the gears one turn. The necessary torque should not exceed 20 Nm=2 kpm=14 lbft. The tool for this check can easily be made from a shortened drive shaft which is adapted to a suitable torque wrench. After the checking and any replacement of the thrust washers, install the lock pin.
3. Install the ring gear. Make sure that the contact surfaces are clean and without burr. Tighten the bolts, torque 65–90 Nm=6.5–9.0 kpm=45–60 lbft.
   NOTE. Always use new bolts.

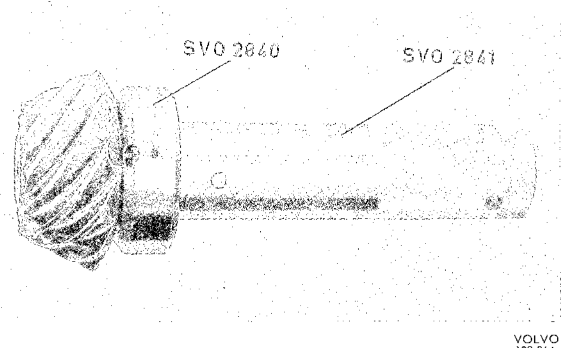


Fig. 4-149. Adjustment of ring and tool for pinion location

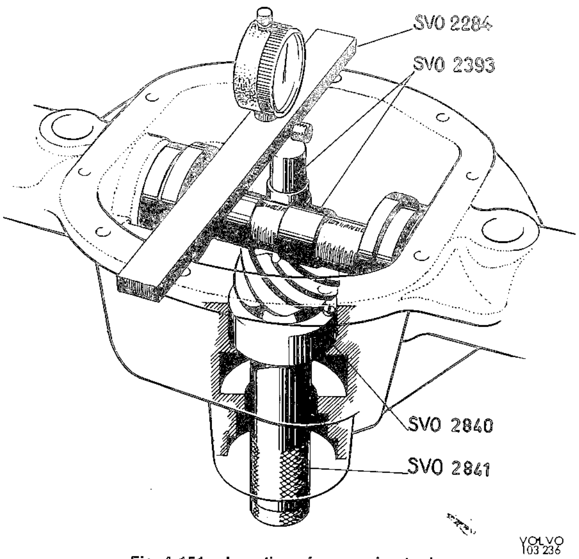


Fig. 4-151. Location of measuring tools

INSTALLING PINION

1. Clean the marking surface on the pinion with extremely fine emery cloth. Fit the adjusting ring 2840 and tool 2841 on the pinion, see Fig. 4-149. Place the pinion in the carrier, see Fig. 4-151, and secure the adjusting ring by screwing out the lock screw.
2. The pinion should have a certain nominal measurement (A, Fig. 4-150) to the center line of the crown wheel. Due to tolerances in the manufacturing, there are deviations from the nominal measurement. This is indicated on the ground surfaces on the pinion with a figure.
   The surface is generally ground down 0.30 mm (0.012") so that the deviation is always indicated by plus tolerance and in hundredths of a millimeter. The plus sign is excluded.
   To check the location of the pinion, use a dial indicator, indicator retainer 2284 and a measuring tool 2393, which consists of two parts: a pinion gauge and an adjusting jig.
   Checking is as follows:

Place the pinion gauge on the ground surface of the pinion and the adjusting jig in the differential bearing positions as shown in Fig. 4-151. Place the indicator retainer on the drive pinion carrier and zero-set the gauge against the adjusting ring, see Fig. 4-152. Then move the indicator retainer over so that the indicator comes against the pinion gauge, see Fig. 4-153. If the pinion is, for example, marked 33, the pinion gauge should lie 0.33 mm (0.013") under the adjuster fixture. The setting is adjusted by turning the cam on the pinion until the gauge dial shows the correct value. Then lock the adjusting ring with the lock screw. Remove the measuring tool and pinion.

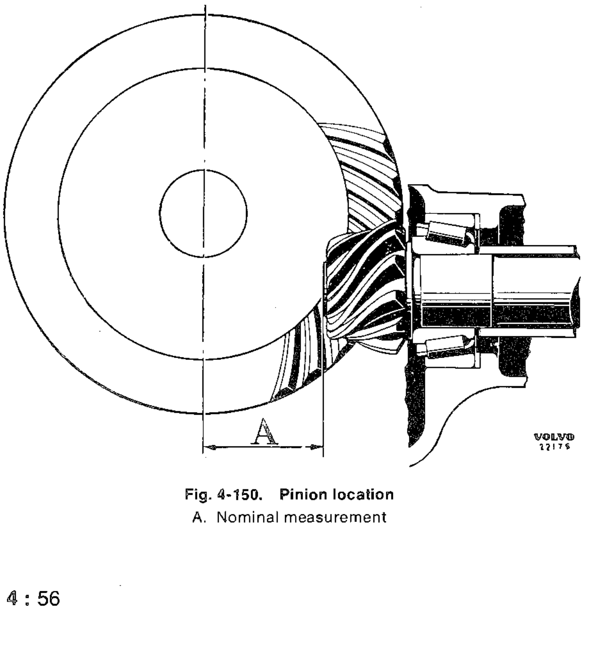


Fig. 4-150. Pinion location
A. Nominal measurement

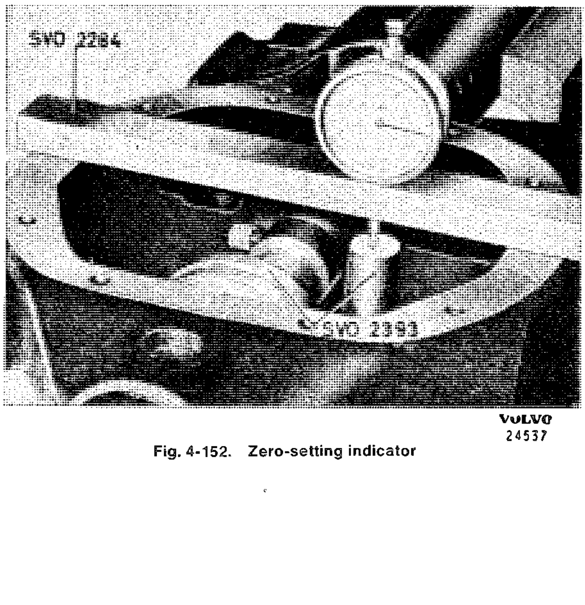
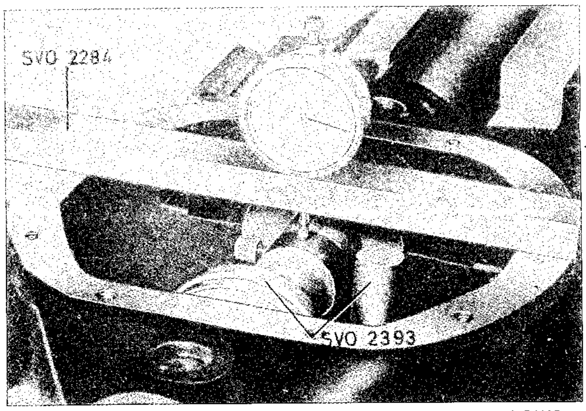


Fig. 4-152. Zero-setting indicator



VOLVO
24536

Fig. 4-153. Measuring pinion location

Conversion table, millimetres to inches			
mm	inches	mm	inches
0.20	0.0079	0.31	0.0122
0.21	0.0083	0.32	0.0126
0.22	0.0087	0.33	0.0130
0.23	0.0091	0.34	0.0134
0.24	0.0094	0.35	0.0138
0.25	0.0098	0.36	0.0142
0.26	0.0102	0.37	0.0146
0.27	0.0106	0.38	0.0150
0.28	0.0110	0.39	0.0154
0.29	0.0114	0.40	0.0157
0.30	0.0118		

3. Place the rear pinion bearing complete with the outer ring in measuring fixture 2600. Put on the plate, spring and nut. Turn the nut with the flat side facing upwards. The plate, and thereby the bearing, is turned forwards and backwards several times so that the rollers take up the correct position. Place the adjusting ring in the measruing point of the indicator oppostie the adjusting ring and zero-set the indicator. Then set the pointer of the indicator to the outer ring of the bearing. The dial indicator now shows directly the thickness the shims should have. Measure the shims for the correct thickness with a micrometer, see Fig. 4-155. NOTE. It is almost impossible to obtain a shim with exactly the correct thickness. However, they must not be 0.03 mm (0.0012") thicker than the measured value, but up to 0.08 mm (0.0032") thinner.

4. Press the rear bearing on the pinion with sleeve 2842, see Fig. 4-156. Fit the measured shims and press in both the outer rings of the bearings with tool 2845, see Fig. 4-157.

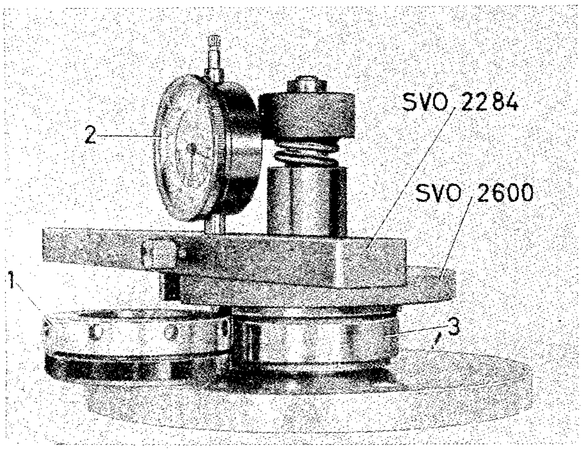


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Fig. 4-154. Determination of shim thickness
1. Adjusting ring 2. Dial indicator 3. Bearing assembly

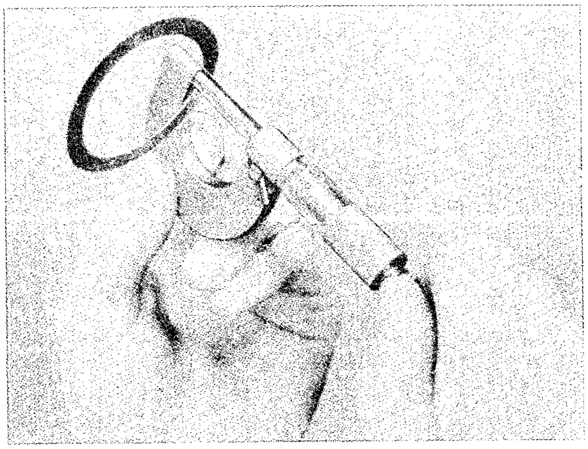

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Fig. 4-155. Measuring shim

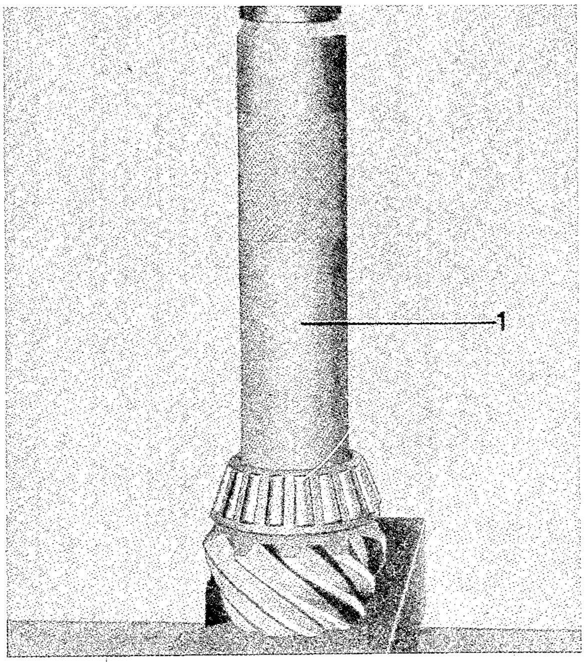

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Fig. 4-156. Installation of rear pinion bearing
1. Fitting sleeve 2842

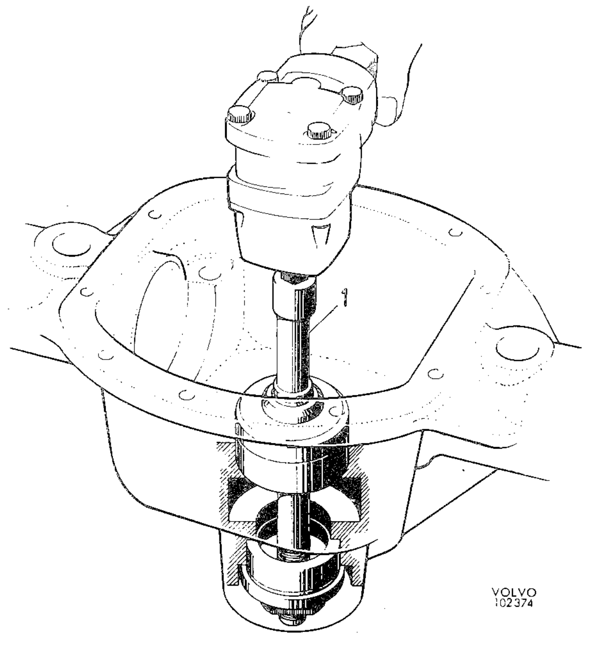


Fig. 4-157. Installation of bearing rings
1. Press tool 2845

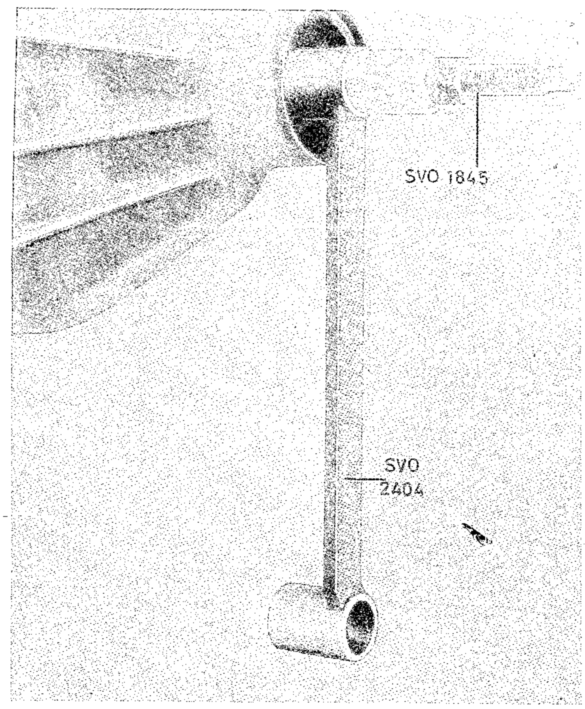


Fig. 4-158. Pinion installation

5. Insert the pinion in the casing and fit on three 0.75 mm (0.03") thick shims and the front pinion bearing. Fit tool 2404 and press tool 1845 on the front end of the pinion and pull in the pinion, see Fig. 4-158. Apply the nut tightener until it must press the pinion forwards so that it does not strike against the bearing positions.
6. Replace press tool 1845 with a washer and nut. Tighten the nut to a torque of 240—300 Nm (24—30 kpm= 180—220 lbft). Fit on the pinion gauge and the dial indicator retainer. Pull down the pinion while turning it forwards and backwards at the same time. Zero-set the indicator. Then press the pinion upwards, turning it at the same time forwards and backwards. Read off the clearance.
7. Remove the pinion. Remove the shims corresponding to the measured clearance +0.07 mm (0.003"). (0.09 mm=0.004" with replacement of pinion.) Re-fit the pinion.
8. Then check the pinion bearing fit with the torque gauge. The torque gauge should show 60—110 Nm (6—11 kpm=5.20—9.55 lbin) for used bearings and 110—230 Nm (11—23 kpm=9.55—20 lbin) for new bearings when the pinion rotates.
   Often an alteration in the thickness of the shims is required because of the tolerances which must be present.
9. Check the locating of the pinion with the dial indicator, retainer 2284 and measuring tool 2393, see also operation 2.

DIFFERENTIAL INSTALLATION

1. Lubricate the inside of the adjusting rings 2595 and put them on the differential carrier. The ring with the black-oxidized adjusting ring should be placed on the crown wheel side. Also lubricate the beraing location in the carrier. Place the differential carrier and the adjusting rings in the final drive housing, see Fig. 4-159. Use the dial indicator and adjust in the rings so that the correct tooth flank clearance 0.12—0.18 mm (0.005—0.008") is obtained. Tighten the lock screws in the adjusting rings.

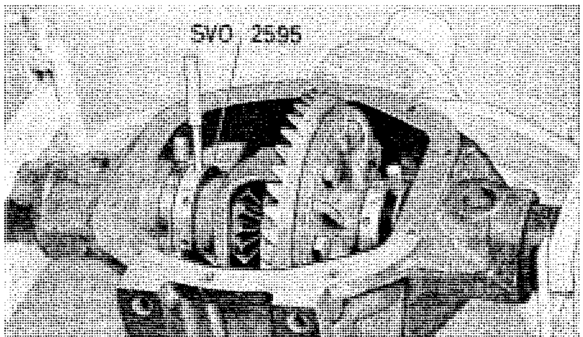


Fig. 4-159. Adjustment of rings for differential
1. Adjusting rings 2595

2. Because of altered manufacturing and testing of the differentials, marking blue can no longer be used as a criterion for correct installation. The pinion must always be installed in the position marked for this irrespective of the marking blue pattern. If in spite of correct installation and bearing pre-loading, the differentials make a noise, test with the pinion displaced 0.05 mm (0.0002") either in one or other direction. This may be of some help if the pinion should be incorrectly marked. One should hereby first try by moving out the pinion.
3. When the correct tooth flank clearance is obtained, remove the differential and adjusting ring. Then place the center washer on the measuring fixture. Install a bearing into the measuring fixture, also the plate, spring and nut. Install the nut with the flat side facing downwards. Rotate the plate forwards and backwards several times. Put on the dial indicator and retainer 2284. Zero-set the indicator to the adjusting ring and then place the measuring point facing the bearing, see Fig. 4-154. Read off the indicator. With a micrometer measure the shims, the total thickness of which corresponds to the read-off value +0.07 mm (0.003"). Place the shims together with the measured bearing to the one side. Repeat the above procedure with the other bearing.
   NOTE. Make sure which side the respective bearing and shims are to be fitted on.
4. Install the shims on the differential carrier and press on the beraings. Do not forget the lock plate for the crown wheel bolts, see Fig. 4-160.

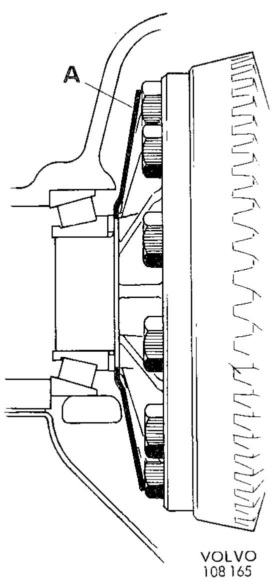


Fig. 4-160. Lock plate (A) for crown wheel bolts

5. Install tool 2394 on the drive pinion carrier, see Fig. 4-142. Expand the tool until the pins are exactly flush against the hole eyes in the carrier and then tighten the screws a further 3–3½ turns. Fit the differential and outer rings. Remove tool 2394. Fit the cap and tighten the bolts to a torque of 50–70 Nm (5–7 kpm=36–50 lbft).
6. Check the tooth flank clearance and the mesh pattern.

REAR AXLE ASSEMBLY

1. Remove spanner 2404. Fit the oil slinger and oil seal. The oil seal is fitted with tool 2806, see Fig. 4-138.
   When fitting the oil seal, smear the seal lips with grease. At the same time apply a layer of grease to the spring coil. This last-mentioned measure is to prevent the spring coil from jumping out of position during the fitting.
   Then press on the flange with the help of tool 1845, see Fig. 4-139. Fit the washer and nut. Tighten the nut to a torque of 280–300 Nm (28–30 kpm=200–220 lbft).
2. Fit the inspection cover and gasket.
3. Pack the drive shaft bearings with durable grease. Also fill the space between the sealing rings and between the sealing ring lips on the outer rings with grease, see Fig. 4–130. Fit the drive shafts. Tighten the bolts for the thrust washers to a torque of 50 Nm (5 kpm=36 lbft).
4. Then fit the brake discs and brake caliper. Finally fit the brake pipes.

REAR AXLE INSTALLATION

1. Place the rear axle in fixture 2714, see Fig. 4-161, and push it in under the vehicle.
2. Fit the bolts securing the rear axle to the support arms and torque rods.
3. Screw tight the springs to the trailing arms. Raise the rear axle and at the same time guide the springs up onto the upper attachments. Make sure that the rubber spacers are fitted properly.
4. Install the Panhard rod to the body bracket.
5. Install the propeller shaft to the flange.
6. Insert the brake wire ends through the plastic pipes and screw them tight to the brackets. Hook on the springs securing the wires to the rear axle.
7. Lubricate the lever joints and their contact surfaces for the brake shoes with a light layer of heat-resistant, graphite grease and then install the levers on the wires.

8. Push in the wires and place the levers in position behind the rear axle flanges.
9. Apply a light layer of graphite grease on the slide surfaces of the shoes. Install the brake shoes and lower return springs.
10. Install the upper return spring and adjusting mechanism.
11. Install the brake durms and calipers. Use lock fluid on the caliper attaching bolts. Check that the brake discs are free from the brake pads.
12. Fix the brake pipes to the rear axle.
13. Adjust the brake drums so that their holes are oppostie the adjusting screws and adjust out the shoes by rotating the serrated wheel on the adjusting rings with a screwdriver. Stop the adjustment when the drums can just be rotated and then back the adjustment mechanism 4–5 teeth. Rotate the brake drums and check that the shoes do not drag. If they do, slacken 2–3 teeth more.
14. Install the shock absorbers to the upper attachments.
15. Install the rear wheels. Lower the vehicle.

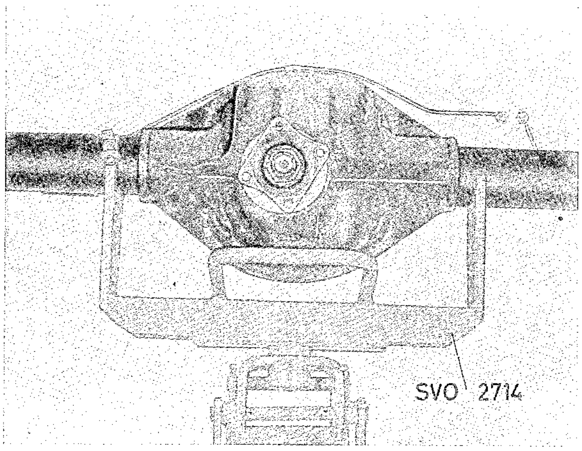


Fig. 4-161. Fixture for rear axle

	A	B	C	D	E	F	a	b	c	d	e	f	g	h	l	m	n	p	s	N	O	P	Q	R	S	T	U	V	W	X	Z
Engagement of "R", "D" or "L"																															
Bumpy	—	2	—	1	—	—	—	—	5	3	—	4	—	—	—	—	—	—	—	—	6	—	7	—	—	—	—	—	—	—	—
Delayed	1	—	2	3	—	—	4	7	6	5	—	—	—	—	—	—	—	—	8	9	—	10	—	—	11	—	—	—	—	12	—
None	1	—	2	—	—	—	3	4	5	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	8	9	10
																						—	—	—	—	5	—	—	—	—	—
Starting from rest																															
None forward	—	—	1	—	—	—	—	3	2	—	—	—	—	—	—	—	—	—	—	4	—										
None reverse	—	—	1	—	—	2	7	6	5	—	—	—	—	—	—	3	4	—	—	—	—	9	—	—	8	—	—	—	—	—	—
Seizure reverse	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—
No neutral	—	—	1	—	—	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—
Upshifts																															
No 1—2	—	—	1	—	2	—	8	9	10	—	—	6	7	3	—	4	—	—	—	—	—	—	—	5	—	—	—	—	—	—	—
No 2—3	—	—	1	—	—	—	8	9	10	—	—	6	7	2	—	—	3	4	—	—	—	5	—	—	—	—	—	—	—	—	—
Above normal shift speeds	—	1	—	—	—	—	—	8	9	10	—	2	7	3	—	4	5	6	—	—	—	—	—	—	—	—	—	—	—	—	—
Below normal shift speeds	—	1	—	—	—	—	—	5	6	—	—	2	—	3	—	—	—	4	—	—	—	—	—	—	—	—	—	—	—	—	—
Upshift quality																															
Slip on 1—2	1	2	3	—	4	—	8	9	10	6	—	7	—	—	—	—	—	—	—	—	—	—	—	5	—	—	—	—	—	—	—
Slip on 2—3	1	2	3	—	4	—	9	10	11	7	—	8	—	—	—	—	—	—	—	—	—	5	—	6	—	—	—	—	—	—	—
Rough on 1—2	—	1	—	—	2	—	—	—	10	3	—	4	5	6	—	—	—	—	—	9	—	—	—	—	—	—	7	8	—	—	—
Rough on 2—3	—	1	—	—	2	—	—	—	6	3	—	4	—	—	—	—	—	—	—	—	—	—	5	—	—	—	—	—	—	—	—
Seizure on 1—2	—	—	—	—	—	1	—	5	6	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	3	4	—	—	—	—
Seizure on 2—3	—	—	—	—	1	—	2	3	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Downshifts																															
No 2—3	—	1	—	—	—	—	—	—	—	—	—	—	—	3	—	2	—	—	—	—	—	—	—	—	4	—	—	—	—	—	—
No 3—2	—	1	—	—	—	—	—	—	—	—	—	—	—	3	—	2	—	—	—	—	—	—	4	5	—	—	—	—	—	—	—
Involuntary high speed 3—2	1	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—	—	—
Above normal shift speeds	—	1	—	—	—	—	—	5	6	—	—	4	—	2	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—
Below normal shift speeds	—	1	—	—	—	—	—	5	6	—	—	4	—	2	—	7	8	3	—	—	—	—	—	—	—	—	—	—	—	—	—
Downshift quality																															
Slip on 2—1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—
Slip on 3—2	—	—	—	—	1	—	6	7	8	4	—	5	—	—	3	—	—	—	—	—	—	9	—	2	—	—	—	—	—	—	—
Rough on 2—1	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	1	—	—	—	—	—
Rough on 3—2	—	—	—	—	1	—	—	—	5	3	—	4	—	—	2	—	—	—	—	—	—	6	7	8	—	—	—	—	—	—	—
Line pressure																															
Low, idling	1	—	2	3	—	—	6	8	5	4	—	—	—	—	—	—	—	—	7	—	—	—	—	—	—	—	—	—	9	—	—
High, idling	—	1	—	2	—	—	—	—	—	3	5	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Low at stall	1	2	—	—	—	—	6	8	7	3	—	5	4	9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	—
High at stall	—	—	—	—	—	—	—	—	4	1	—	2	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Stall speed																															
More than 10 r/s (600 r/m) below nominal speed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Over 43.3 r/s (2600 r/m)	1	—	2	—	—	3	4	5	6	7	—	—	—	—	—	—	—	—	—	8	—	9	—	—	10	11	—	12	—	—	13
Overheating	1	—	—	—	2	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4

The numbers indicate the recommended sequence of fault investigation

FAULT INVESTIGATION KEY

Preliminary adjustment faults

A. Fluid level incorrect.
B. Downshift valve cable incorrectly assembled or adjusted.
C. Manual linkage incorrectly assembled or adjusted.
D. Incorrect engine idling speed.
E. Incorrect front brake band adjustment.
F. Incorrect rear brake band adjustment.

Hydraulic control faults

a. Oil tubes missing or not installed correctly.
b. Sealing rings missing or broken.
c. Valve body assembly screws missing or incorrectly tightened.
d. Primary regulator valve sticking.
e. Secondary regulator valve sticking.
f. Throttle valve sticking.
g. Modulator valve sticking.
h. Governor valve sticking, leaking or incorrectly fitted.
l. Orifice control valve sticking.
m. 1—2 shift valve sticking.
n. 1—2 shift valve sticking.
p. 2—3 shift valve plunger sticking.
s. Pump check valve missing or sticking.

Mechanical faults

N. Front clutch slipping due to worn plates or faulty parts.
O. Front clutch seized or plates distorted.
P. Rear clutch slipping due to worn plates or faulty check valve in piston.
Q. Rear clutch seized or plates distorted.
R. Front band slipping due to faulty servo, broken or worn brake band.
S. Rear brake band slipping due to faulty servo, broken or worn brake band.
T. One-way clutch slipping or incorrectly fitted.
U. One-way clutch seized.
V. Input shaft broken.
W. Pump drive fingers on converter hub broken.
X. Pump worn.
Y. Rear pump worn or drive key broken.
Z. Converter blading and/or one-way clutch fails.

QUICK-REFERENCE TROUBLE-SHOOTING CHART FOR AUTOMATIC TRANSMISSION
(The numbers indicate the recommended sequence of fault investigation)

1. Crankshaft
2. Clutch plate shaft (input shaft, gearbox)
3. Support bearing in crankshaft
4. Circlip
5. Clutch plate
6. Flywheel
7. Flywheel casing
8. Clutch cover
9. Retainer
10. Thrust plate
11. Support rings
12. Pressure spring
13. Release bearing
14. Clutch wire
15. Washer
16. Rubber bushing
17. Washer
18. Nut
19. Rubber stop
20. Stop bracket
21. Pedal shaft
22. Clutch pedal
23. Adjusting nuts
24. Cover, gearbox
25. Lever and release shaft
26. Release fork
27. Return spring
28. Washer

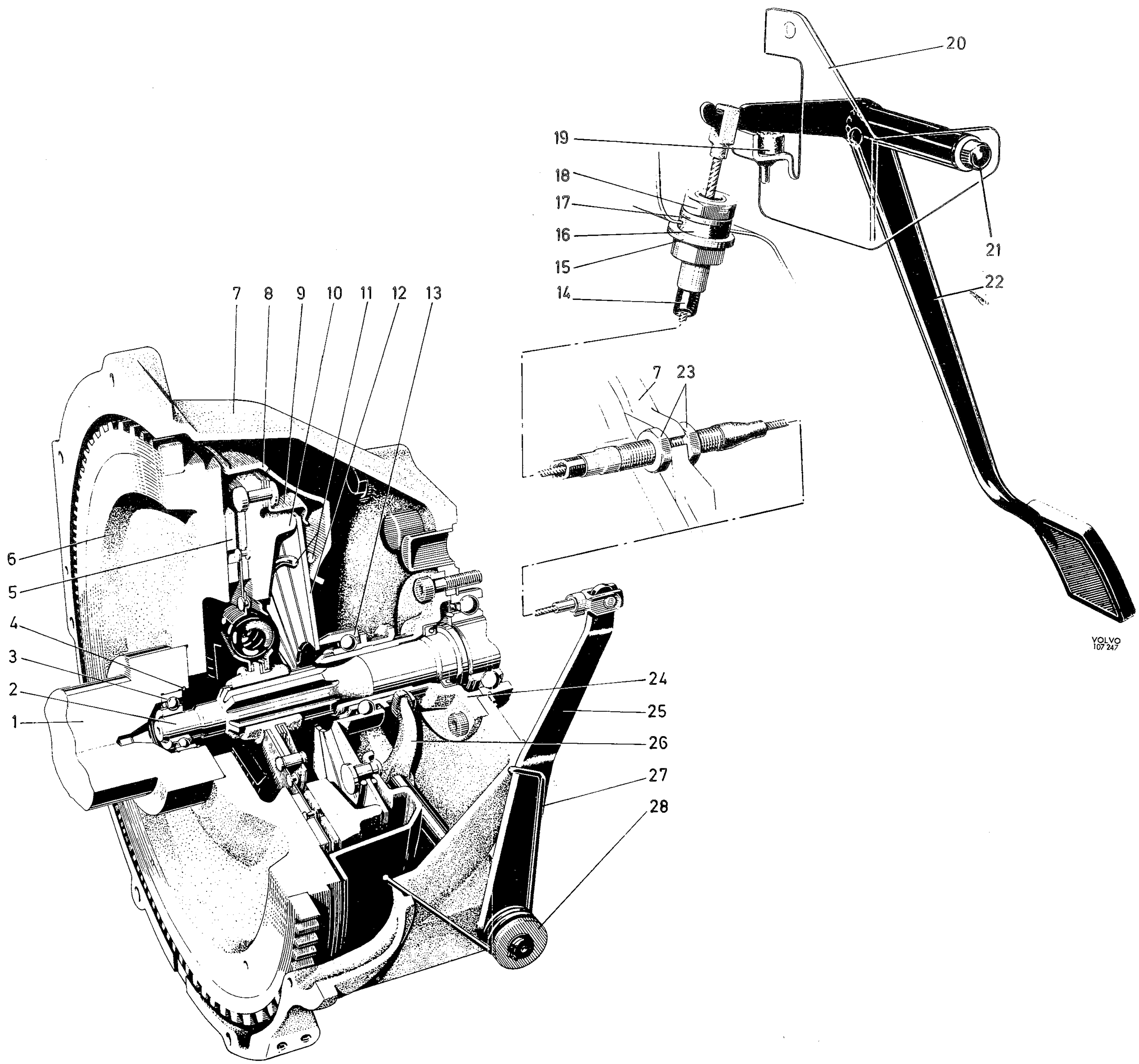


Illustration 4-A. Clutch and clutch controls

1. Clutch casing
2. Engaging ring
3. Interlock ball
4. Spring
5. Selector rail, reverse gear
6. Selector rail for 1st and 2nd gears
7. Selector rail for 3rd and 4th gears
8. Insert
9. Spring
10. Selector fork
11. Gear wheel, 3rd speed
12. Switch for overdrive
13. Gear wheel, 2nd speed
14. Actuator for switch
15. Needle bearing
16. Spring
17. Synchronizing hub. 1st–2nd gears
18. Interlock ball
19. Sliding plate
20. Gate
21. Selector fork, 1st and 2nd gears
22. Gearbox cover
23. Synchronizing cone
24. Gate
25. Switch for reversing lights and seat belt reminder
26. Bushing
27. Thrust washer
28. Ball bearing
29. Selector fork reverse gear
30. Mainshaft
31. Shaft
32. Bushing
33. Gear lever knob
34. Gear lever, upper section
35. Rubber bushing
36. Rubber bushing
37. Gear lever, lower section
38. Circlip
39. Spring
40. Washer
41. Casing
42. Intermediate flange
43. Shift lever
44. Gear wheel, 1st gear
45. Needle bearing
46. Reverse gear
47. Bushing
48. Flange pin
49. Engaging sleeve and gear wheel for reverse gear
50. Circlip
51. Reverse gear shaft
52. Needle bearing
53. Gear wheel
54. Gearbox housing
55. Friction ring
56. Synchronizing hub
57. Engaging sleeve
58. Circlip
59. Synchronizing cone
60. Roller bearing
61. Drain plug
62. Gear wheel
63. Countershaft
64. Roller bearing
65. Ball bearing
66. Oil seal
67. Cover
68. Input shaft

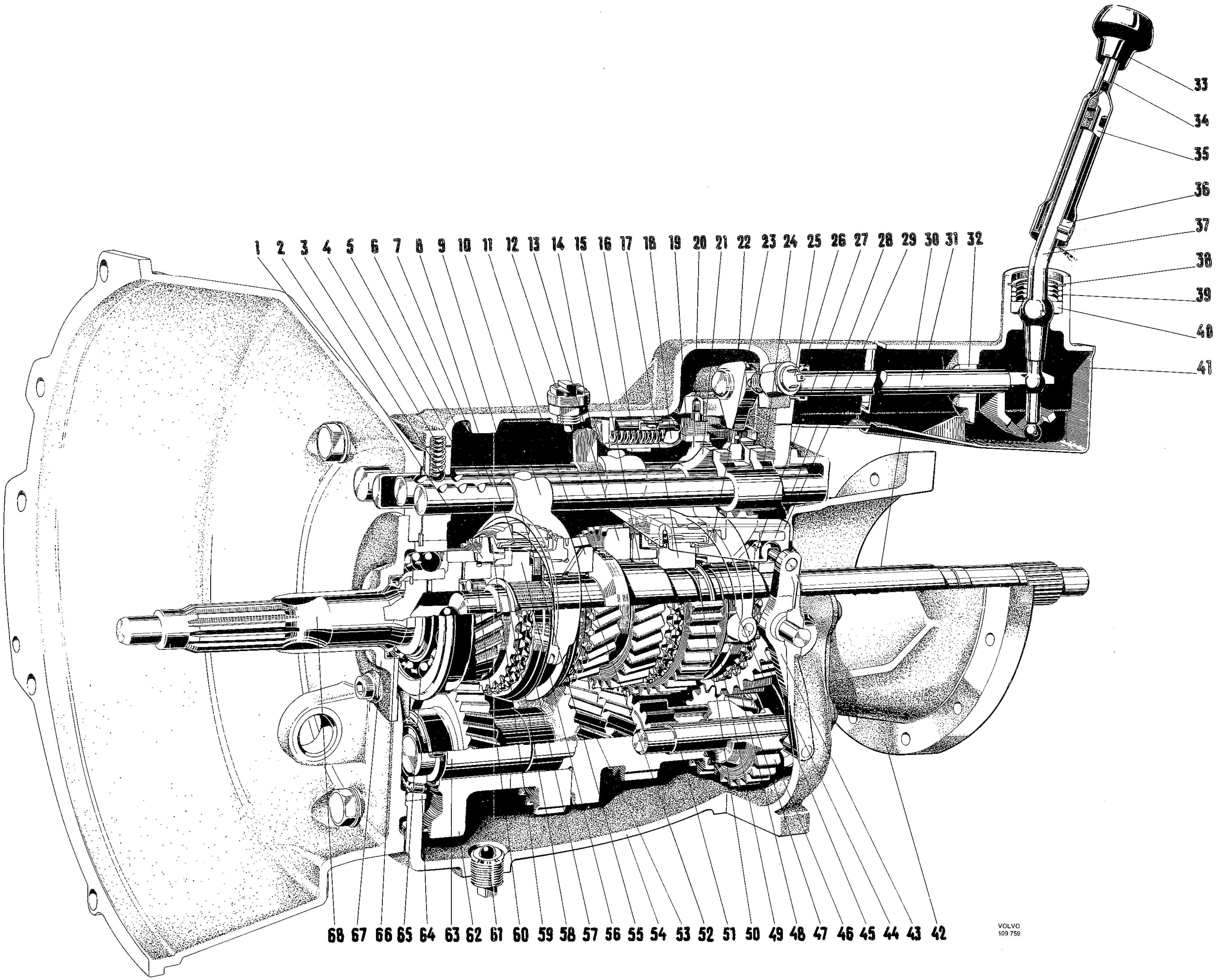


Illustration 4-B. Transmission

1. Nut
2. Lock washer
3. Bridge piece
5. Breather
6. Front casing
7. Gasket
8. Brake ring
9. O-ring
10. O-ring
11. Seal
12. Gasket
13. Solenoid
14. Bolt
15. Thrust bearing retainer
16. Spring
17. Ball bearing
18. Snap ring
19. Snap ring
20. Snap ring
21. Stud
22. Piston seal
23. Piston
24. Connecting rod
25. Non-return ball
26. Non-return valve spring
27. Plug
28. Key
29. Resilient ring
30. Snap ring
31. Eccentric
32. Piston pin
33. Gasket
36. Stud
37. Orifice nozzle
38. Seal
39. Plug
40. O-ring
41. End piece
42. Piston
43. Washer
44. Spring
45. Retainer
46. Spring
47. Screw
48. Screw
49. Holder
50. Spring
51. O-ring
52. Plug
53. Nut
54. Piston
57. O-ring
58. Cylinder
59. O-ring
60. Plug
61. Spring
62. Ball
63. Non-return body
64. O-ring
65. Pump body
66. Pump plunger
67. Washer
68. Fine filter
69. Seal
70. Plug
71. Data plate
72. Screw
73. Planet gear and carrier
74. Sun gear
75. Clutch sliding member
76. Pre-filter
77. Gasket
78. Magnet
79. Base plate
80. Bolt
81. Resilient washer
84. Bush
85. Thrust washer
86. Oil thrower
87. Snap ring
88. Uni-directional clutch
89. Stud
90. Resilient washer
91. Nut
95. Speedometer pinion
96. O-ring
97. Bushing
99. Bolt
100. Retainer
101. Oil seal
102. Stud
106. Speedometer driving gear
110. Output shaft
111. Ball bearing
112. Spacer
113. Rear casing
114. Ball bearing
115. Oil seal
116. Flange
117. Washer
118. Nut

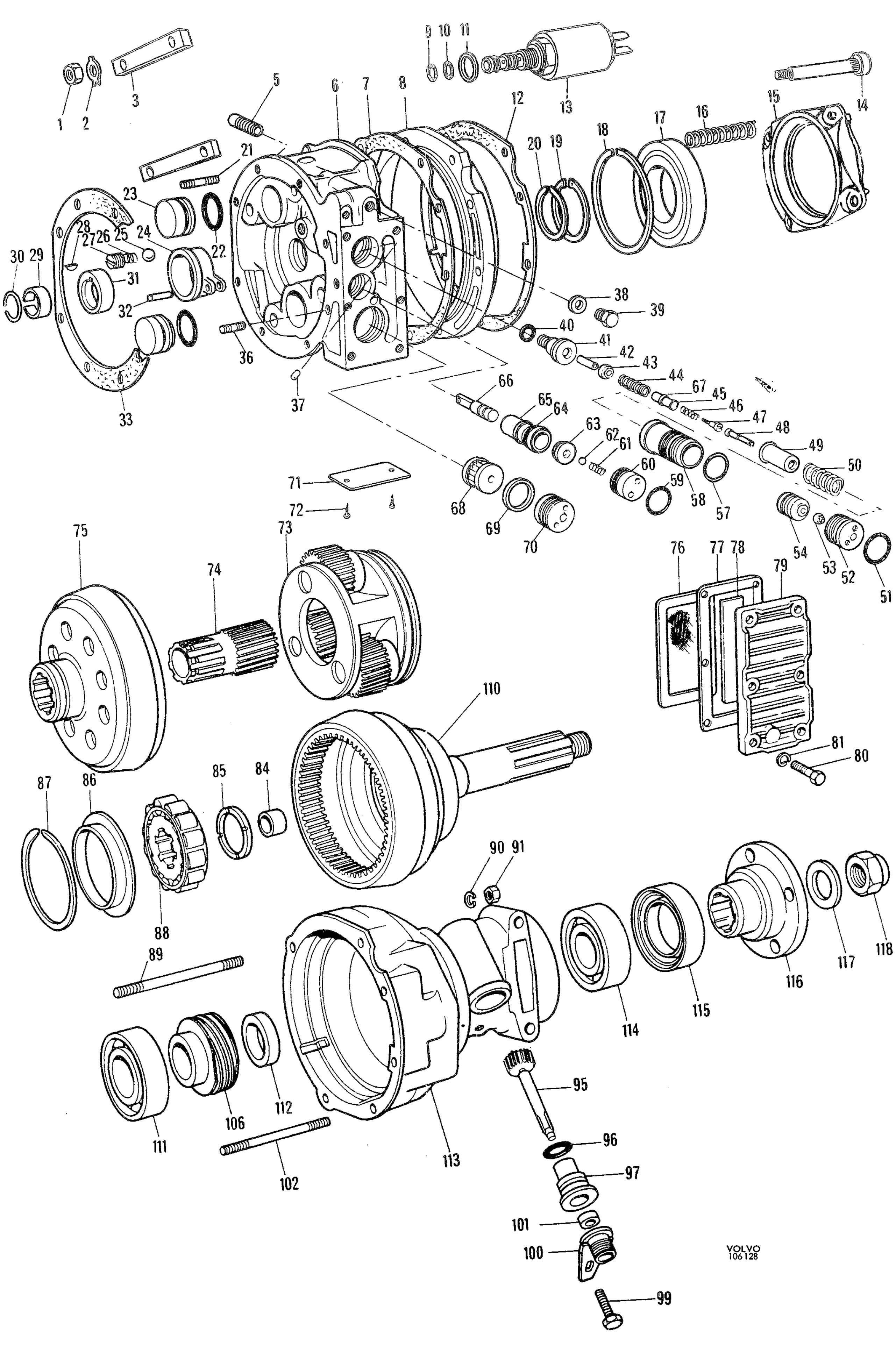


Illustration 4-C. Overdrive

1. Oil seal
2. Pump
3. O-ring
4. Pump body
5. Gasket
6. Thrust washer
7. Snap ring
8. Input shaft
9. Thrust washer
10. Hub
11. Disc kit
12. Snap ring
13. Spring
14. Ring
15. Piston ring (rubber)
16. Piston and reed
17. Rubber ring
18. Front clutch cylinder
19. Front servo
20. Servo strut
21. Contact pin
22. Brake band
23. Thrust washer
24. Thrust washer
25. Snap ring
26. Spring seat
27. Spring
28. Snap ring
29. Disc kit
30. Piston ring
31. Piston
32. Front drum
33. Oil ring
34. Rubber ring
35. Needle bearing
36. Key
37. Reverse sun gear
38. Needle thrust plate
39. Oil rings
40. Forward sun gear
41. Oil ring
42. Center bearing
43. Servo strut
44. Brake band
45. Needle thrust bearing
46. Thrust plate
47. Snap ring
48. Free wheel
49. Brace
50. Planetary gear
51. Thrust plate
52. Gear
53. Snap ring
54. Driven shaft
55. Washer
56. Oil ring
57. Seal ring
58. Gearbox housing
59. Rear servo
60. Stop shaft
61. Nipple
62. Plate
63. Oil deflector flange
64. Bolt
65. Valve spindle
66. Spring
67. Valve
68. Centrifugal governor
69. Counter weight
70. Speedometer gear
71. Flange

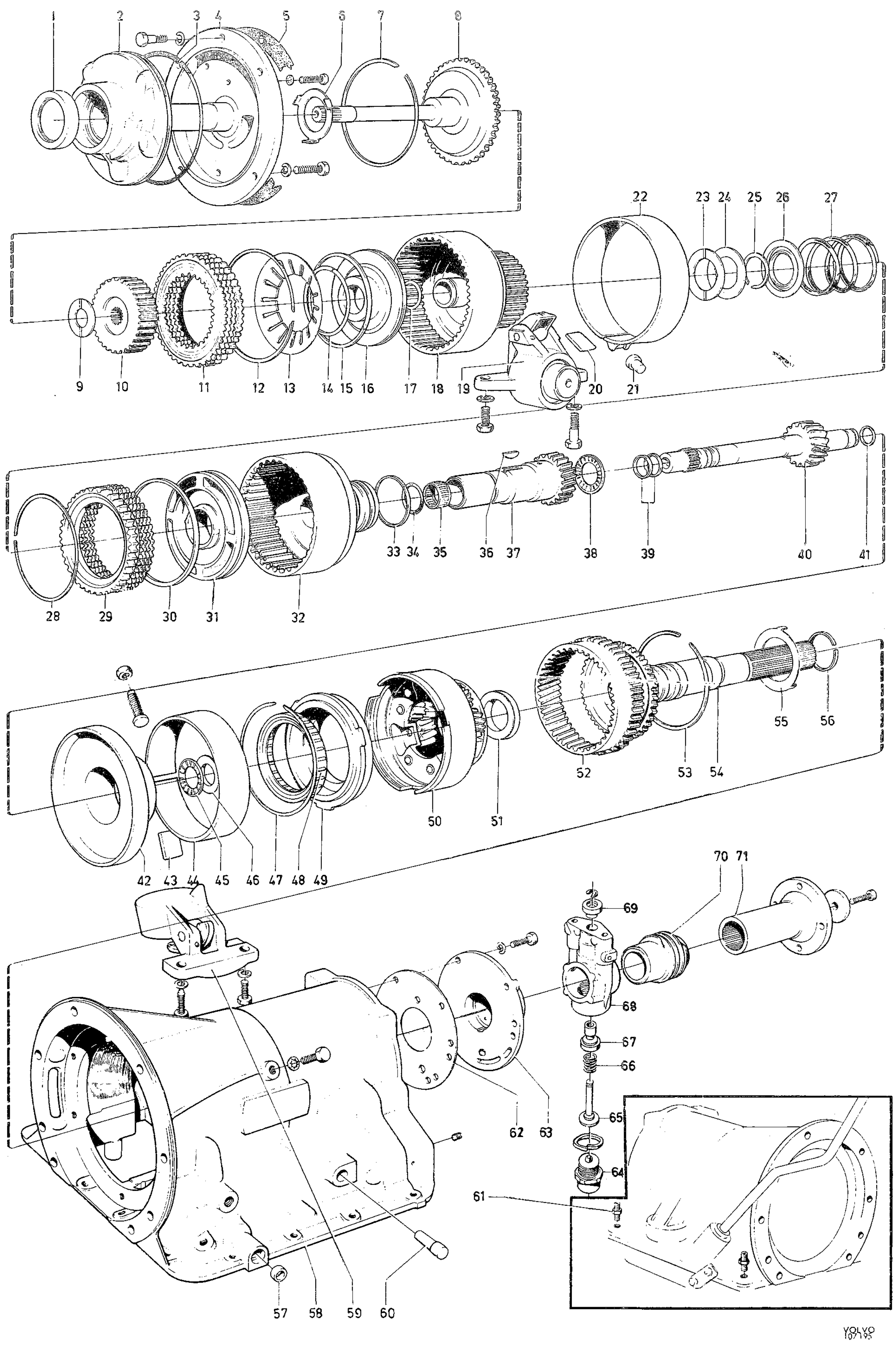


Illustration 4-D. Automatic transmission BW 35

1. Tubular shaft
2. Differential carrier bearing
3. Bearing cap
4. Shims
5. Differential carrier
6. Thrust washer
7. Differential side gear
8. Lock pin
9. Differential pinion
10. Crown wheel
11. Shaft
12. Thrust washer
13. Lock plate
14. Rear axle casing
15. Flange
16. Dust cover plate
17. Oil seal
18. Oil slinger
19. Shims
20. Front pinion bearing
21. Pinion
22. Rear pinion bearing
23. Shims

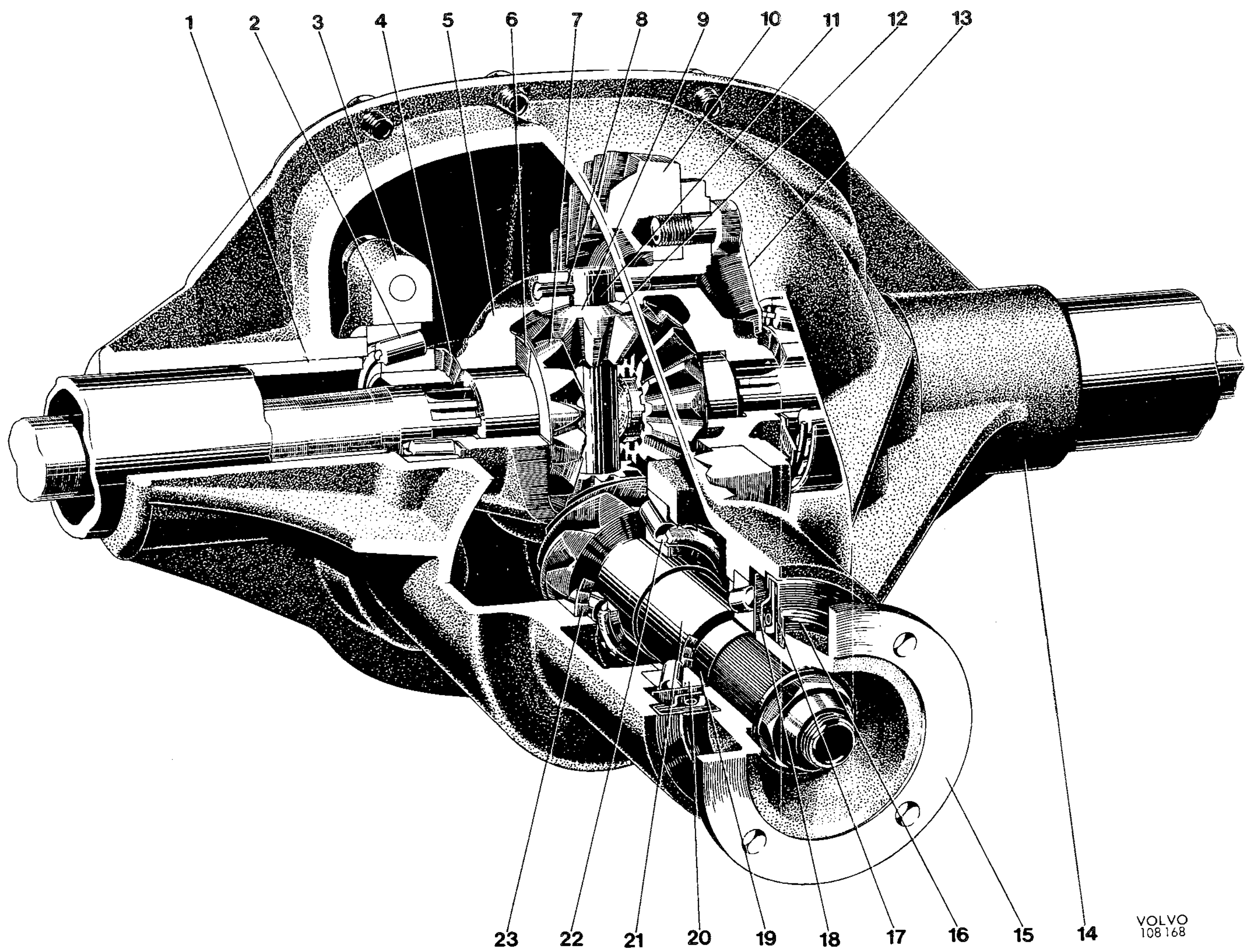


Illustration 4-E. Final drive

Section 5

BRAKES

CONTENTS

GENERAL
TOOLS

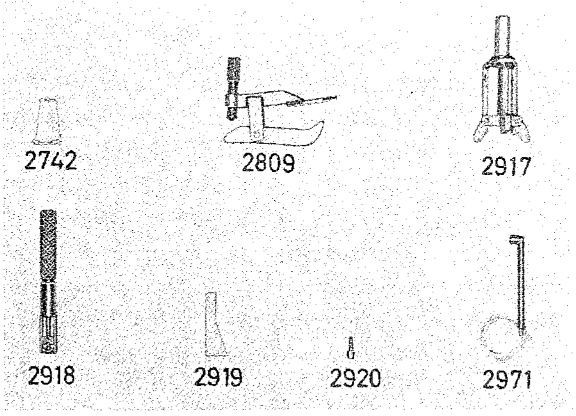


Fig. 5-1. Special tools

999 (SVO)

2742	Holder for cable spring
2809	Tool for pressing in piston
2917	Extractor for brake pads
2918	Tool for turning piston
2919	Template for piston
2920	Nipple for testing
2971	Bleeder wrench

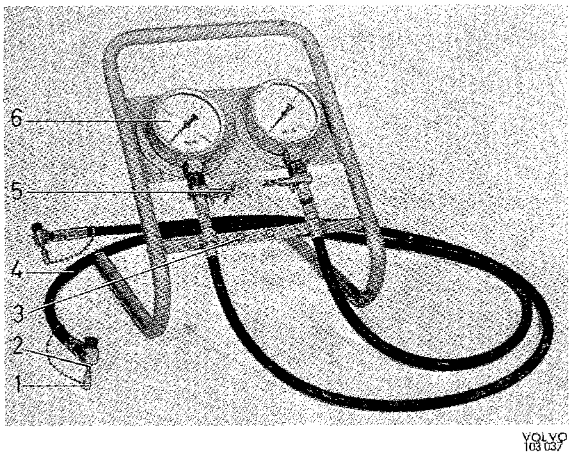


Fig. 5-2. Testing device 2741

1. Nipple plug
2. Connection nipple
3. Enlarging nipple
4. Hose
5. Bleeder device
6. Pressure gauge

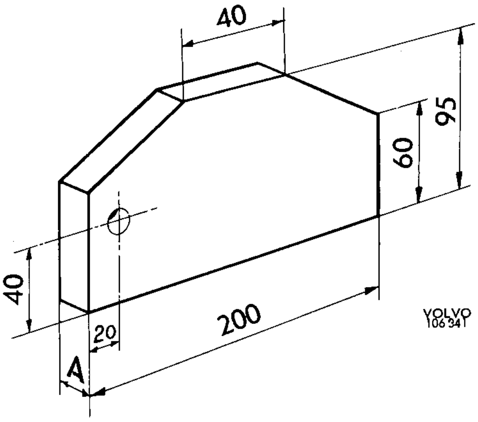


Fig. 5-3. Wooden insert for brake calipers

A=26 mm (1") for front and 13 mm (½") for rear brake calipers

The number for the special tools is preceded by 999 or SVO (e.g. 999 2742 or SVO 2742).

The following special tools are used for repair work on the brake system.

The testing device (Fig. 5-2) is used, for example, to trace faults in the brake system.

Removal of the pistons in the brake caliper is made easier with the help of wooden inserts according to Fig. 5-3.

A hose connection (see 2, Fig. 5-4) is possibly required for removing the pistons in the calipers.

A bleeder unit of the type shown in Fig. 5-5 is used for bleeding the system. A connection cover (see 1, Fig. 5-4) is also required for connecting the unit to the brake fluid container.

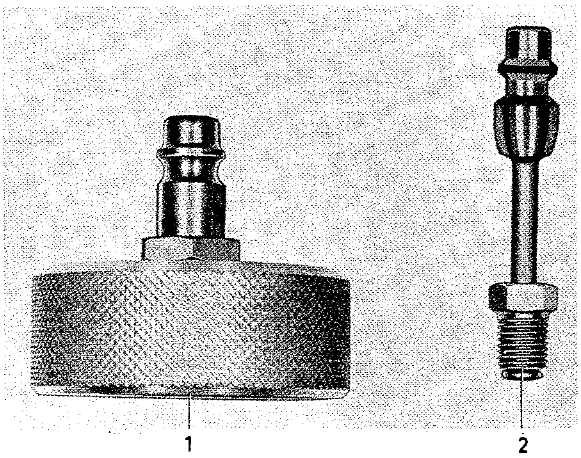


Fig. 5-4. Connections

1. Connection
   (Can be obtained from Volvo Service Dept.)
2. Connection for brake caliper

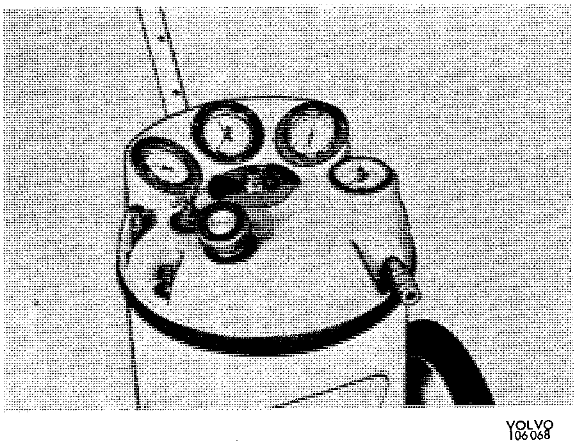


Fig. 5-5. Bleeder unit

GENERAL INFORMATION

The 164 is fitted with two brake systems which are independent of each other. One of these, the footbrake system, is controlled by a brake pedal and operates on all four wheels through a hydraulic system. The other brake system, the parking brake, functions by means of a brake lever and operates both the rear wheels mechanically.

Fig. 5-6 shows the arrangement of the footbrake system which has disc brakes all round.

The hydraulic part has two separate circuits. The master cylinder (1) is of the tandem-type and each front wheel brake unit (13) has two pairs of cylinders entirely separated from each another. One of the circuits serves the lower cylinders of the front wheel brake units and the right rear wheel, while the other circuit takes care of the upper cylinders of the front wheel brake units and the left rear wheel. With such an arrangement, braking effect is ensured, should one of the brake lines fail.

The power brake cylinder (5) is directly influenced by the brake pedal, and with vacuum assistance from the induction manifold of the engine less pedal pressure is required for braking. The function of the brake valves (10 and 11) is to assist in providing a suitable distribution of braking power between the front and rear wheel brakes. Concerning a more detailed description of the units making up the footbrake and the parking brake systems, see the respective Groups in question.

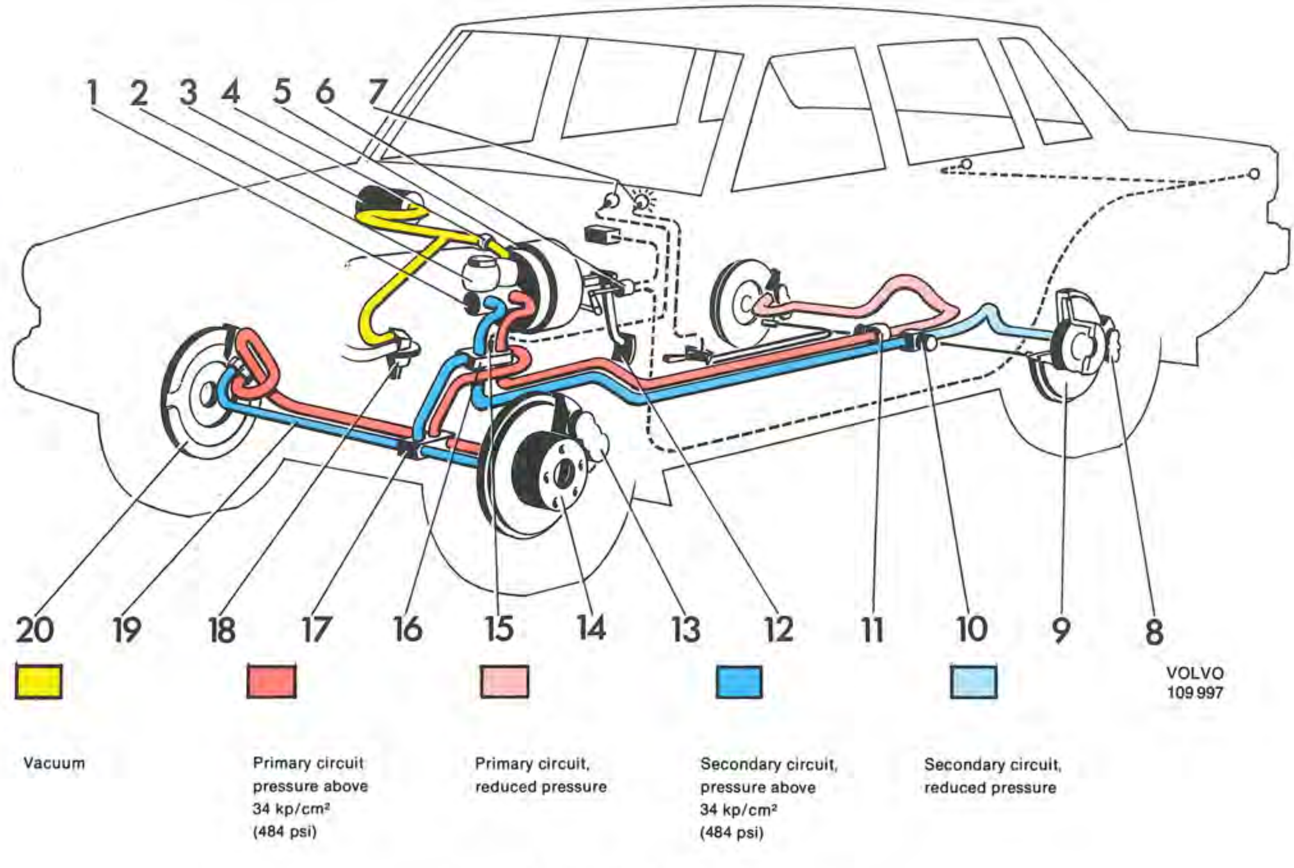


Fig. 5-6. Brake system

1. Tandem master cylinder
2. Brake fluid container
3. Vacuum
4. Check valve
5. Power brake cylinder
6. Brake switch
7. Wrning lamps
8. Rear brake caliper
9. Brake disc with drum
10. Brake valve, secondary circuit
11. Brake valve, primary circuit
12. Brake pedal
13. Front brake caliper
14. Brake disc
15. Warning switch
16. Warning valve
17. 6-brake union, (double 3-branch union)
18. Vacuum pump
19. Brake pipe
20. Cover plate

CLEANING

The components of the hydraulic brake system should be cleaned in clean brake fluid or denatured alcohol, which does not contain benzene (benzol).

Of the existing kinds of denatured alcohol being sold generally only methylated spirit is free from benzene. Brake fluid is an excellent but expensive cleaning agent. From most viewpoints, methylated spirit is therefore the most suitable.

Petrol, white spirit, trichloroethylene or alcohol with benzene must not be used for cleaning as, like the slightest trace of mineral oil, they attack the rubber seals and cause them to swell out. For this reason, hands should be washed with soap and water before the internal parts are touched. The mechanic working with the hydraulic components should be provided with rubber gloves.

Final rinsing should take place in a cleaning agent free from impurities after which the parts can be dried in the open air. To precipitate the drying and complete the cleaning process, filtered, compressed air free from moisture can be used. It is of the utmost importance that no alcoholic residue is left in the system when filled with brake fluid. Traces of alcohol in the brake fluid reduces its boiling point and can result in the formation of vapor which can affect brake functioning.

After being cleaned and dried, the parts should be moistened with brake fluid, assembled and then the complete unit filled with brake fluid as soon as possible in order to prevent corrosion attacks from moisture in the air. This applies to parts which should be fitted immediately in the vehicle. To counteract corrosion on brake parts which are stored, or for any other reason are not covered by brake fluid, the plungers, cylinders and seals should be coated with a thin layer of lubricant called brake paste intended for this purpose. Under no conditions whatsoever must other types of grease or rustproofing oil be used.

BRAKE FLUID

Only first-class brake fluid, which is guaranteed by a well-known manufacturer to fulfil the requirements according to the standard SAE J 1703, should be used for the brake system. Brake fluid with designation DOT 3 or DOT 4 can also be used. Fluids which only fulfil the requirements according to SAE 70 R 1, for example HD-quality and FS-VV-H 910 A, should not be used. Mixing of brake fluids produced by different firms should be avoided.

When the container of the master cylinder is being filled, likewise with all work concerning connections, etc. the greatest cleanliness should be observed in order to prevent dirt from getting into the system. Only clean, unused brake fluid should be filled. **Brake fluid which is expelled during, for example, bleeding, may not be put back into the system.**

After use over a long period, it is normal that even first-class brake fluid gradually deteriorates through the absorption of moisture and small impurities. Thus, deteriorated brake fluid can be recognized by the fact that, compared with new brake fluid, it is darker or has changed its color, is relatively odorless and watery, i.e. when felt between the fingers it lacks the normal feeling of a light lubricating film. Such brake fluid should be replaced by new fluid, and this should also be done when the master cylinder and wheel brake units are being overhauled, and at certain intervals, see under "Servicing".

TROUBLE SHOOTING

The following trouble shooting procedure can be used, for example, after the discovery, following upon some kind of brake testing, that the capacity of the footbrake system is not what it should be. Trouble shooting can also be carried out with a view to preventing faults arising.

1. Check that the level of the brake fluid reaches up to the "Max" mark on the container. Top up, if necessary. See under "Brake Fluid".
2. Remove inner and upper, also outer venting nipples at one of the front brake calipers and connect up the testing device 2741 shown in Fig. 5-2.
3. Depress the brake pedal several times to even out any partial vacuum in the power brake cylinder and in this way disconnect it. Check that when free the brake pedal is about level with the clutch pedal.
4. Apply and release the footbrake while reading off the pressure gauges of the testing device. The pressure in both the circuits should be observed. At 100 kp/cm² (1422 psi), there must not be a difference in pressure of more than 3 kp/cm² (42.7 psi).
5. With the help of a pedal jack apply the footbrake to a hydraulic brake pressure of about 100 kp/cm² (1422 psi). Check the lines and parts for damage and leakage. The pressure should remain unchanged for at least 15 seconds.
6. Remove the pedal jack. Depress the brake pedal and maintain this pressure. Start the engine. Here a noticeable lowering of the pedal should be felt when the power cylinder starts to operate.
7. Stop the engine after it has run at least 1 minute. With the help of the pedal jack apply a hydraulic pressure of 25 kp/cm² (356 psi). Wait a couple of minutes. The hydraulic pressure should not drop more than 5 kp/cm² (71 psi).
8. Check the warning valve. Connect a hose to one of the bleeder nipples of the testing device and open the

device. Switch on the ignition switch and check that the warning lamp lights when the parking brake is applied.

Release the parking brake. With a pedal jack apply the footbrake slowly. When the warning lamp lights, check the pressure on the pressure gauge. The lamp should light at a pressure difference of 5—15 kp/cm² (71—213 psi) between the circuits.

After the test, shut off the bleeder nipple and remove the pedal jack. Disconnect the electric cable and unscrew the warning valve switch so that the warning valve returns to its normal position. Screw in the electric switch to a tightening torque of 14—20 Nm (1.4—2.0 kpm=10—14 lbft). Connect the electric cable.

9. Check the brake valve of the secondary circuit by connecting the testing device to the bleeder nipple on the left rear wheel brake unit and to the upper outer nipple on one of the front wheel brake units. Apply the footbrake with the pedal jack to the incoming pressure according to the table below. Read off the incoming pressure on the pressure gauge for the front wheel brake unit. Read off the outgoing pressure on the gauge which is connected to the rear wheel brake unit. From the point of view of leakage, the brake valve is not defective if the pressure remains unaltered for at least 15 seconds.

Incoming pressure kp/cm² (psi)	25	45	100 (1422)
Outgoing pressure kp/cm² (psi)	25	32—37	48—55

10. Check the other brake valve in the same way by connecting it to right rear wheel brake unit and the inner nipple of the front wheel brake unit.
11. Jack up the vehicle so that the wheels rotate freely. Apply and release the brake during which a check is made to see if the wheels can be rotated. The wheels should be free for half a second after the pedal has been released. The test should be carried out with and without a partial vacuum in the power brake cylinder.

TROUBLE SHOOTING SCHEME

Test operation	Fault	Cause	Remedy
3	Pedal too low or too high	Faulty brake pedal or carpet	Adjust
4	Fading pressure	Damaged brake line	Replace the damaged line
		Blocked hose	Replace hose
	Difference between circuits greater than 3 kp/cm² (42.7 psi)	Leakage in one of the circuits	See point 5
		Faulty master cylinder	Overhaul master cylinder
5	The pressure drops	External leakage	Tighten connections and replace line or recondition leaking part
		Leaking brake valve	Replace brake valve
		Leaking seal in wheel unit cylinder	Overhaul wheel unit cylinder
		Leaking seal in master cylinder	Overhaul master cylinder
6	The pedal does not go down	Leaking vacuum line	Replace vacuum line
		Blocked air filter or leaking seal for front pressure plunger in power cylinder.	Replace filter or seal
		Faulty power cylinder	Replace power cylinder completely

Test operation	Fault	Cause	Remedy
7	The pressure drops more than 5 kp/cm² (71 psi)	Leaking check valve	Remove and blow clean the valve and replace the seal ring. If insufficient, replace check valve
		Leaking seal for front pressure plunger in power cylinder	Remove master cylinder and replace seal
		Internal fault in power cylinder	Replace power cylinder completely
8	The parking brake warning lamp does not light	Wrongly adjusted switch	Adjust the switch
		Faulty electrical parts	Replace faulty parts
	Footbrake warning lamp does not light	Faulty switch	Replace switch
	Warning lamp does not go out when pistons have returned to normal positon	Pistons seize	Replace warning valve
	Warning when pressure difference is other than 5—15 kp/cm² (71—213 psi)	Faulty warning valve	Replace valve
9—10	Faulty outgoing pressure	Faulty valve	Replace brake valve
11	A circuit fades	Blocked equalizing hole in master cylinder	Overhaul the master cylinder
	The rear wheel brakes fade	Parking brake cable chafes	Replace the cable
		Faultily adjusted parking brake	Adjust the parking brake
		Faulty brake valve	Replace brake valve
	A wheel brake fades	Damaged brake line	Replace line
		Blocked hose	Replace hose
		Worn sealing ring	Overhaul wheel brake unit

SERVICING

From the point of view of traffic safety, the condition of the brakes is an extremely important factor. It is essential, therefore, that any work carried out on the system should be done by qualified mechanics with the greatest care, likewise that a regular check is made according to the instructions given below.

CHECKING BRAKE FLUID LEVEL

When filling the tank with fuel, check to make sure that the fuel level in the master cylinder container is not below the "Min" mark. This can be done without removing the cap. Every 10 000 km (6 000 miles) top-up, if necessary, to the "Max" container mark.
A first-class brake fluid which meets the requirements according to SAE J 1703 should be used for topping-up. Brake fluid with designation DOT 3 or DOT 4 can also be used. Before removal, clean the cap of the container and observe maximum cleanliness when filling with fluid. Avoid spilling the brake fluid onto the paintwork as this can damage it. Check to make sure that the vent-hole in the cap is not blocked.

CHECKING BRAKE PADS

Every 10 000 km (6 000 miles) check the wear on the linings. The brake pads should be replaced when the linings are worn down to a thickness of about 3 mm (1/8"). Under no circumstances must the linings be worn down below 1.5 mm (1/16"). For replacement of the pads, see pages 5 : 10 and 5 : 11.

FUNCTION CHECK

In addition to the regular check on the brakes carried out by the driver as result of the driving done, the brakes should be checked every 10 000 km (6 000 miles) by a workshop mechanic. The footbrake should also be checked then to make sure that it functions satisfactorily; if necessary, check with the help of proper testing equipment (see "Trouble Shooting"). A check should also be made that there is no leakage and that the brake lines are not exposed to such damage that leakage can be expected. The parking brake should provide full braking power at the 3rd—4th ratchet segment. If it does not do so, adjust the parking brake according to the instructions given on page 5 : 34.

OVERHAUL

Every third year or 80 000 km (48 000 miles) the brake system seals and air filter for the power cylinder should be replaced. Where driving conditions are mostly dusty, the air filter should be replaced more often. The brake fluid in the entire system should be changed at the same time. With continuously hard driving, for example, hill climbing, etc., where the brakes have to be used very often, we recommend a change of brake fluid once a year. This also applies in a very damp climate.

WHEEL BRAKE UNITS

GENERAL INFORMATION

FRONT WHEEL BRAKE UNIT DESIGN

Fig. 5-7 shows the location of the brake components on the front wheels. The disc (3) is of cast iron and is attached to the wheel hub with which it rotates. The disc is of the so-called "ventilated" type, that is, it has air ducts. This improves the cooling. The cover plate (4) protects the disc from dirt.

Mounted on the stub axle is the front wheel caliper (2) which houses the wheel unit cylinders and brake pads. The front wheel brake caliper consists of a housing in two halves (6 and 7, Fig. 5-8) bolted together and located on either side of the brake disc. Each half contains two cylinders and pistons. The upper cylinder is completely separated from the lower one, but both upper and lower cylinders are each connected through channels to the corresponging cylinder in the other half. The function of the sealing rings (1) is partly to prevent brake fluid from oozing out and partly to return the pistons to the rest position after braking. Rubber dust covers (3) prevent dirt from entering. Each sealing ring has a square section and presses against the piston from the slightly oblique groove in the housing. The brake pads (12) are provided with bonded facings and are held in position by means of guide pins (9).

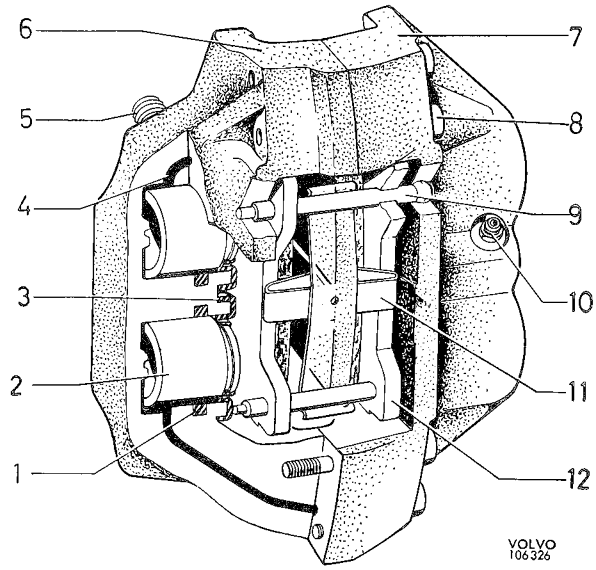


Fig. 5-8. Front wheel brake caliper

1. Sealing ring
2. Piston
3. Rubber dust cover
4. Channel
5. Upper bleeder nipple
6. Outer half
7. Inner half
8. Bolt
9. Guide pin
10. Inner bleeder nipple
11. Damping spring
12. Brake pad

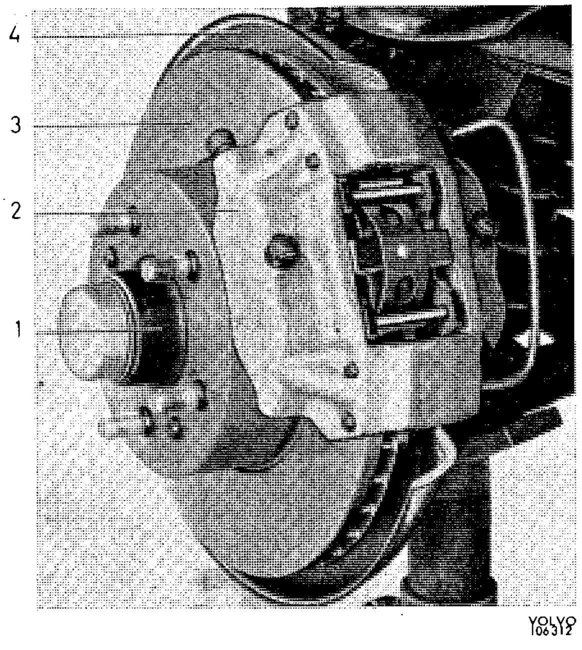


Fig. 5-7. Brake components, front wheel

1. Hub
2. Front brake caliper
3. Brake disc
4. Cover plate

REAR WHEEL BRAKE UNIT DESIGN

(Footbrake component)

Fig. 5-9 shows the location of the brake components on the rear wheels. The brake disc (2) is of cast iron and is fixed to the drive shaft with which it rotates. The cover plate (3) prevents dirt from reaching the disc.

The rear wheel brake caliper is mounted to the rear axle casing with the help of a retainer. It houses the wheel unit cylinders and brake pads. It consists of a housing divided in two halves (2 and 8, Fig. 5-10) bolted together and located on either side of the brake disc. Each half contains a piston and a cylinder linked by means of a channel in the housing.

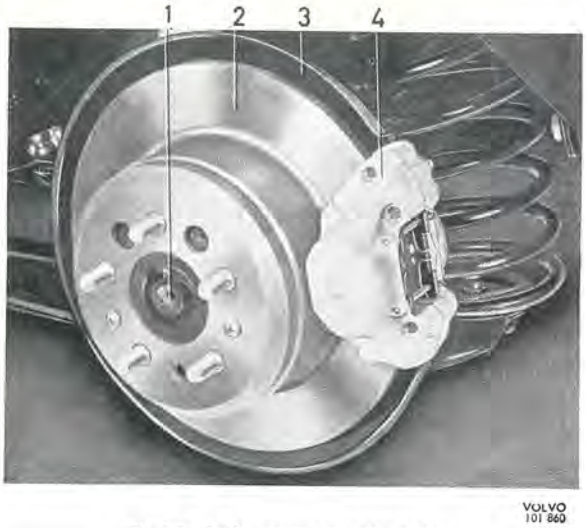


Fig. 5-9. Brake components, rear wheel
1. Drive shaft
2. Brake disc
3. Cover plate
4. Rear brake caliper

The sealing rings (5) have a square section and press against the piston from the slightly oblique groove in the housing. The function of the sealing rings is partly to prevent brake fluid from oozing out and partly to return the pistons to the rest position after braking. The rubber dust covers (3) prevent dirt from entering. The brake pads (9) are provided with bonded facings and are held in position by means of guide pins (11).

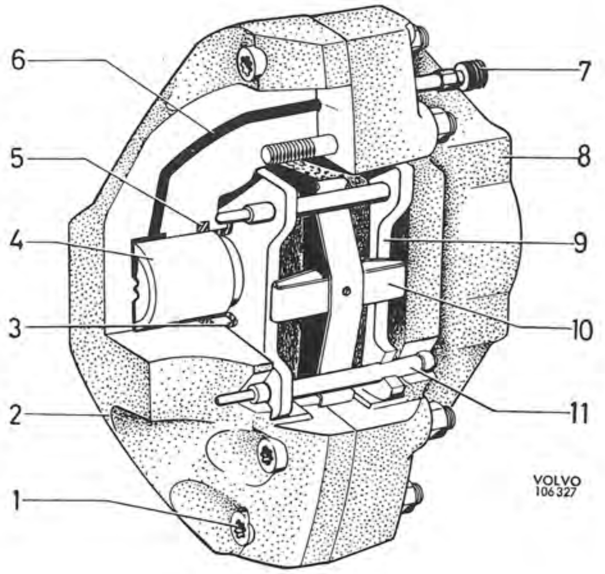


Fig. 5-10. Rear brake caliper
1. Bolt
2. Outer half
3. Rubber dust cover
4. Piston
5. Sealing ring
6. Channel
7. Bleeder nipple
8. Inner half
9. Brake pad
10. Damping spring
11. Guide pin

FUNCTION

HYDRAULIC

The lower cylinders of the front wheel brake units and the right rear wheel brake unit are connected through brake lines to the primary chamber of the master cylinder, see Fig. 5-11. In the same way the upper cylinders of the front wheel brake units and the left rear wheel brake unit are connected to the master cylinder through the secondary chamber.

A warning valve is located between the master cylinder and the brake lines for both the circuits. The valve is connected to the same warning lamp which indicates when the parking brake is applied. The lamp will light during brake application if there is too large a pressure difference (about 0.1 MPa=142 psi) between the two brake circuits.

When the pressure in the master cylinder rises as a result of brake application, the pistons are displaced and press the lining pads against the rotating friction surface of the brake disc, see Fig. 5-12. The pressure applied, and thus the braking effect, varies in proportion to the foot effort applied to the pedal. When the pistons are displaced, the sealing rings are tensioned laterally. They remain in this

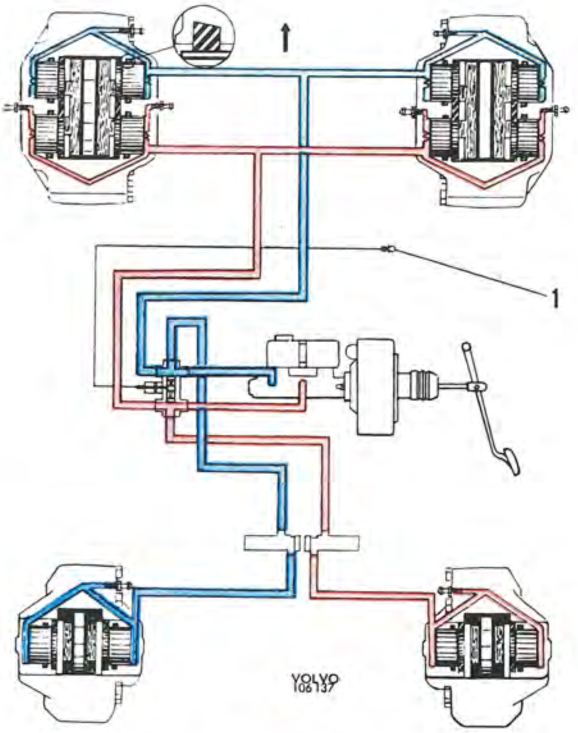
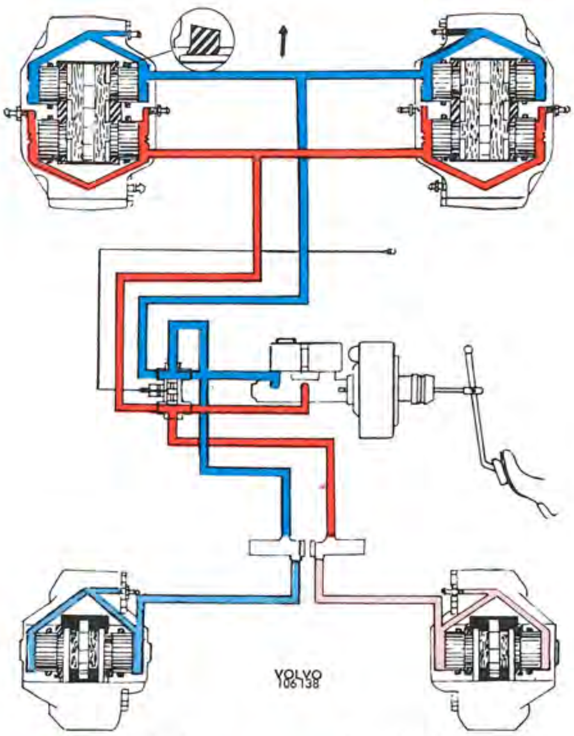


Fig. 5-11. Rest position
1. Warning lamp

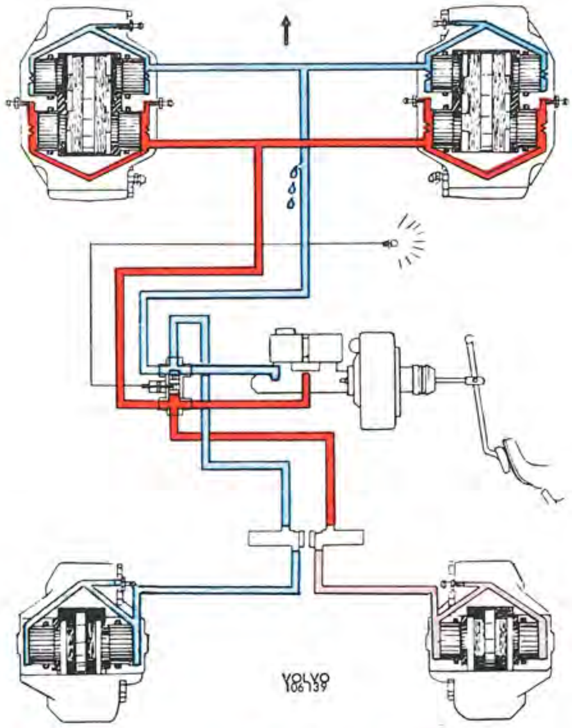
state as long as the footbrake is applied. When the brake pedal is released, the pistons are relieved of hydraulic pressure. Since there is nò residual hydraulic pressure in the system line, the tension in the sealing rings is sufficient to move the pistons back to a certain extent, see Fig. 5-11. The return movement forms the clearance between the brake linings and the brake disc. This means that, in the rest position, the brake linings are always at a certain distance from the brake disc regardless of wear, so that the wheel brakes are self-adjusting.

Should leakage occur in one of the circuits, full braking effect is still obtained on both the front wheels and one rear wheel if pedal pressure is increased. Fig. 5-13 shows how this operates when leakage occurs in the secondary circuit. When there is a pressure difference in the brake circuits of about 0.1 MPa (142 psi), the warning valve piston is pressed over to the side with less pressure and the warning lamp lights. The warning lamp will remain lighted until the leakage in the circuit concerned is repaired.



Primary circuit, pressure above 34 kp/cm² (484 psi)
Primary circuit, reduced pressure
Secondary circuit, pressure above 34 kp/cm² (484 psi)
Secondary circuit, reduced pressure

Fig. 5-12. Brake application



Primary circuit, pressure above 34 kp/cm² (484 psi)
Primary circuit, reduced pressure
Secondary circuit, pressureless

Fig. 5-13. Brake application, leakage in secondary circuit

SERVICE PROCEDURES

REPLACING BRAKE PADS

The brake pads should be replaced when about 3 mm ($^1/_8$") of the lining thickness remains. On no account may the linings be worn down to below 1.5 mm ($^1/_{16}$").

1. Remove the hub caps and slacken the wheel nuts slightly.
2. Jack up the vehicle and prop blocks under the rear axle and front jack attachments. Unscrew the wheel nuts and lift off the wheels.
3. Tap out the upper guide pin with a drift with diameter 2.5 mm ($^9/_{64}$"), see Fig. 5-14. Take out the tensioning spring. Tap out the lower guide pin.
4. Pull out the pads with tool 2917, see Fig. 5-15. If the used pads are to be re-fitted, mark them to ensure they are restored to their original position.
5. Carefully clean out the cavity in which the pads are located. Replace any dust covers that are damaged. If dirt has penetrated into the cylinder due to a damaged cover, recondition the brake unit. Check the friction area of the brake disc. Grind off any rust.
6. To provide room for the new brake pads, press the pistons into the cylinders.
   With tool 2809, the pistons can be pressed in evenly and without risk of damage according to Fig. 5-16. If carried out properly, this pressing in can be done with another tool more rapidly with the same results, but faulty pressing in with a screwdriver can cause damage to the disc, rubber seal and piston. Note that when pushing in the pistons, the fluid level will rise in the brake fluid container so that the fluid may spurt out.

Fig. 5-15. Removing brake pads

7. Concerns rear wheel brakes: Check to make sure the pistons are in the proper position to avoid brake squeal. The piston recess should incline 20° in relation to the lower guide area on the caliper. Check the position with template 2919, see Fig. 5-29. The tolerance is ±2°, that is, when the template is placed against the one recess, the distance to the other (meas. A) may be max. 1 mm (0.039").
   If necessary, adjust the location of the piston with tool 2918. To do this, move the tool into position, see Fig. 5-30, press it against the piston and force out the shoes by screwing in the handle. Turn the piston, release the tool and re-measure with the template.
8. Install new pads. Place one of the guide pins in position and tap it in with a hammer without help from a tool, see Fig. 5-18.

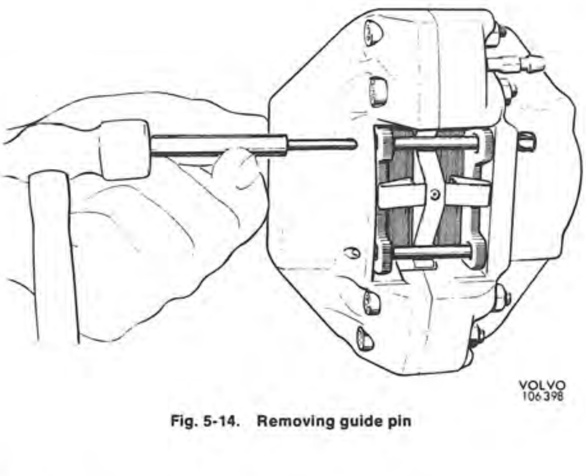


Fig. 5-14. Removing guide pin

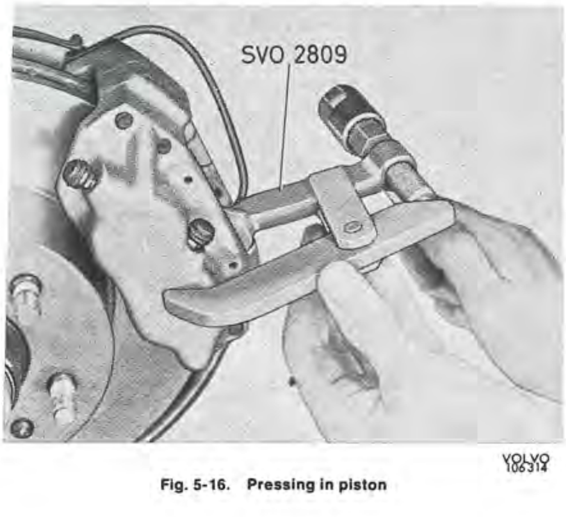


Fig. 5-16. Pressing in piston

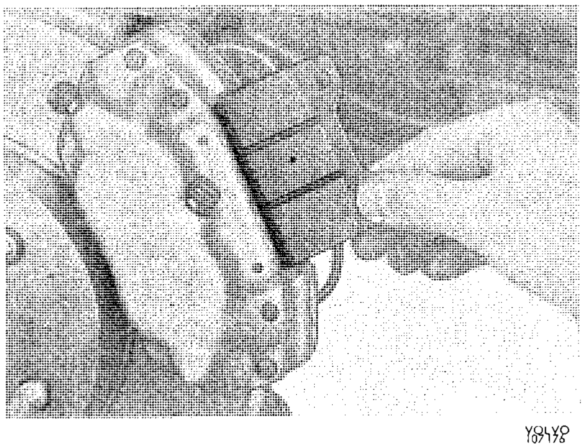


Fig. 5-17. Installing brake pads

Note: The guide pin must not be knocked in with the drift which has a smaller diameter than the pin since the tensioning sleeve can then shear off the pin flange. Fit a new tensioning spring for the pads. Fit the other guide pin while pushing in the tensioning spring. Check that the pads can move.

9. After replacing the necessary brake pads, depress the brake pedal several times to check that the movement is normal. Generally the system does not require bleeding after replacing the brake pads.
10. Install the wheels after cleaning the contact surfaces and brake disc of sand, dirt, etc. Tighten the nuts sufficiently so that the wheels are securely held. Lower the vehicle and tighten finally the wheel nuts. Tighten every other nut a little at a time until all are tightened to a torque of 100−140 Nm (10−14 kpm=70−100 lbft). Fit the hub caps.
    NOTE. The function and lifetime of the linings will benefit if lengthy and hefty braking is avoided in the beginning.

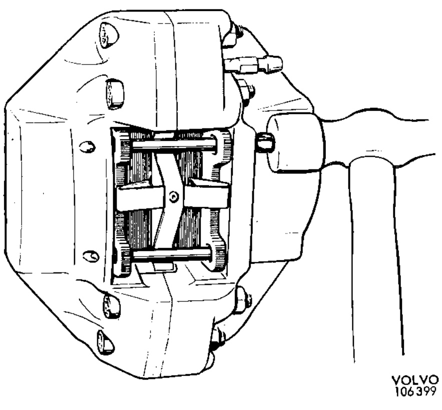


Fig. 5-18. Installing guide pin

OVERHAULING WHEEL BRAKE UNITS

When working with the hydraulic system, observe the instructions under "Cleaning" and "Brake fluid", Group 50.

Front brake calipers

REMOVAL

1. Remove the hub caps and slacken the wheel nuts slightly. Temporarily plug the vent-hole in the brake fluid container cap to reduce possible leakage.
2. Jack up the front end and prop blocks under the front jack attachments. The linkage arms should be off-loaded so that the brake hoses can be fitted in the correct position. Unscrew the wheel nuts and lift off the wheels.
3. Remove the clip (5, Fig. 5-19). Disconnect the connection (2) and the lower hose (4) from the bracket. Place the protective casing on the brake lines to prevent unnecessary leakage. Disconnect the connection (6) for the upper hose from the brake.
4. Unscrew the attaching bolts (5 and 7, Fig. 5-20) and remove the brake caliper, see Fig. 5-21.

DISASSEMBLY

1. Remove the brake pads, see ops. 3 and 4 under "Replacing brake pads".
2. Remove the retaining rings for the rubber dust covers. Place a piece of wood, similar in shape to that shown in Fig. 5-3, between the pistons and press them out

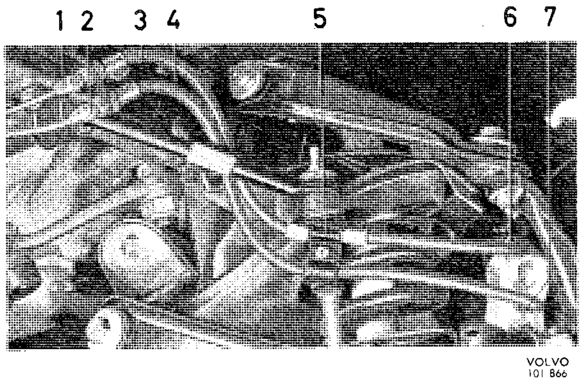


Fig. 5-19. Installing front brake hoses

1. Connection for the primary circuit
2. Connection for the secondary circuit
3. Upper brake hose
4. Lower brake hose
5. Clip
6. Connection for lower wheel unit cylinder
7. Connection for upper wheel unit cylinder

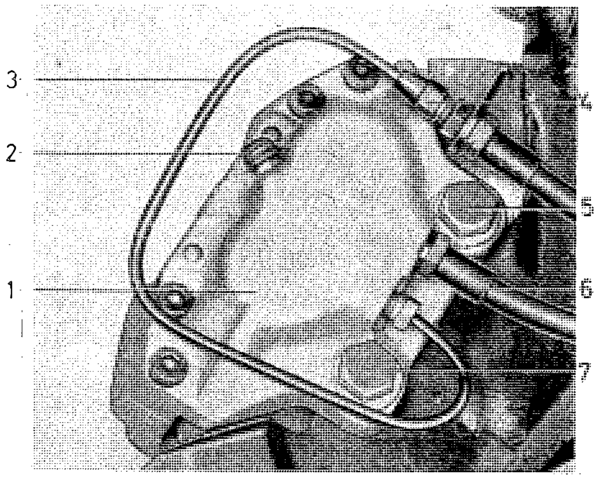


Fig. 5-20. Front wheel brake unit fitted

1. Front wheel brake caliper
2. Lower bleeder nipple
3. Upper bleeder nipple
4. Connection for lower wheel unit cylinder
5. Attaching bolt
6. Connection for upper wheel unit cylinder
7. Attaching bolt

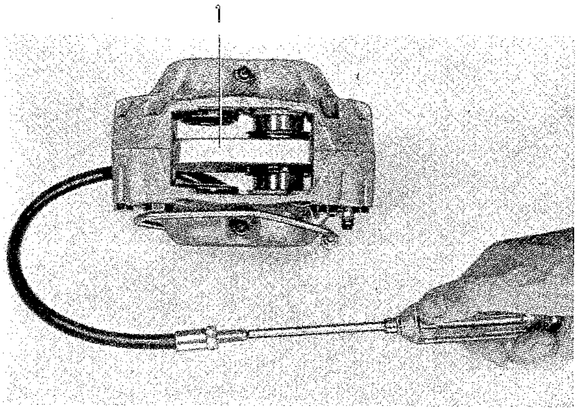


Fig. 5-22. Removing pistons
1. Wooden disc

NOTE. Both halves of the brake caliper should not be separated. The reason for this is that the assembling requires test pressure equipment and special fluid for the bolts.

against the wocd with the help of compressed air, see Fig. 5-22. The pistons can then be easily removed. Should any piston be so stiff that more pressure is required, connect up an air line, see Fig. 5-28. Lever off the rubber dust covers.

3. Remove the sealing rings with the help of a blunt tool. Be careful not to damage the edge of the grooves. Unscrew the bleeder nipples and also the brake lines.

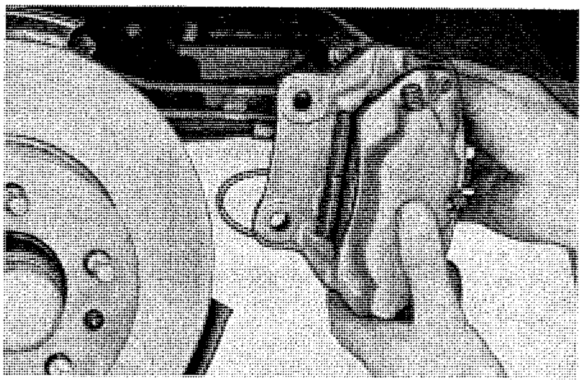


Fig. 5-21. Removing front wheel brake caliper

INSPECTION

Before inspecting clean all the parts according to the instructions given under "Cleaning", Group 50. Make sure that the channels are clean.

The sealing rings and rubber dust covers should be replaced whenever reconditioning takes place. If any of the cylinders are scored or scratched, or damaged in any way, the complete cylinder housing should be replaced. Inspect the other parts and replace any that are damaged or worn. Check also the brake disc, see under "Brake Disc".

ASSEMBLY

1. Coat the working surfaces of the pistons and cylinders with brake fluid.
2. Install new sealing rings in cylinders, see Fig. 5-23.
3. Install plungers with large end diameter facing inwards. Make sure that the plungers are installed straight and are not scratched.
4. Install rubber covers on plunger and housing. Install lock rings, compare Fig. 5-28.
5. Install brake pads, see op. 8. under "Replacing brake pads".
6. Install bleeder nipples and brake lines.

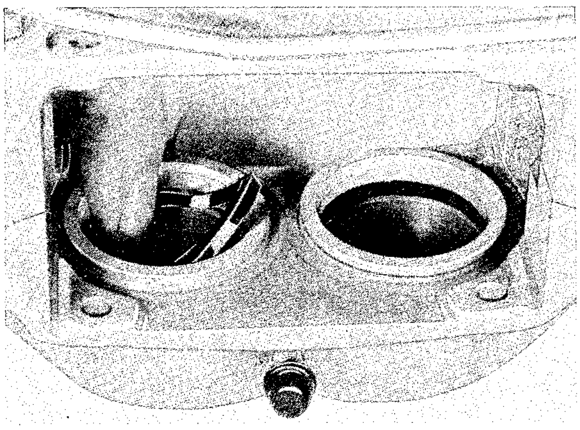


Fig. 5-23. Installing sealing ring

INSTALLATION

1. Place the caliper in position. Check that the contact surfaces of the retainer are clean and not damaged. Check the location of the brake caliper in relation to the brake disc. Axial deviation is checked by measuring with a feeler gauge on both sides of the disc the distance between disc and caliper support nib. The difference in measurement is max. 0.25 mm (0.010"). The caliper should be parallel with the disc. This is checked by measuring the distance to the upper and lower support nibs on the caliper. The location of the brake caliper can be adjusted with shims, which are available in thicknesses of 0.2 and 0.4 mm (0.008 and 0.016"). Fit the attaching bolts after they have been coated with a couple of drops of Locktite, type AV. Check that the brake disc rotates easily in the brake pads.

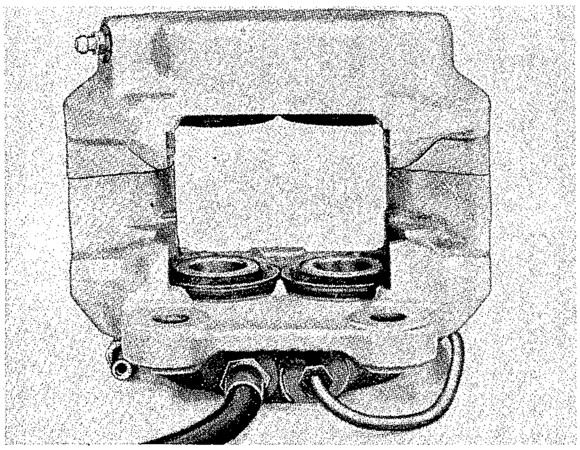


Fig. 5-24. Front brake caliper assembled

2. Install hoses and their connection as well as the guide clip as shown in Fig. 5-19. It is important that the hoses are fitted in the correct way, that is, without being tensioned and with the linkage arms unloaded. Remove the plug for the vent-hole in the brake fluid container cover.
3. Install wheel after the contact surfaces have been cleaned of dirt, and then tighten the nuts sufficiently so that the wheel cannot be displaced on the hub. Lower the vehicle and tighten the wheel nuts. Tighten every other nut a little at a time until all are finally tightened to a torque of 100—140 Nm (10—14 kpm=70—100 lbft). Install hub cap.
4. Bleed the brake system, see Group 52.

Rear wheel brake shoes

REMOVAL

1. Remove hub caps and slacken wheel nuts slightly. Temporarily block the vent-hole in the brake fluid container cap to reduce possible leakage.
2. Place front end on stands and under rear axle. Remove wheels. Release parking brake.
3. Disconnect the brake line (4, Fig. 5-25) at the connection to the caliper and fit a protective cover on the brake line. Remove attaching bolts (2 and 5, Fig. 5-25). Remove brake caliper, see Fig. 5-26.

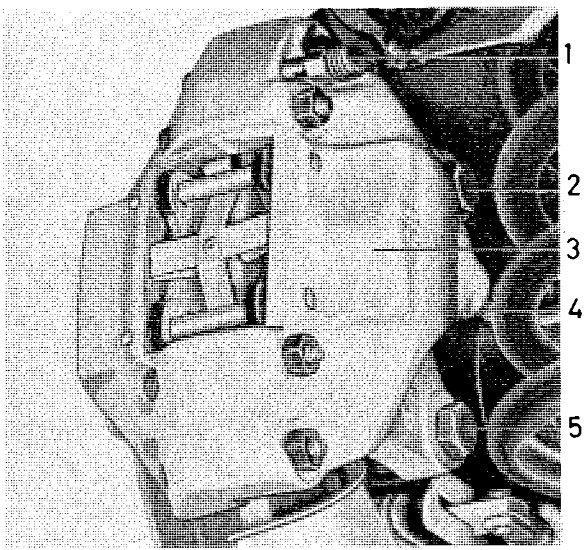


Fig. 5-25. Rear wheel brake unit installed

1. Bleeder nipple
2. Attaching bolt
3. Rear wheel brake caliper
4. Brake line
5. Attaching bolt

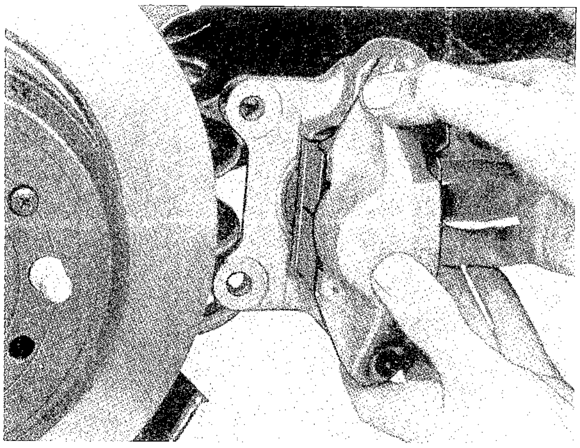


Fig. 5-26. Removing rear wheel brake caliper

DISASSEMBLY

1. Remove brakes pads, see ops. 3 and 4 under "Replacing brake pads".
2. Remove retaining rings and rubber dust covers. Place a wooden disc, see Fig. 5-3, between the pistons and press them out towards the disc with the help of an air line, see Fig. 5-27. The pistons can then be easily removed. Lever off rubber covers.
   If any piston is so stiff that greater pressure is required, connect up an air line, see Fig. 5-28. If one of the pistons has been removed, the cylinder can be sealed with a rubber washer and 2809 (see Fig. 5-28).

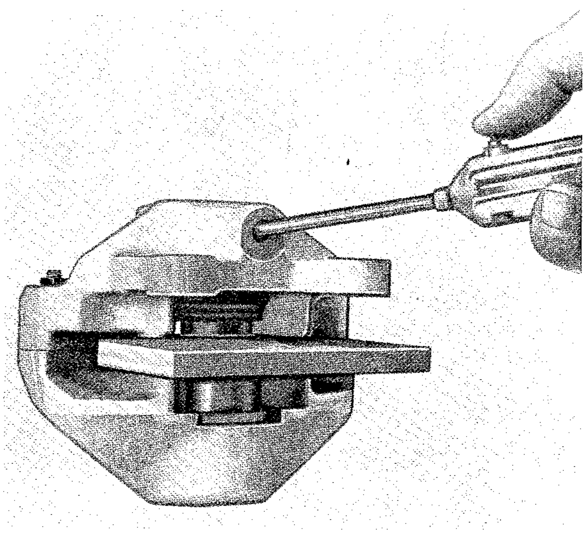
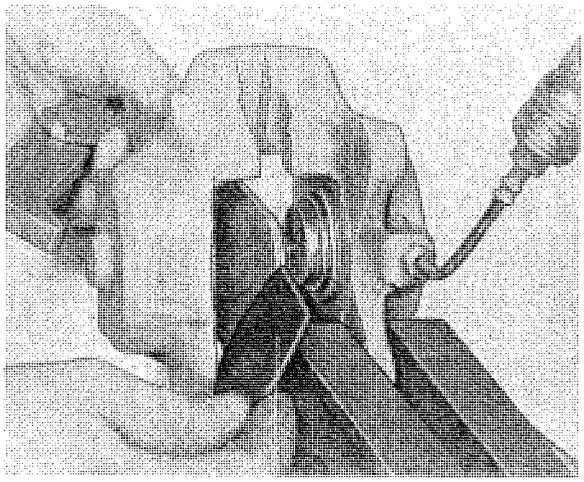


Fig. 5-27. Removing piston



A

Fig. 5-28. Removing piston
A=Rubber seal

3. Remove sealing rings with help of a blunt tool. Take care not to damage the edges of the grooves. Screw out the bleeder nipple.

NOTE. Both halves of the brake caliper should not be separated. The reason for this is, that assembling of these halves requires pressure testing equipment and special fluid for the screws.

INSPECTION

Before inspecting, clean the parts according to the instructions given under "Cleaning" Group 50. Pay particular attention to the cleaning of the channels. Sealing rings and rubber dust covers should be replaced when overhauling. If there are any scratches, etc., on any of the cylinders, change the entire cylinder housing complete. Inspect the other parts and replace those that are damaged and worn.

ASSEMBLY

1. Coat the working surfaces of the pistons with brake fluid.
2. Install new sealing rings in the cylinder, see Fig. 5-23.
3. Check to make sure the pistons are in the proper position to avoid brake squeal. The piston recess should incline 20° in relation to the lower guide area on the caliper. Check the location with template 2919, see Fig. 5-29. The tolerance is ±2°, that is, when the

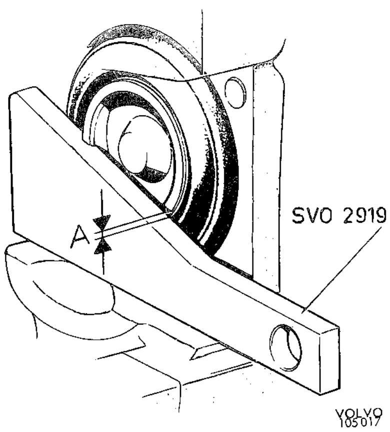


Fig. 5-29. Checking location

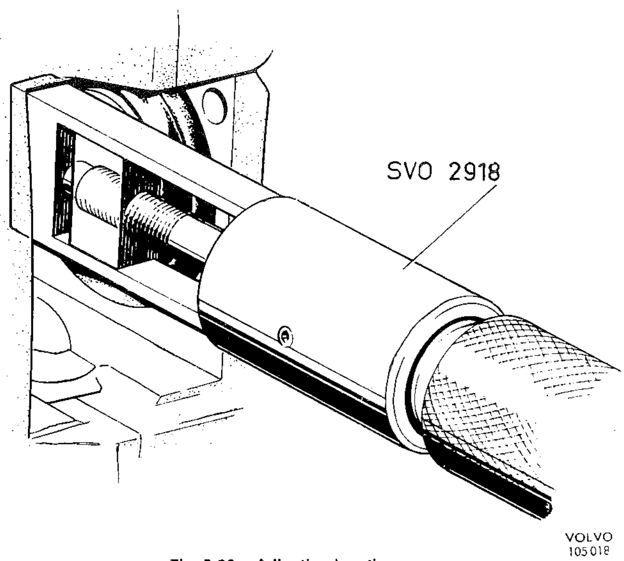


Fig. 5-30. Adjusting location

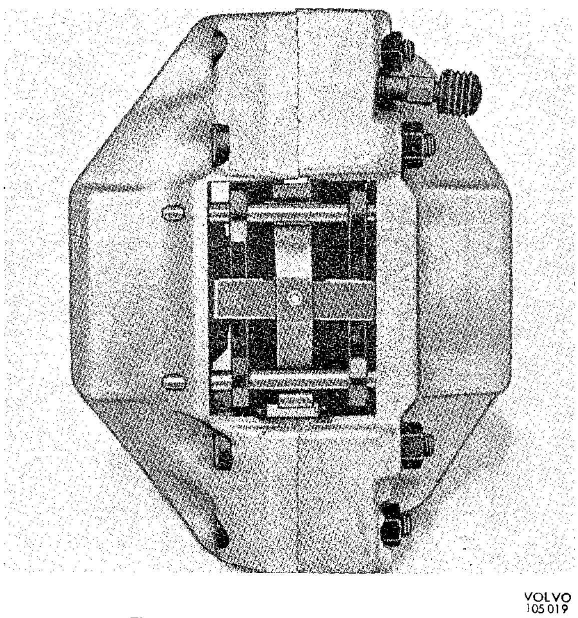


Fig. 5-31. Rear brake caliper assembled

template is placed against the one recess, the distance to the other (meas. A) may be max. 1 mm (0.039").
If necessary, adjust location of the piston with tool 2918. To do this, move the tool into position, see Fig. 5-30, press it against the piston and force out the shoes by screwing in the handle. Turn the piston, release the tool and re-measure with the template.

4. Install and test the other piston in the same way as above. Place the new rubber dust covers on the piston and housing. Fit the new retaining rings.
5. Install brake pads, see op. 8 under "Replacing the brake pads".
6. Screw in the bleeder nipple.

INSTALLATION

1. Place caliper in position. Check that the contact surfaces of the retianer are clean and not damaged. Check the location of the brake caliper in relation to the brake disc when the drive shaft is at the outer position within the clearance limits. Axial deviation is checked by measuring with a feeler gauge on both sides of the disc the distance between disc and caliper support nib. The difference in measurement is 0.25 mm (0.010"). The caliper should be parallel with the disc. This is checked by measuring the distance to the upper and lower support nibs on the caliper. The brake caliper location can be adjusted with shims, which are availble in thicknesses between 0.6 and 1.8 mm (0.024 and 0.072"). Coat the attaching bolts with a couple of drops of Locktite, type AV, and then fit them.
2. Connect the brake line, see Fig. 5-25.
   Remove the plug for the bleeder hole in the brake fluid container cover.
3. Clean the wheel contact surfaces and disc before installing the wheel. Tighten the wheel nuts so much that the wheel cannot be moved. Lower the vehicle and tighten the wheel nuts finally. Tighten every other nut a little at a time until all are finally tightened to a torque of 100—140 Nm (10—14 kpm=70—100 lbft). Install hub cap.
4. Bleed fitted brake caliper, see Group 52.

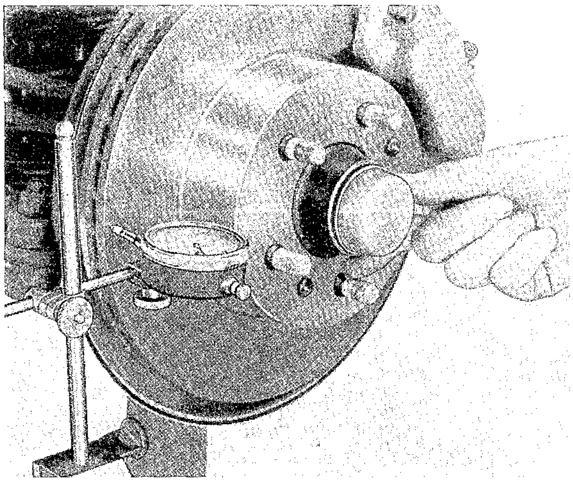


Fig. 5-32. Checking run-out

BRAKE DISC

The brake disc should be examined for wear.

Small marks on the friction surface or linings are of minor importance, but radial scratches reduce the braking effect and increase wear on the linings. The run-out must not exceed 0.1 mm (0.004") for the rear wheel brakes at the outer edge of the disc and is measured, for example, according to Fig. 5-32. Check first that the wheel bearings are correctly adjusted and that the disc fits securely on the hub. The thickness is measured with a micrometer. It should not vary more than 0.03 mm (0.0012") when the disc is rotated one turn, since this can cause the brake pedal to vibrate.

If a fault is discovered during the above-mentioned inspection, the brake disc should be replaced. When doing this, the brake caliper should first be removed. Then unscrew the lock bolts and lift off the brake disc, see Fig. 5-83. Tap on the inside of the disc with several light blows from a plastic hammer or similar tool. When fitting, check that the contact surface is clean.

If, for any reason, a new brake disc is not availbable, the old one can be reconditioned by fine turning. Here accurate aligning of the disc is required and machining should be carried out on both sides. After the machining, the thickness of the disc must not be less than 22.8 mm (0.90") for the front wheel brakes and 8.4 mm (0.331") for the rear wheel brakes. The surface irregularity should be max. 3 μ measured on an arbitrary diameter and max. 5 μ measured radially. After the reconditioning, the disc must not have a run-out of more than 0.1 mm (0.004" and its thickness must not vary more than 0.03 mm (0.0012"). The brake disc must not have static imbalance greater than 200 grammes. The balance can be improved by placing in the channels springs intended for this purpose.

HYDRAULIC FOOTBRAKE SYSTEM

GENERAL INFORMATION

MASTER CYLINDER

The master cylinder is of the tandem type. Its design is shown in Fig. 5-33.

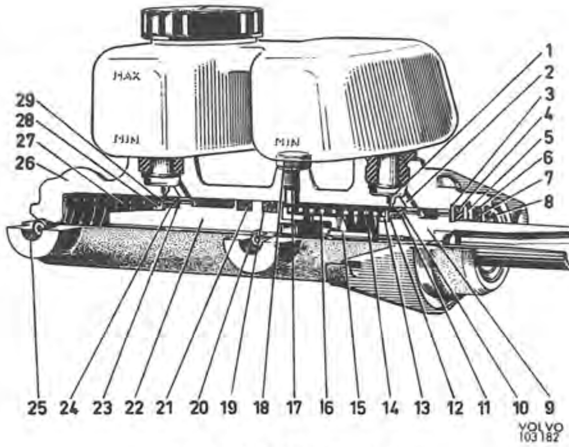
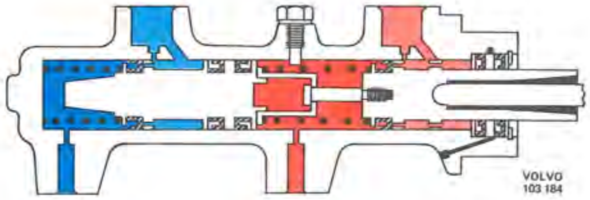


Fig. 5-33. Master cylinder

1. Equalizing hole
2. Overflow hole
3. Washer
4. Piston seal
5. Washer
6. Piston seal
7. Washer
8. Snap ring
9. Primary piston
10. Washer
11. Piston seal
12. Washer
13. Thrust washer
14. Spring
15. Screw
16. Spring retainer
17. Stop screw
18. Seal
19. Piston seal
20. Connection for primary circuit
21. Piston seal
22. Secondary piston
23. Washer
24. Piston seal
25. Connection for secondary circuit
26. Cylinder
27. Spring
28. Thrust washer
29. Washer



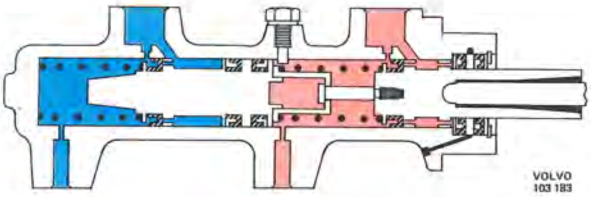
Secondary circuit, pressureless
Primary circuit, pressureless
Secondary circuit, high pressure
Primary circuit, high pressure

Fig. 5-35. Normal brake application

FUNCTION

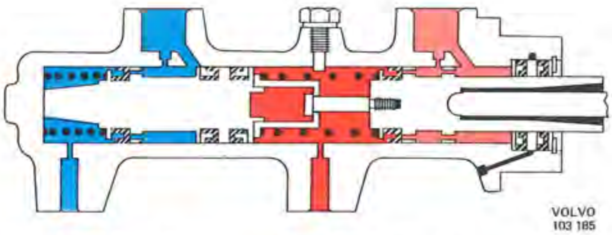
The master cylinder functions as follows:

When the system is at rest (Fig. 5-34), the pistons are kept pressed back by the force of the springs. When the pistons are in this position, the connections between the brake fluid container and wheel brake units are open. At the moment braking takes place, the primary piston (to the right) is pressed in by the piston rod. This closes the connection between the container and the wheel brake unit and the pressure in front of the piston rises. The pressure influences the secondary piston so that it is also moved to the left. The same over-pressure arises in front of both pistons (Fig. 5-35), the brake fluid is forced out into the respective brake line and all the wheel brakes are applied, providing the system is functioning properly. With leakage in the secondary circuit, no hydraulic counter-pressure builds up in front of the secondary piston. Instead, this piston moves inwards when the brakes are applied until it is stopped by the end of the cylinder (Fig. 5-36).



Secondary circuit, pressureless
Primary circuit, pressureless

Fig. 5-34. Rest position
1 and 2. Connection for brake fluid container



Secondary circuit pressureless
Primary circuit, pressureless
Primary circuit, high pressure

Fig. 5-36. Brake application with leakage in secondary circuit

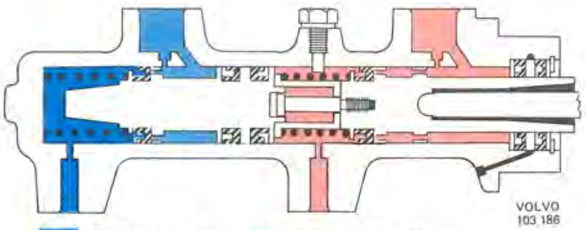


Fig. 5-37. Brake application with leakage in the primary circuit

The hydraulic pressure between the pistons can then rise and apply the brakes in the primary circuit. If leakage occurs in the primary circuit, the primary piston is moved and the brakes are applied until the primary piston makes contact with the secondary piston. Both pistons are then pressed inwards, the pressure in front of the secondary plunger rises and the brakes in the secondary circuit are applied (Fig. 5-37).

WARNING VALVE

A warning valve is connected between the brake lines from the master cylinder and the six-branch union for both brake circuits. Its function is to warn the driver when the

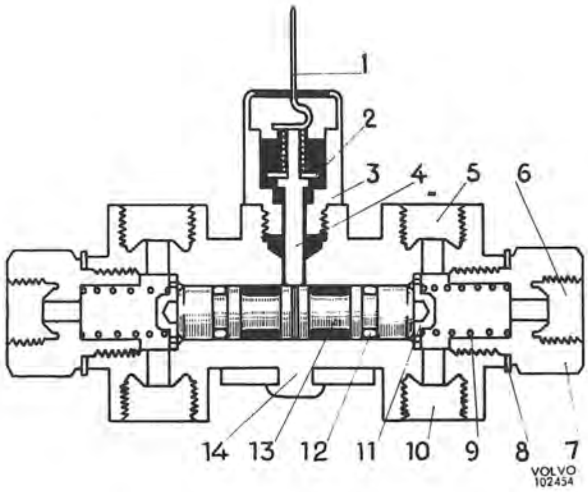


Fig. 5-38. Warning valve

1. Electrical connection
2. Switch washer
3. Switch housing
4. Guide pin
5. Connection, rear wheel brakes
6. Connection, master cylinder
7. End piece
8. Sealing washer
9. Spring
10. Connection, front wheel brakes
11. Thrust washer
12. O-ring
13. Piston
14. Housing

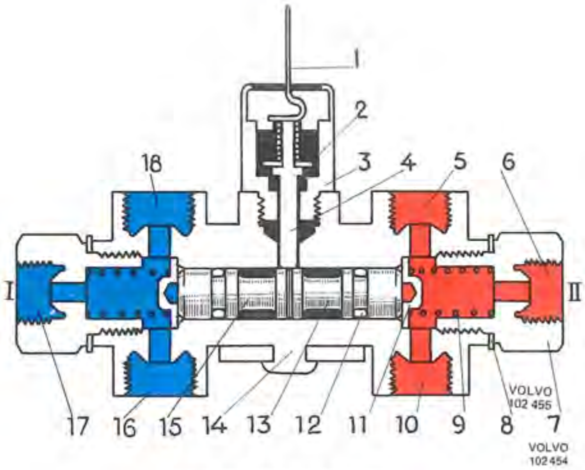


Fig. 5-39. Normal position

pressure difference between the two brake circuits exceeds about 10 kp/cm² (142 psi). The valve design is shown in Fig. 5-38. The valve operates as follows:

During normal braking when the pressure is the same in both circuits, the piston position is according to Fig. 5-39. But if the pressure is lower in one of the circuits, for instance because of leakage, the higher pressure will displace the piston. This lifts the thrust washer (11) and the pressure of the spring (9) counteracts the displacement.

It is only when there is a pressure difference between the circuits of about 1 MPa (142 psi) that the pistons are pushed so far to the right that the guide pin (4) can be pressed downwards. When this happens, the switch washer (2) reaches the housing (3) and current cuts in (Fig. 5-40). The guide pin is prevented from returning to its normal position until the fault has been rectified and the switch housing (3) screwed out.

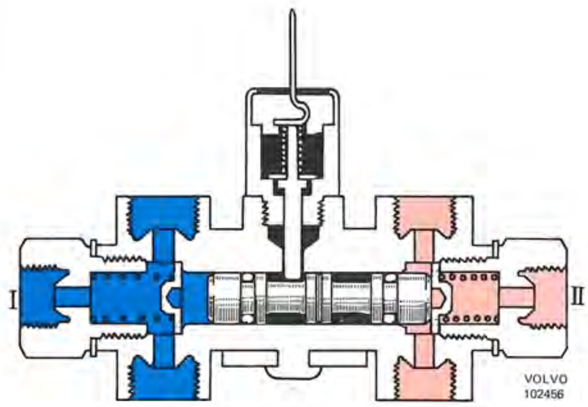


Fig. 5-40. Warning position

BRAKE VALVE

A brake valve is connected to each of the rear wheel brake lines, see Fig. 5-6. When the ingoing brake pressure exceeds 34 kp/cm² (484 psi) a reduction takes place in the valve. The more powerful the pedal pressure, the greater will be the reduction and thereby the larger the difference between the hydraulic pressure in the front wheel and rear wheel cylinders. This results in a suitable distribution of braking force between both pairs of wheels. The construction of the brake valve is shown is Fig. 5-41 and its function is the following.

When the footbrake is applied, the pressure from the master cylinder is transmitted via the connection (4, Fig. 5-41). The pressure then proceeds through the cylinder (5), the counterbore, past the valves (8) and (2) to cylinder (11) and then on through connection (10) to the rear wheel cylinders, see Fig. 5-42. The hydraulic pressure per unit surface is equal on the different parts of the piston (9), but since its pressure surface is larger in cylinder (11) than in cylinder (5), the force developed will move the piston to the right of the figure. However, this is counteracted by the pressure from the springs (6).

When the hydraulic pressure approaches 34 kp/cm² (484 psi) the spring pressure is overcome and the piston (9) is moved to the right. By means of pressure from the smaller spring (3), the valve (2) shuts off the connection between the two cylinders and forms two separate systems, one for the front wheels and one for the rear wheels.

With continued increase in pressure in the master cylinder and front wheel cylinders, the hydraulic force in cylinder (5) moves the piston to the left so that the valve rod comes up against its stop and opens the valve this causing the pressure in cylinder (11) to increase. Due to the larger pressure surface in this cylinder, the piston is moved to the right again and the valve closes. In this way, the piston assumes a position of balance and the outgoing pressure from the brake valve will be lower than the ingoing pressure, see Fig. 5-42. The difference in these pressures is determined by the different areas and spring tension.

When the brake pedal is released, the pressure in the cylinder (4) falls. The piston (9) is moved to the right by spring (6). When the pressure on the right-hand side of the valve (2) falls so much that the hydraulic pressure on the left-hand side enables the valves to be actuated, the connection between both the cylinders is opened again. As the pressure falls, spring (6) presses the left piston back to its original position where the valve is held in the open position by mechanical means, see Fig. 5-41. The equalizing valve (8) is fitted with control channels which ensure an even flow of pressure through the valve.

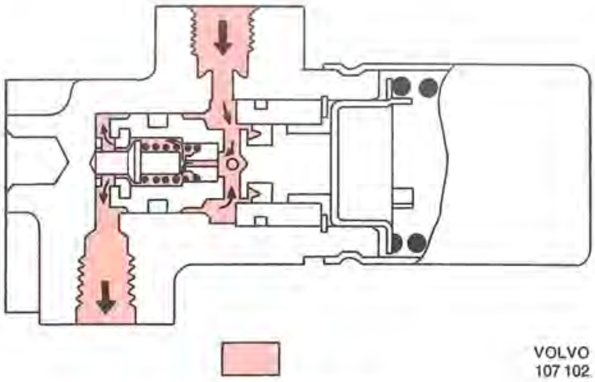


Fig. 5-42. Brake application

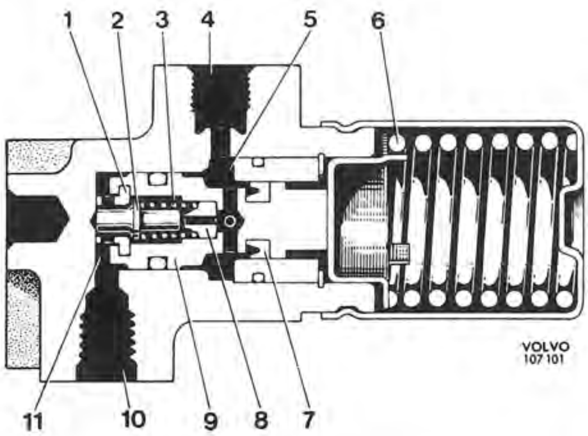


Fig. 5-41. Brake valve design

1. Valve seat
2. Valve
3. Valve spring
4. Connection to master cylinder
5. Cylinder
6. Spring
7. Piston gasket
8. Equalizing valve
9. Piston
10. Connection to rear wheel brake cylinders
11. Cylinder

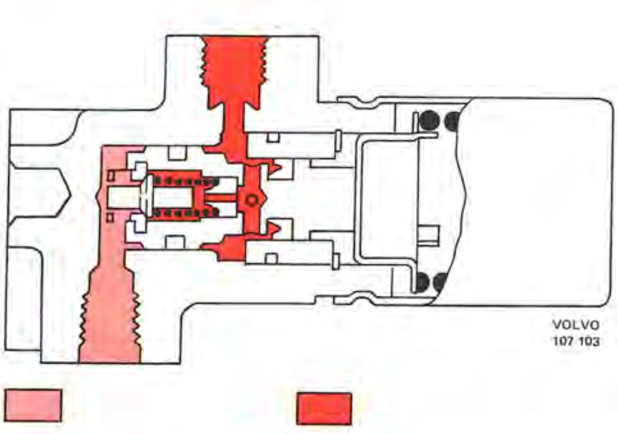


Fig. 4-53. Reducing action

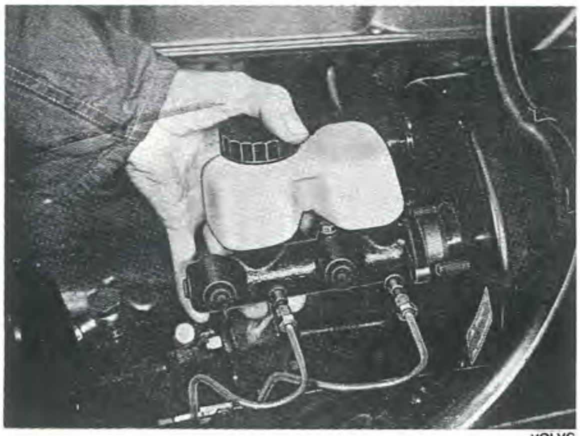


Fig. 5-44. Removing master cylinder

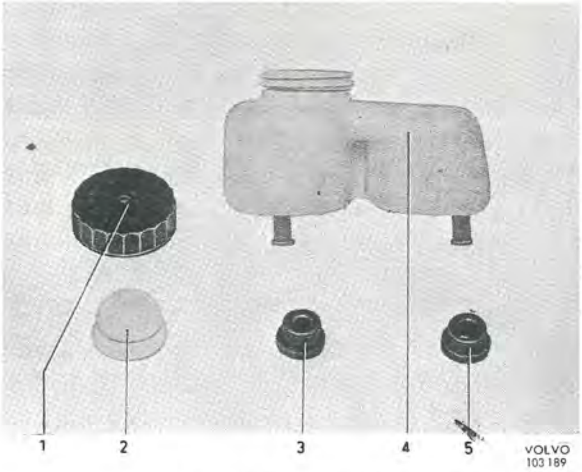


Fig. 5-46. Container parts
1. Filler cap
2. Strainer
3. Rubber seal
4. Container
5. Rubber seal

MASTER CYLINDER

With regard to repair work on the hydraulic system, the instructions given under "Cleaning" and "Brake Fluid", Group 50, should be observed. When the master cylinder is removed, the brake pedal should not be depressed because the resulting abnormal position for the parts of the power cylinder may cause damage.

REMOVAL

1. Place a cover over the fender and rags under the master cylinder in order to avoid possible damage to the paintwork from the brake fluid.
2. Remove the lines from the master cylinder and fit plastic plugs as the lines are disconnected.
3. Remove the two retaining nuts for the master cylinder and lift the cylinder forwards, see Fig. 5-44. Empty out the brake fluid.

DISASSEMBLY

1. Fix the flange of the master cylinder firmly in a vise, see Fig. 5-45.
2. Place both hands under the container and pull it up from the rubber seals. Remove the filler cap and strainer from the container and also the rubber seals from the cylinder, see Fig. 5-46.

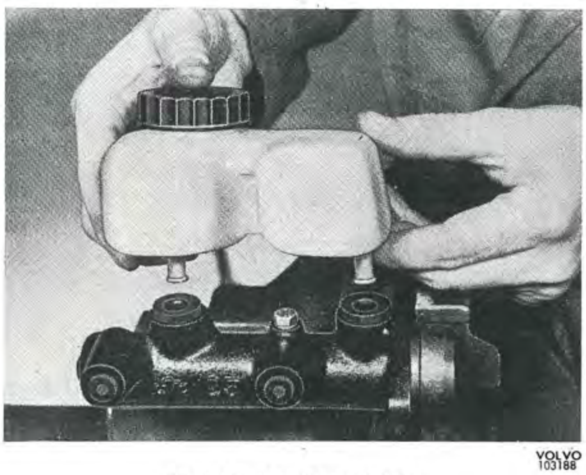


Fig. 5-45. Removing container

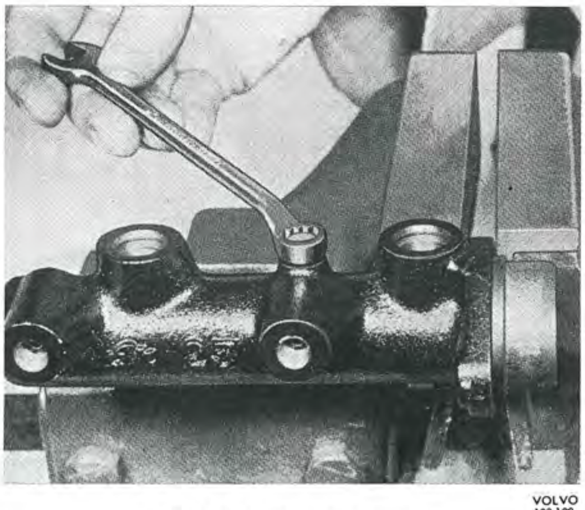


Fig. 5-47. Removing stop screw

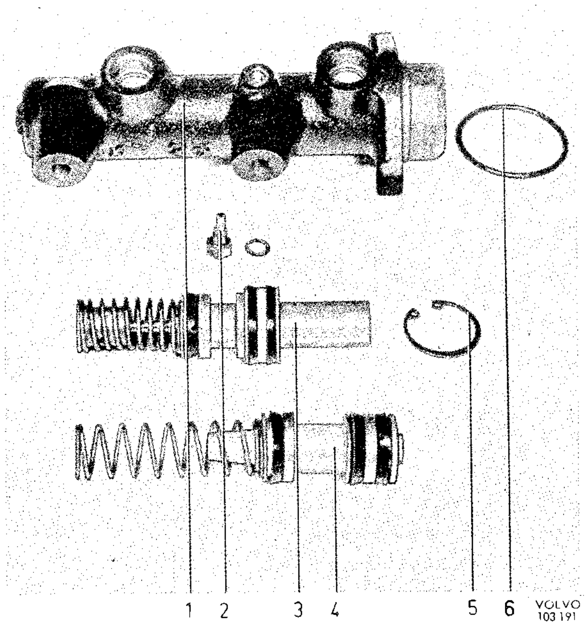


Fig. 5-48. Master cylinder disassembled

1. Cylinder housing
2. Stop screw
3. Primary piston
4. Secondary piston
5. Circlip
6. Sealing ring

3. Unscrew the stop screw (Fig. 5-47). Remove the snap ring from the primary piston with the help of pliers. Remove the pistons.

INSPECTION

Before inspecting, clean all the parts according to the instructions given under "Cleaning", Group 50. Examine the inside of the cylinder carefully. If scored or scratched, the cylinder should be replaced. Rust and similar damage can as a rule be eliminated by honing the cylinder. The procedure for this varies with different makes of tools so that no general description can be given. Follow, therefore, the instructions of the manufacturer. Clean the cylinder carefully after honing and check that the holes are clear.

If wear on the cylinder or secondary piston is suspected, the diameter should be measured with a micrometer or indicator. The cylinder bore must not exceed 23.92 mm (0.942") and the diameter of the piston may not be less than 23.66 mm (0.931"). Each time reconditioning is carried out, replace the primary piston (3, Fig. 5-48) and the secondary piston (4, Fig. 5-48) complete as well as the stop screw (2) with washer and circlip (5), also the sealing ring (6). Moreover, the rubber seals (Fig. 5-46) for the container should be replaced.

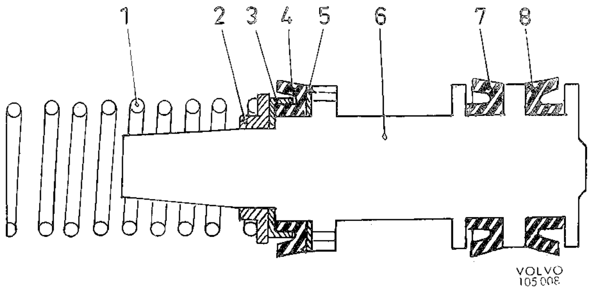


Fig. 5-49. Secondary piston

1. Spring
2. Thrust washer
3. Back-up ring
4. Piston seal
5. Washer
6. Piston
7. Piston seal
8. Piston seal

ASSEMBLY

1. Install the brass washer (5, Fig. 5-49) and the piston seal (4) on the secondary piston (6). Check to make sure that the seals are turned correctly, see Fig. 5-49.
2. Coat brake fluid on the cylinder and dip the piston and seals in brake fluid before fitting. Install the back-up ring (3), the thrust washer (2) and the spring (1) on the secondary piston and install the piston as shown in Fig. 5-50. Be careful when inserting the seals in the cylinder.
3. Install the washer (9, Fig. 5-51), the piston seal (10), the plastic washer (11), the piston seal (12) and the washer (13) on the primary piston. Check that the seals are facing correctly, see Fig. 5-51.
4. Dip the piston and the seals in brake fluid and install the piston in the cylinder, see Fig. 5-52. Press in the piston and fit the circlip (5, Fig. 5-48).
5. Check that the hole for the stop screw is clear and install the screw (2, Fig. 5-48) with a new sealing washer. The tightening torque is 5 – 8 Nm (0.5 – 0.8 kpm = 3.6 – 5.7 lbft).
6. Check the movement of the pistons and make sure that the through-flow holes are clear. Check the

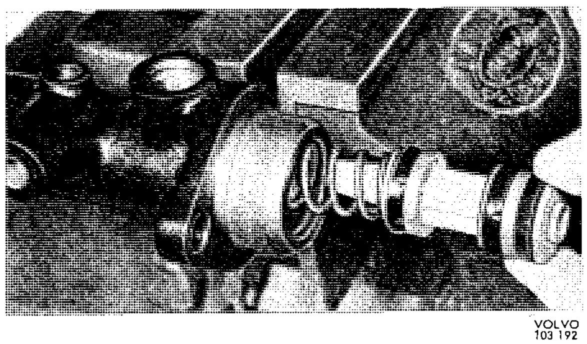


Fig. 5-50. Installing secondary piston

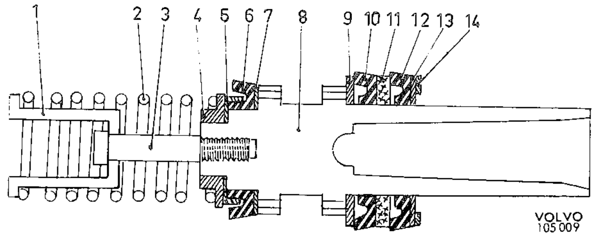


Fig. 5-51. **Primary Piston**
1. Sleeve
2. Spring
3. Screw
4. Thrust washer
5. Back up ring
6. Piston seal
7. Washer
8. Piston
9. Washer
10. Piston seal
11. Plastic washer
12. Piston seal
13. Washer
14. Circlip

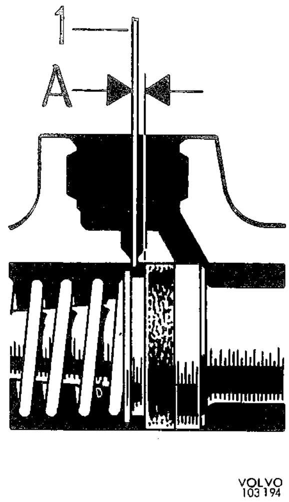


Fig. 5-53. **Checking equalizing hole**
1. 0.7 mm (22 s.w.g.) soft wire
A=Clearance between washer and seal

equalizing hole by pressing the pistons in about 1.0 mm (0.04") and by inserting a soft copper wire, diameter 0.7 mm (22 s.w.g.), down through the hole as shown in Fig. 5-53. If the equalizing hole is not clear, the master cylinder is generally wrongly assembled.

7. Install the rubber seals (3 and 5, Fig. 5-46). Install the brake fluid container, see Fig. 5-45. Fill the container with brake fluid and bleed the cylinder. Place plastic plugs in the cylinder. Check to make sure that the vent-hole in the cap (1) is open and install the strainer (2) and cap in position.

INSTALLATION

1. Place the sealing ring (6, Fig. 5-49) on the master cylinder. Position the cylinder and then the washers together with the attaching nuts. The tightening torque for the nuts is 12−15 Nm (1.2−1.5 kpm=8.7−10.8 lbft).
2. Connect up the lines, see Fig. 5-54. Depress the pedal and tighten the nuts for the lines when fluid free from air forces its way out.
3. Bleed the entire brake system.

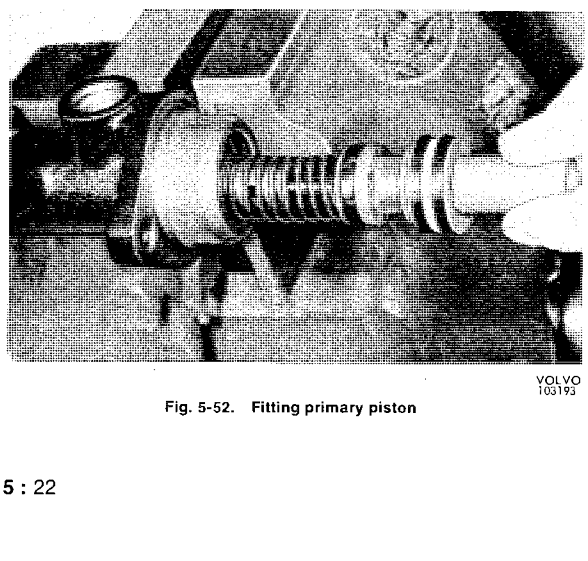


Fig. 5-52. **Fitting primary piston**

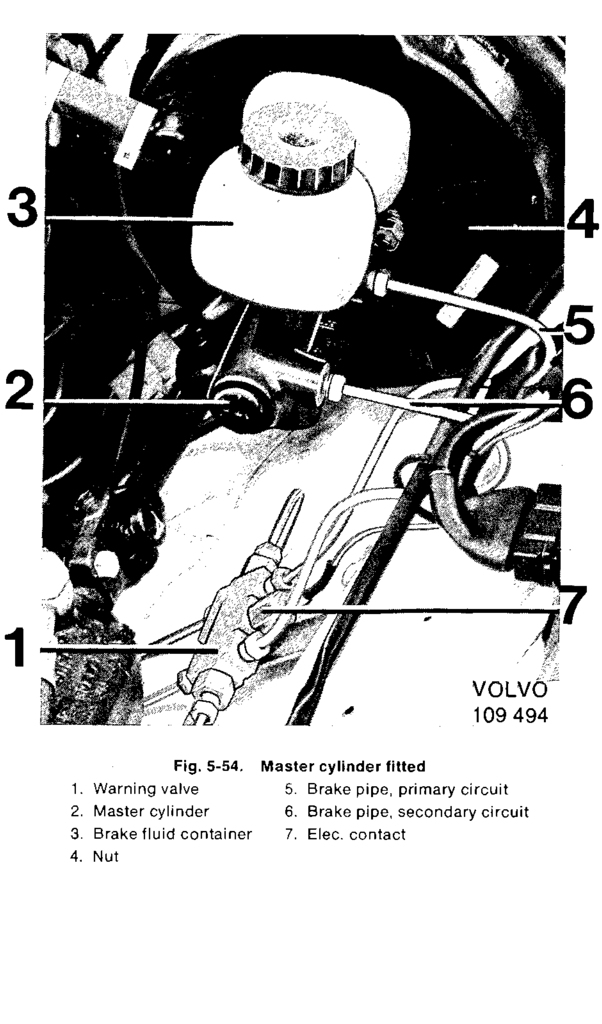


Fig. 5-54. **Master cylinder fitted**
1. Warning valve
2. Master cylinder
3. Brake fluid container
4. Nut
5. Brake pipe, primary circuit
6. Brake pipe, secondary circuit
7. Elec. contact

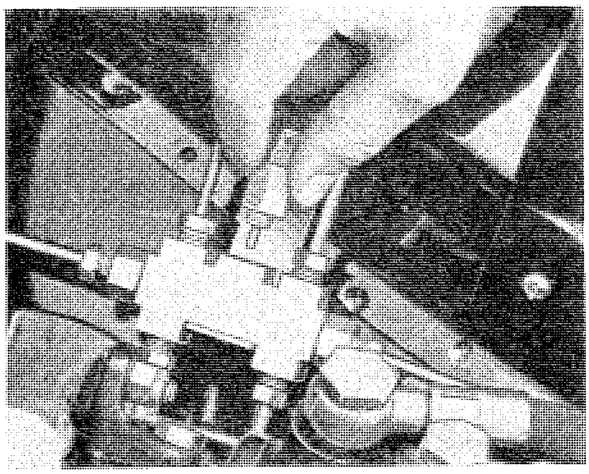


Fig. 5-55. **Removing elec. contact**

WARNING VALVE

NORMALIZING THE PISTONS

1. Disconnect the electric cable and screw out the warning switch (Fig. 5-55) so that the pistons return to normal position.
2. Repair and bleed the faulty hydraulic circuit.
3. Screw in the warning switch and tighten it to a torque of 14–20 Nm (1.4–2.0 kpm=10–14 lbft). Connect the electric cable.

REPLACING THE WARNING VALVE

1. Disconnect all connections. Remove the attaching nut and then the valve.
2. Install the new valve in reverse order to removal. Fig. 5-56 shows the various connections.
3. Bleed the brake system.

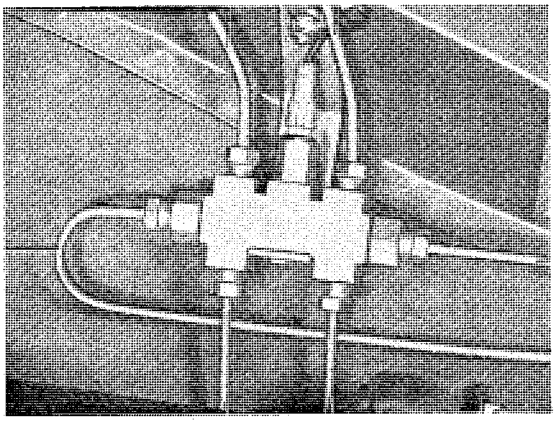


Fig. 5-56. **Warning valve installed**
1. Primary circuit, front wheels
2. Master cylinder primary circuit
3. Master cylinder secondary circuit
4. Secondary circuit, front wheels
5. Secondary circuit, rear wheels
6. Primary circuit, rear wheels

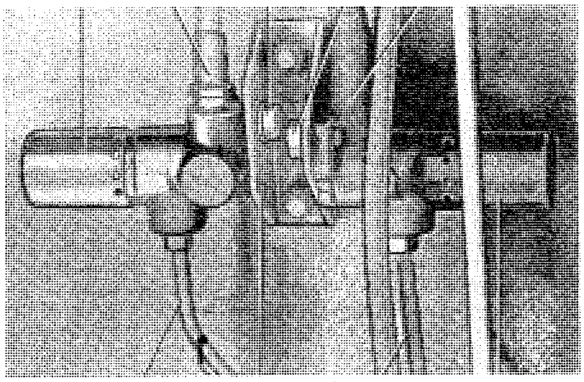


Fig. 5-57. **Brake valves installed**
1. Left brake valve (secondary circuit)
2. Brake hose to left rear wheel
3. Attaching screw
4. Attaching screw
5. Brake hose to right rear wheel
6. Right brake valve
7. From primary circuit
8. Bracket
9. From the master cylinder secondary circuit

BRAKE VALVE

CHECKING

Concerning checking brake valve with testing device 2741, see page 5 : 4, point 9. The valve cannot be repaired. If faulty, it must be replaced.

REPLACING

Unscrew the brake valve and plug the brake pipe connection (10, Fig. 5-57). Slacken the brake hose (4) a max. 1/4 turn at the valve. Remove the attaching screw and unscrew the valve from the brake hose, see Fig. 5-58. Screw the new brake valve on to the brake hose with new packing, compare Fig. 5-58. Place the valve in position and check that there is no tension in the hose. Fit the attaching screws and connect up the brake pipe. Tighten the connections. Bleed the brake system.

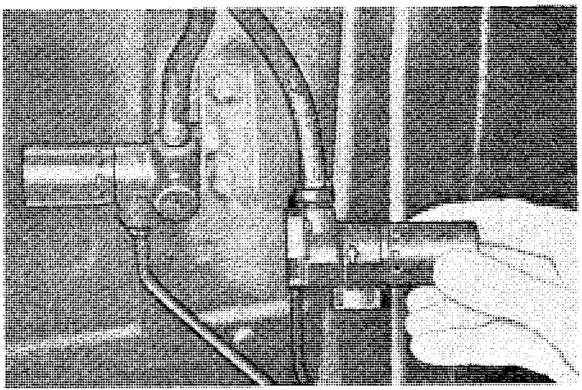


Fig. 5-58. **Removing brake valve**

BRAKE LINES

CLEANING

The brake lines can be cleaned by flushing them with brake fluid or spirit and then by blowing them clean with moisture-free filtered compressed air. The purpose of this is to remove all brake fluid and dirt particles and should be carried out in connection with the complete reconditioning of the hydraulic system and a new fitting.

When complete reconditioning is being carried out, the brake service unit (see Group 50) can suitably be connected to the master cylinder and then the system emptied through the bleeder nipples. The system should therefore be flushed with spirit, after which it should be blown clean with compressed air. When such a reconditioning has been carried out, the components of the hydraulic system should be taken out and checked to ensure that any dirt and flushing fluid have been effectively removed.

NOTE. Concerning the cleaning agent, see the general instructions in Group 50. Do not fill up with brake fluid which has been drained from the system.

REPLACING BRAKE LINES

If leakage occurs, or if the brake lines have been exposed to such external damage that leakage or constriction can result, the damaged lines should be replaced according to the following instructions:

If the replacement concerns the front brake hoses, it should be carried out with the front wheels unloaded.

If the replacement concerns the front brake hoses, it should be carried out with the front wheels unloaded.

1. To prevent unnecessary spilling of brake fluid, the existing filler cap on the master cylinder container should be temporarily replaced with one without a vent-hole.
2. Clean round the connections and remove the damaged brake line.
3. Take a completely new brake line, blow it clean internally with mosture-free filtered compressed air and fit it. Make sure that the brake line lies in such a position that it does not chafe while driving. Particularly important points are where the pipes pass the steering rod, where they must not come nearer than 10 mm (3/8"). If a pipe is not bent correctly, it should be adjusted manually before being fitted.
   Bending a pipe already connected often results in deformation at the connections. The front brake hoses must only be fitted according to Fig. 5-19 and always with the linkage arms unloaded. Do not forget the clips.
4. Bleed the brake system according to the instructions given below. Fit the filler cap with vent-hole on the container.

BLEEDING HYDRAULIC SYSTEM

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

When any part of the system has been removed, bleeding must be carried out. Air can also enter the system if there is too little brake fluid in the container. If, for example, only one rear brake caliper has been removed and very little

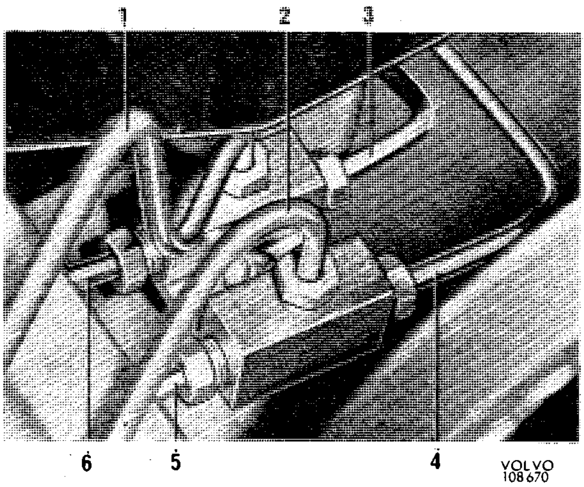


Fig. 5-59. 6-branch union
1. Secondary circuit from warning calve
2. Secondary circuit, right front wheel
3. Primary circuit, right front wheel
4. Primary circuit warning valve
5. Primary circuit, left front wheel
6. Secondary circuit, left front wheel

Fig. 5-60. Pedal travel
A=approx. 152 mm (6")

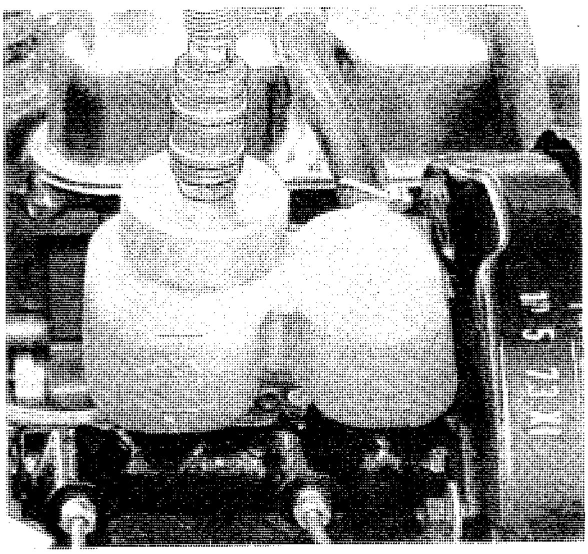


Fig. 5-61. Connecting bleeder unit VOLVO 108 662

brake fluid run out, as a rule it is only necessary to bleed the brake caliper. Otherwise bleed the entire system.

When bleeding or other similar work is being carried out, no brake fluid must be permitted to get on to friction surfaces or linings. Do not spill any fluid on the paintwork as this may damage it. If the vehicle is to be placed on stands during the bleeding, the rear end should be somewhat higher than the front end.

When filling with oil observe the following: The brake fluid must meet the requirements according to SAE J 1703. Brake fluid with designation DOT 3 or DOT 4 can also be used. **Brake oil which has been bled from the system must under no circumstances be put back into the bleeder unit or the container.**

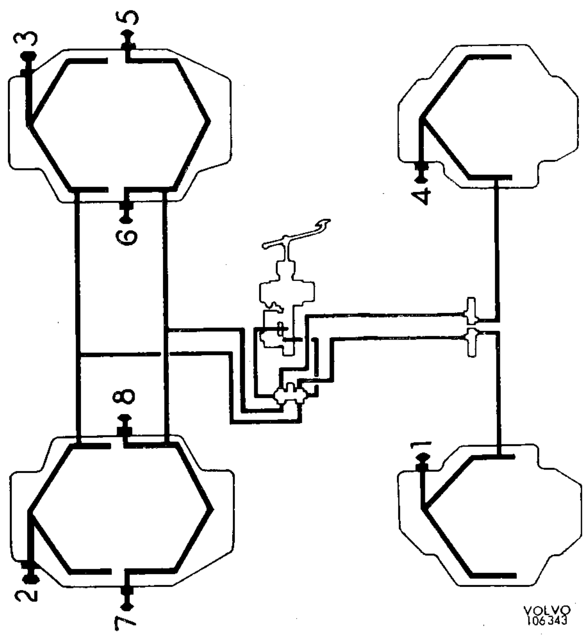


Fig. 5-62. Bleeding diagram VOLVO 106343

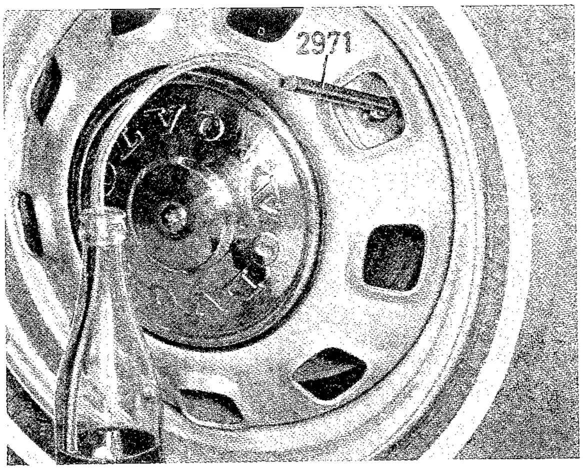


Fig. 5-63. Bleeding front wheel brake unit VOLVO 106418

BLEEDING BRAKE SYSTEM WITH BLEEDER UNIT

1. Check to make sure there is full return on the brake pedal and that neither mats nor suchlike prevent full travel (about 152 mm=6") from being utilized during the bleeding. Depress the brake pedal several times to even out any underpressure in the power cylinder and in this way disconnect it.
2. Remove the electric switch from the warning valve.
3. Clean round the cap on the brake fluid container. If necessary fill the container with brake fluid up to the "Max." mark.
4. Fit on the container a cap specially used when bleeding, see Fig. 5-61. Connect the bleeder unit according to the instructions of the manufacturer. The working pressure is 2 kp/cm^2 (28.4 psi). The type of bleeder unit which may be used is shown in Fig. 5-5.
5. Bleeding should take place in the order shown in Fig. 5-62. Note that the bleeder nipple should be opened max. half a turn in order to prevent air from sneaking in via the threads of the nipple.

   When bleeding remove the protective cap and fit the

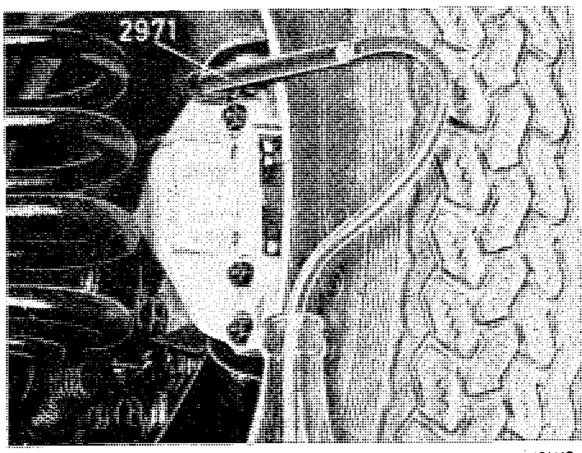


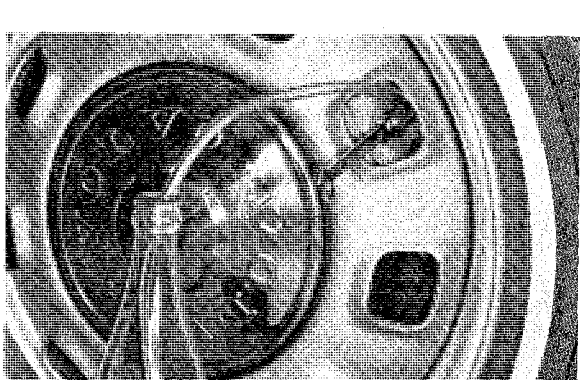
Fig. 5-64. Bleeding left rear wheel brake unit VOLVO 106417

bleeder tool 2740. See Figs. 5-63 and 5-64. Let the other end of the hose hang down into a collecting vessel. Open the bleeder nipple. Close the nipple when brake fluid free from air bubbles flows out. Make sure there is no leakage between the nipple and the tool, as this can give rise to misleading results. Refit the protective caps on the nipples.

6. As a rule it is sufficient to bleed each of the circuits once. If the brake pedal can still be depressed without any resistance worth mentioning or if it feels spongy, repeat the bleeding.
7. Remove the hose to the brake fluid container and release air to the unit. Remove the cap on the container. Blow clean the vent-hole in the standard cap and refit this on the container.
8. Install the warning switch and tighten it to a torque of 14–20 Nm (1.4–2.0 kpm=10–15 lbft). Connect the electric cable. Check that the warning light goes on only when the parking brake is applied.

MECHANICAL BLEEDING

1. Check to make sure there is full return on the brake pedal and that neither mats nor suchlike prevent full travel (about 152 mm=6") from being utilized during the venting. Depress the brake pedal several times to even out any underpressure in the power cylinder and in this way disconnect it.
2. Remove the electric switch from the warning valve.
3. Clean round the cap on the brake fluid container. Blow clean the vent-hole in the cap. If necessary, fill the container with brake fluid up to the "Max." mark. To prevent air forcing its way in through the brake fluid container, the oil level in the container must not go below the "Min." mark.



VOLVO 106419

Fig. 5-65. Bleeding front wheel brakes

4. Required for the bleeding is a plastic hose which can be pressed on to and sealed round the bleeder nipple. The lower end of the hose should be extended by means of a glass or plastic tube. Also required is a glass bottle filled with so much brake fluid that the opening of the pipe can be kept under the surface in order to prevent air from being sucked into the system. To turn the nipple use a 5/16" ring spanner. New brake fluid must be available so that the container can be gradually filled. The level must not go below the "Min." mark since this would allow air to penetrate into the system via the container.
5. Bleeding should be carried out in the order shown in Fig. 5-62 and as follows:
   Remove the masking cap and fit the ring spanner and plastic hose on to the bleeder nipple. Allow the opening of the pipe to hang down below the surface of the fluid in the glass bottle, see Fig. 5-65. Open the bleleder nipple at the most half a turn. Slowly press the brake pedal down to the bottom. When the pedal reaches the bottom, pause a little and then quickly release the pedal. Repeat this procedure until brake fluid free from air bubbles flows out. The press the pedal to the bottom and close the bleeder nipple.
   Re-fit the protective caps on the nipples.
6. As a rule it is sufficient to bleed each of the circuits once. If the brake pedal can still be depressed without any resistance worth mentioning or if it feels spongy, repeat the bleeding.
7. Fill the container with brake fluid up to the "Max." mark.
8. Install the warning switch and tighten it to a torque of 14–20 Nm (1.4–2.0 kpm=10–15 lbft). Connect the electric cable. Check that the warning lamp lights only when the parking brake is applied.

ADJUSTING BRAKE LIGHT SWITCH

Check the distance from the brass hub on the brake light switch to the brake pedal, see Fig. 5-66, when the brake pedal is released. The distance should be 4 ± 2 mm (0.16–0.08"). To adjust, slacken the screw for the bracket (12, Fig. 5-67). Remember to tighten the screw after adjustment.

REPLACING BRAKE PEDAL

1. Remove the panel under the dash board.
2. Remove the bracket (12, Fig. 5-67) for the brake light switch (11). Remove the split pin and bolt (13). Unhook the return spring (10) and the spring (16). Unscrew the nut for the bolt (7) and pull out the bolt.
3. Lift out the pedal (18).

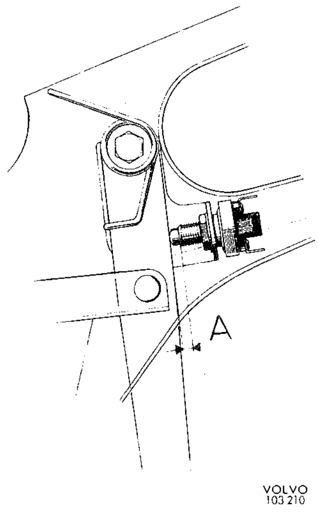


Fig. 5-66. **Adjusting brake light switch**
A=2–6 mm (1/8")

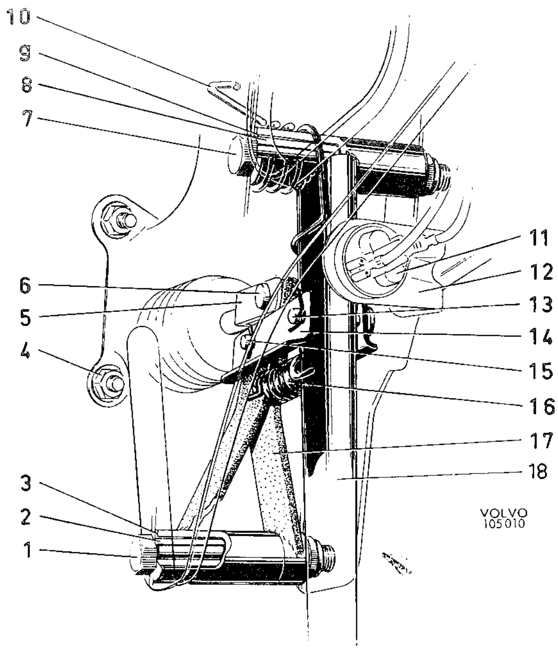


Fig. 5-67. **Brake pedal suspension components**

1. Bolt	10. Return spring
2. Bearing sleeve	11. Brake light switch
3. Bushing	12. Brakcet
4. Nut	13. Split pin bolt
5. Thrust rod	14. Link
6. Split pin bolt	15. Split pin bolt
7. Bolt	16. Spring
8. Bearing sleeve	17. Link arm
9. Bushing	18. Brake pedal

4. Install the new pedal bushings (9) and lubricate the bearing sleeves (8) with a light layer of ball bearing grease. Fit the sleeve and the return spring.
5. Place the pedal in position and fit the bolt (7) and nut. Hook on the springs. Fit the split pin bolt (13) and split pin.
6. Fit the bracket (12) and adjust the brake light switch (11), see under "Adjusting brake light switch".
7. Re-install the panel.

REPLACING BUSHINGS IN BRAKE PEDAL AND LEVER

1. Remove the panel under the dash board.
2. Remove the bracket (12, Fig. 5-67) for the brake light switch. Remove the split pins and bolts (6 and 13). Unhook the return spring (10) and the spring (16). Unscrew the nuts for the bolts (1 and 7) and remove the screws.
3. Lift out the pedal (18) and the link arm (17).
4. Press out the bearing sleeves (2–8) and the bushings (3–9).
5. Clean the parts. If the bearing sleeves are worn, replace them.
6. Press in the new bushings (3 and 9) and lubricate them with a light layer of ball-bearing grease. Fit the bearing sleeves (2 and 8) and the return spring (10).
7. Place the link arm (17) in position and fit the screw (1) and the nut. Fit the split pin bolt (6) and the split pin.
8. Place the pedal (18) in position and fit the bolt (7) and the nut. Hook on the return spring. Fit the split pin bolt (13) and the split pin.
9. Install the bracket (12) and adjust the brake light switch (11), see under "Adjusting brake light switch".
10. Re-install the panel.

AUXILIARY BRAKE SYSTEM

GENERAL INFORMATION

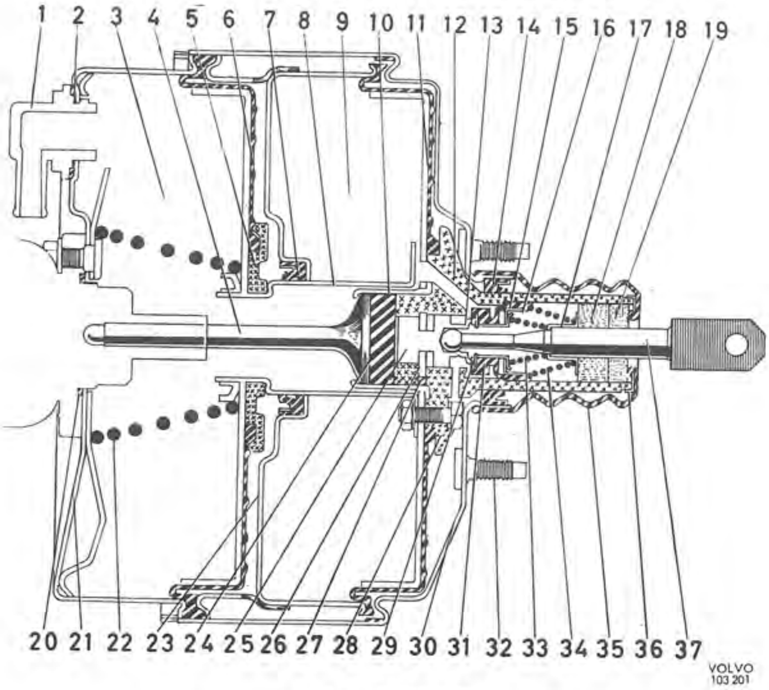


Fig. 6-58. Power cylinder

1. Vacuum inlet
2. Sealing ring
3. Front vacuum chamber
4. Front thrust rod
5. Retainer
6. Diaphragm
7. Sealing ring
8. Guide sleeve
9. Rear vacuum chamber
10. Retainer
11. Diaphragm
12. Guide housing
13. Valve piston seat
14. Sealing ring
15. Seal
16. Guide
17. Retainer
18. Filter
19. Silencer
20. Sealing ring
21. Cylinder
22. Return spring
23. End
24. Reaction disc
25. Valve piston
26. Stop washer
27. Washer
28. Guide housing
29. Valve guide
30. End
31. Valve plate
32. Attaching screw
33. Valve spring
34. Return spring
35. Rubber cover
36. Washer
37. Rear thrust rod

POWER CYLINDER

This is a mechanical tandem-type power-boost device located between the brake pedal and the master cylinder, see Fig. 5-6. Due to the power cylinder, which is assisted by vacuum from the engine induction manifold, less pedal pressure is required when braking. The construction as well as the designation and location of the parts are shown in Fig. 5-68. The power cylinder functions as follows.

When the system is at rest, the parts of the power cylinder are in the position shown in Fig. 5-71. The thrust rod spring holds the thrust rod and the valve piston flexibly connected to it pressed to the right. Movement is limited by the stop plate. In this position, the valve plunger keeps the valve lifted from the seat in the guide housing, and this closes the air channel and opens the vacuum channel. Thus an equivalent vacuum exists on both sides of the diaphragm which, together with the guide housing, is

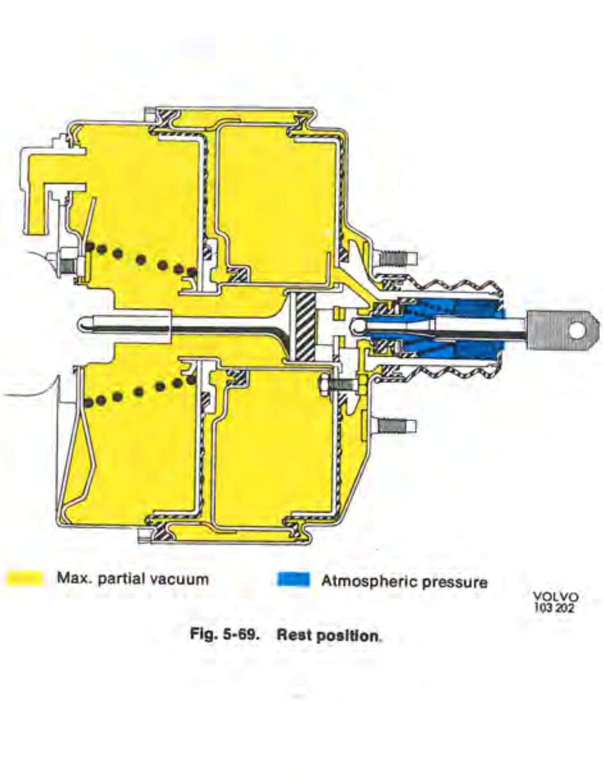


Fig. 5-69. Rest position.

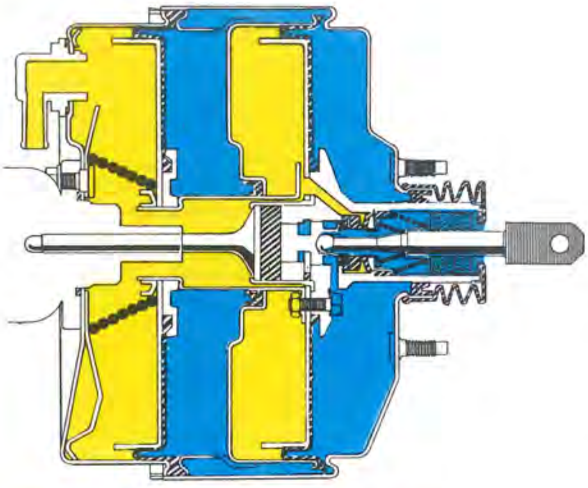


Fig. 5-70. Full brake application

held pressed to the right end position of the diaphragm spring.

When the brake pedal is depressed, the rear thurst rod and valve piston are moved to the left (forwards). The valve spring causes the valve plate to move also until it reaches the seat in the guide housing. This closes the connection between the front and rear side of the diaphragm. When the piston continues moving, its movements are transferred via the reaction disc and front thrust rod to the master cylinder. When the seat of the valve piston leaves the plate, the connection between the rear side and the center of the valve section is opened. Air from atmospheric pressure can then flow in behind the diaphragm. When there is partial vacuum on the front side of the diaphragm, it is moved, and also the guide housing, forwards. In this way, the force applied to the front thrust rod is increased. The parts of the power cylinder are in the position shown in Fig. 5-70 when the pedal pressure provides maximum power effect.

If the pedal pressure is less than that mentioned above, the same procedure takes place in the beginning. During brake application, the hydraulic pressure in the master cylinder increases and also the counterpressure on the front thrust rod. The pressure of the guide housing is transmitted to the thrust rod through the outer part of the reaction disc. Because the disc is made of rubber, its periphery contracts while its center tends to expand, see Fig. 5-71. This causes the guide housing to be moved further forwards than the valve piston and results in the seat of the piston reaching the valve shutting off the air supply. The pressure behind the diaphragm remains constant and is thus unable to overcome the hydraulic counterpressure in the master cylinder. The movable parts of the power cylinder, therefore, remain in this position, and constant braking is obtained as long as the same pressure is maintained on the brake pedal.

If pressure on the pedal is increased, the pressure of the valve piston on the reaction disc center will be greater, this causing a certain displacement forwards of the piston. When this happens, the valve leaves the seat of the piston, more air can flow in and greater brake application is obtained until the new equalizing position is attained.

If the pressure on the pedal is reduced, the reaction disc center can be thrust out still further, and this causes the valve piston to lift the valve from the seat in the guide housing. The spaces on both sides of the diaphragm are thereby connected with each other, equal pressure arises, the guide housing is moved backwards by the spring pressure and there is a reduction in the brake application. This procedure also reduces the contraction of the reaction disc periphery, so that the valve piston can return to the position shown in Fig. 5-71 and the new equalzing position is reached. If the brake pedal is released fully, all the parts of the power cylinder are returned to the rest position and the brakes are released.

Should any fault occur with the vacuum supply, brake application can still take place due to the fact that the power cylinder functions as an extended thrust rod. As no power effect is then obtained, greater pressure on the pedal is of course required.

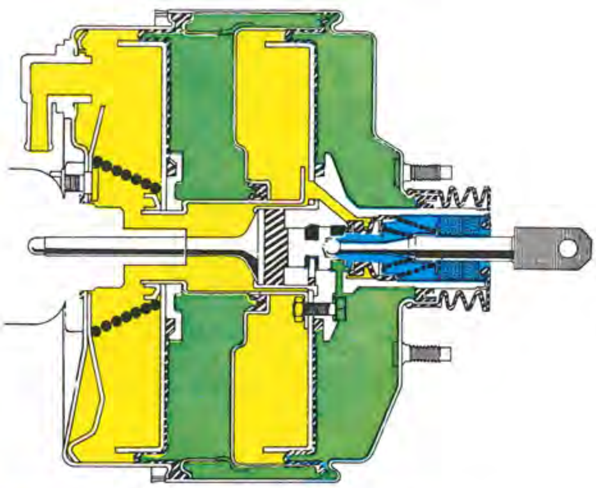


Fig. 5;71. Partial brake application

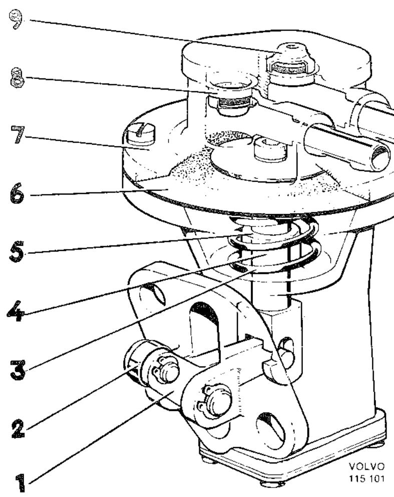


Fig. 5-72. Vacuum pump

1. Lever
2. Roll
3. Spring
4. Pump rod
5. Bushing
6. Diaphragm
7. Valve housing
8. Valve (inlet)
9. Valve (outlet)

VACUUM PUMP

The vacuum pump design can be seen from Fig. 5-72. It is of the diaphragm type and is located on the left of the engine and is driven from the camshaft. The pump outlet is connected to the engine intake manifold. The inlet is connected to the vacuum tank and the power cylinder via the one-way valve. The pump provides power for the power brake assist.

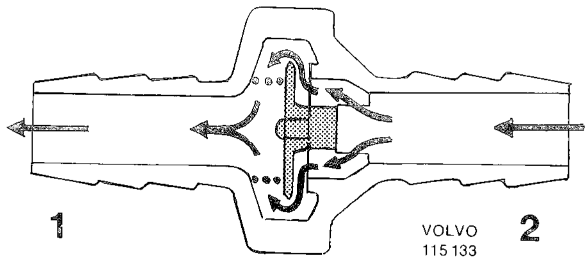


Fig. 5-73. Check valve

1. Connection for vacuum tank
2. Connection for power cylinder

CHECK VALVE

The check valve (Fig. 5-73) is placed on the line between the vacuum tank and the power brake cylinder. Its purpose is to prevent air from flowing back to the power brake cylinder. The valve only opens when there is a larger degree of vacuum at connection 1 than at connection 2.

SERVICE PROCEDURES

REPLACING AIR CLEANER AND DAMPER FOR INSTALLED POWER CYLINDER

REMOVAL

1. Remove the panel under the dash board.
2. Remove the fusing for the brake light.
3. Remove the bracket (12, Fig. 5-67) for the brake light switch.
4. Remove the split pins and the split pin bolts (6 and 13).
5. Lift up the brake pedal. Remove the rubber cover (6, Fig. 5-74).
6. Remove the protective washer (4) from the cylinder.
7. Remove the damper (3) and the air cleaner (2).

INSTALLATION

1. Install the cleaner and the silencer. The slots on the cleaner and damper should be displaced 180° from each other.
2. Install the protective washer and the rubber cover. Check to make sure that the cover is pressed down properly at the inner edge of the protective washer.
3. Install the split pin bolts.
4. Install the bracket (12, Fig. 5-67), and adjust the brake light switch (11), see under "Adjusting brake light switch" on page 5 : 26.
5. Install the panel under the dash board and the fusing.

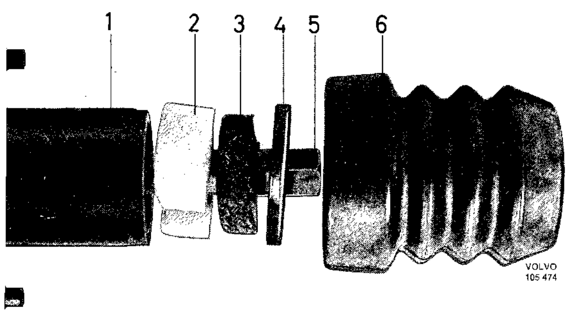


Fig. 5-74. Filter parts

1. Locating sleeve
2. Air cleaner
3. Damper
4. Washer
5. Thrust rod
6. Rubber cover

Fig. 5-75. Fitting pin

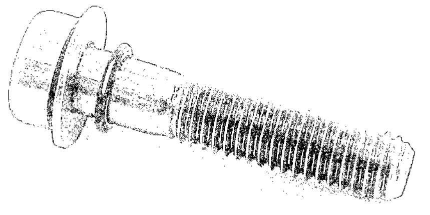


Fig. 5-76. Center screw

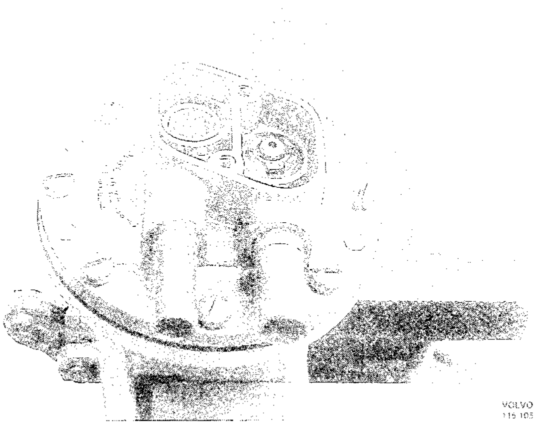


Fig. 5-78. Valve housing

VACUUM PUMP

REMOVAL

Disconnect the hose clamps and pull off the hoses. Remove both the attaching screws and the pump and gasket.

DISASSEMBLY

1. Place the pump in a vise and remove the valve housing cover.
2. Mark up the position for the valve housing on the pump housing and remove the valve housing. If necessary use a rubber mallet.
3. Unscrew the center screw and remove the diaphragm with washers and spring from the pump housing.
4. Turn the pump and remove the lower cover.
5. Remove the lever shaft and the lever as well as the pump rod and bushing.

Note: If disassembly only applies to the diaphragm, it is not necessary to remove the lever. The pump rod can be locked with a retainer made according to the sketch supplied with the diaphragm kit.

INSPECTION

Clean and inspect the parts. With replacement, replace all parts of the valve and diaphragm kits. For locking purposes, the center screw and pump rod inner thread must be free from oil and grease.

ASSEMBLY

1. Put the pump in a vise and remove the valve housing cover.

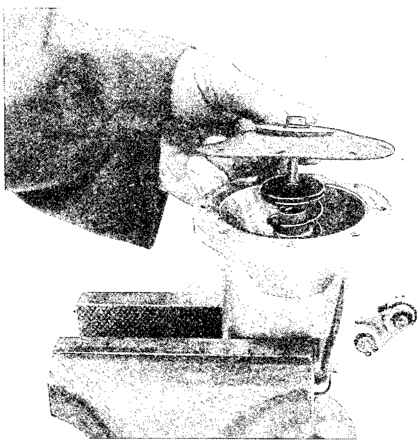


Fig. 5-77. Fitting diaphragm

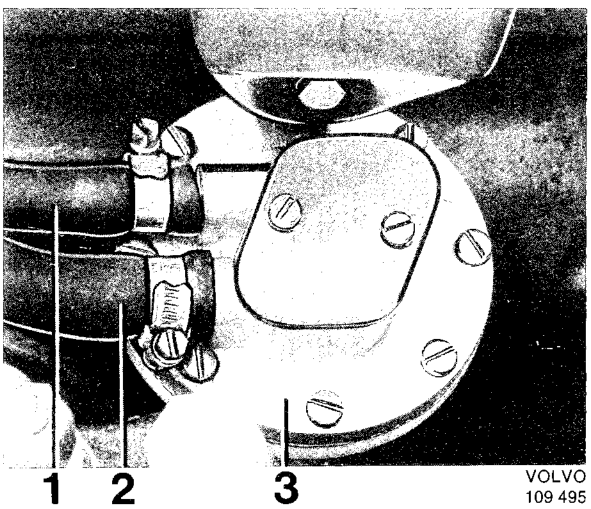


Fig. 5-79. Vacuum pump installed
1. Inlet
2. Outlet
3. Vacuum pump

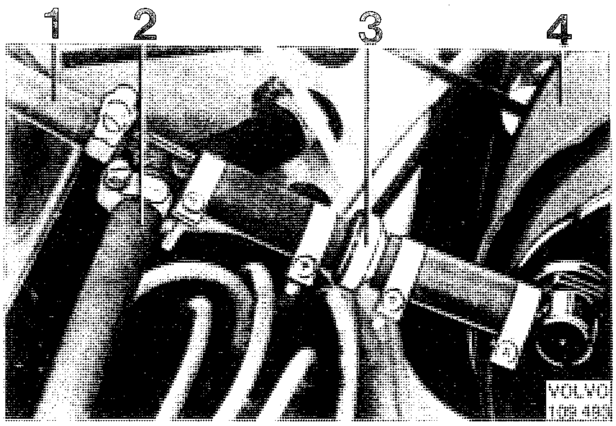


Fig. 5-80. Vacuum components
1. Connection to vacuum tank
2. Connection to vacuum pump
3. Check valve
4. Power cylinder

2. Install pump rod and pin (Fig. 5-75). Make sure the lock rings fit in the pin slot.
3. Install bottom cover and gasket.
4. Place washer and O-ring on center screw and apply lock fluid (Loctite, type A) to the screw thread.
5. Install diaphragm, washers and spring. The raised part of the diaphragm upwards and the dished sides of the washers against the diaphragm, see Figs. 5-76 and 5-77. Tighten the screw to a torque of 9 Nm (0.9 kpm=6.5 lbft). Hold against the upper washer and make sure that the diaphragm hole is opposite the housing hole.
6. Install valve housing according to marking.
7. Install gaskets and valves (Fig. 5-78).
8. Install valve springs, gasket and cover.

INSTALLATION

Place the pump in position with new gasket. Tighten attaching screws. Connect hoses and tighten clamps (Fig. 5-79).

TESTING

With pump mounted on engine, connect a vacuum gauge to inlet (the narrow pipe). During the test the outlet should be connected to the atmosphere. Run the engine at a speed of approx. 67 r/s (4 000 rpm). The pump should give a vacuum of at least 70 MPa (0.7 kp/cm^2=10 psi).

REPLACING CHECK VALVE

Remove the check valve, see Fig. 5-80, from the vacuum hose. Ensure that the new check valve functions properly. Install the valve so that the arrows on the valve housing point away from the power cylinder. The vacuum hose connection should face downwards.

REPLACING POWER CYLINDER

REMOVAL

1. Remove the master cylinder, see page 5 : 20. Disconnect the vacuum hose from the power cylinder.
2. Disconnect the link arm (16, Fig. 5-67) from the brake pedal. Remove the bracket with clutch pedal stop from the cowl.
3. Remove the 4 nuts securing the power cylinder to the cowl.
4. Pull the power cylinder forwards and disconnect the fork from the link arm.

INSTALLATION

1. Check that the rubber cover (35, Fig. 5-67) is pressed down properly at the protective washer for the cleaner. Secure the fork to the link arm. Push in the power cylinder so that the attaching bolts come into position.
2. Place the resilient washers under the attaching nuts. Secure the cylinder.
3. Install the bracket for the clutch pedal. Secure the link arm to the brake pedal.
4. Install the vacuum hose. The connection for the vacuum hose should face downwards.
5. Bleed the entire brake system.

PARKING BRAKE

GENERAL INFORMATION

The design of the parking brake is shown in Fig. 5-81. The parking brake lever (1), whcih is located between the front seats, acts on two levers (3) via a yoke (2). Two cables (4) lead from the levers to the rear wheel brakes. The two cables are routed parallel with the propeller shaft tunnel inside the car and pass out under the floor through the rear seat support. The cables cross each other on top of the rear axle before being connected to the brakes.

The pulling movements of the cables are transferred to the brake shoes via scissor-type levers (7) located between the front ends of the shoes. Located between the rear ends is an adjustment device (9) for the shoes.

With this mounting, the brake shoes are self-centering and both shoes partly self-braking (Duo-Servo). The brake drum is fixed to the drive shaft and so designed that it also serves as a brake disc for the footbrake.

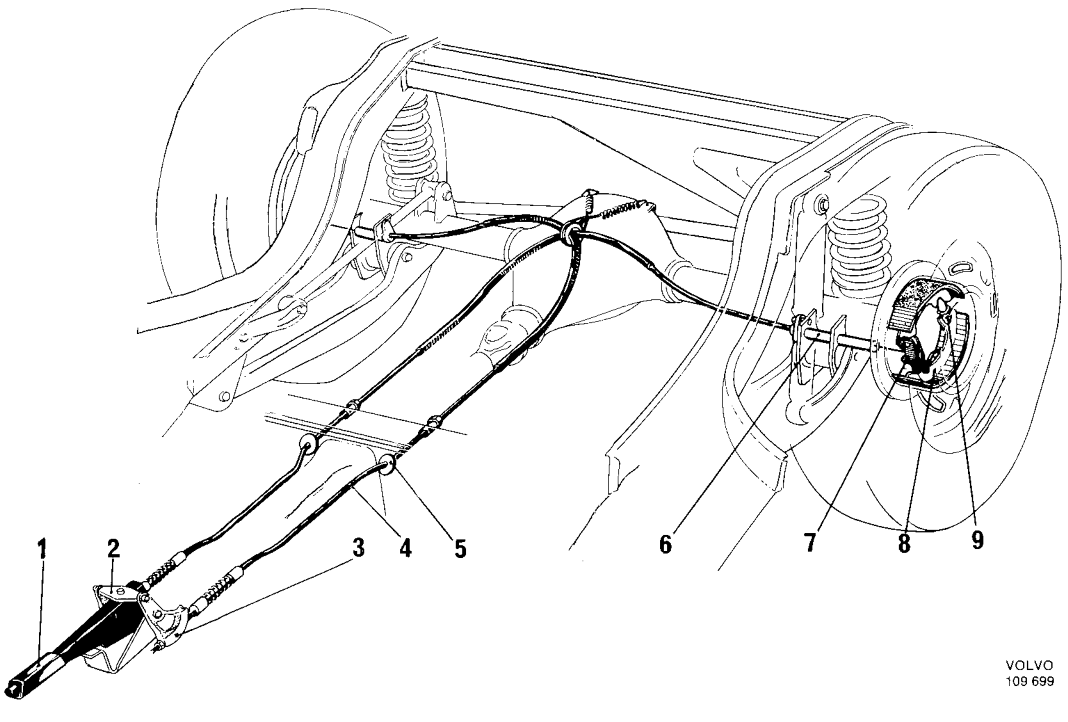


Fig. 5-81. Parking brake

1. Lever
2. Yoke
3. Lever
4. Cable
5. Rubber grommet
6. Plastic tube
7. Levers
8. Brake shoes
9. Adjustment device

ADJUSTING PARKING BRAKE

The parking brake should be fully applied at notches 3-4. Otherwise, adjust the parking brake as follows:

1. Remove the rear ash-tray.
2. Screw out the adjustment screw at the rear end of the parking brake lever to slacken the cables. The screw is accessible through the ash-tray hole by using a 17 mm socket with extension (Fig. 5-82).
3. Put the rear end on stands and remove the rear wheels.
4. Align the brake drum so that its hole is in front of the adjustment screw and adjust the shoes by turning the adjustment wheel with a screwdriver (Fig. 5-83). Stop turning the wheel when the drum just about can be turned around, then turn back 4 – 5 teeth. Turn the brake drum and check that the brake shoes do not drag. If they do, turn back another 2 – 3 teeth.
5. Repeat the adjustment for the other rear wheel.
6. Install the wheels.
7. Tighten the wires with the adjustment screw at the rear end of the parking brake lever so that the brake is fully applied after 3 – 4 notches.
8. Install the ash-tray.

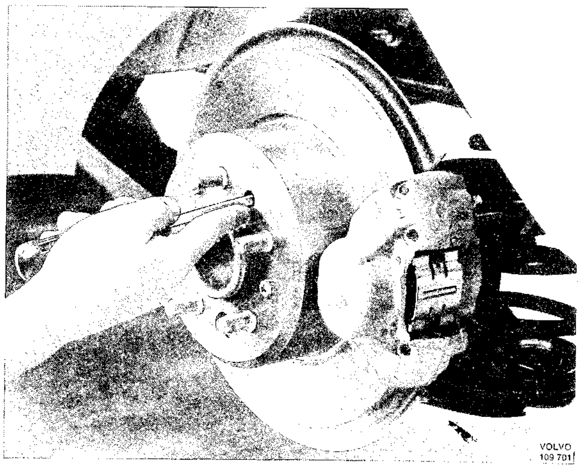


Fig. 5-83. Parking brake adjustment

REPLACING BRAKE SHOES

1. Remove the rear ash-tray and screw out the adjustment screw at the rear end of the parking brake lever to slacken the cable (Fig. 5-82).
2. Put the rear end on stands and remove the rear wheels.
3. Remove the clamp (1, Fig. 5-84) for the brake line. Screw out the retaining screws (2) for the caliper.
4. Hang the brake caliper up on a wire so that no sharp bends are made on the brake line.
5. Remove the bolts for the brake drum and remove the drum.
6. Unhook the springs with a brake spring tool. Remove the brake shoes and the adjustment device.
7. Before installing new shoes, check the rear axle for oil leakage. Also check levers, cables and adjustment devices for wear or seizure. The brake drums should be replaced if they are scored, convex or out of round more than 0.2 mm = 0.008". Clean the sliding surfaces for the brake shoes on the brake shields.
8. Apply a thin layer of heat-resistant graphite grease on the brake shoe sliding surfaces on the brake shields, on the levers and on the adjustment devices.
9. Install brake shoes and lower return spring (Fig. 5-85).
10. Install upper return spring and adjustment device (Fig. 5-86).

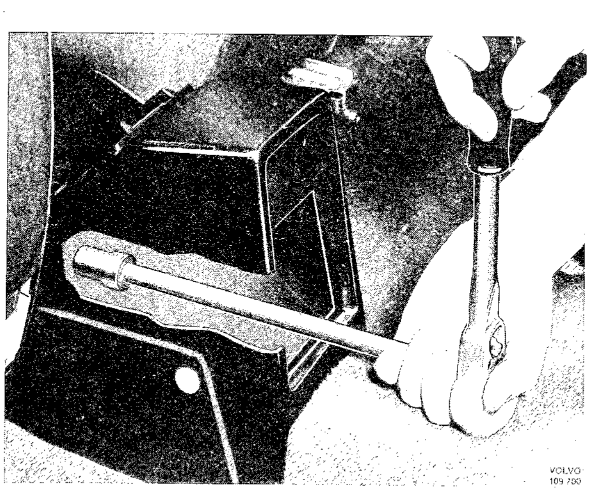


Fig. 5-82. Cable adjustment

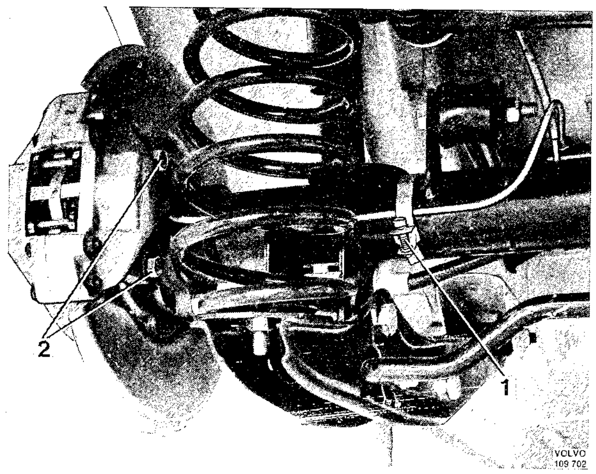


Fig. 5-84. Brake components
1. Clamp
2. Retaining screw

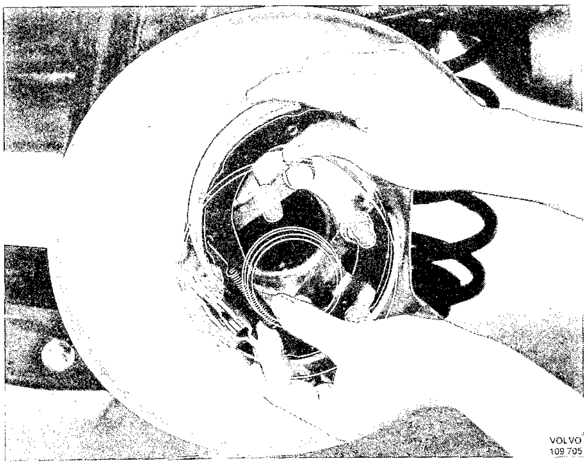


Fig. 5-85. Brake shoe installation

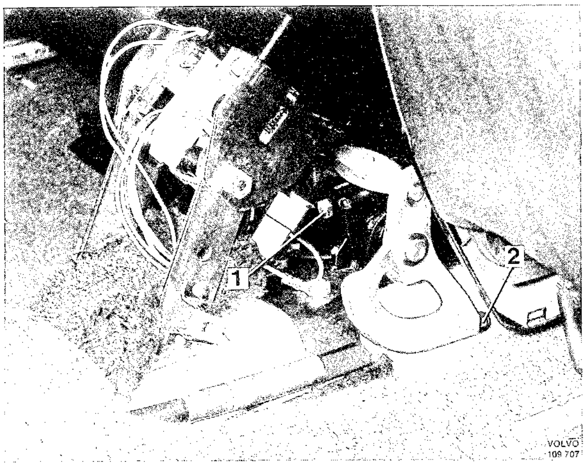


Fig. 5-87. Wire attachment
1. Adjustment bolt
2. Lock screw

11. Install brake drum and brake caliper. Use a locking fluid for the caliper retaining screws. Check that the brake disc is free from the brake pads.
12. Clamp the brake line to the rear axle (Fig. 5-84).
13. Align the brake drum so its hole is in front of the adjustment screw and adjust the shoes by turning the adjustment wheel with a screwdriver (Fig. 5-83). Stop turning when the drum just about can be turned around, then turn back 4–5 teeth. Turn the brake drum and check that the brake shoes do not drag. If they do, turn back another 2–3 teeth.
14. Install the rear wheels.
15. Tighten the wires with the adjustment screw at the rear end of the parking brake lever so that the brake is fully applied after 3–4 notches. Restore the ash-tray and lower the rear end.

REPLACING PARKING BRAKE CABLE, ONE SIDE

1. Remove the parking brake lever cover. Disconnect the wire for the ash-tray light.
2. Slacken the wire by screwing out the adjustment screw (1, Fig. 5-87). Remove nut (2) while retaining the cable with a small screwdriver at the end.
   NOTE: The cables cross each other under the floor. This means that left cable controls right wheel, and right cable the left wheel.
3. Lift the front end of the rear seat cushion, fold away the floor mat and loosen the clamps holding the wire to the floor.
4. Disconnect the wire end sleeve and rubber grommet from the rear seat support.
5. Put the rear end on stands and remove the rear wheel.
6. Remove the clamp (1, Fig. 5-84) for the brake line. Remove the retaining screws (2) for the caliper.
7. Hang up the brake caliper on a wire so that no sharp bends are made on the brake line.
8. Remove the brake drum.
9. Unhook the springs with a brake spring tool and remove the brake shoes.
10. Press out the lock pin retaining the cable to the lever (Fig. 5-88).

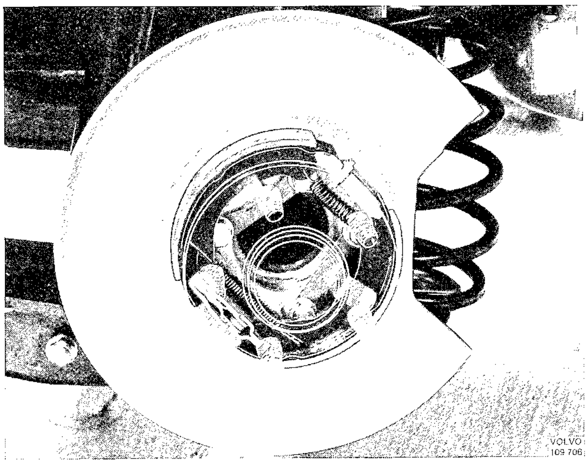


Fig. 5-86. Parking brake installed

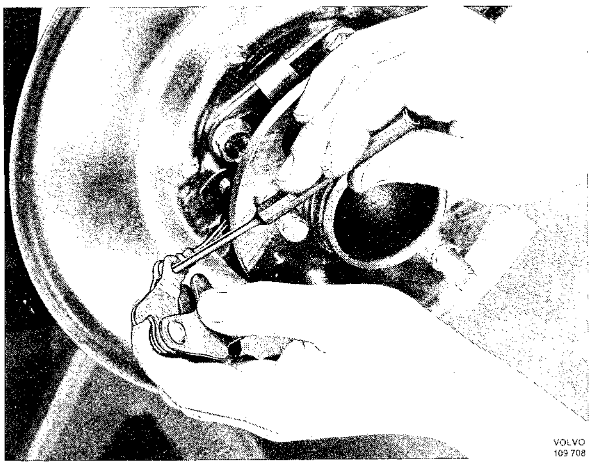


Fig. 5-88. Lock pin removal

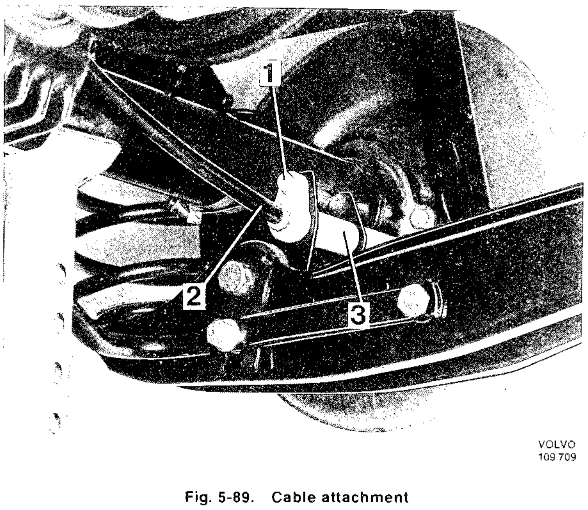


Fig. 5-89. Cable attachment
1. Screw
2. Cable
3. Plastic tube

Fig. 5-91. Lever installation

11. Remove the screw (1, Fig. 5-89). Pull out the cable (2) and plastic tube (3) with rubber seal.
12. Pull out the cable assembly from the center support and floor passage.
13. Align the plastic tube through the bracket and install the rubber seal (Fig. 5-90).
14. Route the new cable through the center support and through the hole in the floor.
    NOTE: The left wheel cable should be routed through the hole to the right of the propeller shaft, and vice versa.
15. Route the cable through the plastic pipe and connect it to the bracket.
16. Lubricate the lever pivot as well as the sliding surfaces for the brake shoes with a thin layer of heat resistant graphite grease. Attach the lever to the cable (Fig. 5-91).
17. Push in the cable and locate the lever behind the rear axle flange according to Fig. 5-92.
18. Apply a thin layer of graphite grease on the sliding surfaces of the brake shoes. Install brake shoes and lower return spring (Fig. 5-85).
19. Install upper return spring and adjustment device (Fig. 5-86).
20. Install brake drum and brake caliper. Use a locking fluid for the caliper retaining screws. Check that the brake disc is free from the brake pads.

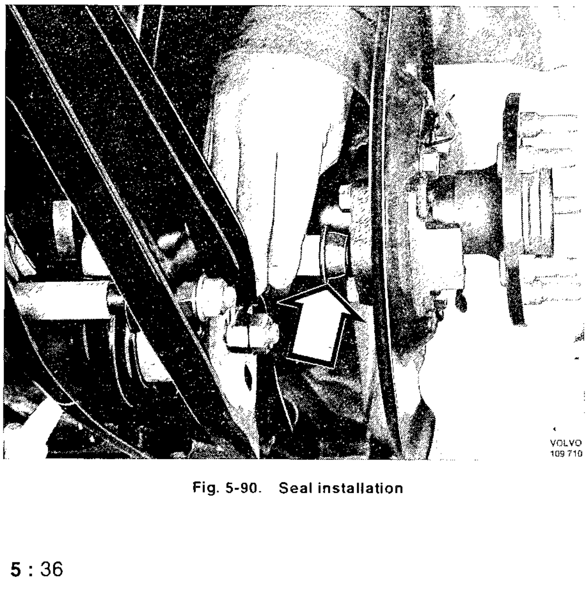


Fig. 5-90. Seal installation

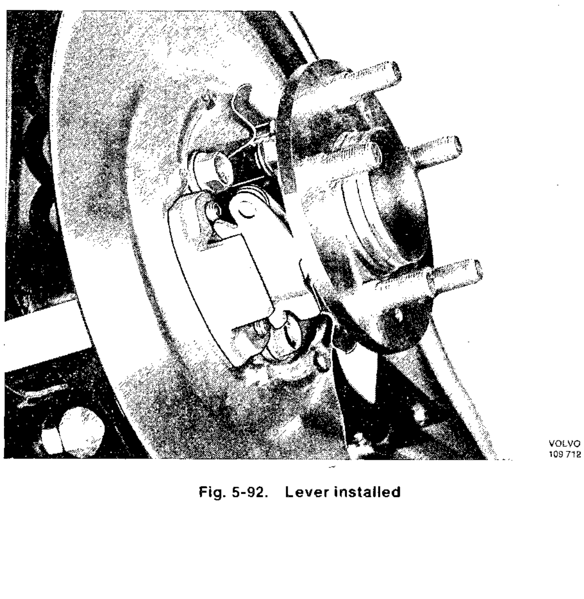


Fig. 5-92. Lever installed

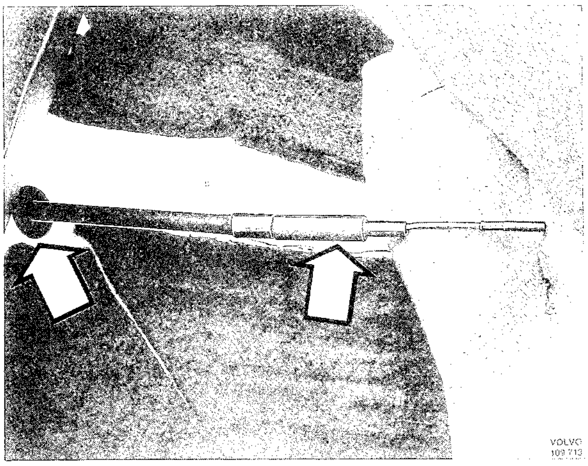


Fig. 5-93. Cable installed

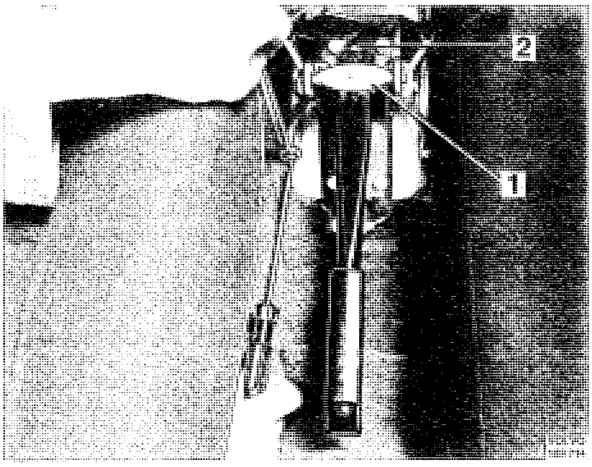


Fig. 5-94. Parking brake components
1. Yoke
2. Screw

21. Clamp the brake line to the rear axle (Fig. 5-84).
22. Align the brake drum so that its hole is in front of the adjustment screw and adjust the shoes by turning the adjustment wheel with a screwdriver (Fig. 5-83). Stop turning when the drum just about can be turned around, then turn back 4–5 teeth. Turn the brake drum and check that the brake shoes do not drag. If they do, turn back another 2–3 teeth.
23. When replacing one cable, both side brake shoes should be adjusted. Then install the wheels.
24. Install rubber grommet and end sleeve (Fig. 5-93). Position cable end in segment.
25. Install the two clamps holding the wire to the floor, fold down the mat and fit the rear seat.
26. Thread on the nut so far that the cable end goes through the nut lock (Fig. 5-94). Stretch the cables so that the yoke (1) is perpendicular to the parking brake lever when applied.
27. Adjust the movement of the parking brake lever with the screw (2) at the rear end of the lever so that the brakes are applied at notches 3–4.
28. Re-connect the wire for the ash-tray light, install the cover over the parking brake lever. Lower the vehicle.

Section 6

FRONT END AND STEERING GEAR

CONTENTS

GENERAL

TOOLS

The numbers for the special tools are preceded by 999 or SVO (e.g. 999 1801 or SVO 1801)

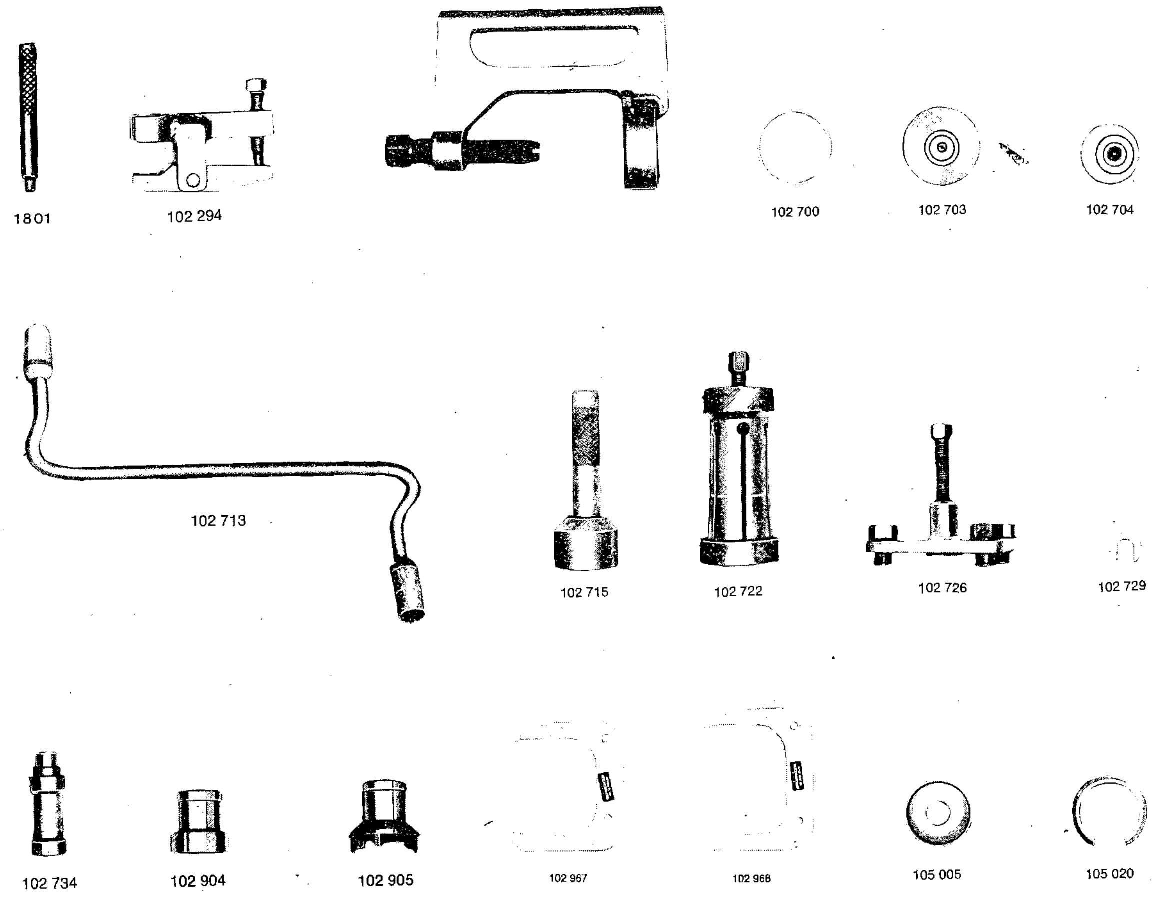


Fig. 6-1. Tools for work on front axle

999 (SVO)

1801 Standard handle 18×200
2294 Press tool, for removing and installing ball joints and rubber bushings, control arms
2700 Sleeve, for installing ball joint, lower control arms
2703 Drift, for installing ball joint, lower control arms
2704 Drift, for installing ball joint, upper control arms
2713 Spanner (5/8") for upper control arm shaft bolt, wheel adjustment
2715 Drift, for removing and installing grease cap in hub
2722 Puller, inner ring, inner front wheel bearing
2726 Puller, front wheel hub

999 (SVO)

2729 Spacer, removing shaft, upper control arm
2734 Driver, for removing bushing, upper control arm
2904 Drift, for removing and installing bushing in lower control arms (diagonal tires)
2905 Drift, for removing and installing bushing in lower control arms (radial tires)
2967 Gauge for lower ball joint, type 1
2968 Gauge for lower ball joint, type 2
5005 Drift, for installing oil seal in hub and bushing in upper control arm
5020 Sleeve, for removing and installing ball joint and bushings in control arms

For removing and fitting front end complete engine lifting tool 5060 is also used, see Fig. 6-14.
With work on removed front end also use 2520, 2560 and 2868, see Fig. 6-2.

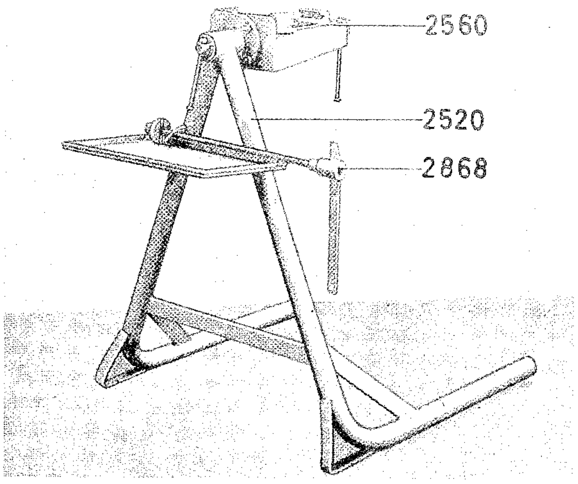
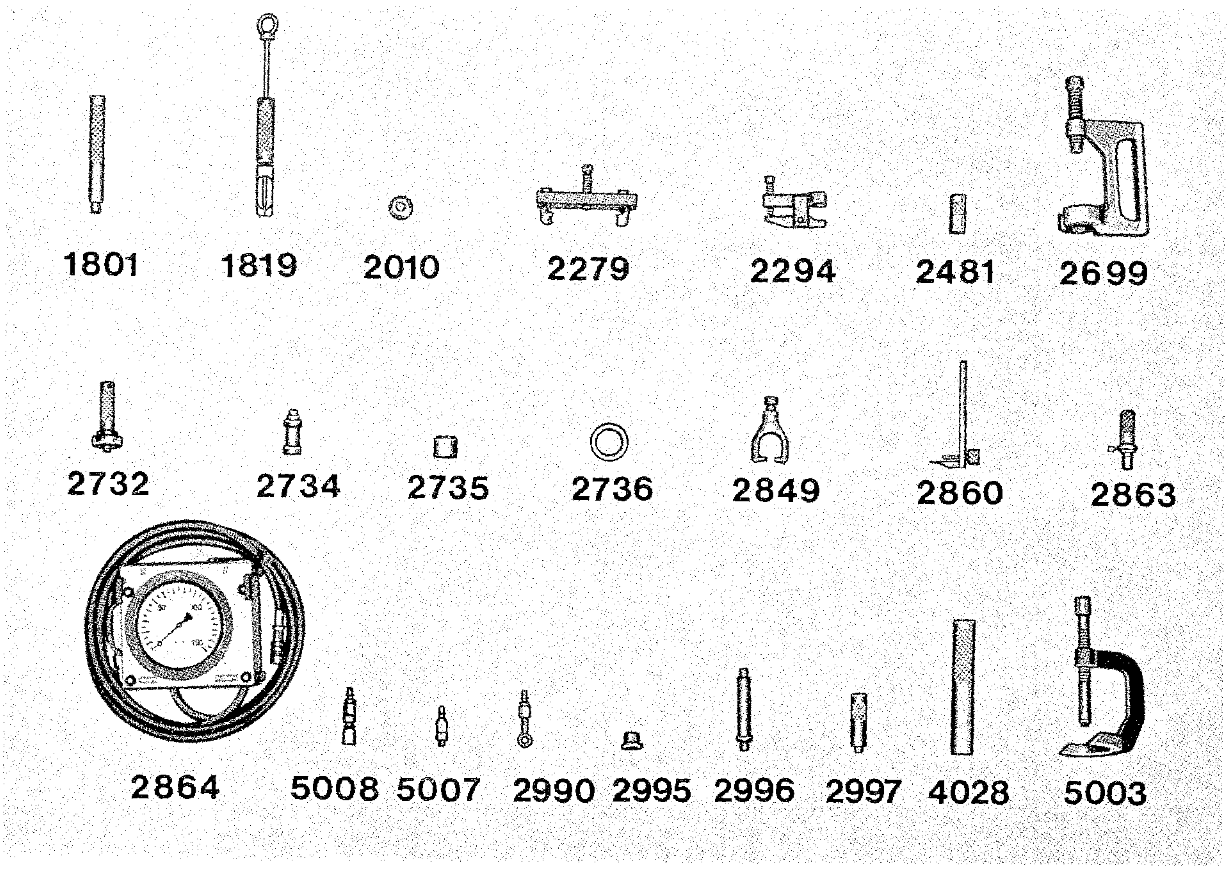


Fig. 6-2. Tools for work on removed front axle
999 (SVO)

2520	Stand for fixture
2560	Fixture
2868	Press tool for spring



Sig. 6-3. Tools for work on steering gear

999 (SVO)

1801	Standard handle 18×200
1819	Extractor for needle bearings
2010	Drift for installing upper sealing ring
2279	Puller for pulley
2294	Press tool for removing ball joint, tie rod
2481	Sleeve for installing bearing sleeve
2699	Press tool, for removing and installing bushing in idler arm
2732	Drift for installing bearing ring
2734	Drift for removing bushing, idler arm
2735	Drift for installing bushing, idler arm
2736	Counterhold, for removing and installing bushing, idler arm

999 (SVO)

2849	Puller, pitman arm
2860	Extractor for sealing ring
2863	Drift for installing sealing ring
2864	Test instrument
2990	Connection nipple for 2864 (right-hand steered vehicle)
2995	Drift for installing needle bearing and sealing ring
2996	Drift for removing and installing needle bearing, pump
2997	Drift for installing sealing ring, pump
4028	Drift for installing lower sealing ring
5003	Extractor for steering wheel
5007	Connection nipple for 2864
5008	Connection nipple for 2864

WHEEL ANGLES

For the vehicle to have good steering properties and a minimum of tire wear, the front wheels must have certain pre-determined settings, generally known as the wheel angles. The wheel angles refer to the caster, camber, king pin inclination, toe-out and toe-in.

CASTER

Caster generally refers to the longitudinal inclination (forwards or backwards) of the king pin. As this vehicle does not have a king pin, the caster consists of the angle between a vertical line and a line through the center of the ball joints (Fig. 6-4).
Caster has the effect of causing the wheels to run straight forwards thereby facilitating the steering.

CAMBER

Camber is the inclination of the wheel itself outwards or inwards. It is positive if the wheel is inclined outwards (see C, Fig. 6-5) and negative if the wheel inclines inwards. Faulty camber causes uneven tire wear.

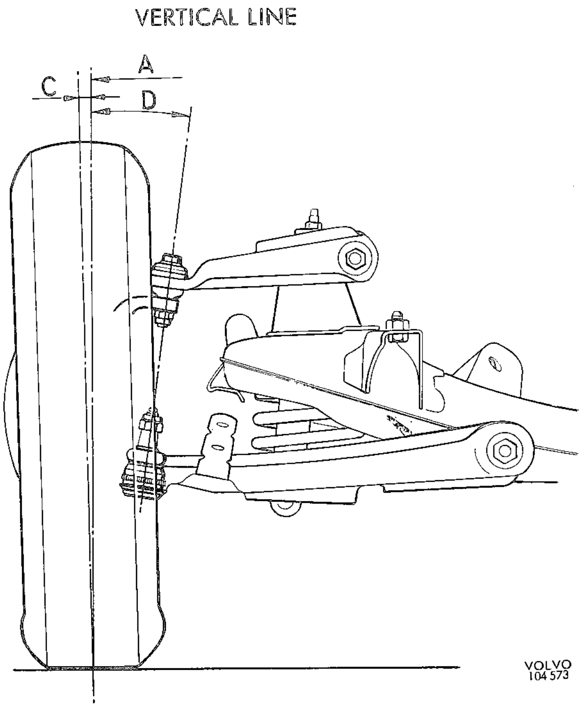


Fig. 6-5. Camber and king pin inclination
A=Vertical line C=Camber D=King pin inclination

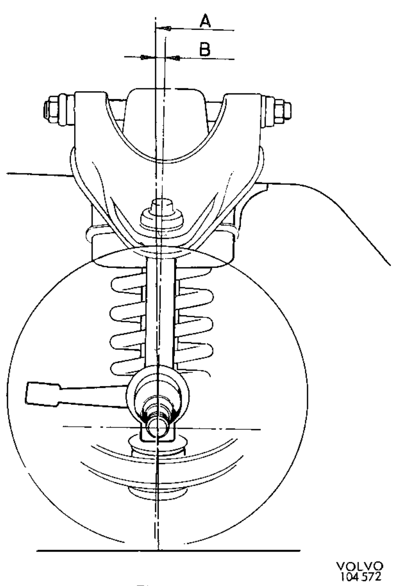


Fig. 6-4. Caster
A=Vertical line
B=Caster

KING PIN INCLINATION

King pin inclination means the inclination of the king pin inwards. Since this car does not have a king pin, the inclination is represented by an angle made between a vertical line and a line through the center of the ball joints (D, Fig. 6-5).
King pin inclination causes the center lines of the ball joints and the wheel to approach each other towards the road surface. This makes the wheel easier to turn. The inclination also assists the tendency of the wheel to run straight forwards since the car is lifted very slightly when whe wheels are turned.

TOE-OUT

When driving round a bend, the wheels roll at different radii. For them to have the same pivoting center and consequently minimum tire wear, the front wheels must be turned to different extents. This relationship is determined by the shape of the steering rod and steering arms, see Fig. 6-6.

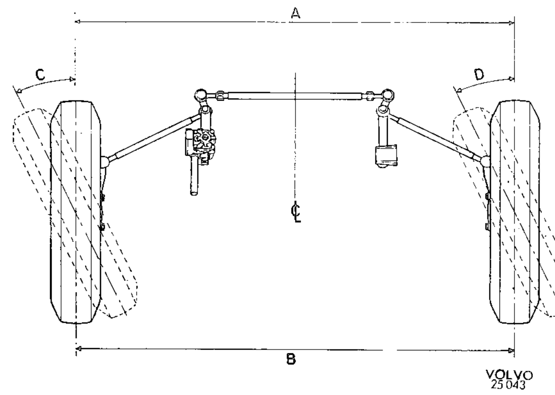


Fig. 6-6. Toe-out and toe-in

TOE-IN

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

PROCEDURE BEFORE WHEEL ADJUSTMENT

Wheel angles can be influenced by the factors listed below. Therefore, before measuring and adjusting, any faults should be remedied.

1. Check tire pressure and wear.
2. Play in front wheel bearings.
3. Play in ball joints or control arm attachments.
4. Broken springs.
5. Abnormal (temporary) equipment or loading.

Other factors which can influence the steering during driving without being revealed when meausring the wheel angles are:

1. Wheel out-of-true more than 2.5 mm (0.1").
2. Poor shock absorbers.
3. Faulty steering housing adjustment.
4. Play in intermediate arm journaling or steering rod parts.

MEASRUING WHEEL ANGLES

The wheel angles are measured with special measuring instruments of which there are many different types. No general description can, therefore, be given as to how measuring should be carried out except in the case of the steering geometry. The measruing principle is that camber is measured directly with the wheels pointing straight forwards. Caster and king pin inclination cannot be measured directly. Instead, the angular alteration which occurs when the wheel is turned from 20° outwards to 20° inwards is measured on the instrument.

Most types of modern wheel alignment measuring instruments require that the wheels are locked with, for example, the help of a pedal jack. When measuring the toe-in, the so-called "wheel spreader" should be applied at the front between the wheels at a spring force of 100—120 N (10—12 kp=22—32 lb.).

When measuring the wheel angles, follow the instructions for the measuring instruments concerned.

CHECKING WITH WHEEL ALIGNER

The wheel aligner should be calibrated to the values −2 to +5 meter/km and should be used as follows:

Straighten up the car so that the left wheels are in a straight line with the wheel aligner when the car is about 2 meters (6 ft.) from the aligner. **Let go** of the steering wheel and drive slowly over the aligner (2—4 kmph=3 mph).

NOTE. The steering wheel must **not** be touched until the front wheels have passed over the aligner.

If the green lamp remains on, then the wheels are properly adjusted and they are in parallel.

If any of the red lamps go on, at the same time as a buzzer emits a sound, then the front wheels are incorrectly adjusted and should be seen to.

CHECKING KING PIN INCLINATION

The king pin inclination, which on this vehicle is represented by the inclination of the center line of the ball joints, should be 7.5° at a camber of 0°. This cannot be adjusted and is difficult to measure exactly due to the tension and resilience in the parts, so that the angle read off on the instruments will not be exact king pin inclination but can serve as a guide.

CHECKING TOE-OUT

1. Place the vehicle front wheels on turntables and make sure that the wheels point straight forwards. Before the car is place on them, the turntables must be set to zero and locked.
2. Turn the wheels to the left until the right wheel has turned 20° inwards. The scale on the left turntable should then read 22.5±1°
3. Check the position of the right wheel in the same manner by turning the wheels to the right until the left wheel has turned 20° inwards, when the right turntable scale should give the same reading as previously indicated on the left. Both measurements should thus lie within the above-mentioned tolerances, otherwise it means that the steering gear or front end is distorted.
4. There are no adjusting possibilities, but if the toe-out is incorrect, the steering arms and steering rods should be checked. Replace any parts that are damaged.

ADJUSTING WHEEL ANGLES

NOTE. The front wheel angles are always adjusted in the following order:

1. Caster
2. Camber
3. Toe-in

To save time and labor, caster and camber should be adjusted at the same time, see under "Camber" below.

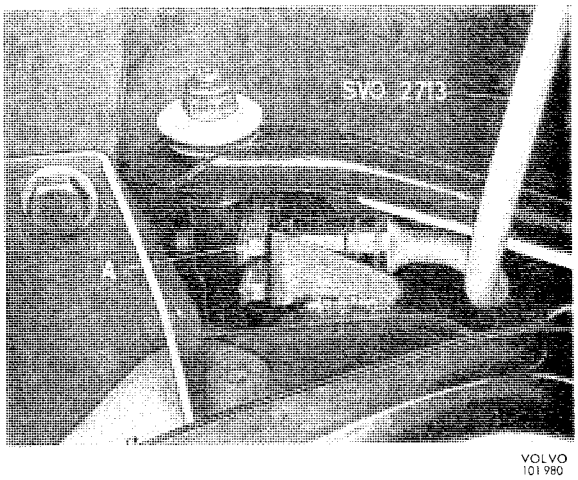


Fig. 6-7. Adjusting caster and camber
A=Shims

CASTER

The caster for each wheel should be within a tolerance range of 1.5° to +2.5°, that is, min 1.5° and max. 2.5° positive. The difference between both sides should, however, not exceed 1/2°.

To adjust, slacken the special bolts at the upper control arm shaft with tool 2713 (Fig. 6-7). Use one end of the tool for the front bolt and the other for the rear bolt. After the bolts have been slackened several turns, the requisite number of shims can be either removed or added, whichever is the case. Positive caster is obtained by either **adding** shims to the **rear** bolt or **removing** shims at the **front** bolt.

The diagram in Fig. 6-8 shows the shim thicknesses required for a certain alteration in angle. Shims are stocked in thicknesses of 0.15–0.5–1.0–3.0 and 6.0 mm (0.006–0.020–0.039–0.12 and 0.24"). The caster is altered to the same extent by either

1. removing a shim from one of the bolts,
2. adding a shim to the other bolt or
3. moving over half of the required shim thickness from one bolt to the other.

For proper caster, adjustment should be according to alternative 3.

After adjustment tighten the bolts to a torque of 55–70 Nm (5.5–7.0 kpm=40–50 lbft).

CAMBER

The camber for each wheel should be within a tolerance range of 0° to +1/2°, that is it should be min. 0° and max. 1/2° positive.

To adjust, slacken the special bolts at the upper control arm shaft several turns with tool 2713 (Fig. 6-7). Use one end of the tool for the front bolt and the other for the rear bolt. Then either increase or reduce the number of shims equally for both bolts. More **positive** camber is obtained by **removing** shims, and **negative** camber by **increasing** the number of shims. The shim thickness required for a certain alteration in angle is shown in the diagram in Fig. 6-8. Shims are stocked in thicknesses of 0.15–0.5–1.0–3.0 and 6.0 mm (0.006–0.020–0.039–0.12 and 0.24"). The camber is altered by removing or adding an equal number of shims at both the bolts.

After adjustment, tighten the bolts to a torque of 55–70 Nm (5.5–7.0 kpm=40–50 lbft).

To save time and labor adust the caster and camber at the same time by removing or adding shims for the camber and altering the number of shims for the caster. If, for example, the camber is increased 0.6° and the caster 1/4°, first remove 2.5 mm (0.1") in shims at both the bolts and move 0.3 mm (0.012") in shims from the front to the rear bolt.

ADJUSTING TOE-IN

The toe-in should be 2–5 mm (1/8"). Incorrect toe-in is adjusted by slackening the lock nuts on the tie rod, after which the rod is turned in the required direction. The distance between the tires at the front is reduced, that is to say, toe-in is increased by turning the tie-rod in the normal direction of rotation of the wheels. Tighten the lock nut after adjustment to a torque of 75–90 Nm (7.5–9.0 kpm=55–65 lbft).

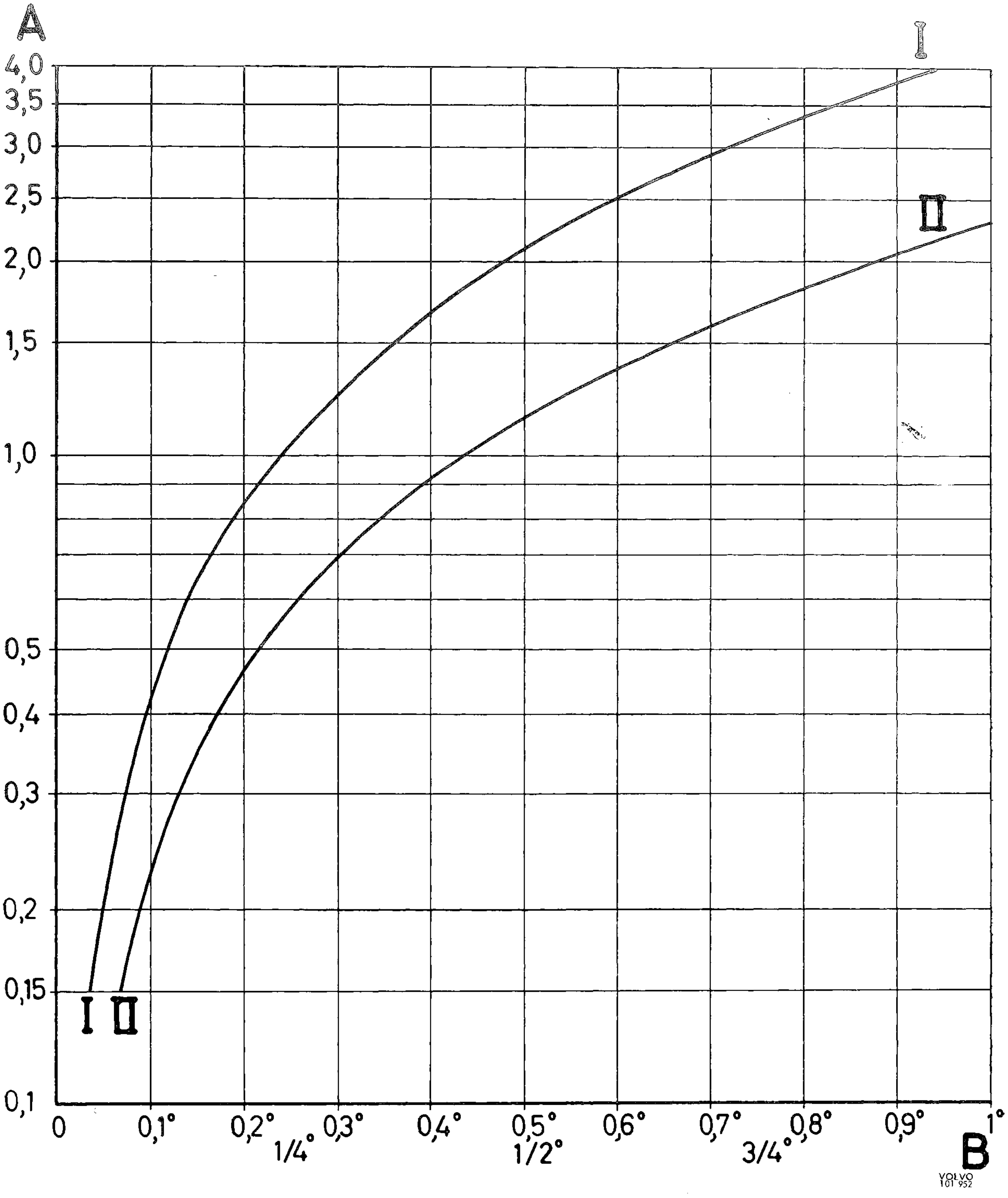


Fig. 6-8. Diagram for alteration of caster and camber
I=Camber
II=Caster
A=Shims (mm)
B=Alteration of angle

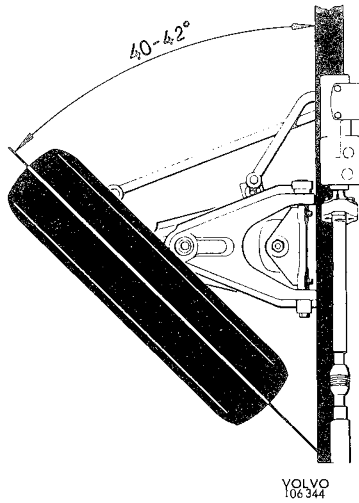


Fig. 6-9. Adjusting max. wheel lock

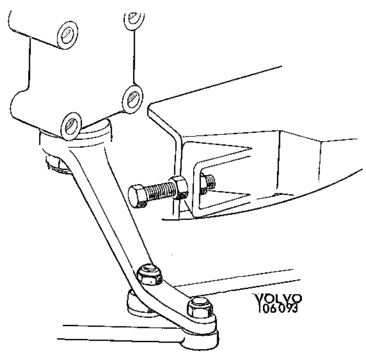


Fig. 6-10. Stop bolt, max. wheel lock

ADJUSTING STEERING LIMITS

Wheel turning is limited by stop bolts, at the pitman arm (Fig. 6-10) and at the relay arm.

Adjusting is done as follows:

1. Turn the left wheel for a left-hand turn as far as it goes. Check that the lock angle of the wheels is 40–42°. If it is not, then adjust to this value with the stop bolt (Fig. 6-10) at the pitman arm.
2. Repeat this procedure with the right wheel and the stop screw on the relay arm.

   NOTE. Check that the brake hoses are clear at full wheel lock.

FRONT END

GENERAL INFORMATION

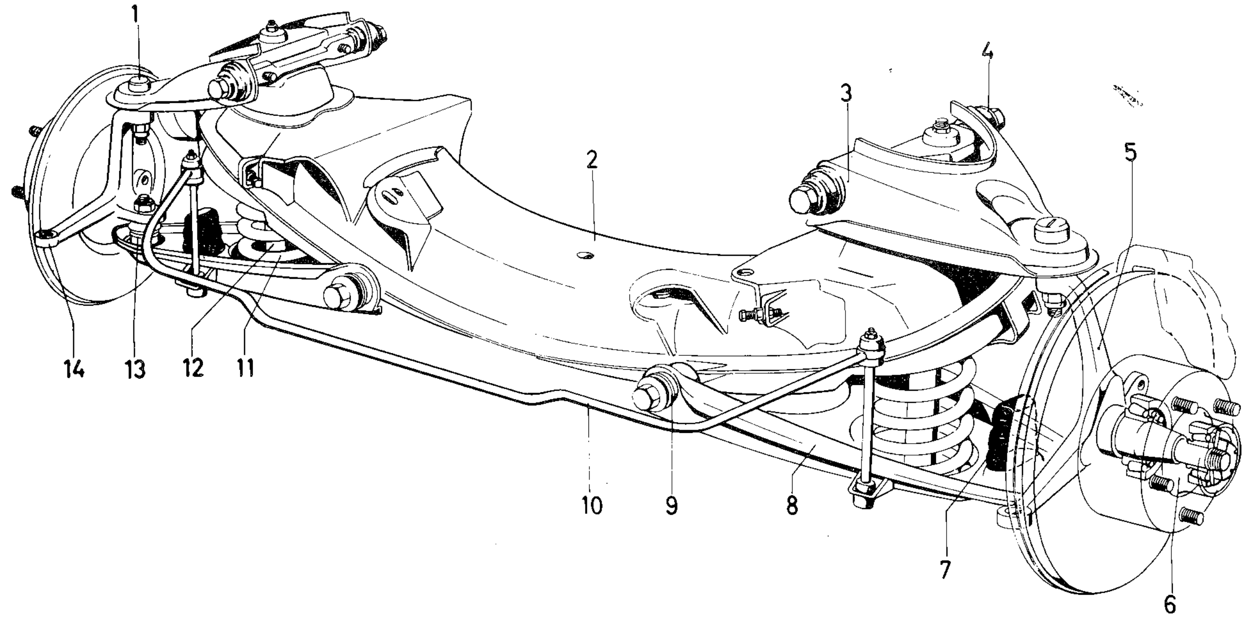


Fig. 6-11. Front end

1. Upper ball joint
2. Front axle member
3. Upper control arm
4. Upper control arm bushing
5. Steering knuckle
6. Hub
7. Rubber buffer
8. Lower control arm
9. Lower control arm bushing
10. Stabilizer
11. Spring
12. Shock absorber
13. Lower ball joint
14. Steering arm

The vehicle has independent front wheel suspension. This means that there is no actual front axle, this being replaced by a strong box-section front axle member. This member is bolted to the self-supporting body and the front wheel suspension and springs are fitted at the ends of the member. The construction is illustrated in Fig. 6-11. The steering knuckle is pivoted on the upper and lower control arms by means of ball joints (1 and 13), which are pressed into control arms. The control arm shafts are carried in rubber bushings, which are journalled in the control arm. Camber and caster are adjusted by means of shims between the upper control arm shaft and its attachment in the front axle member (see Fig. 6-7).

The front wheels are carried in taper roller bearings (Fig. 6-11). The front spring assembly consists of coil springs (11) inside which telescopic shock absorbers (12) are fitted. In order to increase its anti-rolling properties, the car is equipped with a stabilizer (10), which is anchored partly to the lower control arms (8) and partly to the body.

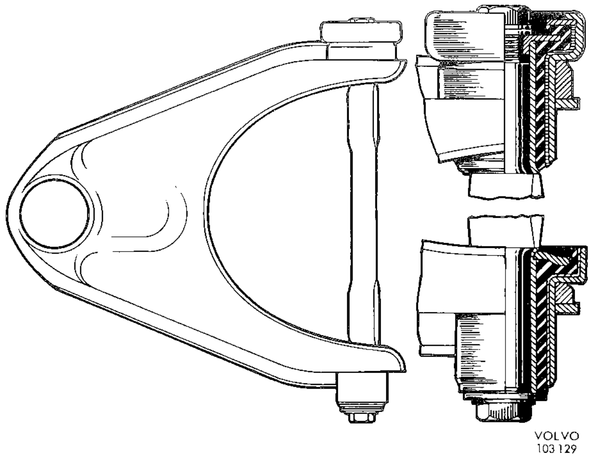


Fig. 6-12. Upper control arm

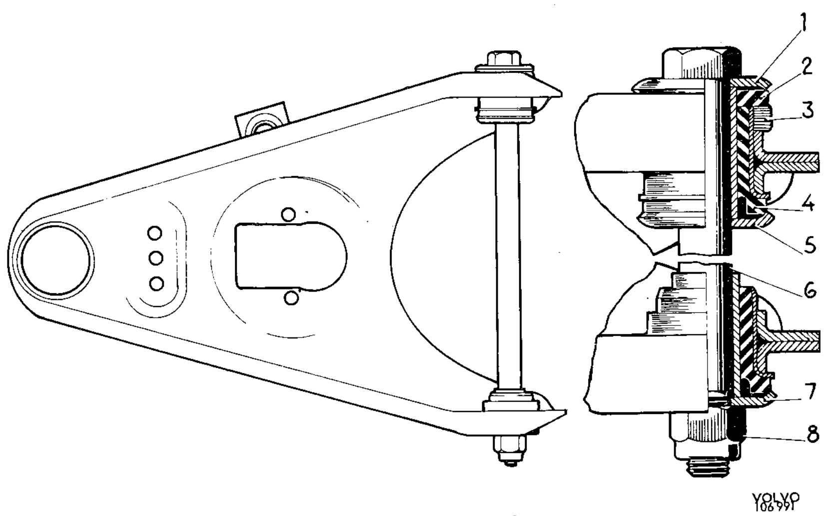


Fig. 6-13. Lower control arm

1. Washer
2. Rubber ring
3. Spacer ring
4. Bushing
5. Washer
6. Control arm shaft
7. Washer
8. Nut

GENERAL

The ball joints are lubricated for life at the factory and thus do not have lubricating nipples. However, the rubber seals should be inspected every 20 000 km (12 000 miles) and if necessary replaced when adding grease. The control arms may only be straightened to a minor extent and then only in a cold condition. If the old control arm deviates to any great extent when compared to a new one, it should be replaced.

No straightening whatsoever is permitted for stub axles and steering knuckles.

The instructions given below indicate certain tightening torques. Otherwise see the standard torque for the respective bolting in question.

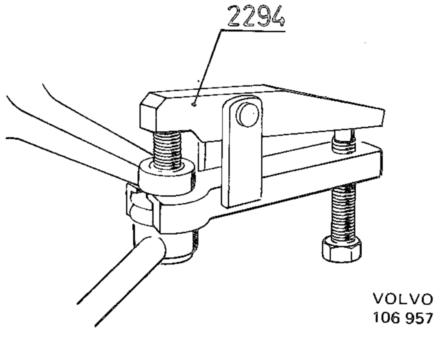


Fig. 6-15. Removing steering rod

FRONT END COMPLETE

REMOVAL

1. Install the lifting tool 5006, see Fig. 6-14. Hook the tool crook under the alternator tensioning bar and as near as possible to the engine block. Raise the engine until the weight is taken off the front engine mounting. Temporarily block the vent-hole in the brake fluid container cover to reduce leakage. Remove the hub caps and loosen the nuts for the front wheels a couple of turns.
2. Place the vehicle on stands under the front jack attachments. Remove the front wheels.
3. Disconnect the steering rods from the steering arms with tool 2294 according to Fig. 6-15.
4. Remove the stabilizer attaching bolts.
5. Loosen the brake hoses from the bracket at the support member.
6. Remove the lower nuts for the front engine mountings.
7. Remove the front axle member attaching bolts, lower and remove the front end.

Disassembly and assembly

For work on a removed front end fixture 2560 and stand 2520 can suitably be used. After the shock absorber has been removed, place tool 2868 according to Fig. 6-16. Compress the spring by screwing in the spindle until there is a clearance at the rubber buffer of the upper control arm.

Concerning other instructions, see under "Removing" and "Installing" for the various components.

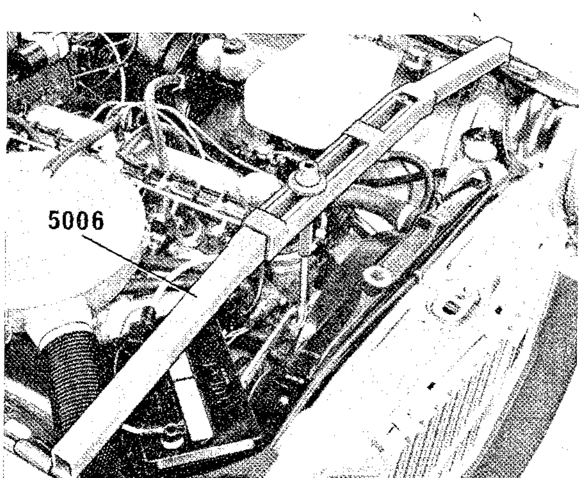


Fig. 6-14. Tool for lifting engine

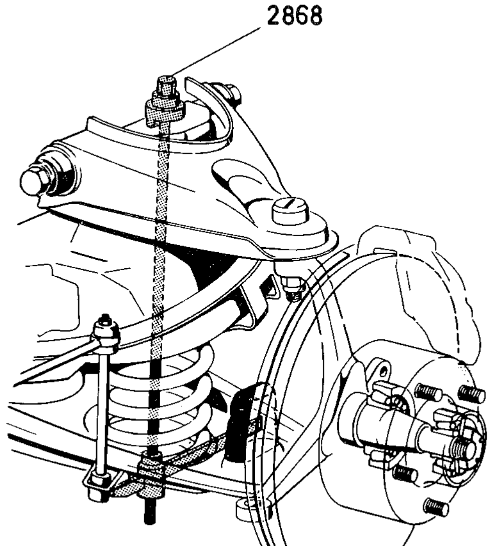


Bild 6-16. Compressing spring

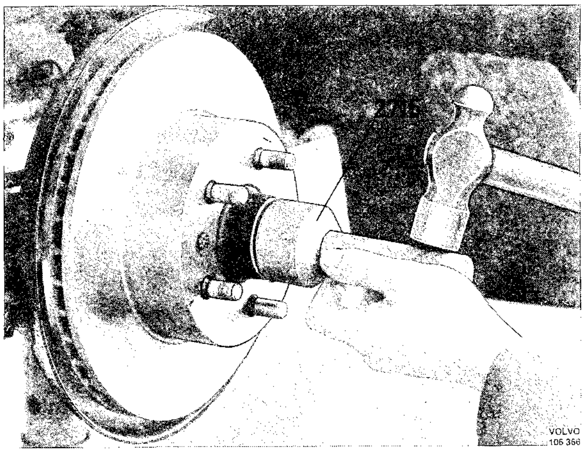


Fig. 6-17. Removing grease cap

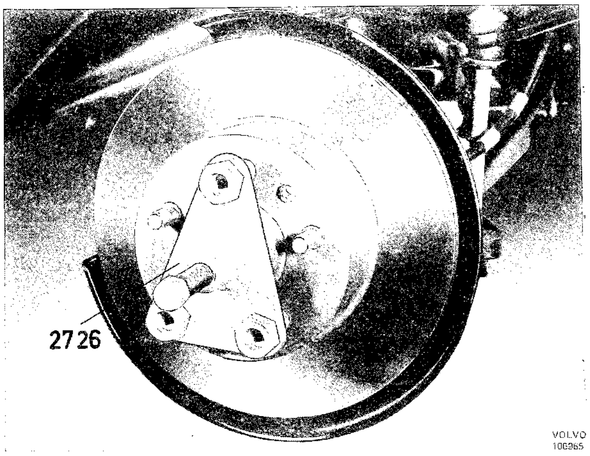


Fig. 6-18. Removing front wheel hub

INSTALLATION

1. Install the guide pins in the front holes for the front axle member.
2. Place a jack under the front end and raise the front end so that it comes into position. Fit rear bolts provided with plastic plugs. Remove the guide pins and fit the front bolts (also those with plastic plug).
3. Tighten the engine moutning bolts to a torque of 21–25 Nm (2.1–2.5 kpm=15–18 lbft).
4. Install the attaching bolts for the stabilizer. Connect the brake hoses, see Fig. 5-19, Section 5. Carefully check the location of the hoses and adjust if necessary.
5. Install the steering rods.
6. Bleed the brakes according to the instructions in Section 5. Remove the temporary seal from the brake fluid container cap.
7. Install the wheels and wheel nuts. Lower the vehicle and tighten the wheel nuts to a torque of 100–140 Nm (10–14 kpm=70–100 lbft). Fit the hub cap. Remove the lifting tool.

STUB AXLE

REMOVAL

1. Remove the front brake caliper according to the instructions given in Section 5.
2. Remove the grease cap with tool 2715, see Fig. 6-17. Remove the split pin and castle nut. Pull off the hub with puller 2726, see Fig. 6-18. If necessary pull off the inner bearing from the stub axle tool 2722, see 6-19.
3. Remove the steering rod from the steering arm with tool 2294, see ig. 6-15.
4. Slacken but do not remove the nuts for the ball joints, knock on the axle with a hammer until the ball joint pins loosen. Raise the lower control arm a little with the jack. Remove the nuts for the ball joints and then the stub axle.

EXAMINING BEARING COMPONENTS

Clean the hub and grease cap thoroughly. Make sure that all the old grease, even inside the hub, is removed. Compressed air can suitably be used for a comprehensive cleaning of the bearings. Then wash the bearing components in white spirit and allow them to dry. Drying by means of compressed air should be avoided since the air often contains water and dust particles. Accessible bearing components are dried with cotton or cloth rags (but not waste). The bearing surfaces must be dry of cleaning fluid in order not to reduce the adhesion of the

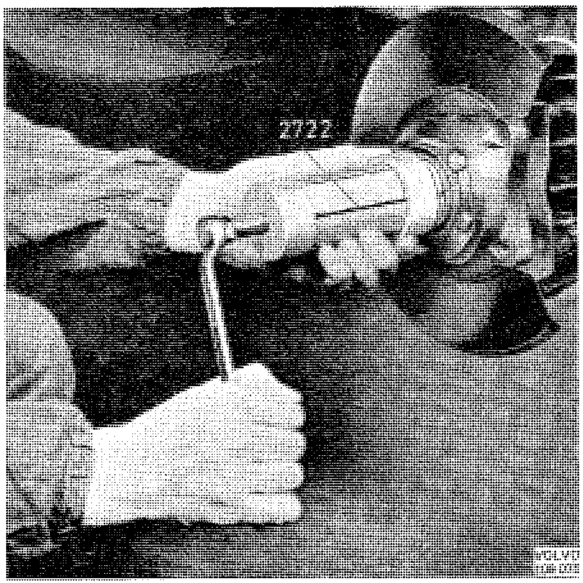


Fig. 6-19. Removing inner bearing

grease which is applied later. A new bearing taken directly from its packing container should not be cleaned.

After the cleaning, inspect the parts. If the bearing races or rollers are damaged, rusted or are blued, replace the bearing. If the outer or inner ring is loose in its seating, try a new ring. The sealing rings should be replaced if they are worn or damaged.

For lubrication of the wheel bearings, use only a high-class, durable grease for wheel bearings. Pack the bearings manually with as much grease as possible between the roller retainers and the inner race. Grease also on the outside of the rollers and container. The intermediate spaces in the hub between the outer and inner bearing should be filled with grease, see Groups 46 and 77. Before fitted, the wheel hub felt rings should be oiled generously with, for example, light engine oil.

Cleanliness of the bearings is of major importance for their lifetime. For this reason, do not let ungreased bearings remain unprotected. Observe the greatest cleanliness when fitting them.

INSTALLATION

1. Place the inner bearing in position in the hub and press in the sealing washer (1, Fig. 6-20) until it is against the outer ring bearing. Use drift 5005 and standard handle 1801.
2. Place the stub axle in position and tighten the ball joint nuts. If the ball joint twists, hold it firmly in position with a screw vise, see Fig. 6-24. Fit the steering onto the steering arm.

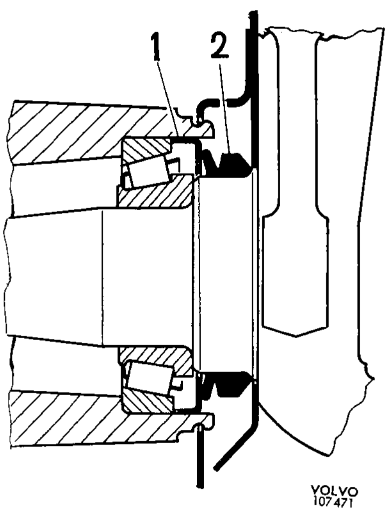


Fig. 6-20. Hub seal
1. Sealing washer 2. Sealing ring

3. Press the sealing ring (2, Fig. 6-20) onto the stub axle without tool until it bottoms. It is important that the ring is not fitted obliquely.
4. Adjust the front wheel bearings by tightening the nut with a torque wrench to a torque of 70 Nm (7 kpm= 50 lbft) while the wheel is rotated. Then slacken the nut one third of a turn. If the slot in the nut does not coincide with the split pin hole in the stub axle, slacken the nut further until the split pin can be fitted. Check that the wheel rotates easily but without any play.
5. Fill the grease cap half full of grease and fit it with tool 2715.
6. Install the front wheel brake unit and wheel according to Section 5 "Installing front wheel brake unit".

UPPER BALL JOINT

CHECKING WEAR

In principle this check can be made with the front end either jacked up or lowered. The upper control arm, however, should not be against the rubber stop.

Check to see whether the ball joint has any **radial** clearance by bending up the wheel. If there is radial clearance, the upper ball joint should be replaced. Note. Do not mix up possible play in the wheel bearings with clearance in the ball joint.

Axial clearance should not be measured for the upper ball joint.

REMOVING

1. Remove the hub cap and slacken the wheel nuts slightly.
2. Jack up the front end of the vehicle under the front jack attachments. Remove the wheel.
3. Slacken but do not remove the nut for the upper ball joint. Tap with a hammer on the steering knuckle round the ball joint pin until it loosens from the axle. Remove the nut and suspend the upper end of the knuckle with a wire to avoid straining the brake hoses, see Fig. 6-21.

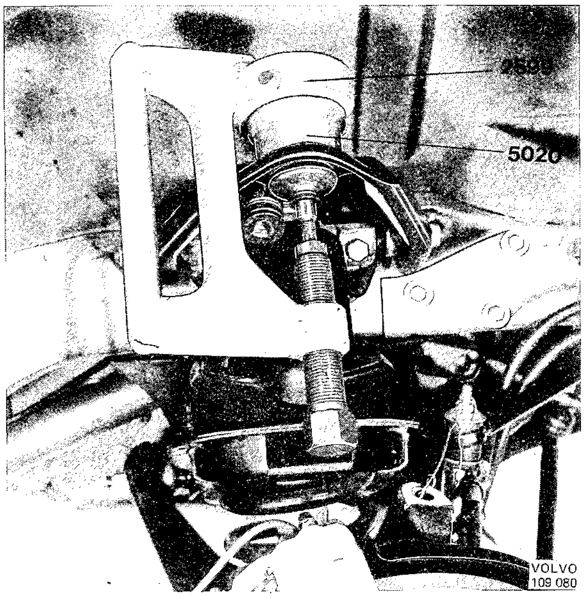


Fig. 6-21. Removing upper ball joint

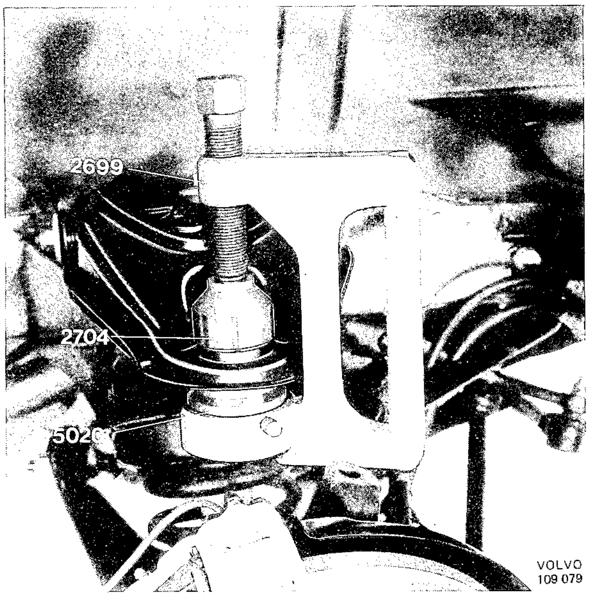


Fig. 6-23. Installing upper ball joint

4. Slacken the nuts for the control arm shaft a 1/2 turn. Lift up the control arm slightly and press out the ball joint with press toll 2699 and sleeve 5020, see Fig. 6-21.

INSTALLATION

1. Before installing the ball joint, check that the rubber seal is filled with grease. Bend the pin end over the slot (A, Fig. 6-22) and check that the grease forces its way out. If necessary, top up with multipurpose grease.
2. Press the ball joint into the control arm with press tool 2699, sleeve 5020 and drift 2704, see Fig. 6-23. Make sure that the ball joint recess coincides with the longitudinal shaft of the control arm (within ±8°) either externally or internally (Fig. 6-22) as the pin has maximum movement along this line. Should the ball joint be incorrectly fitted when being pressed in, turn the tool 2699 half a turn and then press the ball joint into the correct position. The ball joint must not be loose in the control arm.

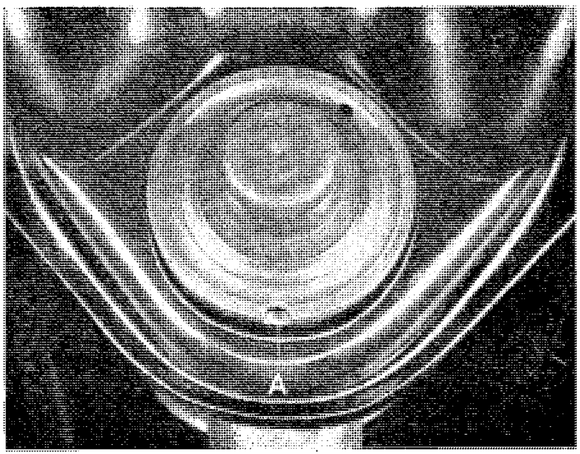


Fig. 6-22. Location of ball joint in upper control arm

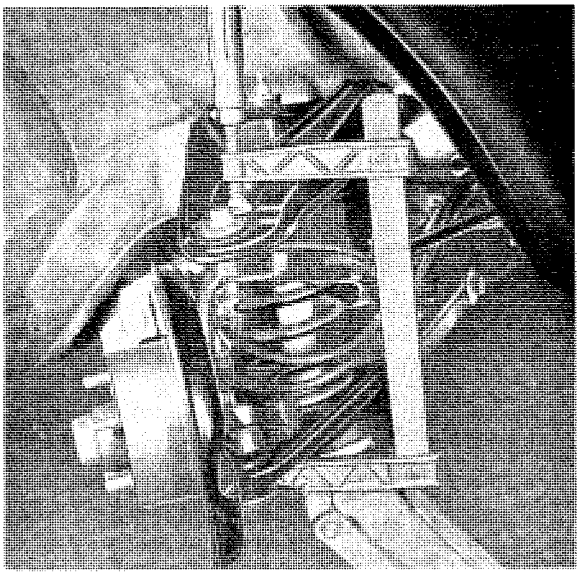


Fig. 6-24. Upper ball joint securely held by vise

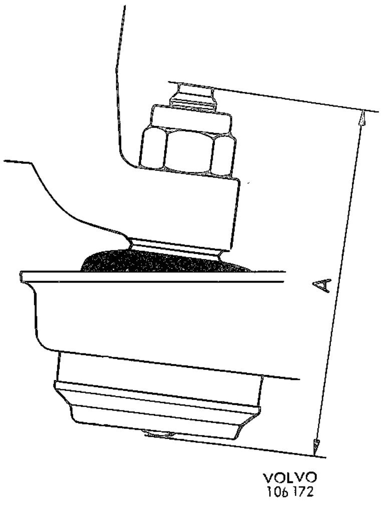


Fig. 6-25. Lower ball joint, type 1(without spring)
A=Max. 99.3 mm (3.91")

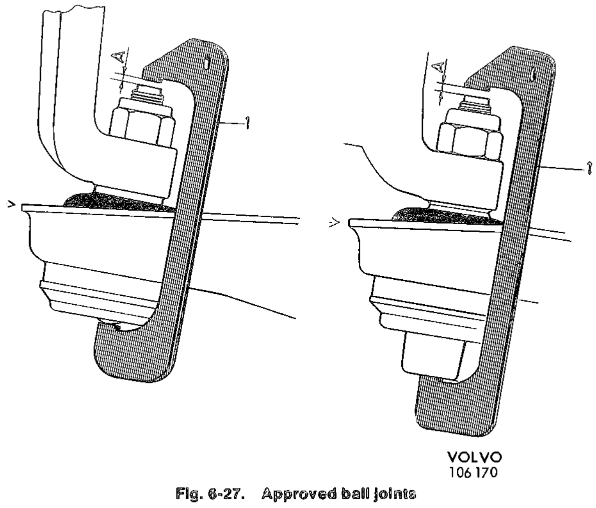


Fig. 6-27. Approved ball joints
1. 2967 for ball joint type 1
2968 for ball joint type 2
A=Clearance

3. Turn down the control arm and tighten the nuts for the control arm shaft. Tighten the ball joint against the steering knuckle. If the pin rotates, hold it firmly with a screw vise, see Fig. 6-24.
4. Fit the wheel and wheel nuts. Lower the vehicle and tighten the wheel nuts to a torque of 100–140 Nm (10–14 kpm=70–100 lbft). Fit the hub cap.

LOWER BALL JOINT

CHECKING WEAR

There are two types of lower ball joints. Type 2 (Fig. 6-26) has a built-in spring, while type 1 (Fig. 6-25) does not have such a spring.

Use a gauge to make a quick check on the lower ball joint in its operaitng position. The check should be made with normal load on the wheels, that is, with the vehicle standing on the ground, or a platform or similar. The wheels should point straight forwards. The tool cannot be used when jacking with a jack or hoist, which off-loads the ball joint. The check is carried out as follows:

Place the gauge over the ball joint. If the gauge (see Fig. 6-27) can be fitted over the ball joint, then the joint can be approved. If the length of the ball joint is greater than the tool span (see Fig. 6-28), the ball joint should be replaced.

REMOVAL

1. Remove the hub cap and slacken the wheel nuts slightly.
2. Jack up the vehicle under the front jack attachments. Take off the wheel.
Disconnect the steering rod from the steering arm with tool 2294, see Fig. 6-15, and remove the brake lines from the stabilizer bolt.

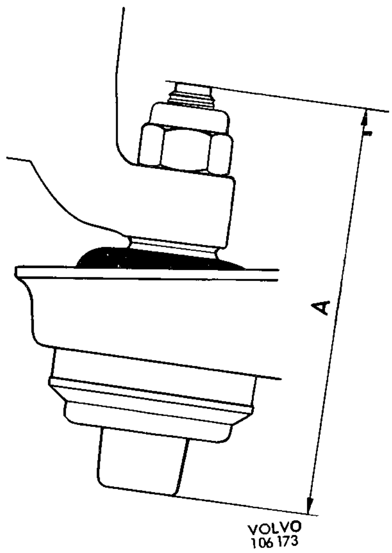


Fig. 6-26. Lower ball joint, type 2 (with spring)
A=Max. 113 mm (4.5")

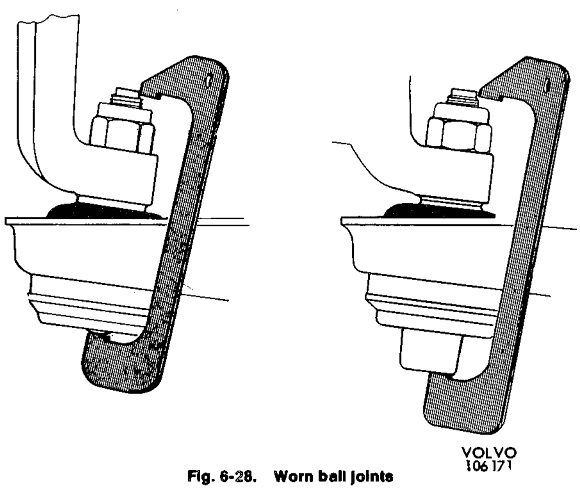


Fig. 6-28. Worn ball joints

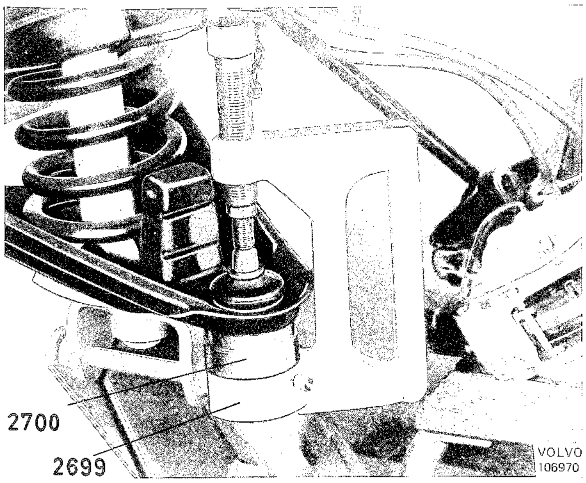


Fig. 6-29. Removing lower ball joint

3. Slacken the nuts for the upper and lower ball joints, but do not remove them. Tap with a hammer until the ball joints loosen from the axle.
   Raise the lower control arm with the jack. Remove the nuts.
4. Remove the steering knuckle with hub and the front wheel brake unit, and place them on a stand or similar.
5. Press the ball joint out of the lower control arm with press tool 2699 and sleeve 2700, see Fig. 6-29.

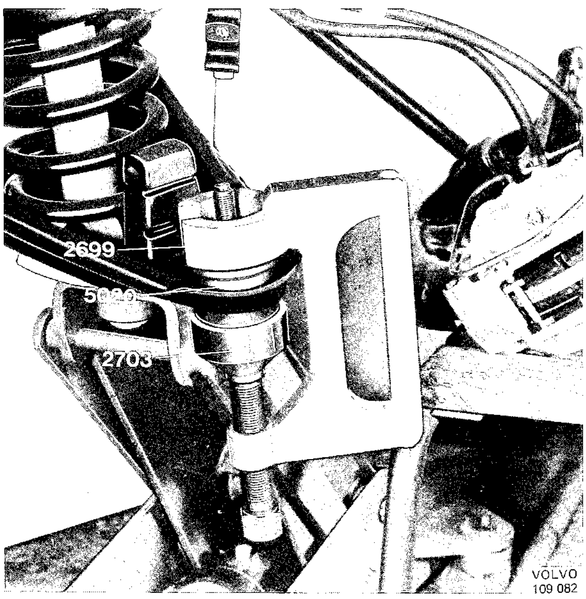


Fig. 6-30. Installing lower ball joint

INSTALLATION

1. Check that the rubber seal is filled with grease by breaking the pin to the side so that grease is forced out. If this does not happen, then fill the seal with grease. Beore fitting, remove any grease that has squeezed out on to the ball pin taper.
2. Press the ball joints in the control arm with tools 2699+5020+2703, see Fig. 6-30. If the ball joint is fitted at a slant turn the tool 180° and press the ball joint in correctly. The joint must not be loose in the control arm.
3. Install the steering knuckle and tighten the nuts of the upper and lower ball joints. If the pins rotate, fix them securely with a screw vise.
4. Install the steering rod and lower the jack in order to take the load off the control arms. Point the wheels straight forwards and fasten the brake hoses to the stabilizer bolt.
5. Install the wheel and wheel nuts. Lower the vehicle and tighten the wheel nuts to a torque of 100−140 Nm (10−14 kpm=70−100 lbft). Fit the hub cap.

UPPER CONTROL ARM

REMOVAL

1. Remove the hub cap and slacken the wheel nuts slightly.
2. Jack up the front end of the vehicle under the front jack attachments. Remove the wheel.
3. Slacken but do not remove the nut for the upper ball joint. Knock with a hammer on the steering knuckle round the ball joint pin until it loosens from the axle. Remove the nut and suspend the upper end of the knuckle with a wire to avoid straining the brake hoses, see Fig. 6-21.
4. Remove the bolts for the control arm shaft with tool 2713, see Fig. 6-7.
   NOTE. Take care of the shims. Lift off the control arm.

REPLACING BUSHINGS

The bushings on a removed upper control arm is replaced as follows:

1. Remove the nuts and washers for the control arm shafts.
2. Fix the control arm shaft in a vise. Carefully bend out the control arm ends so that tool 2729 can be attached, Fig. 6-31. Schrew a bolt into the hole at the other end of the shaft. Positon adapter 5020 on the flanged end of the bushing. Press on the bolt and push out the shaft and bushing, Fig. 6-32.
3. Press out the front bushing with the help of driver 2734 and adapter 5020, Fig. 6-33.
4. Clean and check the shaft and control arm.

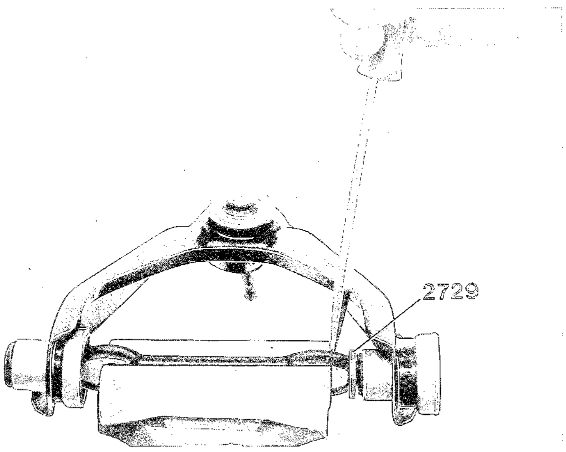


Fig. 6-31. Positioning removal tool

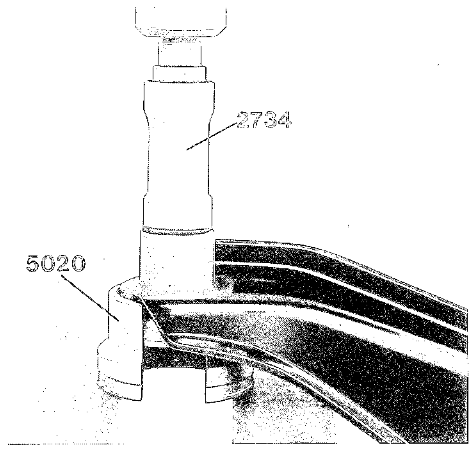


Fig. 6-33. Bushing removal

5. Press in the front bushing (P/N 679 247-7) with the help of driver 5005, handle 1801 and adapter 5020, Fig. 6-35.
6. Position the shaft. Note that the longer end should face forwards. Press in the rear bushing (P/N 679 248-5) with the help of driver 5005, handle 1801 and adapter 5020, Fig. 6-36.
7. Fit the washers and bolts. The small washer at the front bushing and the spring washers on the outside. The bolts are tightened when the control arm is installed and in the position it has when the gap rubber buffer—front axle member (meas. D, Fig. 6-37) is about 30 mm ($1^1/_8$"). Tightening torque 40—50 Nm (4—5 kpm= 29—36 lb.ft.).

INSTALLATION

NOTE. The control arm shaft is fixed with a special bolt containing a nylon plug.

1. Place the control arm in position and fit the bolts by hand. Install the shims in the position they occupied previously. Tighten the bolts with tool 2713. Tighten the nuts for the control arm shaft to a torque of 55—62 Nm (5.5—6.2 kpm=40—45 lbft).
2. Install the upper ball joint in the steering knuckle and tighten the nut.
3. Install the wheel and wheel nuts. Lower the vehicle and tighten the wheel nuts to a torque of 100—140 Nm (10—14 kpm=70—100 lbft). Fit the hub cap.

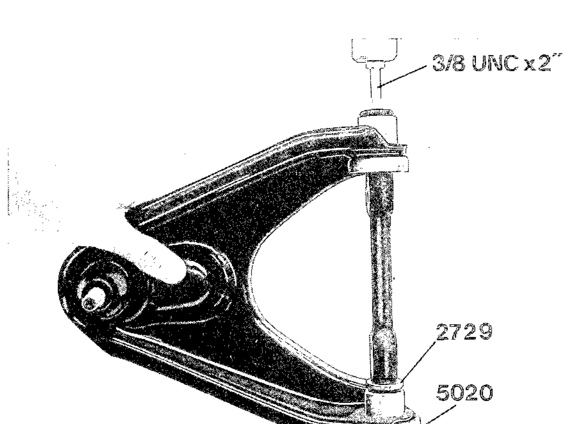


Fig. 6-32. Shaft removal

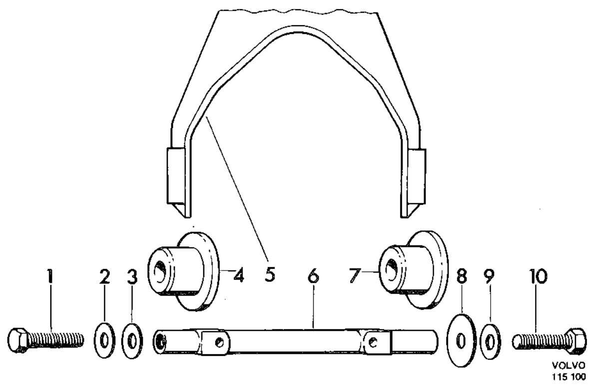


Fig. 6-34. Upper control arm components

1. Bolt
2. Spring washer
3. Small flat washer
4. Front bushing
5. Upper control arm
6. Shaft
7. Rear bushing
8. Large flat washer
9. Spring washer
10. Bolt

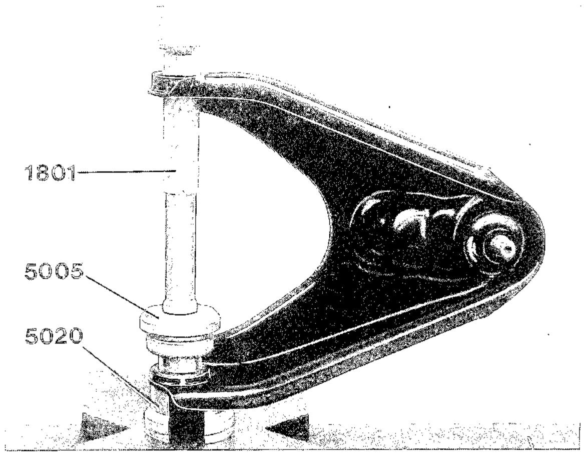


Fig. 6-35. Front bushing installation

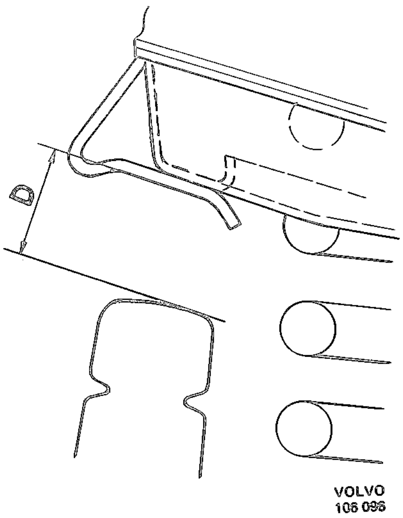


Fig. 6-37. Installation position.
D=30 mm ($1^{1}/_{8}$")

LOWER CONTROL ARM

REMOVAL

1. Remoe the hub cap and loosen the wheel nuts a couple of turns.
2. Jack up the vehicle at the front jack attachments. Remove the wheel.
3. Remove the shock absorber, see Section 7, "Removing shock absorber".
4. Disconnect the steering rod from the steering arm with tool 2294, see Fig. 6-15. Loosen the clamp or the brake hoses. Remove the bolt for the stabilizer.
5. Place the jack under the lower control arm. Slacken the nuts or the ball joints, and knock with the hammer until the ball joints loosen from the steering knuckle. Remove the nuts and lower the jack. Take off the knuckle with the front wheel brake unit and place it on a stand or similar.
6. Lower the jack and remove the spring.
7. Take off the nut and remove the control arm shaft. Turn the relay arm with the tie rod so that the control arm shaft is free and thus can be removed. Take off the control arm.

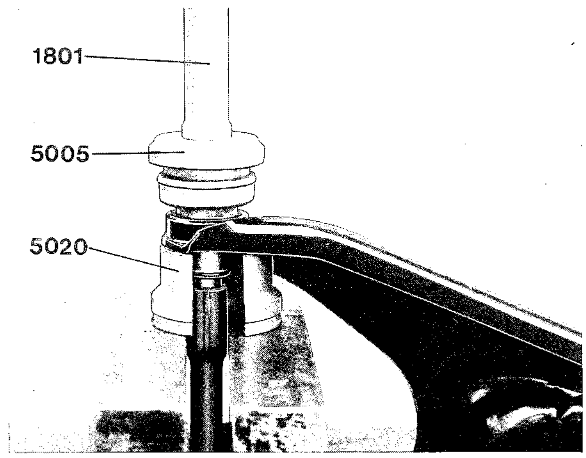


Fig. 6-36. Rear bushing installation

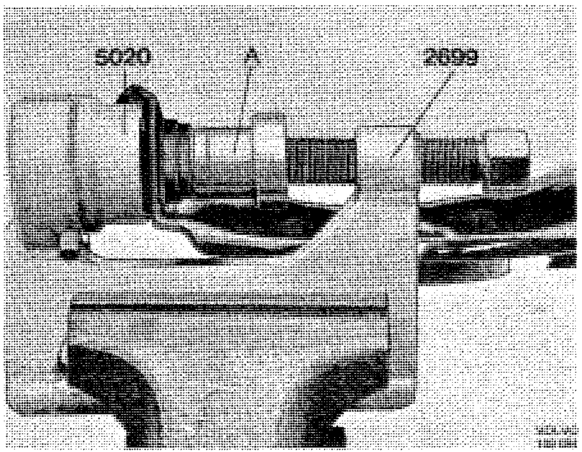


Fig. 6-38. Removing rubber bushing, lower control arm
A=2904 for bushings intended for diagonal tires and 2905 for radial tires

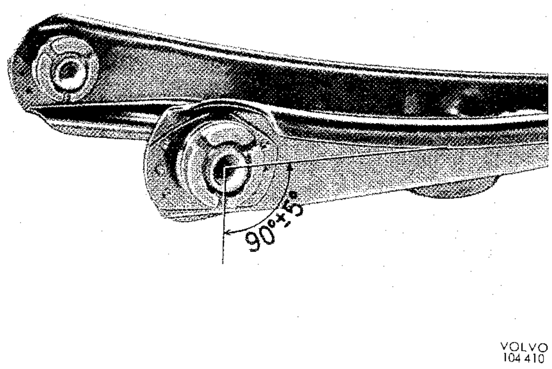


Fig. 6-39. Bushings for radial tires

REPLACING BUSHINGS

Note that there are special bushings intended for radial tires. When about to replace the bushings, bear in mind if the vehicle is fitted with radial or diagonal tires.

1. Tension the press tool 2699 in the vise. Remove the washer (1, Fig. 6-13), the rubber ring (2) and the spacing ring (3). Press the bushings out with counter-hold 5020. Use drift 2904 for bushings where diagonal tires are fitted and 2905 for radial tires. The tools are placed as shown in Fig. 6-38. The bushings are, of course, pressed out in the direction towards their flanges.
2. Press in the bushings with the control arm and drift (A, Fig. 6-38) facing in the opposite direction.

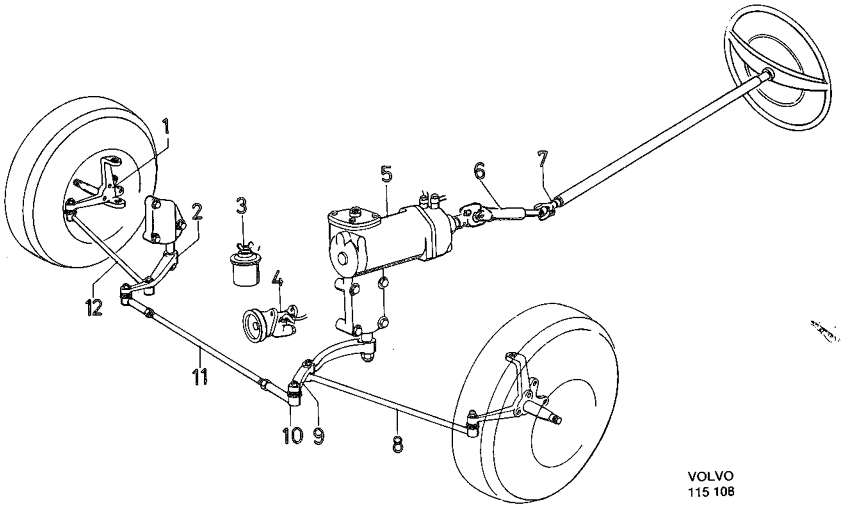
Note. Both the bushings should be faced with the flange towards the rear in the vehicle, see Fig. 6-13. If it concerns a bushing for radial tires, its recess must also be turned downwards at right angles to the longitudinal direction of the control arm, see Fig. 6-39.

INSTALLATION

1. Supplement the control arm with a spacer ring (3, Fig. 6-13), rubber ring (2) and washers (1, 5 and 7). Place the control arm in position and fit the control arm shaft (6). Hold the control arm roughly horizontal and tighten the nut (8) to a torque of 140–180 Nm (14–18 kpm=100–130 lbft).
2. Insall the spring. Raise the jack and fit the steering knuckle. Tighten the nuts for the ball joints. If the pins rotate, hold them securely with a vise.
3. Install the shock absorber according to the instructions given in Section 7.
4. Install the wheel and wheel nuts. Lower the vehicle and tighten the wheel nuts to a torque of 100–140 Nm (10–14 kpm=70–100 lbft). Fit the hub cap.

STEERING

GENERAL INFORMATION



Sig. 6-40. Steering gear

1. Steering knuckle
2. Relay arm
3. Container, power steering
4. Pump
5. Steering housing
6.
7. Steering column
8. Steering rod, left
9. Pitman arm
10. Ball joint
11. Tie rod
12. Steering rod, right

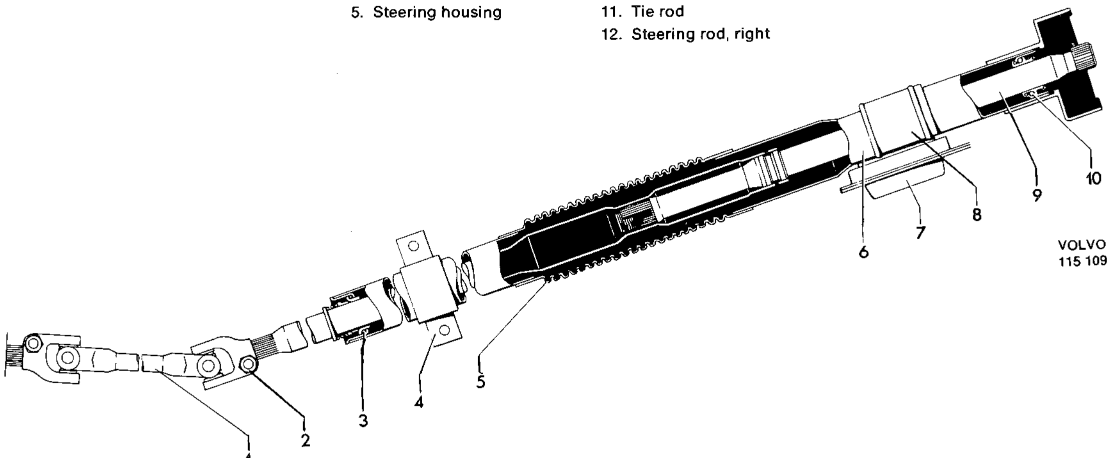


Fig. 6-41. Steering column journaling

1. Rubber coupling
2. Universal joint
3. Lower bearing
4. Lower attachment
5. Crumple unit
6. Steering column jacket
7. Upper attachment
8. Steering wheel lock
9. Steering column
10. Upper bearing

GENERAL

The design of the steering gear is shown in Fig. 6-40. Steering wheel movement is transmitted to the wheels via the steering column (7), the steering housing (5), the pitman arm (9), the tie rod (11), the steering rods (8 and 12) and the steering knuckles (1). Steering power is boosted by the power mechanism.

Steering column journaling

The upper and lower sections of the steering column are linked by means of a universal joint (2, Fig. 6-41). The lower section is mounted to the steering housing via flanging consisting of among other things a rubber disc. In the event of frontal collision causing compression of the front end, the lower steering column section has every possibility of giving way thus eliminating the risk of the steering wheel being forced backwards and upwards inside the car. Also contributing to this is a crumple unit on the upper part of the steering wheel column, which permits axial compression under powerful impact.

The upper section of the steering wheel column is journaled in a column tube by means of two ball bearings. The steering column tube is fixed to and supported by the body via rubber bushings.

Steering wheel lock

The engine of the vehicle has been made tamperproof by the installation of a steering wheel lock, which is integrally built with the ignition switch. The ignition switch has four positions, 0—I—II—III. Removing the ignition key, which can only take place when it is in position "0", releases a catch and lock pin (A) is pressed forwards by a spring. When the steering wheel is turned, so that a slot coincides with the lock pin, the lock pin enters the slot and locks the steering column so that the front wheels cannot be turned.

When the igntion key is inserted and switched to position "I", the lock pin is pulled back and this releases the steering column which is secured in a withdrawn position. At position "I" the vehicle can be moved with the ignition switched off.

At position "II" the ignition is connected up and in postition "III" the starter motor can be engaged. The ignition switch and steering wheel lock can only be replaced as a single unit.

The steering wheel lock is mounted to the column by means of two shear-off bolts, and to the dashboard with two screws.

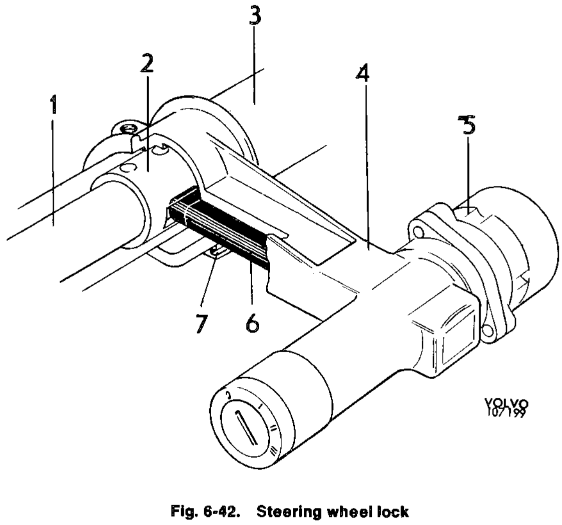


Fig. 6-42. Steering wheel lock

1. Steering column
2. Lock sleeve
3. Steering column jacket
4. Steering wheel lock
5. Contact
6. Lock pin
7. Attachment

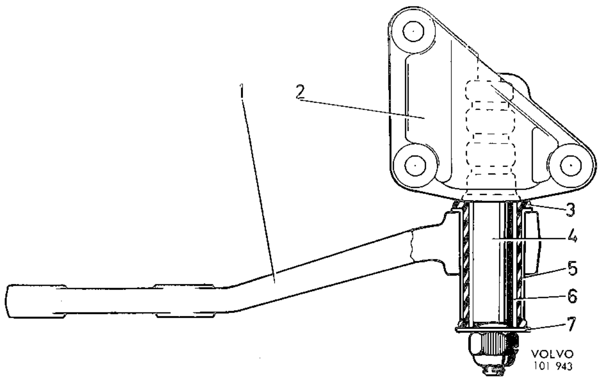


Fig. 6-43. Relay arm journaling

1. Relay arm
2. Bracket
3. Rubber bushing
4. Bearing pin
5. Sleeve
6. Sleeve
7. Washer

STEERING RODS AND RELAY ARM

The ball joints of the steering rod are plastic-lined, and this makes maintenance lubrication unnecessary. The tie rod (11, Fig. 6-40) has replaceable ball joints (tie-rod ends) while the ball joints of the steering rods (8 and 12) are made in one piece with the rod.

The relay arm (Fig. 6-43) is journaled by means of a bushing on a pin in the bracket. The bushing consists of three parts, a rubber bushing with an outer sleeve of plate and an inner one comprising a spacer sleeve. The outer sleeve has a press-fit in the relay arm hole. When the relay arm is turned, there is movement between the outer sleeve and rubber bushing, the space between which has been lubricated for life. The journaling is, in other words, "lubricated for life".

POWER STEERING

This vehicle is fitted with the ZF recirculating ball and nut type power steering. The main components of the power steering system are the steering gear, power pump and oil container with filter. These are connected to the various oil lines, see Fig. 6-44.

The number of steering wheel turns from lock to lock is 3.7.

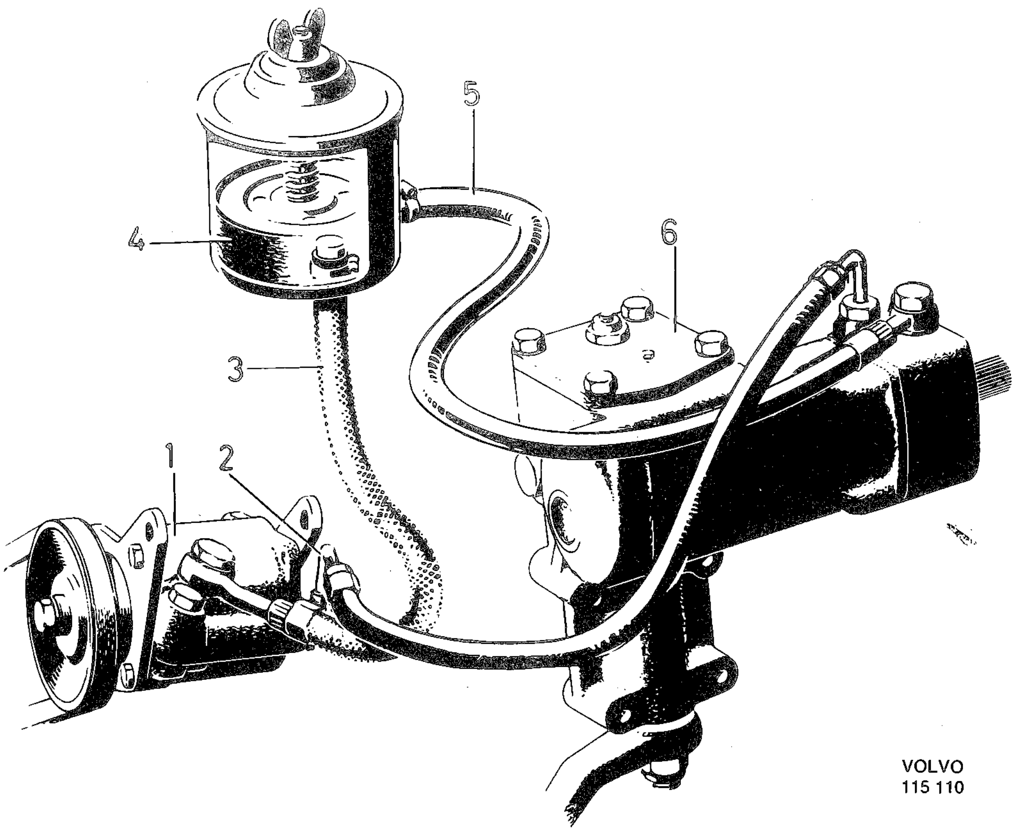


Fig. 6-44. Power steering

1. Power pump
2. Delivery oil line
3. Pump suction line
4. Oil container with filter
5. Return oil line
6. Steering housing

Power steering gear

DESIGN

The steering gear is of the worm and roller type. In addition to the mechanical section, the power cylinder and control valves are built into the steering housing. The lower part of the steering housing (1, Fig. 6-46) is in the shape of a cylinder in which the piston (2) is fitted. On the one side the piston is in the form of a rack gear which meshes with the tooth segment of the sector shaft (20).

The axial movement of the piston which determines the direction the wheel turns, is obtained via the worm (5) and the recirculating balls. The recirculating balls (4) are located in radial grooves and form the thread for the worm. Movement of the worm comes from the steering column at the steering spindle (16) and the torsion bar (17) secured in the spindle. The worm is journaled in the upper section of the steering housing partly by means of an axial thrust needle bearing and partly by means of a taper ball bearing. Located in the upper part of the worm are the control valves (9 and 10): they are drawn out in the figures. These valves are influenced by two pins in the lower end of the steering spindle (16).

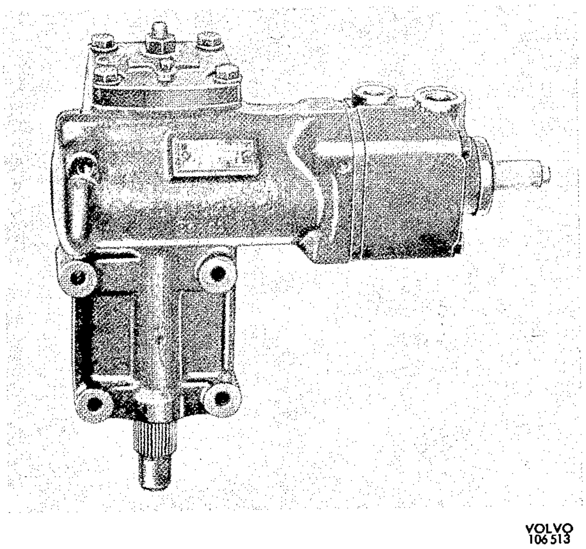
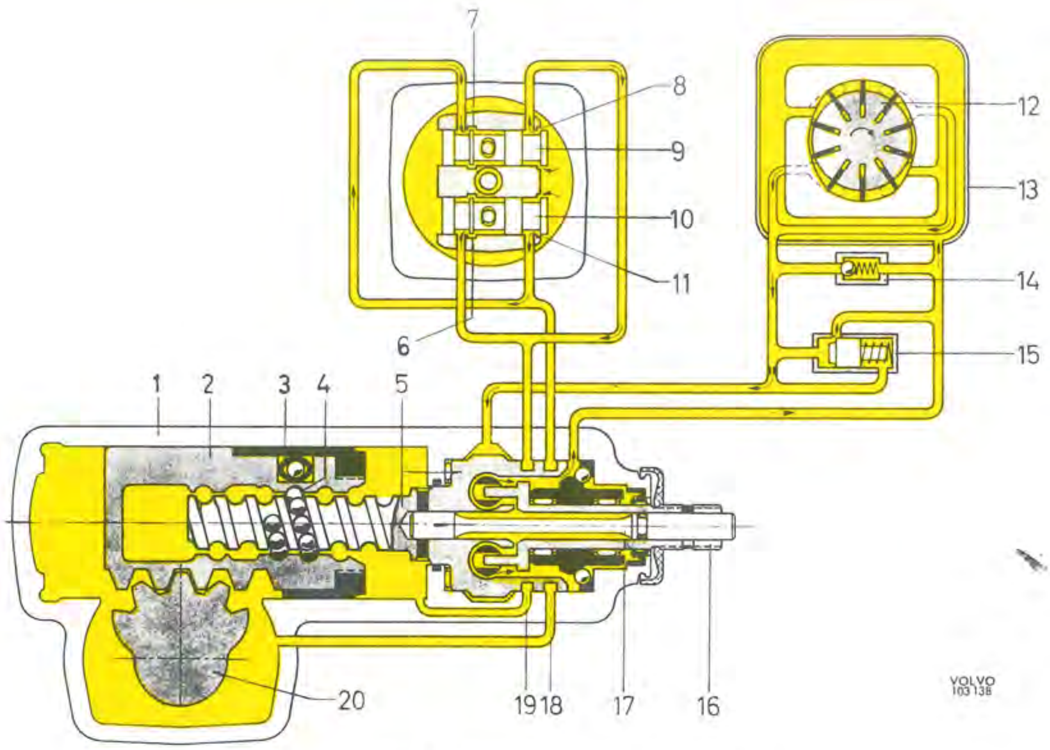


Fig. 6-45. Steering housing



Sig. 6-46. Function, neutral position

1. Steering housing	7. Return groove	14. Safety valve
2. Piston	8. Intake port	15. Regulating valve
3. Recirculation pipe, ball nut	9. Valve piston	16. Steering spindle
	10. Valve piston	17. Torsion bar
4. Balls	11. Intake port	18. Radial groove
5. Worm	12. Power pump	19. Radial groove
6. Return groove	13. Oil container	20. Sector shaft

The inner race of the taper ball bearing also is an outer race for the double needle bearings of the steering spindle.

The sector shaft (20) is journaled in the steering housing and side cover by means of needle bearings, see Fig. 6-48. Sealing between the valve housing and the upper section of the housing as well as between the intermediate piece and worm is catered for by O-rings and plastic rings.

The steering gear reduction ratio is 15.7:1.

The construction of the steering gear differs with regard to a left-hand steered and a right-hand steered vehicle in the matter of the location of the sector shaft and the worm thread. Fig. 6-45 shows the steering gear for left-hand steering while Figs. 6-46—6-48 shows that for right-hand steering. The following description of the function applies to both.

FUNCTION

The location of the valve pistons as well as that of the oil flow are shown schematically in Figs. 6-46, 6-47 and 6-48.

In order to illustrate more clearly how the valve pistons are connected to the part of the housing where the power piston operates, a cross-section has been made through the valve pistons in addition to longitudinal section. Moreover, extra channels have been drawn to link up both sections.

As soon as the front wheels have been turned to the desired position, and the forces acting on the steering wheel become less, the valve pistons return to the neutral position under the influence of the torsion rod. When the steering wheel is turned to the right (see Fig. 6-43), the piston (2) is screwed to the right in the figure. The valve piston (10) is moved to the right and permits oil under pressure to pass to the radial groove (18) of the valve housing and from there to the left side of the cylinder. Oil under pressure also flows to the return groove (7) which, however, is closed so that the oil pressure on the left side of the operating piston (2) rises and facilitates turning of the sector shaft. Oil at the right side of the cylinder is pressed by the piston via the radial groove (19) through the return groove (6) of the valve piston (10) back to the oil container (13).

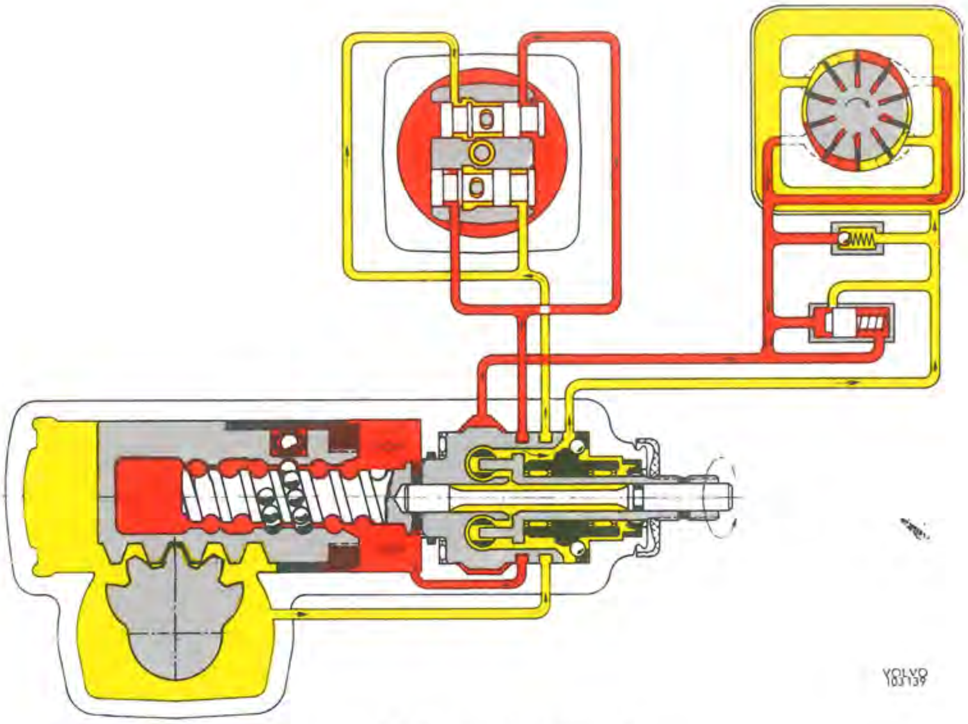


Fig. 6-47. Function, left-hand turn

Oil is conveyed under pressure from the pump into an annular chamber round the valve housing (the large circle in the cross-section). In the neutral position (Fig. 6-46) the valve pistons (9 and 10) are so adjusted that oil can pass the intake ports (8 and 11) and flow on to the radial grooves (18 and 19) in the valve housing. From here the oil is led partly to both sides of the piston (2) through the radial grooves (18 and 19), and partly—as long as the valves are in the neutral position—to both the return grooves (6 and 7) at the valve pistons. From the return grooves oil flows through the return channel back to the container.

When the steering wheel is turned to the left (see Fig. 6-47) movement is transmitted via the steering spindle (16) and the torsion bar (17) to the worm (5), so that the piston (2) is screwed to the left in the figure (downwards in the vehicle). Since the torsion rod is resilient, the steering spindle will be turned in relation to the worm and thus influence the valves placed in the worm. The greater the turning movement, the greater will be the valve displacement. One of the valve pistons (9) is then displaced to the right and opens the intake port (8) wider, while at the same time the other valve piston (10) is displaced to the left and closes the intake port (11). The delivery line of the valve piston (9) is linked with the radial groove (19) in the valve housing. This also applies to the return groove (6) of the valve piston (10). The delivery line of the valve piston (10) is connected to the radial groove (18) and to the return groove (7) for the valve piston (9).

Under such conditions, oil under pressure flows in through the intake port (8) to the radial groove (19) and then on to the cylinder on the right-hand side of the piston (2). Oil also flows to the return groove (6). Since the outlet port is blocked, pressure will rise and assist in pressing the piston (2) to the left.

Oil in the left-hand section of the cylinder is forced away via the radial groove (18) in the valve housing to the intake port (11) which is closed. At the same time, oil flows to the return groove (7) and then through the return line to the oil container.

As soon as the front wheels are turned to the desired angle and the forces operating on the steering wheel become less, the control valve returns to neutral position as a result of the influence of the torsion rod.

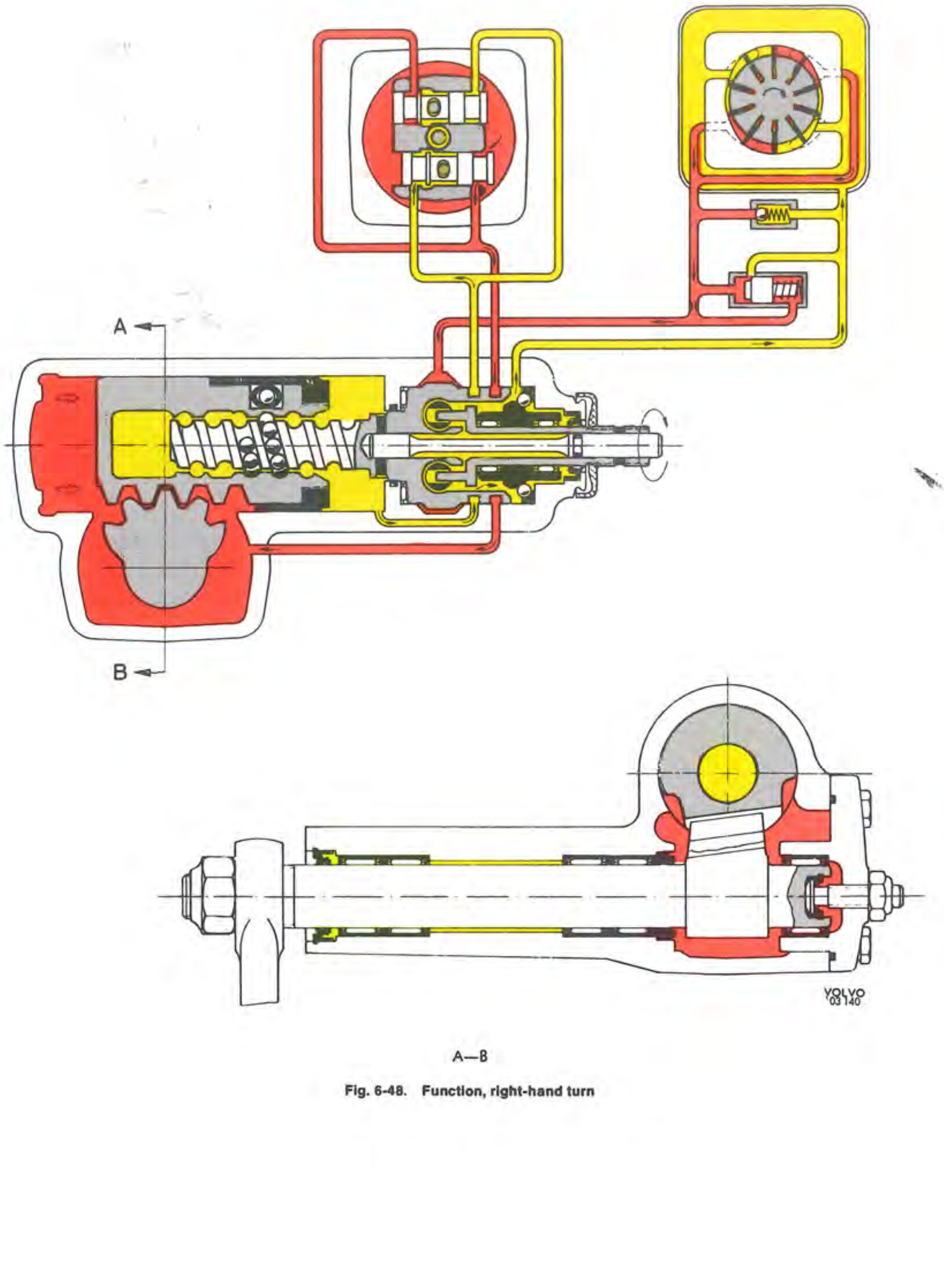


Fig. 6-48. Function, right-hand turn

Turning the steering wheel to the right (see Fig. 6-48) will screw the piston (2, Fig. 6-46) to the right on the figure. The valve piston (10) is displaced to the right and permits oil under pressure to pass to the radial groove (18) of the valve housing and from there on to the left-hand side of the cylinder. Oil under pressure also flows to the return groove (7) which, however, is closed so that oil pressure on the left-hand side of the operating piston (2) rises and facilitates the turning of the lever shaft. Oil at the right-hand section of the cylinder is pressed by the piston via the radial groove (19) through the return groove (6) of the valve piston (10) back to the oil container (13).

Power pump

The power pump (Fig. 6-49) is of the vane type. It is mounted on a bracket on the left-hand side of the engine and is pulley-driven by the engine at engine speed.

The pump rotor is provided with 10 loose vanes and rotates in a circular-shaped intermediate piece. The vanes are pressed against the wall of the intermediate piece partly by centrifugal force and partly by oil pressure.

The space in the intermediate piece is oval, see Fig. 6-48. This permits the area between the rotor, the wall of the intermediate piece and two of the vanes to alter when the rotor rotates. When a couple of vanes are moved from the

Fig. 6-49. Power pump

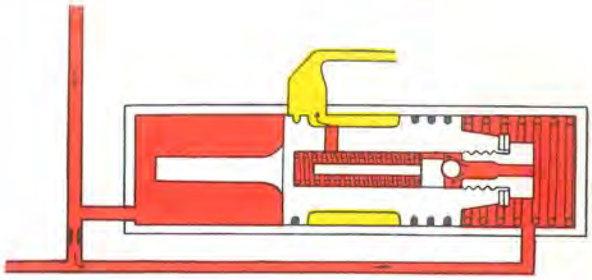


Fig. 6-51. Control valve, maximum pressure

suction side to the pressure side, the area between them and the sucked-in oil increases to start with. When the connection with the suction side has been passed, a link-up with the pressure side is then attained instead. Since the space between the vanes contracts at the same time, the pressure will rise and oil will be forced out into the delivery line. Due to the fact that there are two inlet and two outlet channels, the pump has double capacity.

CONTROL VALVE

The pump housing contains a control valve which regulates partly the oil flow and partly the maximum pressure. When the pump starts functioning, the valve (5, Fig. 6-50) maintains the valve pressed to the left of the spring (7). The oil supplied by the pump passes through the delivery channel (3) via the check valve (2) out into the delivery line (1) and from there to the steering housing. The space to the right of the control valve is linked-up with the delivery line (1) by means of the link channel (8) and has, therefore, the same pressure.

The check valve's (2) function is to ensure that the pressure on the left-hand side of the control valve piston is higher than that in the line and also to the right of the piston. When the spring pressure is overcome, the piston is, therefore, displaced to the right. And when the speed is sufficiently high in relation to the counterpressure, the piston has been displaced so much that the surplus oil can flow back to the inlet side of the pump, see Fig. 6-50. Since the pump should deliver a quantity smaller than the maximum capacity, this valve adjustment can be called normal. Should the pump flow through the outlet be stopped, for example, because the front wheel turning is blocked, the pressure in the delivery line (1), will rise and the pressure difference between both ends of the control valve will be equalized. This will cause the spring to be moved to the left, the connection with the return channel to be closed and the pressure to rise even more. At about 75 kp/cm² (1066 psi) the spring pressure on the safety valve (6) is overcome, that is, the inner part of the control valve, and oil can then pass out to the return channel (4). See Fig. 6-51. The pressure on the right-hand side of the piston will then drop and the entire control valve will be moved to the right so that the connection with the return channel opens. When the pressure drops to its normal value, the safety valve closes and the control valve returns to its normal position.

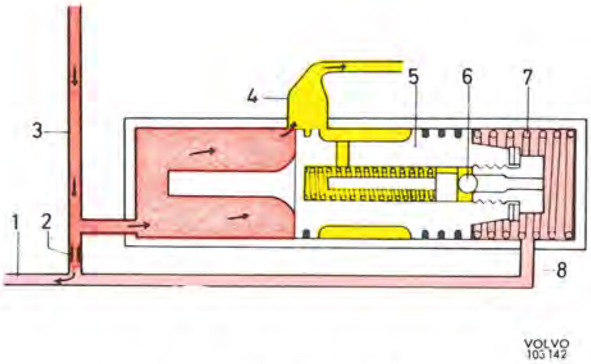


Fig. 6-50. Control valve, normal positon

1. Delivery line
2. Check valve
3. Delivery channel
4. Return channel
5. Control valve
6. Safety valve
7. Spring
8. Link channel

Oil reservoir

The oil reservoir is placed in the engine compartment where it is easily accessible. It is provided with a filter, from the center of which oil is sucked to the pump. By means of the by-pass valves, oil can flow past the filter should it become blocked. The oil level can be seen against the level line after removing the cap.

REPLACING STEERING WHEEL

REMOVAL

1. Lever loose the impact pad (5, Fig. 6-52).
2. Unscrew the attaching screws for the upper part of the directional indicator housing and lift off the housing.
3. Remove the steering wheel nut.
4. Point the front wheels straight forward. Install steering wheel extractor 5003 as shown in Fig. 6-53 and pull off the steering wheel.

INSTALLATION

1. Make sure that the front wheels are pointing straight forward.
2. Place the steering wheel in position with the slip contact to the left.
3. Install the steering wheel nut. The tightening torque is 30–40 Nm (3–4 kpm=20–30 lbft).
4. Install the impact pad and test the horn function.
5. Install the lower part of the turn signal lever housing.

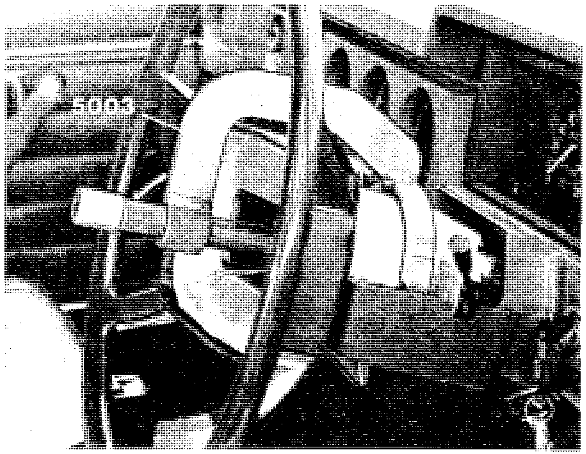


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Fig. 6-52. Steering wheel components

1. Steering wheel
2. Crumple unit
3. Steering wheel housing
4. Horn plate
5. Impact pad

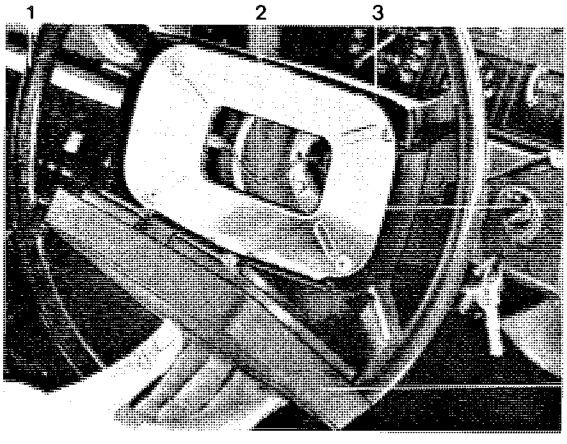

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Fig. 6-53. Removing steering wheel

STEERING COLUMN JOURNALING

The upper bearing can be replaced separately. If the lower bearing is damaged, the steering column shaft must be replaced complete.

Replacing upper bearing

1. Remove the steering wheel, see under "Replacing steering wheel". Remove the upper part of the directional indicator switch housing.
2. Remove the turn signal lever from its attachment on the steering wheel column.
3. Remove the attachment from the steering column tube.
4. Pull out the spring and seat, see Fig. 6-54.
5. Remove the bearing.
6. Fit the new bearing after having greased it with universal grease.
7. Fit the other parts.

REPLACING COMPLETE JOURNALING

REMOVAL

1. Remove the steering wheel and steering wheel lock, see instructions for this.

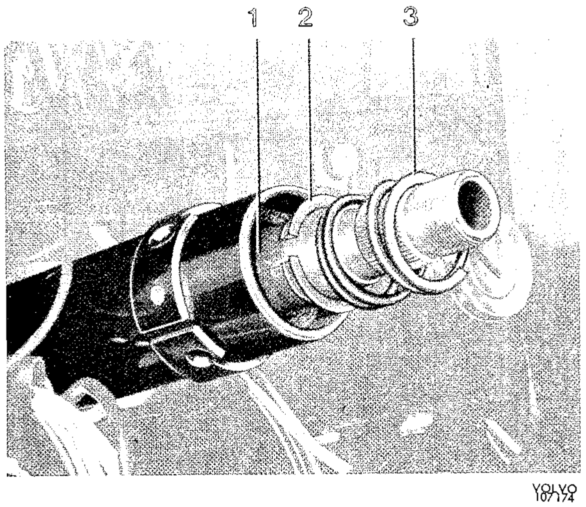


Fig. 6-54. Replacing upper bearing
1. Bearing 2. Seat 3. Spring

2. Remove the turn signal lever and the other parts from the steering column jacket.
3. Remove the nuts at the coupling between the upper and lower steering column shafts. Remove the nuts and clamp for the lower attachment.
4. Pull forward the steering column complete.
5. Fit the new parts in reverse order to removal. Check all functions before shearing off the shear-off bolts for the upper steering column jacket attachment and steering wheel lock.

Steering wheel lock

With damage to the steering column jacket or steering shaft lock register, replace the steering shaft complete. The following instructions apply with replacement of a steering wheel lock.

REMOVAL

1. Remove the combined instrument, see Section 3.
2. Remove the steering wheel lock contact unit (5, Fig. 6-42).
3. Remove the collars on the shear-off bolts (4, Fig. 6-55). Start with a smaller drill and finish up with, e.g., a 13 mm (1/2") drill. The bolt guide has a diameter of 12 mm (15/32").
4. Remove the attaching bolts and also the left impact guard and side member (7) with slide piece (6).
5. Screw out the crosshead screw (3) and unhook the attaching plate (5).
6. With a spanner turn back the lock pin and lift up the steering wheel lock.

INSTALLATION

1. Fit the new steering wheel lock and electrical section in position. Hook on the attaching plate (5, Fig. 6-55) and screw in the crosshead screw (3). Check the locking function.
2. Install the side member (7) with a slide piece (6) in good condition. Fit the impact guard.
3. Install the shear-off bolts (4) but do not shear off the heads.
   Install the contact piece.
4. Check all functions at the steering wheel lock. Thereafter tighten up the shear-off bolts until the heads shear off.
5. Install the combined instrument and other parts, see Section 3.

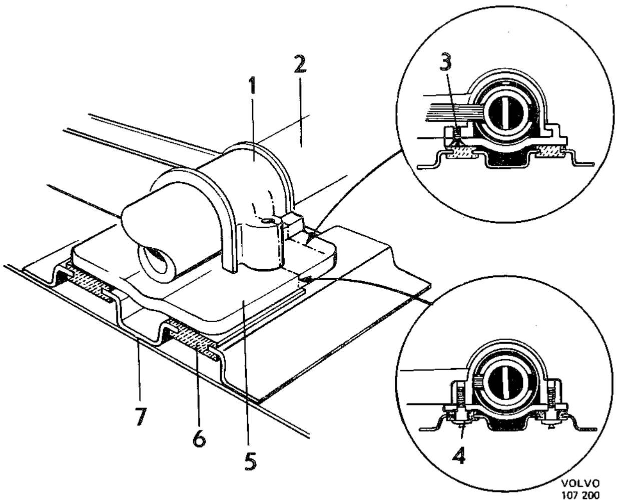


Fig. 6-55. Upper attachment
1. Steering wheel lock 5. Attaching plate
2. Steering column 6. Slide
3. Slotted screw 7. Side member (dash)
4. Shear-off bolt

STEERING RODS AND TIE RODS

Bent stereing rods and tie rods may nof be straightened out but must be replaced. This also applies if they are damaged in any other way.
The ball joints cannot be disassembled or adjusted so when worn or damaged they must be replaced.

The ball joints of the tie rod can be replaced individually. When removing, first take off the split pins and crown nuts. Then place tool 2294 on the ball joints as shown in Fig. 6-15. Press in the tool well and make sure that the thread on the ball joint enters the recess in the tool. Screw in the bolt until the ball joint loosens. Then remove the lock nut on the rod and unscrew the ball joint. From the beginning the new ball joint is screwed the same number of turns and this facilitates adjusting toe-in. Lock the ball joint with the rod.

The steering rod ball joints are made in one piece with the steering rods and for this reason the steering rod and ball joint are replaced complete. To make sure that the steering rods are not mixed up when installed, the left one is marked "L" and the right steering rod "R" at their outer ends. The marked end should be fitted to the steering knuckle.

After having reconditioned the rods and ball joints, the toe-in should always be checked.

RELAY ARM

Replacing as complete unit

1. Jack up the front end of the vehicle.
2. Disconnect the steering rod and tie rod ball joints from the relay arm with puller 2294, see Fig. 6-15.
3. Remove the three attaching bolts for the bracket (2, Fig. 6-43) and lift out the unit.
4. Fit the new complete unit.
5. Connect up and lock the ball joints for the rod. Lower the vehicle.

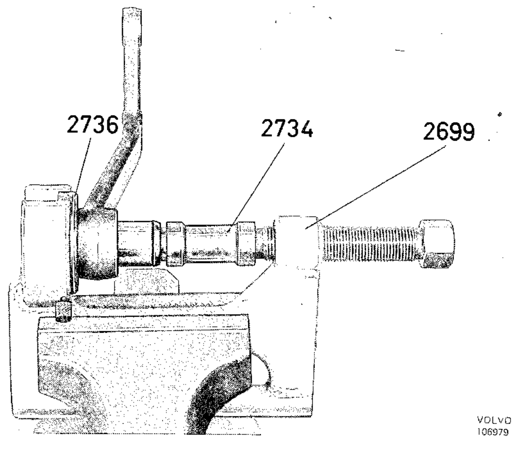


Fig. 6-56. Removing rubber bushing, relay arm

REPLACING THE RELAY ARM BUSHING

1. Jack up the vehicle at the front end.
2. Disconnect the ball joints for the steering rod and tie rod from the relay arm with puller 2294, see Fig. 6-15.
3. Remove the nut and washer (7, Fig. 6-43) and take down the relay arm (1).
4. Secure press tool 2699 in a vise and press the bushing out with counterhold 2736 and drift 2734 (see Fig. 6-56).
5. Turn the relay arm and press in the new bushing with tools 2699+2736 and drift 2735 (see Fig. 6-57).
6. Place the relay arm in position, install the washer (7) and the nut. Tighten the nut to a torque of 70–85 Nm (7.0–8.5 kpm=50–60 lbft).
7. Install the steering rod (in the inner hole on the relay arm) and the tie rod. Tighten the Nyloc nuts to a torque of 35–41 Nm (3.5–4.1 kpm=25–30 lbft).

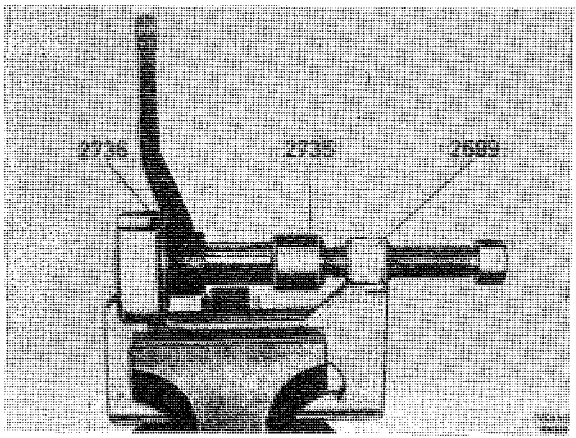


Fig. 6-57. Installing rubber bushing, relay arm

POWER STEERING

Work on power steering in vehicle

NOTE: The utmost cleanliness should be observed for all work on the power steering equipment. Always clean the connections before disconnecting them, also the outside of the oil reservoir before removing its cover.

Only Automatic Transmission Fluid, Type A, F or Dexron may be used for the power steering system.

CHECKING OIL LEVEL

The oil level should first be checked with the engine stationary in order to see whether there has been any loss of oil. The oil level should then come about 5–10 mm (1/4") above the level mark. If the level is lower than this, fill with oil with the engine stationary: this will eliminate risk of air being sucked in. Start the engine and then check the oil level again, which should now fall to the maximum mark, see Fig. 6-58. When the engine has stopped, the oil level may rise to 5–10 mm (1/4") above the level mark.

DRAINING OIL

With the power steering pump complete, oil is drained off as follows:

Jack up the front end. Screw out the drain plug (2, Fig. 6-59). Turn the steering wheel to the left to the stop position. Remove the cover on the container. Start the engine and allow it to run max. 10 seconds until the oil is emptied out of the container and pump. Stop the engine and turn the steering wheel from the stop lock to stop lock until all the oil has run out.

FILLING WITH OIL AND BLEEDING

NOTE: The oil capacity is about 1.2 liters (2.5 US pints). Drained-off oil may not be put back into the system.

1. Fill with oil up to the edge of the oil container.
2. With oil within easy reach, start the engine. Gradually fill the reservoir with oil as the level drops. When the level has stabilized itself, proceeed to the next operation.
3. Turn the steering wheel repeatedly and evenly in both directions. The steering wheel should be turned slowly so that the pump operates at low pressure. If necessary, fill with more oil.

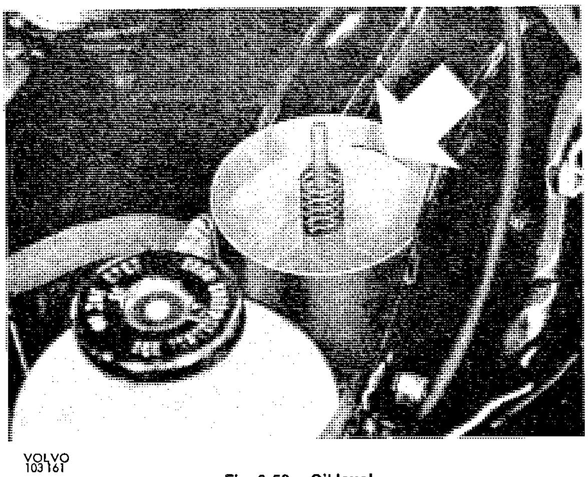


Fig. 6-58. Oil level

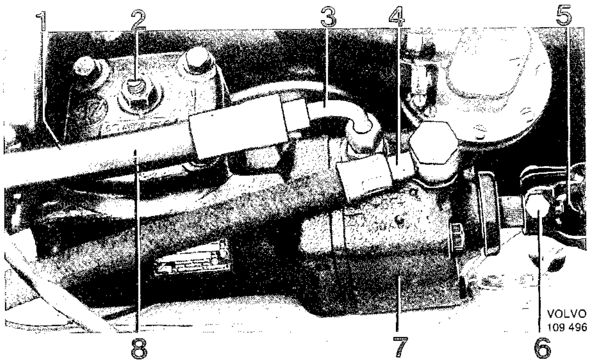


Fig. 6-59. Steering housing

1. Drain plug
2. Adjusting screw
3. Delivery line
4. Return line
5. Flange
6. Clamping bolt
7. Steering housing
8. Bleeder screw

4. Open the bleeder screw (8, Fig. 6-59) 1/2–1 turn. Close it when oil starts flowing out.
5. Continue turning the steering wheel until the oil in the reservoir is practically free from air bubbles.
6. Stop the engine. The oil level should then rise 5–10 mm (1/4") above the level mark. If it rises furhter than this, there must be air still in the system, in which case continue bleeding.
7. Lower the front end.

After the bleeding, a small number of air bubbles may remain in the system. When the pump causes pressure to be applied to the oil during driving, these air bubbles will eventually disappear in the reservoir.

INSPECTION OF POWER STEERING

The inspection procedure described below can be applied with a view to trouble shooting for preventing possible faults.

I. Checking outer sealing

1. Check to make sure that all screw unions are not damaged. Re-tighten if necessary.
2. Check the hoses for damage. Replace those that are damaged.

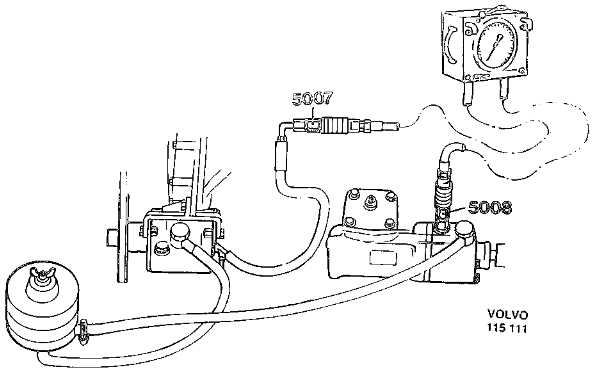


Fig. 6-60. Pressure gauge connected

II. Checking oil level and bleeding

1. Connect the test instrument 2864 to the delivery line at the steering housing, see Fig. 6-60. The inlet hose of the instrument is connected to the nipple with tool 5007 (Fig. 6-60) and the outlet hose to the steering housing with tool 5008 (right-hand steered vehicle, 2990). Check to make sure that the operating lever of the instrument is in the open position (to the left).
2. Jack up the front end of the vehicle. Check that the oil level is 5–10 mm (1/4") above the level mark with the engine stationary.
3. Start the engine. Check the level and fill with oil if the level has fallen below the level mark with the engine running. Turn the steering wheel from full lock to full lock as long as air bubbles are visible in the container. With the engine idling, the oil level should be at the level mark.
4. When the engine is stopped, the oil level should rise 5–10 mm (1/4").

III. Checking hydraulic function for steering housing and pump

1. Run the engine warm.
2. **Pump testing:** With the engine idling, move the operating lever of the instrument briefly (max. 10 seconds) to the closed position. Read off the max. pressure on the pressure-gauge. This should be maximum 10 % below the indicated maximum pressure of the pump, that is, at least 67 kp/cm^2 (953 psi). If pressure less than this is obtained, examine the pump and drive as follows:
   a) Check the tension and condition of the drive belt. Replace the belt if defective.
   b) Remove the pump control valve, see Fig. 6-61. Observe the utmost cleanliness. Wash and blow clean before screwing out the plug (4), which should be done from underneath. Check the valve piston and drilling in the housing. The hole in the valve piston must not be blocked. The piston should run easily in the housing and not jam. If necessary, fit a new valve. If this does not help, replace or recondition the pump.
3. **Steering housing test:** With the engine idling and the instrument operating lever open, turn the steering wheel to the right to the end position. Increase the force on the steering wheel to about 100 N (10 kp=22 lb) and maintain this position for about 5 seconds and read off the gauge. Repetat this procedure after turning the wheel to the left. If it is established that the steering housing oil pressure, with the steering wheel turned either to the right or to the left or in both directions, is below the previously determined oil pressure for the pump, then the function of the power steering is not satisfactory. If no external leakage can be discovered, the reason for the pressure drop must be an internal leakage, in which case the steering housing must be replaced.

IV. Checking mechanical function

1. Check the mechanical components of the front end and steering such as ball joints, rods, bearings, steering housing and flanges concerning play. Retighten attaching bolts and replace damaged or worn components.
2. Adjust the pressure point between the steering gear piston and the steering shaft as follows:
   NOTE. This adjustment should be made only if there is reason to suspect some fault. Accurate adjustment is made in connection with reconditioning.
   a) Remove the lock nut for the pitman arm. Pull the pitman arm off with tool 2849. When fitting the puller, turn the wheels fully to the right, see Fig. 6-64.
   b) Place the steering housing in the middle position (count the number of steering wheel turns).

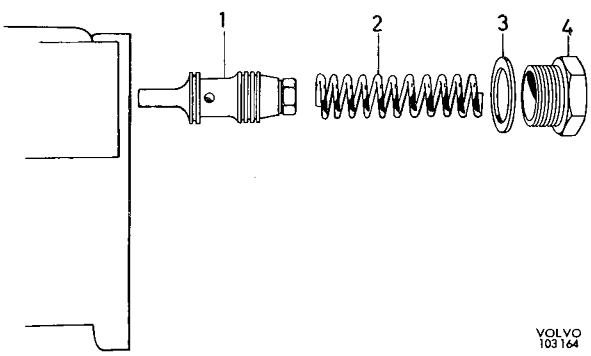


Fig. 6-61. Removing control valve
1. Piston 2. Spring 3. Gasket 4. Plug

c) Slacken the nut for the adjusting screw (4, Fig. 6-59).
d) Turn the adjusting screw clockwise until a slight resistance is felt in the flange device when it is turned to the left or to the right on both sides of the center positon.
e) Tighten the lock nut while holding the adjusting screw firmly.
f) Check the adjustment by turning the steering wheel several times more past the center position. In the center positon a slight increase in resistance should be felt.
g) Set the front wheels straight forwards and fit the pitman arm with the steering housing in the center position. Tighten the nut to a torque of 175–200 Nm (17.5–20.0 kpm=125–145 lbft).

V. Test drive

If the power steering is only normally worn and is not damaged or overloaded, the steering should function satisfactorily during the test drive, that is, the hydraulic power assistance should not be staccatic and result in erratic steering.

REPLACING CONTROL SPINDLE SEALING RING

1. Dismantle the flange device by removing the two nuts (9, Fig. 6-59) and the screws (9). Move the rubber disc and lower steering column section to the one side.
2. Mark up the location of the flange (7) on the control spindle. Slacken the clamping bolt (6) and pull off the flange.
3. Remove the rubber cover as well as the snap ring for the sealing ring.
4. Carefully apply tool 2860 to the sealing ring. Tighten the screw (Fig. 6-63). This also tightens the sealing ring. If the ring sticks in the snap ring groove, carefully turn the tool backwards and forwards.

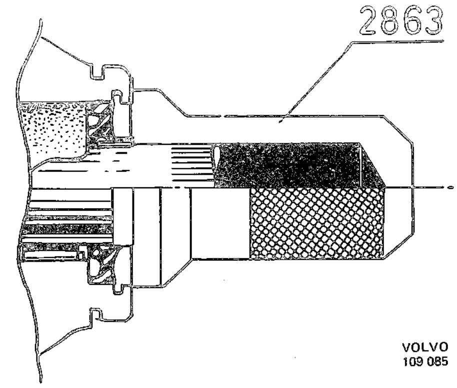


Fig. 6-62. Installing sealing ring

5. Fill the space between the new sealing ring lips with multipurpose grease. Fit the sealing ring on to installation tool 2863 with the help of the loose guide. Remove the guide and fit the sealing ring in the steering housing, see Fig. 6-62.
6. Fit the snap ring and cover.
7. Re-fit the flange according to the line-up marks. Check that the distance between the steering housing and the lower flange is 7±5 mm (0.28±0.20").
   Assemble the other parts.

Replacing steering housing

REMOVAL

1. Jack up the front end.
2. Drain the oil, see under "Draining the oil".
3. Remove the lock nut for the pitman arm. Pull the pitman arm off with tool 2849. When installing the puller, turn the wheels fully to the right, see Fig. 6-64.
4. Disconnect the oil lines (5 and 10, Fig. 6-59) from the steering housing after the connections have been cleaned. Slacken the clamping bolt (6).
5. Remove the retaining bolts (1) and pull the steering housing forward.

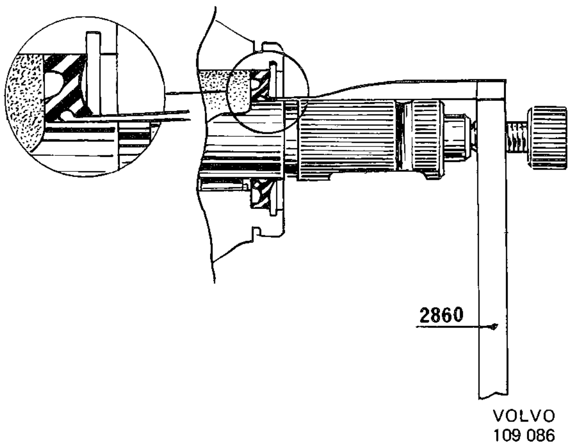


Fig. 6-63. Removing sealing ring

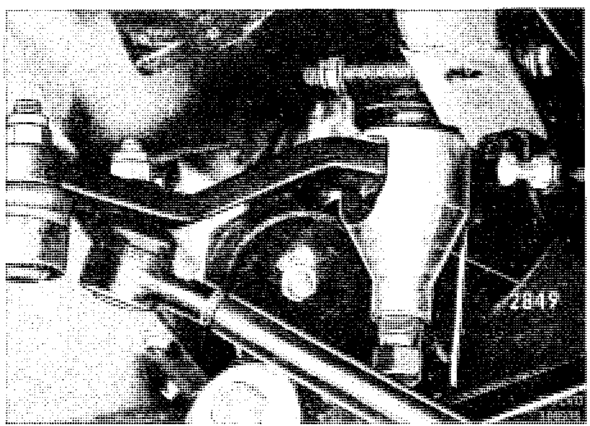


Fig. 6-64. Removing pitman arm

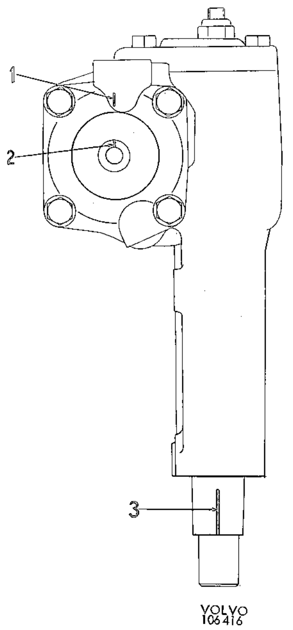


Fig. 6-65. Steering gear housing in middle positon

INSTALLATION

1. Place the steering gear housing in the middle position. A slight increase in resistance should then be felt and the position of the pitman arm shaft lands should be as in Fig. 6-65 and the line-up marks on the steering spindle and housing should coincide.
2. Check to make sure that steering wheel is pointing the front wheels straight forward.
3. Fit the steering spindle in the flange of the lower steering column section. Fit and tighten the retaining bolts (1, Fig. 6-59). Tighten the clamping bolt (6). Check that the distance between the steering gear housing and the lower flange is 7±5 mm (0.28±0.20"). Connect up the oil lines. The longer delivery line should run in a curve backwards (see Fig. 6-44) and should be clamped.
4. Point the front wheels straight forward and install pitman arm. Torque the nut 175−200 Nm (17.5−20.0 kpm=125−141 lbft).
5. Fill with oil and bleed, see under the heading "Oil filling and bleeding".

OVERHAULING STEERING GEAR

In the following instructions references are made to figures within brackets. These refer to the figures given in Illustration A. Concerning work which can be carried out with the power steering in the vehicle as well as removal and installation, refer to the previous pages.

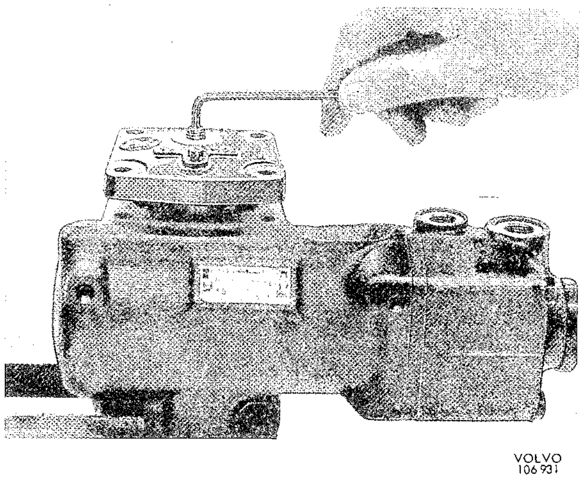


Fig. 6-66. Removing housing cover

DISASSEMBLY

1. Clamp the stering gear in a vise as shown in Fig. 6-66.
2. Remove the lock nut (17) and the retaining bolts (19) from the cover. Screw in the adjustment screw (11) through the cover and remove the cover (16). Take out the loose needles in the cover bearing (14).
3. Remove the snap ring (13) and the adjustment screw (11), see Fig. 6-67. Adjust the steering gear (10) to the middle position and lift it up, see Fig. 6-92. With a magnet remove the loose rollers in the bearings (3 and 7).
4. Remove the rubber protective cover (51) and the retaining bolts (50 and 52). Pull off the valve housing (56), see Fig. 6-68. Remove the snap ring (53) and press out sealing ring (54).
5. Pull out the worm (68), the cover (30) and the piston (22), see Fig. 6-69.

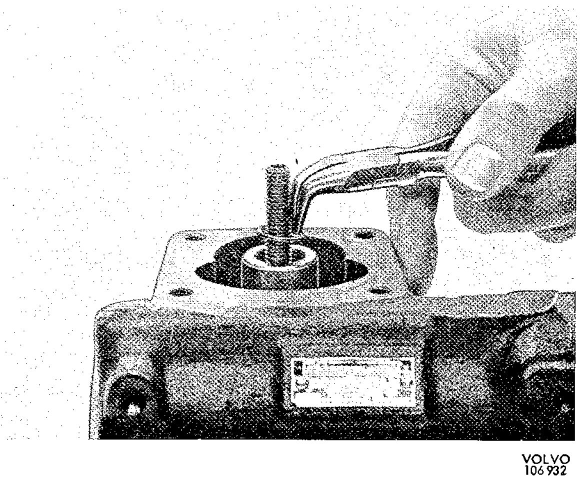


Fig. 6-67. Removing snap ring

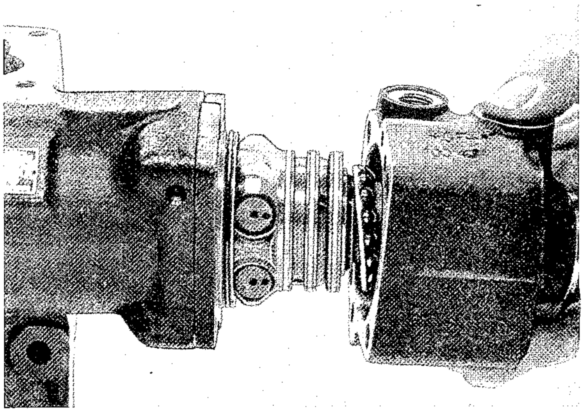


Fig. 6-68. Removing valve housing

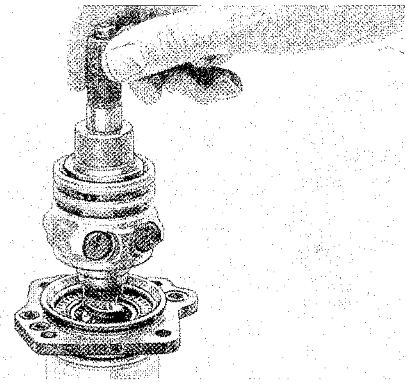
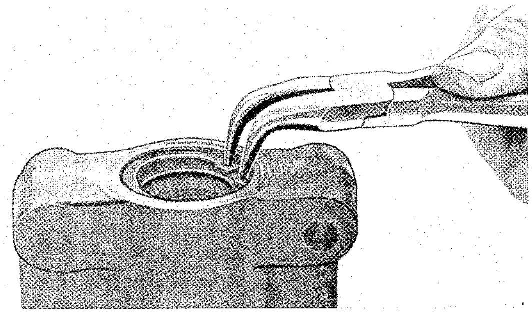


Fig. 6-70. Removing piston

6. Lift the piston and screw out of the worm, see Fig. 6-70. Take care that the 23 balls that drop out are not damaged. Remove the cover (30), needle bearing (36) and bearing washer (35). Remove the gasket (34) and O-ring (33), shims (32) and O-rings from the cover.
7. With a screwdriver remove the upper sealing ring (9) in the housing. When doing this carefully demolish the ring so that the position in the housing is not damaged. Turn the housing and remove the snap ring (1), see Fig. 6-71. Remove the sealing ring (2) with a chisel. The retainer (3) for the needle bearings is removed only if the bearing is damaged, see under "Inspecting".
8. Secure the worm between copper jaws of a vise. Remove the inner bearing sleeve (60) and bearing (61), see Fig. 6-72. Remove all rings (62–67) from the worm.



Sig. 6-71. Removing snap ring

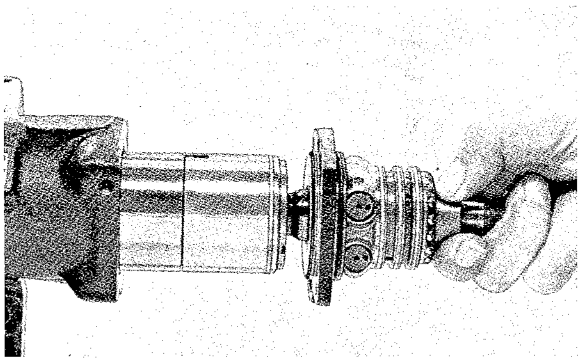


Fig. 6-69. Removing worm

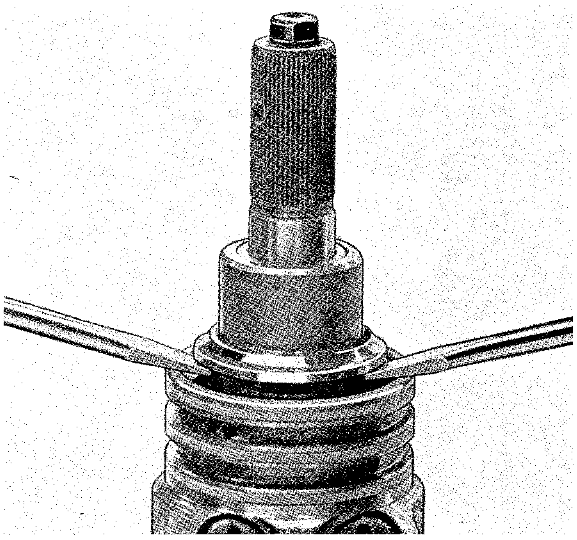


Fig. 6-72. Removing bearing sleeve

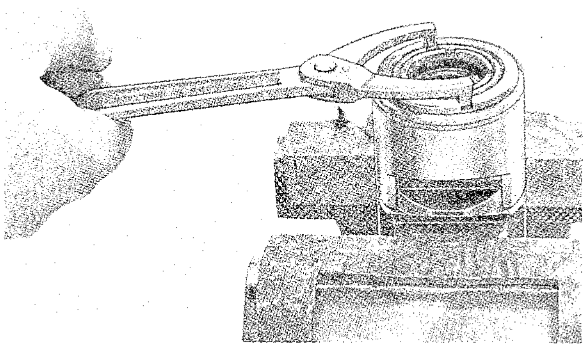


Fig. 6-73. Removing lock ring

9. Clamp the piston between soft jaws of a vise and unscrew the lock ring (27) with a hook spanner, see Fig. 6-73. Remove the sleeve (24) and its ring (25), the gasket (41) and the tube halves (42).
   Do not disassemble the worm valve head. The parts are installed and fixed in special instruments and their mutual position must not be altered.

Inspection

NOTE: Wash all parts thoroughly in a cleaning agent. The sealing rings and other rubber parts may not be washed in trichlorethylene, but can be washed in an agent which is entirely soluble in water. Since new sealing parts are used when assembling, washing them is generally unnecessary.

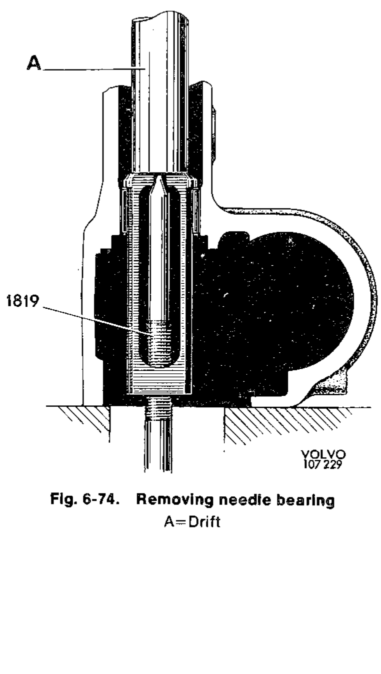


Fig. 6-74. Removing needle bearing
A=Drift

HOUSING AND COVER

1. Check the cylinder bore in the housing for wear and scoring. The piston must run easily in the bore.
2. Check the sealing surfaces and the threads in the connections for the delivery and return lines for damage.
3. Check the needle bearings in the housing and cover for damage. Replace bearings if necessary. For removal use tool 1819 (Fig. 6-74) and for pressing in use drift 2995 and handle 1801 (Fig. 6-75).
4. Check the threads in the cover and housing for damage.
5. Check the bearing ring in the valve housing. To replace it knock it out with a chisel and fit the new ring with tool.

PISTON AND WORM

1. Check the thread on the worm and piston.
2. Check the piston and sleeve running surfaces for scoring.
3. Check the piston teeth for damage.

SECTOR SHAFT

1. Check the sector shaft for cracks.
2. Check the teeth for wear and dents.
3. Check the bearing points of the sector shaft for wear and indentation.
4. Check the running surfaces for the sealing rings concerning wear and corrosion.
5. Check the serration for damage.
6. Check the threads of the adjustment screws as well as the two plane surfaces for damage. Check the sealing surfaces for damage and any paint residues. Remove any paint residues.

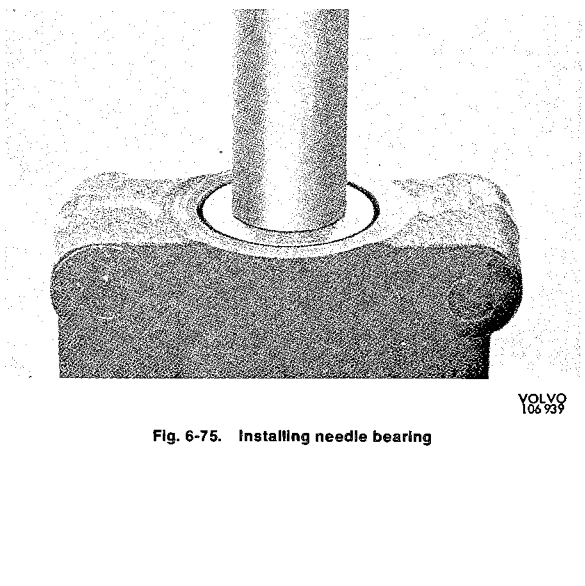


Fig. 6-75. Installing needle bearing

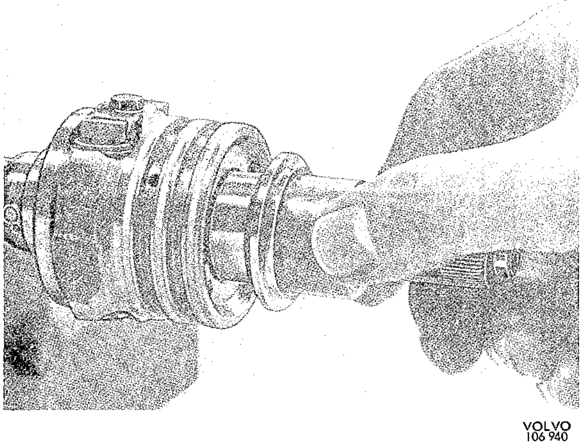


Fig. 6-76. Checking bearing

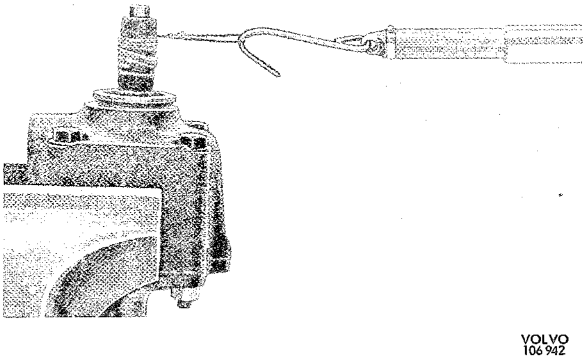


Fig. 6-78. Checking torque

Assembly

Before assembly, all the parts should be well cleaned and lightly oiled. All seals should be replaced by new ones.

1. Place the needle bearing (61) in the bearing sleeve (60) and test on the worm spindle (Fig. 6-76). The sleeve should rotate easily without any noticeable play. If there is play, test with a needle bearing with thicker needles. These are available in four sizes with a difference of 2 μm (0.002 mm=0.0008"), see "Specifications". Bearing sleeves are available with external diameter 28.0 and 28.015 mm (1.103"). For installing the sleeve, use tool 2481.
2. Clamp the valve housing (56) with the large hole facing upwards (see Fig. 6-77). Place the pre-assembled worm in the housing. Fit on the needle bearing (36), bearing washer (35) and cover (30), see Fig. 6-77. Tighten up the cover with the help of the bolts (50 and 52) and 4 nuts M8. Tightening torque is 34 Nm (3.4 kpm=25 lbft). Check to make sure there is no play in the journaling. A torque of between 0.15–0.25 Nm (1.3–2.2 lb.in.) is required in order to turn the worm. If this is measured according to Fig. 6-71, the balance should give a reading of between 17–29 N (1.7–2.9 kp=2.7–6.5 lb).
   NOTE: The test should take place without a sealing ring.
   The pre-loading can be regulated by replacing bearing washers (35). There are 6 different thicknesses between 1.9 and 2.4 mm (0.075 and 0.094"). After the correct pre-loading has been obtained, remove the valve housing.
3. Place the O-rings (63, 65 and 67) in the three grooves on the worm. Carefully fit on the packings (62, 64 and 66) on top of the O-rings starting with the inner one (see Fig. 6-79).

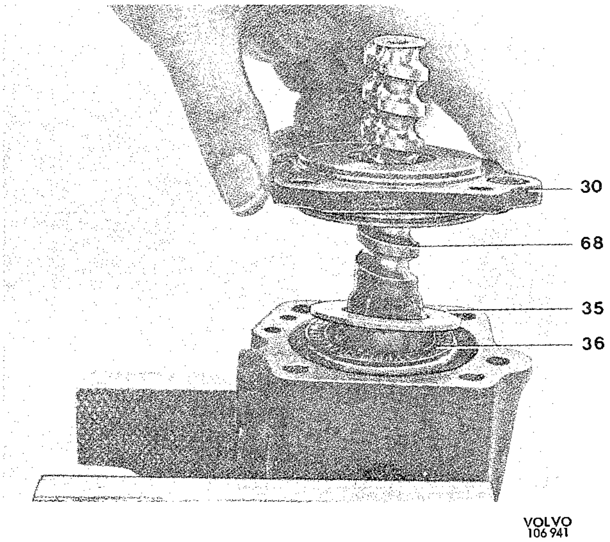


Fig. 6-77. Fitting cover
30. Cover
35. Bearing washer
36. Needle bearing
68. Worm

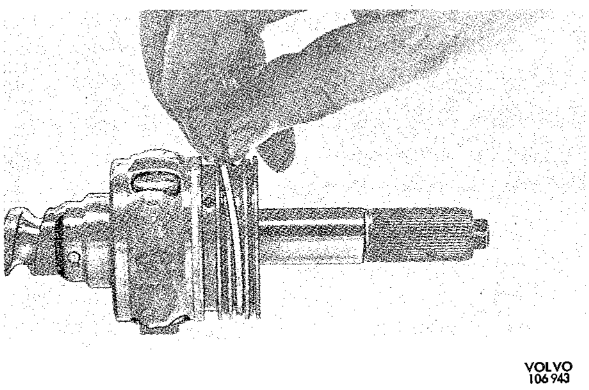


Fig. 6-79. Installing gasket

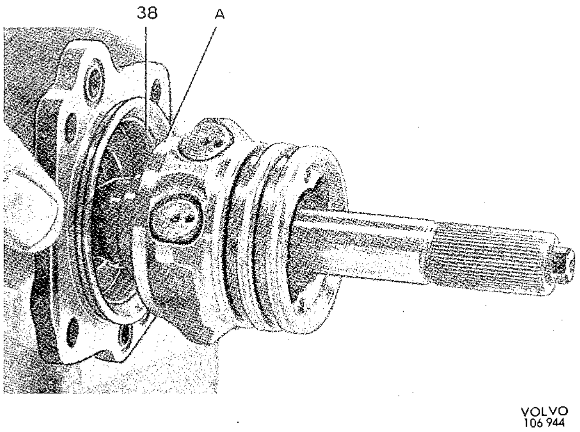


Fig. 6-80. Checking the gasket
38. Gasket A. Contact surface

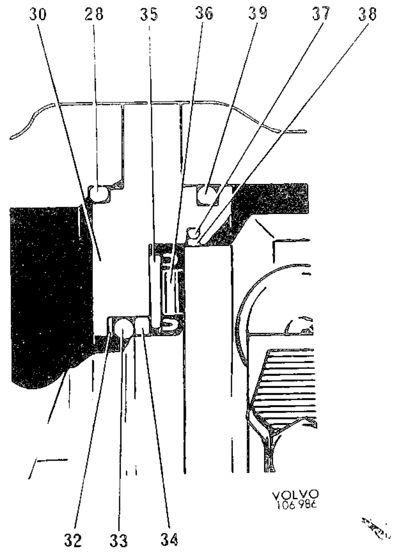


Fig. 6-82. Sealing parts

28. O-ring	35. Bearing washer
30. Cover	36. Needle bearing
32. Shims	37. O-ring
33. O-ring	38. Gasket
34. Gasket	39. O-ring

4. Place the O-ring (37) in position in the cover (30). The gasket (38) with thickness 1.7 mm (0.067") is placed on the O-ring.
   Apply marking colour to the contact surface (A) and install the worm (Fig. 6-80). Rotate the worm. Lift and check the contact against the gasket. If full contact is not established, the gasket should be changed for one with a thickness of 1.8 mm (0.071").
   Remove and clean the worm. Fit all the O-rings on the valve housing side of the cover. Fit the same number of shims (32) as was fitted previously. Fit the O-ring (33) and thereafter the gasket (34). Oil the gaskets in the cover. Place the bearing washer (35) and bearing (36) in the cover.
5. Install the sealing ring (54) on the installation tool 2863 with the help of the loose guide. Remove the guide and fit the sealing ring in the valve housing, see Figs. 6-81 and 6-62. The sealing lip is faced inwards. Install the snap ring.
6 The pre-assembled cover and the valve housing are fitted on the worm with the help of installation sleeve 2863. Screw the cover and valve housing together with 4 bolts and nuts. Tightening torque is 34 Nm (3.4 kpm=25 lbft).

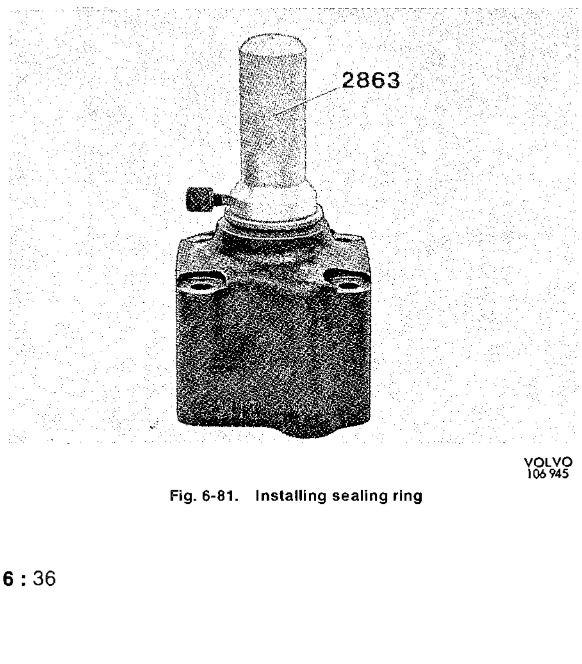


Fig. 6-81. Installing sealing ring

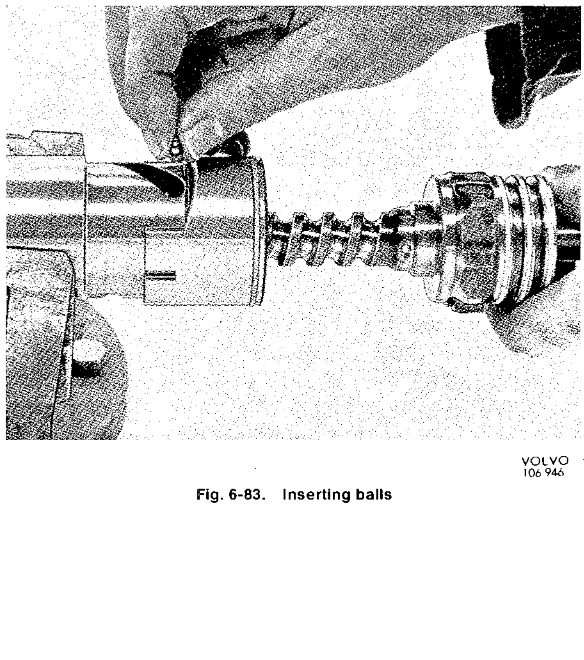


Fig. 6-83. Inserting balls

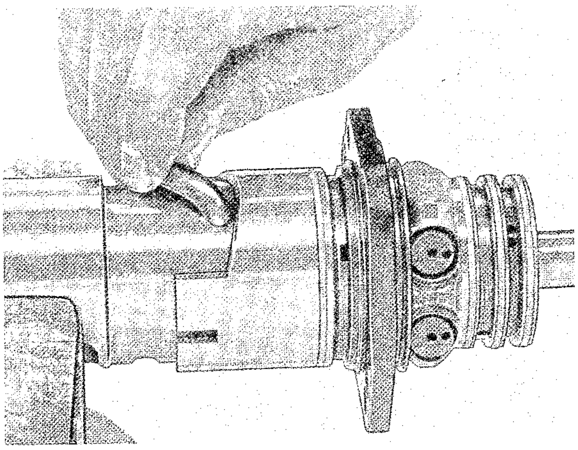


Fig. 6-84. Installing tube halves

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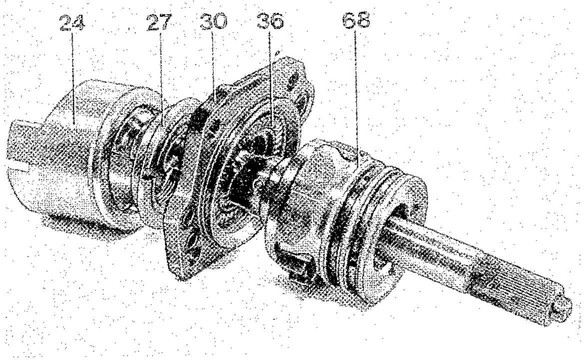

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Fig. 6-86. Worm parts
24. Sleeve
27. Ring nut
30. Cover
36. Needle bearing
68. Worm

Check the worm torque (see Fig. 6-78). This should now be between 0.4–0.6 Nm (3.4–5.2 lb.in.), that is, the balance should give a reading of between 45–70 N (4.5–7.0 kp=10–15 lb). If any other value is obtained, adjust with shims. Remove the worm and bearing from the valve housing.

7. Clamp the valve between soft jaws of a vise. Slide the sleeve (24) onto the worm. Insert the worm far enough into the bore of the piston so that 16 balls can be inserted from the front piston bore for the ball recirculating pipe into the thread of the worm as follows: Insert the balls through the front piston bore (Fig. 6-83). Simultaneously, screw the worm further down so that the balls are carried along up to the rear piston for the recirculating pipe. When the 16 balls have been inserted, the first ball should appear at the other recess for the pipe half. Insert the remaining 7 balls in the recirculating pipe. To facilitate assembly, the outer balls are packed in with grease, upon which the filled recirculating pipe is inserted into the piston bores. Put the pipe halves together and fit them, see Fig. 6-84.

Check the torque required to turn the worm in the piston. The correct torque is between 0.2–0.4 Nm

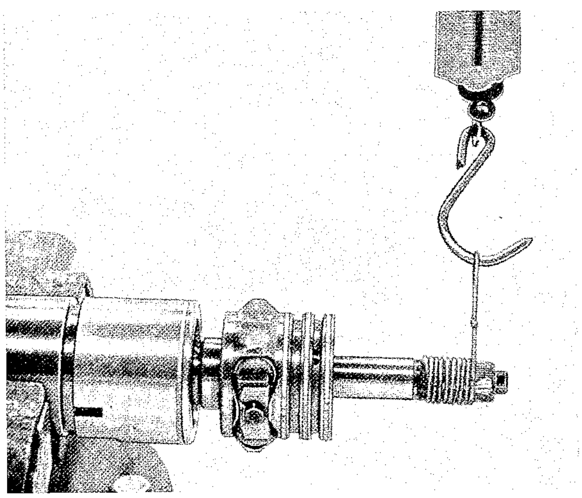

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Fig. 6-85. Checking torque

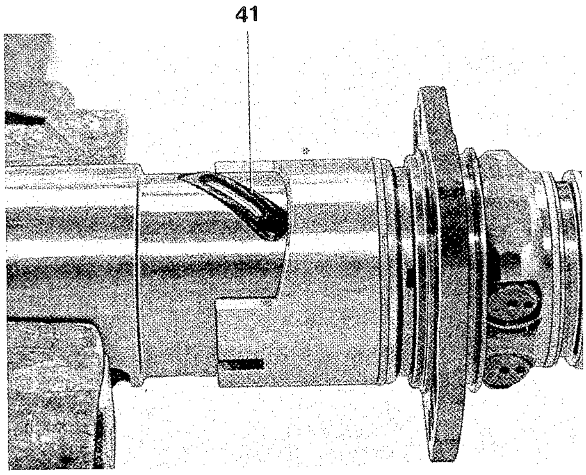

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Fig. 6-87. Gasket installed
41. Gasket

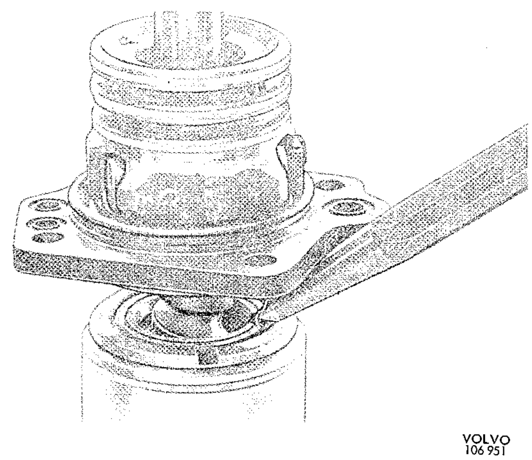


Fig. 6-88. Locking the ring

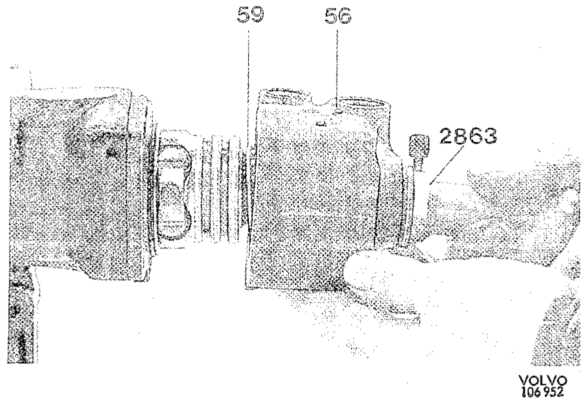


Fig. 6-90. Installing valve housing
56. Valve housing 59. Ball bearing

(0.02–0.04 kpm=1.7–2.5 lb.in.). Measure the torque with a cord (see Fig. 6-85). The balance should give a reading of between 23–46 N (2.3–4.6 kp=5–10 lb). If another value is obtained, replace all the 23 balls. The balls are available in 5 different dimensions.

After the correct value has been obtained, remove the 23 balls and keep them in a safe place.

8. Place the O-ring (26) and piston ring (25) in the recess on the sleeve (24). Fit the pre-assembled cover (30) with bearing washer (35), bearing (36), ring (27) and sleeve (24) on the worm, see Fig. 6-86.
   Insert the worm into the piston while fitting the 23 balls, see under point 7. Install the gasket (41), see Fig. 6-87. Assemble the piston and sleeve and fit the pin (23), if it was removed. The sleeve recess should be on the tooth side, see Fig. 6-88. Warning! The worm must not be pulled so far out of the pistons that the balls fall out (into the piston). Pull out the ring (27) and lock it, see Fig. 6-88. Protect the worm from any metal filings.
9. Clamp the housing (4) with the neck facing downwards. Place the washer (8) in the housing. Fit the sealing ring (9) with the sealing lip facing upwards. Use tools 2010 and 1801, see Fig. 6-89.

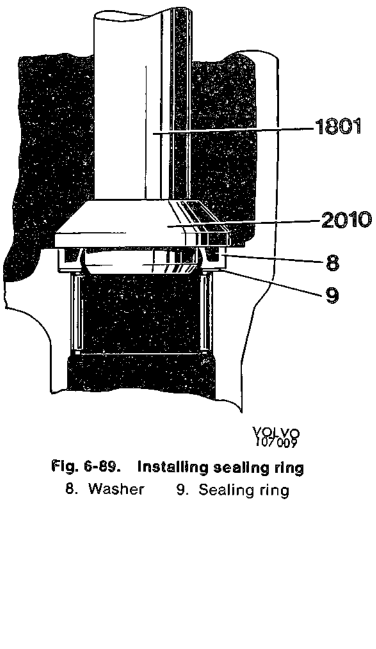


Fig. 6-89. Installing sealing ring
8. Washer 9. Sealing ring

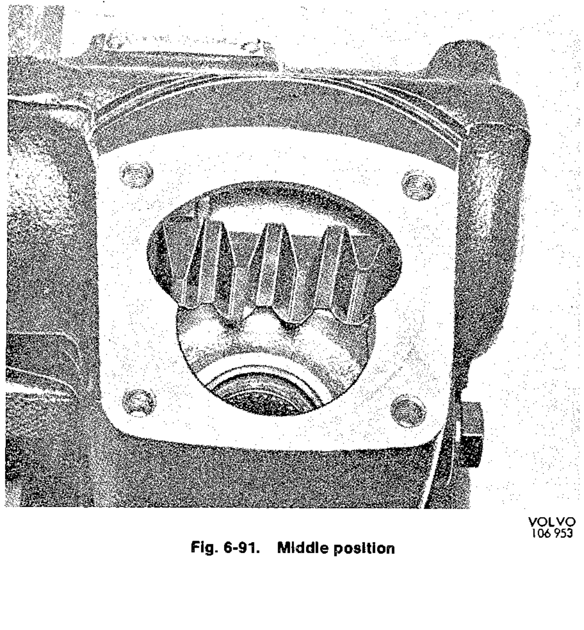


Fig. 6-91. Middle position

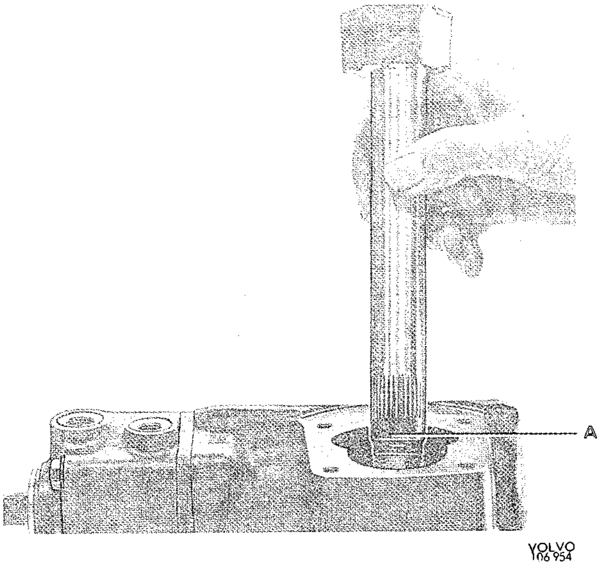


Fig. 6-92. Installing steering shaft
A. Tape

10. Install the oiled O-ring (28) and the other O-rings in position in the cover with the help of grease. Insert the piston complete with cover and worm into the housing, see Fig. 6-69.
11. Tension out the sealing ring (54) with tool 2863. Place the bearing (59) in position. Install the valve housing (56), see Fig. 6-90. The tightening torque for the bolts (50 and 52) is 34 Nm (3.4 kpm=25 lbft).
12. Place the piston teeth in the middle position, that is, the cover between the second and third tooth about opposite the steering shaft hole (Fig. 6-91). Fine-adjust by adjusting the worm line-up mark to coincide with the line-up mark on the housing (Fig. 6-58).

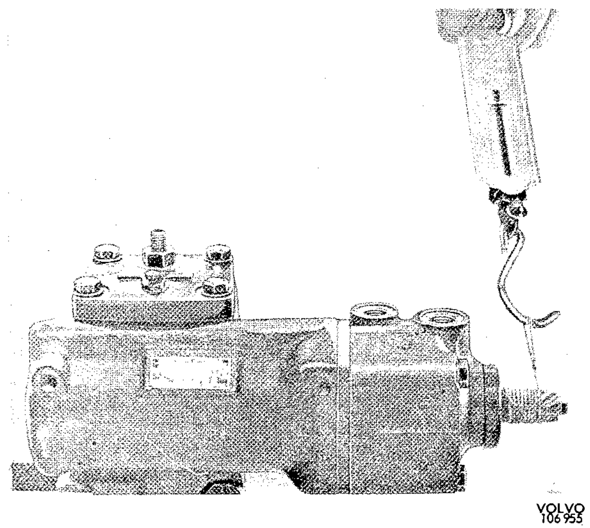


Fig. 6-93. Checking torque

If the bearings (3 and 7) have not been replaced, place the needles in position with the help of grease.
Put tape on the steering shaft serration as protection for the sealing ring in the housing. Install the steering shaft (Fig. 6-92) using great care to avoid damage to the sealing ring in the housing. Push the steering shaft into the bottom position. Rotate the steering spindle back and forth while pressing the steering shaft inwards at the same time so that the steering shaft and piston take up the proper position in relation to each other.
Fit the adjustment screw (11), adjustment washer (12) and snap ring (13) in the steering shaft (10). Check the adjuster screw play in the shaft. This may not exceed max. 0.05 mm (0.002") and is adjusted with the adjuster washer (12). This washer is available in 7 thicknesses between 2.15–2.45 mm (0.085–0.096"). Start with the thick washers and choose the first dimension which gives play after the circlip has been fitted.

13. Install the needles in the bearing (14). Place the O-ring (15) on the cover. Fit the cover by screwing up the adjustment screw (11) until the cover is in position. For the moment fit a nut (17). Insert the washers (20) and bolts (19). The tightening torque is 31 Nm (3.1 kpm=22 lbft). Fit the protective cover (51).
14. Install the sealing ring (2) with the help of tool 4028. Fit the snap ring (1) in position. Remove the tape.
15. Rotate the steering spindle to one of the end positions. Check the requisite turning torque about 1/2 turn from the end position (Fig. 6-93). Adjust the steering spindle to the middle position. Screw in the adjustment screw (11) so that a noticeable pressure point is obtained. Measure the torque and adjust so that the balance gives a reading of 45–60 N (4.5–6.0 kp=10–13 lb) greater than at the end positon, but maximum 185 N (18.5 kp=40 lb).
    Tighten the nut (17) to a torque of 25 Nm (2.5 kpm=18 lbft) while keeping the adjustment screw in positon.

FUNCTION TEST

After assembly, the power steering should be tested with regard to function and for leakage. The instructions given on page 6 : 27 should thus be followed.

Replacing power pump

REMOVAL

1. Clean round the connections (5 and 6, Fig. 6-94).
2. Disconnect the suction line (5) and collect the oil running out in a vessel.
3. Disconnect the delivery line (6), and unscrew the tensioning bolt (1) and the retaining bolts (2). Protect the nipples and connections from dirt.
4. Unscrew and remove the pump.

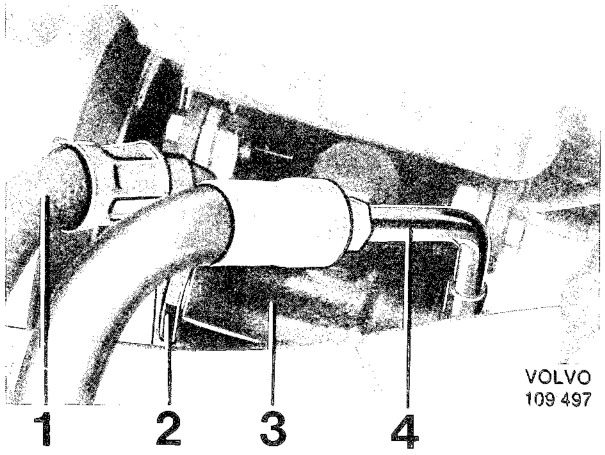


Fig. 6-94. Power pump, installed
1. Suction line
2. Plug for control valve
3. Power pump
4. Delivery line

INSTALLATION

Concerning replacement of pump, supplement the new pump with brackets, pulley and other parts, see Fig. 6-94. When installing the pulley, the tolerances may be such that the pulley cannot be pressed on by hand. In these cases, press on the pulley with care. It must not be hammered on, otherwise the bearings might easily get damaged, resulting in noise in the pump.

1. Place the pump in position and connect the oil lines with new seals.
2. Fit the attaching bolts and other components, see Fig. 6-94. Tension the drive belt so that it can be pressed in about 5 mm ($^3/_{16}$") in the middle. Tighten the bolts and the connections.
3. Fill with oil and bleed, see under "Oil filling and bleeding".

Overhauling power pump

DISASSEMBLY

1. Unscrew the nut (1, Fig. 6-95) and pull off the pulley. Use if necessary puller 2279. Remove the brackets.
2. Remove the snap ring (20) with snap ring pliers.
3. Remove the cover (19), spring (22) and plate (18). Use snap ring pliers.
4. Shake out the intermediate piece (16) and rotor (25), see Fig. 6-96. If the intermediate piece does not come out easily, let it remain there until later on.
5. Remove the snap ring (5) at the drive end.
6. Carefully press out the shaft (4).

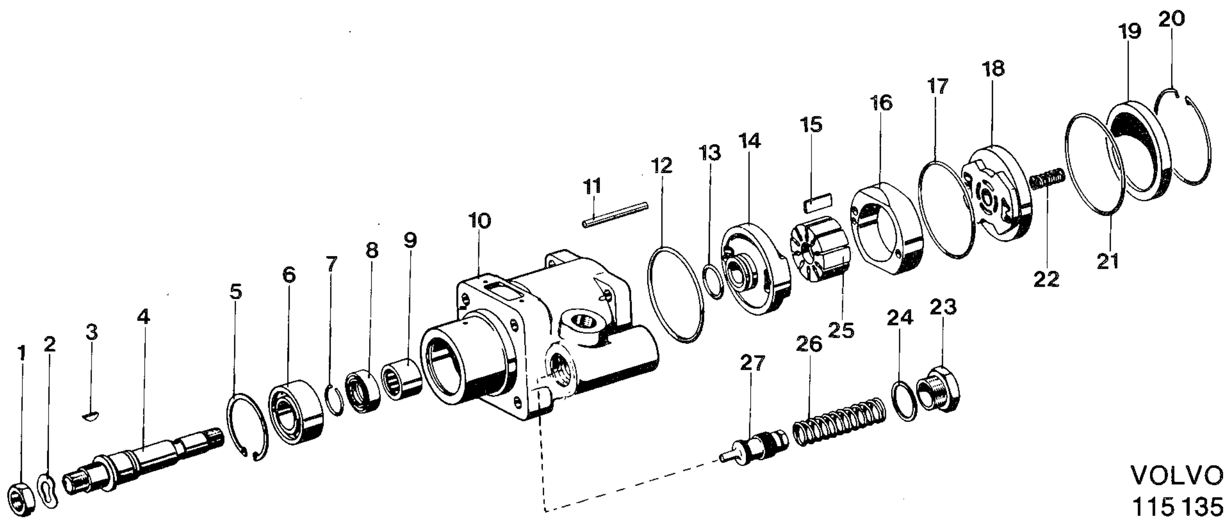


Fig. 6-95. Power pump disassembled

1. Nut
2. Washer
3. Key
4. Shaft
5. Snap ring
6. Bearing
7. Snap ring
8. Sealing ring
9. Needle bearing
10. Housing
11. Pin
12. O-ring
13. O-ring
14. Inner plate
15. Blade
16. Intermediate piece
17. O-ring
18. Outer plate
19. Cover
20. Gasket
21. O-ring
22. Spring
23. Plug
24. Gasket
25. Rotor
26. Spring
27. Control valve

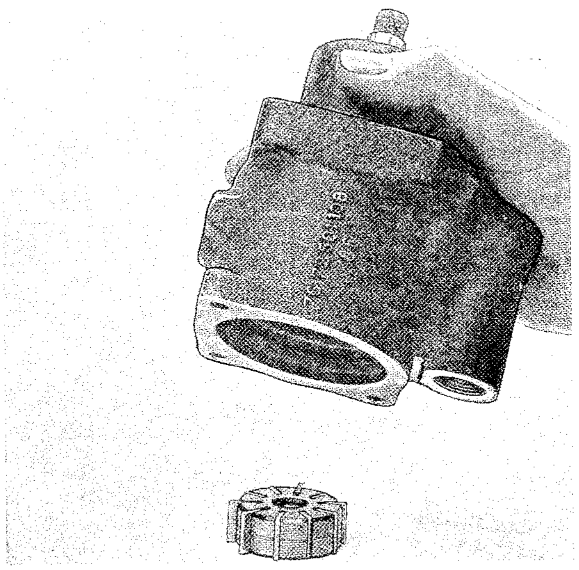


Fig. 6-96. Removing rotor

7. Press the plate (14) out of the housing. The intermediate piece, if not removed, should accompany the plate.
8. Screw out the plug (23) and shake out the spring (26) and piston (27).
9. Press out the needle bearing (9) and sealing ring (8) together with tool 2996, see Fig. 6-97.
10. Take the O-rings out of the housing.

INSPECTION

1. Check the shaft (4, Fig. 6-95) for scores from the sealing ring and needle bearing. Check the threads and lands for damage. If the bearing (6) is damaged, it can be removed after the snap ring (7) has been taken off.
2. Check the needle bearing (9) and replace if necessary.
3. Check the plate (14 and 18) for wear and scoring.
4. Check the rotor (25), intermediate piece (16) and blade (15) for wear. The blade should easily enter the rotor. These parts are replaced together in sets.
5. Check that the control valve piston (27) does not jam in the housing drilling. Make sure that the piston has the same tolerance group as the housing, that is, that the numbers agree ("1" and "2" or "II").
   Screw the control valve piston apart. Do not clamp round the guide surfaces but use snap ring pliers at the holes. Take care of the parts, clean and inspect. Replace the piston complete if damaged. Assemble the parts. The number of washers will determine the opening pressure.
6. Blow all channels in the housing clean.

ASSEMBLY

Before assembling, all parts should be well cleaned and lightly oiled. All seals should be replaced by new ones.

1. Press the needle bearing (9, Fig. 6-95) into the housing with the help of drift 2996, see Fig. 6-98. The bearing should be pressed in until the tool bottoms so that the needle bearing outer edge is 37.0—37.2 mm (1.465—1.466") from the edge of the housing.

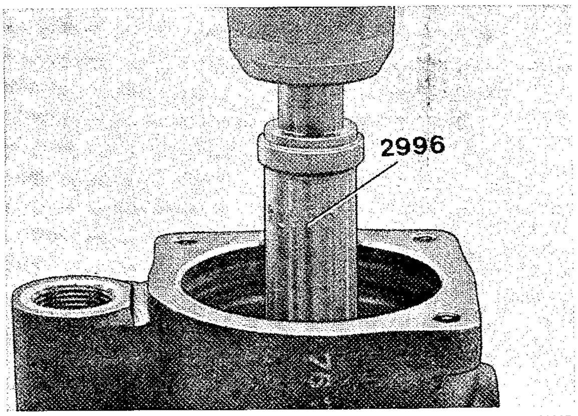


Fig. 6-97. Removing sealing ring

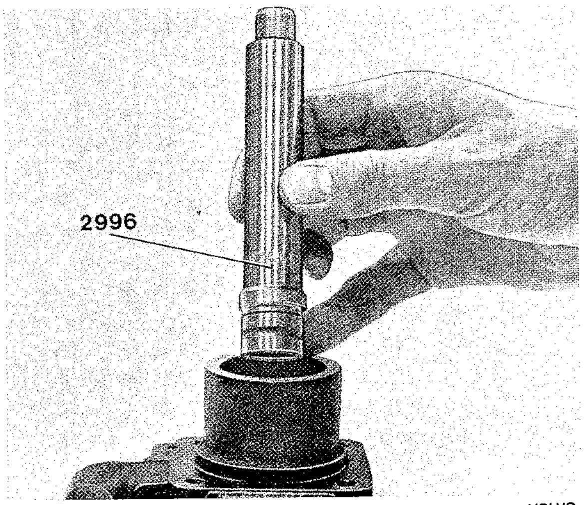


Fig. 6-98. Installing needle bearing

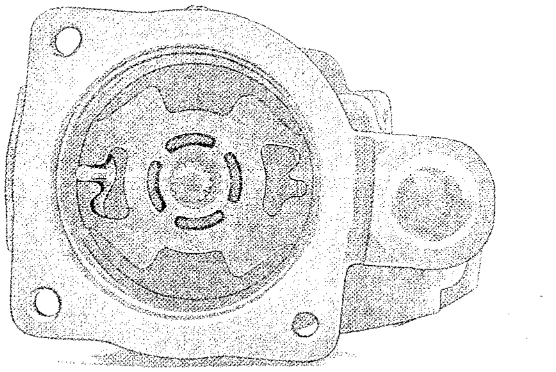


Fig. 6-99. Inner plate installed

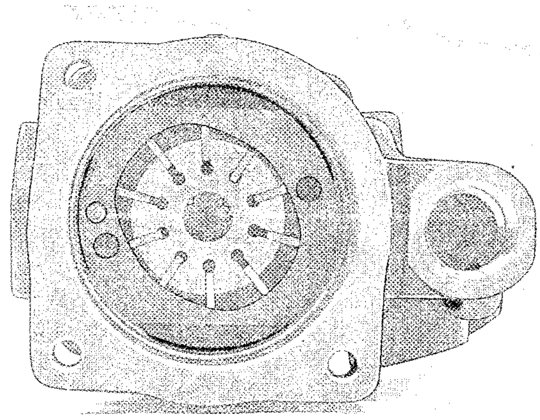


Fig. 6-101. Rotor blades installed

2. Apply universal grease between the sealing ring (8) lips and press it in with drift 2997.
3. Place the O-ring (12) in position in the housing's inner groove.
4. If the bearing (6) was removed, press the shaft into the bearing. Fit the circlip (7) in its groove.
5. Install the shaft with bearing. Fit the circlip (5) in its groove.
6. Place the O-ring (13) in its groove on the plate (14). Fit the plate according to Fig. 6-99.
7. Install the intermediate piece (Fig. 6-100): the small hole on the pin, both the other holes opposite the plate holes.
8. Install the O-ring (17) in position in the housing.
9. Install the rotor (25) with the smooth drill facing the drive side. Install the 10 blades (15) with the rounded surface outwards towards the intermediate piece (Fig. 6-101).
10. Install the plate (18) on the intermediate piece as shown in Fig. 6-102. The pin should be in one of the two outer holes.
11. Install the O-ring (21) in its groove (Fig. 6-103). Fit the spring (22) and cover according to Fig. 6-103. Hold down the cover with pliers and fit the snap ring (20) in its groove.
12. Install the control valve piston (Fig. 6-104). Install the spring (26), packing (24) and plug (23).
13. Install the nipple, brackets and pulley, see Fig. 6-49.

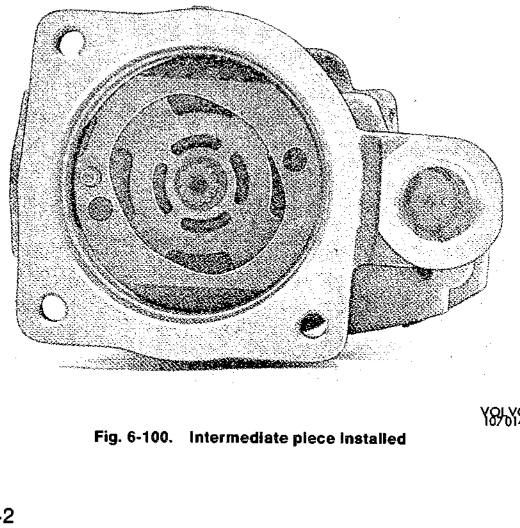


Fig. 6-100. Intermediate piece installed

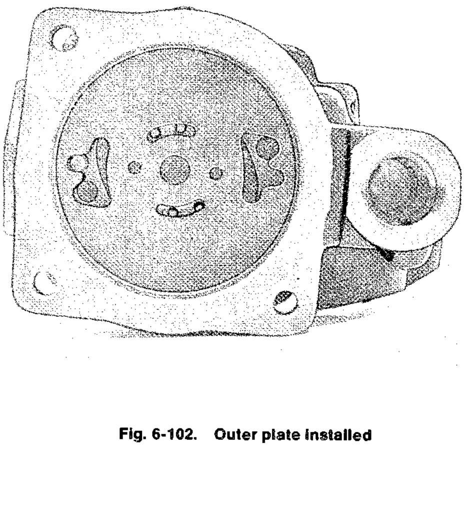


Fig. 6-102. Outer plate installed

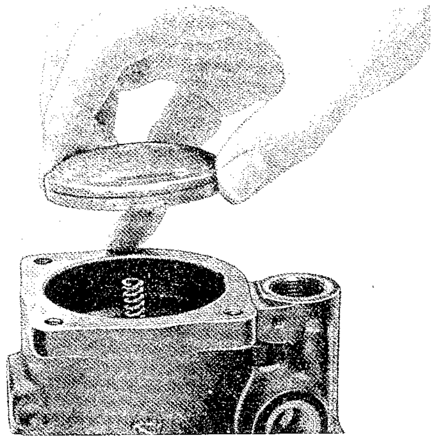


Fig. 6-103. Installing cover

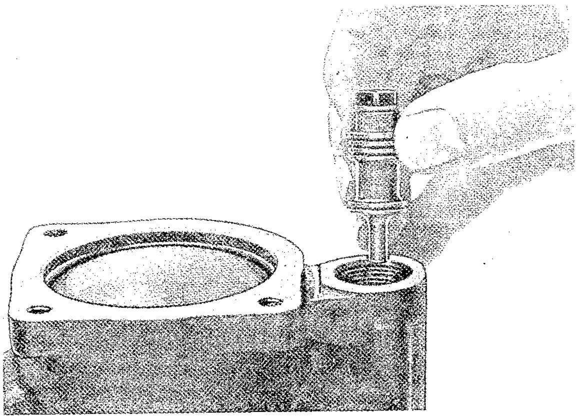


Fig. 6-104. Installing control valve

Replacing oil filter

When changing the oil, which is normally done only in connection with replacement of the power steering components, the filter should also be replaced. This is accessible after the spring and retainer in the oil reservoir have been lifted off. Clean the reservoir before fitting the new filter. Also replace the gasket in the outer cover.

TROUBLE SHOOTING

When trouble shooting on vehicles with power steering, always start by checking the oil level, see page 6 : 29. Any leakage should be put right before topping up with oil.

FAULT

REASON	ACTION
THE CAR WANDERS	
Too little oil or air in the system.	Check the oil level and bleed, see page 6 : 29.
Abnormal loading.	Dristribute the loading.
Unsuitable tire equipment.	Shift round the wheels.
Faulty wheel alignment.	Check and adjust the alignment.
Loose steering parts.	Check and tighten up.
THE CAR PULLS TO THE ONE SIDE	
Too low or uneven air pressure in tires.	Check air pressure (see Section 7).
The front springs are fatigued or have different heights.	Check and adjust the springs (see Section 7).
A roller bearing has jammed.	Check the bearings. Replace damaged bearings and adjust (see Section 7).
Faulty track.	Check-measure the body and straighten up if necessary (see Section 8).
Bent steering rod.	Replace damaged steering rod.
Faulty camber.	Check and adjust the camber. Due to the fact that the wheels can give different camber within the tolerance, this can give rise to the pulling.
STEERING IS STIFF IN EITHER DIRECTION	
Too low oil level or air in the system.	Check the oil level and bleed, see page 6 : 29.
Pump control valve seizes or is blocked.	Remove, wash and check control valve.
Filter blocked, channel blocked.	Remove filter, clean channel.
Excessive caster.	Check and adjust the caster.
Jamming ball joint.	Replace ball joint.
Damaged sealing rings in power steering gear.	Recondition or replace steering gear.
STEERING HEAVY ONLY EITHER LEFT OR EITHER RIGHT	
Pressure does not build up on one side of the power piston.	Recondition or replace the power steering gear.

STEERING HEAVY WHEN TURNING THE STEERING WHEEL RAPIDLY

The pump drive belt slips.	Tension or replace drive belt.
Pump control valve blocked.	Remove, wash and clean control valve.
Pump has insufficient capacity.	Recondition the pump.
Air in the power steering system.	Bleed the system, fill with oil according to page 6 : 29.

FRONT WHEELS JAZZ

Air in the system.	Bleed the system.
Unbalanced or warped wheels.	Balance and if necessary straighten up the wheels (see Section 7).
Faulty wheel alignment.	Check wheel alignment.
Loose or worn front wheel bearings.	Adjust or replace bearings.

BUMPS AND IMPACTS IN STEERING WHEEL

Too low oil level or air in the system.	Check the oil level or bleed, see page 6 : 29.
The steering shaft has axial play.	Adjust the pressure point.
The worm is loose.	Recondition the steering gear.
Looseness in other steering parts.	Tighten up or replace worn part.

THE STEERING RUNS AUTOMATICALLY ON ONE SIDE INTO THE END POSITION

The valve setting to hydraulic center is not accurate.	Recondition the steering gear.

PUMP NOISE TOO LOUD

Lack of oil or air in the system.	Check the oil level, see page 6 : 29.
Worn pump.	Recondition the pump.

OIL LEAKAGE

Defective seals or connections.	Clean and dry-wipe outside steering gear. Test-run and load steering gear. Locate the leakage.

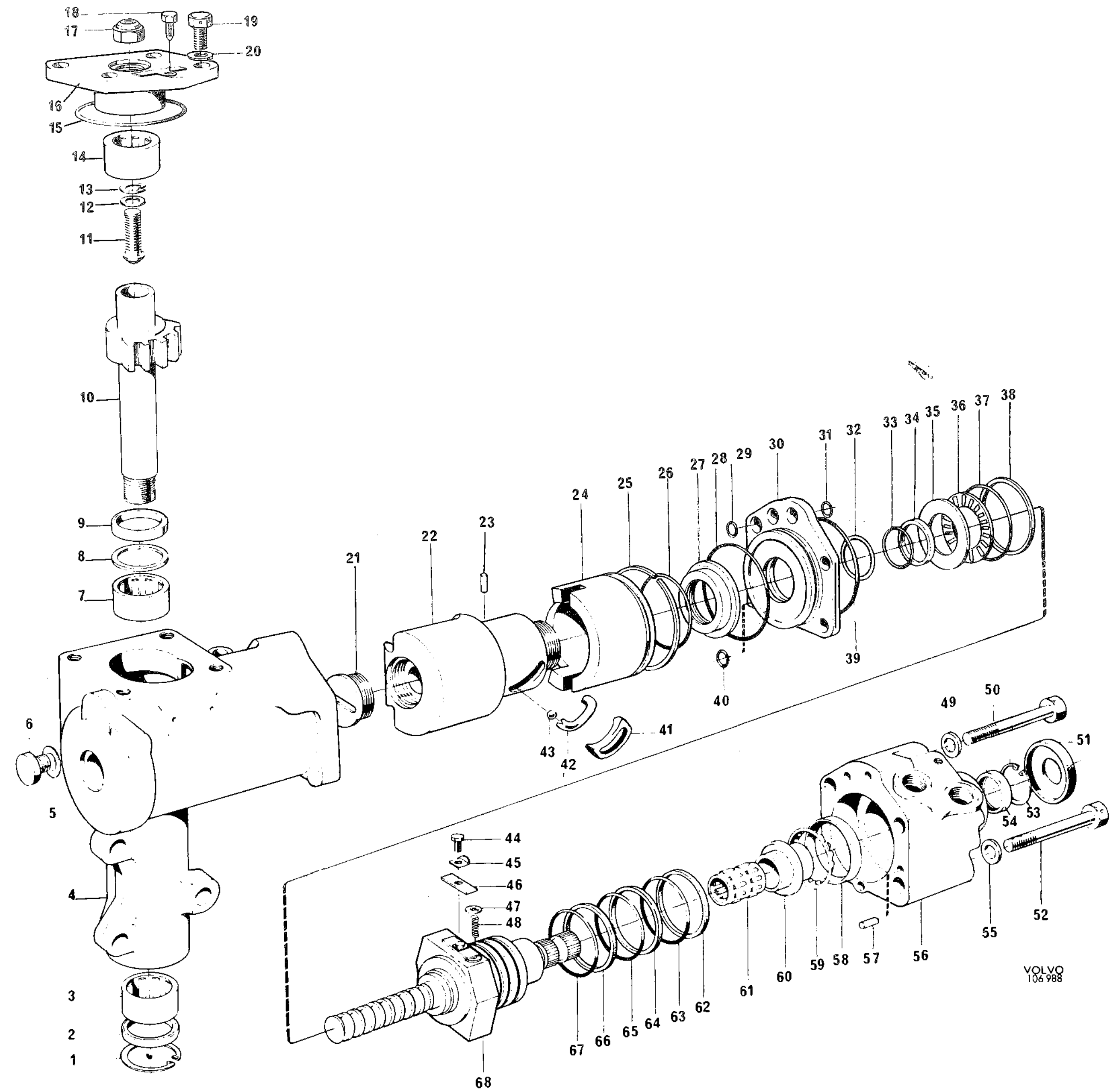
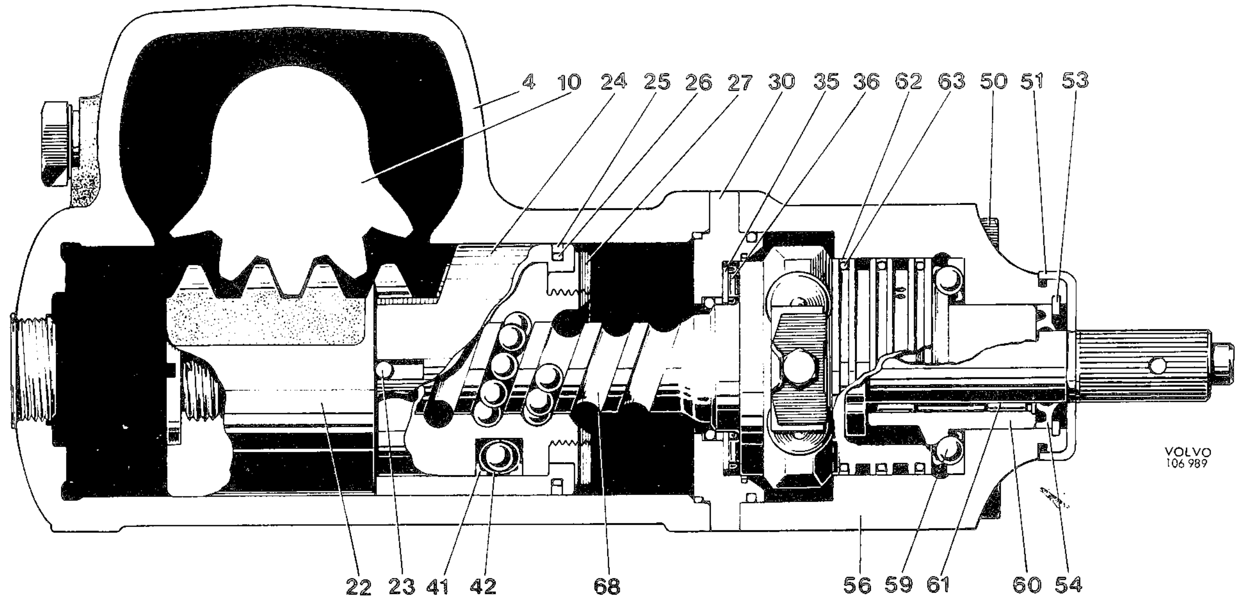


Illustration A. Steering gear disassembled

1. Snap ring
2. Lower sealing ring
3. Needle bearing
4. Housing
5. Gasket
6. Plug
7. Needle bearing
8. Washer
9. Upper sealing ring
10. Steering shaft
11. Adjustment screw
12. Adjustment washer
13. Snap ring
14. Needle bearing
15. O-ring
16. Cover
17. Lock nut
18. Bleeder screw
19. Bolt
20. Washer
21. Plug
22. Piston
23. Pin
24. Sleeve
25. Piston ring
26. O-ring
27. Ring nut
28. O-ring
29. O-ring
30. Cover
31. O-ring
32. Shims
33. O-ring
34. Packing
35. Bearing washer
36. Needle bearing
37. O-ring
38. Gasket
39. O-ring
40. O-ring
41. Gasket
42. Pipe halves
43. Ball
44. Bolt
45. Lock washer
46. Retainer
47. Washer
48. Spring
29. Washer
50. Bolt
51. Rubber cover
52. Bolt
53. Snap ring
54. Sealing ring
55. Washer
56. Valve housing
57. Guide pin (only early prod.)
58. Bearing ring
59. Ball bearing
60. Bearing sleeve
61. Needle bearing
62. Gasket
63. O-ring
64. Packing
65. O-ring
66. Packing
67. O-ring
68. Worm



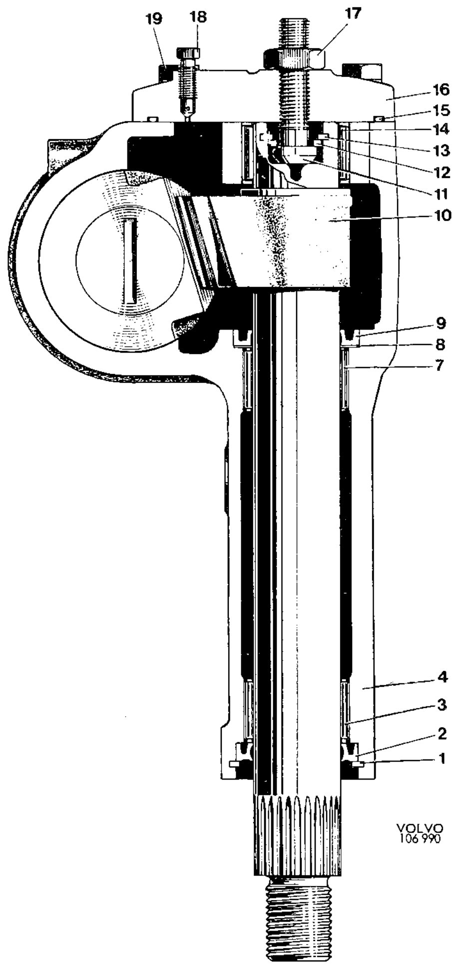


Illustration B. Steering gear assembled

1. Snap ring
2. Lower sealing ring
3. Needle bearing
4. Housing
7. Needle bearing
8. Washer
9. Upper sealing ring
10. Steering shaft
11. Adjustment screw
12. Adjustment washer
13. Snap ring
14. Needle bearing
15. O-ring
16. Cover
17. Lock nut
18. Bleeder screw
19. Bolt
22. Piston
23. Pin
24. Sleeve
25. Piston ring
26. O-ring
27. Ring nut
30. Cover
35. Bearing washer
36. Needle bearing
41. Packing
42. Pipe half
50. Bolt
51. Rubber cover
53. Snap ring
54. Sealing ring
56. Valve housing
59. Ball bearing
60. Bearing sleeve
61. Needle bearing
62. Gasket
63. O-ring
68. Worm

Section 7

SPRINGS, SHOCK ABSORBERS, WHEELS

CONTENTS

GROUP 70

GENERAL

TOOLS

The numbers for the special tools are preceded either by 999 or SVO (e.g. 999 1801 or SVO 1801).

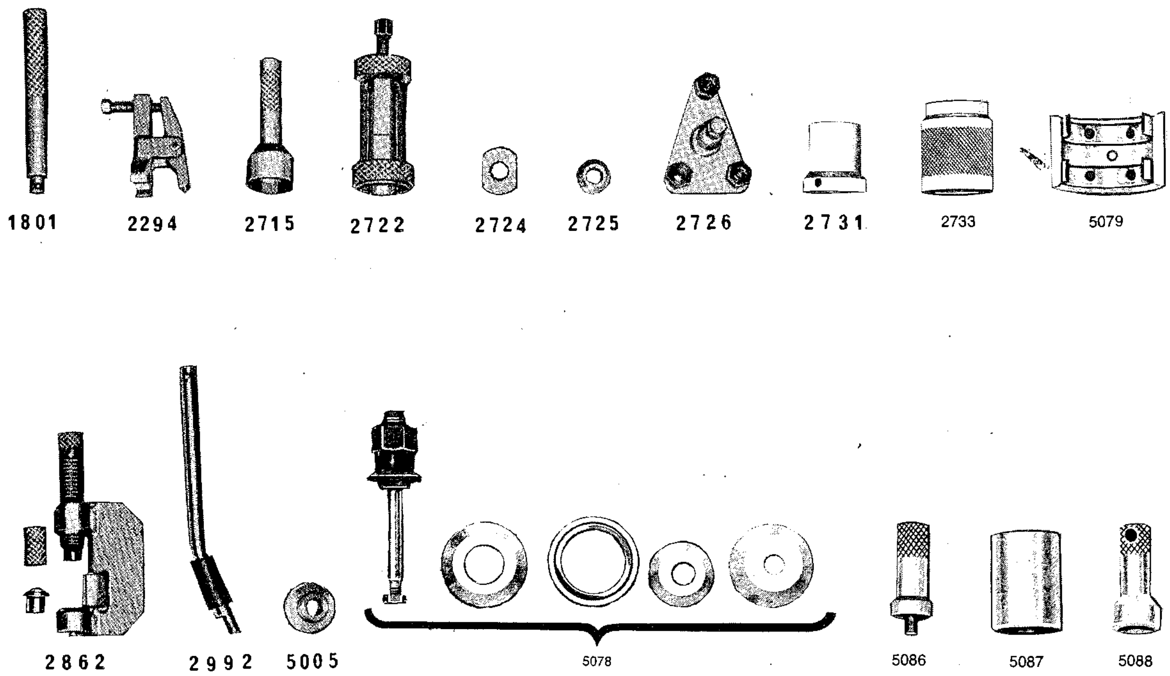


Fig. 7-1. Tools used for work on rear axle suspension and hub

999 (SVO)

1801	Standard extension 18×200
2294	Puller for ball joints, steering rod
2706	Drift for removal and replacing of track rod bushings
2715	Drift for removal and replacing of grease cap
2722	Puller for inner ring, inner front wheel bearing
2724	Drift for replacing of outer ring, outer front wheel bearing and removal of outer ring, inner front wheel bearing
2725	Drift for removal of outer ring, outer front wheel bearing
2726	Puller for front wheel hub
2731	Drift for removal and replacing of track rod bushings
2733	Sleeve for removal and replacing of track rod bushings
2862	Pressing tool for changing wheel studs
2992	Tool for removal of rim ring
5005	Drift for replacing sealing ring and outer bearing ring, inner front wheel bearing
5078	Pressing tool for support arm bushings in rear axle casing
5079	Spacer for support arm bushings in rear axle casing
5086	Drift for removal and replacing of torque rod bushings
5087	Sleeve for removal and replacing of bushing in torque rod and front bushing in support arm
5088	Drift for removal and replacing of front bushing in support arm

SPRINGS

GENERAL INFORMATION

The Volvo 164 is provided with coil springs both front and rear. The front wheel suspension is independent. The upper ends of the front spirngs (1, Fig. 7-2) are seated in housings formed in the front axle member, and are seated in the bottom of the lower control arms. The lower control arms are also provided with rubber buffers (5), which absorb any impacts arising from loading on the spring. The front axle member is fitted with rubber buffers (4) which limit the downward movements of the control arms. The rear springs are bolted at the bottom next to the support arms behind the rear axle. At the top, the springs support against the spring seats, which are bolted to the rear side members. Rubber buffers (4) fitted on the rear side-members take up any impacts from loading on the springs.

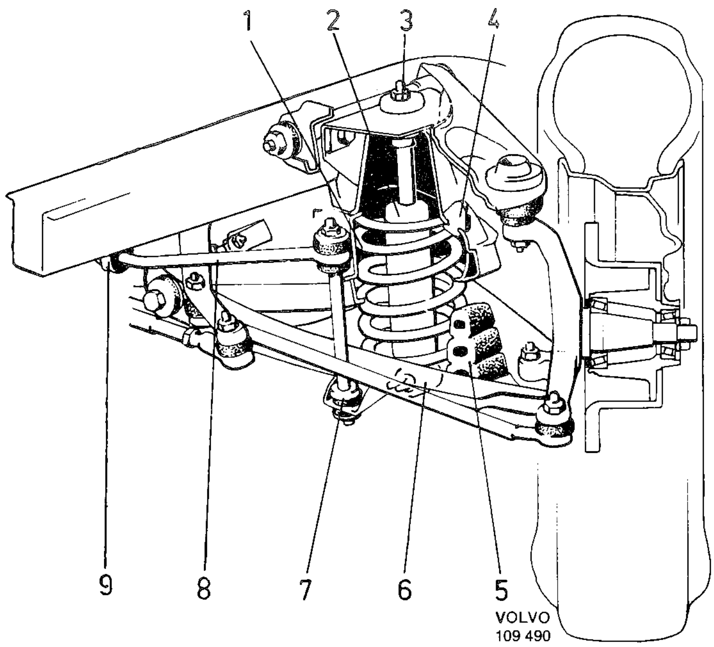


Fig. 7-2. Front suspension and shock absorber
1. Spring
2. Shock absorber
3. Upper shock absorber attachment
4. Rubber buffers
5. Rubber buffers
6. Lower shock absorber attachment
7. Attachment for stabilizer
8. Stabilizer
9. Attachment (in frame) for stabilizer

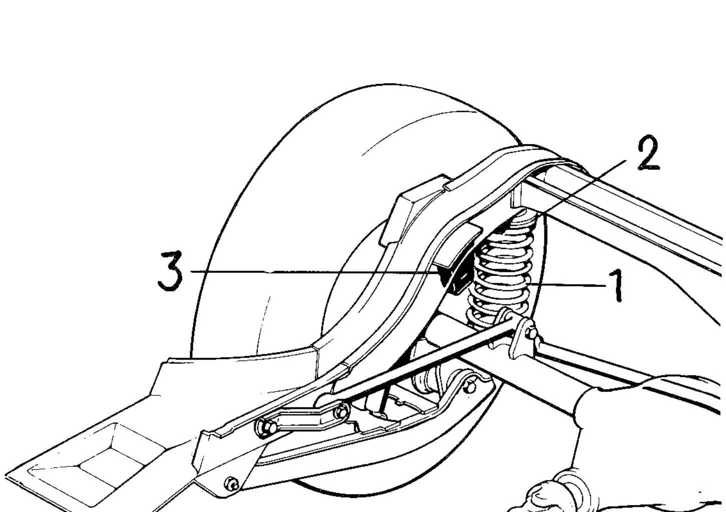


Fig. 7-3. Rear suspension
1. Spring
2. Rubber spacer
3. Rubber buffer

FRONT SPRINGS

REMOVAL

1. Remove the hub cap and loosen the wheel nuts a couple of turns.
2. Jack up the front end at the front jack attachments. Remove the wheel.
3. Remove the shock absorber according to the instructions given in Group 76.
4. Disconnect the steering rod from the steering arm. Loosen the clamp for the brake hoses. Remove the attachment (7, Fig. 7-2) for the stabilizer.
5. Place a jack under the lower control arm. Loosen the nuts for the ball joints, knock with a hammer until the ball joints loosen from the knuckle. Remove the nuts and lower the jack slightly. Remove the steering knuckle with the front wheel brake unit and place it on a suitable stand.
6. Lower the jack fully and remove the spring.

INSTALLATION

1. Place the rubber spacer and spring in position. With the jack (placed immediately under the spring) lift up the lower control arm and fit the steering knuckle.
2. Tighten the ball joints at the steering knuckle. Firmly screw the stabilizer to the lower control arm.
3. Check the rubber bushing and lower washer (1, and 7, Fig. 7-8) of the upper shock absorber attachment. Place the shock absorber in position and tighten its attachment.
4. Point the wheels straight forwards (with the lower control arm unloaded) and clamp firmly the brake hoses to the screw of the stabilizer.
5. Install the wheel and wheel nuts. Lower the vehicle. Tighten the nuts.

REAR SPRINGS

REMOVAL

1. Place the rear end on stands. Position the stands in front of the rear jack supports and close to the rocker panels (Fig. 7-4).
2. Remove the wheel at the side the spring is to be replaced.
3. Support the spring by using a jack while disconnecting the lower shock absorber mounting (1, Fig. 7-5) at the side the spring is to be replaced.
4. Remove the spring lower retaining nut (2).
5. Lower the jack and remove the spring.

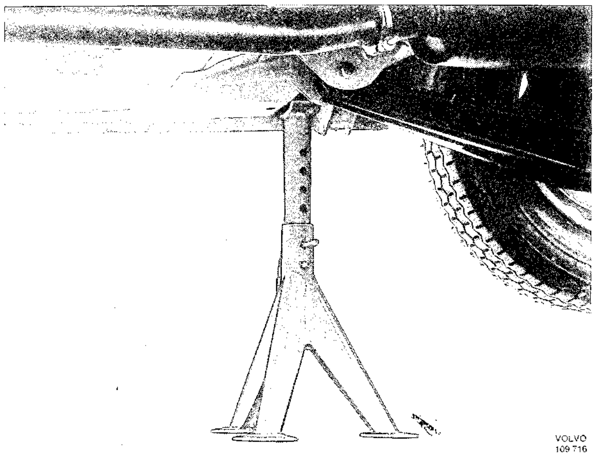


Fig. 7-4. Location of rear end stand

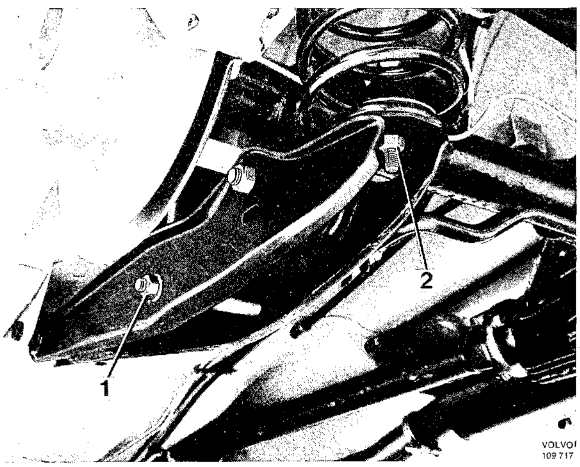


Fig. 7-5. Rear spring
1. Shock absorber attachment
2. Lower spring attachment

INSTALLATION

1. Check that the rubber spring support is correct (Fig. 7-6).
2. Place the spring on the trailing arm and attach the lower end.
3. Jack up the rear axle and at the same time guide the spring into position.
4. Install shock absorber lower retaining bolt with the spacer sleeve located on the inside.
5. Install the wheel and lower the vehicle.

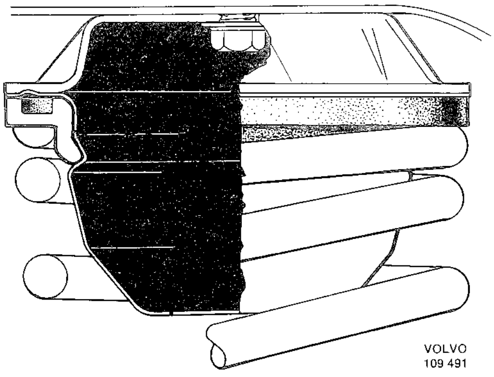


Fig. 7-6. Rear spring seat

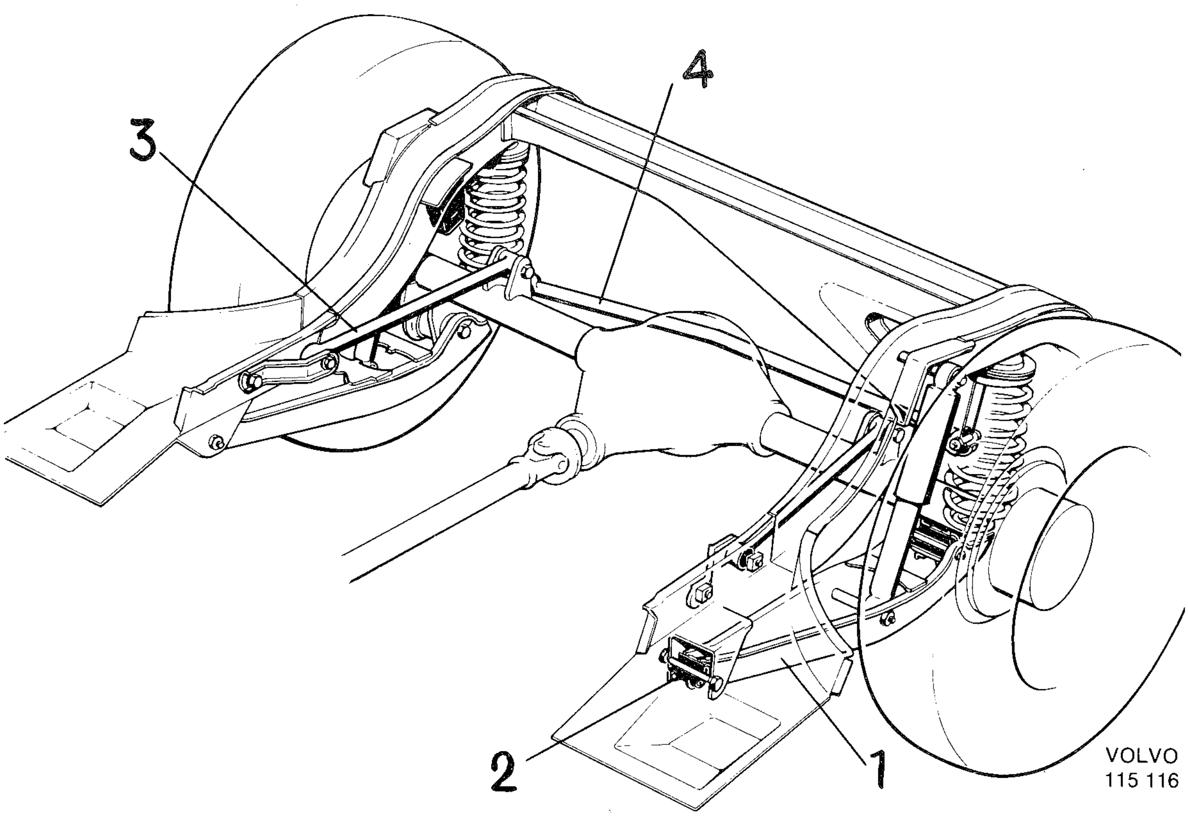


Fig. 7-7. Rear suspension
1. Trailing arm
2. Trailing arm leading bushing
3. Reaction rod
4. Track rod

SHOCK ABSORBERS AND STABILIZERS
GENERAL INFORMATION

GENERAL

The 164 is fitted with hydraulic, double-acting, telescopic type shock absorbers. They are maintenance free and cannot be disassembled.

The front shock absorber upper attachment (Fig. 7-9) consists of a spindle (5), which with upper bushings (1 and 6), wahsers (3 and 7) and a spacing sleeve, are fixed in a housing in the front axle member.

The lower attachment (Fig. 7-10) consists of an eyelet provided with a rubber bushing, which cannot be dismantled and a piece of tubular piping, the flattened ends of which are screwed to the bottom side of the lower control arm.

The stabilizer (8, Fig. 7-2), which is attached to both the lower control arms (7) and to the frame (9), increases the stability of the vehicle.

The rear shock absorber attachment (Fig. 7-11) consists of eyelets provided with rubber bushings (1 and 3) which cannot be dismantled. These absorbers are bolted at the top to the rear side-members and at the bottom to the trailing arms.

The rear axle is attached to the body through two flexibly mounted trailing arms (1, Fig. 7-7). Longitudinal forces are transferred by two reaction rods (3) and the transversal forces by a track rod (4). The trailing arms are fore-mounted in rubber bushings (2). The reaction rods and track bar are attached to the rear axle frame through the rubber bushings.

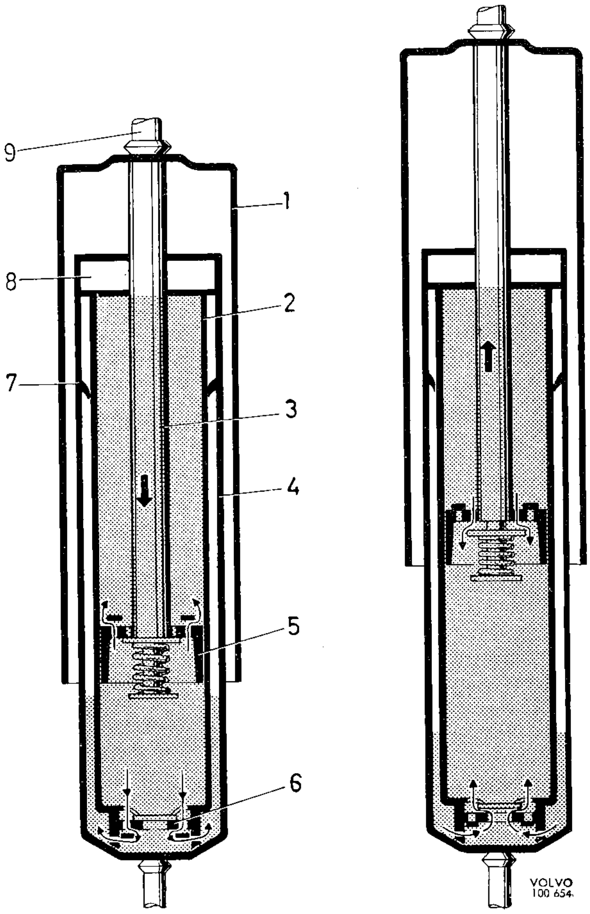


Fig. 7-8. Shock absorber, function

1. Dust cover
2. Working cylinder
3. Piston rod
4. Reservoir cylinder
5. Piston
6. Valve
7. Baffle ring
8. Cover
9. Upper attachment

SHOCK ABSORBERS

DESIGN

The design of the shock absorbers is shown in Fig. 7-8. The outer cylinder (1) serves only as a protection against dust and dirt. The other two cylinders (2 and 4) are concentrically arranged, one inside the other. The inner cylinder (2) is the actual working cylinder, the lower end of which has a valve (6). Inside the inner cylinder there is a piston (5) with drilled holes. Oil flowing through these holes is controlled by valves.

The piston is attached to a piston rod (3), the upper end of which forms an attachment to the body. At the opposite end of the shock absorber a similar screw attachment is fitted. The space between the cylinders (2 and 4) serves as a reservoir and is only partially filled with fluid. The inner cylinder (2) is completely filled with fluid on both sides of the piston (5). The cover (8) serves as a seal and guide for the piston rod (3). The baffle ring (7) acts as a baffle for the fluid.

FUNCTION

When the shock absorber is compressed or extended through the suspension of the vehicle, the piston (5) moves in the inner cylinder (2). Fluid then flows through the valve-controlled holes in the piston. The speed with which the piston moves is determined by the rate at which the fluid passes through the holes from one side of the piston to the other. Since the drilled holes are very narrow, the fluid can only pass through slowly, thus braking the movement of the piston. When the shock absorber is suddenly compressed or extended, a further braking effect is caused by turbulence in the fluid passing through the holes in the piston. This dampens any rolling tendency on the part of the vehicle and ensures smoother riding.

When the shock absorber is compressed or extended, the volume on each side of the piston is not altered by the same amount since the piston rod occupies a certain space. When the shock absorber is compressed, therefore, some of the fluid passes out through the valve (6) into the reservoir, and when the shock absorber is extended, fluid is again sucked into the cylinder (2) on the underside os the piston.

SERVICE PROCEDURES

CHECKING SHOCK ABSORBERS

Accurate checking of the shock absorbers can only be carried out with special checking devices. A rough check, however, can be made in order to see that the shock absorbers are functioning on the whole by noting the damping effect when rocking the car up and down and then releasing it. Testing can also be carried out by driving the vehicle over a bumpy surface. The removed absorber can be tested by tightly fixing the lower attachment in a position similar to that when fitted in the vehicle. If it is then alternately pulled out and compressed, it is possible to judge whether it is operating or not. Notice on making this check that, when the shock absorber is extended, its resistance is three times as great as when it is compressed, this due to its way of operating.

If the shock absorber does not function satisfactorily in both directions, or if the fixed rubber bushings are damaged, the shock absorbers should be replaced.

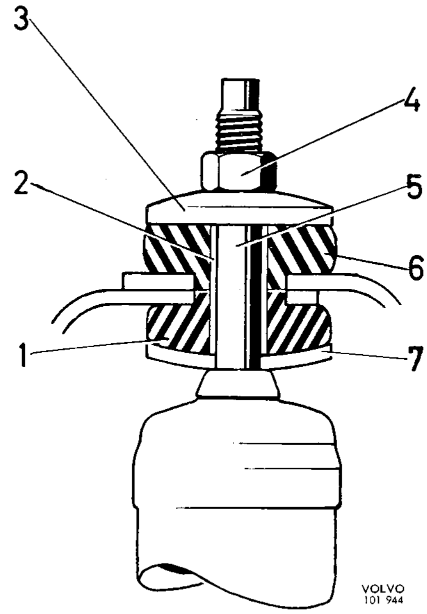


Fig. 7-9. Upper attachment, front shock absorber
1. Rubber bushing
2. Spacer sleeve
3. Washer
4. Nut
5. Spindle
6. Rubber bushing
7. Washer

REPLACING FRONT SHOCK ABSORBERS

1. Remove the upper nut (4, Fig. 7-9), the washer (3) and the rubber bushing (6).
2. Remove the two lower attaching screws (Fig. 7-10) on the underside of the lower control arm, and take down the shock absorber.
3. Install the washer (7), the spacer sleeve (2) and the rubber bushing (1).
4. Pull apart the shock absorber and then install it. Install and tighten the lower screws.
5. Install the upper rubber bushing (6), the washer (3) and the nut. Tighten the nut until it makes firm contact with the spacer sleeve.

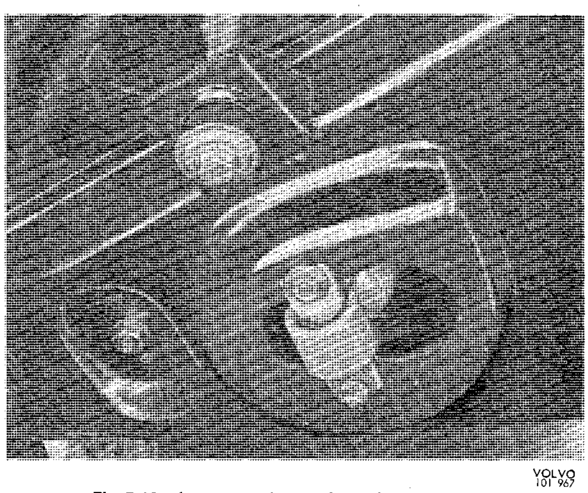


Fig. 7-10. Lower attachment, front shock absorber

REPLACING REAR SHOCK ABSORBERS

1. Put the rear end on stands, with the stands located as shown in Fig. 7-4.
2. Remove the wheel at the shock absorber to be replaced and unload the shock absorber by jacking up the rear axle.
3. Remove upper and lower retaining nuts and remove the shock absorber.
4. Install the new shock absorber with the spacer sleeve for the lower attachment positioned on the inside (Fig. 7-11).
5. Install the wheel and lower the vehicle.

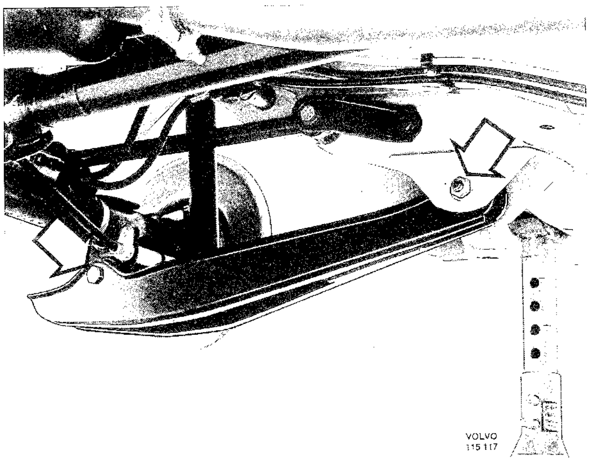


Fig. 7-12. Trailing arm attachments

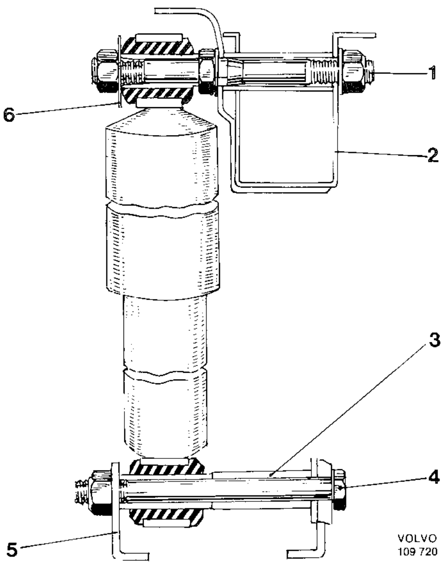


Fig. 7-11. Rear shock absorber

1. Upper retaining bolt
2. Side member
3. Spacer sleeve
4. Lower retaining bolt
5. Trailing arm
6. Washer

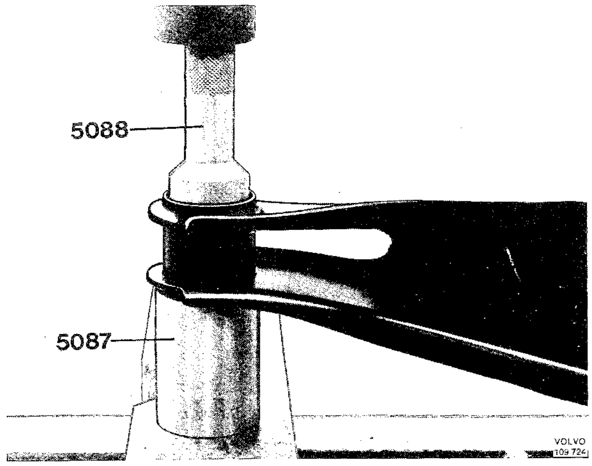


Fig. 7-13. Pressing out front bushing

REPLACING TRAILING ARMS AND/OR BUSHINGS

1. Put the rear end on stands with the stands located according to Fig. 7-4, and remove the wheel on the side the trailing arm is to be removed.
2. Unload the shock absorber by jacking up the rear axle. Disconnect the shock absorber from the trailing arm.
3. Remove the spring lower retaining nut and lower the jack and remove the spring.
4. Remove front and rear retaining bolts for the trailing arm and remove the trailing arm (Fig. 7-12).
5. Press the trailing arm front bushing out with tools 999 5088 and 999 5087, see Fig. 7-13.
6. Press in the new bushing using the same tools (Fig. 7-14).

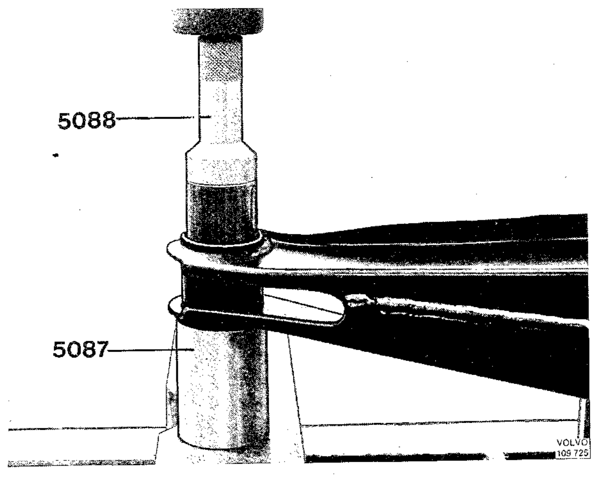


Fig. 7-14. Pressing in front bushing

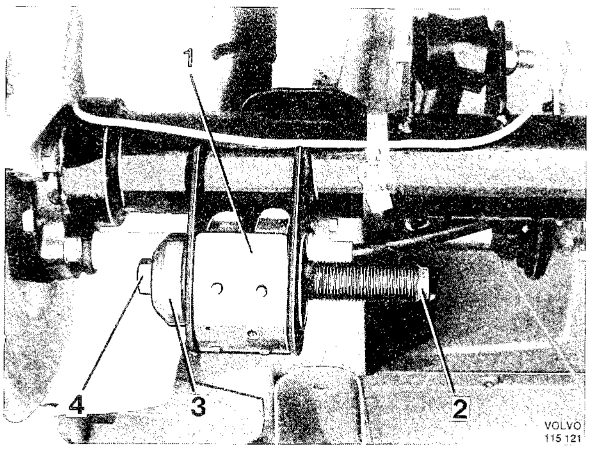


Fig. 7-15. Setting up press tool and spacer sleeve
1. Spacer sleeve 999 5079 3. Drift "C"
2. Spindle 4. Nut

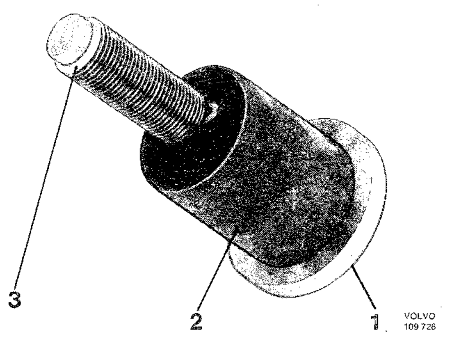


Fig. 7-17. Positioning bushing on spindle
1. Drift "D" 2. Bushing 3. Spindle

7. When replacing the rear bushing in the rear axle bracket, use press tool 999 5078 and spacer sleeve 999 5079.
8. Place the spacer sleeve (1, Fig. 7-15) around the bushing and fit the spindle (2) through the bushing from the inside. Position drift "C" (3) and nut (4) on the outside. Center drift "C" on the bushing before it is tightened with the spindle.
9. Position sleeve "B" (1, Fig. 7-16) on the bracket and drift "A" (2) and the nut (3) on the spindle. Center the drift "A" on sleeve "B" before tightening the nut.
10. Pull out the bushing with, for example, an impact wrench on the nut (3) and remove the tool from the bushing.
11. Position drift "D" on the bushing square end and center it on the bushing. Fit the spindle through the bushing, fit the nut on the spindle and tighten drift "D" with the spindle (Fig. 7-17).
12. Positon the bushing in the bracket from the inside. At the same time position drift "A" (2, Fig. 7-18) and nut (3).
    NOTE: The bushing center hole is displaced and the bushing is positioned in the bracket according to Fig. 7-19. Both slots (1) in the rubber should be horizontal and the arrow (2) should point downwards.
13. Pull the bushing into place in the bracket, using the nut (3), Fig. 7-18.
14. Remove the press tool and the spacer sleeve.
15. Install the trailing arm, starting with front attachment and thereafter the rear attachment simultaneously

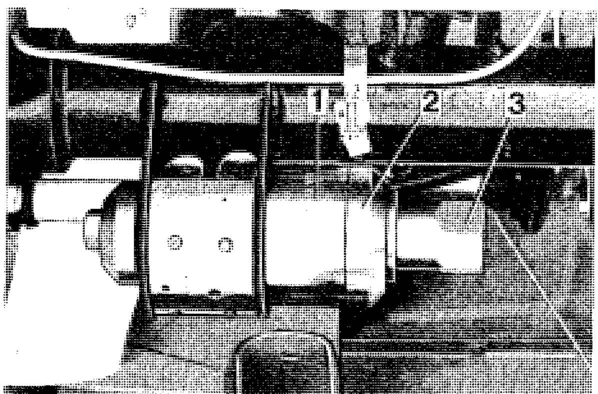


Fig. 7-16. Press tool for pressing out bushing
1. Sleeve "B" 2. Drift "A" 3. Nut

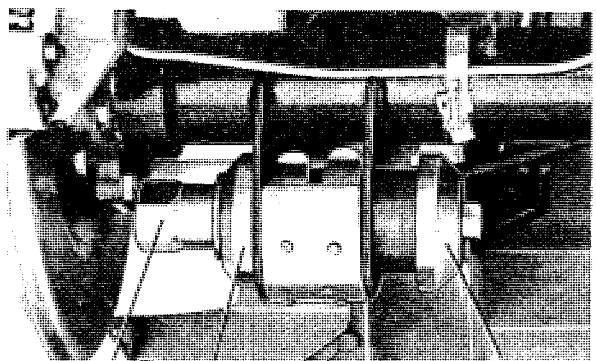


Fig. 7-18. Press tool for pressing in bushing
1. Drift "D" 2. Drift "A" 3. Nut

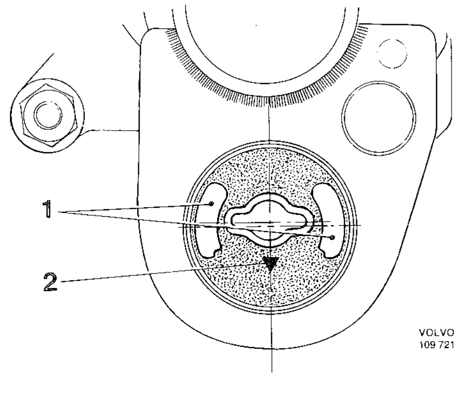


Fig. 7-19. Positioning of bushing on rear axle bracket
1. Slots in rubber 2. Marking

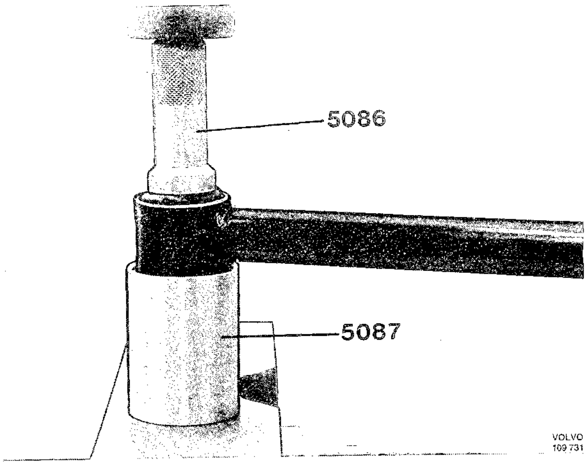


Fig. 7-21. Pressing out track rod bushing

with the stabilizer (Fig. 7-12). Torque the bolts finger tight.

16. Attach the spring to the trailing arm.
17. Raise the rear axle and at the same time guide the spring into position.
18. Install lower shock absorber attachment with the spacer sleeve on the inside.
19. Torque both trailing arm attachments, install the wheel and restore.

REPLACING REACTION RODS AND/OR BUSHINGS

1. Put the rear end on stands with the stands located according to Fig. 7-4.
2. Remove the reaction rod from the vehicle (Fig. 7-20).
3. Remove the bushings, using tools 999 5086 and 999 5087 (Fig. 7-21).
4. Press in the new bushings using the same tools.
   NOTE: Position the bushings in the reaction rod so that the flat sides are parallel to the rod.
5. Install the reaction rod and restore.

REPLACING TRACK ROD AND/OR BUSHINGS

1. Put the rear end on stands with the stands located according to Fig. 7-4.
2. Remove the track rod from the body and rear axle (Fig. 7-22).

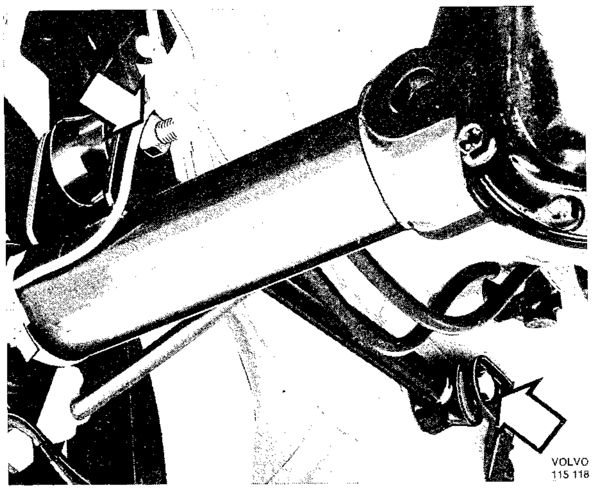


Fig. 7-20. Reaction rod attachments

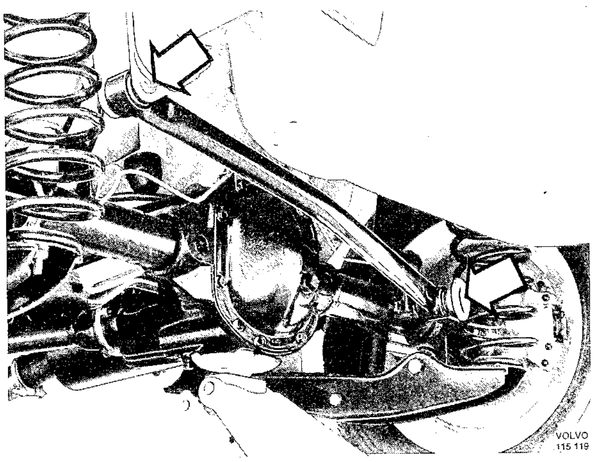


Fig. 7-22. Track rod attachments

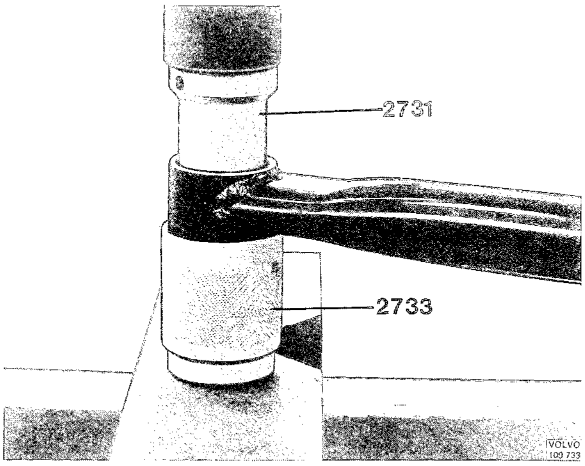


Fig. 7-23. Pressing bushing off rear axle end

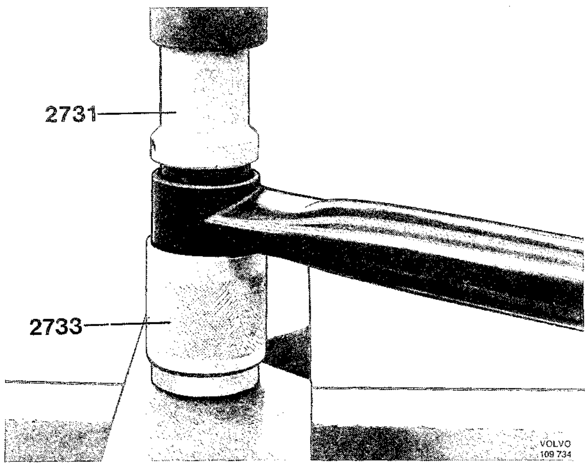


Fig. 7-24. Pressing bushing on rear axle end

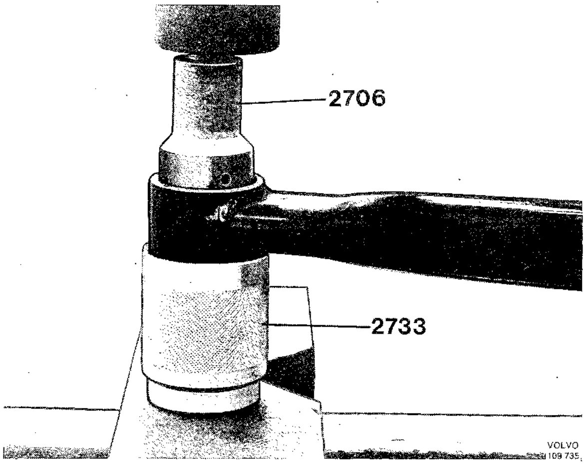


Fig. 7-25. Pressing bushing from body end

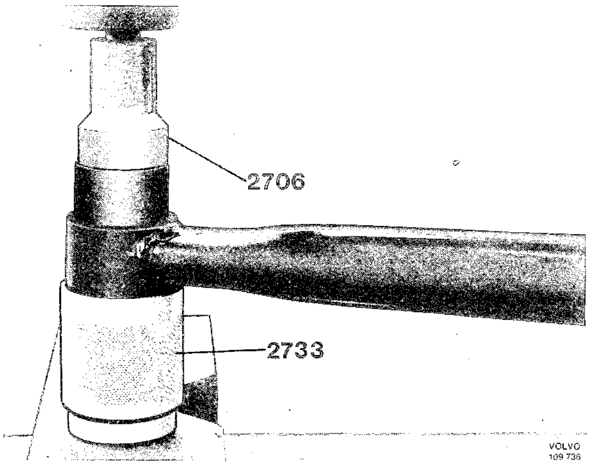


Fig. 7-26. Pressing bushing in body end

3. Remove the bushing in the end attached to the rear axle, using tools 999 2731 and 999 2733. Use the bigger end against the rod (Fig. 7-23).
4. Press in the new bushing, using the same tools, but invert 2731 (Fig. 7-24).
5. Press out the bushing on the body side with drift 999 2706 and counterhold 999 2733 turned with the narrow end facing downwards (Fig. 7-25).
6. Press in the new bushing, using the same tools (Fig. 7-26).
7. Attach the track rod to body bracket and rear axle. Restore.

WHEELS

SERVICE PROCEDURES

CHANGING WHEELS

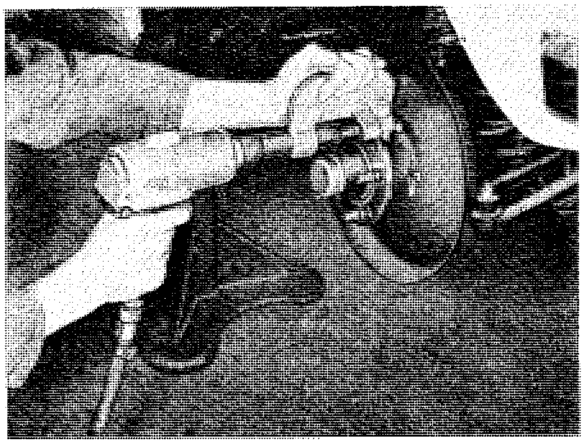
When fitting wheels, it is important that all grit and dirt and any surplus paint is cleaned off from the contact surfaces between wheel and hub.

REPLACING WHEEL STUDS

The wheel studs can be replaced without removing the front wheel hubs or drive shafts.

1. Remove the brake caliper and brake disc according to the instructions in Section 5.
2. Set up tool 2862, without the accessory components, as shown in Fig. 7-27. Run the nut runner until the stud is fully removed. If the old stud is loose in the hub, the hole must be check-measured. If the hole diameter exceeds 16.27 mm (0.64"), the hub must be replaced.
3. Insert a new, oversize wheel stud and press it in by hand as far as possible.
4. Place the accessory part, the pin, in the press tool.
5. Place the sleeve on the outer end of the wheel stud.
6. Place the tool in position (see Fig. 7-28) and use a nut runner to screw in the stud completely.

NOTE: When replacing a wheel stud, always use a new, oversize stud. The oversize stud can be fitted without previously machining the hole.

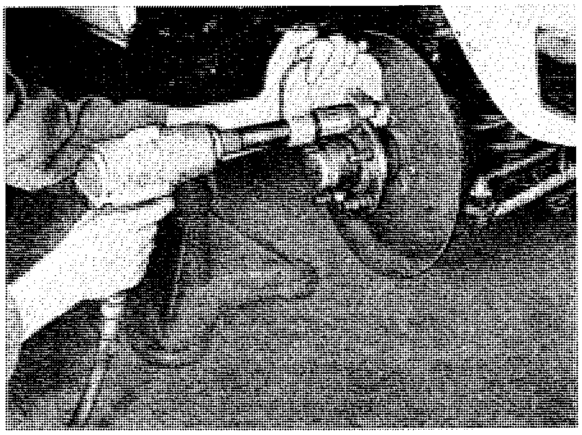


VOLVO 104306

Fig. 7-27. Removing wheel stud

REPLACING AND ADJUSTING FRONT WHEEL BEARINGS

1. Remove the hub cap and slacken the wheel nuts slightly.
2. Jack up the front end and place props under the lower control arms. Unscrew the wheel nuts and lift off the wheel.
3. Remove the front wheel brake according to the instructions given in Section 5 under "Removing front wheel brake unit".
4. Remove the grease cap with tool 2715 (Fig. 7-29). Remove the split pin and castle nut. Pull off the hub



VOLVO 104307

Fig. 7-28. Installing wheel stud

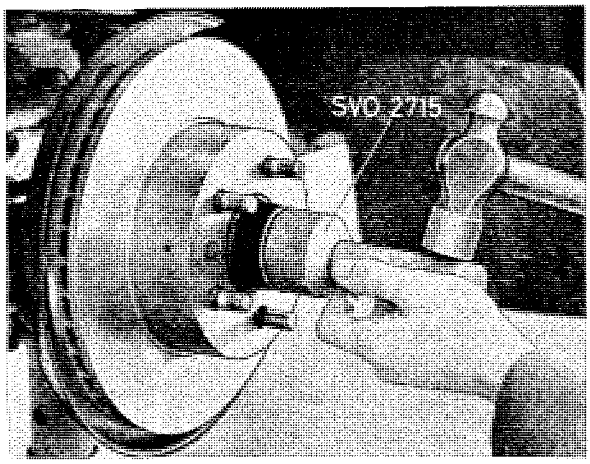


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Fig. 7-29. Removing grease cap

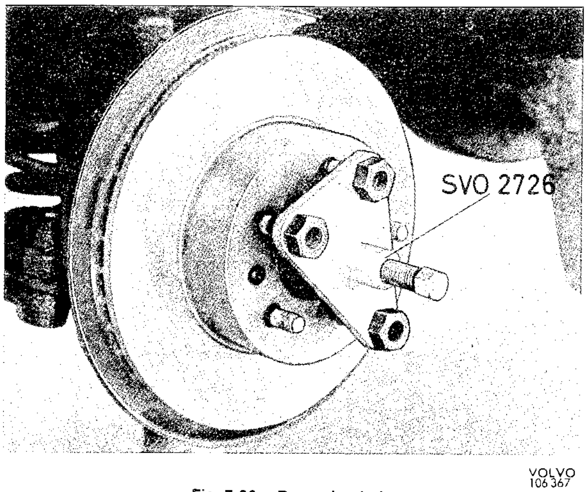


Fig. 7-30. Removing hub

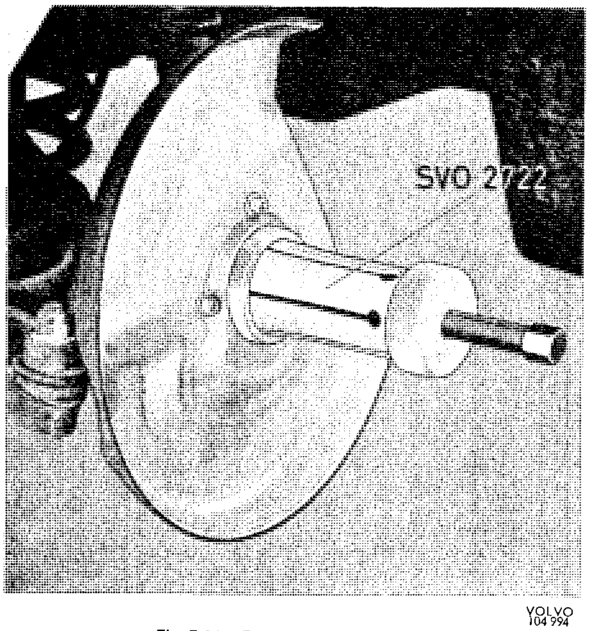


Fig. 7-31. Removing inner bearing

with puller 2726 (see Fig. 7-30). Pull off the inner bearing from the stub axle with puller 2722 (see Fig. 7-31) if the bearing remains in place.

5. Remove the bearing rings. Use driver 2724 (Fig. 7-32) for the inner bearing ring and driver 2725 (Fig. 7-33) for the outer bearing ring together with standard handle 1801.
6. Clean the hub, brake disc and grease cap.
7. Press in the new bearing rings. In addition to using standard handle 1801, use driver 5005 (Fig. 7-34) for the inner ring, and driver 2724 (Fig. 7-35) for the outer bearing ring.
8. Grease the bearing with the help of a greasegun. If there is not one available, pack the bearings by hand with as much thick grease as there is room for between the roller retainer and inner ring of the beraing. Also apply grease to the outer sides of the bearings and on the outer rings pressed into 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. 7-37.
   Use a high-class bearing grease for the bearing. Place the inner bearing in position in the hub. Press in the washer until it lies against the bearing outer ring. Use tools 1809 and 5005, see Fig. 7-36. Without the tools, however, press the rubber ring onto the steering knuckle until it bottoms.
   NOTE: It is important that the ring is fitted flat and not at an angle.
9. Place the hub on the stub axle. Fit the outer bearing, washer and castle nut.
10. The front wheel bearings are adjusted by first tightening the nut with a torque wrench to a torque of 70 Nm

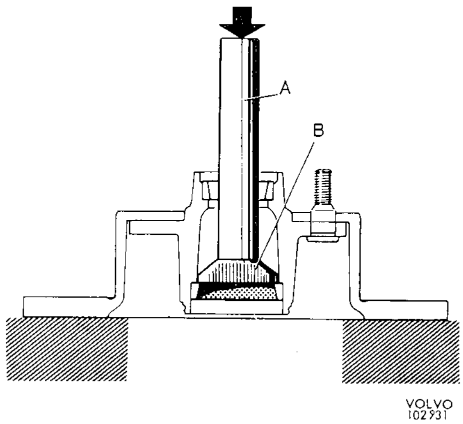


Fig. 7-32. Removing inner bearing ring
A=1801 B=2724

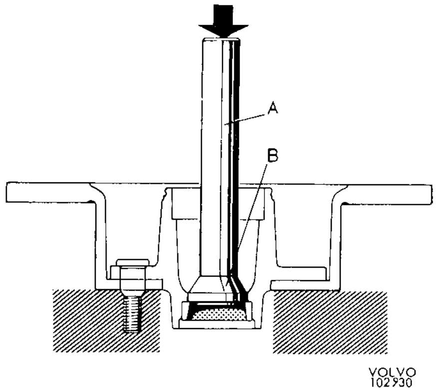


Fig. 7-33. Removing outer bearing ring
A=1801 B=2725

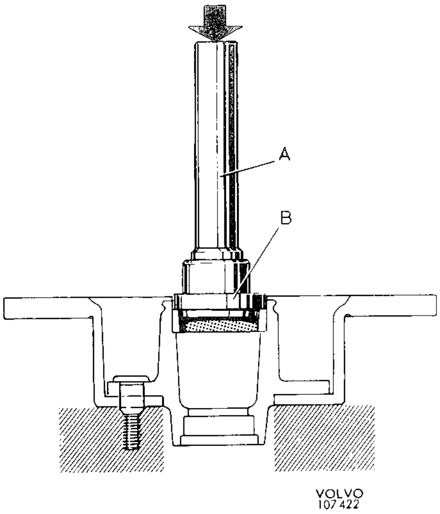


Fig. 7-34. Installing inner bearing ring
A=1801 B=5005

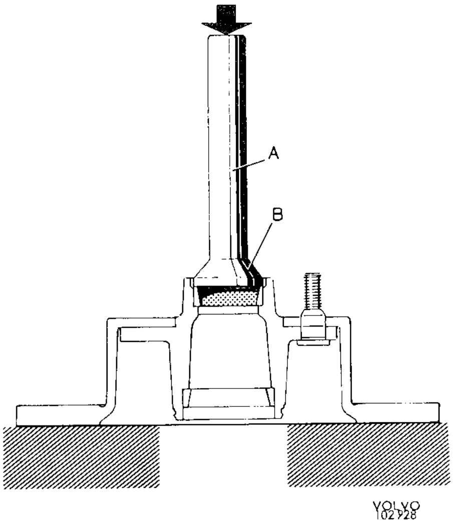


Fig. 7-35. Installing outer bearing ring
A=1801 B=2724

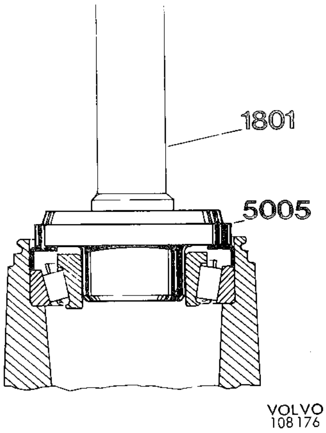


Fig. 7-36. Fitting seal

(7 kpm=50 lbft). Then slacken the nut 1/3 turn. If the slot in the nut does not coincide with the split pin hole in the stub axle, slacken it further to enable the split pin to be fitted. Check that the wheel rotates easily without any play.

11. Fill the grease cap half full of grease and fit it with tool 2715.
12. Install the front wheel brake unit according to Section 5.
13. Lift on the wheel after having cleaned any grit and dirt from the contact surfaces between the wheel and hub, and then tighten up the nuts sufficiently so that the wheel cannot be displaced on the hub. Lower the vehicle and tighten the wheel nuts firmly. Tighten every other nut a little at a time until all of them are finally tightened to a torque of 100—140 Nm (10—14 kpm=70—100 lbft). Install the hub cap.

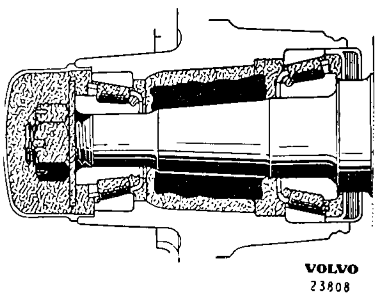


Fig. 7-37. Lubrication of front bearing

Section 8

BODY

CONTENTS

GENERAL
TOOLS

Special tools may have SVO or 999 in front of their number, e.g., SVO 2739 or 999 2739.

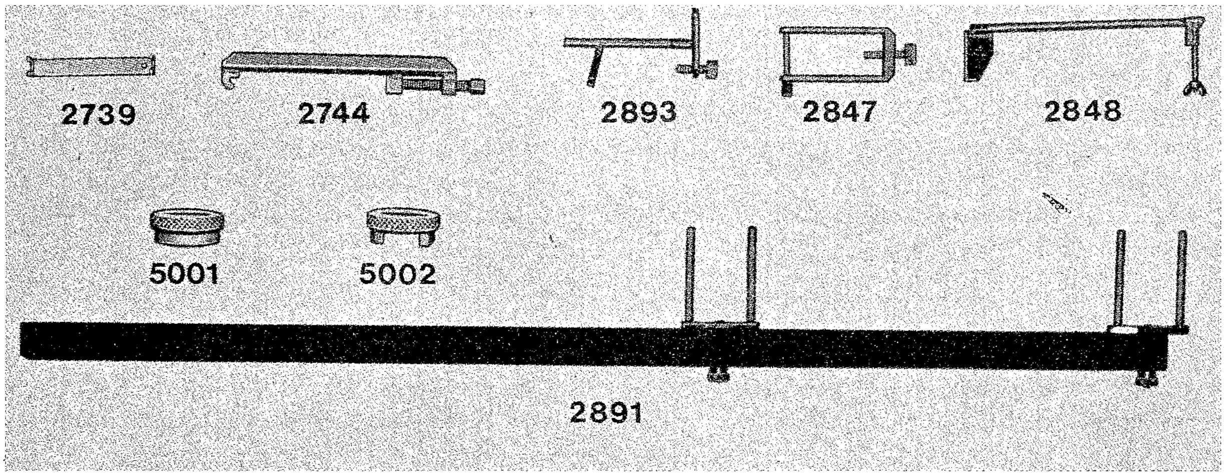


Fig. 8-1. Tools for the body

999 (SVO)

2739	Clamp for gas spring, trunk lid	2891	Straight edge for measuring height of side-member
2744	Press tool for gas spring, trunk lid	2893	Holder for fixing straight edge
2847	Holder for securing fixture 2777 (2 are used)	5001	Guide for fixture for replacing side members, left
2848	Arm for measuring height of side-member	5002	Guide for fixture for replacing side members, right

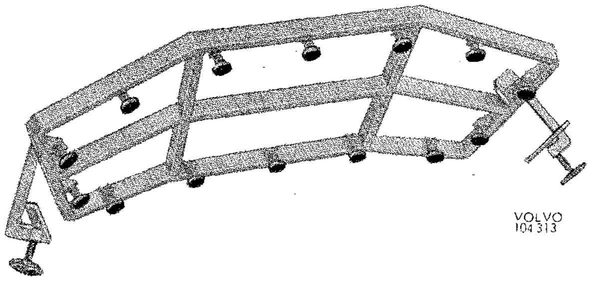


Fig. 8-3. 2899 Fixture for fitting windshield

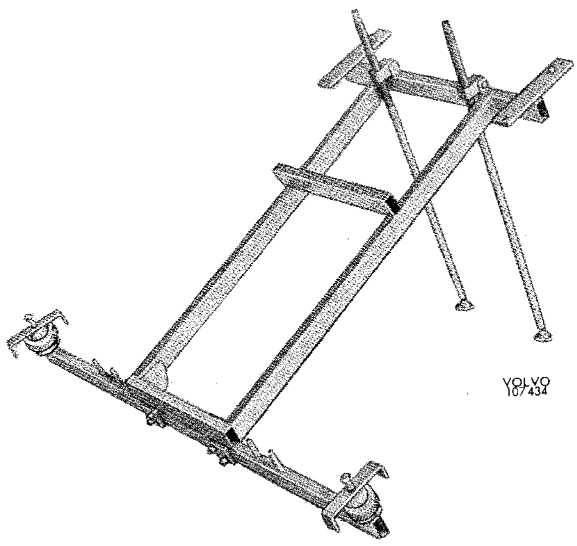


Fig. 8-2. 2777 Fixture for replacing side members

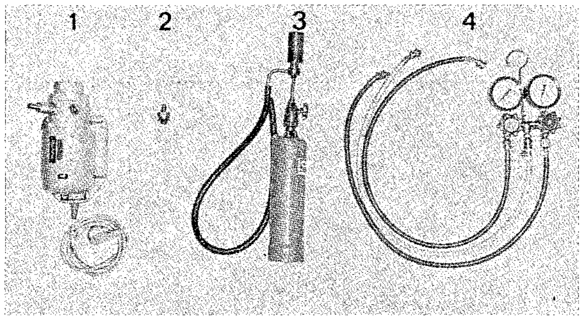


Fig. 8-4. Equipment for filling and leakage test
1. Vacuum pump
2. Nipple for vacuum pump, SK–1229
3. Leak detector with LPG-bottle
4. Pressure gauge kit with hoses

GROUP 81

BODY

GENERAL INFORMATION

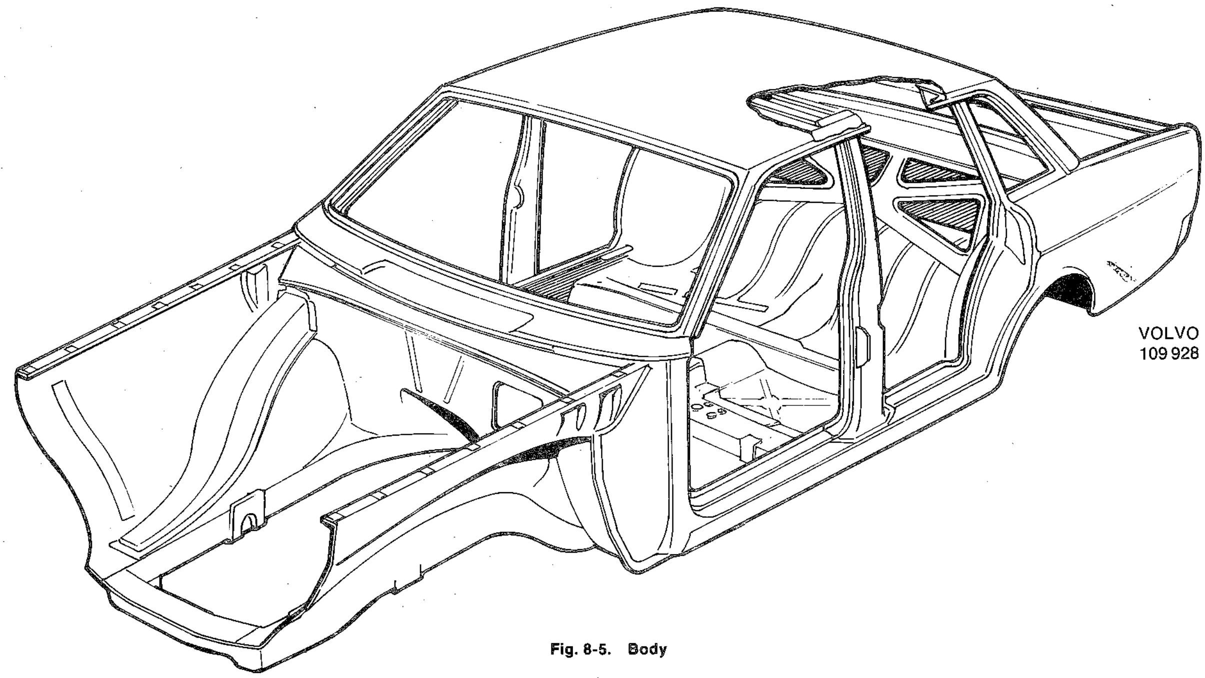


Fig. 8-5. Body

The car has an integral body so that there is no chassis frame. The body is composed of a number of pressed steel plates, each of which forms part of the supporting construction.
The body can suitably be divided up to the floor, side sections, rear section, scuttle, roof section, front mudguards, doors, trunk lid and hood.
The floor and frame section (Fig. 8-6) consists of a front and rear floor plate, inner cantrail, front and rear cross-members, tunnel and scuttle. The floor plates are welded together at the rear seat support. The tunnel, which accomodates the propeller shaft, is spot-welded to the floor plates.The rear floor plate has a longitudinal reinforcing member on each side at the bottom and between these a number of cross-members. One of the cross-members is provided with an attachment for the rear axle track bar. The scuttle (Fig. 8-6) consists of the bulkhead, wheel arches, front upper cross-member and lower cross-member. The bulkhead forms the front transverse wall of the body and has welded end pieces. Two front side members project from the front floor section. At the front they are jointed together by a cross-member and at the rear they are connected to the front cross-member under the front seats. The front axle member and bumper support bars are attached to the side members.
Heat transfer from exhaust system to body is reduced by three heat protection plates. These are fitted at the joint between firewall and front floor, above the front muffler and above the rear muffler.
The side section consists of the front pillar, intermediate pillar, rear pillar, inner and outer cantrails, roof former, windshield pillar, rear wheel arch with wheel arch member, rear mudguard, back plate and joining plate. The cowl member, inner bottom rails, end plates in the rear wheel housings are made of galvanized sheet metal.
The roof section (see Fig. 8-5) consists of a number of pressed steel plates. These roof plates form the upper part of the shuttle, the windshield opening, the roof itself, the opening for the rear window and the front limit of the trunk lid.
The body is noise- and heat-insulated. The insulation consists of self-adhesive foam rubber material.
Vehicles equipped with catalytic muffler are provided with extra heavy insulation above the catalytic muffler and the heat protection plates as the catalytic muffler system increases exhaust system temperatures.

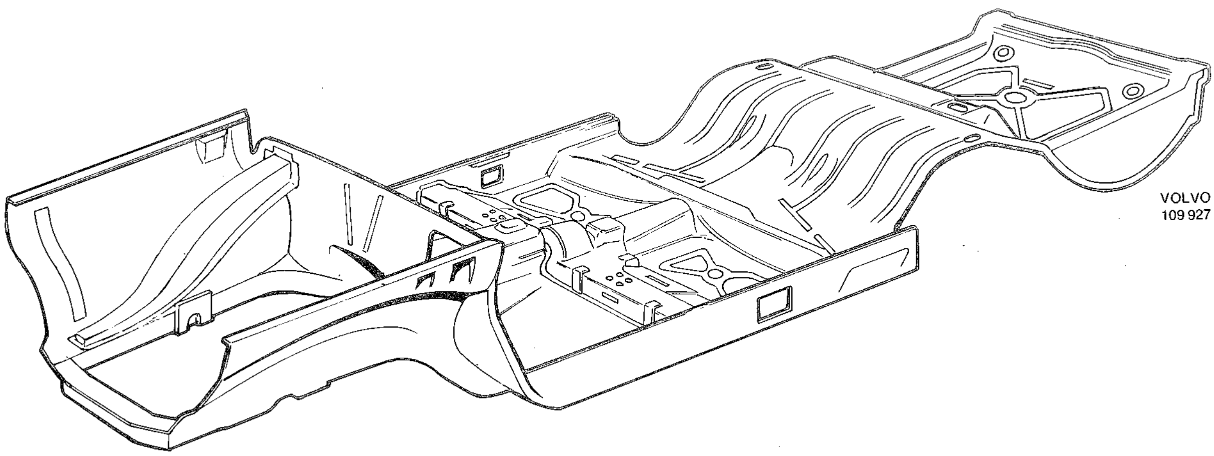


Fig. 8-6. Floor section

SERVICE PROCEDURES

Installing tool for front side members

There is a fixture with tools to ensure accurate joining or straightening of front side members. Before the fixture can be placed in position, the front end, engine and transmission must be removed.

1. Set up the fixture 2777. The rear guide pins with the guides 5001 and 5002 (8, Fig. 8-7) fit in the holes in the floor plating and are held in position by clasps (9).
2. Screw the retainer 2893 (6) on the side-member, with a bolt in the second attaching hole from the front for the rear engine mounting.
3. Place the straight edge 2891 (3) immediately under the side-member so that the front support studs (4) are immediately behind the member for the jack attachment. Rotate the support studs so that they almost support against the sides of the member and lock them in this position. Make sure that the contact points of the support pins are free from underbody sealing and that they do not come against the member flange profile. Tighten the bolt (5) in the holder 2893, so that the straight edge remains steady. Do not tighten so hard as to bend the straight edge.
4. The measuring arm 2848 (2) is secured to the side-member by studs in both the lower attaching holes for the steering gear. On the right member place the measuring arm on the outside, and on the left member on the inside.
   The distance between the measuring arm and the straight edge should be the same for both side-members within 2 mm (0.08"). The distance may not be greater than 6 mm (0.24").

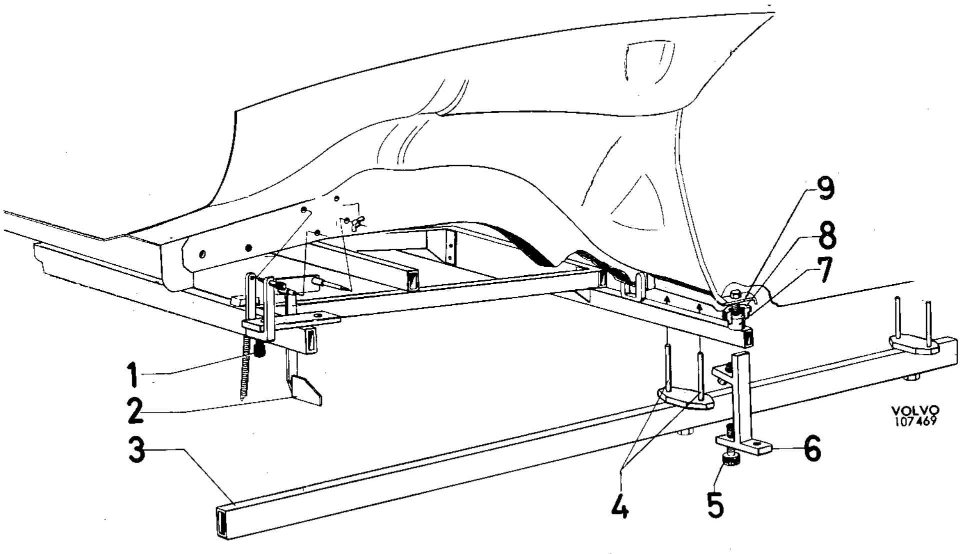


Fig. 8-7. Tool for front side-members

1. Retainers 2. Measuring arm 3. Straight edge 4. Front support studs 5. Bolt 6. Retainer 7. Rear guide pin 8. Guide 9. Clasp

HOOD AND FENDERS

GENERAL INFORMATION

The hood consists of an outer and an inner plate bonded together with adhesive. The hood is hinged at the back on two hinges. In the closed position it is secured by a lock fitted on the front section. The lever for the hood lock is operated by means of a knob handle placed underneath the dash board inside the car.

The front fenders, front section and hood make up the front end. The front fenders are pressed in one piece and bolted to the wheel arch plates. The front section forms the front part of the front end as well as the air duct to the radiator.

SERVICE PROCEDURES

FRONT FENDERS

The front fenders are removed after the plastic cover over the headlights and the headlight itself have been removed (see Section 3). This is done by unscrewing the following bolts: the bolts joining the fenders and front plate, the bolts on the wheel arch, and the bolts linking the fender rear edge and the brackets on the body. The bolts on the rear edge of the fenders are accessible when the front door is opened.

FRONT SECTION

The front section is attached to the front fenders wheel arch plates and the front cross-member.

When removing, first take off the plastic cover over the headlights and also the headlights (see Section 3) and any extra lights if fitted. Then remove the grille, the horn, the bumper and the impact absorbers. Pull out of the way all electric cables, remove the radiator, the expansion tank and any other components which are mounted on the front plate. Also remove the battery and the hose for the air cleaner. Disconnect the wire for the hood lock, the bolts between the front plate and fenders, wheel arch and front cross-member.

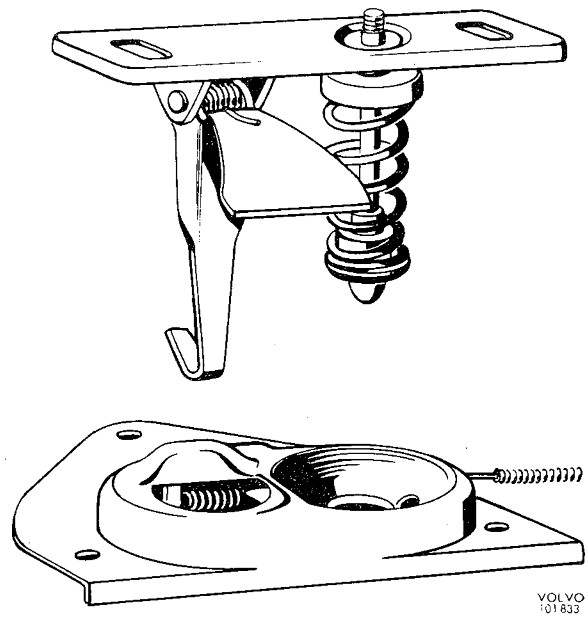


Fig. 8-8. Hood lock

HOOD AND HOOD LOCK

The hood is attached in each hinge by two bolts. It is removed by unscrewing the bolts between the hinges and hood. The hinges are attached to the body with three bolts each of which are accessible for removal under the fenders. All the holes in the hinges are oval in order to permit hood adjustment.

The hood lock (Fig. 8-8) is adjustable longitudinally since the holes in the front section are oval. The locking pin is adjustable longitudinally since the holes in the attaching plate are oval. The length of the locking pin is adjustable by means of nuts. The locking pin and spring are lubricated with grease.

The hood contact at the corners when closed can be adjusted by screwing out or in the rubber stops at the hood corners.

DOORS AND TRUNK LID

GENERAL INFORMATION

The doors are built up of an inner and an outer plate which are flanged and spot-welded together. The hinges are fitted to the inner plate. The doors are adjustable both longitudinally, vertically and laterally. The doors have bonded cord strips at the windows. The door locks are screwed to the doors.
The door handle on the outside actuates a lever which lifts the lock pin of the door lock by means of a pull rod. The door opener inside the car is fitted in the inner door plate with screws. The handle transmits the movement to a lever which lifts the locking pin by means of link rods in the lock. On the front doors the lock mechanism is fitted in a cylinder under the door handle.
The rear doors are fitted with child-safety locks. The locks consist of a latch which prevents the door from being opened from the inside when the latch is down. The door arches are of steel and are welded to the door plate. The winders consist of lifting arms with toothed segments. The window runs in sliding grooves in the inner door plate and is set to the desired positon by means of a lifting arm from the toothed segment with the assistance of a helper arm.

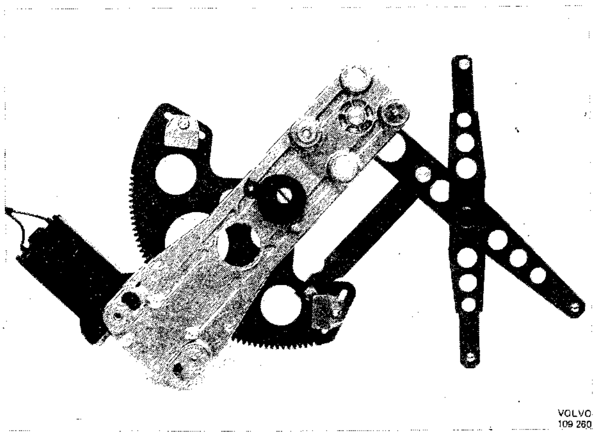


Fig. 8-9. Electrically operated window winder

The front door windows are electrically operated, Fig. 8-9. The window winders are driven by an electric motor in each of the doors and operated by switches on the control panel, Fig. 8-10. From fully closed to fully open window takes approx. 5 seconds. Fig. 8-11 shows the wiring diagram for the electircally operated window winders.

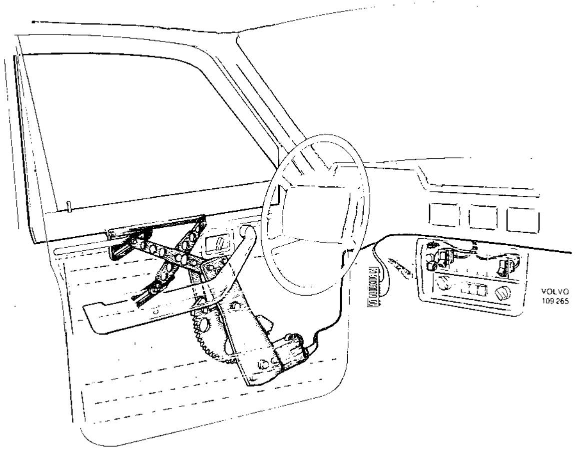


Fig. 8-10. Electrically operated window winder installed in door

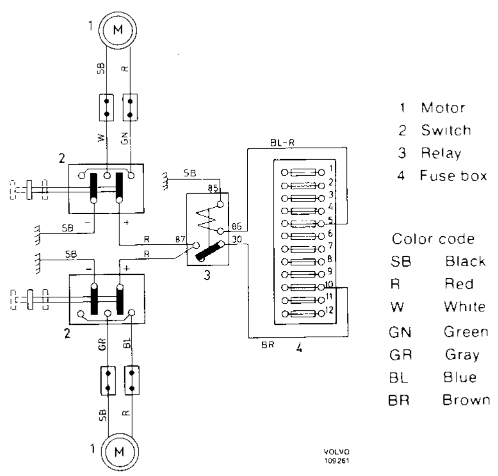


Fig. 8-11. Wiring diagram

The trunk lid is built up of an outer and inner plate bonded together with adhesive. The catch for the locking device is fitted on the rear edge of the trunk lid and the hinges are fitted on the front edge of the lid. The hinges are bolted to the body. The trunk lid is counter-balanced by means of springs and can be opened to any desired position. The locking device is fitted on the body below the lid and is of the turning type.
The 164 is also available with a sun roof. The roof is operated by means of a crank handle, which is folded in the recess in the roof upholstery between the sun visors when not in use.
Any water that penetrates the joint between the body roof and sun roof is collected in the inner roof plate and conducted away through four hoses taken through the corner posts of the roof.

DOORS

Removing and installing door stops

Remove the door panel in accordance with the instructions under "Removing door upholstery".
Then unscrew the screw between the door stop and post, and remove the rubber sealing (see Fig. 8-12). After this remove the three screws securing the door stop to the door. The door stop can now be taken out through the upper opening in the inner plate of the door.
Installing is in the reverse order.

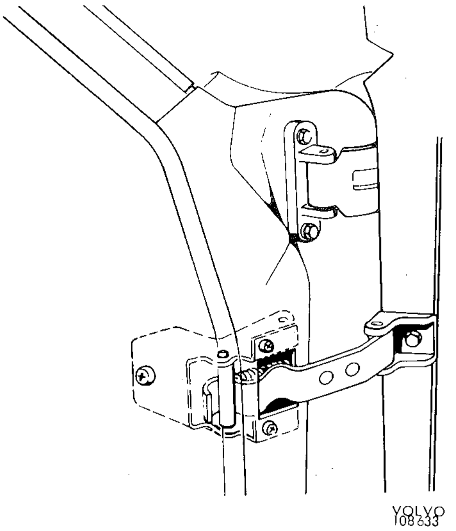


Fig. 8-12. Door stop

Removing and installing front doors

Remove door panel and waterproofing sheet.
Remove fuse box (left side) and control unit (right side). Separate the contats and pull out the cables for the winder motor through the A-pillar.
First remove the screw between the door stop and door pillar and then the bolts between the hinges and door. The bolts are accessible when the door is opened. The door can then be taken off (Fig. 8-13).
The hinges are fixed to the door pillar with three screws, these are accessible from inside the A-pillar.
The door and hinges are installed in reverse order.
Since the holes in the hinges and in the attachment between the door and hinges are oval, the door can be adjusted laterally. The door can be adjusted vertically and sideways in the attachment between the hinges and door post. This is possible since the holes in the door post are larger than the diameter of the bolts.

Removing and installing rear doors

See the corresponding section above.

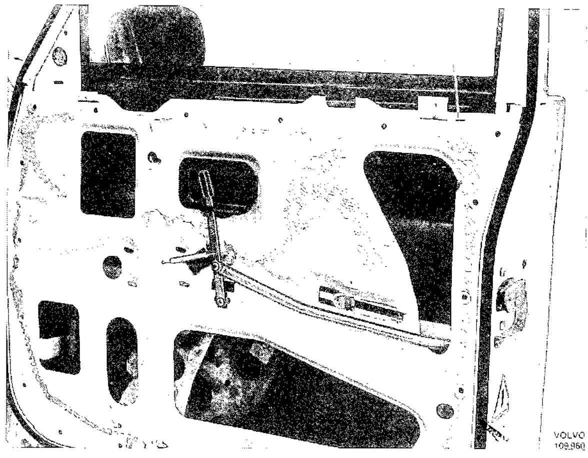


Fig. 8-13. Front door

Removing door upholstery

1. Remove the armrest in the front door by taking out the two plastic plugs with a narrow screwdriver and removing the attaching screws located on the inside. Then turn the plastic ring at the front edge of the armrest several turns to the left, push the armrest forwards and the hook at the front edge disengages leaving the armrest to be removed.
   The armrest in the rear door is removed by undoing the attaching screws.
2. (Only rear doors.) Insert a finger behind the window crank and push the button retaining the cover washer. Prise loose the cover with, for example, a screwdriver. Unscrew the slotted screw and remove the crank.

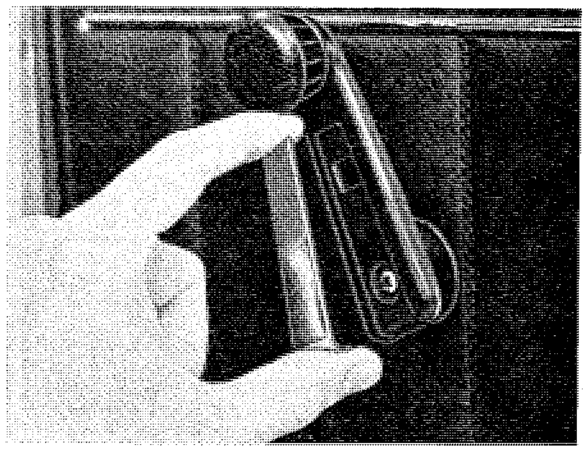


Fig. 8-14. Rear door window crank

3. Unscrew and remove the lock button and the screws at the top edge of the upholstery. Remove the door upholstery by inserting a screwdriver or similar under the upholstery edge and carefully levering outwards so that the upholstery comes away.

Latch plates

The latch plate is made of steel and is fitted with a floating nut plate. The latch plate is adjustable since the holes in the body are larger than the diameter of the attaching screw.

The vertical position of the latch plate is controlled by closing the door with the outside door handle pulled out, when the door latch should slide correctly into the latch plate. The latch plate should have an inward inclination of 1.5° for the front doors and 2.5° for the rear doors, see Fig. 8-15.

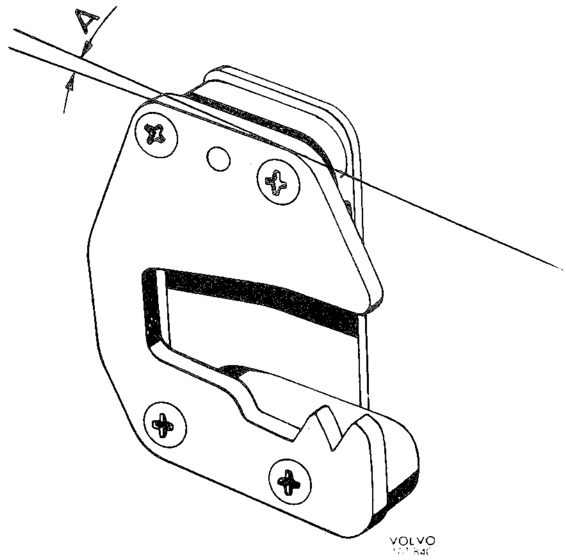


Fig. 8-15. Latch plate
A. Front door 1.5°
Rear door 2.5°

Removing front door lock

1. Carry out operations 1 and 3 under "Removing door upholstery".
2. Remove the lock cylinder by unscrewing the attaching screw which is fitted in the rear edge of the door (Fig. 8-13).
3. Remove the locking for the pull rod locking knob and take out the pull rod.
4. Remove the locking for the inner door opener push rod.
5. Remove the locking for the outer handle pull rod.
6. Unscrew the three screws for the door lock and remove the door lock. These screws are placed on the rear edge of the door (Fig. 8-13).

Removing outer handle, front doors

1. Run up the window to closed position.
2. Remove inner door handle and upholstery according to previous instructions.
3. Run down the window to get at the two retaining screws (7, Fig. 8-16). Remove the screws.
4. Unhook the return spring (8, Fig. 8-16) and lift out the handle and cover as one unit.

Installing outer handle, front doors

1. Place the handle in position in the door and move the pull rod (9, Fig. 8-16) in the lifting arm for the handle.
2. Screw in both the attaching screws (7, Fig. 8-16).
3. Check to make sure the lock functions properly. If necessary, adjust the length on the pull rod (9, Fig. 8-16).
4. Install the return spring (8, Fig. 8-16).
5. Put back the door upholstery and install the inner handle.

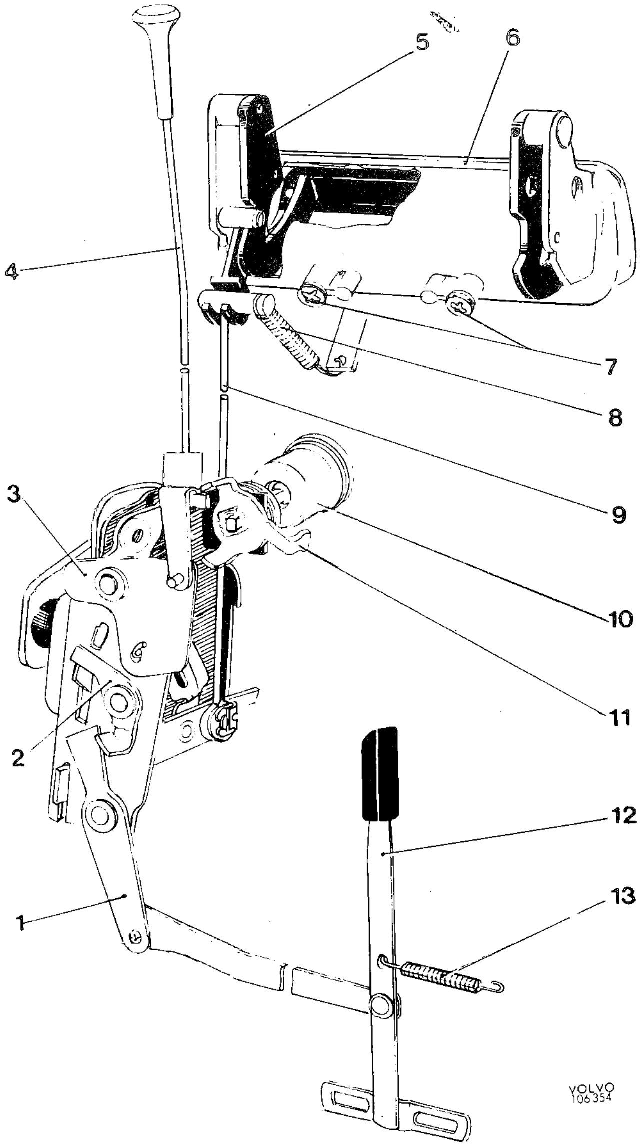


Fig. 8-16. Lock, front door

1. Lever
2. Lever
3. Lever
4. Pull rod for lock button
5. Outer handle
6. Cover for outer handle
7. Screws for outer handle cover
8. Return spring for outer handle
9. Pull rod for outer handle
10. Lock cylinder
11. Lock device
12. Inner door opener
13. Return spring for inner door opener

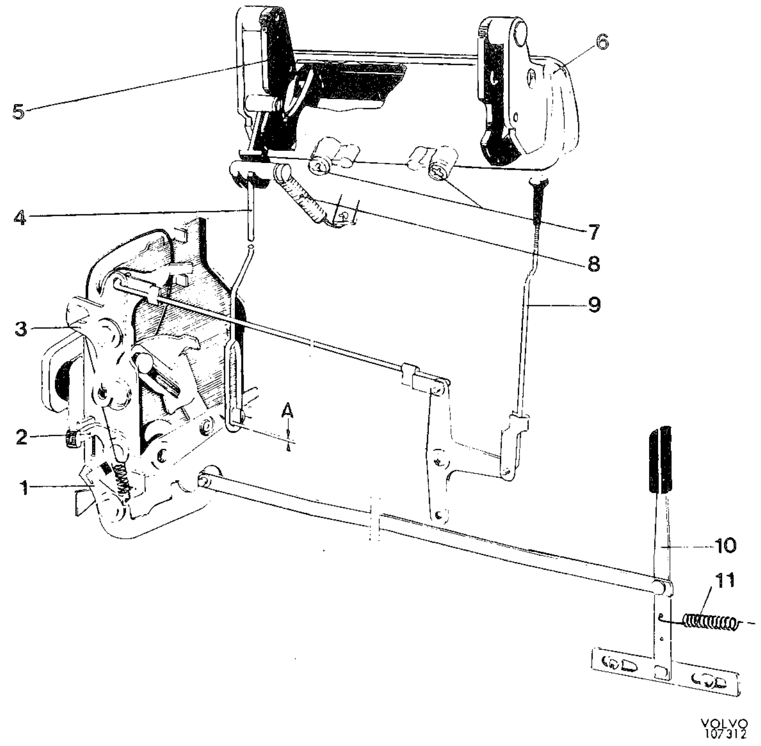


Fig. 8-17. Lock, rear doors
1. Lever for remote control
2. Lever for child safety door lock
3. Lever
4. Pull rod for outer handle
5. Outer handle
6. Cover for outer handle
7. Screws for outer handle cover
8. Return spring for outer handle
9. Pull rod for lock button
10. Inner door opener
11. Return spring for inner door opener

Removing rear door lock

1. Carry out operations 1–3 under "Removing door upholstery".
2. Remove the locking for the pull rod locking knob.
3. Remove the locking for the inner door opener push rod.
4. Remove the locking for the outer handle pull rod.
5. Unscrew the retaining screw for the window winder rear guide rail and the retaining screws for the door lock and remove the lock from the door. The retaining screws for the lock and guide rail are placed on the rear edge of the door.

Removing outer handle, rear doors

1. Run up the window to closed position.
2. Remove the inner handle and upholstery according to the previous instructions.
3. Unhook the return spring (8, Fig. 8-17).
4. Undo the screws (7, Fig. 8-17) and lift out the handle and cover as one unit.

Installing outer handle, rear doors

1. Place the handle in position in the door and move the pull rod (4, Fig. 8-17) in the lifting arm for the handle.
2. Screw in the retaining screws (7, Fig. 8-17).
3. Check to make sure that there is a clearance (A, Fig. 8-17) of 1 ± 1 mm (0.04 ± 0.04") between the pull rod eyelet and pin in the lock lever.
4. Install the return spring (8, Fig. 8-17) and check that the lock functions properly.
5. Restore the door upholstery and install the inner handle.

Removing front door window

1. Run down the window to its bottom position.
2. Remove the armrest and door panel. Remove the large waterproof sheet.
3. Remove the lock springs and washers on the inside of the regulator arms. Bend the regulator arms outwards and separate them from the window channel.
4. Remove the window by lifting and turning towards the vehicle as shown in Fig. 8-18.

Fig. 8-18. Removing door window

Installing front door window

1. Install the window in the window channel according to Fig. 8-19.

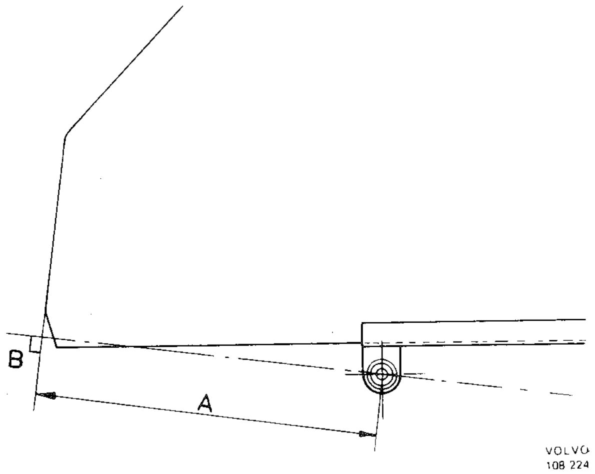


Fig. 8-19. Window dimensions, front door
A=264±2 mm (10.275–10.433") B=89°±1

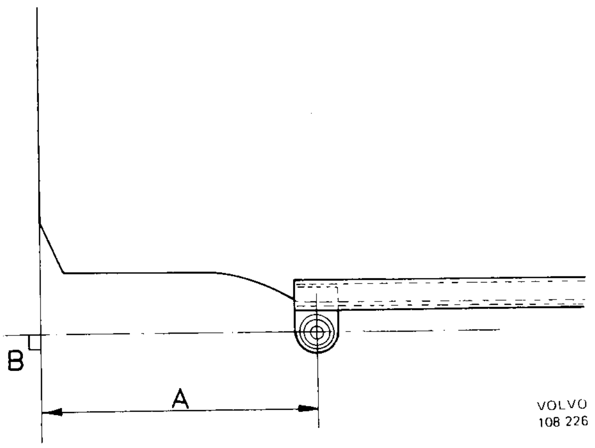


Fig. 8-20. Window dimensions, rear door
A=169±2 mm (6.654–6.732") B=90°±1°

2. Lower the window with the shorter end first and turn it at the same time as shown in Fig. 8-21.

Fig. 8-21. Installing door window

3. Make sure that the window is aligned in the window rails.
4. Fit the regulator arms in the window channel and install the washers and lock springs.
5. Install the waterproof sheet.
6. Install the door panel and the arm rest.

Removing and installing rear door window

See the corresponding section above.
Remove the winder by bending loose the cover washer and then remove the attaching screw.

Adjusting stop positions, front window winders

1. Remove door panel and the waterproofing sheet.
2. Run up the window to the stop and release the stop lug, using a 5 mm setscrew wrench, Fig. 8-22. Run up the window as far as it can go. Adjust the stop lug against the tooth segment and tighten up the lock bolt.

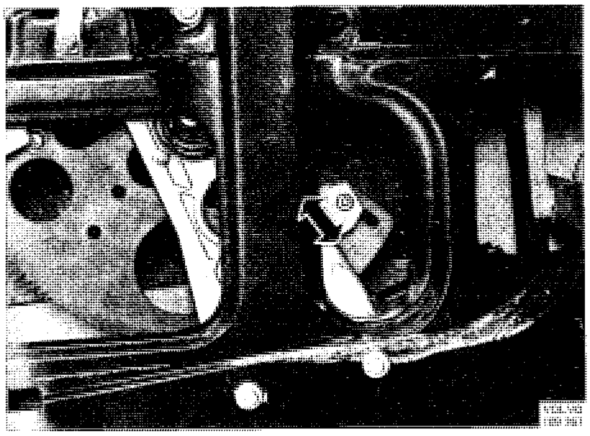


Fig. 8-22. Stop lug, upper position

3. Run down the window to the stop position. Check that the lifting arm does not bottom in the slide fork. Adjust if necessary the stop lug so that there is a clearance of approx. 1/32" (1 mm), Fig. 8-23.

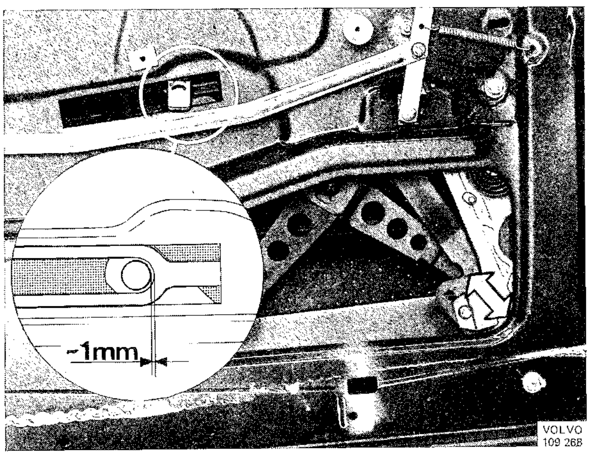


Fig. 8-23. Adjusting lower stop position

4. Restore door panel and waterproofing sheet.

Replacing window winder or motor, front doors

Figures in brackets apply to replacement of winder.

1. Remove door panel and waterproofing sheet.
2. Run down the window to the stop position.
3. Release the lifting arms from the window rail by pushing loose the safety brackets and remove the washers. Then lever the arms towards you.
4. Remove the window by lifting and turning it towards the vehicle at the same time. See Fig. 8-18.
5. Disconnect the battery ground cable.
6. Remove the under-dash panel and the side panel (at the front door pillar).
7. Remove the fuse box and disconnect the contacts, see Fig. 8-24.

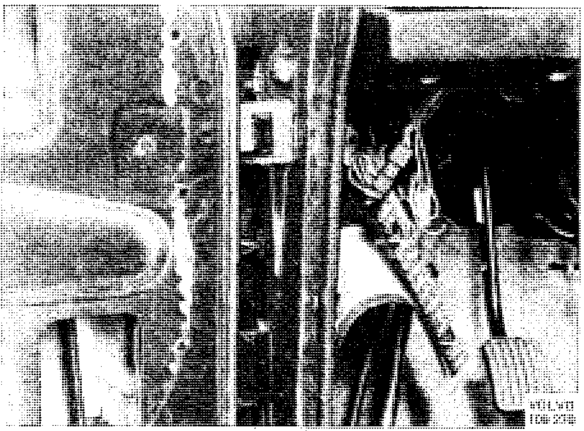


Fig. 8-24. Removing fuse box

9. Release the lifting arm from the side rail in the door. Remove the window retaining screws and take the winder out of the door.
10. Secure the window winder in a vise, Fig. 8-25, and remove the motor from the winder.

Fig. 8-25. Fixing window winder vise

(11.) Remove the window winder from the vise. **NOTE:** Take care not to jam your fingers when releasing the vise since the window winder is spring-loaded.

(12.) Tension the spring on the new window winder to the bottom, Fig. 8-26, and place the winder in the vise.

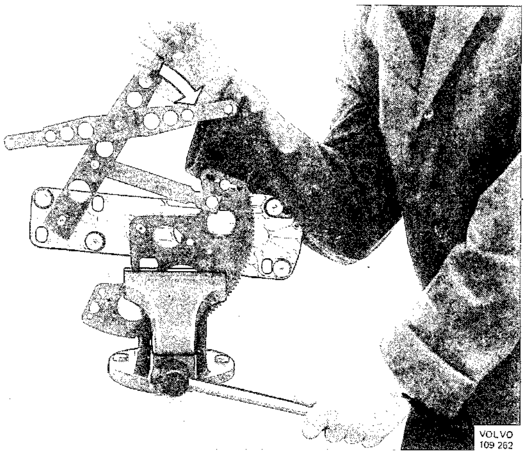


Fig. 8-26. Tensioning window winder spring

13. Mount the motor on the winder. Remove the winder from the vise.
14. Position winder and motor in the door.
15. Run the wires through door and door pillar.
16. Fit the lifting arm with washer and safety bracket in the door slide rail.
17. Lift the window into the door with the pointed part first and then turn it slightly away from the car, as shown in Fig. 8-21.
    Make sure that the window enters the slot in the guide rails.
18. Fit the lifting arms for the window rail together with plastic washers and safety brackets.
19. Reconnect contacts and install fuse box.
20. Install side panel and under-dash panel.
21. Connect the battery ground cable.
22. Adjust window winder stop positions, as described under "Adjusting stop positions".
23. Fit waterproofing sheet and door panel.

Removing rear door window crank mechanism

1. Crank down the window to its bottom position.
2. Remove the door panel and the water protection sheet.
3. Remove the lock springs and the washers on the inside of the crank arms. Bend the arms outwards and remove them from the window channel. **NOTE:** Be careful not to let the window drop down inside the door. Even if the window is only carelessly placed in the bottom inside the door, this can damage the outer plate.
4. Remove the clip at one of the crank arm's retaining points in the door.
5. Remove the door window crank mechanism retaining screws.
6. Remove the crank mechanism.

TRUNK LID

The trunk lid is mounted on two hinges, which are attached by means of two bolts to the inner plate of the lid and with three bolts to the pillar under the rear window.

The trunk lid is counter-balanced by means of spring supports.

The trunk lid is removed by unscrewing the two bolts on each hinge and lifting it off.

When replacing a spring support, the lid is first opened fully. It is then lowered slightly and clamp 2739 applied and the lid opened fully again, after which the spring support can be removed. When fitting a new spring support press tool 2744 is used as shown in Fig. 8-27 in order to enable clamp 2739 to be fitted. Installing is done in the reverse order.

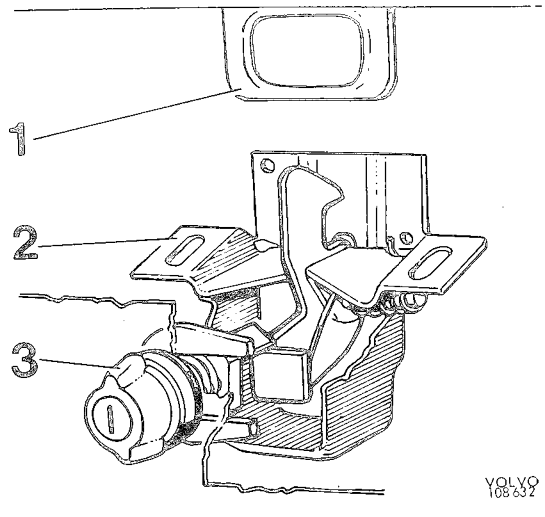


Fig. 8-28. Lock for trunk lid

1. Lock catch, fitted in lid
2. Lock mechanism, fitted in rear section
3. Lock knob, fitted in rear section

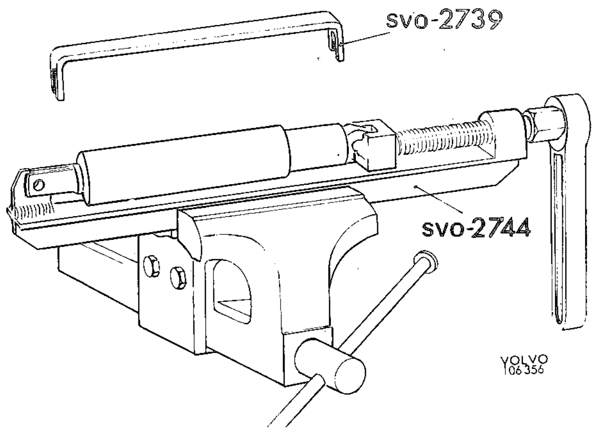


Fig. 8-27. Tools for spring support

When removing the hinges, first remove the spring supports as described above. The lid is then removed from the hinges and the hinges from the body.

The holes in the part of the hinges which fit on the trunk lid are oval in order to permit longitudinal adjustment. For vertical adjustment the holes in the part of the hinges which fit in the body are oval.

The locking device (Fig. 8-28) is fitted in the rear section and is released by turning the lock knob. The lock catch on the lower edge of the lid is adjustable in order to permit variation of the closing tension of the lid.

The lock bolt is removed by releasing the horseshoe clamp. Remove the clamp with polygrip pliers. The lock knob can then be pulled out backwards.

To remove the lock, first remove the lock knob and then unscrew the two bolts under the upper edge of the rear section, after which the lock can be taken off. The lock is adjustable longitudinally since the bolt holes are oval.

SUN ROOF

Removing cable

1. Open the sun roof and release the clips securing the roof upholstery at the front end. Then move the upholstery back to leave an opening.
2. Crank the sun roof forwards and slacken the screws at its four attachments (9 and 11, Fig. 8-29). Bend the blade springs (10) to the one side and remove the reinforcing plates (13) at the rear attachments. Lift off the sun roof.
3. Remove the wind deflector (2).
4. Remove the intermediate pieces (8), covering strip (3) and holders above the drive. Release the front guide rails (6) and pull out the cables (5).

Installing cables

1. Install the cables so that the attachments for the sun roof come opposite each other, and at the rear end of the roof opening. Screw on securely the front guide rails.
2. Install the intermediate pieces, holders and covering plate.
3. Install the wind deflector.
4. Screw on the roof securely and put back the leaf springs.
5. Crank the sun roof forwards until it is completely closed and check that it is level with the roof. To adjust vertically, use the front attachments (9) and the lifts at the rear attachments (11). Also check that both the lifts stand straight up when the roof is closed.
6. Unscrew the crank and crank gear housing (4). Turn the crank to the stop position on the removed gear housing.
7. Install the crank gear housing and crank. The crank should now point straight forwards in the vehicle when the sun roof is completely closed.
8. Put back the upholstery and test the function of the sun roof.

Replacing sealing strips

The sun roof must be removed in order to replace the insulating strip and sealing strip there. See points 1 and 2 under "Removing cable".

When replacing the insulating strip round the roof opening of the sun roof, all that is required is to crank the roof back to its rearmost position.

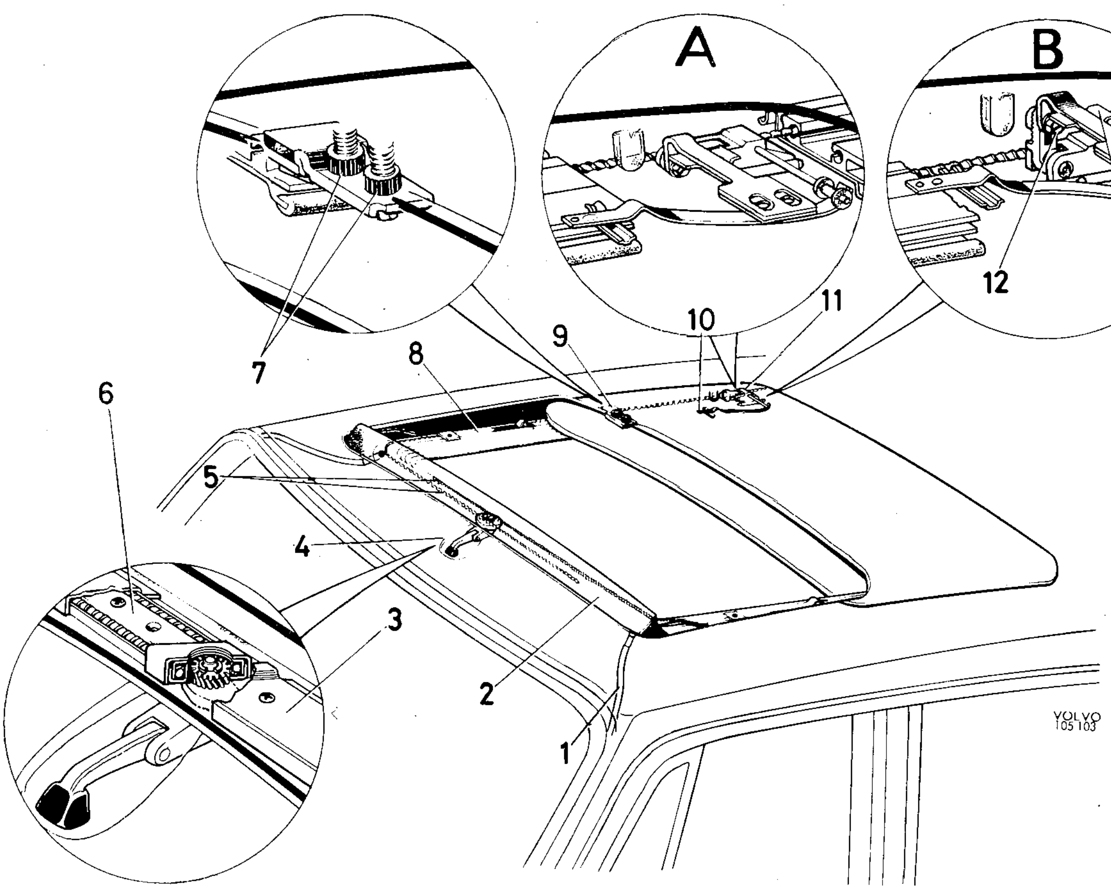


Fig. 8-29. Sun roof

A. Rear attachment when roof is open
B. Rear attachment when roof is closed

1. Drain hose
2. Wind deflector
3. Covering strip
4. Crank gear with crank
5. Cables
6. Front guide rail
7. Front adjustment
8. Intermediate piece
9. Front attachment
10. Blade spring
11. Rear attachment
12. Rear adjustment
13. Reinforcing plate

SEALING STRIPS, TRIM MOULDINGS AND GLASS
SERVICE PROCEDURES

SEALING STRIPS

The sealing strips are secured by means of spotwelded fastening rails.

A sealing strip is removed by pulling it outwards, when the ridge of the strip releases from the rail. When installing the sealing strip, one of the ridges is placed in position in the rail, the other ridge is then pressed down into the rail with the help of a wooden putty knife. This is moved along the rail as shown in Fig. 8-30.

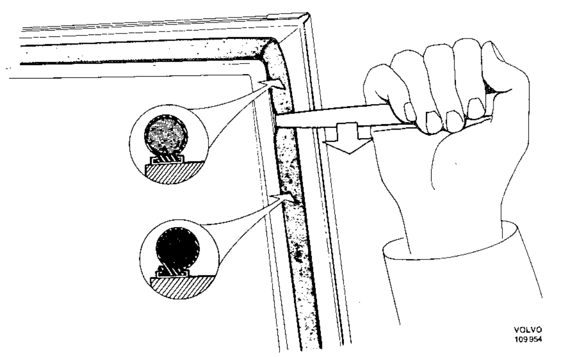


Fig. 8-30. Fitting sealing strip

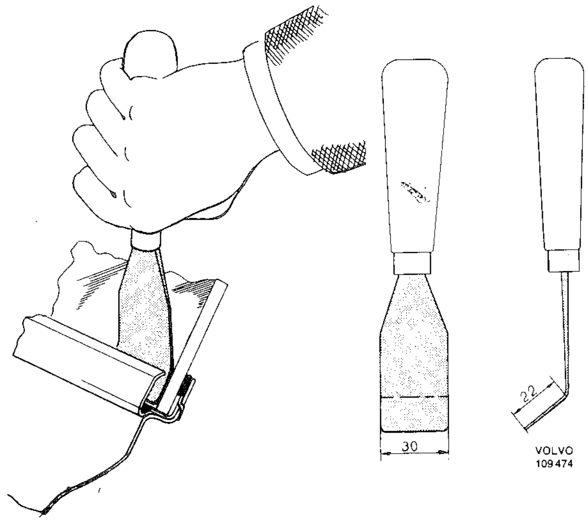


Fig. 8-31. Removing trim moulding

TRIM MOULDINGS
Waist mouldings

The waist mouldings are attached with plastic clips. The mouldings are removed with the help of a wooden putty knife with which they are carefully levered off. The clips can be removed by carefully pulling them off with pliers. When installing, begin by placing in the clips and locking them by pressing in the stud in the middle. The moulding is then pressed onto the clips.

Removing windshield moulding

The windshield moulding is fixed by means of clips pressed into the slits in the windshield opening in the body.

The moulding can, for example, be suitably removed with a steel putty knife, see Fig. 8-31. Insert the knife between the windshield and moulding opposite a clip, see Fig. 8-31. Then lever the moulding loose.

Installing windshield moulding

Install the windshield moulding by pressing it in between the body frame and the clips. To ensure that the moulding coincides with the corner joints, fitting should be done in the following order. First, install the lower moulding with a corner joint on. Then install a side moulding also with a corner on. Finally, install the remaining moulding together with corners on to the body frame.

Removing trim moulding for rear window

1. Remove the moulding from the rubber strip by inserting a moistened nylon putty knife and moving it all round between the strips (do not pull off the trim moulding).
2. Push over the joining pieces to one of the halves of the moulding.
3. Remove the trim moulding by levering out the ridge of the rubber strip from the trim moulding with a moistened wooden putty knife and releasing the trim moulding in the middle with another putty knife as shown in Fig. 8-32. Lever off the moulding carefully while releasing the rubber strip with the other putty knife.

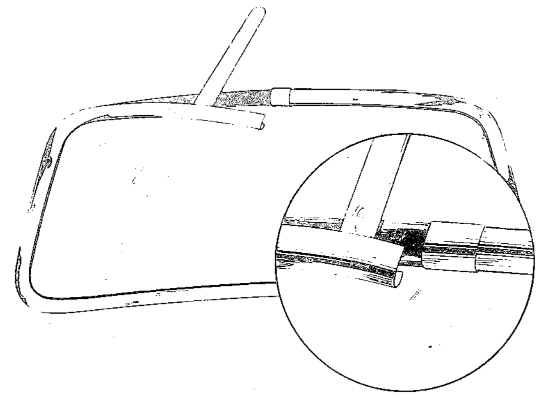


Fig. 8-32. Removing trim moulding VOLVO 24814

Installing trim moulding for rear window

Moisten a 4.0 mm ($^5/_{32}$") leather cord in soap solution or paraffin and place it in the groove of the rubber strip for the trim moulding.

Place one half of the trim moulding in position and hold it there while pulling the leather cord out upwards over the moulding so that it is pressed against the rubber strip as shown in Fig. 8-33. Push over the joining pieces and repeat the procedure with the other half of the moulding. Adjust the position of the joining pieces over the joints.

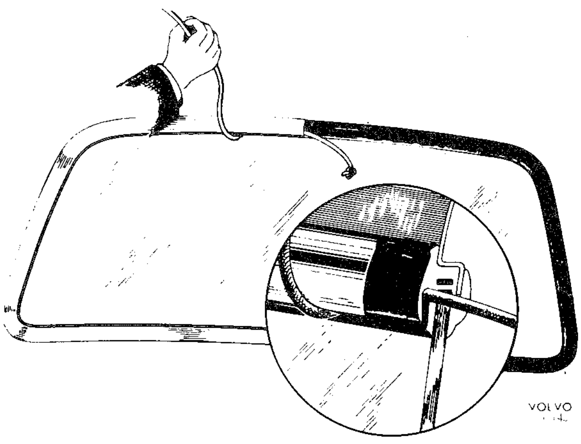


Fig. 8-33. Installing trim moulding

WINDSHIELD

Removing windshield

1. Place protective covering over the hood and front seats.
2. Remove the windshield wiper arms.
3. Remove the external trim moulding. See "Removing windshield moulding".
4. Remove the inner covering strips and rearview mirror.
5. Cut the windshield loose with a warm soldering iron, see Fig. 8-34.
   Insert the point of the iron in between the windshield and the body, from the inside of the vehicle, see Fig. 8-34. Then draw the soldering iron all round the windshield. The windshield can now be pressed out by hand. Cut off any remaining strands with a knife.

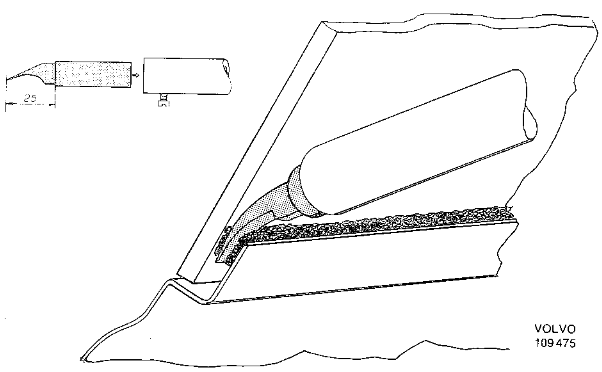


Fig. 8-34. Removing windshield
The soldering iron should be on 200 W and its body diameter should not exceed 30 mm (1.18").
The tip should be made acc. to the Figure. The tip may not be so thick that it can come in contact with the glass.

6. Clean the body (also the windshield if it is to be refitted) of any tape.
7. Remove any defective clips.

Installing windshield

1. Inject sealing agent into the holes where the new clips are to be fitted. Use pump No. 210163.
2. Install new clips.
3. Clean well the surfaces where the tape is to lie on the body and windshield. Use ethyl or methyl acetate for the cleaning. Be careful not to touch the cleaned surfaces.
4. Coat the clips with sealing agent No. 686275 so that the agent forms a smooth bridge between the clips and body for the butyl tape to seal against.
5. Coat adhesive on the cleaned surfaces on the body and windshield. Coat an edge between 18 and 21 mm ($^3/_4$ and $^7/_8$") in width round the windshield, measured from its outer edge. Apply the adhesive twice to ensure total coverage. Any adhesive spill on the body or glass surfaces can be removed with methyl acetate. The adhesive can be applied within 5 minutes after the cleaning.
6. Install both the spacers on the lower edge of the windshield opening. They should lie between the 2nd and 3rd clip from each windshield post.
7. Install the butyl tape on the body not less than 10 minutes and not more than 1 hour after the adhesive has been applied. Roll the tape round the whole of the windshield opening with the protective paper on. The joint should be opposite one of the side posts and the joint ends should be cut at an angle.
   The tape is best cut with a heated knife.
   Place the tape edge to edge with the spot-welded flange. The tape profile may not be altered by stretching. The protective paper is removed immediately before the windshield is installed. Be careful not to dirty or touch the adhesive surface of the tape.

8. Use a glass lifter for fitting the windshield. Two men are required to fit the windshield. It must be carefully fitted in the opening before being placed against the tape. Once the windshield has been placed in position, then adjusting possibilities are very small. The windshield must not lie against any clip.
9. Install the fixture 2899 and press the windshield firmly in position. When the outer plane of the windshield lies 1±1.5 mm (0.04±0.06") from the outer edge of the body, then the windshield is in the correct position. Let the fixture remain about 45 seconds.
10. If the butyl tape is squeezed outside the edge of the windshield on its inside, cut it off with a warm knife. **Note:** If any part of the painted edge on which the butyl tape is fitted is seen through the windshield from the outside of the vehicle, apply sealing agent 686275 to these points. This is only required for light-coloured vehicles.
11. Install the outer trim moulding, see "Installing windshield moulding".
12. Install the inner cover strips and rearview mirror.
13. Install the windshield wiper arms.

REAR WINDOW

Removing rear window

1. Remove the trim mouldings as described in operations 1–3 under "Removing rear window moulding".
2. Remove the cables for the electrically heated rear window.
3. Release the rubber strip both from the rear window and sheet metal by inserting a wooden putty knife moistened in synthetic washing solution (the putty knife should be moistened now and then during the course of the work) between the rubber strip and rear window and between the rubber strip and sheet metal respectively and moving it all round.
4. Start removing the rubber strip in the upper left hand corner by levering the rubber strip over the edge of the sheet metal from inside and at the same time carefully pulling out the strip from outside with a pair of wide-nosed grips. Then carefully pull off the strip by hand all round and remove the rear window.
   Remove all sealing compound from the sheet metal. If it has dried on, first carefully scrape off the sealing compund and then wash clean with naphtha. Check that the sheet metal edge is not deformed. If the sealing compund has not dried on, clean the rubber strip with naphtha, otherwise replace it.

Installing rear window

1. Moisten the outer edge of the windshield and fit the rubber strip starting at one of the corners. Adjust the strip so that it lies correctly all round.
2. Install a cord (preferably of terylene) of a suitable size in the groove of the rubber strip or the sheet metal edge, beginning at the top center as shown in Fig. 8-35.

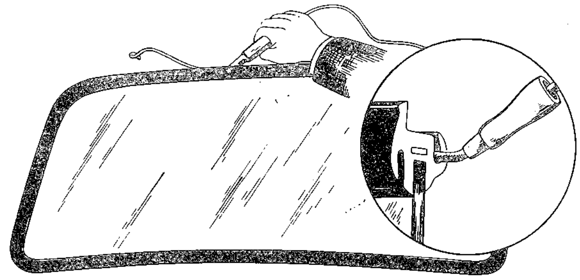


Fig. 8-35. Placing cord in rubber strip VOLVO 24817

3. Place the rear window in position with the rubber strip fitted. Wearing working gloves, carefully strike the rear window a few blows with the **palm of the hand** so that it makes good contact all round. Then carefully pull out the cord from inside. This will cause the rubber strip to "creep" over the sheet metal edge as shown in Fig. 8-36. It may sometimes be necessary to adjust the position of the rear window with the palm of the hand. If the cord is difficult to pull out, this may damage the strip, in which case the rear window should be struck from inside or outside with the palm of the hand if the rubber strip does not "creep" over the edge of the sheet metal properly.

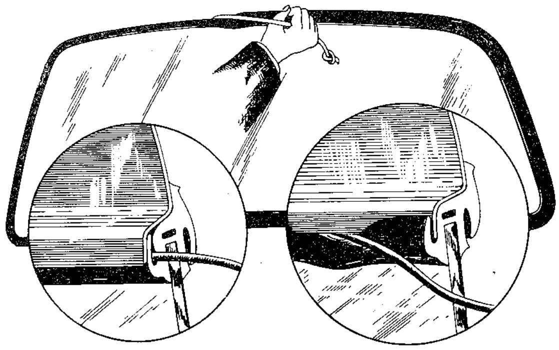


Fig. 8-36. Fitting rear window VOLVO 24822

4. Check that the rubber strip seals well all round. If necessary adjust the position of the rear window both vertically and laterally **by striking with the palm of the hand.**
5. Seal the joints between the rubber strip and rear window and rubber strip and sheet metal with sealing compound using a gun with a flat nylon nozzle. Make sure that the sealing compund fills the joint well. Scrape off surplus sealing compund and wash the rear window and sheet metal with naphtha. Clean the rear window and sheet metal around it with polish.
6. Install the trim mouldings as previously described.
7. Install the cables for the electrically heated rear window.

REAR QUARTER WINDOWS

See the corresponding section under rear window.

UPHOLSTERY, INTERIOR AND CLIMATE CONTROL
GENERAL INFORMATION

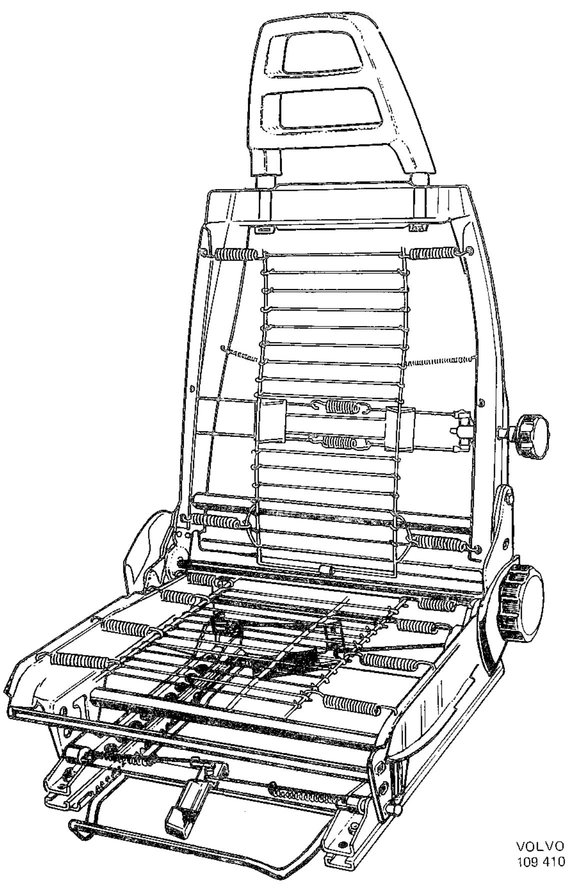


Fig. 8-37. Front seat

UPHOLSTERY AND INTERIOR

Front seats

The front seats, Fig. 8-37, are built up on a tubular frame, on which pullmaflex platforms are tensioned. The padding consists of a soft rubber material and foam plastic. The seat cover material is either of leather or plush. To adjust the seat lengthwise to a desired position, raise the loop handle at the front under the seat. The slide rails are locked on both sides. There are two levers, each with three positions, for positioning the driver's seat vertically both in front and rear. This means that also the cushion angle can be changed.

The front passenger seat is screwed tight in different positions on standard brackets so that the seat can be adjusted vertically and also the cushion angle changed. The back rest has a reclining mechanism of the gear segments type. To adjust the inclination of the back rest, use the hand wheel on the outside of the seat. The front seats are provided with an adjustable lumbar support, the tension of which can be adjusted by means of a knurled knob located on the outside of the back rest.

Both front seats are fitted with fixed head restraints.

The driver's seat is equipped with electrical, thermostat controlled heating pads. Together the current draw for seat and back rest is 60 W. The thermostat opens the circuit at +26°C=78°F and closes the circuit at +14°C=57°F.

Rear seat

Rear seat cushion and rear seat back are in polyuretan foam, moulded on a frame of wires which stabilize the foam and retain the upholstery.

Door upholstery

The door upholstery consists of wood-fibre sheeting lined with non-woven padding and covered with upholstery material. It is secured to the door by means of clips. The arm rests are made of moulded plastic and are screwed to the inner plate of the door.

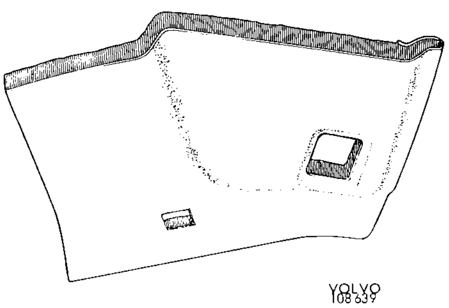


Fig. 8-38. Glasswool headling, section

Headlining

The healdining consists of form-pressed glasswool with a plastic foil underneath (Fig. 8-38). It is made in one single piece and cannot be bent. It is held in position by means of the sun visors, reariew mirror, grab handle and three plugs at the rear end of the headlining.

Covering for firewall and floor

The sides of the firewall are lined with millboard while the bulkhead itself is covered with self-adhesive insulating material. The floor is covered with carpets.

Vehicles equipped with catalytic muffler are provided with extra heavy insulation above the catalytic muffler and the heat protection plates as the catalytic muffler system increases exhaust system temperatures.

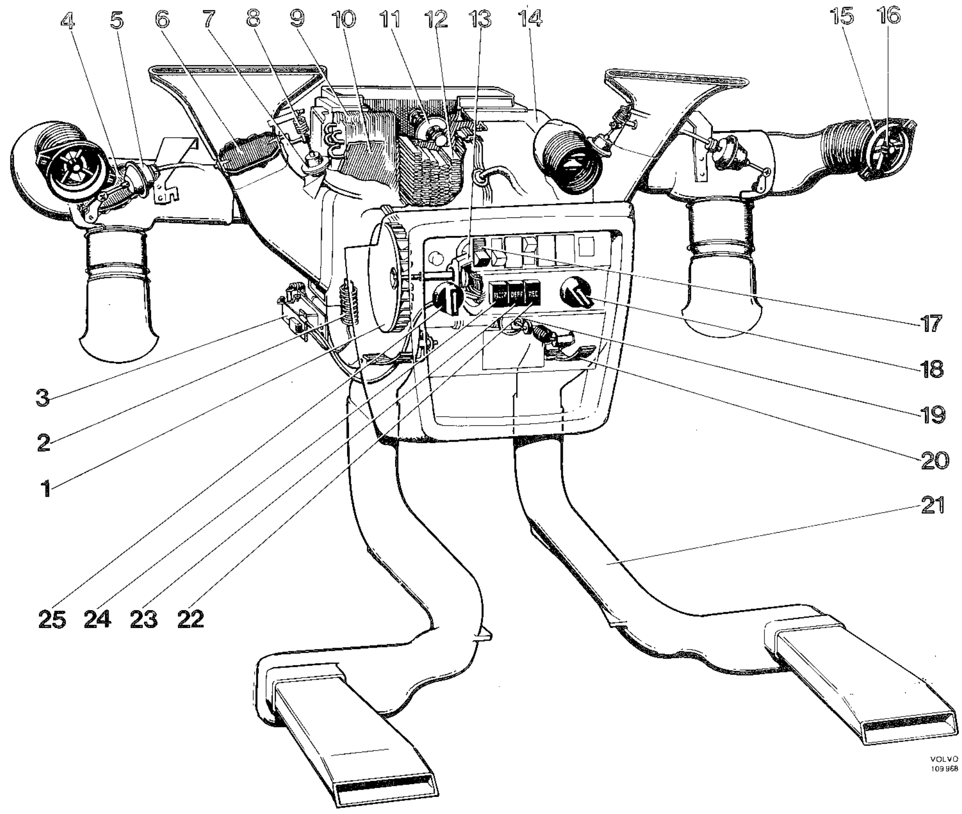


Fig. 8-39. Combined unit

1. Turbine
2. Capillary tube for heater control
3. Heater control valve
4. Shutter, air vent left floor
5. Vacuum motor
6. Shutter, left defroster nozzle
7. Vacuum motor
8. Return spring for vacuum motor
9. Evaporator
10. Air intake cover
11. Vacuum motor for air intake cover
12. Heater cell assembly
13. Fan motor
14. Central unit
15. Blow-in valve
16. Shutter knob
17. Air conditioning switch
18. Fan motor switch
19. Vacuum motor
20. Shutter, right air duct, rear floor
21. Air duct to rear floor
22. Knob, air intake cover
23. Knob, defroster shutter
24. Knob, floor shutter
25. Temperature control

COMBINED UNIT

This is a combined heater and fresh-air unit, prepared for installation of air conditioning. It consists of a central unit (14, Fig. 8-39), located under the dash, and air ducts and vents for distributing the air to the various points inside the car. All shutters for directing the air are regulated by vacuum, which is taken from the engine intake manifold via a vacuum tank placed under the dash. The four blow-in valves (15) on the dash are manually adjustable and can be turned, opened and closed irrespective of each other and by means of a knob (16) in the center of the blow-in valve. An fan motor (13) located in the central unit takes care of the air circulation. This motor is provided with a through-flowing shaft and two turbine wheels (1). The cellular assembly (12) of the heater system is placed in front of the fan motor. The evaporator (9), for the air conditioning, is mounted in front of the heater system cellular assembly.

The combined unit is operated by means of two knobs and three push buttons placed on the dashboard. The right knob "FAN" (18) is the switch and speed control for the fan motor, and it has three speed positions.

With the left knob "TEMP" (25), influences via a wire the heater control valve (3) so that the desired air temperature is obtained.

The air shutter and the air intake cover are turned with the help of vacuum. At each shutter there is a vacuum motor (7) which opens the shutter when acutated by vacuum. Vacuum is transmitted to the vacuum motors by pushing in the appropritate buttons on the dash. When the buttons are pushed out again, the shutters return to the closed position with the help of return springs (8).

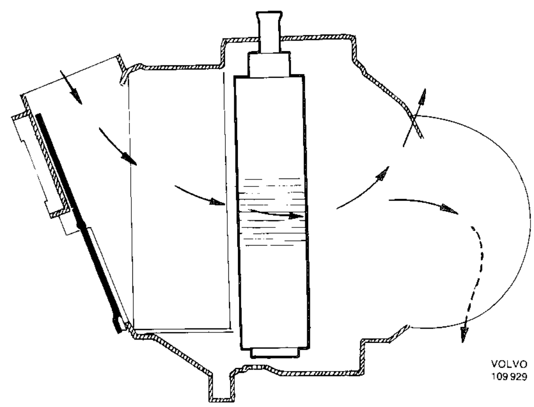


Fig. 8-40. Air circulation through system

The air flow through the blow-in valves on the dash is only regulated by the valve shutter and is not influenced by the push buttons. When all buttons are out, only fresh air is drawn into the unit (Fig. 8-40), all flow ducts are closed and the defroster effect is weak. When the button marked "FLOOR" is pushed in, full air flow is supplied to the front and rear floor together with weak defroster effect. When the middle button "DEF" is pushed in, full defroster effect is obtained while the floor ducts on the other hand are fully closed.

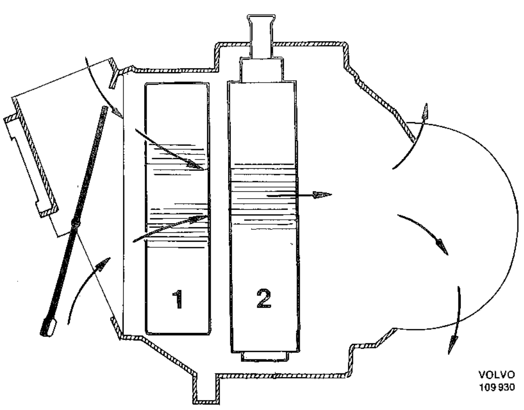


Fig. 8-41. Air circulation through system with re-circulation
1. Evaporator 2. Heater cell assembly

When the right button marked "REC" is pushed in, the air intake cover is adjusted to re-circulation of the compartment air (Fig. 8-41). With the cover in this position, only a small portion of fresh air is sucked in and mixed with the compartment air. When the air conditioner is on, the REC button should be pressed in during the cooling period and also when the ambient temperature and/or air humidity is high.

For rapid removal of mist inside the car, the air conditioner can be used with advantage, even though it is relatively cold outside, since the air is demoistened in the air conditioner before being blown into the car.

Even when the air conditioning is switched on, the air temperature is regulated by the "TEMP" control. Fig. 8-41 shows how the sucked-in air is first cooled when it passes the evaporator (1) and how it is heated when it passes the heater cell assembly (2) up to the temperature adjusted by the "TEMP" control. When the air passes the evaporator, it liquifies as it cools. The moisture which condenses on the evaporator during the cooling, is drained through the hose, which runs through the transmission tunnel.

A fresh-air vent is located in the left-hand firewall panel. The air vent has a grille which can be regulated to control the fresh air supplied to the compartment.

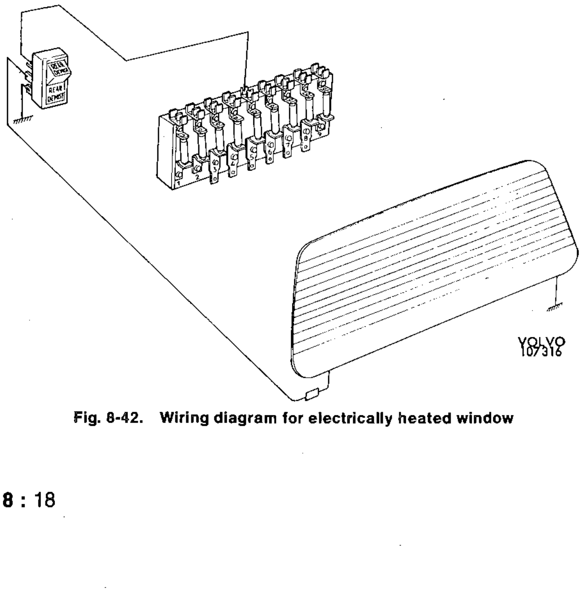


Fig. 8-42. Wiring diagram for electrically heated window

Also incorporated in the heating system is the electrically heated rear window, which has an output of 200 W. It is regulated by means of a switch located on the control panel (Fig. 8-42).

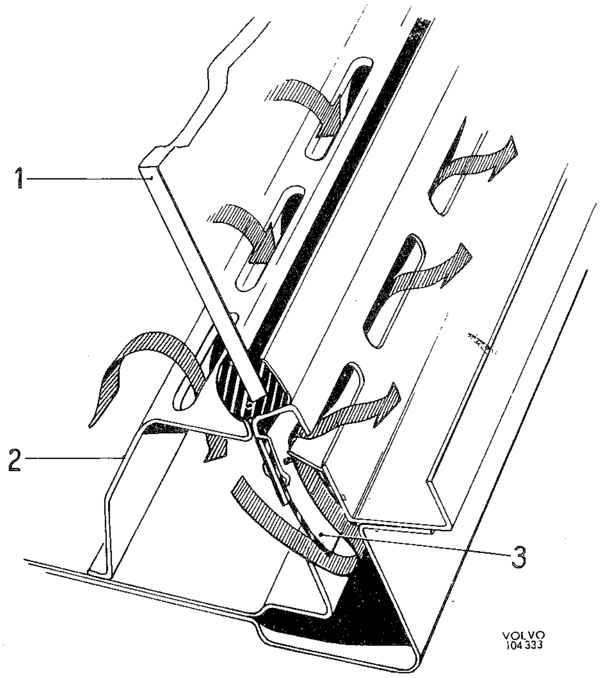


Fig. 8-43. Air extractor vents
1. Rear window 2. Inner panel 3. Non-return valve

In order to obtain good through ventilation of the vehicle, air vents are located at the back under the rear window (Fig. 8-43). These vents have a total area of 50 cm² (7.8 sq.in.).

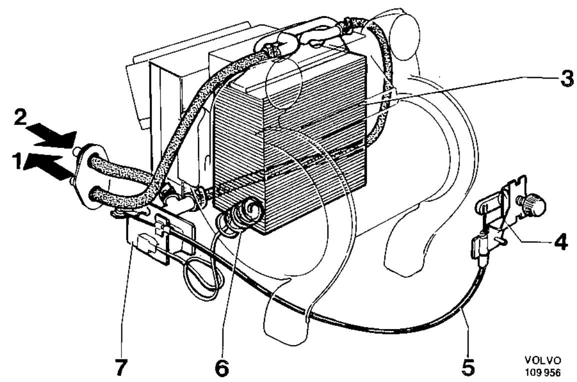


Fig. 8-44. Heating system

1. Water hose, output
2. Water hose, input
3. Cell assembly
4. TEMP control
5. Control wire
6. Capillary tube for heater control valve
7. Heater control valve

Heater system

The heater system in the combined unit consists of a cell assembly and a heater control valve. The cell assembly (3, Fig. 8-44) is located in the central unit, while the heater control valve (7) is placed underneath.

The function of the heater control valve, which is regulated by means of the "TEMP" control on the control panel is to maintain the heated air at a pre-set constant temperature. This is done by means of the thermostat built into the control valve. The temperature control regulates the volume of heated coolant which is supplied to the cell system. The heater control valve is connected in series to the cell system so that all coolant passing through the cell system also passes through the control valve. The coolant heats up the air, which with the help of the fan motor or speed wind, is pressed through the cell assembly. If the temperature of the coolant increases, the capillary tube in the thermostat expands with the result that the valve in the control system is influenced and less fluid flows through in consequence. This reduces the temperature of the through-flowing air and the capillary tube is again affected, this time resulting in more coolant flowing through. This cycle is repeated continuously so that a stable air temperature is maintained.

Cooling system

DESIGN

The cooling system in the unit is of the compressor type, which means that the circulation of the refrigerant is carried out by a compressor. The system is divided up into the main components: evaporator (1, Fig. 8-45), thermostatic expansion valve (2) compressor (3), receiver-dryer (4), and condensor (5). The evaporator and expansion valve are placed in front of the heater system cell assembly inside the passenger compartment and the other components in the engine compartment.

The evaporator consists of a tube provided with flanges for taking up heat. The thermostatic expansion valve is connected to the inlet pipe on the evaporator. It is the function of the valve to regulate the flow of refrigerant to the evaporator. The two-cylinder piston compressor is provided with an electromagnetic clutch and is driven by a pulley belt from the car engine. The condensor consists of piping with cooling flanges and it is placed in front of the car's standard radiator. The function of the receiver-dryer is to absorb the moisture which can remain in the system and to store the refrigerant for the evaporator. Refrigerant hoses are used for conveying the refrigerant between the various components. They are provided with tapered pipes and unions at the ends.

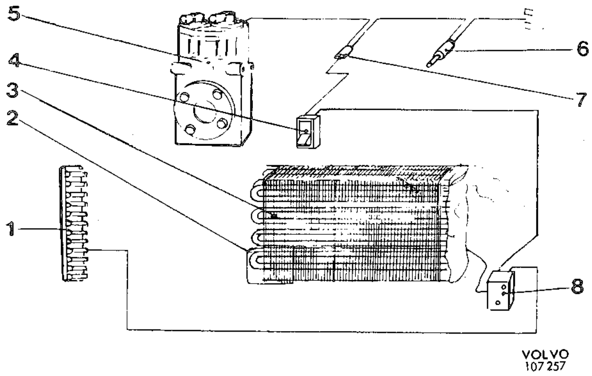


Fig. 8-46. Wiring diagram for air condition

1. Fuse box
2. Thermostat capillary tube
3. Evaporator
4. Switch
5. Compressor
6. Solenoid
7. Connector
8. Thermostat

The unit is started by means of the switch (4, Fig. 8-46) on the control panel inside the vehicle. When the current is switched on, the electromagnetic clutch and the compressor (5) start operating. A cut-out thermostat (8) is fitted at the evaporator in order to prevent it from being iced.

In order to eliminate risk of engine stop, when the engine is idling and the compressor is engaged, there is a solenoid (6) connected to the fuel system. When the compressor starts, the solenoid opens an overflow channel so that the engine idling speed rises.

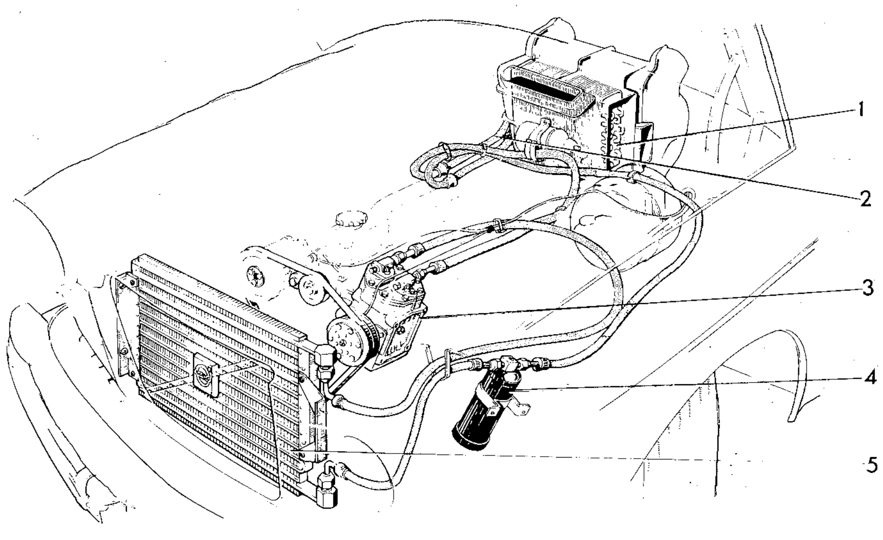


Fig. 8-45. Cooling system

1. Evaporator
2. Expansion valve
3. Compressor
4. Receiver-dryer
5. Condensor

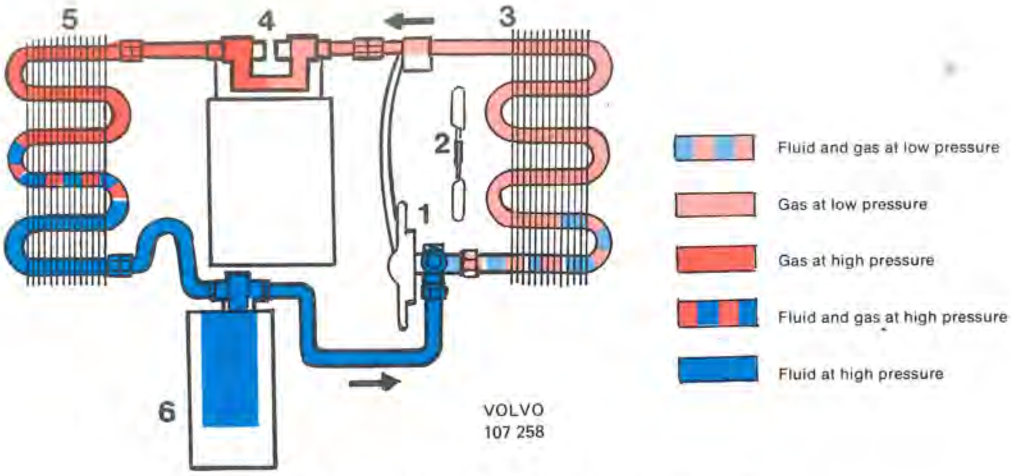


Fig. 8-47. Refrigerant circulation in air conditioning system

1. Expansion valve
2. Heater fan
3. Evaporator
4. Compressor
5. Condensor
6. Receiver-dryer

FUNCTION

The various components in the air conditioning unit form with their hoses a closed system where the refrigerant is kept in curculation by means of the compressor. The actual cooling process has no direct beginning or end in the unit but works continuously with the refrigerant changing between gas and fluid due to the changes in temperature and pressure in the system.

In order to explain the cooling process that takes place, it is suitable to start off with the thermostatic expansion valve, usually called the TEV (1, Fig. 8-47). Before the TEV, the refrigerant is in liquid form and at high pressure. When it flows into the inlet pipe of the evaporator, the temperature of the refrigerant immediately drops and is converted to part vapor, part fluid. Since the freezing point of the refrigerant is −32°C (−26°F) at normal air pressure, it starts to boil and changes to vapor in the evaporator coil (3), while it absorbs heat from the warm air which the heater fan (2) blows round the pipeline. Due to the fact that heat is absorbed from the air, it becomes colder. It is this cold air which is blown out through the air ducts into the compartment. In the evaporator coil, the latent heat has caused the refrigerant to convert to a gaseous form, without any change in temperature. Before the refrigerant reaches the end of the coil, it absorbs, however, more heat and the gas temperature rises.

From the evaporator, the gaseous refrigerant is sucked to the compressor (4) where it is compressed so that the temperature rises. The hot refrigerant is thereafter conveyed under pressure to the condensor coil (5). The coil is provided with cooling flanges around which it is cooled by air with the help of the car cooling fan. Due to the fact that it always moves from a warmer to a colder object, the hot refrigerant will emit a part of its heat to the colder air. Since the hot gaseous refrigerant loses a part of its heat, it starts condensing and changes to a fluid.

The condensed refrigerant, which has changed to a fluid, is conveyed at high pressure and high temperature further to the receiver-dryer (6). The dryer contains a moisture-absorbing agent which not only absorbs moisture from the refrigerant but also stores the refrigerant. From the receiver-dryer the refrigerant is conveyed further via the TEV to the evaporator, so the cycle is complete.

In order to clarify the function of the TEV, the purpose of which is to regulate the amount of refrigerant which is to be supplied to the evaporator, a more detailed description is required. A spring-loaded ball valve is located in the valve body and this valve is actuated by a diaphragm via push rods. In its turn, the diaphragm is influenced by a gas-filled capillary tube, which is fixed to the outlet pipe of the evaporator.

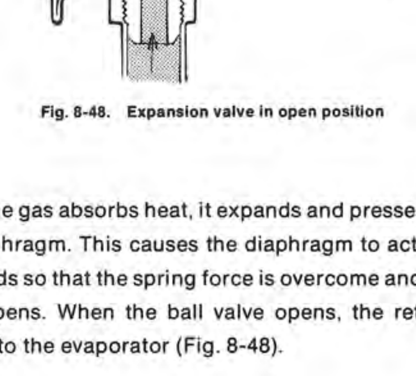


Fig. 8-48. Expansion valve in open position

When the gas absorbs heat, it expands and presses against the diaphragm. This causes the diaphragm to actuate the push rods so that the spring force is overcome and the ball valve opens. When the ball valve opens, the refrigerant flows into the evaporator (Fig. 8-48).

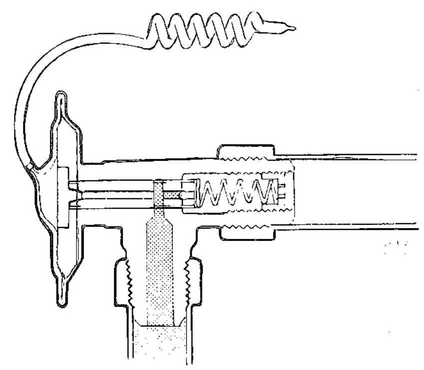


Fig. 8-49. Expansion valve in closed position

When refrigerant flows into the evaporator, it becomes colder. The gas in the capillary tube is affected by this difference so that the pressure against the diaphragm reduces and the ball valve closes off further supply of the refrigerant (Fig. 8-49).

By the TEV regulating in this way the right amount of refrigerant to the evaporator, it is possible for the evaporator to cope with the various heat loads and produce an even temperature for the cooled air.

Belonging to the unit control system is the cut-out thermostat, the function of which is to prevent icing in the evaporator. The thermostat is placed at the evaporator and is provided with a capillary tube (2, Fig. 8-46) which is inserted in between the evaporator fins. When the vapour temperature has dropped to +3°C (37°F), the capillary tube actuates the thermostat (8) so that current to the compressor clutch is broken off and the compressor stops. When the temperature of the evaporator again rises, this cuts in the current and the compressor starts working again.

SERVICE PROCEDURES

FRONT SEATS

REPLACING HEATER DEVICE FOR DRIVER'S SEAT

1. Disconnect the seat pad electrical wires at the junction box.
2. Remove the seat, complete with runners, from the vehicle.
3. Separate the contacts between seat back and cushion. Remove the screws acc. to Fig. 8-50 and take out the seat cushion.

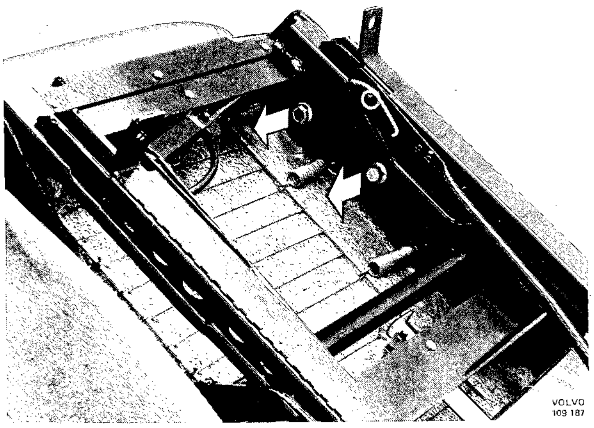


Fig. 8-50. Removing seat cushion

SEAT BACK HEATER PAD

A. Place the cushion upside down on a table.
B. Cut and remove the front upholstery retaining clamps.
C. Unhook the plastic hooks and pull out the heater pad. See Fig. 8-51.

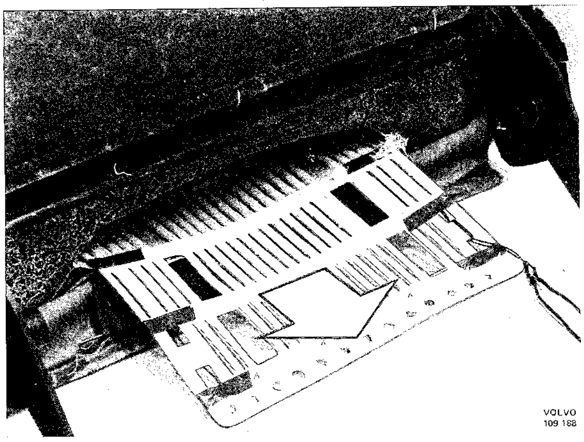


Fig. 8-51. Removing heater pad

D. Install the new heater pad in the seat back. NOTE: The heater element barbs should point towards the padding.
E. Hook the plastic hooks to the suspension mat lower wire.
F. Fit and attach front upholstery to rear upholstery, using four clamps. The heater pad electric wires should be routed towards the inboard side of the cushion.

SEAT CUSHION HEATER PAD

A. Place the seat cushion on a table, upside down.
B. Remove the cover plate. Cut and remove the clamps at the rear end of the cushion.
C. Pull out the heater pad.

D. Fit the new heater pad in the seat cushion. NOTE: The heater element barbs should point towards the padding. The heater pad electric wires should be routed towards the inboard side of the cushion, see Fig. 8-52.
E. Fold back the upholstery and install five new clamps.

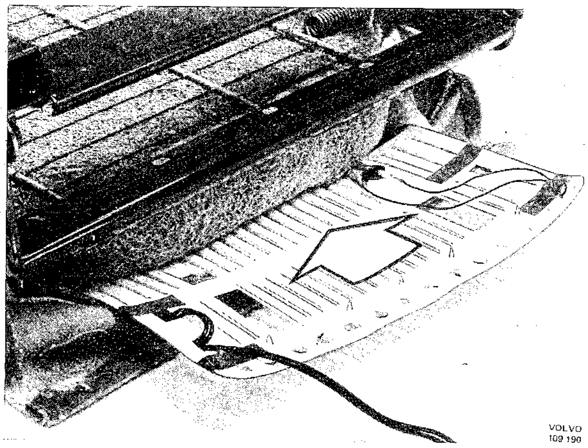


Fig. 8-52. **Installing seat cushion heater pad**

4. Fit the seat cushion to the seat fittings. Connect the wires beween the seat back and cushion, Fig. 8-53.
5. Install the seat in the vehicle and connect up the contacts, Fig. 8-53.

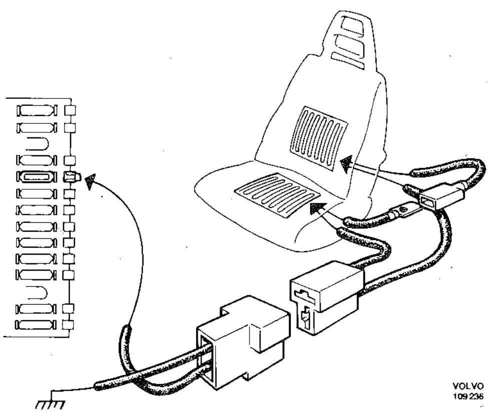


Fig. 8-53. **Wires for heater pads**

THERMOSTAT

1. Remove the seat heater pad (see separate instructions).
2. Disconnect the thermostat wires. Remove the thermostat.
3. Place the new thermostat in the heater pad and connect up the electric wires.
4. Install the heater pad (see separate instructions).

REPLACE: SEAT RECLINING MECHANISM OR HEAD RESTRAINT OR SEAT BACK UPHOLSTERY

1. Disconnect the seat and pad electrical wires at the junction box.
2. Remove the seat, complete with runners, from the vehicle.
3. Disconnect the junction box between the seat back and cushion. Remove the screws according to Fig. 8-50 and remove the seat cushion.
4. Use a screwdriver to press out the hand wheel cover through one of the hand wheel holes. See Fig. 8-54.

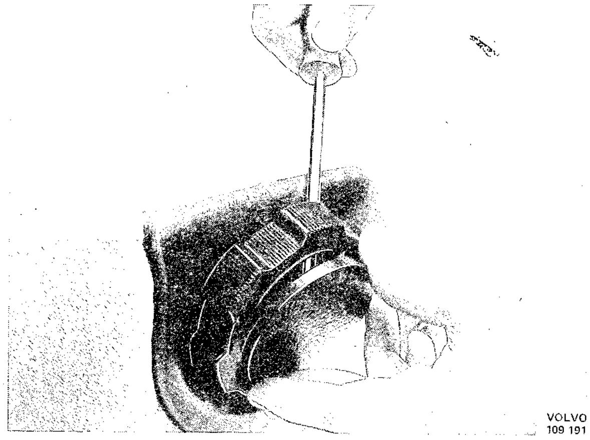


Fig. 8-54. **Removing hand wheel cover**

5. Turn the lock in the hand wheel counter-clockwise and remove the wheel. See Fig. 8-55.

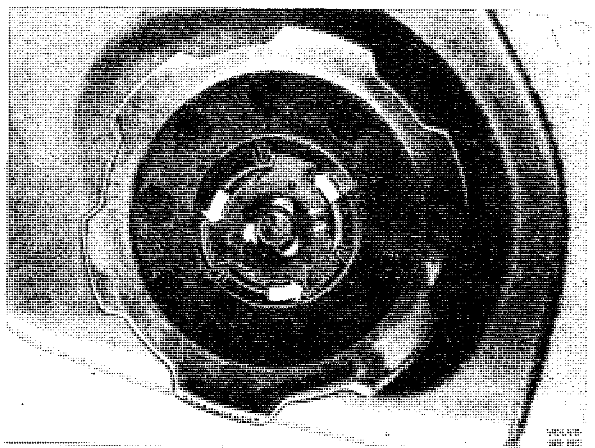


Fig. 8-55. **Removing hand wheel**

6. Remove the mechanism covers by bending loose the lower edge and then pressing upwards, see Fig. 8-56.
7. Unhook the upholstery from the seat reclining mechanism. Cut and remove the clamps at the seat back upholstery joint.
8. Unhook the plastic hooks. Fold up the upholstery cover and pull out the heater pad.

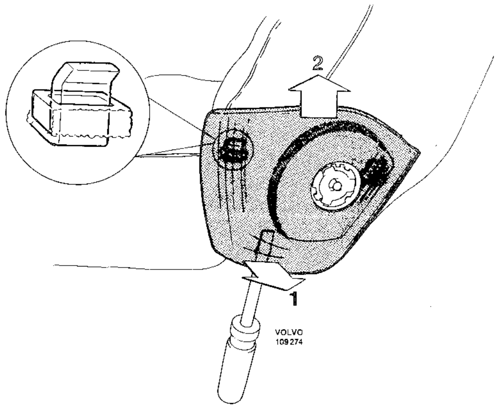


Fig. 8-56. Removing plastic cover

REPLACING SEAT RECLINING MECHANISM

A. Unfold the upholstery to gain access to the mechanism retaining screws.

B. Fold down the padding, remove the screws and the mechanism, see Fig. 8-57.
NOTE: The seat reclining mechanism cannot be repaired and the whole assembly must be replaced.

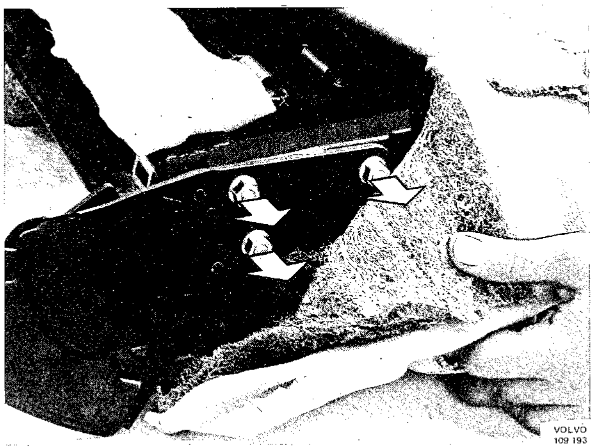


Fig. 8-57. Removing seat reclining mechanism

C. Use a screwdriver to turn the new reclining mechanism to the rear stop position. Put the mechanisms on top of each other and check that they are aligned.

D. Attach the mechanism to the seat back. Attach the control shaft to the mechanism.

E. Position the other mechanism on the shaft and tighten it to the seat back. Finalize the installation of the seat reclining mechanisms.

REPLACING HEAD RESTRAINT OR SEAT BACK UPHOLSTERY

A. Unscrew the lumbar support hand wheel. Pull loose the plastic bushing in the seat back, see Fig. 8-58.

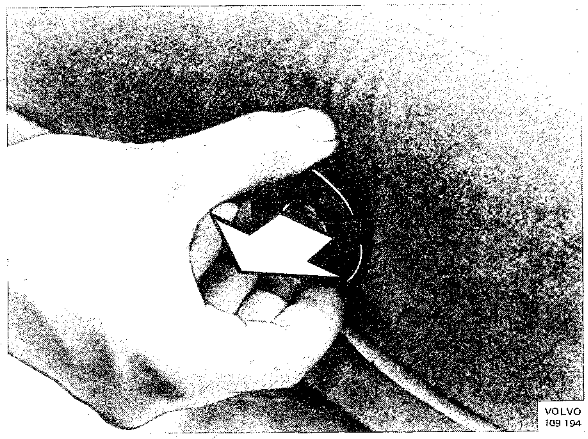


Fig. 8-58. Removing bushing in seat back

B. Fold away the upholstery until three clamps are accessible. Cut and remove the clamps, see Fig. 8-59.

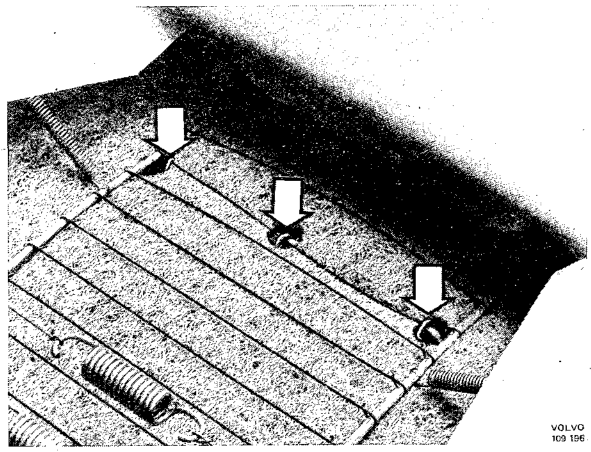


Fig. 8-59. Clamps

C. Unfold the upholstery completely. Knock loose the head restraint. Remove head restraint and upholstery. See Fig. 8-60.

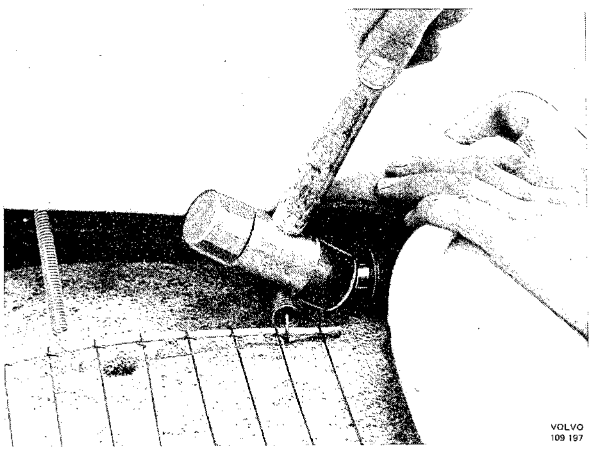


Fig. 8-60. Removing head restraint

D. Carefully loosen the padding and fold it loose from the seat frame. Remove the head restraint lower bushings (locks).
E. Install new bushings (locks), see Fig. 8-61.

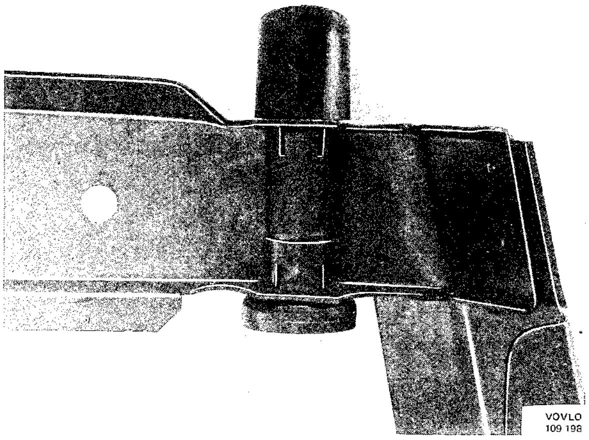


Fig. 8-61. **Fitting head restraint bushings**

F. Apply glue to the seat frame back side and fold on the padding.
G. Fold on the upholstery slightly. Install the head restraint. Check that the head restraint is securely locked.
H. Attach the rod to the suspension mat with three clamps.

9. Fold on the upholstery completely. Smoothe out.
10. Install the seat back heater pad. NOTE: The barbs on the heater pad should face the stuffing and the heater pad electric wires should be routed towards the inboard side of the cushion, see Fig. 8-62.

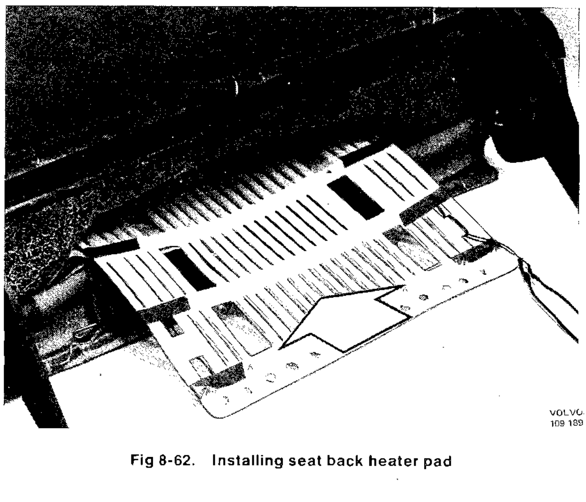


Fig 8-62. **Installing seat back heater pad**

11. Attach the upholstery plastic hooks to the suspension mat lower wire.
12. Fit and attach rear upholstery to the seat frame with three clamps, see Fig. 8-63.

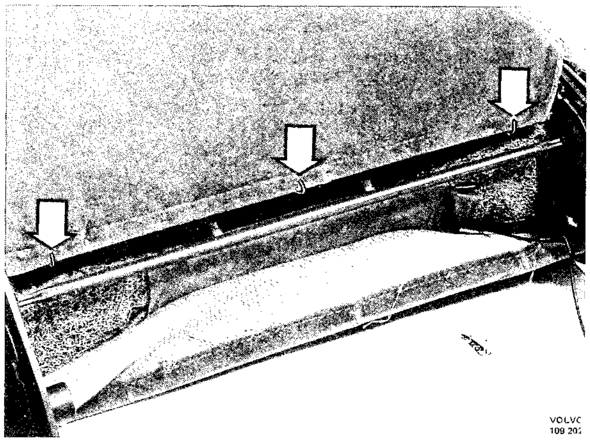


Fig. 8-63. **Installing seat back upholstery**

13. Fit and attach front upholstery to rear upholstery, using four clamps.
14. Bend out the sheet metal tabs of the seat reclining mechanisms. Fit and hook on the side upholstery, see Fig. 8-64, and then reshape the tabs.

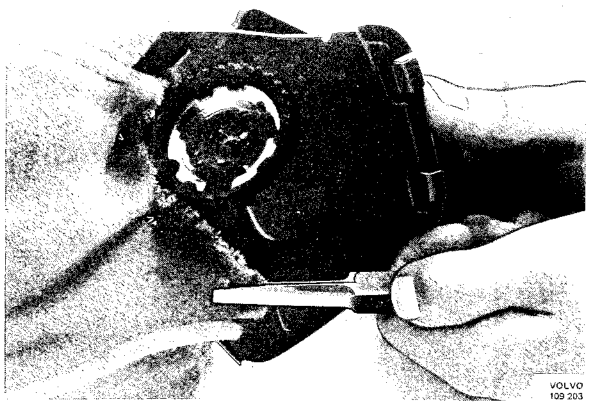


Fig. 8-64. **Installing side upholstery**

15. Press on the release lever frame. Press on the bushing for the lumbar support hand wheel. Install the hand wheel.
16. Install the plastic covers for the seat reclining mechanisms.
17. Turn the lock clockwise and install the hand wheel for the reclining mechanisms. Press on the hand wheel cover.
18. Attach seat cushion to the seat reclining mechanisms. Connect the wires between the seat back and cushion, see Fig. 8-65.
19. Install the seat in the vehicle and connect the wires at the junction box, see Fig. 8-65.

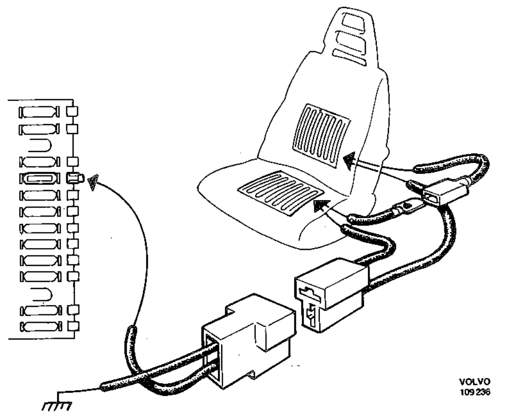


Fig. 8-65. Wires for heater pads

REPLACING HEADLINING

The points within brackets apply only to vehicles with sun roof.

REMOVING

1. Disconnect the battery negative lead.
2. Remove the rear seat cushion and back rest, also take out the hat shelf together with the plastic covers and attachments for the rear seat belts.
3. Remove the side panels located between the rear side window and rear window to prevent them from getting dirty.
4. Disconnect the electric connections for the rear window.
5. Remove the rear window according to the instructions given elsewhere in this manual.
6. Remove the interior rearview mirror by pressing it forwards (Fig. 8-66). Unscrew the rearview mirror attaching plate from the roof.

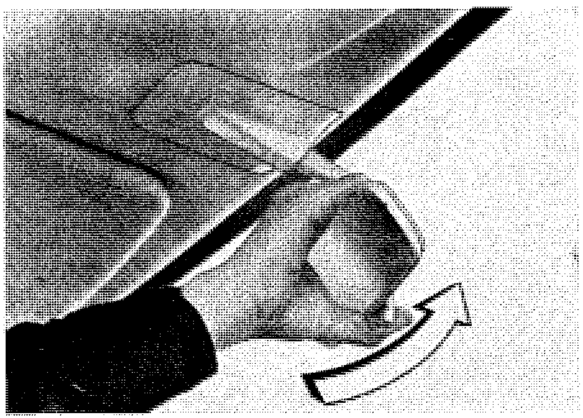


Fig. 8-66. Removing rear view mirror VOLVO 108149

7. Remove the attachments with support bearings for the sun visors and remove the sun visors.
8. Bend loose the interior lighting and disconnect the connections.

(9.) Unscrew the crank and gear and remove the housing for the crank.

10. Remove the grab handle and attachments over the door on the driver's side. By bending loose the trim cover (Fig. 8-67) it is then possible to get at the screws.

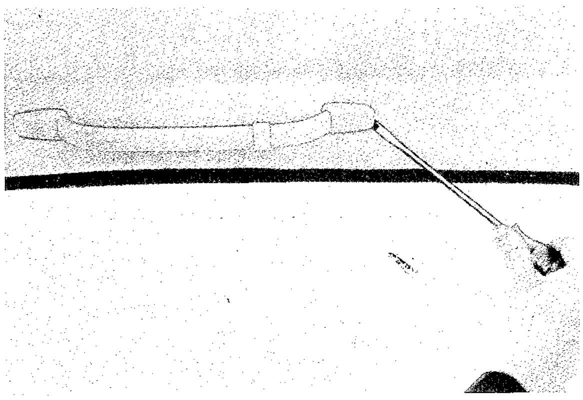


Fig. 8-67. Removing grab handle VOLVO 108150

11. Release the headling at the rear edge by turning the plastic plugs a quarter turn with a screwdriver.
12. Take down the headlining and lift out through the opening for the rear window.
13. Remove the panels on the A-pillars and the upper cover strip on the windshield by bending it loose with a screwdriver.

INSTALLATION

1. Take the rooflining in through the opening for the rear window and hold it up against the plate roof.
2. Fit the attaching plate for the rearview mirror without tightening up the screws.
3. Tighten up the plastic plugs at the rear end of the headlining. This is done by pressing them in and turning them a quarter turn.
4. Screw tight the grab handle and the attachments over the front doors, also press on the trim covers.
5. Tighten up the attaching plate for the rearview mirror. Fit the sun visors together with their support bearings.
6. Fix in position the front cover strip and the panels on the A-pillars.
7. Wire up the interior lighting and attach it to the roof.
8. Fix the rearview mirror in position.

(9.) Fit the crank housing, the gear and the crank.

10. Fit the rear window and connect up its electrical connections.
11. Fix in position the rear side panels. Also fit the caps and attachments for the rear seat belts.
12. Fix the hat shelf in position and also the rear seat.
13. Connect up the battery negative lead.

REMOVING INSTRUMENT PANEL

1. Disconnect the battery ground lead.
2. Remove the steering wheel (see Section 6) and the casings over the steering column.
3. Undo the screws securing the switch for the directional indicators and then remove the plastic cover in front of the steering wheel.
4. Remove the bracket and the holder for the horn slip ring.
5. Remove the combined instrument according to instructions given in Section 3.
6. Disconnect the switch for the lighting from the instrument panel.
7. Remove the steering wheel lock according to the instructions in Section 6.
8. Remove the bulb holders for the combined instrument lights and the bulb holder in the clock.
9. Disconnec the electric cable from the clock and the calbe harness from the lower part of the instrument panel. A clamp is situated under the clock and another under the left-hand side of the combined instrument.
10. Remove the center panels and the air ducts for the outer air vents. Remove the defroster vents from the dash board (2 rubber pins/side).
11. Unscrew both the lower screws for the control panel and then fold the panel backwards as far as the cables permit.
12. Disconnect the electric cables to the glove box lighting by opening the glove box cover and then pulling the entire lighting inwards. In this position, the cables can be disconnected.
13. Remove the outer impact guards for the instrument panel. These are removed by pulling them straight out backwards.
14. Undo the screws securing the instrument panel. There are three at each side of the tunnel, two underneath and one which is visible when the impact guards are removed. A further two attaching screws are located above the upper attaching screws for the control panel.
15. Remove the instrument panel from the attachment to the dash by pulling it over the control panel and support legs.
16. Lift off the instrument panel.

INSTALLING INSTRUMENT PANEL

1. Check to make sure that the rubber bushings in the firewall are in good condition. Otherwise replace them.
2. Place the instrument panel in position with the guide pins in the rubber bushings and secure them to the sides of the firewall and support legs.
   Check that the hoses for the center air vents are in the right position.
3. Install the impact guards.
4. Install the defroster vents on the dash board and the air ducts to the outer air vents.
5. Install the bulb holder for the clock and wire up the electric cable to the clock.
6. Install the bulb holders for the combined instrument lighting and connect up the cable harness to the instrument panel with its clamp.
7. Fit the steering wheel lock according to the instructions given in Section 6.
8. Fit the switch for the lighting.
9. Install the combined instrument according to the instructions given in Section 3.
10. Fit the holder for the horn device slip ring onto the steering column and thereafter the bracket.
11. Fit the controls for the directional indicator switch and windshield wipers, also wire the electric cables to them.
12. Place the casings over the steering column.
13. Fit the steering wheel (see Section 6).
14. Connect up the electric cables to the glove box lighting.
15. Fit the lower attaching screws for the control panel.
16. Fit the center panels.
17. Connect up the battery negative pole to ground and check the function of the instruments and lamps affected by the installation.

REPLACING GLOVE BOX

1. Remove the four screws on the impact guard under the glove box and take down the guard.
2. Remove the two upper attaching screws for the glove box.
3. Move the glove box inwards and release the box cover stop from the recesses in the ends of the box.
4. Push up the bottom of the glove box in order to release the cover hinges. Remove the cover.
5. Remove the five screws in the member under the glove box. Remove the member.
6. Disconnect the electric cables at the glove box contact and lamp. Take down the glove box.
7. Remove the contact, bulb, upper and lower rail from the glove box.
   Installation is in reverse order.

When installing the glove box, it must be adjusted in position before the screws are finally tightened up.

CONTROL PANEL

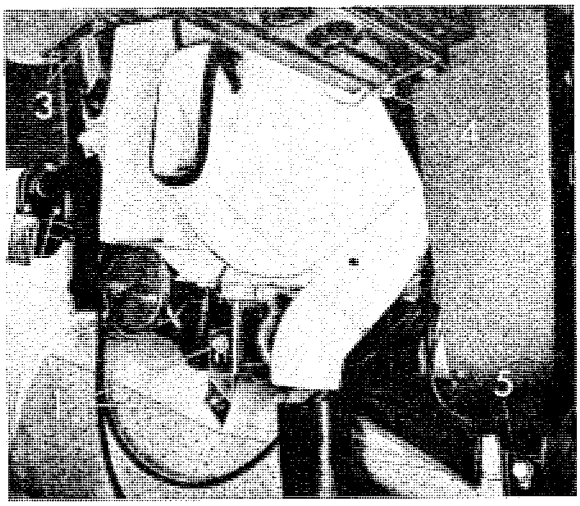
After the battery ground lead has been disconnected, the control panel can be removed. First release the panel attaching screws and then lift forward the panel until the cable connections are accessible. Note that the panel is attached by means of six screws, two of which are underneath the panel. The cable connections should be marked and the cables disconnected. The panel can then be lifted off.

When installing, place the panel first in a suitable position, then wire up the cables to their connections and then place the panel in position. Thereafter screw the attaching screws tight and re-connect the battery lead.

COMBINED UNIT

Replacing turbine wheel, left-hand side

1. Disconnect the ground lead from the battery.
2. Fold the floor carpet to the one side and remove the side panels from the central unit.
3. Unscrew the screws (4 and 5, Fig. 8-68) for the control plate support legs on both sides, and move the plate as far back on the transmission tunnel as the electric cables permit.



VOLVO 107 261

Fig. 8-68. Central unit, left-hand side

1. Screws for bottom bracket
2. Screws for connection pipe
3. Screws for upper bracket
4. Upper screws for support legs
5. Lower screw for support legs

4. Remove the attaching screw for the rear floor air duct so that the duct can be disconnected from the central unit.
5. Remove the combined instrument (see instructions, Section 3).
6. Disconnect the vacuum hose from the left defroster nozzle's vacuum motor and remove the defroster nozzle and air duct to the left air vent.
7. Remove the air hose between the central unit and the left, inside, air vent.
8. Remove the clamps on the central unit outer end (Fig. 8-69) and remove the end.

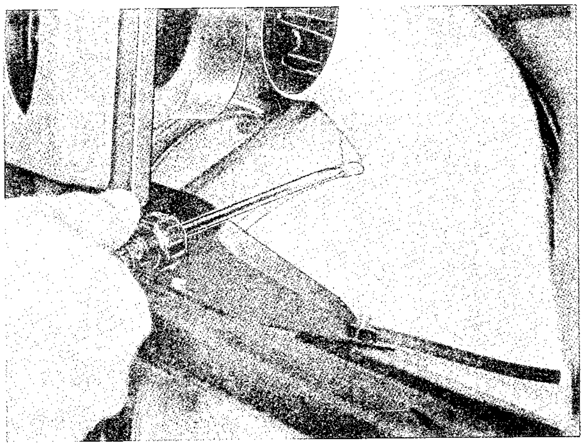


Fig. 8-69. Removing clamps for outer end VOLVO 107 262

9. Remove the turbine wheel locking with the help of two screwdrivers (Fig. 8-70), and remove the turbine.

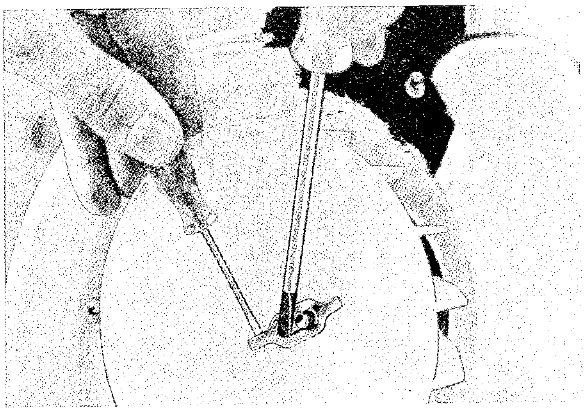


Fig. 8-70. Removing turbine lock VOLVO 107 263

10. Place the new turbine wheel on the shaft and fit the locking.
11. Fit the outer end and check at the same time that the heater control valve capillary tube with rubber grommet is properly fitted in the air duct. Concerning location of the clamps, see Fig. 8-71.

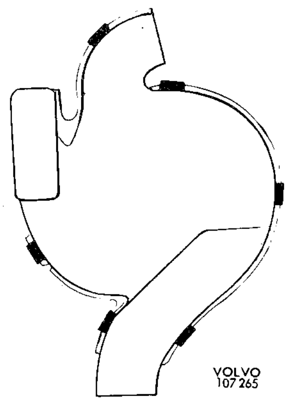


Fig. 8-71. Placing clamps for outer end

12. Connect up the ground battery lead and carry out a function test.
13. Disconnect the ground battery lead from the battery.
14. Fit the air duct between the central unit and the air vent.
15. Fit the defroster nozzle and air duct and connect up the vacuum hose.
16. Fit the combined instrument (see instructions, Section 3).
17. Fit the air duct to the rear floor.
18. Place the control plate and support legs in position and screw tight the support legs.
19. Put back the floor mat and fit the side panels.
20. Connect up the ground battery lead.

Replacing turbine wheel, right-hand side

1. Carry out points 1 to 4 under "Replacing turbine wheel, left-hand side".
2. Remove the right side panel, the insulation panel, the impact guard and the glove box cover (Fig. 8-72).

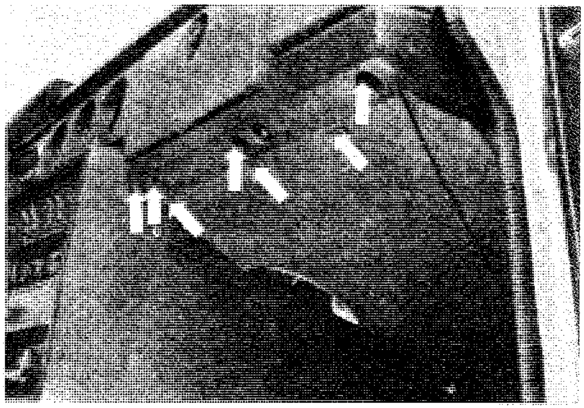


Fig. 8-72. Screws for panels and impact guard VOLVO 108 729

3. Remove the member under the glove box, also the box and box light (Fig. 8-73).

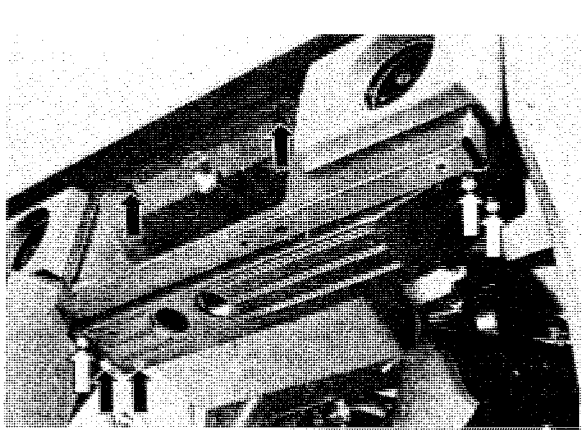


Fig. 8-73. Screw for member and glove box VOLVO 108 730

4. Disconnect the vacuum hose from the right defroster nozzle vacuum motor and remove the defroster nozzle and the air duct to the right air vent.
5. Remove the air duct between the central unit and the right inside air vent.
6. Remove the clamps on the central unit outer end (Fig. 8-69), and remove the end.
7. Remove the turbine wheel locking with the help of two screwdrivers (Fig. 8-70) and remove the turbine.
8. Place the new turbine wheel on the shaft and fit the locking.
9. Fit the outer end. Concerning the location of the clamps, see Fig. 8-71.
10. Connect up the ground battery lead and carry out a function test.
11. Disconnect the ground battery lead from the battery.
12. Fit the hose between the central unit and the air vent.
13. Fit the defroster nozzle and the vacuum hose.
14. Fit the glove box, member, impact guard and insulation panel.
15. Carry out points 17 to 20 under "Replacing turbine wheel, left-hand side".

Replacing fan motor

1. Remove the right and left turbines according to prevoius instructions.
2. Move the heater control valve capillary tube to the one side.
3. Remove the left inner end from the central unit.
4. Unscrew the fan motor retainer (Fig. 8-74).

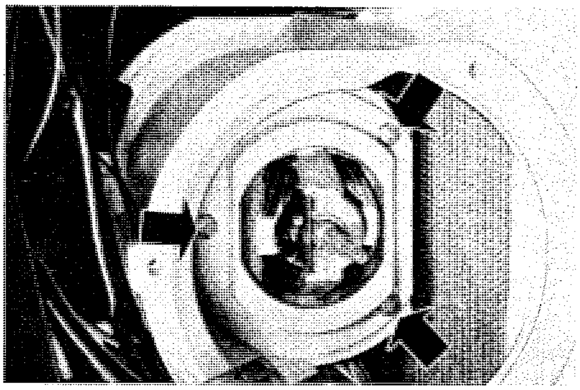
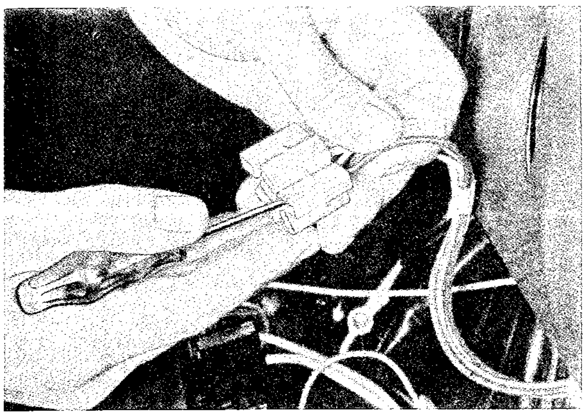


Fig. 8-74. Screws for fan motor holder VOLVO 107 267

5. Disconnect the contact unit from the fan motor control and disconnect the fan motor electric cables from the contact unit (Fig. 8-75) and the control plate.



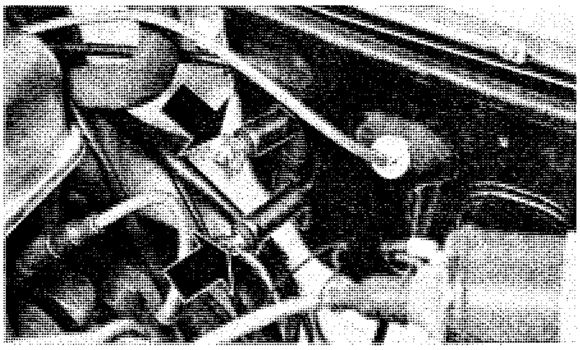
VOLVO 107268

Fig. 8-75. Removing electric cables for contact unit

6. Remove the rubber grommet and pull down the electric cables through the right opening in the central unit.
7. Lift out the fan motor through the left opening.
8. Place the fan motor in position in the central unit and screw tight the retainer.
9. Pull through the electric cables and fit the rubber grommet.
10. Connect up the electric cables to the contact unit and the control plate, also connect the contact unit to the fan motor control.
11. Fit the inner left end and adjust in the heater control valve capillary tube.
12. Fit the turbine wheels according to previous instructions.

Removing central unit

1. Drain the coolant.
2. Disconnect the ground lead from the battery.
3. Remove the heater system's water hoses from the joint pipes in the fire wall, and plug the pipes (Fig. 8-76).

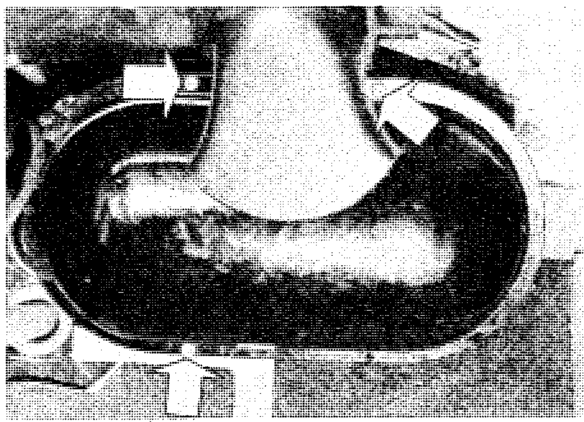


VOLVO 107269

Fig. 8-76. Fitting plugs in heater system connection pipe

4. Remove the clamps for the evaporator hoses and disconnect the receiver-dryer from its bracket. Place the receiver-dryer as near the fire wall as permitted by the hose between condensor and receiver-dryer.
5. Remove the combined instrument (see instructions, Section 3), the air hose between the central unit and the left, inner, air vent, also the vacuum hose to the left defroster nozzle's vacuum motor.
6. Remove the left side panel for the central unit.
7. Fold the floor mat out of the way and disconnect the rear floor air duct from the central unit.
8. Disconnect the joint pipes for the heater system's water hoses from the fire wall.
9. Remove the upper and lower screws for the left support leg, and the screws for the upper and lower brackets, from the fire wall and transmission tunnel (Fig. 8-68).

   NOTE. If the screw holes for the upper bracket are slotted, the screws should only be slackened a couple of threads.
10. Remove the right side panel for the central unit.
11. Remove the right insulation panel, impact guard, the member under the glove box and the box (Figs. 8-72 and 8-73).
12. Remove the vacuum tank (Fig. 8-77), the right defroster nozzle, and the air hose between the central unit, and the right, middle air vent.



VOLVO 108731

Fig. 8-77. Screws for vacuum tank

13. Fold the floor carpet out of the way and disconnect the rear floor air duct.
14. Remove the upper and lower screws for the right support leg, also the lower screws for the control panel.
15. Disconnect the ground cables from the control plate and the contact unit from the fan motor control (2, Fig. 8-78).

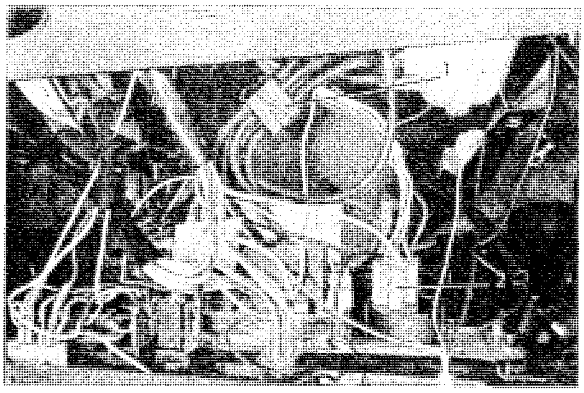


Fig. 8-78. Control panel reverse side
1. Connector for vacuum hoses
2. Contact unit for fan motor control

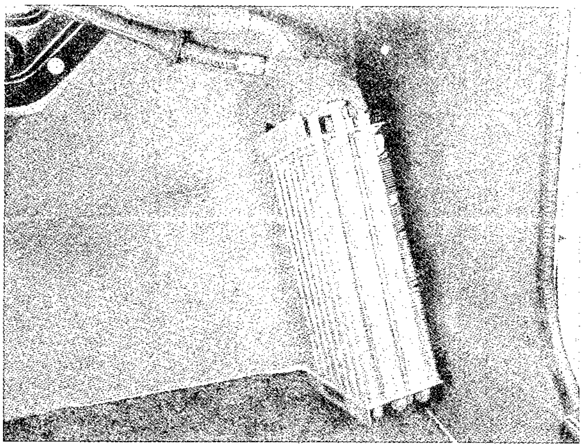


Fig. 8-80. Location of evaporator on floor

16. Disconnect the current-carrying cable (the thick yellow one) from the contact unit.
17. Separate the connector (1) for the vacuum hoses and disconnect the vacuum tank hose from the connector.
18. Move the control plate as far back on the transmission tunnel as the cables permit.
19. Remove the screws, for the upper and lower brackets, from the fire wall and the transmission tunnel.
20. Disconnect the thermostat attachment (1, Fig. 8-79) from the central unit, and both the clamps (2) securing the cover to the evaporator.

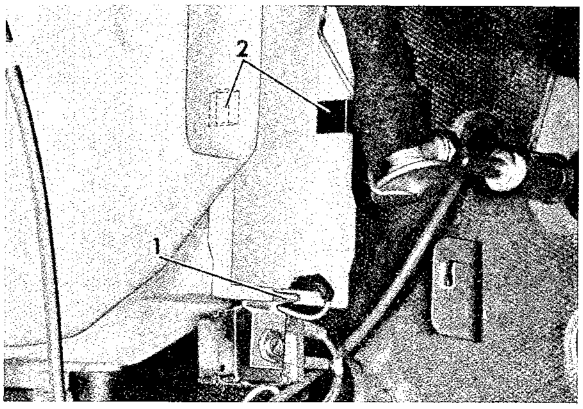


Fig. 8-79. Cover for evaporator
1. Attaching clamp for thermostat
2. Clamps for cover

21. Remove the evaporator from the central unit without disconnecting any of the refrigerant hoses, and place it at the right-hand side of the cowl (Fig. 8-80).
22. Remove the central unit right, outer, end (Fig. 8-69), turbine wheel (Fig. 8-70) and the inner end.
23. Lift off the seat cushion from the right front seat.
24. Lift forwards the central unit.

Installing central unit

1. Lift the central unit onto the right floor, and fit the rubber seal for the air intake.
2. Install the right seat cushion.
3. Lift the central unit into position and insert the left, upper bracket over the screws on the dashboard. Install the right bracket screws and tighten the left ones.
4. Install the evaporator in the central unit. Put on the cover and secure it with the two clamps (2, Fig. 8-79), also the thermostat on the opening's lower flange (1). Seal with sealing compound round the evaporator pipes and the thermostat capillary if necessary.
5. Install the connection pipe for the heater hoses to the dashboard.
6. Install the lower tunnel brackets and the drainage hose through the hole in the transmission tunnel.
7. Install the right, inner end and the vacuum hose for the floor shutter.
8. Install the turbine wheel and the outer end. The location of the clamps can be seen from Fig. 8-71.
9. Install the air hose between the central unit and the right inner air vent.
10. Install the right defroster nozzle and connect up the vacuum hose.
11. Install the vacuum tank, glove box and member with impact guard.
12. Install the air duct to the right air vent.
13. Install the air ducts for the rear floor.
14. Install the air hose to the left inner air vent and adjust the left defroster nozzle and connect up its vacuum hose.

15. Install the combined instrument (see instructions, Section 3).
16. Put the connection piece of the vacuum hoses together and connect up the hose from the vacuum tank.

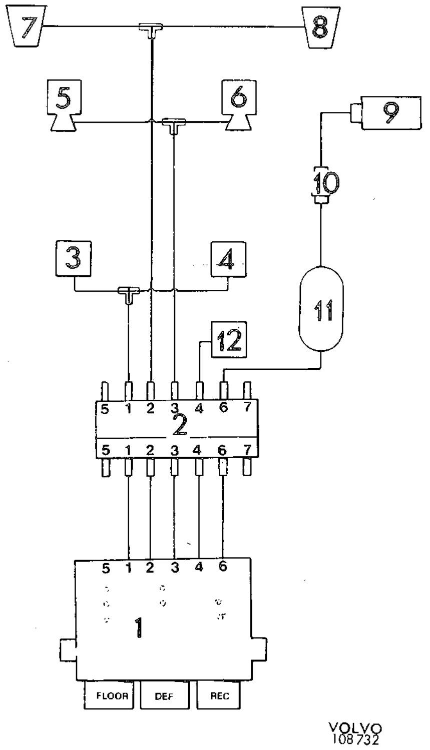


Fig. 8-81. Layout diagram for vacuum control system

1. Control panel
2. Connector
3. Vacuum motor for rear floor, left
4. Vacuum motor for rear floor, right
5. Vacuum motor for front floor, left
6. Vacuum motor for front floor, right
7. Vacuum motor for defroster, left
8. Vacuum motor for defroster, right
9. Engine intake manifold
10. Check valve
11. Vacuum tank
12. Vacuum motor for air intake cover

17. Connect up the current-carrying cable (the thick yellow one) to the fan motor control contact unit, and connect up the contact unit to the control.
18. Connect up the ground cables, and screw tight the instrument plate and support legs.
19. Restore the floor mat and fit the control panel, the side panels and the insulation panels.
20. Connect up the heater system water hoses to the connection pipes on the dashboard.
21. Install the clamps for the refrigerant hoses in the engine compartment.
22. Fill with coolant.
23. Install the ground battery lead and carry out a function test.

Replacing vacuum motor for rear floor air shutter

1. Disconnect the ground lead from the battery.
2. Remove the side panel for the central unit, right or left depending on the vacuum motor to be replaced.
3. Remove the upper and lower screws for the support legs and lift the control plate to the one side.
4. Disconnect the vacuum motor locking from the shutter shaft and attachment (Fig. 8-82), and lift forward the motor with vacuum hose.

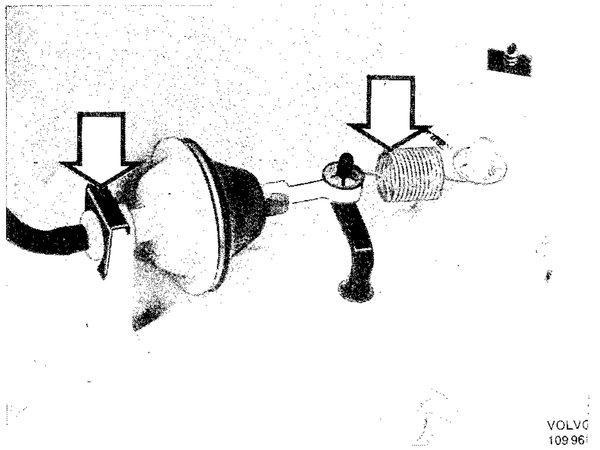


Fig. 8-82. Vacuum motor for air shutter to rear floor

5. Move the hose over to the new vacuum motor.
6. Place the vacuum motor in position and fit the locks.
7. Fit the control plate, support legs and side panel.
8. Connect up the ground battery lead and carry out a function test.

Replacing vacuum motor for central unit air intake

The instructions apply to a removed central unit.

1. Disconnect the hose at the vacuum motor.
2. Bend loose the vacuum motor outer plastic lock (Fig. 8-83). Remove the vacuum motor from the housing and remove the spring.

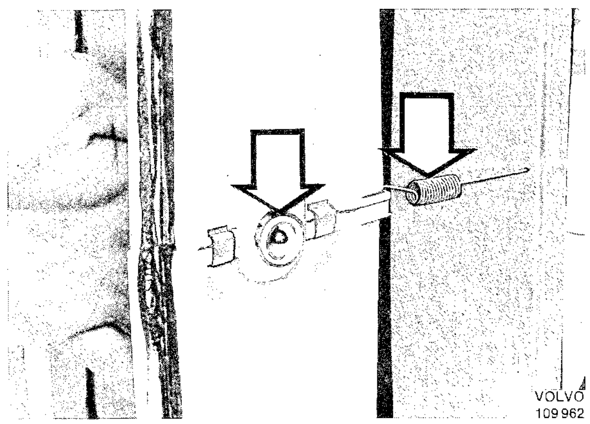


Fig. 8-83. Removing lock for vacuum motor

3. Unhook the return spring at the air valve.
4. Remove the valve shaft locks. Push the air valve sideways so that one end of the shaft comes loose from the housing. Disengage the other end of the shaft. Pull out air valve with vacuum motor from the housing.
5. Bend loose the vacuum motor inner plastic lock in the valve. Remove vacuum motor and spring.
6. Install the spring. Attach a new vacuum motor to the valve (Fig. 8-84). Use a new plastic lock.

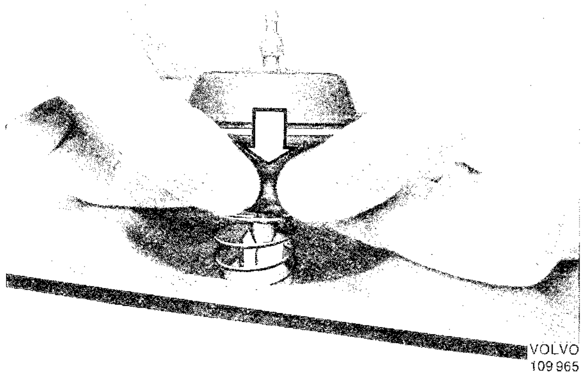


Fig. 8-84. Installing vacuum motor for air intake cover

7. Install air valve with vacuum motor in the housing. Engage the valve shaft in the hose in the housing and install the shaft locks.
8. Hook on the valve return spring.
9. Position the spring. Install the vacuum motor in the housing. Use a new plastic lock.
10. Re-connect the vacuum hose to the vacuum motor.

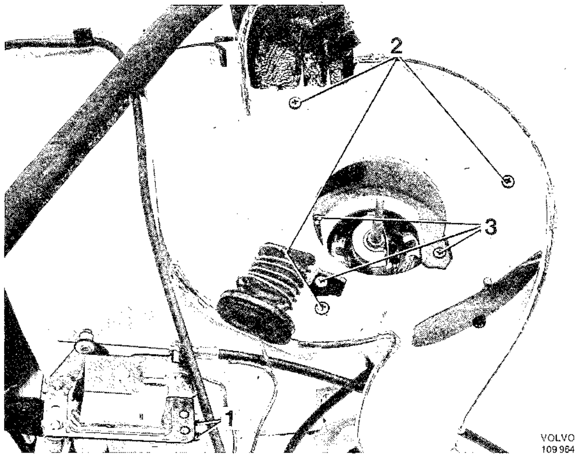


Fig. 8-85. Disassembling central unit
1. Screws for lower bracket
2. Screws for inner end
3. Screws for fan motor holder

Heater system

REMOVING CELL ASSEMBLY

The instructions apply to a removed central unit.

1. Remove the left outer end and turbine wheel (Figs. 8-69 and 8-70).
2. Unscrew the two left screws for the tunnel bracket (1, Fig. 8-85).
3. Remove the air intake left shutter shaft locking.
4. Undo the screws (2) for the inner end and lift off the end.
5. Undo the screws for the fan motor retainer (3).
6. Disconnect the water hoses from the cell assembly.
7. Remove the clamps for the central unit's middle joint, lift off the left half and remove the cell assembly.
8. Place the new cell assembly with insulation in position in the right half of the central unit (Fig. 8-86).

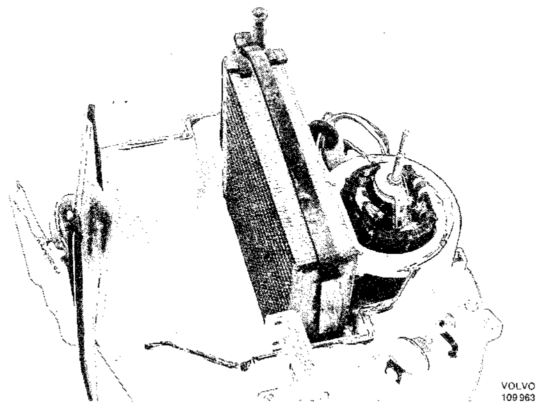


Fig. 8-86. Placing cell assembly

9. Fit the left half. Concerning the location of the clamps, see Fig. 8-87.

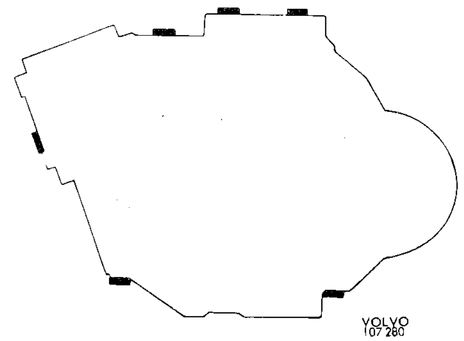


Fig. 8-87. Placing clamps for middle connector

10. Fit the reatiner for the fan motor.
11. Fit the inner end, turbine wheel and outer end. The clamps for the outer end are placed according to Fig. 8-71.
12. Fit the attaching screws for the tunnel bracket.
13. Fit the shutter shaft locking for the air intake.

Replacing heater control valve

1. Remove left side panel for the central unit.
2. Unfold the floor mat and put rags under the valve to protect against water spill.
3. Pull off the control valve from the heater housing. Use tongs to block the water hoses or drain the coolant.
4. Disconnect cable and sheath from the control valve.
5. Disconnect the sensor from the heater housing. Disconnect the water hoses at the control valve. Remove the valve.
6. Transfer the bracket to the new valve.
7. Re-connect the water hoses to the valve. Remove tongs.
8. Install cable and sheath to the valve. Adjust the cable.
9. Install the control valve in the heater housing. Transfer the rubber seal. Install the sensor in the heater housing.
10. Fill coolant and check tightness and function.
11. Fold back the floor mat and install the side panel.

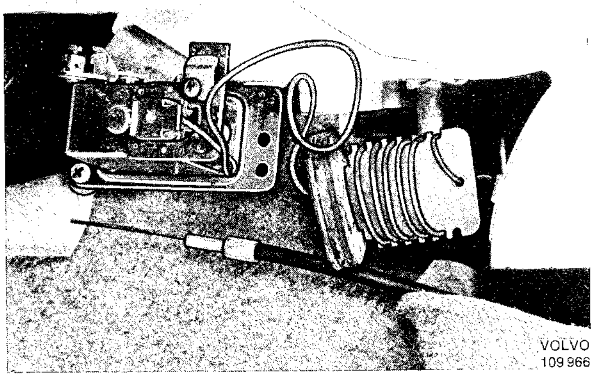


Fig. 8-88. Replacing heater control valve

Cooling system

CHECKING OIL LEVEL IN COMPRESSOR

For checking the oil level in the compressor use a dipstick with measurements according to Fig. 8-89. Suitable material is a 3 mm (1/8") brass wire. Make ten marks 3 mm (1/8") apart at the bottom of the stick.

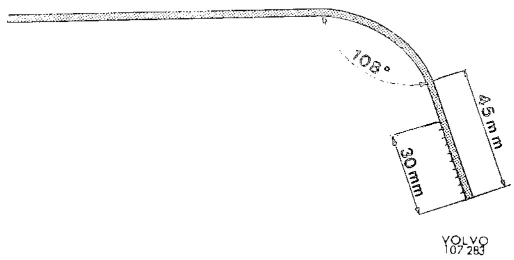


Fig. 8-89. Oil dipstick for compressor

When carrying out an oil check with a fitted compressor, it is important that the refrigerant is emptied before the oil plug is screwed out. Due to the fact that the compressor's crankcase is connected to the rest of the system, refrigerant will otherwise spurt out through the filler hole and take with it at the same time any oil left in the compressor. The refrigerant can suitably be drained by connecting the pressure gauge hoses to the service valves. Before connecting up the hoses, check to make sure that the valves on the pressure gauges are closed.

NOTE. Use rubber gloves as protection when emptying the refrigerant.

The blue hose is connected to the suction side of the compressor marked "suction", the red hose to the discharge side marked "disch" and the white hose is led into an exhaust suction hose. The valves are then opened slowly otherwise there is risk of the compressor oil accompanying the refrigerant.

When checking the oil level, hold the dipstick so that the graduated part is vertical to the compressor bottom (Fig. 8-90). The correct level is 28–29 mm (1.10–1.14"), 0.3 dm^3 (0.3 qt.). When filling, use only refrigerant compressor oil. Sutiable oils are Suniso 5, BP Energol LPT 100, Shell Clavus 33, Texaco Capella E 500 or corresponding. Before screwing tight the oil plug, check to make sure that the O-ring is in good condition and that neither the plug nor the crankcase sealing surfaces are damaged. The oil plug is tightened to a torque of 5 Nm (0.5 kpm=3.5 lbft).

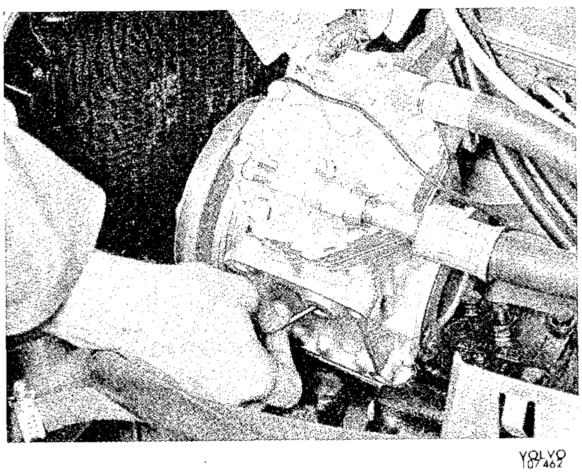


Fig. 8-90. Checking oil level in compressor

REPLACING COMPRESSOR CLUTCH

When replacing the compressor solenoid clutch, first disconnect the pulley center bolt. Thereafter remove the pulley with the help of a 5/8" UNC bolt, which is threaded into the center of the pulley, which is pulled off the shaft (Fig. 8-91). The solenoid is removed by undoing the four bolts (1, Fig. 8-92).

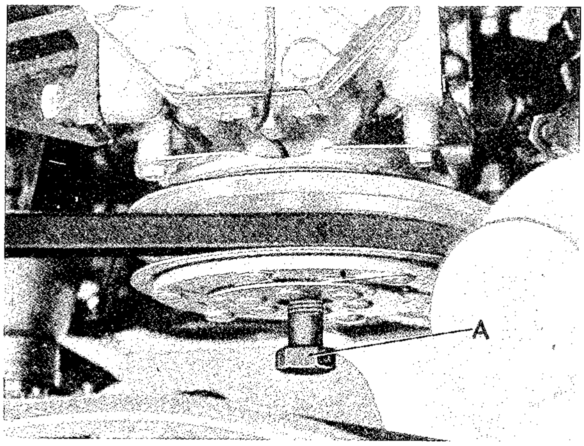


Fig. 8-91. Removing pulley
A. Bolt 5/8" UNC

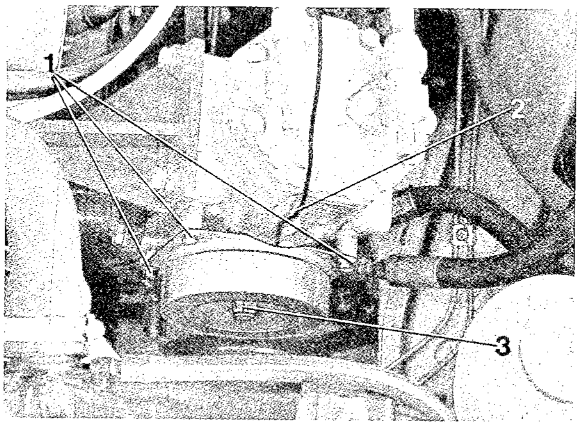


Fig. 8-92. Removing solenoid
1. Attaching bolts for solenoid
2. Electric cable
3. Key

When installing the solenoid, turn it so that the cable (2) comes upwards. Before fitting the pulley, check that the key (3) fits properly in the shaft groove. Tighten the pulley center bolt to a torque of 25—30 Nm (2.5—3.0 kpm=18—22 lbft). When tightening the center bolt, the simplest way to lock the clutch is by switching on the current and holding the pulley with the compressor belt. Then check by rotating the pulley several revolutions that it does not slip in the solenoid.

REPLACING THERMOSTAT

The thermostat can be replaced without emptying the system of refrigerant.

1. Release the clamps for the evaporator hoses in the engine compartment.
2. Remove the dryer from its bracket and place it as near the cowl as the hose between dryer and condensor permits.
3. Disconnect the thermostat attachment (1, Fig. 8-79) from the central unit and both the clamps (2) holding the cover on the evaporator.
4. Pull the evaporator out of the central unit without disconnecting any hoses and place it on the floor (Fig. 8-80).
5. Remove the thermostat with capillary.
6. Insert the new thermostat capillary in the evaporator and bend it according to the measurements in Fig. 8-93. It is important that no sharp bends are made on the capillary.

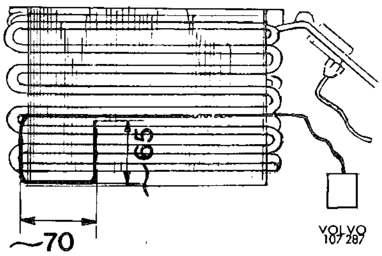


Fig. 8-93. Location of capillary tube in evaporator

7. Install the evaporator in the central unit. Secure the cover with the two clamps and fix the thermostat to the lower flange. With sealing compound seal all round the evaporator pipes and thermostat capillary if necessary.
8. Install the dryer and clamp the refrigerant hoses securely in position in the engine compartment.

REPLACING RECEIVER-DRYER

Each time work is carried out on the air conditioning system involving evacuation of refrigerant, the receiver-dryer should be replaced. The receiver-dryer is removed by disconnecting the hose connections as well as the two bolts for the bracket (Fig. 8-94). When the receiver-dryer is to be installed, it is important that it faces with the marking "OUT" towards the evaporator. Use copper washers on the hose connections.

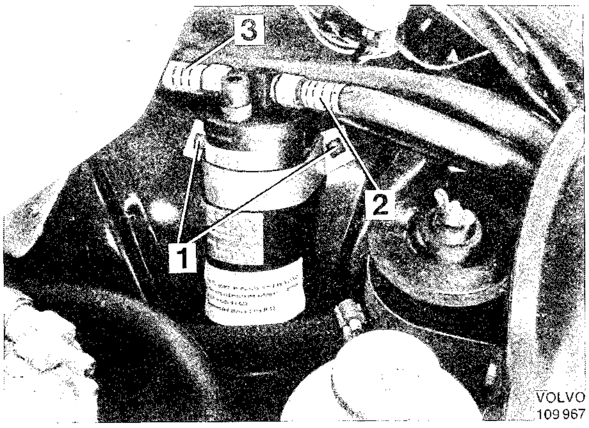


Fig. 8-94. Removing receiver-dryer
1. Screws for bracket
2. Hose from condensor
3. Hose for evaporator

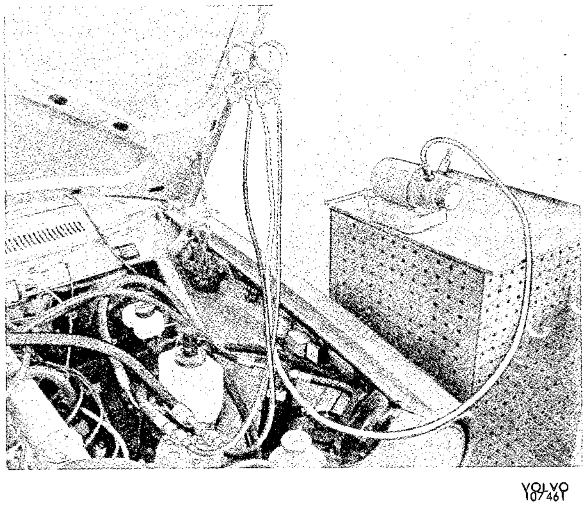


Fig. 8-95. Connecting vacuum pump

FILLING WITH REFRIGERANT

The air conditoning system may only be filled with refrigerant of type Freon 12 (dichlorodifluorometan). During the filling work, which is divided up into the stages vacuum pumping, leakage test and filling, a suitable balance for weighing the refrigerant container is necessary in addition to the equipment shown in Fig. 8-4.

NOTE: Before starting the filling, check that the pressure gauges and hoses are properly tightened up in the distributing piece and that the valves are closed. Check also that there are spacers on the end nipples on the hoses that are connected to the compressor and vacuum pump or refrigerant can.

Vacuum pumping

1. Screw off the cap nuts from the compressor valves.
2. Connect up the low-pressure gauge hose, the blue one, to the suction side of the compressor (marked "suction" on top of the compressor), and the high-pressure gauge hose, the red one, to the discharge side (marked "disch"). The middle white hose is connected to the suction side of the vacuum pump (Fig. 8-95). NOTE: The packings in the nipples must only be tightened with the fingers when they are connected up in order not to damage them.
3. Start the vacuum pump and then open both the valves at the pressure gauges slowly and simultaneously. NOTE: With all pressure balancing in the system, the valves should be opened very slowly otherwise there is risk of the compressor oil being sucked out.
4. Let the vacuum pump run until the low-pressure gauge indicates a vacuum of about 28" below atmospheric pressure. This vacuum is generally obtained quite quickly, but in order to be sure that all moisture has been removed from the system, the pump should be driven for at least 60 minutes at a temperature of below 30°C (86°F) and at least for 30 minutes at temperatures above 30°C (86°F). Thereafter close the pressure gauge valves and stop the pump.
5. If a vacuum of 28" does not arise or if it drops a lot after the valves have been closed, there must be considerable leakage in the system, which is easy to trace. After putting right the leakage, repeat points 3 and 4.

Leakage test

1. Disconnect the white hose from the vacuum pump and connect it to the refrigerant can (Fig. 8-96). NOTE. Under no circumstances whatsoever may the refrigerant can be placed on its side or inverted. It must always be upright while the system is being filled, otherwise fluid will be sucked into the compressor and damage it.

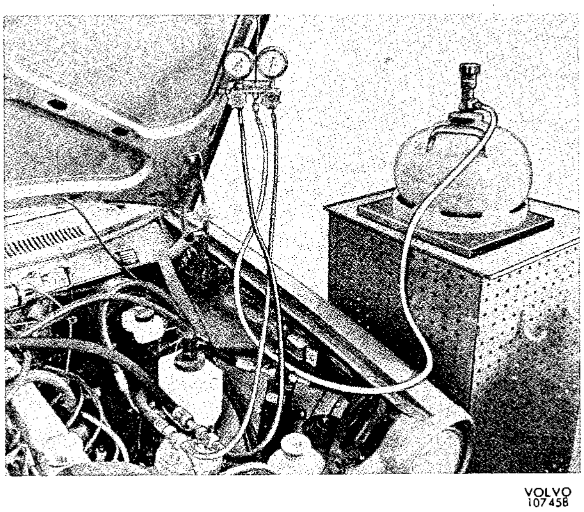


Fig. 8-96. Connecting refrigerant can

2. Open the valve on the refrigerant can and both the valves at the pressure gauges.
3. When the whistling sound ceases, there is pressure balance in the system, and about 1 hg ($3^1/_2$ ozs.) refrigerant left in it. By letting all the valves remain open, this situation will remain even if there is some leakage in the system.
4. Light the leak detector and check the entire system at all the connections by holding the end of the hose next to the connection (Fig. 8-97). If there is leakage, the color of the flame will change to blue-green.
   Check the entire system even if leakages are discovered at an early stage. NOTE: In all cases where gas might escape, the hands and bare skin should be protected with rubber gloves, etc.
5. If a leak is discovered, seal it and then test the system again.

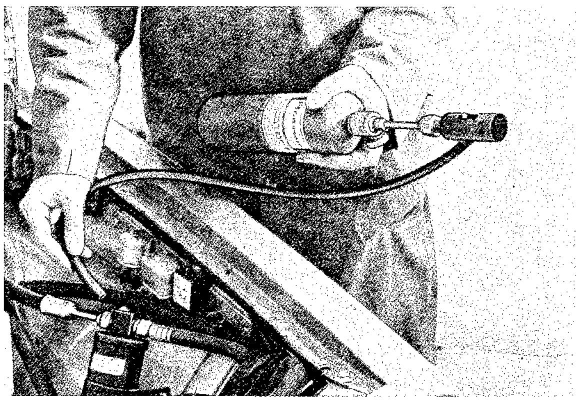


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Fig. 8-97. Leakage test

Filling

1. Shut off the valves on the refrigerant can and the pressure gauges.
2. Disconnect the hose from the refrigerant can and insert it in an exhaust suction hose. Slowly open the valves at the pressure gauges and release the gas in the system. By releasing 1 hg ($3^1/_2$ ozs.) refrigerant, the air in the system accompanies it and this results in an effective drying of the system. Moisture is bad for the air conditioning system since it can easily freeze and plug the TEV valve at the evaporator unit.
3. When the pressure gauges indicate zero, close the valves on the gauges. Connect up the white hose to the vacuum pump. Start the pump and open the valves slowly. Allow the pump to go for about two minutes after the low-pressure gauge has shown 28" below atmospheric. Then close the valves and stop the pump.
4. Disconnect the hose from the vacuum pump and connect it to the refrigerant can.
5. Place the can on a balance and read off the weight with the hose connected.
6. Open the valves on the refrigerant can and both the pressure gauges. When the whistling sound ceases, close the valve on the high-pressure gauge. NOTE: This valve must not be opened while the work is in progress.
   Connect the rev counter and the exhaust hose. Start the engine and run it at about 33 r/s (2000 rpm). Set the cooling control to maximum cooling and the fan to maximum speed. Open the car doors and let them stay open otherwise the vehicle will cool down internally and this will cause the solenoid coupling on the compressor to cut out.
8. When the balance shows 8 hg (28 ozs.) less than at the reading in point 5, and the bubbling in the dryer sightglass stops, lower the engine speed to idling and close the low-pressure gauge valve. If no bubbles are observed in the sightglass at idling, then the filling is completed. If there are still bubbles in the sightglass proceed as follows: Open the low-pressure gauge valve, raise the engine speed and add a further 0.5 hg (1.8 ozs.) refrigerant.
9. Close the valves on the low-pressure gauge and the refrigerant can. Stop the engine. Disconnect the hoses and screw tight the compressor cap nuts.

BUMPERS

GENERAL INFORMATION

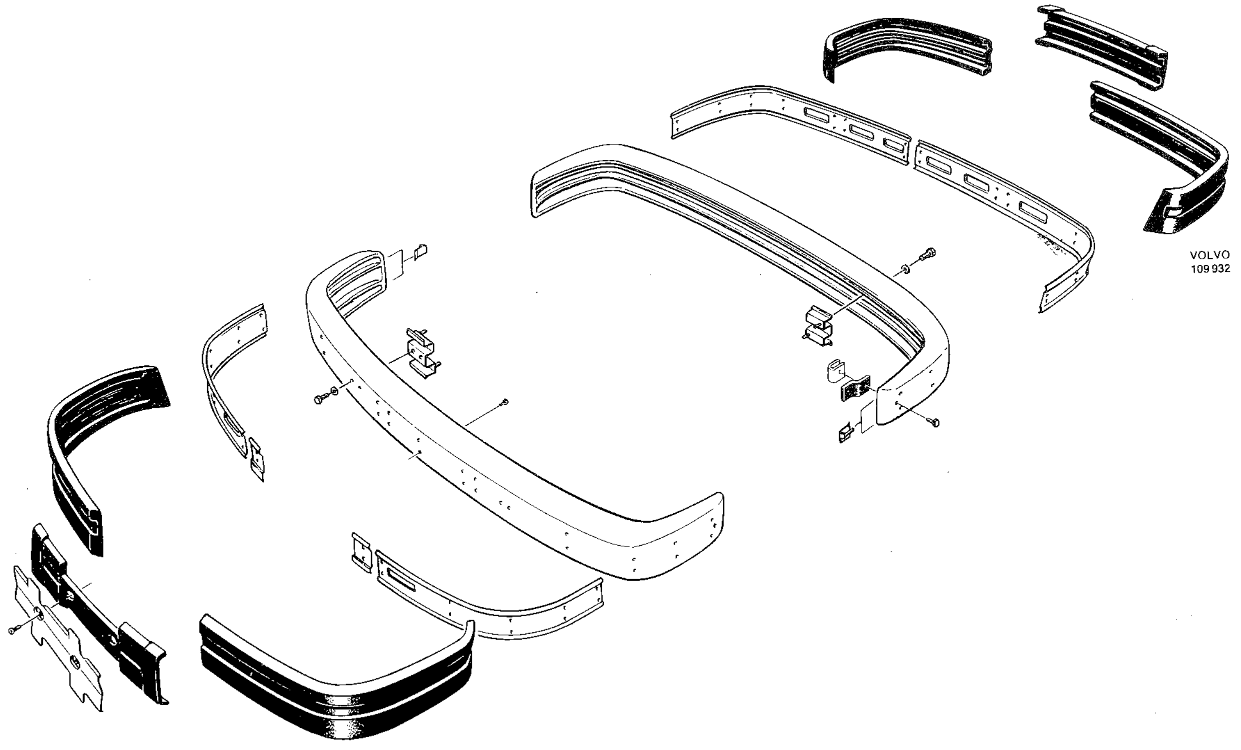

Fig. 8-98. Bumpers

The bumpers (Fig. 8-98) are made of aluminium and are provided with energy-absorbing rubber strips. The bumpers are fitted with impact absorbers. With this bumper arrangement, the bumpers should be able to withstand front or rear collisions up to 8 kmph (5 mph). The rear impact absorbers are partly filled with gas. This acts as a spring and restores the bumper to its initial position after, for example, a collision.
Since the rear impact absorbers are partly filled with gas, no welding work may be carried out on or near them. The reason for this is that on being heated, the gas can explode so powerfully as to burst the cylinders.

REMOVING AND INSTALLING FRONT BUMPER

The front bumper is removed as follows: First remove the directional indicators. Then take off the rubber cover washers which are situated in the cover strip over the bumper. Thereafter release the nuts (2, Fig. 8-99) and pull out the bolts (1). Finally take off the bumper complete. Installing is in reverse order to removal.

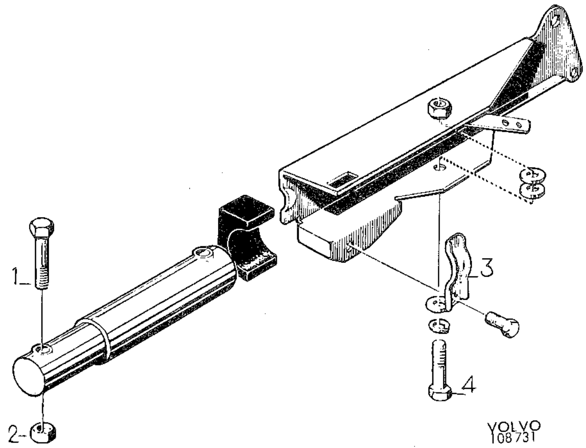

Fig. 8-99. Front impact absorber

REMOVING AND INSTALLING REAR BUMPER

1. Remove the spacer rubber retaining plates (Fig. 8-100).
2. Remove the nuts for the bumper brackets and lift off the bumper.
3. Installation is in opposite order.

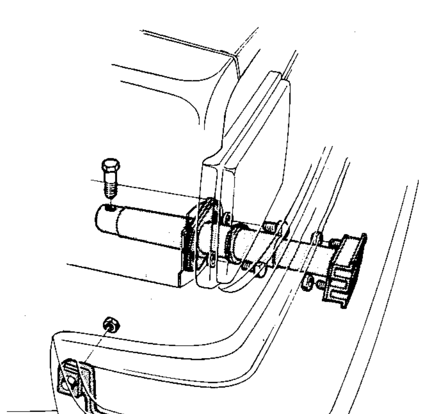

Fig. 8-100. Rear impact absorber

REPLACING FRONT IMPACT ABSORBERS

The impact absorbers are removed by taking off the clamps (3, Fig. 8-99), and then releasing the nuts and taking off the bolts (4). Now the bumper with impact absorbers is completely loose and can be taken off. Thereafter undo the bolting (1 and 2) and replace the impact absorber with a new one by first fitting it to the bumper, but without tightening up the bolting. Then fit the impact absorber to its rear attachment. Fit the bolt (4) with spring washer, spacer washer (one on each side of the impact absorber) and the nut but without tightening the nut. Now fit the clamp (3). Use polygrip pliers. Thereafter tighten up bolts and nuts.

REPLACING REAR IMPACT ABSORBERS

The impact absorbers are partly gas-filled and no welding on or close to them is permitted. Heating may expand the gas to such an extent that the impact absorbers are blown.

If, therefore, oxy-acetylene cutting must be performed to remove the impact absorbers, the gas pressure should first be released. To do this proceed as follows: Drill a 4 mm ($^5/_{32}$") diam. hole according to Fig. 8-101 and let out the gas. Welding can then be carried out without any risk. Also if the impact absorber does not function, it should be empty of gas before being discarded.

NOTE: Use safety glasses when drilling.

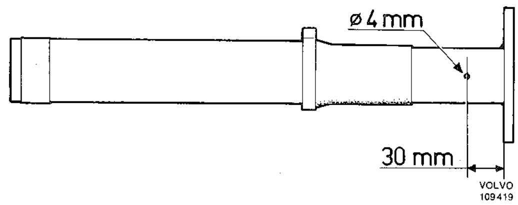

Fig. 8-101. Releasing of gas pressure in rear impact absorber

1. Remove the bumper as previously described.
2. Remove two retaining bolts (Fig. 8-100) for the bracket.
3. Remove retaining bolt in the side member. It is accessible from inside the trunk. Remove impact absorber. Pull off the bracket and spacer. NOTE: Empty the gas before scrapping.
4. Attach bracket and spacer to the new impact absorber.
5. Position the impact absorber and fit the bolt from the side member.
6. Install bracket bolts.
7. Install bumper.

Replacing cover moulding, rear bumper

1. Open the trunk lid and lift out the spare wheel, also the rear end panels on the inside.
2. Detach the ends of the cover moulding held in position by two rubber pins.
3. Remove the attachment nut, Fig. 8-102 (both sides).

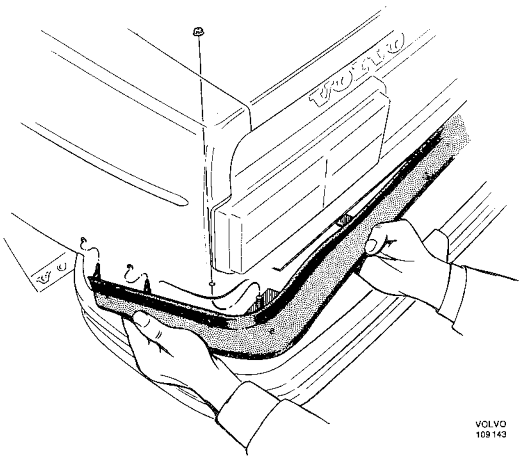

Fig. 8-102. Removing rear bumper cover moulding

4. Pull out the strip with the attaching rail from the rear end.
5. Installation is in reverse order to removal. Check that the attaching rail clips have locked securely.

Replacing rubber strip on rear bumper

1. Unscrew the attaching bolts for the impact absorbers from the bumper.
2. Remove the bumper.
3. Unscrew the rubber strip attaching plates from the bumper.
4. Remove the rubber strip from the attaching plates.
5. Fit the new rubber strip by pressing in over the attaching plates.
6. Fit the rubber strip with attaching plates onto the bumper.
   Align with the holes with the help of a small screwdriver.
7. Lift up the bumper towards the impact absorbers and fit the attaching bolts.

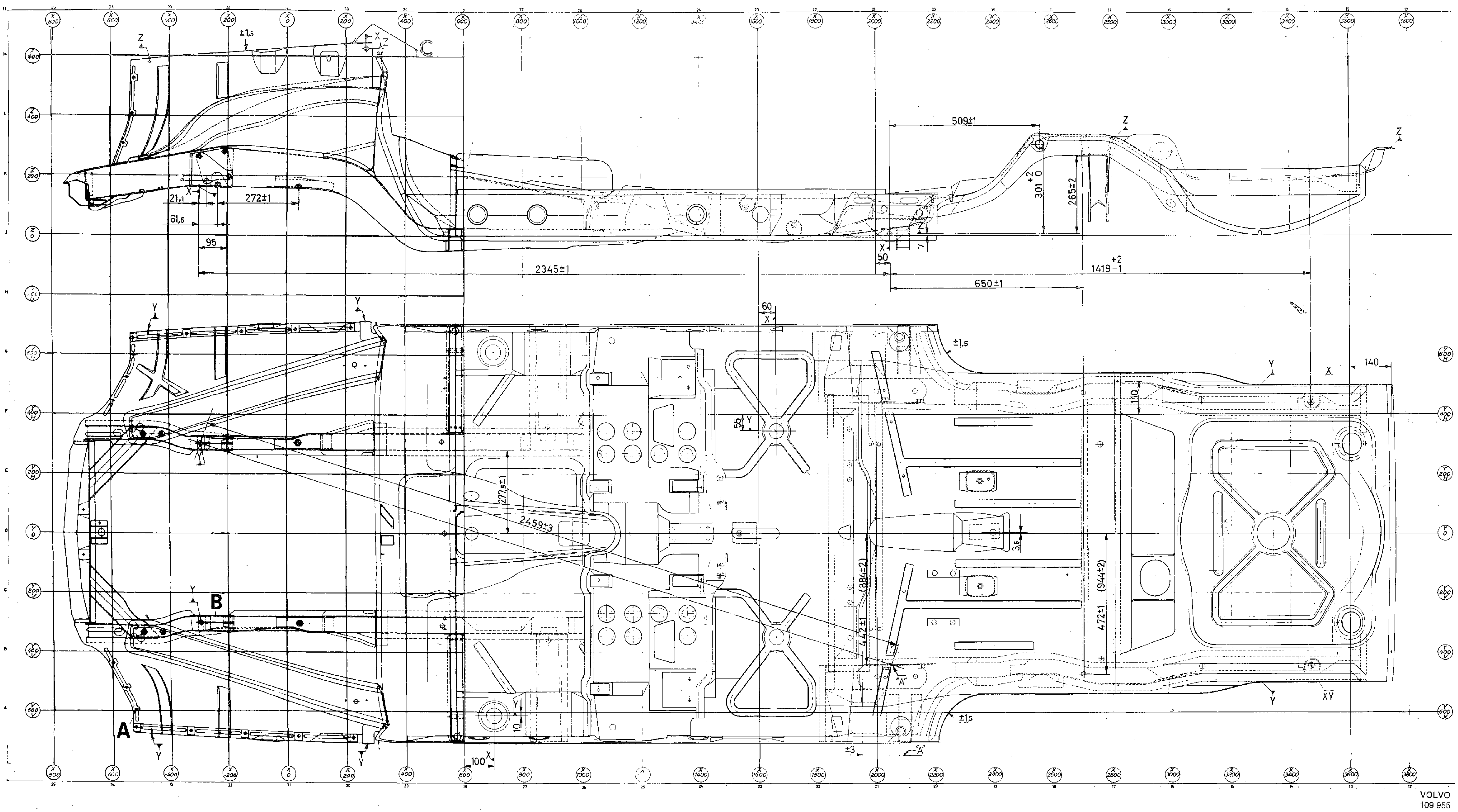

Illustration 8 A. Check diagram for body floor

A = Max. deviation from theoretical position for hole group = 1.5 mm (0.06″)
B = 227±1 mm (8.9±0.04″). L = 200 mm (7.9″) plane of steering box
C = Max. deviation between these flanges and the Z-direction±1 mm (0.04″)

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