



SERVICE MANUAL

VOLVO 164 1974



FOREWORD

This Manual contains servicing instructions for the Volvo 164, 1974 model from chassis No. 102950.

The book is divided up into 9 parts 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 part, 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 parts are divided up as follows:

- Tools
- Description
- Repair Instructions

The specifications are to be found in Part 0, General.

The instructions given in this book generally assume that special tools are used and are based on experience gained from method studies. The same 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

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0 General

1 Servicing and maintenance

2 Engine

3 Electrical system and instruments

4 Power transmission, rear axle

5 Brakes

6 Front end and steering gear

7 Frame, suspension, wheels

8 Body



Part 0

GENERAL

GROUP 01

TYPE DESIGNATIONS

MODEL PLATE

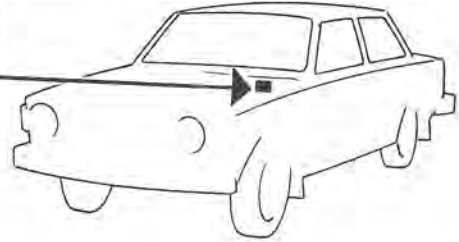
Earlier version

Vehicle:

Type and Designation
Color Code
Upholstery Code

Location:

Engine compartment, left side of the firewall



MODEL PLATE

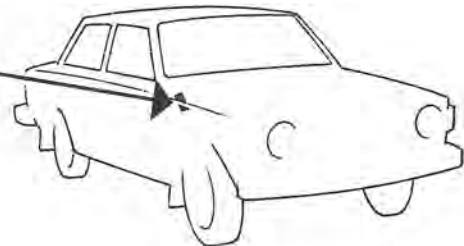
Later version, introduced Nov. 1973

Vehicle:

Type and Designation
Chassis No
Weight Specifications
Color Code
Upholstery code

Location:

Right side wheel housing



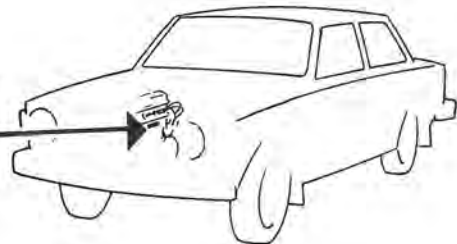
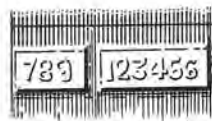
VOLVO
108753

ENGINE

Type, P/N and Serial No.

Location:

Stamped on the engine left side

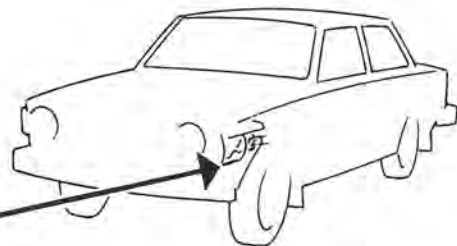


TRANSMISSION

Type and Designation P/N and Serial No

Location:

On the transmission underside

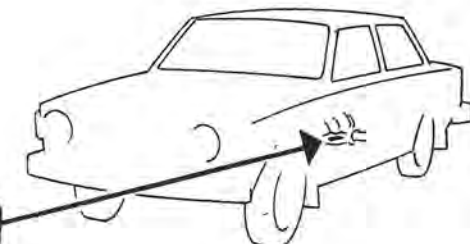


FINAL DRIVE

Ratio, P/N and Serial No

Location:

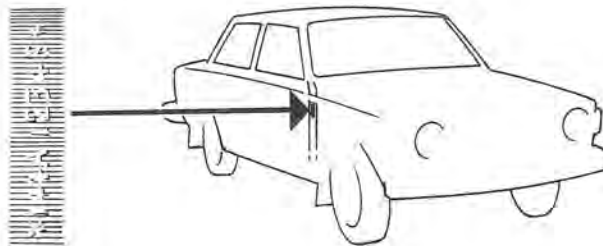
On the left side of the final drive housing



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.



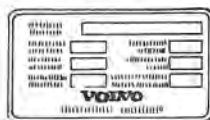
SERVICE PLATE

Introduced Nov. 1973

Chassis No, Codes for brakes, clutch etc.

Location:

The pillar behind right front door



BODY NO.

Location:

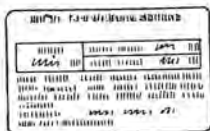
On the left side of the firewall in the engine compartment



USA: CHASSIS NO. AND WEIGHT SPECIFICATIONS

Location:

The pillar behind left front door

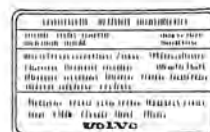


USA: *) VEHICLE EMISSION CONTROL INFORMATION

Location:

On the left side of the firewall in the engine compartment

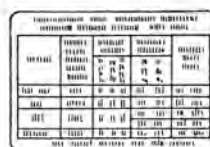
For California there is also a label with Emission Control Information on the rear window



TIRE PRESSURES

Location:

rear front door jam



*) European vehicles have a plate with information on European regulations.

GROUP 03

DIMENSIONS AND WEIGHT

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 $-12^{\circ}\text{C} = +10^{\circ}\text{F}$)	Multigrade Oil SAE 20 W-40 or 20 W-50
winter (below $-12^{\circ}\text{C} = +10^{\circ}\text{F}$)	Multigrade Oil SAE 10 W-30
continuous temp. below $-18^{\circ}\text{C} = 0^{\circ}\text{F}$	Multigrade Oil SAE 5 W-20
Oil capacity, excluding oil filter	5.2 dm ³ (4.5 Imp.qts.=5.5 US qts.)
including oil filter	6.0 dm ³ (5.3 Imp.qts.=6.3 US qts.)
Oil for carburetor damping cylinder	Automatic Transmission Fluid

GEARBOX (WITHOUT OVERDRIVE)

Lubricant, type	Gear oil
viscosity	SAE 90
at continuous air temperature below -10°C (14° F)	SAE 80
Alternative lubricant, type	Engine oil
viscosity, all year round	SAE 40
Oil capacity	0.6 dm ³ (1.1 Imp.pints=1.3 US pints)

GEARBOX WITH OVERDRIVE

Lubricant, type	Engine oil
grade	Service MS
viscosity, all year round	SAE 30
alternative	Multigrade Oil SAE 20 W-40
Oil capacity, gearbox and overdrive	1.4 dm ³ (2.5 Imp.pints=3.0 US pints)

AUTOMATIC TRANSMISSION

Lubricant, type	Automatic Transmission Fluid, Type F
Normal operating temp. of oil	100—115° C (212—239° F)
Oil capacity	8.2 dm ³ (14.4 Imp.pints=17.3 US pints)

FINAL DRIVE

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 dm ³ (2.8 Imp.pints=3.4 US pints)

POWER STEERING

Lubricant, type	Automatic Transmission Fluid, Type A or Dexron
Oil capacity	approx. 1.2 dm ³ (2.1 Imp.pints=2.5 US pints)

ENGINE

GENERAL

Type, designation		B 30 A	B 30 E	B 30 F
Output, hp at r/m	SAE	145/5500	175/5800	(SAE J 245) 138/5500
	DIN	130/5000	160/5500	
Output, kW at r/s	SAE	107/92	129/97	(SAE J 245) 101/92
	DIN	96/83	118/92	
Max. torque, $\frac{\text{kpm}}{\text{lbft}}$ at r/m	SAE	$\frac{22.5}{163}$ /3000	$\frac{24.5}{178}$ /2500	(SAE J 245) $\frac{21.5}{154}$ /3500
	DIN	$\frac{21.0}{152}$ /2500	$\frac{23.5}{170}$ /2500	
Max. torque, Nm at r/s	SAE	221/50	240/42	(SAE J 245) 209/58
	DIN	206/42	230/42	

	B 30 A	B 30 E	B 30 F
Compression pressure (warm engine) when turned over with starter motor, 4.2—5.0 r/s (250—300 r/m)	10—12 kp/cm ² (142—170 psi)	11—13 kp/cm ² (156—185 psi)	9—11 kp/cm ² (128—156 psi)
Compression ratio	9.3:1	10.0:1	8.7:1
Number of cylinders	6	6	6
Bore	88.9 mm (3.50")	88.9 mm (3.50")	88.9 mm (3.50")
Stroke	80 mm (3.15")	80 mm (3.15")	80 mm (3.15")
Displacement	2.98 dm ³	2.98 dm ³	2.98 dm ³
Weight, including electrical equipment and gearbox	241 kg (530 lb)	241 kg (530 lb)	241 kg (530 lb)
Weight excluding gearbox, starter motor, oil and water	192 kg (422 lb)	192 kg (422 lb)	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 oz.)
Permissible weight deviation between pistons in same engine	10 grammes (0.35 oz.)
Height, total	71 mm (2.79")
Height from piston pin centre 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 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

	B 30 A	B 30 E	B 30 F
Height, measured from cylinder head contact face to face for bolt heads	86.7 mm (3.413")	85.5 mm (3.366")	87.0 mm (3.425")
Cylinder head gasket, thickness standard, unloaded ..	0.8 mm (0.031")	0.8 mm (0.031")	1.2 mm (0.047")
loaded ..	0.7 mm (0.028")	0.7 mm (0.028")	1.0 mm (0.039")
Distance from top side of head to overflow pipe upper end (pipe placed under thermostat)	35 mm (1.38")	35 mm (1.38")	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")
2 (" " 0.020")	39.163—39.203 mm (1.5419—1.5434")

BIG-END BEARINGS

Big-end bearing journals

Width of bearing recess	29.95—30.05 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")
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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, B 30 A	42 mm (1.654")
B 30 E and B 30 F	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 warm 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 warm 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

B 30 A

Length, unloaded, approx.	45.0 mm (1.77")
with a loading of 255±20 N (56±4.4 lb)	39.0 mm (1.54")
with a loading of 660±35 N (145±7.7 lb)	30.5 mm (1.20")

B 30 E and B 30 F

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 dm ³ (5.3 Imp.qts=6.3 US qts)
excluding oil filter	5.2 dm ³ (4.5 Imp.qts=5.5 US qts)
Oil pressure at 33.3 r/s (2000 r/m) (with warm engine and new oil filter)	2.5—6.0 kp/cm ² (36—85 psi)

OIL FILTER

Type	Full-flow type
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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 (0.0032—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, B 30 A

FUEL PUMP

Diaphragm type, pump alt. 1, make	S.E.V. 200 050 12
alt. 2, make	Pierburg PE 15695
Fuel pressure at engine speed 16.6—100 r/s (1000—6000 r/m) ...	min. 0.15 kp/cm ² (2.1 psi)
	max. 0.28 kp/cm ² (4.0 psi)

CARBURETORS

Type	Horizontal carburetor
Make and designation	Zenith-Stromberg 175CD-2SE
Number	2
Air intake diameter	41.3 mm (1.63")
Idling speed	13.33 r/s (800 r/m)
For cars with automatic transmission	11.67 r/s (700 r/m)
Metering needle designation	B1 BE
Oil for damping cylinder	Automatic Transmission Fluid
CO-test	2.5 %

FUEL SYSTEM, B 30 E and B 30 F

FUEL FILTER

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

FUEL PUMP

Type	Rotor pump
Capacity	100 dm ³ /h at 2 kp/cm ² (22 imp. galls=26 US galls/h at 28 psi)
Current consumption	5 amps
Relief valve opens	approx. 4.5 kp/cm ² (64 psi)

PRESSURE REGULATOR

Setting value	2.1 ± 0.1 kp/cm ² (30 ± 1.4 psi)
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INJECTORS

Resistance in magnetic winding	2.4 ohms at +20° C (68° F)
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COLD-START VALVE

Resistance in magnetic winding	4.2 ohms at +20° C (68° F)
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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)
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TEMPERATURE SENSOR II (COOLANT)

Resistance	approx. 2500 ohms at +20° C (68° F)
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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 %)
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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/cm ² (10.0 psi)
Capacity	approx 12.4 dm ³ = 11.0 imp.qts./13.0 US qts. (expansion tank of which 1.5 dm ³ = 1.3 imp. qts./1.5 US qts.)

Fan belt, designation HC-38-888

Fan belt tensioning: with tool 2906

A	B	C	F N (lb)
9.5—10.5	8.1—8.6	11.5	75—110 (16.5—24)

A=Check value with belt tensioner gauge, 2906, new belt

B=With belt in outer position (stretched belt)

C=Value when fitting new belt

F=Depression force in N (lb) when depressing 10 mm (3/8") midway between pulleys.

(The lower value with belt in outer position, stretched.)

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 bolts)	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")
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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

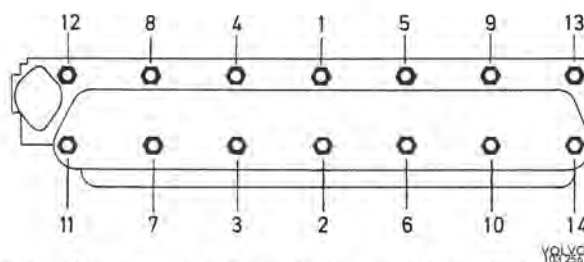
Permissible clearance between valve stems and valve guides, max.	0.15 mm (0.0060")
Valve stems, permissible wear, max.	0.02 mm (0.0008")

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")
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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 op or equivalent
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 r/m)
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 r/m] 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 r/m)
Loaded starter motor:	
9 V and 185—200 A	17.6—22.5 r/s (1050—1350 r/m)
Locked starter motor:	
6 V and 300—350 A	0 r/s

CONTROL SOLENOID

Cut-in voltage	Min. 8 V
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IGNITION SYSTEM

B 30 A

Firing order	1-5-3-6-2-4
Ignition timing	
(at 10.0—13.3 r/s [600—800 r/m] with vacuum governor disconnected)	10° before TDC
Spark plugs, type	Bosch W 200 T 35 or equivalent
thread	14 mm (0.5")
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 JFUR 6
Direction of rotation	Anti-clockwise
Breaker points, gap	Min. 0.25 mm (0.010")
contact pressure	5.0—6.3 N (1.10—1.40 lb.)
dwell angle	40±3°
Capacitor	0.2 µ F±10 %

Centrifugal governor:

Advance range, total	11±1° (distr. graduation)
Advance begins at	7.20—8.75 r/s (425—525 r/m) (distr.)
Values, 5°	10.04—12.05 r/s (625—725 r/m) (distr.)
10°	19.20—27.5 r/s (1150—1650 r/m) (distr.)
Advance finishes at	27.5 r/s (1650 r/m) (distr.)

Vacuum governor:

Positive control (not U.S.A.)

Advance range, total	5±1° (distr. graduation)
Advance begins at	8—12 cm (3.1—4.7") Hg
Value, 2.5°	12—16.5 cm (4.7—6.5") Hg
Advance finishes at	17—19 cm (6.7—7.5") Hg

Negative control

Retard, total	3±0.5° (distr. graduation)
Retard begins at	7—16 cm (2.8—6.3") Hg
Value 2°	12—19 cm (4.7—7.5") Hg
Retard finishes at	15—20 cm (5.9—7.9") Hg

B 30 E and B 30 F

Firing order	1-5-3-6-2-4
Ignition timing	
(at 10.0—13.3 r/s [600—800 r/m] with vacuum governor disconnected)	10° before TDC
Spark plugs type	Bosch 225 WT 35 (B 30 F: W 200 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 PFX 6 (B30F Bosch PFUX 6)
Direction of rotation	Anti-clockwise
Breaker points, gap	Min. 0.25 mm (0.010")
contact pressure	5.0—6.3 N (1.10—1.40 lb)
dwell angle	42±3°
Capacitor	0.2 µ F±10 %

Centrifugal governor:

Advance range, total	10.5±1° (distr. graduation)
Advance begins at	7.08—9.58 r/s (425—575 r/m) (distr.)
Values, 5°	12.50—15.00 r/s (750—900 r/m) (distr.)
9°	20.00—25.33 r/s (1200—1520 r/m) (distr.)
Advance finishes at	26.50 r/s (1590 r/m) (distr.)

Negative control (B 30 F)

Drop, total	5.0±1.0 (distr. graduation)
Drop begins at	30—110 mm (1.2—4.3") Hg
Drop 2°	64—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 f - 38	2
Foglights	55	P 14.5 s	2
Parking lights, front	5 (4 cp)	Ba 15 s	2
rear	5 (4 cp)	Ba 15 s	2
Flashers	32 CP	Ba 15 s	4
Stop lights	25 (32 cp)	Ba 15 s	2
Reversing lights	15 (32 cp)	Ba 15 s	2
License plate light	5	SV 8.5	2
Side marker lamps	3	Ba 15 s	4
Interior lighting	10	SV 8.5	1
Glove compartment light	2	Ba 9 S	1
Engine and luggage compartments	18	SV 8.5	2
Instrument lighting, combined instrument	3	W 2.2 d	2
Control panel lighting	1.2	w 1.8 d	3
Gear selector lighting	1.2	W 1.8 d	1
Lighting, heater controls, clock	2	Ba 7 s	1
Control lamp, instrument panel	1.2	W 1.8 d	5
Control lamp, overdrive	1.2	W 1.8 d	1
Control lamp, elec. heated rear window	1.2	W 1.8 d	1
Control lamp, 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, at second position of switch Approx. 150 W

INSTRUMENTS**SPEEDOMETER GEARS**

Tyre 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 tyres 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, 2½", dry-plate, diaphragm spring
Disc B 30 A	9"
B 30 E, F	9½"
Clutch friction area, total, B 30 A	460 cm² (71.3 sqin)
B 30 E, F	540 cm² (83.7 sqin)
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

M 400

Reduction ratios:	
1st speed	3.54:1
2nd speed	2.12:1
3rd speed	1.34:1
4th speed	1:1
Reverse	3.54:1
Flange nut tightening torque	110—140 Nm (80—101 lbft)
Countershaft, end float	0.03—0.10 mm (0.0012—0.039")
Lubricant	Gear oil
viscosity	SAE 90
at continuous air temperature below	
—10° C (14° F)	SAE 80
Alternative lubricant	Engine oil
viscosity, all year round	SAE 40
Oil capacity	approx. 0.6 dm³ (1.1 Imp.pints=1.3 US pints)

M 410 (GEARBOX M 400 WITH OVERDRIVE)

Reduction ratio, overdrive	0.797:1
Oil pressure, direct drive	Approx. 1.5 kp/cm² (21 psi)
overdrive	32—35 kp/cm² (455—500 psi)
Nut for driving flange	110—140 Nm (80—101 lbft)
Lubricant,	Engine oil
viscosity	SAE 30 or SAE 20 W-40
quality	Service ML or higher
Oil capacity, gearbox and overdrive	approx. 1.4 dm³ (2.5 Imp.pints=3.0 US pints)

AUTOMATIC TRANSMISSION

Make and type	Borg-Warner, type 35
Type designation, B 30 A	323
B 30 E, F	319
Colour of type plate, B 30 A	Light French blue
B 30 E, F	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 r/m)
B 30 E	38.3 r/s (2300 r/m)
B 30 F	36.7 r/s (2200 r/m)
Weights:	kg lb
Gearbox	37.2 82

X Converter ratios

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 dm ³ (14 pints)	
Normal operating temperature of fluid	approx. 110—115° C (212—240° F)	

Approximative shift speeds

Engine	Throttle position	1—2		2—3		3—2		3—1	
		kmph	mph	kmph	mph	kmph	mph	kmph	mph
B 30 A	Full throttle	50	31	90	56	—	—	—	—
	Kick-down	61	38	110	70	98	60	max 49	30
B 30 E, F	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)	40.4 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
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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	0.13—0.20 mm (0.005—0.008")
Pre-loading on pinion bearings, new bearings	110—230 Ncm (9.55—20 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 dm ³ (2.8 Imp.pints=3.4 US pints)

TIGHTENING TORQUES

	Nm	Lbft
Flange	280—300	200—220
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 cm ² (22.5 sqin)

Wheel unit cylinders:	
Number per wheel	4
Area per wheel	40.68 cm ² (1.63")

REAR WHEEL BRAKES

Type	Disc brakes
Brake discs:	
Outside diameter	295.5 mm (11.6")
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 cm ² (16.3 sqin)
Wheel unit cylinders:	
Number per wheel	2
Area per wheel	22.66 cm ² (6.30 sqin)

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"
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BRAKE VALVE

Make	Ate
Operating pressure	34±2 kp/cm ² (484±28.4 psi)

POWER CYLINDER

Make	Ate
Designation	Bremsgerät T 51

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 cm ² (27 sqin)

TIGHTENING TORQUES

	Nm	Lbft
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 cylinder	5—8	3.6—5.8
Attaching nuts, master cylinder	12—15	8.7—10.8
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 and 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—0.0788")
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 (0.2751") 6.996 mm (0.2754") 7.000 mm (0.2756") 7.008 mm (0.2759") 7.012 mm (0.2761")
Washer for adjuster screw, thickness, alt.	2.15—2.45 mm (0.085—0.096") in steps of 0.05 mm (0.002")
Power pump:	
Make and type	ZF, vane pump
Max. pressure	75±5 kp/cm ² (1066±71 psi)
Theoretical capacity at 8.3 r/s (500 r/m)	6.65 dm ³ /m (12 Imp.pints=14 US pints/minute)
Min. capacity, 8.3 r/s (500 r/m) 50 kp/cm ² (711 psi), 80° C (176 F)	4.5 dm ³ /m (8 Imp.pints=9.5 US pints/minute)
Regulated capacity	5—8 dm ³ /m (9 Imp.pints=10.5 US pints — 14 Imp pints=17 US pints/minute)
Drive	Belt
Ratio, engine—pump	1:1
Oil type	Oil approved as "Automatic Transmission Fluid, Type A" or Dexron
Oil changing quantity	Approx. 1.2 dm ³ (2.0 Imp.pints=2.5 US pints)

TIGHTENING TORQUES

	Nm	Lbft
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—85
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	24
Bolt, upper cover	31	22
Nut, adjuster screw	25	20
Nut, pitman arm	170—200	120—145
Attaching nut, steering gear and idler arm bracket	35—40	250—300
Locknut, 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
Locknut for tie rod	75—90	55—65

SUSPENSION, WHEELS

SPRINGS

	USA	Others
Type	Coil springs	
Wire diameter	16.7 mm = .657"	16.4 mm = .646"
Outer diameter	126.7 mm = 4.99"	126.4 mm = 4.97"
Springing coils	8.4	8.4
Test datas:		
Loading for a compression of 10 mm (25/64")	898 N = 201 lb	821 N = 184 lb
Length, fully compressed	135.3 mm = 5.33"	132.3 mm = 5.21"
Load	7239—7730 N = 740—790 kp = 1628—1738 lb	6429—6920 N = 655—705 kp = 1440—1550 lb
at spring length	202.4 mm = 7.968"	199.5 mm = 7.854"

REAR SPRINGS

Type	Coil springs
Wire diameter	12 mm = 0.472"
Outer diameter	128 mm = 5.04"
Springing coils	8
Test datas:	
Loading for a compression of 10 mm (25/64")	164 N = 37 lb
Length, fully compressed	112 mm = 4.41"
Load	2070—2207 N = 464—495 lb
at spring length	287 mm = 11.3"

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

Designation	5.5 J×15 L
Type	Disc
Radial throw	max. 1.6 mm (0.063")
Warp	max. 1.6 mm (0.063")
Imbalance, complete wheel	0.09 Nm (7.8 lbin)
Tightening torque for wheel nuts	100—140 Nm (72—101 lbf·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 dm ³ (0.6 pint)
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 50×1300
System pressure at approx. 30°C (86°F)*	
low-pressure side	1—3 kp/cm ² (14—40 psi)
high-pressure side	10—15 kp/cm ² (140—220 psi)

TIGHTENING TORQUES

	Nm	Lbft
Unions, expansion valve equalizing tube	20	14
expansion valve	50	36
expansion valve hose	42	30
evaporator hose	42	30
condenser	42	30
compressor	42	30
receiver dryer	30	22
Compressor, top cover	20—30	14—22
bottom cover	20—30	14—22
rear bearing housing	20	14
connecting rod bolts	20	14
oil plug	5	3.6
Compressor clutch centre bolt	25—30	18—22

* For these pressures to apply, the car must either be driven, or a powerful fan must be used to blow air through the condenser and radiator corresponding to wind developed thorough driving.

Part 1

SERVICING AND MAINTENANCE

CONTENTS

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Lubricating chart	

LUBRICATION

OIL LEVEL CHECKING AND CHANGING

ENGINE

The oil level is checked with the dipstick, see Fig. 1-14. With a new or reconditioned engine, the oil should be changed after the first 2 500 km (1 500 miles). Thereafter the oil should be changed every 10 000 km (6 000 miles), or at least twice a year, whichever comes first. 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. 1-1. When all the oil has run out, check the washer and screw the plug tightly into position again. Oil is added through the rocker arm casing 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 $-12^{\circ}\text{C} = +10^{\circ}\text{F}$)	20 W - 40 or 20 W - 50
WINTER (below $-12^{\circ}\text{C} = +10^{\circ}\text{F}$)	10 W - 30

At very low temperature (below $-18^{\circ}\text{C} = 0^{\circ}\text{F}$) or when cold-starting difficulties are anticipated, multigrade oil SAE 5 W-20 is recommended. This oil should

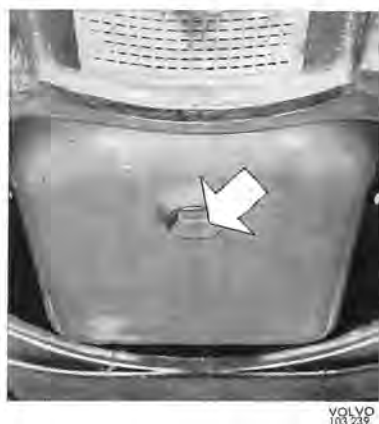


Fig. 1-1. Drain plug on sump



Fig. 1-2. Checking the oil level in centre spindle

not be used when the temperature is continuously above 0°C (32°F).

The quantity of oil changed is 5.2 dm^3 (4.5 Imp.qts = 5.5 US qts). The corresponding quantity when the oil filter is included is 6.0 dm^3 (5.3 Imp.qts = 6.3 US qts).

CARBURETORS

Each time the engine oil is changed, the oil level in the center spindle of the carburetors should be checked to see that it reaches up to about 6 mm ($1/4''$) from the edge of the spindle. If this is not the case, use Automatic Transmission Fluid for filling up.

GEARBOX (WITHOUT OVERDRIVE)

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

In the case of a new or reconditioned gearbox, the oil should be changed and the gearbox flushed out after the first 2 500 km (1 500 miles). The oil should subsequently be changed after every 40 000 km (24 000 miles).

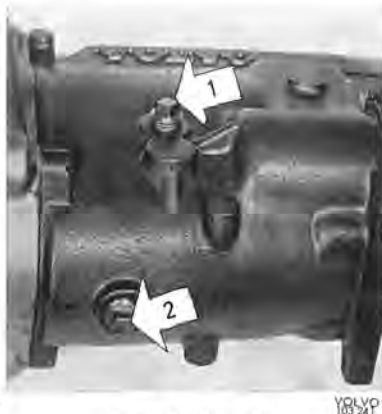


Fig. 1-3. Gearbox
1. Filler plug 2. Drain plug

The oil should be drained off immediately after the car has been driven and while the oil is still warm. When draining the oil, remove the plugs marked 1 and 2 in Fig. 1-3.

Fill up with new oil after the drain plug (2) has been screwed tightly back into position. The oil should reach up to the filler hole (1). Screw the filler plug tightly back into position.

Gear oil SAE 90 is used for the gearbox all the year round. Alternatively engine oil with viscosity SAE 40 can be used all the year round.

The oil changing quantity is 0.6 dm³ (1.1 Imp.pints=1.3 US pints).

GEARBOX 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.



Fig. 1-4. Overdrive

In the case of a new or reconditioned gearbox, the oil should be changed after the first 2 500 km (1 500 miles). The oil should subsequently be changed after every 40 000 km (24 000 miles).

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 dm³ (2.5 Imp.pints—3.0 US pints).

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 10 000 km (6 000 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 trans-

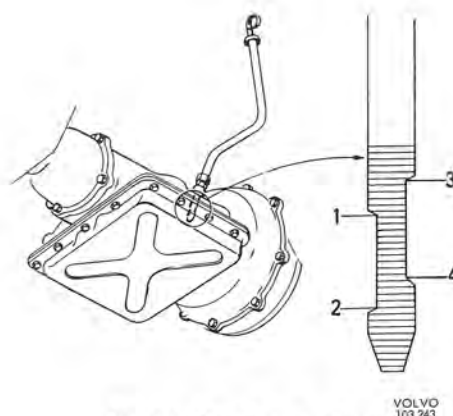


Fig. 1-5. Checking the oil level

1. Max. oil level, cold transmission
2. Min. oil level, cold transmission
3. Max. oil level, warm transmission
4. Min. oil level, warm transmission

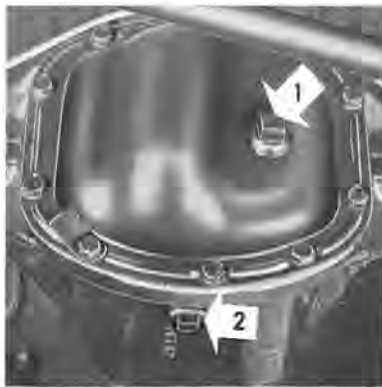


Fig. 1-6. Final drive
1. Filler plug 2. Drain plug

mission. For a warm transmission, which is the case after driving 8—10 km (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 dm³ (1 pint). For topping-up, use Automatic Transmission Fluid, Type F, that is, a fluid meeting Ford specification H2C 33F.

If frequent filling up is found to be necessary, this indicates leakage which must be put right immediately.

FINAL DRIVE

To check the oil level, remove the filler plug (1, Fig. 1-6) and then check to ensure that the oil reaches up to the hole for the plug.

With a new or reconditioned final drive, the oil should be changed after the first 2 500 km (1 500 miles). Oil changing should therefore be carried out only when overhauling is being done.

Oil changing should preferably be done 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 of the final drive that particles and other impurities accumulated during the running-in are removed.

After the drain plug or cover has been re-fitted, fill with new oil. The oil should reach up to the filler

hole and the oil capacity is about 1.6 dm³ (2.8 imp. pints=3.4 US pints). For changing the oil in the final drive oil which meets the requirements of the American Military Standard 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 of the American Military Standard MIL-L-2105B provided with an additive for final drives with limited slip differential. For subsequent topping-up and when changing, oil is according to MIL-L-2105B 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 differential.

POWER STEERING

CHECKING OIL LEVEL

The oil level should be checked every 10 000 km (6 000 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.

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.



Fig. 1-7. Oil level

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 fluid which meets the requirements according to SAE J 1703. Brake fluid with designation DOT 3 or DOT 4 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.

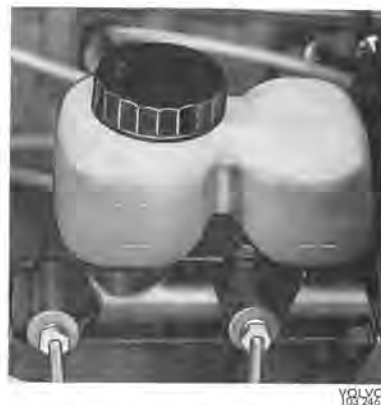


Fig. 1-8. Brake fluid container

INSTRUCTIONS FOR LUBRICATING

DISTRIBUTOR

After every 10 000 km (6 000 miles) the distributor should be lubricated. The distributor shaft should be lubricated by filling the oil cup (3, Fig. 1-9) with engine oil. After filling, close the cup. The surface (2) of the cam disc is lubricated with a thin coating of grease, Bosch Ft 1 v 4, or corresponding grease. The ignition advance mechanism is lubricated by pouring 2—3 drops of light engine oil (SAE 10 W) on the wick (1) in the distributor shaft.



Fig. 1-9. Distributor

1. Lubricating wick 2. Cam disc 3. Oil cup

BALL JOINTS

The upper and lower ball joints of the front end together with the ball joints of the tie rod and steering rod are plastic-lined. Therefore, they do not require lubricating and thus have no grease nipples. As the sealing is extremely important with regard to the service life of these ball joints, the rubber seals should be checked every 20 000 km (12 000 miles) to ensure that they are not damaged. If cracked or damaged, the ball joint should be replaced, see Part 6.

BODY

To avoid squeaking and unnecessary wear, the body should be lubricated as described below. Nos. 2, 8, 10 and 11 of the lubricating scheme on the next page should be lubricated approx. every 10 000 km (6 000 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.

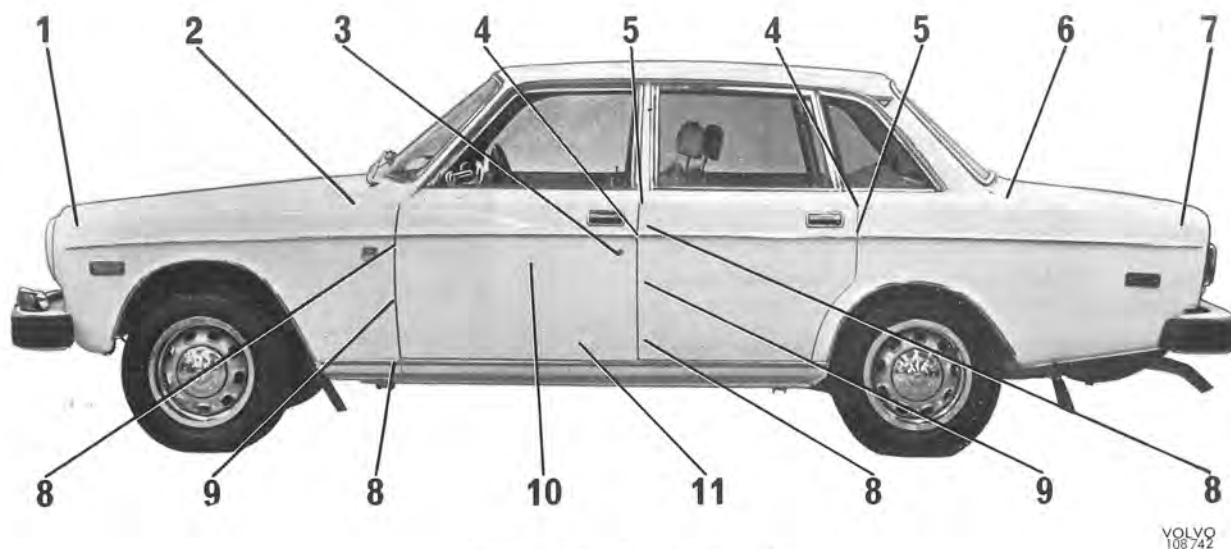


Fig. 1-10. Lubricating points on body

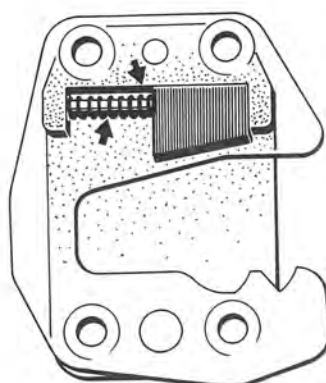
No. Lubricating point	Lubricant	No. Lubricating point	Lubricant
1 Bonnet (hood) catch	Paraffin wax	8 Door hinges	Grease
2 Bonnet (hood) hinges	Oil	9 Door stops	Paraffin wax
3 Keyholes	Lock oil	10 Window winders	Oil and grease
4 Striker plate	See Fig. 1-12	Locks	Silicon grease
5 Outer sliding surface of door lock	Paraffin wax	(Accessible after door upholstery panels have been removed.)	Paraffin wax and oil
6 Luggage compartment lid hinges	Oil	11 Front seat slide rails and catches	
7 Luggage compartment lid lock ..	Oil		
Keyhole	Lock oil		



VOLVO
107159

Fig. 1-11. Hinges

1. Hinges, grease
2. Door stop, paraffin wax
3. Hinges, grease



VOLVO
102965

Fig. 1-12. Striker plate

Inner sliding surfaces, spring and pin are lubricated with molybdenum disulphide grease



VOLVO
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Fig. 1-13. Door lock with guide plate

Apply paraffin wax

CHECKS WHEN FILLING TANK

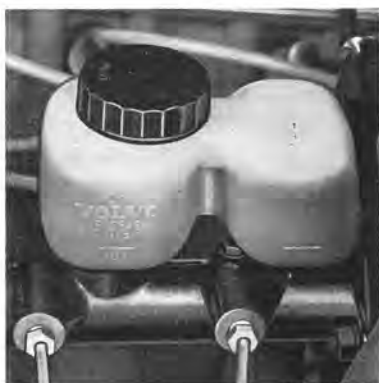
The following should be carried out when filling the tank

1. Check to make sure that the oil level in the engine is between the "Max" and "Min" marks on the dipstick (see Fig. 1-14).
2. Without removing the cap, check that the level in the brake fluid container is above the "Min" mark (see Fig. 1-15).
3. Check that the coolant level is between the "Max" and "Min" marks on the expansion tank (see Fig. 1-16).
4. Check that the fluid container for the windscreen washer is filled (see Fig. 1-17).



VOLVO
108 667

Fig. 1-14. Oil dipstick



VOLVO
108 249

Fig. 1-15. Brake fluid container



VOLVO
106 239

Fig. 1-16. Expansion tank



VOLVO
108 666

Fig. 1-17. 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. 1-18). 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:

Air pressure cold tyres, kp/cm ² (psi)	Front	Rear
1—3 persons	1.9 (27)	1.9 (27)
Fully loaded	2.0 (28)	2.4 (34)

For long-distance driving at high speed, the pressure must be increased by 0.3 kp/cm² (4.3 psi). However, total pressure must not exceed 2.5 kp/cm² (36 psi).



VOLVO
104 302

Fig. 1-18. Battery

INSTRUCTIONS FOR LUBRICATING CHART

SYMBOLS

□ **Engine oil**
Grade: "For Service SD, SE and CC" (MS)
Viscosity: See page 1:1

● **Final drive oil**
Grade: 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: SAE J 1703

OIL CHANGING QUANTITIES

Engine, oil changing quantity	approx. 5.2 dm ³ (4.5 Imp.qts=5.5 US qts)
including oil filter	approx. 6.0 dm ³ (5.3 Imp.qts=6.3 US qts)
Gearbox, without overdrive	approx. 6.0 dm ³ (1.1 Imp.pints=1.3 US pints)
with overdrive	approx. 1.4 dm ³ (2.5 Imp.pints=3.0 US pints)
automatic transmission	approx. 8.2 dm ³ (14.4 Imp.pints=17.3 US pints)
Final drive	approx. 1.6 dm ³ (2.8 Imp.pints=3.4 US pints)
Power steering	approx. 1.2 dm ³ (2.0 Imp.pints=2.5 US pints)

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 1-6.

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 1:4.

Note 4. Lubricate the distributor in accordance with the instruction on page 1:4.

Note 5. Every 10 000 km (6 000 miles) check that the oil reaches up to the filler plug. After every 40 000 km (24 000 miles) the oil should be changed (mechanical gearbox). N.B. The grade of oil to be used depends on the type of gearbox, see pages 1:1 and 1:2.

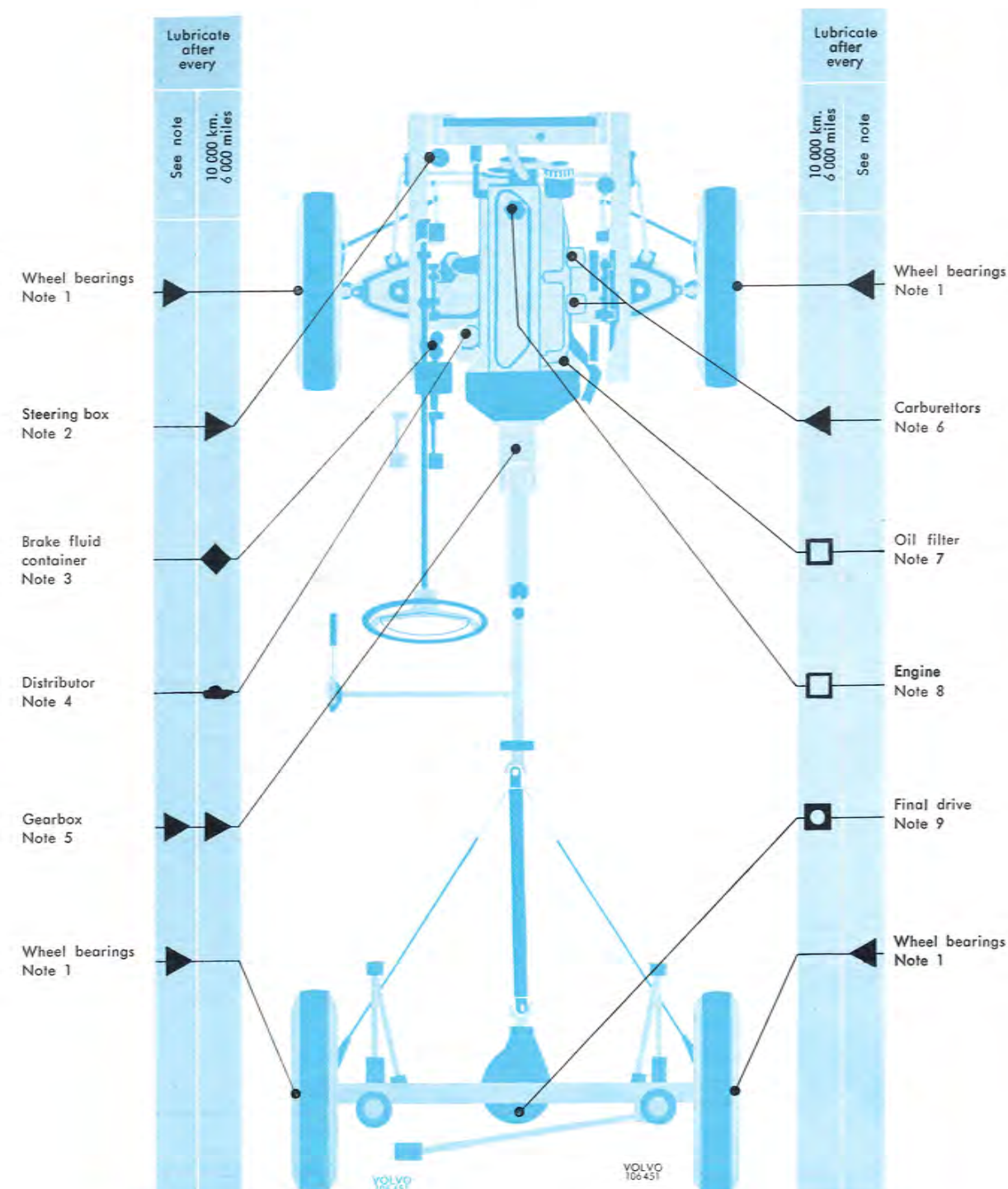
Note 6. Check the oil level in the carburetors when changing the engine oil, see page 1:1.

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

Note 8. Change the oil according to the instructions on page 1:1.

Note 9. Every 10 000 km (6 000 miles) check that the oil reaches up to the filler plug. Concerning lubricant for the final drive with limited slip differential, see page 1:3.

LUBRICATING CHART 164



Part 2
ENGINE

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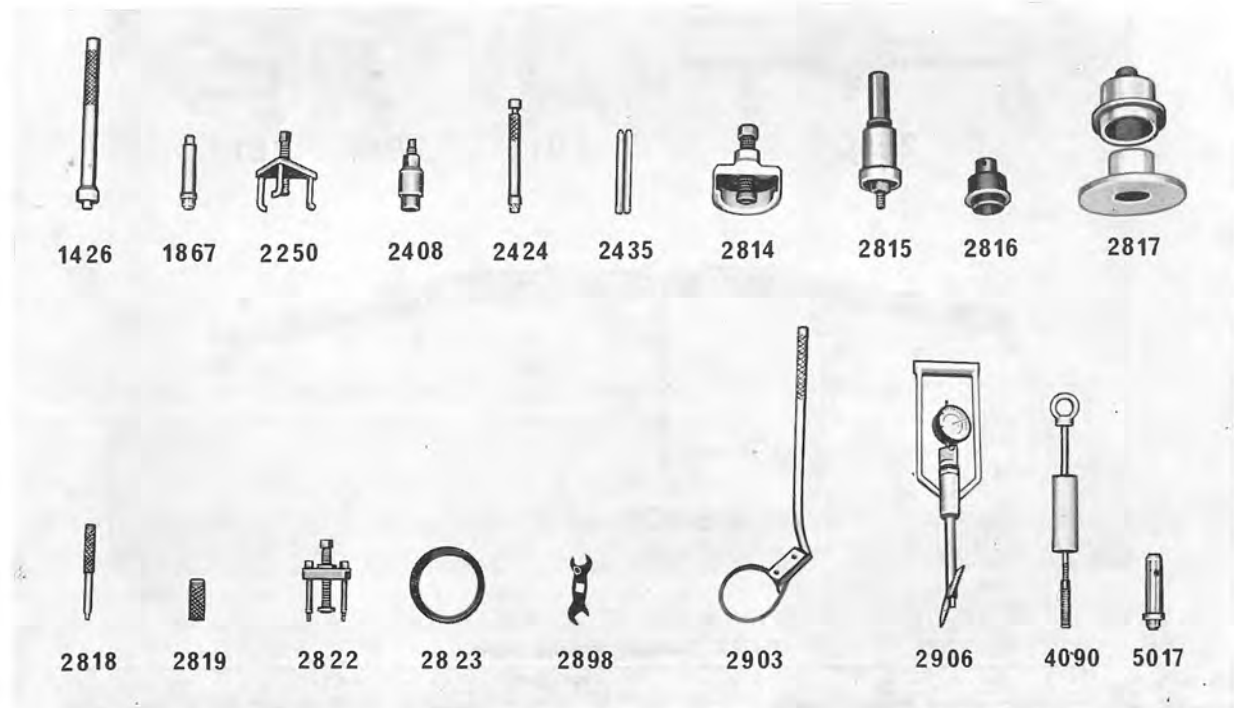
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TOOLS

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



VOLVO
108691

Fig. 2-1. Tools for engine

999 (SVO)

- 1426 Drift for fitting pilot bearing in flywheel (crankshaft)
- 1867 Drift for removing and fitting bush in rocker arm
- 2250 Puller for camshaft gear
- 2408 Press tool for fitting camshaft gear
- 2424 Grip tool for removing and fitting valve tappets
- 2435 Dowel pin (2) for fitting cylinder head
- 2814 Puller for polygon hub
- 2815 Press tool for fitting crankshaft drive and polygon hub
- 2816 Drift for fitting crankshaft oil seal on engine front end
- 2817 Drift for fitting crankshaft oil seal on engine rear end
- 2818 Drift for removing valve guide
- 2819 Drift for fitting valve guide
- 2822 Puller for crankshaft drive
- 2823 Ring for fitting standard piston
- 2898 Spanner for re-tightening cylinder head bolts
- 2903 Spanner for removing oil cleaner
- 2906 Fan belt tensioning tool
- 4090 Puller for crankshaft pilot bearing
- 5017 Drift for removing and fitting bush in connecting rod

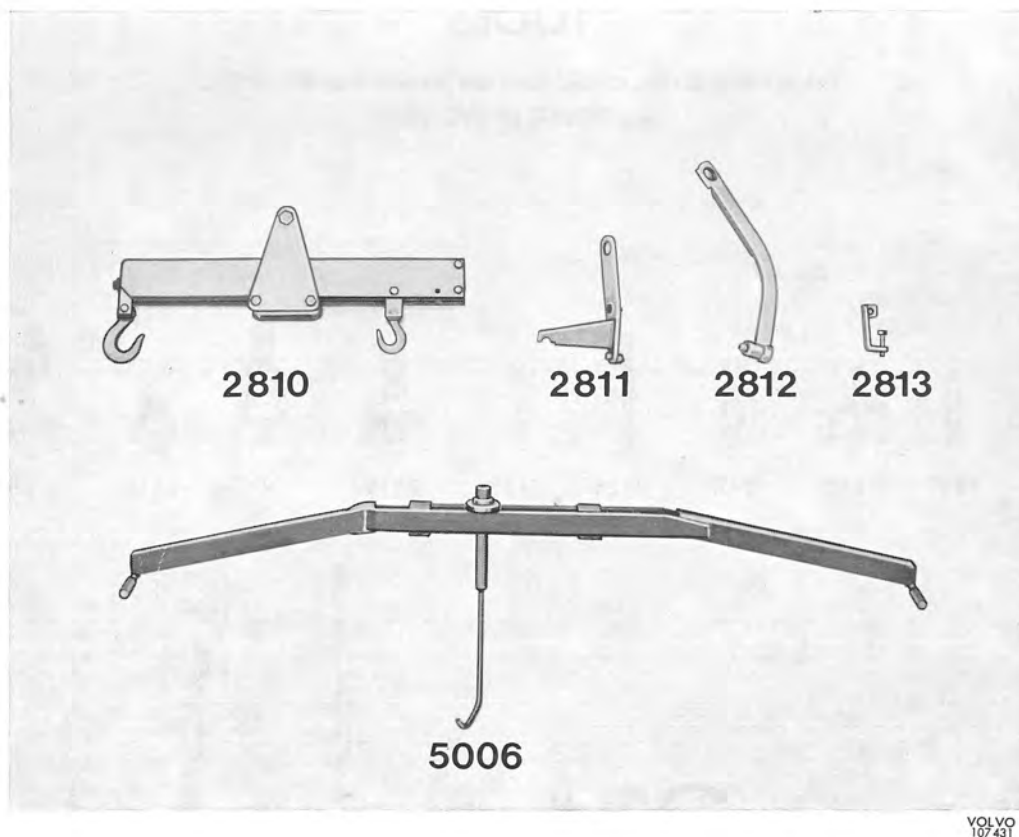


Fig. 2-2. Tools for removing engine

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 (for B 30 E/F altered acc. to separate workshop bulletin)

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

GROUP 20

GENERAL DESCRIPTION

The B 30 engine (Figs. 2-4, 2-5, 2-8 and 2-10) 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 A is provided with two horizontal carburetors as well as an exhaust emission control system which produces cleaner exhaust gases.

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

The B 30 F has the same injection system as the B 30 E but has lower compression and output.

The output figures for the engines are given in the Figs. 2-6, 2-9 and 2-11.



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



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

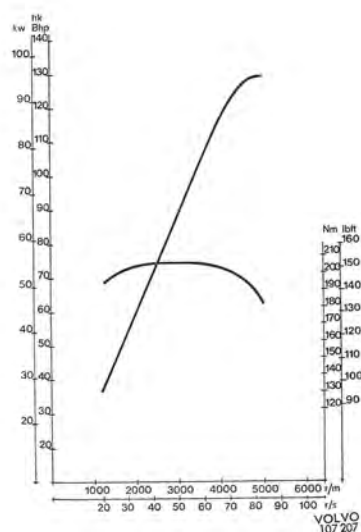


Fig. 2-6. Output and torque curves B 30 A (DIN)



Fig. 2-7. Engine compartment

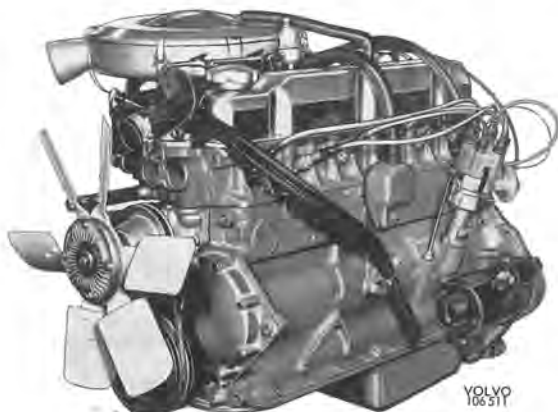


Fig. 2-8. Engine B 30 E viewed from left

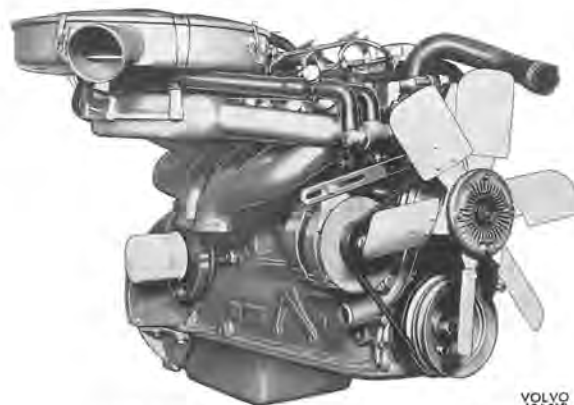


Fig. 2-10. Engine B 30 E viewed from right

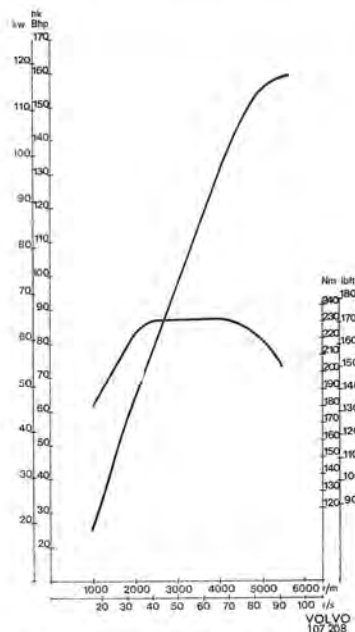


Fig. 2-9. Output and torque curves, B 30 E (DIN)

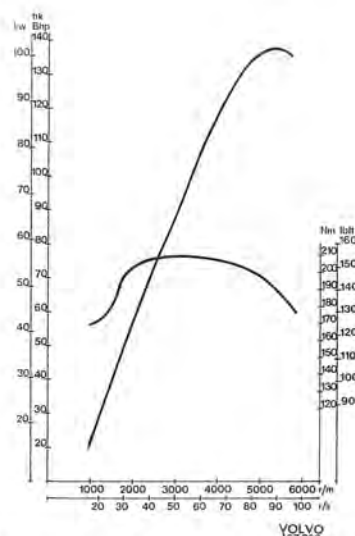


Fig. 2-11. Output and torque curves, B 30 F (SAE J 245)

REPAIR INSTRUCTIONS

REMOVING ENGINE, B 30 A

1. On vehicles with manual gearbox: Remove the gear lever.
2. Disconnect the ground lead from the battery. Empty the coolant.
3. Remove the bonnet (hood) from the hinges.
4. Disconnect the hose for the expansion tank as well as the lower radiator hose from the radiator. Remove the upper radiator hose from the engine. With automatic transmission: Remove the lines for the oil cooler. Remove finally the radiator and fan shroud.
5. Remove the distributor cap and the ignition leads from the spark plugs. Remove the electric cable from the distributor. Disconnect the ignition coil and place it to the one side.
6. Disconnect the fuel hose from the pump and plug the hose. Remove the electric cables from the starter motor.
7. Remove the air cleaner cover and lift it forwards together with the attached hoses. Remove the electric cables from the alternator and also the temperature and oil pressure tell-tale units.
8. Remove the preheating plate and the attaching nuts for the exhaust manifold flange.
9. Remove the cable from the control shaft lever. (With automatic transmission: Remove also the throttle cable.) Remove the linkages and bracket, also the control shaft. Remove the choke wire from the carburetor and the vacuum hose for the brake servo from the manifold. Disconnect the water hoses for the heater element from the engine.

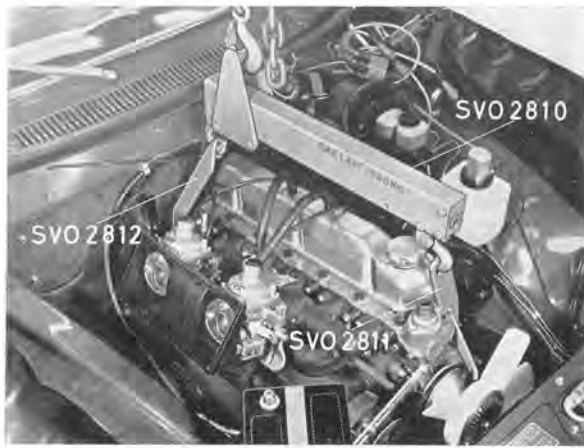


Fig. 2-12. Lifting out engine with lifting tool 2810

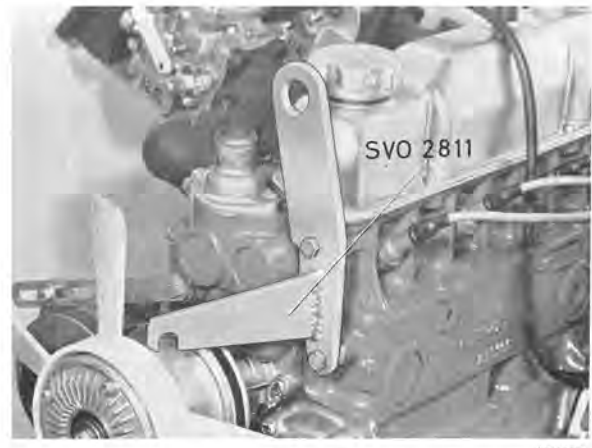


Fig. 2-13. Lifting lug 2811 on engine front end

10. Fit lifting lug 2811 to the front end of the engine as shown in Fig. 2-13 and lifting arm 2812 on the engine rear end as shown in Fig. 2-14. Prop up under the vehicle.
11. Remove the lower nuts from the engine front mountings. Fit the engine lifting unit with lifting beam 2810 and move the block runner to the rear end of the lifting beam, see Fig. 2-12. (Use a nut puller for this adjustment.)
12. Remove the propeller shaft from the gearbox. Disconnect the ground cable from the engine. With automatic transmission: Remove the ground cable for the start inhibitor contact. With manual gearbox: Disconnect the electric cables from the gearbox and overdrive. Remove the speedometer hose.
13. Remove the exhaust pipe clamp from the bracket. Remove the gearbox member and the rubber block and bracket from the gearbox.
14. With manual gearbox: 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.
15. Hoist the engine with the lifting unit, lowering at the same time the engine rear end by adjusting the block unit on the lifting beam. Pull the engine forwards across the front member raising it at the same time. Level out the engine and gearbox and pull the entire assembly forwards.
2. Fit the bracket and rubber block on the gearbox. (Do not tighten the bolts finally. This is done at point 7 below.) Fit the gearbox member.
3. Fit the ground cable. (With manual gearbox: Fit the electric cables for the overdrive and gearbox. With automatic transmission: Connect the ground cable to the start inhibitor contact.) Install the speedometer hose as well as the propeller shaft.
4. Remove the lifting beam and lifting lugs from the engine. Fit the nuts for the engine front mountings.
5. Secure the exhaust manifold together with gasket and fit the preheating plate.
6. With manual gearbox: Fit the clutch wire sleeve and connect the wire to the lever. Adjust the clutch according to Part 4 (41). With automatic transmission: Fit the control rod to the lever for the selector lever.
7. Fit the clamp for the exhaust manifold. Tighten the bolts for the engine rear mountings. Lower the vehicle.

INSTALLING ENGINE, B 30 A

1. Fit lifting lug 2811 and arm 2812. Install the engine in position with the help of lifting beam 2810. Observe! Make sure that the exhaust pipe does not come into contact with the oil filter.



Fig. 2-14. Lifting arm 2812 on rear end of engine



Fig. 2-15. Fitting support 2813 with cylinder head removed

8. Connect the water hoses for the heater unit. Install the electric cables to the temperature and oil pressure tell-tale units as well as the alternator.
9. Connect the vacuum hose. Fit the throttle control shaft and the cable. (For automatic transmission, throttle cable.) Fit the choke wire as well the air cleaner casing. Connect the hoses to the air intake and preheating plate respectively.
10. Wire the electric cables to the starter motor and connect the fuel hose.
11. Fit the ignition coil, the distributor cap and the ignition leads as well as the electric cables.
12. Fit the radiator and connect the radiator hoses and hose for the expansion tank. With automatic transmission: Connect the lines for the oil cooler. Fill with coolant and check the engine oil.
13. Fit the bonnet (hood) and connect the battery lead. Fit the gear lever. Check function and for leakage.

REMOVING ENGINE, B 30 E, B 30 F

1. On vehicle with manual gearbox: Remove the gear lever.
2. Remove the bonnet (hood) and then the battery. Drain out 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 harness 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



Fig. 2-16. Lifting engine, B 30 E/F

- 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 harness 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 (see Figs. 2-13 and 2-14). (Note that 2812 should be provided with a recess as described in a separate workshop bulletin.)
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 gearbox: Remove the electric cables from the gearbox 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 gearbox. With manual gearbox: 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, B 30 E, B 30 F

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 gearbox: 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 selector lever.
Connect the speedometer hose. Fit the propeller shaft.
4. Fit the rear engine mounting loose to the gearbox. 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 gearbox: Connect the electric cables to the gearbox 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 harness 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 harness 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 engine bonnet (hood).
26. With manual gearbox: Fit the gear lever.
27. Carry out function and leakage checks.

OIL SUMP

Because much time can be spared by being able to remove the oil sump without lifting out the engine



Fig. 2-17. Lifting tool 5006

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. 2-17. 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 casing). Unscrew the bolts for the oil sump and lift down the sump.
5. Remove the old gasket and clean the contact surfaces of the cylinder block and oil sump.

INSTALLING

1. Place the oil sump and gasket in position and re-fit the bolts. Tighten securely the drain plug.
2. Place the reinforcing bracket in position and tighten all the bolts 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.

GROUP 21

ENGINE

DESCRIPTION

CYLINDER BLOCK

The cylinder block (43, Illustration 2 A) is made of special cast iron and is cast in a single unit. The cylinder bores, which are surrounded by cooling jackets, are machined directly in the block. The 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 (37) is secured to the block by means of bolts. All the combustion chambers are machined throughout and have separate inlet and exhaust ports, one for each valve.

The valves (6 and 9, Illustration 2 A) which are fitted suspended in the cylinder head, are made of special steel and are carried in replaceable guides. The valve stems are chromed.

The valve collet is provided with three lands and the valve with corresponding grooves, which hold the valve but also make suitable rotation possible. (Compare with Fig. 2-28.) 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 type seals with a metal frame.

CAMSHAFT AND VALVE TAPPETS

The camshaft (61) is made of special-alloy cast iron and has case-hardened cams. It is driven from the crankshaft through a gear train which has a ratio of 1:2. The camshaft is carried in four bearings, all of which have the same diameter. Camshaft axial location is maintained by means of a bronze axial washer located at the front end of the camshaft. Axial play is determined by a spacer ring behind the camshaft gear. The valve tappets (41) are actuated directly by the camshaft. They are located in holes in the block above the camshaft and transfer movement to the valves by means of push rods and rocker arms. There are no inspection covers for the valve tappets since these are accessible after the cylinder head has been removed.

CONNECTING RODS, PISTONS AND PISTON RINGS

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

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

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

FLYWHEEL DAMPER

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

INTAKE AND EXHAUST MANIFOLDS

On the B 30 A engine the intake and exhaust manifolds, the material of which is of nodular iron, are cast onto a branch pipe. They have been designed with a view to the exhaust emission control system, with preheating chamber wherein the temperature of the fuel-air mixture is raised by the heat from the exhaust ports.

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

The inlet duct for the B 30 E/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

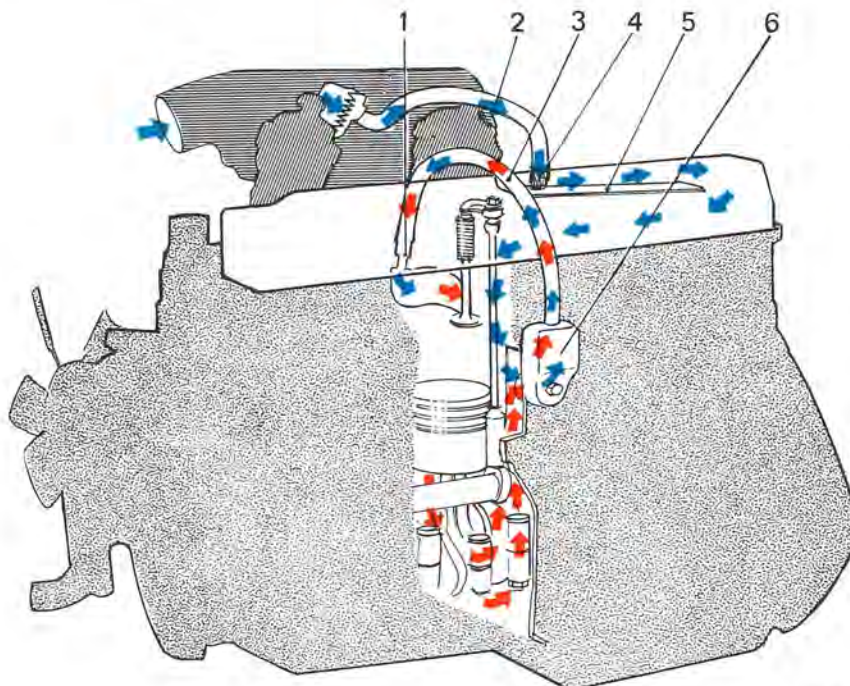
This arrangement prevents crankcase gases from being released into the atmosphere. Instead, they are sucked into the engine through the intake manifold and take part in the combustion process. The residues are blown out through the exhaust pipe together with other combustion residues.

Between the oil trap (6, 2-18) and the intake manifold there is a hose (3). It is connected to the intake manifold by means of a calibrated nipple (1). This nipple should be cleaned every 40 000 km (24 000 miles). On vehicles for U.S.A. the 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 a partial vacuum in the crankcase through the hose (3).

Fresh air is supplied to the rocker arm casing through the air cleaner via the hose (2). A plate in the rocker arm casing (see Fig. 2-18) 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.



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Fig. 2-18. Positive crankcase ventilation

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

REPAIR INSTRUCTIONS

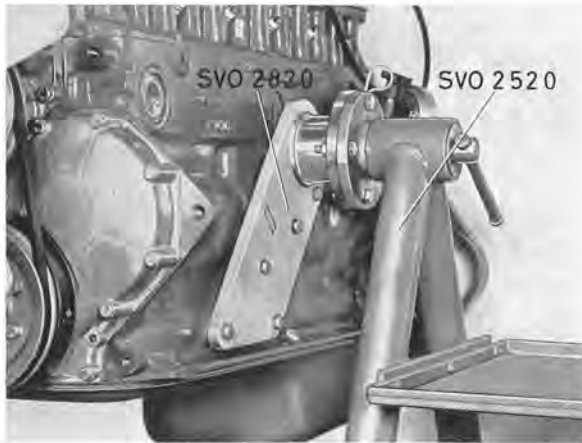


Fig. 2-19. Engine on stand

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. 2-19. 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, rocker arm casing, rocker arms and oil filter. Remove the manifolds with carburetors. Take off the cylinder head. Remove the valve tappets with tool 2424, see Fig. 2-20.
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 sump, rear sealing flange, oil pump and connecting rods with pistons. Replace the caps correctly on the respective connecting rods.
6. Invert and turn the engine. Remove the crankshaft. Place the caps correctly in their respective positions.

CLEANING

After 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



Fig. 2-20. Removing valve tappet

they should preferably be cleaned with white spirit. Pistons and bearing shells must never be washed in caustic soda. Rinse the parts with warm water and blow them dry with compressed air after washing. Clean the oilways with particular thoroughness. All sealing plugs at the oilway openings in the cylinder block must be removed during the cleaning process.

ASSEMBLING ENGINE

When assembling the engine, follow the instructions for the components concerned. Check the marking of the bearings according to Fig. 2-21. The main bearings are marked 1-7, and the big-end bearings 1-6, counting from the front.



Fig. 2-21. Marking main and big-end bearings
1. Main bearing No. 1 2. Big-end bearing No. 1
3. Main bearing No. 2

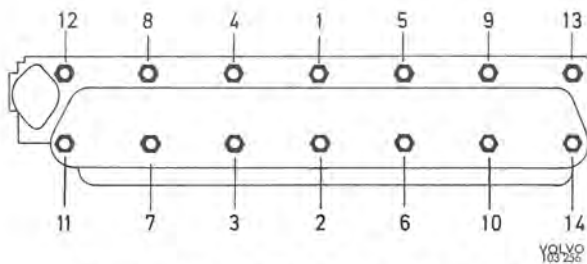


Fig. 2-22. Tightening sequence for cylinder head bolts
To be tightened in three stages
1st stage: 40 Nm (29 lbft) 2nd stage: 80 Nm (58 lbft)
3rd stage: 90 Nm (65 lbft)

Check that all parts are clean and lubricate sliding surfaces with oil before assembling. Always use new gaskets, split pins and lock washers. No adhesive should be used on the gaskets. Sealing at the ends of both the oil pump delivery pipe and the water pump pipes is provided by rubber rings. These rings, which seal radially, are made of special rubber with very close tolerances. Only genuine Volvo parts should be used. Fitting is facilitated by coating the rings with soapy water. Slip the rings on the pipes and then press them into their correct positions before finally tightening the attaching screws. The oil pump flange should lie flush against the cylinder block before tightening. Crankshaft seals at the front and rear ends respectively are installed according to the instructions given on page 2 : 18.

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 : 8.

The cylinder head is fitted with the help of dowels 2435. The bolts must be tightened in a certain sequence, see Fig. 2-22, to avoid unnecessary stresses.

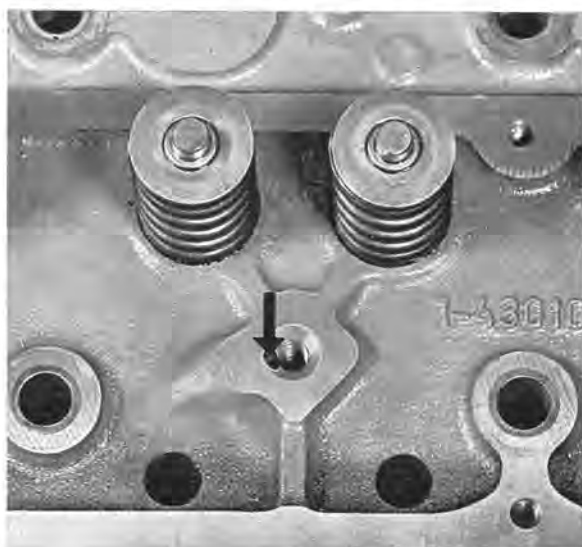


Fig. 2-23. Oil hole in cylinder head

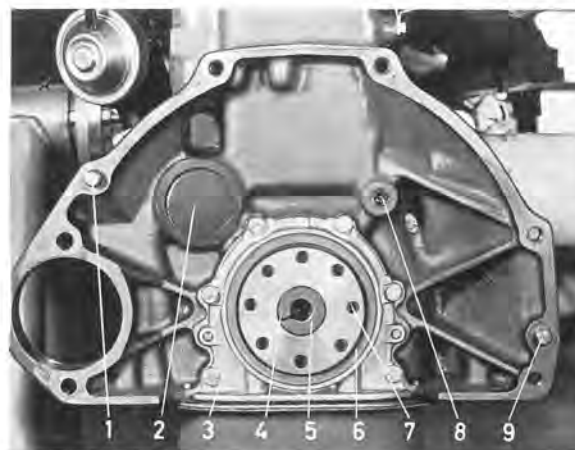


Fig. 2-24. Rear end of engine

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

The bolts should be tightened in two stages and final-tightened after running the engine warm. Check that the oil hole (Fig. 2-23) for lubricating the rocker arms is not blocked.

The pilot bearing (5, Fig. 2-24) 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".

VALVE GRINDING AND DECARBONIZING

REMOVING CYLINDER HEAD, B 30 A

1. Drain off the coolant from the radiator and cylinder block.
2. Remove the choke wire and all the hoses from the intake manifold, carburetors and air cleaner casing. Remove the throttle cable from the control shaft. Remove the link rods and bracket also the control shaft.
3. Remove the heat control valve hose from the engine. Remove the upper radiator hose.
4. Take off the ignition leads from the spark plugs and the electric cable from the temperature tell-tale.
5. Unscrew the preheating plate from the exhaust manifold as well as the nuts for the exhaust manifold flange.
6. Remove the tensioning bar for the alternator from the cylinder head.
7. Remove the rocker arm casing and the rocker arm shaft. Lift out the push rods. Unscrew the bolts for the cylinder head and lift off the head. Remove the manifold from the cylinder head.

8. Recondition the valve system according to the description given under the heading "Cylinder head and valves".

FITTING CYLINDER HEAD, B 30 A

1. Check to make sure that the cylinder head and block as well as the pistons and cylinder liners are clean.

Check that the oilway (Fig. 2-23) for the rocker arm mechanism is clean on the tappet side. In the cylinder head the oil goes up through the bolt hole, between the bolt and the wall cavity and then through an oblique drilling to the attaching bolt for the rocker arm shaft and finally up the shaft.

Mount the manifold onto the cylinder head. Place the cylinder head gasket and cylinder head in position with the lettering "TOP" facing upwards. (Wide edge faces upwards.) Dowel pins 2435 can be suitably used for this purpose. Oil the bolts. Tighten them a 1st and 2nd stage according to the tightening sequence given in Fig. 2-22.

2. Fit the push rods in position and mount the rocker arm mechanism. Adjust the valve clearance, 0.55—0.60 mm (0.022—0.024"), for both the exhaust and intake valves. Note that these are not the final values for the clearance.
3. Fit the alternator tensioning bar to the cylinder head.
4. Fit the nuts for the exhaust manifold flange and also the preheating plate.
5. Fit the throttle control and choke wire, also connect all hoses to the intake manifold and carburetors. Fit the air cleaner cover with hoses.
6. Connect the ignition leads and electric cable for the temperature tell-tale.
7. Fit the hose for the heater control valve and the upper radiator hose. Fill with coolant.
8. Drive the vehicle for about 10 minutes. Check function and also for leakage. Fill if necessary with coolant.
9. **Final-tighten** the cylinder head bolts in the proper sequence, to 90 Nm (65 lbft). Use spanner 2898.
10. Check and adjust the valve clearance to 0.50—0.55 mm (0.020—0.022"). Fit the rocker arm casing and the hoses.
11. Test-run the vehicle and check the engine's performance.

REMOVING CYLINDER HEAD, B 30 E, B 30 F

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.



Fig. 2-25. Re-tightening cylinder head bolts

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 ignition distributor.
5. Remove the contacts for the throttle valve switch, cold start valve, thermal timer contact, temperature sensor for coolant and injectors. Remove the cable harness.
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 rocker arm 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".

FITTING CYLINDER HEAD, B 30 E, B 30 F

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 dowels 2435.

3. Check that the oil hole (Fig. 2-23) 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. 2-22.
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 rocker arm 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 gaskets in position and connect the exhaust pipe to the manifold.
12. Place the cable harness 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 rocker arm 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

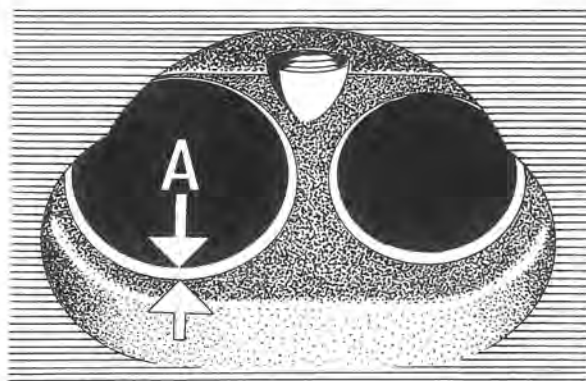


Fig. 2-26. Valve seat width $A=2$ mm (0.08")

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. 2-26. If the sealing surface is too wide after grinding, it can be reduced by using a 70° grinding stone from the inside and a 20° grinding stone from the outside.
3. Coat the valve sealing 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. 2-27.

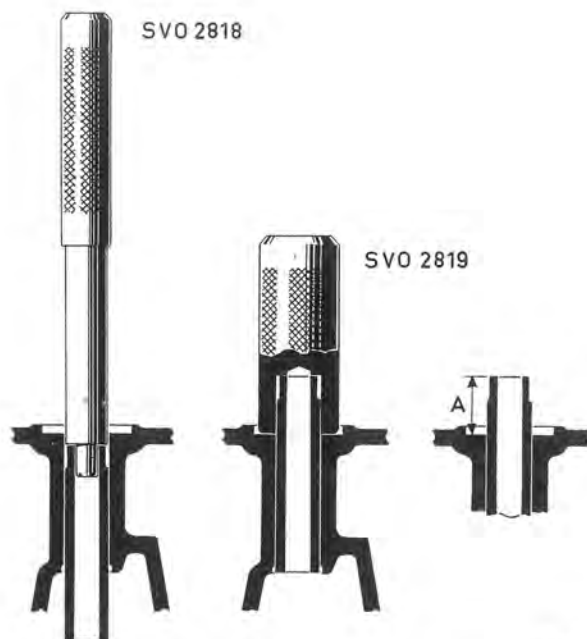


Fig. 2-27. Replacing valve guides
A=17.5 mm (0.689")

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

REPLACING ROCKER ARM BUSHES AND GRINDING ROCKER ARMS

1. If wear amounts to 0.1 mm (0.004") replace the rocker arm bush. Use tool 1867 for pressing the bush out and in, see Fig. 2-29. Then ream the bush with a suitable reamer until an accurate fit on the shaft is obtained. The hole in the bush should coincide with the hole in the rocker arm.
2. If necessary, grind the pressure pad of the rocker arm in a special machine.

ADJUSTING 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.

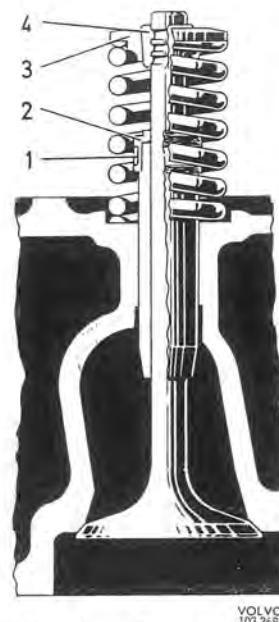


Fig. 2-28. Valve collet and valve guide seal

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

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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.



Fig. 2-29. Replacing bush in rocker arm

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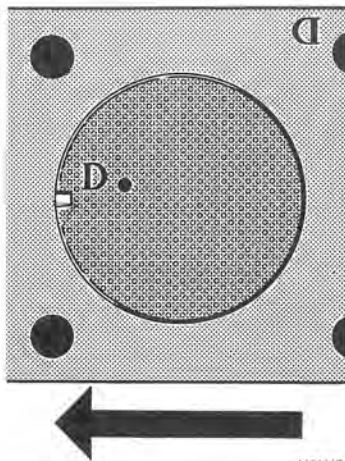


Fig. 2-30. Marking on pistons and cylinder block

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 GUDGEON PINS

MEASURING PISTONS

The pistons are measured with a micrometer at right angles to the gudgeon 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 gudgeon pin hole is measured with a feeler gauge 1/2" wide and 0.05 mm (0.0020") thick attached to a spring balance. The force applied should be 1 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.

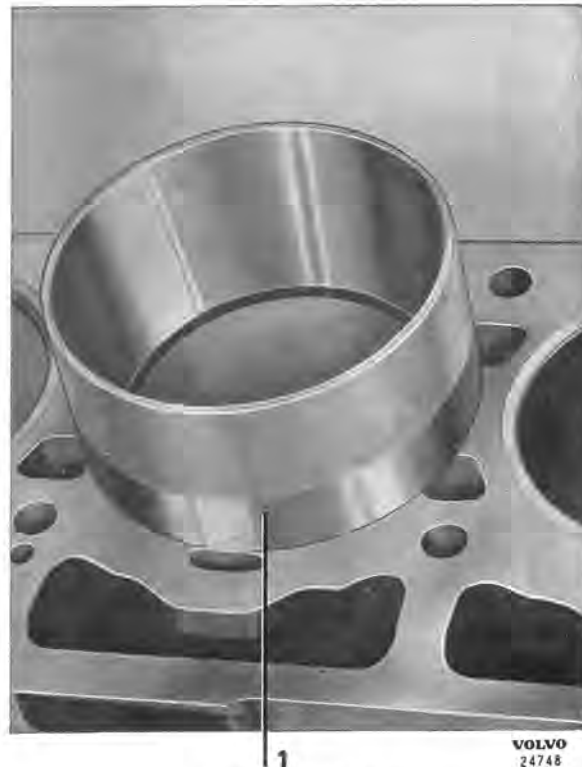


Fig. 2-31. Fitting piston
1. Fitting ring 2823

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

PISTON RING FIT

In a new or re-bored cylinder

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

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. 2-30. If the piston is turned

the wrong way, this will cause a loud noise. The number marking on the connecting rod should be turned to face away from the camshaft side. The gudgeon pin is then fitted, the circlip placed in position and the piston rings fitted.

Use piston ring grips when fitting the rings. The 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 2823, see Fig. 2-31, when fitting the piston in the cylinder bore. Tighten the connecting rod bolts with a torque wrench, see "Specifications" for the correct tightening torque.

GUDGEON PINS

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

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



Fig. 2-32. Replacing bush in connecting rod

CONNECTING RODS

REPLACING BUSHES

If the old bush in a connecting rod is worn, press it out by using drift 5017 and press in a new bush with the same tool, see Fig. 2-32. Make sure that the lubricating holes index with the holes in the connecting rod. Then ream the bush to the correct fit. The gudgeon pin should slide through the hole under light thumb pressure without any noticeable looseness.

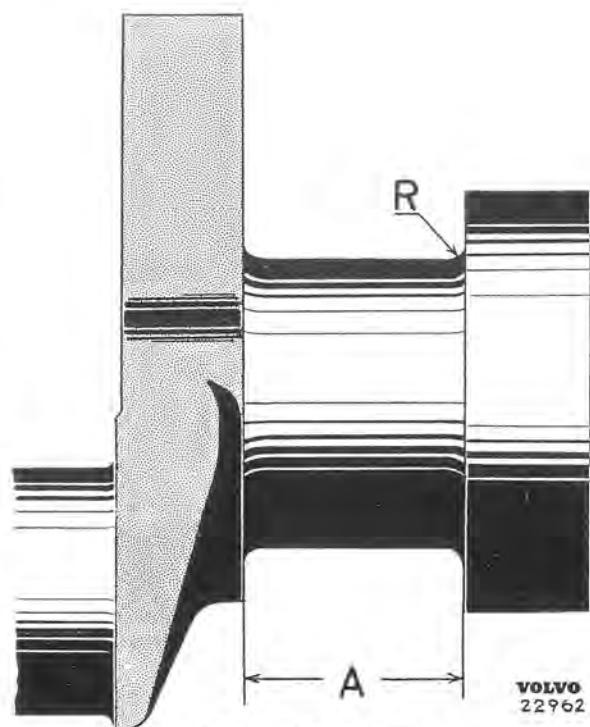


Fig. 2-33. Bearing journal

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 concerned are to be found in the "Specifications".

Check that the crankshaft is straight to within 0.05 mm (0.002") by using a dial gauge. The crankshaft is placed on two V-blocks and a dial gauge placed against the 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 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 uneven or burnt, the surface can be ground in a saddle-mounted grinding machine. Not more than 0.75 mm (0.03") of the original thickness must be ground off.

PILOT BEARING FOR 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.



Fig. 2-34. Fitting oil seal

REPLACING CRANKSHAFT REAR OIL SEAL

1. After having removed the gearbox, clutch and flywheel from the engine, remove the two bolts for the oil sump in the sealing flange. Slacken one of the two bolts on each side so that oil sump pressure on the sealing flange will not be so great. Remove the sealing flange.
2. Press out the seal with the help of the drift for tool 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. 2-34.

NOTE. First inspect the wear surface of the crankshaft.

The sealing ring can be fitted in three positions with tool 2817, see Fig. 2-38. 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.

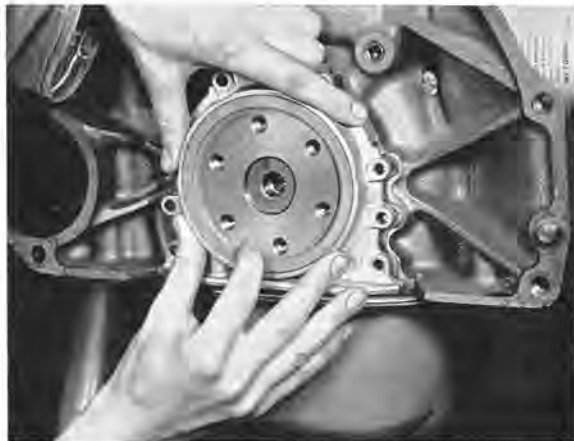


Fig. 2-35. Fitting sealing flange

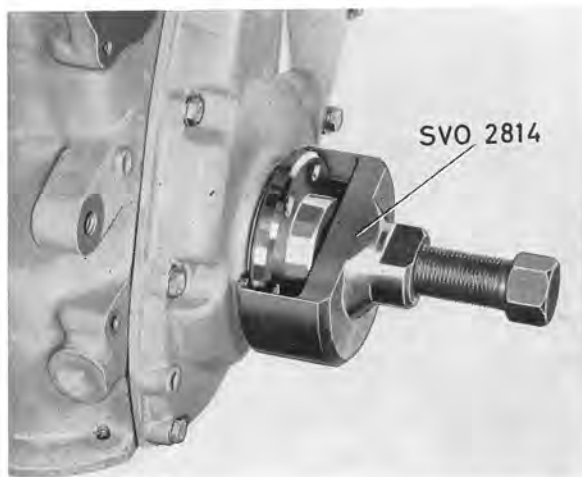


Fig. 2-36. Removing polygon hub

4. Fit the sealing flange, its sealing surface being well cleaned, and a new gasket. (Oil first the sealing ring.) The sealing flange should be mounted on the crankshaft carefully, see Fig. 2-35. Use your finger to fit on the sealing lip.

REPLACING OIL SEAL IN TIMING GEAR CASING

1. Empty the coolant from the system and remove the radiator and radiator grille.
2. Release the fan belt. Unscrew the bolts for the pulley and the flywheel damper and remove the bolts.
3. Remove the center bolt and take off the polygon hub with puller 2814, see Fig. 2-36. (First check to see whether it is possible to pull off the polygon hub by hand.)

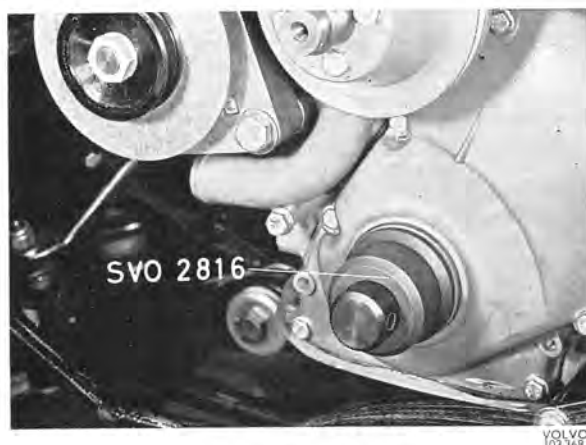


Fig. 2-37. Fitting oil seal

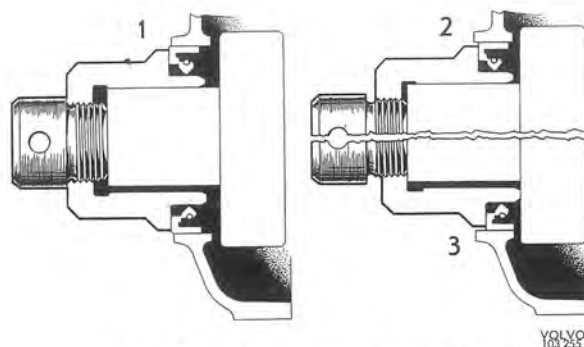


Fig. 2-38. Center spindle position on 2816

4. Remove the oil seal. Lubricate the sealing lip on the new seal and fit the seal with drift 2816, see Fig. 2-37.

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. 2-38. In this position, the seal will be fitted in its outer position (position 1). With a wear mark on the polygon hub, fit the seal in position 2 (1¼ turns of center bolt screwed out). With two wear marks on the hub, fit the sealing in position 3 (center bolt screwed out fully). With three wear marks, the polygon hub should be replaced with a new one.

5. Fit the polygon hub with tool 2815, see Fig. 2-39. 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 torque of 70—80 Nm (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.

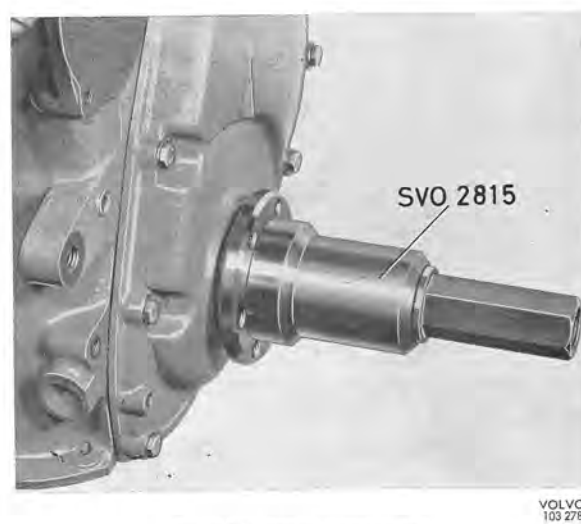


Fig. 2-39. Fitting polygon hub

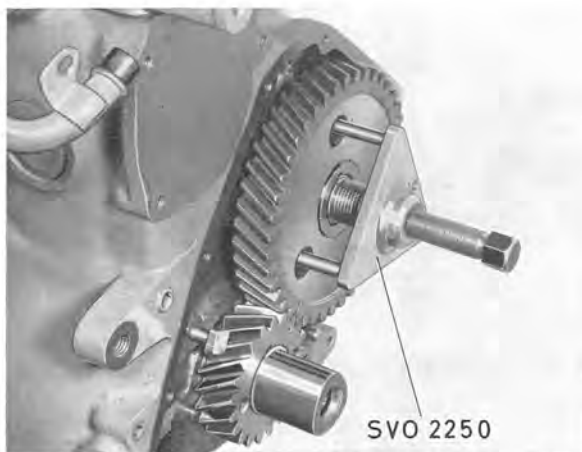


Fig. 2-40. Removing camshaft gear

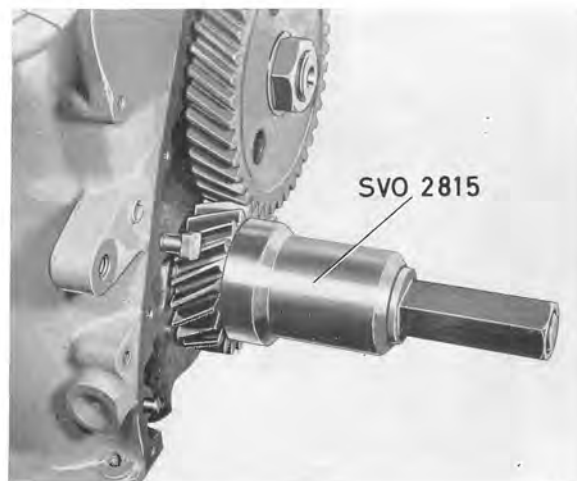


Fig. 2-42. Fitting crankshaft gear

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. 2-40.
5. Pull off the crankshaft gear with puller 2822, see Fig. 2-41.
Screw out the oil nozzle, blow it clean and re-fit it, see Fig. 2-44. The gears are lubricated from this nozzle.
6. Re-fit the crankshaft gear with tool 2815, see Fig. 2-42.
7. Re-fit the camshaft gear with tool SVO 2408, see Fig. 2-43. Both gear wheels should take up the correct position relative to each other, see Fig. 2-44. 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 (94—108 lbft). The measuring values for the tooth flank clearance and the camshaft axle clearance, which is deter-



Fig. 2-41. Removing crankshaft gear

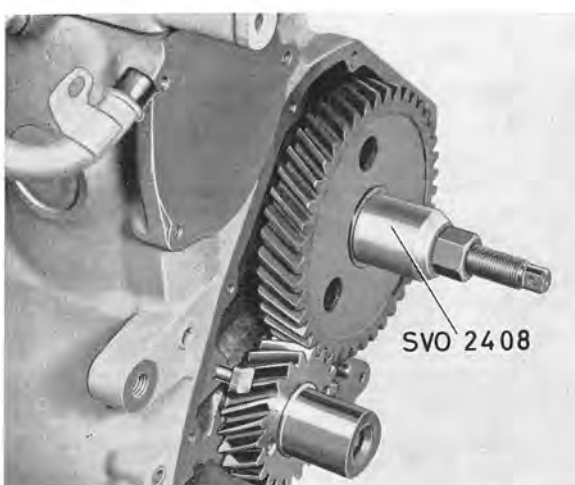


Fig. 2-43. Fitting camshaft gear

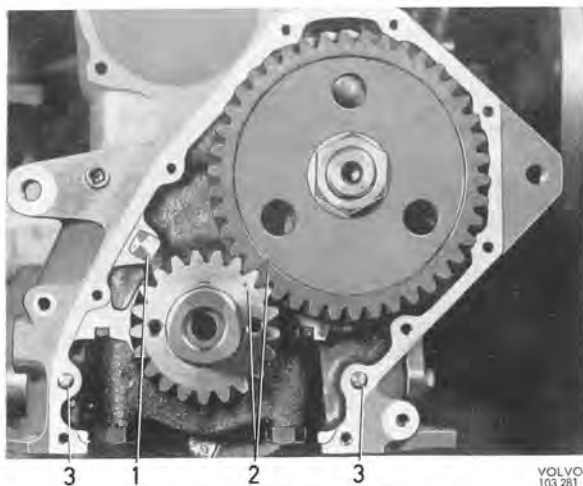


Fig. 2-44. Markings on timing gears
1. Oil nozzle 2. Markings 3. Dowel pins

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

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

POSITIVE CRANKCASE VENTILATION OVERHAUL

At intervals of 40 000 km (24 000 miles), the nipple (1, Fig. 2-18), the hoses and flame guard (4) should be removed and cleaned. At the same time check the hoses and replace those in poor condition. For U.S.A. vehicles, the interval is 20 000 km (12 000 miles).

LUBRICATING SYSTEM

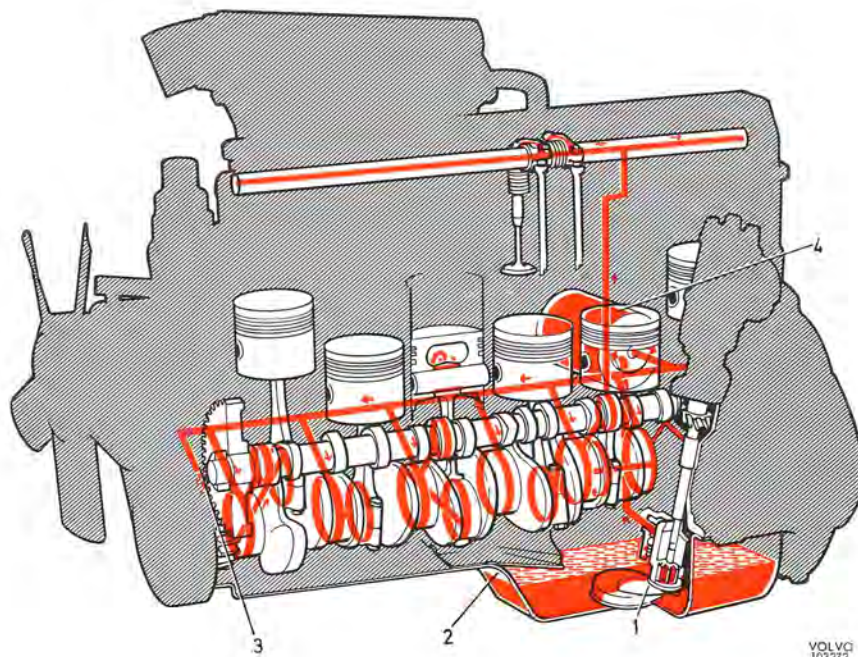
DESCRIPTION

The engine has a force-feed lubricating system, see Fig. 2-45. 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. The B 30 E engine is fitted with an oil cooler.

Fig. 2-45. Lubrication system

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



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OIL PUMP, RELIEF VALVE

The oil pump, see Fig. 2-46, 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. 2-47), 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.

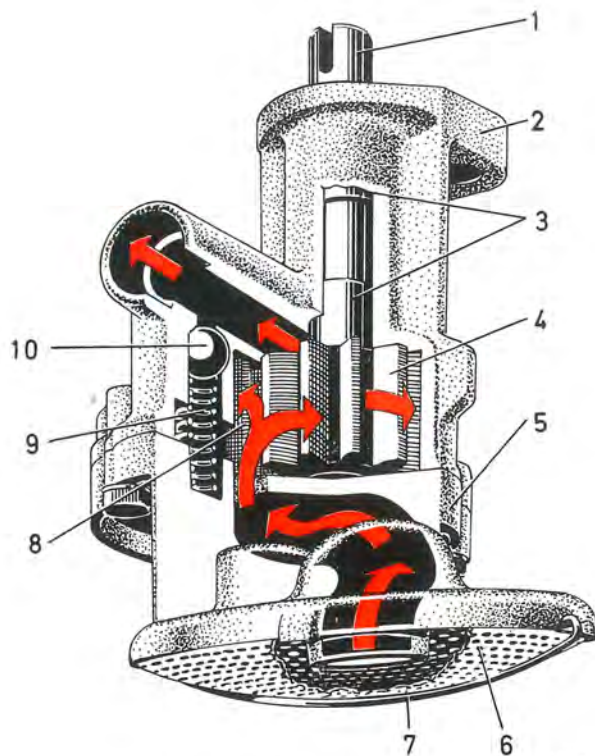


Fig. 2-46. Oil pump

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

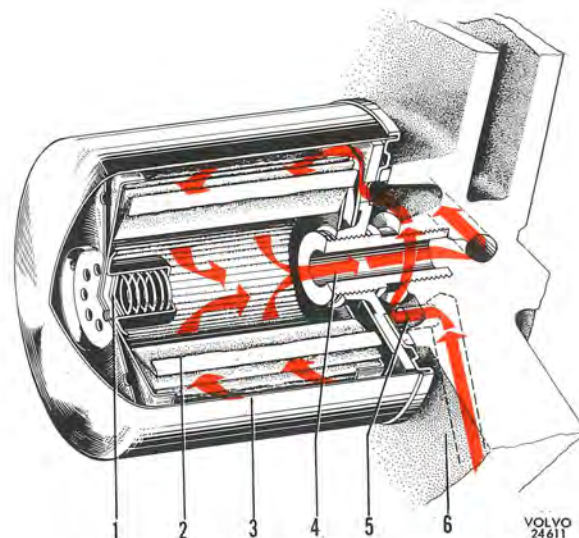


Fig. 2-47. Oil filter

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

REPAIR INSTRUCTIONS



Fig. 2-48. Removing oil filter

REPLACING OIL FILTER

Together with the element and relief valve, the oil filter (see Fig. 2-47) 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. 2-48.

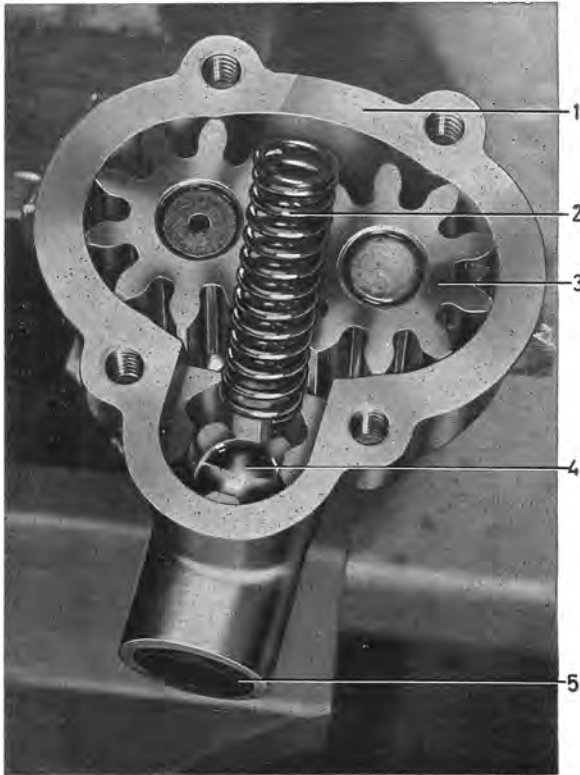
2. Coat the rubber gasket (1, Fig. 2-49) of the new filter with oil and make sure that the contact surface for the oil filter is free from dirt. By smearing it with oil, the gasket slides into better contact with the sealing surface. Screw on the filter by hand until it just touches the cylinder block.
3. Continue to screw on the oil filter a further half turn by hand. **Chain tongs must not be used for fitting.** Start the engine and check that there is no leakage at the joint. Fill up with oil if necessary.



Fig. 2-49. Oil filter ready for fitting
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. 2-50), see "Specifications" for the values concerned.



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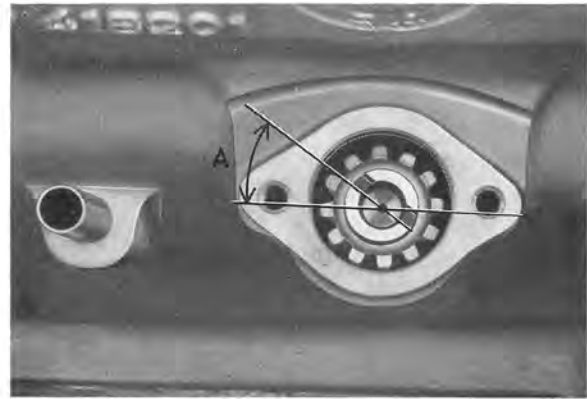
Fig. 2-50. Oil pump

- | | |
|----------------------------|----------------------|
| 1. Pump body | 3. Gear |
| 2. Spring for relief valve | 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. 2-52.

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

The sealing rings at the ends of the delivery pipe are made of special rubber and are manufactured to very close tolerances, see Fig. 2-53. 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



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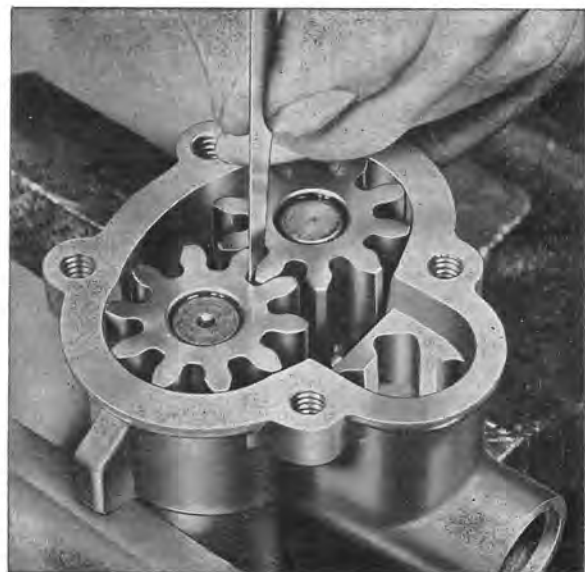
Fig. 2-51. Distributor drive position
A=approx. 35°

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.

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.



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Fig. 2-52. Measuring tooth flank clearance



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. 2-51 (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

CARBURETOR ENGINE

DESCRIPTION

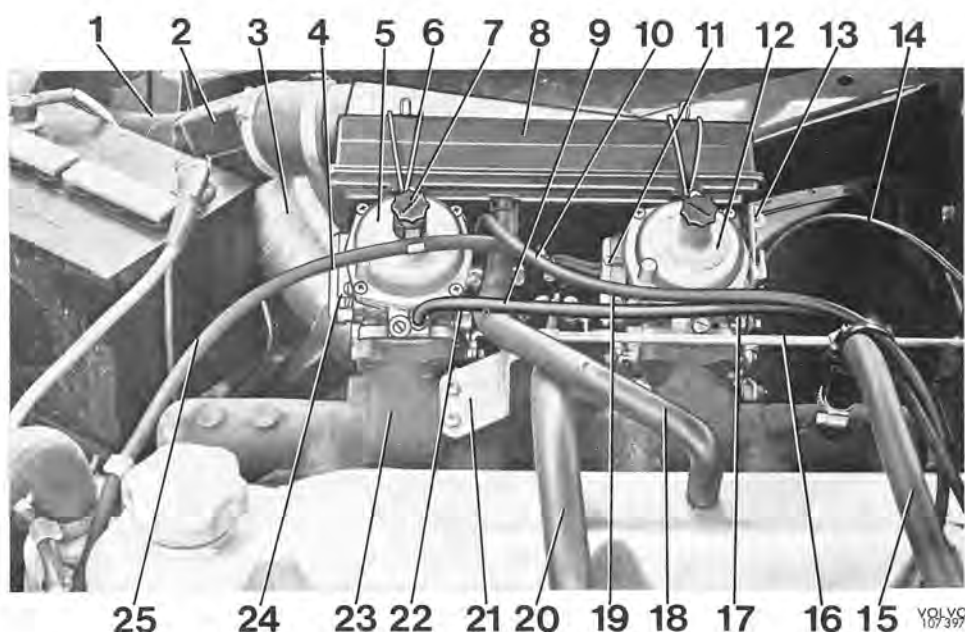


Fig. 2-54. Carburetors, B 30 A engine

- | | | |
|--|---|--------------------------------------|
| 1. Cold air hose | 10. Vacuum hose for distributor (negative vacuum setting) | 19. Idle trimming screw |
| 2. Constant temperature device flap | 11. Temperature compensator | 20. Hose for crankcase gases |
| 3. Warm air hose | 12. Rear carburetor | 21. Bracket |
| 4. Temperature compensator | 13. Hot start valve | 22. Throttle stop screw |
| 5. Front carburetor | 14. Choke wire | 23. Manifold with preheating chamber |
| 6. Clasp for air cleaner cover | 15. Vacuum hose for power brake | 24. Idle trimming screw |
| 7. Hydraulic damper | 16. Control shaft | 25. Fuel hose |
| 8. Air cleaner | 17. Throttle stop screw | |
| 9. Vacuum hose for distributor (positive vacuum setting) | 18. Air hose for crankcase gases | |

The B 30 A engine is fitted with two horizontal carburetors of type Stromberg 175 CD-2SE (Fig. 2-54), the construction of which is shown in Figs. 2-55, 2-56, 2-58 and 2-59. This type of carburetor has been designed with a view to the exhaust emission control system. It is provided with a fixed jet, pressed into the carburetor housing, the fuel flow orifice area of which is varied by means of a movable tapered needle. The position of the needle is determined by the carburetor housing vacuum operating an air valve in which the needle is fitted in a spring-loaded suspension. The spring force always presses the needle against the same side of the jet, and this ensures an accurately controlled fuel flow through the jet.

The carburetor consists of three main parts of light-alloy, the middle part of which comprises the carburetor housing.

The lower section is made up of a floatchamber, which encloses the jet and the float.

The upper section consists of a suction chamber cover, which forms a suction chamber together with a diaphragm fixed in the air valve. The suction chamber regulates the air valve lift and thereby the location of the needle in the jet.

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

Both carburetors are fitted with a temperature compensator (6, Fig. 2-56 and 2, Fig. 2-59). This is constructed as an air valve regulated by the carburetor temperature and maintains the fuel-air mixture constant irrespective of the fuel temperature.

The throttle spindles are provided with seals to reduce

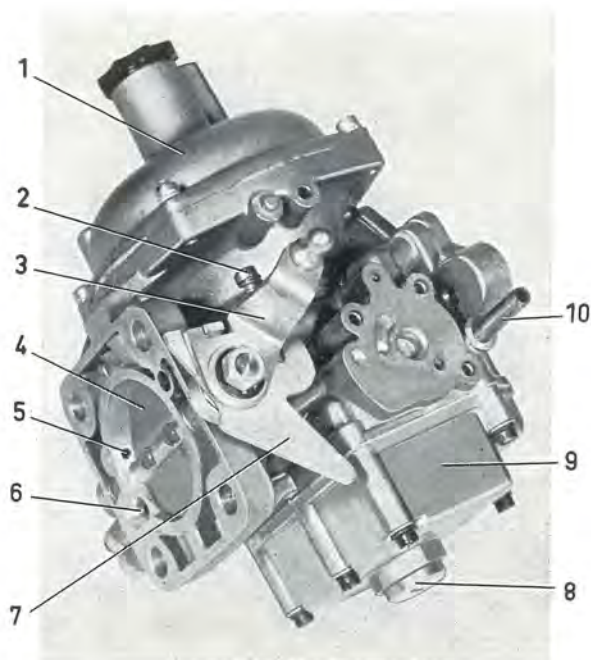


Fig. 2-55. Carburetor, front, the left

1. Suction chamber
2. Throttle stop screw
3. Lever
4. Primary throttle
5. Drilling to vacuum side of by-pass valve
6. Drilling for fuel-air mixture from by-pass valve
7. Throttle spindle cam (for regulating secondary throttle)
8. Floatchamber plug
9. Floatchamber
10. Fuel inlet

the wear on the spindles and bushes and also to eliminate air leakage.

The hot-start valve (13, Fig. 2-54) is described on page 2 : 30.

The negative vacuum connection for the ignition distributor is located under the part of the flange for the front carburetor. On vehicles with position vacuum connection, this is located on front carburetors. The front carburetor has a connection (next to the vacuum outlet) for the speed compensator on vehicles with air conditioning.

FLOAT SYSTEM

Fuel flows into the floatchamber via the float valve (4, Fig. 2-57). The float (1), which is made up of twin expanded rubber floats, is carried on a bridge on the lower side of the carburetor housing. As the fuel level rises, the float lifts and, by means of the float arm (2) and tag, closes the needle on its seating when the correct level has been attained.

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

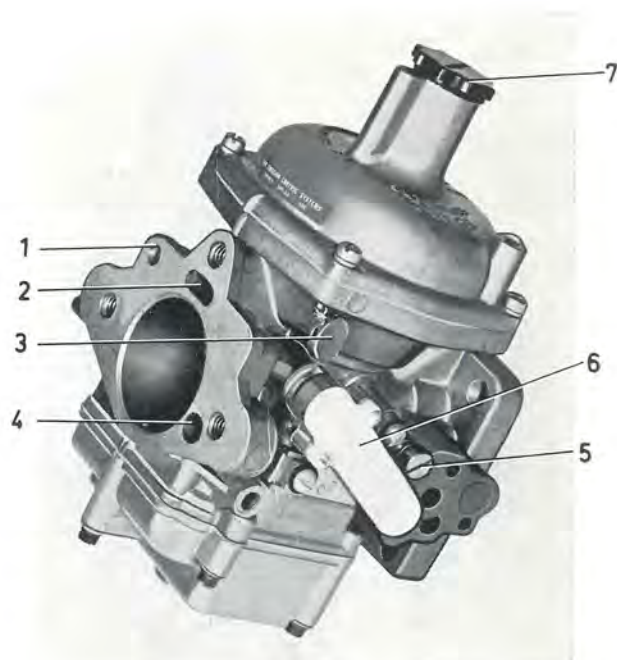


Fig. 2-56. Carburetor, front, from the right

1. Venting channel from floatchamber
2. Drilling for air supply under diaphragm
3. Sealed plug
4. Drilling for air supply to temp. comp. and idle trimming screw
5. Idle trimming screw
6. Temperature compensator
7. Hydraulic damper

COLD START DEVICE AND FAST IDLE

To facilitate starting during cold weather, the rear carburetor is fitted with a cold start device (Figs. 2-58, 2-60 and 2-61).

The cold start device consists of a valve disc (3, Fig. 2-60) which is provided with four calibrated holes and an elongated opening as well as a disc (4) mounted on a spindle which is operated by the choke control. On the same spindle, outside the housing (5), there is

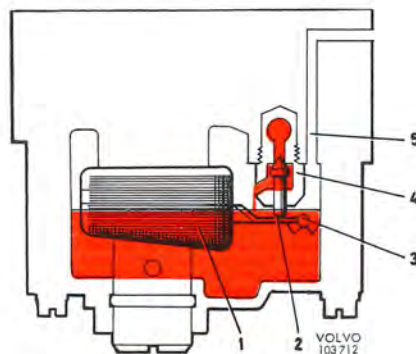


Fig. 2-57. Float system

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

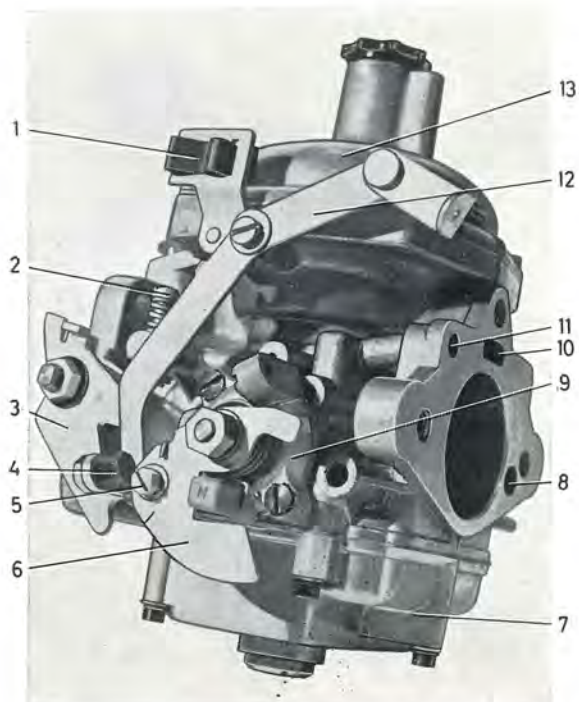


Fig. 2-58. Carburetor, rear, from the left

1. Clamp for choke wire
2. Throttle stop screw
3. Throttle spindle cam
4. Fast idle stop screw
5. Connection for choke wire
6. Cam disc for fast idle
7. Floatchamber
8. Drilling for air supply to temp. comp. and idle trimming screw
9. Cold start device
10. Drilling for air supply under diaphragm
11. Venting channel from floatchamber
12. Hot start valve control
13. Suction chamber

a cam disc (6, Fig. 2-58) with connection for the choke control pull wire. When the cold start device is engaged, the valve disc turns and this links up the channel (1, Fig. 2-60) from the floatchamber via one or several of the calibrated holes to the channel behind the valve disc and then the opening to the channel which terminates in the venturi (2), between the vacuum plunger and choke flap. Through this link-up, the engine receives extra fuel (a richer mixture), to facilitate cold starting. At the same time, less air is supplied by means of the choke device. When the choke control is pushed in, the valve disc turns and closes the inlet to the channel. At the same time as the cam disc is operated, the throttle flap opening is also influenced in such a way that turning the cam disc opens the throttle through the fast idle stop screw (4, Fig. 2-60) and the lever, before any of the calibrated holes open the connection to the fuel drilling. With this arrangement, the idling speed can if necessary be raised by the driver of the vehicle during the warming-up period of the engine.

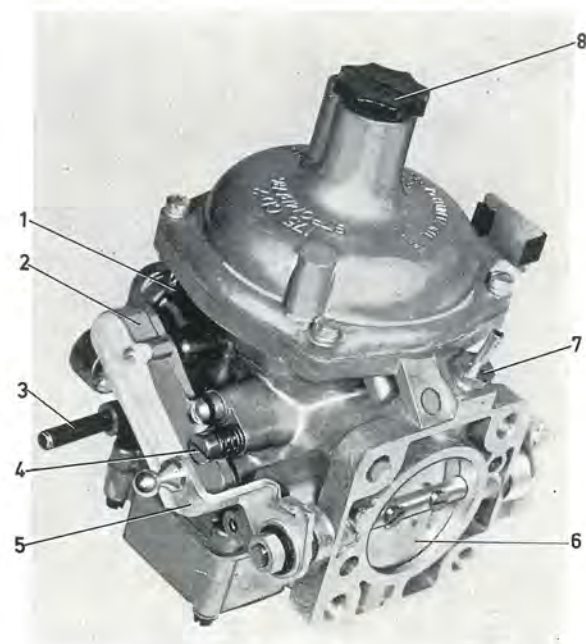


Fig. 2-59. Carburetor, rear, from the right

1. Sealed plug
2. Temperature compensator
3. Fuel inlet
4. Idle trimming screw
5. Lever
6. Primary throttle
7. Connection for vacuum hose
8. Hydraulic damper

IDLING

When the engine is idling, the vacuum in the carburetor suction chamber is low and the column between the air valve and the bridge will be small (see

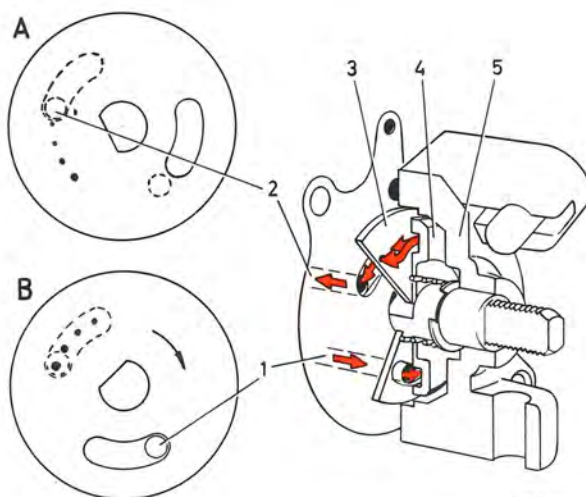


Fig. 2-60. Cold start device

- A. Cold start device, disengaged B. Cold start device, engaged
1. From floatchamber
 2. To venturi
 3. Valve disc
 4. "Channel Disc"
 5. Housing

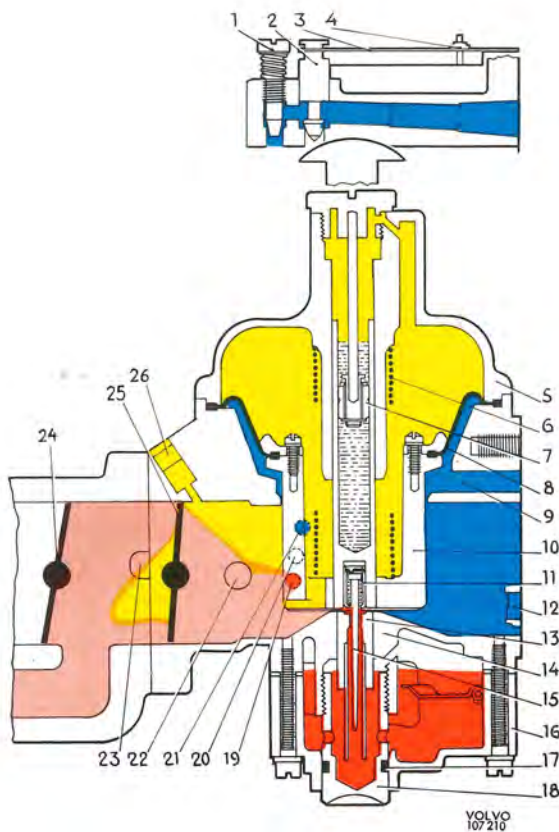


Fig. 2-61. Cold starting, principle

1. Idle trimming screw
2. Valve for temperature compensator
3. Bi-metal spring for temperature compensator
4. Adjuster nut
5. Suction chamber
6. Spring
7. Damper piston
8. Diaphragm
9. Drilling for air supply under diaphragm
10. Air valve
11. Metering needle suspension
12. Drilling for air supply to temp. comp. and idle trimming screw
13. Fuel jet
14. Carburetor housing (middle section)
15. Metering needle
16. Floatchamber
17. Rubber ring
18. Floatchamber plug
19. Drilling for cold start fuel (located in carb. opposite wall)
20. Drilling for extra air through temperature compensator
21. Drilling for extra air through idle trimming screw
22. Inlet channel for fuel mixing through by-pass valve
23. Outlet channel for fuel mixing through by-pass valve
24. Secondary throttle
25. Primary throttle
26. Vacuum outlet

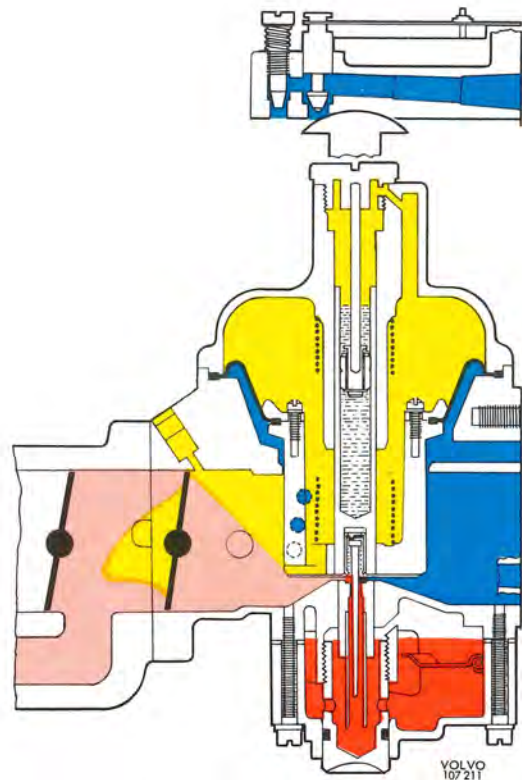


Fig. 2-62. Idling, warm engine

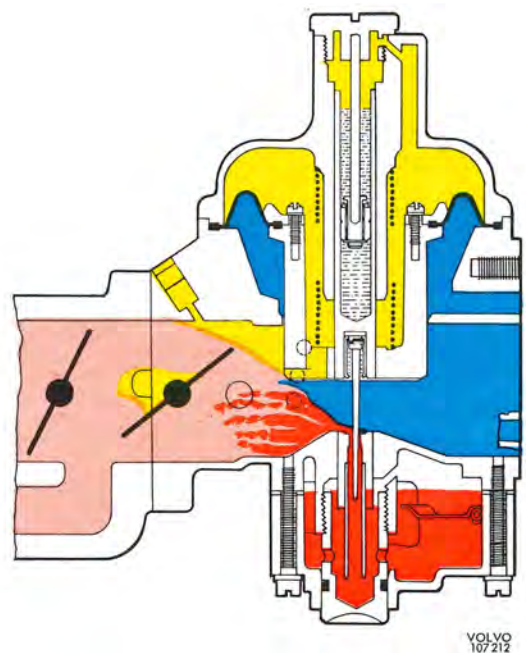


Fig. 2-63. Normal running, with open secondary throttle

Fig. 2-62). At this stage, the thicker section of the metering needle is in the jet and thus only a small quantity of fuel, corresponding to idling requirements, is sucked into the engine. The temperature compensator (Fig. 2-61) is regulated by a bi-metal spring (3) which influences a valve (2). When the engine is hot and the temperature in the carburetor rises, the valve opens and air is supplied to the carburetor venturi to compensate for the increase in the fuel flow, which is obtained due to the alteration in the fuel's viscosity, see Fig. 2-62. Fine adjustment of the engine idling speed can be carried out with the idle trimming screw (1, Fig. 2-61).

NORMAL RUNNING

With the opening of the throttle flap, engine induction manifold depression is transferred via the channels in the plunger to the suction chamber which is sealed from the main body of the carburetor by the diaphragm. The pressure difference between the underside of the air valve, where there is pressure in the carburetor inlet port, and the upper side of the valve, where there is vacuum, causes the valve to lift from the bridge. This also lifts the tapered metering needle (15, Fig. 2-61), which is attached to the plunger, out of the jet. The effective choke area widens and increases the fuel flow. See Fig. 2-63.

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

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

ACCELERATION

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

When the air valve (10, Fig. 2-61) lifts, the damper piston (7) is forced against its seat and oil is prevented from flowing past from the upper side the lower side of the damper plunger, this retarding the movement of the valve (10). This temporarily results in a more powerful vacuum above the jet so that the fuel-air mixture becomes for the moment richer.

The downward stroke of the air valve is assisted by

the spring (6). The rod in the valve should be filled to approximately within a 1/4" from the upper edge with oil which is approved as "Automatic Transmission Fluid".

EXHAUST EMISSION CONTROL SYSTEM

The engine is equipped with an exhaust emission control system in accordance with the principle of a more complete combustion which reduces the contents of carbon monoxide and hydrocarbons in the exhaust gases to an acceptable level. This is achieved mainly by a modified induction system that enables a more exact and leaner mixture ratio between fuel and air to be used.

How the system works is illustrated in Fig. 2-64.

The intake manifold is fitted with a secondary throttle (3) at each carburetor. For normal driving (with low power output the throttles (3) are closed thus forcing the mixture of fuel and air from the carburetors to a central preheating chamber (6) where the intake charge is heated and thoroughly mixed, whereby a completely evaporated and homogenous mixture is obtained.

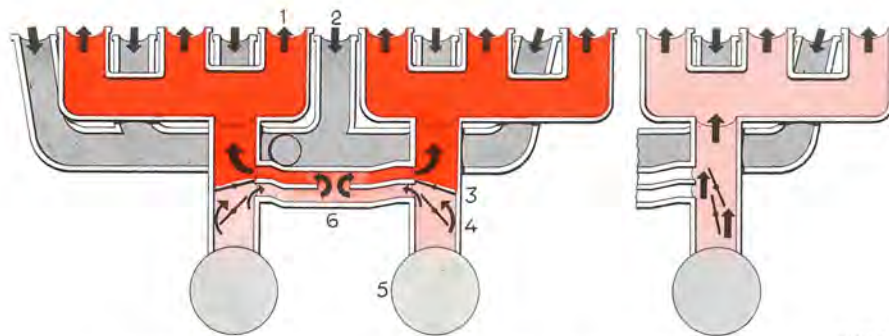
When higher output is required, that is the primary throttles (4) are opened wider, the secondary throttles (3) also open up and the mixture of fuel and air passes from the carburetors directly to the cylinders without going through the preheating chamber.

No particularly accurate synchronizing of the carburetors is required since they are linked to each other through the intake manifold.

HOT START VALVE

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

When the throttle is at idling position, the lever (1), Fig. 2-65, presses against the valve control (2). The piston (14) is thereby lifted to its upper position by the control rod (16). The connection between the floatchamber and air cleaner is closed and fuel fumes are led directly out into the atmosphere through the outlet (12). When the accelerator pedal is depressed (See Fig. 2-66), the lever (1) releases the valve control (2) and the piston (14) is pressed by the spring (15) against its lower position. The outlet (12) is shut off, the fuel fumes are led into the air cleaner, and when the engine starts running, further through the carburetor and into the engine combustion chambers.



Light load (preheating)

Heavy load (direct inlet)

Fig. 2-64. Exhaust emission control system, principle of operation

1. Intake manifold
2. Exhaust manifold
3. Secondary throttle

4. Primary throttle
5. Carburetor
6. Preheating chamber

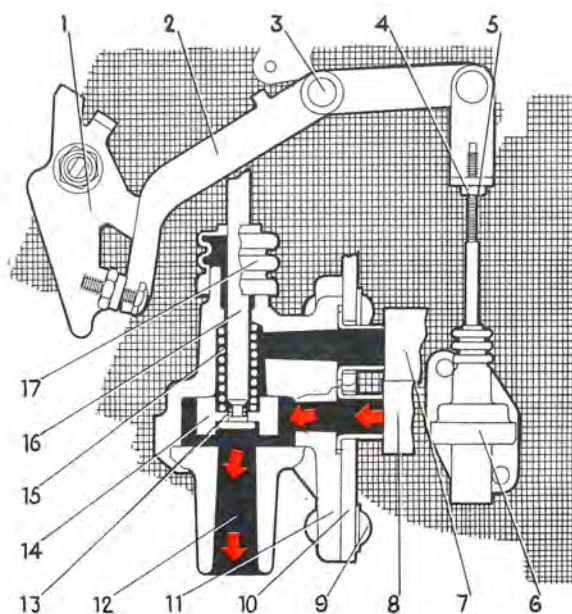


Fig. 2-65. Hot start valve, function, idling

- | | |
|----------------------------|--|
| 1. Throttle lever | 10. Air cleaner housing |
| 2. Valve control | 11. Valve housing |
| 3. Screw for valve control | 12. Outlet to atmosphere or venting filter |
| 4. Locknut | 13. Rubber rings |
| 5. Control rod | 14. Piston |
| 6. Hot start valve | 15. Thrust spring |
| 7. Outlet to air cleaner | 16. Control rod |
| 8. Hose to floatchamber | 17. Rubber seal |
| 9. Rivet | |

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

AIR CLEANER

The air cleaner (Fig. 2-68) functions both as a cleaner for the intake air and as an intake silencer. It is fitted with a replaceable paper insert. This insert must not be washed or moistened. At the recommended interval, 40 000 km (24 000 miles), it should be discarded and replaced by a new none.

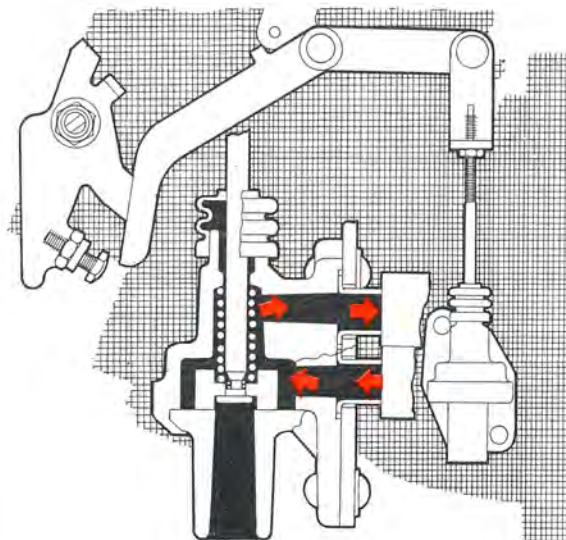


Fig. 2-66. Hot start valve, function, driving



Fig. 2-67. Hose connection for hot start valve

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

CONSTANT AIR TEMPERATURE DEVICE

The engine is fitted with a constant air temp. device, see Fig. 2-69. (Not, however, on vehicles with right-hand drive.) This device consists of a flap housing (5), a hose (6) for cold air and a heat-resistant hose (7)

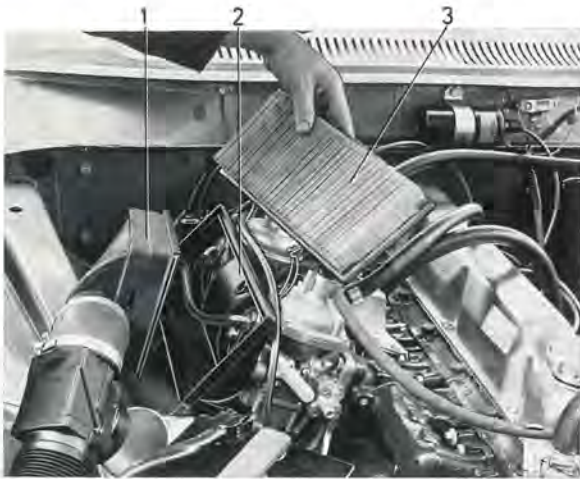


Fig. 2-68. Air cleaner

1. Air cleaner housing, upper section
2. Air cleaner housing, lower section
3. Cleaner

for warm air as well as a heater plate (8), which is secured to the exhaust pipe. The thermostat (2), fitted in the flap housing, is inserted in the air cleaner housing and regulates the flap (4) by means of the flap control (3). The warm air taken at the exhaust pipe and the cold air taken at the front of the vehicle are regulated by the flap, mixed. The temperature of the mixture then influences the thermostat. In this way, the air supplied to the carburetors is maintained at a constant temperature ($30 \pm 5^\circ \text{C} = 87 \pm 42^\circ \text{F}$). This arrangement eliminates ice forming in the carburetors. Thanks to this system in conjunction with the temperature compensator, the vehicle can be driven more or less irrespective of the temperature of the atmosphere.

FUEL PUMP

The fuel pump is of the diaphragm type and is driven by a cam on the camshaft. When the rocker arm in the pump is pressed upwards by the cam, the diaphragm is pulled downwards and fuel is drawn up to the pump. When the rocker arm returns, the diaphragm is pressed upwards by a spring (5, Fig. 2-71) and fuel is fed to the floatchamber in the carburetor. When the level in the floatchamber is sufficiently high, the float valve closes and the pressure in the delivery line rises until the pressure on the upper side of the diaphragm exceeds the spring pressure and pumping action ceases.

Two alternative fuel pumps are used. One (Fig. 2-70) is of make S.E.V. and the other comes from Pierburg (Fig. 2-71).

It applies for both filters that the filter (13, Figs. 2-70 and 2-71) should be cleaned every 10 000 km (6 000 miles). No parts are stocked for the pumps. A defective pump must be replaced by a new one, of make Pier-

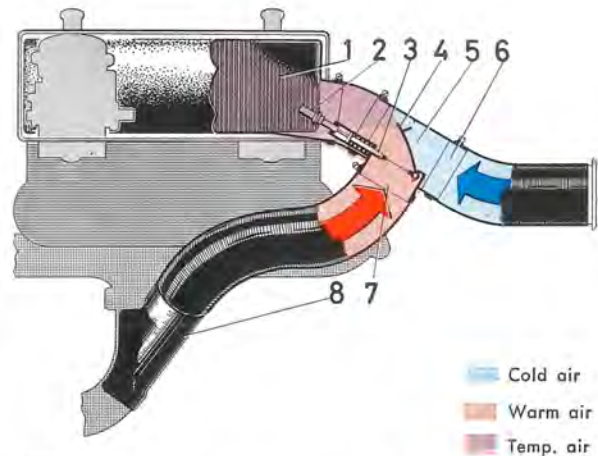


Fig. 2-69. Constant air temp. device

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

burg. There is, however, a filter kit for cleaning the Pierburg pump and one for the S.E.V. pump.

FUEL TANK

Fig. 2-72 shows the layout of the tank which holds 60 litres (13 Imp. galls.=16 US galls.) and is fitted with a built-in plastic expansion tank (12) for 5 litres (5 qts.). The expansion tank has an equalizing hole on top and an inlet hole underneath, dimensioned for slow filling.

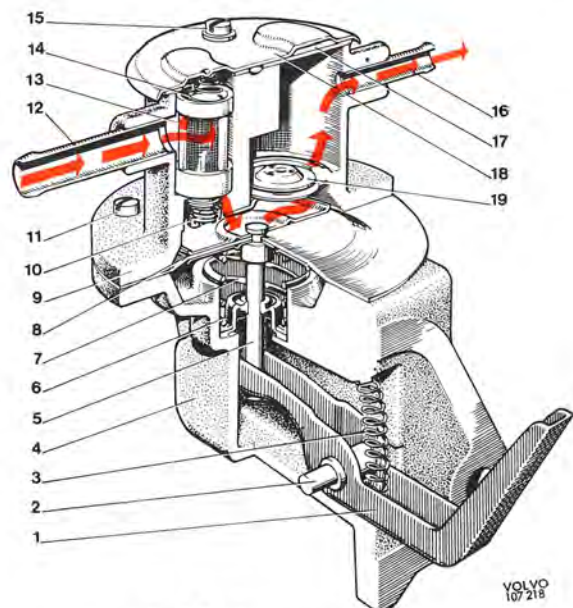


Fig. 2-70. Fuel pump, make S.E.V.

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

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

Cars fitted with a fuel injection system are provided with a baffle can (13). Fuel is taken from it via the filter (15). The return line (6) is connected to a fuel output on carburetor engines.

For cars fitted with a fuel injection system the filter (15) is accessible for cleaning after the plug underneath the tank has been removed. The filter should be cleaned every 2 000 km (1 250 miles).

On cars with carburetor engines, the filter (14) is accessible after removal of the level sender unit. This filter should be cleaned every 4 000 km (2 500 miles).

The tank is fitted with a breather pipe (10) and equalizing hose (11).

The equalizing hose end opening out into the atmosphere is clamped to a bracket on the tank (see 7, Fig. 2-72).

On vehicles with a fuel evaporative system 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", Group 24.

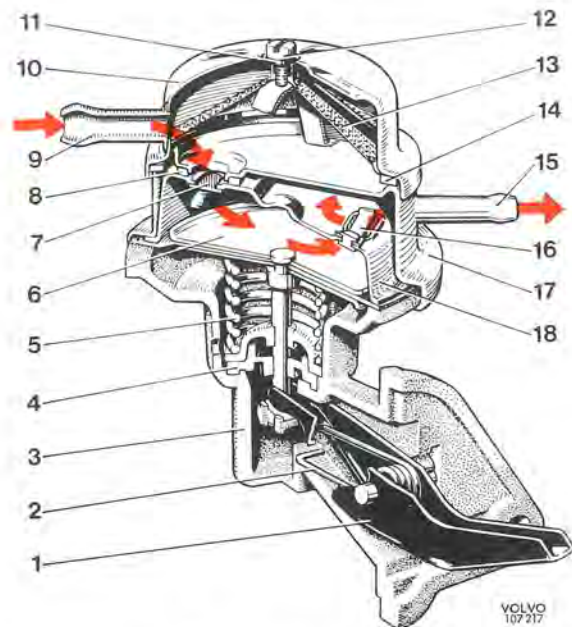


Fig. 2-71. Fuel pump, make Pierburg

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

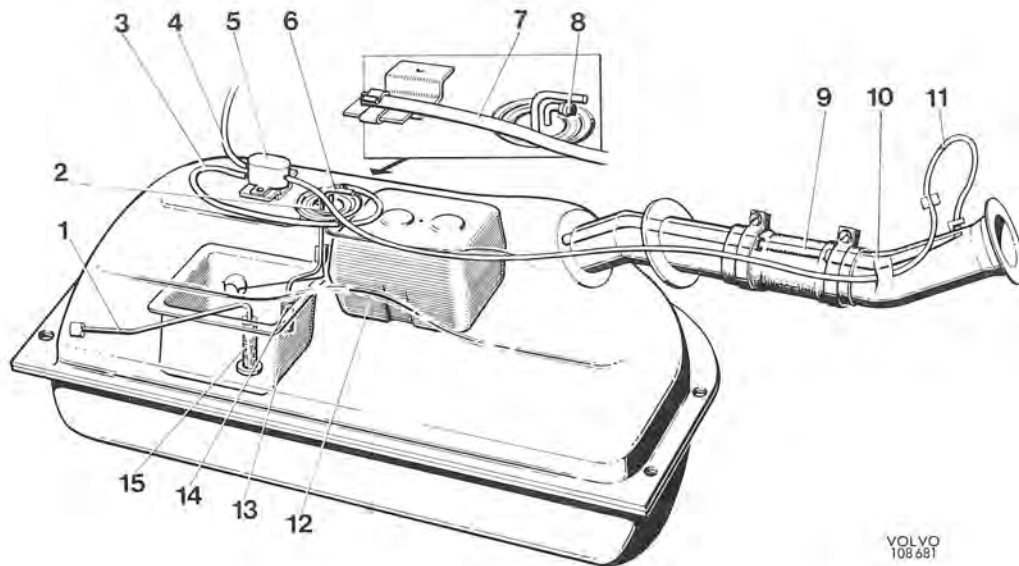


Fig. 2-72. Fuel tank

Type for gas evaporative system. Pos. 7 and 8 show the type without a gas evaporative system.

1. Fuel output, injection engines
2. Level sender unit
3. Hose connecting tank and equalizing valve
4. Venting filter hose
5. Equalizing valve
6. Fuel output, carburetor engines (for injection engines: connection for return line)
7. Equalizing hose from filler pipe, see pos. 11 (type without equalizing valve)

8. Rubber plug for connection to hose acc. to pos. 3 (type without equalizing valve)
9. Hose
10. Breather pipe
11. Equalizing hose
12. Expansion tank
13. Baffle can (only vehicles with injection engines)
14. Fuel filter, carburetor engines
15. Fuel filter, injection engines

REPAIR INSTRUCTIONS

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

PERIODICAL CHECK

Every 10 000 km (6 000 miles) check that there is oil in the damper cylinder (see, Fig. 2-74).

The spindle in the piston should be filled to about a 1/4" from the upper edge with oil approved as "Automatic Transmission Fluid".

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

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

Also check that there is no air leakage on the intake side and that the air cleaner is not blocked. To be on the safe side, check also the flap function of the constant air temperature device. (See page 2 : 40.)

The function of the throttle control and throttles should be checked as well.

SETTING THE CARBURETOR

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

However, the setting can be checked without the use of this meter, but if the checking with either of these methods results in unsatisfactory running of the engine and it has been established that the fault is due to an "over-rich" carburetor or "too lean" fuel mixture, the carburetor nozzle should be adjusted with a special tool in accordance with Workshop Bulletin P-23-44.

SETTING WITHOUT CO-METER

1. Check that there is oil in the damper cylinders. See under "Periodical Check".
2. Run the engine warm. The adjustment should be carried out within about 10 minutes after the coolant thermostat has opened. (One way of finding this out is by feeling the upper radiator hose at the radiator which should start to get warm.)
3. Adjust the engine speed to 13.3 r/s (800 r/m) with the throttle stop screws (2, Fig. 2-55). The speed should be adjusted to 11.7 r/s (700 r/m) for a vehicle with automatic transmission.

NOTE. Screw equally for both carburetors. Check to make sure that both carburetors have the

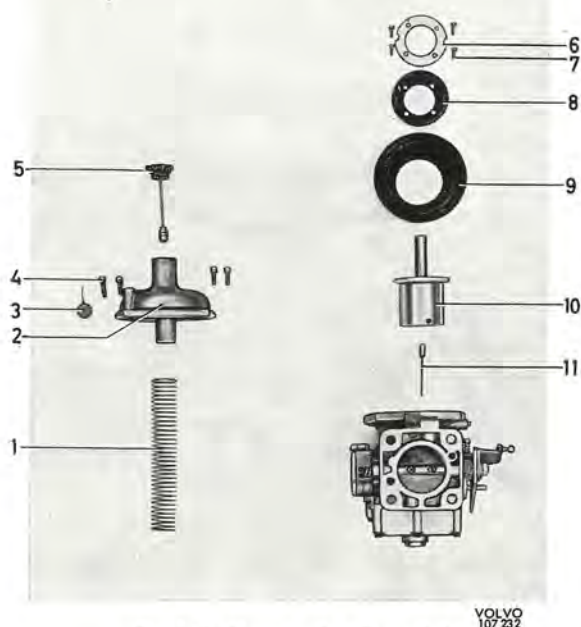


Fig. 2-73. Upper section dismantled

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

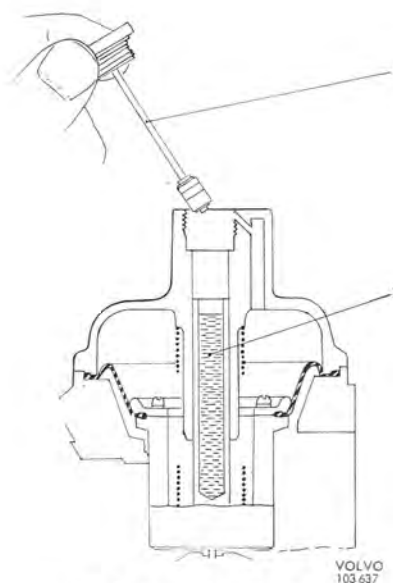


Fig. 2-74. Checking the damper

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

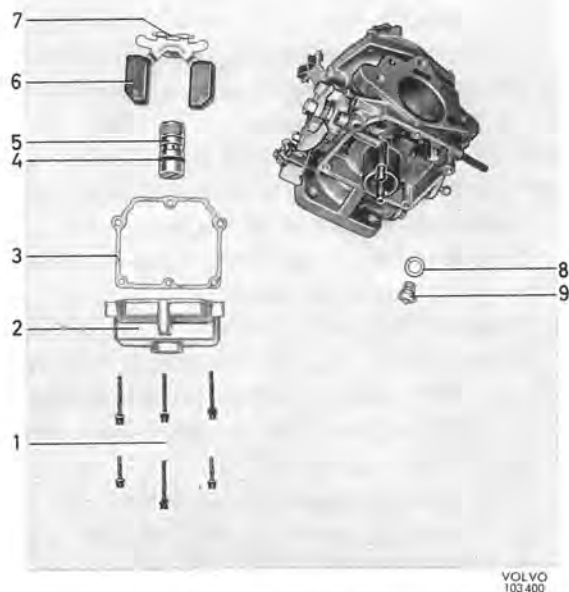


Fig. 2-75. Floatchamber dismantled

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

same air valve lift. This is checked easily by simply making sure that the distance visually between the bridge of the carburetor housing and the air valve is the same for both carburetors. A more accurate synchronization is not required.

4. Adjust with the idle trimming screws (5, Fig. 2-56) from the basic setting, (they are screwed to bottom). Turn so that the best idling speed is obtained. Screw equally for both carburetors.
5. Adjust the link rods. With the control against its stop on the manifold bracket, the link rods should be adjusted so that there is a clearance of about

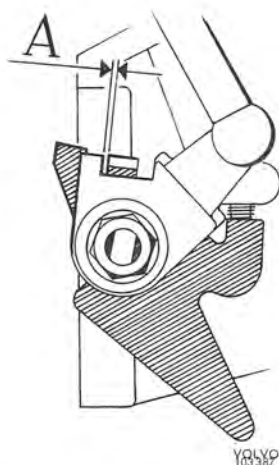


Fig. 2-76. Setting the control

A=0.1 mm (0.004")

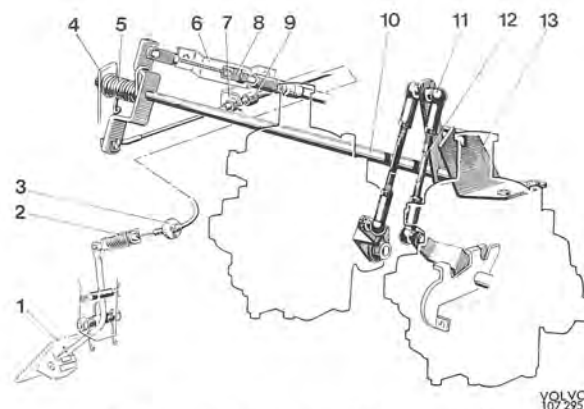


Fig. 2-77. Throttle control, l-h steered vehicle

1. Accelerator pedal
2. Unloading spring
3. Wear washer
4. Bracket
5. Return spring
6. Bracket for throttle cable (only autom. trans.)
7. Bracket for throttle control cable
8. Throttle cable for autom. trans.
9. Adjusting sleeve for throttle control cable
10. Throttle control shaft
11. Ball joint
12. Link rod
13. Bracket (located on manifold)

0.1 mm (0.004") between the lever and the primary throttle spindle flange. See Fig. 2-76.

6. Adjust so that the valve control of the hot start valve is against the carburetor lever with the valve piston in the upper position and the throttle control at idle. (See Figs. 2-65 and 2-66.)

Lubricate the contact surface with Molykote and check that the engine returns to idling speed after briefly revving-up several times.

7. Setting the fast idle: Pull out the choke control 20 mm (0.8").

Then adjust the fast idle screw to give an engine speed of 23.3—25.0 r/s (1400—1500 r/m).

8. Check that the cable (Fig. 2-77) is well stretched and if necessary adjust on the cable sleeve adjuster (9).

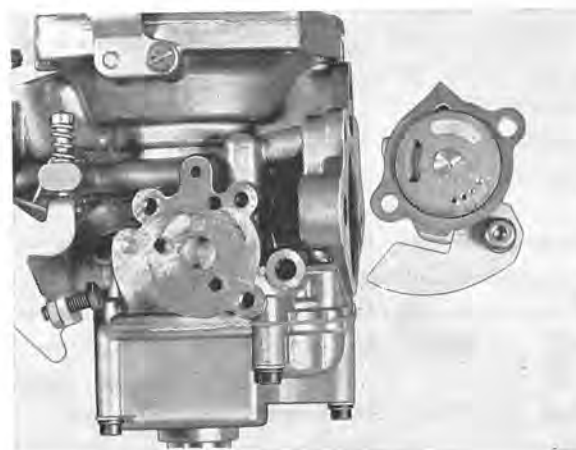


Fig. 2-78. Cold-start device

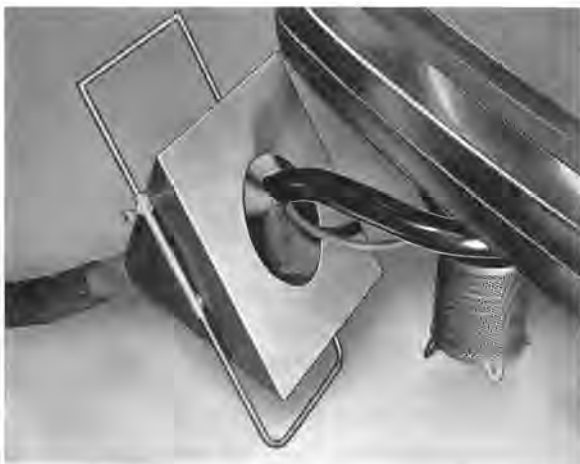


Fig. 2-79. Funnel for exhaust evacuation

VOLVO
163 722

Right-hand steered vehicle

Adjust the length of the long, vertical link so that there is a clearance of 1 mm (0.040") between the throttle lever lug and the full throttle stop on the carburetors, when the accelerator pedal is depressed.

9. Lubricate all ball joints.

SETTING WITH CO-METER

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

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

Before reading off the CO-meter, briefly rev up the engine so that the air valve is in the proper position. In order to be certain that the measured CO-value is correct, measuring should be carried out within the time period mentioned above.

There are a number of different types of CO-meters available which function with acceptable accuracy. The instructions on their use accompany each meter. Note that when connecting the hose for evacuating the exhaust gases, the hose must not be placed so that the exhaust gases are completely evacuated from

the CO-meter connection to the exhaust manifold. A funnel, see Fig. 2-79 could suitably be used here. With the funnel installed, the suction at the connection would not be so great as to upset the measuring but sufficient to suck up the exhaust gases so that they do not fill the workshop.

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

1. Check that there is oil in the damper cylinders. See under "Periodical Check".
2. Connect a tachometer and run the engine warm at 25 r/s (1500 r/m) until the coolant thermostat opens. (One way of finding this out is by feeling the upper radiator hose at the radiator which should start to get warm.)
3. Adjust the engine speed to 13.3 r/s (800 r/m) with the throttle stop screws (2, Fig. 2-55). The speed should be adjusted to 11.7 r/s (700 r/m) for a vehicle with automatic transmission.

NOTE. Screw equally for both carburetors. Check that both carburetors have the same air valve lift. This is easily checked by measuring with the eye the distance between the carburetor house bridge and the air valve. The distance should be the same for both carburetors. More accurate synchronization is not required.

4. Connect a CO-meter and check that the CO-content is 2.5 %. With the help of the idle trimming screws (5, Fig. 2-56) the CO-content can be adjusted within small deviations. (If the CO-content is too high, check first the temperature compensator, see under "Temperature Compensator".)
5. Adjust the link rods. With the control against its stop on the manifold bracket, the link rods should be adjusted so that there is a clearance of about 0.1 mm (0.004") between the lever and the flange of the primary throttle spindle. See Fig. 2-76.
6. Adjust so that the valve control of the hot-start valve is against the carburetor lever with the valve piston in the upper position and the throttle control at idle. (See Figs. 2-65 and 2-66).
Lubricate the contact surface with Molykote and check that the engine returns to idling speed after briefly revving-up several times.
7. Setting the fast idle: Pull out the choke control 20 mm (0.8").
Then adjust the fast idle screw to give an engine speed of 23.3—25.0 r/s (1400—1500 r/m.)
8. Check that the cable (Fig. 2-77) is well stretched and if necessary adjust on the cable sleeve adjuster (9).

Right-hand steered vehicle

Adjust the length of the long, vertical link so that

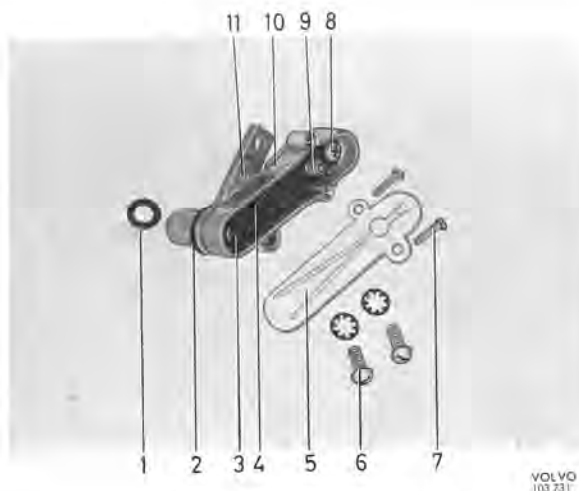


Fig. 2-80. Temperature compensator

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

there is a clearance of 1 mm (0.040") between the throttle lever lug and the full throttle stop on the carburetors, when the accelerator pedal is depressed.

9. Lubricate all ball joints.

FAULTY CARBURETOR FUNCTION

1. Check to make sure that the reason for the fault in the function is not due to wrong damper oil or oil level, impurities in the floatchamber or a faulty float valve and float. See the respective headings.
2. Remove the air cleaner and check that the suction valve(s) operate easily and without jamming. (The damper piston(s) removed.) If this is not the case, remove the suction chamber cover and clean the pistons. At the same time, check to make sure the diaphragm is in good condition. Plug-seal after fitting.

NOTE. If the metering needle must be released or moved, it should be adjusted, see under the heading "Replacing metering needle". A CO-meter is recommended for this purpose.

Temperature compensator

3. Should there be a powerful drop in the idling speed during idling for a lengthy period, especi-

ally when the weather is warm, check the function of the temperature compensator by removing the plastic cover and pressing in the valve (3, Fig. 2-80). This should move under very light pressure and return to its position without sticking. This applies at a temperature above 80° F. The valve starts opening at 70°—77° F.

Pressing the valve inwards deteriorates the quality of the idle. If the valve has a tendency to be stiff in operation or if the compensator is incorrectly adjusted, the latter should be replaced complete. See under "Replacing temperature compensator". For adjusting slacken one of the cross-slotted screws (8), for the bi-metal spring and center the valve so that its function will be as above. If necessary adjust as follows:

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

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

REMOVING CARBURETORS

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

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

FITTING CARBURETORS

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

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

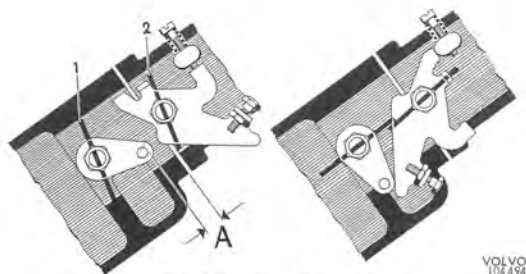


Fig. 2-81. Throttle position

Throttle position
at low output

Fully open throttle

1. Secondary throttle 2. Primary throttle
"A" = 2.7—4.3 mm (0.11—0.17")

CHECKING SECONDARY THROTTLES

Check to make sure that the secondary throttles are centered and can be turned without jamming. Check the location ("A", Fig. 2-81) of the levers. When the secondary throttle is closed, the distance "A" between the lever pin and the intake manifold flange should be 2.7—4.3 mm (0.11—0.17").

CLEANING FLOATCHAMBER

The floatchamber is removed by unscrewing the floatchamber plug (5, Fig. 2-75)) and the screws (1). Clean the gasket surface and fit a new rubber ring (4). Fit the floatchamber with a new gasket.

NOTE. Fit the floatchamber plug before tightening the floatchamber screws. (Concerns metal floatchamber plug, i.e., the early prod. type.)

FLOAT LEVEL

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

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

At the correct float level, the top point on the float should lie 15—17 mm (0.59—0.67") and the rear edge 9—13 mm (0.35—0.51") above the sealing surface (see Fig. 2-82). If the level is incorrect, adjust by bending the tag at the float valve.

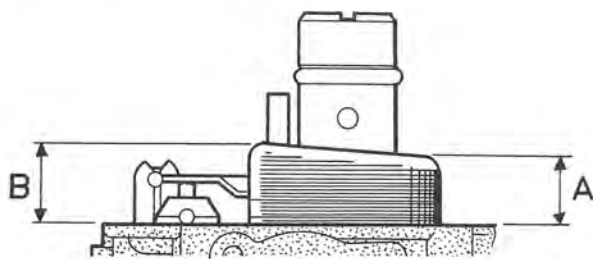


Fig. 2-82. Float level

A = 9—13 mm (0.35—0.51")
B = 15—17 mm (0.59—0.67")



Fig. 2-83. Diaphragm in air valve

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

REPLACING DIAPHRAGM

1. Screw out the damper piston. Make line-up marks on the suction chamber cover and carburetor housing. Remove the seal plug, release the screws and take off the suction chamber cover. Remove the spring.

2. Pull up the air valve with diaphragm. Remove the diaphragm by unscrewing the four screws. Clean the air valve.

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

3. Fit the new diaphragm, see Fig. 2-83. The rubber register should fit into the valve groove.

4. Move the air valve down and fit in the rubber register as shown in Fig. 2-84. Fit the cover and fill with damper oil.

5. Plug-seal the suction chamber cover.



Fig. 2-84. Diaphragm in carburetor housing

REPLACING TEMPERATURE COMPENSATOR

The temperature compensator is replaced complete. It is removed from the carburetor by unscrewing the screws. (6, Fig. 2-80). Take out the old seal (1) from the carburetor and fit a new one. Place a new seal (2) on the temperature compensator and fit the compensator. The temperature compensator is marked "60" (see 11, Fig. 2-80).

REPLACING METERING NEEDLE

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

1. Remove the air valve from the carburetor and clean it.
2. Remove the needle by unscrewing the lock screw and pull the needle out with the spring suspension.
3. Before fitting the new needle, check that the needle designation is B1 BE.
The designation is punched on the needle and can be read by pulling the needle out of the spring suspension far enough to reveal the designation.
4. Fit the needle with the spring suspension so that the flat surface faces the lock screw. The needle should incline from the holes in the air valve, i.e. in towards the air cleaner flange.
The needle should be inserted so far that the plastic washer lies flush with the valve, see Fig. 2-85. Tighten the lock screw.
5. Fit the air valve in the carburetor. Plug-seal the suction chamber cover.

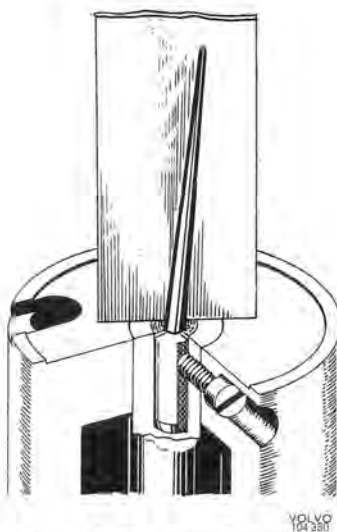


Fig. 2-85. Fitting metering needle



Fig. 2-86. Damper plunger clearance

DAMPER DEVICE

If the engine does not react properly during acceleration, the reason may be a faulty clearance on the damper plunger, the axial clearance of which (see A, Fig. 2-86) should be 1.0—1.8 mm (0.04"—0.07").

With any fault in the damper plunger change it complete.

If the damper device is to function correctly, then the level of the damper oil must be correct (see Fig. 2-74). The interval prescribed for the periodical check is 10 000 km (6 000 miles).

REPLACING THROTTLE CABLE

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

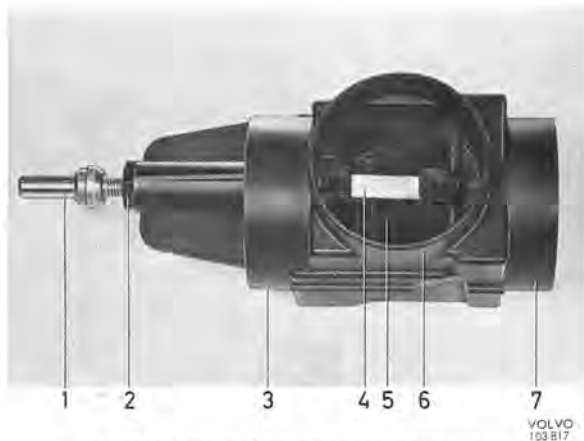


Fig. 2-87. Constant air temperature device flap

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

FLAP HOUSING FOR CONSTANT AIR TEMPERATURE DEVICE

If the flap (5, Fig. 2-87) does not open, there will be too high a temperature for the intake air and this will have a negative effect on the engine.

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

The flap location can be checked with the flap housing fitted in position. A small tab (see 3, Fig. 2-88) on the flap spindle projects from both sides of the housing. The longitudinal pin for these tabs coincides with that of the spindle and turns parallel with the spindle. In other words, the location of the flap can be seen at different temperatures by comparing the angle of a tab in relation to the markings "COLD" and "HOT".

The thermostat can be checked in lukewarm water. The flap should be closed for cold air at 70–80° F and closed for hot air at 95–105° F. If correct function is not obtained, change the flap housing with thermostat complete.

When fitting the flap housing, observe that the thermostat is located in the centre of the air flow and the tightening screw for the hose clamp is on the upper side of the flap housing.

AIR CLEANER

The insert should be replaced with a new one every 40 000 km (24 000 miles), if the vehicle is driven in areas with moderate air pollution. With driving in very dusty areas, replacement may have to be done more often.

No cleaning of any type should be carried out be-

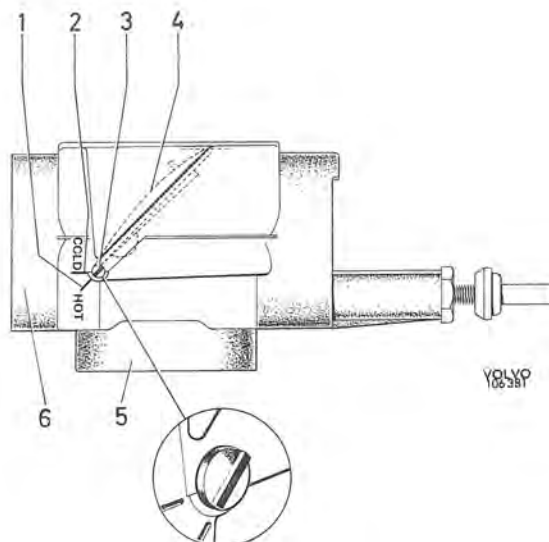


Fig. 2-88. Checking flap function

- | | |
|---------------------------|--------------------|
| 1. HOT=open for warm air | 4. Flap |
| 2. COLD=open for cold air | 5. Hot air intake |
| 3. Tab | 6. Cold air intake |

tween the replacements. The insert must on no condition be moistened or oiled.

Increased fuel consumption is a sign of a blocked air cleaner.



Fig. 2-89. Fuel pump, Pierburg

- | | |
|--|-------------------------------|
| 1. Profile (fits profile [5] in cover [6]) | 4. Screw for cover |
| 2. Seal | 5. Profile (fits profile [1]) |
| 3. Filter | 6. Cover |

FUEL PUMP PIERBURG

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

Cleaning fuel pump

1. Remove the cover (6, Fig. 2-89), the filter (3) and the seal (2).
2. Clean the body and cover. Blow the filter clean or replace it.
3. Place the seal and filter on the body.
4. Fit the cover. Make sure that the profiles in the body and cover (see 1 and 5, Fig. 2-89) coincide.



Fig. 2-90. Fuel pump, S.E.V.

- | | |
|----------------------------------|-----------|
| 1. Cover | 4. Seal |
| 2. Boss for centering spring (5) | 5. Spring |
| 3. Screws | 6. Filter |

FUEL PUMP S.E.V.

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

Cleaning fuel pump

1. Remove the cover (1, Fig. 2-90), the spring (5) and the seal (4).
2. Blow clean in the fuel pump body.
3. Remove the filter (6) and blow it clean or replace it.
4. Fit the filter. Place the seal in position with the open part over the filter. Place the spring (5) in position and fit the cover with the boss (1) facing the spring.

FILTER IN FUEL TANK

Carburetor engines

Carburetor engines clean the filter every 40 000 km (24 000 miles). To reach the filter, remove the fuel level sender with tool 5016, see Fig. 2-91.

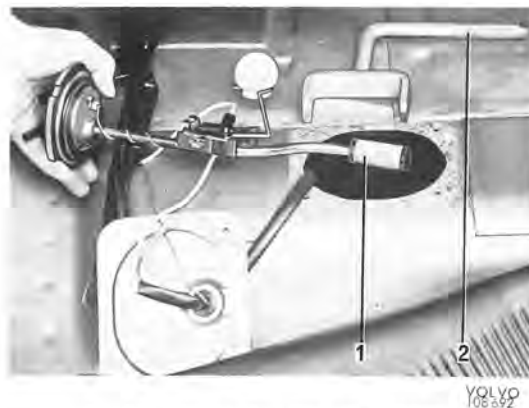


Fig. 2-91. Filter in fuel tank, carb. engines

1. Filter 2. Tool 5016

Injection engines

Clean the tank filter every 20 000 km (12 000 miles). The filter is accessible after the bottom plug (see Fig. 2-92) 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.

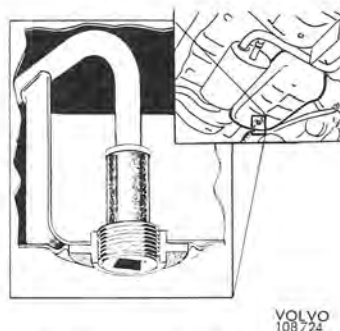


Fig. 2-92. Filter in fuel tank, injection engines

FUEL SYSTEM

FUEL INJECTION ENGINES

DESCRIPTION

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, pressure regulator, injectors, cold start valve, inlet duct, throttle valve switch, auxiliary air regulator, temperature sensors (for induction air

and coolant), pressure sensor (for pressure in inlet duct) 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. 2-93.

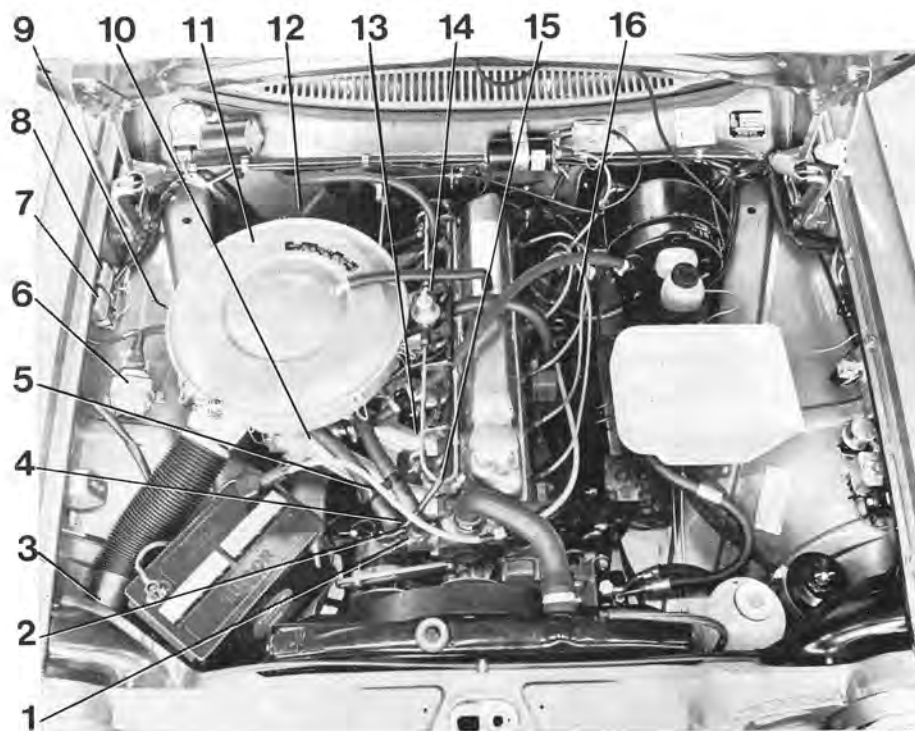


Fig. 2-93. Electronically controlled fuel injection (B 30 E and F)

- | | |
|--------------------------------------|-----------------------------------|
| 1. Auxiliary air regulator | 9. Cold start valve |
| 2. Thermal timer | 10. Throttle switch |
| 3. Temperature sensor, induction air | 11. Air cleaner |
| 4. Temperature sensor, coolant | 12. Stop screw for throttle valve |
| 5. Screw for adjusting idling | 13. Inlet duct |
| 6. Pressure sensor | 14. Pressure regulator |
| 7. Pump relay | 15. Injector |
| 8. Main relay | 16. Triggering contacts |

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108797

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

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

The pressure sensor senses the absolute pressure in the inlet duct and converts this to electric impulses which are computerized by the control unit. Since the pressure in the inlet duct 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.

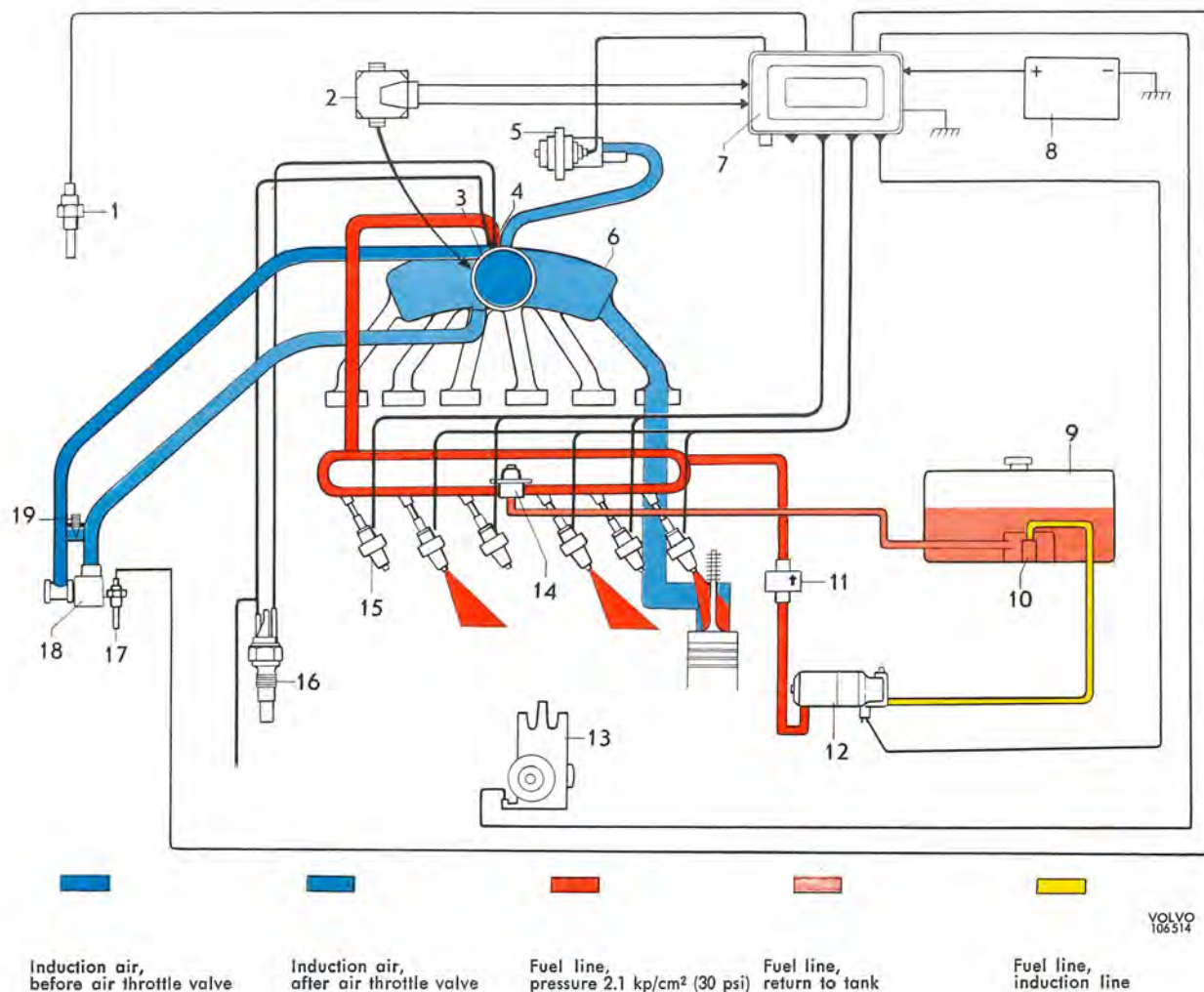


Fig. 2-94. Fuel injection system, principle of operation

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

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 timer.

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 regulator which gradually closes as the engine temperature rises.

The electronic control unit receives impulses for additional fuel during acceleration from the throttle valve switch. When the accelerator pedal is depressed, impulses are released from the throttle switch to the control unit which 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. 2-95. 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.

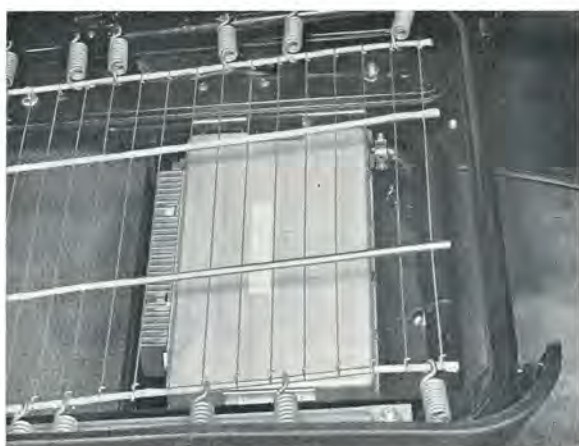


Fig. 2-95. Control unit, installed

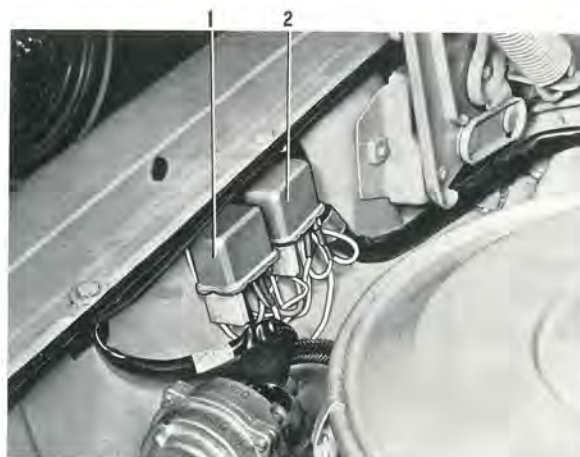


Fig. 2-96. Control relays, installed
1. Pump relay
2. Main relay

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. 2-98.

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

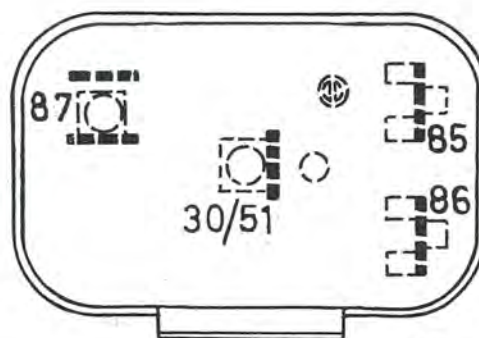


Fig. 2-97. Control relay terminals

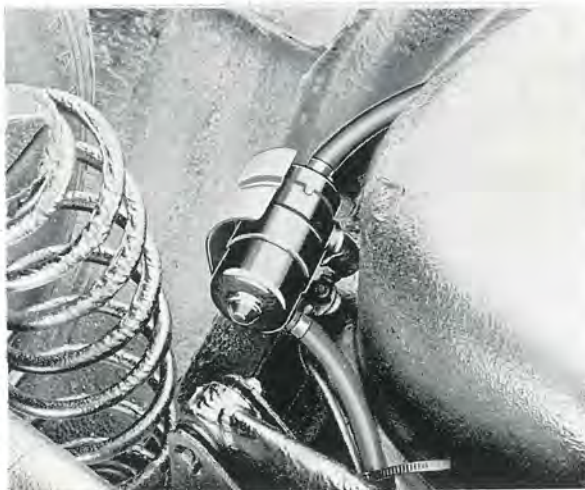


Fig. 2-98. Fuel pump installed

The pump runs only 1—2 seconds when the ignition is switched 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).

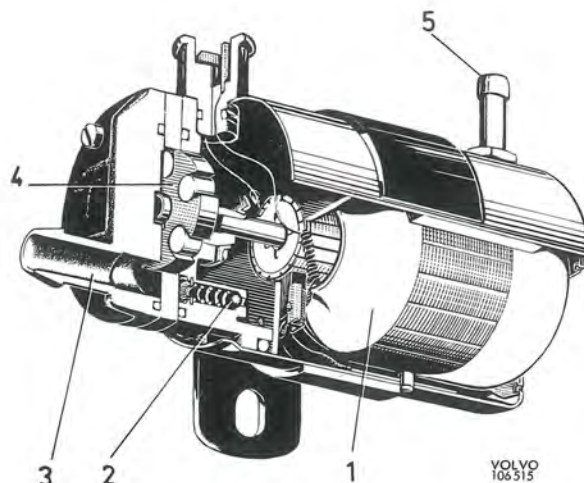


Fig. 2-99. Fuel pump

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

PRESSURE REGULATOR

The location of the pressure regulator is shown in Fig. 2-104. 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).

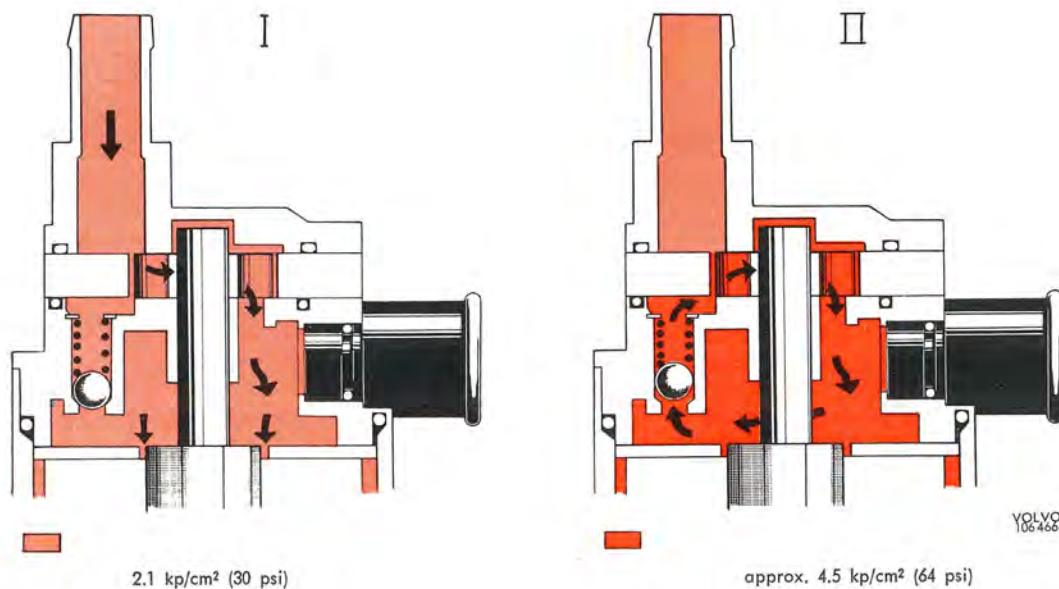


Fig. 2-100. Relief valve function

I Valve closed

II Valve open



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Fig. 2-101. Fuel filter, tank



VOLVO
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Fig. 2-102. Fuel filter installed



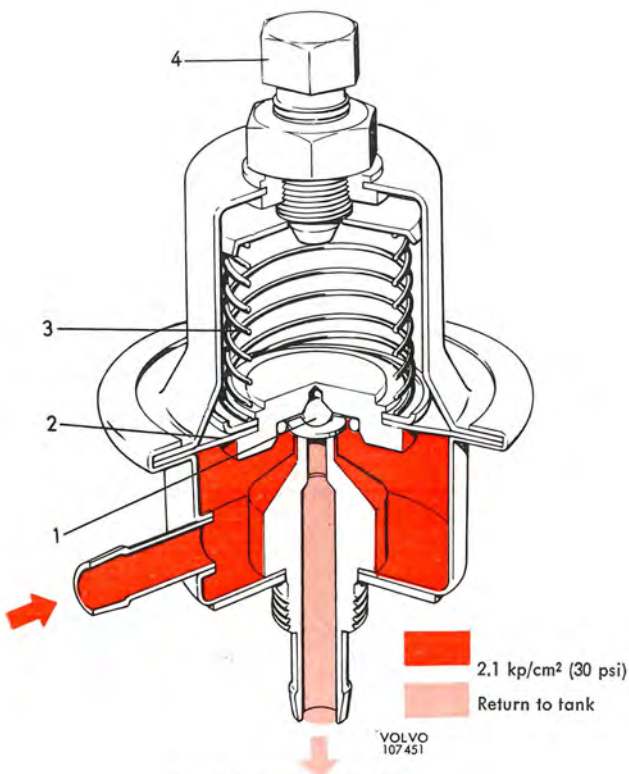
VOLVO
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Fig. 2-104. Pressure regulator, installed

When pressure is lower than 2.1 kp/cm^2 (30 psi) the valve (1, Fig. 2-103) is closed. When the pressure exceeds 2.1 kp/cm^2 (30 psi) the valve opens and releases excess fuel into the return line to the tank.

INJECTORS

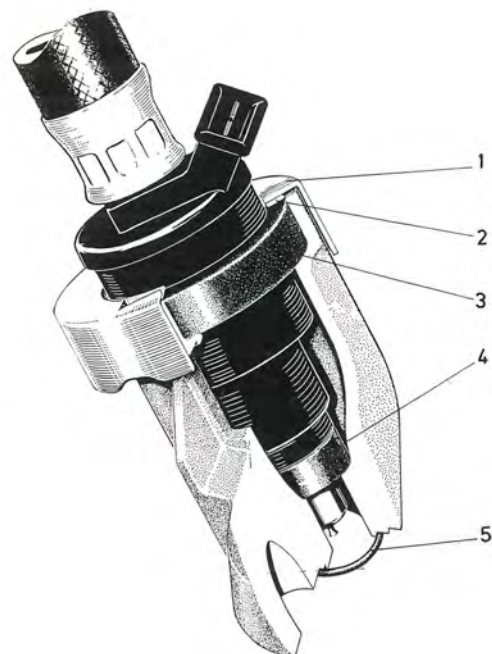
Fuel is injected into the intake ports in the cylinder head by six injectors, one for each port. The injectors are mounted in holders which sit in the cylinder head.



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Fig. 2-103. Pressure regulator

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



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Fig. 2-105. Injector with holder

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

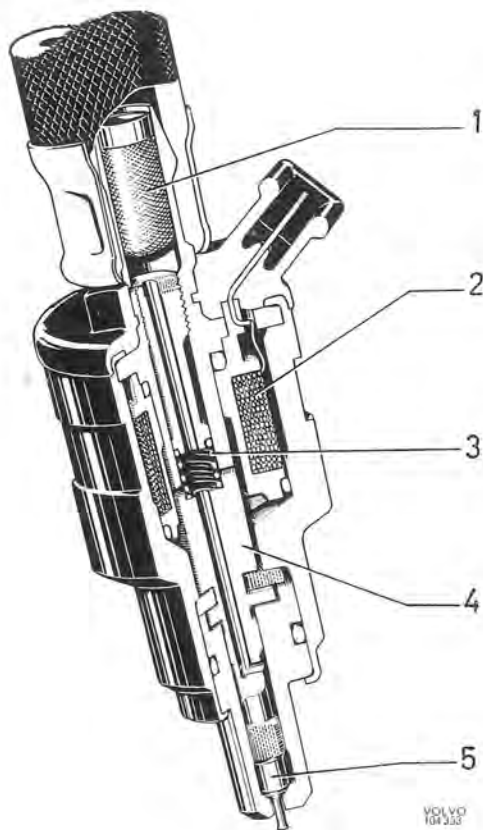


Fig. 2-106. Injector

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

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. 2-106. 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°F) and colder, the cold start valve provides extra fuel for 12 seconds. At $+35^{\circ}\text{C}$ (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. 2-107. 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.

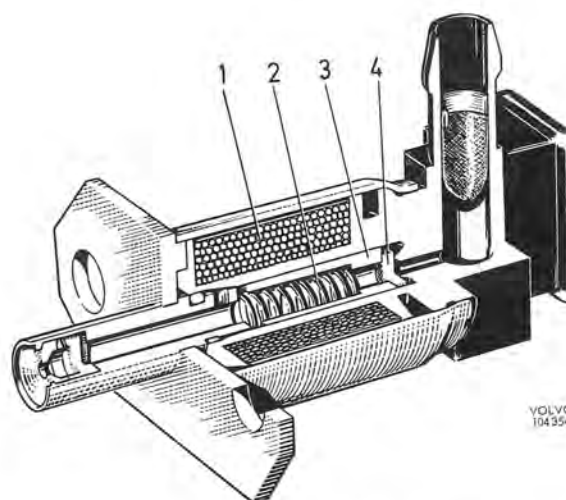


Fig. 2-107. Cold start valve

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



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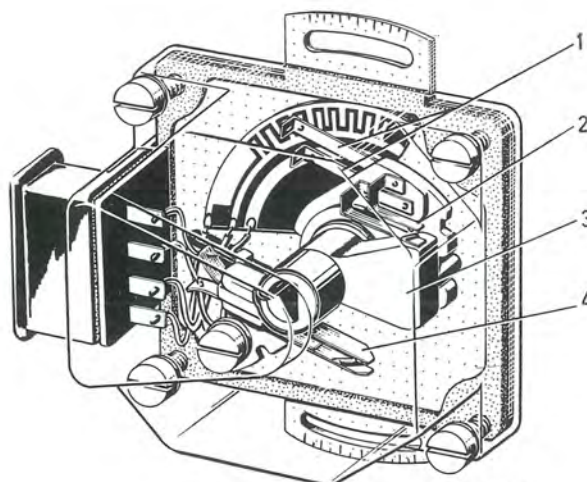
Fig. 2-108. Cold start valve, installed

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. 2-110) 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.



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Fig. 2-110. 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

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. 2-111.

The pressure sensor, Fig. 2-112, is built into a housing of light-alloy.



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Fig. 2-109. Throttle valve switch installed



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Fig. 2-111. Pressure sensor installed

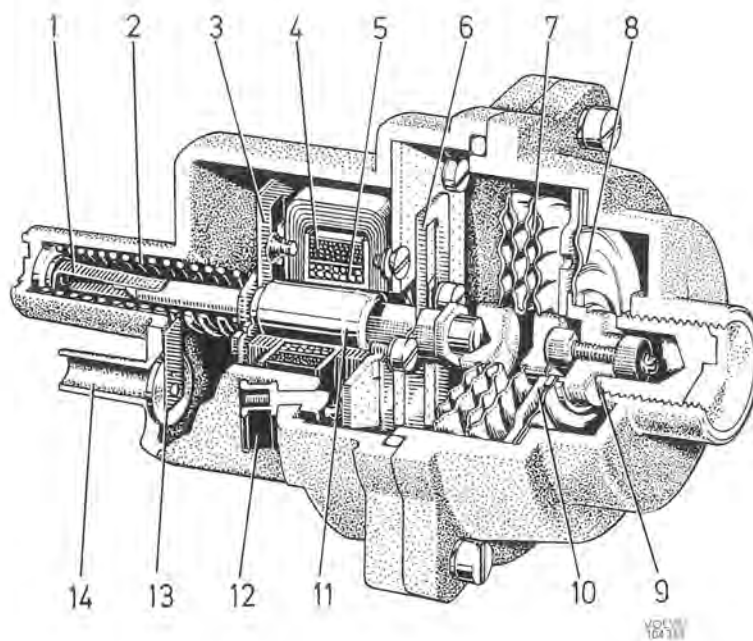


Fig. 2-112. Pressure sensor

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 moveable 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.

AUXILIARY AIR REGULATOR

The auxiliary air regulator is located at the front end of the cylinder head and has its expanding element projecting into the coolant system, see Fig. 2-113.

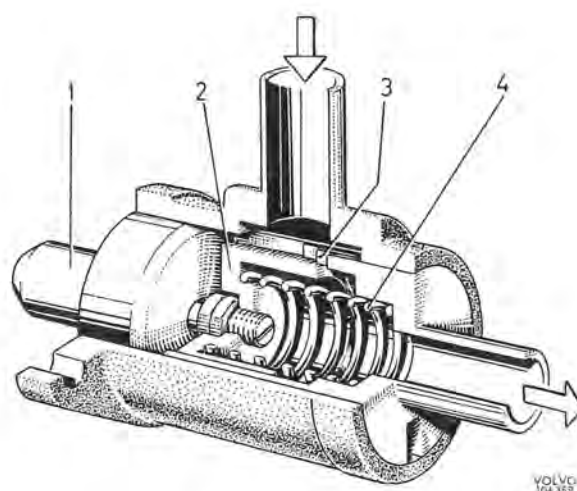


Fig. 2-113. Auxiliary air regulator

1. Expanding element
2. Regulator
3. Auxiliary air pipe
4. Return spring

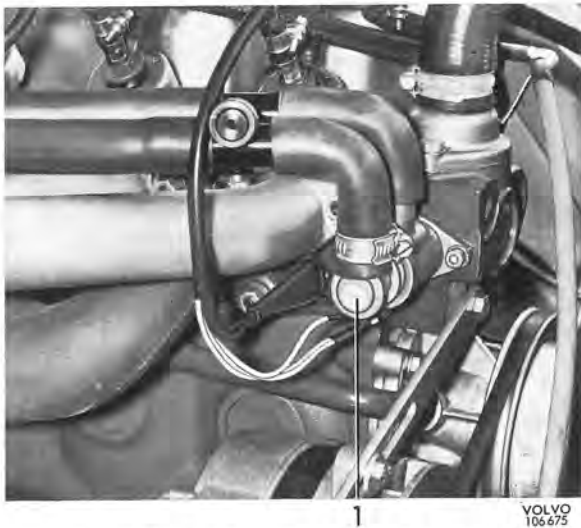


Fig. 2-114. Auxiliary air regulator (1) installed

The regulator operating range is from -25°C (-13°F), fully open, to $+60^{\circ}\text{C}$ (140°F), fully closed. At cold start, the auxiliary air regulator opens (how much will depend on the temperature) and admits additional air into the inlet duct. Gradually as the engine heats up, the regulator element (1, Fig. 2-113) expands and presses back the regulator (2) which, at 60°C (140°F), completely closes off the cross-sectional area of the auxiliary air pipe.



Fig. 2-115. Thermal timer installed

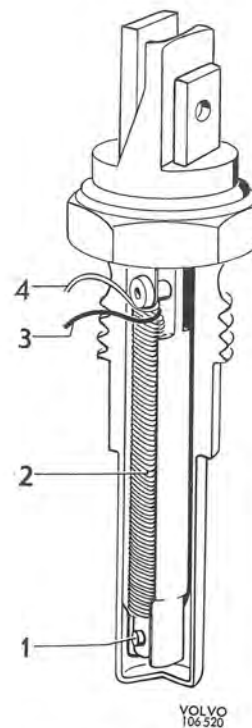


Fig. 2-116. Thermal timer

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

THERMAL TIMER

The thermal timer regulates the injection interval for the cold start valve. With a cold engine (below $+35^{\circ}\text{C}$ $=95^{\circ}\text{F}$), 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.



Fig. 2-117. Temperature sensor for intake air, installed

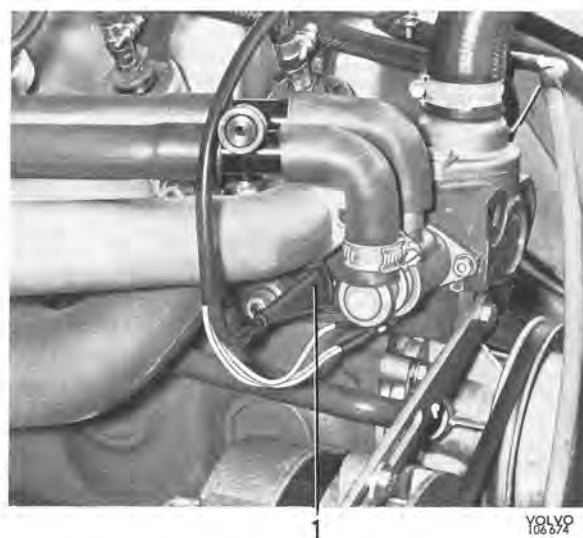


Fig. 2-118. Temperature sensor (1) for coolant, installed

TEMPERATURE SENSORS

The system is equipped 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 quantity somewhat at low intake air temperature. Compensation ceases when the temperature of the intake air is greater than $+30^{\circ}\text{C}$ (86°F).

The temperature sensor for the coolant is located at the front of the cylinder head, see Fig. 2-118, and the temperature sensor for the induction air in front of the battery, see Fig. 2-117.

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 $+60^{\circ}\text{C}$ (140°F) the resistance is only 600 ohms.

AIR CLEANER

The air cleaner is placed above the inlet duct, see Fig. 2-119, and is of the paper type. It should be replaced after every 40 000 km (24 000 miles).

INLET DUCT

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

A throttle valve is mounted at the mouth of the common inlet duct. During idling, the throttle valve is completely closed 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. 2-120.



Fig. 2-119. Air cleaner, installed



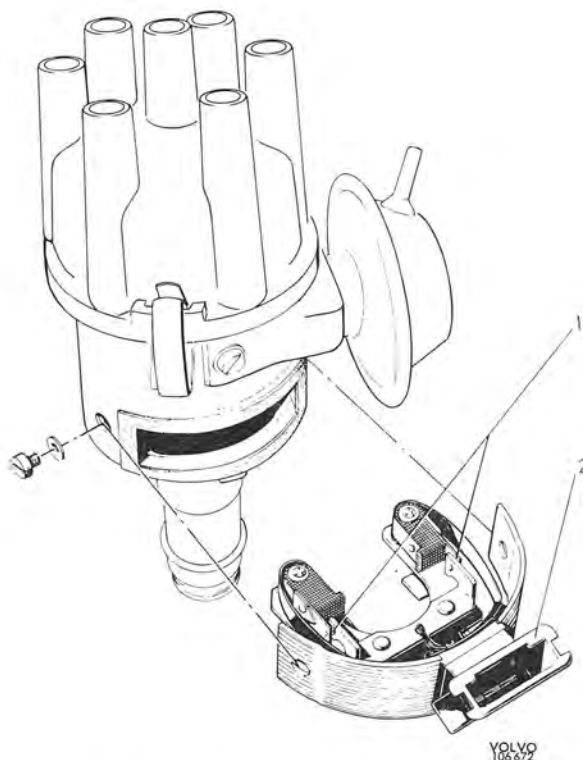
VOLVO
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Fig. 2-120. Idle adjusting screw

TRIGGERING CONTACTS

Below the centrifugal governor in the distributor there is a contact device with two triggering contacts, see Fig. 2-121.

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.



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Fig. 2-121. Distributor with control device
1. Triggering contacts 2. Electrical connection



Fig. 2-122. Venting filter, fitted

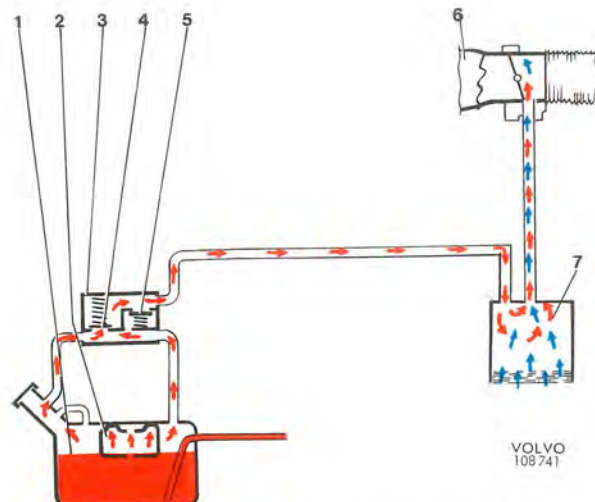


Fig. 2-124. Gas evaporative control system, principle

- | | |
|------------------------|------------------------|
| 1. Fuel tank | 5. Underpressure valve |
| 2. Expansion cannister | 6. Inlet duct |
| 3. Balance valve | 7. Venting filter |
| 4. Overpressure valve | |

GAS EVAPORATIVE CONTROL SYSTEM

Cars intended for the U.S.A. market are fitted with a gas evaporative control system that prevents gas fumes from being released into the atmosphere.

The system consists of a venting filter (Fig. 2-122), a balance valve (Fig. 2-123) and hoses that connect the various components.

An expansion cannister (2, Fig. 2-124) in the fuel evaporative control system absorbs any fuel expansion caused by temperature with a full tank.

Fig. 2-124 shows how the system functions in principle. Fuel fumes arising in the fuel tank, particularly during warm weather, are conveyed through hoses to the balance valve (3, see red arrow).

The balance valve (3) consists of an overpressure valve (4) and an underpressure valve (5). When pressure rises above $0.05\text{--}0.2\text{ kp cm}^2$ ($0.7\text{--}2.8\text{ psi}$), the valve (5) opens and the fuel fumes go to venting filter where they are absorbed by active carbon.

The balance 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 $0.1\text{--}0.2\text{ kp/cm}$ ($1.4\text{--}2.8\text{ psi}$), the valve (5) opens and air goes via the venting filter to the tank.

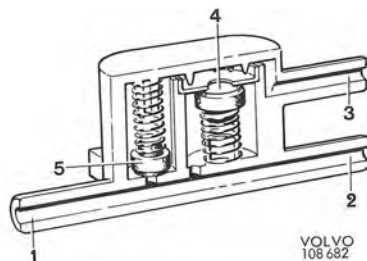


Fig. 2-123. Balance valve (on fuel tank)

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



Fig. 2-125. EGR valve, installed

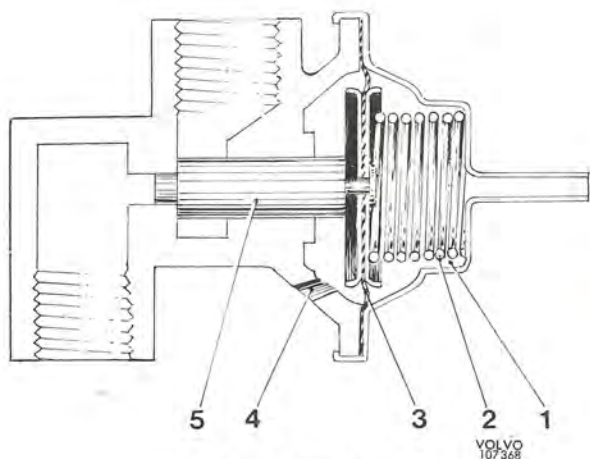


Fig. 2-126. Control valve

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

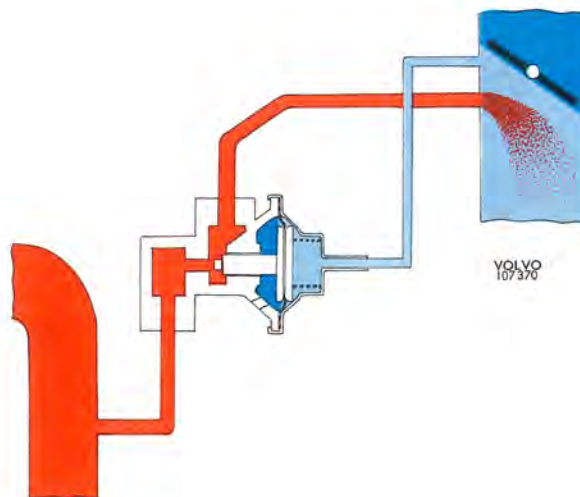


Fig. 2-128. Air shutter partly open, exhaust gas recirculation

Exhaust gas recirculation (EGR)

Vehicles with a B30 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 return channel and an EGR valve operated under a vacuum.

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. 2-127, the opening for the EGR line on the EGR valve is in front of the air shutter. The pressure in the EGR line and also in the EGR valve vacuum chamber is then

equal to atmospheric pressure. Since the pressure in the EGR valve reference chamber is always equal to atmospheric pressure, the same pressure exists on both sides of the diaphragm and this keeps the valve in a closed position under the force of the spring. In other words, there is no exhaust gas recirculation. When the air shutter is partly opens, Fig. 2-128 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.

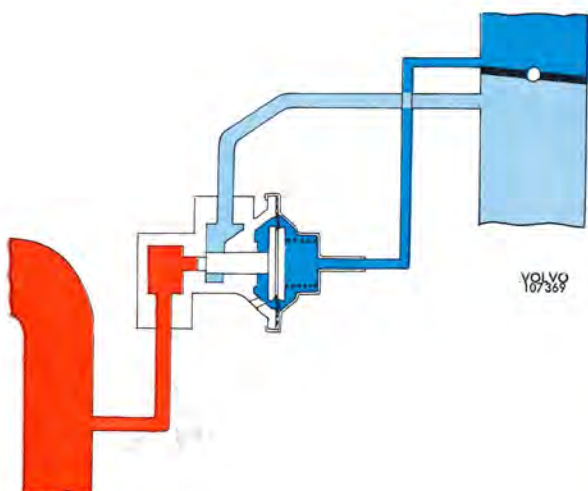


Fig. 2-127. Air shutter closed, no exhaust gas recirculation

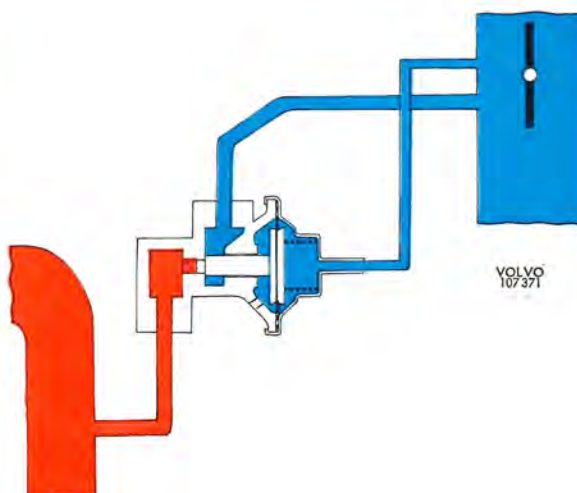


Fig. 2-129. Air shutter fully open, no exhaust gas recirculation

With a fully open air shutter, Fig. 2-129, 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.

CABLE HARNESS

All electrical components in the electronic injection system are mounted in a special cable harness with numbered cables. The connections between the cable harness and components are of the so-called "Amp" plug type, which makes for good electrical contact as well as rapid removal and fitting of the various. 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 harness plug securely. The connections are covered by rubber protectors which also serve for locking purposes. These protectors are removed by pulling the "tongues".

CABLE HARNESS 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 timer	Pump relay, terminal 30
		Starter motor 50

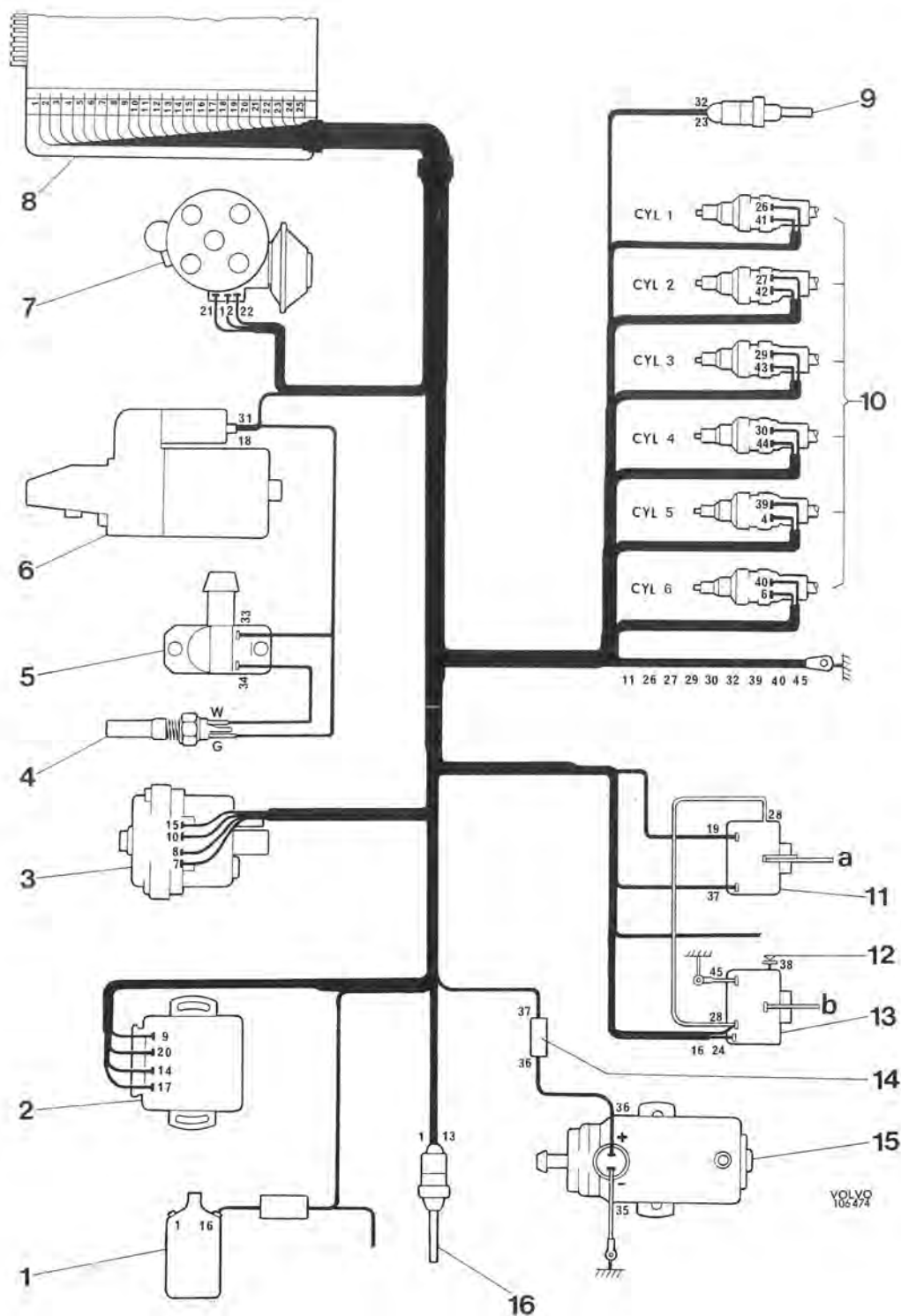


Fig. 2-130. Cable harness

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

REPAIR INSTRUCTIONS

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 $+85^{\circ}\text{C}$ (185°F). The control unit must not be connected up (the engine started) when the ambient temperature exceeds $+70^{\circ}\text{C}$ (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 $+85^{\circ}\text{C}$ (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 : 63).
Connect the cable from the test instrument to the cable harness in the vehicle, see Fig. 2-131.
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.)



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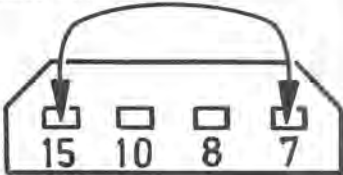
Fig. 2-131. Test instrument connected to cable harness

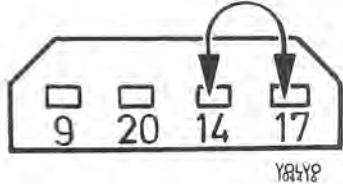


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Fig. 2-132. Test instrument connected to cable harness

Position of switch "B"	Operate	To measure	Indication (nominal value)	Deviation from nominal value. Possible faults and elimination
Voltage I	Switch on ignition	Voltage supply for the of starter solenoid	11.0—12.5 (11.0—12.5 volt)	<p>No reading:</p> <ol style="list-style-type: none"> 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.) <p>Voltage below 11 volts:</p> <ol style="list-style-type: none"> 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	control unit Voltage at terminal 50	9.0—12.0 (9.0—12.0 volt)	<p>No voltage, starter operates:</p> <p>Open circuit in cable 18 from terminal 50 on starter motor to control unit.</p> <p>No voltage as above, starter does not operate:</p> <ol style="list-style-type: none"> 1. Ignition/starter switch defective. 2. Open circuit in cable between ignition and terminal 50 on starter. <p>Voltage below 9.0 volts:</p> <ol style="list-style-type: none"> 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)	<p>Resistance "0":</p> <p>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.)</p> <p>Resistance between "0" and "∞":</p> <p>Damage to insulation. (Proceed as described above.)</p>

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)	<p>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.)</p> <p>Resistance considerably larger than nominal value: Voltage drop in cables or contacts. (Check cables and contacts.)</p> <p>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.)</p> <p>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.)</p> 
	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)	<p>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.)</p>

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 2:66. 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 2:65. 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	<p>Adjust instrument to "∞" again (with switch "B" in position "valves")</p> <p>Push buttons:</p> <p>1=injector for cyl. 1/3 2=injector for cyl. 2/4 3=injector for cyl. 6 4=injector for cyl. 5</p>	Resistance of the windings in the injector with cable	<p>1—2 (1—1.5 Ω) 3—4 (2—3 Ω) 2—3 (2.4 Ω at 20° C=68° F)</p>	<p>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.)</p> <p>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.)</p> <p>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.)</p>

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	<p>Connect pressure gauge to pressure regulator, see page 2: 64</p> <p>Press "Pump" button on the instrument</p>	Pressure in fuel system	Nominal value 2.0—2.2 kp/cm ² (28—31 psi)	<p>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.)</p> <p>Pressure above or below 2.1 kp/cm² (30 psi): Pressure regulator incorrectly adjusted or damaged. (Adjust or change regulator.)</p>
	<p>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: 64</p> <p>Press in "Pump" button on the instrument and check the injectors for leakage.</p>	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/cm ² (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. 2-131. 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. 2-133. Seat folded back

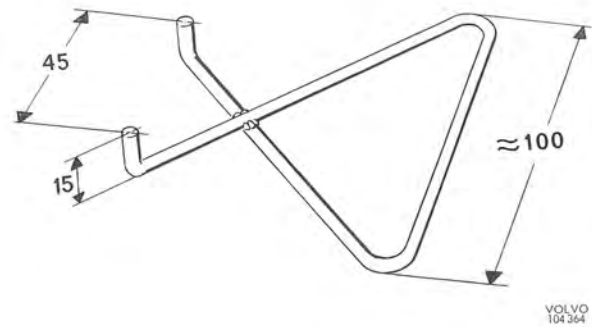


Fig. 2-135. Puller for plug contact
Material: 2 mm (5/64") welding wire

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. 2-133.
3. Unscrew the two attaching screws and lift out the control unit.
4. Unscrew the screw for the cap holding the cable harness to the control unit, see Fig. 2-134.
5. Make a puller as shown in Fig. 2-135. Hook in the puller, see Fig. 2-136, 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.

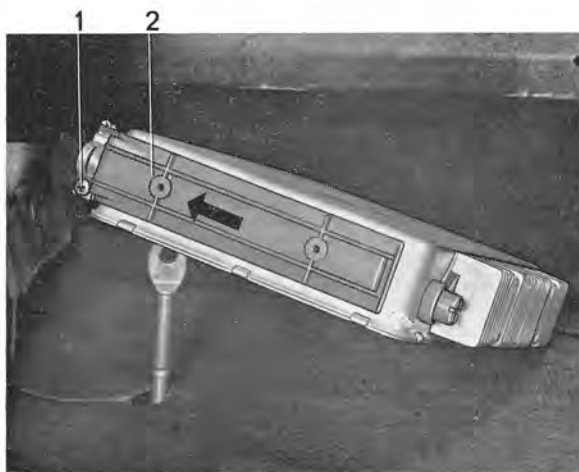


Fig. 2-134. Removing plastic cover

1. Cap screw
2. Plastic cover



Fig. 2-136. 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 dm³/h (22 Imp. galls. = 26.4 US gall./h) at a pressure of 2.1 kp/cm² (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.



Fig. 2-137. Removing fuel 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. 2-138. 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. 2-139.
2. Remove the pressure regulator.
3. Install the new regulator.
4. Tighten the three hose connections.
5. Check for leakage.



Fig. 2-138. Removing fuel filter



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Fig. 2-139. 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. 2-140.
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 locknut 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.



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Fig. 2-140. 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. 2-141, anti-clockwise so that it loosens from the bayonet fitting. Pull up the injector.
6. Move over the sealing ring, washers, bayonet fitting.

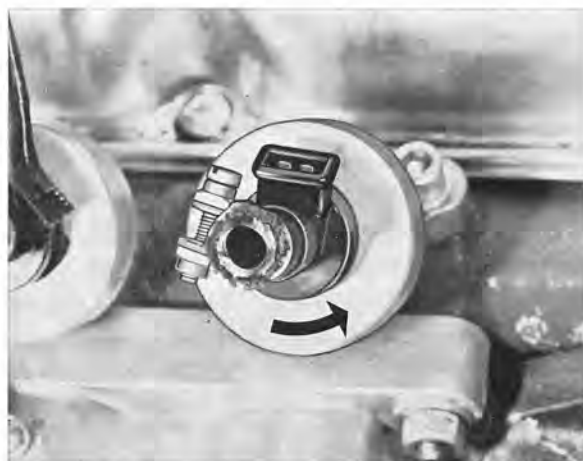
NOTE. The small rubber seal on the injector should be replaced each time the injector is removed.

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).



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Fig. 2-141. Removing injector



Fig. 2-142. Injectors removed for checking

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 locknut for the stop screw (2, Fig. 2-143) 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 locknut. 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.

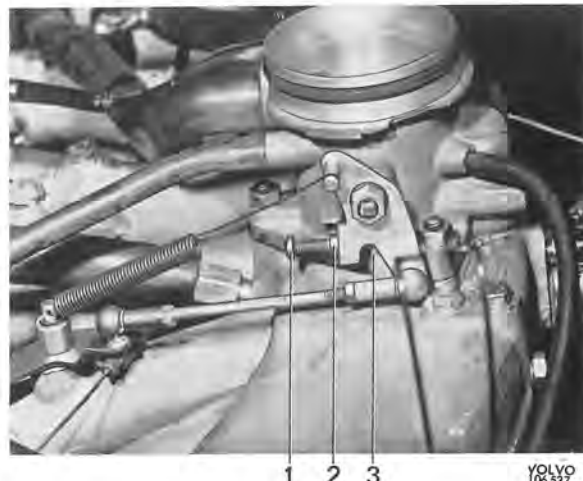


Fig. 2-143. Stop screw for throttle valve

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

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 anti-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. 2-144.

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 (Insex 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.

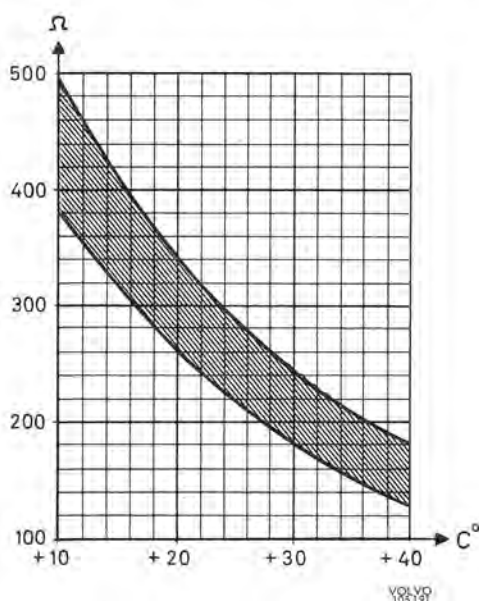


Fig. 2-144. Resistance in temperature sensor for induction air

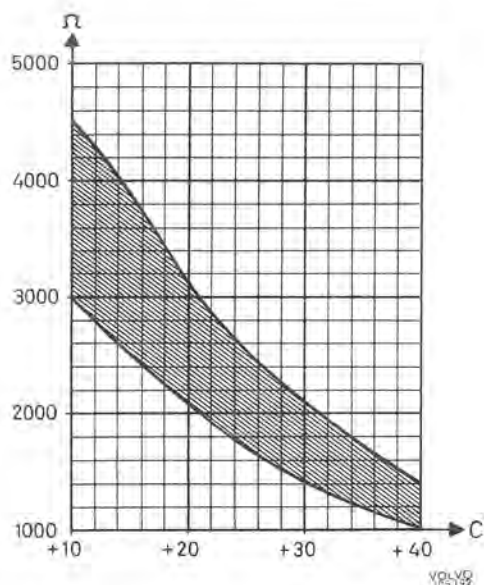


Fig. 2-145. Resistance in temperature sensor for coolant

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. 2-145.

PRESSURE SENSOR

REPLACING

1. Disconnect the hose and remove the plug contact from the sensor. Remove the sensor.
3. Move the bracket from the old to the new sensor.
4. 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

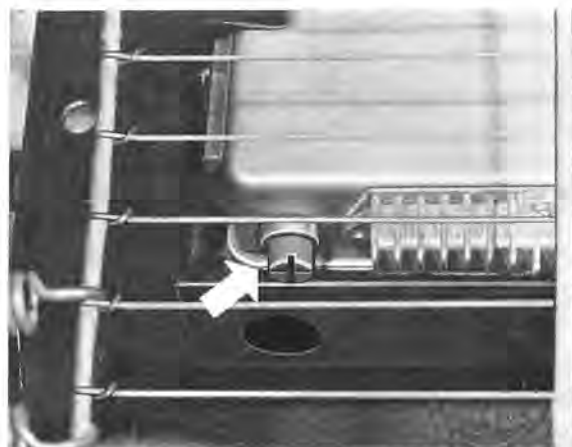
1. Disconnect the hoses from the rocker arm casing and side plate.
2. Release the tensioning clamps from the air cleaner.
3. Lift off the air cleaner.
4. Check the rubber sealing.
Installing is in reverse order to removing.

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.



Y08198

Fig. 2-146. Adjusting CO-value

3. Adjust the idling speed to 15 r/s (900 r/m) (for vehicles with automatic transmission, 13.3r/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 : 66).
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

The return line and control line of the system should be cleaned every 20 000 km (12 000 miles).

The intake manifold should only be cleaned when necessary. To do this, first remove the manifold. The 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 40 000 km (25 000 miles).

INTAKE AND EXHAUST SYSTEM DESCRIPTION

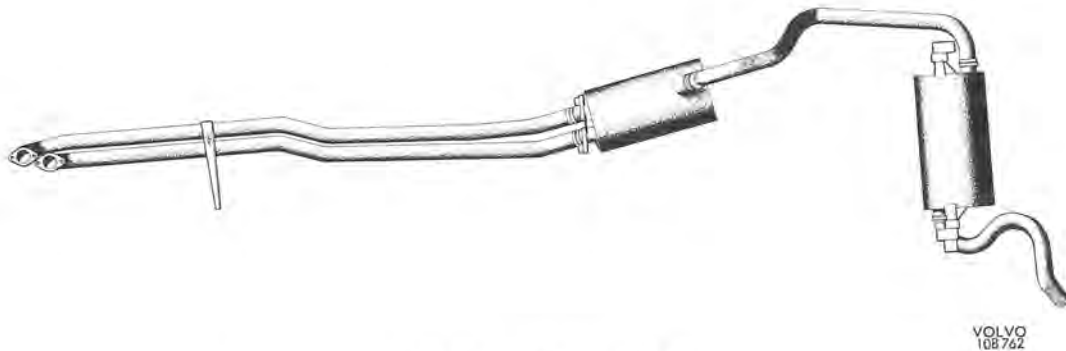


Fig. 2-147. Exhaust system B 30 E/F

INTAKE AND EXHAUST MANIFOLDS

On the B 30 A engine the intake and exhaust manifolds, the material of which is of nodular iron, are cast onto a branch pipe. They have been designed with a view to the exhaust emission control system, with preheating chamber wherein the temperature of the fuel-air mixture is raised by the heat from the exhaust ports.

A spring-loaded throttle (secondary throttle, 10—Illustration 2 A) is to be found in each of the intakes.

The inlet duct for the B 30 E/F engines 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.

SILENCERS AND SILENCER PIPES

The exhaust system is made up of a twin leading pipe (the B 30 A has a single leading pipe), a leading

silencer, intermediate pipe, rear silencer and rear pipe.

The leading pipes are bolted to the exhaust manifold pipes by means of studs and nuts. The other connections are in two versions; **early prod.**: the joints are clamped by means of conventional screw clamps; **late prod.**: the joints, intermediate pipe — rear silencer and rear silencer—rear pipe are hydraulically clamped. The leading pipe is suspended to the gearbox in order to reduce stresses in the manifold. The leading silencer is suspended at its front end by means of two rubber rings and the rear silencer is held in position by means of a rubber shackle, one at each end.

On certain markets, the vehicles are equipped with a system for returning exhaust gases to the engine (known as EGR system). For a description and repair instructions concerning this system, see pages 2 : 54 and 2 : 68 respectively.

REPAIR INSTRUCTIONS

REPLACING MANIFOLD GASKET, B 30 E/F

1. Disconnect the ground battery connection.
2. Remove the air cleaner.
3. Remove the throttle control, all hoses and electrical cables from the inlet duct.
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 inlet duct.
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 inlet duct against the cylinder head, fit the duct nuts and tighten to a torque of 18-22 Nm (13-16 lbft).
11. Fit the clamp fixing the exhaust pipes to the gearbox.
12. (F-engine). Fit the EGR-valve with the lower pipe on the exhaust pipe but without 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 inlet duct.
14. Fit the air cleaner and the ground battery lead.

REPLACING EXHAUST SYSTEM COMPLETE

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

1. Release the clamps on the leading silencer.
2. Pull off the intermediate pipe from the leading silencer.
3. Remove the rubber rings suspending the leading silencer. Use, for example, a screwdriver and lever the rubber rings off their brackets.
4. Pull off the leading silencer from the leading pipe.
5. Remove the rubber shackles suspending the rear silencer and lift down as a unit the intermediate pipe, rear silencer 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 exhaust pipe.
7. Unscrew the flange nuts and clamps securing the leading pipe to the gearbox 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 gearbox 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 battery and the air cleaner.
12. Tighten up the clamp securing the leading pipe to the gearbox attachment.
13. Hang the clamp up on the leading pipe and insert the leading silencer into the leading pipe. The pipe ends should be stuck in about 40 mm (1 1/2").
14. Fit the rubber rings for the leading silencer. Use, for example, a screwdriver and lever the rubber rings over the brackets.
15. Place the rubber shackle for the rear silencer on the underbody brackets.
16. Hang the clamps on the silencer and insert the rear pipe into the silencer about 40 mm (1 1/2"). NOTE! Rear silencers 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 silencer about 40 mm (1 1/2"). Lift up the entire unit intermediate pipe, rear silencer, rear pipe and suspend the silencer on the rubber shackles.
18. Hang up the clamp on the leading silencer and fit the intermediate pipe on to the leading silencer.
19. Adjust the location of the rear silencer. This is done by turning the rear silencer and by moving the leading silencer on the leading pipe. The suspension pins for the rear silencer should be vertical to the body pins. The silencer should incline forwards (lower at the front than at the rear) 15° in relation to the horizontal, see Fig. 2-148.
20. Tighten up all clamps; the clamps should be exactly over the jointed sections.

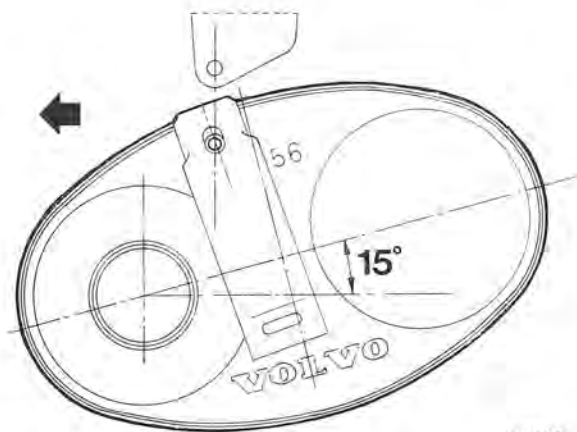


Fig. 2-148. Fit rear exhaust silencer.
The arrow points forwards in the vehicle

GROUP 26

COOLING SYSTEM DESCRIPTION

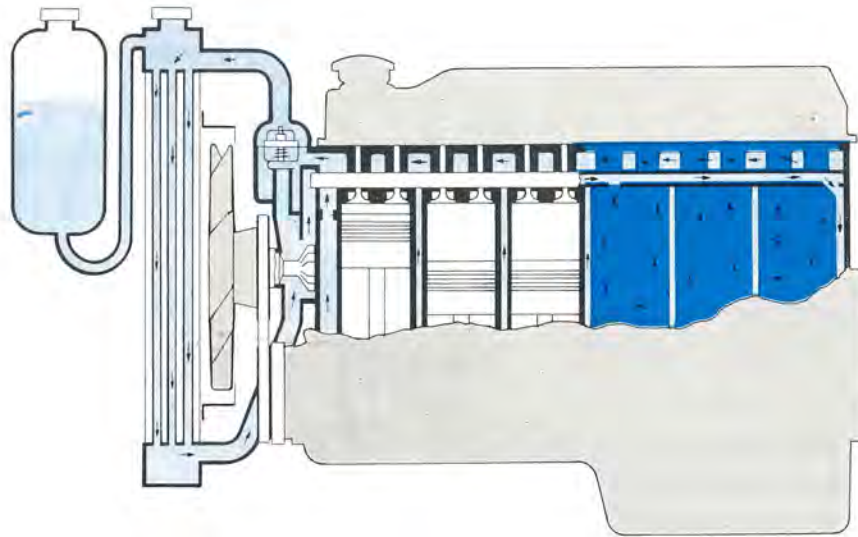


Fig. 2-149. Sealed cooling system

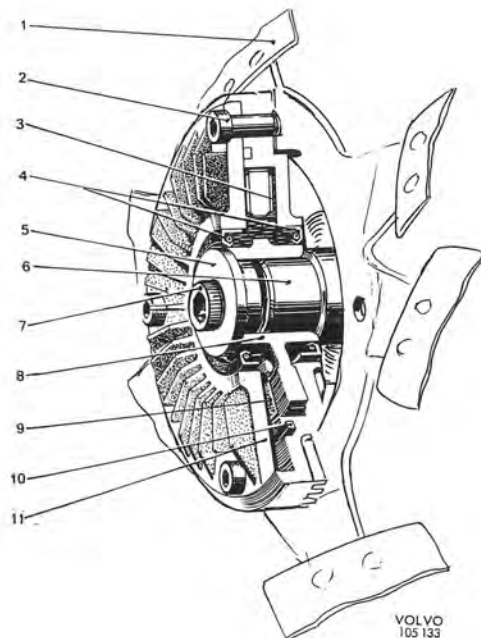


Fig. 2-150. Fan coupling

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

GENERAL

The engine is water-cooled and the cooling system is of the sealed type, see Fig. 2-149. 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. 2-150), 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. 2-158. The six fan blades are mounted asymmetrically to keep down the noise level. The fan coupling consists of the casing (11, Fig. 2-150) 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 (3500 r/m), the slipping

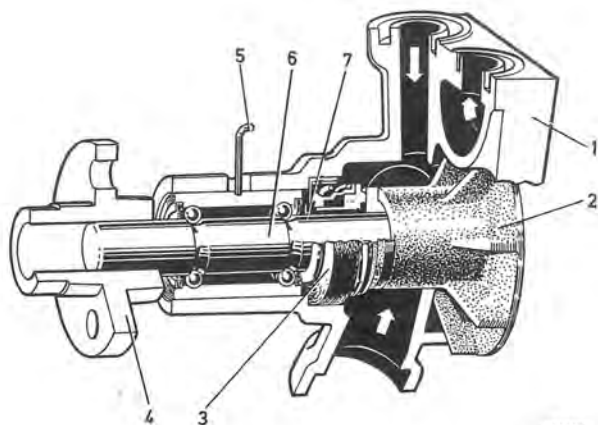


Fig. 2-151. Water pump

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

increases (see Fig. 2-158). With this arrangement, the fan speed should never exceed about 41.7 r/s (2500 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. 2-151, takes care of the coolant circulation and a twin operating thermostat provides rapid warming up of the engine and contributes to the engine maintaining the most suitable temperature under all operating conditions.

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 colour), 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

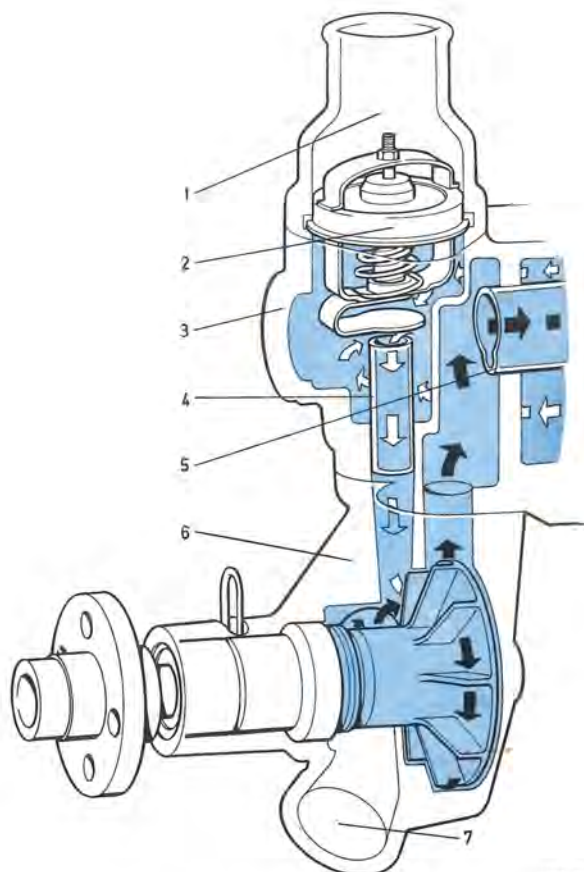


Fig. 2-152. Coolant flow, thermostat closed

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

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. 2-152) in the cylinder head. This results in a uniform cooling of the warmest parts in the cylinder head. Even the parts around the spark plugs are also cold and thereby maintained at a constant temperature. The coolant surrounding the cylinder walls is circulated by means of thermo-syphon action.

COOLANT SYSTEM OUTER CIRCUIT

When the coolant in the inner circuit reaches a suitable temperature for the engine, the thermostat begins to open during which time the by-pass between the thermostat housing and the pump is gradually closed, see Fig. 2-153.

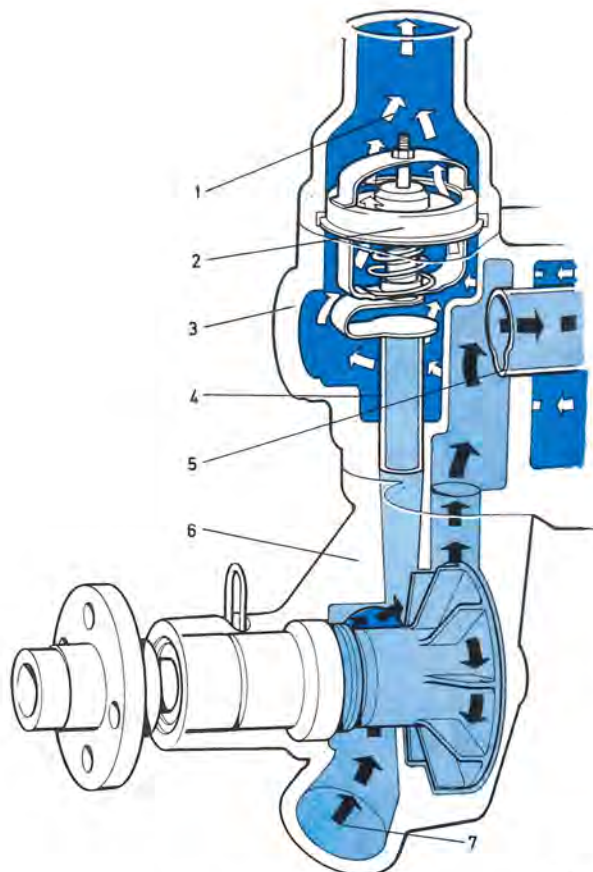


Fig. 2-153. Coolant flow, thermostat open
Concerning numbers above, see previous figure

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

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

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

REPAIR INSTRUCTIONS

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

Before filling, flush the cooling system with clean water. When filling with coolant, through the filler opening on top of the radiator, the heater control

should be set at max. heat. Fill the radiator to the top and fit the cap. Fill also the expansion tank to the "Max" mark or to max. 30 mm (1/8") 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.



Fig. 2-154. Expansion tank

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.

REPLACING THE RADIATOR

1. Remove the radiator cap and drain the system of coolant by disconnecting the lower radiator hose.
2. Remove the expansion tank with hose and empty out the coolant. Remove the upper radiator hose.
3. Remove the bolts for the radiator and fan casing. Lift off the radiator.
4. Place the new radiator in position and tighten the bolts for the radiator and fan 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 THE WATER PUMP

Remove the radiator according to the instructions given under "Replacing the 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

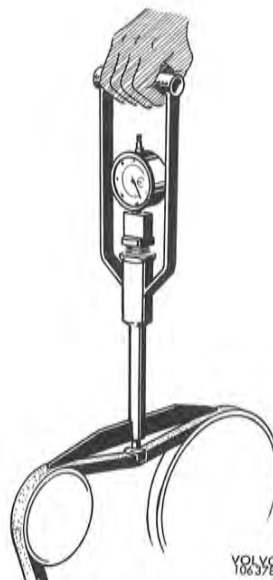


Fig. 2-155. Belt tensioner 2906

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 THE PULLEY BELT

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

The gauge is placed on the belt as shown in the Fig. 2-153. The belt must lie in the fork on the thrust rod. Push the gauge down until both ends on the stop rule lie against the belt. In this position, read off the gauge. Fig. 2-154 shows the correct values.

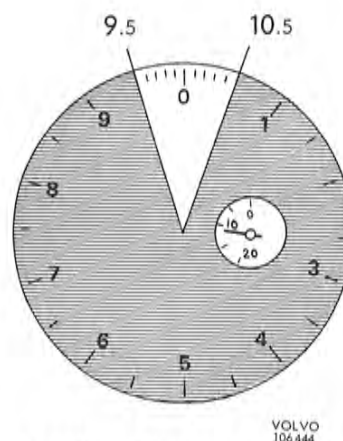


Fig. 2-156. Belt tensioning gauge values
(see also table overleaf)

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

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

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

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

WITHOUT 2906

The pulley belt is tensioned so that it can be deflected 10 mm (approx 3/8") with a force acc. to table applied to the belt midway between the water pump pulley and alternator pulley, see Fig. 2-157.

The amount of force applied will depend on the location of the bolt in the oblong slot in the tensioner. With the bolt at the end of the slot (long belt), the force applied should be the lower value; and with the bolt at the beginning of the slot (short belt), a force of the higher value should be applied. If the bolt is located anywhere between these extremes, the force applied should be proportionally within the two limits given.

FAN COUPLING

The fan coupling 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. 2-158.

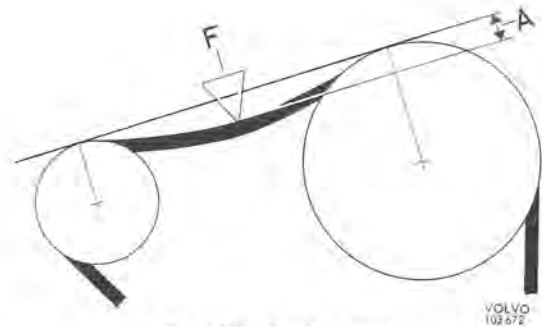


Fig. 2-157. Fan belt tension
F=75—110 N (16.5—24 lb)

Fan belt tensioning:

with 2906			F N (lb)
A	B	C	
9.5—10.5	8.1—8.6	11.5	75—110 (16.5—24)

A=Check value with belt tension gauge 2906, new belt

B=With belt in outer position (stretched belt)

C=Value when fitting new belt

F=Depression force in N (lb) when depressing 10 mm (3/8") midway between pulleys.
(The lower value with belt in outer position, stretched.)

Fan speed r/m

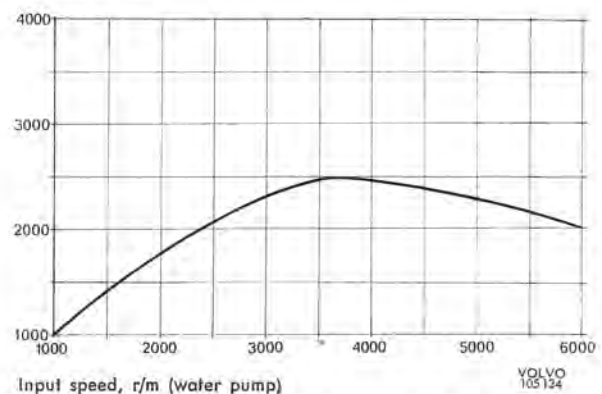
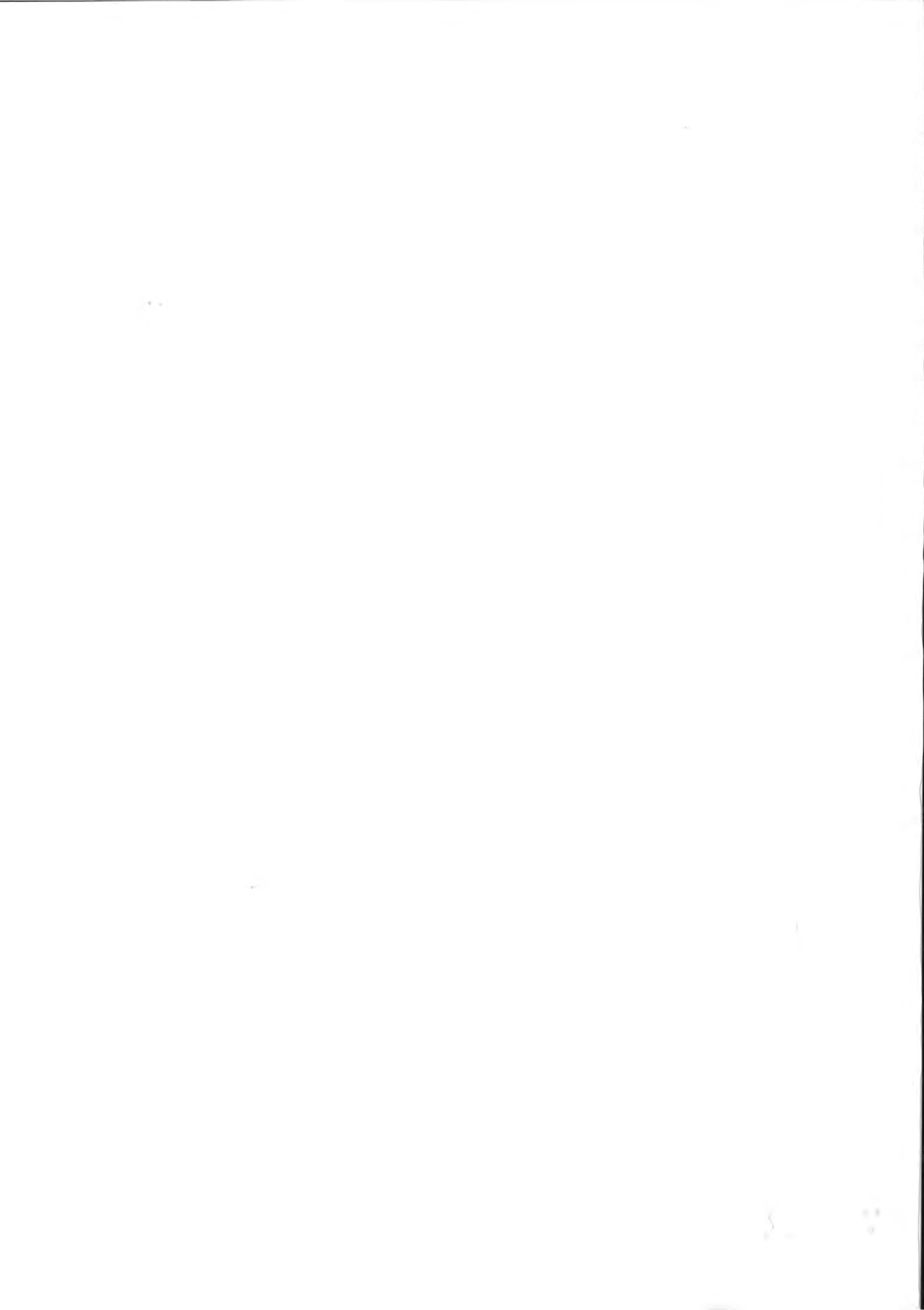


Fig. 2-158. Curve for fan coupling slip



- | | |
|--|-----------------------------|
| 1. Valve guide | 44. Gear wheel |
| 2. Valve spring | 45. Bush |
| 3. Air preheating flap | 46. Rubber lip seal |
| 4. Valve guide seal | 47. Flywheel |
| 5. Valve collet | 48. Sealing flange |
| 6. Intake valve | 49. Main bearing bolt |
| 7. No longer fitted (By-pass valve) | 50. Delivery pipe |
| 8. Temperature compensator | 51. Cover plate |
| 9. Exhaust valve | 52. Oil pump |
| 10. Secondary throttle | 53. Sump |
| 11. Front carburetor | 54. Cap |
| 12. Air cleaner | 55. Connecting rod |
| 13. Manifold pipe | 56. Splash plate |
| 14. Bracket | 57. Main bearing |
| 15. Hose for fresh air supply | 58. Bush |
| 16. Nipple | 59. Gudgeon pin |
| 17. Fuel hose | 60. Circlip |
| 18. Carburetor control | 61. Camshaft |
| 19. Hose for crankcase gases | 62. Piston |
| 20. Rear carburetor | 63. Piston rings |
| 21. Cylinder head gasket | 64. Crankshaft |
| 22. Rocker arm shaft | 65. Thrust washer |
| 23. Spring | 66. Spacer ring |
| 24. Vacuum hose for ignition distributor | 67. Camshaft gear |
| 25. Flame protector | 68. Nut |
| 26. Adjusting device | 69. Seal |
| 27. Rocker arm | 70. Crankshaft gear |
| 28. Bearing bracket | 71. Rubber lip seal |
| 29. Push rod | 72. Polygon hub |
| 30. Cable terminal | 73. Washer |
| 31. Rubber seal | 74. Pulley |
| 32. Rubber seal | 76. Flywheel damper |
| 33. Choke wire | 77. Fan belt |
| 34. Vacuum hose for negative vacuum adjustment | 78. Coolant pipe |
| 35. Rocker arm casing | 79. Fan blade |
| 36. Ignition cable to ignition coil | 80. Pulley |
| 37. Cylinder head | 81. Flange |
| 38. Distributor | 82. Washer |
| 39. Oil dipstick | 83. Center bolt |
| 40. Vacuum governor | 84. Fan coupling |
| 41. Valve tappet | 85. Water pump |
| 42. Retainer | 86. Alternator |
| 43. Cylinder block | 87. Tensioner |
| | 88. Water distribution pipe |
| | 89. Thermostat |

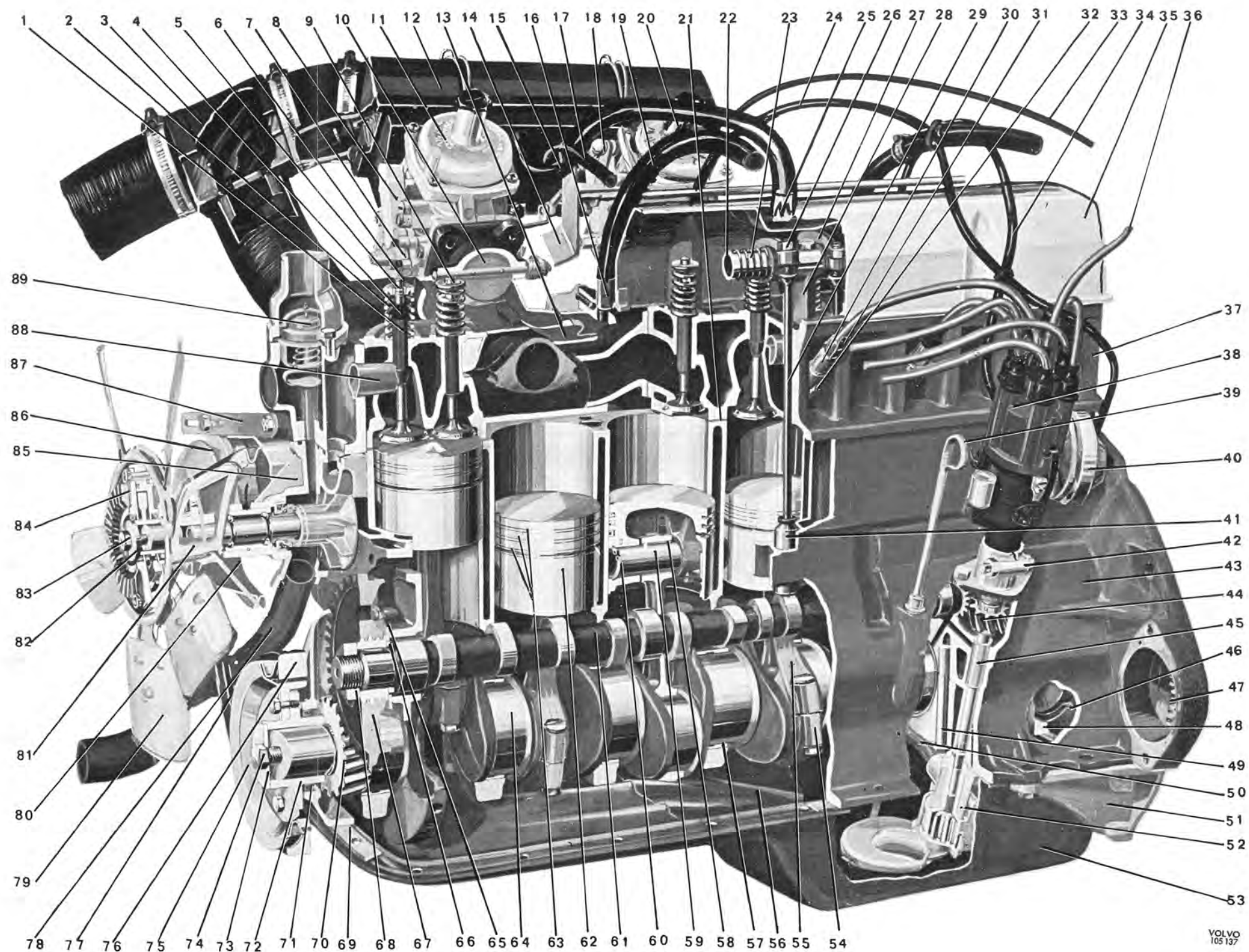


Illustration 2 A. B 30 A Engine

Part 3

**ELECTRICAL SYSTEM
AND
INSTRUMENTS**

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Wiring Diagram

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 DESCRIPTION

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.

REPAIR INSTRUCTIONS

REMOVING

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.

INSTALLING

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.

SERVICING

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
105 433

Fig. 3-1. Battery

ALTERNATOR

DESCRIPTION

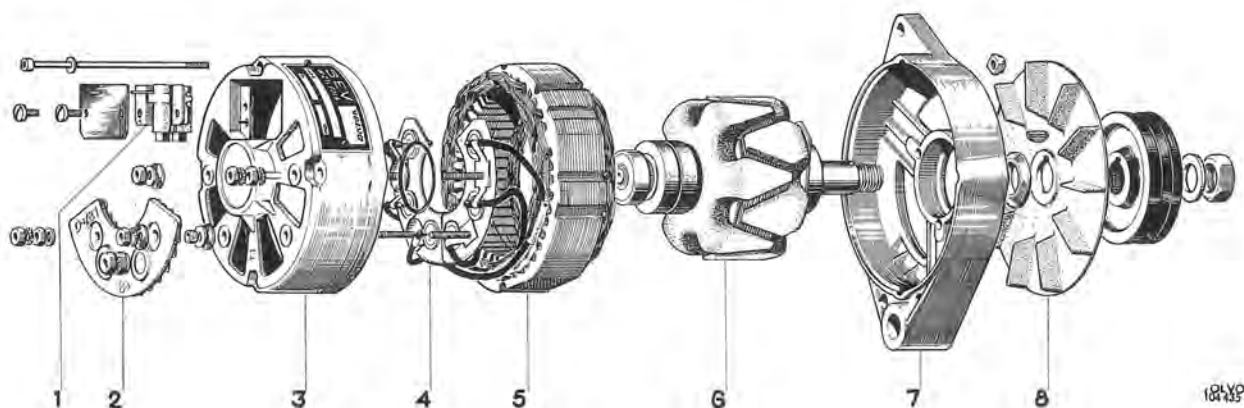


Fig. 3-2. Exploded view of alternator

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

The alternator is a three-phase, star-connected 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 isolation 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.

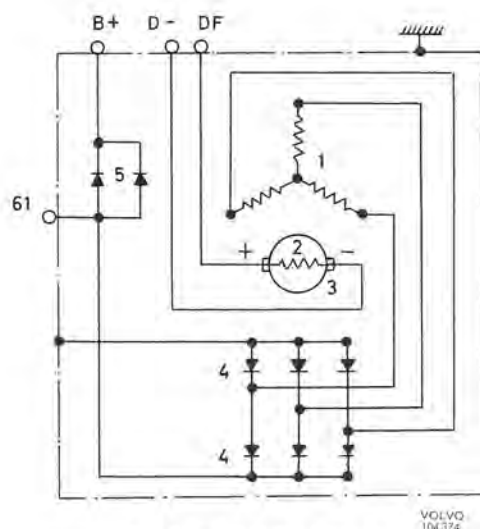


Fig. 3-3. Alternator inner circuit

- | | |
|-------------------------------|---------------------|
| 1. Stator | 4. Rectifier diodes |
| 2. Rotor (field winding) | 5. Isolation diodes |
| 3. Slip ring and brush holder | |

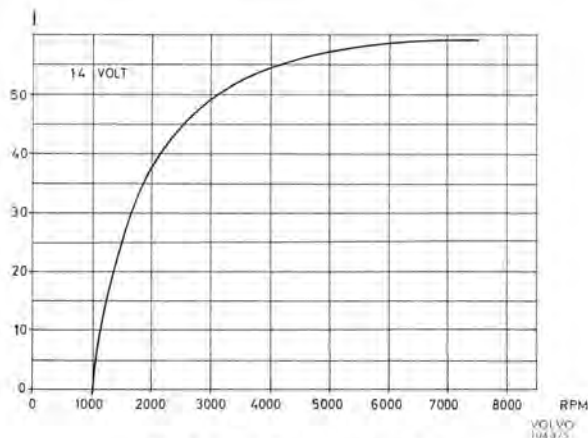


Fig. 3-4. Alternator output curve

REPAIR INSTRUCTIONS

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 alternator 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.



Fig. 3-5. Alternator fitted

VOLVO
104 469

DISASSEMBLING ALTERNATOR

1. Release the two screws holding the brush holder and remove the isolation plate. 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 and the corresponding on the other side of the isolation diode. Lift off the isolation diode holder, see Fig. 3-6.
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.



Fig. 3-6. Removing isolation diodes

VOLVO
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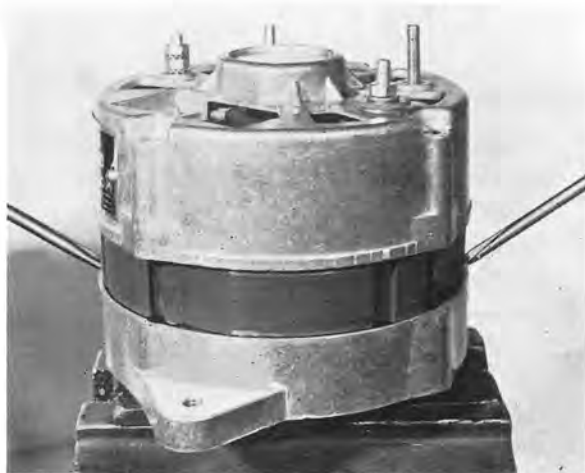


Fig. 3-7. Disassembling alternator

VOLVO
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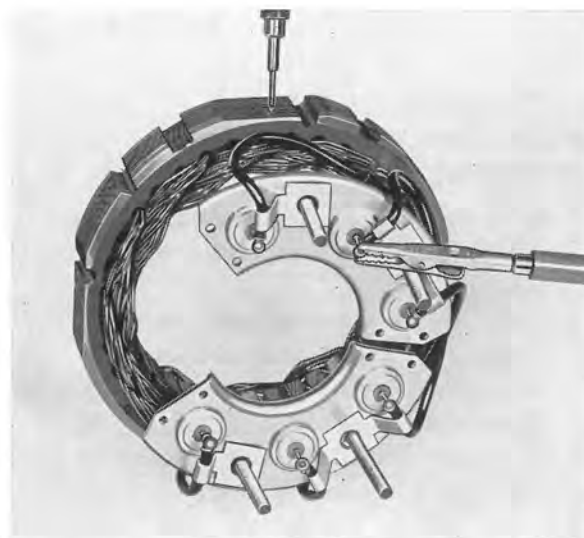


Fig. 3-9. Checking stator

VOLVO
103 011

CHECKING DISASSEMBLED ALTERNATOR

STATOR

Check the stator for any short-circuiting. If one or several of the coils are burnt, there must be a short-circuit 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 isolation diodes is faulty, replace the holder, complete with isolation diodes.

If a diode tester is not available, the diodes should be soldered loose (see page 3—6) 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.



Fig. 3-8. Removing drive end shield

VOLVO
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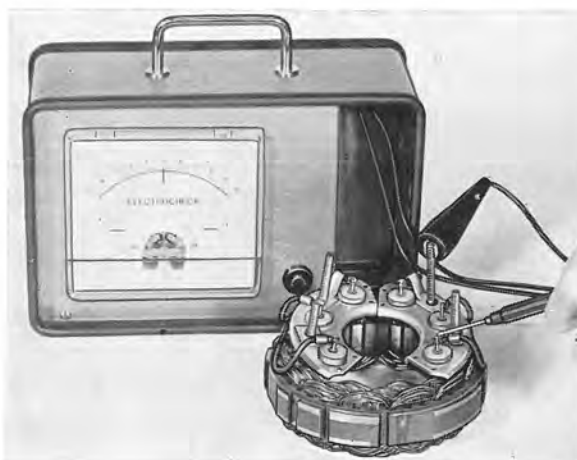


Fig. 3-10. Checking diodes

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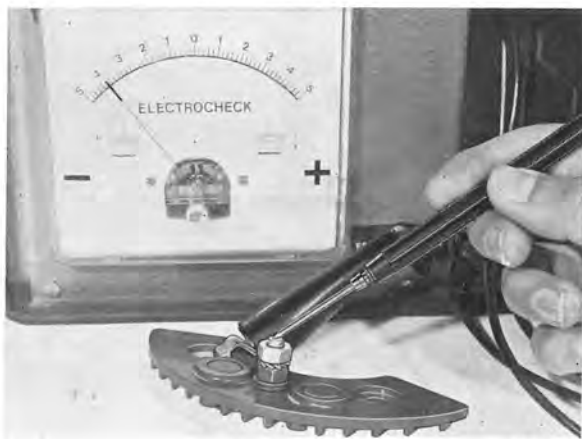


Fig. 3-11. Checking isolation diodes

If the slip rings are dirty, clean them carefully with a cloth moistened in trichlorethylene. 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



Fig. 3-12. Check-measuring rotor

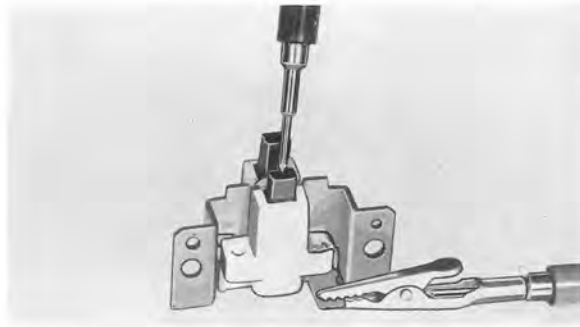


Fig. 3-13. Checking brush holder

frame "-" 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.

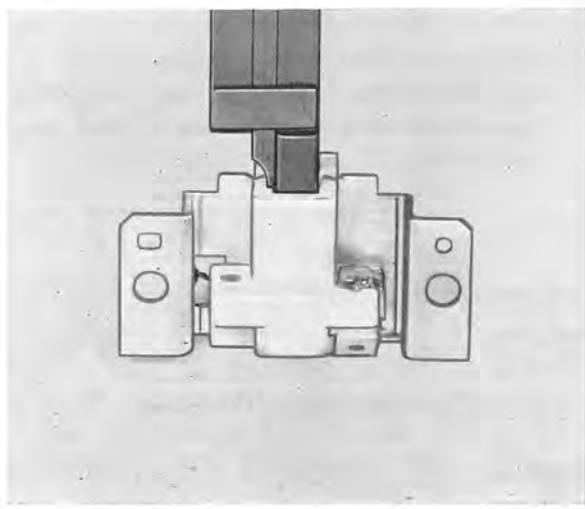


Fig. 3-14. Measuring brush length

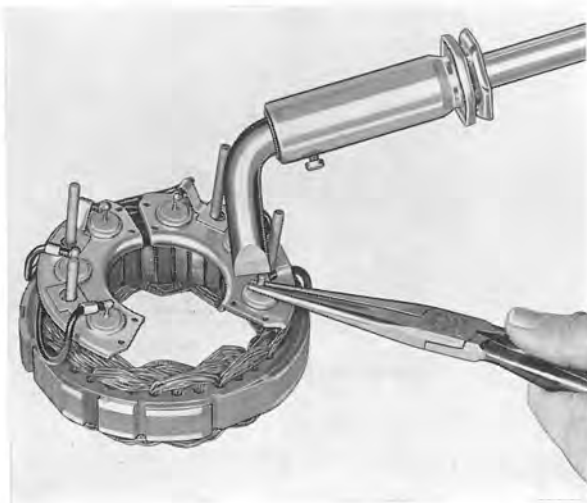


Fig. 3-15. Soldering on diodes

VOLVO
103016

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

Removing

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

Installing

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

Removing

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

Installing

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

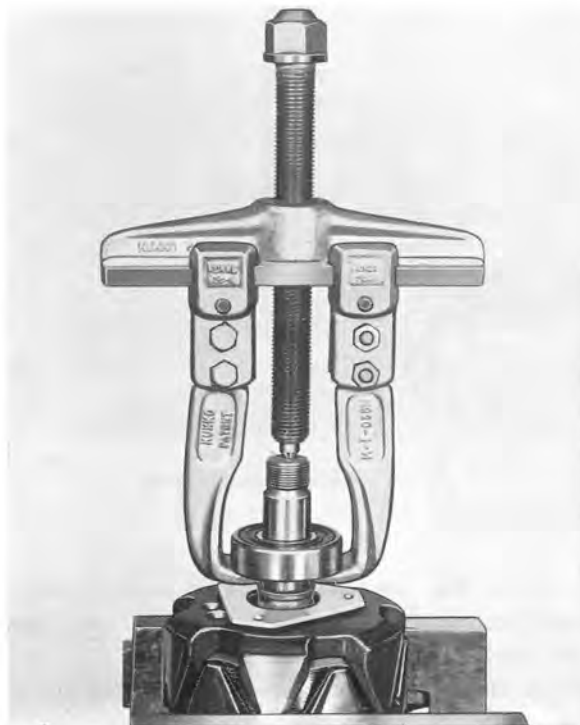


Fig. 3-16 Removing bearing

VOLVO
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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.

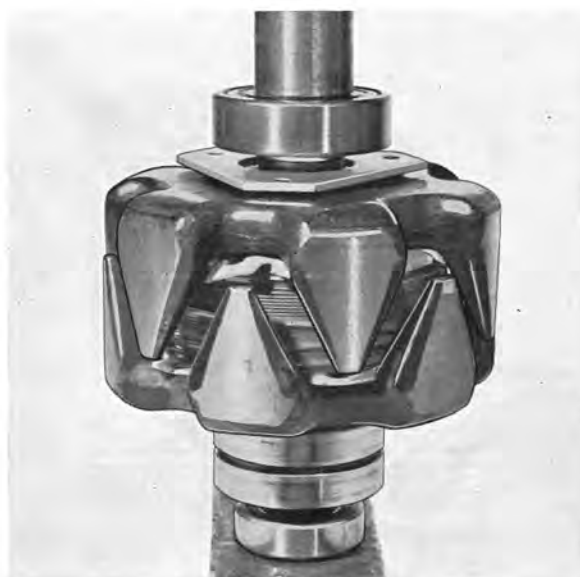


Fig. 3-17. Installing bearing

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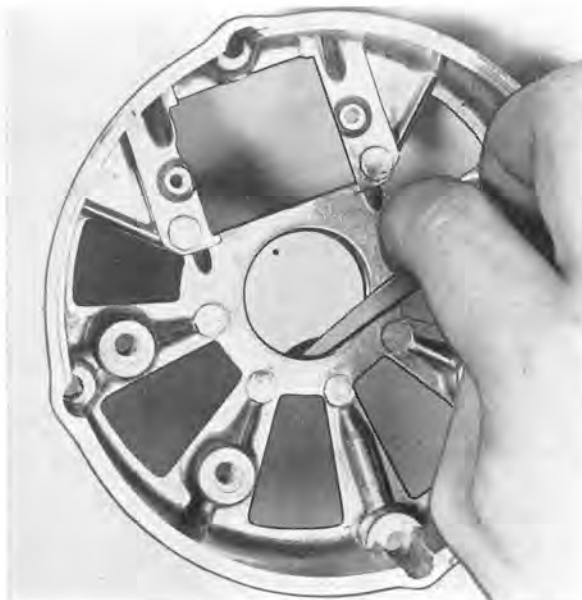


Fig. 3-18. Removing O-ring

VOLVO
103 019

3. Fit a new O-ring.
Lubricate the O-ring and the hole with mineral oil or similar.
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 (2.0—2.2 lbft)
5. Fit the plastic tube and isolation washers on the screws on which the isolation diode is to be mounted.



Fig. 3-19. Checking alternator

VOLVO
104 293

- Fit the isolation diode, put on the nuts and washers. Fit the brush holder.
6. Fit the spacer washer, key, fan, pulley, washer and nut. Tightening torque 40 Nm (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 Part 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

DESCRIPTION



Fig. 3-20. Voltage regulator fitted

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.

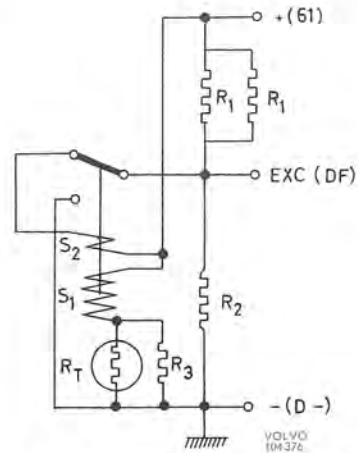


Fig. 3-21. Inner wiring of regulator

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

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.

TESTING THE 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.

CHECKING ALTERNATOR CIRCUIT

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 Part 2, Engine, Group 25). Any of the above faults must be remedied before the electrical checks can be started.

TESTING BATTERY

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.

CHECKING VOLTAGE DROP

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. Suitable load: Mainbeam lights switched on. With the engine running and the alternator supplying 10 amps., measure 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 once again. With the same load as above, 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.

CHECKING ALTERNATOR

(In 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 diodes is faulty and should be replaced.

CHECKING VOLTAGE REGULATOR

(In 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).

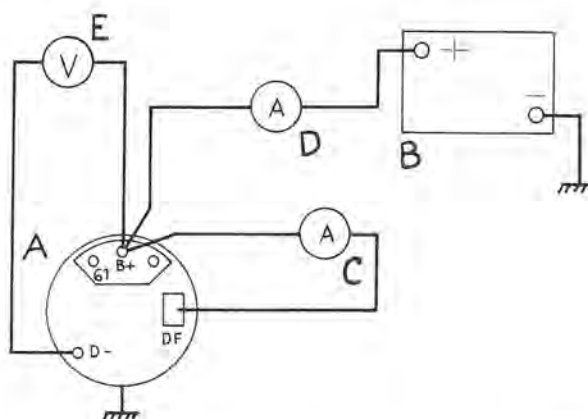


Fig. 3-22. Wiring diagram for testing alternator

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

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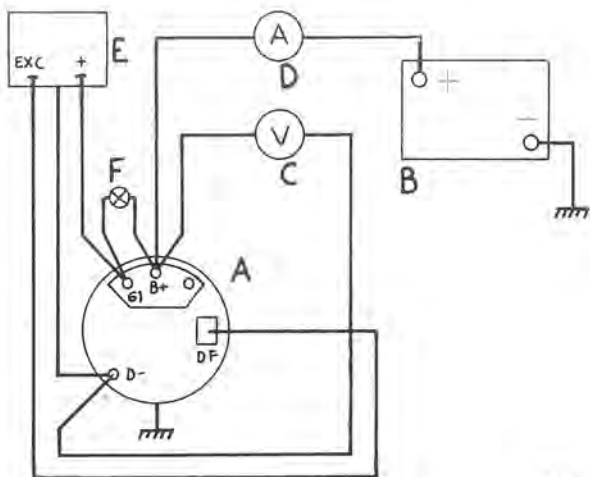


Fig. 3-23. Wiring diagram for testing voltage regulator

- | | |
|------------------------|-------------------------------------|
| A Alternator | D Ammeter 0—50 amps. |
| B Battery 60 Ah | E Voltage regulator |
| C Voltmeter 0—20 amps. | 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 13.7—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 alter-

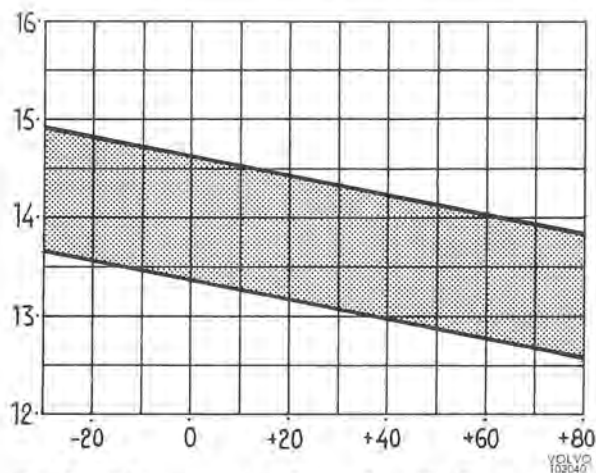


Fig. 3-24. Voltage-temperature diagram for cold voltage regulator

nator. The engine should be turning over at about 25 r/s (1500 r/m), 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.

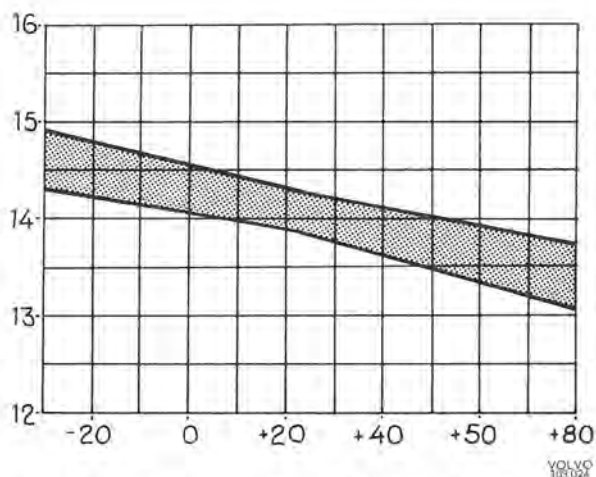


Fig. 3-25. Voltage-temperature diagram for warm voltage regulator

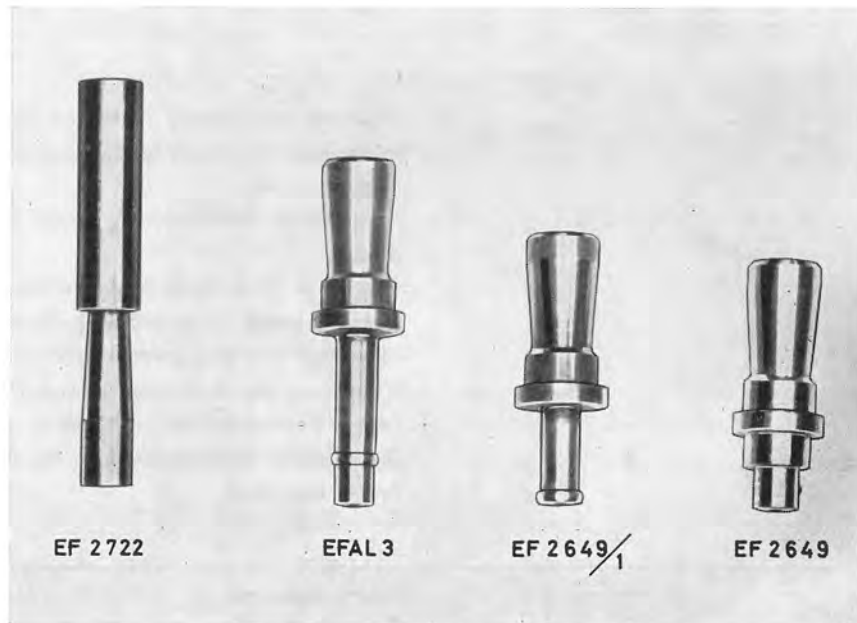
FAULT TRACING

FAULT	REASON
Alternator does not charge.	Worn or insufficiently tensioned fan belt. Breakage in charging circuit. Worn brushes. Breakage in rotor winding. Breakage in isolation diodes. Faulty regulator.
Charging weak or irregular.	Worn or insufficiently 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.) Partial short-circuiting in the rotor. Breakage or short-circuiting in the stator. Faulty regulator.
Too high charging.	Faulty regulator. Faulty terminals on regulator or alternator. Short-circuiting in isolation diodes.
Noise in alternator.	Worn fan belt. Loose pulley. Worn bearings. Short-circuiting in one or several rectifier diodes. Alternator pulley incorrectly aligned in relation to the crankshaft pulley.
Charging warning lamp glows.	Voltage drop in fusebox.

GROUP 33

STARTER MOTOR

TOOLS



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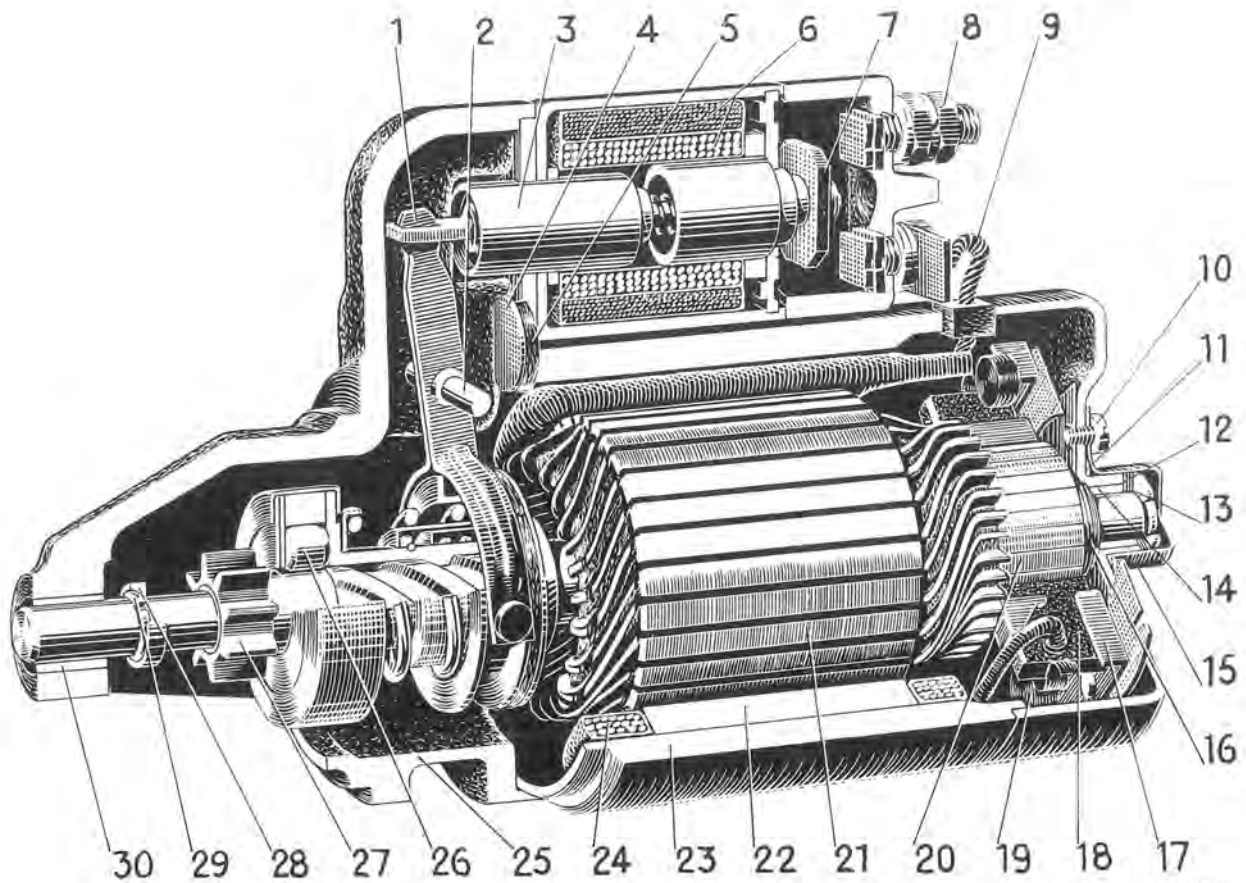
Fig. 3-26 Bosch special tools

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

DESCRIPTION

The starter motor, Fig. 3-27, is fitted on the flywheel housing on the left-hand side of the engine. It consists of a 4-pole series-wound motor. The pinion on the starter motor rotor shaft moves axially to engage with the flywheel ring gear. The pinion is controlled by a solenoid.

An extra contact is built into the solenoid for by-pass connecting of the pre-coupling resistor on the ignition coil.



VOLVO
101 139

Fig. 3-27. Starter motor

- | | | |
|------------------------------|--------------------------|---------------------|
| 1. Shift lever | 11. Rubber gasket | 21. Armature |
| 2. Pivot pin | 12. Shims | 22. Pole shoes |
| 3. Plunger | 13. Lock washer | 23. Stator |
| 4. Steel washer | 14. Bush | 24. Field winding |
| 5. Rubber washer | 15. Commutator end frame | 25. Drive end frame |
| 6. Winding | 16. Adjusting washers | 26. One-way clutch |
| 7. Contact plate | 17. Brush holder | 27. Pinion |
| 8. Terminal for battery lead | 18. Brush | 28. Stop ring |
| 9. Connection lead to field | 19. Brush spring | 29. Snap ring |
| 10. Screw | 20. Commutator | 30. Bush |

REPAIR INSTRUCTIONS

REMOVING

1. Remove the cable terminal from the battery negative terminal studs.
2. Disconnect the leads from the starter motor.
3. Unscrew the bolts which hold the starter motor to the flywheel housing and lift it off.

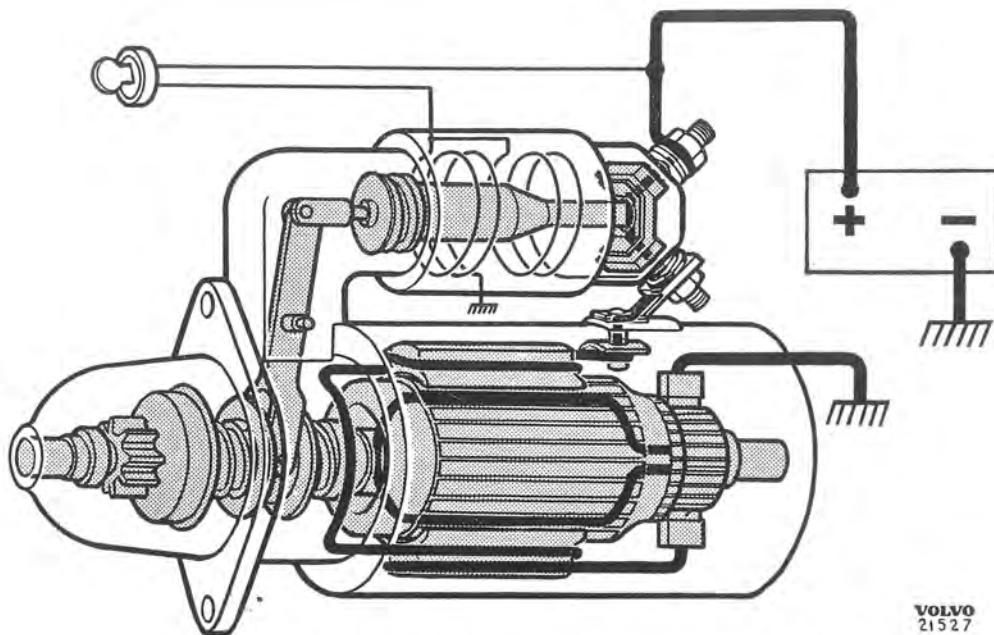


Fig. 3-28. Starter motor, general arrangement

DISASSEMBLING STARTER MOTOR

1. Remove the small cover on the front end of the shaft.
2. Lift off the lock washer and adjusting washers as shown in Figs. 3-31 and 3-32.
3. Remove the two bolts holding the commutator bearing end and remove the frame.
4. Lift up the brushes and holders.
5. Remove the bridge from the armature shaft. NOTE. The washers are as shown in Fig. 3-34. When the bridge is removed, the "—" brushes follow also, but "+" brushes will remain in the field winding.

6. Unscrew the nut which holds the field terminal connection to the control solenoid.
7. Unscrew the attaching screws for the control solenoid. Remove the solenoid.
8. Remove the drive end frame and armature from the stator.
9. Remove the rubber washer and metal washer, see Fig. 3-36.



Fig. 3-29. Starter motor installed



Fig. 3-30. Starter motor terminals

- | | |
|-------------------------|---------------------|
| 1. From battery | 3. To field winding |
| 2. From ignition switch | 4. To ignition coil |

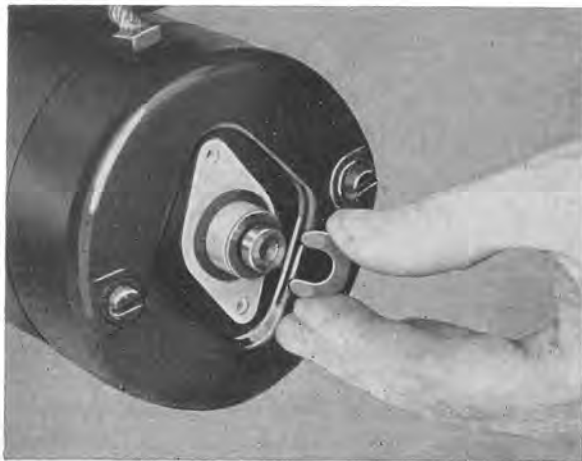


Fig. 3-31. Removing lock washer

VOLVO
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10. Remove the screw on which the shift lever is carried.
11. Lift the armature with pinion and arm out of the drive end frame.
12. Knock back the stop washer and remove the snap ring on the armature shaft.
13. Remove the stop washer and pull off the starter pinion.

INSPECTING

Examine the armature for mechanical damage such as a bent or worn shaft, scored commutator and damaged windings.

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").

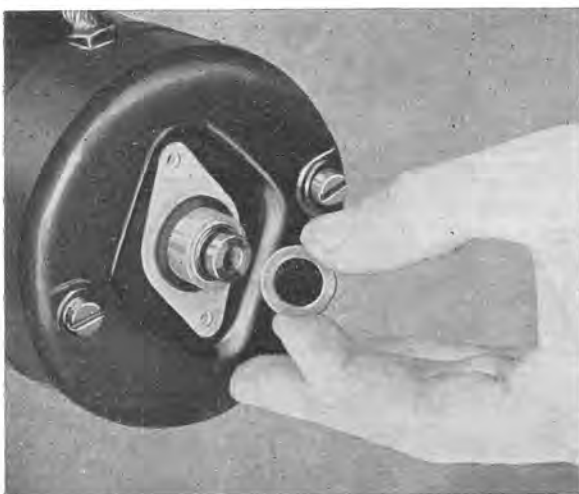


Fig. 3-32. Removing adjusting washers

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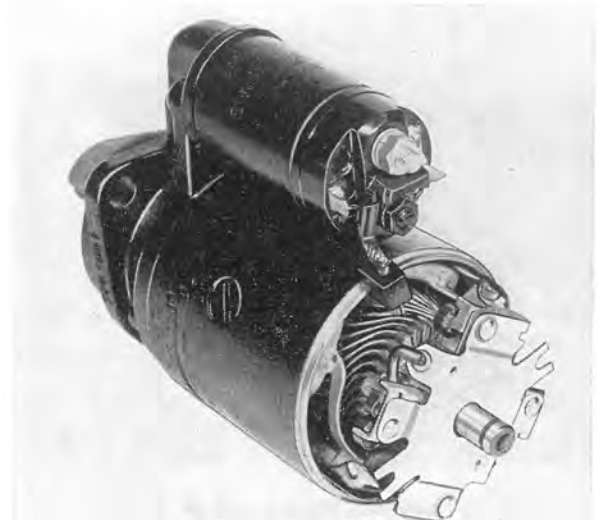


Fig. 3-33. Starter motor with bearing frame removed

VOLVO
103 302

The commutator should be checked with a micrometer after turning. A radial throw of 0.08 mm (0.003") can be considered permissible. The insulation between the laminations should be milled down to 0.4 mm (0.016") below the surface of the laminations, see Figs. 3-38 and 3-39. This work is carried out in a special apparatus, or if such is not available, with a ground-off hacksaw blade.

Examine the armature for shorting by placing it in a growler machine. Switch on and hold a hacksaw blade a few mm from the armature, see Fig. 3-40. 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.

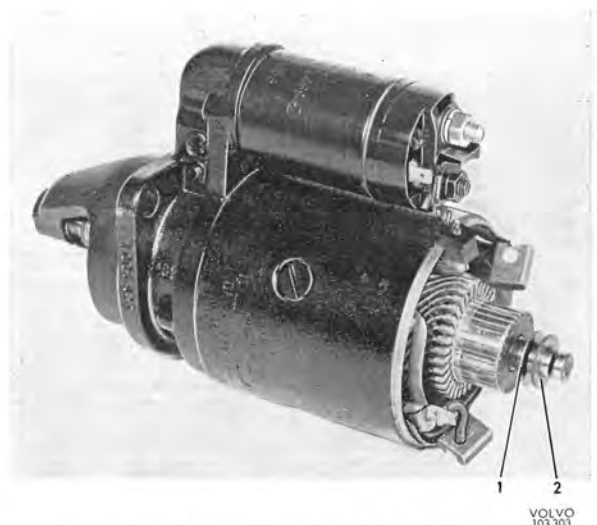


Fig. 3-34. Starter motor with brush bridge removed

1. Steel washer 2. Fiber washer

VOLVO
103 303



Fig. 3-35. Control solenoid

Check the stator with 40 V A.C., see Fig. 3-41. Examine the drive end frame with brush holders. If any of these parts are damaged or excessively worn, they must be replaced. A bearing clearance of up to 0.12 mm (0.005") may be considered permissible.

Inspect the other parts and replace any that are damaged or worn. The snap ring should always be replaced with a new one, since when being removed it may have been damaged or lost its tension.

CHECKING CONTROL SOLENOID

If the control solenoid does not function, first check that the battery is in good condition. If there is no fault in the battery, connect a lead between the battery positive terminal and the control solenoid contact screw for the control lead. If the control solenoid still does not engage the starter pinion and main current, it should be removed from the starter

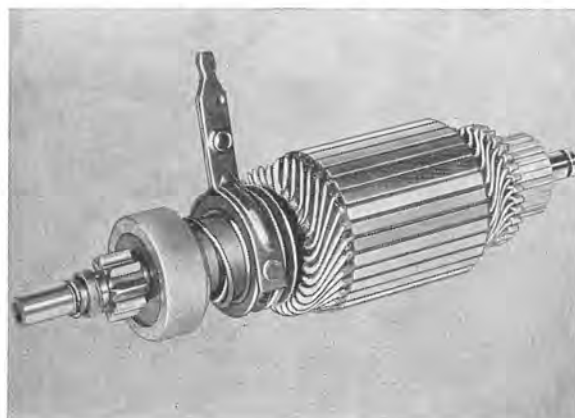


Fig. 3-37. Armature with pinion

motor. If, on the other hand, it engages satisfactorily, examine the starter switch and leads.

When the control solenoid has been removed, it should be wiped clean. Then press the plunger in several times and test again by connecting it to a battery. If the control solenoid does not function after the above measures, replace it with a new one.

REPLACING BRUSHES

When replacing the brushes the starter motor is removed and disassembled. The brushes are soldered loose from their attachments in the brush holder and field winding respectively. The new brushes should be soldered on quickly and with sufficient heat. Solder must not be allowed to run down into the brush leads as this will prevent the movement of the brushes in the brush holders and may reduce the brush spring pressure. Brushes which have worn down shorter than 14 mm (9/16") should be replaced with new ones.

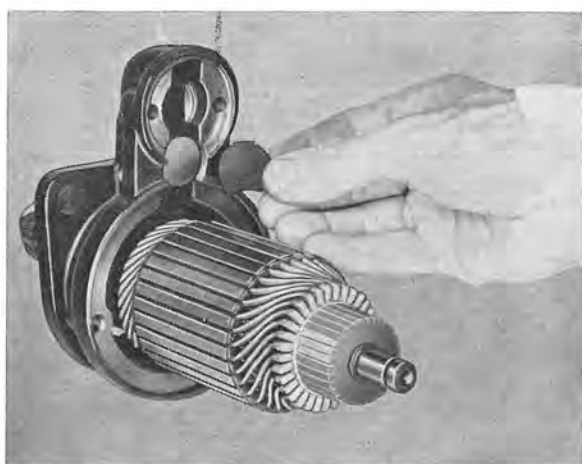


Fig. 3-36. Removing sealing washers

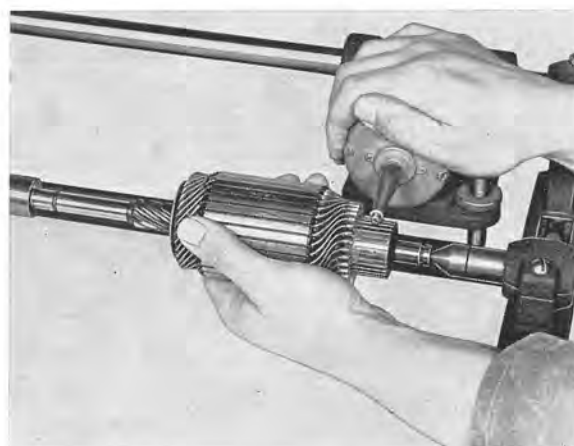


Fig. 3-38. Milling commutator

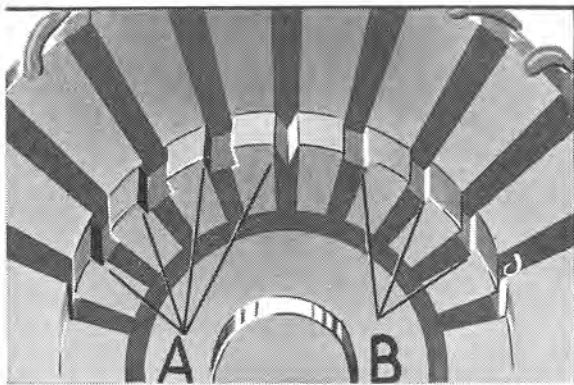


Fig. 3-39.

A. Incorrect milling B. Correct milling

VOLVO
21547



Fig. 3-41. Checking stator

VOLVO
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INSTALLING SELF-LUBRICATING BUSHES

The self-lubricating bushes are only worn insignificantly during operation if they are lubricated in the correct manner. If lubrication is neglected, the bushes dry out, with the result that they are worn quickly. For replacement purpose, bushes are supplied ready-machined to suitable dimensions. When being fitted, the bushes should not be machined internally or externally since the pores can then be partially blocked up, resulting in reduced lubricating capacity.

1. Drive out the worn bushes with the help of a suitable tool.
2. Clean the hole for the bushes and cut away any burr.
3. Press in the new bushes with the help of a suitable drift.

NOTE. Before a self-lubricating bush is fitted, it should lie in light oil for at least 1 hour.



Fig. 3-40. Testing armature

VOLVO
24807

REPLACING FIELD WINDINGS

1. If the starter motor has not been disassembled, this must be done. Follow the instructions under the heading "Disassembling".
2. Mark the pole shoes and pole housing in a suitable manner so that they come in the same position when assembling.
3. Then place the stator in the rotary clamping block as shown in Fig. 3-42 (Bosch EFAW 9) or similar and unscrew the pole screws.

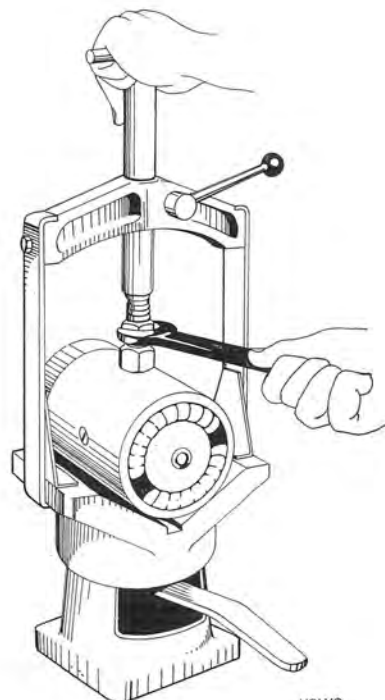


Fig. 3-42. Rotary clamping block for removing field windings

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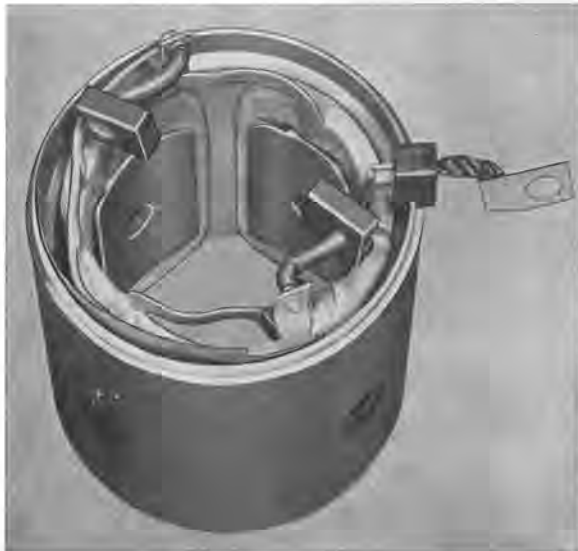


Fig. 3-43. Stator with soldered brushes

4. Before fitting new field coils, these should be heated slightly. Then place the pole shoes in position in the field coils and slide them into the stator. Tighten the pole screws slightly. Press in a suitable drift. Set up the stator in a rotary clamping block and tighten the pole shoes.
5. Press out the drift with a press. Check the field windings fitted for breakage and shorting.

ASSEMBLING

1. Lubricate the parts of the starter motor according to Fig. 3-45.

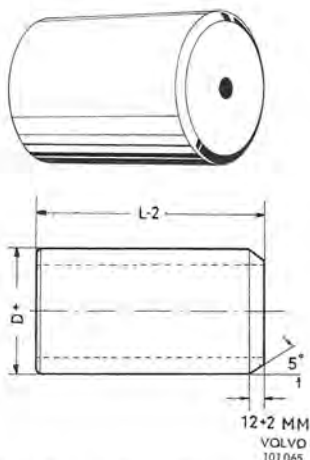


Fig. 3-44. Press drift for fitting field windings
D=66.04—66.09 mm (2.599—2.602") L=85 mm (3.346")

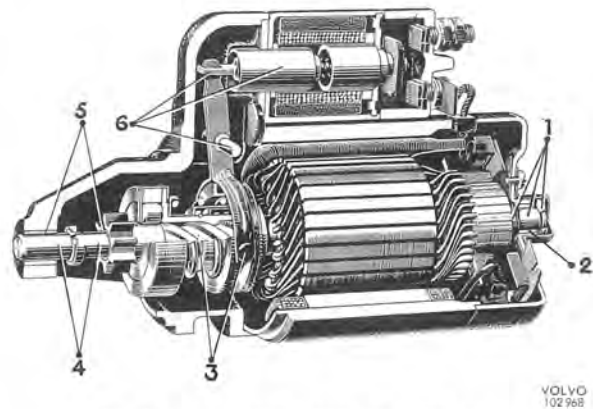


Fig. 3-45. Lubricating scheme for starter motor

Use Bosch lubricant (or equivalent) in accordance with the following directions:

1. Ft 2 V 3. Place a thin layer of grease on the insulation washers, the shaft end, the adjusting washers and lock washer.
2. Ol 1 V 13. Place the bush in oil for 1 hour before fitting.
3. Ft 2 V 3. Apply plenty of grease in the rotor 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 bushes in oil for 1 hour before fitting.
6. Ft 2 V 3. Lubricate the engaging lever joints and the iron core of the solenoid with a thin layer of grease.
2. Fit the starter pinion on the armature shaft, and the wear washer as well as the snap ring. Secure the wear washer in position.
3. Fit the shift lever on the pinion. Fit the armature in the drive end frame.
4. Fit the screw for the shift lever.
5. Fit the metal washer and rubber washer in the drive end frame.
6. Fit the stator on the armature and the end shield.
7. Secure the solenoid in the shift lever. Screw tight the solenoid.
8. Fit the washers on the armature shaft as known in Fig. 3-34.
9. Place the brush bridge in position. Fit the brushes.
10. Fit the commutator bearing frame. Screw the starter motor together with the two through bolts.
11. Fit the adjusting washers and the snap ring on the shaft end. Check the axial clearance of the armature. If necessary, adjust with the washers until the play agrees with the values in the "Specifications".
12. Screw on securely the small casing over the shaft end.

INSTALLING

1. Place the starter motor in position and secure it.
2. Connect the electric cables.
3. Fit the lead terminal on the negative pole stud of the battery.

IGNITION SYSTEM

DESCRIPTION

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, see Fig. 3-46. 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 ignition 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.



Fig. 3-46. Ignition coil and advance engaging resistor

DISTRIBUTOR

The distributor is mounted on the left-hand side of the engine, see Figs. 3-47 and 3-48, and is driven from the camshaft. The setting of the distributor in relation to engine speed is regulated by a centrifugal governor fitted under the breaker plate. Adjustment in relation to loading is controlled by a vacuum regulator mounted outside the distributor (4, Figs. 3-47 and 3-48).

The vacuum regulator has two diaphragms and is

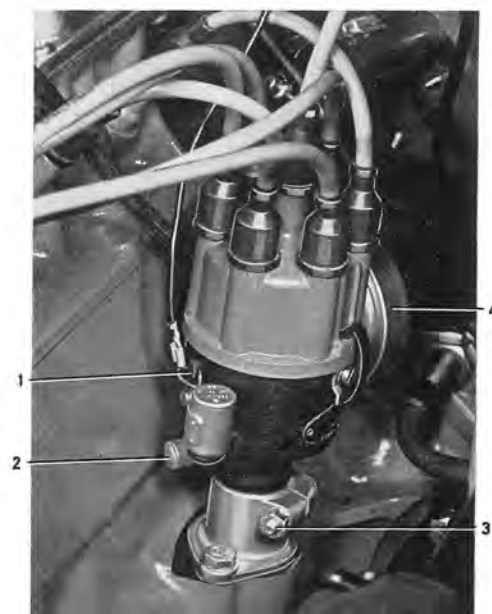


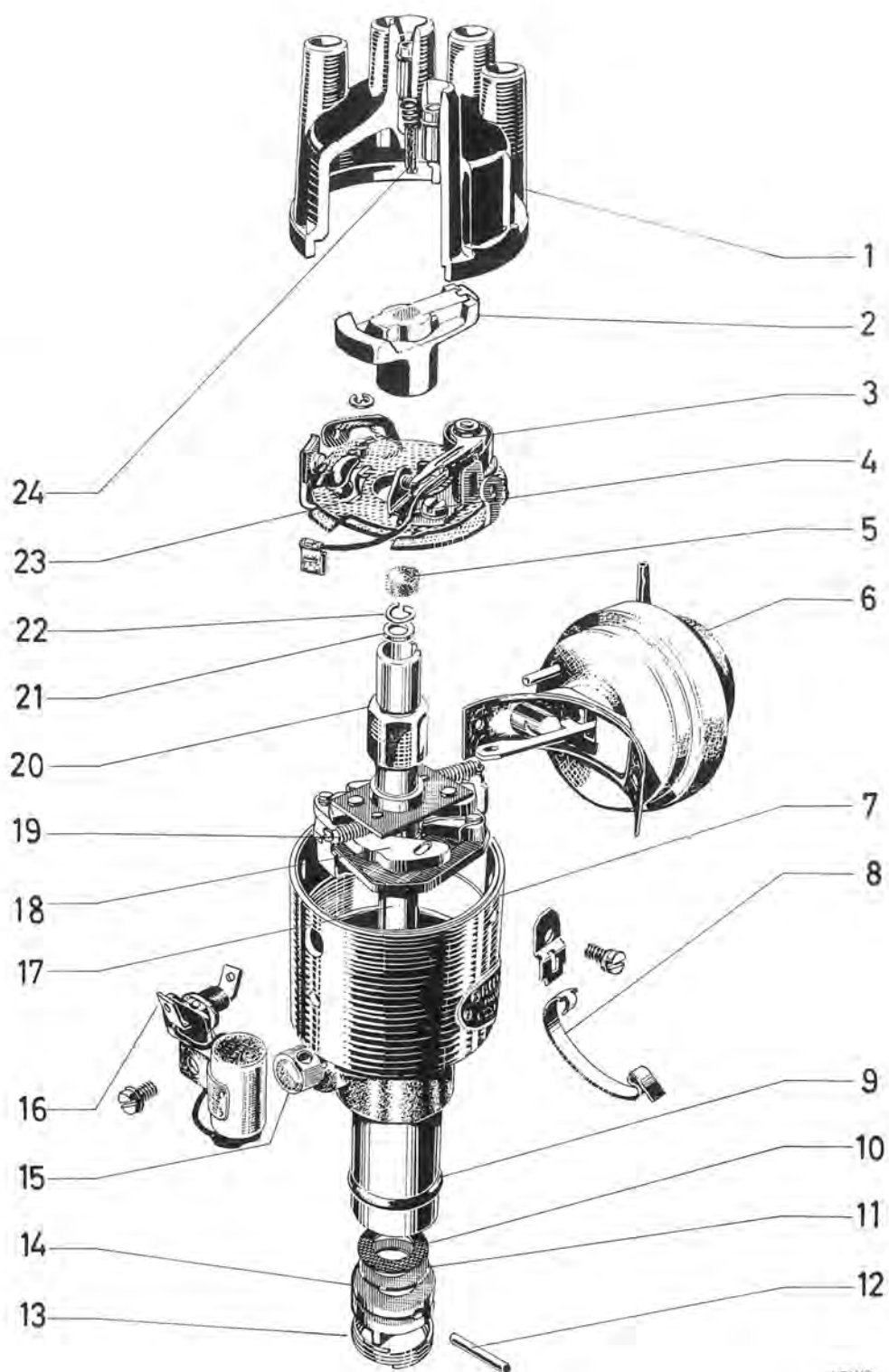
Fig. 3-47. Distributor, B 30 A

1. Primary connection with capacitor
2. Lubricator
3. Attaching bolt
4. Vacuum regulator



Fig. 3-48. Distributor, B 30 E and F

1. Primary connection with capacitor
2. Attaching bolt
3. Plug contact for triggering contacts
4. Vacuum regulator



VOLVO
102 369

Fig. 3-49. Distributor, B 30 A

- | | | | |
|------------------------------------|------------------------|------------------------|---------------------------------|
| 1. Distributor cap | 7. Distributor housing | 13. Spring ring | 19. Centrifugal governor spring |
| 2. Distributor arm | 8. Cap clamp | 14. Flange | 20. Breaker cam |
| 3. Ignition contact breaker | 9. Rubber seal | 15. Lubricator | 21. Washer |
| 4. Lock screw for breaker contacts | 10. Fiber washer | 16. Primary connection | 22. Snap ring |
| 5. Lubricating felt | 11. Steel washer | 17. Distributor shaft | 23. Breaker plate |
| 6. Vacuum regulator | 12. Lock pin | 18. Centrifugal weight | 24. Rod brush (carbon) |

constructed so that during engine braking or idling it lowers the firing during the basic adjustment. When engine braking or idling takes place, the throttles in the carburetors are closed so that there is no vacuum in the connection from the carburetors (5, Fig. 3-51) so that the return spring (6) presses back the primary diaphragm (7) against the stop (8). The pull rod (2) which is secured to the primary diaphragm (7) transmits the movements in the diaphragm to the breaker plate. If the vacuum in the connection from the intake manifold (3) is sufficiently large, pull the secondary

diaphragm (4) from the stop (8) and this lowers the firing during the basic adjustment.

During throttling, diaphragm (7) is influenced by the vacuum in the carburetors and takes over the regulating function irrespective of the vacuum in the intake manifold.

The positive part of the vacuum regulator is not used in vehicles intended for the U.S.A. market. Only the negative part, which lowers the firing during idling, is used.

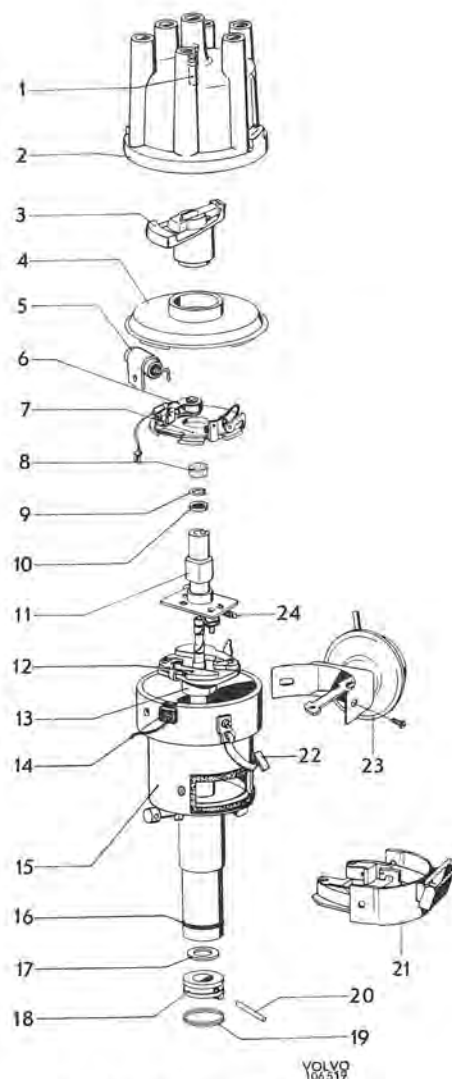


Fig. 3-50. Distributor, B 30 E and F

- | | | | |
|-----------------------------|---------------------------------|----------------------|----------------------------------|
| 1. Rod brush (carbon) | 8. Lubricating felt | 14. Primary terminal | 21. Contact device |
| 2. Distributor cap | 9. Circlip | 15. Distributor body | 22. Lock clamp for distr. cap |
| 3. Distributor arm | 10. Washer | 16. Rubber seal | 23. Vacuum regulator (only B30F) |
| 4. Protective cover | 11. Breaker cam | 17. Washers | 24. Centrifugal governor spring |
| 5. Capacitor | 12. Centrifugal weight | 18. Driving collar | |
| 6. Ignition contact breaker | 13. Cam for triggering contacts | 19. Resilient ring | |
| 7. Breaker plate | | 20. Lock pin | |

REPAIR INSTRUCTIONS

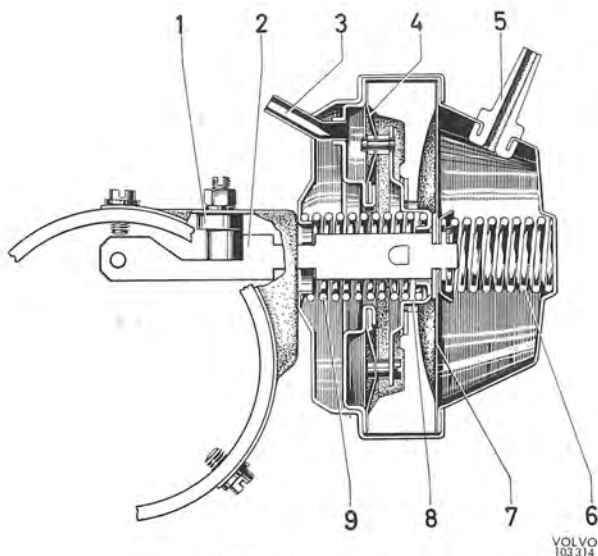


Fig. 3-51. Vacuum regulator

1. Eccentric for adjusting firing drop
2. Pull rod
3. Connection from intake manifold
4. Secondary diaphragm
5. Connection from the carburetors
6. Return spring for primary diaphragm
7. Primary diaphragm
8. Register
9. Return spring for secondary diaphragm

DISTRIBUTOR B 30 A

REMOVING

1. Release the lock clamps for the distributor cap and lift off the cap.
2. Remove the primary lead from the primary connection (1, Fig. 3-47).
Remove the vacuum hoses from the vacuum regulator. (When removing the hose from the bakelite connection, observe great care not to break the connection.)
3. Slacken the screw (3, Fig. 3-47) and pull up the distributor.

DISASSEMBLING

1. Pull off the distributor arm.
Remove the circlip for the pull rod from the vacuum regulator.
Remove the vacuum regulator according to Fig. 3-52.
2. Mark up how the clamps for the cap are located and remove them.

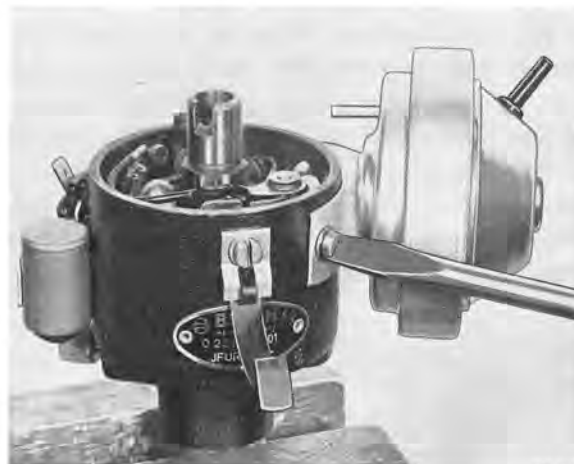


Fig. 3-52. Removing vacuum regulator

Disconnect the lead from the breaker contacts and remove the primary connection, Fig. 3-53.

Lift up the breaker plate.

3. Disconnect the springs for the centrifugal governor and mark up how the breaker cam is located in relation to the distributor shaft. Secure the breaker cam in a vice with soft jaws. Carefully knock on the distributor housing with a plastic mallet (Fig. 3-54) until the snap ring (22, Fig. 3-49) has released.



Fig. 3-53. Removing primary connection



Fig. 3-54. Removing snap ring

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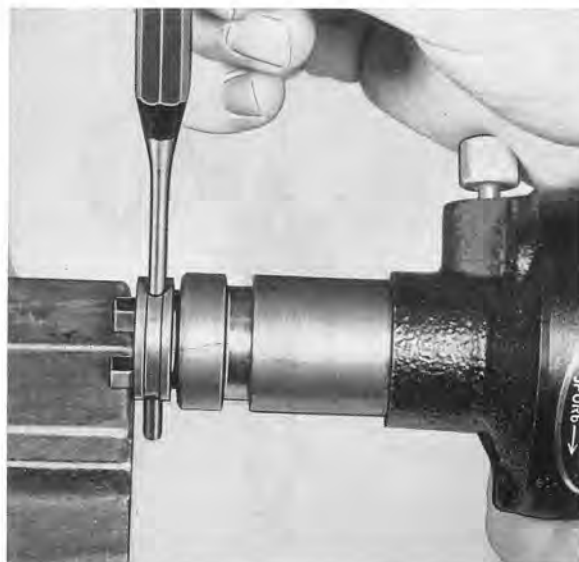


Fig. 3-55. Removing driving collar

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4. Remove the resilient ring (13, Fig. 3-49) and mark up how the driving collar (14, Fig. 3-49) is located in relation to the distributor shaft.
Tap out the pin (Fig. 3-55), lift off the driving collar and pull up the distributor shaft.
Check that no washers have been lost.
5. Remove the lock springs for the centrifugal weights and lift up the weights.

INSPECTING

Distributor plate

1. The surface of the contact breaker points should be flat and smooth. The colour of the contacts should be grey. Oxidized or burnt contacts must be replaced. After a long period of use, the contact lip can be worn and the spring fatigued, so that the contacts should be replaced if the distributor for any reason is disassembled.
2. The contact plate must not be loose, worn or have burr on.

Distributor shaft

1. The play between the distributor shaft and the breaker camshaft must not exceed 0.1 mm (0.004").
2. The cams on the breaker camshaft must not be scored or worn down so that the dwell angle is altered.
3. The holes in the centrifugal weights must not be oval or deformed in any other way.
4. The centrifugal weight springs must not be deformed or damaged.

Distributor housing

1. The play between the distributor housing and the shaft should not exceed 0.2 mm (0.008"). If the play is excessive, replace the bushes and, if this is insufficient, also the shaft.

ASSEMBLING

1. Lubricate the distributor parts according to the instructions given in Fig. 3-57.
2. Fit the centrifugal weights and also the lock springs on to the weights. Fit the breaker camshaft on to the distributor shaft. Hook on the

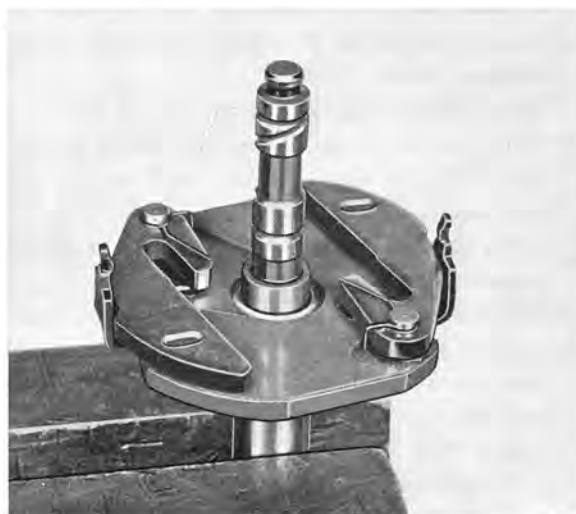


Fig. 3-56. Distributor shaft with centrifugal weights

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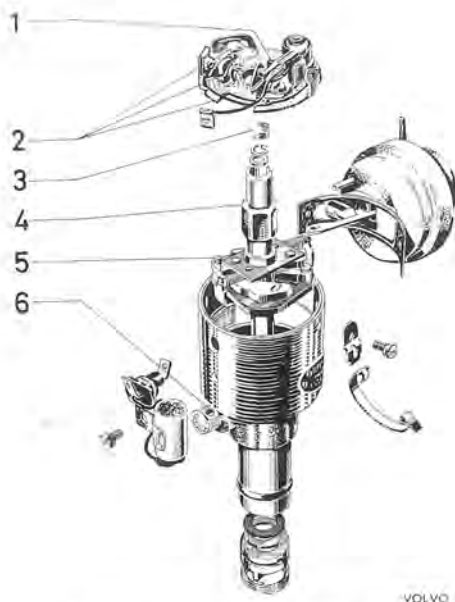


Fig. 3-57. Lubricating scheme for distributor

Use Bosch lubricant (or equivalent) according to below.

- | | |
|---------------|---|
| 1. Ft 1 v 4. | 4. Place a little grease on the contact lip |
| 2. Ft 1 v 26. | Grease |
| 3. Ol 1 v 13. | Lubricate |
| 4. Ft 1 v 4. | A very light layer of grease |
| 5. Ft 1 v 26. | Grease |
| 6. Ol 1 v 13. | Fill with oil |

springs for the centrifugal governor. Fit the washer and circlip for the breaker camshaft. The circlip is placed into position by means of a suitable sleeve. Fit the lubricating felt.

3. Fit the distributor shaft in the distributor housing and install the driving collar on the distributor shaft. Make sure that the fibre washers come against the distributor housing. Fit the pin in the collar and check the axial clearance on the distributor shaft. The clearance should be 0.1—0.25 mm (0.004—0.010"). Any adjustment can be done by altering the number of adjusting washers on the distributor shaft.

Fit the resilient ring on to the driving collar.

4. Fit the breaker plate. Fit the lock clamps for the cap. Fit the primary connection and connect the lead from the breaker contacts.
5. Fit the vacuum regulator and connect the pull rod to the breaker plate.
6. Check that the breaker contacts are mounted correctly both horizontally and vertically. Adjustment should be made with a suitable tool, (for example, Bosch EFAW 57 A), but only the fixed contact may be bent. Wash the contacts with trichlorethylene or chemically pure gasoline. Run the distributor on a test bench and check according to the "Specifications".

REPLACING IGNITION CONTACT BREAKER

The ignition contact breaker can be replaced with the distributor fitted, but it **should** be done with the distributor disassembled.

1. Remove the distributor rotor arm.
2. Disconnect the electric lead at the primary connection.
3. Remove the screw for the ignition contact breaker and lift up the old contacts.
4. Lubricate the distributor according to the instructions given in Fig. 3-57.
5. Fit the new contact breaker.
6. Connect the electric cable at the primary connection.
7. Check that the ignition contact breaker is located correctly both vertically and horizontally.

Adjustment should be made with a suitable tool, (for example, Bosch EFAW 57 A), but only the fixed contact may be bent. Wash the breaker contacts with trichlorethylene or chemically pure gasoline.

Run the distributor on a test bench and check according to the "Specifications".

TESTING DISTRIBUTOR IN TEST BENCH

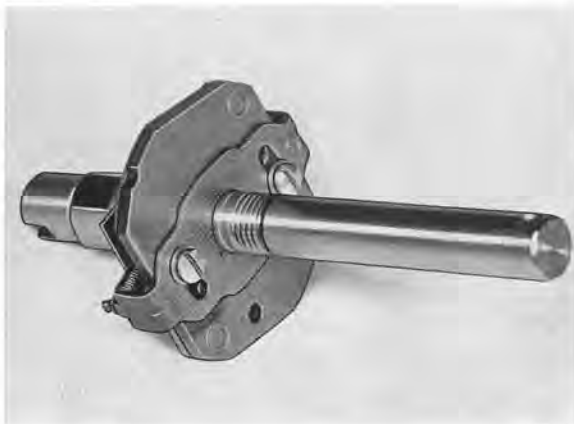
1. Run the distributor in its ordinary direction of rotation (anti-clockwise) and adjust the ignition contact breaker dwell angle according to the "Specifications".

Adjustment is done by slackening a little the screw for the breaker contacts and then inserting a screwdriver in the recess, Fig. 3-58 and 3-68 and turning the screwdriver until the dwell angle is the correct one.

Then tighten the screw for the ignition contact breaker.



Fig. 3-58. Recess for adjusting ignition contact breaker



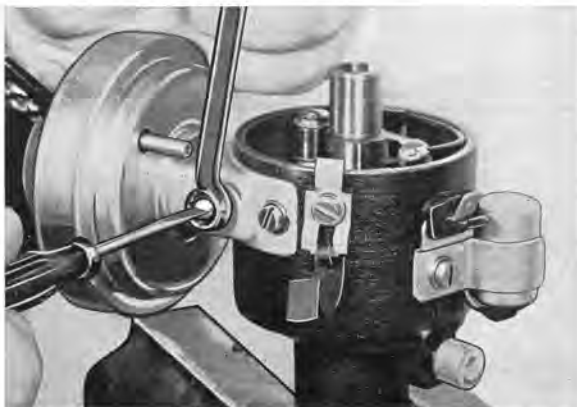
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Fig. 3-59. Driving collar for centrifugal governor

2. Run the distributor and set the protractor on the test bench so that a marking comes opposite 0° at such a low speed (below 400 distributor r/m) that the centrifugal governor does not function. Increase the speed slowly and read off the values at the prescribed graduations. A newly lubricated distributor should first be run up to maximum speed several times. Permissible tolerance for the centrifugal regulator is $\pm 1^\circ$.

If the centrifugal governor curve is too high or too low, this can be remedied by altering the spring tension in the centrifugal governor. To do this, the distributor must be disassembled and the distributor shaft lifted up (the ignition contact breaker camshaft does not need to be removed from the distributor shaft). The screws holding the driving collar are then released, see Fig. 3-59. If the driving collar is turned in the direction of rotation, the curve rises, turning the driving collar opposite the direction of rotation will lower the curve.

NOTE. The governor curve must not be adjusted by bending the spring clamps of the driving collar.



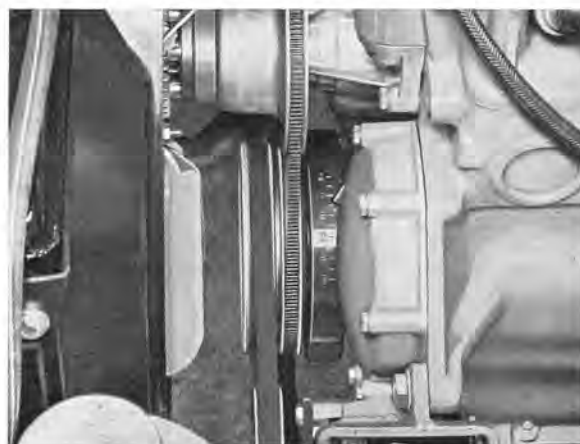
VOLVO
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Fig. 3-60. Eccentric for adjusting max. ignition drop

3. Run the distributor at low speed and adjust the protractor so that a marking is obtained at 0°. Connect the vacuum hose to the bakelite connection on the vacuum regulator (the primary diaphragm). Increase the vacuum gradually and read off the values on the prescribed graduations. The difference between the rising/falling vacuum must not exceed $1\frac{1}{2}^\circ$. A certain adjustment of the max. reading can be obtained by slackening the screws for the vacuum regulator and moving the regulator.
4. Move over the vacuum hose to the metal pipe on the vacuum regulator (the secondary diaphragm) and check that the ignition drop mechanism is functioning satisfactorily. If the max. drop is too great or too small, it can be adjusted by slackening the counternut and by turning the eccentric, see Fig. 3-60.

INSTALLING

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 primary lead. Fit on the distributor cap.
5. Start the engine and set the ignition. (If the engine does not start, turn the distributor housing until it does so.)



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Fig. 3-61. Flywheel damper with graduation for ignition setting

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. 3-61.
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 (3, Fig. 3-47) 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.

DISTRIBUTOR, B 30 E, B 30 F

REMOVING

1. Undo the lock clasps for the distributor cap and take off the cap.
2. Disconnect the primary lead from the ignition coil and the plug contact from the triggering contacts.
3. Remove the vacuum hose from the vacuum regulator. (Only B 30 F.)
4. Release the attaching screw and pull up the distributor.



Fig. 3-62. Removing condenser and primary cable

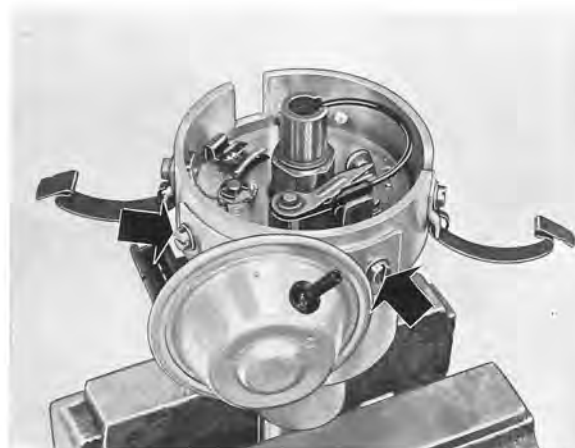


Fig. 3-63. Removing vacuum regulator

DISASSEMBLING

1. Lift up the distributor arm.
Make line-up marks for the lock clasps for the cap and remove the clasps. Disconnect the cable from the ignition breaker contacts and remove the condenser, see Fig. 3-62.
2. Remove the snap ring for the pull rod from the vacuum regulator. Remove the vacuum regulator, see Fig. 3-63. (Only B 30 F.)
3. Lift up the breaker plate.
4. Disconnect the springs to the centrifugal governor and mark up where the breaker cam is located in relation to the distributor shaft. Secure the breaker cam in a vice with soft jaws, see Fig. 3-65.
Carefully tap on the distributor housing with a plastic mallet until the circlip (9, Fig. 3-50) releases.

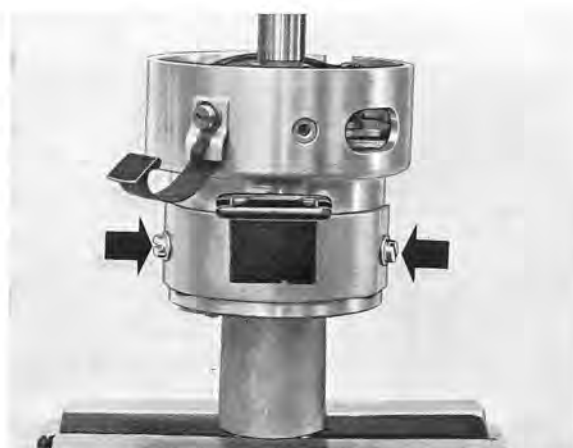


Fig. 3-64. Removing triggering contacts

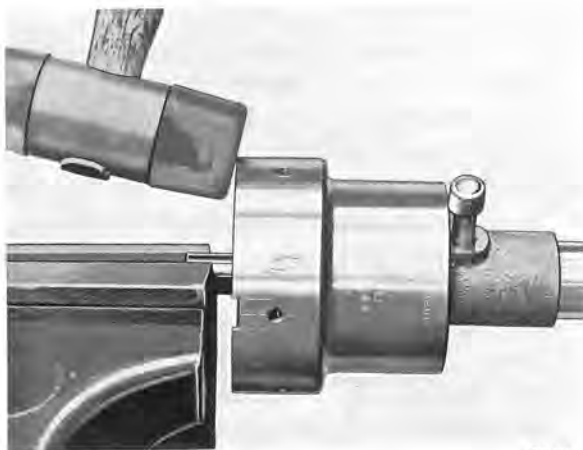


Fig. 3-65. Removing circlip

5. Remove the triggering contacts, see Fig. 3-64.
6. 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.
7. Remove the lock springs for the centrifugal weights and take off the weights.

INSPECTING

Distributor plate

The contacts should be smooth and even on the surfaces. The colour of the contacts should be grey. Oxidized or burnt contacts are to be replaced. After being used for some time, the breaker tab can become worn and the spring fatigued, on which occasion the contacts should be replaced if the distributor has to be disassembled for some reason or other. The contact plate may not be loose or worn and have burr on.

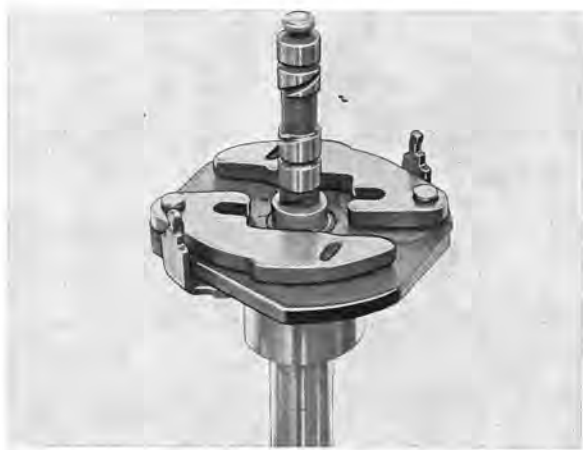


Fig. 3-66. Distributor shaft with centrifugal weights

Distributor shaft

The clearance between the distributor shaft and ignition breaker cam may not exceed 0.1 mm (0.004"). The cams on the ignition breaker cam may not be scored or worn as this alters the dwell angle. 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 bushes and, if this is still not sufficient, the shaft.

1. Lubricate the parts of the distributor according to the instructions given in Fig. 3-67.

Assembling is in reverse order to disassembling.

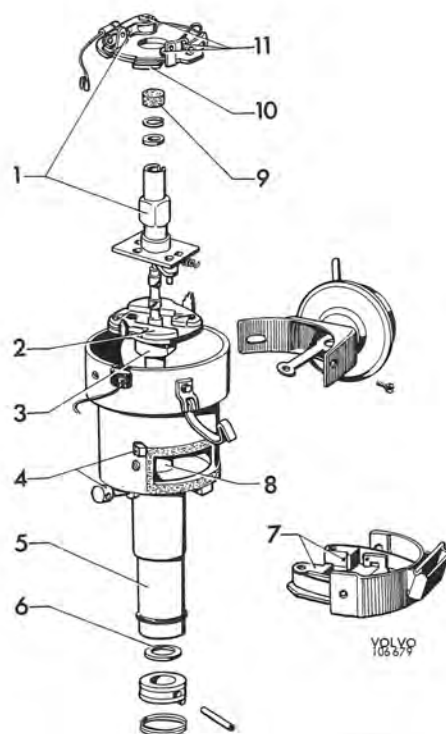


Fig. 3-67. Lubricating chart for distributor

1. FI 1 v 4. Place a little grease on the fiber tab and a light layer on the breaker cam.
2. FI 2 v 3. Grease the weights.
3. FI 1 v 4. Place a light layer on the breaker cam.
4. OI 1 v 13. Fill the lubricator with oil and soak the felts in oil.
5. OI 1 v 13. Place the brushes in oil for at least 1/2 hour before fitting. Soak the lubr. felt in oil.
6. FI 2 v 3. Grease the washers.
7. FI 1 v 4. Place a little grease on the fiber tabs.
8. OI 1 v 13. Oil the shaft before fitting.
9. OI 1 v 13. Soak the lubr. felt in oil.
10. OI 1 v 2. Oil the ignition plate.
11. FI 1 v 26. Grease the bush for the movable contacts, the pin for the vacuum regulator and the ball.

REPLACING IGNITION BREAKER CONTACTS

The ignition breaker contacts can be replaced in the vehicle but the distributor should be removed.

1. Lift off the distributor arm cover.
 2. Disconnect the electric cable to the primary terminal.
 3. Remove the old contacts.
 4. Fit the new contacts and wire up the electric cable to the primary terminal.
 5. Check that the ignition breaker contacts are placed properly vertically and that they are flat.
- Alignment can be made with an aligning tool (e.g. Bosch EFAW 57 A), but only the fixed contact may be bent.

Wash the ignition breaker contacts with trichloroethylene or chemically pure gasoline (petrol).

Run the distributor on a test bench and adjust according to the values given in the "Specifications".

Re-fit the cap and distributor arm.

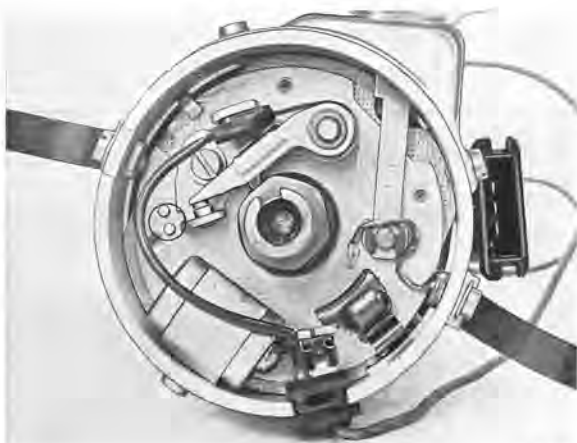


Fig. 3-68. Recess for adjusting ignition breaker contacts

TEST RUNNING DISTRIBUTOR ON TEST BENCH

1. Run the distributor at approx. 8.3 r/s (500 rpm) in its ordinary direction of rotation (clockwise) and adjust the dwell angle on the breaker contacts according to "Specifications".
2. Adjustment is made by slightly slackening the screw for the ignition breaker contacts and then inserting a screwdriver in the recesses, Fig. 3-68, and turning until the dwell angle is correct. Then tighten the screw for the ignition breaker contacts.
3. Run the distributor and adjust the protractor on the test bench so that a marking comes opposite 0° at such a low r/m (below 3.6 r/s=200 distr. r/m) that the centrifugal governor cannot function. Gradually increase the r/m and read off the values at the prescribed graduation. A recently lubricated distributor should first be run up to max. r/m several times. Permissible tolerance for the centrifugal governor is $\pm 1^\circ$.
4. Run the distributor at low r/m and adjust the protractor so that the marking is obtained at 0°. Connect the vacuum hose from the test bench to the vacuum regulator. (Only B 30 F). Increase the vacuum gradually and read off the values at the prescribed graduations.

INSTALLING

Installing is in reverse order to removing.

Start the engine and adjust the ignition, see Fig. 3-61. (If the engine does not start, turn the distributor housing until it does.)

GROUP 35

LIGHTING DESCRIPTION



VOLVO
108758

Fig. 3-69. Headlights and foglights



VOLVO
108757

Fig. 3-70. Rear light

The lighting consists of two full- and dipped-beam headlights with halogen lamps, H-4 lamps, for both full-beams and dipped (Sealed-Beam inserts on U.S.A. market), parking lights, rear lights and license plate light. Vehicles intended for U.S.A. are also fitted with side-marker lights and for all markets except U.S.A. the vehicles are fitted with foglights.

The headlights are fitted in the mudguards and the foglights are housed in the front end, see Fig. 3-69. Vehicles delivered to U.S.A. have small grille coverings over the recesses instead of foglights. Extra lights can be installed in these recesses merely by removing these covers.

Switching between full- and dipped-beam positions is done by moving the turn indicator lever switch towards the steering wheel. This causes a relay to connect up the lighting. Up front the parking lights are integrally built with the turn indicators and are mounted on the front bumper at the corners.

The rear lights are provided with separate bulbs for rear lights, stop lights, back-up lights and turn indicators, see Fig. 3-70.

REPAIR INSTRUCTIONS

HEADLIGHTS

REPLACING HEADLIGHT INSERT

1. Remove the screw and take off the plastic cover over the space behind the headlight, see Fig. 3-73.
2. Remove the connecting contact by pulling it straight backwards.
3. Remove the outer rim by pulling it upwards-forwards, see Fig. 3-74.
4. Release the screws for the inner rim a couple of turns, see Fig. 3-75, turn the rim and lift it off together with the headlight insert.

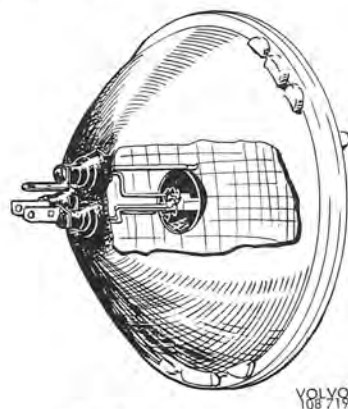


Fig. 3-71. Sealed-Beam insert

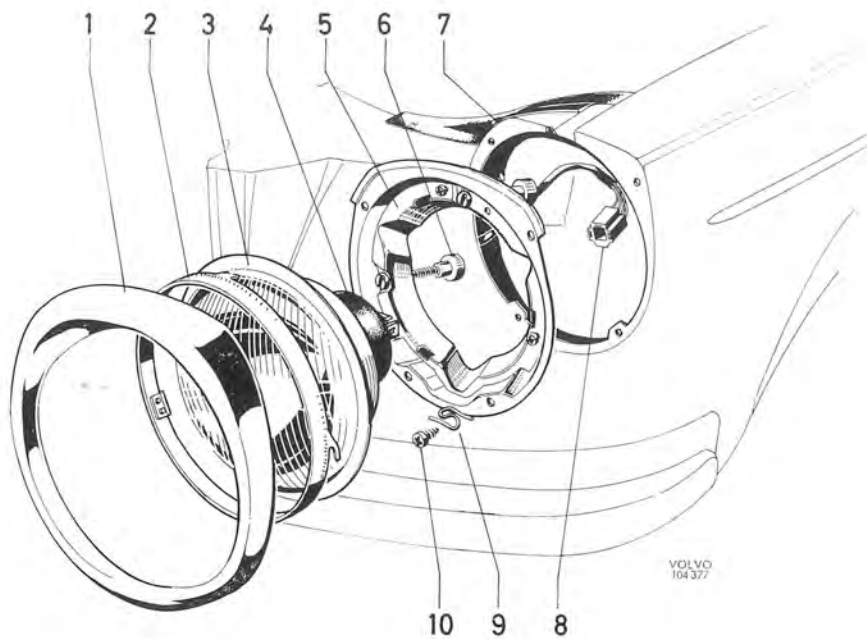


Fig. 3-72. Headlight

1. Outer rim
2. Inner rim
3. Headlight insert
4. Rubber cover
5. Holder unit
6. Adjusting screws
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. 3-72. Use approved light adjusting equipment.
8. Fit the plastic cover over the space behind the headlight.



Fig. 3-74. Removing outer rim

VOLVO
104 478

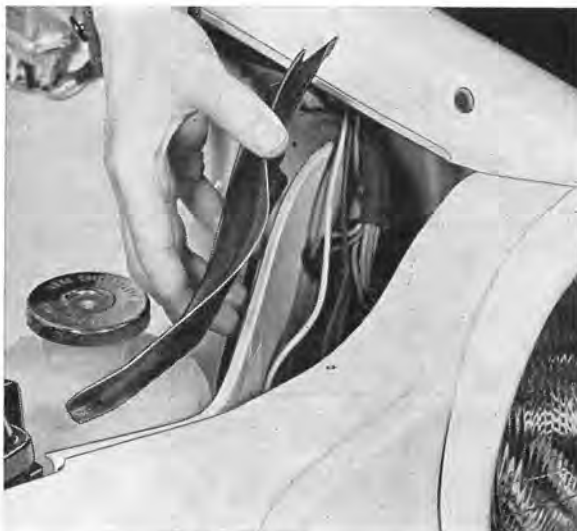


Fig. 3-73. Removing plastic cover

VOLVO
103 325



Fig. 3-75. Screws for inner rim

VOLVO
104 479

REPLACING BULB

1. Remove the screw and take off the plastic cover over the space behind the headlight, see Fig. 3-73.
2. Remove the connector by pulling it straight out backwards.
3. Remove the rubber cover and the spring holding the bulb, and take out the bulb.
4. Fit the new bulb. Make sure that the bulb collar fits into the socket in the insert.
NOTE. Do not touch the bulb globe with your fingers.
5. Fit the spring and rubber cover. Fit the connector.
6. Check the lighting adjustment. This is done by the two adjusting screws, see Fig. 3-72.
7. 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 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 colour. 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.

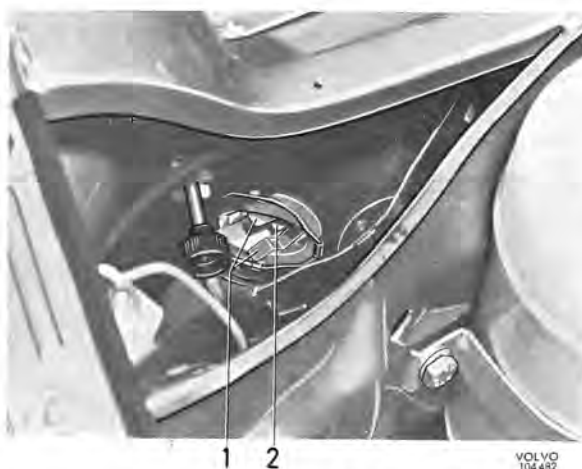


Fig. 3-76. Foglight

1. Holder
2. Bulb electrical connection



Fig. 3-77. Foglight attachment

VOLVO
104 483

Adjustment is made by varying the two adjusting screws behind the headlight, see Fig. 3-72. The upper screw adjusts the headlight vertically and the screw at the side adjusts the headlight laterally.

FOGLIGHTS

REPLACING BULB

1. Remove the screw and take off the plastic casing over the space behind the headlights, see Fig. 3-73.
2. Remove the electric cable to the bulb.
3. Squeeze the holder together and pull it straight out.
4. Take out the bulb.
5. Fit the new bulb. Make sure that it is turned correctly. The bosses on the bulb socket will only fit in the bulb housing if the bulb is fitted correctly.
NOTE. Never grasp the bulb globe with your fingers.
6. Fit the holder and electric cables.
7. Check the light setting. To adjust vertically slacken the nut holding the lamp, see Fig. 3-77.
8. Fit the plastic cover.

CHECKING

See "Checking and adjusting headlights".

PARKING AND DIRECTIONAL FLASHER LIGHTS

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.

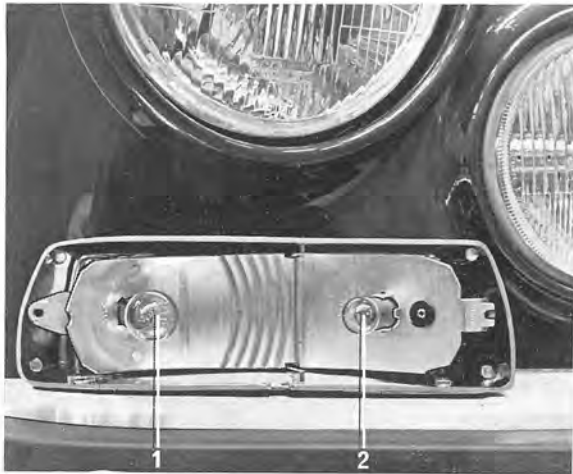


Fig. 3-78. Parking and directional flasher light

1. Bulb for directional flasher 2. Bulb for parking light

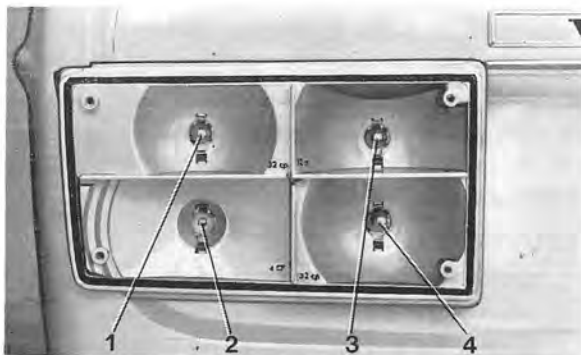


Fig. 3-79. Bulb location

1. Directional indicator light 2. Rear light
3. Reversing light 4. Brake light

REAR LIGHTS

REPLACING BULBS

1. Unscrew the four attaching screws for the lamp glass and remove the glass.
2. Replace the bulb, see Fig. 3-79.
3. Re-fit the glass.



Fig. 3-80. Removing license plate light

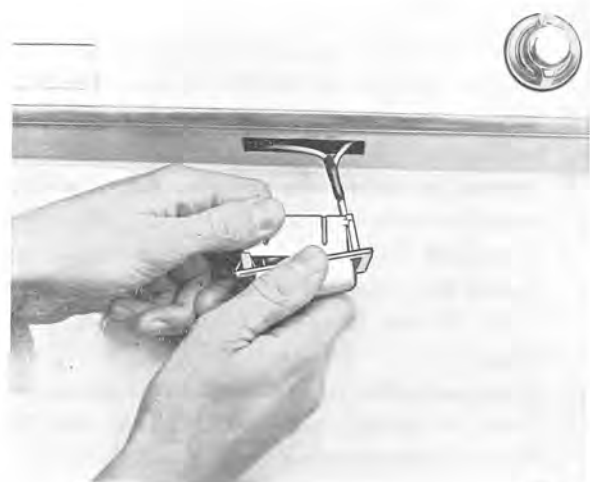


Fig. 3-81. Disassembling license plate light

REPLACING REAR LIGHT

The rear 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 rear light.
6. Installing is in reverse order to removal.
7. Check to make sure that the rear light functions properly.

LICENSE PLATE LIGHT

REPLACING BULB

1. Remove the license plate light with the help of a crosshead screwdriver according to Fig. 3-80.
2. Disconnect the electric cable from the plate.
3. Disassemble the plate according to Fig. 3-81.
4. Replace the bulb.
5. Re-connect the electric cable to the plate.
6. Install the plate by pressing it firmly into its recess.

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.



Fig. 3-82. Side marker light

OTHER ELECTRICAL STANDARD EQUIPMENT

DESCRIPTION

DIRECTIONAL INDICATOR SYSTEM

The directional indicator system consists of an electronic flasher relay, directional indicator switch, flash lamps on the front mudguards and bulbs in the rear lights. The turn signal switch is located under the plastic casing on the left-hand side of the steering column, see Fig. 3-84. 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 control lamp is wired in parallel across the switch.

The directional indicator signals 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. 3-83. Vehicles intended for U.S.A. are equipped with a special steering wheel lock 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 disconnected and steering wheel locked.

1. Current to fusebox (Intermediate position).
2. Same as position 1 but also current to ignition 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.

The buzzer is placed under the dashboard on the left-hand side and is wired to the fuse box (via the ignition) and the door switch on the driver's side. The buzzer consists of a pair of contacts and a coil. When current passes across the contacts and through the coil, the armature is drawn down towards the core of the coil. While the armature is being drawn down towards the core, the contacts cut the current and the armature springs back, etc. This cycle is repeated continuously as long as current is switched on, that is, as long as the driver's door is open and the ignition key is in the ignition.

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.

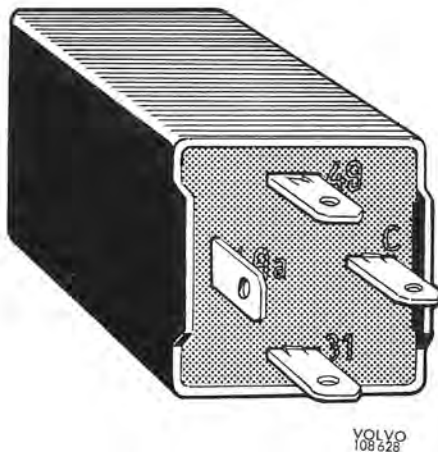


Fig. 3-83. Flasher



Fig. 3-84. Directional indicator lever switch

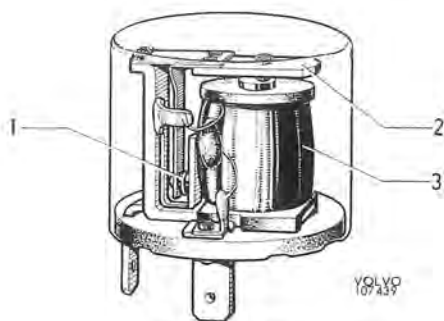


Fig. 3-85. Buzzer

1. Contacts 2. Armature 3. Coil

FUSES

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

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 brushes. 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 r/m) and 0.92 ± 0.8 r/s (55 ± 5 r/m). 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. 3-120 and 3-121 irrespective of where the wiper is switched off.

WINDSHIELD WASHER

The windshield washer, see Fig. 3-88, which is located on the left wheel housing, is driven by an electric motor. Motor and pump are placed on the underside of

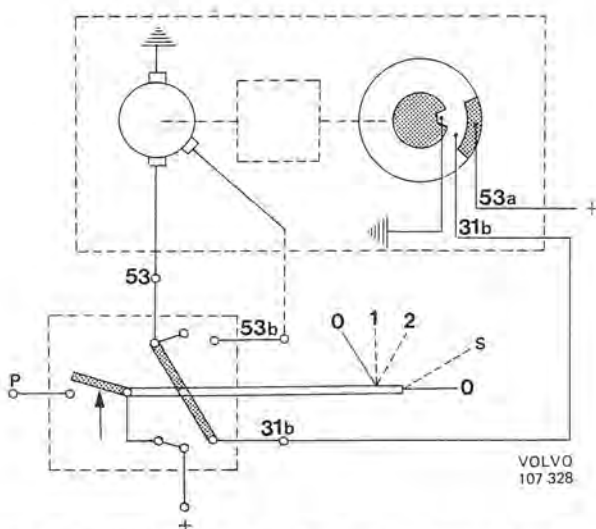


Fig. 3-86. Wiring diagram for windshield wiper motor, Electrolux

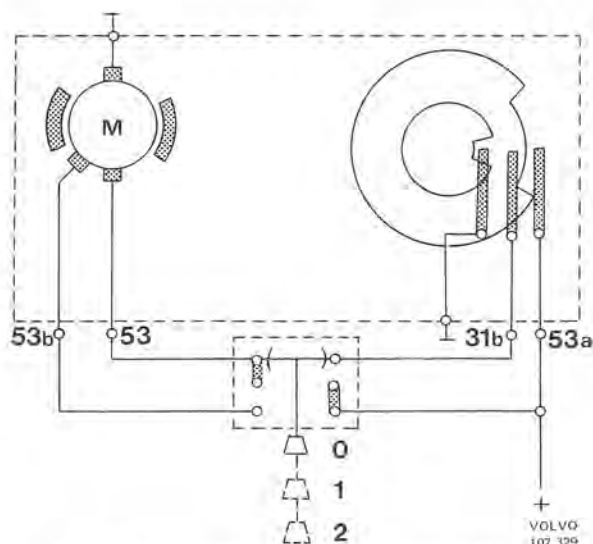


Fig. 3-87. Wiring diagram for windshield wiper motor, SWF

the washer container. The pump is of the gear type, see Fig. 3-88.

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

SWITCHES

The switches for the warning 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 LIGHTING

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.

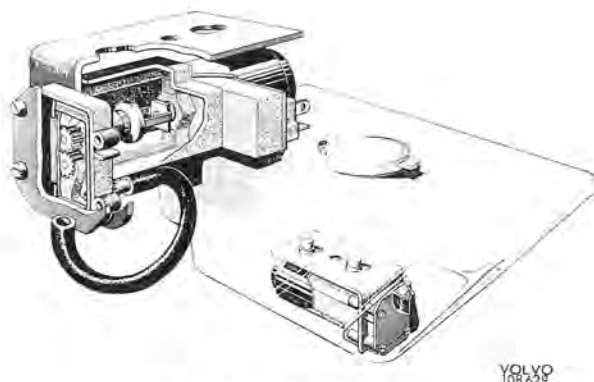


Fig. 3-88. Windshield washer

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 function "Ignition key left in the lock".

FUNCTION

The driver's seat and the passenger's seat each have one set of seat 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. 3-89, 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 function 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. 3-90. Interlock Control Unit (1)

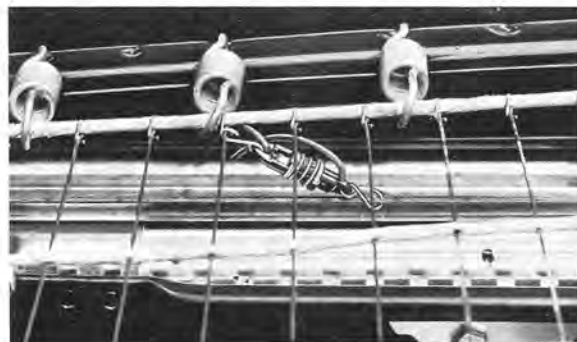


Fig. 3-91. Seat contact

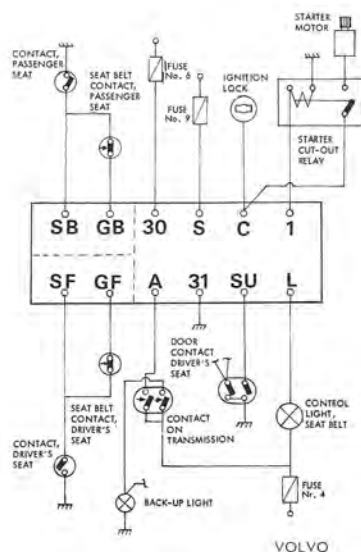


Fig. 3-89. Interlock Control System, wiring diagram



Fig. 3-92. Starter Cut-Out Relay (1)

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 three control relays:

- One for switching between upper and lower beams
- one for the back-up lights
- one for the rear window defroster.

Vehicles with automatic transmission are equipped with a start relay instead of 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. 3-93, and the warning lights is located in the combination instrument.



Fig. 3-93. Reed Relay

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).

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. 3-94. 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. 3-94.

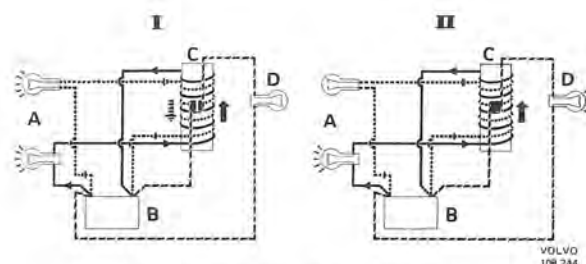


Fig. 3-94. Bulb Integrity Sensor, function

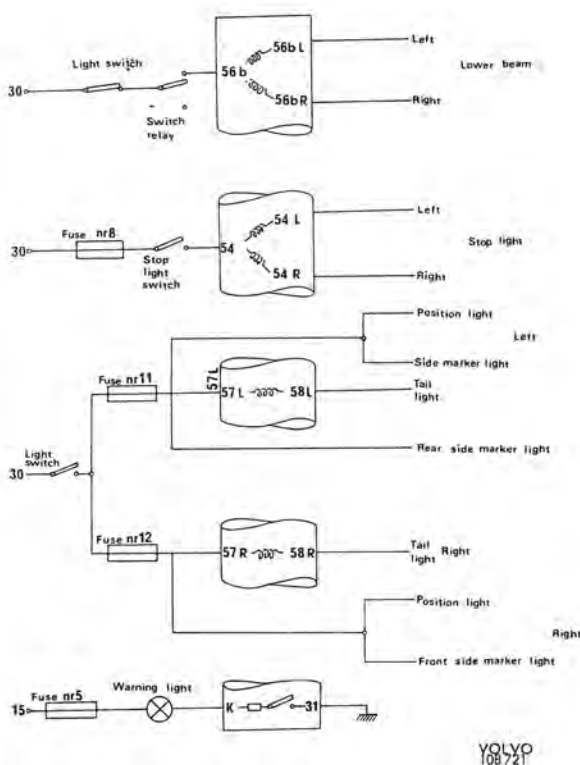
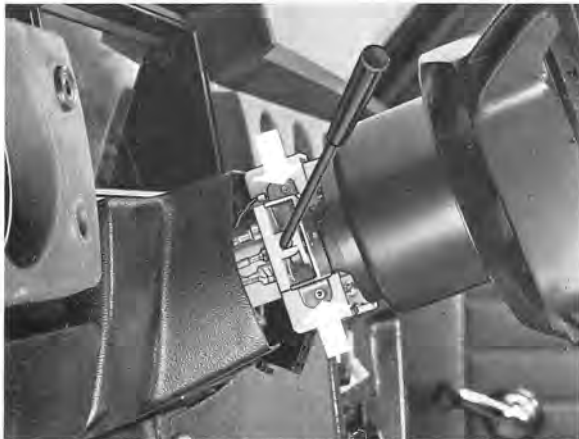


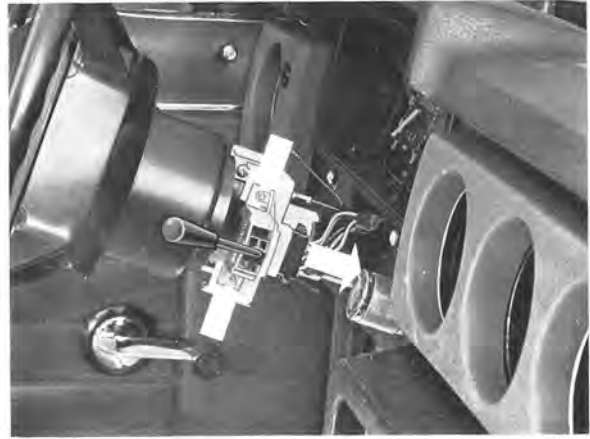
Fig. 3-95. Bulb Integrity Sensor, wiring diagram

REPAIR INSTRUCTIONS



VOLVO
107331

Fig. 3-96. Switch for flashers



VOLVO
107332

Fig. 3-97. Switch for windshield wipers

REPLACING SWITCHES FOR DIRECTIONAL SIGNALS AND WINDSHIELD WIPERS

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

REMOVING HORN CONTACT BAR

1. Remove the impact guard (1, Fig. 3-99). (Carefully lever it loose with the help of a screwdriver.)
2. Disconnect the electric cable (4, Fig. 3-99) from the contact bar (3, Fig. 3-99).
3. Remove the four attaching screws (2, Fig. 3-99) 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 harness in engine compartment.
2. Remove the light glass, see Fig. 3-98.
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 glass.



VOLVO
108759

Fig. 3-98. Removing flasher light glass

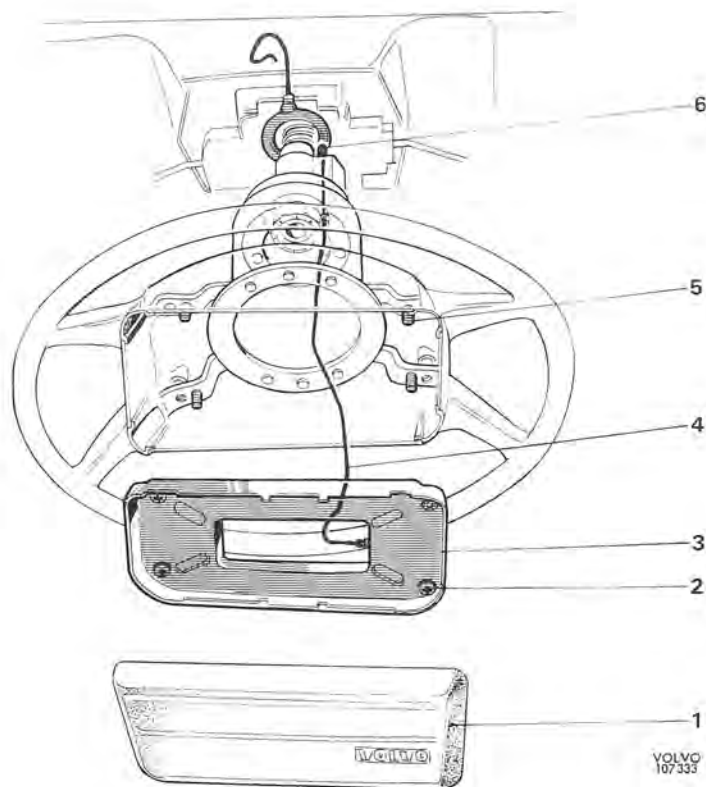


Fig. 3-99. Contact bar

- | | |
|--------------------|-------------------|
| 1. Impact guard | 4. Electric cable |
| 2. Attaching screw | 5. Contact pin |
| 3. Contact bar | 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. 3-101.
2. Remove the contact from the wiper motor.

3. Remove the three attaching screws (Fig. 3-102).
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.

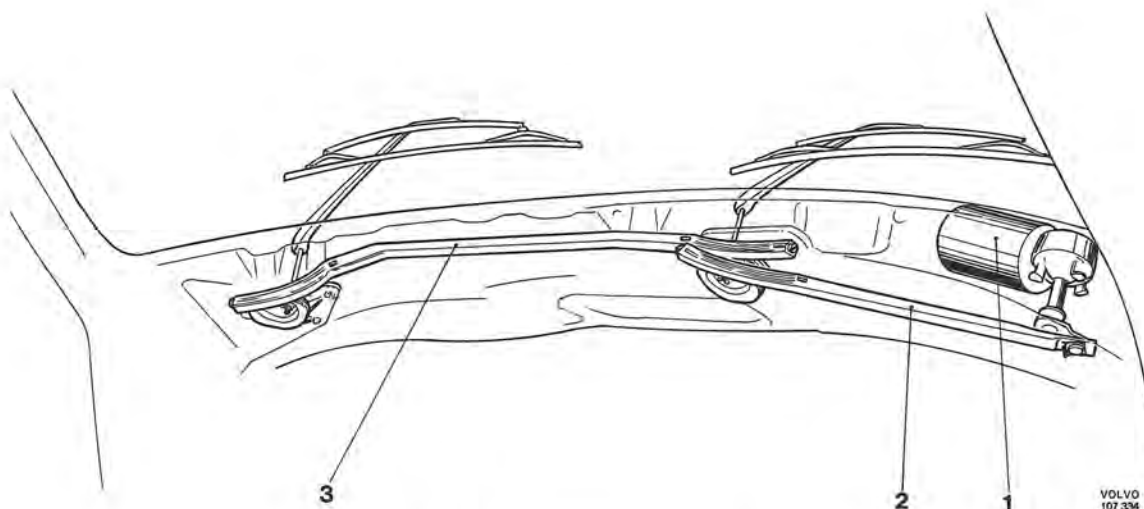


Fig. 3-100. Windshield wiper unit

- | | | |
|----------------|---------------|------------------------|
| 1. Wiper motor | 2. Drive link | 3. Parallel drive link |
|----------------|---------------|------------------------|



Fig. 3-101. Removing lock

INSTALLING WIPER MOTOR

1. Place the wiper motor in position and install the attaching screws, see Fig. 3-102.
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 locker.
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.

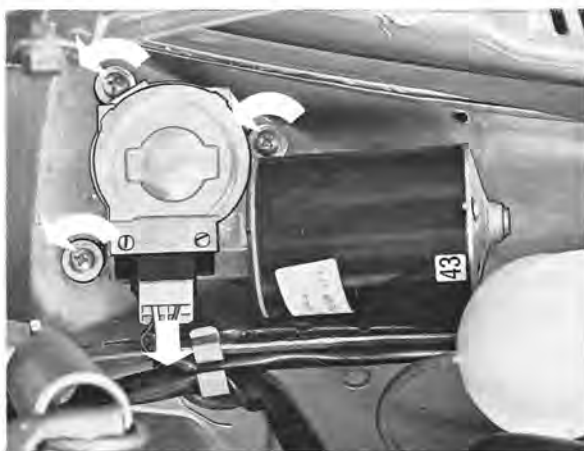


Fig. 3-102. Removing windshield wiper motor

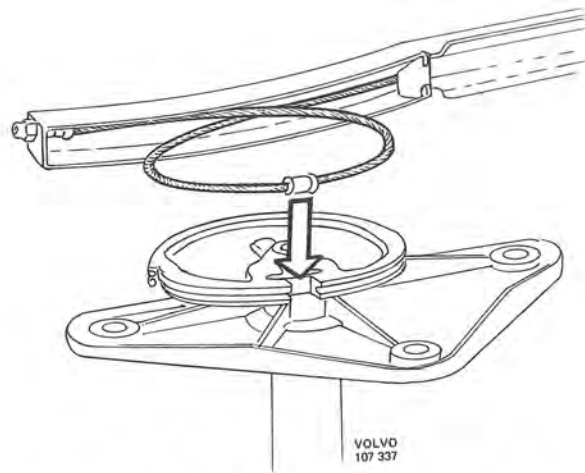


Fig. 3-103. Installing cable for drive link and parallel drive link, left-hand side

INSTALLING DRIVE LINK

1. Place the cable's flange nipple in the segment recess and then lever the cable over the segment, see Fig. 3-103). 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 locker.

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.

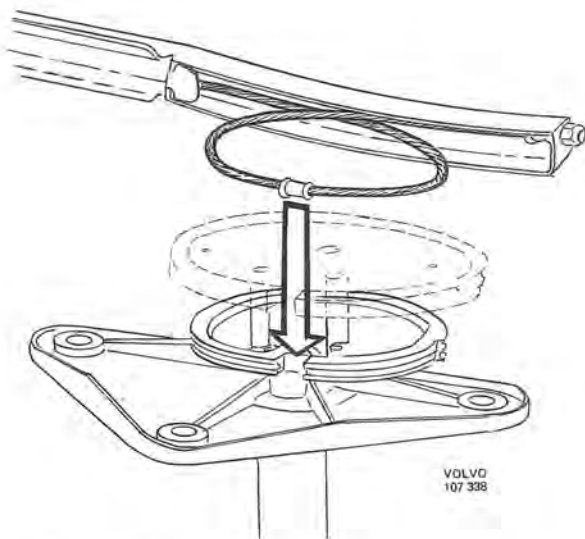


Fig. 3-104. Installing cable for parallel drive link, right-hand side

Right-hand side

1. Remove the side panel and defroster hose.
2. Remove glove locker 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. 3-103. 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 disturbance 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. 3-104. 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 could lead to disturbance in operation. Tension the cable.

2. Place the drive link cable's flange nipple in the front segment recess and thereafter prise the cable over the segment, see Fig. 3-103. 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 locker.

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.

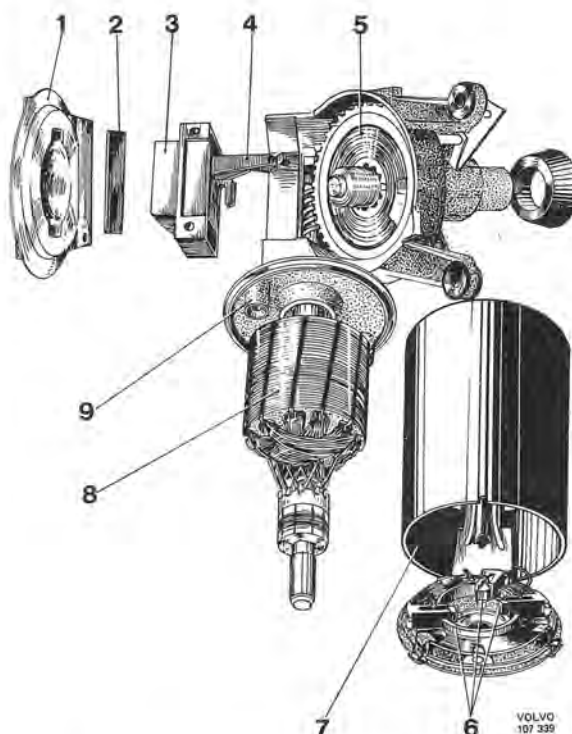


Fig. 3-105. Windshield wiper motor, Electrolux

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

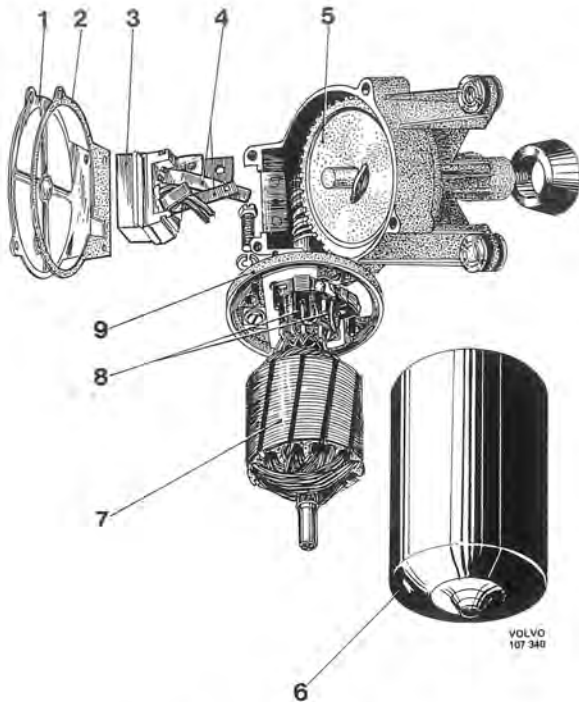


Fig. 3-106. Windshield wiper motor, SWF

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

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 ± 0.008 ") (A, Fig. 3-107). 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.

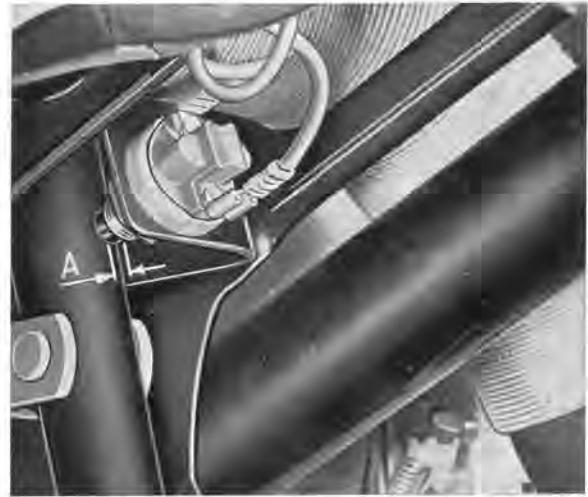


Fig. 3-107. Brake light switch

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. 3-108.

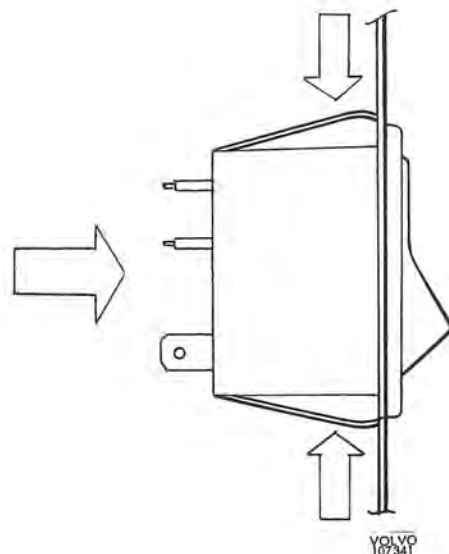


Fig. 3-108. Removing headlight switch

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 connected 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.

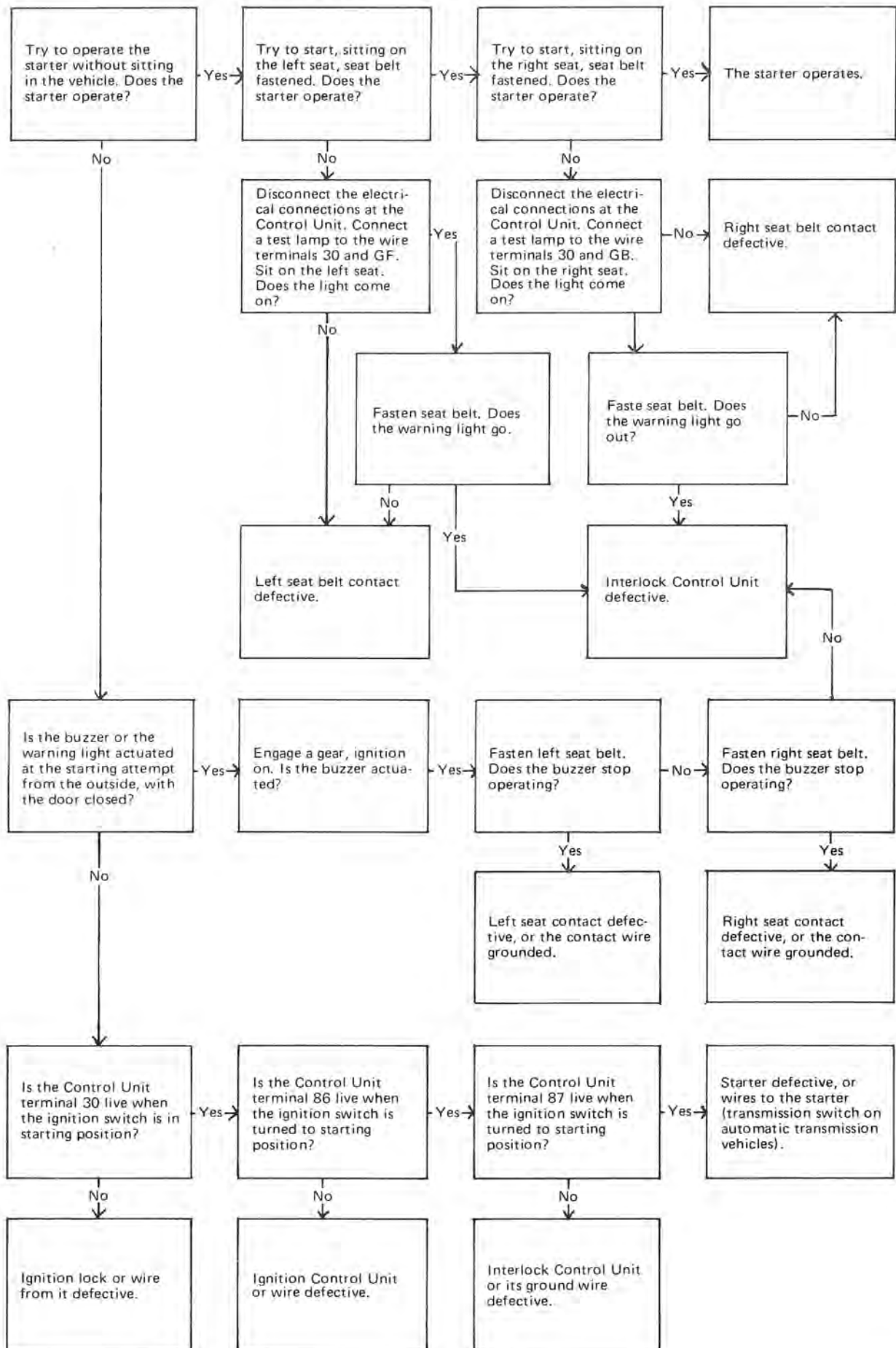
INTERLOCK CONTROL UNIT, REPLACEMENT

1. Disconnect 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 position.
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.

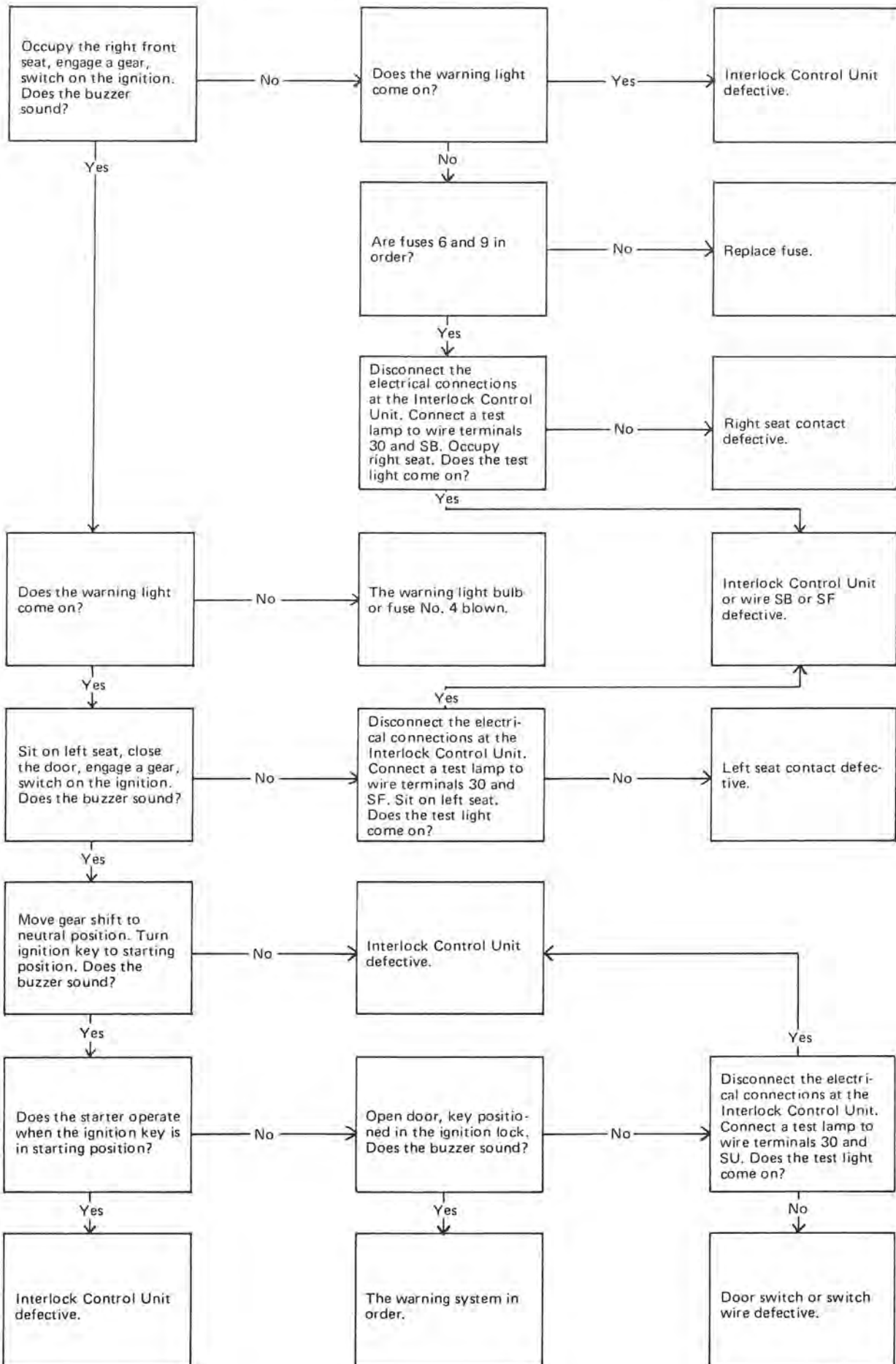
FAULT TRACING

Concerning fault tracing on the Seat/Ignition Interlock System, see pages 3 : 43—3 : 45.

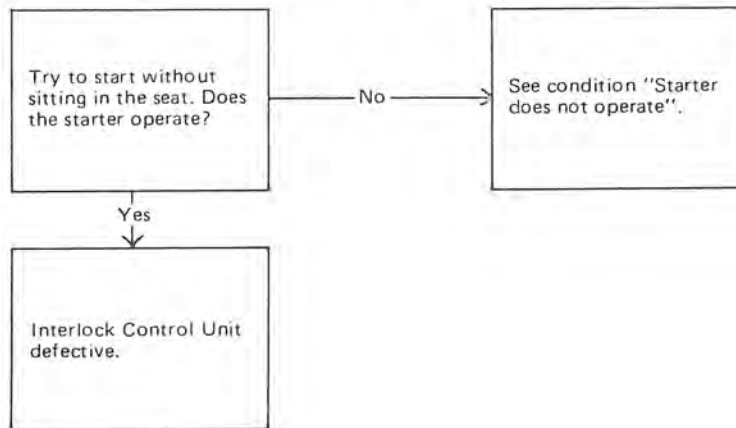
THE STARTER DOES NOT OPERATE



WARNING SYSTEM DOES NOT FUNCTION



WARNING SYSTEM OPERATES CONTINUOUSLY



GROUP 38

INSTRUMENTS TOOLS



Fig. 3-109. 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

DESCRIPTION

The instrumentation consists of a combined instrument, see Figs. 3-110 and 3-111. 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. 3-110. Combined instrument, front side

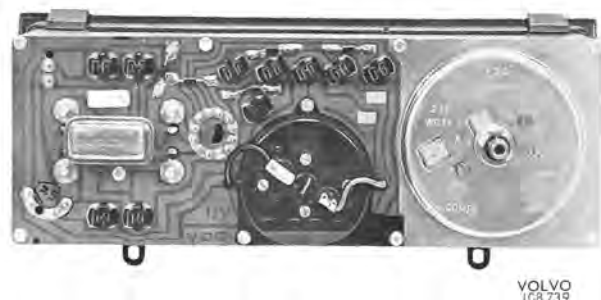


Fig. 3-111 Combined instrument, reverse side

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. 3-112. Speedometer and mileometer

VOLVO
107389

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 eddy 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 consists 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. 3-113. Tachometer

VOLVO
107345

The rotational coil system consists of an annular chapped 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 bimetal 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. 3-114. Temperature gauge

VOLVO
108709

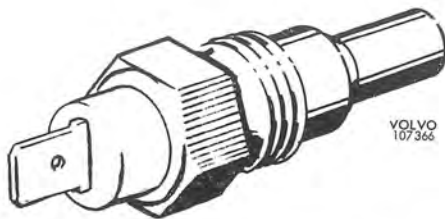


Fig. 3-115. Sensor for temperature gauge

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 bimetal spring connected to a pointer. A resistance wire, connected in series with the voltage stabilizer and sensor, is wound round the bimetal 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 is in inverse proportion to the resistance of the sensor, and for this reason the gauge reading increases with increased engine temperature.



Fig. 3-117. Fuel gauge

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.

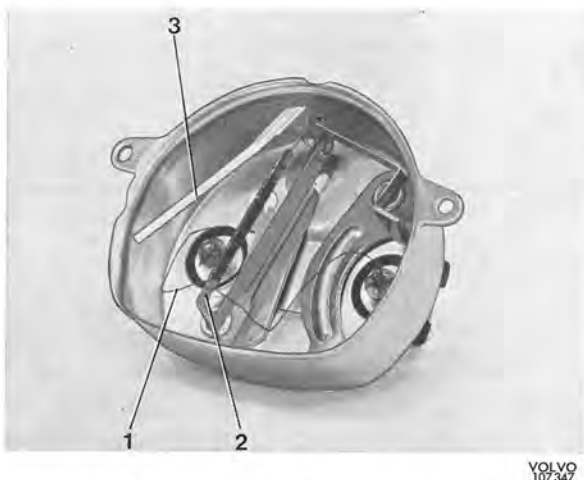


Fig. 3-116. Registering instrument, disassembled

1. Resistance wire 2. Bimetal spring 3. Pointer

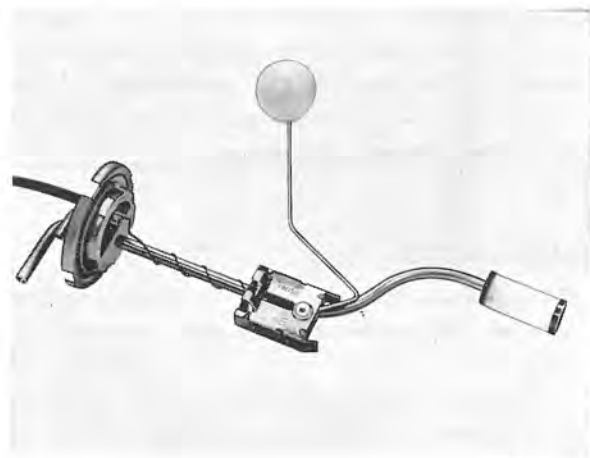


Fig. 3-118. Sender for fuel gauge

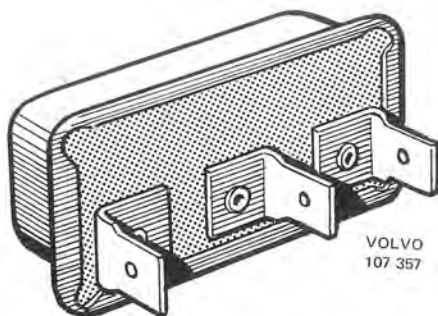


Fig. 3-119. Voltage stabilizer

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 bimetal 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 bimetal 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. 3-120, and this switches on the warning lamp which remains lighted as long as the parking brake is on.



Fig. 3-120. 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. 3-121 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.

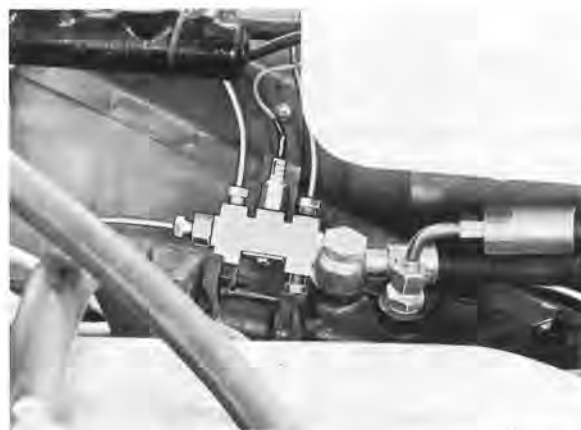


Fig. 3-121. Warning valve

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.

DIRECTIONAL SIGNALS

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

FULL-BEAM HEADLIGHTS

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.

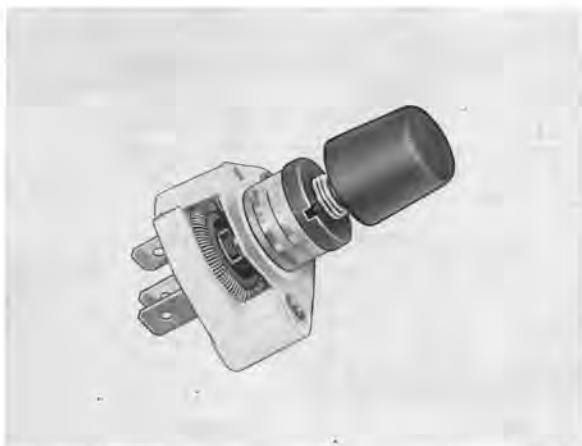


Fig. 3-122. Rheostat for instrument light

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.

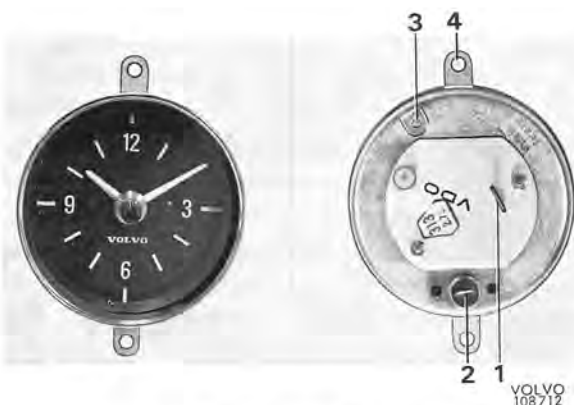


Fig. 3-123. Electric clock, front and reverse

1. Battery connection
2. Bulb
3. Battery connection
4. Attaching screws

CLOCK

The clock, Fig. 3-123, is electrically driven and is located above the control panel.

REPAIR INSTRUCTIONS

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.

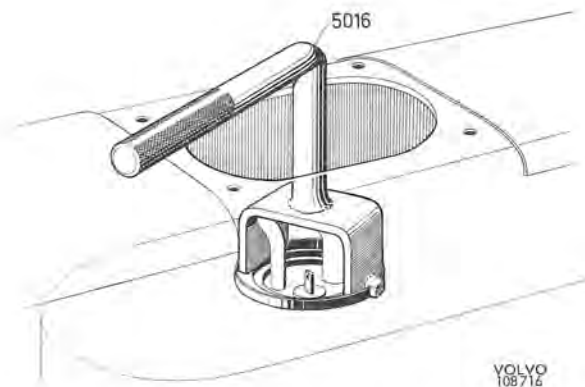


Fig. 3-124. Tool for removing sender for fuel gauge

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. 3-124.

REPLACING TEMPERATURE GAUGE SENSOR

1. Drain some of the coolant, about 2 dm³ (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.

CHECKING 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)	(r/m)

Speedometer reading

33±2.5	63±2.5	108.5±2.5	mph
--------	--------	-----------	-----

CHECKING 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 casing of the cable. This is checked with the cable rotating.

CHECKING 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.

ed. 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.

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.

CHECKING 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

CHECKING FUEL GAUGE

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

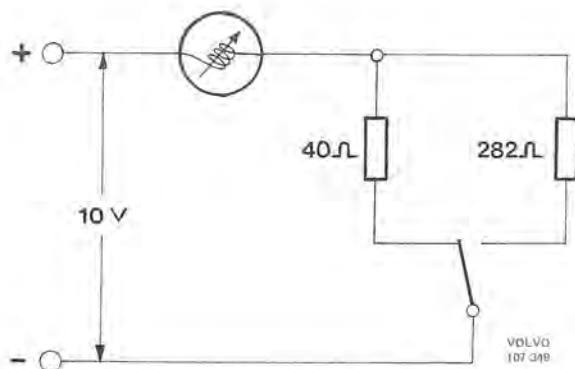


Fig. 3-125. Wiring diagram for checking temperature gauge or fuel gauge indicating instrument

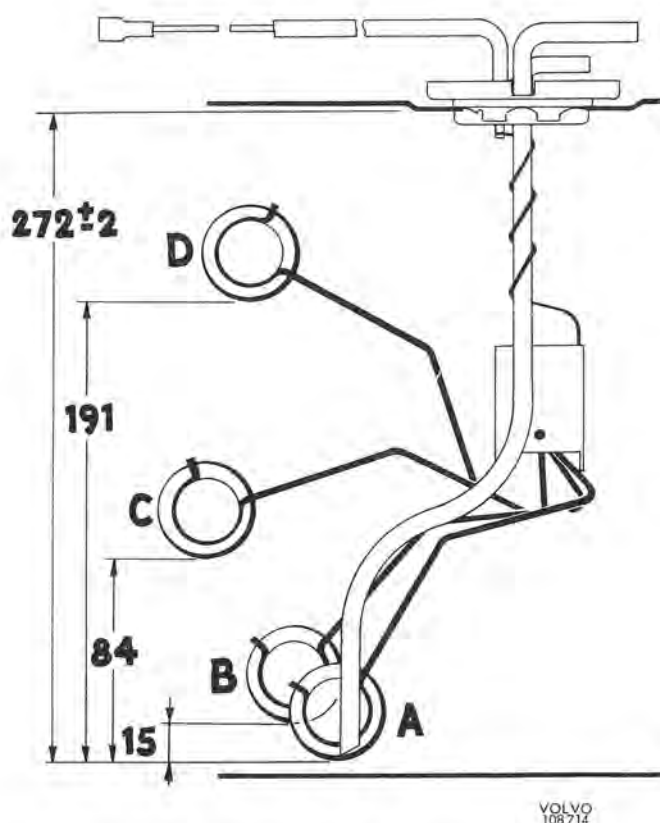
CHECKING REMOVED FUEL GAUGE SENDER

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. 3-128. Its measurement indications indicate the number of mm the float should be lifted from its bottom position.

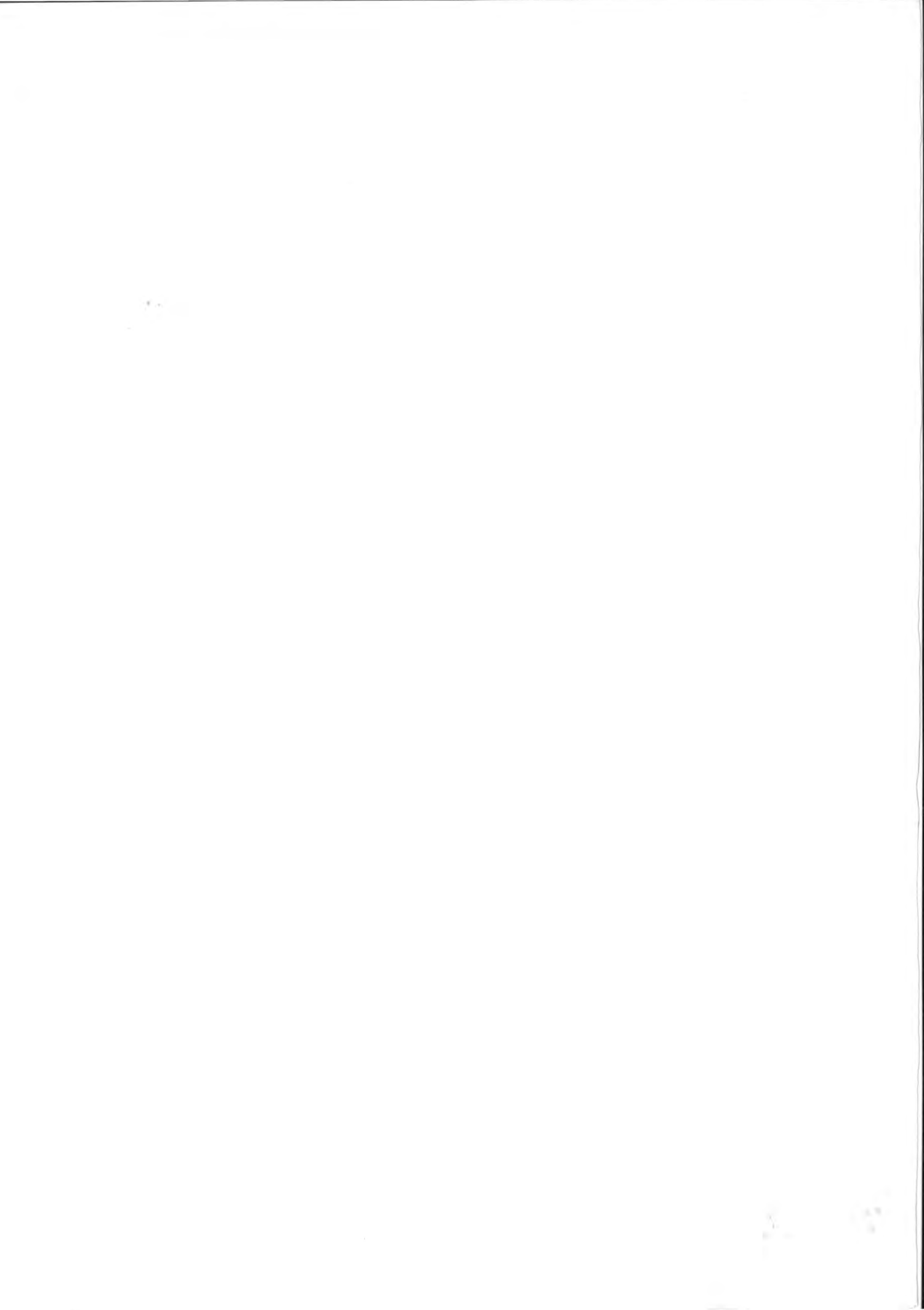
CHECKING REMOVED VOLTAGE STABILIZER

The function of the voltage stabilizer be 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. 3-126. Checking fuel sender



- Pos. Unit
1. Battery
 2. Connection box
 3. Ignition switch
 4. Ignition coil firing order
 5. Distributor, firing order 1-5-3-6-2-4
 6. Spark Plugs
 7. Starter motor
 8. Alternator
 9. Voltage regulator
 10. Fuse box
 11. Light switch
 12. Bulb Integrity Sensor
 13. Switch relay, upper and lower beams
 14. Upper beams
 15. Lower beams
 16. Position lamp
 17. Tail light
 18. Side marker light
 19. License plate light
 20. Stop light switch
 21. Stop light
 22. Contact on transmission, M400—M410
 23. Contact on transmission, BW 35
 24. Back-up light
 25. Flasher
 26. Directional signal switch
 27. Hazard warning light switch
 28. Front turn signal
 29. Rear turn signal
 30. Connection at instrument
 31. Connection at instrument
 32. Brake warning light
 33. Connection at instrument
 34. Tachometer
 35. Temperature gauge
 36. Fuel gauge
 37. Voltage stabilizer
 38. Directional signal control light
 39. Diode
 40. Upper beam control light
 41. Bulb Integrity Sensor warning light
 42. Charging control light
 43. Parking brake control light
 44. Choke control light
 45. Oil pressure warning light
 46. Contact, passenger's seat
 47. Contact, driver's seat
 48. Contact, parking brake
 49. Contact, choke
 50. Temperature sensor
 51. Oil pressure sender
 52. Contact, brake warning
 53. Starter cut-out relay
 54. Fuel gauge sender
 55. Horn
 56. Horn ring
 57. Switch, wiper/washer
 58. Wiper
 59. Washer
 60. Blower switch
 61. Blower
 62. Switch, electrically heated rear window
 63. Electrically heated rear window

64. Clock
65. Cigarette lighter
66. Instrument light rheostat
67. Instrument light
68. Control panel light
69. Gear shift panel light
70. Contact, glove locker
71. Light, glove locker
72. Interior light
73. Door contact, driver's side
74. Door contact, passenger's side
75. Relay, headlight wiper
76. Interlock Control Unit
77. Buzzer, seat belt
78. Warning light, seat belt
79. Seat belt contact, passenger's side
80. Seat belt contact, driver's side
81. Connection
82. Switch, overdrive M410
83. Switch for overdrive, on transmission M410
84. Solenoid for overdrive, on transmission M410
85. Overdrive control light
- 86.
87. Headlight wiper
- 88.
89. Heater pad with rheostat, driver's seat
90. Heater pad, driver's seat
91. Light reminder buzzer
- 92.
93. Switch for compressor
94. Thermostat
95. Solenoid on compressor
96. Solenoid valve
97. Relay, fuel pump
98. Main relay, fuel injection
99. Cold start injector
100. Thermal time switch
101. Control unit
102. Fuel pump
103. Throttle valve switch
104. Pressure sensor
105. Temperature sensor, induction air
106. Temperature sensor, coolant
107. Injection valves
108. Triggering contacts
109. Resistor
110. Engine comp, lighting
111. Fuse box, foglamp
112. Foglamp
113. Foglamp relay
114. Foglamp switch
- 115.

Colour code

SB	Black
GR	Gray
W	White
R	Red
BR	Brown
Y	Yellow
BL	Blue
GN	Green

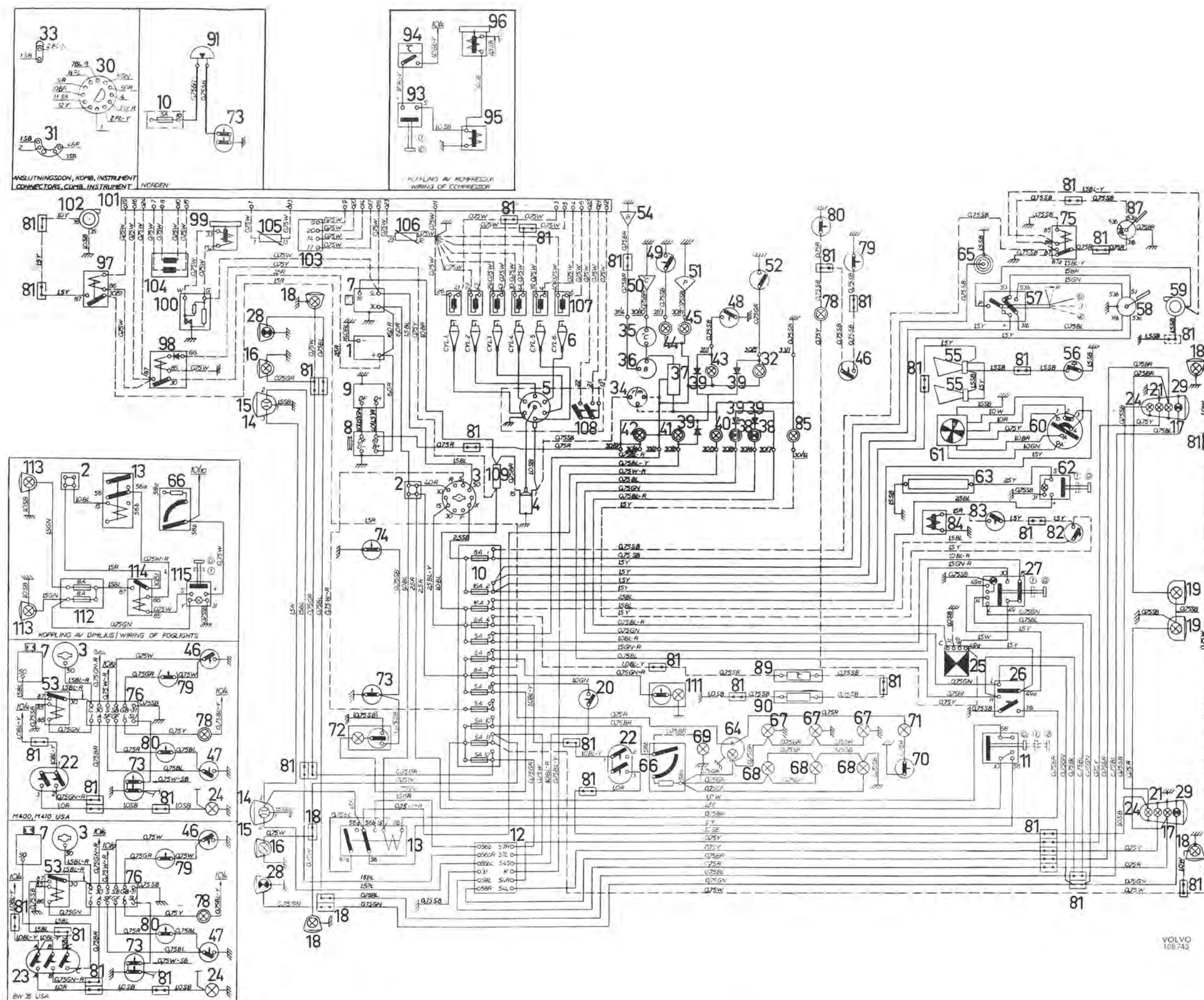


Illustration 3-A. Wiring diagram 164

Part 4

POWER TRANSMISSION
REAR AXLE

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Quick-reference fault-tracing chart for automatic transmission

Illustration 4-A. Clutch and clutch controls
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GROUP 41

CLUTCH

TOOLS

The following tools are used for repairs on the clutch.

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

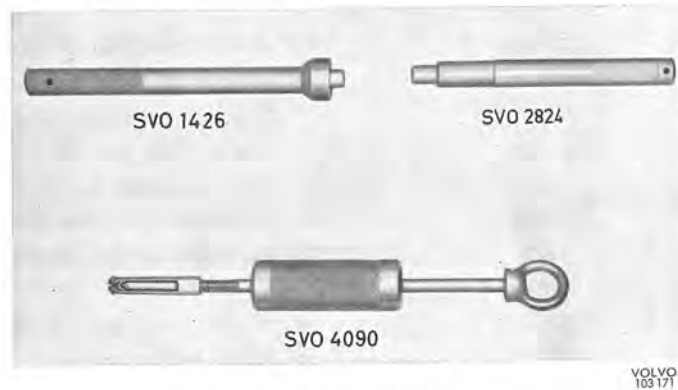


Fig. 4-1. Special tools

- | | |
|----------------|-------------------------------------|
| 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 |

DESCRIPTION

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.

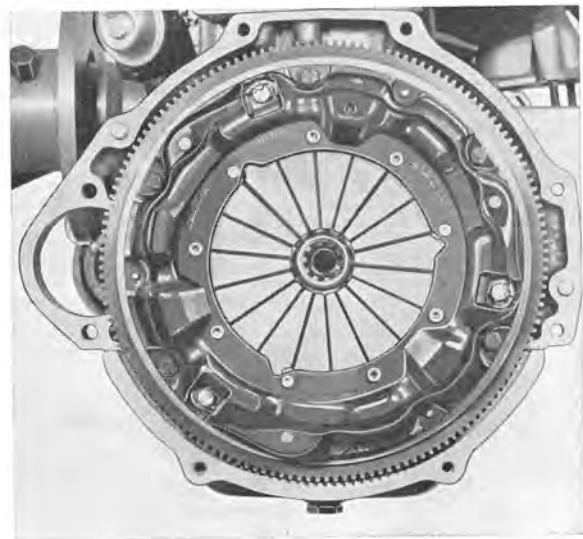


Fig. 4-2. Clutch

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REPAIR INSTRUCTIONS

WORK ON CLUTCH 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,

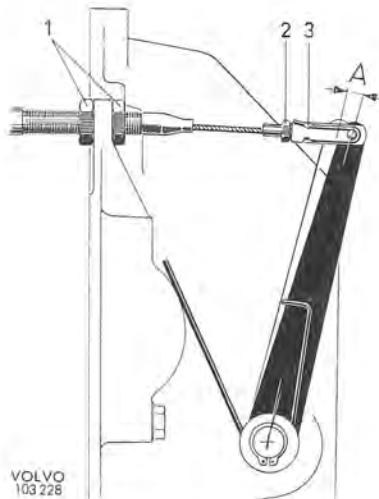


Fig. 4-3. Release lever play
A = 4—5 mm (0.16—0.20")

1. Adjusting nuts 2. Locknut 3. Fork

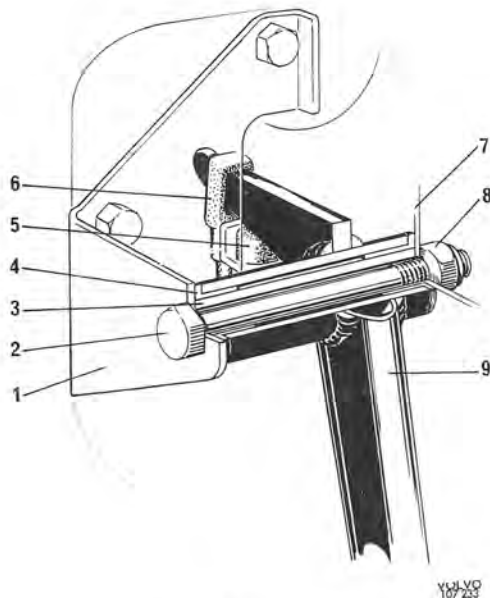


Fig. 4-4. Pedal carrier

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

for example, because of replacement of the clutch wire, the sleeve attachment to the clutch casing is moved by means of the nuts (1).

For right-hand steered vehicles, the corresponding play should be 2.5—3.5 mm (0.10—0.14") and adjustment is made by altering the length of the thrust rod.

REPLACING CLUTCH WIRE

1. Unhook the return spring for the release lever. 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. Fit the new wire in reverse order to removal. Adjust the pedal play.

REPLACING CLUTCH PEDAL OR BUSHES

The description given below is applicable if it concerns either the replacement of the pedal or of the bushes.

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 bushes with a suitable drift.
3. Fit the new bushes. 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. Fit the bolt which holds the pedal.



Fig. 4-5. Removing clutch

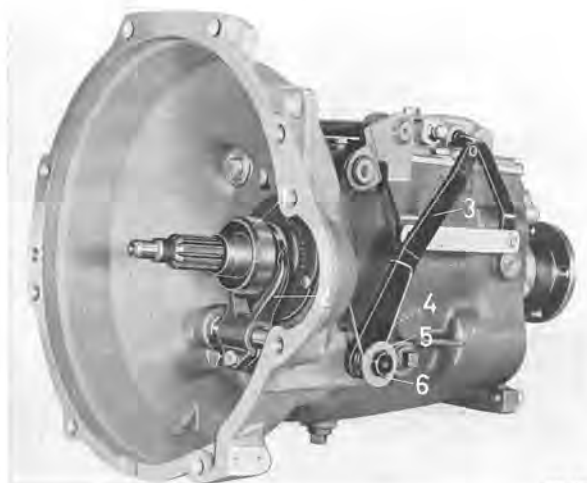


Fig. 4-6. Release components

- | | |
|----------------------------|------------------|
| 1. Release bearing | 4. Return spring |
| 2. Release fork | 5. Washer |
| 3. Release shaft and lever | 6. Circlip |

REMOVING CLUTCH

1. Remove the gearbox in accordance with the instructions given 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.

RECONDITIONING 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 bushes with a suitable drift. Press in the new bushes.
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.

REPLACING INPUT 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 fit it with the help of drift 1426. Fit the circlip.

INSPECTING

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

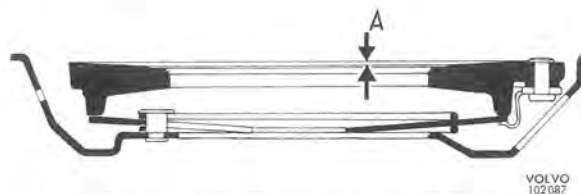


Fig. 4-7. Checking curvature of pressure plate

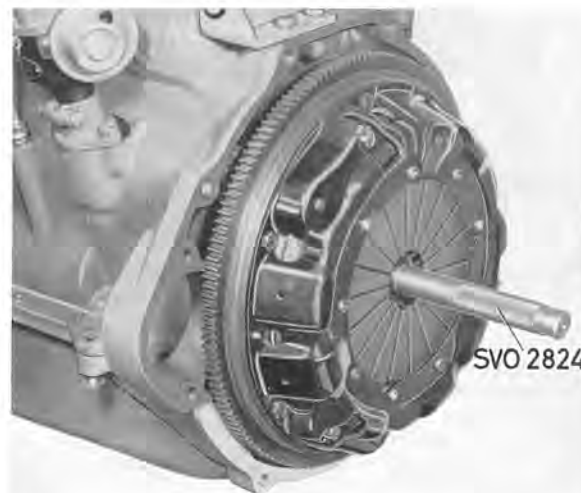


Fig. 4-8. Installing clutch

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.

INSTALLING

Before installing, check that the clutch facings, the flywheel and the pressure plate are completely free from oil. Wash them with clean petrol (gasoline) and wipe off well 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 journal 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. Fit the gearbox according to the instructions given in Group 43. Adjust the clutch pedal play.

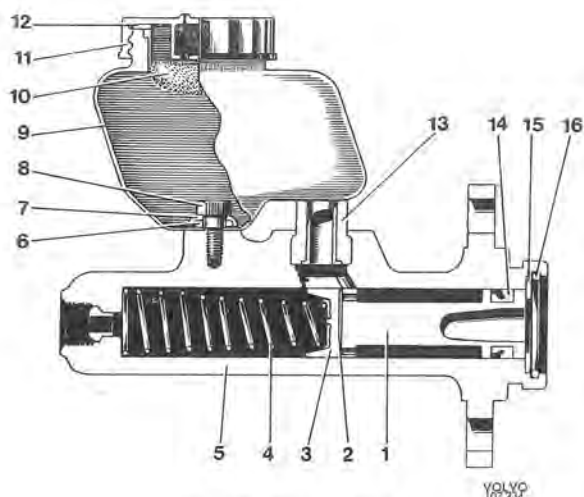


Fig. 4-9. Master cylinder

- | | | |
|-------------------|----------------|---------------------|
| 1. Piston | 7. Washer | 13. Connection pipe |
| 2. Washer | 8. Bolt | 14. Piston seal |
| 3. Piston seal | 9. Container | 15. Washer |
| 4. Spring | 10. Strainer | 16. Circlip |
| 5. Cylinder | 11. Filler cap | |
| 6. Sealing washer | 12. Washer | |

CLUTCH CONTROL, RIGHT-HAND DRIVE

MASTER CYLINDER

Removing

1. Remove the hose from the clutch fluid container and allow the fluid to run out into a clean vessel. Disconnect the pipe from the master cylinder.
2. Remove the bolt in the clutch pedal. Release the bolts and remove the master cylinder.

Disassembling

1. Remove the rubber cover and the thrust rod.
2. Remove the circlip and take out the washer, piston, piston seal and return spring.
3. Remove the outer piston seal from the piston.

Inspecting

Clean all the parts in white spirit and check them for wear or damage.

Assembling

1. Dip the piston seals and the piston in brake fluid. Fit the outer seal on the piston.
2. Fit the return spring, piston seal, piston and washer in the cylinder. Fit on the circlip.
3. Fit the thrust rod and the rubber cover. Make sure that the vent hole in the rubber cover faces downwards.

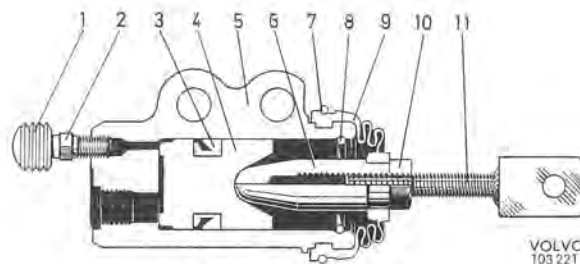


Fig. 4-10. Slave cylinder

- | | | |
|-------------------|------------------|-----------------|
| 1. Rubber cover | 5. Cylinder | 9. Rubber cover |
| 2. Venting nipple | 6. Thrust sleeve | 10. Locknut |
| 3. Piston seal | 7. Circlip | 11. Thrust rod |
| 4. Piston | 8. Stop ring | |

Installing

Fitting is in reverse order to removal. Fill with brake fluid and bleed the system.

SLAVE CYLINDER

Removing

Disconnect the pipe from the hose. Release the hose from the container. Unhook the return spring. Slacken the bolts and lift off the slave cylinder.

Disassembling

Remove the rubber cover and the thrust rod. Take off the circlip and also the piston.

Inspecting

Clean all the parts in white spirit and check them for wear or damage.

Assembling

Dip the piston and seal in brake fluid and place the seal on the piston. Fit the piston in the cylinder. Fit the circlip, the thrust rod and the dust cover.

Installing

Fitting is in reverse order to removal. Bleed the system and adjust the free travel of the clutch lever.

BLEEDING HYDRAULIC SYSTEM

Check to make sure that the fluid container is filled with brake fluid. Remove the rubber cap on the bleeder valve on the master cylinder. Fit a bleeder hose to the valve and insert the hose down into a container with brake fluid. Open the bleeder valve and depress the clutch pedal. Shut off the bleeder valve while the pedal is fully depressed. Then release the pedal. Repeat this procedure until fluid free from air bubbles flows out. Fill the container with brake fluid.

GROUP 43 A

GEARBOX

TOOLS

The following special tools are used for repairs on the gearbox.
The numbers for the special tools are preceded by 999 or SVO, e.g., 9992825 or SVO 2825.

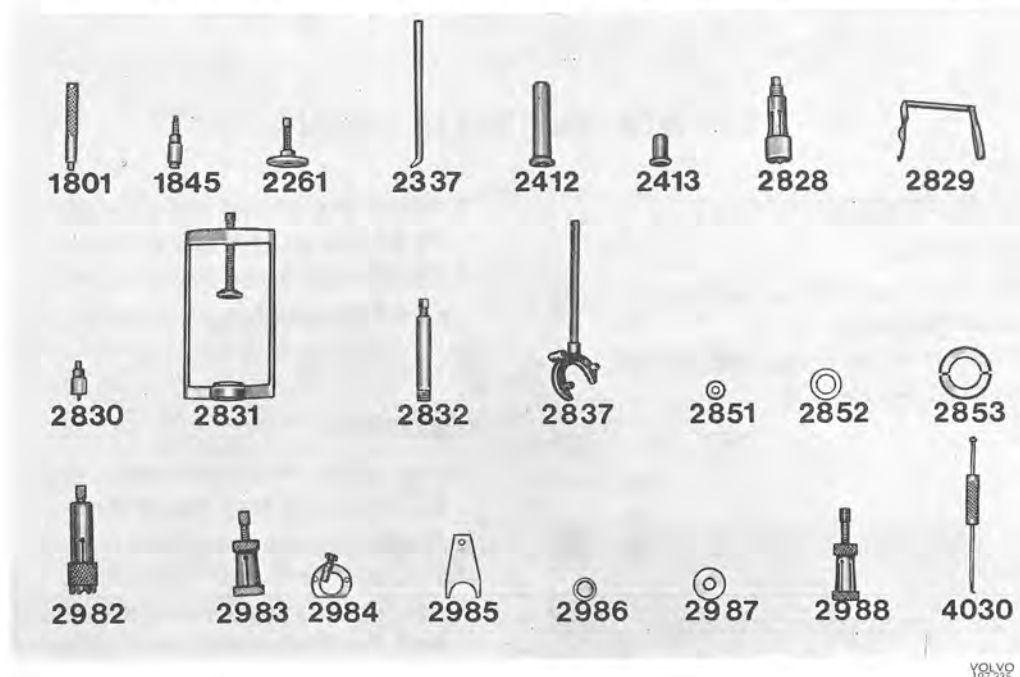


Fig. 4-11. Special tools

999 (SVO)

- 1801 Standard handle 18x200 mm
- 1845 Press tool for fitting the flange
- 2261 Puller for flange
- 2337 Drift for removing oil seal in cover for input shaft
- 2412 Drift for fitting oil seal in rear cover
- 2413 Drift for removing sealing ring in rear cover and outer ring for front bearing for intermediate shaft
- 2520 Stand, see Fig. 4-12. Used together with fixture 2825
- 2825 Fixture for holding gearbox. Used together with stand 2520
- 2828 Puller for rear bearing on mainshaft, M 400
- 2829 Device for lifting and installing the mainshaft in gearbox
- 2830 Puller for reverse shaft
- 2831 Press tool for fitting bearing on intermediate shaft and rear bearing on mainshaft
- 2832 Puller for rear bearing on mainshaft, M 410
- Used together with 2828
- 2833 Fixture for gearbox. Used on garage jack when removing and fitting gearbox, see Fig. 4-16
- 2837 Counterhold for flange (handle used only for automatic transmission)
- 2851 Drift for fitting oil seal in cover for input shaft
- 2852 Cushioning ring for fitting bearing on input shaft and synchronizers on mainshaft
- 2853 Ring for disassembling mainshaft
- 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 fitting rear bearing inner ring on intermediate shaft

999 (SVO)

- 2987 Drift for fitting front bearing inner ring on intermediate shaft
- 2988 Puller for front bearing inner ring on intermediate shaft
- 4030 Puller for oil seal at flange



Fig. 4-12. Stand 2520 with fixture 2825

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DESCRIPTION

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

The gearbox is four-speed and fully synchronized. Its design and construction are shown in Fig. 4-13 and Illustration 4B. All gears except reverse are in constant mesh with one another. For this reason, the

mainshaft gear is journalled with needle bearings. When a gear is engaged, the corresponding gear wheel is connected to the mainshaft by means of an engaging sleeve.

REPAIR INSTRUCTIONS

WORK ON GEARBOX IN VEHICLE

REPLACING OIL SEAL

1. Carry out where applicable operations 1—6 under the heading "Removing".
2. Release the nut for the flange. Pull off the flange with puller 2261, see Fig. 4-14.

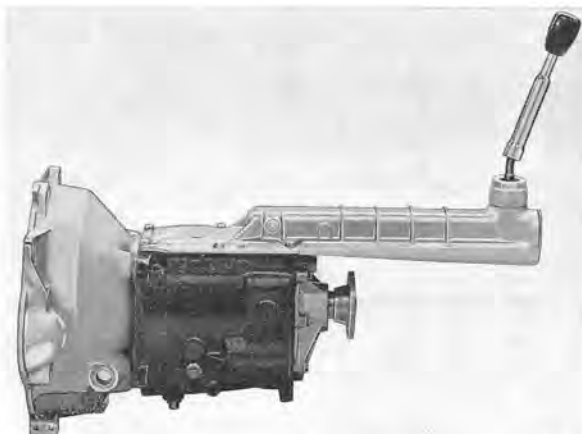


Fig. 4-13. Gearbox M 400

3. Pull out the old seal with puller 4030.
Fit the new oil seal with the help of sleeve 2412.
4. Press on the flange with tool 1845, see Fig. 4-15.
Fit the other parts.

REMOVING

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. Support under the gearbox with a jack. Release and remove the supporting member under the gearbox. 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 gearbox.

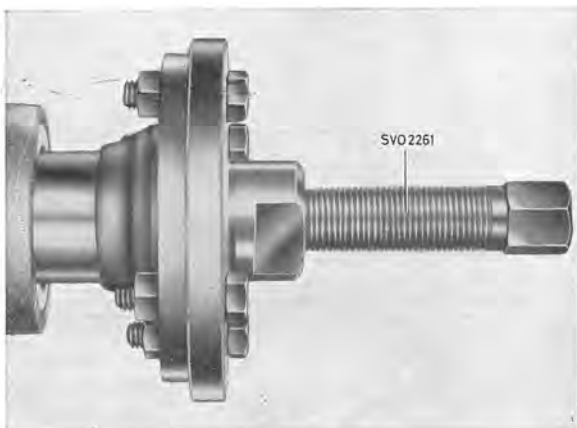


Fig. 4-14. Removing flange

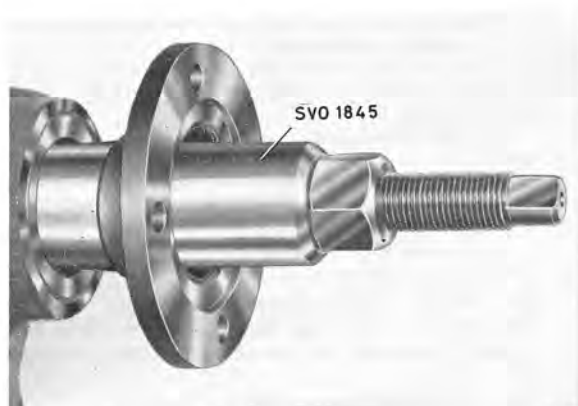


Fig. 4-15. Fitting flange

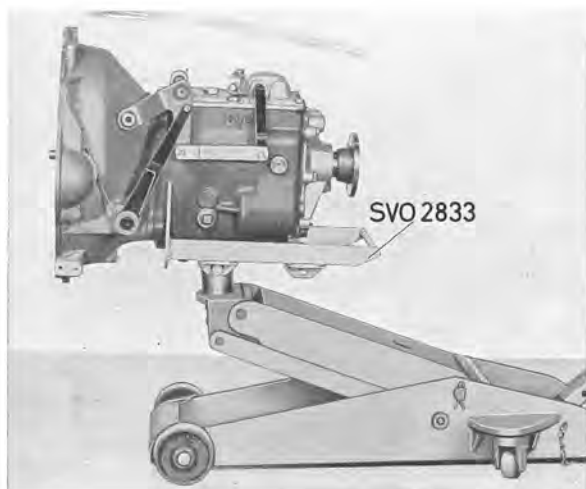


Fig. 4-16. Fixture for removing gearbox

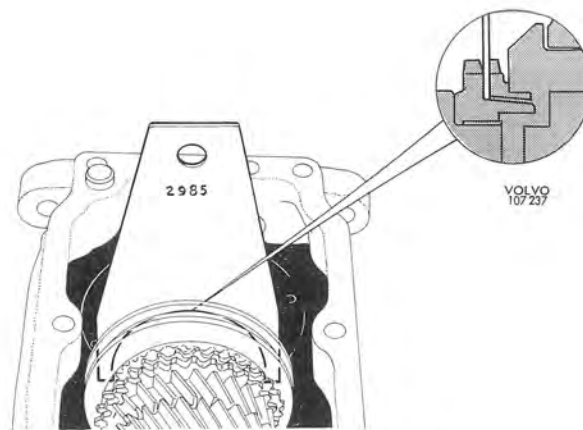


Fig. 4-17. Counterhold for mainshaft

5. Replace the lifting plate on the jack with fixture 2833. The pin in the fixture should then be located in its front position for gearbox M 400 and in the rear position for the M 410 gearbox. Support the gearbox with the fixture. Slacken the bolts in the clutch casing. Pull the gearbox rearwards and then lower it, see Fig. 4-16.

DISASSEMBLING

Applies also to M 410 after the overdrive has been removed.

1. Fit fixture 2825 in stand 2520, see Fig. 4-12. Secure the gearbox in the fixture. The bolt for securing the gearbox to the fixture is fitted in the gearbox drainage hole.
2. Release the nut for the flange. Use for this counterhold 2837. Pull off the flange with 2261, see Fig. 4-14. Remove the bolts and take off the rear cover as well as the large speedometer gear.
3. Release the bolts and lift off the gearbox cover. Remove the springs and interlock balls for the selector forks.
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.
5. Place counterhold 2985 between the input shaft and the front synchronizing, see Fig. 4-17. Pull off the mainshaft rear bearing with puller 2828, see Fig. 4-18. For M 410, remove the bolt in 2828 and replace with tool 2832. Thereafter pull off the rear bearing in the same way as for M 400, see Fig. 4-19.

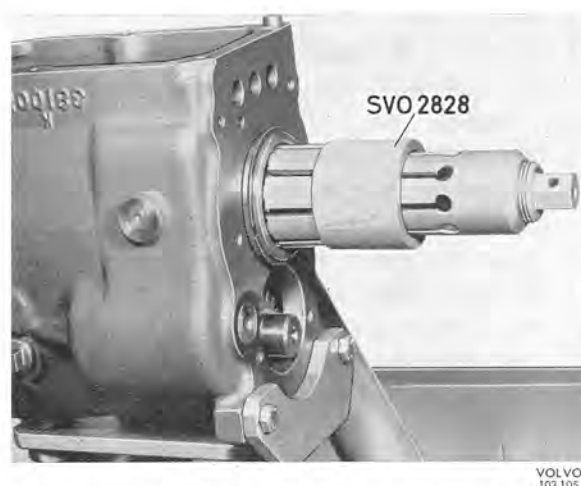


Fig. 4-18. Removing mainshaft rear bearing, M 400

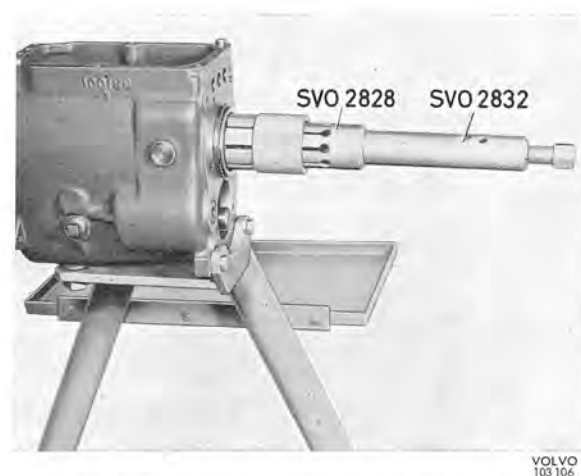


Fig. 4-19. Removing mainshaft rear bearing, M 410

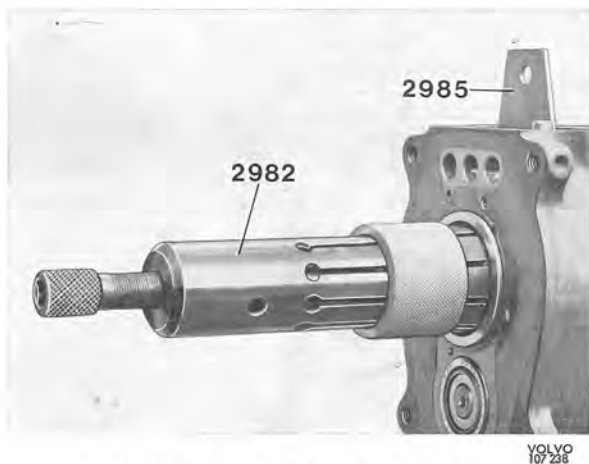


Fig. 4-20. Removing bearing for input shaft

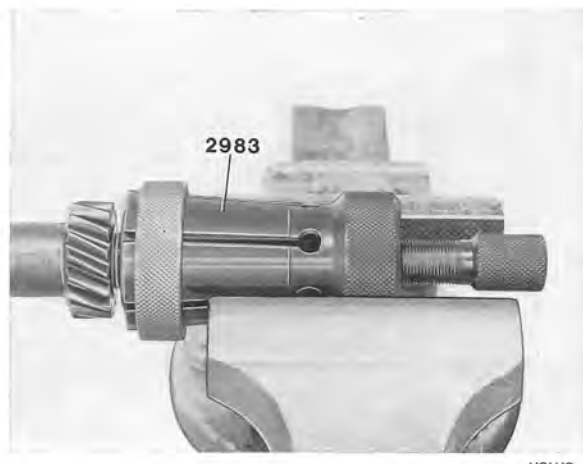


Fig. 4-22. Removing rear inner ring

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. 4-20. Remove counterhold 2985.
8. Turn the gearbox upside down. Carefully drive the intermediate shaft forwards with a metal drift in the centre 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 gearbox 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. 4-21.

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 puller 2983 (rear bearing, see Fig. 4-22) and 2988 (front bearing).
11. Drive out the reverse shaft with puller 2830, see Fig. 4-23, 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.

DISASSEMBLING MAINSHAFT

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.



Fig. 4-21. Lifting out mainshaft



Fig. 4-23. Removing reverse shaft



Fig. 4-24. Disassembling mainshaft, I

3. Fit tool 2853 on to the mainshaft. Place the shaft in a press and support it with the tool as shown in Fig. 4-24. 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. 4-25. Press off 3rd speed gear wheel and 4th speed synchronizing hub.

INSPECTING

After the dismantling, clean all the parts in white spirit and check for wear or other damage. Check the gear wheels particularly for cracks or

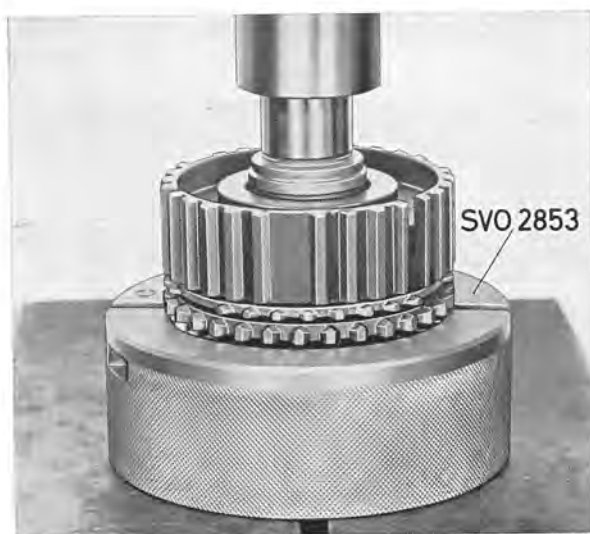


Fig. 4-25. Disassembling mainshaft, II

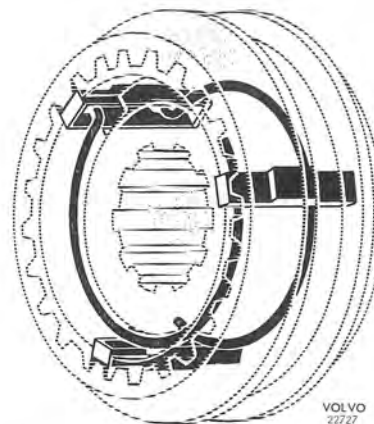


Fig. 4-26. Assembling synchronizing

scoring on the teeth surfaces. Damaged or worn gear wheels should be replaced.

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

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

ASSEMBLING

ASSEMBLING MAINSHAFT

1. Assemble 1st-2nd and 3rd-4th speed synchronizers. Fit the snap rings correctly, see Fig. 4-26. Place the resilient ring in the hub for 3rd—4th synchronizers, see Fig. 4-27.
2. Centre the resilient ring 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 syn-

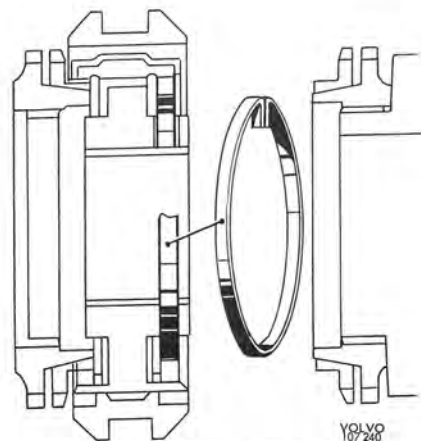


Fig. 4-27. Fitting resilient ring

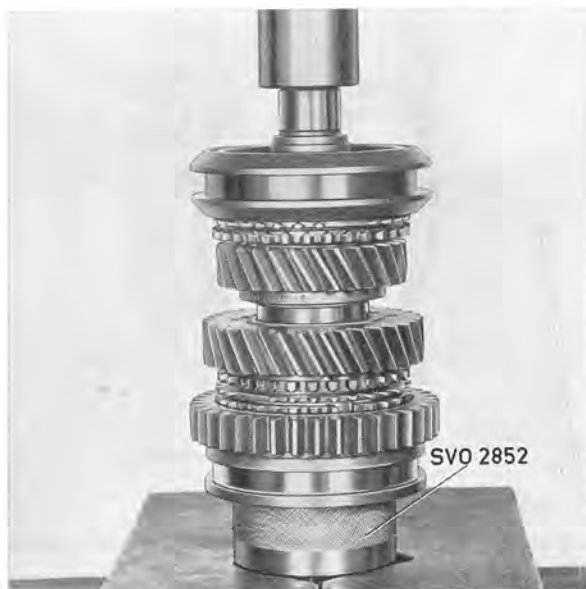


Fig. 4-28. Installing synchronizing

chronizing and the gear wheel. Fit the needle bearing and press in the mainshaft, see Fig. 4-28. 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 bearing 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. 4-28. 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

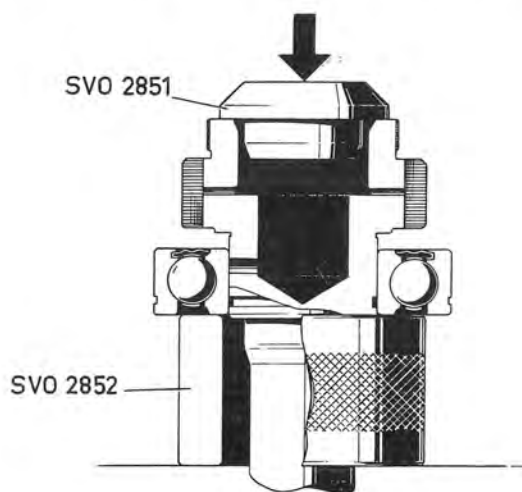


Fig. 4-29. Installing ball bearing on input shaft

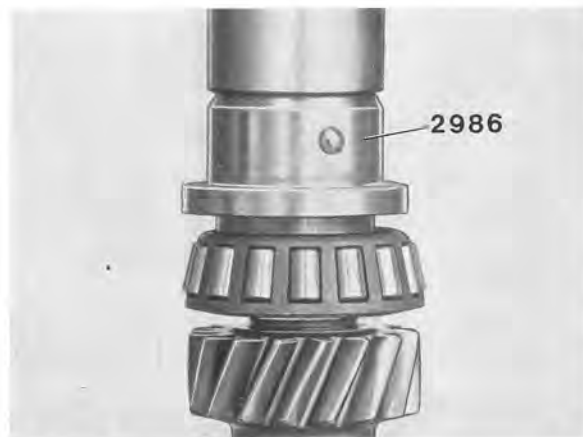


Fig. 4-30. Installing rear inner ring

synchronizing cone on the mainshaft. Fit on lifting tool 2829.

ASSEMBLING GEARBOX

1. Press the sealing rings in the front and rear covers with drift 2851+1801 and 2412 respectively. Press the ball bearing on the input shaft with the help of the cushioning ring 2852 and drift 2851, see Fig. 4-29.
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. 4-30.
2. Place the gear lever for the reverse shaft onto the bearing pin in the gearbox 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 gearbox 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.

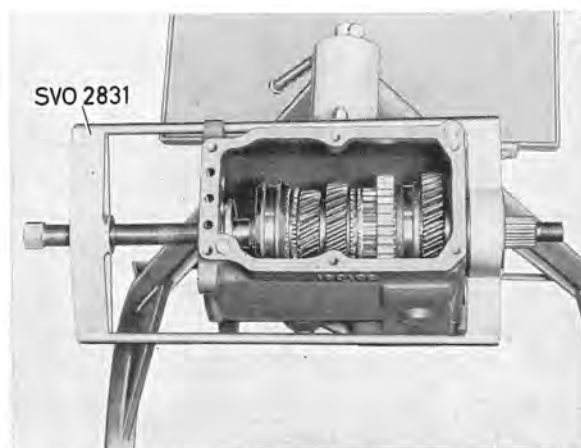


Fig. 4-31. Fitting mainshaft rear bearing

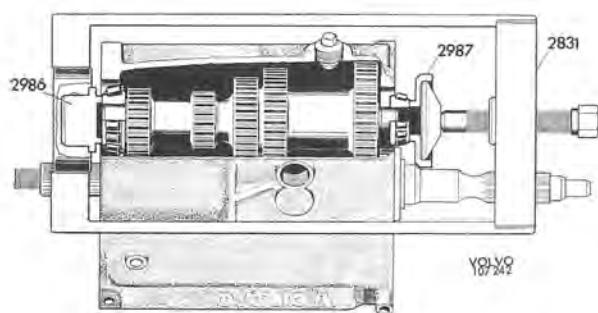


Fig. 4-32. Installing front inner ring

The ball holder should be faced inwards. Fit press tool 2831 over the bearing and the mainshaft as shown in Fig. 4-31. 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.

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 gearbox upside down. Press the front bearing inner ring onto the intermediate shaft with 2831, 2986 and 2987, see Fig. 4-32. Drive in the outer rings until they are about 3 mm (0.12") above the face.
7. Turn the gearbox with the front end upwards and fit the engaging casing and the front cover with gaskets.
8. Turn the gearbox 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. 4-33. 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 centre hole,

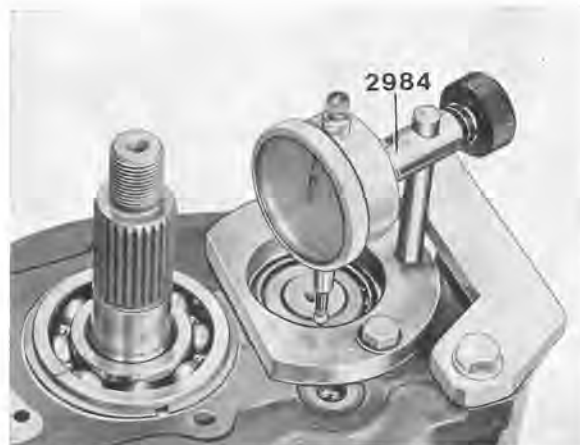


Fig. 4-33. Measuring axial clearance

and rotate it at the same time by rotating the mainshaft 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 tension pins. Use new pins.
13. Fit on the large speedometer gear. Fit the rear cover with a new gasket. Press on the flange with tool 1845. Fit the washer and nut. Tighten the nut to a torque of 110—140 Nm (80—110 lbft).
14. Place the interlocking balls and springs in position. Fit the gearbox cover with gasket. Fit the release bearing and the small speedometer gear.

INSTALLING

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

GROUP 43 B

OVERDRIVE

TOOLS

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

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

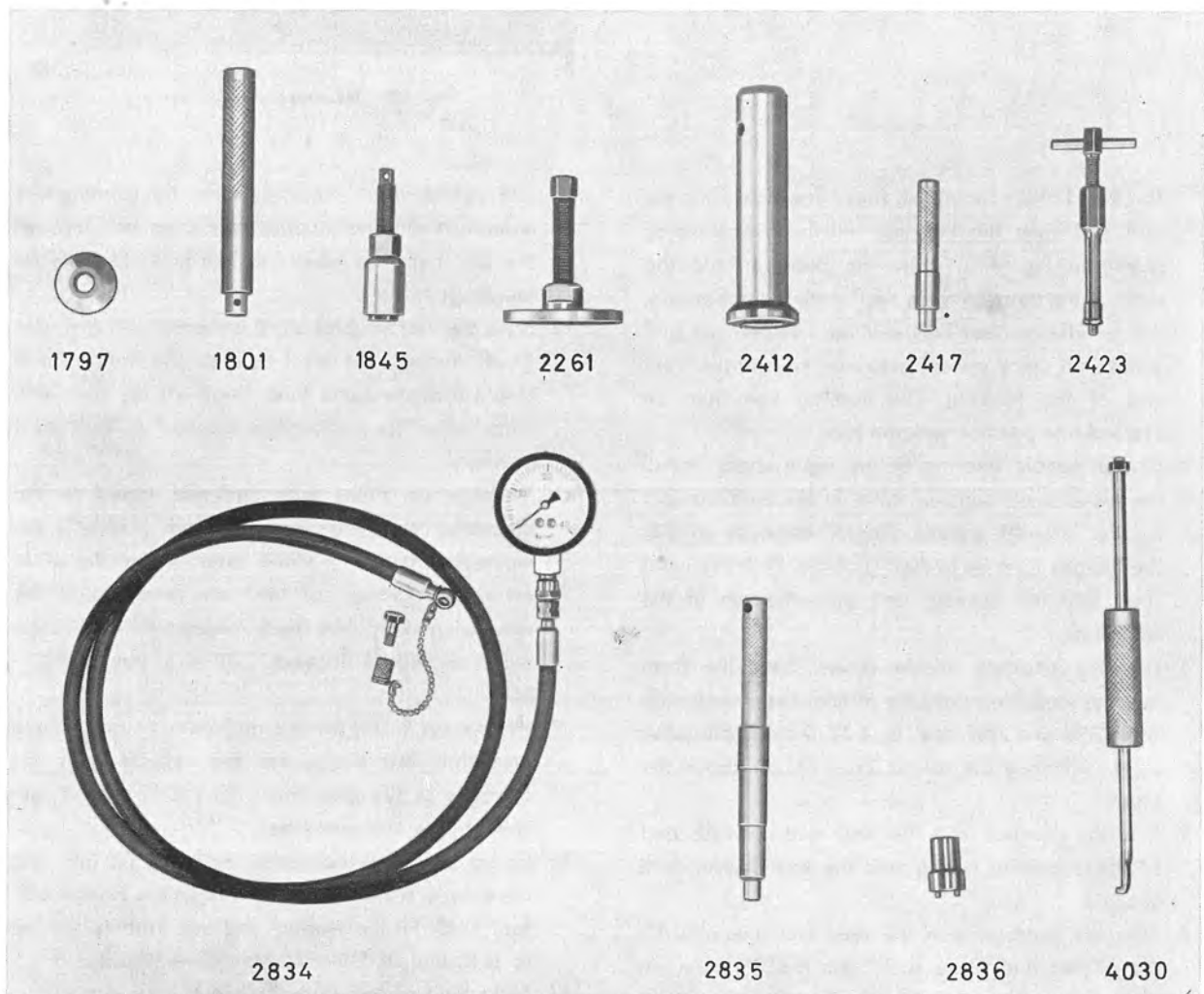


Fig. 4-34. Special tools

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
- 2417 Drift for fitting bush in output shaft
- 2423 Puller for bush in output shaft
- 2834 Pressure gauge for checking oil pressure
- 2835 Centering mandrel for splines in planet carrier and uni-directional clutch
- 2836 Socket for removing and fitting plugs for fine filter, oil pump and relief valve
- 4030 Puller for oil seal at flange

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DESCRIPTION

The overdrive unit is of the epicyclic type and is attached to the rear end of the gearbox. 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 travelling forwards the power is transmitted from the gearbox mainshaft through the uni-directional clutch to the output shaft of the overdrive. At the same time the clutch sliding member (position I, Fig. 4-36) 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. 4-36) with

the help of the pistons (27, Fig. 4-43) in the hydraulic cylinders. This also locks the sunwheel. Since the planet gear retainers are linked to the mainshaft through the splines, the planet gears are forced to rotate around the sunwheel. 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 gearbox 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 gearbox 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. 4-40.

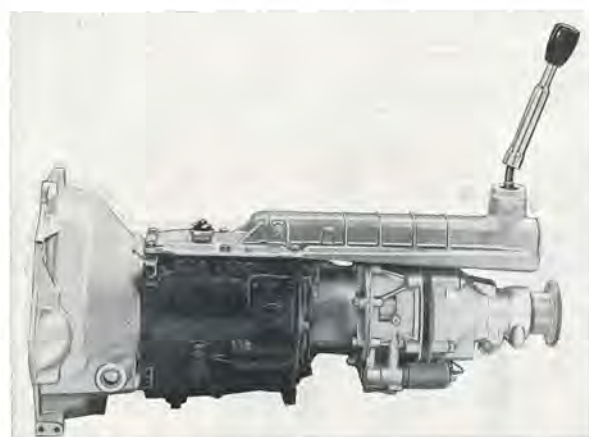


Fig. 4-35. Gearbox M 410

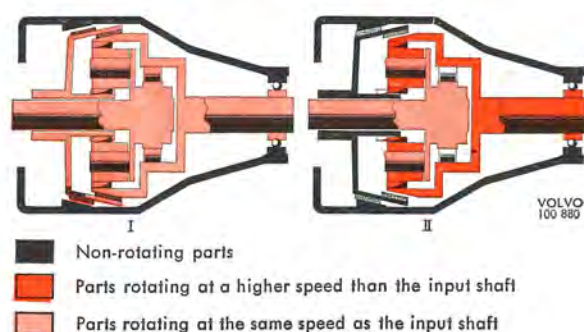


Fig. 4-36. Working principle of overdrive

- I. Direct drive position
- II. Overdrive position

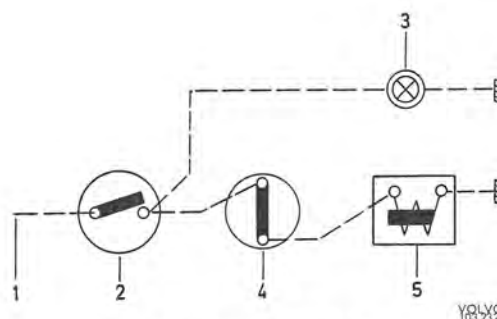


Fig. 4-37. Electrical circuit diagram

1. Lead from fusebox
2. Switch for overdrive
3. Indicator lamp for overdrive
4. Switch on gearbox
5. Solenoid on overdrive

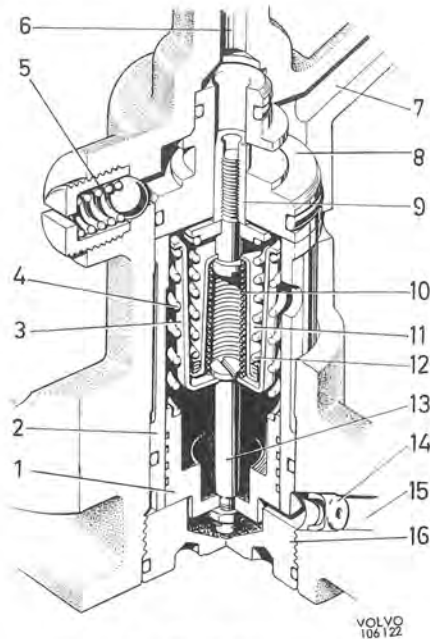


Fig. 4-38. Relief valve

- | | |
|-------------------------|-----------------------------------|
| 1. O-ring | 10. Residual spring |
| 2. Cylinder | 11. Relief valve spring cup |
| 3. Large piston unit | 12. Relief valve spring |
| 4. Spring | 13. Dashpot spindle |
| 5. Valve ball | 14. Orifice nozzle |
| 6. Channel for oil pump | 15. Drilling from operating valve |
| 7. Channel to mainshaft | 16. Dashpot plug |
| 8. Relief valve body | |
| 9. Relief valve spindle | |

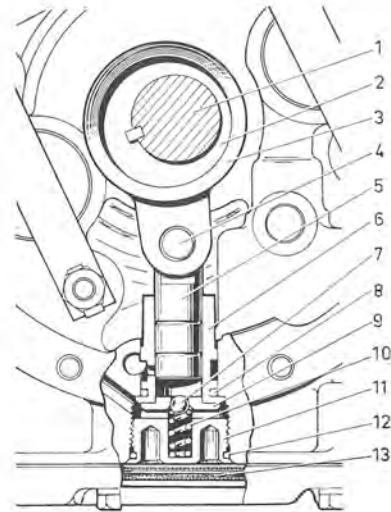


Fig. 4-39. Oil pump

- | | |
|-------------------|----------------|
| 1. Mainshaft | 8. O-ring |
| 2. Eccentric | 9. Valve seat |
| 3. Connecting rod | 10. Spring |
| 4. Gudgeon pin | 11. Plug |
| 5. Piston | 12. O-ring |
| 6. Cylinder | 13. Pre-filter |
| 7. Ball | |

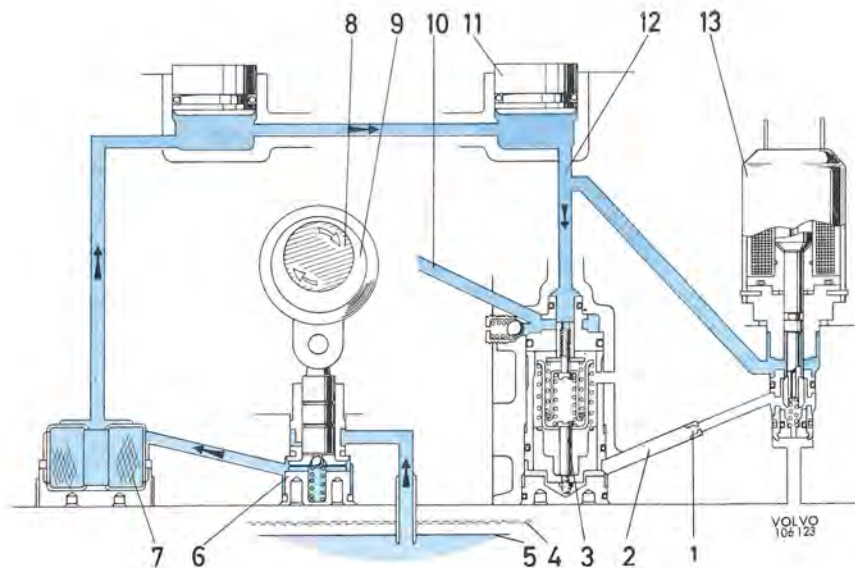


Fig. 4-40. Function with direct drive

- | | |
|--|--|
| 1. Nozzle | 9. Eccentric |
| 2. Channel, control valve-relief valve | 10. Channel, relief valve — mainshaft |
| 3. Relief valve | 11. Piston |
| 4. Pre-filter | 12. Channel, oil pump — hydraulic cylinder — control and relief valves |
| 5. Oil sump | 13. Control valve and solenoid |
| 6. Oil pump | |
| 7. Fine filter | |
| 8. Gearbox mainshaft | |

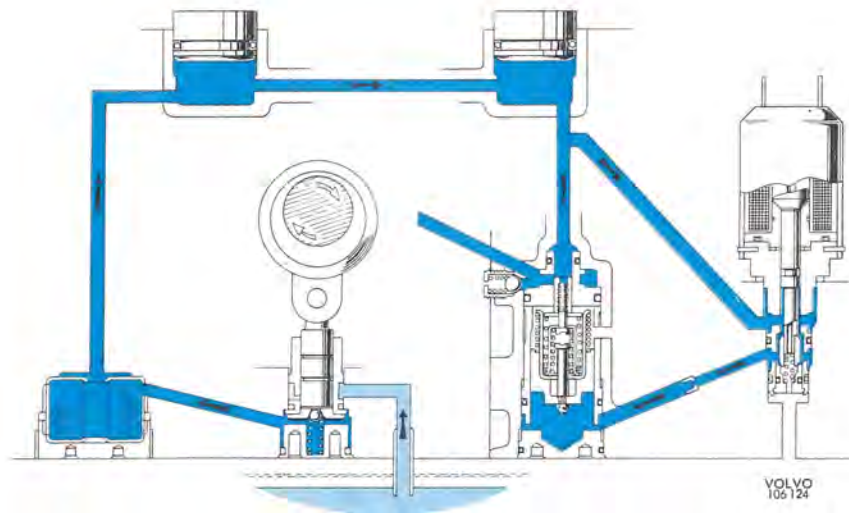


Fig. 4-41. Overdrive in function

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.

When the overdrive disengages, the connection between channels 12 and 2 closes. Instead, the connection between channel 2 and the sump is opened. 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 gear-box housing, see Fig. 4-42.

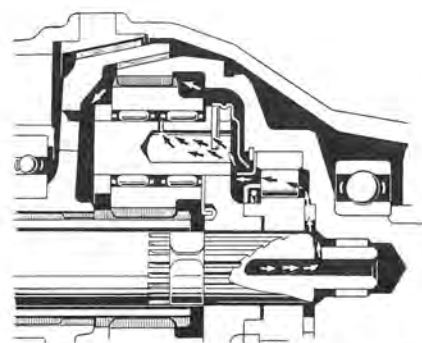


Fig. 4-42. Lubricating system

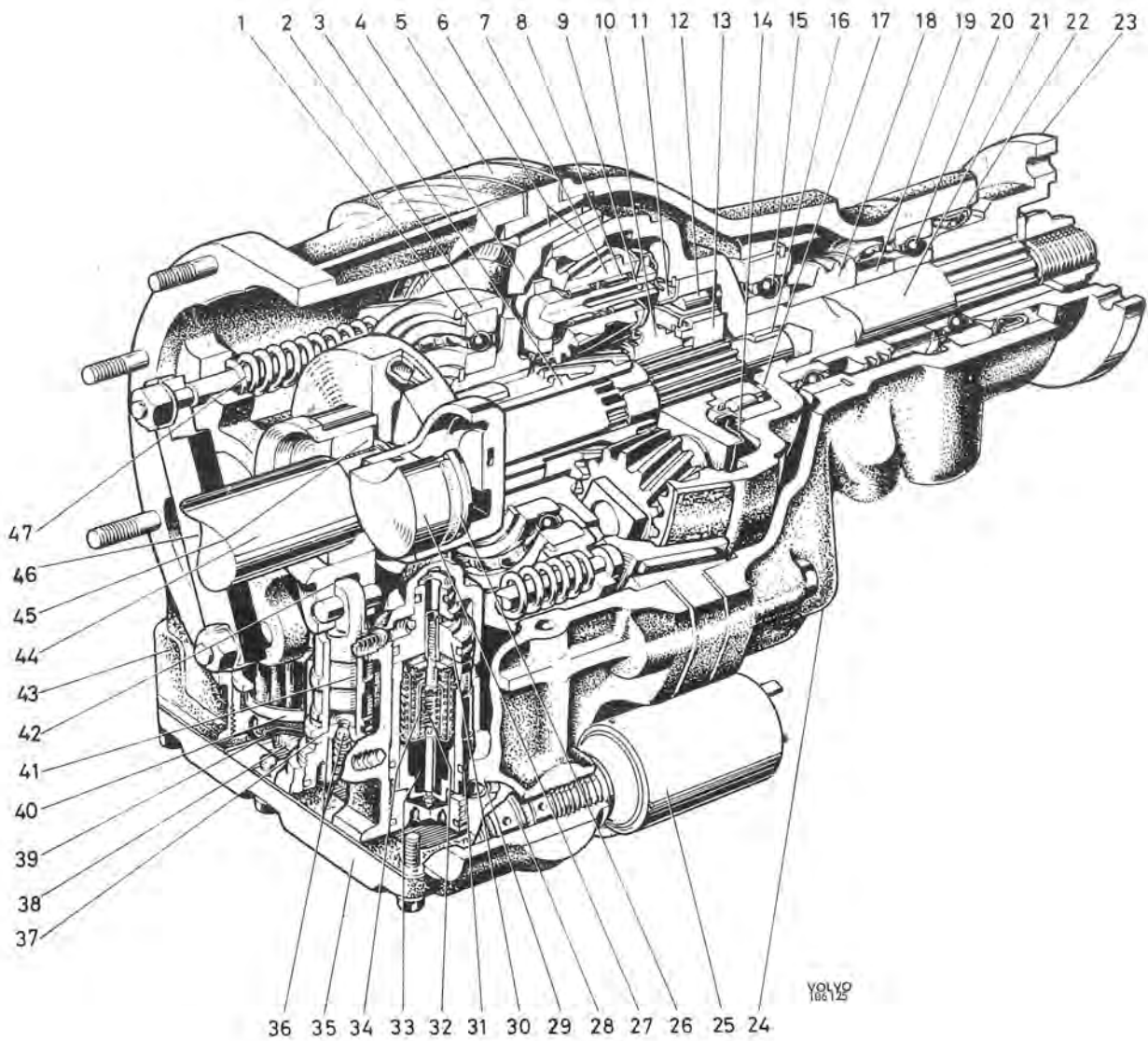


Fig. 4-43. Overdrive

- | | | |
|---------------------------------------|------------------------------|--|
| 1. Output shaft support bearing | 17. Thrust washer | 34. Small piston |
| 2. Thrust bearing retainer | 18. Speedometer driving gear | 35. Base plate |
| 3. Sunwheel | 19. Spacer | 36. Check valve for oil pump |
| 4. Clutch sliding member | 20. Ball bearing | 37. Pump cylinder |
| 5. Brake ring | 21. Output shaft | 38. Magnet |
| 6. Clutch member outer lining | 22. Oil seal | 39. Pre-filter |
| 7. Planet gear | 23. Coupling flange | 40. Fine filter |
| 8. Needle bearing | 24. Rear casing | 41. Pump plunger |
| 9. Shaft | 25. Solenoid | 42. Connecting rod |
| 10. Planet carrier | 26. Piston seal | 43. Front casing |
| 11. Oil thrower | 27. Piston | 44. Input shaft
(gearbox mainshaft) |
| 12. Uni-directional clutch
rollers | 28. Operating valve | 45. Eccentric |
| 13. Uni-directional clutch | 29. Orifice nozzle | 46. Bridge piece |
| 14. Oil trap | 30. Cylinder top | 47. Spring |
| 15. Ball bearing | 31. Cylinder | |
| 16. Bush | 32. Spring | |
| | 33. Large piston | |

REPAIR INSTRUCTIONS

WORK ON OVERDRIVE IN VEHICLE

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. 4-44.
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.

REPLACING SOLENOID AND OPERATING VALVE

The solenoid and operating valve are integrally built as one unit, which is replaced complete. For removing and fitting, use a 25 mm (1") fixed spanner. Use a new seal and O-rings when fitting. The tightening torque should be 42—55 Nm (30—40 lbf).

CHECKING AND REPLACING RELIEF VALVE

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. 4-45. 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. 4-46, for the cylinder and washer.

3. Wash all the parts in white spirit 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.

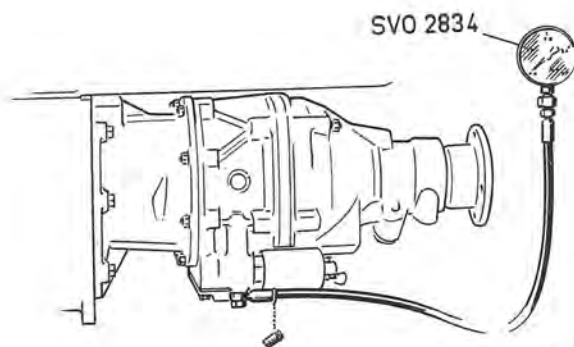


Fig. 4-44. Checking oil pressure

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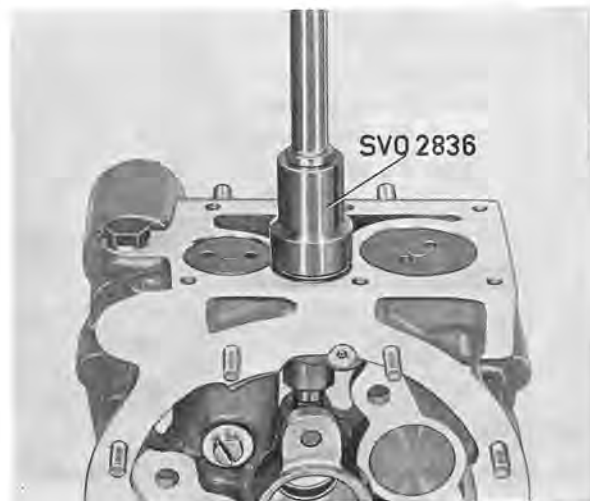


Fig. 4-45. Removing plug

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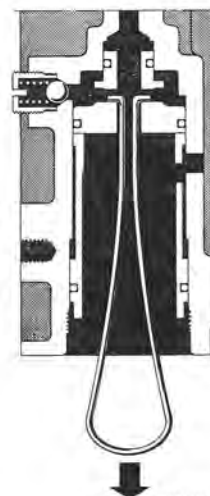


Fig. 4-46. Removing relief valve

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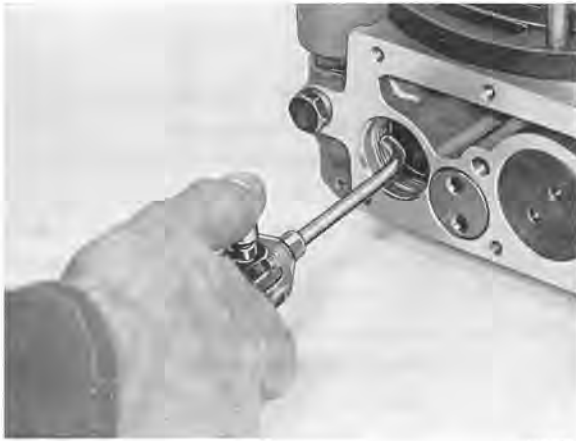


Fig. 4-47. Blowing orifice nozzle clean

4. Before fitting the parts of the relief valve, it may be suitable to blow the orifice nozzle clean with compressed air, see Fig. 4-47.
5. Fit 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 (16 lbft).
6. Fit 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. 4-47.

CHECKING AND REPLACING CHECK VALVE

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 white spirit and blow them dry with compressed air. Check the parts for damage and wear. Replace faulty parts.
4. Fit 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 (16 lbft).

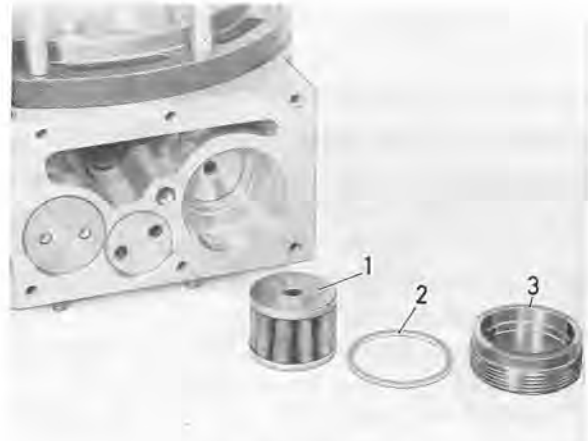


Fig. 4-48. Fine filter
1. Filter 2. Seal 3. Plug

5. Re-fit the pre-filter and base plate together with a new gasket. Do not forget the magnet on the bottom plate. Fill with oil.

CLEANING FILTER

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. 4-48.
3. Clean all the parts in white spirit. 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 (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.

REMOVING OVERDRIVE

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 uni-directional clutch. Any stresses will disappear even if oil with pressure of 20–25 kp/cm² (284–335 psi) is connected to the output at the operating valve. The overdrive is engaged and disengaged with this pressure.

Removal is as follows:

1. Carry out operations 1–5 under "Removing" in Group 53 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 gearbox mainshaft.

DISASSEMBLING OVERDRIVE

Maximum cleanliness must be observed when working with the overdrive unit. Before the disassembling, clean the outside of the unit thoroughly. Then first disassemble the main parts as follows:

1. Place the overdrive vertically in a vice 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. 4-49.
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 sunwheel.
6. Lift out the planet gear carrier complete.

REMOVING FRONT CASING

1. Place the casing with the front side downwards on a bench. Connect compressed air to the hole for the operating 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".

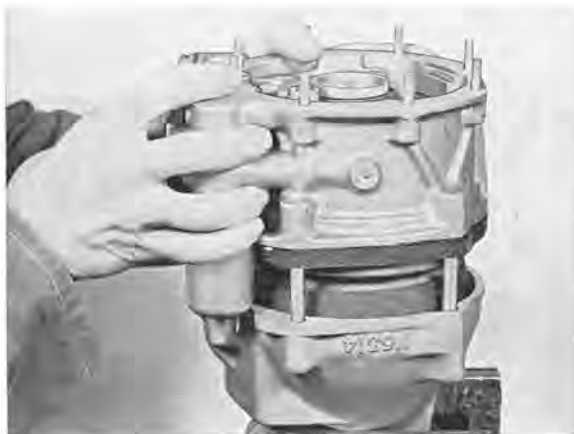


Fig. 4-49. Disassembling overdrive

3. Press down and pull out the pump cylinder. Then take out the connecting rod and pump plunger.

DISASSEMBLING CLUTCH UNIT

1. Remove the circlip for the sunwheel. Pull out the sunwheel 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.

DISASSEMBLING REAR CASING

1. Remove the bolt and pull out the retainer, the bush 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 circlip and the oil thrower, which hold the uni-directional clutch on the output shaft. Lift out the uni-directional clutch components. Remove the thrust washer. If necessary pull the bush on the output shaft out with puller 2423, see Fig. 4-50.

INSPECTING OVERDRIVE

Before inspecting, clean all the parts in white spirit and then blow them dry with compressed air. Pay particular attention to the cleaning of the filters and

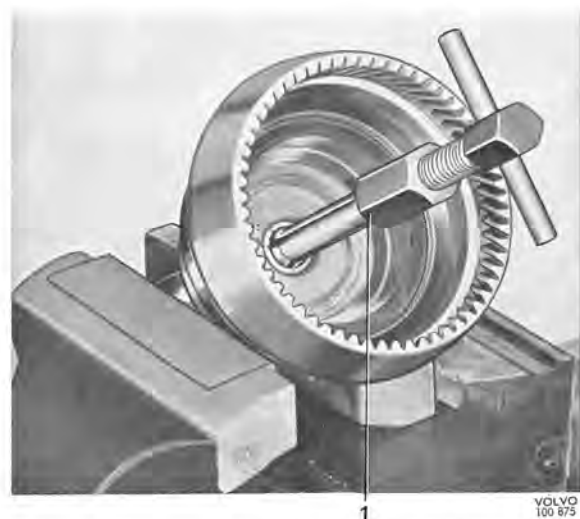


Fig. 4-50. Removing bush, output shaft
1. Puller 2423

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.

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 bush on the sunwheel is not worn. With replacement, change the sunwheel complete with bush. The bush 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.

ASSEMBLING OVERDRIVE

Use new gaskets, O-rings, lock washer and seals when assembling. Observe maximum cleanliness since the hydraulic system is sensitive to impurities.

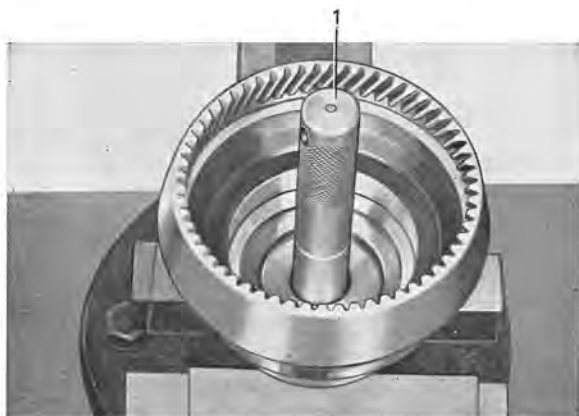


Fig. 4-51. Fitting bush, output shaft
1. Drift 2417

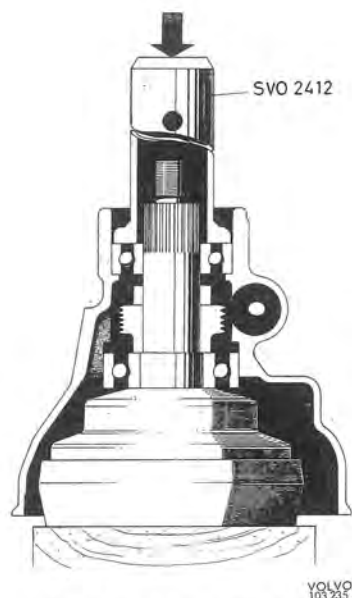


Fig. 4-52. Installing output shaft

ASSEMBLING REAR CASING

1. Fit the bush on the output shaft with drift 2417, see Fig. 4-51. 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. 4-52.
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 (80—100 lbft).

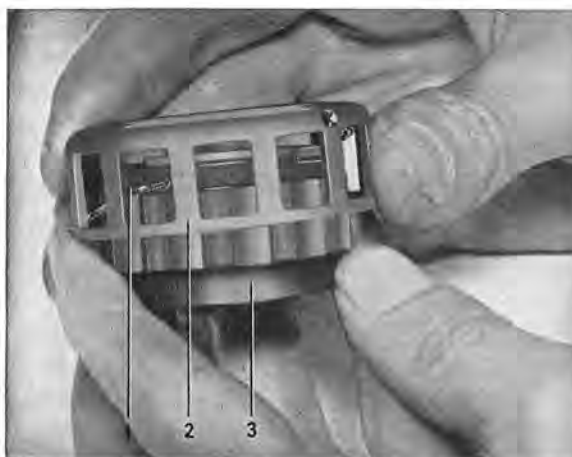


Fig. 4-53. Assembling uni-directional clutch, I
1. Spring 2. Cage 3. Uni-directional clutch hub

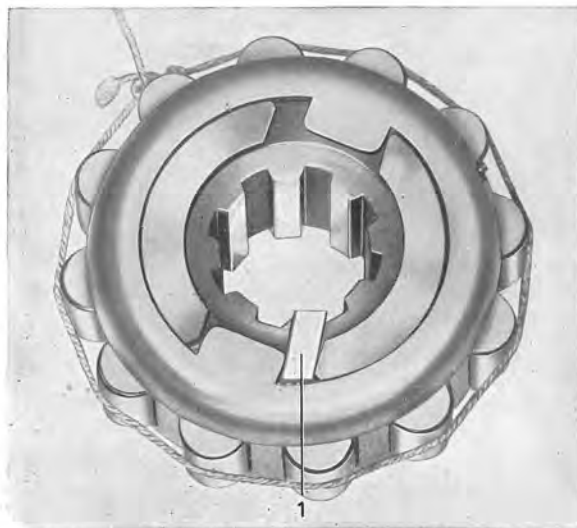


Fig. 4-54. Assembling uni-directional clutch, II
1. Key

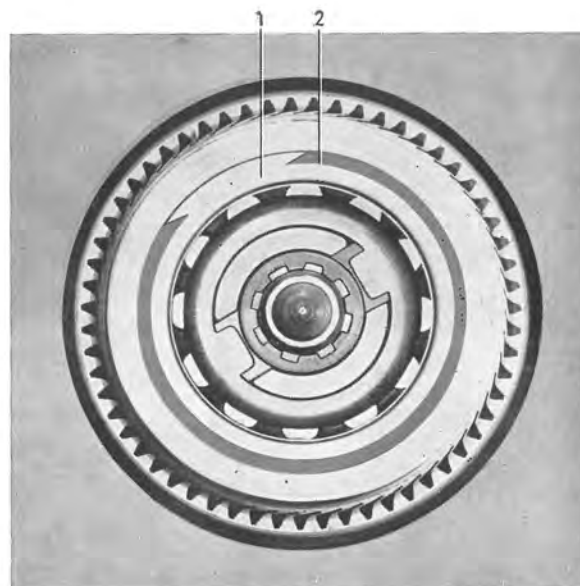


Fig. 4-56. Installing oil thrower
1. Oil thrower plate 2. Circlip

5. Assemble the uni-directional clutch, spring and roller cage, see Fig. 4-53. Turn the roller cage clockwise as far as it will go and lock it in this position with a key as shown in Fig. 4-54. Place in the rollers. Tie a piece of rubber band or string round the rollers.
6. Fit the thrust washer and then the uni-directional clutch in position on the output shaft, see Fig. 4-55. Fit the oil thrower and install the circlip, see Fig. 4-56.
7. Fit the speedometer pinion and bush. 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 uni-directional clutch with drift 2835, Fig. 4-57.

ASSEMBLING CLUTCH UNIT

1. Press the ball bearing into the retainer and fit the circlip.



Fig. 4-55. Fitting the uni-directional clutch



Fig. 4-57. Installing planet gear

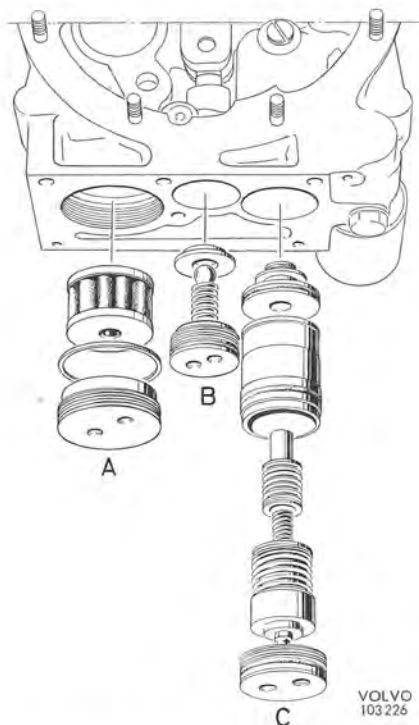


Fig. 4-58. Installing fine filter, oil pump check valve and relief valve

ASSEMBLING AND INSTALLING FRONT CASING

1. Fit the fine filter. Also fit the relief valve parts in the following order: End washer, cylinder, small piston, low-pressure spring, large piston and plug, see 4-58.
2. Place the connecting rod and pump plunger in position in the casing. Then push in the cylinder. After that fit 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 (16 lbft). Fit the pre-filter, magnet, gasket and base plate.

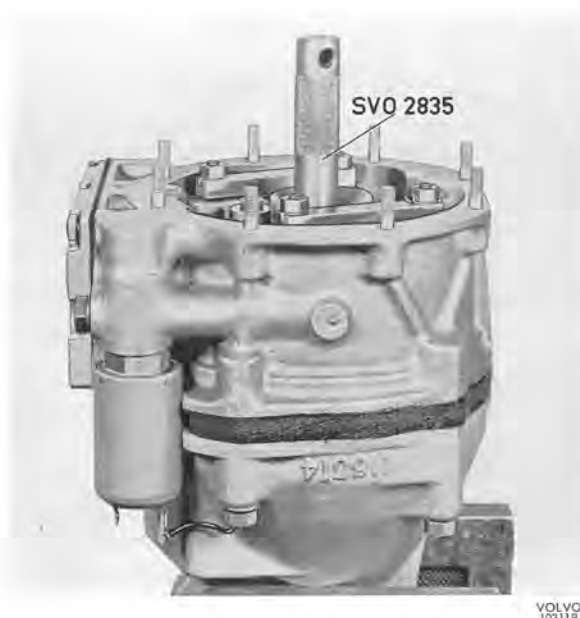


Fig. 4-59. Installing front casing

4. Fit 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. 4-59. 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. Fit 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 repairs on the automatic transmission.

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

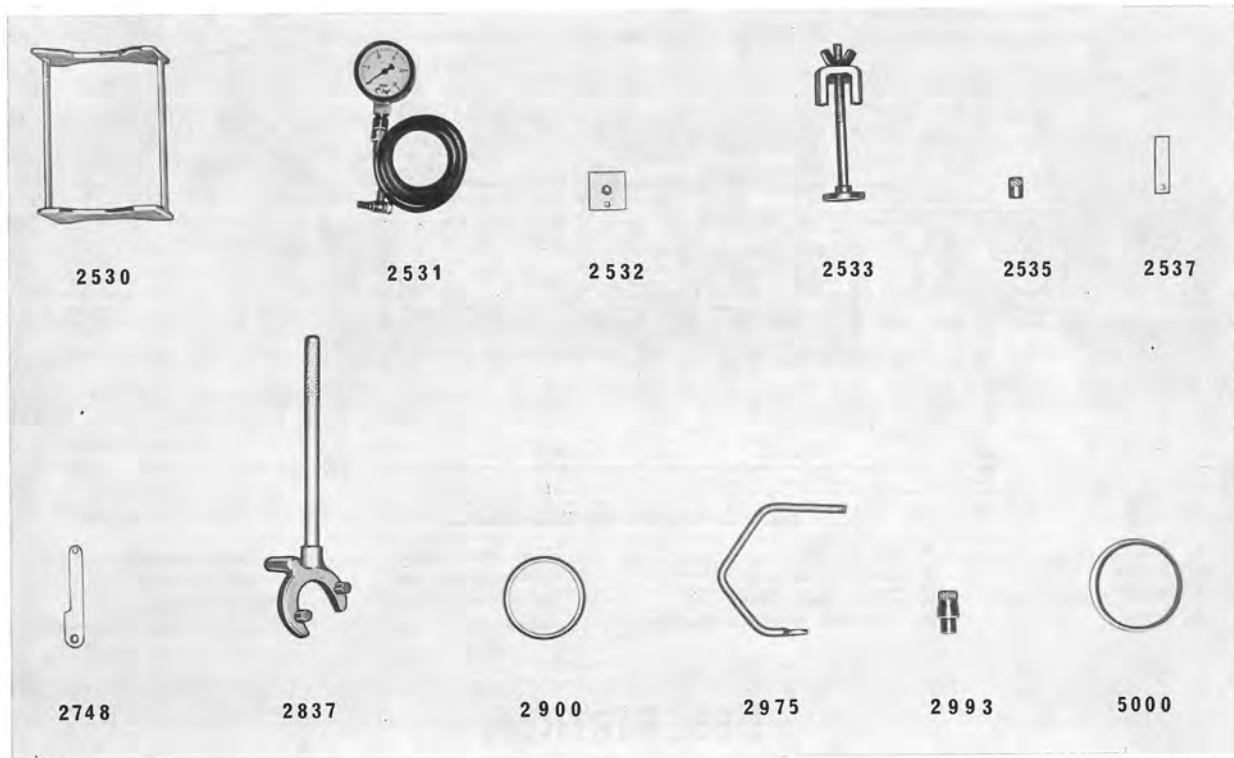


Fig. 4-60. Special tools

999 (SVO)

- 2530 Fixture for disassembling and assembling the transmission.
- 2531 Manometer 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.
- 2535 5/16" square socket for adjusting rear brake band.
- 2537 Spacer for adjusting front brake band.
- 2746 Transmission fixture when removing and fitting, see Fig. 4-78.

999 (SVO)

- 2748 Wrench for adjusting front brake band.
- 2837 Counterhold for flange.
- 2900 Ring for fitting piston in front clutch.
- 2975 Spanner for contact for starter inhibitor, etc.
- 2993 Guide for fitting piston in front clutch.
- 5000 Ring for fitting piston in rear clutch.

Instead of bench rack 2530, the following can be used for disassembling and assembling, see Fig. 4-79:

999 (SVO)

- 2520 Stand
- 2934 Fixture

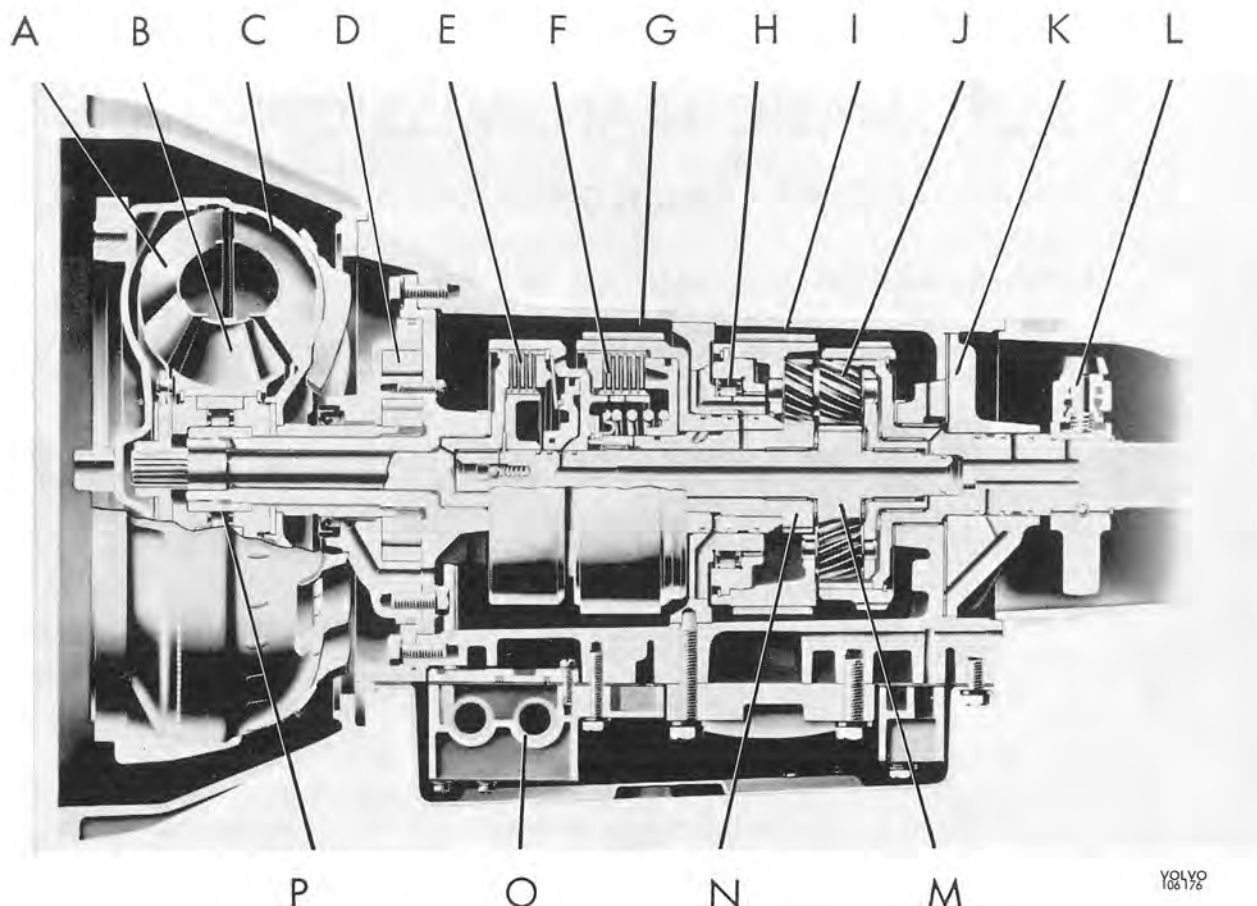


Fig. 4-61. Sectioned view of transmission

- | | | | |
|-----------------------|------------------------------|-------------------------|--------------------------------|
| A. Turbine | E. Front clutch | I. Rear brake band | M. Forward sun gear |
| B. Stator | F. Rear clutch | J. Planetary gear set | N. Reverse sun gear |
| C. Impeller and cover | G. Front brake band | K. Oil deflector flange | O. Control system |
| D. Pump | H. One-way clutch in gearbox | L. Governor | P. One-way clutch in converter |

DESCRIPTION

The Volvo automatic transmission for cars is of Borg-Warner manufacture, type 35. It 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. 4-63.

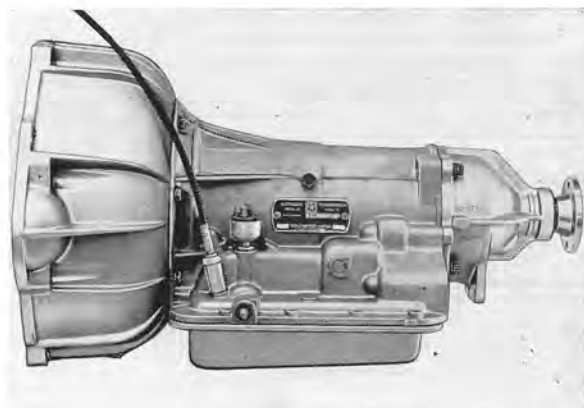


Fig. 4-62. The Borg-Warner Automatic Transmission type 35

THE 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 gear-

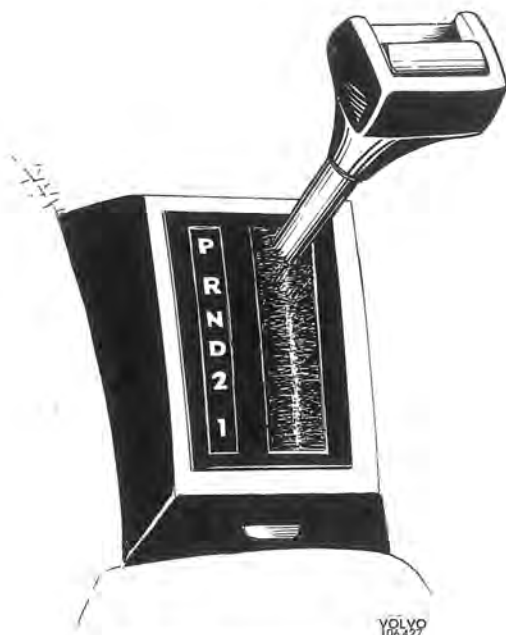


Fig. 4-63. Selector lever positions

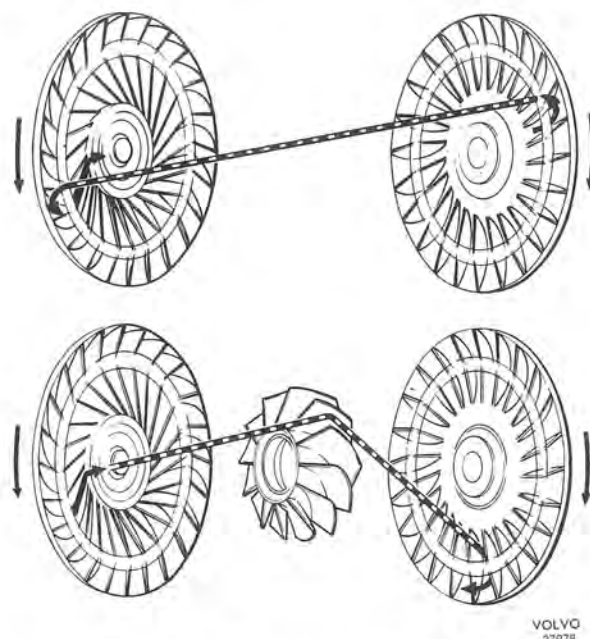


Fig. 4-65. Function of converter

box is in 3rd gear and, due to the ability of multiplying engine torque, it provides 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. 4-65. 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. 4-64. 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.

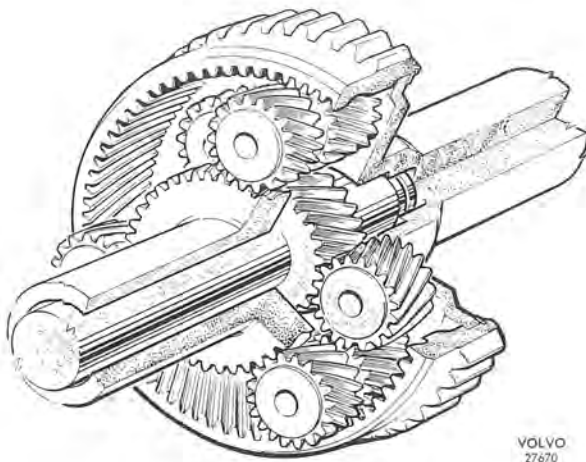


Fig. 4-66. Planetary gear

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. 4-66. 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 positions 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. 4-67, 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 "lock-up", the rear band holds the pinion carrier stationary

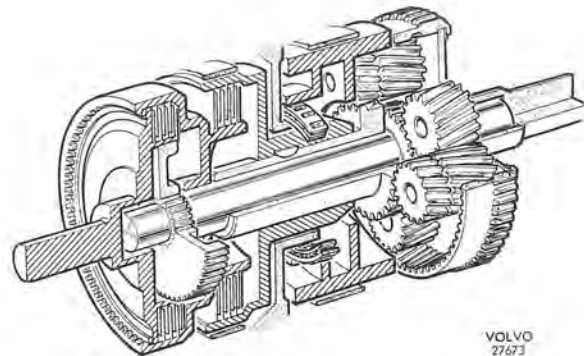


Fig. 4-67. Planetary gear, clutches and brake bands

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. 4-69. The oil cooler is connected to the nipples (Fig. 4-68) on the right-hand side of the transmission.



Fig. 4-68. Oil cooler connection

1 and 2 Connection nipples for oil cooler

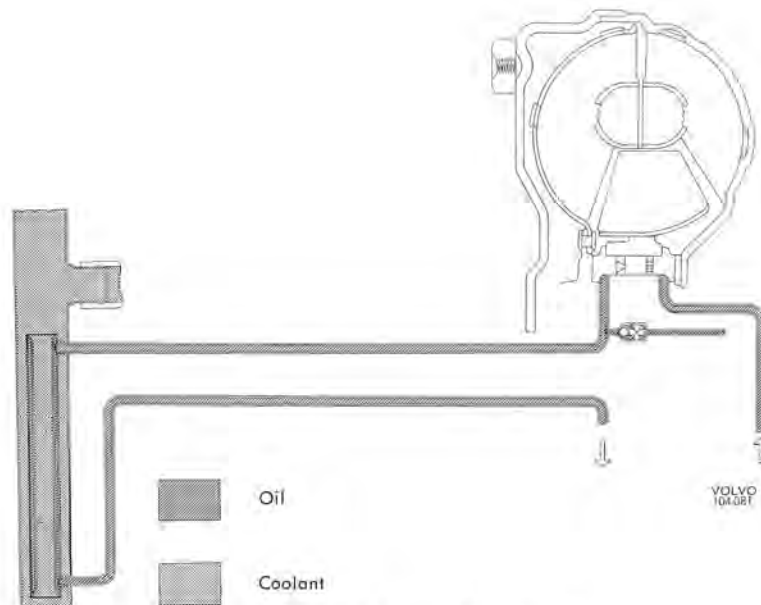


Fig. 4-69. Principle of operation for oil cooler

REPAIR INSTRUCTIONS

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.**

mission. 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. 4-70) 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 litre). 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.

WORK ON TRANSMISSION IN VEHICLE

CHECKING FLUID LEVEL

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. 4-70. **NOTE. There are different oil level marks for a warm or cold trans-**

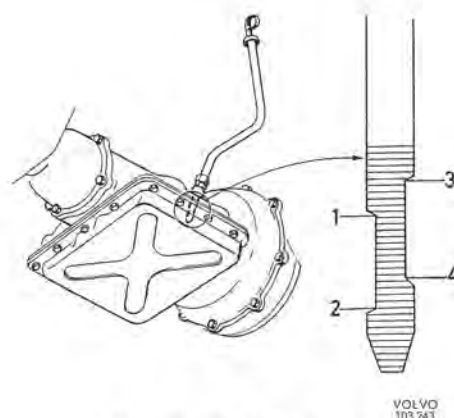


Fig. 4-70. Checking oil level

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

REMOVING AND INSTALLING CONTROL SYSTEM

1. Jack up and place props under the vehicle. Drain off the oil into a vessel which is absolutely clean. See Fig. 4-77.
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. 4-80).
3. Release the throttle cable from the cam. Remove the three bolts, see Fig. 4-81, which secure the control system to the transmission casing. Remove the control system 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 control system in position and secure it with the three bolts, see Fig. 4-81.
5. Fit the throttle cable to the cam. Mount the oil pipes as shown in Fig. 4-80. Check that the magnetic element lies in the oil sump and fit the sump. Use a new gasket. Coat the threads on the oil drain plug with sealing fluid 277961 and then fit the plug.
6. Lower the vehicle, fill with oil.

ADJUSTING SELECTOR CONTROLS

1. Disconnect the control rod from the transmission lever. 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. 4-71) between the selector lever inhibitor and selector gate when the rod is connected to the lever on the transmission.

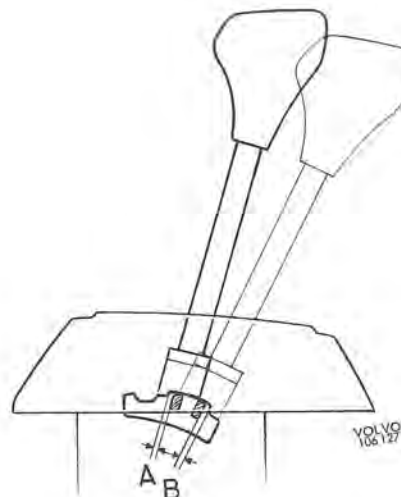


Fig. 4-71. Adjusting selector controls

A = B

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.
4. Lock the bolt with the safety bracket and tighten the locknut. Make sure that the shift rod's lug is parallel with the fork.
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".

ADJUSTING THROTTLE CABLE

Correct adjustment of this cable is most important for satisfactory operation of the transmission. There are three different methods. **Adjust first in accord-**

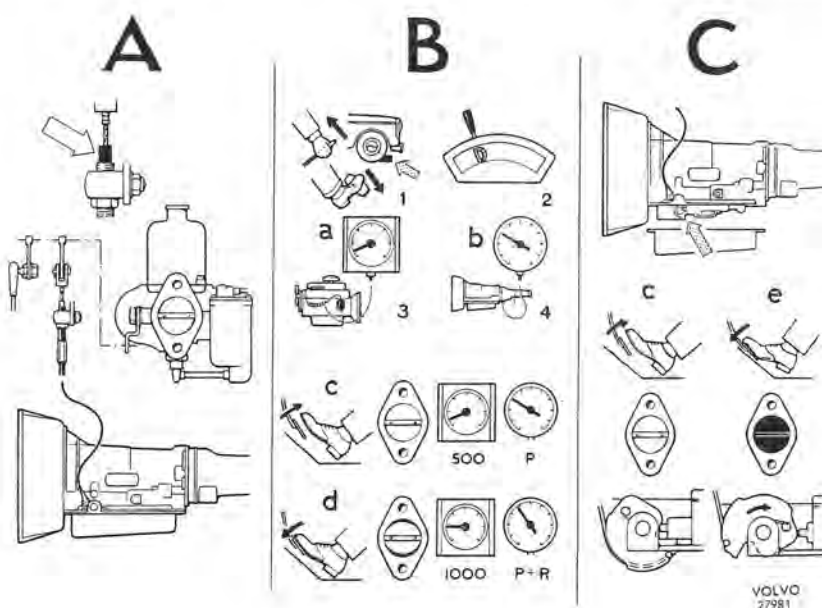


Fig. 4-72. Adjusting throttle cable

- A. Adjusting cable stop
- B. Adjusting with tachometer and manometer
 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 r/m)
 - d. Measure pressure (P+R) at 16.6 r/s (1000 r/m)
 - 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

ance with A, see Fig. 4-72. 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. 4-73.
 2. Chock 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 r/m). At 16.6 r/s (1000 r/m) the gauge to the transmission as shown in Fig. 4-73, pressure should be 1.8–2.1 kp/cm² (25–30 psi) higher than at 8.3 r/s (500 r/m). 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 r/m). The pressure increase also in this case should be 1.8–2.1 kp/cm² (25–30 psi).

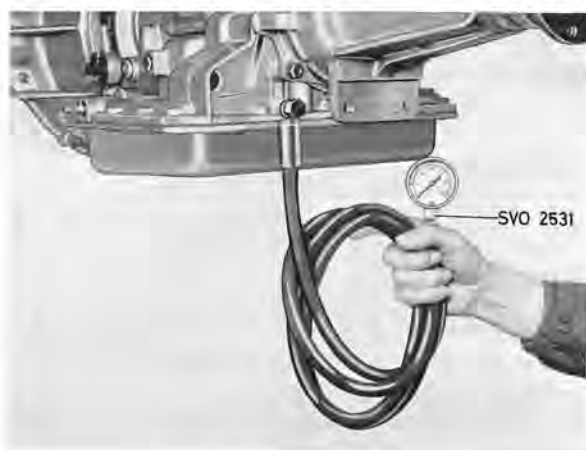


Fig. 4-73. Connecting pressure gauge

VOLVO
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- 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.

REPLACING STARTER INHIBITOR SWITCH

1. Disconnect the electric cables from the contact. Release the contact with spanner 2975 and unscrew it.
2. Fit a new packing (A, Fig. 4-74) onto the contact. Screw in the contact and tighten it to a torque of 8–11 Nm (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.

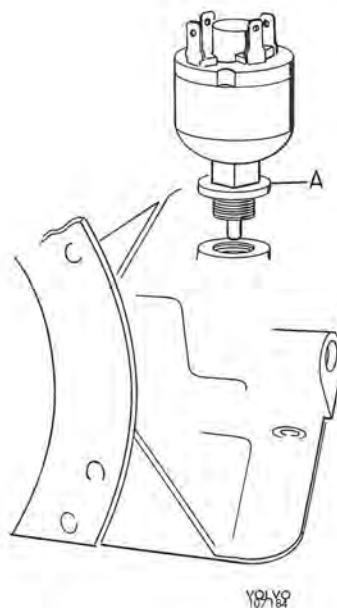


Fig. 4-74. Fitting starter inhibitor switch
A. Packing

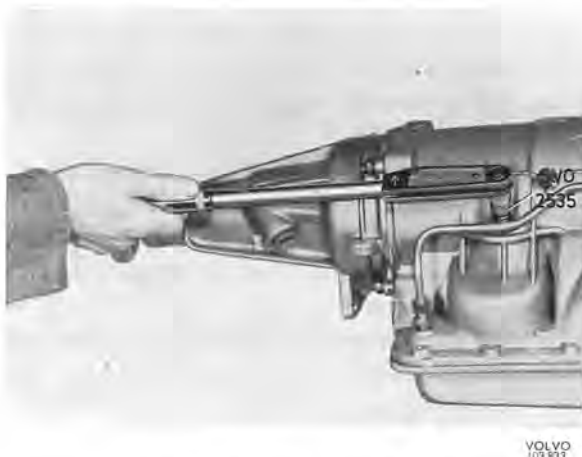


Fig. 4-75. Adjusting rear brake band

ADJUSTING REAR BRAKE BAND

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. Slacken the locknut for the adjusting screw.
2. Use the special socket 2535 and connect the torque wrench to the adjusting screw, see Fig. 4-75. Tighten the screw to 14 Nm (10 lbft). Back off the adjusting screw one turn.
3. Tighten the locknut and fit any parts which have been removed.

AIR PRESSURE CHECKS

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

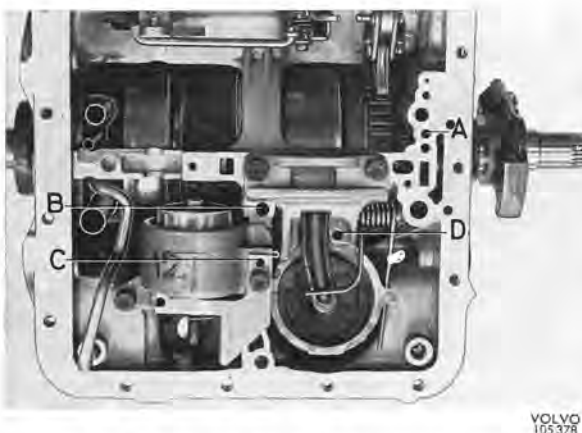


Fig. 4-76. Functioning test with compressed air

- A. Front clutch (5)
- B. Rear clutch (15)
- C. Front servo application
- D. Rear servo

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.

FRONT CLUTCH AND GOVERNOR FEED "A"

Apply air pressure to the passage (5) of the transmission case rear wall, see Fig. 4-76. 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.

REMOVING

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.

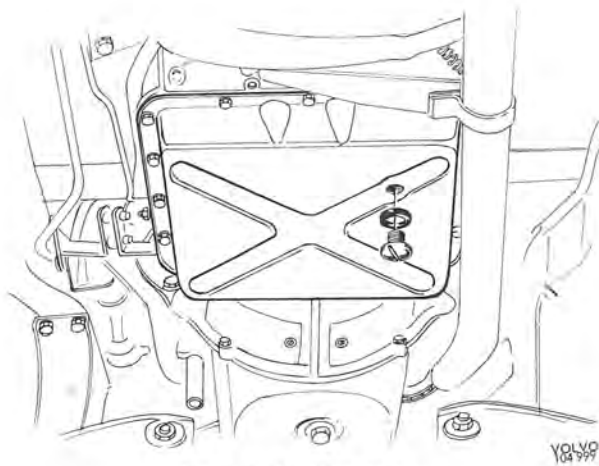


Fig. 4-77. Oil drain plug

2. Drain the oil into a clean container, see Fig. 4-77.

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. 4-78.
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.

DISASSEMBLING

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. 4-79, 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 disassembled, 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 $\frac{3}{8}$ " 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. 4-80.

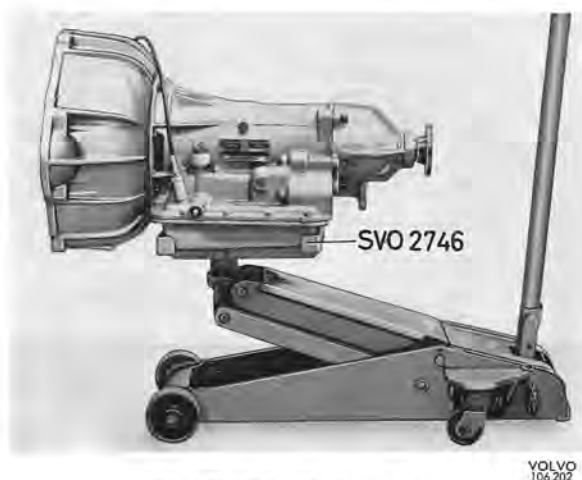


Fig. 4-78. Fixture for transmission

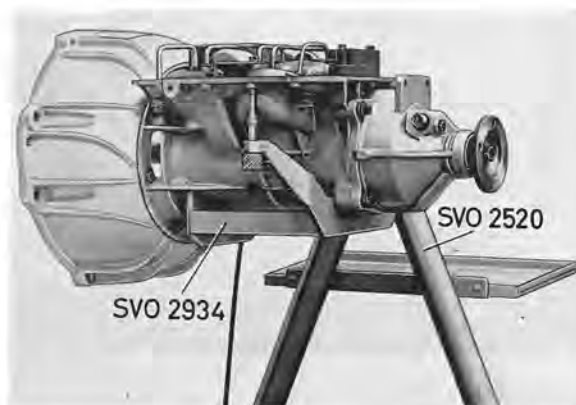


Fig. 4-79. Transmission in fixture

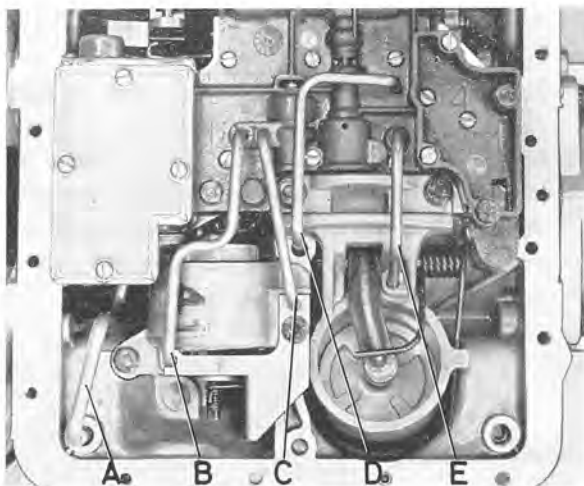


Fig. 4-80. Oil tubes

- A. Converter outlet
- B. Front servo release
- C. Front servo apply
- D. Rear clutch
- E. Rear servo

THE 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. 4-81. 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

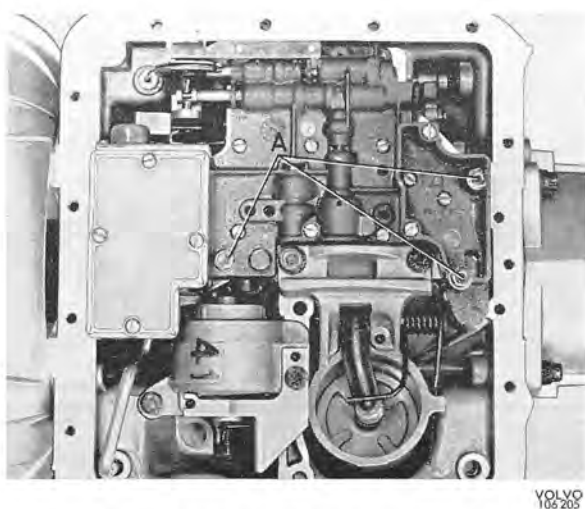


Fig. 4-81. Valve bodies assembly

- A. Attaching screws

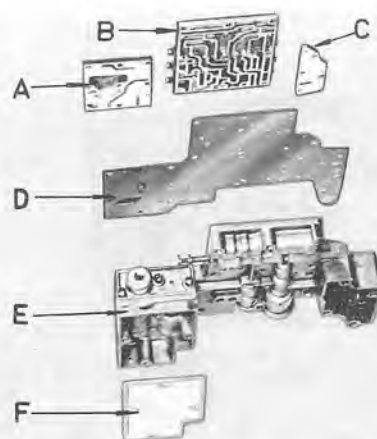


Fig. 4-82. Main components of valve bodies assembly

- A. Oil tube collector
- B. Upper valve body
- C. Governor line plate
- D. Separating plate
- E. Lower valve body
- F. Pump strainer

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. 4-83. Withdraw the manual control valve, see "A", Fig. 4-84.
11. Remove the stops for the throttle valve and the return spring. Then withdraw the downshift valve, spring and throttle valve, see "B", Fig. 4-84.
12. Remove the dowel pin which retains the plug for the modulator valve. Then remove the plug, valve, plunger and spring.

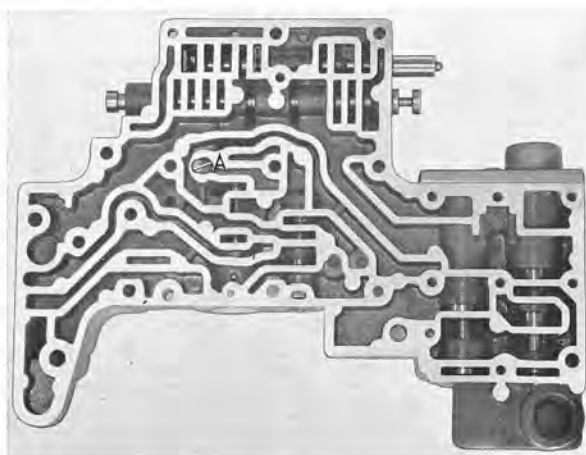
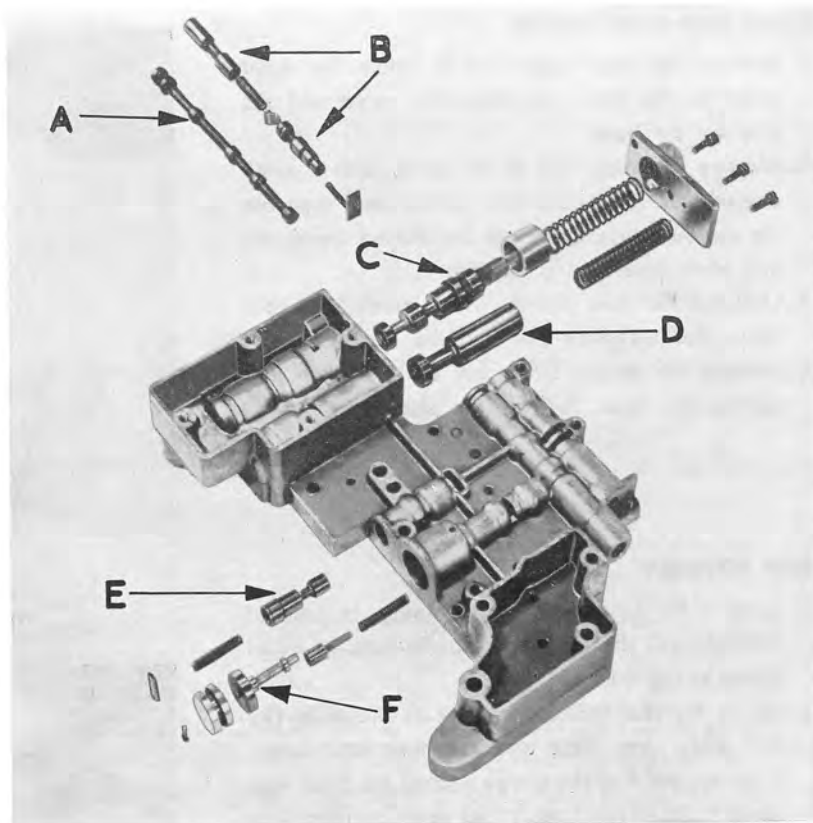


Fig. 4-83. Check valves in lower valve body

- A. Check valve for fast 3-2

Fig. 4-84. 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



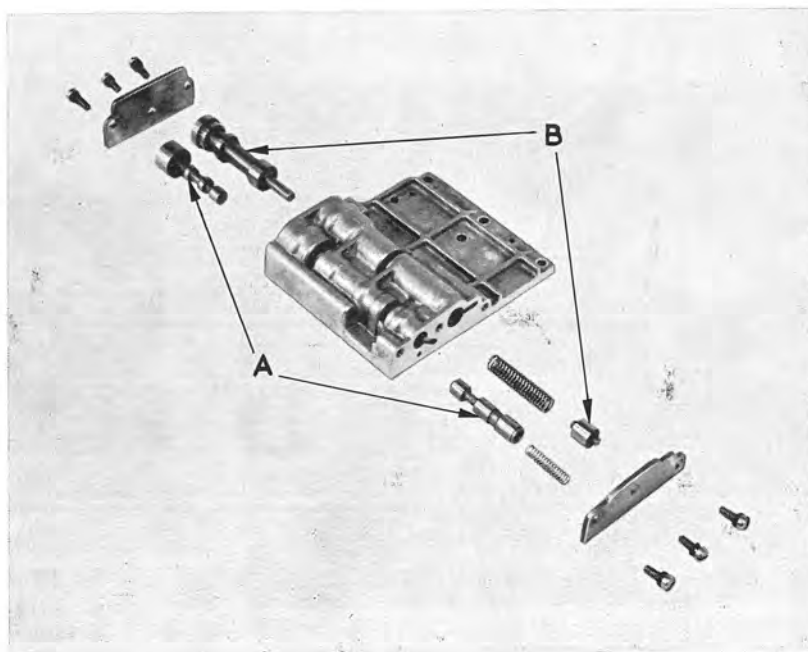
VOLVO
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13. Remove the stop for the servo orifice control valve and then the spring and valve.
14. From the manual valve side of the lower valve body, remove the following components: three screws, lower body end plate, primary regulator spring, primary 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. 4-85. 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. 4-85. Upper valve body

- A. 1—2 shift valve and plunger
- B. 2—3 shift valve and plunger



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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.

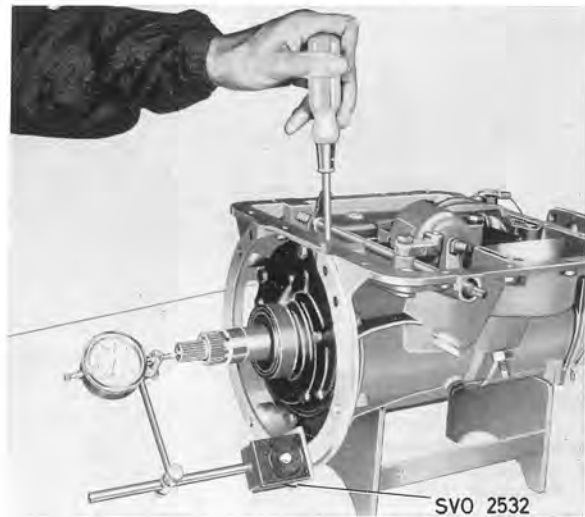
PUMP ASSEMBLY

20. Remove the oil tubes in the housing. In case of difficulty pull them out with needle-nose pliers as shown in Fig. 4-86.
21. Set up the dial indicator gauge as shown in Fig. 4-87 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. 4-88.
23. Unscrew the five hexagon bolts and the slotted screw. Separate the pump body, gears and other parts, see Fig. 4-89.



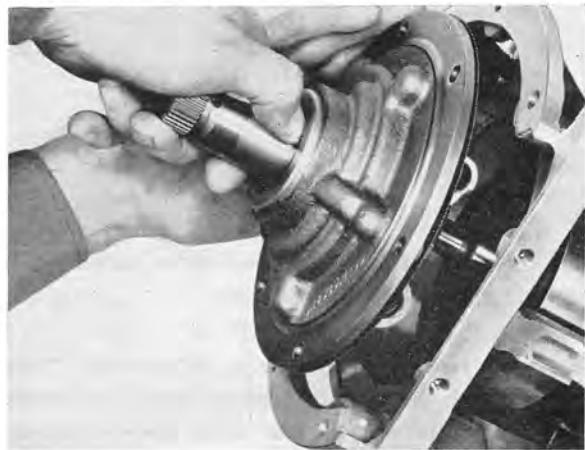
Fig. 4-86. Removing converter inlet and outlet tubes using needle-nose pliers

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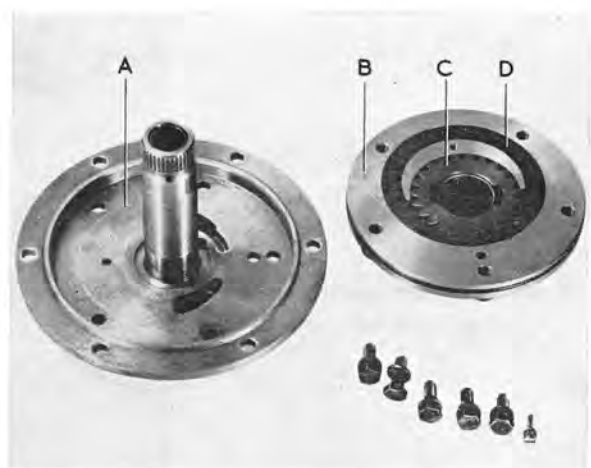
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Fig. 4-87. Checking end float



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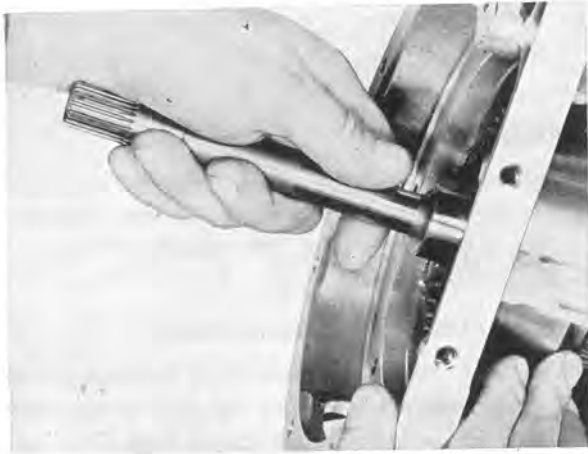
Fig. 4-88. Removing pump



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Fig. 4-89. Converter support separated from pump

- A. Pump adapter and converter support assembly
- B. Body and bush assembly
- C. Driving gear
- D. Driven gear



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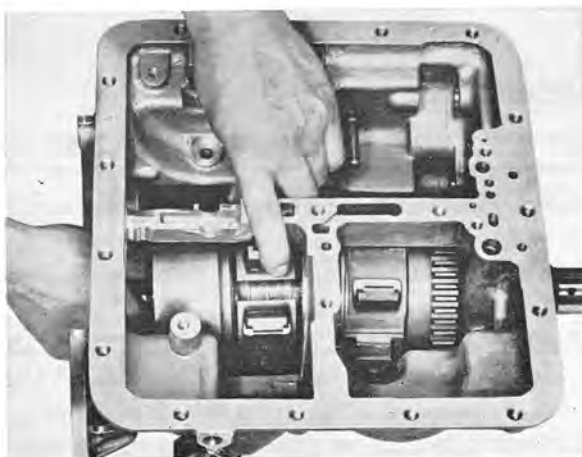
Fig. 4-90. Withdrawing front clutch assembly

FRONT CLUTCH ASSEMBLY

24. Withdraw the front clutch assembly and input shaft complete, see Fig. 4-90. 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.

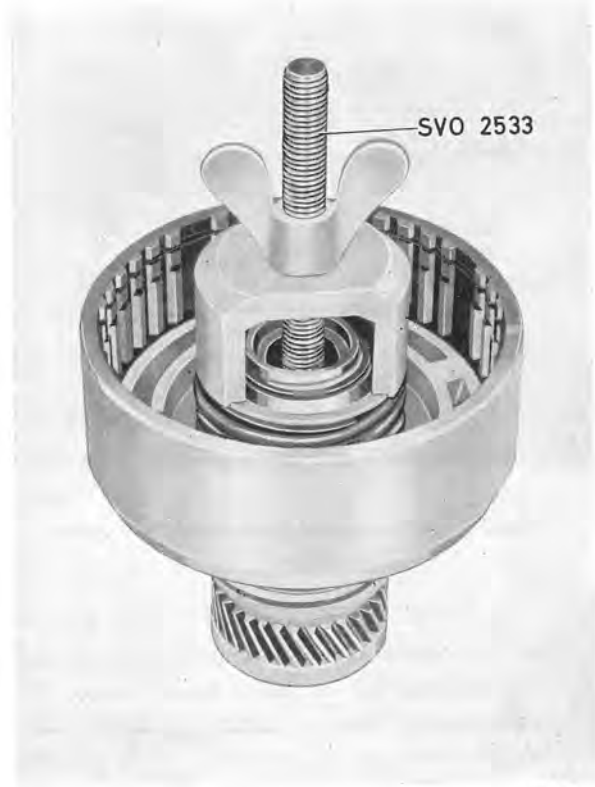
REAR CLUTCH ASSEMBLY

27. Withdraw the rear clutch assembly together with the forward sun gear shaft, see Fig. 4-91.
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. 4-91. Withdrawing rear clutch and forward sun gear group



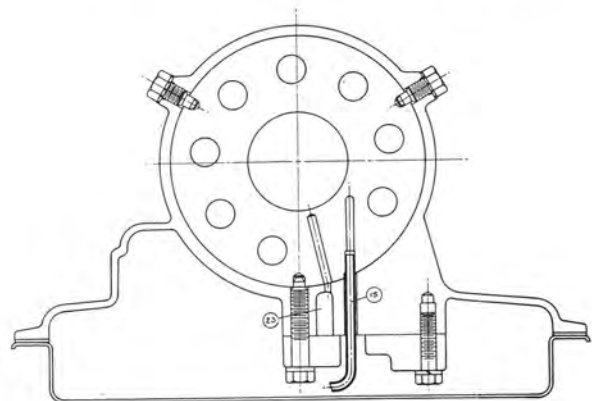
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Fig. 4-92. Disassembling rear clutch

30. Remove the snap ring and take out the pressure plate, inner and outer plates.
31. Place special tool 2533 on the clutch as shown in Fig. 4-92. 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. 4-93. With-



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Fig. 4-93. Center support, retention and passages

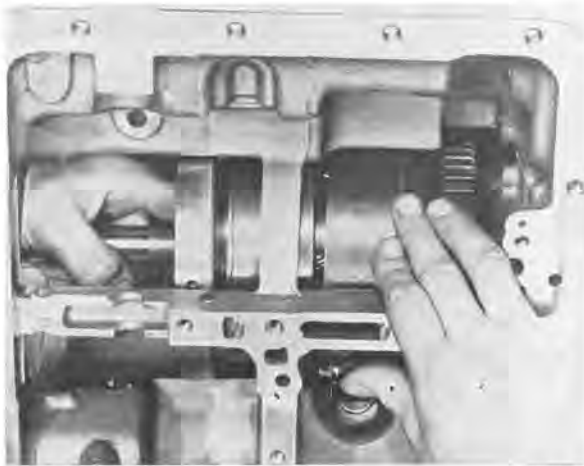


Fig. 4-94. Withdrawing center support and planet gears

draw the center support and planet gears, see Fig. 4-94. 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. 4-95.
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.

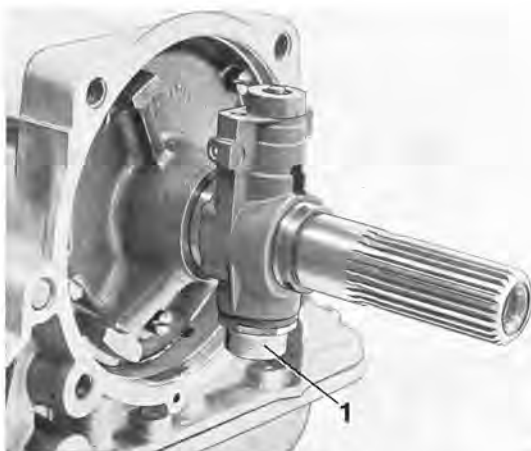


Fig. 4-95. Removing governor
1. Bolt

36. Remove the three oil sealing rings from the driven shaft.

DRIVEN SHAFT

37. Withdraw the driven shaft. Remove the thrust washer. 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 on the shaft and remove the lock pin. Separate the various 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.

INSPECTING

After cleaning, all parts should be thoroughly checked for wear or other damage.

Check that the white metal bush 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 bands and discs for wear, overheating or other damage.

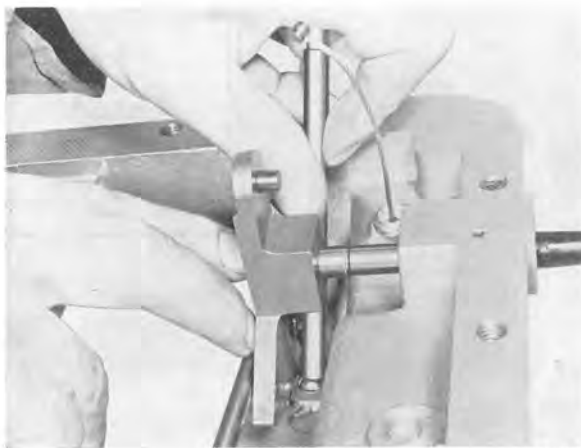
ASSEMBLING

The utmost cleanliness must be observed when assembling the transmission.

Before assembling, all parts must be carefully washed in white spirit.

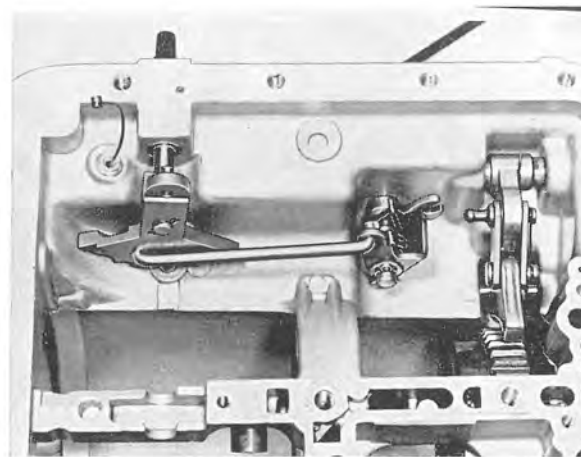
Use new gaskets when assembling. Lubricate the parts with "Automatic Transmission Fluid Type F".

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



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Fig. 4-96. Locating manual valve lever on detent ball spring



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Fig. 4-97. Parking pawl and linkage installed

oil cooler connections. Note: Items not described in this section are assembled in the reverse order to disassembling.

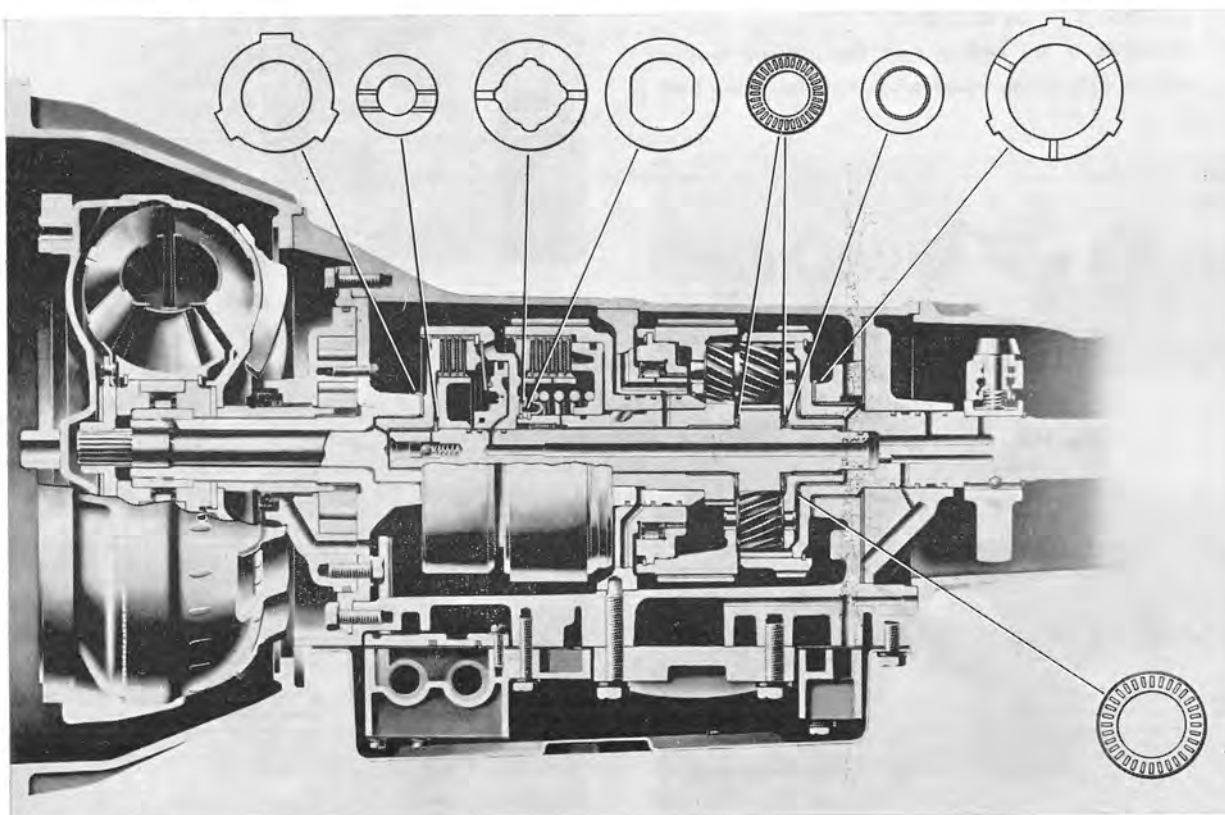
springs for the levers are correctly fitted, see Fig. 4-97. Fitting the detent ball is facilitated by pressing down the ball using a short length of tubing as shown in Fig. 4-96.

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

DRIVEN SHAFT

3. The thrust washer for driven shaft, see Fig. 4-98, is stuck onto the transmission case with vaseline. The driven shaft complete with ring gear is then installed into the transmission case.



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Fig. 4-98. Location of thrust washers

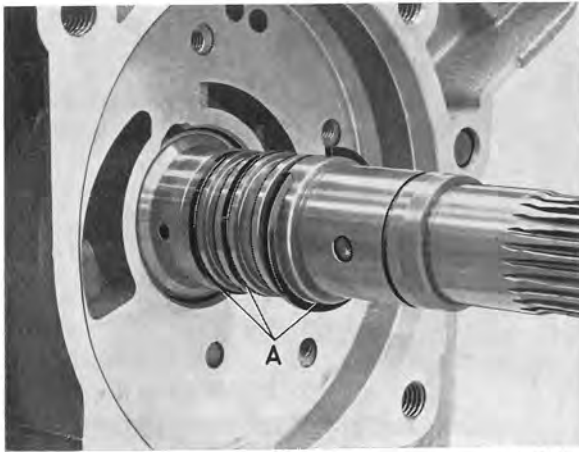


Fig. 4-99. Installing driven shaft oil rings
A. Oil rings

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OIL DEFLECTOR FLANGE

4. Install the three oil sealing rings on the shaft, see Fig. 4-99. 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. 4-102. Make sure that the pin on the bolt enters the recess on the shaft. Tighten the bolt to a torque of 20—25 Nm (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. 4-100. Gear train components

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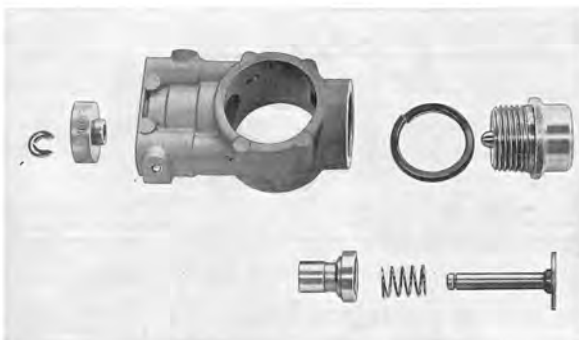


Fig. 4-101. Governor assembly disassembled

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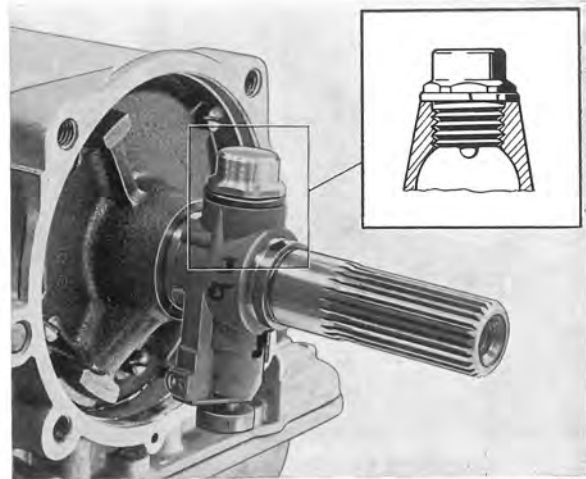


Fig. 4-102. Governor and driven shaft

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REAR BRAKE BAND AND SERVO

6. Place the rear brake band in position in the case, see Fig. 4-103. Then fit the rear servo assembly. Tighten only the rear (short) servo screw since the long one also locates the center support.

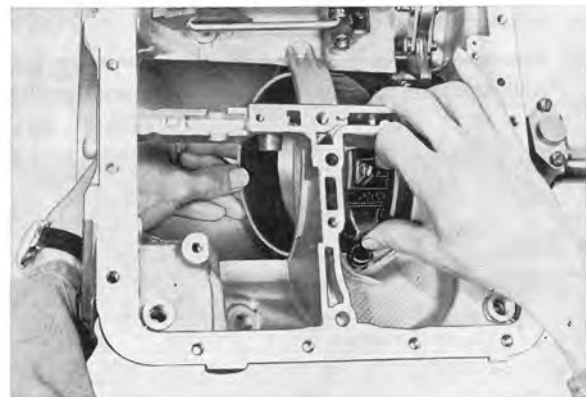


Fig. 4-103. Installing rear brake band

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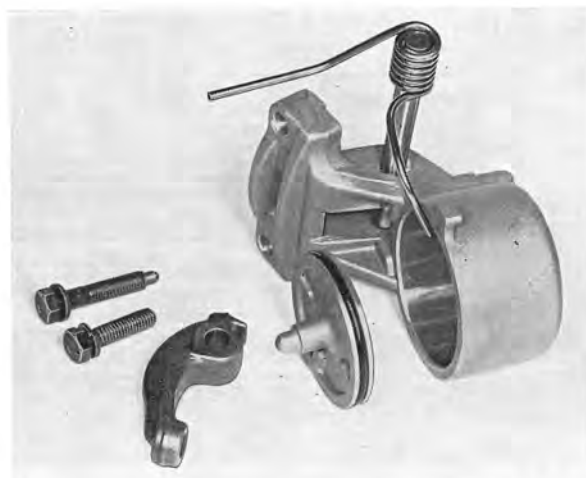


Fig. 4-104. Rear servo assembly disassembled

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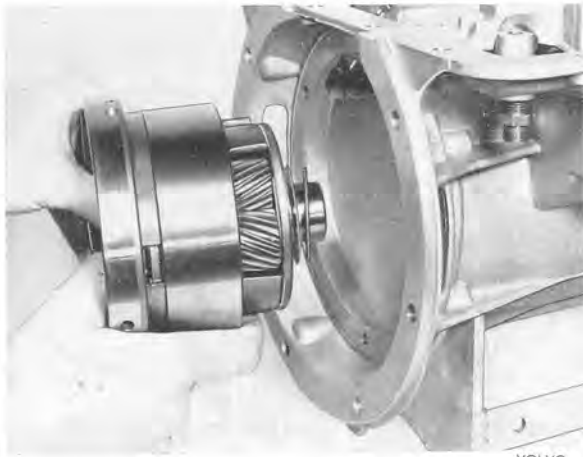


Fig. 4-105. Installing center support and planet gears with needle thrust bearing and plate washer.

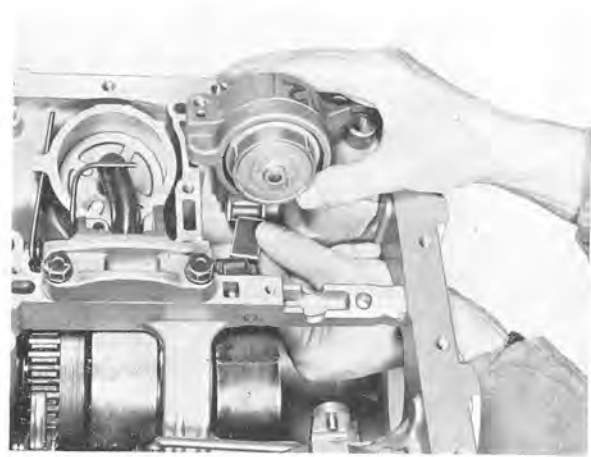


Fig. 4-106. Installing front servo and strut

PLANET GEAR AND CENTER SUPPORT

7. Assemble the planet gear, one-way clutch and center support, see Fig. 4-105. 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. 4-93.)
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. 4-106. 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-adjustment 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. 4-109.
12. Fit the spring, spring seat and snap ring using special tool 2533, which is used when disassembling, see Fig. 4-92.
13. Install the clutch plates. Note that the outer plates are coned and that all the plates should be fitted

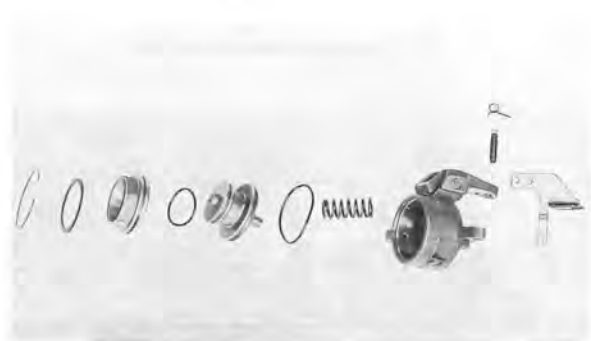


Fig. 4-107. Front servo assembly disassembled

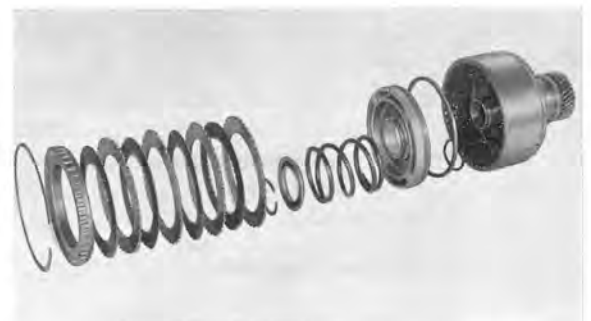


Fig. 4-108. Rear clutch disassembled

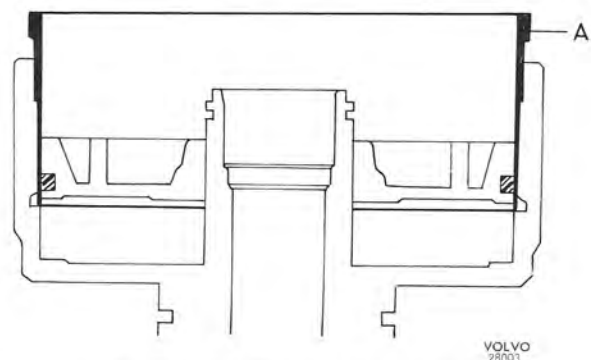
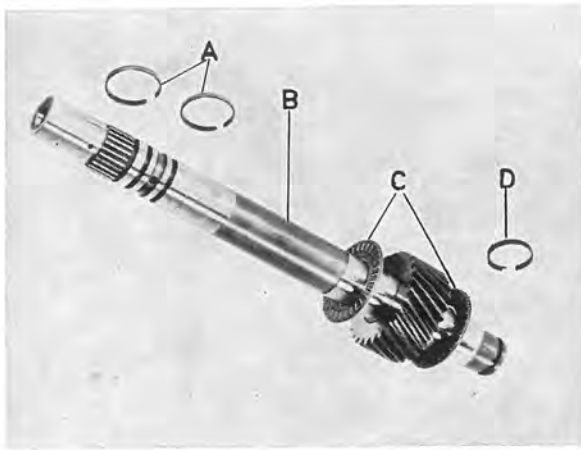


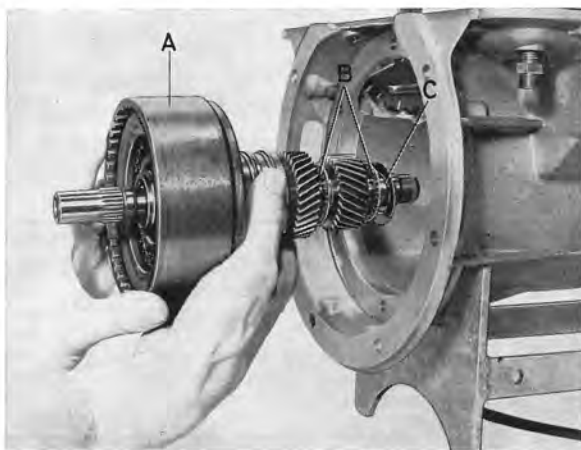
Fig. 4-109. Installing piston for rear clutch
A. Fitting ring 5000



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Fig. 4-110. Forward sun gear components

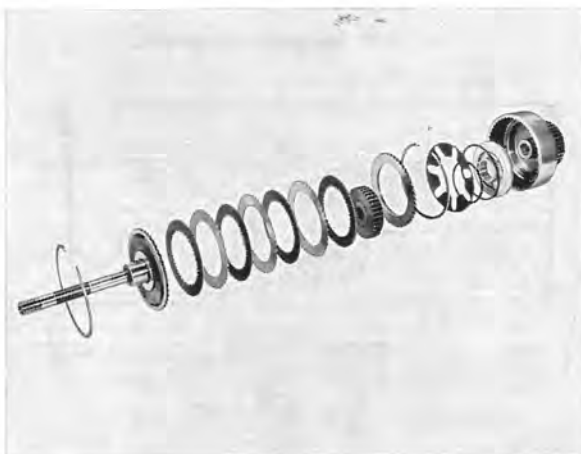
- A. Oil sealing rings, front clutch
- B. Forward sun gear assembly
- C. Needle thrust washers
- D. Oil sealing ring, governor feed



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Fig. 4-111. Installing rear clutch and forward sun gear group

- A. Rear clutch
- B. Needle thrust bearings
- C. Thrust washer plate



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Fig. 4-112. Front clutch disassembled

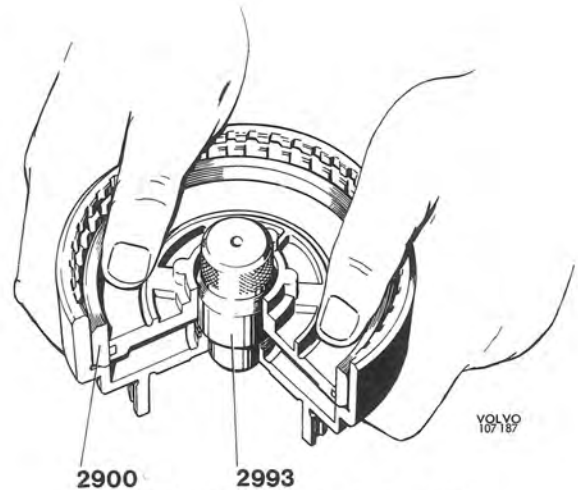


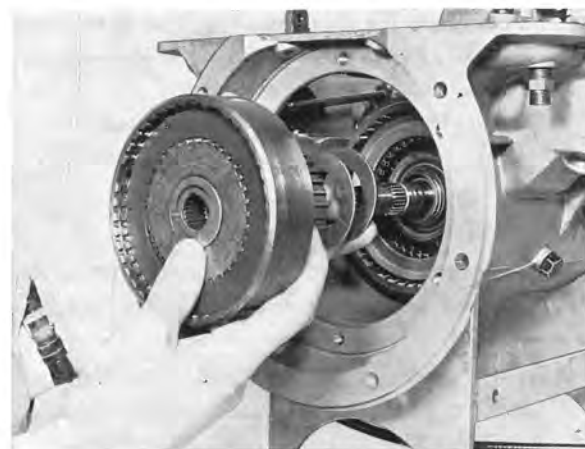
Fig. 4-113. Installing piston for front clutch

with the 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 bearing on the rear sun gear shaft. Fit the shaft in the rear clutch assembly. Install the oil sealing rings, see Fig. 4-110.
15. Install the rear needle thrust bearing and fit the clutch in the gearbox as shown in Fig. 4-111.

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. 4-113. Take hold of the housing with the hands and press down the piston



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Fig. 4-114. Installing sequence, front clutch cylinder thrust and backing washers

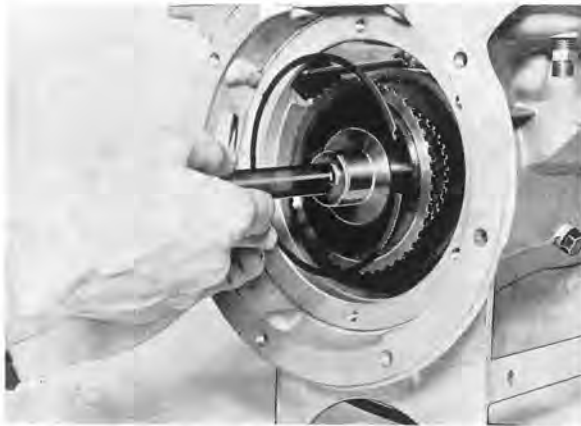


Fig. 4-115. Installation sequence, front clutch snap ring, input shaft and thrust washer

with the thumbs. Remove the tools. Fit the spring with the dished side facing rear. Put on the snap ring.

17. Install the clutch assembly with its two different thrust washers in the gearbox, see Fig. 4-114. Be careful not to damage the oil sealing rings. For identifying the thrust washers, see Fig. 4-98.
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. 4-115. 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.

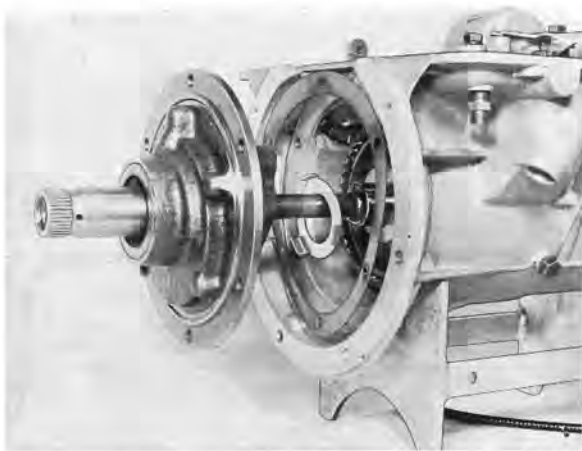


Fig. 4-116. Installation sequence, front pump assembly thrust washer and gasket

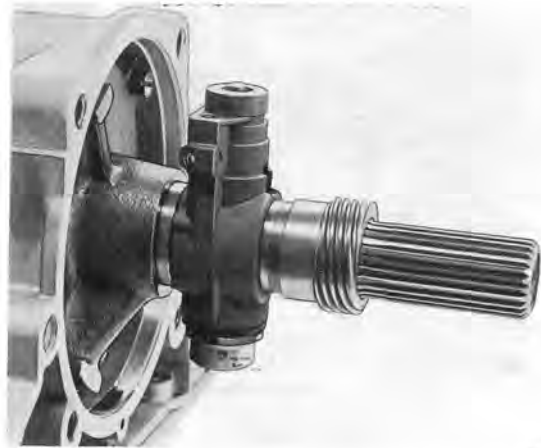


Fig. 4-117. Installing speedometer gear

PUMP

19. Fit the O-ring on the pump body, then assemble the pump in the reverse order to dismantling.
20. Stick on the thrust washer with vaseline and then fit the pump with a new gasket on the transmission case, see Fig. 4-116. Re-check the end float in accordance with point 21, page 34.

EXTENSION HOUSING

21. Place the speedometer gear correctly on the driven shaft as shown in Fig. 4-117. Fit the extension housing with a new gasket and fit the drive flange with washer and nut.

VALVE BODIES ASSEMBLY

22. 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.
23. Fit the oil tubes for the pump and converter on the pump body, see Fig. 4-118. Do not forget the O-ring for the pump inlet tube.
24. Fit the valve bodies assembly onto the gearbox. Connect the throttle cable.

MISCELLANEOUS

25. Place the spacer bar 2537 between the bolt and cylinder, see Fig. 4-119. Tighten the bolt with torque wrench 2748 until the ratchet handle

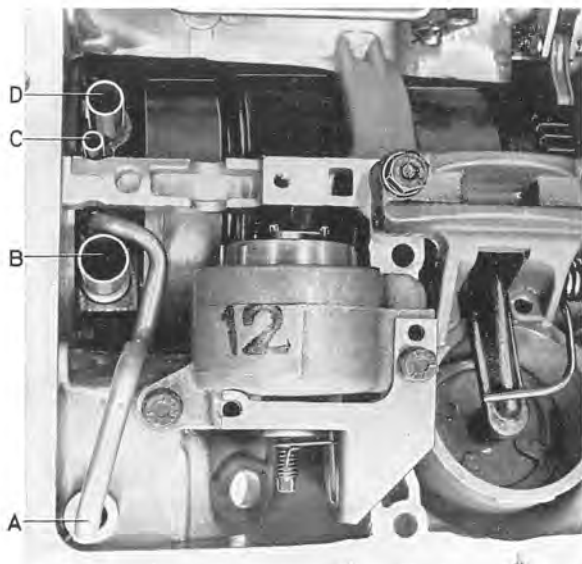


Fig. 118. Location of oil tubes, front of gearbox

- | | |
|---------------------|--------------------|
| A. Converter outlet | C. Converter inlet |
| B. Pump inlet | D. Pump outlet |

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Fig. 4-119. Adjusting front brake band

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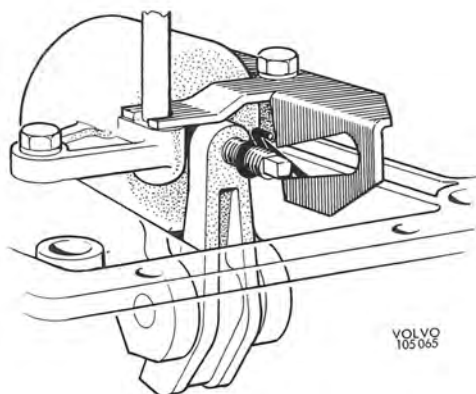


Fig. 4-120. Self-adjusting spring bolt cam

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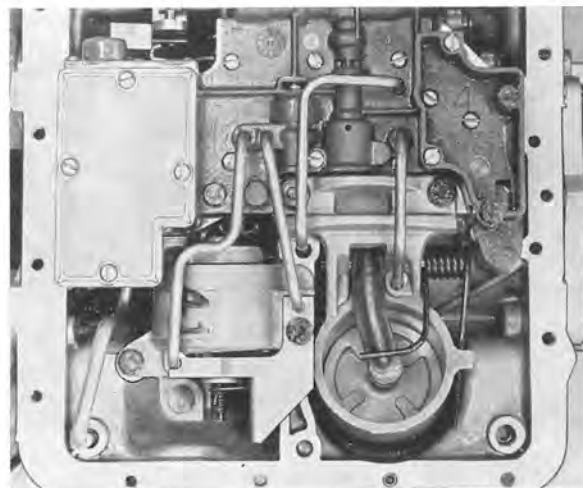


Fig. 121. Retention of front and rear pump strainers

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clicks out. This should be at a torque of 115 Ncm (10 lbin).

26. 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. 4-120.
27. Fit the four oil tubes according to Fig. 4-121. Note that the oil tube for releasing the front control cylinder has a construction (A, Fig. 4-122) on vehicles with B 30 E and B 30 F engine. This end is fitted in the valve bodies system.
28. Adjust the brake bands, see "Adjusting rear brake band" on page 30. Fit the starter inhibitor switch, see "Replacing starter inhibitor switch" on page 29.
29. Place the magnetic piece in the oil pan. Fit the oil pan with a new gasket.

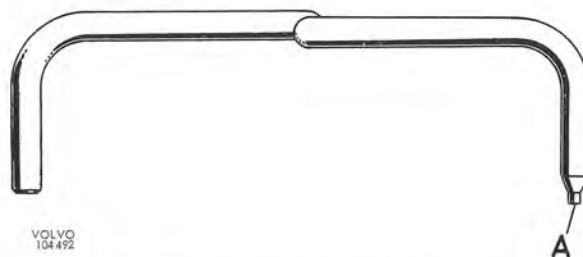


Fig. 4-122. Oil tube for valve bodies system, vehicle with B 30 E and F engines

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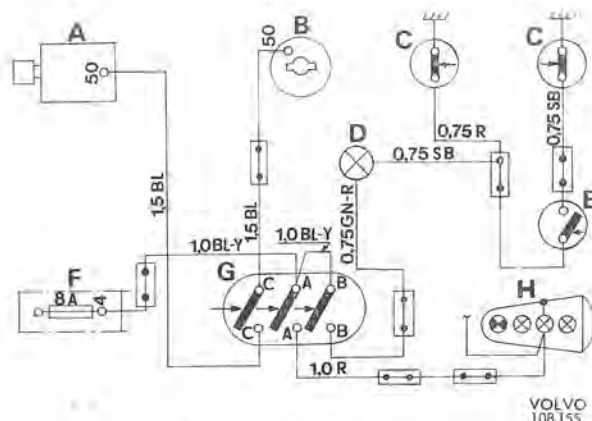


Fig. 4-123. Wiring diagram

Not USA. For USA, see wiring diagram in Part 3 of this manual.

- | | |
|-------------------------------|-----------------------------|
| A Starter motor | E Contact in passenger seat |
| B Ignition | F Fusebox |
| C Contact for seat belt | G Contact on gearbox |
| D Reminder lamp for seat belt | H Reversing lights |

Colour code:

- | | |
|------|---------------|
| BL | = blue |
| BL-Y | = blue-yellow |
| GN-R | = green-red |
| R | = red |
| SB | = black |

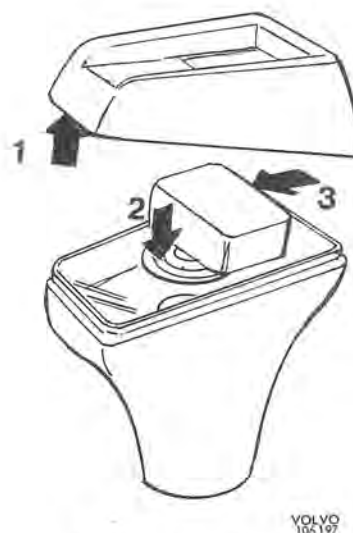


Fig. 4-125. Disassembling knob

INSTALLING

The converter, converter housing and gearbox are fitted in the reverse order to removing. Connect the leads for the starter inhibitor switch, reversing light, and belt reminder correctly, see Fig. 4-123 and 4-124.

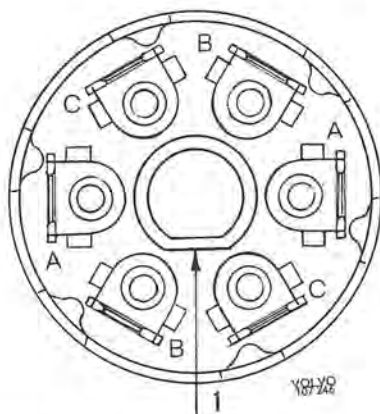


Fig. 4-124. Contact on autom. trans.

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

SELECTOR CONTROLS

DISASSEMBLING AND ASSEMBLING

1. Move selector lever to "P" position. Prop up under the vehicle. Remove the shift rod (13) from the selector lever (12) on the selector lever housing (10, Fig. 4-126).
2. With the help of a knife lever up at the front edge the cap (1) on the selector lever knob (see Fig. 4-125). Press down the spring washer (3) and push the button (18) 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 (15) off the selector lever housing (10).
5. Knock up the tubular studs. Remove the push rod (5) and inhibitor (17). Drive out the shaft (11). Release the screws from the gate (9). Drive out the bushes from the bracket (15).

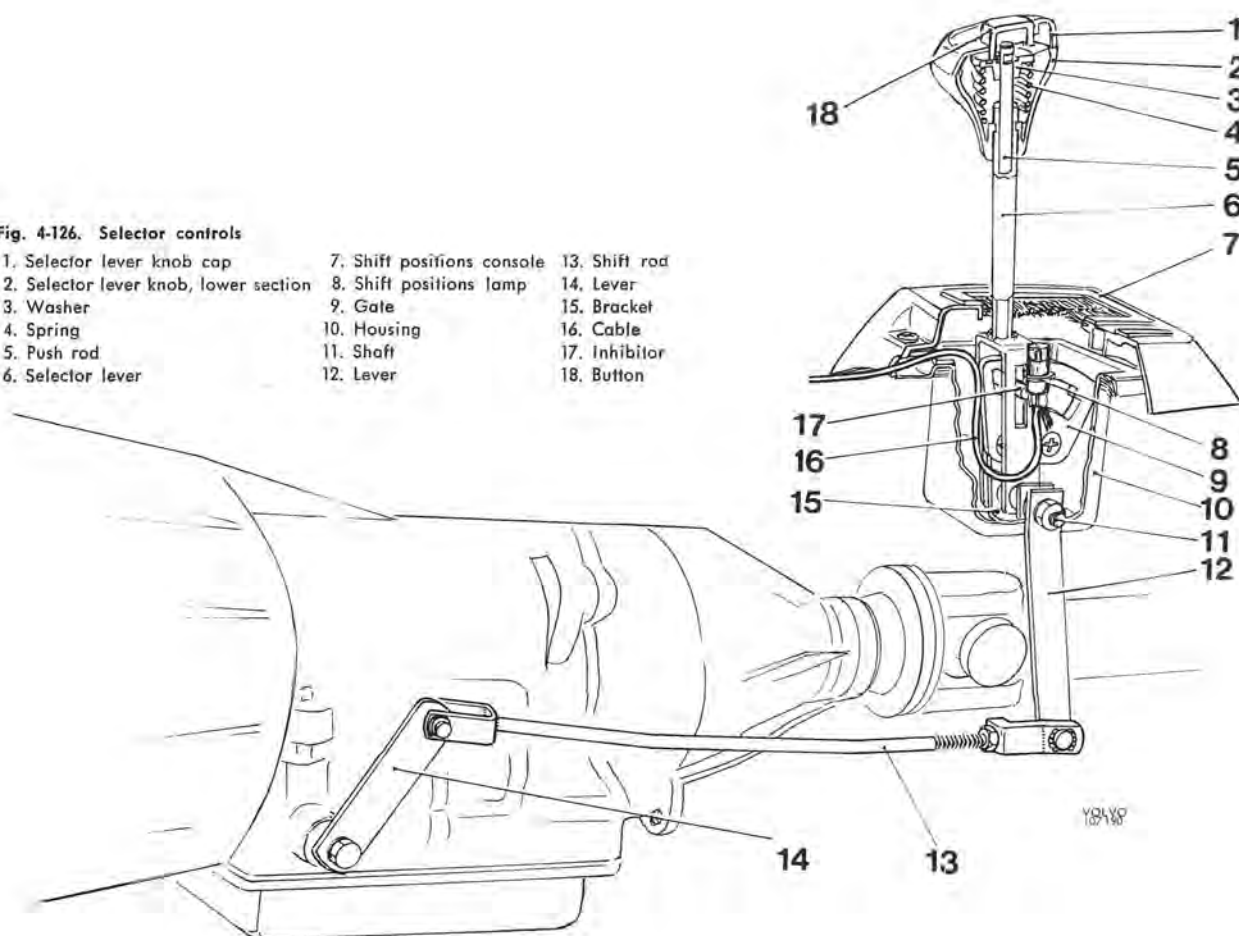
ASSEMBLING AND INSTALLING

1. Press the bushes into the bracket and screw tight the gate.
Grease the slide surfaces on the bushes, 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 $\frac{3}{8}$ ") from the center to the center for the bolts. Grease the bushes 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. 4-71) 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. 4-126. Selector controls

- | | | |
|---------------------------------------|----------------------------|---------------|
| 1. Selector lever knob cap | 7. Shift positions console | 13. Shift rod |
| 2. Selector lever knob, lower section | 8. Shift positions lamp | 14. Lever |
| 3. Washer | 9. Gate | 15. Bracket |
| 4. Spring | 10. Housing | 16. Cable |
| 5. Push rod | 11. Shaft | 17. Inhibitor |
| 6. Selector lever | 12. Lever | 18. Button |



FAULT TRACING

ROAD-TESTING

(Used together with the fault-tracing scheme).

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.
- 5a. 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.
- 6a. 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".

FAULT-TRACING SCHEME

(To be used in conjunction with the road-test procedure.)

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 full 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.

FAULT-TRACING ON CONVERTER

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 an 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 r/m) 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 r/m) 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.

GROUP 45

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

DESCRIPTION

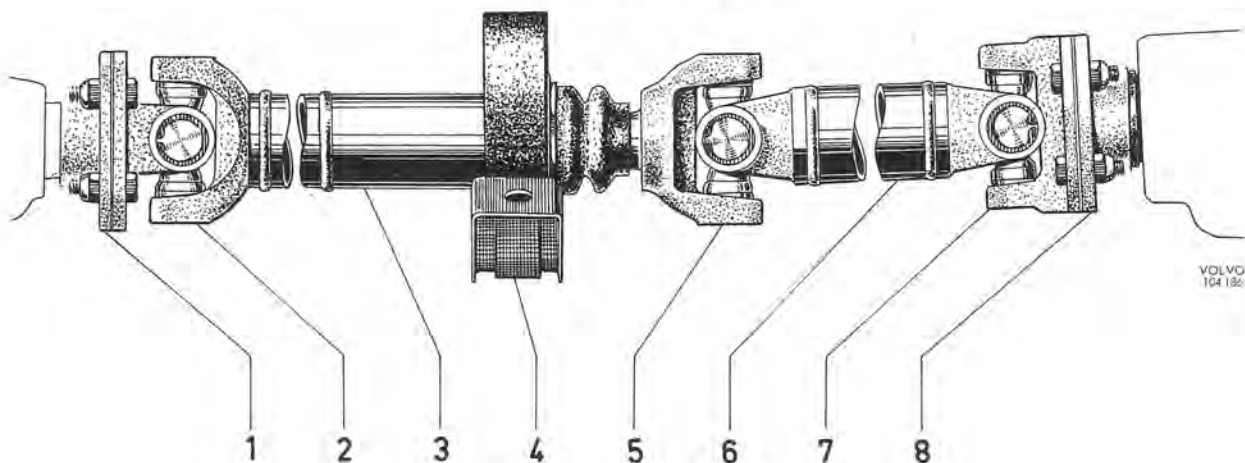


Fig. 4-127. Propeller shaft with support bearing

- | | |
|-------------------------------------|---------------------------------|
| 1. Flange on gearbox | 5. Intermediate universal joint |
| 2. Front universal joint | 6. Rear propeller shaft |
| 3. Front section of propeller shaft | 7. Rear universal joint |
| 4. Support bearing | 8. Flange on rear axle |

The propeller shaft is of the divided, tubular type, see Fig. 4-127. 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. 4-128. 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.

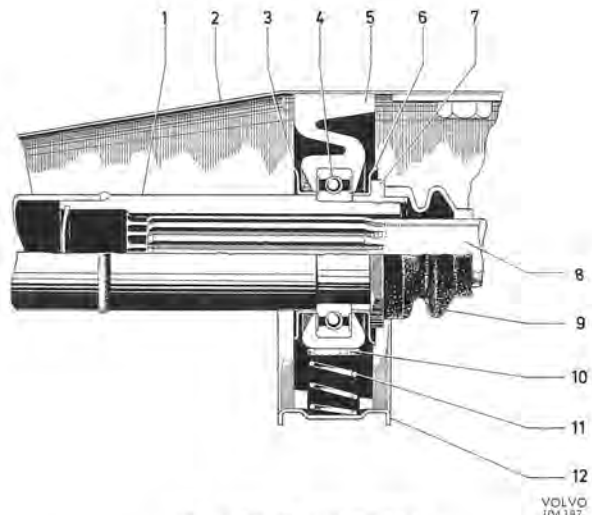


Fig. 4-128. Support bearing

- | | | |
|-------------------------------------|------------------------------------|-----------------------|
| 1. Front section of propeller shaft | 5. Rubber housing | 9. Rubber cover |
| 2. Floor tunnel | 6. Dust cover | 10. Washer |
| 3. Dust cover | 7. Nut | 11. Suspension spring |
| 4. Ball bearing | 8. Rear section of propeller shaft | 12. Cover |

REPAIR INSTRUCTIONS

REPLACING SUPPORT BEARING

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.

REMOVING

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. 4-129. Loosen the cover for the support bearing and take down the propeller shaft complete.

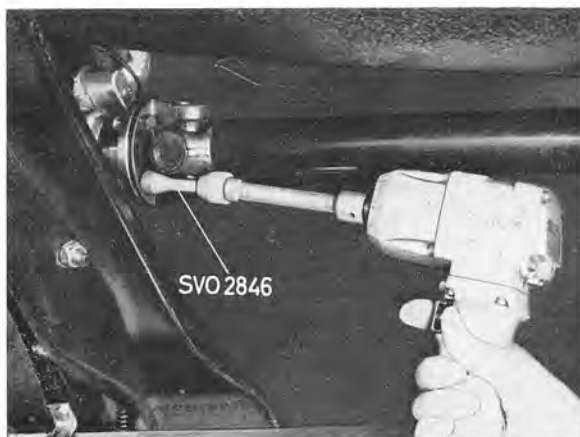


Fig. 4-129. Removing bolts

VOLVO
103 227

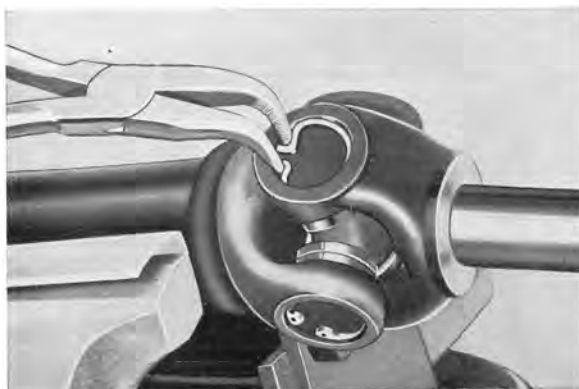


Fig. 4-130. Removing snap ring

VOLVO
101 777

DISASSEMBLING

DISASSEMBLING PROPELLER SHAFT

1. Bend back the lock washer and unscrew the nut for the support bearing. Remove the rear section of the propeller shaft. Pull off the support bearing.
2. Remove the support bearing from the housing.

DISASSEMBLING UNIVERSAL JOINTS

1. Remove the snap rings securing the needle bearings in the yokes, see Fig. 4-130.
2. Secure the shaft in a vice so that the universal joint comes as near as possible to the vice 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. 4-131.



Fig. 4-131. Removing spider, I

VOLVO
101 778



Fig. 4-132. Removing spider, II

VOLVO
101 779

5. Drive out one of the needle bearings with a thin metal punch. Remove the spider, see Fig. 4-132. Drive out the other needle bearing.

INSPECTING

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 bearing by pressing the bearing 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.

ASSEMBLING

ASSEMBLING UNIVERSAL JOINTS

1. When fitting the old needle bearings, check that they are filled with grease and that the rubber seals are not damaged. New bearings should be half-filled with grease.



VOLVO
101780

Fig. 4-133. Installing spider

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. 4-133. Then press the needle bearing 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.
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.

INSTALLING

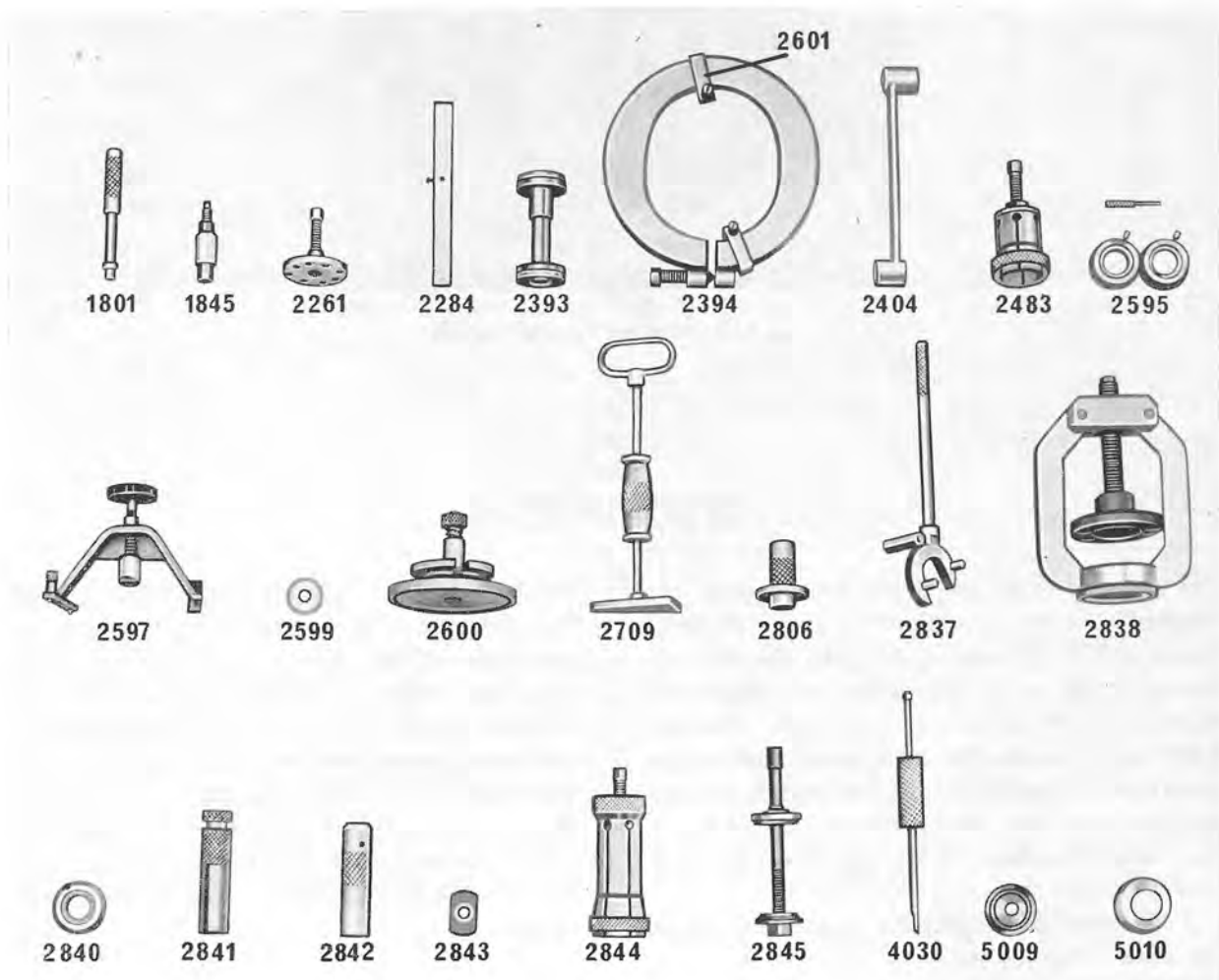
Installing is in reverse order to removal.

GROUP 46

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 repair work on the rear axle.



VOLVO
108169

Fig. 4-134. 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 Measuring 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. 4-135
- 2522 Fixture for rear axle (used together with stand SVO 2520 for work on the final drive)
- 2595 Adjusting rings for differential
- 2597 Brake for crown wheel, used when checking tooth mesh
- 2599 Drift for removing outer ring, front pinion bearing
- 2600 Measuring fixture for adjusting rings
- 2601 Holder for expander tool 2394 (fitted on tool)

999 (SVO)

- 2709 Puller for drive shaft
- 2714 Fixture for rear axle, used on garage jack for removing and fitting rear axle, see Fig. 4-170
- 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
- 4030 Puller for oil seal at flange
- 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



Fig. 4-135. Stand and fixture for rear axle

DESCRIPTION

The rear axle is carried in two support arms. The support arms are provided with a couple of robust bushes 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 centre of the crown wheel. It consists of the drive pinion, crown wheel and differential gears. The gear backlash and differential carrier bearing tension are adjusted by means of shims inside the differential carrier bearings.

The differential carrier and the crown wheel are journalled in the final drive housing by means of two taper roller bearings. The crown wheel 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 journalled 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 journalled in a taper roller bearing. Bearing clearance is not adjustable but is determined by the construction of the bearing, see Fig. 4-136. There are oil seals on both sides of the drive shaft bearings.

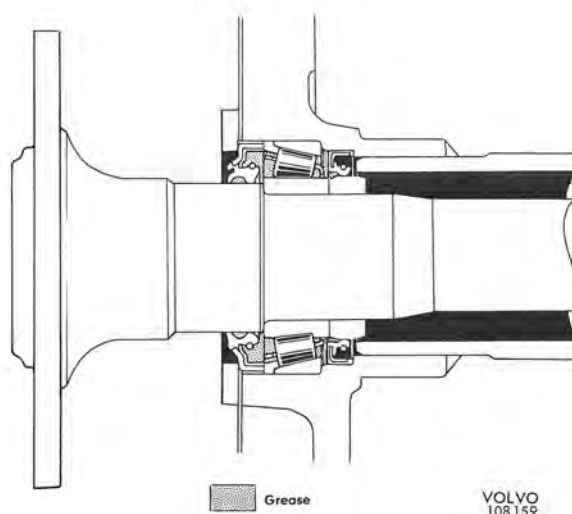


Fig. 4-136. Drive shaft journaling

REPAIR INSTRUCTIONS

WORK ON REAR AXLE IN VEHICLE

REPLACING BEARINGS AND DRIVE SHAFT OIL SEALS

1. Jack up the vehicle and prop up 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. 4-137.
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 vice. 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. 4-138. Screw out the spindle and press off the bearing and lock ring. Remove the oil seal.
6. Fill the space between the seal lips on the new oil with grease. Then place it on the drive shaft.

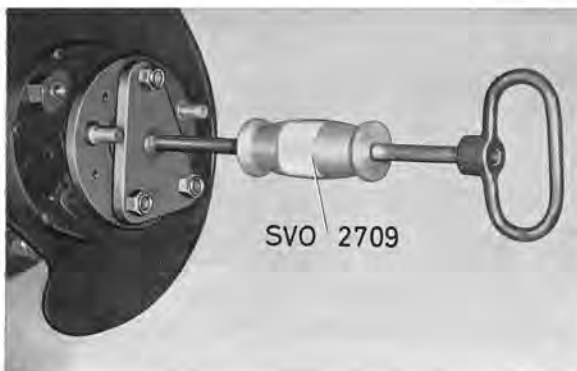


Fig. 4-137. Removing drive shaft

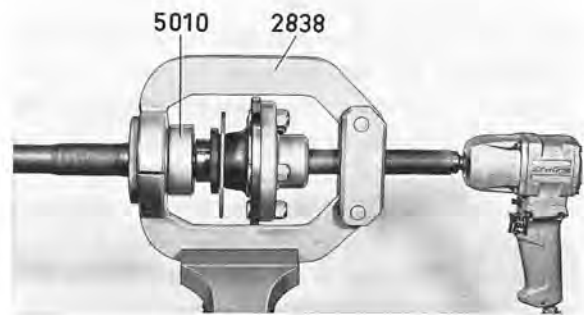


Fig. 4-139. Fitting drive shaft bearing

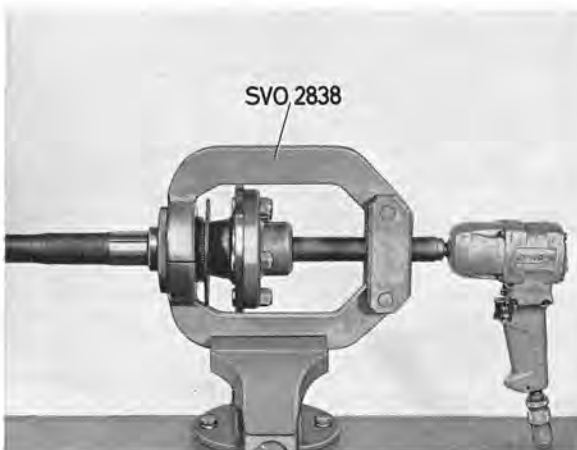


Fig. 4-138. Removing drive shaft bearing

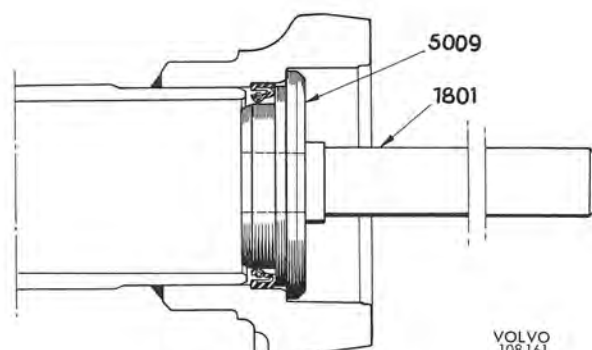


Fig. 4-140. Fitting the inner sealing ring

Fit the bearing and lock ring. Turn the bearing correctly, see Fig. 4-136.

NOTE. Always use a new lock ring.

Place fitting ring 2839 against the bearing and the lock ring. Close the tool arms and lock them round the fitting ring, see Fig. 4-139. 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. 4-140.
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. 4-136. Then fit the drive shaft. Tighten the bolts for the thrust washer to a torque of 50 Nm (36 lbft). Fit the brake disc and brake caliper. Connect the brake line. Bleed and adjust the brakes, see Part 5.
9. Fit on the wheels and wheel nuts. Lower the vehicle. Tighten the wheel nuts.
Pack the bearing with durable grease. Also fill the space between the sealing ring lips on the outer ring with grease, see Fig. 4-139.

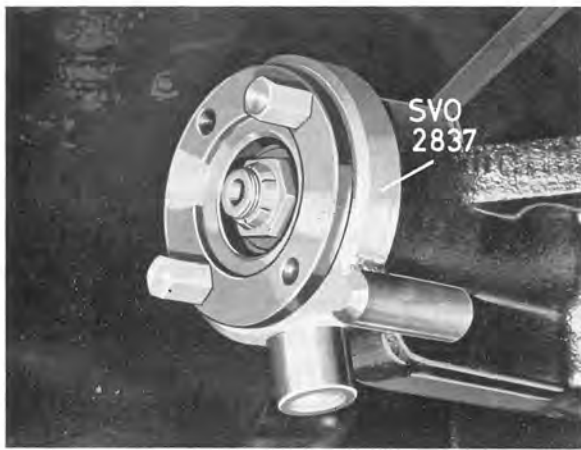


Fig. 4-141. Counterhold for flange

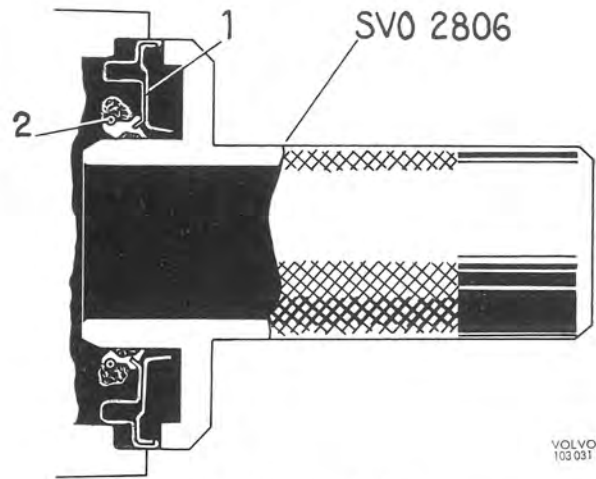


Fig. 4-143. Fitting oil seal

1. Oil seal 2. Spring coil with grease coating

REPLACING PINION OIL SEAL

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. 4-141. Pull the flange off with puller 2261, see Fig. 4-142. Pull out the old oil seal with puller 4030.
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. 4-143. 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. 4-144. Fit the washer and nut. Tighten the nut to a torque of 280—300 Nm (200—220 lbft).
5. Connect the propeller shaft section.

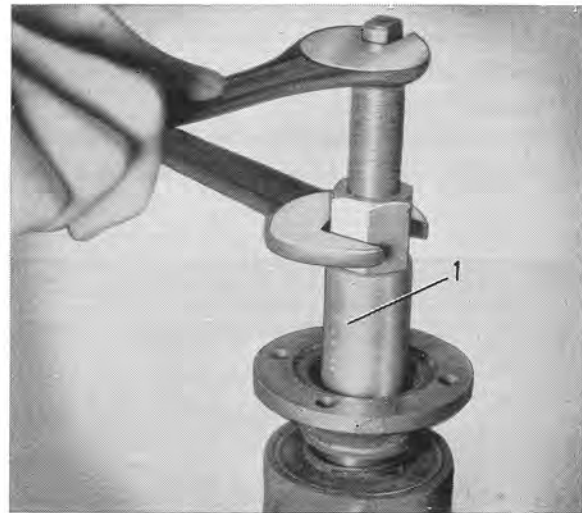


Fig. 4-144. Fitting flange

1. Press tool 1845

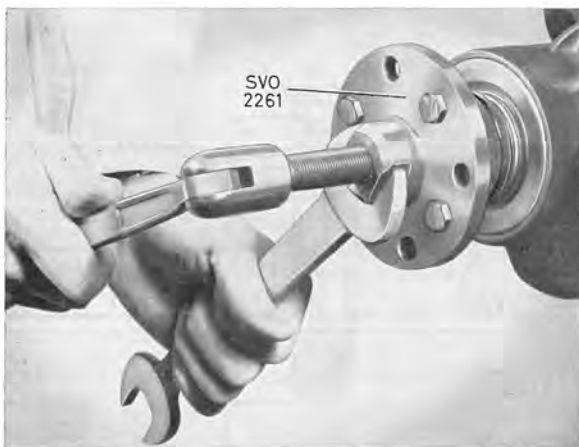


Fig. 4-142. Removing flange



Fig. 4-145. Locating axle prop

REMOVING REAR AXLE

1. Place chocks in front of the front wheels. Slacken the rear wheel nuts. Raise the rear end of the vehicle and place an axle prop under in front of the rear jack attachments, see Fig. 4-145. Note that the prop must not be placed at a point further than the dash line indicated in the figure. Take off the rear wheels.
2. Replace the lifting plate on the jack with fixture 2714 (compare with Fig. 4-170) and raise the rear axle slightly. Slacken the upper attaching bolts for the shock absorbers. Disconnect the parking brake wires from the levers and brackets on the brake backing plates. Use for this purpose a spring fixture, see Part 5.
3. Disconnect the propeller shaft section from the flange on the pinion. Remove the brake pipe union from the rear axle casing.
4. Loosen the front attaching bolts for the support arms about 1 turn. Unscrew the rear bolts for the torque rods. Loosen the track bar from the bracket on the rear axle casing. Remove the lower attaching bolts for the springs.
5. Lower the jack until the support arms release from the spring. Slacken the bolts securing the rear axle casing to the support arms. Lower the jack and pull the rear axle forwards.

DISASSEMBLING REAR AXLE

1. Place the rear axle in fixture 2522, see Fig. 4-135. 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. 4-137.
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. 4-146. 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. 4-147. 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 crown wheel. 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. 4-141. Pull off the flange with puller 2261, see Fig. 4-142. Press out the pinion.
8. Drive out the front pinion bearing, the washer and the oil seal with standard handle 1801 and drift 2599.
9. If necessary, drive out the rear bearing outer ring out of position, see Fig. 4-148. 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.



Fig. 4-146. Alignment marking on cap and carrier



Fig. 4-147. Expanding drive pinion carrier



Fig. 4-148. Removing rear pinion bearing race
1. Removing drift 2843

11. If necessary, pull off the rear bearing from the pinion with puller 2844, see Fig. 4-149. The puller is fitted in the following way (see Fig. 4-150): 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.

DISASSEMBLING DIFFERENTIAL

1. Pull off the differential carrier bearings with puller 2483, see Fig. 4-152. 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.
3. Drive out the lock pin, see Fig. 4-151, and then the shaft for the differential gears. Take out the differential gears and the thrust washers.

INSPECTING REAR AXLE

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

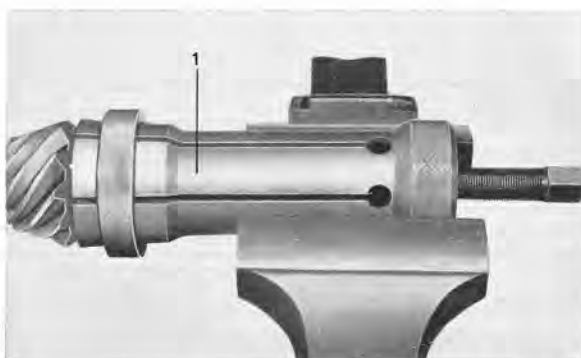


Fig. 149. Removing rear pinion bearing
1. Puller 2844

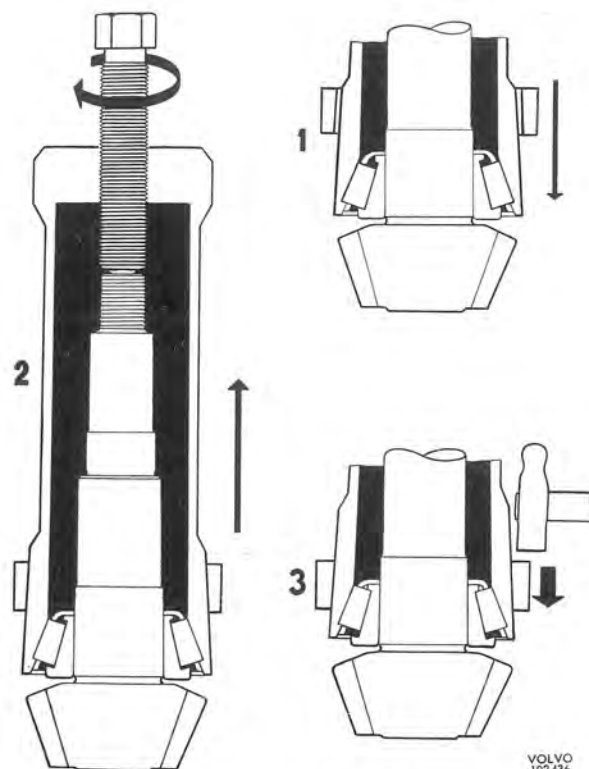


Fig. 4-150. Puller fitted

1. Puller is pressed down over the rollers
2. Rollers are pulled up
3. Lock ring knocked securely into position

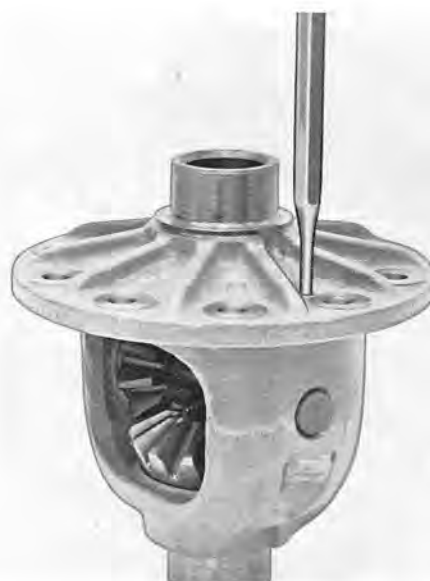


Fig. 4-151. Removing lock pin

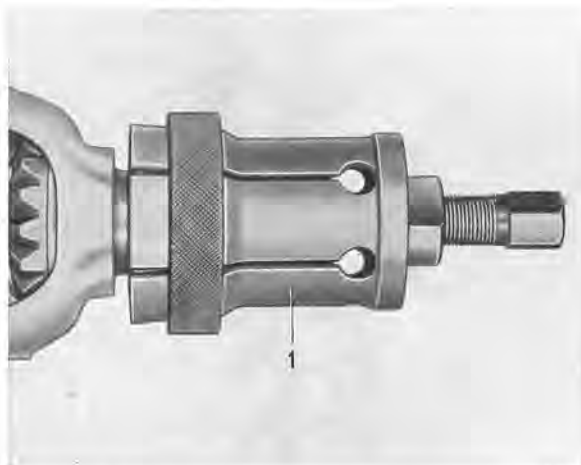


Fig. 4-152. Removing differential carrier bearings
1. Puller 2483

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 0.06 mm (0.0024"), 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.



Fig. 4-153. Installing differential gear

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.

ASSEMBLING

ASSEMBLING DIFFERENTIAL

1. Place the differential side gears together with the thrust washers in the differential carrier. Then "roll" in both the side pinions simultaneously with the dished thrust washers, see Fig. 4-153.
2. Drive in the shaft. Check the differential. If there is any play, fit new dished thrust washers, see Fig. 4-153.
3. Fit the crown wheel. Make sure that the contact surfaces are clean and without any burr. Tighten the bolts to a torque of 65–90 Nm (45–65 lbf). Always use new bolts.

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. 4-154. Place the pinion in the carrier, see Fig. 4-156, and secure the adjusting ring by screwing out the lock screw.
2. The pinion should have a certain nominal measurement (A, Fig. 4-155) 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.



Fig. 4-154. Adjusting ring and tool for pinion location

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 millimetre. 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. 4-156. Place the indicator retainer on the drive pinion carrier and zero-set the gauge against the adjusting ring, see Fig. 4-157. Then move the indicator retainer over so that the indicator comes against the pinion gauge, see Fig. 4-158. 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.

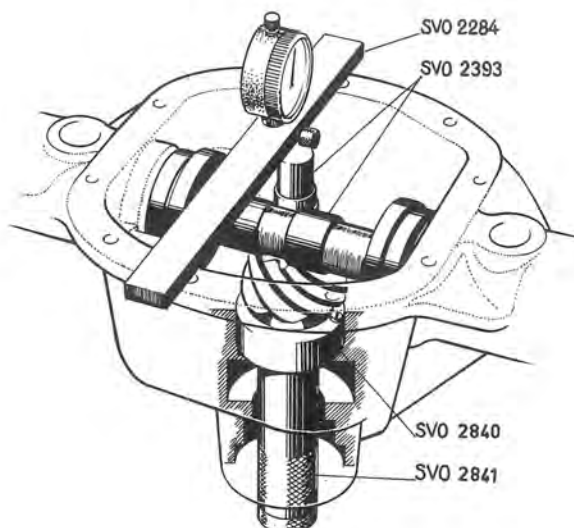


Fig. 4-156. Locating measuring tools

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		

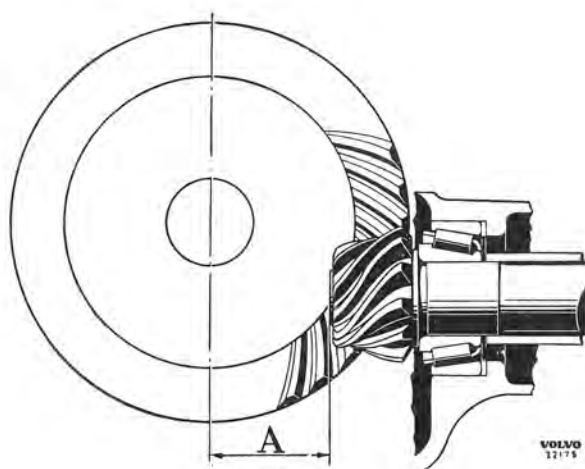


Fig. 4-155. Pinion location

A. Nominal measurement

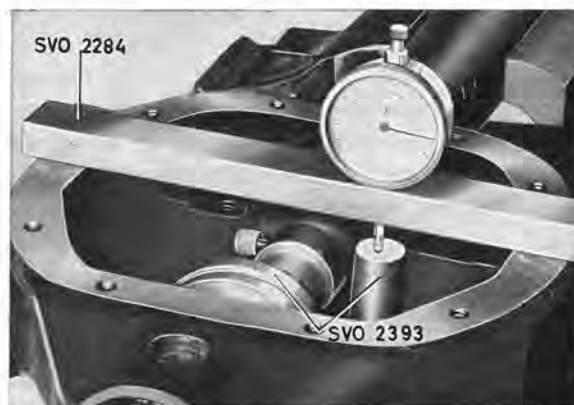


Fig. 4-157. Zero-setting indicator

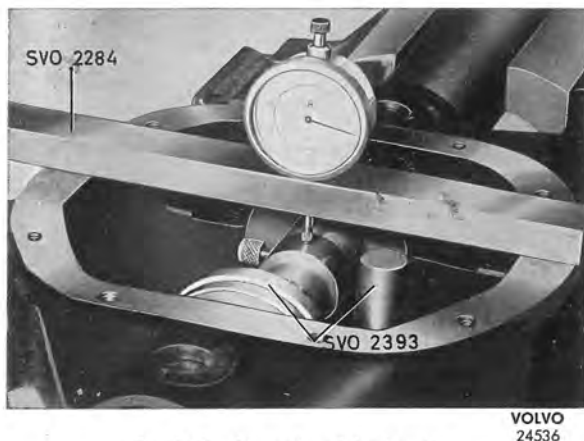


Fig. 4-158. Measuring pinion location



Fig. 4-160. Measuring shim

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 measuring fixture as shown in Fig. 4-159. Use retainer 2284 and dial indicator, place the measuring point of the indicator opposite 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. 4-160. 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

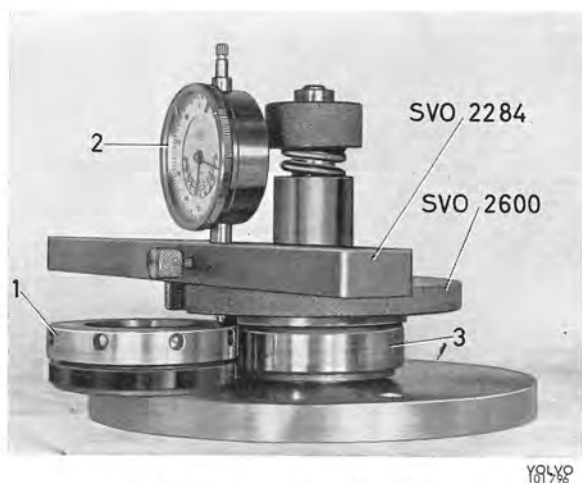


Fig. 4-159. Determining shim thickness

1. Adjusting ring
2. Dial indicator
3. Bearing, complete

2842, see Fig. 4-161. Fit the measured shims and press in both the outer rings of the bearings with tool 2845, see Fig. 4-162.

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. 4-163. 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 280—300 Nm (200—220 lbft). Fit on the pinion gauge and the

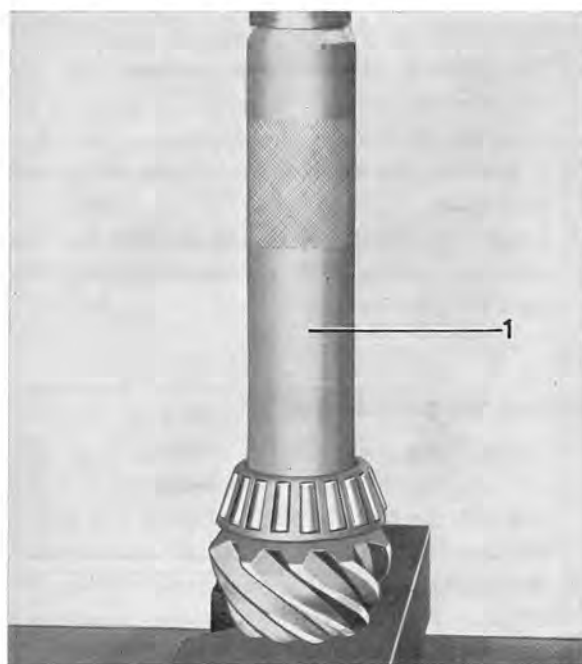


Fig. 4-161. Installing rear pinion bearing

1. Fitting sleeve 2842

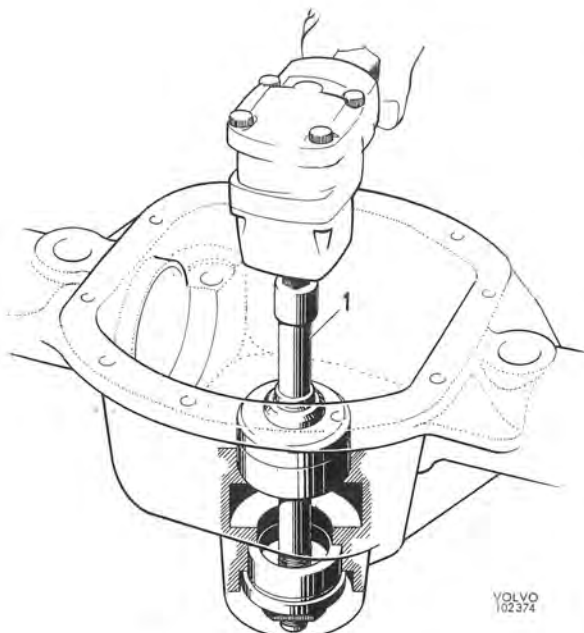


Fig. 4-162. Installing bearing rings
1. Press tool 2845

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"). Re-fit the pinion.
8. Then check the pinion bearing fit with the torque gauge. The torque gauge should show 60—110 Nm (5.20—9.55 lbin) for used bearings and 110—230 Nm (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.

FITTING THE DIFFERENTIAL

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 bearing location in the carrier. Place the differential carrier and the adjusting rings in the final drive housing, see Fig. 4-164. Use the dial indicator and adjust in the rings so that the correct tooth flank clearance 0.13—0.20 mm (0.005—

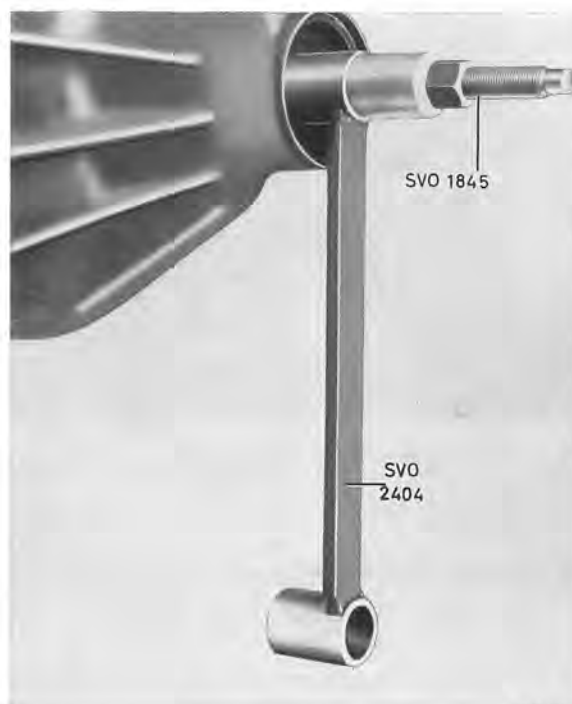


Fig. 4-163. Installing pinion

0.008") is obtained. Tighten the lock screws in the adjusting rings.

2. Fit on brake tool 2597 as shown in Fig. 4-165. Apply marking blue to several teeth at three points on the crown wheel. This can serve as a check on the crown wheel for possible warping. Rotate the pinion 10—12 turns in both directions and check the mesh marking pattern. With correct tooth mesh, the mesh marking pattern should be horizontal in the middle of the tooth but somewhat nearer to the toe than the heel. The patterns on the coast side and drive side should coincide with each other. See Fig. 4-166. If the patterns do not coincide, the pinion location must be adjusted

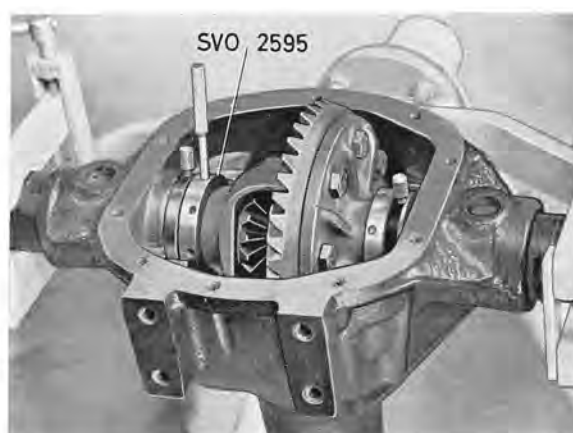


Fig. 4-164. Adjusting rings for differential
1. Adjusting rings 2595

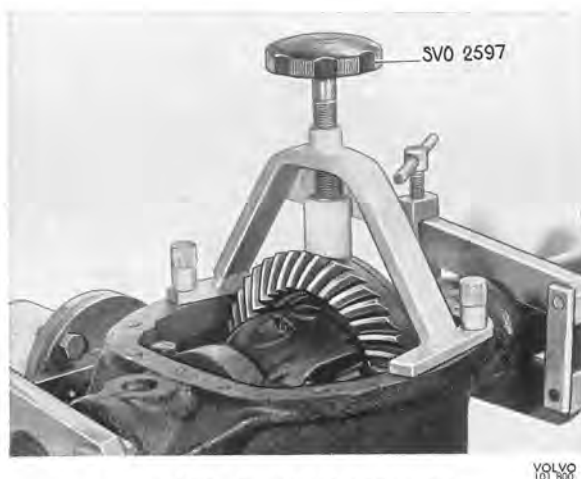


Fig. 4-165. Brake tool for differential

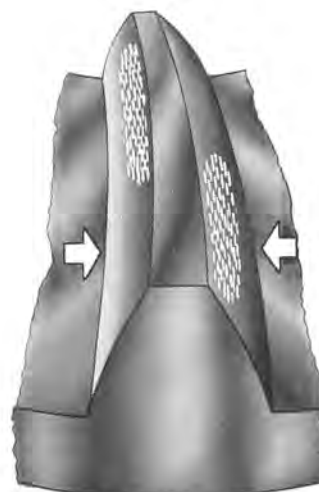


Fig. 4-167. Faulty tooth contact

before assembling is continued. If the patterns lie too far towards the heel on the drive side and too far towards the toe on the coast side, see Fig. 4-167, the pinion should be moved inwards. If the mesh patterns lie too far towards the toe on the drive side and too far towards the heel on the coast side, see Fig. 4-168, the pinion should be moved outwards. Note that the patterns will lie somewhat nearer the toe when the adjusting rings are fitted than when the bearings are installed.

3. When the correct tooth flank clearance and mesh pattern are obtained, remove the differential and adjusting ring. Then place the center washer on the measuring fixture. Fit a bearing into the measuring fixture, also the plate, spring and nut. Fit 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. 4-159. 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. Fit the shims on the differential carrier and press on the bearings. Do not forget the lock plate for the crown wheel bolts, see Fig. 4-169.
5. Fit tool 2394 on the drive pinion carrier, see Fig. 4-147. Expand the tool until the pins are exactly flush against the hole edges in the carrier and then tighten the screws a further 3—3½ turns.

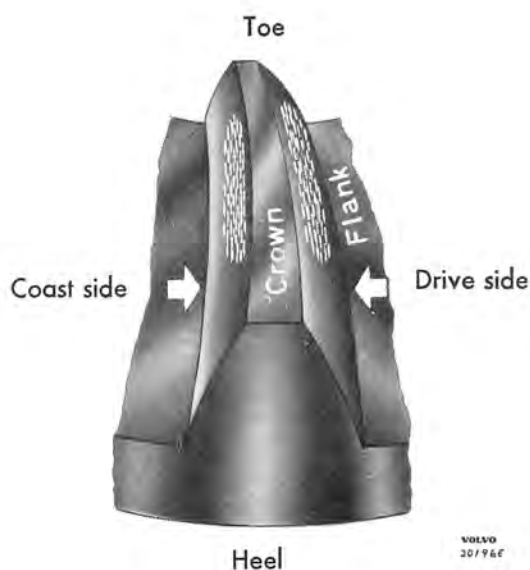


Fig. 4-166. Correct tooth contact

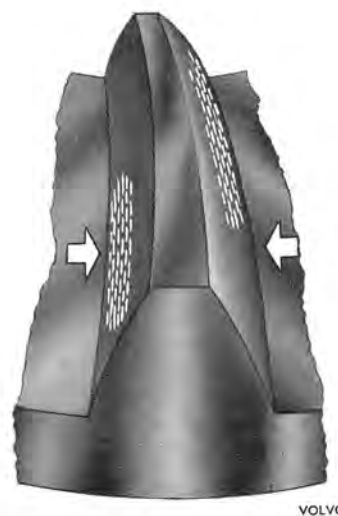


Fig. 4-168. Faulty tooth contact

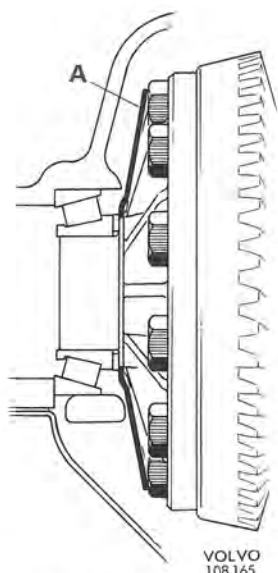


Fig. 4-169. Lock plate (A) for crown wheel bolts

Fit the differential and outer rings. Remove tool 2394. Fit the cap and tighten the bolts to a torque of 50—70 Nm (36—50 lbft).

6. Check the tooth flank clearance and the mesh pattern.

ASSEMBLING THE REAR AXLE

1. Remove spanner 2404. Fit the oil slinger and oil seal. The oil seal is fitted with tool 2806, see Fig. 4-143.
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. 4-144. Fit the washer and nut. Tighten the nut to a torque of 280—300 Nm (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

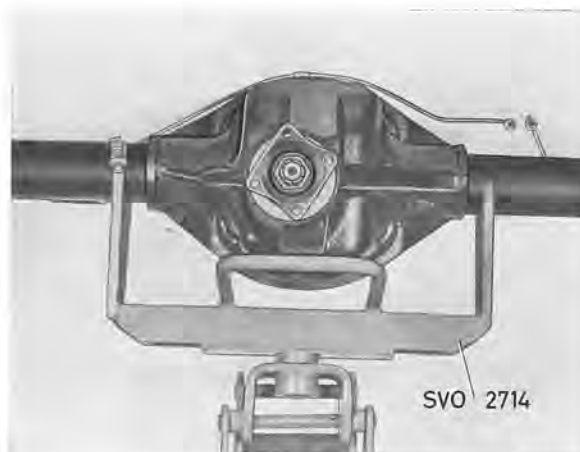


Fig. 4-170. Fixture for rear axle

with grease, see Fig. 4-136. Fit the drive shafts. Tighten the bolts for the thrust washers to a torque of 50 Nm (36 lbft).

4. Then fit the brake discs and brake caliper. Finally fit the brake pipes.

INSTALLING REAR AXLE

1. Place the rear axle on fixture 2714, which is mounted on a garage jack, see Fig. 4-170. Move the rear axle in under the vehicle and fit on the bolts for the support arms and torque rods.
2. Raise the jack until the track bar attachment on the rear axle is on the same level with the attachment on the body. Fit the track rod.
3. Fit the attaching bolts for the springs. Tighten the nuts for the torque rods and support arms.
4. Fit the bracket, screw union and brake hoses. Fit the universal joint to the flange.
5. Fit the upper bolts for the shock absorbers. Fit the parking brake wire in the brackets and at the levers. Adjust the parking brake and bleed the brakes, see Fig. Part 5.
6. Fit on the wheels and wheel nuts. Lower the vehicle. Tighten the wheel nuts to a final torque of 100—140 Nm (70—100 lbft).

Engagement of "R", "D" or "L"	A	B	C	D	E	F	a	b	c	d	e	f	g	h	i	m	n	p	s	N	O	P	Q	R	S	T	U	V	W	X	Z	
Bumpy		2		1					5	3		4								8	9	6		7								
Delayed	1		2	3			4	7	6	5										8	9		10							12		
None	1		2				3	4	5	6																5		7	8	9	10	
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		1						
Rough on 2—1							3																									
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.
- i. 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 FAULT-TRACING 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 bush
- 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

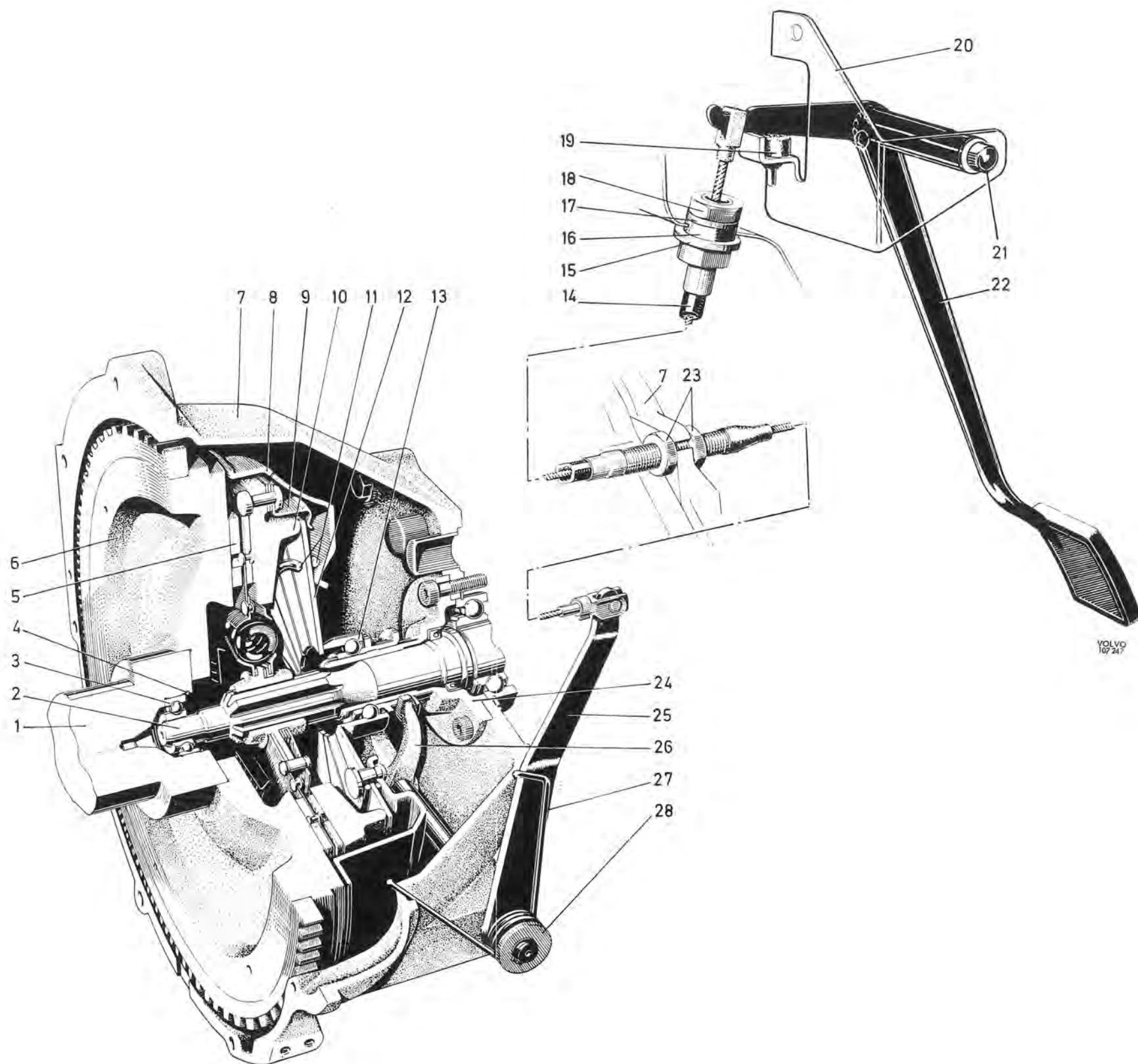


Illustration 4-A. Clutch and clutch controls

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. Gear wheel, 2nd speed
13. Needle bearing
14. Spring
15. Synchronizing hub, 1st—2nd gears
16. Interlock ball
17. Sliding plate
18. Gate
19. Selector fork, 1st and 2nd gears
20. Gearbox cover
21. Synchronizing cone
22. Gate
23. Switch for reversing lights and seat belt reminder
24. Bush
25. Thrust washer
26. Ball bearing
27. Selector fork reverse gear
28. Flange
29. Shaft
30. Bush
31. Gear lever knob
32. Gear lever, upper section
33. Rubber bushes
34. Gear lever, lower section
35. Washer
36. Cover
37. Spring
38. Protective casing
39. Oil seal
40. Mainshaft
41. Speedometer drive
42. Rear cover
43. Speedometer pinion
44. Shift lever
45. Gear wheel, 1st gear
46. Needle bearing
47. Reverse gear
48. Bush
49. Slide register
50. Engaging sleeve and gear wheel for reverse gear
51. Circlip
52. Reverse gear shaft
53. Needle bearing
54. Gear wheel
55. Gearbox housing
56. Friction ring
57. Synchronizing hub
58. Engaging sleeve
59. Circlip
60. Synchronizing cone
61. Needle bearing
62. Drain plug
63. Gear wheel
64. Countershaft
65. Roller bearing
66. Ball bearing
67. Oil seal
68. Cover
69. Input shaft

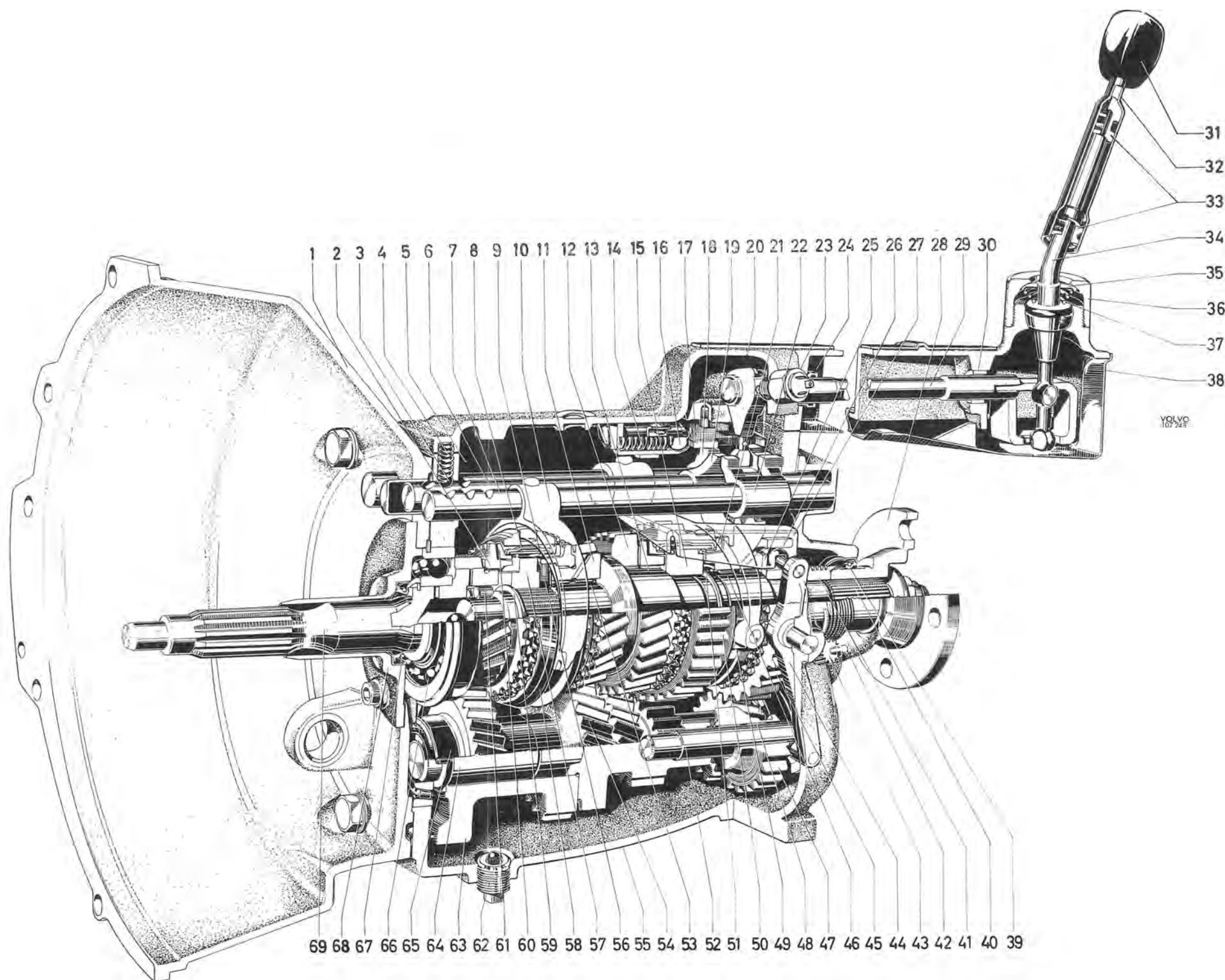
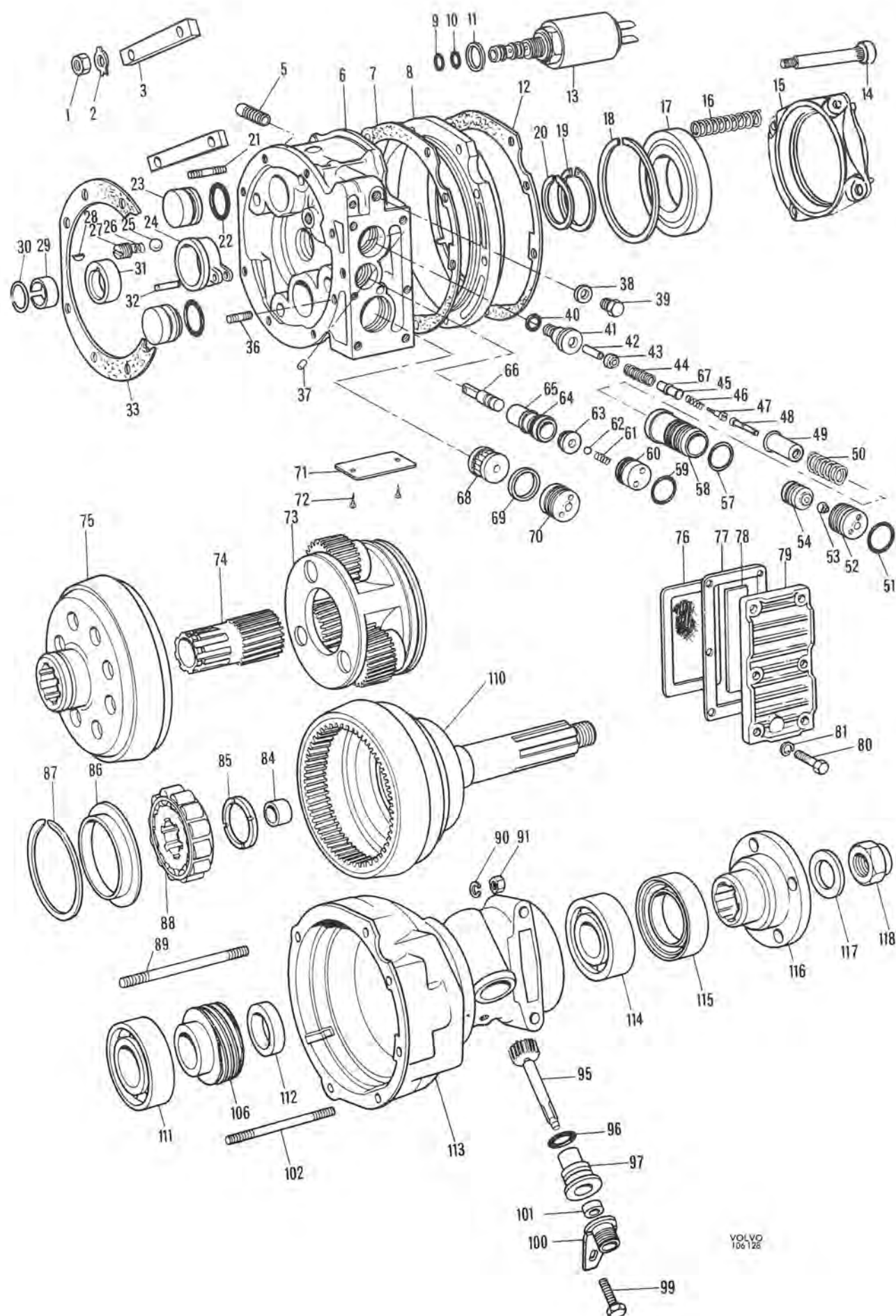


Illustration 4-8. Gearbox



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. Circlip
19. Circlip
20. Circlip
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. Circlip
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. Circlip
88. Uni-directional clutch
89. Stud
90. Resilient washer
91. Nut
95. Speedometer pinion
96. O-ring
97. Bush
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

VOLVO
106 126

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. Centre 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

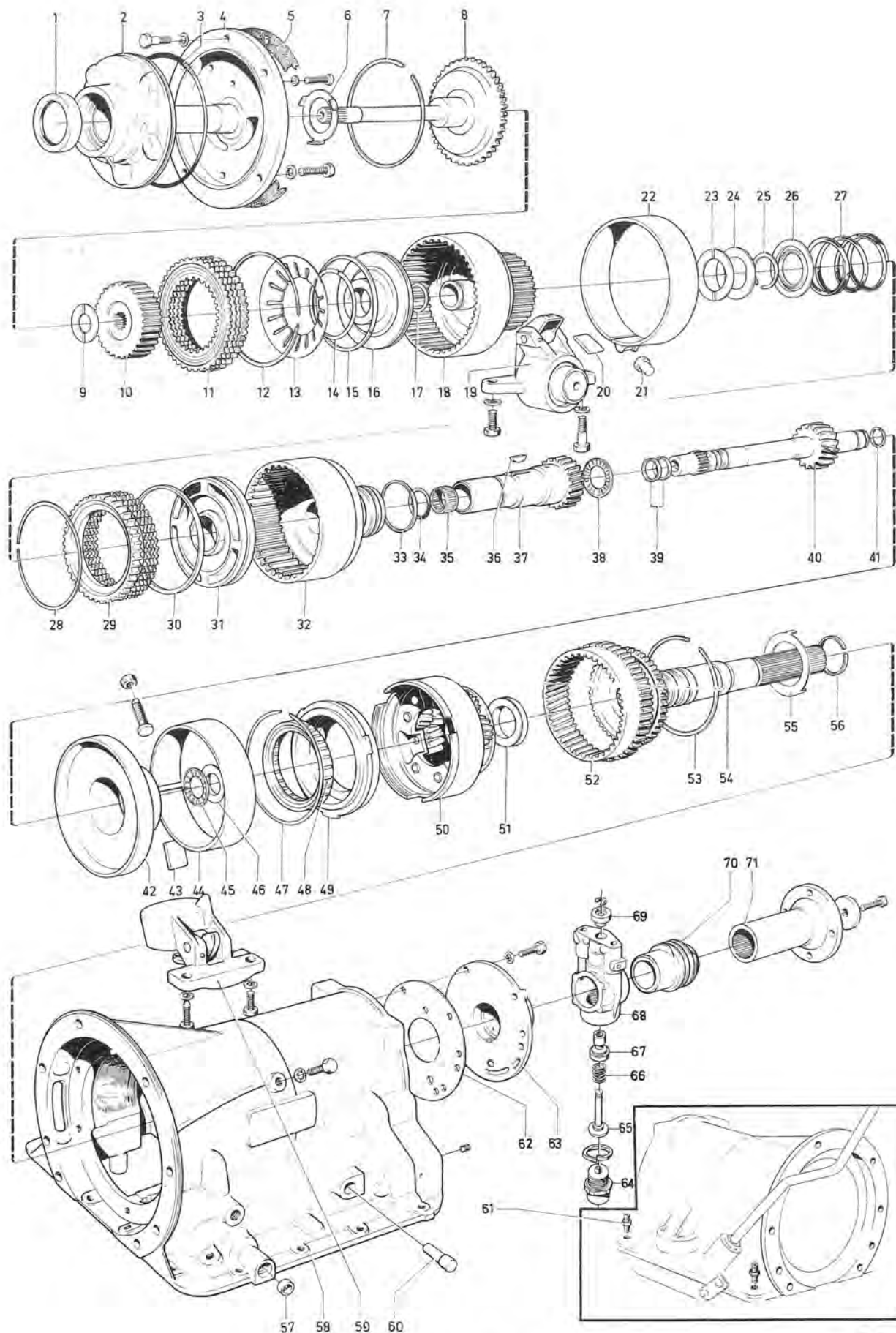


Illustration 4-D. Automatic transmission BW 35

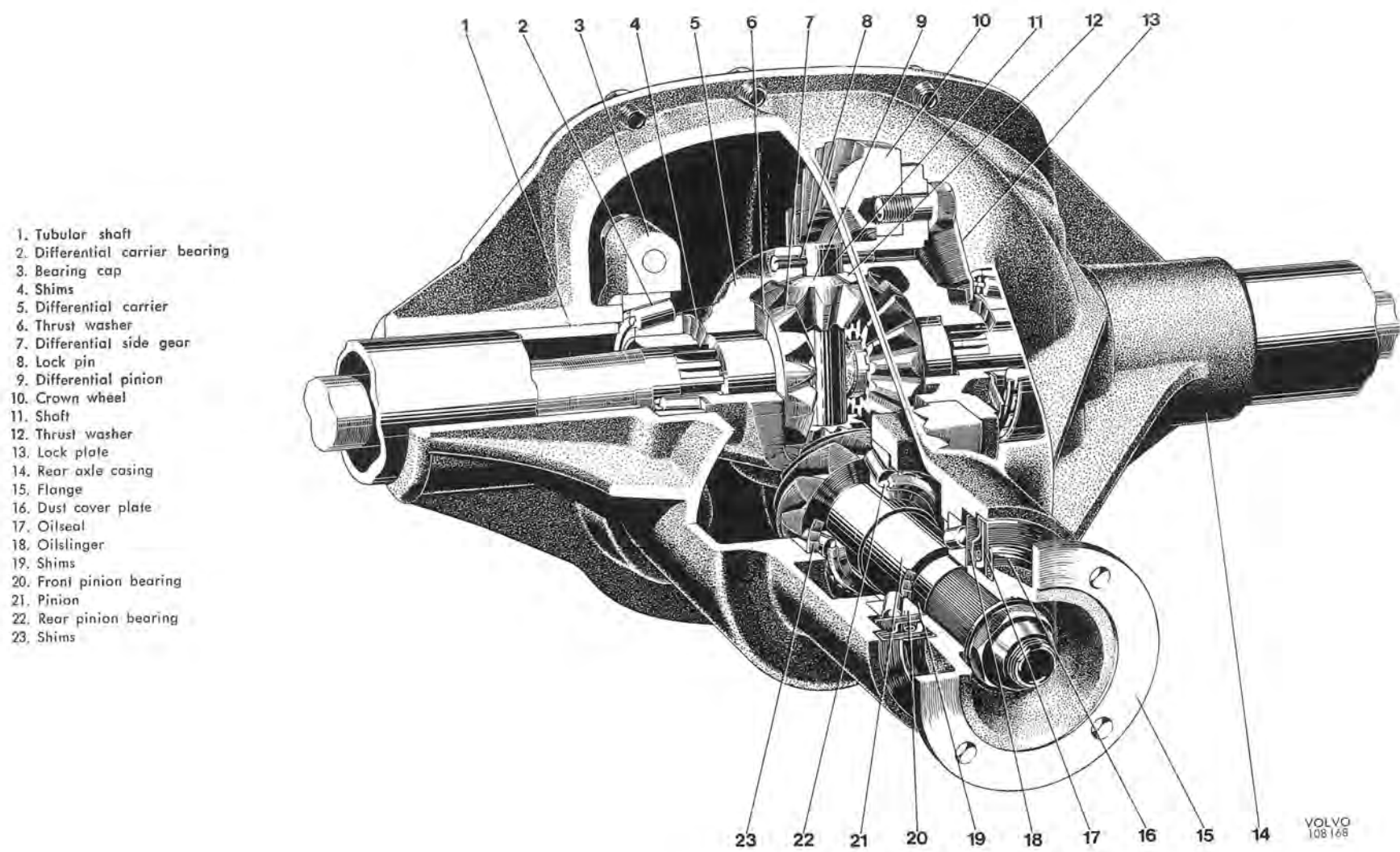


Illustration 4-E. Final drive

Part 5

BRAKES

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GROUP 50

GENERAL TOOLS

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.

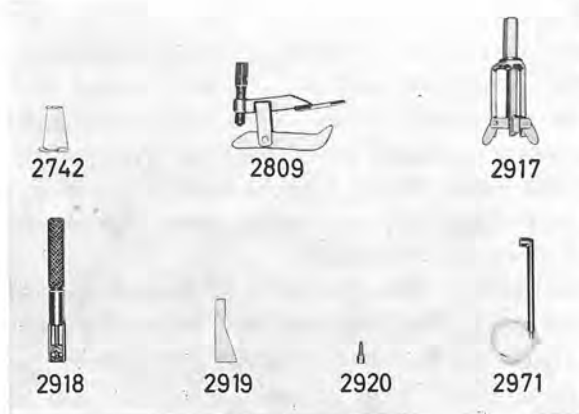


Fig. 5-1. Special tools

VOLVO
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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.

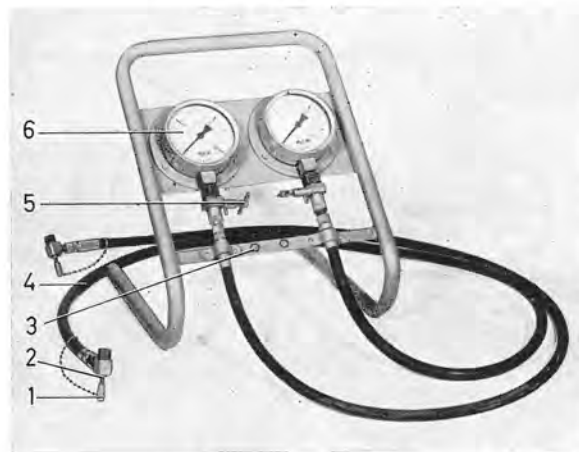


Fig. 5-2. Testing device 2741

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- 1. Nipple plug
- 2. Connection nipple
- 3. Enlarging nipple
- 4. Hose
- 5. Bleeder device
- 6. Pressure gauge

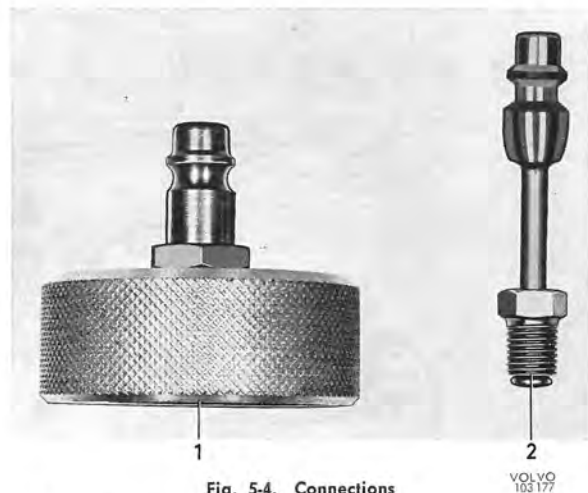


Fig. 5-4. Connections

VOLVO
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- 1. Connection
(Can be obtained from Volvo Service Dept.)
- 2. Connection for brake caliper

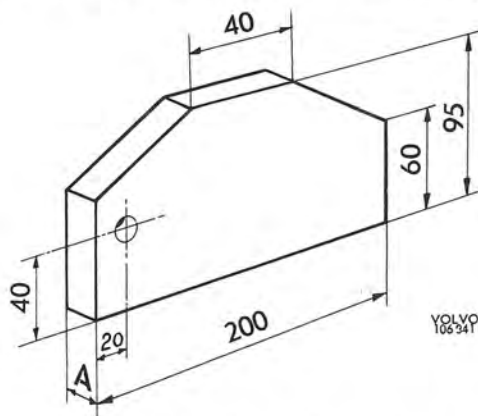


Fig. 5-3. Wooden insert for brake calipers

A=26 mm (1") for front and 13 mm (1/2") for rear brake calipers

VOLVO
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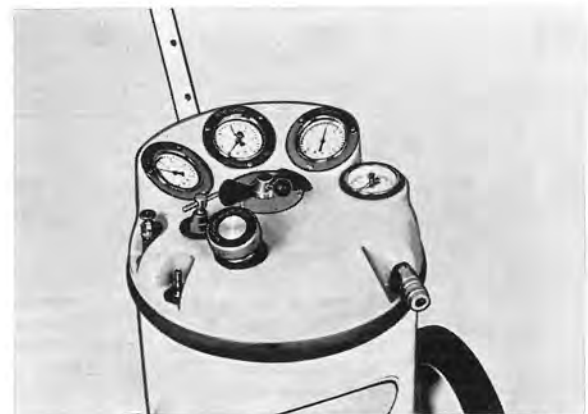


Fig. 5-5. Bleeder unit

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DESCRIPTION

The 164 is fitted with two brake systems which are independent of each other. One of these, the foot-brake 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.

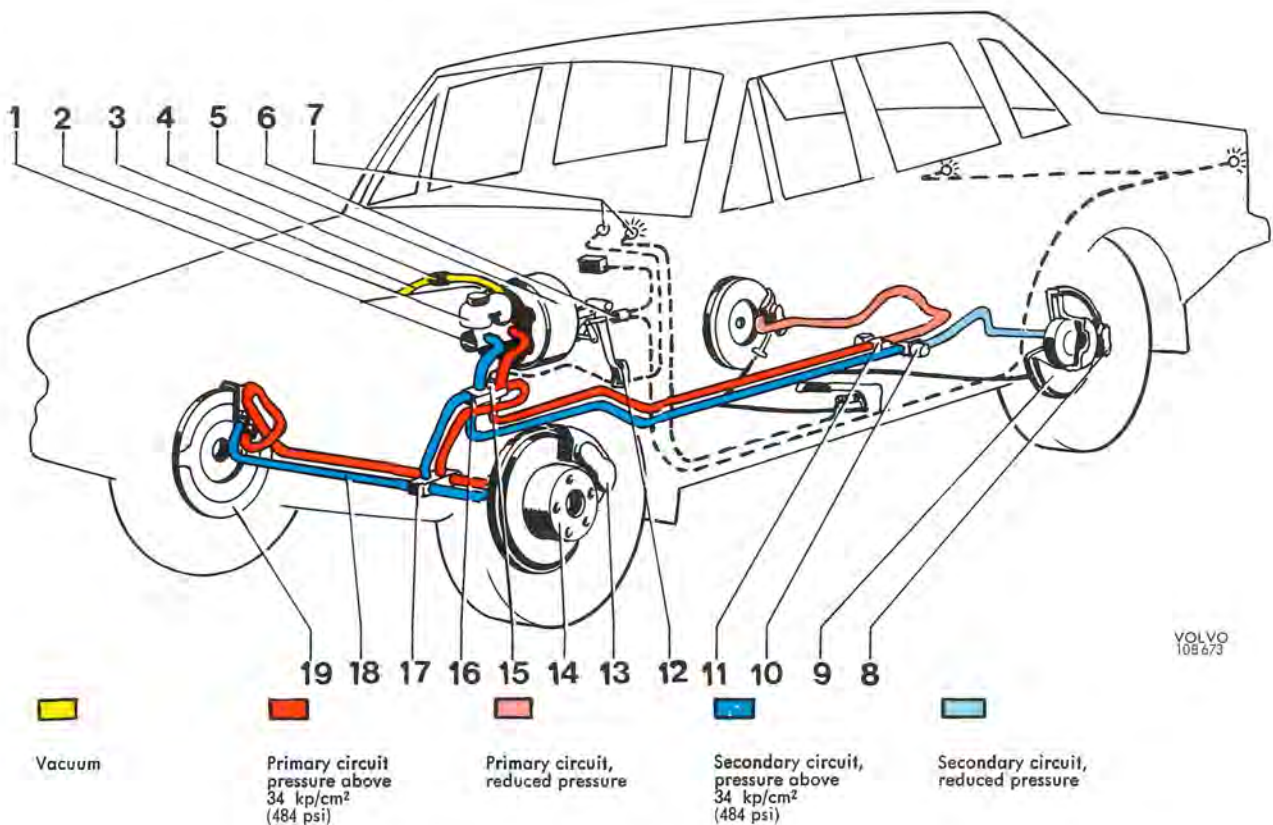


Fig. 5-6. Brake system

- | | | |
|---------------------------|------------------------------------|---|
| 1. Tandem master cylinder | 9. Brake disc with drum | 15. Warning switch |
| 2. Brake fluid container | 10. Brake valve, secondary circuit | 16. Warning valve |
| 3. Vacuum line | 11. Brake valve, primary circuit | 17. 6-branch union, (double 3-branch union) |
| 4. Check valve | 12. Brake pedal | 18. Brake pipe |
| 5. Power brake cylinder | 13. Front brake caliper | 19. Cover plate |
| 6. Brake switch | 14. Brake disc | |
| 7. Warning lamp | | |
| 8. Rear brake caliper | | |

REPAIR INSTRUCTIONS

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, trichlorethylene 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 preferably 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 vapour 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 colour, is relatively odourless 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".

FAULT TRACING

The following fault tracing procedure can be used, for example, after the discovery, following upon some kind of brake testing, that the capacity of the foot-brake system is not what it should be. Fault tracing 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 the heading "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 (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/cm ² (psi)	30 (427)	50 (711)	100 (1422)
Outgoing pressure kp/cm ² (psi)	30 (427)	36—42 (512—597)	62—69 (882—981)

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.

FAULT TRACING SCHEME

Test operation	Fault	Cause	Remedy
3	Pedal too low or too high	Faulty brake pedal or carpet	Adjust
4	Fading pressure Difference between circuits greater than 3 kp/cm ² (42.7 psi)	Damaged brake line Blocked hose Leakage in one of the circuits Faulty master cylinder	Replace the damaged line Replace hose See point 5 Recondition master cylinder
5	The pressure drops	External leakage Leaking brake valve Leaking seal in wheel unit cylinder Leaking seal in master cylinder	Tighten connections and replace line or recondition leaking part Replace brake valve Recondition wheel unit cylinder Recondition master cylinder
6	The pedal does not go down	Leaking vacuum line Blocked air filter or leaking seal for front pressure plunger in power cylinder. Faulty power cylinder	Replace vacuum line Replace filter or seal Replace power cylinder completely

Test operation	Fault	Cause	Remedy
7	The pressure drops more than 5 kp/cm ² (71 psi)	Leaking check valve Leaking seal for front pressure plunger in power cylinder Internal fault in power cylinder	Remove and blow clean the valve and replace the seal ring. If insufficient, replace check valve Remove master cylinder and replace seal Replace power cylinder completely
8	The parking brake warning lamp does not light Footbrake warning lamp does not light Warning lamp does not go out when pistons have returned to normal position Warning when pressure difference is other than 5—15 kp/cm ² (71—213 psi)	Wrongly adjusted switch Faulty electrical parts Faulty switch Pistons seize Faulty warning valve	Adjust the switch Replace faulty parts Replace switch Replace warning valve Replace valve
9—10	Faulty outgoing pressure	Faulty valve	Replace brake valve
11	A circuit fades The rear wheel brakes fade A wheel brake fades	Blocked equalizing hole in master cylinder Parking brake cable chafes Faultily adjusted parking brake Faulty brake valve Damaged brake line Blocked hose Worn sealing ring	Recondition the master cylinder Replace the cable Adjust the parking brake Replace brake valve Replace line Replace hose Recondition 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 fluid 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 J1703 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 "Fault Tracing"). 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 : 33.

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

DESCRIPTION

CONSTRUCTION OF FRONT WHEEL BRAKE UNITS

Fig. 5-7 shows how the brake components are located at 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 cylinder are each connected through channels to the corresponding 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

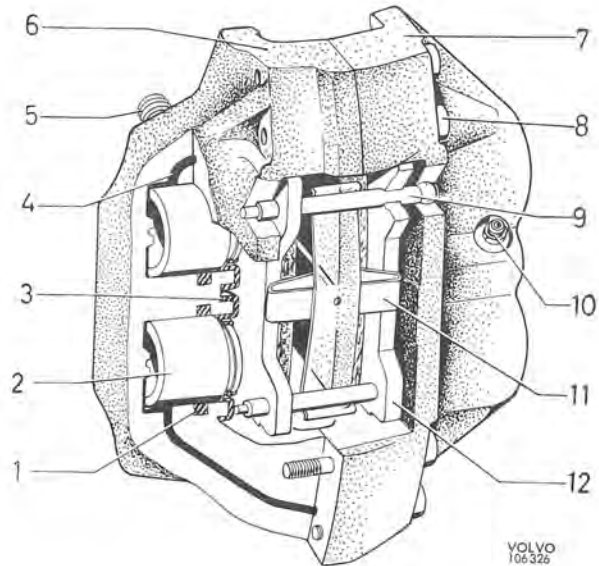


Fig. 5-8. Front wheel brake caliper

- | | |
|-------------------------|--------------------------|
| 1. Sealing ring | 7. Inner half |
| 2. Piston | 8. Bolt |
| 3. Rubber dust cover | 9. Guide pin |
| 4. Channel | 10. Inner bleeder nipple |
| 5. Upper bleeder nipple | 11. Damping spring |
| 6. Outer half | 12. Brake pad |

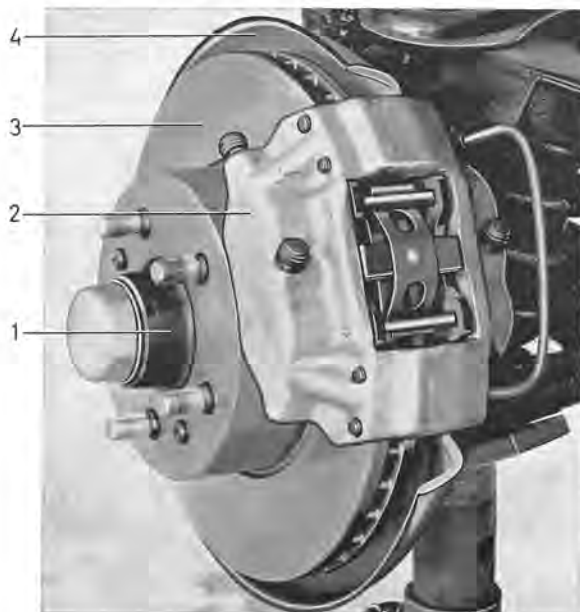


Fig. 5-7. Brake components, front wheel

- | | |
|------------------------|----------------|
| 1. Hub | 3. Brake disc |
| 2. Front brake caliper | 4. Cover plate |

groove in the housing. The brake pads (12) are provided with bonded facings and are held in position by means of guide pins (9).

CONSTRUCTION OF REAR WHEEL UNITS

(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.

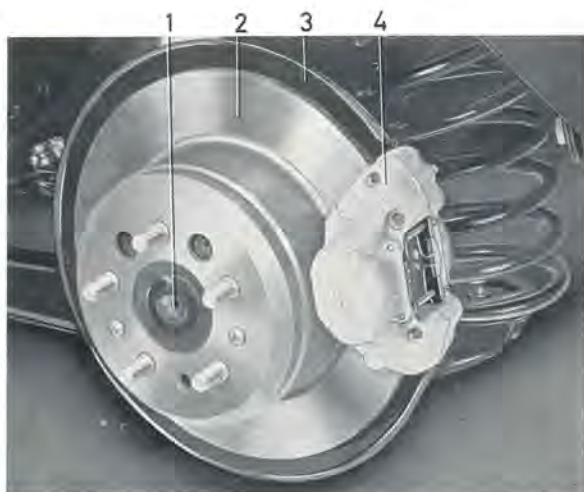


Fig. 5-9. Brake components, rear wheel

- | | |
|----------------|-----------------------|
| 1. Drive shaft | 3. Cover plate |
| 2. Brake disc | 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).

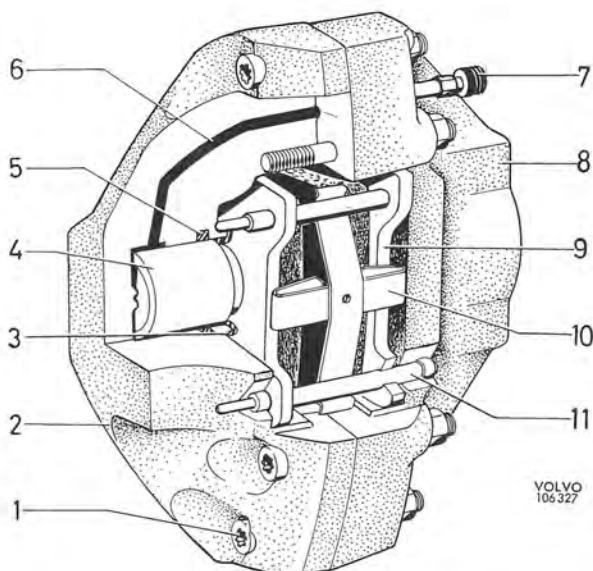


Fig. 5-10. Rear brake caliper

- | | |
|----------------------|--------------------|
| 1. Bolt | 7. Bleeder nipple |
| 2. Outer half | 8. Inner half |
| 3. Rubber dust cover | 9. Brake pad |
| 4. Piston | 10. Damping spring |
| 5. Sealing ring | 11. Guide pin |
| 6. Channel | |

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 $10 \text{ kp/cm}^2 = 142 \text{ psi}$) 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 ten-

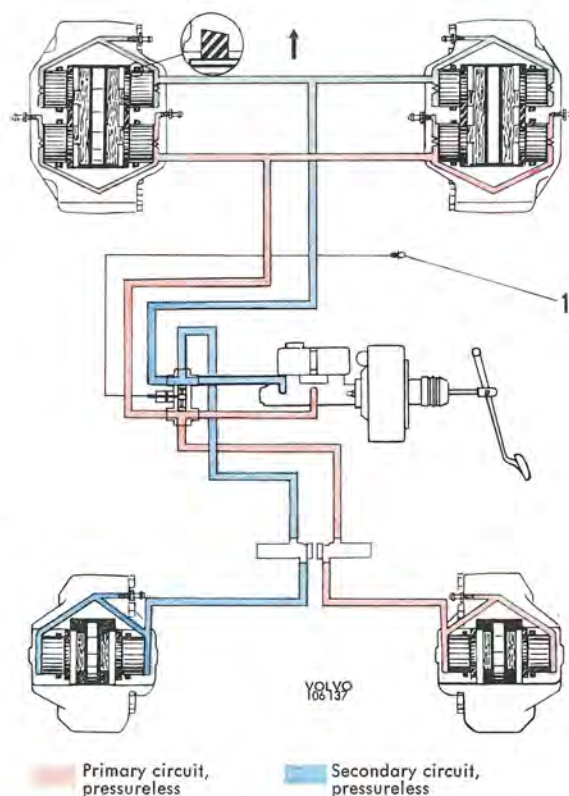


Fig. 5-11. Rest position

1. Warning lamp

sioned laterally. They remain in this state as long as the footbrake is applied. When the brake pedal is released, the pistons are relieved of hydraulic pressure. Since there is no 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 10 kp/cm^2 (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.

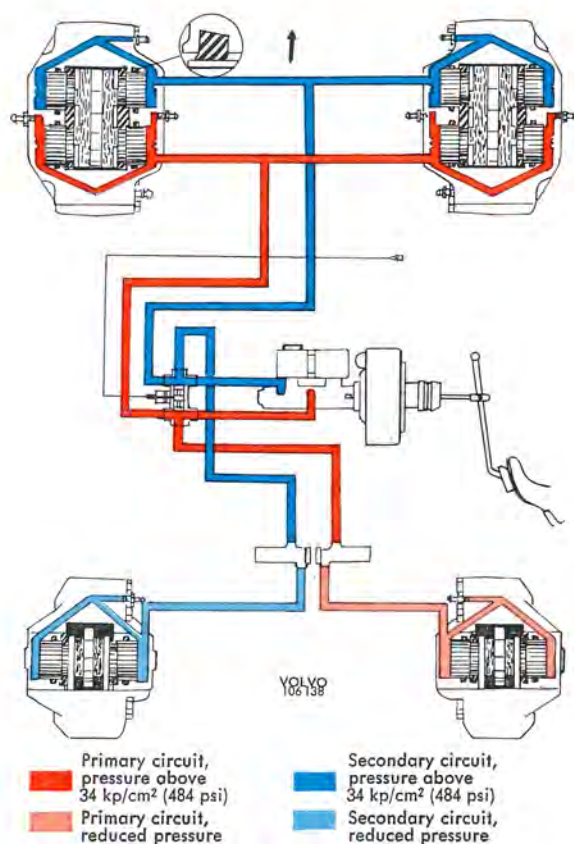


Fig. 5-12. Brake application

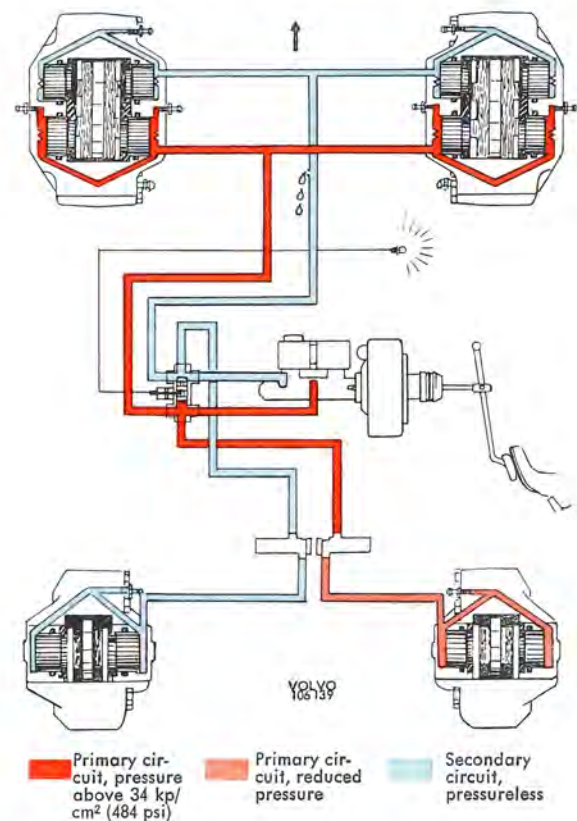


Fig. 5-13. Brake application, leakage in secondary circuit

REPAIR INSTRUCTIONS

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.

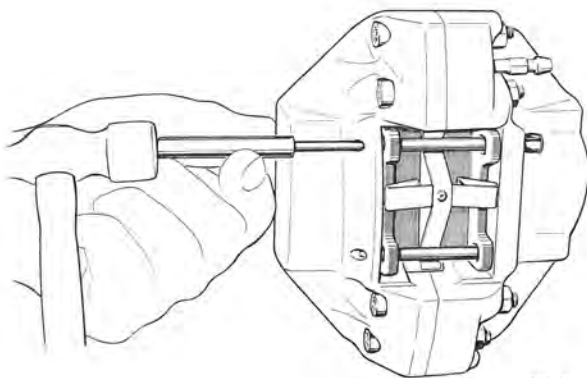
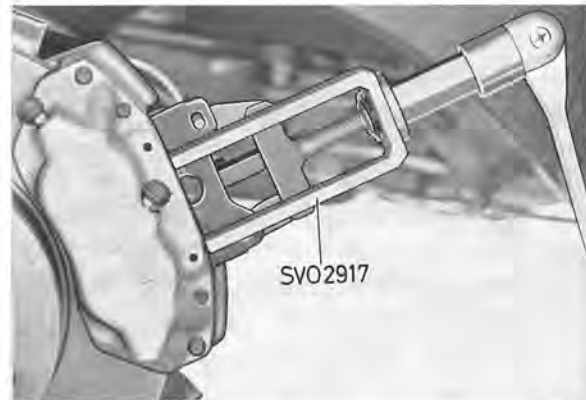


Fig. 5-14. Removing guide pin

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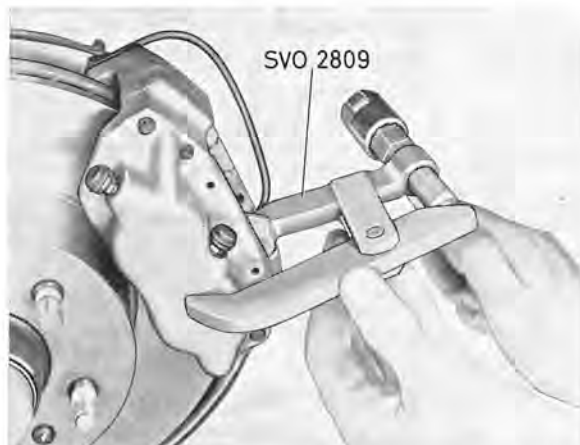
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Fig. 5-15. Removing brake pads

7. Concerns rear wheels 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 $\pm 2^\circ$, 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. Fit the 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.



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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. Re-fit 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 each other nut a little at a time until all are finally tightened to a torque of 100—140 Nm (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.

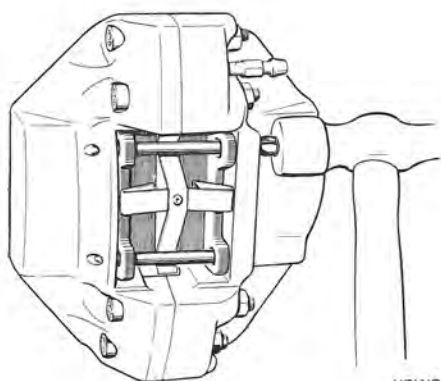


Fig. 5-18. Installing guide pin

RECONDITIONING WHEEL BRAKE UNITS

When working with the hydraulic system, observe the instructions under "Cleaning" and "Brake fluid", Group 50.

Front brake calipers

REMOVING

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.

DISASSEMBLING

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

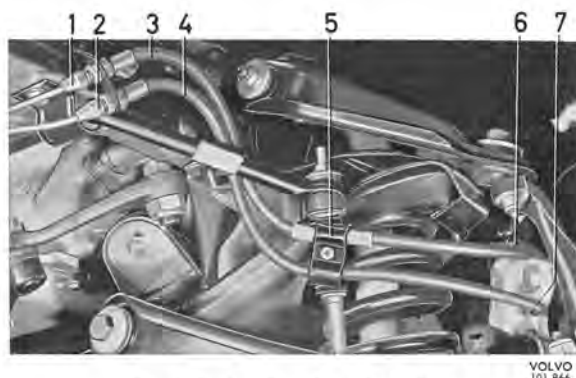


Fig. 5-19. Installing front brake hoses

- | | |
|---|---|
| 1. Connection for the primary circuit | 5. Clip |
| 2. Connection for the secondary circuit | 6. Connection for lower wheel unit cylinder |
| 3. Upper brake hose | 7. Connection for upper wheel unit cylinder |
| 4. Lower brake hose | |

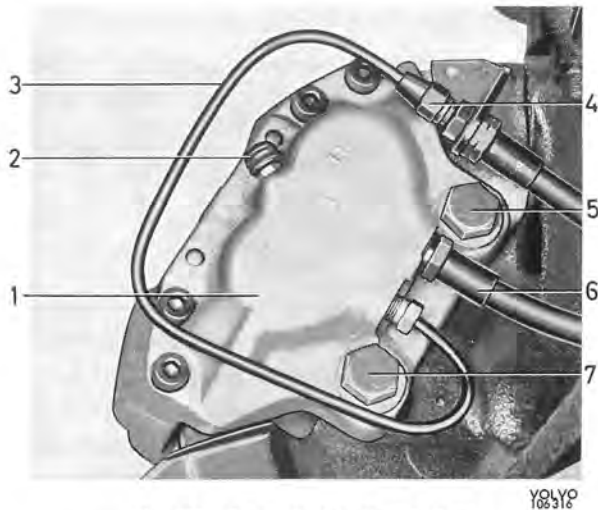


Fig. 5-20. Front wheel brake unit fitted

- | | |
|---|---|
| 1. Front wheel brake caliper | 5. Attaching bolt |
| 2. Lower bleeder nipple | 6. Connection for upper wheel unit cylinder |
| 3. Upper bleeder nipple | 7. Attaching bolt |
| 4. Connection for lower wheel unit cylinder | |

and press them out against the wood 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.

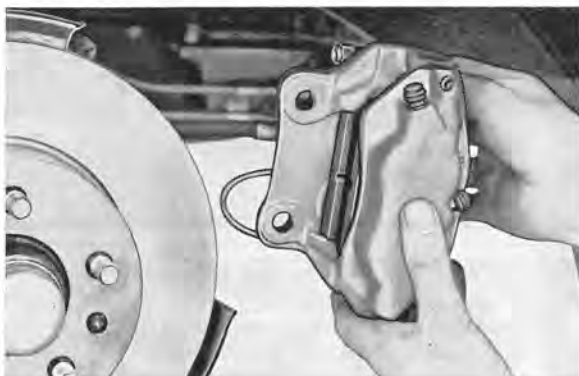


Fig. 5-21. Removing front wheel brake caliper

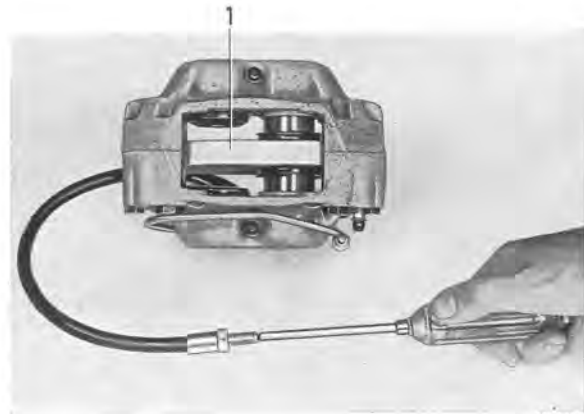


Fig. 5-22. Removing pistons
1. Wooden disc

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.

INSPECTING

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".

ASSEMBLING

1. Coat the working surfaces of the pistons and cylinders with brake fluid.
2. Fit new sealing rings in the cylinders, see Fig. 5-23.
3. Fit the plungers with the large end diameter facing inwards. Make sure that the plungers are fitted in straight and are not scratched.
4. Fit the rubber covers on the plunger and housing. Fit the lock rings, compare Fig. 5-28.
5. Fit the brake pads, see op. 8. under "Replacing brake pads".
6. Fit the bleeder nipples and also the brake lines.

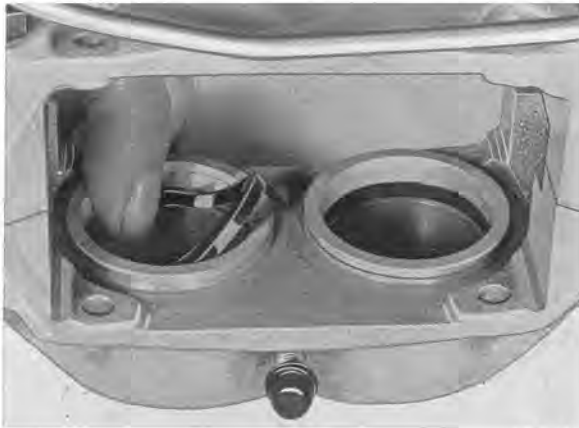


Fig. 5-23. Installing sealing ring

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INSTALLING

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 guage 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 Lock-tite, type AV. Check that the brake disc rotates easily in the brake pads.

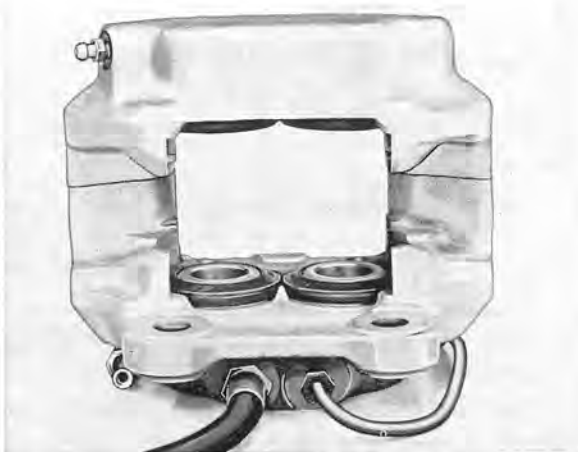


Fig. 5-24. Front brake caliper assembled

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2. Fit the 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. Fit on the 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 (70—100 lbft). Fit the hub cap.
4. Bleed the brake system, see Group 52.

Rear wheel brake shoes

REMOVING

1. Remove the hub caps and slacken the wheel nuts slightly. Temporarily block the vent-hole in the brake fluid container cap to reduce possible leakage.
2. Jack up the front end and prop blocks under the rear axle. Remove the wheels. Release the 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 the attaching bolts (2 and 5, Fig. 5-25). Remove the brake caliper, see Fig. 5-26.



Fig. 5-25. Rear wheel brake unit installed

- | | |
|-----------------------------|-------------------|
| 1. Bleeder nipple | 4. Brake line |
| 2. Attaching bolt | 5. Attaching bolt |
| 3. Rear wheel brake caliper | |

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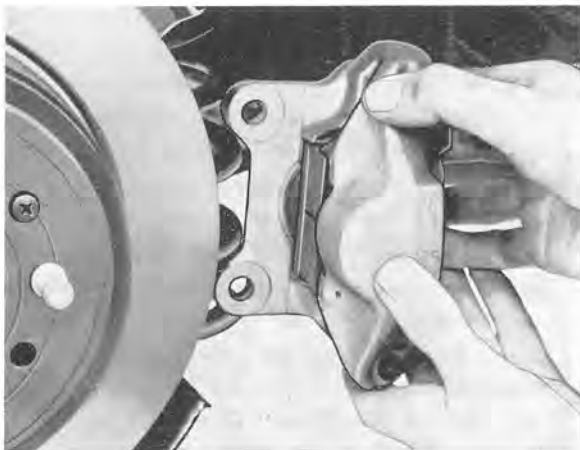


Fig. 5-26. Removing rear wheel brake caliper

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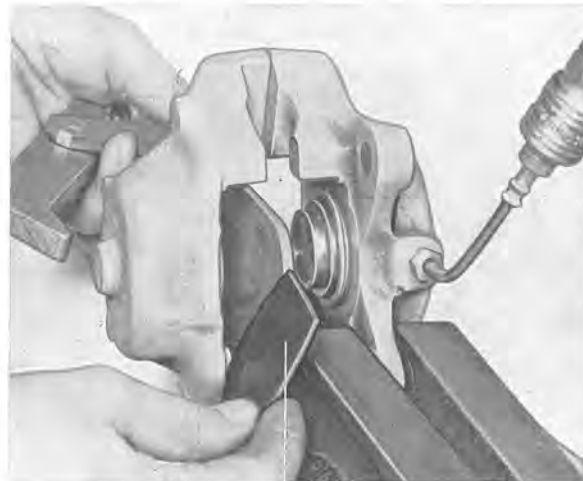


Fig. 5-28. Removing piston
A=Rubber seal

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DISASSEMBLING

1. Remove the brake pads, see ops. 3 and 4 under "Replacing brake pads".
2. Remove the retaining rings and the 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 the 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).

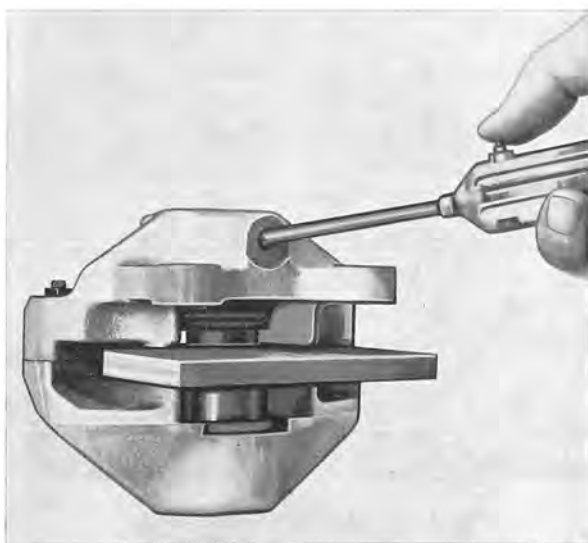


Fig. 5-27. Removing piston

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3. Remove the sealing rings with help of a blunt tool. Take care not to damage the edges of the grooves. Screw out the venting 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.

INSPECTING

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 reconditioning. If there are any scratches or suchlike in any of the cylinders, change the entire cylinder housing complete. Inspect the other parts and replace those that are damaged and worn.

ASSEMBLING

1. Coat the working surfaces of the pistons with brake fluid.
2. Fit the 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 $\pm 2^\circ$.

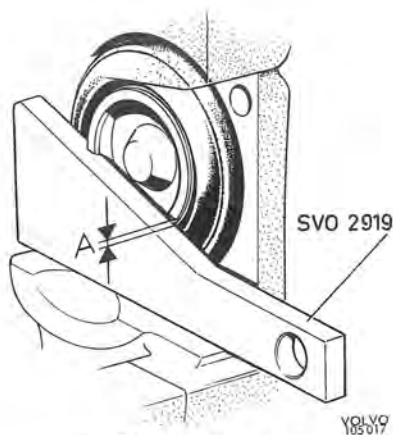


Fig. 5-29. Checking location

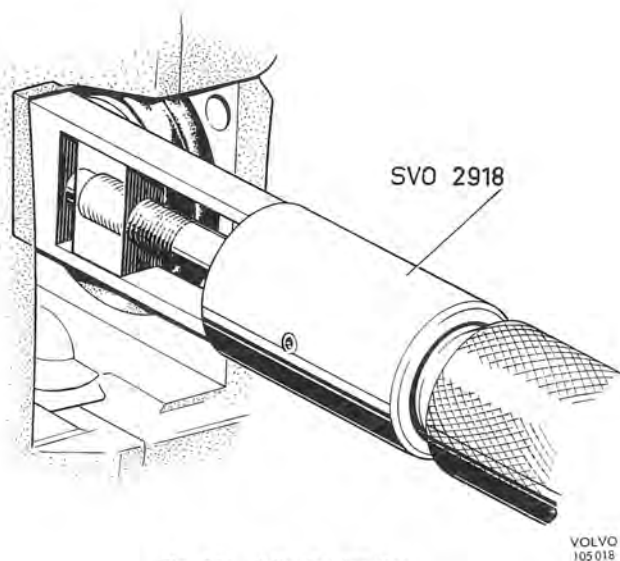


Fig. 5-30. Adjusting location

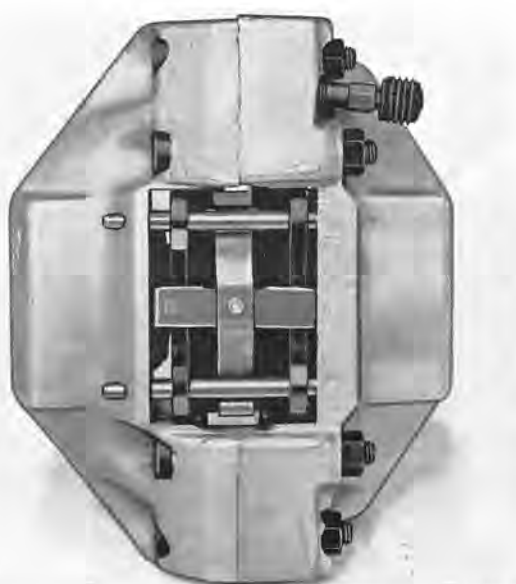


Fig. 5-31. Rear brake caliper assembled

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.

4. Fit 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. Fit the brake pads, see op. 8 under "Replacing the brake pads".
6. Screw in the bleeder nipple.

INSTALLING

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 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 available 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 vent-hole in the brake fluid container cover.
3. Clean the wheel contact surfaces and disc before fitting on the wheel. Tighten the wheel nuts so much that the wheel cannot be moved. Lower the vehicle and tighten the wheel nuts finally. Tighten each other nut a little at a time until all are finally tightened to a torque of 100—140 Nm (70—100 lbft). Fit the hub cap.
4. Bleed the fitted brake caliper, see Group 52.

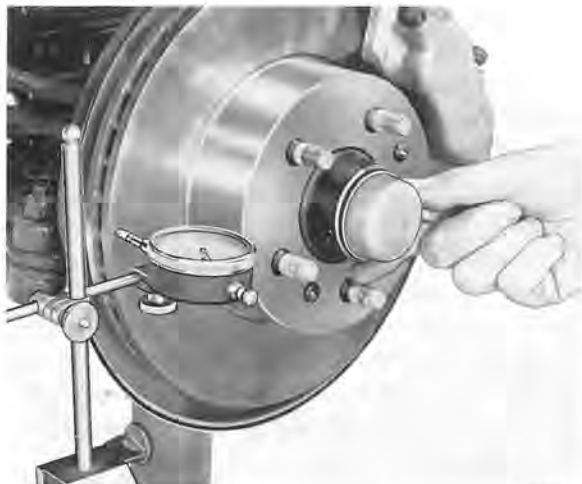


Fig. 5-32. Checking run-out

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BRAKE DISC

The brake disc should be examined with regard to the friction surface run-out thickness.

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 front wheel brakes and 0.15 mm (0.006") 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, for example, a micrometer. It should not vary more than 0.03 mm (0.0012") when the disc is rotated one turn, since this can cause a vibrating brake pedal.

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 Figs. 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 available, 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

DESCRIPTION

MASTER CYLINDER

The master cylinder is of the tandem type. Its construction is shown in Fig. 5-33 and its function is as follows:

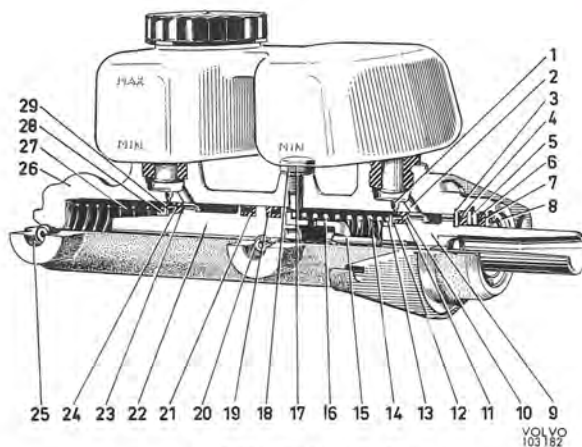


Fig. 5-33. Master cylinder

- | | |
|---------------------|--------------------------------------|
| 1. Equalizing hole | 17. Stop screw |
| 2. Overflow hole | 18. Seal |
| 3. Washer | 19. Piston seal |
| 4. Piston seal | 20. Connection for primary circuit |
| 5. Washer | 21. Piston seal |
| 6. Piston seal | 22. Secondary piston |
| 7. Washer | 23. Washer |
| 8. Circlip | 24. Piston seal |
| 9. Primary piston | 25. Connection for secondary circuit |
| 10. Washer | 26. Cylinder |
| 11. Piston seal | 27. Spring |
| 12. Washer | 28. Thrust washer |
| 13. Thrust washer | 29. Washer |
| 14. Spring | |
| 15. Screw | |
| 16. Spring retainer | |

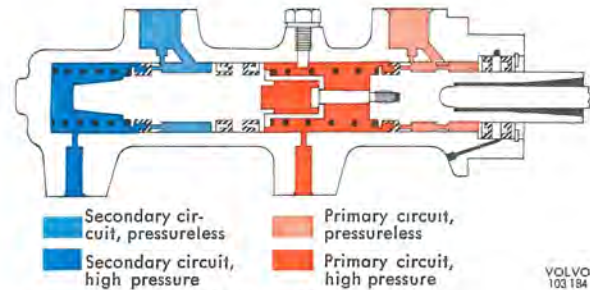


Fig. 5-35. Normal brake application

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 also is 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. If a leakage has occurred in the secondary circuit no hydraulic counterpressure builds up in front of the secondary piston. Instead, this piston is moved inwards when the brakes are applied until it is stopped by the end of the cylinder (Fig. 5-36).

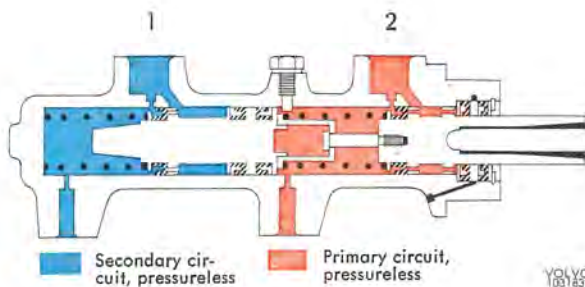


Fig. 5-34. Rest position

1 and 2. Connection for brake fluid container

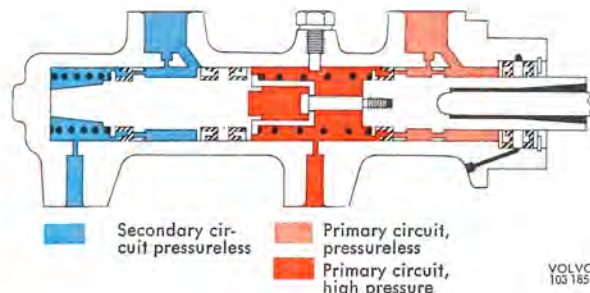


Fig. 5-36. Brake application with leakage in the secondary circuit

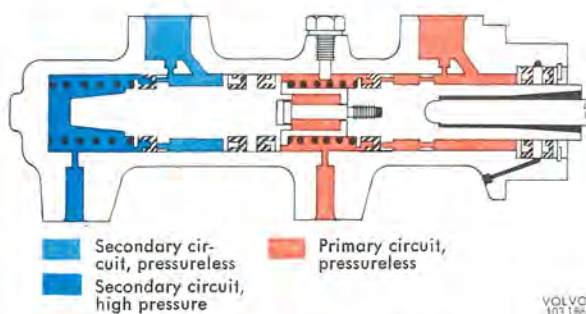


Fig. 5-37. Brake application with leakage in the primary circuit

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 pressure difference between the two brake

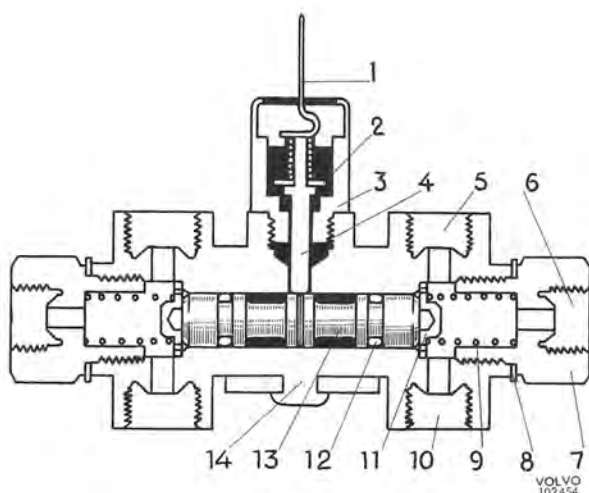


Fig. 5-38. Warning valve

- | | |
|----------------------------------|------------------------------------|
| 1. Electrical connection | 8. Sealing washer |
| 2. Switch washer | 9. Spring |
| 3. Switch housing | 10. Connection, front wheel brakes |
| 4. Guide pin | 11. Thrust washer |
| 5. Connection, rear wheel brakes | 12. O-ring |
| 6. Connection, master cylinder | 13. Piston |
| 7. End piece | 14. Housing |

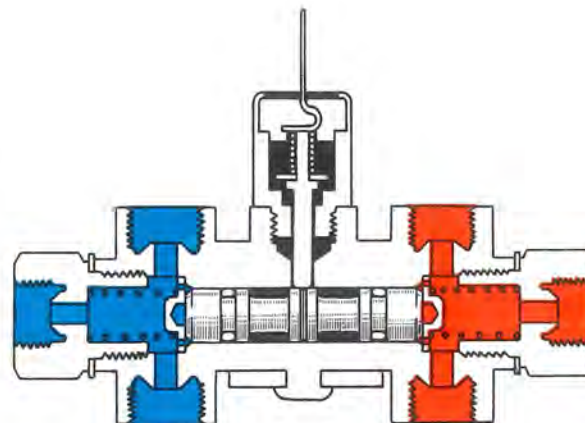


Fig. 5-39. Normal position

circuits exceeds about 10 kPa/cm² (142 psi). The valve construction is shown in Fig. 5-38 and it operates as follows:

If there is no fault in the circuits and the brakes are applied, the hydraulic pressure on the pistons is largely the same on both sides (Fig. 5-39). But should, for example, the pressure in the secondary circuit be somewhat higher than in the primary circuit, this will try to displace the pistons to the right in the figure. This lifts the thrust washer (11) and the pressure of the spring (9) counteracts the displacement.

It is only when the pressure in the secondary circuit first exceeds that in the primary circuit by about 10 kPa/cm² (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.

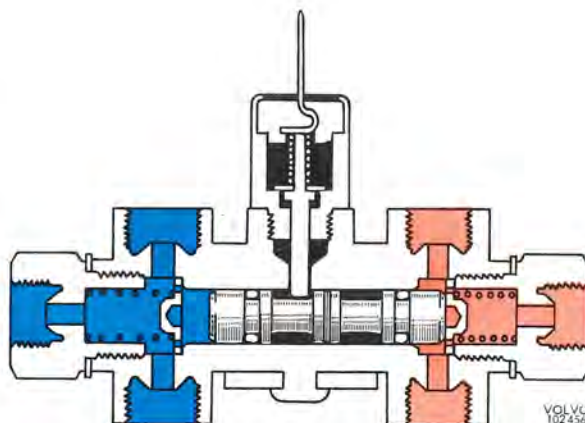


Fig. 5-40. Warning position

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/cm^2 (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 in 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/cm^2 (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

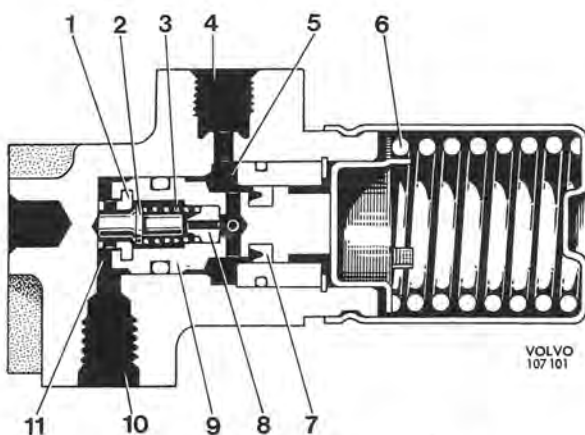


Fig. 5-41. Brake valve, construction

- | | |
|----------------------------------|--|
| 1. Valve seat | 7. Piston gasket |
| 2. Valve | 8. Equalizing valve |
| 3. Valve spring | 9. Piston |
| 4. Connection to master cylinder | 10. Connection to rear wheel brake cylinders |
| 5. Cylinder | 11. Cylinder |
| 6. Spring | |

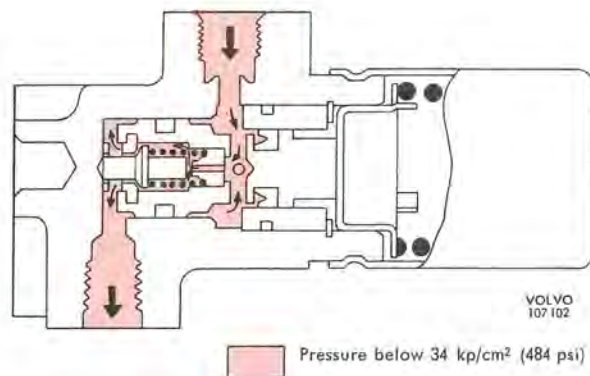


Fig. 5-42. Brake application

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.

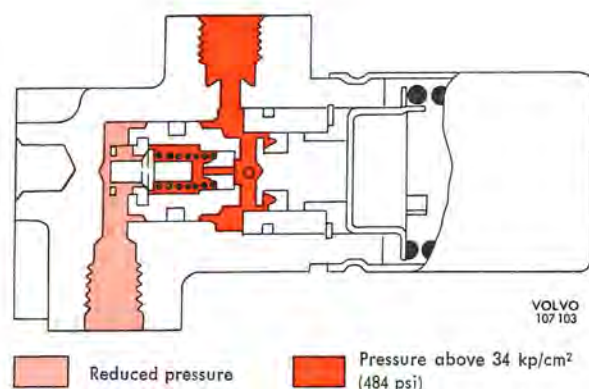


Fig. 5-43. Reducing action

REPAIR INSTRUCTIONS

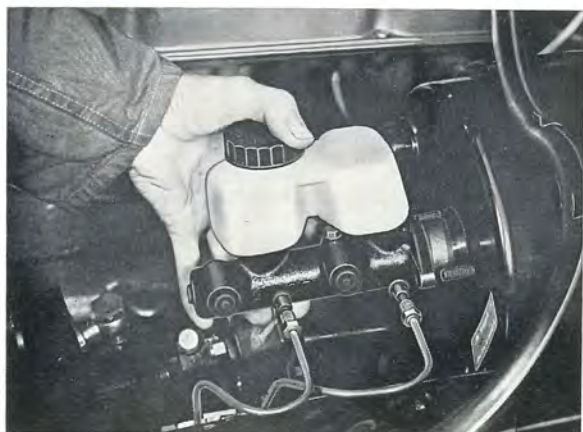


Fig. 5-44. Removing master cylinder

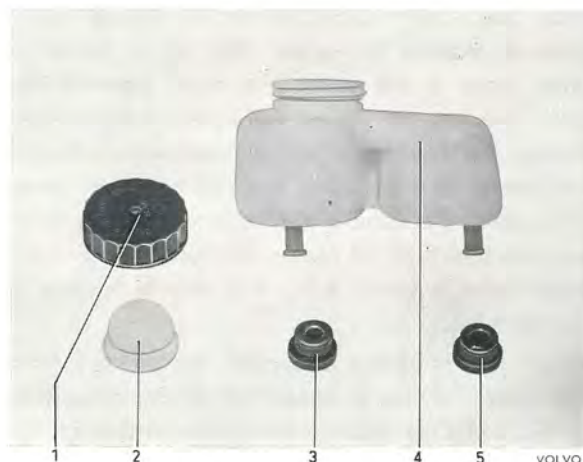


Fig. 5-46. Container parts

- | | |
|----------------|----------------|
| 1. Filler cap | 4. Container |
| 2. Strainer | 5. Rubber seal |
| 3. 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 can cause damage.

REMOVING

1. Place a cover over the mudguard and rags under the master cylinder in order to avoid possible damage to the paintwork should the brake fluid spill over.

2. Remove the lines from the master cylinder and fit plastic plugs as the lines are disconnected.
3. Remove the two attaching nuts for the master cylinder and lift the cylinder forwards, see Fig. 5-44. Empty out the brake fluid.

DISASSEMBLING

1. Fix the flange of the master cylinder firmly in a vice, 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.

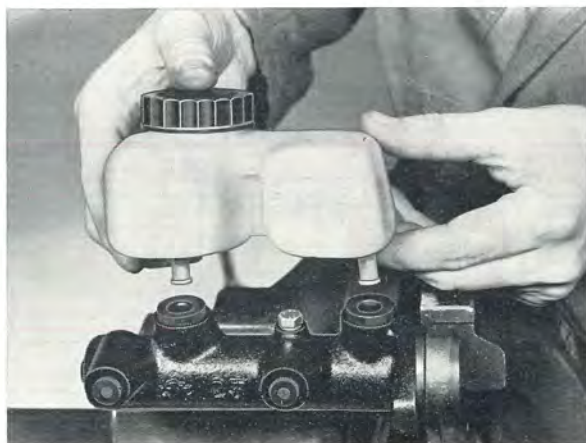


Fig. 5-45. Removing container

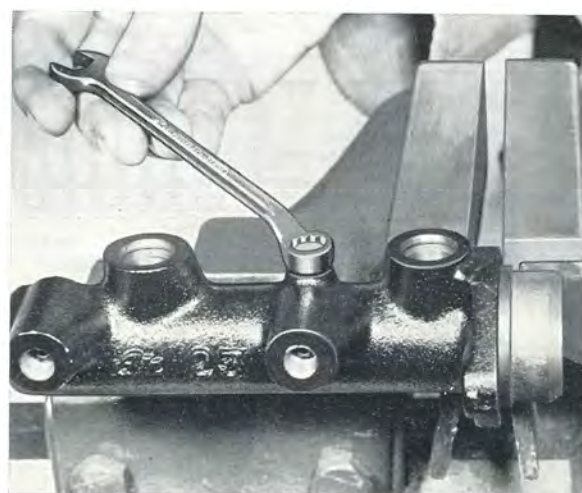


Fig. 5-47. Removing stop screw

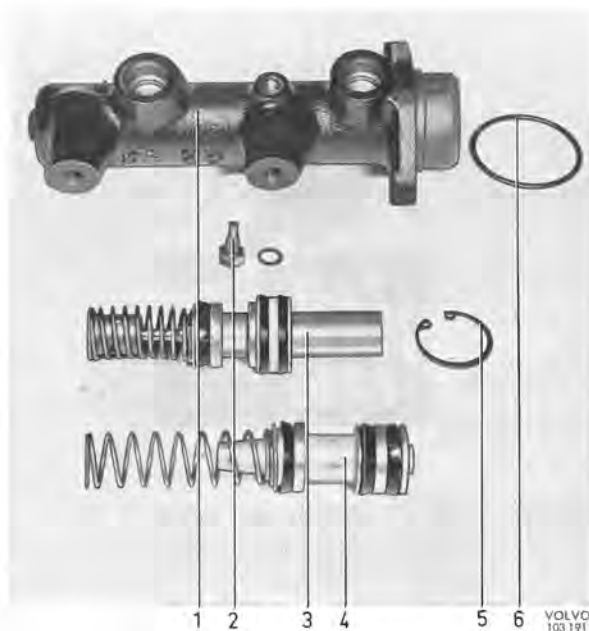


Fig. 5-48. Master cylinder disassembled

- | | |
|---------------------|---------------------|
| 1. Cylinder housing | 4. Secondary piston |
| 2. Stop screw | 5. Circlip |
| 3. Primary piston | 6. Sealing ring |

3. Unscrew the stop screw (Fig. 5-47). Remove the circlip from the primary piston with the help of circlip pliers. Remove the pistons.

INSPECTING

Before inspecting, clean all the parts according to the instructions given under "Cleaning", Group 50. Examine the inside of the cylinder carefully. If there are any scores or scratches, the cylinder should be replaced. Rust formation 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.

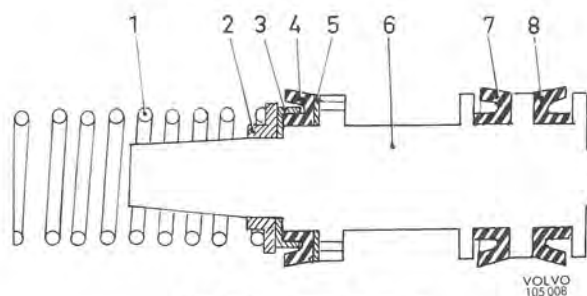


Fig. 5-49. Secondary piston

- | | |
|------------------|----------------|
| 1. Spring | 5. Washer |
| 2. Thrust washer | 6. Piston |
| 3. Back-up ring | 7. Piston seal |
| 4. Piston seal | 8. Piston seal |

ASSEMBLING

1. Fit 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. Fit the back-up ring (3), the thrust washer (2) and the spring (1) on the secondary piston and fit the piston as shown in Fig. 5-50. Be careful when inserting the seals in the cylinder.
3. Fit 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 fit 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 fit the screw (2, Fig. 5-48) with a new sealing washer. The tightening torque is 5–8 Nm (3.6–5.7 lbf).
6. Check the movement of the pistons and make sure that the through-flow holes are clear. The



Fig. 5-50. Installing secondary piston

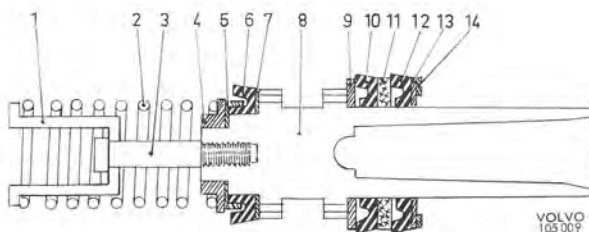


Fig. 5-51. Primary Piston

- | | |
|------------------|--------------------|
| 1. Sleeve | 8. Piston |
| 2. Spring | 9. Washer |
| 3. Screw | 10. Piston seal |
| 4. Thrust washer | 11. Plastic washer |
| 5. Back up ring | 12. Piston seal |
| 6. Piston seal | 13. Washer |
| 7. Washer | 14. Circlip |

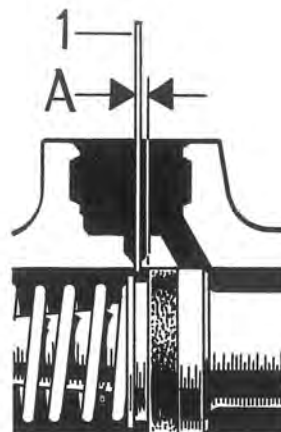


Fig. 5-53. Checking equalizing hole

1. 0.7 mm (22 s.w.g.) soft wire
A=Clearance between washer and seal

equalizing hole is checked 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.

- Fit the rubber seals (3 and 5, Fig. 5-46). Fit 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 fit the strainer (2) and cap in position.

INSTALLING

- Place the sealing ring (6, Fig. 5-49) on the master cylinder. Fit the cylinder in position and then the

washers together with the attaching nuts. The tightening torque for the nuts is 12–15 Nm (8.7–10.8 lbf ft).

- 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.
- Bleed the entire brake system.



Fig. 5-52. Fitting primary piston

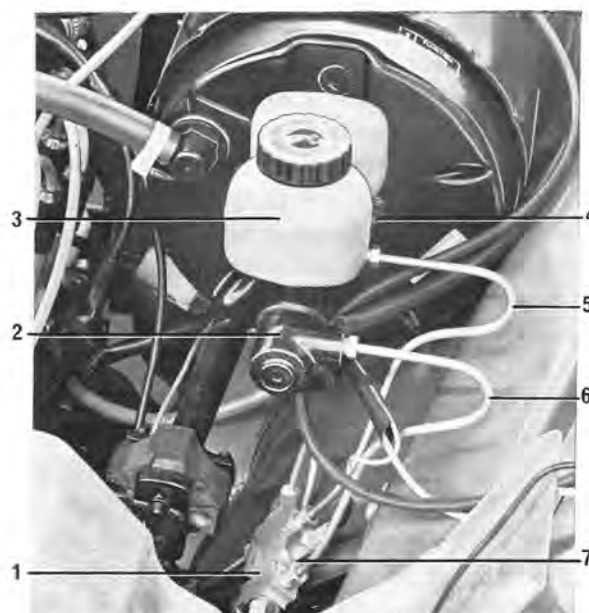


Fig. 5-54. Master cylinder fitted

- | | |
|--------------------------|----------------------------------|
| 1. Warning valve | 5. Brake pipe, primary circuit |
| 2. Master cylinder | 6. Brake pipe, secondary circuit |
| 3. Brake fluid container | 7. Elec. contact |
| 4. Nut | |

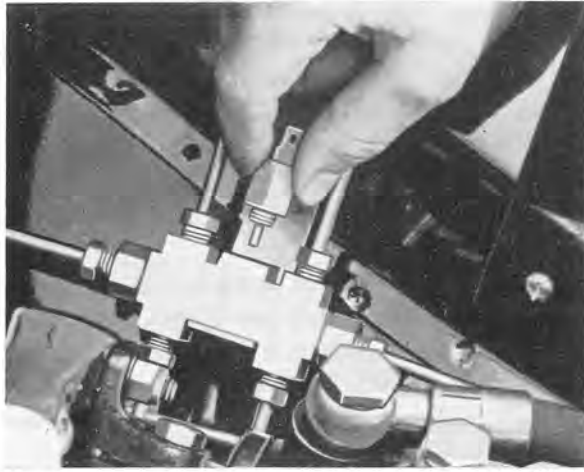


Fig. 5-55. Removing elec. contact

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 (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.

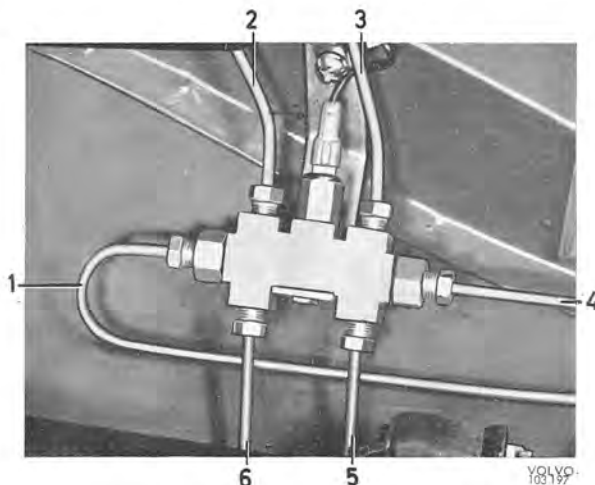


Fig. 5-56. Warning valve installed

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

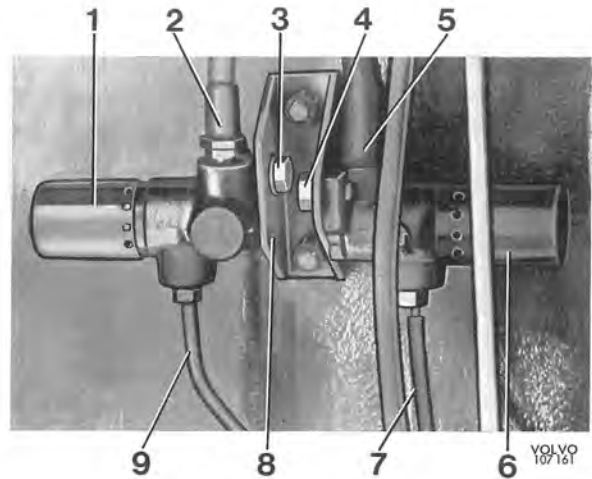


Fig. 5-57. Brake valves installed

- | | |
|---|---|
| 1. Left brake valve (secondary circuit) | 6. Right brake valve |
| 2. Brake hose to left rear wheel | 7. From primary circuit |
| 3. Attaching screw | 8. Bracket |
| 4. Attaching screw | 9. From the master cylinder secondary circuit |
| 5. Brake hose to right rear wheel | |

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. With regard to requirements concerning the cleaning agent, see the general instructions, 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 instructions given below.

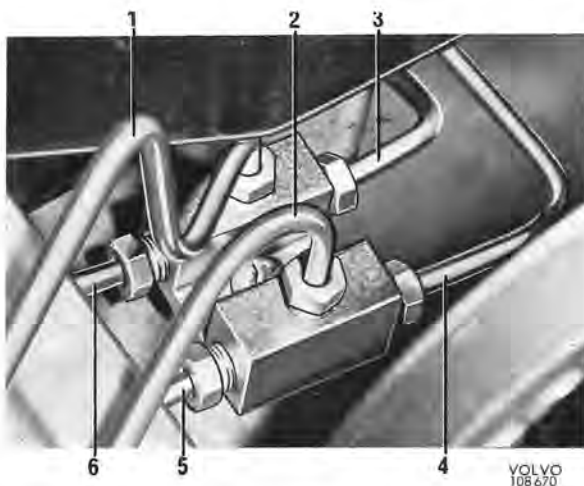


Fig. 5-59. 6-branch union

1. Secondary circuit from warning valve
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

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

As soon as any part of the system has been removed, bleeding must be carried out. Air can also enter the system if there is too small a quantity of brake fluid in the container. If, for example, only one rear brake



Fig. 5-60. Pedal travel

A=approx. 152 mm (6")



Fig. 5-61. Connecting bleeder unit VOLVO 108 662

caliper has been removed and very little 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 blocks 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 J1703. Brake fluid with designation DOT 3 or DOT 4 can also be used. **Brake oil which has been bled out of the system must under no circumstances be put back into the bleeder unit or the container.**

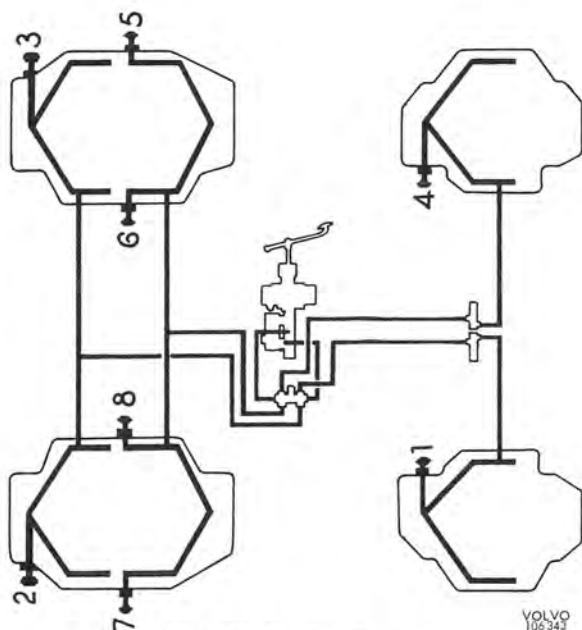


Fig. 5-62. Bleeding diagram VOLVO 108 342



Fig. 5-63. Bleeding front wheel brake unit

BLEEDING 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/cm² (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

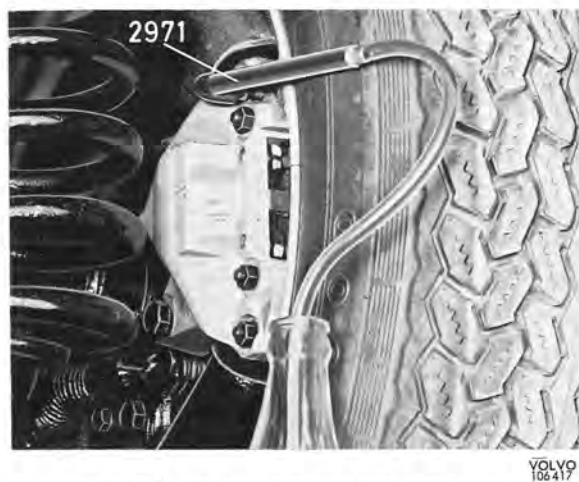


Fig. 5-64. Bleeding left rear wheel brake unit

the 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 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. Fit the warning switch and tighten it to a torque of 14–20 Nm (10–15 lbft). Connect the electric cable. Check that the warning lamp lights 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.
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 bleeder 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. Then 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. Fit the warning switch and tighten it to a torque of 14–20 Nm (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 dashboard.
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).
4. Fit the new pedal bushes (9) and lubricate the bearing sleeves (8) with a light layer of ball-



Fig. 5-65. Bleeding front wheel brakes

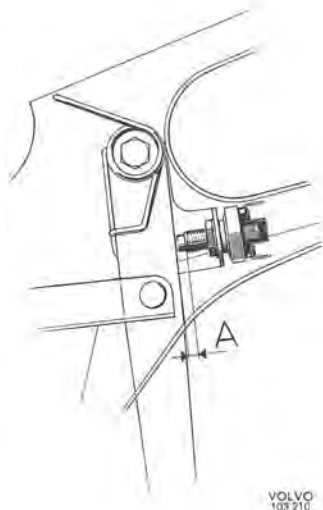


Fig. 5-66. Adjusting brake light switch
A=2—6 mm (1/8")

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 BUSHES IN BRAKE PEDAL AND LEVER

1. Remove the panel under the dashboard.
2. Remove the bracket (12, Fig. 5-67) for the brake light switch. Remove the split pins and bolts (6—13). Unhook the return spring (10) and the spring (16). Unscrew the nuts for the bolts (1—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 bushes (3—9).
5. Clean the parts. If the bearing sleeves are worn, replace them.

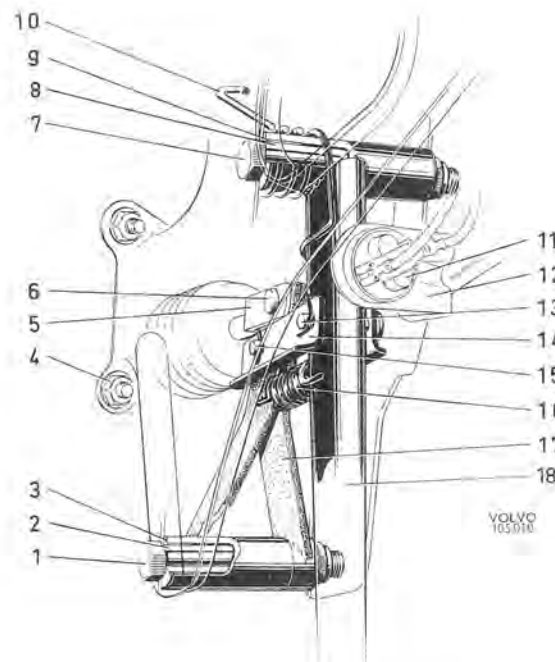


Fig. 5-67. Brake pedal suspension components

- | | |
|-------------------|------------------------|
| 1. Bolt | 10. Return spring |
| 2. Bearing sleeve | 11. Brake light switch |
| 3. Bush | 12. Bracket |
| 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. Bush | 18. Brake pedal |

6. Press in the new bushes (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. Fit the bracket (12) and adjust the brake light switch (11), see under "Adjusting brake light switch".
10. Re-install the panel.

AUXILIARY BRAKE SYSTEM

DESCRIPTION

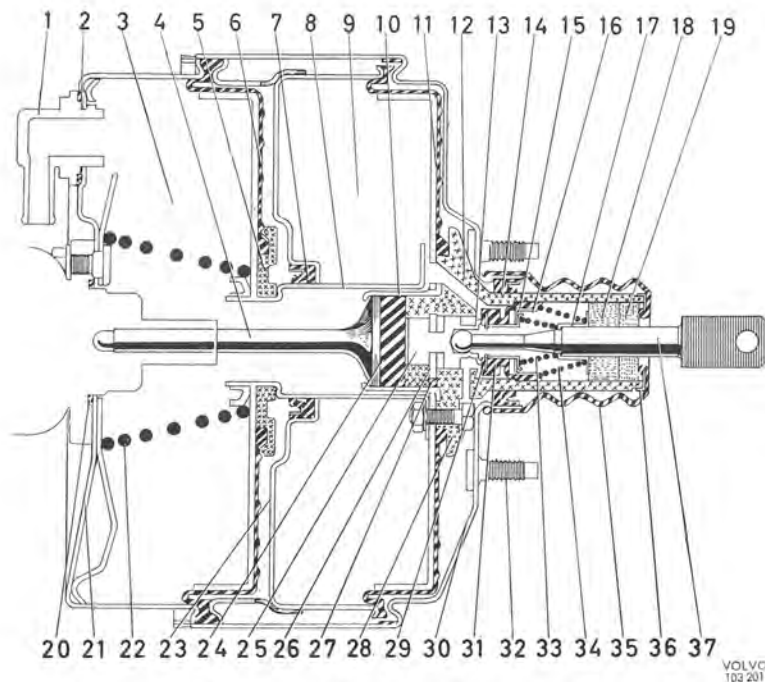


Fig. 5-68. Power cylinder

- | | | | | |
|-------------------------|------------------------|-------------------|---------------------|---------------------|
| 1. Vacuum inlet | 9. Rear vacuum chamber | 17. Retainer | 25. Valve piston | 33. Valve spring |
| 2. Sealing ring | 10. Retainer | 18. Filter | 26. Stop washer | 34. Return spring |
| 3. Front vacuum chamber | 11. Diaphragm | 19. Silencer | 27. Washer | 35. Rubber cover |
| 4. Front thrust rod | 12. Guide housing | 20. Sealing ring | 28. Guide housing | 36. Washer |
| 5. Retainer | 13. Valve piston seat | 21. Cylinder | 29. Valve guide | 37. Rear thrust rod |
| 6. Diaphragm | 14. Sealing ring | 22. Return spring | 30. End | |
| 7. Sealing ring | 15. Seal | 23. End | 31. Valve plate | |
| 8. Guide sleeve | 16. Guide | 24. Reaction disc | 32. Attaching screw | |

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

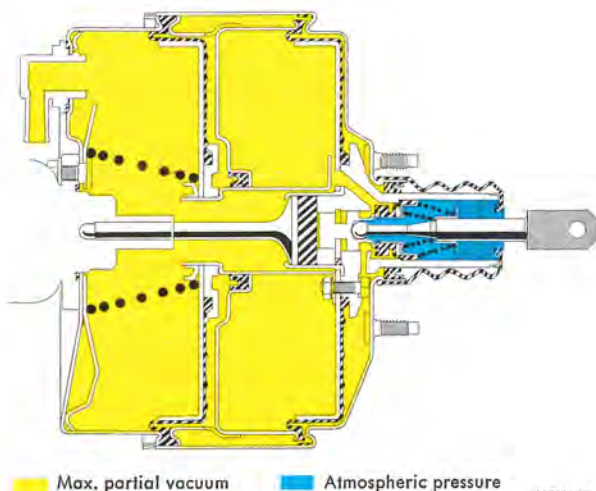


Fig. 5-69. Rest position

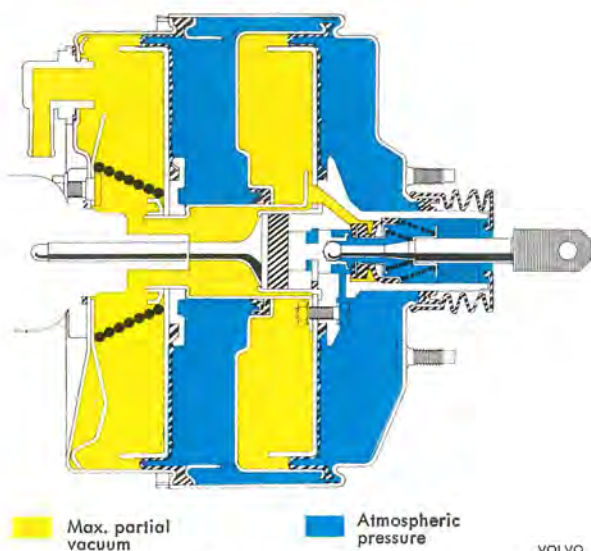


Fig. 5-70. Full brake application

equivalent vacuum exists on both sides of the diaphragm which, together with the guide housing, is held pressed to the right end position of the diaphragm spring.

When the brake pedal is depressed, the rear thrust 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 centre 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 centre 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 centre 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 centre 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 equalizing 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.

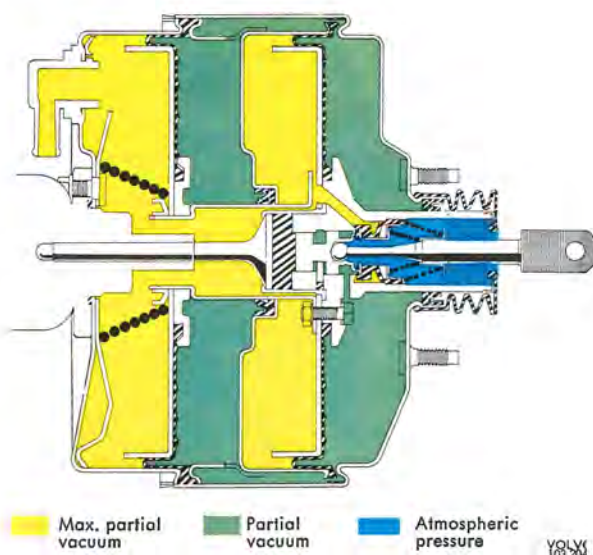


Fig. 5-71. Partial brake application

CHECK VALVE

The check valve (Fig. 5-72) is placed on the line between the engine intake manifold 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.

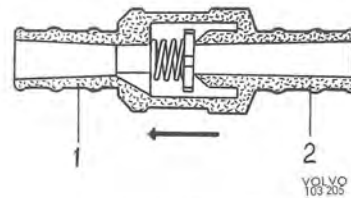


Fig. 5-72. Check valve

1. Connection for intake manifold 2. Connection for power cylinder

REPAIR INSTRUCTIONS

REPLACING AIR CLEANER AND DAMPER FOR POWER CYLINDER

REMOVING

1. Remove the panel under the dashboard.
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 (35, Fig. 5-68).
6. Remove the protective washer, see Fig. 5-73, from the cylinder.
7. Remove the damper (1, Fig. 5-74) and the air cleaner (2).



Fig. 5-73. Removing washer

INSTALLING

1. Fit the cleaner and the silencer. The slots on the cleaner and damper should be displaced 180° from each other.
2. Fit 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. Fit the split pin bolts.
4. Fit the bracket (12, Fig. 5-67), and adjust the brake light switch (11), see under "Adjusting brake light switch" on page 5 : 26.
5. Fit the panel under the dashboard and the fusing.

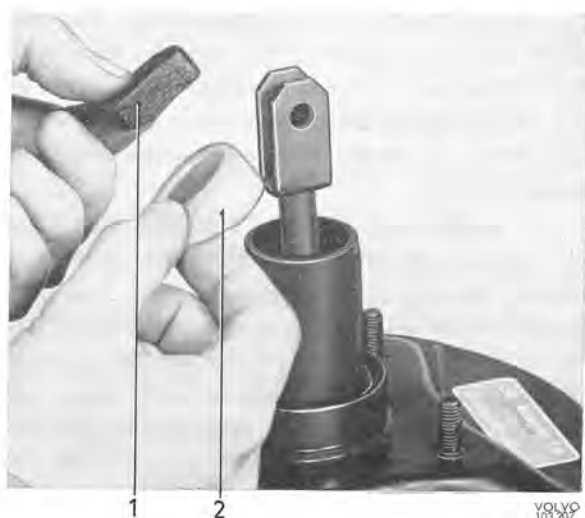


Fig. 5-74. Replacing cleaner and damper

1. Damper 2. Air cleaner



VOLVO
108 668

Fig. 5-75. Check valve installed

REPLACING CHECK VALVE

Remove the check valve, see Fig. 5-75, from the vacuum hose. Ensure that the new check valve functions properly. Fit 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

REMOVING

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.

INSTALLING

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. Fit the bracket for the clutch pedal. Secure the link arm to the brake pedal.
4. Fit the vacuum hose. The connection for the vacuum hose should face downwards.
5. Bleed the entire brake system.

PARKING BRAKE

DESCRIPTION

The construction of the parking brake is shown in Fig. 5-76. The parking brake lever is mounted on the floor on the outside of the driving seat. The movement of the lever is transmitted via the shaft (4), lever and pull rod (5) to the pulley (6). From here the movement is transmitted through the cable (7) to the rear wheel brake units. At each rear wheel, the movements of the cable influence the lever (16), which is carried in a movable rod (17) on the brake shoes. The lower ends of the brake shoes are held pressed against the anchor bolt (18) by the lower spring. The upper ends are jointed through the adjusting devices (15) to which

they are held pressed by the spring (14), which also locks the small serrated wheel of the adjusting screw. Due to this type of suspension, the brake shoes are self-centring and both the shoes are partly self-applying (Duo-Servo). The brake drum is fitted on the drive shaft and so designed that it also serves as a brake disc for the footbrake.

When the parking brake is applied, the lever and rod press the shoes against the brake drum. When the wheels or drive shaft attempt to turn the drum, the shoes accompany the rotation because of the friction between lining and drum. Due to the "floating" sus-

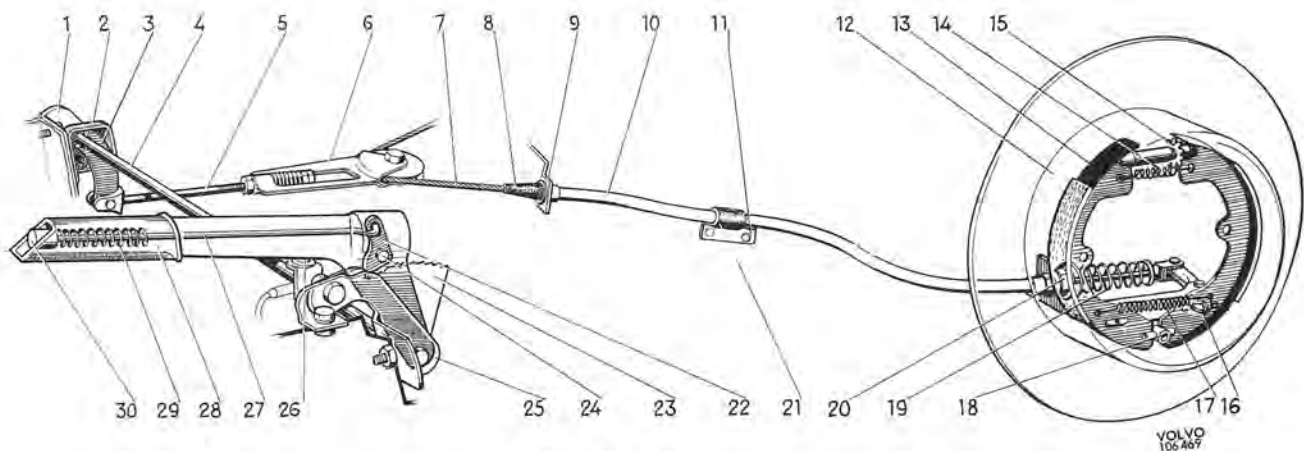


Fig. 5-76. Parking brake

- | | | |
|------------------------------|------------------------|--------------------------------|
| 1. Inside support attachment | 12. Brake drum | 22. Pawl |
| 2. Rubber cover | 13. Brake shoe | 23. Ratchet segment |
| 3. Lever | 14. Return spring | 24. Rivet |
| 4. Shaft | 15. Adjusting device | 25. Outside support attachment |
| 5. Pull rod | 16. Lever | 26. Warning valve switch |
| 6. Pulley | 17. Movable rod | 27. Push rod |
| 7. Cable | 18. Anchor bolt | 28. Parking brake |
| 8. Rubber cover | 19. Return spring | 29. Spring |
| 9. Front attachment | 20. Rear attachment | 30. Push button |
| 10. Cable sleeve | 21. Rubber cable guide | |
| 11. Attachment | | |

pension of the shoes, the primary shoe is thus pressed upwards and the secondary shoe downwards until the lower end moves towards the anchor bolt, see Fig. 5-77.

Due to the fact that the turning centre of the secondary shoe lies in the anchor bolt and that of the primary shoe in the adjusting device, the friction between the drum and the linings will assist in brake application. Also contributing to this is the retarding effect on the secondary shoe because of the primary shoe's endeavour to accompany the direction of rotation of the drum.

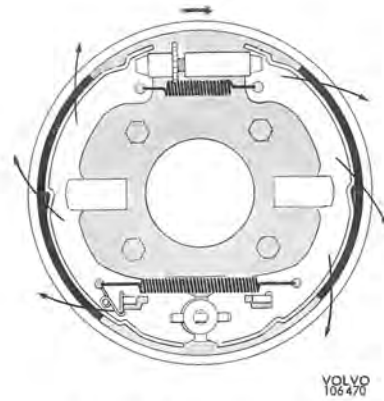


Fig. 5-77. Duo-servo principle

REPAIR INSTRUCTIONS

ADJUSTING PARKING BRAKE

The parking brake should give full effect at the third-fourth notch. If it does not do so, adjustment should be carried out. Here the wheel brake units are first adjusted and, if necessary, the cable.

1. Apply the parking brake, remove the hub caps of the rear wheels and loosen the wheel nuts.
2. Jack up the rear end, prop blocks under the rear axle, remove the nuts and take off the wheels. Release the parking brake.
3. Check that the brake pads are not stuck to the brake disc. To prevent the lever when adjusting from influencing the shoes and thus give misleading results, the spring tension acting on the lever should be reduced. This can be done by fitting holder 2742 (Fig. 8-81) or by disconnecting the cable from the lever.
4. Set the drum so that its hole coincides with the serrations on the adjusting screw and apply the shoes by moving the screwdriver handle upwards, see Fig. 5-78. When the drum cannot be rotated easily, discontinue applying the shoes. Then turn the adjusting screw back 4—5 serrations. Check that shoes do not "drag" by rotating the drum in its normal direction of rotation. Very little dragging may be permitted. If, however, the dragging is more pronounced, the adjusting screw should be released a further 2—3 serrations. Con-

nect the cable to the lever and remove the holder 2742.

5. Repeat the adjusting procedure with the other rear wheel.
6. Apply the parking brake lever and check that full braking effect is obtained on the 3rd—4th notch. If the parking brake can be applied still further, the



Fig. 5-78. Adjusting the parking brake, rear wheel

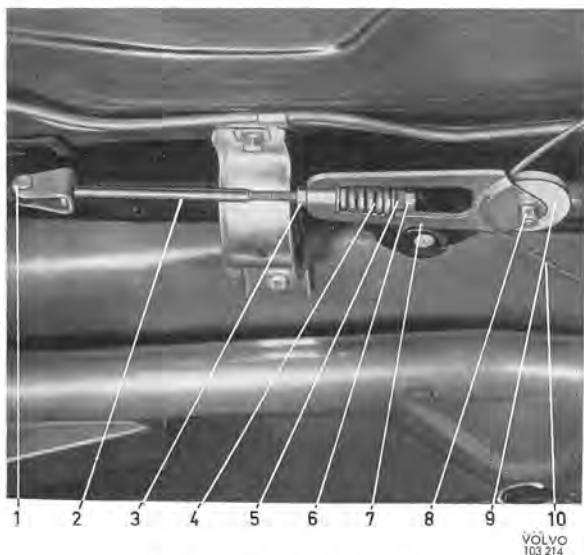


Fig. 5-79. Adjusting device cable

- | | |
|------------------|------------|
| 1. Bolt | 6. Locknut |
| 2. Pull rod | 7. Pulley |
| 3. Locknut | 8. Bolt |
| 4. Spring | 9. Wheel |
| 5. Adjusting nut | 10. Cable |

cable should be tensioned. This is done by loosening the locknuts and screwing in the pulley or the clevis on the pull rod. After adjusting, tighten the locknuts. Check that there is approximately the same braking effect on both rear wheels.

7. Mount the wheels after having cleaned any dirt from the contact surfaces, and tighten the wheel nuts sufficiently so that the wheel cannot move. Lower the vehicle and tighten the nuts. Tighten every other nut a little at a time until all are tightened to a torque of 100–140 Nm (70–100 lbft). Fit the hub caps.

REPLACING CABLE

REMOVING

1. Apply the parking brake, remove the hub caps of the rear wheels and loosen the wheel nuts.
2. Jack up the rear end, place blocks under the rear axle, remove the nuts and take off the wheels. Release the parking brake.
3. Remove the pulley (7, Fig. 5-79) or the clevis (4, Fig. 5-80). Remove the wheel (9) to get at the cable.
4. Remove the rubber cover (8, Fig. 5-76) for the front attachment of the cable sleeve and the nut as well as the attachment for the rubber suspension ring on the frame member. Remove the cable from the other side of the attachment in the same way.

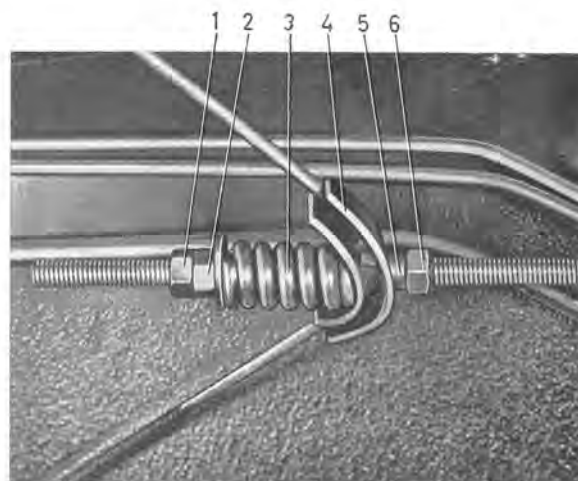


Fig. 5-80. Brake components, right-hand drive

- | | |
|------------------|------------|
| 1. Locknut | 4. Clevis |
| 2. Adjusting nut | 5. Sleeve |
| 3. Spring | 6. Locknut |

5. Place holder 2742 so that the return spring is held in position according to Fig. 5-81. Bend up the lock and remove the lock pin so that the cable releases from the lever.
6. Remove the return spring with washers. Loosen the nut for the rear attachment of the cable sleeve. Lift the cable forwards after having loosened both sides of the attachments.

INSTALLING

1. Adjust the brake shoes of the rear wheels. Check that the brake pads do not stick to the brake disc and adjust the drum so that its hole coincides with the serrations of the adjusting screw. Place a screwdriver between the serrations of the adjusting screw and apply the shoes by moving the

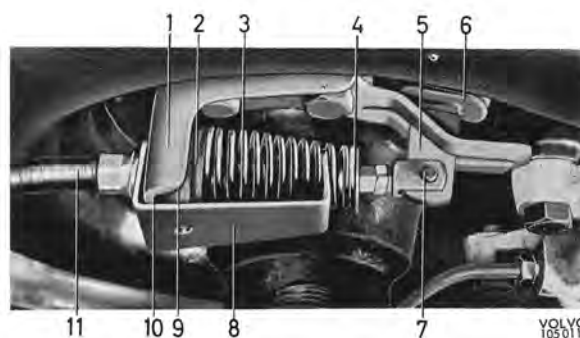


Fig. 5-81. Installing spring tool

- | | |
|---------------------|------------------|
| 1. Cable attachment | 7. Lock pin |
| 2. Washer | 8. Holder 2742 |
| 3. Return spring | 9. Nut |
| 4. Washer | 10. Lock washer |
| 5. Lever | 11. Cable sleeve |
| 6. Rubber cover | |

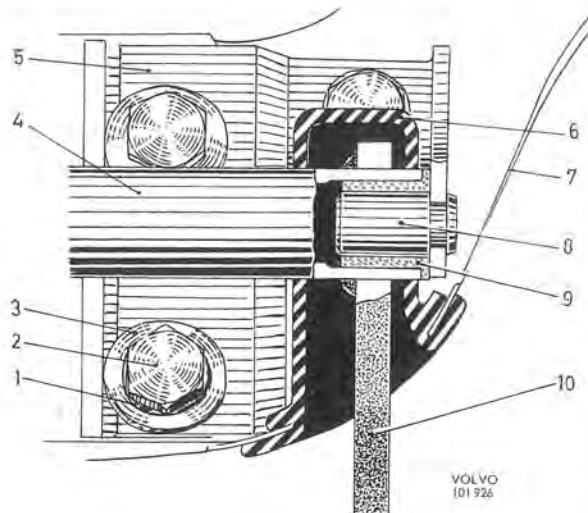


Fig. 5-82. Inner shaft support

- | | |
|-----------------------------|-----------------|
| 1. Spring washer | 6. Rubber cover |
| 2. Attachment bolt | 7. Floor |
| 3. Flat washer | 8. Support pin |
| 4. Shaft | 9. Bush |
| 5. Inner support attachment | 10. Lever |

screwdriver handle upwards, see Fig. 5-78. When the drum can be turned easily, discontinue applying the shoes. Then turn the adjusting screw 4—5 serrations back.

- Fit on new rubber cable guides for the cable suspension. Place the cable in position in the rear attachment and tighten the nut. Fit the washers and return spring. Compress the spring with the help of the holder tool, see Fig. 5-81. Oil the lock pin and fit it together with the cable on the lever. Fit the attachment and rubber cable guide on the frame member.
- Fit the cable in the same way as above on the other side of the vehicle.
- Place the cable sleeve in position in the front attachments and fit rubber covers.
- Lubricate and fit the wheel and pulley or the clevis on the pull rod. Adjust so that the parking brake gives full effect at the 3rd—4th notch.
- Fit the wheels, see operation under "Adjusting the parking brake".

REPLACING PARKING BRAKE LEVER OR RATCHET PARTS

- Jack up the rear end and prop blocks under the rear axle.
- Remove the split pin and stretch the cable so that the pull rod (5, Fig. 5-76) can be removed from the lever.
- Loosen the three attachments for the frame of the seat slide rails and lift the whole seat forwards.
- Remove the rubber covers, the ratchet segment



Fig. 5-83. Removing the brake drum

and the bearing. Pull the parking brake lever with shaft and lever forwards.

- Unscrew the button (30, Fig. 5-76) and remove the spring (29) from the parking brake lever. Remove the rivet (24) and take out the push rod (27) and the pawl (22).
- Fit the new parts in the reverse order, see Fig. 5-76. Make sure that the rivet is firmly fixed but does not obstruct the movement of the pawl. Lubricate the bushes with a thin coat of ball bearing grease. Do not forget to lock the pull rod and make sure that the rubber covers seal well.

REAR WHEEL BRAKE UNIT (PARKING BRAKE COMPONENT)

DISASSEMBLING

- Apply the parking brake, remove the hub caps of the rear wheels and loosen the wheel nuts.
- Jack up the rear end, prop blocks under the rear axle, remove the nuts and take off the wheels. Release the parking brake.
- Screw loose the brake line (4, Fig. 5-25) from the rear brake caliper and plug the connection. Brake fluid must not spill onto the disc or brake pads. Remove the attaching bolts (2 and 5, Fig. 5-25). Lift out the caliper, see Fig. 5-26.
- Remove the attaching bolts for the brake drum and lift off the drum, see Fig. 5-83.
- Remove both the return springs and the adjusting device. Lift forward the shoes, see Fig. 5-84. Manoeuvring the links will facilitate removal.

INSPECTING

First check that there is no oil leakage. If there is oil leakage, replace the sealing ring, see Group 46. Clean



Fig. 5-84. Removing the brake shoes

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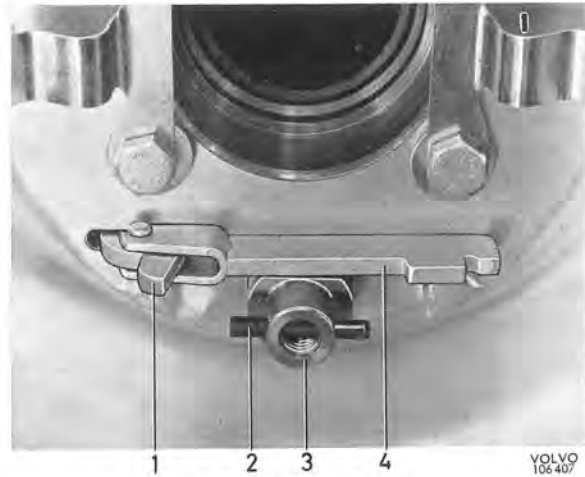


Fig. 5-85. Brake parts

1. Lever 2. Guide pin 3. Anchor bolt 4. Link

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all the parts except the brake linings. Check that the lever joint does not chafe and replace parts which are damaged or worn.

If the brake linings are oily or worn down to the rivets, replace the shoes completely. The brake drum should be replaced if its friction surface is concave, or if its out-of-round exceeds 0.2 mm (0.008"). Rust spots can, however, be polished off. Wipe the contact surfaces on the backing plate.

ASSEMBLING

1. If new linings or drums are to be fitted, slacken the pulley (7, Fig. 5-79) or the clevis (4, Fig. 5-80) to remove tension in the cable.
2. Coat the 6 guide lips on the backing plate as well as the lever joint and adjusting screw with heat-resistant graphite grease intended for this purpose.
3. Check that the lever and anchor bolt parts are correctly fitted, see Fig. 5-85. Check that the washer (8, Fig. 5-86) and the spring (9) are in position in the primary shoe. Fit the brake shoes, see Fig. 5-84. The shorter sleeve on the adjusting device should be turned forwards on the right-hand side and backwards on the left-hand side, see Fig. 5-86.
4. Hook on the return springs.
5. Fit the brake drum with attaching bolts.
6. Place the brake caliper in position. Fit any shims and the attaching bolts (1 and 3, Fig. 5-25) after smearing the bolts with a couple of drops of Lock-tite, type AV.

7. Check that the brake pads move freely from the brake disc and adjust the parking brake, see operation 4—6 under "Adjusting the parking brake".
8. Bleed the fitted brake caliper, see Group 52.
9. Fit the wheel, see operation 7 under "Adjusting parking brake".

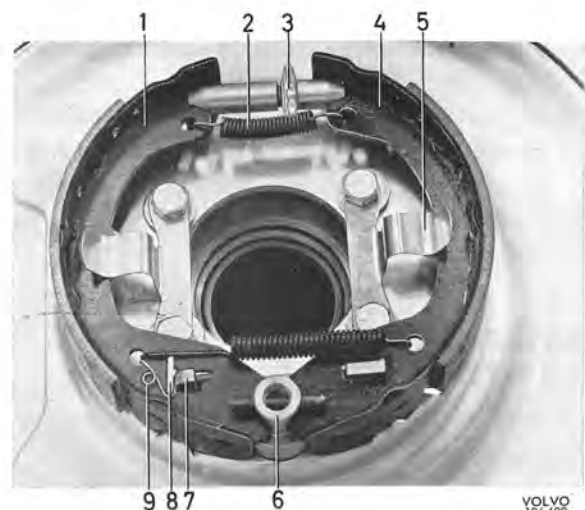


Fig. 5-86. Parking brake

- | | |
|--------------------------------------|----------------------------|
| 1. Rear brake shoe (spring shoe) | 5. Retainer for brake shoe |
| 2. Upper return spring | 6. Anchor bolt |
| 3. Adjusting device | 7. Lever |
| 4. Front brake shoe (secondary shoe) | 8. Washer |
| | 9. Spring |

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Part 6

FRONT END
AND
STEERING GEAR

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Group 64. Steering Gear

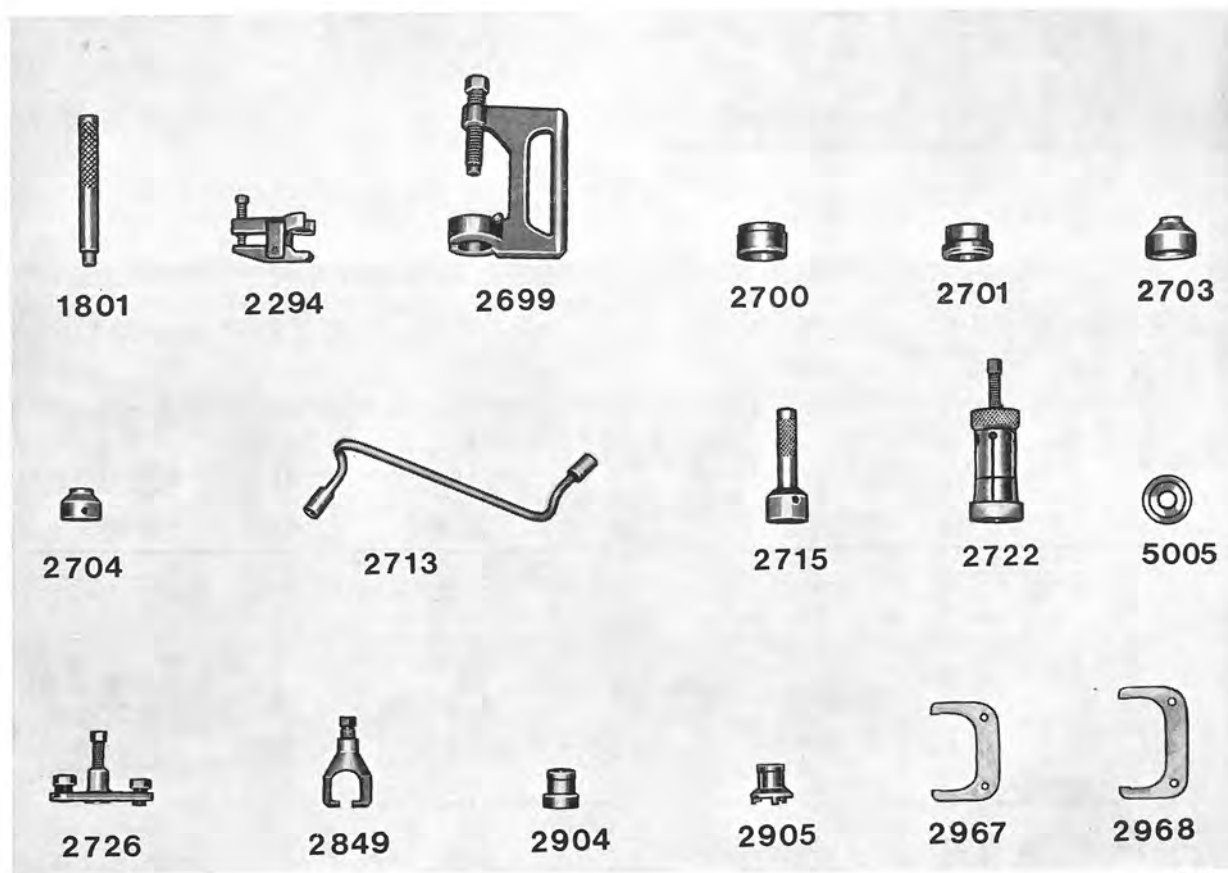
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Illustration A and B

GROUP 60

GENERAL TOOLS

The numbers for the special tools are preceded by 999 or SVO (e.g. 999 1801 or SVO 1801)



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Fig. 6-1. Tools for work on front axle

999 (SVO)

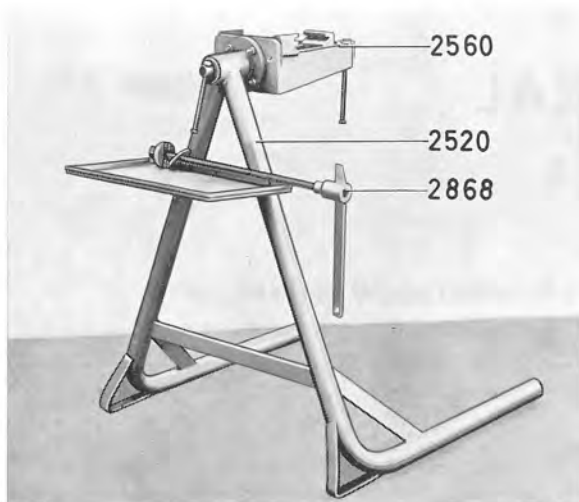
- 1801 Standard handle 18×200
- 2294 Press tool, for removing ball joints, tie-rod end
- 2699 Press tool, for removing and installing ball joints and rubber bushes, control arms
- 2700 Sleeve, for installing ball joint, lower control arms
- 2701 Sleeve, for removing and installing ball joint, upper control arms, and bushes in lower control arms, incl. 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

999 (SVO)

- 2715 Drift, for removing and installing grease cap in hub
- 2722 Puller, inner ring, inner front wheel bearing
- 2726 Puller, front wheel hub
- 2849 Puller, for pitman arm
- 2904 Drift, for removing and installing bush in lower control arms (diagonal tires)
- 2905 Drift, for removing and installing bush 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

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.

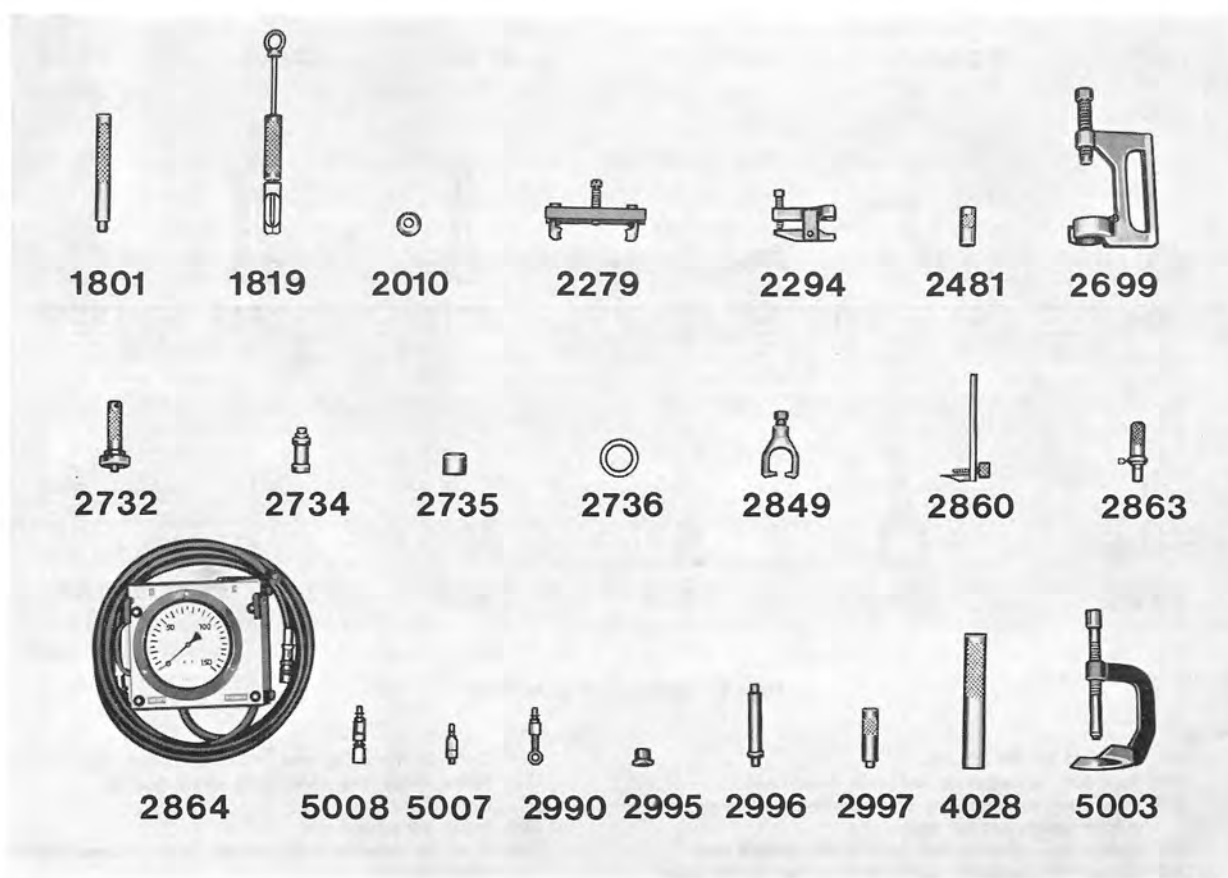


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Fig. 6-2. Tools for work with removed front axle

999 (SVO)

- 2520 Stand for fixture
- 2560 Fixture
- 2868 Press tool for spring



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Fig. 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 bushes in idler arm
- 2732 Drift for installing bearing ring
- 2734 Drift for removing bush, idler arm
- 2735 Drift for installing bush, idler arm
- 2736 Counterhold, for removing and installing bush, 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 ALIGNMENT

WHEEL ANGLES

For the vehicle to have good steering properties and a minimum of tyre 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 centre 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 tyre wear.

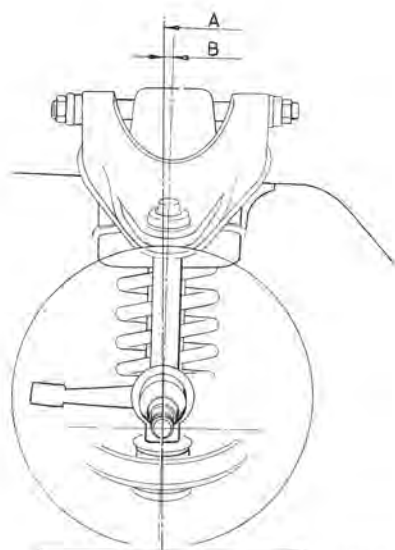


Fig. 6-4. Caster

A = Vertical line
B = Caster

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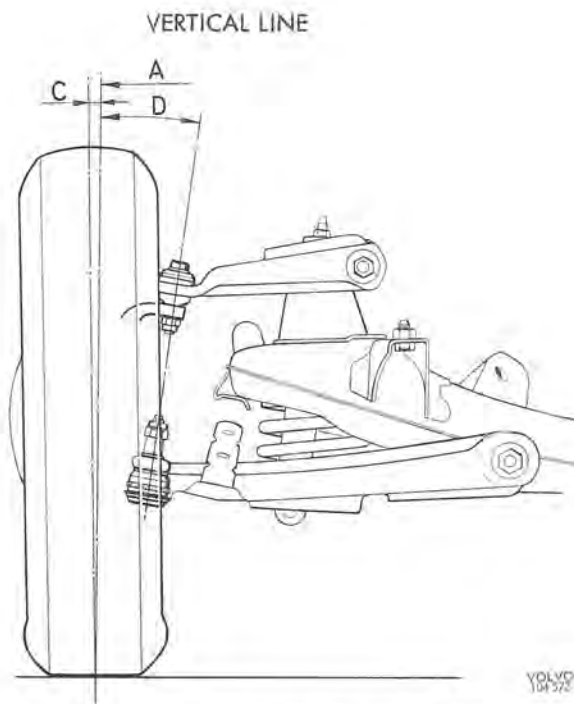


Fig. 6-5. Camber and king pin inclination

A = Vertical line C = Camber D = King pin inclination

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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 centre of the ball joints (D, Fig. 6-5).

King pin inclination causes the centre 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 the wheels are turned.

TOE-OUT

When driving round a bend, the wheels roll at different radii. For them to have the same pivoting centre, and consequently minimum tyre 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.

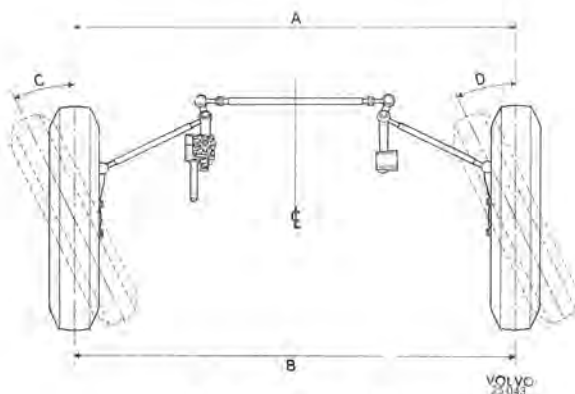


Fig. 6-6. Toe-out and toe-in

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 tyres is known as toe-in. The purpose of toe-in is to reduce tyre wear.

PROCEDURE BEFORE WHEEL ADJUSTING

Wheel angles can be influenced by the factors listed below. Therefore, before measuring and adjusting any faults should be remedied.

1. Check tyre 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 measuring 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 jounalling or steering rod parts.

MEASURING 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 measuring 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 (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 metre/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 metres (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 centre 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 placed 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 $22.5 \pm 1^\circ$.
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 labour, caster and camber should be adjusted at the same time, see under "Camber" below.

CASTER

The caster for each wheel should be within a tolerance range of 1° to $+2^{\circ}$, that is, min 1° and max. 2° positive. The difference between both sides should, however, not exceed $1/2^{\circ}$.

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 at one of the bolts,
2. adding a shim to the other bolt,
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 has been carried out, tighten the bolts to a torque of 55—70 Nm (40—50 lbft).

CAMBER

The camber for each wheel should be within a tolerance range of 0° to $+1/2^{\circ}$, that is, it should be min. 0° and max. $1/2^{\circ}$ 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

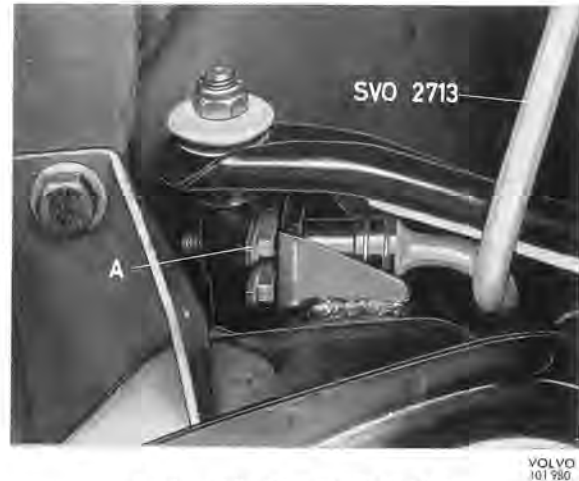


Fig. 6-7. Adjusting caster and camber
A=Shims

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 has been carried out, tighten the bolts to a torque of 55—70 Nm (40—50 lbft).

To save time and labour adjust 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 $1/4^{\circ}$, 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 locknuts on the tie rod, after which the rod is turned in the required direction. The distance between the tyres 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 locknut after adjustment to a torque of 75—90 Nm (55—65 lbft).

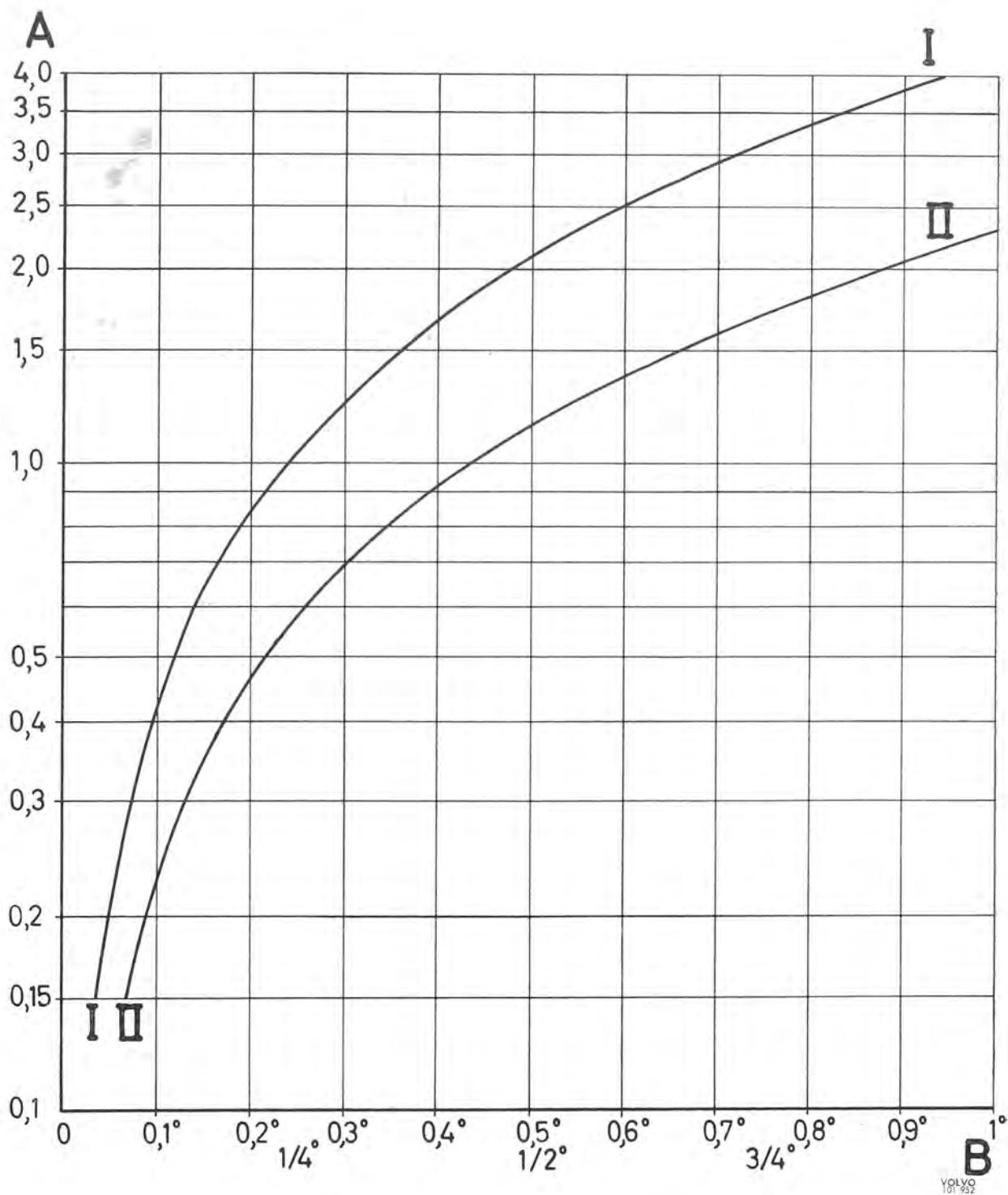


Fig. 6-8. Diagram for alteration of caster and camber

I = Camber
 II = Caster
 A = Shims (mm)
 B = Alteration of angle

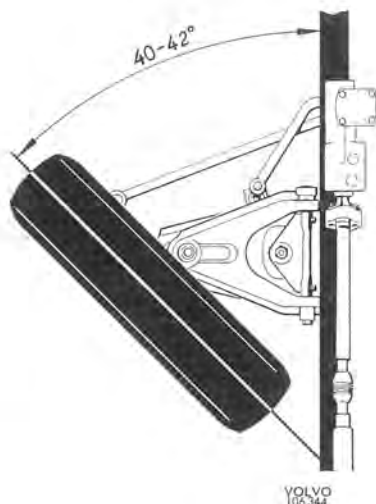


Fig. 6-9. Adjusting max. wheel lock

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.

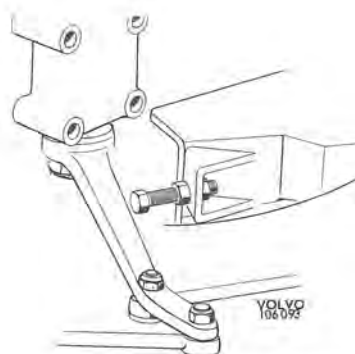


Fig. 6-10. Stop bolt, max. wheel lock

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.

GROUP 62

FRONT END

DESCRIPTION

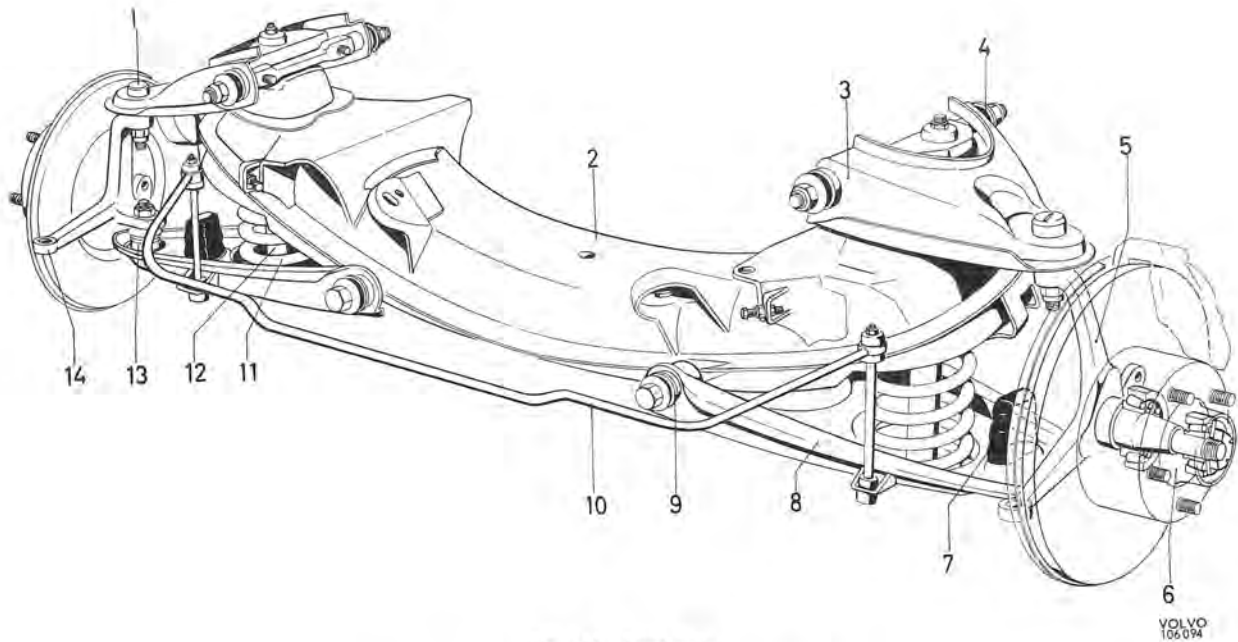


Fig. 6-11. Front axle

- | | |
|---------------------------|---------------------------|
| 1. Upper ball joint | 8. Lower control arm |
| 2. Front axle member | 9. Lower control arm bush |
| 3. Upper control arm | 10. Stabilizer |
| 4. Upper control arm bush | 11. Spring |
| 5. Steering knuckle | 12. Shock absorber |
| 6. Hub | 13. Lower ball joint |
| 7. Rubber buffer | 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 bushes, which are journaled 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.

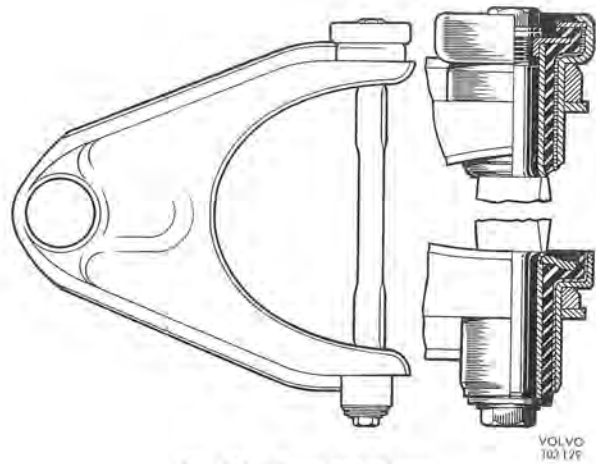


Fig. 6-12. Upper control arm

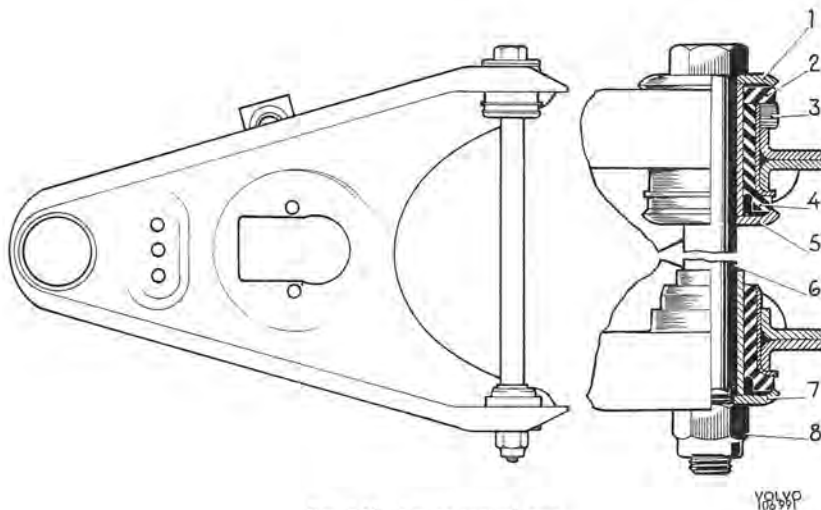


Fig. 6.13. Lower control arm

- | | |
|----------------|----------------------|
| 1. Washer | 5. Washer |
| 2. Rubber ring | 6. Control arm shaft |
| 3. Spacer ring | 7. Washer |
| 4. Bush | 8. Nut |

REPAIR INSTRUCTIONS

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 20000 km (12000 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.

FRONT END COMPLETE

REMOVING

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. Jack up the vehicle 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.

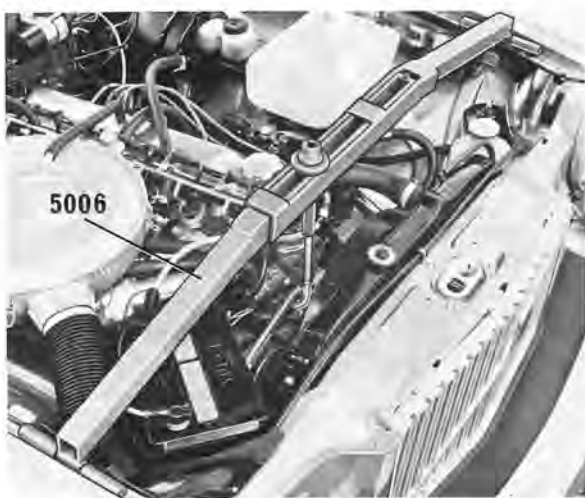


Fig. 6-14. Tool for lifting engine

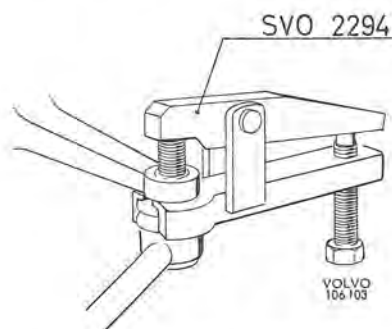


Fig. 6-15. Removing steering rod

6. Remove the lower nuts for the front engine mountings.
7. Remove the front axle member attaching bolts, lower and remove the front end.

Disassembling and assembling

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.

If the rubber buffer for the engine suspension travel limit is to be replaced, place the new one on the reverse side of the front axle member as shown in Fig. 6-17.

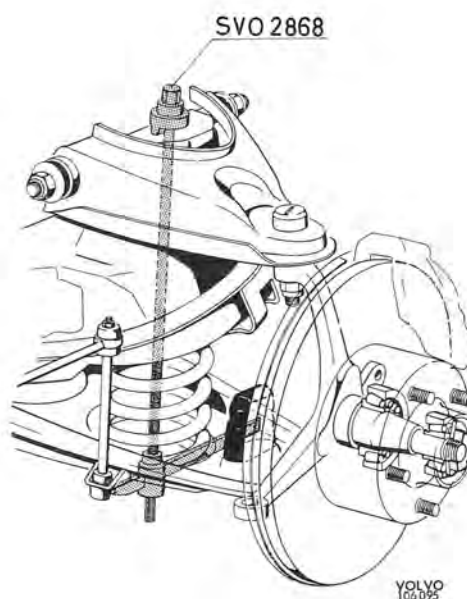


Bild 6-16. Compressing spring

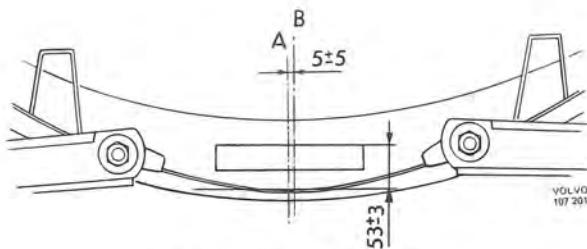


Fig. 6-17. Location of rubber buffer

INSTALLING

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 mounting bolts to a torque of 21—25 Nm (15—18 lbft).
4. Install the attaching bolts for the stabilizer. Connect the brake hoses, see Fig. 5—19, Part 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 Part 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 (70—100 lbft). Fit the hub cap. Remove the lifting tool.

STUB AXLE

REMOVING

1. Remove the front brake caliper according to the instructions given in Part 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 Fig. 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.

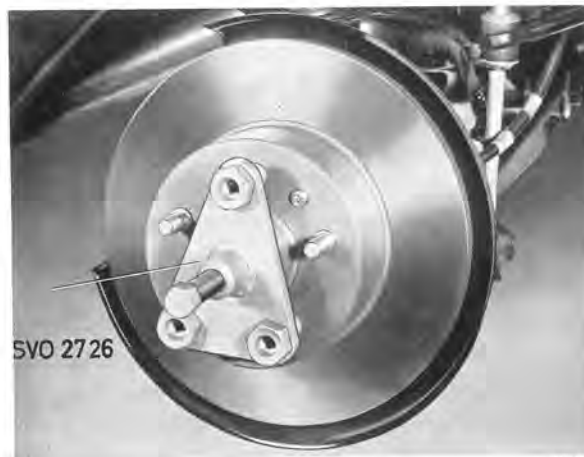


Fig. 6-18. Removing front wheel hub

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 grease which is

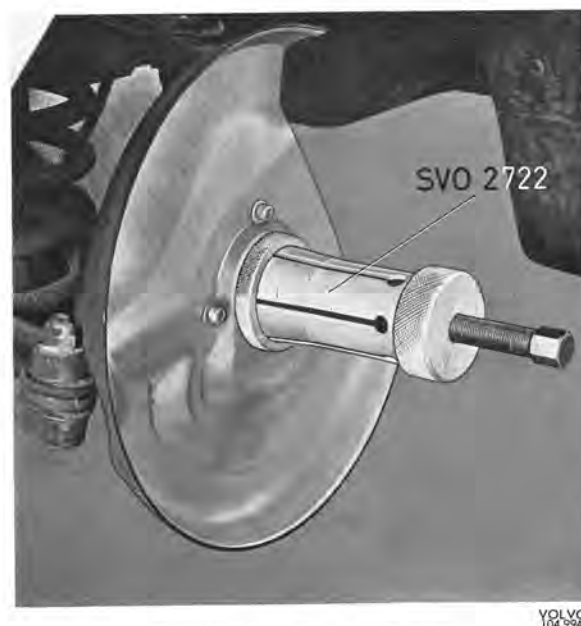


Fig. 6-19. Removing inner bearing

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 being 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.

INSTALLING

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

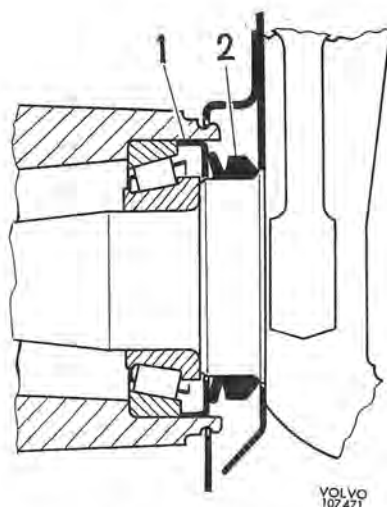


Fig. 6-20. Hub seal

1. Sealing washer 2. Sealing ring

position with a screw vice, see Fig. 6-24. Fit the steering onto the steering arm.

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 (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 Part 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

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 tool 2699 and sleeve 2701, see Fig. 6-21.

INSTALLING

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.

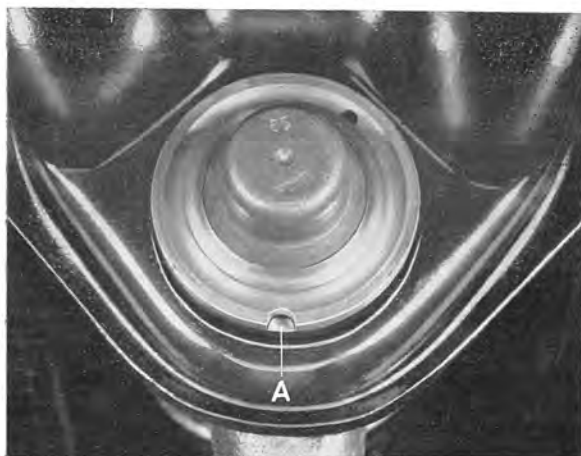


Fig. 6-22. Location of ball joint in upper control arm

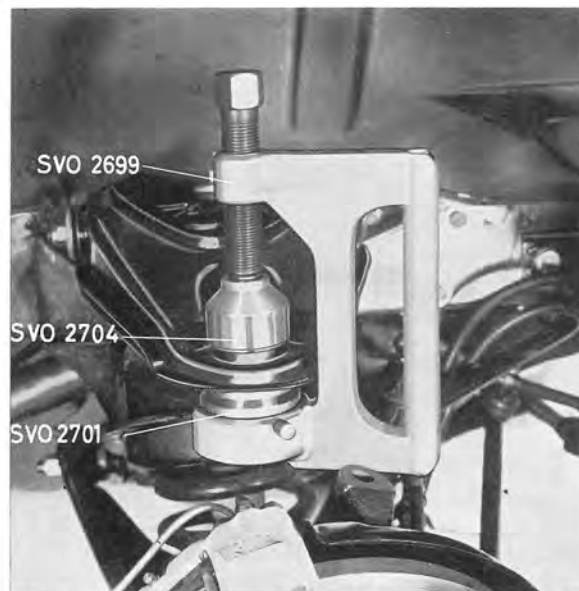


Fig. 6-23. Installing upper ball joint

2. Press the ball joint into the control arm with press tool 2699, sleeve 2701 and drift 2704, see Fig. 6-23. Make sure that the ball joint recess coincides with the longitudinal shaft of the control arm (within $\pm 8^\circ$) 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.

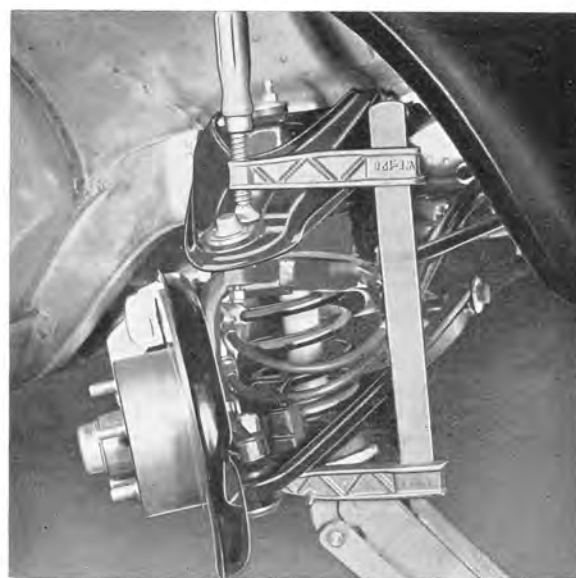


Fig. 6-24. Upper ball joint securely held by vice

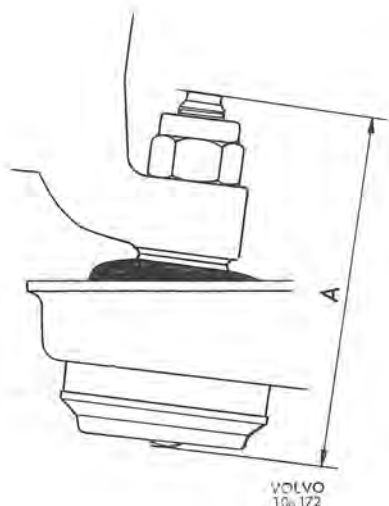


Fig. 6-25. Lower ball joint, type 1 (without spring)

A=Max. 99,3 mm (3.91")

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 vice, see Fig. 6-24.
4. Fit the wheel and wheel nuts. Lower the vehicle and tighten the wheel nuts to a torque of Nm (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.

This tool is available for making a quick check on the lower ball joint in its operating position. The check

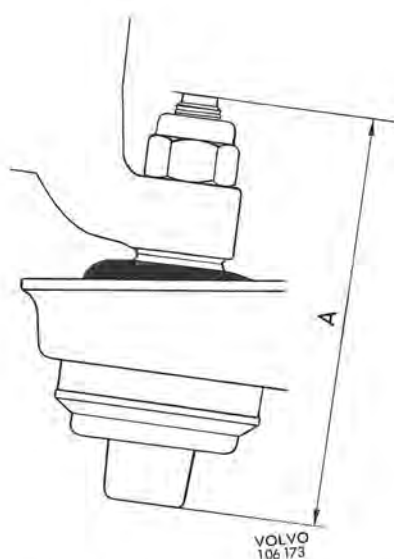


Fig. 6-26. Lower ball joint, type 2 (with spring)

A=Max. 113 mm (4.5")

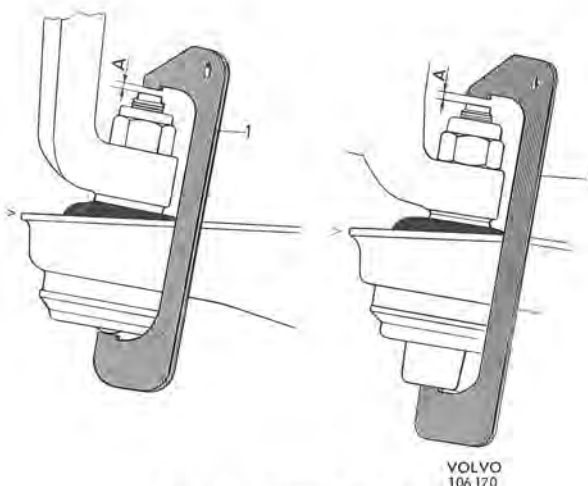


Fig. 6-27. Approved ball joints

1. 2967 for ball joint type 1

2968 for ball joint type 2

A=Clearance

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.

REMOVING

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.

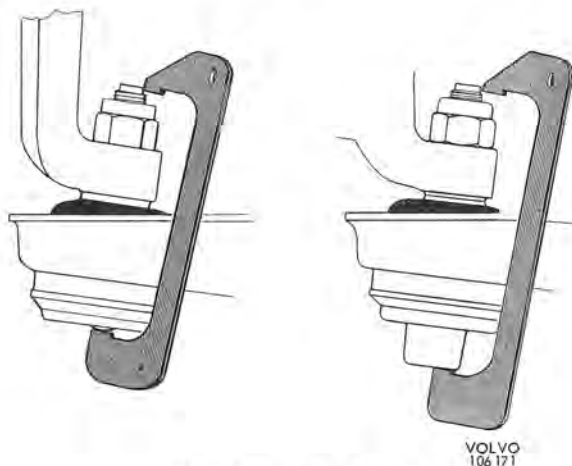


Fig. 6-28. Worn ball joints

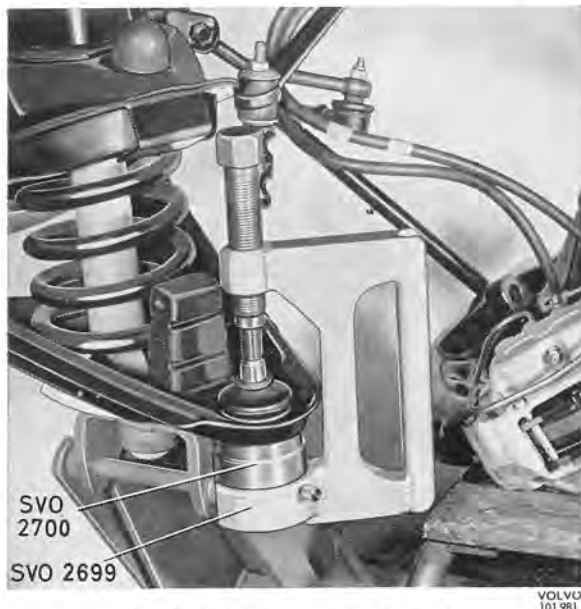


Fig. 6-29. Removing lower ball joint

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

INSTALLING

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. Before 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+2701+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 vice.
4. Fit 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 (70—100 lbft). Fit the hub cap.

UPPER CONTROL ARM

The bushes in the upper control arm are not replaceable. If the link arm or bushes become damaged, replace the link arm complete together with the bushes and 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. 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.

INSTALLING

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 (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 (70—100 lbft). Fit the hub cap.

LOWER CONTROL ARM

REMOVING

1. Remove 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 Part 7, "Removing shock absorber".
4. Disconnect the steering rod from the steering arm with tool 2294, see Fig. 6-15. Loosen the clamp for the brake hoses. Remove the bolt for the stabilizer.
5. Place the jack under the lower control arm. Slacken the nuts for 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.

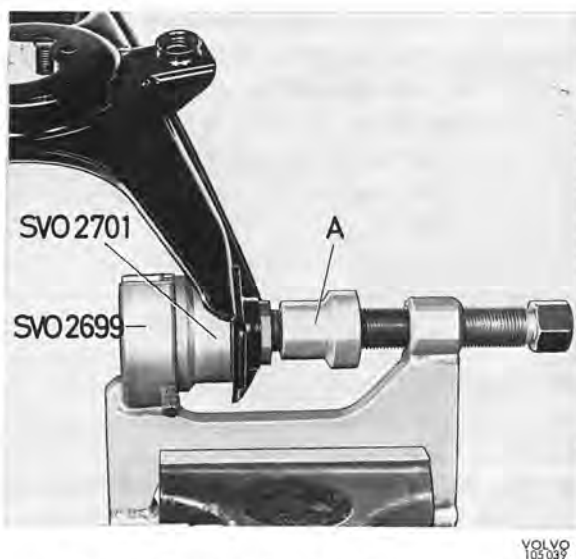
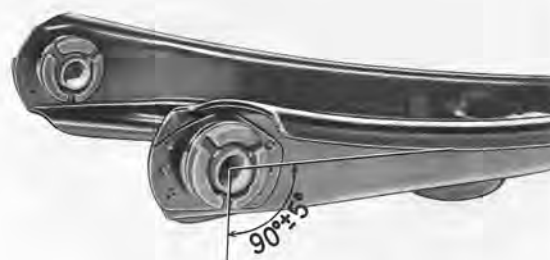


Fig. 6-31. Removing rubber bush, lower control arm

A=2904 for bushes intended for diagonal tyres and 2905 for radial tyres



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Fig. 6-32. Bushes for radial tyres

REPLACING BUSHES

Note that there are special bushes intended for radial tyres. When about to replace the bushes, bear in mind if the vehicle is fitted with radial or diagonal tyres.

1. Tension the press tool 2699 in the vice. Remove the washer (1, Fig. 6-13), the rubber ring (2) and the spacing ring (3). Press the bushes out with counterhold 2701. Use drift 2904 for bushes where diagonal tyres are fitted and 2905 for radial tyres. The tools are placed as shown in Fig. 6-31. The bushes are, of course, pressed out in the direction towards their flanges.
2. Press in the bushes with the control arm and drift (A, Fig. 6-31) facing in the opposite direction.

Note. Both the bushes should be faced with the flange towards the rear in the vehicle, see Fig. 6-13. If it concerns a bush for radial tyres, its recess must also be turned downwards at right angles to the longitudinal direction of the control arm, see Fig. 6-32.

INSTALLING

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 (100—130 lbft).
2. Install 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 vice.
3. Install the shock absorber according to the instructions given in Part 7.
4. Install the wheel and wheel nuts. Lower the vehicle and tighten the wheel nuts to a torque of 100—140 Nm (70—100 lbft). Fit the hub cap.

STEERING GEAR DESCRIPTION

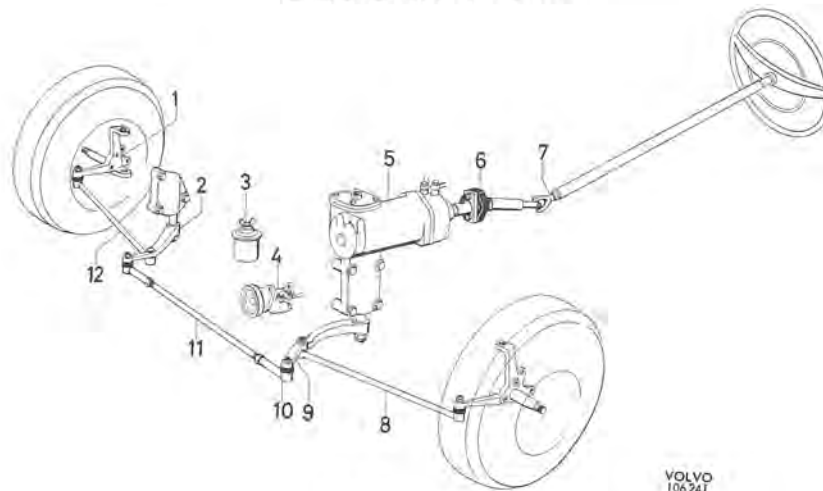


Fig. 6-33. Steering gear

- | | |
|------------------------------|-------------------------|
| 1. Steering knuckle | 7. Steering column |
| 2. Relay arm | 8. Steering rod, left |
| 3. Container, power steering | 9. Pitman arm |
| 4. Pump | 10. Ball joint |
| 5. Steering housing | 11. Tie rod |
| 6. Rubber coupling | 12. Steering rod, right |

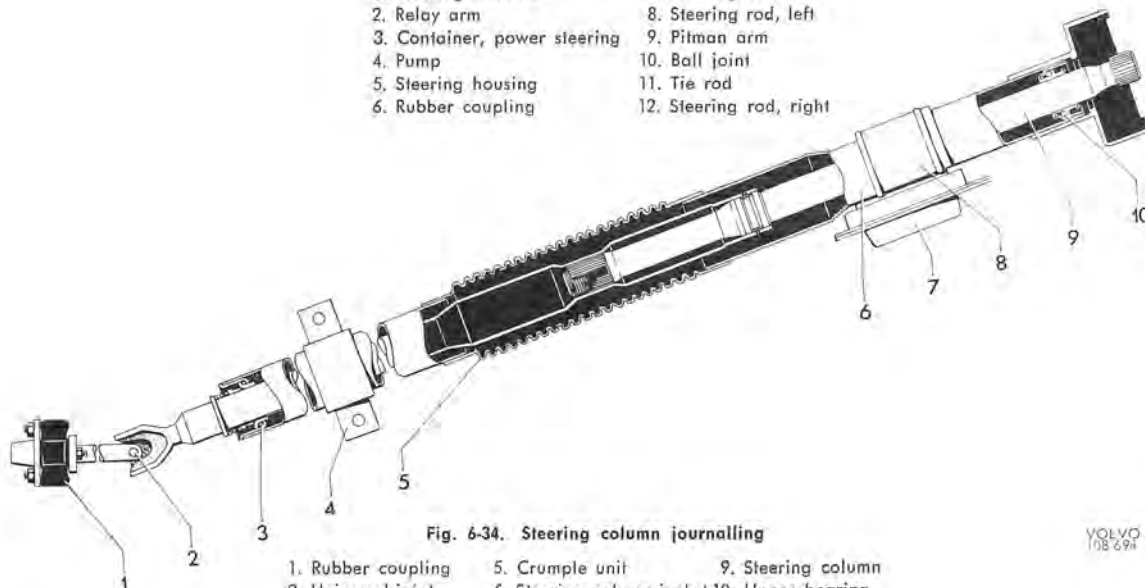


Fig. 6-34. Steering column journalling

- | | | |
|---------------------|---------------------------|--------------------|
| 1. Rubber coupling | 5. Crumple unit | 9. Steering column |
| 2. Universal joint | 6. Steering column jacket | 10. Upper bearing |
| 3. Lower bearing | 7. Upper attachment | |
| 4. Lower attachment | 8. Steering wheel lock | |

GENERAL

The design of the steering gear is shown in Fig. 6-33. 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 journalling

The upper and lower sections of the steering column are linked by means of a universal joint (2, Fig. 6-34). 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 bushes.

Steering wheel lock

The engine of the vehicle has been made tamper-proof 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 ignition 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 position "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.

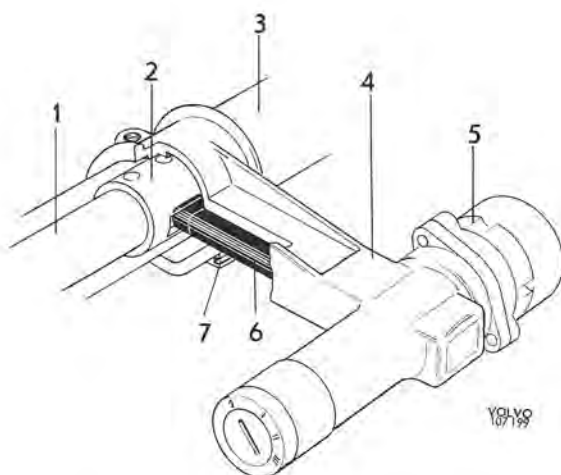


Fig. 6-35. Steering wheel lock

- | | |
|---------------------------|---------------|
| 1. Steering column | 5. Contact |
| 2. Lock sleeve | 6. Lock pin |
| 3. Steering column jacket | 7. Attachment |
| 4. Steering wheel lock | |

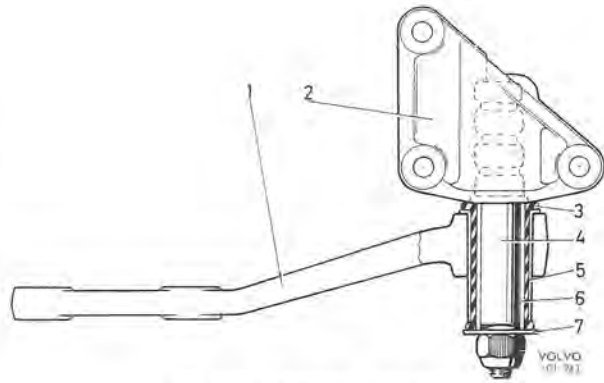


Fig. 6-36. Relay arm journaling

- | | |
|----------------|-----------|
| 1. Relay arm | 5. Sleeve |
| 2. Bracket | 6. Sleeve |
| 3. Rubber bush | 7. Washer |
| 4. Bearing pin | |

STEERING RODS AND RELAY ARM

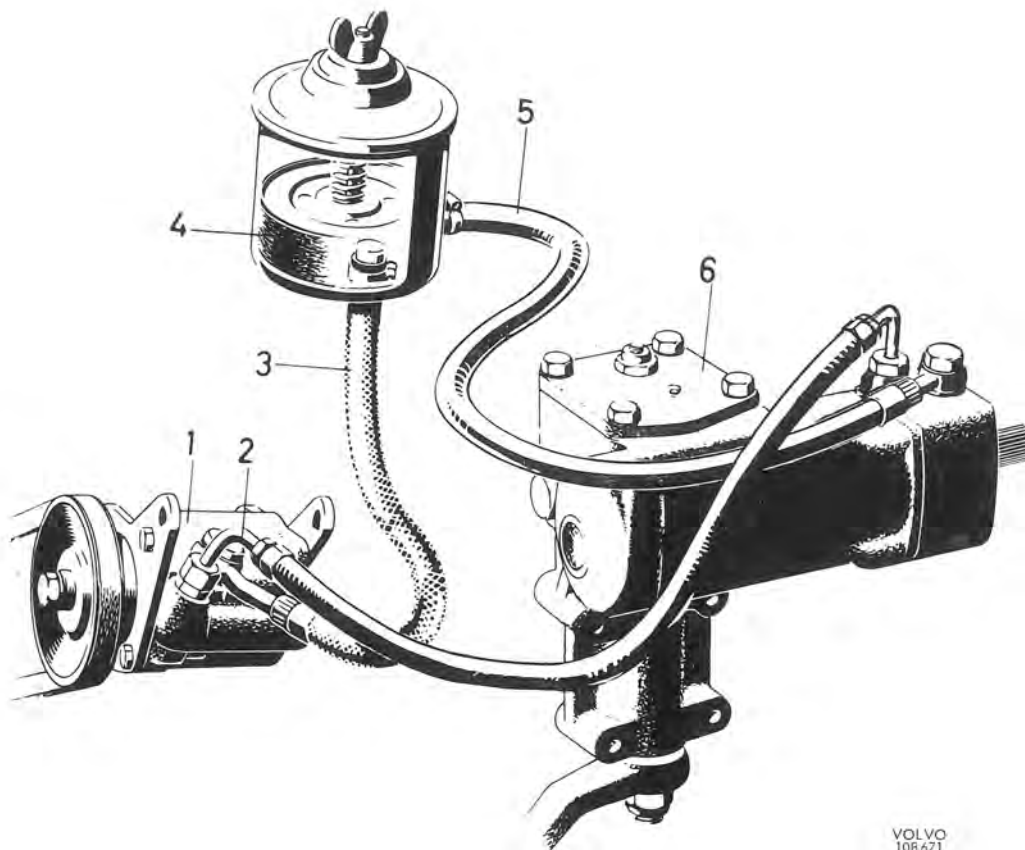
The ball joints of the steering rod are plastic-lined, and this makes maintenance lubrication unnecessary. The tie rod (11, Fig. 6-33) has replaceable ball joints (tie-rod ends) while the ball joints of the steering rods (8 and 12) are made in one piece with the rod.

The relay arm (Fig. 6-36) is journalled by means of a bush on a pin in the bracket. The bush consists of three parts, a rubber bush 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 bush, 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. 6-37.

The number of steering wheel turns from lock to lock is 3.7.



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Fig. 6-37. Power steering

- | | |
|----------------------|------------------------------|
| 1. Power pump | 4. Oil container with filter |
| 2. Delivery oil line | 5. Return oil line |
| 3. Pump suction line | 6. Steering housing |

Power steering gear

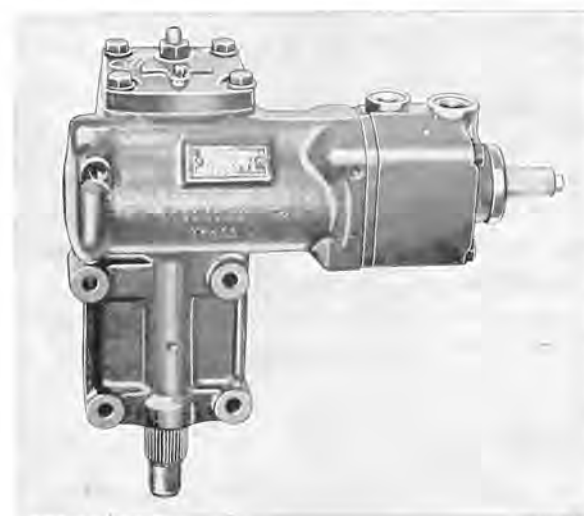
CONSTRUCTION

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. 6-39) 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).

The inner race of the taper ball bearing also is an outer race for the double needle bearings of the steering spindle.



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Fig. 6-38. Steering housing

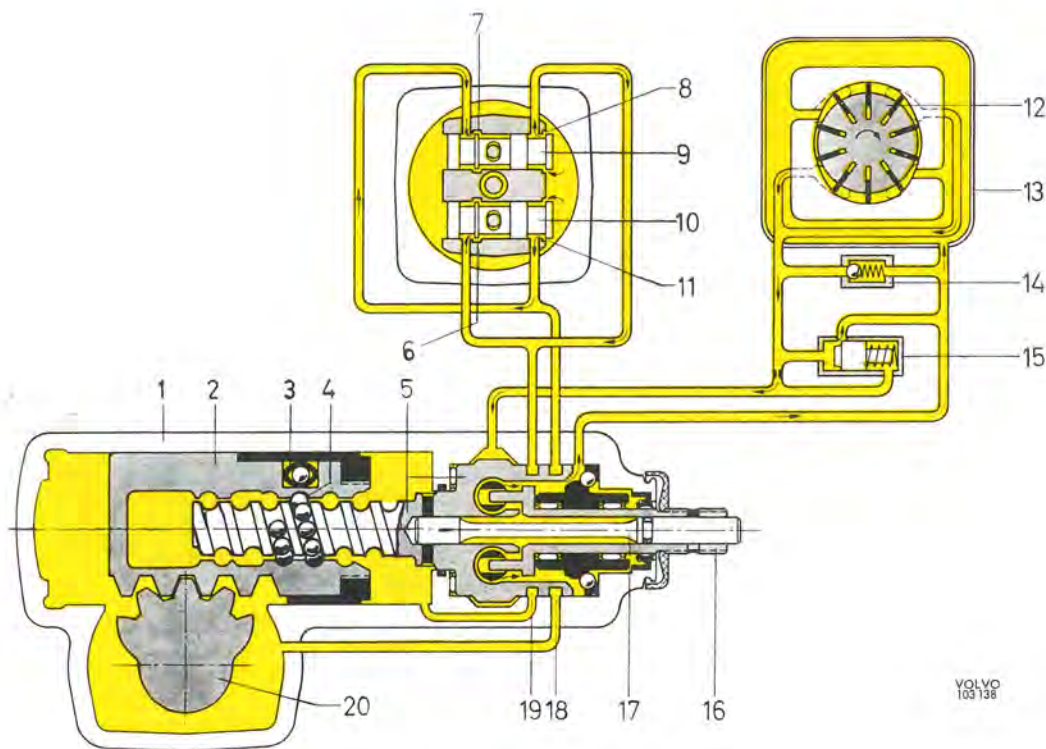


Fig. 6-39. Function, neutral position

- | | | |
|---------------------------------|-------------------|----------------------|
| 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 |
| 4. Balls | 10. Valve piston | 17. Torsion bar |
| 5. Worm | 11. Intake port | 18. Radial groove |
| 6. Return groove | 12. Power pump | 19. Radial groove |
| | 13. Oil container | 20. Sector shaft |

The sector shaft (20) is journaled in the steering housing and side cover by means of needle bearings, see Fig. 6-35. 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. 6-37 shows the steering gear for left-hand steering while Figs. 6-39—6-41 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. 6-39, 6-40 and 6-41. 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. 6-41), 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)

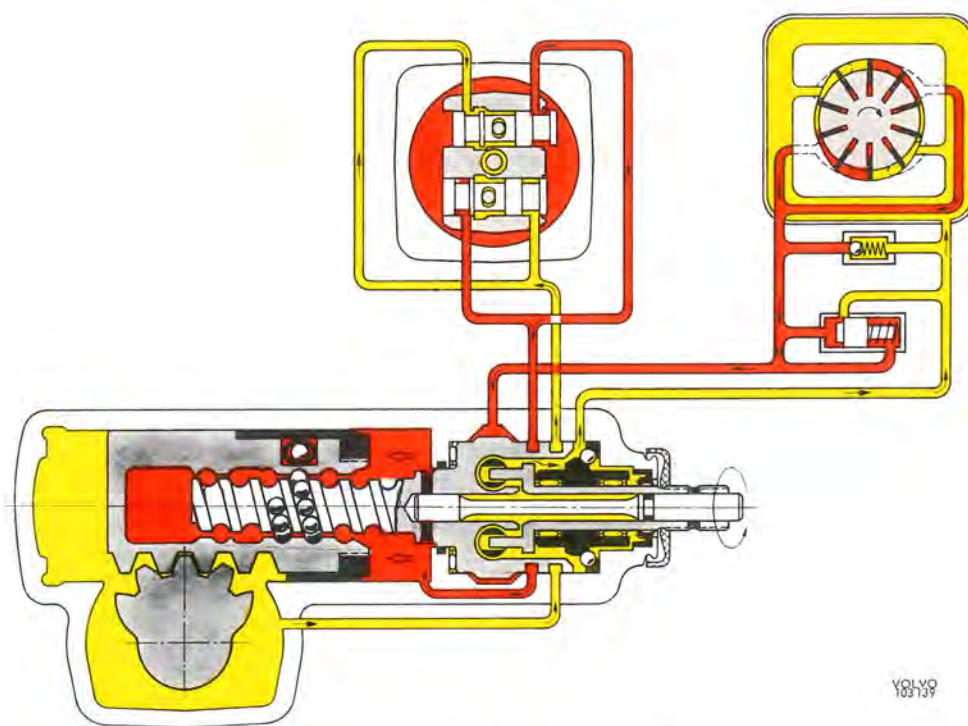


Fig. 6-40. Principle of function, left-hand turn

through the return groove (6) of the valve piston (10) back to the oil container (13).

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. 6-39) 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. 6-40) 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.

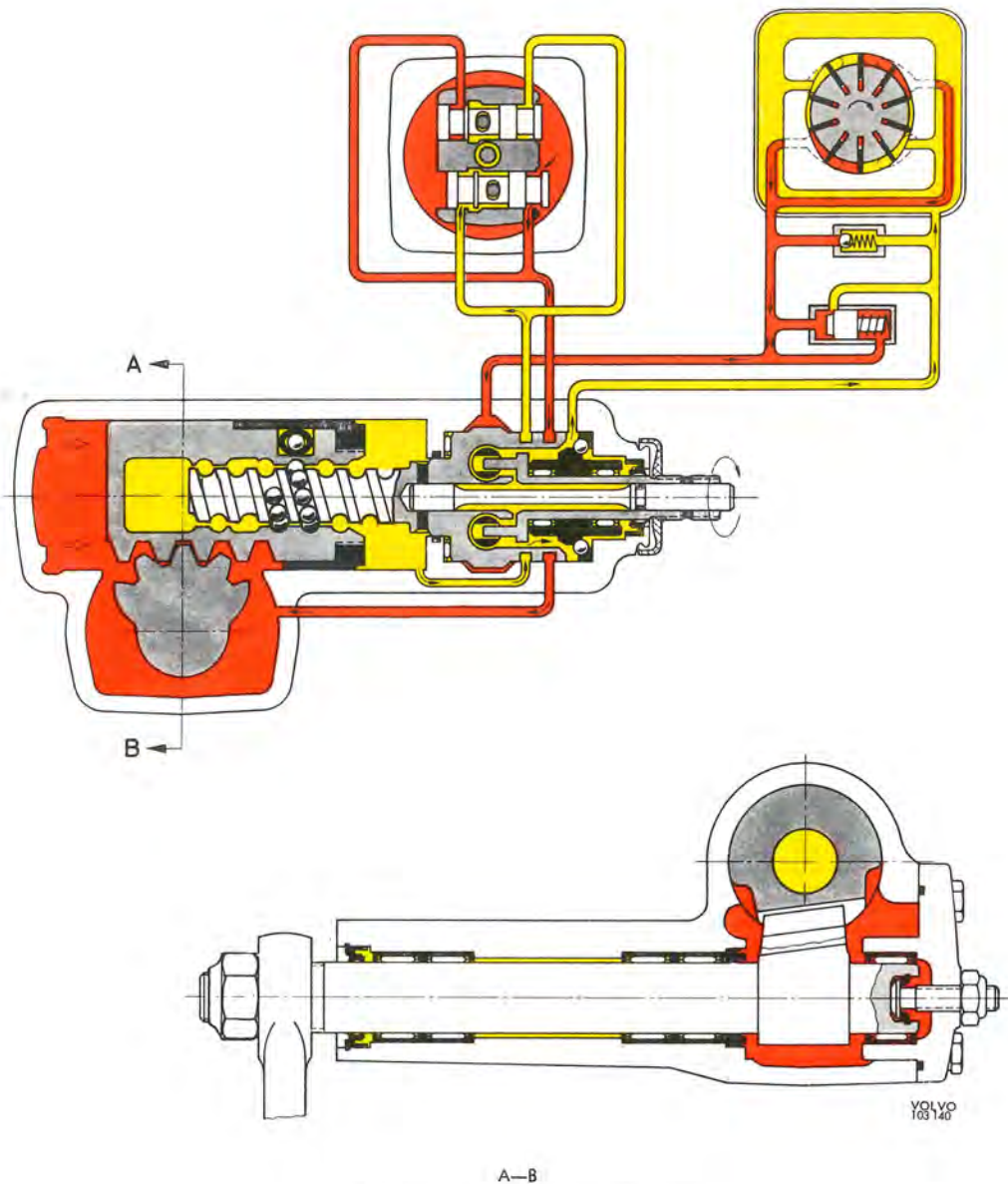


Fig. 6-41. Function, right-hand turn

Turning the steering wheel to the right (see Fig. 6-41) will screw the piston (2, Fig. 6-39) 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. 6-42) 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. 6-41. This permits the area between the rotor, the wall of the intermediate piece and two of the vanes to



Fig. 6-42. Power pump

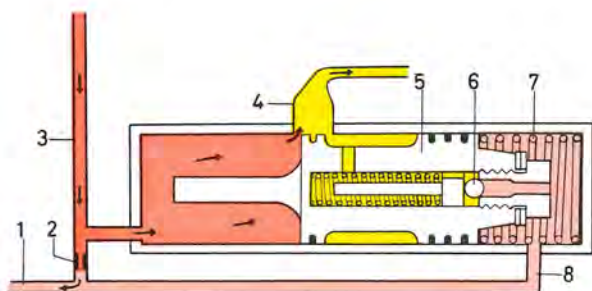
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alter when the rotor rotates. When a couple of vanes are moved from the suction side to the pressure side, the area between them and the sucked-in oil increases to start with. When the connection with the suction side has been passed, a link-up with 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. 6-43) 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



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Fig. 6-43. Control valve, normal position

- | | |
|---------------------|------------------|
| 1. Delivery line | 5. Control valve |
| 2. Check valve | 6. Safety valve |
| 3. Delivery channel | 7. Spring |
| 4. Return channel | 8. Link channel |

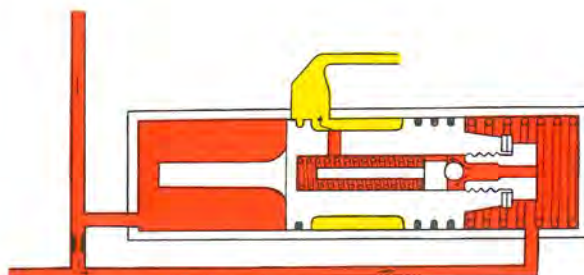


Fig. 6-44. Control valve, maximum pressure

(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. 6-43. 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. 6-44. 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.

Oil container

The oil container 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.

REPAIR INSTRUCTIONS

REPLACING STEERING WHEEL

REMOVING

1. Lever loose the impact pad (5, Fig. 6-45).
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. Fit steering wheel extractor 5003 as shown in Fig. 6-46 and pull off the steering wheel.

INSTALLING

1. Make sure that the front wheels are pointing straight forward.
2. Fit the steering wheel in position with the slip contact to the left.
3. Fit the steering wheel nut. The tightening torque is 30—40 Nm (20—30 lbft).
4. Fit the impact pad and test the horn function.
5. Fit the lower part of the directional indicator switch housing.



Fig. 6-45. Steering wheel components

- | | |
|---------------------------|---------------|
| 1. Steering wheel | 4. Horn plate |
| 2. Crumple unit | 5. Impact pad |
| 3. Steering wheel housing | |



Fig. 6-46. Removing steering wheel

STEERING COLUMN JOURNALLING

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 directional indicator switch 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. 6-47.
5. Remove the bearing.
6. Fit the new bearing after having greased it with universal grease.
7. Fit the other parts.

REPLACING COMPLETE JOURNALLING

REMOVING

1. Remove the steering wheel and steering wheel lock, see instructions for this.

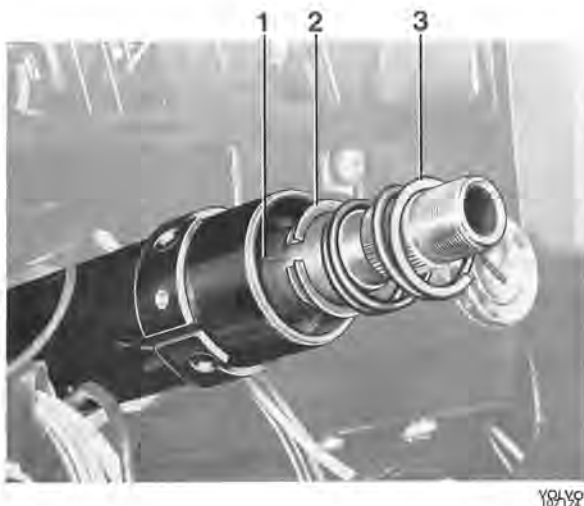


Fig. 6-47. Replacing upper bearing
1. Bearing 2. Seat 3. Spring

2. Remove the directional indicator switch 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.

REMOVING

1. Remove the combined instrument, see Part 3.
2. Remove the steering wheel lock contact unit (5, Fig. 6-35).
3. Remove the collars on the shear-off bolts (4, Fig. 6-35). 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.

INSTALLING

1. Fit the new steering wheel lock and electrical section in position. Hook on the attaching plate (5, Fig. 6-35) and screw in the crosshead screw (3). Check the locking function.
2. Fit the side member (7) with a slide piece (6) in good condition. Fit the impact guard.
3. Fit the shear-off bolts (4) but do not shear off the heads.
Fit 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. Fit the combined instrument and other parts, see Part 3.

STEERING RODS AND TIE RODS

Bent steering rods and tie rods may not 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. 6-48. 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 locknut 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.

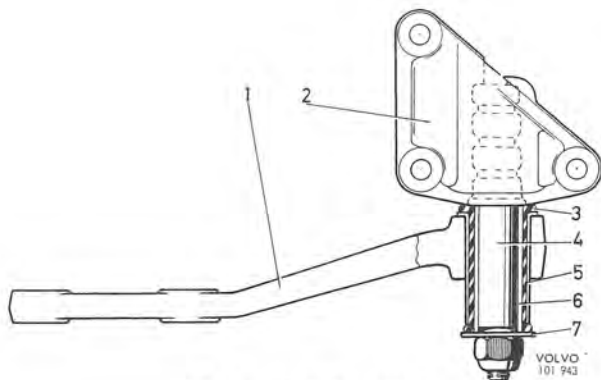


Fig. 6-48. Relay arm bearing

- | | |
|----------------|-----------|
| 1. Relay arm | 5. Sleeve |
| 2. Bracket | 6. Sleeve |
| 3. Rubber bush | 7. Washer |
| 4. Bearing pin | |

REPLACING THE RELAY ARM BUSH

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. 6-48.
3. Remove the nut and washer (7, Fig. 6-36) and take down the relay arm (1).
4. Secure press tool 2699 in a vice and press the bush out with a counterhold 2736 and drift 2734 (see Fig. 6-49).
5. Turn the relay arm and press in the new bush with tools 2699+2736 and drift 2735 (see Fig. 6-50).
6. Place the relay arm in position, fit the washer (7) and the nut. Tighten the nut to a torque of 70—85 Nm (50—60 lbft).
7. Fit 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 (25—30 lbft).

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. 6-36) 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.

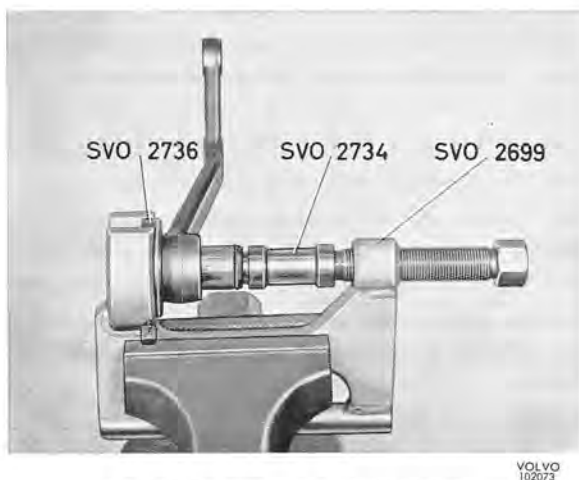


Fig. 6-49. Removing rubber bush, relay arm

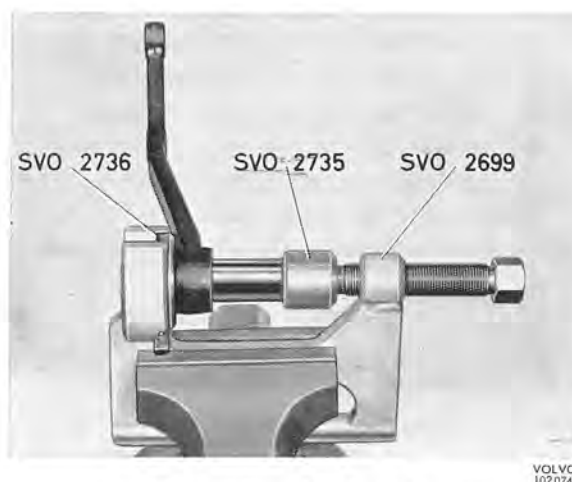


Fig. 6-50. Installing rubber bush, relay arm

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 container before removing its cover.

Only Automatic Transmission Fluid, Type A or Dexron may be used for the power steering system.

CHECKING OIL LEVEL

The oil level should be checked every 10 000 km (6 000 miles). The 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 ($\frac{1}{4}$ ") 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. 6-51. When the engine has stopped, the oil level may rise to 5–10 mm ($\frac{1}{4}$ ") 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. 6-52). 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 litres (2.1 Imp. pints=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 container with oil as the level drops. When the level has stabilized itself, proceed to the next operation.
3. Turn the steering wheel repeatedly and evenly in both directions. The steering wheel should be



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Fig. 6-51. Oil level

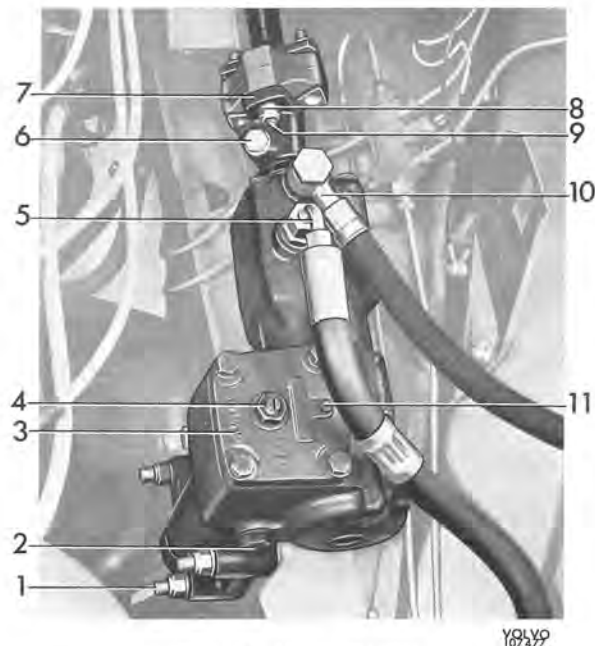


Fig. 6-52. Steering housing

- | | |
|--------------------------------|-------------------|
| 1. Bolt | 7. Flange |
| 2. Drain plug | 8. Nut |
| 3. Steering housing | 9. Screw |
| 4. Adjusting screw | 10. Return line |
| 5. Delivery line (early prod.) | 11. Bleeder screw |
| 6. Clamping bolt | |

turned slowly so that the pump operates at low pressure. If necessary, fill with more oil.

4. Open the bleeder screw (11, Fig. 6-52) $\frac{1}{2}$ –1 turn. Close it when oil starts flowing out.
5. Continue turning the steering wheel until the oil in the container is practically free from air bubbles.
6. Stop the engine. The oil level should then rise 5–10 mm ($\frac{1}{4}$ ") above the level mark. If it rises further 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 container.

INSPECTING POWER STEERING

The inspection procedure described below can be applied with a view to fault tracing or 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.

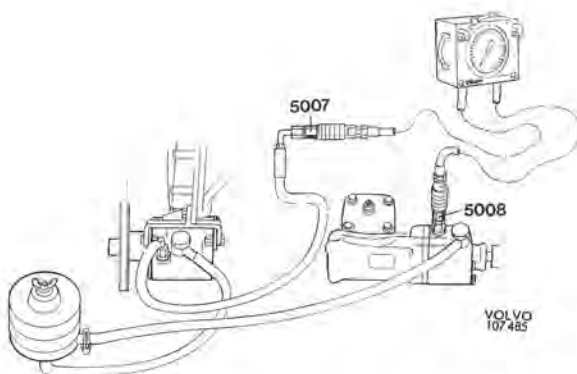


Fig. 6-53. Pressure gauge connected

II. Checking oil level and bleeding

1. Connect the test instrument 2864 to the delivery line at the steering housing, see Fig. 6-53. The inlet hose of the instrument is connected to the nipple with tool 5007 (Fig. 6-53) 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/cm² (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. 6-54. Observe the utmost cleanliness. Wash and blow clean before screwing out the plug (4, 6-67), 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 (22 lb.) and maintain this position for about 5 seconds and read off the gauge. Repeat this procedure after turning the steering 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. Re-tighten 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 locknut 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. 6-57.
 - b) Place the steering housing in the middle position (count the number of steering wheel turns).

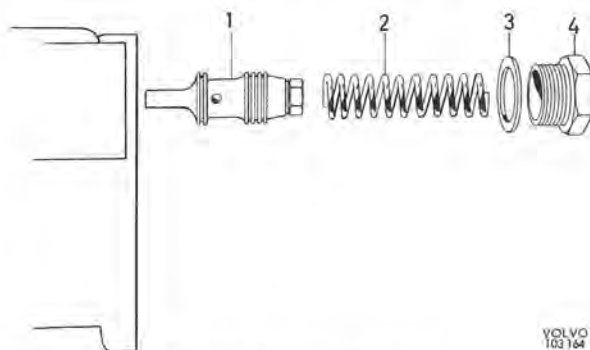


Fig. 6-54. Removing control valve

1. Piston 2. Spring 3. Gasket 4. Plug

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- c) Slacken the nut for the adjusting screw (8, Fig. 6-52).
- d) Turn the adjusting screw clockwise until a light resistance is felt in the flange device when it is turned to the left or to the right on both sides of the centre position.
- e) Tighten the locknut while holding the adjusting screw firmly.
- f) Check the adjustment by turning the steering wheel several times more past the centre position. In the centre position 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 centre position. Tighten the nut to a torque of 175—200 Nm (125—145 lbf).

V. Test driving

If the power steering is only normally worn and is not damaged or overloaded, the steering should function satisfactorily during the test driving, 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 (8, Fig. 6-52) 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 circlip for the sealing ring.
4. Carefully apply tool 2860 to the sealing ring. Tighten the screw (Fig. 6-55). This also tightens the sealing ring. If the ring sticks in the circlip groove, carefully turn the tool backwards and forwards.

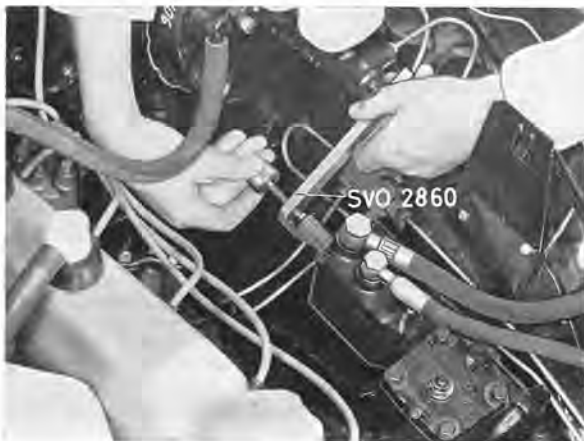


Fig. 6-55. Removing sealing ring

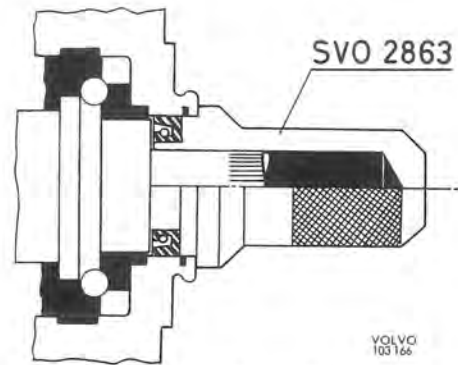


Fig. 6-56. Installing sealing ring

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. 6-56.
6. Fit the circlip 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

REMOVING

1. Jack up the front end.
2. Drain the oil, see under "Draining the oil".
3. Remove the locknut 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. 6-57.
4. Disconnect the oil lines (5 and 10, Fig. 6-52) from the steering housing after the connections have been cleaned. Slacken the clamping bolt (6).
5. Remove the attaching bolts (1) and pull the steering housing forwards.



Fig. 6-57. Removing pitman arm

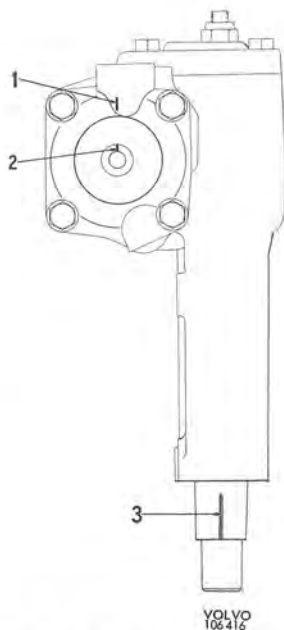


Fig. 6-58. Steering gear housing in middle position

INSTALLING

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. 6-58 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 attaching bolts (1, Fig. 6-52). 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. 6-37) and should be clamped.
4. Point the front wheels straight forward and fit the pitman arm. Tighten the nut to a torque of 175—200 Nm (125—141 lbft).
5. Fill with oil and bleed, see under the heading "Oil filling and bleeding".

RECONDITIONING 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 removing and fitting, refer to the previous pages.



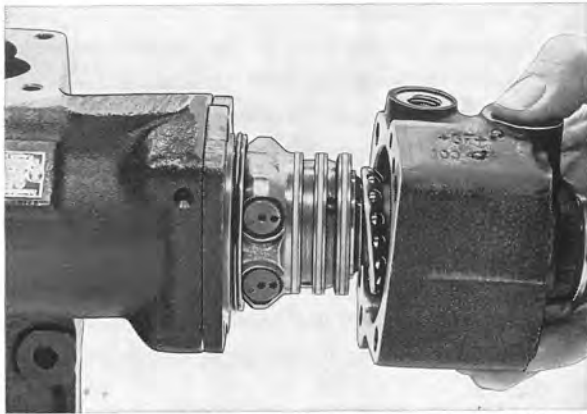
Fig. 6-59. Removing housing cover

DISASSEMBLING

1. Clamp the steering gear in a vice as shown in Fig. 6-59.
2. Remove the locknut (17) and the attaching bolts (19) from the cover. Screw in the adjusting screw (11) through the cover and remove the cover (16). Take out the loose needles in the cover bearing (14).
3. Remove the circlip (13) and the adjuster screw (11), see Fig. 6-60. Adjust the steering gear (10) to the middle position and lift it up, see Fig. 6-85. With a magnet remove the loose rollers in the bearings (3 and 7).
4. Remove the rubber protective cover (51) and the attaching bolts (50 and 52). Pull off the valve housing (56), see Fig. 6-61. Remove the circlip (53) and press out sealing ring (54).
5. Pull out the worm (68), the cover (30) and the piston (22), see Fig. 6-62.
6. Lift the piston and screw out the worm, see Fig. 6-63. Take care that the 23 balls that drop out are



Fig. 6-60. Removing circlip



VOLVO
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Fig. 6-61. Removing valve housing

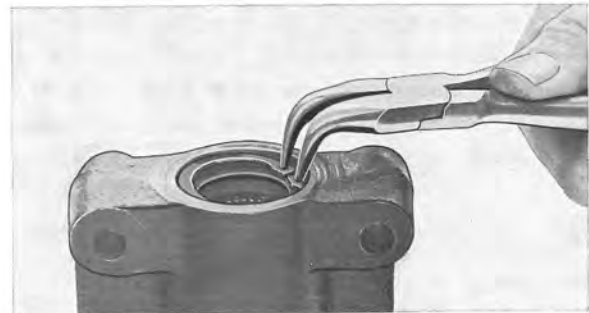


VOLVO
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Fig. 6-63. Removing piston

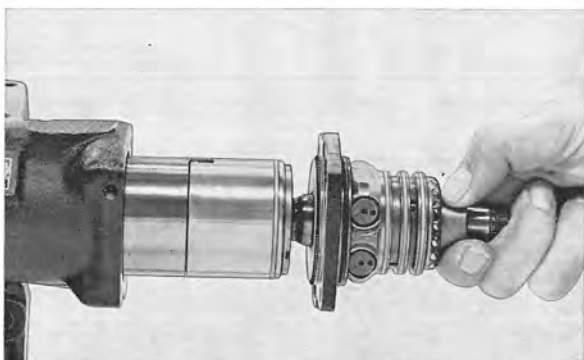
not damaged. Remove the cover (30), needle bearing (36) and bearing washer (35). Remove the packing (34) and O-ring (33), shims (32) and O-rings from the cover.

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 circlip (1), see Fig. 6-64. 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 vice. Remove the inner bearing sleeve (60) and bearing (61), see Fig. 6-65. Remove all rings (62—67) from the worm.



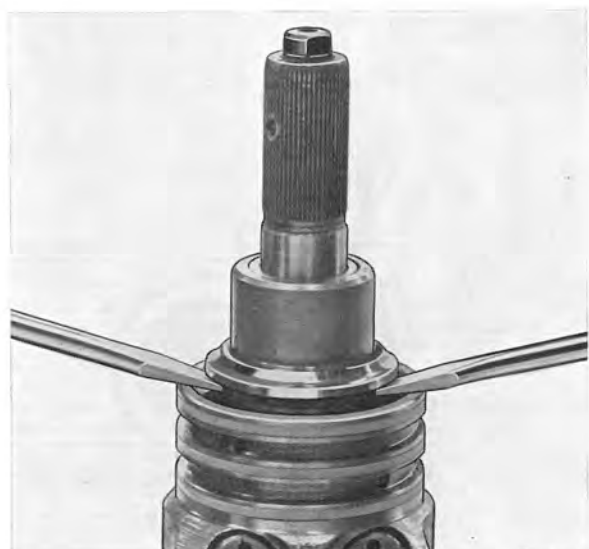
VOLVO
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Fig. 6-64. Removing circlip



VOLVO
106 934

Fig. 6-62. Removing worm



VOLVO
106 937

Fig. 6-65. Removing bearing sleeve

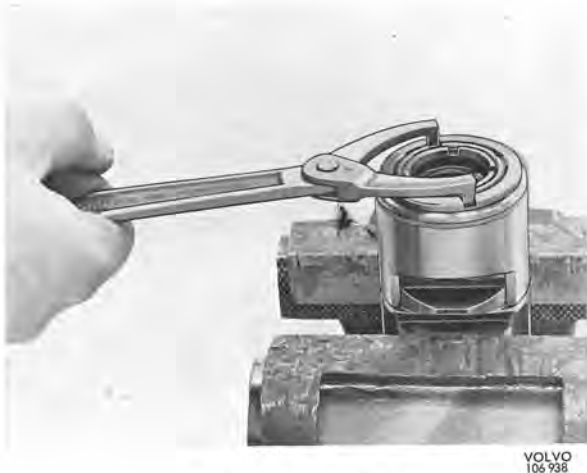


Fig. 6-66. Removing ring

9. Clamp the piston between soft jaws and unscrew the lock ring (27) with a hook spanner, see Fig. 6-66. Remove the sleeve (24) and its ring (25), the packing (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.

Inspecting

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.

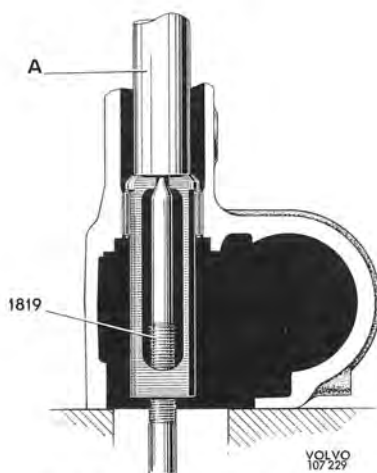


Fig. 6-67. Removing needle bearing

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. 6-67) and for pressing in use drift 2995 and handle 1801 (Fig. 6-68).
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 adjusting screws as well as the two plane surfaces for damage. Check the sealing surfaces for damage and any paint residues. Remove any paint residues.

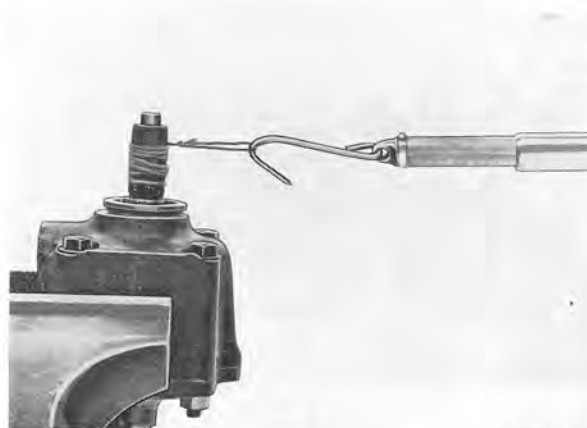


Fig. 6-68. Installing needle bearing



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Fig. 6-69. Checking bearing



VOLVO
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Fig. 6-71. Checking torque

Assembling

Before assembling, 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. 6-69). 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 $2 \mu\text{m}$ ($0.002 \text{ mm} = 0.0008''$), 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. 6-70). Place the pre-

assembled worm in the housing. Fit on the needle bearing (36), bearing washer (35) and cover (30), see Fig. 6-70. Tighten up the cover with the help of the bolts (50 and 52) and 4 nuts M8. Tightening torque is 34 Nm (25 lbft). Check to make sure there is no play in the journalling. A torque of between 0.15—0.25 Nm (1.3—2.2 lbin) 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 (3.7—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.

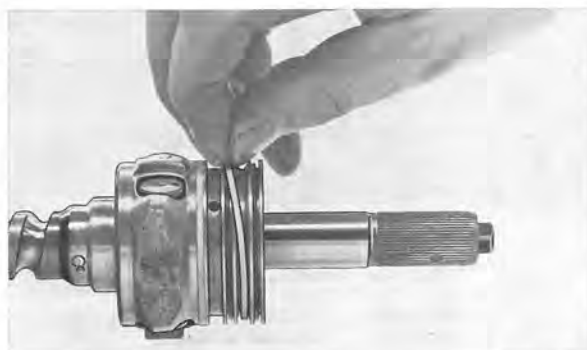
3. Place the O-rings (63, 65 and 67) in the three grooves on the worm. Carefully fit on the packings (62, 64 and 66) on top of the O-rings starting with the inner one (see Fig. 6-72).



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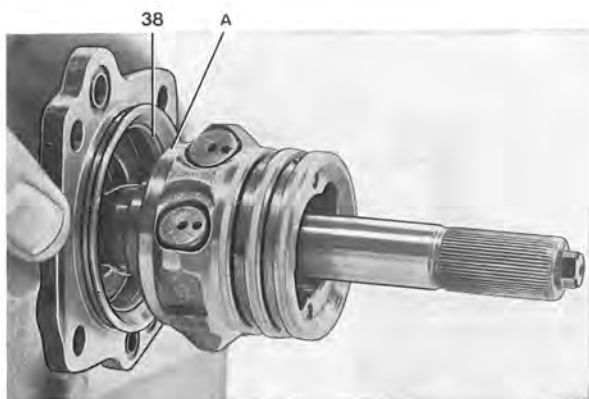
Fig. 6-70. Fitting cover

- | | |
|--------------------|--------------------|
| 30. Cover | 36. Needle bearing |
| 35. Bearing washer | 68. Worm |



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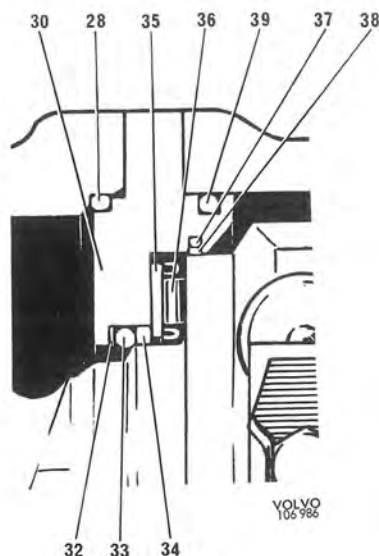
Fig. 6-72. Installing packing



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Fig. 6-73. Checking packing

38. Packing A. Contact surface



VOLVO
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Fig. 6-75. Sealing parts

4. Place the O-ring (37) in position in the cover (30). The packing (38) with thickness 1.7 mm (0.067") is placed on the O-ring.

Apply marking colour to the contact surface (A) and fit the worm (Fig. 6-73). Rotate the worm. Lift and check the contact against the packing. If full contact is not established, the packing 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 packing (34). Oil the packings in the cover. Place the bearing washer (35) and bearing (36) in the cover.

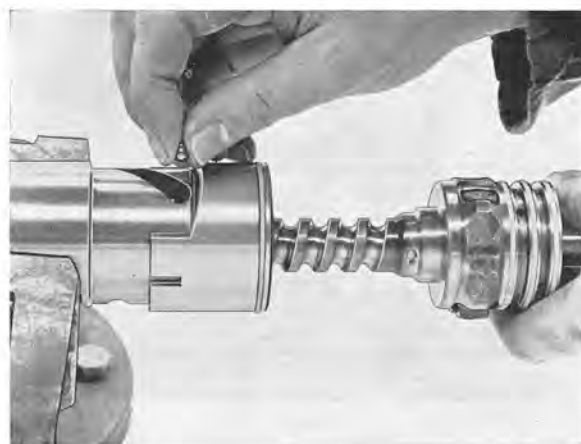
5. Fit the sealing ring (54) on the installation tool 2863 with the help of the loose guide. Remove the guide and fit the sealing ring in the valve housing, see Figs. 6-74 and 6-56. The sealing lip is faced inwards. Fit the circlip (53).
6. The pre-assembled cover and the valve housing are fitted on 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 (25 lbft).



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Fig. 6-74. Installing sealing ring

28. O-ring	35. Bearing washer
30. Cover	36. Needle bearing
32. Shims	37. O-ring
33. O-ring	38. Packing
34. Packing	39. O-ring



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Fig. 6-76. Inserting balls

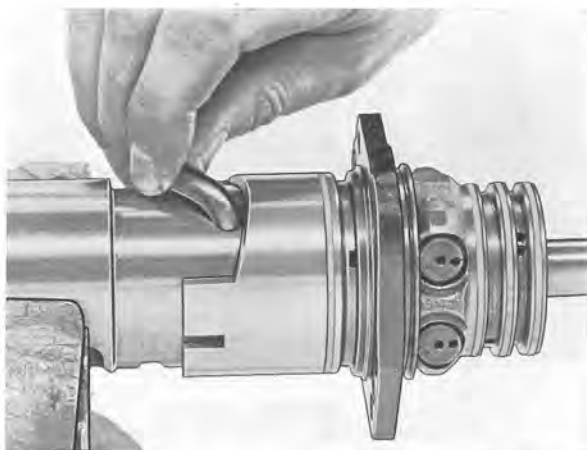


Fig. 6-77. Installing tube halves

Check the worm torque (see Fig. 6-71). This should now be between 0.4–0.6 Nm (3.4–5.2 lbin), that is, the balance should give a reading of between 45–70 N (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. 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. 7-76). 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

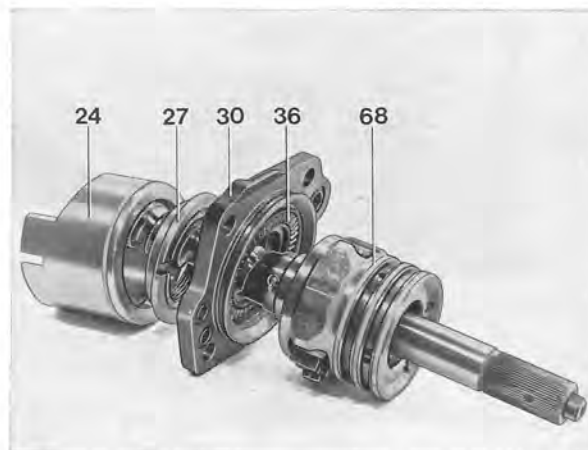


Fig. 6-79. Worm parts

- | | |
|--------------|--------------------|
| 24. Sleeve | 36. Needle bearing |
| 27. Ring nut | 68. Worm |
| 30. Cover | |

filled recirculating pipe is inserted into the piston bores. Put the pipe halves together and fit them, see Fig. 6-77.

Check the torque required to turn the worm in the piston. The correct torque is between 0.2–0.4 Nm (1.7–3.5 lbin). Measure the torque with a cord (see Fig. 6-78). The balance should give a reading of between 23–46 N (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 preassembled cover (30) with bearing washer (35), bearing (36), ring (27) and sleeve (24) on the worm, see Fig. 6-79.

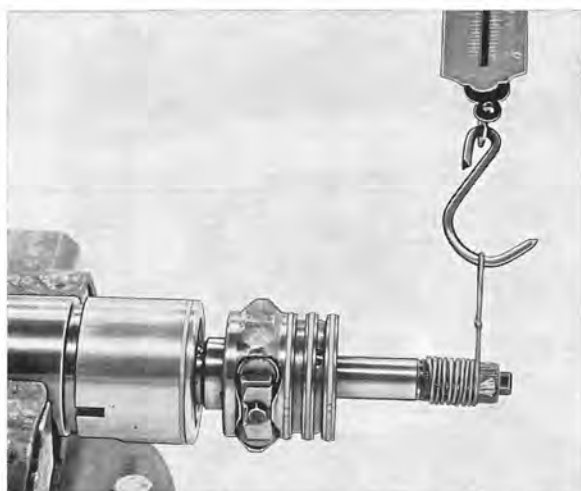


Fig. 6-78. Checking torque

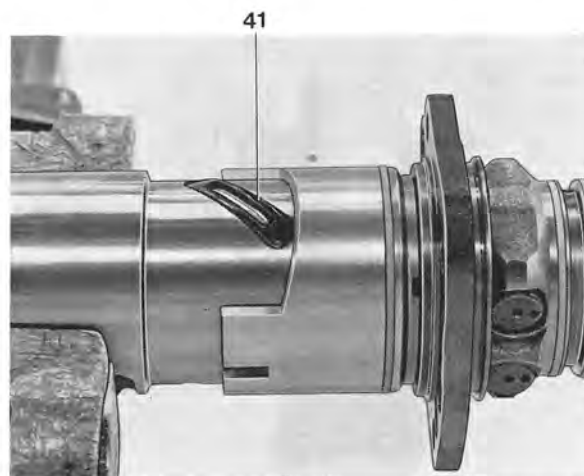


Fig. 6-80. Packing installed

41. Packing



Fig. 6-81. Locking the ring

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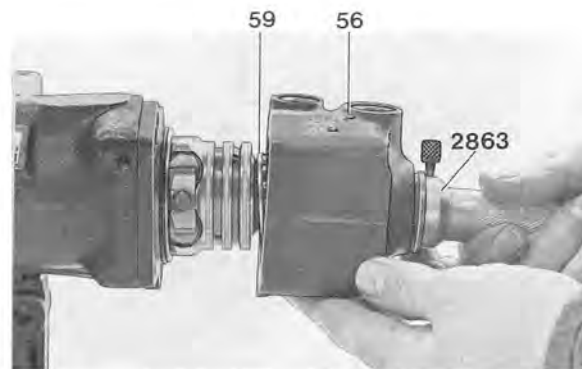


Fig. 6-83. Fitting valve housing
56. Valve housing 59. Ball bearing

VOLVO
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Insert the worm into the piston while fitting the 23 balls, see under point 7. Fit the packing (41), see Fig. 6-80. 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. 6-81. 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. 6-81. 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. 6-82.
10. Fit on the oiled O-ring (28) and install 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. 6-62.

11. Tension out the sealing ring (54) with tool 2863. Place the bearing (59) in position. Fit the valve housing (56), see Fig. 6-83. The tightening torque for the bolts (50 and 52) is 34 Nm (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. 6-84). Fine-adjust by adjusting the worm line-up mark to coincide with the line-up mark on the housing (Fig. 6-58).

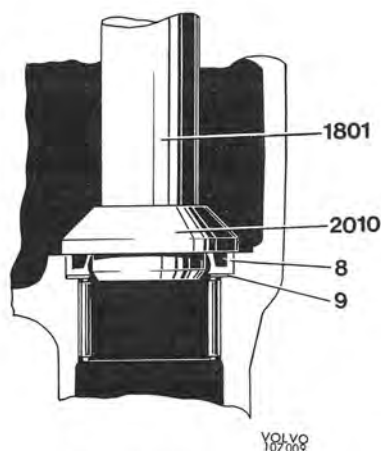


Fig. 6-82. Installing sealing ring
8. Washer 9. Sealing ring

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Fig. 6-84. Middle position

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Fig. 6-85. Installing steering shaft

A. Tape

If the bearings (3 and 7) have not been replaced, place the needles in position with the help of grease.

Fit tape on the steering shaft serration as protection for the sealing ring in the housing. Install the steering shaft (Fig. 6-85) 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 forwards and backwards 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 adjuster screw (11), adjuster washer (12) and circlip (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. Fit the needles in the bearing (14). Place the O-ring (15) on the cover. Fit the cover by screwing up the adjuster 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 (22 lbft). Fit the protective cover (51).
14. Fit the sealing ring (2) with the help of tool 4028. Fit the circlip (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. 6-86). Adjust the steering spindle to the middle position. Screw in the adjuster 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 (10—13 lb) greater than at the end position, but maximum 185 N (40 lb).

Tighten the nut (17) to a torque of 25 Nm (18 lbft) while keeping the adjuster screw in position.

FUNCTION TEST

After being assembled, the power steering should be tested with regard to function and for leakage. The instructions given on page 6-28 should thus be followed.

Replacing power pump

REMOVING

1. Clean round the connections (5 and 6, Fig. 6-87).
2. Disconnect the suction line (5) and collect the oil running out.
3. Disconnect the delivery line (6), and unscrew the tensioning bolt (1) and the attaching bolts (2). Protect the nipples and connections from dirt.
4. Unscrew and remove the pump.

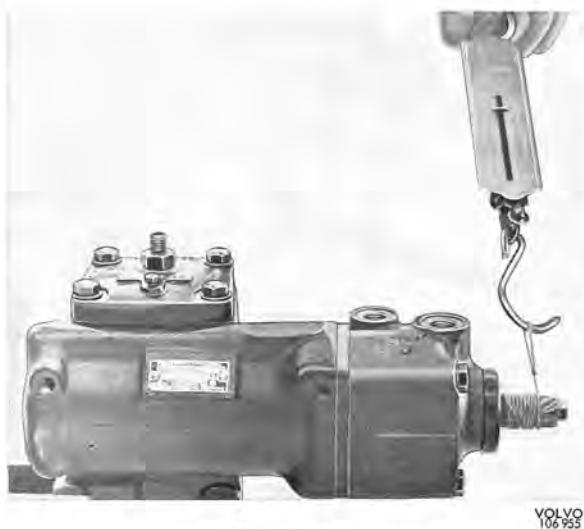


Fig. 6-86. Checking torque

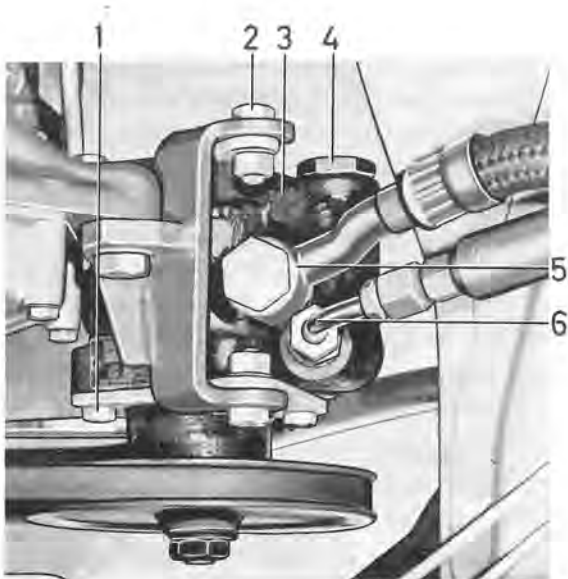


Fig. 6-87. Power pump, installed

- | | |
|-------------------|---------------------------|
| 1. Tension bolt | 4. Plug for control valve |
| 2. Attaching bolt | 5. Suction line |
| 3. Power pump | 6. Delivery line |

INSTALLING

Concerning replacement of pump, supplement the new pump with brackets, pulley and other parts, see Fig. 6-87. 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. 6-87. 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".

Reconditioning power pump

DISASSEMBLING

1. Unscrew the nut (1, Fig. 6-88) and pull off the pulley. Use if necessary puller 2279. Remove the brackets.
2. Remove the circlip (20) with polygrip pliers.
3. Remove the cover (19), spring (22) and plate (18). Use polygrip pliers.
4. Shake out the intermediate piece (16) and rotor (25), see Fig. 6-89. If the intermediate piece does not come out easily, let it remain there until later on.
5. Remove the circlip (5) at the drive end.
6. Carefully press out the shaft (4).

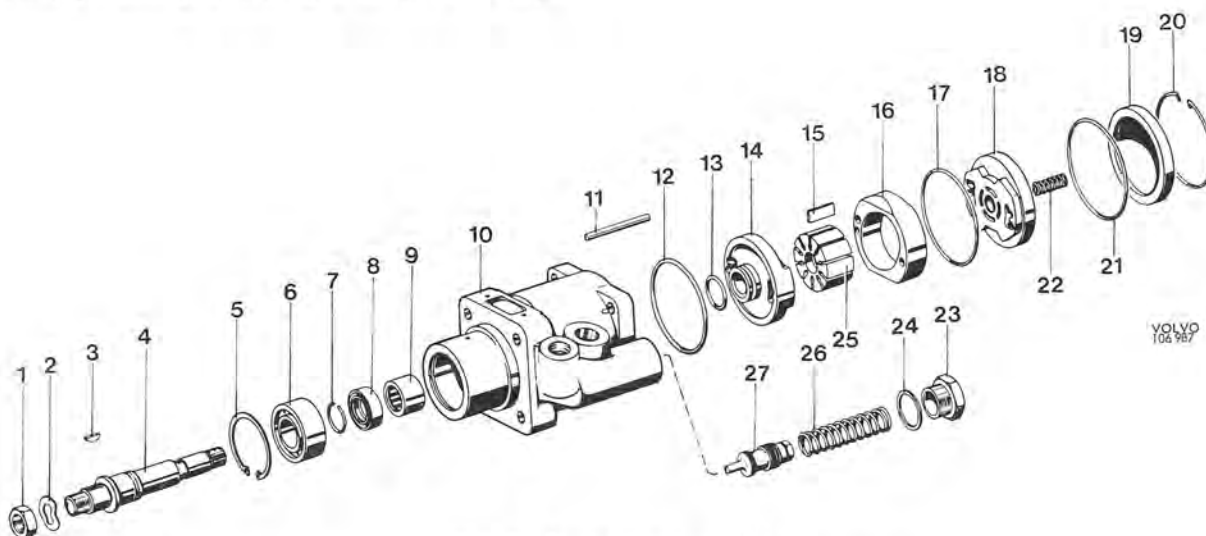


Fig. 6-88. Power pump disassembled

- | | | | |
|------------|-------------------|------------------------|-------------------|
| 1. Nut | 8. Sealing ring | 15. Blade | 22. Spring |
| 2. Washer | 9. Needle bearing | 16. Intermediate piece | 23. Plug |
| 3. Key | 10. Housing | 17. O-ring | 24. Packing |
| 4. Shaft | 11. Pin | 18. Outer plate | 25. Rotor |
| 5. Circlip | 12. O-ring | 19. Cover | 26. Spring |
| 6. Bearing | 13. O-ring | 20. Circlip | 27. Control valve |
| 7. Circlip | 14. Inner plate | 21. O-ring | |



Fig. 6-89. Removing rotor

YOLVO
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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. 6-90.
10. Take the O-rings out of the housing.

INSPECTING

1. Check the shaft (4, Fig. 6-88) 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 circlip (7) has been taken off.

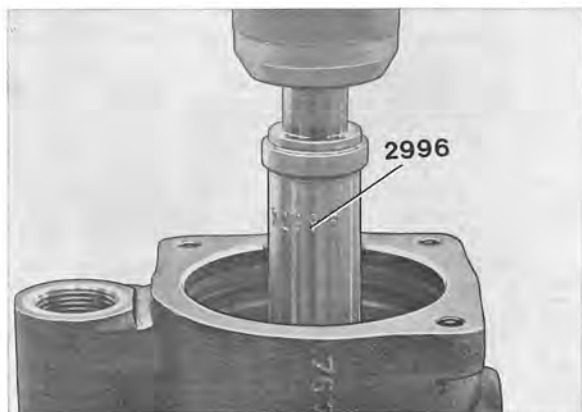


Fig. 6-90. Removing sealing ring

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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 polygrip 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.

ASSEMBLING

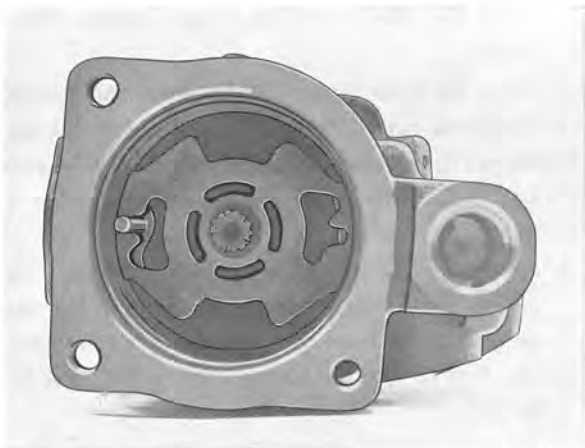
Before assembling, all parts should be well cleaned and lightly oiled. All seals should be replaced by new ones.

1. Press the needle bearing (9, Fig. 6-88) into the housing with the help of drift 2996, see Fig. 6-91. 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.



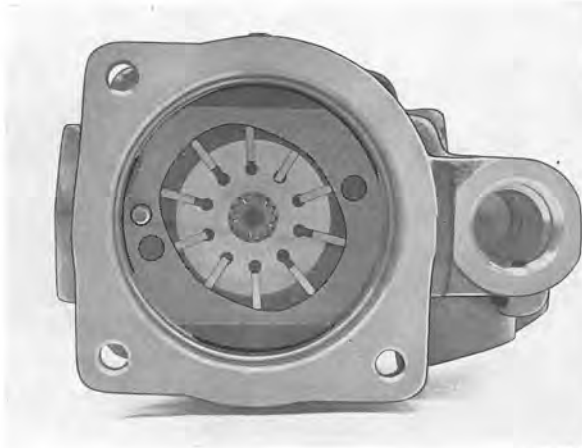
Fig. 6-91. Installing needle bearing

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Fig. 6-92. Inner plate installed

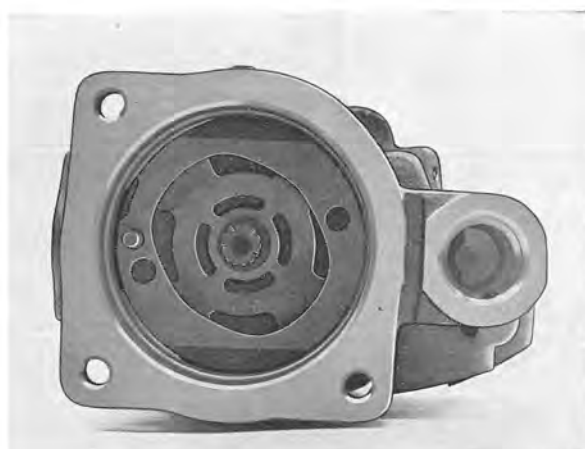


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Fig. 6-94. Rotor blades installed

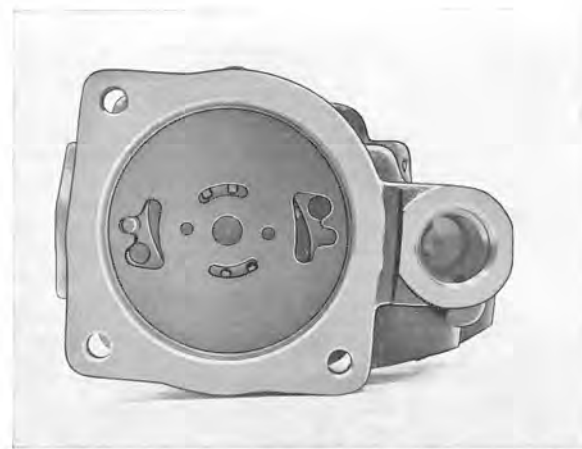
2. Apply universal grease between the sealing ring (8) lips and press it in with drift 2997.
3. Place the O-ring (12) in position in the housing's inner groove.
4. If the bearing (6) was removed, press the shaft into the bearing. Fit the circlip (7) in its groove.
5. Fit the shaft with bearing. Fit the circlip (5) in its groove.
6. Place the O-ring (13) in its groove on the plate (14). Fit the plate according to Fig. 6-92.
7. Fit the intermediate piece (Fig. 6-93): the small hole on the pin, both the other holes opposite the plate holes.
8. Fit the O-ring (17) in position in the housing.

9. Fit the rotor (25) with the smooth drill facing the drive side. Fit the 10 blades (15) with the rounded surface outwards towards the intermediate piece (Fig. 6-94).
10. Fit the plate (18) on the intermediate piece as shown in Fig. 6-95. The pin should be in one of the two outer holes.
11. Fit the O-ring (21) in its groove (Fig. 6-96). Fit the spring (22) and cover according to Fig. 6-96. Hold down the cover with pliers and fit the circlip (20) in its groove.
12. Fit the control valve piston (Fig. 6-97). Install the spring (26), packing (24) and plug (23).
13. Install the nipple, brackets and pulley, see Fig. 6-42.



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Fig. 6-93. Intermediate piece installed



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Fig. 6-95. Outer plate installed



Fig. 6-96. Installing cover



Fig. 6-97. 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 container have been lifted off. Clean the container before fitting the new filter. Also replace the gasket in the outer cover.

FAULT TRACING

When fault tracing on vehicles with power steering, always start by checking the oil level, see page 6 : 27. Any leakage should be put right before topping up with oil.

FAULT

REASON	ACTION
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THE CAR WANDERS

<p>Too little oil or air in the system. Abnormal loading. Unsuitable tyre equipment. Faulty wheel alignment. Loose steering parts.</p>	<p>Check the oil level and bleed, see page 6 : 27. Distribute the loading. Shift round the wheels. Check and adjust the alignment. Check and tighten up.</p>
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THE CAR PULLS TO THE ONE SIDE

<p>Too low or uneven air pressure in tyres. The front springs are fatigued or have different heights. A roller bearing has jammed. Faulty track. Bent steering rod. Faulty camber.</p>	<p>Check air pressure (see Part 7). Check and adjust the springs (see Part 7). Check the bearings. Replace damaged bearings and adjust (see Part 7). Check-measure the body and straighten up if necessary (see Part 8). Replace damaged steering rod. 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.</p>
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STEERING IS STIFF IN EITHER DIRECTION

<p>Too low oil level or air in the system. Pump control valve seizes or is blocked. Filter blocked, channel blocked. Excessive caster. Jamming ball joint. Damaged sealing rings in power steering gear.</p>	<p>Check the oil level and bleed, see page 6 : 27. Remove, wash and check control valve. Remove filter, clean channel. Check and adjust the caster. Replace ball joint. Recondition or replace steering gear.</p>
---	--

STEERING HEAVY ONLY EITHER LEFT OR EITHER RIGHT

<p>Pressure does not build up on one side of the power piston.</p>	<p>Recondition or replace the power steering gear.</p>
--	--

STEERING HEAVY WHEN TURNING THE STEERING WHEEL RAPIDLY

The pump drive belt slips.
Pump control valve blocked.
Pump has insufficient capacity.
Air in the power steering system.

Tension or replace drive belt.
Remove, wash and clean control valve.
Recondition the pump.
Bleed the system, fill with oil according to page 6 : 27.

FRONT WHEELS JAZZ

Air in the system.
Unbalanced or warped wheels.
Faulty wheel alignment.
Loose or worn front wheel bearings.

Bleed the system.
Balance and if necessary straighten up the wheels (see Part 7).
Check wheel alignment.
Adjust or replace bearings.

BUMPS AND IMPACTS IN STEERING WHEEL

Too low oil level or air in the system.
The steering shaft has axial play.
The worm is loose.
Looseness in other steering parts.

Check the oil level or bleed, see page 6 : 27.
Adjust the pressure point.
Recondition the steering gear.
Tighten up or replace worn part.

THE STEERING RUNS AUTOMATICALLY ON ONE SIDE INTO THE END POSITION

The valve setting to hydraulic centre is not accurate.

Recondition the steering gear.

PUMP NOISE TOO LOUD

Lack of oil or air in the system.
Worn pump.

Check the oil level, see page 6 : 27.
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.

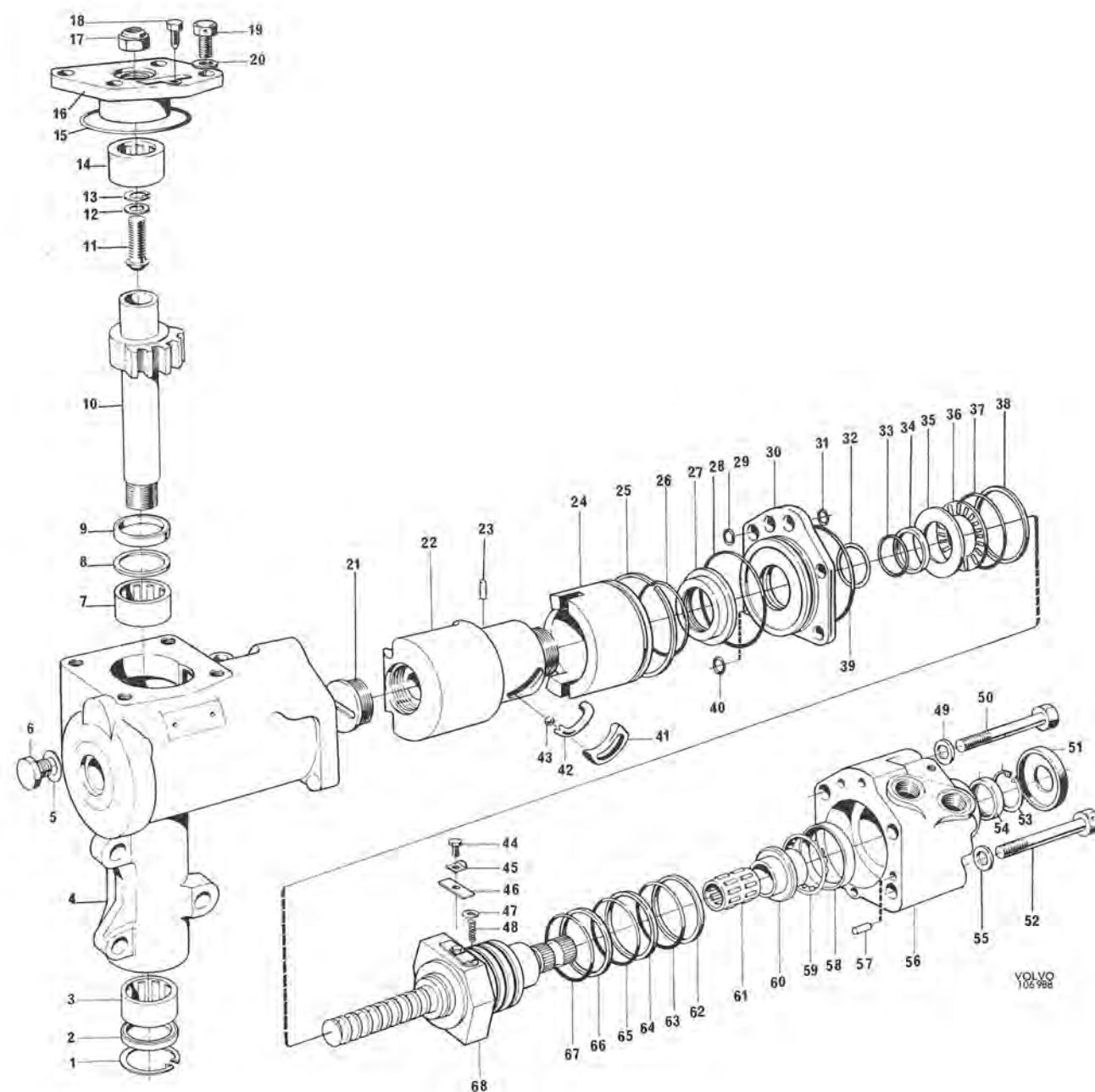


Illustration A. Steering gear disassembled

- | | | | | |
|-----------------------|-------------------|--------------------|-------------------|----------------------------------|
| 1. Circlip | 15. O-ring | 29. O-ring | 43. Ball | 57. Guide pin (only early prod.) |
| 2. Lower sealing ring | 16. Cover | 30. Cover | 44. Bolt | 58. Bearing ring |
| 3. Needle bearing | 17. Locknut | 31. O-ring | 45. Lock washer | 59. Ball bearing |
| 4. Housing | 18. Bleeder screw | 32. Shims | 46. Retainer | 60. Bearing sleeve |
| 5. Packing | 19. Bolt | 33. O-ring | 47. Washer | 61. Needle bearing |
| 6. Plug | 20. Washer | 34. Packing | 48. Spring | 62. Packing |
| 7. Needle bearing | 21. Plug | 35. Bearing washer | 49. Washer | 63. O-ring |
| 8. Washer | 22. Piston | 36. Needle bearing | 50. Bolt | 64. Packing |
| 9. Upper sealing ring | 23. Pin | 37. O-ring | 51. Rubber cover | 65. O-ring |
| 10. Steering shaft | 24. Sleeve | 38. Packing | 52. Bolt | 66. Packing |
| 11. Adjuster screw | 25. Piston ring | 39. O-ring | 53. Circlip | 67. O-ring |
| 12. Adjuster washer | 26. O-ring | 40. O-ring | 54. Sealing ring | 68. Worm |
| 13. Circlip | 27. Ring nut | 41. Packing | 55. Washer | |
| 14. Needle bearing | 28. O-ring | 42. Pipe halves | 56. Valve housing | |

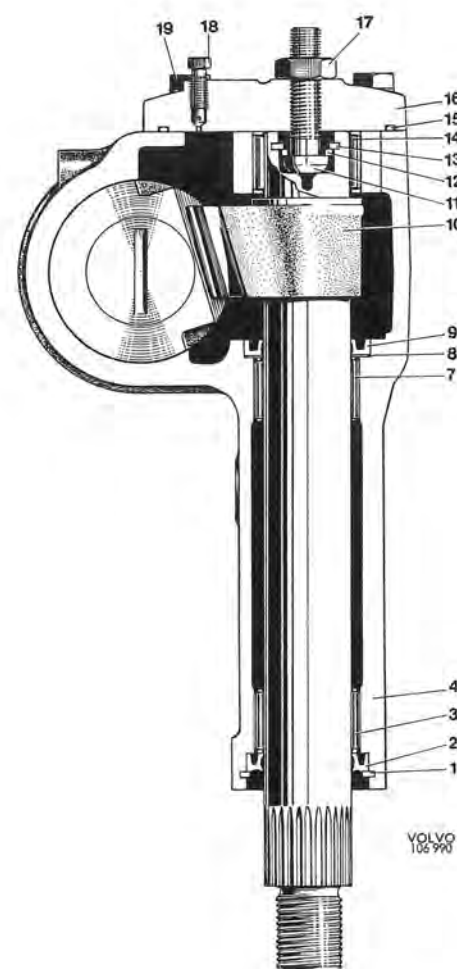
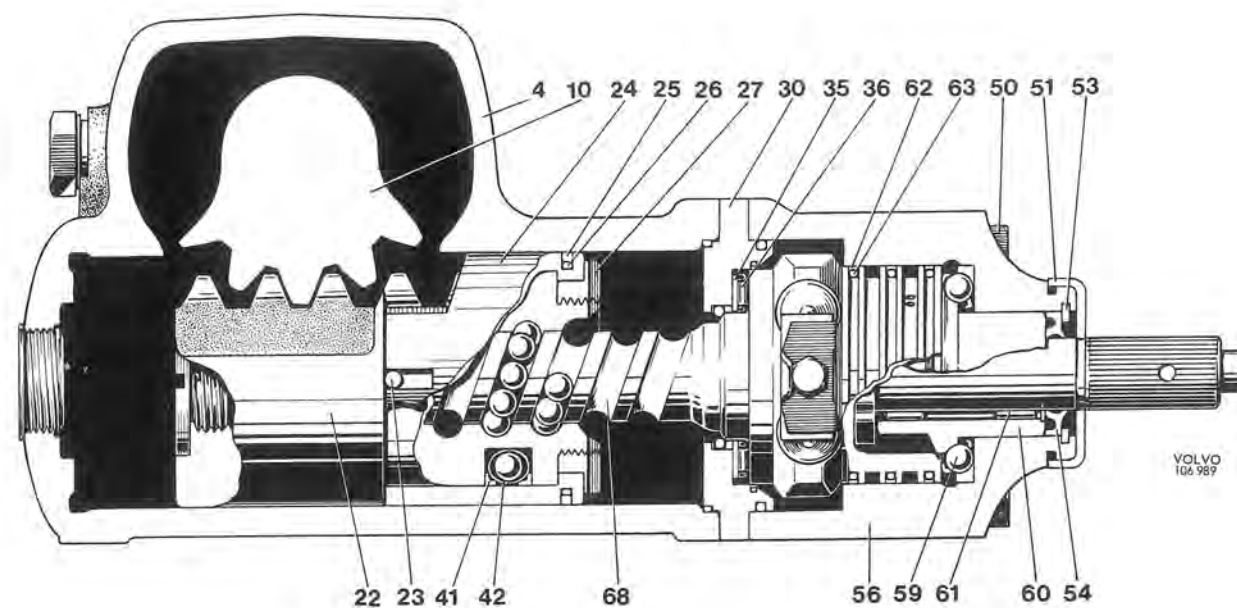


Illustration B. Steering gear assembled

1. Circlip
2. Lower sealing ring
3. Needle bearing
4. Housing
7. Needle bearing
8. Washer
9. Upper sealing ring
10. Steering shaft
11. Adjuster screw
12. Adjuster washer
13. Circlip
14. Needle bearing
15. O-ring
16. Cover
17. Locknut
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. Circlip
54. Sealing ring
56. Valve housing
59. Ball bearing
60. Bearing sleeve
61. Needle bearing
62. Packing
63. O-ring
68. Worm

Part 7

SPRINGS, SHOCK ABSORBERS, WHEELS

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Group 70. General

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Group 73. Springs

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Group 77. Wheels

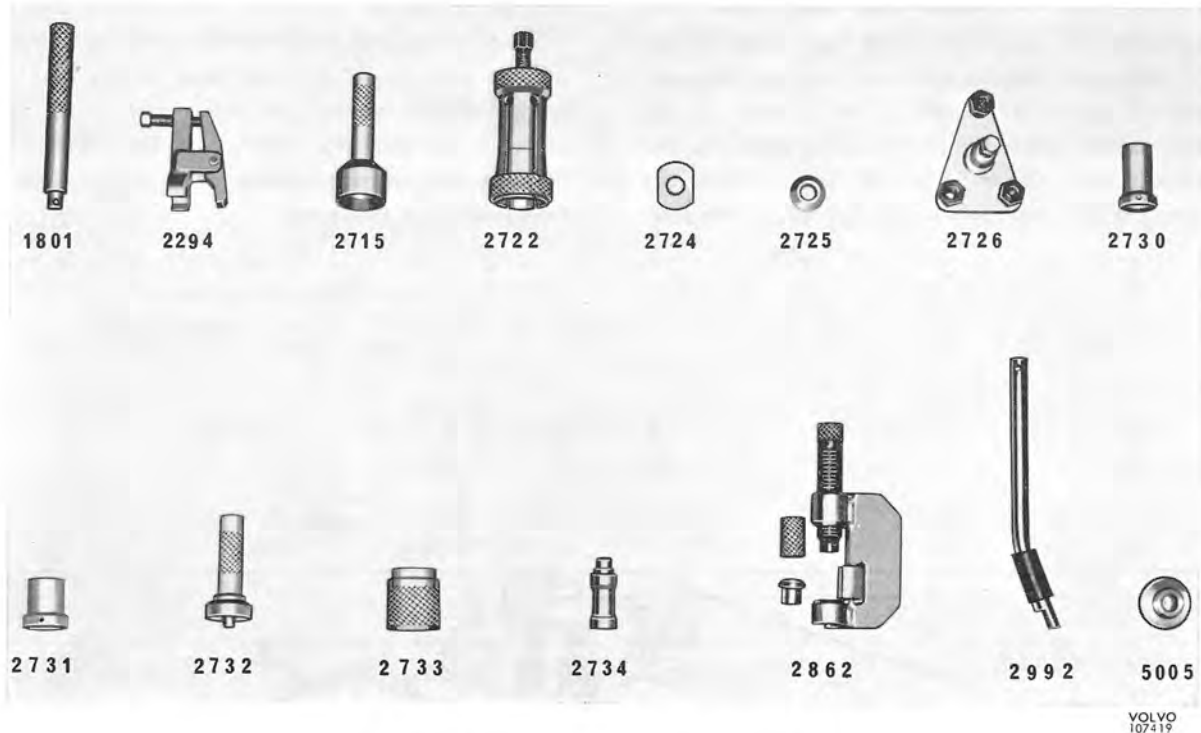
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GROUP 70

GENERAL

TOOLS

The numbers for the special tools are preceded either by 999 or SVO
(e.g. 999 1801 or SVO 1801).



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Fig. 7-1. Tools used for work on rear axle suspension and hub

999 (SVO)

- 1801 Standard handle 18×200 mm.
- 2294 Puller for ball joint, steering rod.
- 2715 Drift for removing and fitting grease cap.
- 2722 Puller for inner ring, inner wheel bearing.
- 2724 Drift for fitting outer ring, outer front wheel bearing, and removing outer ring, inner wheel bearing.
- 2725 Drift for removing outer ring, outer front wheel bearing.
- 2726 Puller for front wheel hub.
- 2730 Drift for removing and fitting rear bush in support arm (2733).
- 2731 Drift for removing and fitting bushes on, track bar (2733).
- 2732 Drift for removing and fitting front bush, support arm.
- 2733 Counterhold for removing and fitting bush, support arm, support stay and track bar.
- 2734 Drift for removing bush in support stay.
- 2862 Press tool for replacing wheel bolt.
- 2992 Tool for removing trim ring.
- 5005 Tool for fitting washer in hub seal and for outer ring of front wheel bearing.

SPRINGS

DESCRIPTION

The Volvo 164 is provided with coil springs at both front and rear. The front wheel suspension is independent. The upper ends of the front springs (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.

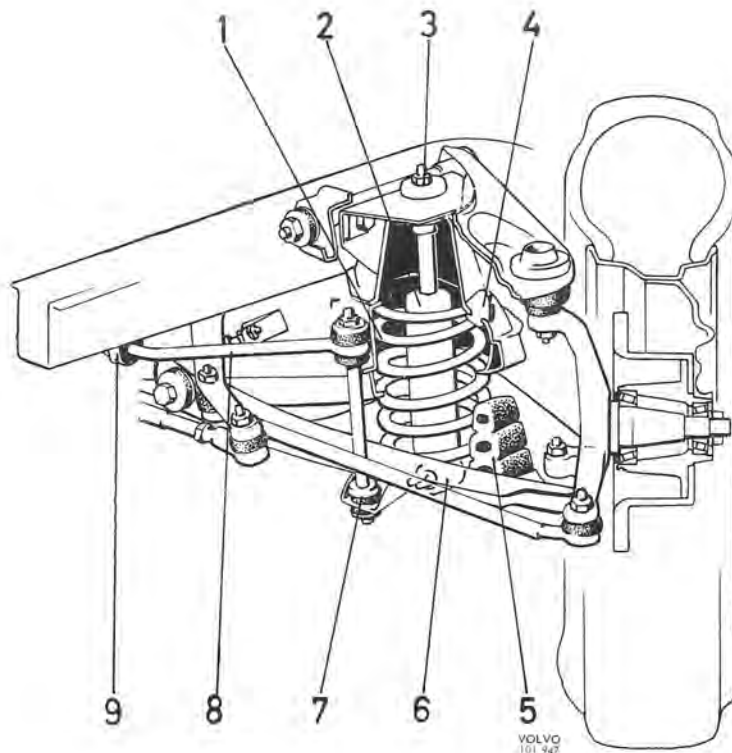


Fig. 7-2. Front spring and shock absorber

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

REPAIR INSTRUCTIONS

FRONT SPRINGS

REMOVING

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 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.

INSTALLING

1. Place the rubber spacer and spring in position. With the jack (placed immediately under the spring) lift up the lower wishbone 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 bush 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 wishbone 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

REMOVING

1. Remove the hub cap and loosen the wheel nuts a couple of turns. Jack up the vehicle. Place axle props in front of the rear jack attachments according to Fig. 7-3. Remove the wheel.
2. Jack up the rear axle with the jack so that the spring compresses. Loosen the upper and lower spring attachments.
3. Remove the upper attachment (9, Fig. 7-6) for the shock absorber. Lower the jack carefully and remove the spring.

INSTALLING

1. If the spring seats have been removed, first re-fit those at the side members, see Fig. 7-5.
2. Place the rubber spacer on the spring seat and move the spring up towards the spacer.



Fig. 7-3. Location of axle prop for propping up vehicle rear end

3. Raise the jack and securely fix the spring to the lower attachment with the washer (14) and the screw (13).
4. Install the upper shock absorber screw, the wheel and the wheel nuts.
5. Lower the vehicle and tighten the wheel nuts. Install the hub cap.



Fig. 7-4. Rear spring

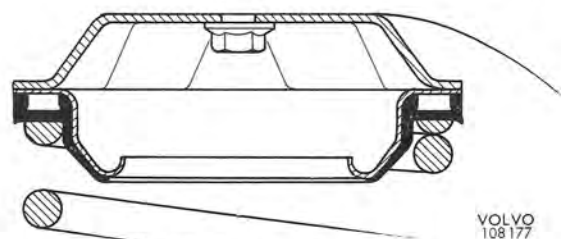


Fig. 7-5. Spring seat for rear spring

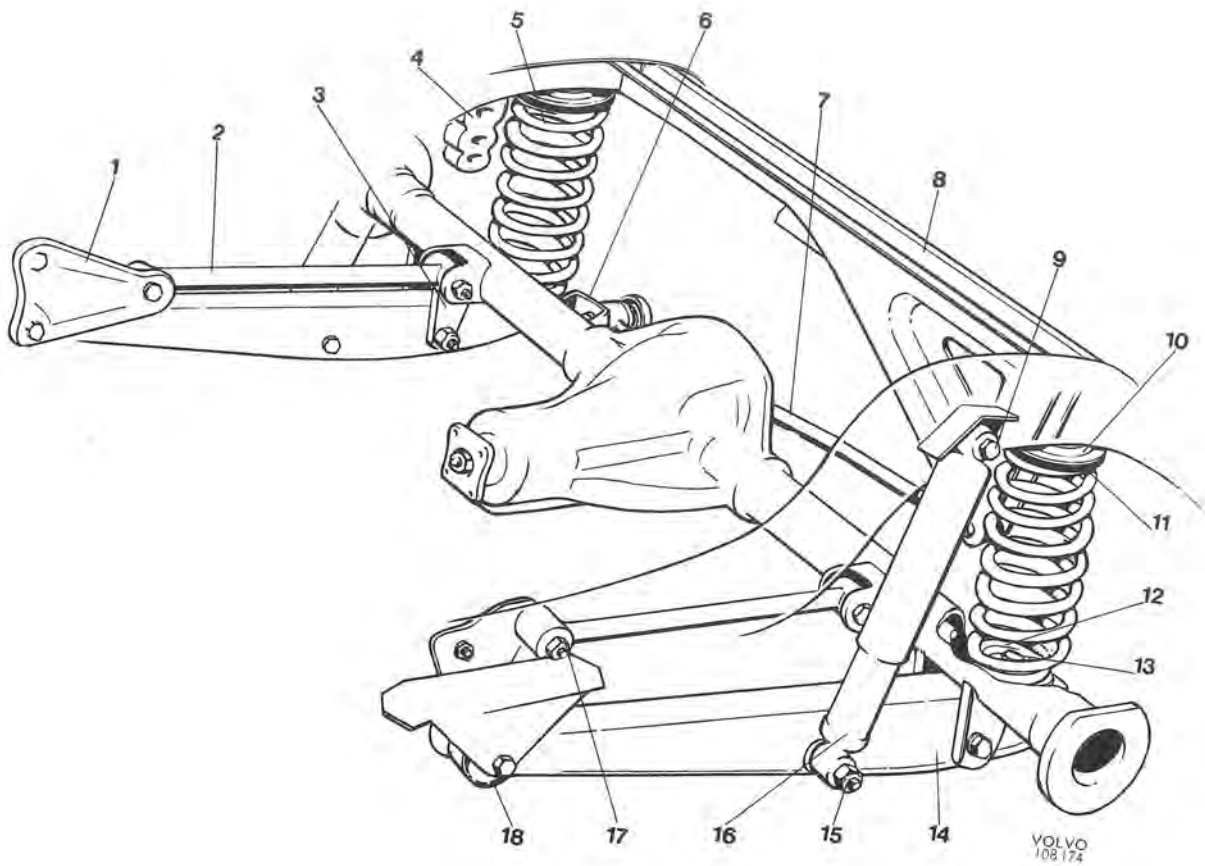


Fig. 7-6. Rear axle suspension

- | | |
|------------------------------------|-------------------------------------|
| 1. Bracket | 11. Rubber spacer |
| 2. Support stay | 12. Bracket |
| 3. Bracket | 13. Screw lower spring attachment |
| 4. Rubber buffer | 14. Washer |
| 5. Rear spring | 15. Support arm |
| 6. Bracket | 16. Shock absorber |
| 7. Track bar | 17. Lower shock absorber attachment |
| 8. Rear side-member | 18. Front support stay attachment |
| 9. Upper shock absorber attachment | 19. Front bush, support arm |
| 10. Washer | |

SHOCK ABSORBERS AND STABILIZING DEVICES

DESCRIPTION

GENERAL

The T64 is fitted with hydraulic, double-acting, telescopic type shock absorbers. They require no maintenance and cannot be disassembled.

The front shock absorber upper attachment (Fig. 7-8) consists of a spindle (5), which with upper bushes (1 and 6), washers (3 and 7) and a spacing sleeve, are fixed into a housing in the front axle member.

The lower attachment (Fig. 7-9) consists of an eyelet provided with a rubber bush, 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. 7-10) consists of eyelets provided with rubber bushes (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 support arms.

The rear axle is attached to the body through two flexibly mounted support arms (15, Fig. 7-6). Forces acting longitudinally are taken up by two support stays (2) and the lateral forces are absorbed by a track bar (7). The support arms are fore-mounted in rubber bushes (19). The support stays and track bar are attached to the rear axle frame through the rubber bushes.

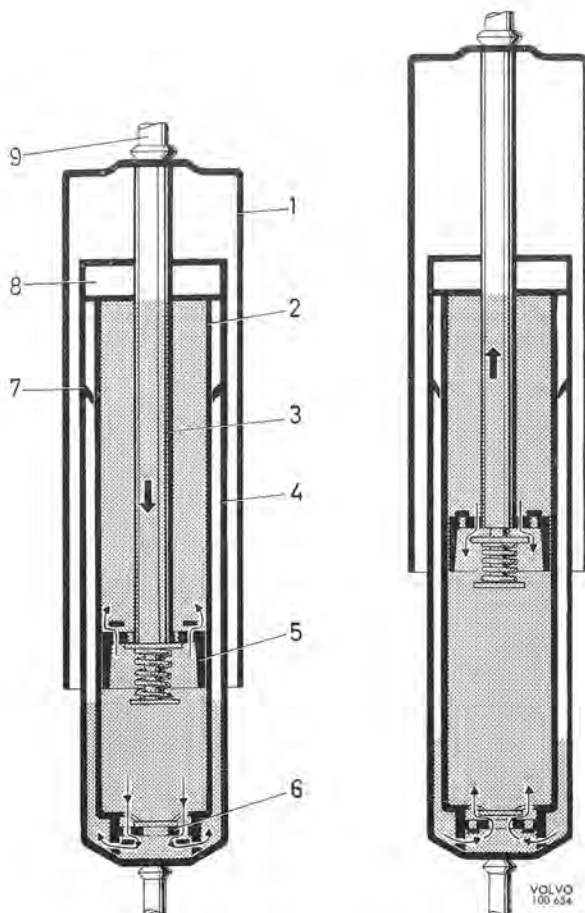


Fig. 7-7. Shock absorber, function

- | | |
|-----------------------|---------------------|
| 1. Dust cover | 6. Valve |
| 2. Working cylinder | 7. Baffle ring |
| 3. Piston rod | 8. Cover |
| 4. Reservoir cylinder | 9. Upper attachment |
| 5. Piston | |

SHOCK ABSORBERS

DESIGN

The design of the shock absorbers is shown in Fig. 7-7. 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 is provided with a valve (6). Inside the inner cylinder there is a piston (5) in which holes are drilled, the passage of oil through these holes being 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) is moved 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 of the piston.

REPAIR INSTRUCTIONS

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 bushes are damaged, the shock absorbers should be replaced.

REPLACING FRONT SHOCK ABSORBERS

1. Remove the upper nut (4, Fig. 7-8), the washer (3) and the rubber bush (6).
2. Remove the two lower attaching screws (Fig. 7-9) on the underside of the lower control arm, and take down the shock absorber.
3. Fit the washer (7), the spacing sleeve (2) and the rubber bush (1).

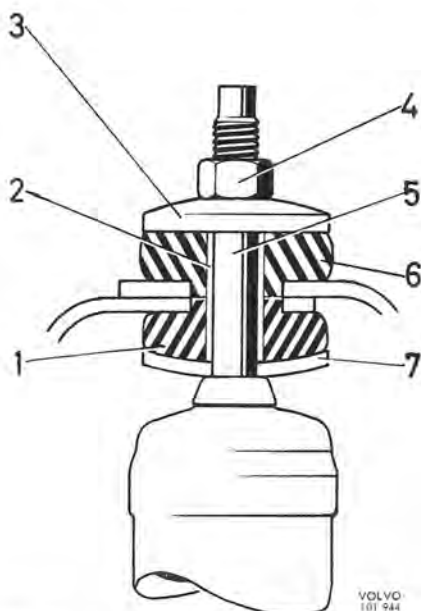


Fig. 7-8. Upper attachment, front shock absorber

- | | |
|-------------------|----------------|
| 1. Rubber bush | 5. Spindle |
| 2. Spacing sleeve | 6. Rubber bush |
| 3. Washer | 7. Washer |
| 4. Nut | |



Fig. 7-9. Lower attachment, front shock absorber

4. Pull apart the shock absorber and then fit it. Fit and tighten the lower screws.
5. Fit the upper rubber bush (6), the washer (3) and the nut. Tighten the nut until it makes firm contact with the spacing sleeve.

REPLACING REAR SHOCK ABSORBERS

1. Remove the hub cap. Slacken the wheel nuts a couple turns. Jack up the rear end of the vehicle at the jack attachments. Place blocks in front of the jack attachments according to Fig. 7-3. Remove the wheel. Unscrew and remove the shock absorber.
2. Fit and tighten the shock absorber, see Fig. 7-10. Fit the wheel and wheel nuts. Lower the vehicle. Put on the hub cap.

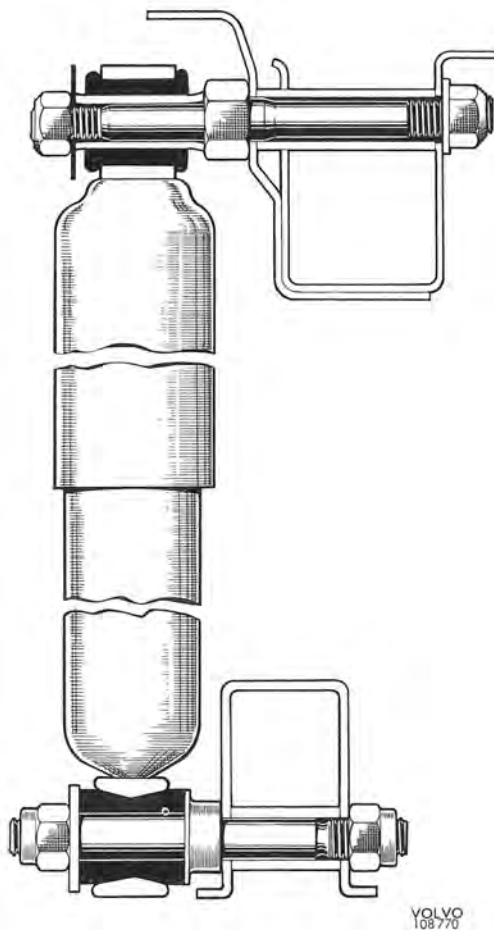


Fig. 7-10. Attachments, rear shock absorber

REPLACING BUSHES FOR SUPPORT ARM

1. Raise the vehicle by placing props in front of the rear jack attachments according to Fig. 7-3. Do not remove the jack.
2. Disconnect the shock absorber at the lower attachment. Remove the lower screw of the spring and then lower the jack until the spring releases from the support arm. Move the spring backwards so that it runs free from the support arm. Raise the jack until the rear axle is in a level position.
3. Remove the screw on the support arm at the rear axle bracket (3, Fig. 7-6). Remove the front screw and take off the support arm.
4. Press out the front bush with tool 2732. Coat the new bush with oil and press it in with the same tool according to Fig. 7-11. Make sure that the plane sides of the bush are at right angles to the support arm shaft (Fig. 7-11).
5. Press out the rear bush with tool 2730 and tool 2733.
Press in the new bush with the same tools, using tool 2730 in the reverse direction.
6. Place the support arm in position and fit the front and rear screws.
7. Lower the jack under the rear axle, move the spring in position on the support arm, again raise the rear axle to the horizontal position and fit the lower screw for the spring.
8. Fit and tighten the nuts for the support arm screws. Fit and tighten the nut for the lower shock absorber attachment, see Fig. 7-10.



Fig. 7-11. Removing (and installing) the front bush, support arm

REPLACING BUSHES FOR TRACK BAR

1. Raise the rear end of the vehicle by placing props in front of the rear shock absorber attachments according to Fig. 7-3.
2. Remove the nuts at both brackets (6 and 12, Fig. 7-6). Remove the track bar from the bracket mounted on the rear axle. Remove the screw at the bracket (12) attached to the frame and take off the track bar.
3. Check the bushes. If necessary, press out the small bushes with 2730 using 2733 as a counterhold. (Fig. 7-12). Pressing in the bushes can be done with the same tools only in this case 2731 is reversed (Fig. 7-13).
4. Fit the bar with the screw to the frame bracket (12).

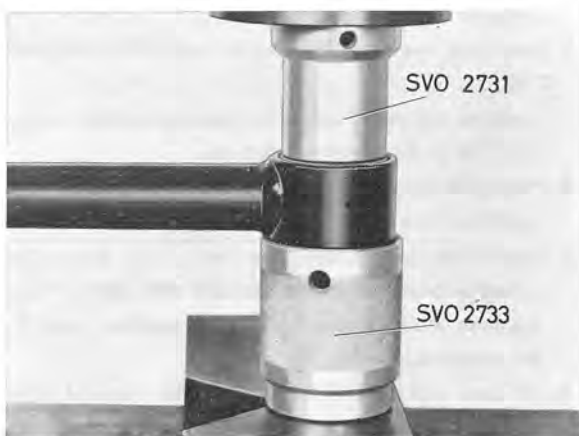


Fig. 7-12. Removing large bush, track bar

5. Place the other end on the rear axle bracket (6) and fit both the nut cover and nut. Screw on the frame bracket nut.
6. Remove the props and lower the vehicle.

REPLACING BUSHES FOR SUPPORT STAY

The bushes of the support stay are pressed out with tool 2734 and counterhold 2733. They are suitably pressed in with a drift press directly on the bush and with tool 2733 as a counterhold (see Fig. 7-14). Before pressing in the rubber bush, coat it with oil so that it slides easily into position and is not damaged.

When installing the bushes, they should be turned so that the markings come at right angles to the length of the stay as shown by the arrows in Fig. 7-15.



Fig. 7-14. Installing bush, support stay



Fig. 7-13. Installing large bush, track bar

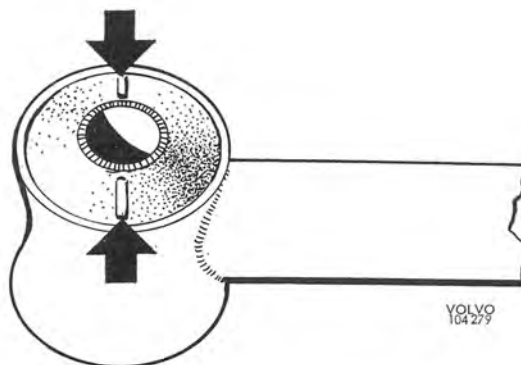


Fig. 7-15. Marking-up support stay bush

WHEELS

REPAIR INSTRUCTIONS

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 Part 5.
2. Set up tool 2862, without the accessory components,

as shown in Fig. 7-16. 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. 7-17) 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.

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Fig. 7-16. 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 wishbones. Unscrew the wheel nuts and lift off the wheel.
3. Remove the front wheel brake according to the instructions given in Part 5 under "Removing front wheel brake unit".
4. Remove the grease cap with tool 2715 (Fig. 7-18). Remove the split pin and castle nut. Pull off

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Fig. 7-17. Installing wheel stud

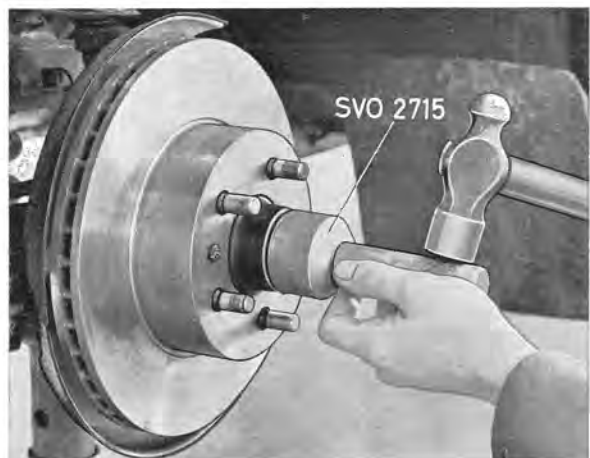
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Fig. 7-18. Removing grease cap

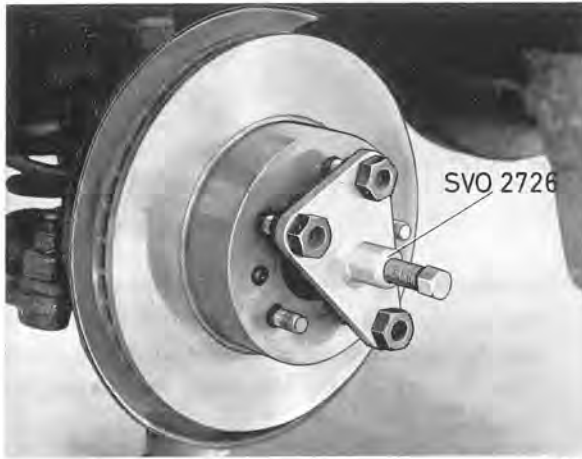


Fig. 7-19. Removing hub

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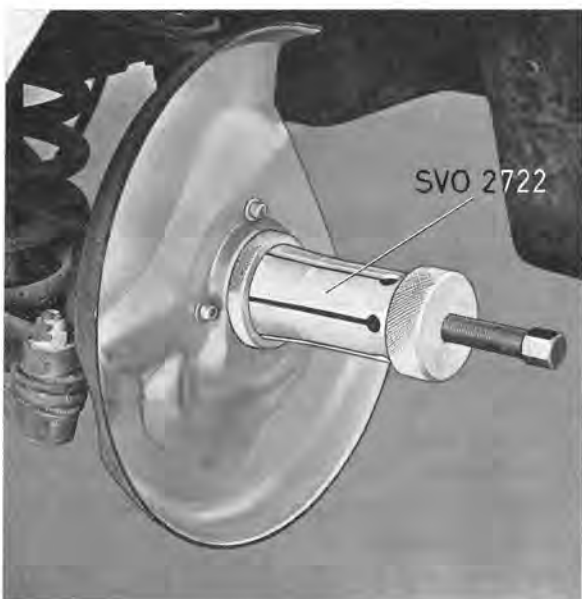


Fig. 7-20. Removing inner bearing

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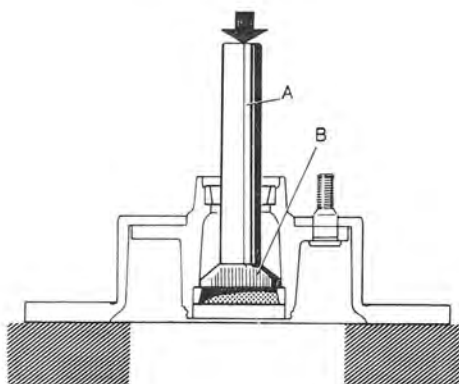


Fig. 7-21. Removing inner bearing ring

A = 1801 B = 2724

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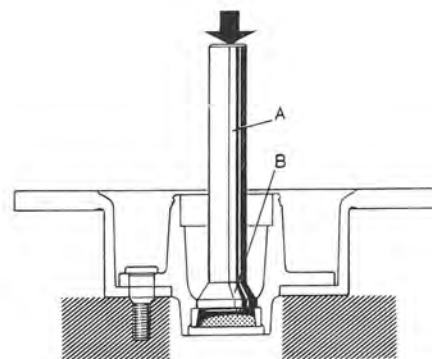


Fig. 7-22. Removing outer bearing ring

A = 1801 B = 2725

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the hub with puller 2726 (see Fig. 7-19). Pull off the inner bearing from the stub axle with puller 2722 (see Fig. 7-20) if the bearing remains in place.

5. Remove the bearing rings. Use drift 2724 (Fig. 7-21) for the inner bearing ring and drift 2725 (Fig. 7-22) 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 drift 5005 (Fig. 7-23) for the inner ring, and drift 2724 (Fig. 7-24) for the outer bearing ring.
8. Grease the bearing with the help of a pressure greaser. 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 bearing. 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. 7-26.

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. 7-25. 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

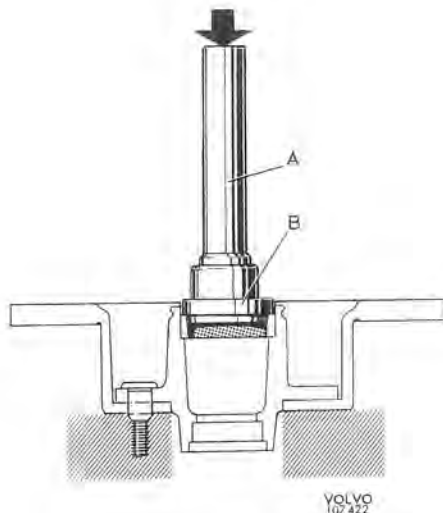


Fig. 7-23. Installing inner bearing ring
A = 1801 B = 5005

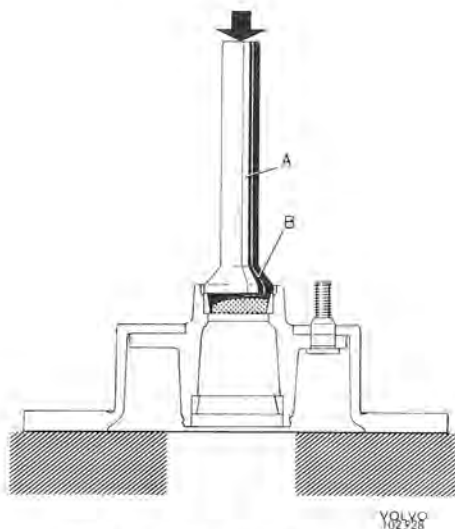


Fig. 7-24. Installing outer bearing ring
A = 1801 B = 2724

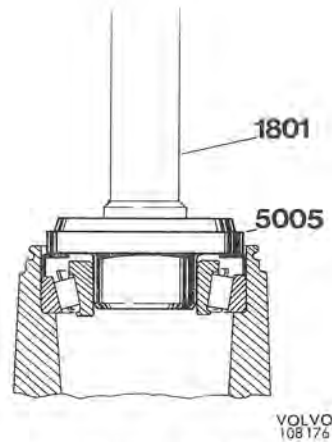


Fig. 7-25. Fitting seal

of 70 Nm (50 lbft). Then slacken the nut 1/3 of a 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 Part 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 (70–100 lbft). Install the hub cap.

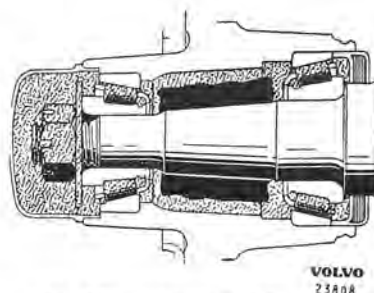


Fig. 7-26. Lubrication of front bearing

Part 8

BODY

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TOOLS

Special tools may have SVO or 999 in front of their number, e.g., SVO 2739 or 999 2739.

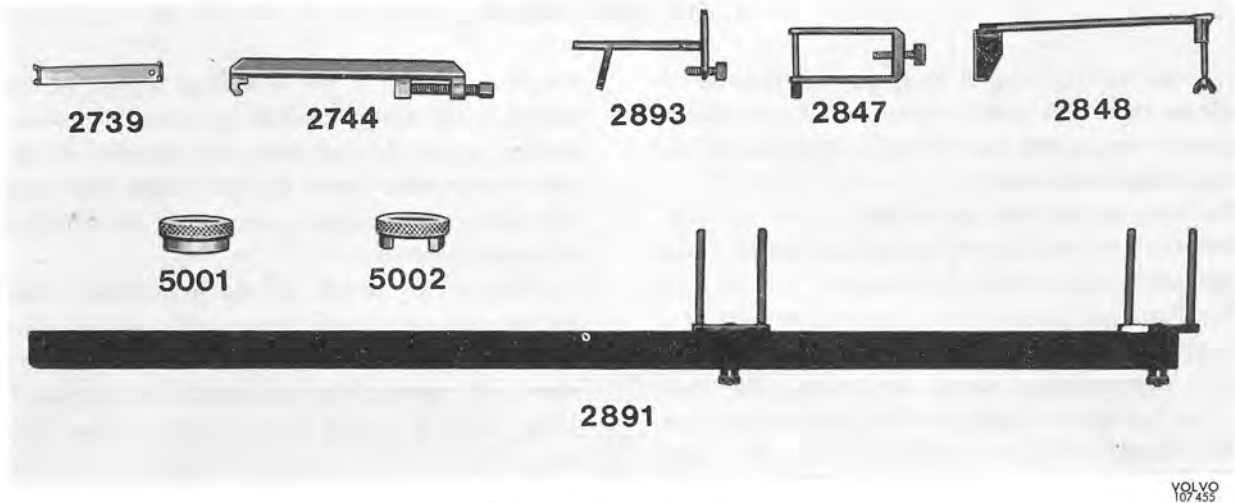


Fig. 8-1. Tools for the body

- 999 (SVO)
- 2739 Clamp for gas spring, trunk lid
 - 2744 Press tool for gas spring, trunk lid
 - 2847 Holder for securing fixture 2777 (2 are used)
 - 2848 Arm for measuring height of side-member
 - 2891 Straight edge for measuring height of side-member
 - 2893 Holder for fixing straight edge
 - 5001 Guide for fixture for replacing side members, left
 - 5002 Guide for fixture for replacing side members, right



Fig. 8-3. 2899 Fixture for fitting windshield

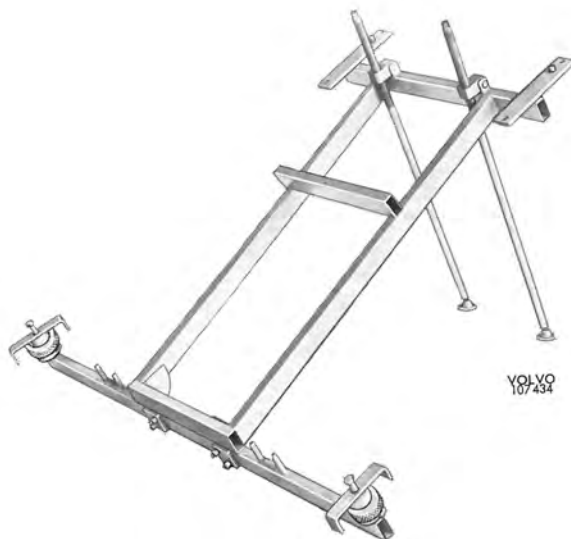


Fig. 8-2. 2777 Fixture for replacing side-members

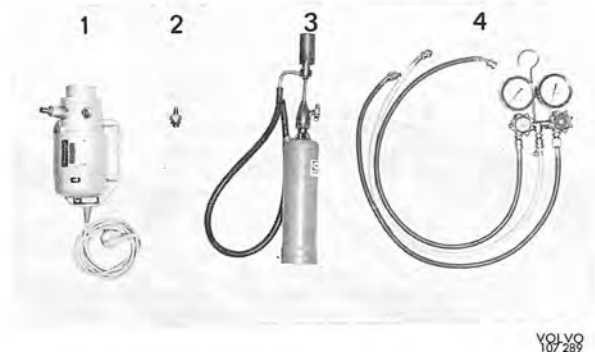


Fig. 8-4. Equipment for filling and leakage test

1. Vacuum pump
2. Nipple for vacuum pump, SK-1229
3. Leak detector with LPG-bottle
4. Pressure gauge kit with hoses

BODY FRAME

DESCRIPTION

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 into the floor, side sections, rear section, scuttle, roof section, front mudguards, doors, trunk lid and hood.

The floor and frame section (Fig. 8-5) 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. 8-5) 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 means of 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.

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 and end plates in the rear wheel housings are made of galvanized sheet metal.

The roof section (see Fig. 8-6) 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.

REPAIR INSTRUCTIONS

Mounting of 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).

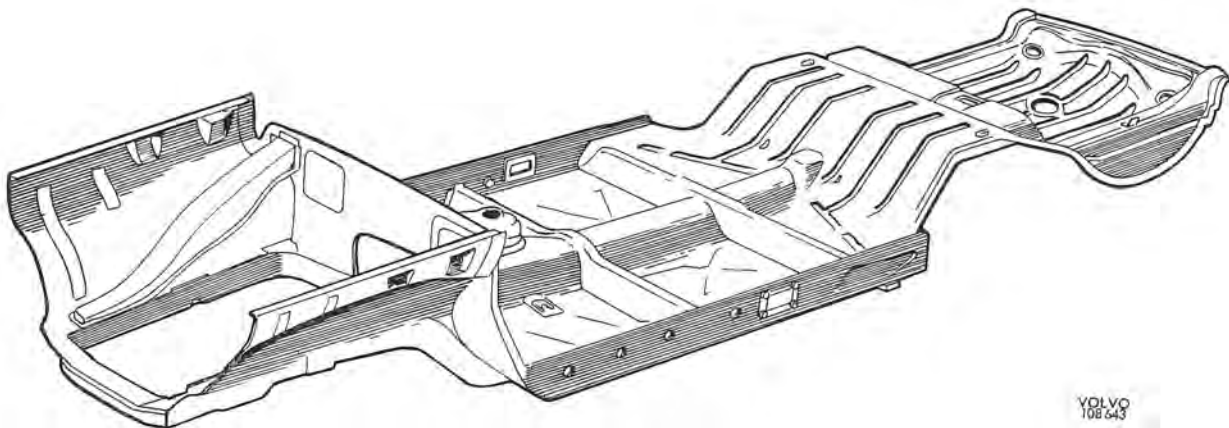


Fig. 8-5. Floor section

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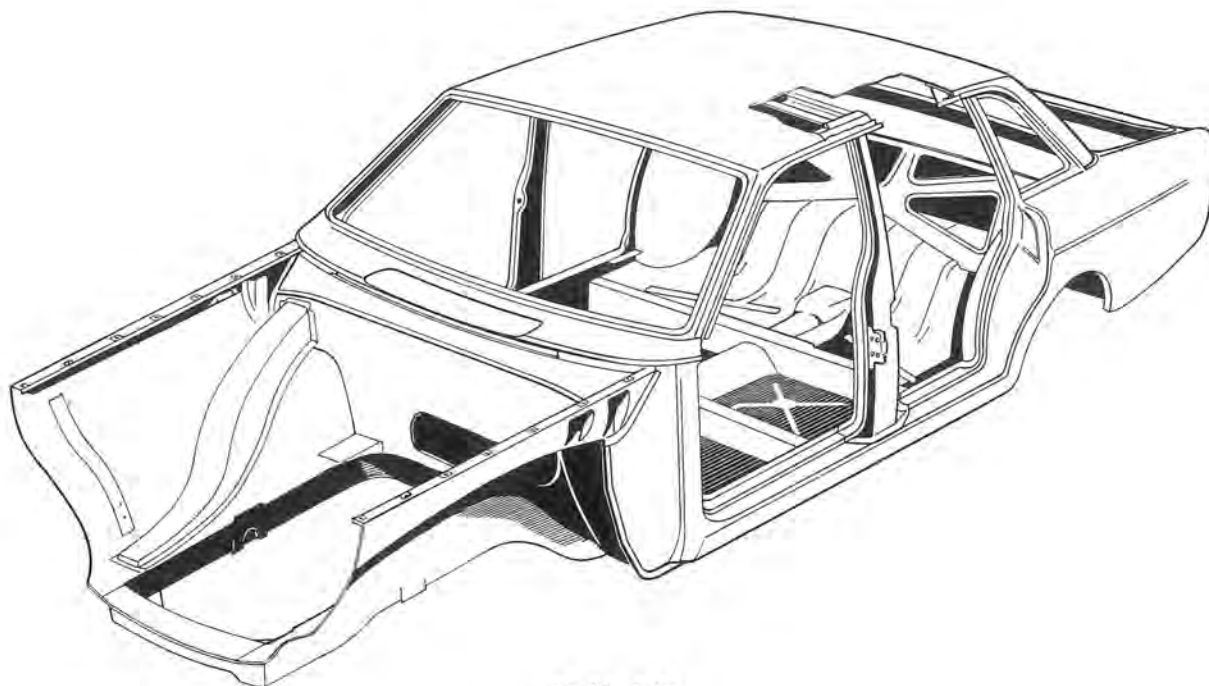


Fig. 8-6. Body

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 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").

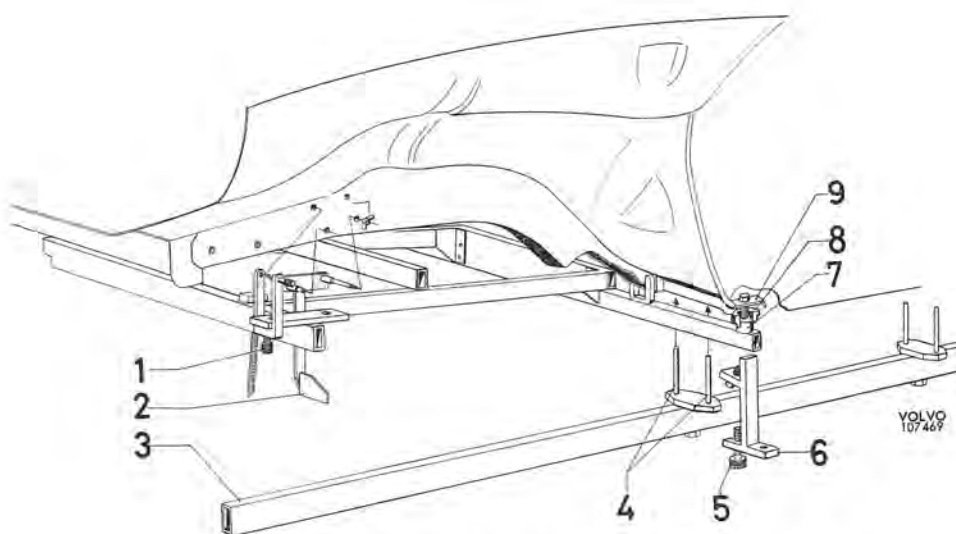


Fig. 8-7. Tool for front side-members

- | | | | | |
|------------------|------------------------|-------------|-------------------|----------|
| 1. Retainers | 3. Straight edge | 5. Bolt | 7. Rear guide pin | 9. Clasp |
| 2. Measuring arm | 4. Front support studs | 6. Retainer | 8. Guide | |

HOOD AND MUDGUARDS

DESCRIPTION

The hood consists of an outer and an inner plate which are 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 control placed underneath the dashboard inside the car.

The front mudguards, front section and hood make up the front end. The front mudguards 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.

REPAIR INSTRUCTIONS

FRONT MUDGUARDS

The front mudguard is removed after the plastic cover over the headlights and the headlight itself have been removed (see Part 3). This is done by unscrewing the following bolts: the bolts joining the mudguard and front plate, the bolts on the wheel arch, and the bolts linking the mudguard rear edge and the brackets on the body. The bolts on the rear edge of the mudguard are accessible when the front door is opened.

FRONT SECTION

The front section is attached to the front mudguards, wheel arch plates and the front cross-member. When removing, first take off the plastic cover over the headlights and also the headlights (see Part 3) and any extra lights if fitted. Then remove the grille, the horn, the bumpers and the support irons for the bumpers. 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 mudguard, wheel arch and front cross-member.

HOOD AND HOOD LOCK

The hood is attached in each hinge by means of 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 mudguard. 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.

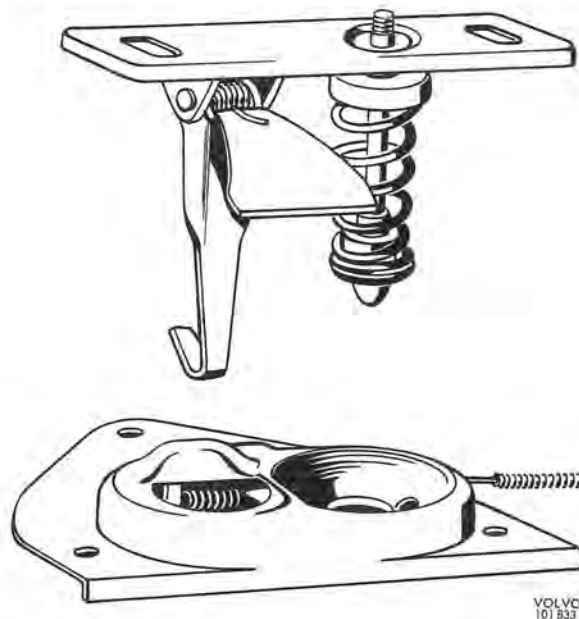


Fig. 8-8. Hood lock

DOORS AND TRUNK LID DESCRIPTION

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 window 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 position by means of a lifting arm from the toothed segment with the assistance of a helper arm.

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 a gas spring and can be set in any desired position when opening. 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.

REPAIR INSTRUCTIONS

DOORS

Removing and installing door stops

Remove the door panel in accordance with the instructions under "Removing inner handles and upholstery". Then unscrew the screw between the door stop and post, and remove the rubber sealing (see Fig. 8-9). 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.

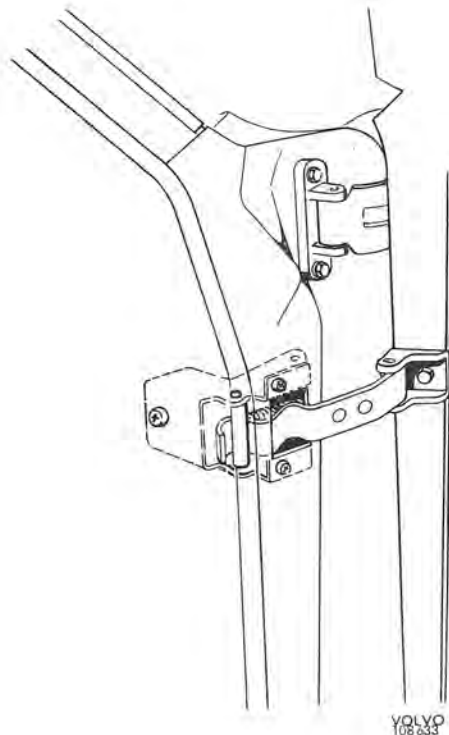


Fig. 8-9. Door stop

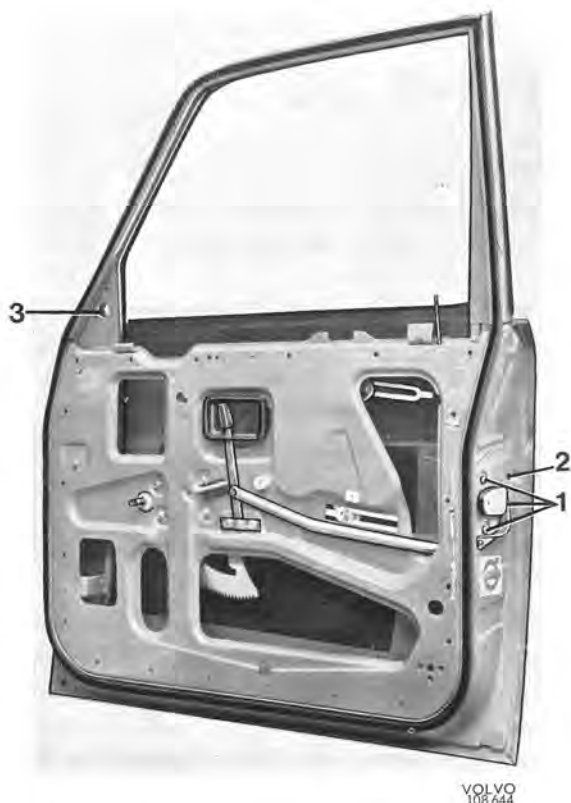


Fig. 8-10. Front door

1. Door lock screws
2. Holes for lock cylinder retaining screws
3. Holes for fitting rearview mirror

Removing and installing front doors

Remove the door stop in accordance with the instructions under "Removing and installing door stops". Unscrew the bolts between the hinges and door. The bolts are accessible when the door is opened. The door can then be taken off (Fig. 8-10).

In order to remove the hinges the panel in front of the door has to be taken off. When this has been done, the three bolts are unscrewed, after which the hinges can be removed.

The door and hinges are installed in reverse order. Concerning installing the door stop, see under "Removing and installing door stops".

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. 8-11. Door window crank

Removing door window crank and 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 taking out the plastic plugs and undoing the attaching screws.
2. 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.
3. Undo the screws at the top edge of the upholstery and then 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. 8-12.

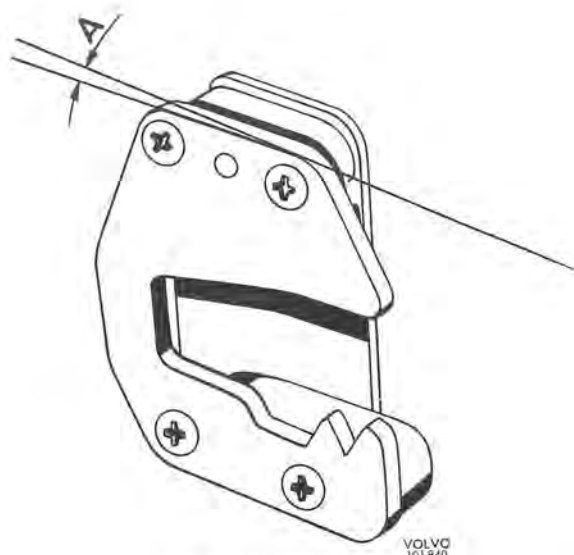


Fig. 8-12. Latch plate

A. Front door 1.5°
Rear door 2.5°

Removing front door lock

1. Carry out operations 1—3 under "Removing inner handles and upholstery".
2. Remove the lock cylinder by unscrewing the attaching screw which is fitted in the rear edge of the door (2, Fig. 8-10).
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 (1, Fig. 8-10).

Removing outer handle, front doors

1. Wind up the window to closed position.
2. Remove inner door handle and upholstery according to previous instructions.
3. Wind down the window to get at the two retaining screws (7, Fig. 8-13). Remove the screws.
4. Unhook the return spring (8, Fig. 8-14) 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. 8-13) in the lifting arm for the handle.
2. Screw in both the attaching screws (7, Fig. 8-13).

3. Check to make sure the lock functions properly. If necessary, adjust the length on the pull rod (9, Fig. 8-13).
4. Install the return spring (8, Fig. 8-13).
5. Put back the door upholstery and install the inner handle.

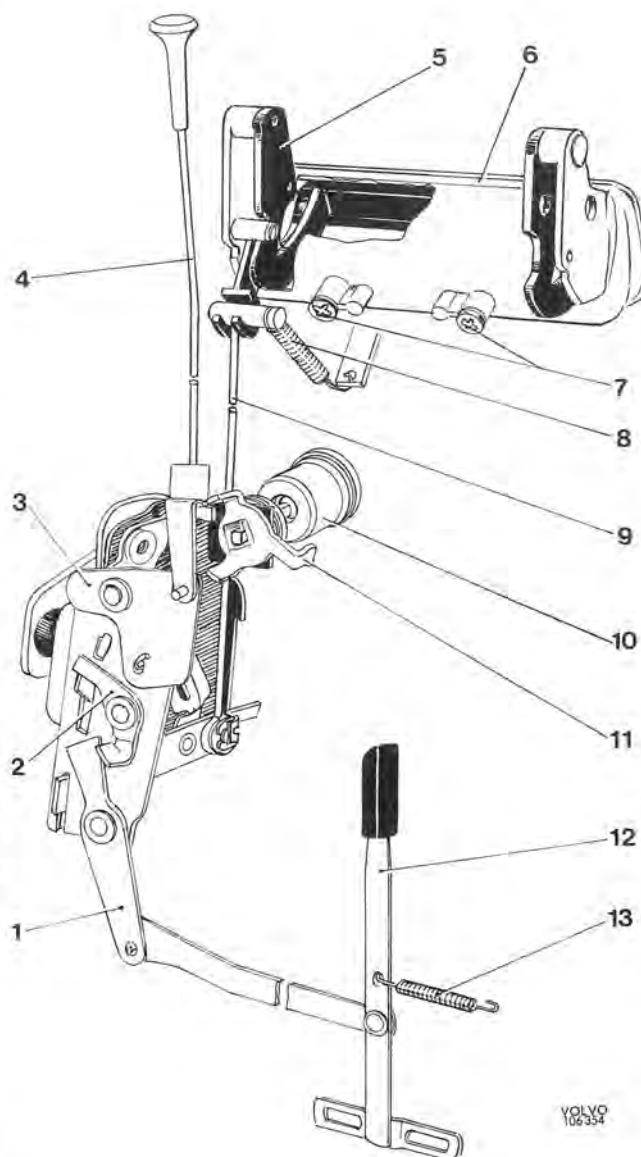


Fig. 8-13. Lock, front door

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

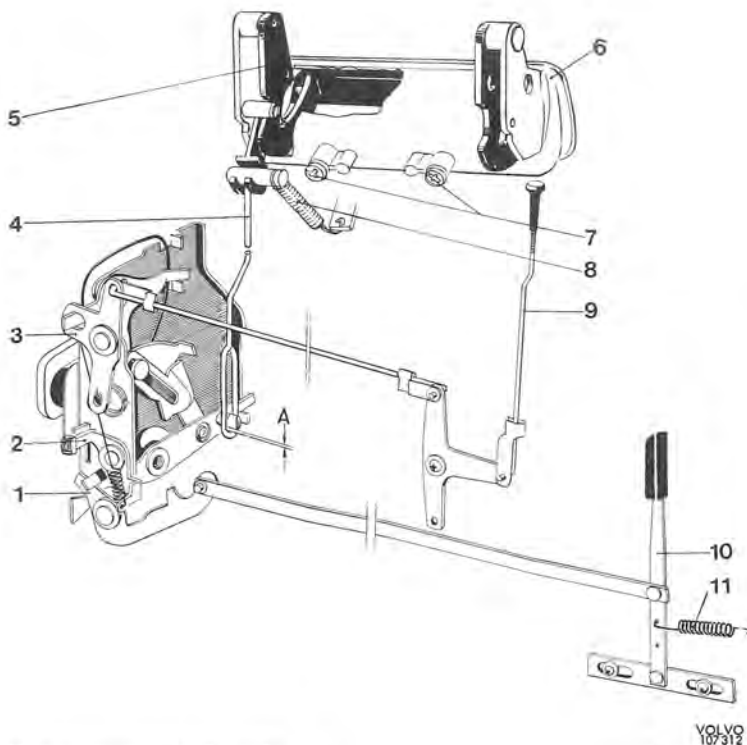


Fig. 8-14. Lock, rear doors

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 window crank and 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 attaching screws for the door lock and remove the lock from the door. The attaching screws for the lock are placed on the rear edge of the door.

Removing outer handle, rear doors

1. Wind 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. 8-14).
4. Undo the screws (7, Fig. 8-14) 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. 8-14) in the lifting arm for the handle.
2. Screw in the attaching screws (7, Fig. 8-14).
3. Check to make sure that there is a clearance (A, Fig. 8-14 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. 8-14) and check that the lock functions properly.
5. Put back the door upholstery and install the inner handle.

Removing door window

1. Crack down the window to its bottom position.
2. Bend out the cover, remove the screw and the crank.
3. Remove the armrest and door panel. Remove the large sheet of water protection.
4. 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.
5. Remove the window by lifting and turning towards the vehicle as shown in Fig. 8-15.



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Fig. 8-15. Removing window

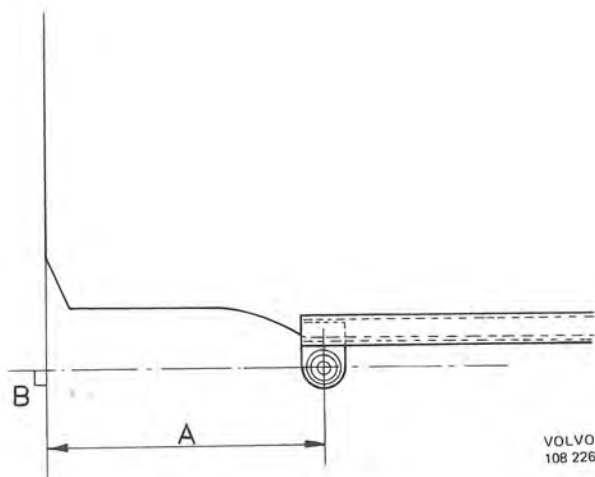


Fig. 8-16. Window dimensions, front door
 $A=263\pm 2$ mm (10.275—10.433") $B=90^\circ\pm 1^\circ$

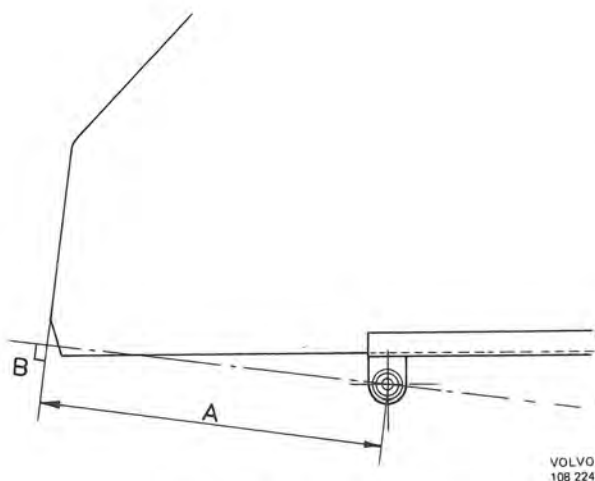


Fig. 8-17. Window dimensions, rear door
 $A=169\pm 2$ mm (6.654—6.732") $B=90^\circ\pm 1^\circ$

Installing door window

1. Install the window in the window channel according to Fig. 8-18.
2. Lower the window with the shorter end first and turn it at the same time as shown in Fig. 8-18.
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 water protection sheet.
6. Install the door panel, the arm rest and the window crank.

Removing and installing rear door window

See the corresponding section above.



Fig. 8-18. Installing window

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Removing 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.
4. Remove the clip (1, Fig. 8-19) at one of the crank arm's retaining points in the door.
5. Remove the door window crank mechanism retaining screws (2, Fig. 8-19).
6. Remove the crank mechanism as shown in Fig. 8-20.

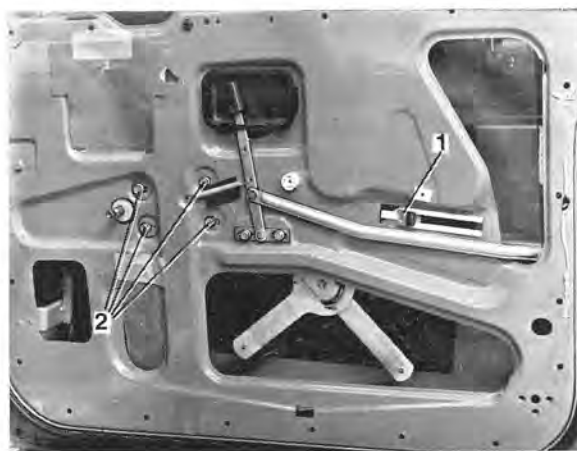


Fig. 8-19. Front door, interior

1. Clip 2. Window mechanism retaining screws

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Fig. 8-20. Window mechanism removal

Removing rear door window crank mechanism

Proceed in the same way as described above.

TRUNK LID

The trunk lid is mounted on two hinges, both of 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 a spring support.

The trunk lid is removed by unscrewing the two bolts on each hinge and lifting it off.

When replacing the 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. 8-21 in order to enable clamp 2739 to be fitted. Installing is done in the reverse order.

When removing the hinges, first remove the spring support as described above. The lid is then removed from the hinges and after this the hinges from the body.

The holes in the part of the hinges which fits on the trunk lid are oval in order to permit longitudinal adjustment. For vertical adjustment the holes in the part of the hinges which fits in the body are oval.

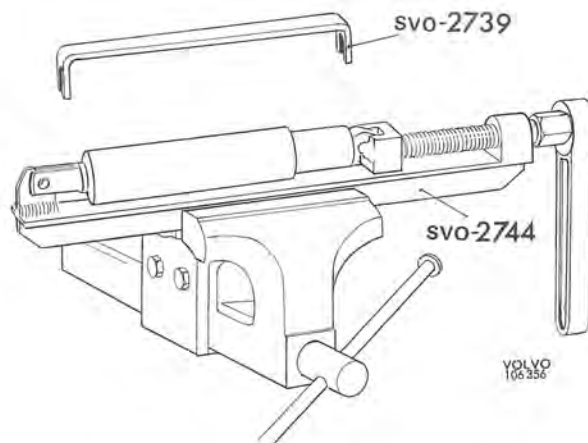


Fig. 8-21. Tools for spring support

The locking device (Fig. 8-22) is fitted in the rear section and is released by turning the lockable 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 knob is removed by unscrewing the large slotted nut inside the trunk. 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.

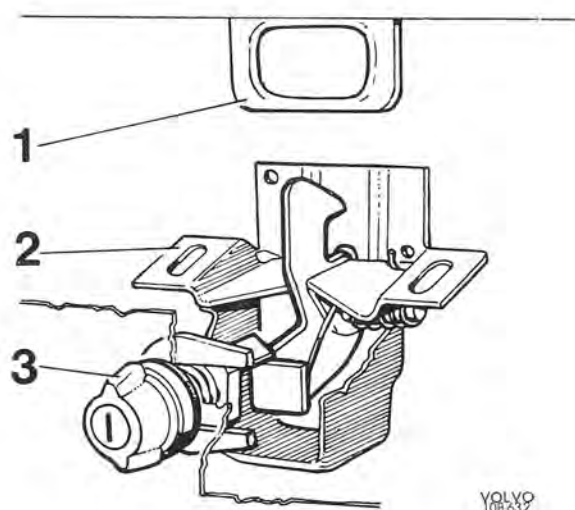


Fig. 8-22. Lock for trunk lid

1. Lock catch, fitted in lid
2. Lock mechanism, fitted in rear section
3. Lock knob, fitted in rear section

SUNROOF

Removing cable

1. Open the sunroof and release the clips securing the roof upholstery at the front end. Then move the upholstery back to leave an opening.
2. Crank the sunroof forwards and slacken the screws at its four attachments (9 and 11, Fig. 8-23). 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).

Fitting of cables

1. Fit the cables so that the attachments for the sunroof come opposite each other, and at the rear end of the roof opening. Screw on securely the front guide rails.
2. Fit the intermediate pieces, holders and covering plate.
3. Fit the wind deflector.

4. Screw on the roof securely and put back the leaf springs.
5. Crank the sunroof 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. Fit the crank gear housing and crank. The crank should now point straight forwards in the vehicle when the sunroof is completely closed.
8. Put back the upholstery and test the function of the sun-roof.

Replacing sealing strips

The sunroof must be removed in order to replace the insulating strip and sealing strip there. See points 1 and 2 under "Removing the cable".

When replacing the insulating strip round the roof opening of the sunroof, all that is required is to crank the roof back to its rearmost position.

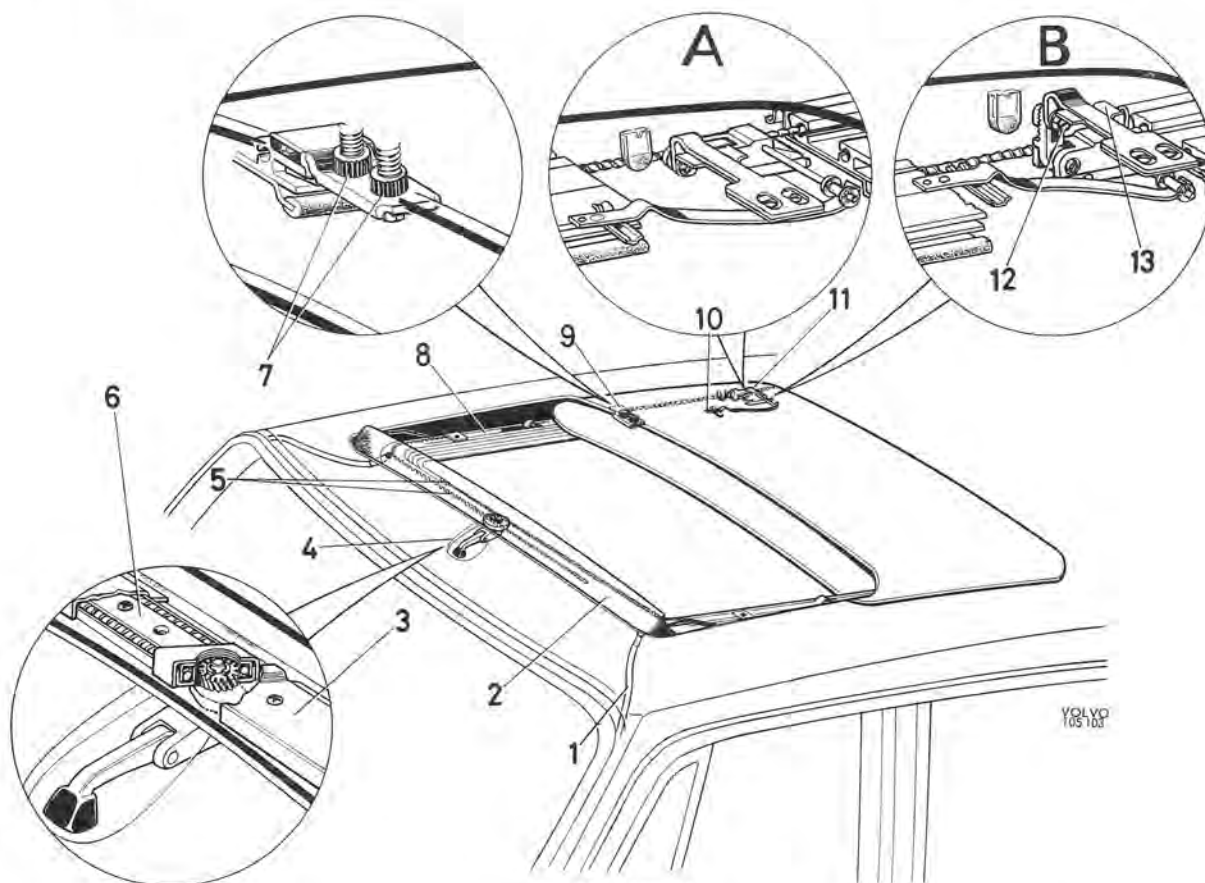


Fig. 8-23. Sunroof

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 REPAIR INSTRUCTIONS

SEALING STRIPS

The sealing strips are secured by means of spot-welded 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. 8-24.

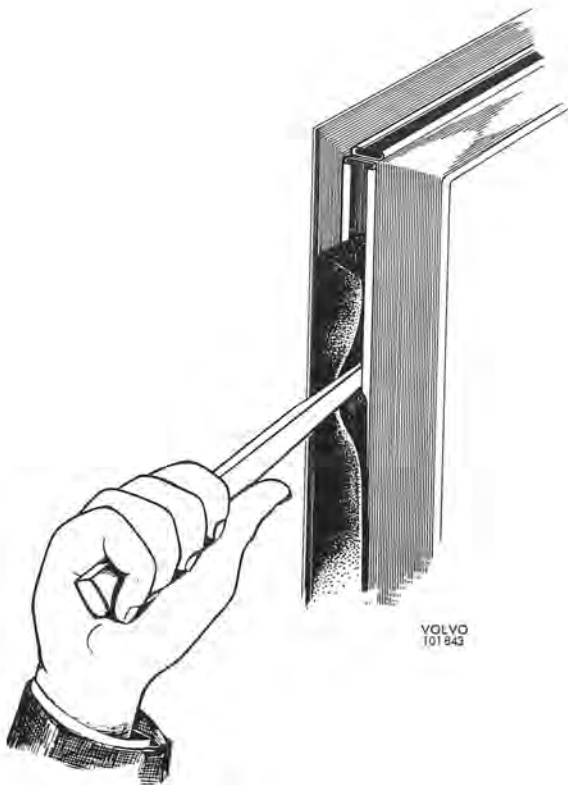


Fig. 8-24. Fitting sealing strip

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. Insert the knife between the windshield and moulding opposite a clip, see Fig. 8-25. Then lever the moulding loose.

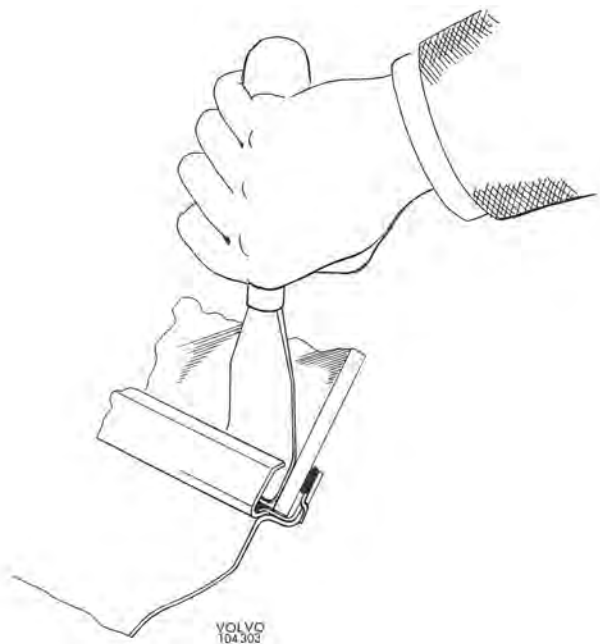


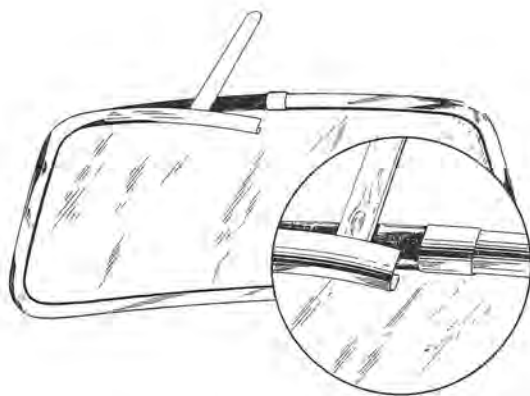
Fig. 8-25. Removing trim moulding

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. 8-26. Lever off the moulding carefully while releasing the rubber strip with the other putty knife.



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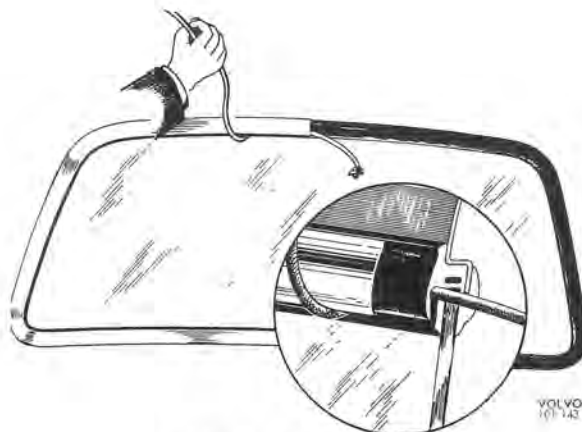
Fig. 8-26. Removing trim moulding

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. 8-27. 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.



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Fig. 8-27. 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. Unscrew the inner covering strips and rearview mirror.
5. Cut the windshield loose with a warm soldering iron. Insert the point of the iron in between the windshield and the body, from the inside of the vehicle, see Fig. 8-28. 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.
6. Clean the body (also the windshield if it is to be refitted) of any tape.
7. Remove any defective clips.

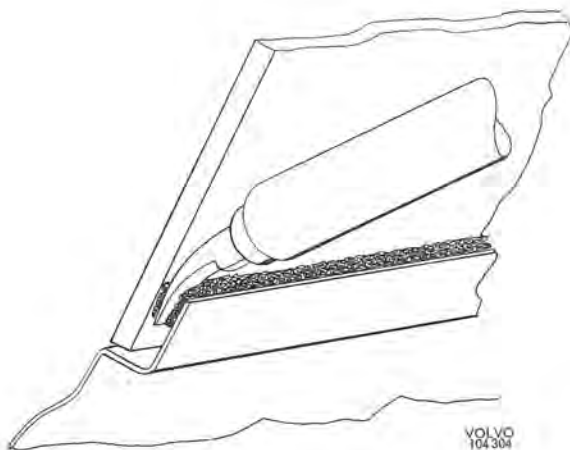


Fig. 8-28. Removing windshield

The soldering iron should be on 200 W. The tip may not be so thick that it comes in contact with the glass.

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 im-

mediately 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 compound and then wash clean with

naphtha. Check that the sheet metal edge is not deformed. If the sealing compound has not dried on, clean the rubber strip with naphtha, otherwise replace it.

Installing rear window

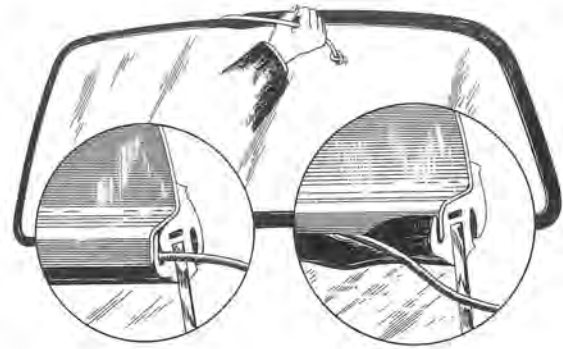
1. Moisten the outer edge of the windshield and fit the rubber strip starting at one of the corners. Adjust the strip so that it lies correctly all round.
2. Install a cord (preferably of terylene) of a suitable size in the groove of the rubber strip for the sheet metal edge, beginning at the top center as shown in Fig. 8-29.



Fig. 8-29. Placing cord in rubber strip

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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. 8-30. It may sometimes be necessary to adjust the position of the rear window with the palm of the hand. If the



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Fig. 8-30. Fitting rear window

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.

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 compound fills the joint well. Scrape off surplus sealing compound 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 EQUIPMENT AND HEATING SYSTEM DESCRIPTION



Fig. 8-31. Front seat

INTERIOR FITTINGS AND UPHOLSTERY

Front seats

The front seats (Fig. 8-31) are built up on a tubular frame. The stuffing consists of foam plastic faced with leather. To adjust the seat lengthwise to a desired position, raise the loop handle at the front of the seat. The slide rails are locked on both sides. The driver's seat is raised or lowered with the lever placed in front of and under the seat. The passenger seat can be bolted to three different heights by means of the bolting arrangement at the rear. Both seats are inclined to the desired angle by means of a screw at the front end. The backrest 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

inner backrest side. The seat cushions are fastened to the seat frame by means of press studs.

Both front seats are fitted with head restraints which can be adjusted vertically.

On certain markets the driver's seat is equipped with electrical, thermostat controlled heating pads (Fig. 8-32). Together the current draw for seat and back rest is 60 W. The thermostat opens the circuit at $+26^{\circ}\text{C}=78^{\circ}\text{F}$ and closes the circuit at $+14^{\circ}\text{C}=57^{\circ}\text{F}$.

Rear seat

The rear seat and backrest are built up on the same principle as the front seats, although in this case the seat has a wooden frame.

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 armrests are made of moulded plastic and are screwed to the inner plate of the door.

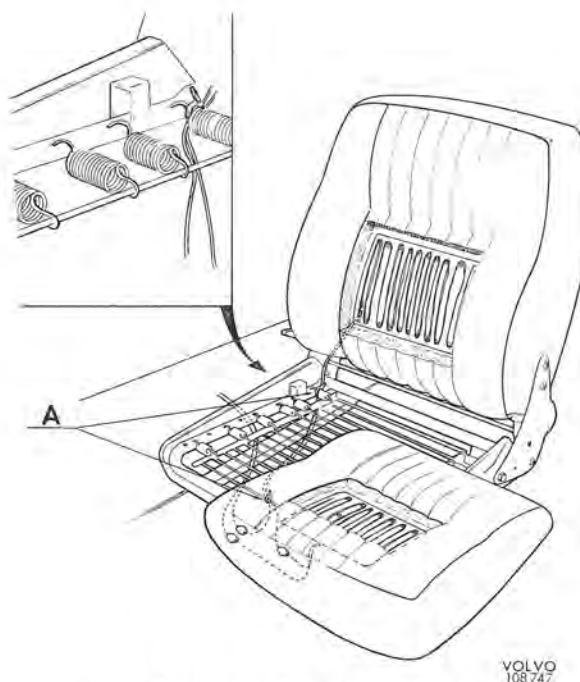


Fig. 8-32. Electrically heated driver's seat

A. Rubber strips

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Fig. 8-33. Glasswool headlining, section

Headlining

There are two different kinds of headlining, one for vehicles without sunroof and one for those with sunroof.

The headlining for vehicles without sunroof consists of form-pressed glasswool with a plastic foil underneath (Fig. 8-33). It is made in one single piece and cannot be bent. It is held in position by means of the sun visors, rearview mirror, grab handle and the two plugs at the rear end of the headlining.

For vehicles with sunroof, the headlining consists of plastic fabric stretched on roof ribs and secured in retainers fitted on the upper limit of the body sides.

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.

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. 8-34), 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 vents (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 centre of the vent.

An electric 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 (3). The cellular assembly (12) of the heater system is placed in front of the fan motor. Vehicles with air conditioning have the evaporator (9) 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. The left knob "TEMP" (25), which is a vacuum valve with infinite adjustment, is actuated by the heater control valve (1) so that desired air temperature can be obtained.

The air shutter and the air intake cover are turned with the help of vacuum. At each shutter there is a vacuum motor (8) which opens the shutter when actuated by

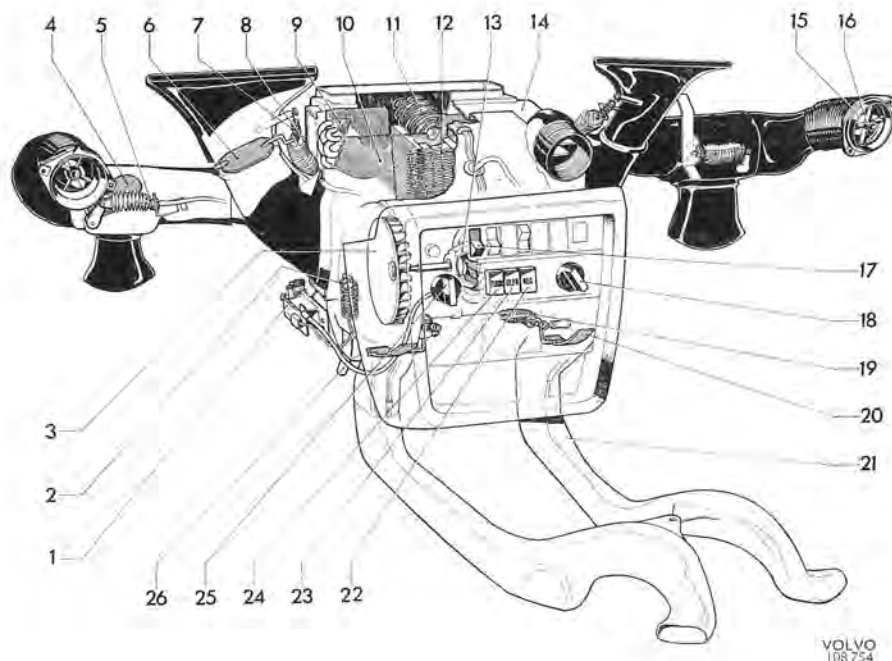


Fig. 8-34. Combined unit

1. Heater control valve
2. Capillary tube for heater control
3. Turbine
4. Shutter, air vent left floor
5. Vacuum motor
6. Shutter, left defroster nozzle
7. Return spring for vacuum motor
8. Vacuum motor
9. Evaporator (only on vehicles with air conditioning)
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 controls
26. Drain hose

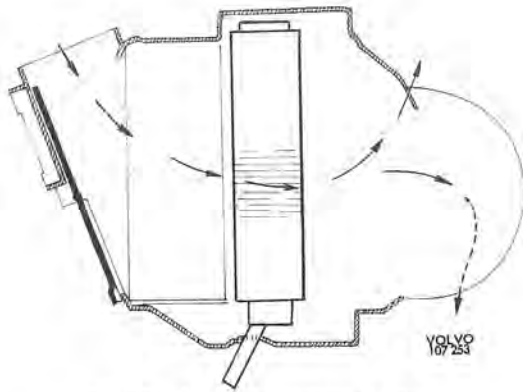


Fig. 8-35. Air circulation through system

vacuum. Vacuum is transmitted to the vacuum motors by pushing in the appropriate buttons on the dash. When the buttons are pushed out again, the shutters return to the closed position with the help of return springs (7).

The air flow through the vents on the dash is only regulated by the vent shutter and is not influenced by the push buttons. When all buttons are out, only fresh air is drawn into the unit (Fig. 8-35), 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. When the right button marked "REC" is pushed in, the air intake cover is adjusted to re-circulation of the compartment air (Fig. 8-36). With the cover in this position, only a small portion of fresh air is sucked in and mixed with the compartment air. If the vehicle is provided with air conditioning, more effective lowering of the temperature inside the compartment is obtained if the re-circulation is used.

Even when the air conditioning is switched on with a switch (17, Fig. 8-34) on the dash, the air temperature is regulated by the "TEMP" control. Fig. 8-33 shows how the sucked-in air is first cooled when it passes the eva-

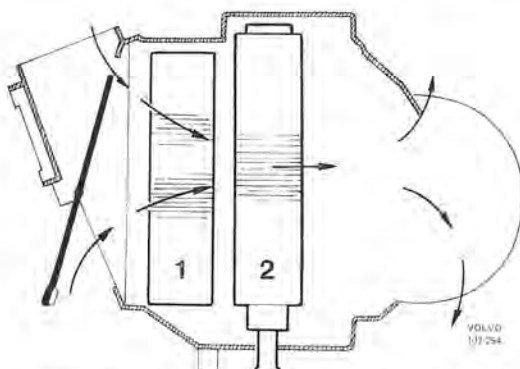


Fig. 8-36. Air circulation through system with re-circulation
1. Evaporator 2. Heater cell assembly

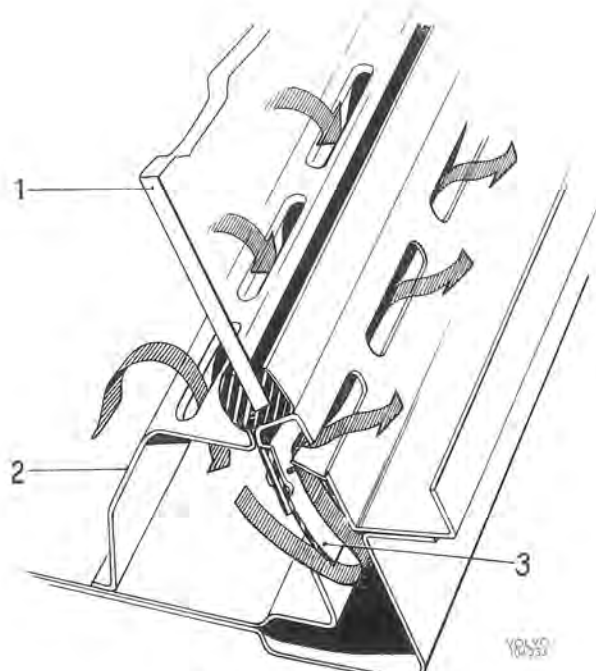


Fig. 8-37. Air extractor vents

1. Rear window
2. Inner panel
3. Non-return valve

porator (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 two hoses (26, Fig. 8-34), which run 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.

In order to obtain good through ventilation of the vehicle, air vents are located at the back under the rear window (Fig. 8-37). These vents have a total area of 50 cm² (7.8 sq. in.).

Also incorporated in the heating system is the electrically heated rear window, which has an output of 150 W. It is regulated by means of a switch located on the dash (Fig. 8-38).

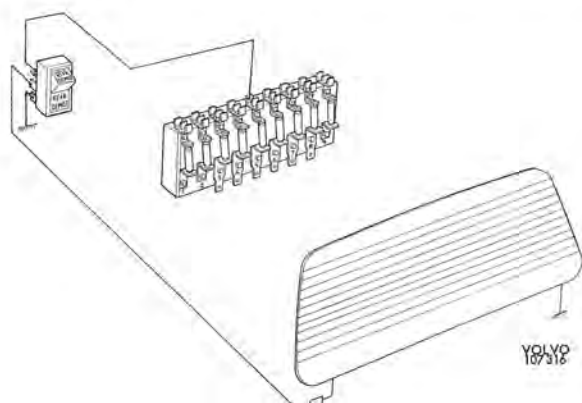


Fig. 8-38. Wiring diagram for electrically heated window

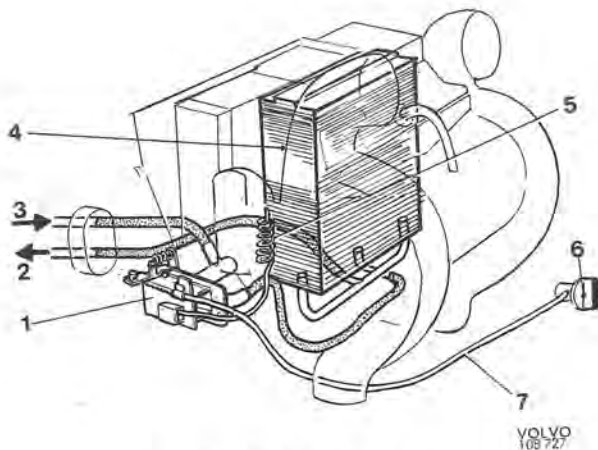


Fig. 8-39. Heating system

1. Heater control valve
2. Water hose, output
3. Water hose, input
4. Cell assembly
5. Capillary tube for heater control valve
6. TEMP control

Heater system

The heater system in the combined unit consists of a cell assembly and a heater control valve. The cell assembly (4, Fig. 8-39) is located in the central unit, while the heater control valve (1) is placed underneath.

The function of the heater control valve, which is regulated by means of the "TEMP" control on the dash, 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. 8-40), thermostatic expansion valve (2), compressor (3), dryer (4), and condenser (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 condenser consists of piping with cooling flanges and it is placed in front of the car's standard radiator. The function of the 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 re-

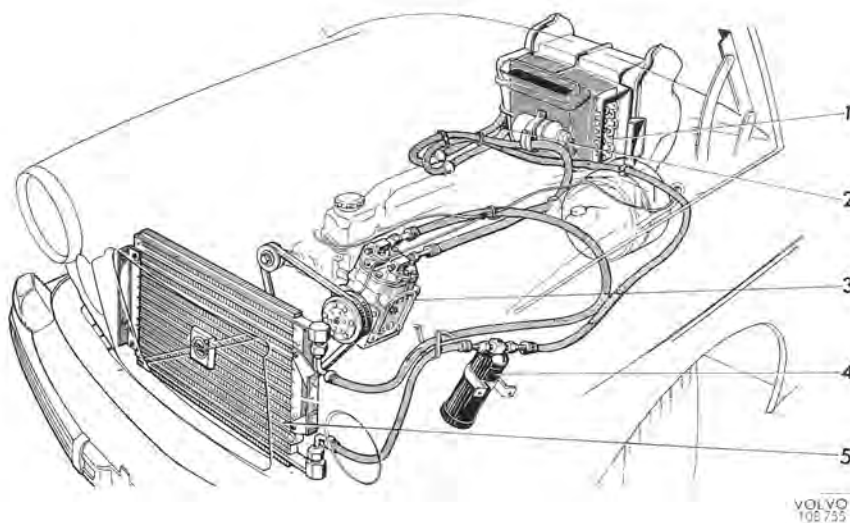


Fig. 8-40. Cooling system

1. Evaporator
2. Expansion valve
3. Compressor
4. Dryer
5. Condenser

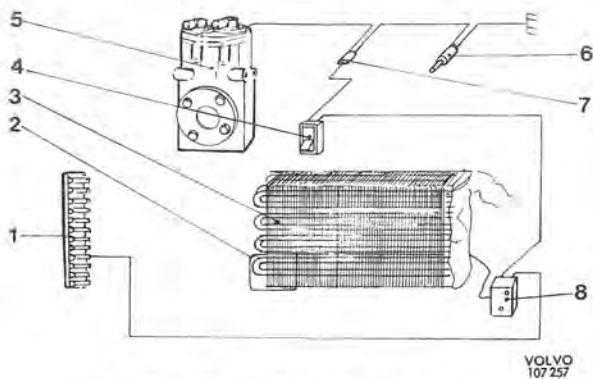


Fig. 8-41. Wiring diagram for air condition

- | | |
|------------------------------|---------------|
| 1. Fusebox | 5. Compressor |
| 2. Thermostat capillary tube | 6. Solenoid |
| 3. Evaporator | 7. Connector |
| 4. Switch | 8. Thermostat |

refrigerant between the various components. They are provided with tapered pipes and unions at the ends. The unit is started by means of the switch (4, Fig. 8-41) on the instrument 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.

FUNCTION

The various components in the air conditioning unit form with their hoses a closed system where the refrigerant is kept in circulation 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. 8-42). 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 vapour, 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 vapour in the evaporator coil (3), where it absorbs heat from the warm air which the fan motor (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 condenser 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 always moves from a warmer to a colder object, the hot refrigerant will emit a part of its

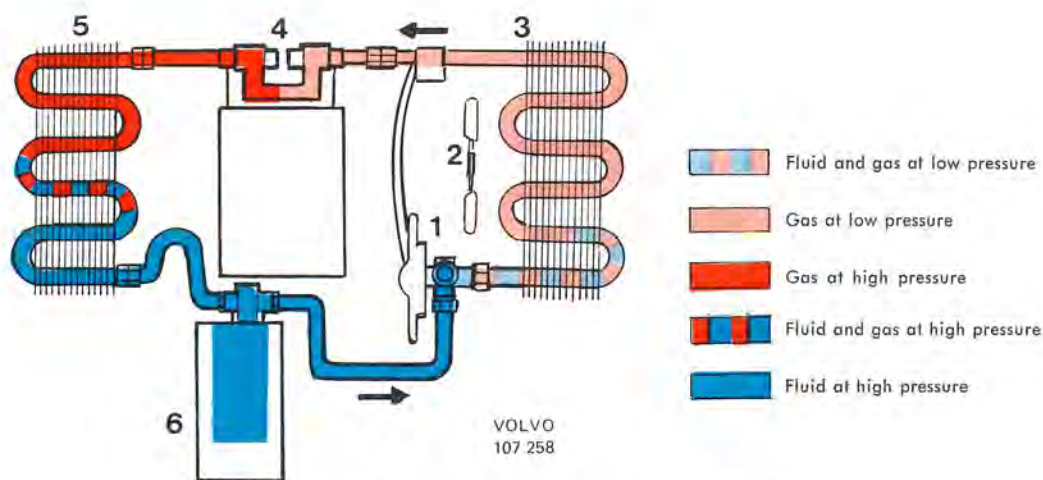


Fig. 8-42. Refrigerant circulation in air conditioning system

- | | |
|--------------------|---------------|
| 1. Expansion valve | 4. Compressor |
| 2. Fan | 5. Condenser |
| 3. Evaporator | 6. Dryer |

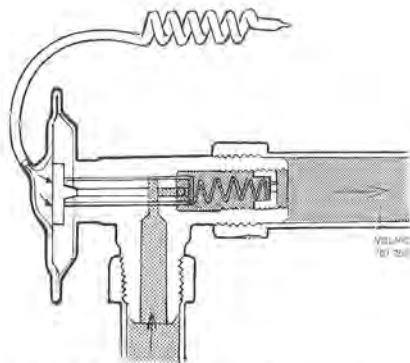


Fig. 8-43. Expansion valve in open position

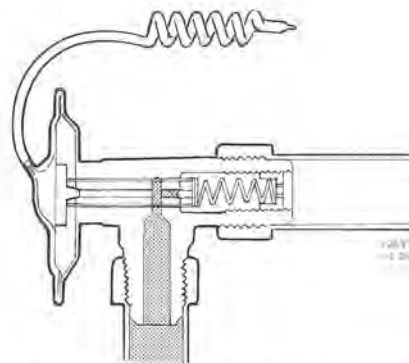


Fig. 8-44. Expansion valve in closed position

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 dryer (6). The dryer contains a moisture-absorbing agent which not only absorbs moisture from the refrigerant but also stores the refrigerant. From the 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.

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. 8-43).

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. 8-44).

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. 8-41) which is inserted in between the evaporator fins (3). When the vapour temperature has dropped to $+3^{\circ}\text{C}$ (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.

REPAIR INSTRUCTIONS

SEATS

Adjusting front seat

1. The inclination of the seat is adjusted with the eyebolt at the front edge of the seat. Slacken the adjusting screw and adjust the eyebolt to the desired position.
2. The height of the seat is adjusted by attaching the rail in a suitable hole in the bracket.

Removing front seats

Unfasten the press-studs which hold the seat cushion to the frame and remove the seat cushion. Unscrew the four nuts for the slide rails. Lift off the seat.

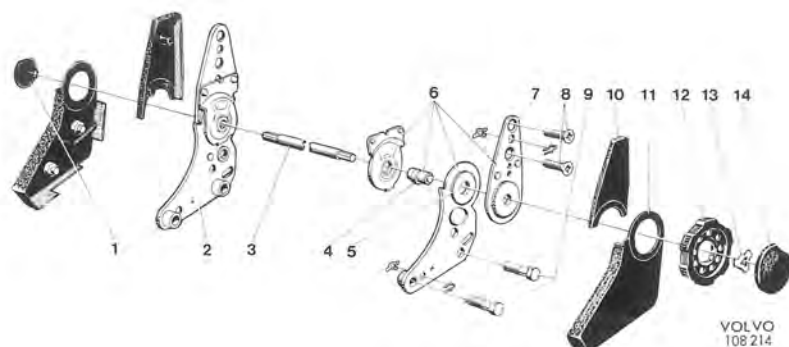


Fig. 8-45. Seat reclining mechanism

- | | |
|---------------------|---------------------|
| 1. Cover | 8. Retaining screws |
| 2. Bracket | 9. Retaining screws |
| 3. Pin | 10. Plastic cover |
| 4. Eccentric | 11. Plastic cover |
| 5. Gear | 12. Hand wheel |
| 6. Lever unit | 13. Lock washer |
| 7. Upper lever part | 14. Cover |

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Replacing seat reclining mechanism

Removing

For proper adjustment of the seat reclining mechanism, the mechanism on both sides of the seat must be removed even if only the mechanism on one side is to be replaced.

1. Remove the cover (14, Fig. 8-45) from the hand wheel by pressing it out through the hole of the hand wheel. See Fig. 8-46.
2. Remove the hand wheel (12, Fig. 8-45) by turning the lock washer (13) anti-clockwise as shown in Fig. 8-47.
3. Remove the plastic covers (10 and 11, Fig. 8-45).
4. Remove the screws (8 and 9, Fig. 8-45) and remove the lever unit.
5. Bend loose the cover (1, Fig. 8-45) and remove the plastic covers from the bracket with a screwdriver.
6. Remove the screws and take off the bracket.

The seat back reclining mechanism cannot be repaired and should be replaced as a unit.

Installing

1. Make a template for installation of the bracket and lever according to Fig. 8-48. Adjust the bracket according to the template with for example a screwdriver.



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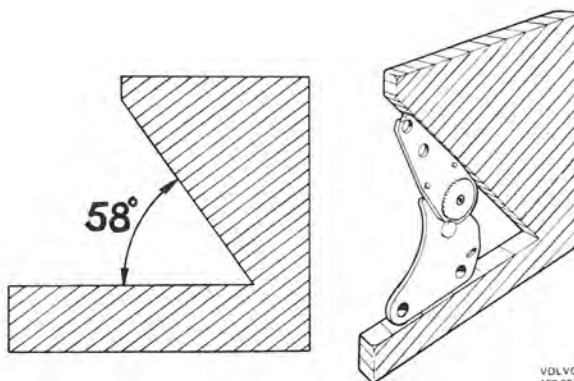
Fig. 8-46. Removing cover



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Fig. 8-47. Removing handwheel

2. Install the shaft in the square hole of the flange bracket and fit the bracket to the back rest with the screws (8, Fig. 8-45).
3. Install the lever with octagon hole on the shaft in such position that the holes in the bracket coincide with the nuts on the back rest. Fit the bracket to the back rest with screws (8, Fig. 8-45).
4. Install the back rest with brackets to the seating frame with screws (9, Fig. 8-45).
5. Press on the plastic covers.
6. Fit the hand wheel by turning the lock washer clockwise as shown in Fig. 8-49.
7. Press on the cover.



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Fig. 8-48. Template for adjusting seat reclining mechanism



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Fig. 8-49. Installing hand wheel

Replacing driver's seat heating device

SEAT CUSHION PAD

1. Unsnap the fasteners on the seat cushion, lift out the cushion and disconnect the electrical cables at the connectors.
2. Place the cushion upside down on a table.
3. Remove the upholstery retaining clamps. Use two side pliers.
4. Remove the wire from the upholstery sides and unfold the upholstery.
5. Remove the heater pad.
6. Fit the new heater pad in the cushion.
7. Locate the heater wires so they protrude at the rear right end of the cushion about 170 mm (6.7") from the rear of the cushion, see Fig. 8-50.
8. Fold back the upholstery and fit lock wire in the upholstery sides.
9. Install the upholstery and clamps.
10. Place the seat cushion in position in the seat. Con-

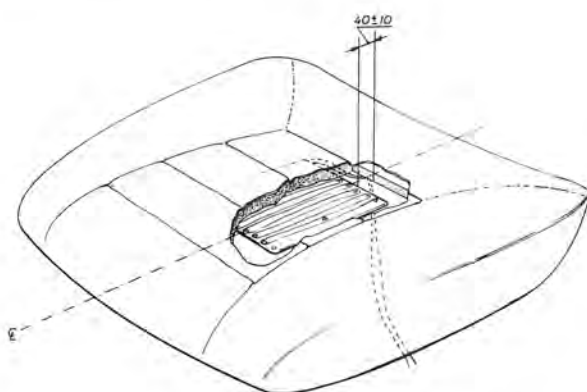


Fig. 8-50. Measurements for installing wiring in seat cushion

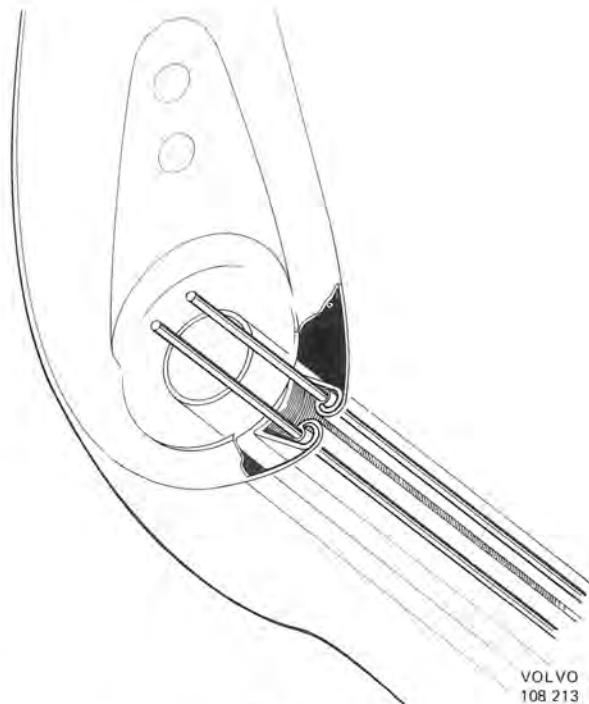


Fig. 8-51. Attaching upholstery at retaining moulding

nect up the electric cables and snap on the fasteners.

SEAT BACK CUSHION PAD

1. Unsnap the fasteners on the seat cushion, lift up the cushion and disconnect the electric cables at the connectors.
2. Lift out the seat cushion.
3. Move the seat forwards as far as possible.
4. Remove the left side seat reclining mechanism (see separate description). Do not change the position of the reclining mechanism after removal.
5. Remove the right side seat reclining mechanism from the seat back. Lift off the seat back and place it with its back facing up on a table.
6. Remove the lock wires for the upholstery (Fig. 8-51). Remove the seat back pocket and lift up the upholstery from the retaining moulding.
7. Put the seat back on the side. Push the hands in under the upholstery, one on the front side, one the rear side, and unhook the heater pad from the frame (Fig. 8-52). Remove the pad.
8. Install the new heater pad and hook the heater pad to the frame.
9. Lay the seat with the rear side up. Align the heater pad wires so they protrude at the lower rear edge.
10. Install the lock wires in the upholstery channel and hook the upholstery in the retaining moulding (Fig. 8-51). Install the seat back pocket and lock the upholstery with the seat back pocket clips.
11. Place the back rest against the right side seat re-

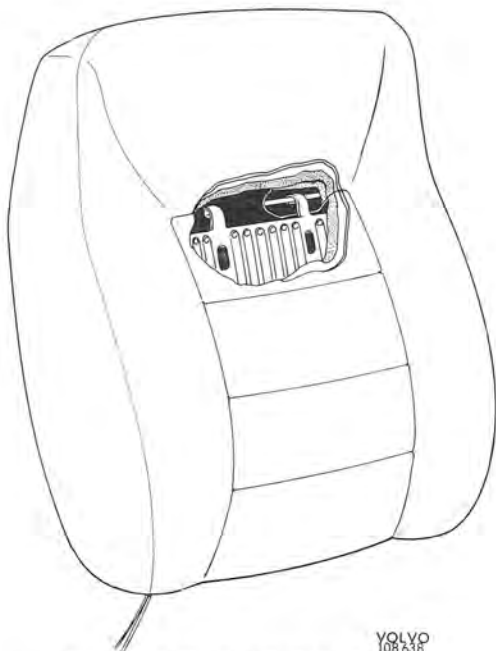


Fig. 8-52. Seat back heater pad attachment

clining mechanism while inserting the shaft into the mechanism at the same time. Screw tight the mechanism.

12. Install the left side reclining mechanism (see separate instructions).
13. Connect up the electric cables.
14. Fit the seat cushion.

NOTE! A template has to be used to adjust the seat reclining mechanism if the bracket location has been altered during the work (see separate instructions).

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).

Replacing the headlining (glasswool)

Removing

1. Disconnect the battery negative lead.
2. Remove the rear seat cushion and backrest, 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



Fig. 8-53. Removing rearview mirror

forwards (Fig. 8-53). Unscrew the rearview attaching plate from the roof.

7. Remove the attachments with support bearings for the sun visors and remove the sun visors.
8. Remove the grab handle and attachments over the door on the driver's side. By bending loose the trim cover (Fig. 8-54) it is then possible to get at the screws.
9. Bend loose the interior lighting and disconnect the connections.
10. Release the headlining at the rear edge by turning the plastic plugs a quarter turn with a screwdriver.
11. Take down the headlining and lift out through the opening for the rear window.
12. Remove the panels on the A-pillars and the upper cover strip on the windshield by bending it loose with a screwdriver.

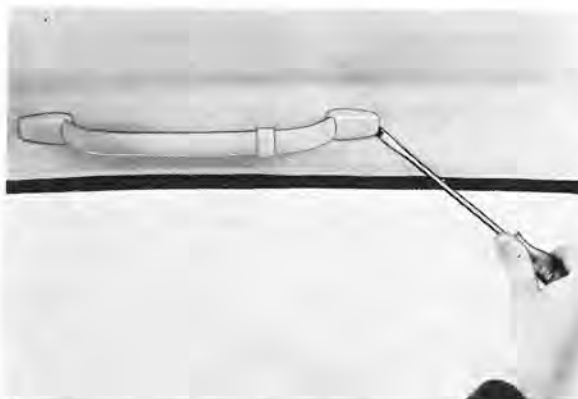


Fig. 8-54. Removing grab handle

FITTING

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 rear window and connect up its electrical connections.
10. Fix in position the rear side panels. Also fit the caps and attachments for the rear seat belts.
11. Fix the hat shelf in position and also the rear seat.
12. Connect up the battery negative lead.

Replacing headlining (only vehicles with sunroof)

Removing

1. Remove the fuse for the interior lighting.
2. Remove the interior lighting, sun visors with support bearing and rearview mirror.
3. Remove the grab handle. To get at the screws, bend loose the trim covers.
4. Open the sunroof fully.
5. Unscrew the crank and gear, also the housing for the crank.
6. Pull loose the strip round the opening for the sunroof.
7. Pull down the headlining edging with finger and thumb on the one side in order to release the plastic strip from its attachment.
8. Then pull down the headlining edging all round.
9. Screw loose the front stretcher.
10. Take down the rear stretcher by bending it down

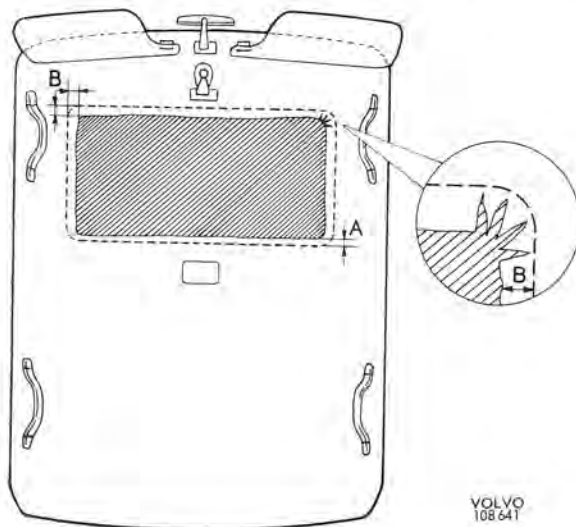


Fig. 8-55. holding headlining for sunroof. Lined area cut out.

A=1 cm (0.393") B=approx. 3-4 cm (1.181-1.575")

in the middle and releasing it from its attachment.
NOTE. Be careful when removing and fitting the stretchers. Careless handling can cause the ends to damage the roof plate.

11. Pull loose the headlining from the adhesive tape round the opening for the sunroof.
12. Scrape off the adhesive tape.

INSTALLING

1. Stick on new tape.
2. Fit the stretchers in the new upholstery.
NOTE. The stretcher with the screw holes should be at the front. Make sure that the rear stretcher is provided with rubber protections on the ends.
3. Install the headlining with the stretchers.
4. Secure the headlining in the tensioning strips. Start with the rear and then the front edge and finally the sides.
5. Fit the grab handle, rearview mirror and sun visors with support bearing.
6. Cut a hole in the headlining to correspond to the sunroof as shown in Fig. 8-55.
NOTE. Measurement A must not be exceeded, see point 8.
7. Stretch out the headlining, bend it over the adhesive tape and fix the piping by tapping it lightly into position.
8. Cut the top side neatly with a sharp knife, that is, the part of the upholstery not covered by the piping (Fig. 8-56). It is not possible to cut the rear edge neatly since the sunroof is in the way.
9. Cut a hole for the interior lighting and also one for the crank housing. Fit these.
10. Cut a hole for the crank gear. Fit the gear and crank.
11. Close the sunroof fully. The crank should point straight forwards.
12. Put back the fuse for the interior lighting and check the function.

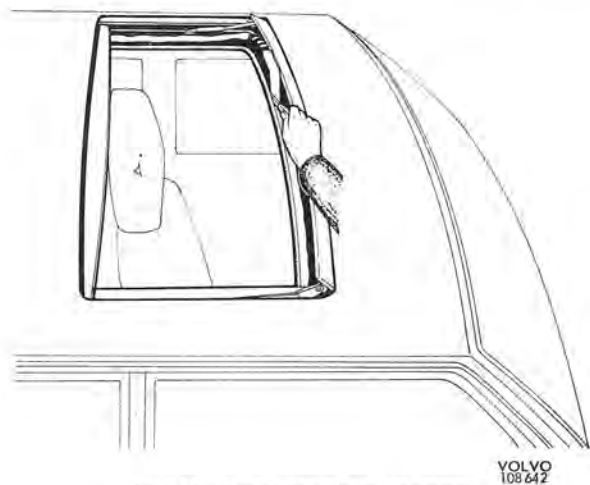


Fig. 8-56. Cutting headlining for sunroof

REMOVING INSTRUMENT PANEL

1. Disconnect the battery ground lead
2. Remove the steering wheel (see Part 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 white plastic holder for the horn slip ring.
5. Remove the combined instrument according to instructions given in Part 3.
6. Disconnect the switch for the lighting and the choke control (if fitted) from the instrument panel.
7. Remove the steering wheel lock according to the instructions in Part 6.
8. Remove the bulb holders in the combined instrument lights and the bulb holder in the clock.
9. Disconnect the electric cable from the clock and the cable 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 centre panels and the defroster hoses on both sides as well as the hoses between the car heater and the intermediate air vents in the instrument panel. Also remove the casing for these hoses.
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 locker lighting by opening the glove locker 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.
3. Install the impact guards.
4. Fit the hoses with casing between the car heater and the intermediate air vents in the instrument panel.
5. Install the bulb holders for the clock and wire up the electric cable to the clock.
6. Install the bulb holder 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 Part 6.
8. Fit the switch for the lighting and the one for the choke control if the latter is installed.
9. Install the combined instrument according to the instructions given in Part 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 Part 6).
14. Connect up the electric cables to the glove locker lighting.
15. Fit the defroster hoses and the centre panels.
16. Fit the lower attaching screws for the control panel.
17. Connect up the battery negative pole to ground and check the function of the instruments and lamps affected by the installation.

REPLACING GLOVE LOCKER

1. Remove the four screws on the impact guard under the glove locker and take down the guard.
2. Remove the two upper attaching screws for the glove locker.
3. Move the glove locker inwards and release the locker cover stop from the recesses in the ends of the locker.
4. Push up the bottom of the glove locker in order to release the cover hinges. Remove the cover.
5. Remove the five screws in the member under the glove locker. Remove the member.
6. Disconnect the electric cables at the glove locker contact and lamp. Take down the glove locker.
7. Remove the contact, bulb, upper and lower rail from the glove locker.
Installation is in reverse order.

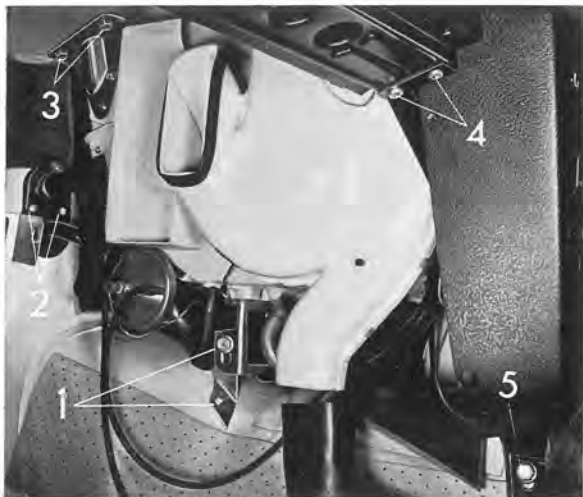


Fig. 8-57. Central unit, left-hand side

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

When installing the glove locker, 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.



Fig. 8-58. Removing clamps for outer end

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. 8-57) 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.
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, Part 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. 8-58) and remove the end.
9. Remove the turbine wheel locking with the help of two screwdrivers (Fig. 8-59), and remove the turbine.
10. Place the new turbine wheel on the shaft and fit the locking.

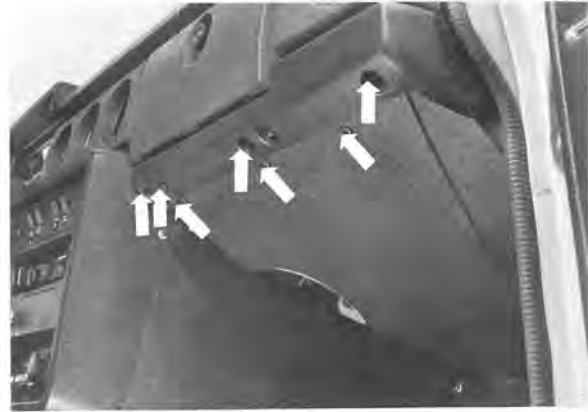


Fig. 8-59. Removing locking for turbine



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Fig. 8-60. Installing clamps for outer end



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Fig. 8-62. Screws for panels and impact guard

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. Use clamps, part No. 676234, for the end and fit them with pliers as shown in Fig. 8-60. Concerning location of the clamps, see Fig. 8-61.
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, Part 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.



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Fig. 8-61. Placing clamps for outer end

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 locker cover (Fig. 8-62).
3. Remove the member under the glove locker, also the locker and locker light (Fig. 8-63).
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. 8-58), and remove the end.
7. Remove the turbine wheel locking with the help of two screwdrivers (Fig. 8-59) and remove the turbine.
8. Place the new turbine wheel on the shaft and fit the locking.
9. Fit the outer end. Use clamps, part No. 676234, which are fitted with the help of pliers, see Fig. 8-60. Concerning the location of the clamps, see Fig. 8-61.



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Fig. 8-63. Screw for member and glove locker



Fig. 8-64. Screws for fan motor holder

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 locker, 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 previous 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. 8-64).
5. Disconnect the contact unit from the fan motor control and disconnect the fan motor electric cables

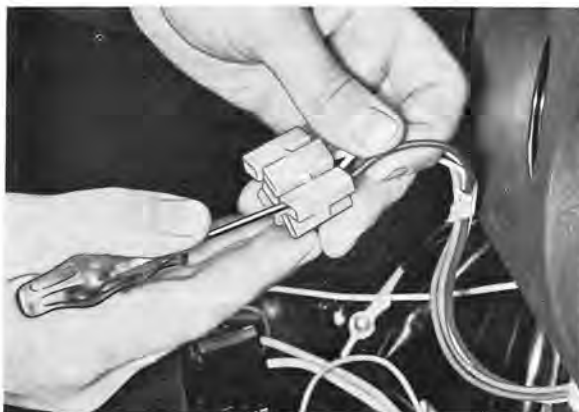


Fig. 8-65. Removing electric cables for contact unit



Fig. 8-66. Fitting plugs in heater system connection pipe

- from the contact unit (Fig. 8-65) and the control plate.
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

The points in brackets apply only to vehicles equipped with air conditioning.

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 firewall, and plug the pipes (Fig. 8-66).
4. Fit the glove locker, member, impact guard and insulation panel.
5. Remove the combined instrument (see instructions, Part 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 firewall.



Fig. 8-67. Screws for vacuum tank

9. Remove the upper and lower screws for the left support leg, and the screws for the upper and lower brackets, from the firewall and transmission tunnel (Fig. 8-45).
- 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 locker and the locker (Figs. 8-62 and 8-63).
12. Remove the vacuum tank (Fig. 8-67), the right defroster nozzle, and the air hose between the central unit and the right, middle air vent.
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



Fig. 8-68. Control panel reverse side

1. Connector for vacuum hoses
2. Contact unit for fan motor control

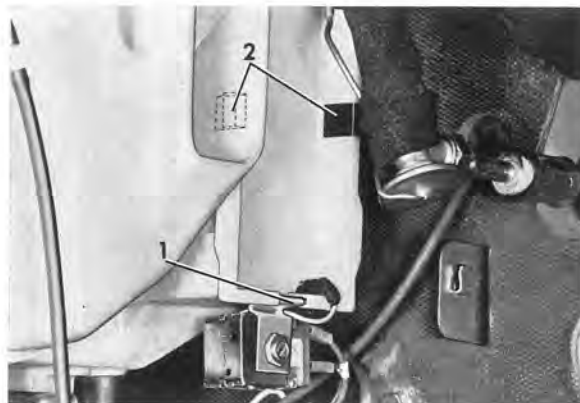


Fig. 8-69. Cover for evaporator

1. Attaching clamp for thermostat
2. Clamps for cover

- and the contact unit from the fan motor control (2, Fig. 8-68).
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 firewall and the transmission tunnel.
20. Disconnect the thermostat attachment (1, Fig. 8-69) from the central unit, and both the clamps (2) securing the cover to the evaporator.
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. 8-70).
22. Remove the central unit right, outer, end (Fig. 8-58), turbine wheel (Fig. 8-59) and the inner end.
23. Lift off the seat cushion from the right front seat.
24. Lift forwards the central unit.



Fig. 8-70. Location of evaporator on floor

Installing central unit

The points in brackets apply only to vehicles equipped with air conditioning.

1. Lift the central unit onto the right floor, and fit the rubber seal for the air intake.
2. Fit the right seat cushion.
3. Lift the central unit into position and insert the left, upper bracket over the screws on the dashboard. Fit the right bracket screws and tighten the left ones.
- (4). Fit the evaporator in the central unit. Put on the cover and secure it with the two clamps (2, Fig. 8-69), also the thermostat on the opening's lower flange (1). Seal with sealing compound round the evapo-

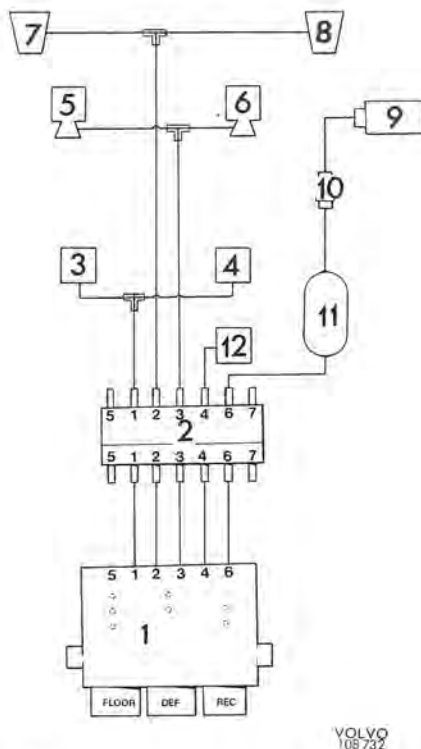


Fig. 8-71. Layout diagram for vacuum control system

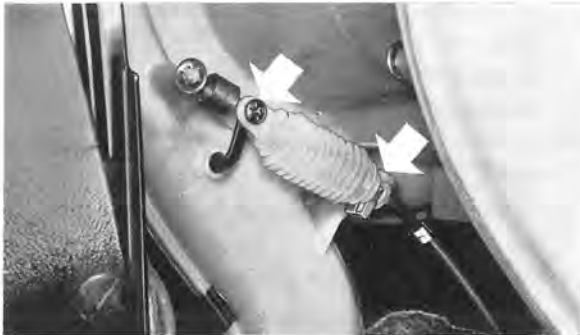
1. Control panel
2. Connector
3. Vacuum motor for rear floor, left
4. Vacuum motor for rear floor, right
5. Vacuum motor for front floor, left
6. Vacuum motor for front floor, right
7. Vacuum motor for defroster, left
8. Vacuum motor for defroster, right
9. Engine intake manifold
10. Check valve
11. Vacuum tank
12. Vacuum motor for air intake cover

lator pipes and the thermostat capillary if necessary.

5. Fit the connection pipe for the heater hoses to the dashboard.
6. Fit the lower tunnel brackets and the drainage hoses through the holes in the transmission tunnel.
7. Fit the right, inner end and the vacuum hose for the floor shutter.
8. Fit the turbine wheel and the outer end. Fix the outer end with clamps, part No. 676234, which are fitted with pliers (Fig. 8-60). The location of the clamps can be seen from Fig. 8-61.
9. Fit the impact guard with member to the dashboard.
10. Fit the air hose between the central unit and the right inner air vent.
11. Fit the right defroster nozzle and connect up the vacuum hose.
12. Fit the vacuum tank, glove locker and member with impact guard.
13. Fit the air duct to the right air vent.
14. Fit the air ducts for the rear floor.
15. Fit the air hose to the left inner air vent and adjust the left defroster nozzle and connect up its vacuum hose.
16. Fit the combined instrument (see instructions, Part 3).
17. Put the connection piece of the vacuum hoses together and connect up the hose from the vacuum tank.
18. 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.
19. Connect up the ground cables, and screw tight the instrument plate and support legs.
20. Restore the floor mat and fit the control panel, the side panels and the insulation panels.
21. Connect up the heater system water hoses to the connection pipes on the dashboard.
- (22). Fit the clamps for the refrigerant hoses in the engine compartment.
23. Fill with coolant.
24. Fit 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.



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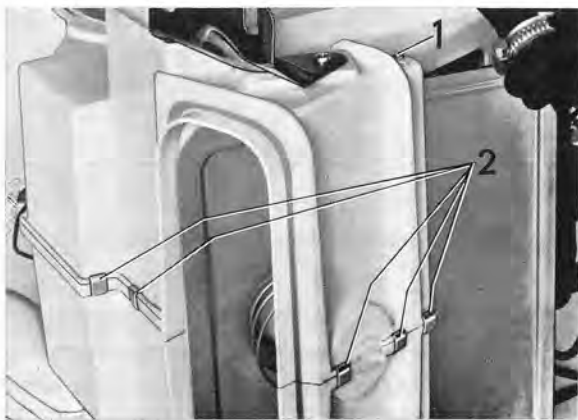
Fig. 8-72. Vacuum motor for air shutter to rear floor

4. Disconnect the vacuum motor locking from the shutter shaft and attachment (Fig. 8-72), and lift forward the motor with vacuum hose.
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.

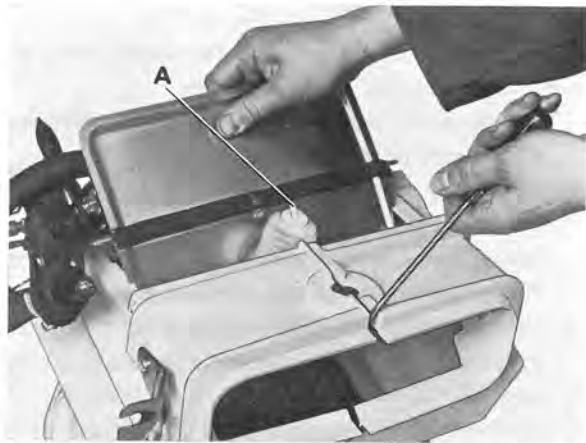
1. Remove the hose from the vacuum motor, and the packing round the air intake.
2. Remove the locks for the shutter shaft (1, Fig. 8-73).
3. Remove the clamps on both sides nearest to the air intake (2).
4. Bend the central unit halves apart so far that the air shutter with vacuum motor can be released.
5. Remove the vacuum motor from the air shutter.
6. Fit a new vacuum motor, and turn it so that its hose connection points to the air shutter shaft.



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Fig. 8-73. Removing vacuum motor for air intake cover

1. Shutter shaft locking
2. Clamps



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Fig. 8-74. Installing air intake cover with vacuum motor. Vacuum motor hose connection (A) should point to cover shaft.

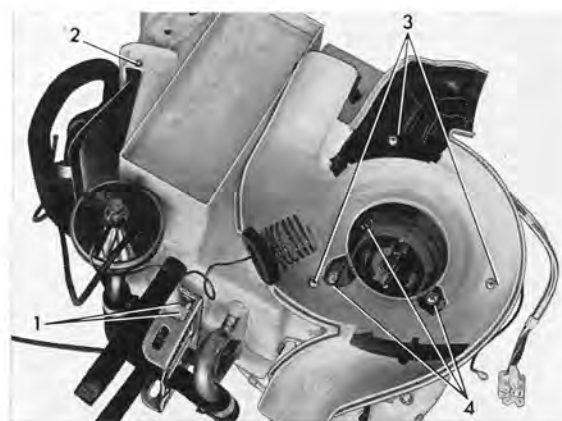
7. Place the air shutter with vacuum motor and spring in position on the central unit (Fig. 8-74).
8. Fit the clamps for the central unit centre joint and the locks for the shutter shaft.
9. Fit the vacuum hose and the packing for the air intake.

Heater system

REMOVING CELL ASSEMBLY

The instructions apply to a removed central unit.

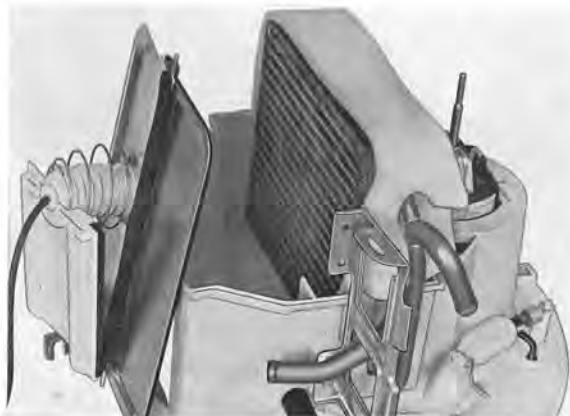
1. Remove the left outer end and turbine wheel (Figs. 8-58 and 8-59).
2. Unscrew the two left screws for the tunnel bracket (1, Fig. 8-75).



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Fig. 8-75. Disassembling central unit

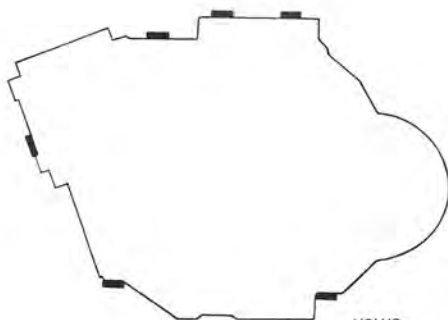
1. Screws for lower bracket
2. Shutter shaft locking
3. Screws for inner end
4. Screws for fan motor holder



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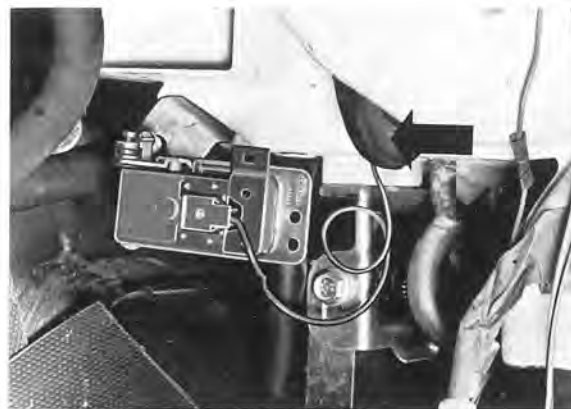
Fig. 8-76. Placing cell assembly

3. Remove the air intake left shutter shaft locking (2).
4. Undo the screws (3) for the inner end and lift off the end.
5. Undo the screws for the fan motor retainer (4).
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. 8-76).
9. Fit the left half. When assembling use clamps with part No. 676234, which are fitted with pliers as shown in Fig. 8-60. Concerning the location of these clamps, see Fig. 8-77.
10. Fit the retainer for the fan motor.
11. Fit the inner end, turbine wheel and outer end. For the outer end use the clamps with part No. 676234, which are placed according to Fig. 8-61.
12. Fit the attaching screws for the tunnel bracket.
13. Fit the shutter shaft locking for the air intake.



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Fig. 8-77. Placing clamps for middle connector

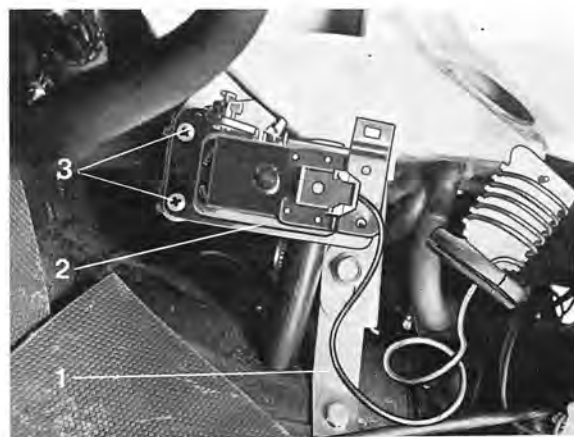


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Fig. 8-78. Removing rubber grommet

Replacing heater control valve

1. Drain the coolant.
2. Remove the left side panel for the control panel.
3. Fold to the onse side the floor mat and place rags under the valve to protect it against water.
4. Remove the control cable from the valve.
5. Remove the rubber grommet for the capillary tube (Fig. 8178).
6. Remove the screws securing the valve to the bracket (Fig. 8-79), and release the capillary tube from the air duct.
7. Disconnect the valve from the water hoses.
8. Move the capillary tube ruber grommet over to the new valve and connect up the hoses.
9. Screw tight the valve to its bracket.
10. Fit the capillary tube and the control cable.
11. Fill the system with coolant and check for leakage and the function.
12. Restore the mat and fit the side panel.



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Fig. 8-79. Replacing heater control valve

1. Capillary tube 2. Heater control valve 3. Screws for valve

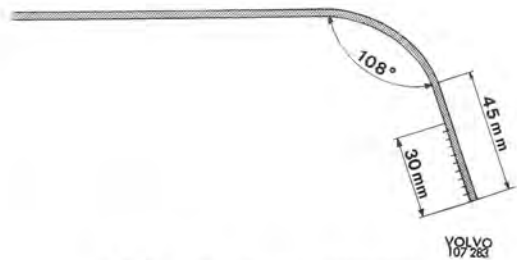


Fig. 8-80. Oil dipstick for compressor

Cooling system

CHECKING OIL LEVEL IN COMPRESSOR

For checking the oil level in the compressor use a dipstick with measurements according to Fig. 8-80. Suitable material is a 3 mm (1/8") brass wire. Make ten marks 3 mm (1/8") apart at the bottom of the stick.

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.



Fig. 8-81. Checking oil level in compressor



Fig. 8-82. Removing pulley
A. Bolt 5/8" UNC

When checking the oil level, hold the dipstick so that the graduated part is vertical to the compressor bottom (Fig. 8-81). The correct level is 28—29 mm (1.10—1.14"), 0.3 dm³ (0.3 qt.). When filling, use only refrigerant compressor oil. Suitable 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 (3.5 lbft).

REPLACING COMPRESSOR CLUTCH

When replacing the compressor solenoid clutch, first disconnect the pulley center bolt. Thereafter remove

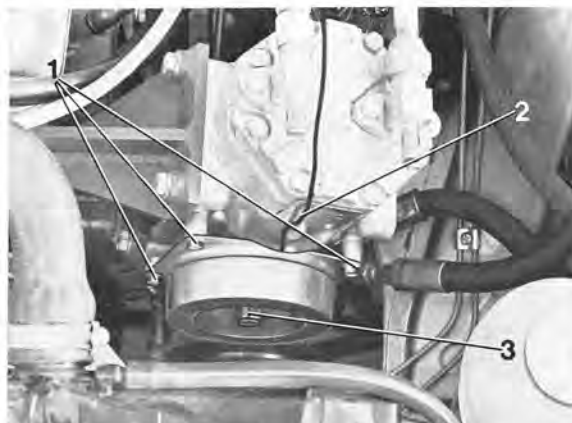


Fig. 8-83. Removing solenoid
1. Attaching bolts for solenoid
2. Electric cable
3. Key

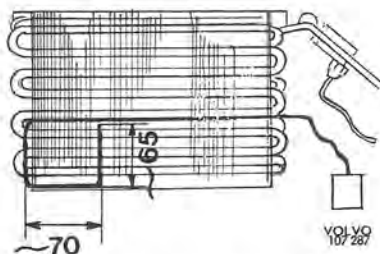


Fig. 8-84. Location of capillary tube in evaporator

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. 8-82). The solenoid is removed by undoing the four bolts (1, Fig. 8-83).

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 (18–22 lbf). 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 condenser permits.
3. Disconnect the thermostat attachment (1, Fig. 8-69) 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. 8-70).
5. Remove the thermostat with capillary.
6. Insert the new thermostat capillary in the evaporator and bend it according to the measurements in Fig. 8-84. It is important that no sharp bends are made on the capillary.
7. Fit 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. Fit the dryer and clamp the refrigerant hoses securely in position in the engine compartment.

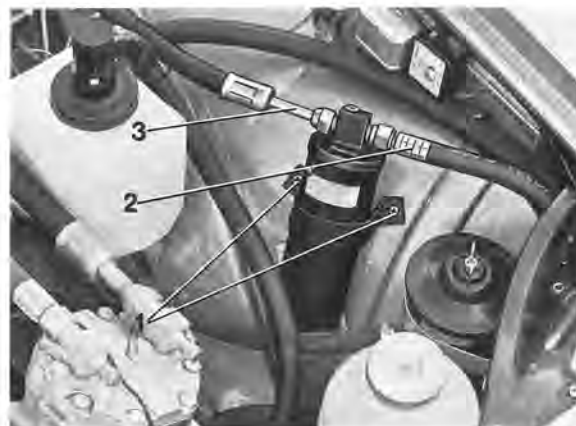


Fig. 8-85. Removing dryer

1. Screws for bracket
2. Hose from condenser
3. Hose for evaporator

REPLACING DRYER

Each time work is carried out on the air conditioning system involving evacuation of refrigerant, the dryer should be replaced. The dryer is removed by disconnecting the hose connections as well as the two bolts for the bracket (Fig. 8-85). When the 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.

FILLING WITH REFRIGERANT

The air conditioning 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



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Fig. 8-86. Connecting vacuum pump

connected to the suction side of the vacuum pump (Fig. 8-86). 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. 8-87). 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.
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 oz.) 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. 8-88). If there is leakage, the colour 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.

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 this hg (3 1/2 oz.) 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.



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Fig. 8-87. Connecting refrigerant can



Fig. 8-88. Leakage test

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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 cea-

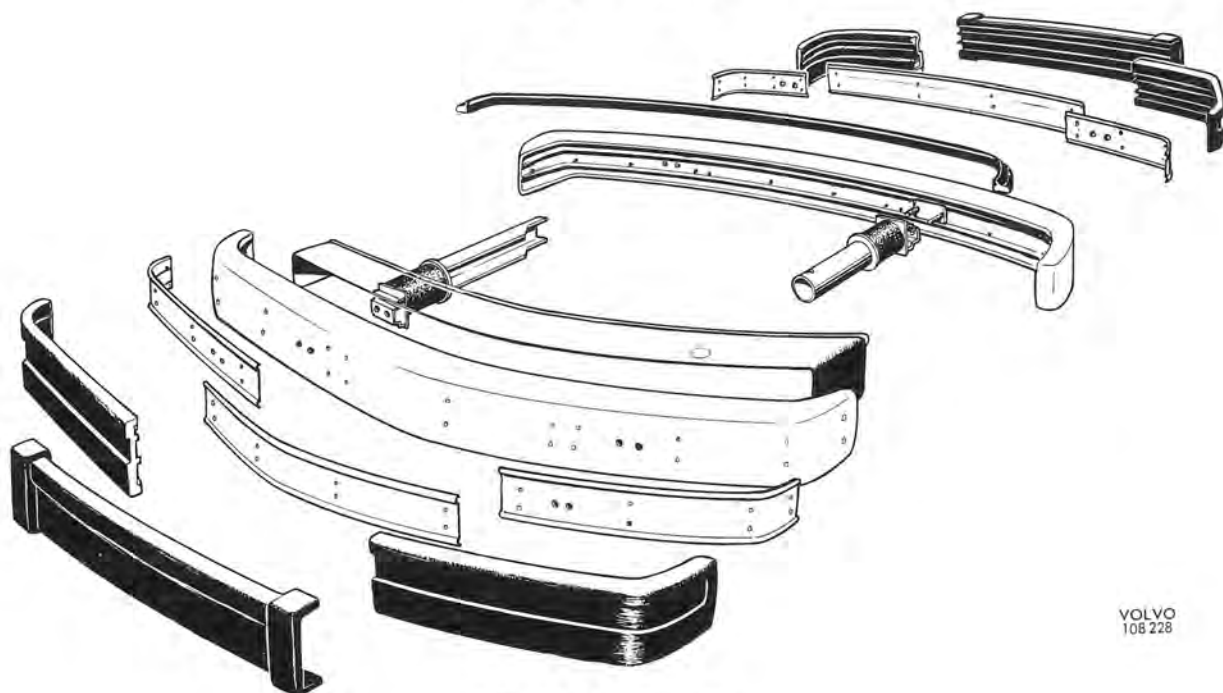
ses, close the valve on the high-pressure gauge. NOTE. This valve must not be opened while the work is in progress.

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 oz) 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 (4 oz.) 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.

GROUP 86

BUMPERS



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Fig. 8-89. Bumper, not USA

The bumpers (Fig. 8-89) are made of aluminium and are provided with energy-absorbing rubber strips. On the USA market, the bumpers are fitted with hydraulic dampers (Fig. 8-90). With this bumper arrangement, the bumpers should be able to withstand

front or rear collisions up to 8 kmph (5 mph). On the other markets, the bumpers are fitted with hollow rubber springs (Fig. 8-91). These provide protection against damage to the car in the event of parking collision up to 4.5 kmph (2.8 mph).

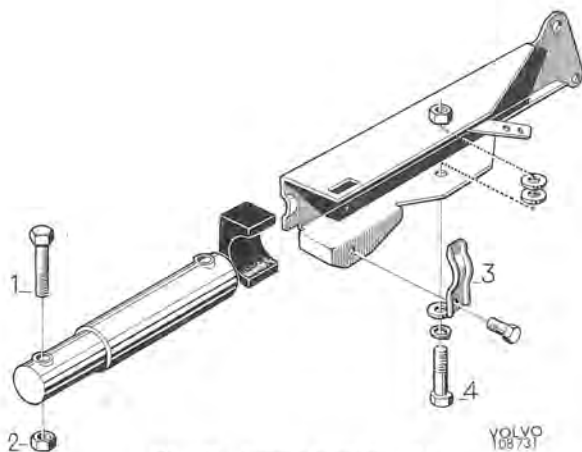


Fig. 8-90. Bumper bracketry, USA

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 (1, Fig. 8-90) and pull out the bolts (2). Finally take off the bumper complete. Installing is in reverse order to removal.

REPLACING FRONT BUMPER SHOCK ABSORBER

The shock absorbers are removed by taking off the clamps (3, Fig. 8-90), and then releasing the nuts and taking off the bolts (4). Now the bumper with shock absorbers is completely loose and can be taken off. Thereafter undo the bolting (1 and 2) and replace the shock absorber with a new one by first fitting it to the bumper, but without tightening up the bolting. Then fit the shock absorber to its rear attachment. Fit the bolt (4) with spring washer, spacer washer (one on each side of the shock absorber) and the nut but without tightening the nut. Now fit the clamp (3). Use polygrip pliers. Thereafter tighten up bolts and nuts.

REMOVING AND INSTALLING, REAR BUMPER WITH HYDRAULIC ABSORBERS

1. Open the trunk lid and fold up the floor mat.
2. Unscrew the front attaching screws from the side members.



Fig. 8-91. Bumper bracketry, not USA

3. Unscrew the rear attaching crews from the rear end.
 4. Remove the bumper with the hydraulic absorbers.
 5. Installation is in reverse order to removal.
- NOTE. Make sure all the attaching screws are properly fitted before tightening up.

Replacing the rubber cover strip over rear bumper

1. Pull out the strip with the attaching rail from the rear end.
2. Remove the strip from the rail.
3. Fit the new strip over the attaching rail.
4. Press the strip with attaching rail firmly against the rear end and check that the attaching rail clips lock securely.

Replacing rubber strip on rear bumper

1. Unscrew the attaching bolts for the hydraulic 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 screw-driver.
7. Lift up the bumper towards the hydraulic absorbers and fit the attaching bolts.



SECT	AIS	BIN	SHELF	PART NO	QTY	BATCH	CUST. NO	INV. NO
	3420	B5	<i>Belga</i>	7776033-8	1	61	2836	96897

