VOLVO

SERVICE

SERVICE MANUAL

VOLVO 164 1972

FOREWORD

This Manual contains servicing instructions for the Volvo 164, 1972 model from chassis No. 52790.
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

Part 0

GENERAL

GROUP 01

TYPE DESIGNATIONS

This Manual deals with the Volvo 164 car of the following types:

Type designation	Engine	Gearbox	Rear axle
164—134	B 30 A	M 400	3.73:1
164—135	B 30 A	M 410	3.73:1
164—136	B 30 A	BW 35	3.31:1
164—155	B 30 A	M 410	3.73:1
164—156	B 30 A	BW 35	3.31:1

1. Vehicle type designation, chassis number and code number for colour and upholstery.
2. Body number.
3. Type designation and chassis number (stamped on the front right-hand door pillar).
4. Engine type designation, part number and manufacturing serial number.
5. Gearbox type designation, part number and manufacturing serial number.
6. Plate on lower part of inspection cover showing number of teeth and reduction ratio of final drive.

GROUP 03

DIMENSIONS AND WEIGHT

Length	4715 mm (186")
Width	1705 mm (67")
Height	1440 mm (56.7")
Wheelbase	2720 mm (107.0")
Ground clearance	180 mm (7.0")
Track, front	1350 mm (53.2")
rear	1350 mm (53.2")
Turning circle	9600 mm (31.6 ft.)
Curb weight ... approx.	1360 kg (2992 lb.)

LUBRICATION

ENGINE

Lubricant, type	Engine oil
grade	Service SD, SE and CC (MS)
viscosity, summer (above —12° C = +10° F)	Multigrade Oil SAE 20 W-40 or 20 W-50
winter (below —12° C = +10° F)	Multigrade Oil SAE 10 W-30
continuous temp. below —18° C = 0° F)	Multigrade Oil SAE 5 W-20
Oil capacity, excluding oil filter	5.2 litres (4.5 Imp.qts = 5.5 US qts)
including oil filter	6.0 litres (5.3 Imp.qts = 6.3 US qts)
Oil for carburettor 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 litre (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 litres (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 litres (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 litres (2.8 Imp.pints = 3.4 US pints)

SERVO STEERING

Lubricant, type	Automatic Transmission Fluid, Type A
Oil capacity approx.	1.2 litres (2.0 Imp.pints = 2.5 US pints)

ENGINE

GENERAL

Type designation	B 30 A	B 30 E	B 30 F
Output, hp at rpm (SAE)	145/5500	175/5800	160/5800
(DIN)	130/5000	160/5500	145/5500
Max. torque, kpm (lbft) at rpm (SAE)	22.5 (163)/3000	24.5 (178) 2500	23.0 (167) 2500
(DIN)	21 (152)/2500	23.5 (170) 2500	22.0 (160) 2500
Compression pressure (warm engine) when turned over with starter motor, 250—300 r.p.m.	10—12 kp/cm² (142—170 psi)	11—13 kp/cm² (156—185 psi)	9—11 kp/cm² (128—156 psi)

	B 30 A	B 30 E	B 30 F
Compression ratio	9.3:1	10.0:1	8.7:1
Number of cylinders	6	6	6
Bore	88.92 mm (3.501")	88.92 mm (3.501")	88.92 mm (3.501")
Stroke	80 mm (3.15")	80 mm (3.15")	80 mm (3.15")
Displacement	2.98 litres	2.98 litres	2.98 litres
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	88.92 mm (3.501")
oversize .030"	89.68 mm (3.531")

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	0.04—0.06 mm (0.0016—0.0024")

PISTON RINGS

Piston ring gap, measured in ring opening	0.40—0.55 mm (0.016—0.022")
Oversize on piston rings	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	22.00 mm (0.866")
oversizes .05"	22.05 mm (0.868")

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 (3.394")	87.0 mm (3.425")
Cylinder head gasket, thickness standard, unloaded	0.8 mm (0.031")	0.8 mm (0.031")	1.2 mm (0.039")
loaded	0.7 mm (0.028")	0.7 mm (0.028")	1.0 mm (0.047")
Distance from top side of head to overflow pipe upper end (pipe placed under thermostat)	35 mm (1.38")		

CRANKSHAFT

Crankshaft, end float	0.047—0.138 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—1.5351")
Oversize 1 (undersize shell 0.010")	39.061—39.101 mm (1.5438—1.5451")
2 (" " 0.020")	39.163—39.203 mm (1.5538—1.5551")

BIG-END BEARINGS

Big-end bearing journals

Width of bearing recess	31.950—32.050 mm (1.2579—1.2618")
Diameter, standard	54.099—54.112 mm (2.1299—2.1304")
undersize 0.010"	53.845—53.858 mm (2.1199—2.1204")
0.020"	53.591—53.604 mm (2.1099—2.1104")

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	6 grammes (0.21 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
Number of bearings	4
Journal, diameter	46.975—47.000 mm (1.8494—1.8504")
Radial clearance	0.020—0.075 mm (0.0008—0.0030")
End float	0.020—0.060 mm (0.0008—0.0024")
Valve clearance for control of camshaft setting (cold engine)	1.45 mm (0.057")
Inlet valve should then open at	0° (TDC)

CAMSHAFT BEARING

Bearing diameter	47.020—47.050 mm (1.8512—1.8524")

TIMING GEARS

Crankshaft drive, number of teeth	21
Crankshaft gear (fibre), number of teeth	42
Backlash	0.04—0.08 mm (0.0016—0.0032")
End float, camshaft	0.02—0.06 mm (0.008—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 (0.32—0.321")
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 mm (1.77")
with a loading of 25.5±2.0 kp (56±4.4 lb)	39 mm (1.54")
with a loading of 66.0±3.5 kp (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 29.5±2.3 kg (65±5 lb)	40 mm (1.57")
with a loading of 82.5±4.3 kg (181.5±9.5 lb)	30 mm (1.18")

LUBRICATING SYSTEM

Oil capacity, including oil filter	6.0 litres (5.3 Imp.qts = 6.3 US qts)
excluding oil filter	5.2 litres (4.5 Imp.qts = 5.5 US qts)
Oil pressure at 2000 rpm (with warm engine and new oil filter)	2.5—6.0 kp/cm² (36—85 psi)

OIL FILTER

Type	Full-flow type

OIL PUMP

Oil pump, type	Gear
number of teeth on each gear wheel	9
end float	0.02—0.10 mm (0.0008—0.0039")
radial clearance	0.08—0.014 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 5.0±0.4 kp (11.0±88 lb)	26.25 mm (1.03")
7.0±0.8 kp (15.4±1.7 lb)	21.0 mm (0.83")

FUEL SYSTEM, B 30 A

FUEL PUMP

Diaphragm type pump	Pierburg PV 3025
Fuel pressure, measured at same level as pump at 1000 rpm	min. 0.15 kp/cm² (2.1 psi) max. 0.25 kp/cm² (3.5 psi)

CARBURETTORS

Type	Horizontal carburettor
Make and designation	Zenith-Stromberg 175CD-2SE
Number	2
Air intake diameter	41.3 mm (1.63")
Idling speed	800 rpm
For cars with automatic transmission	700 rpm
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 l/h at 2 kp/cm² (22 Imp. galls= US galls/h at 28 psi)
Current consumption	5 amps
Relief valve opens	approx. 4.5 kp/cm² (64 psi)

PRESSURE REGULATOR

Setting value	2.0 kp/cm² (28 psi)

INJECTORS

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

COLD-START VALVE

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

AUXILIARY AIR REGULATOR

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

TEMPERATURE SENSOR I (INTAKE AIR)

Resistance	approx. 300 ohms at +20° C

TEMPERATURE SENSOR II (COOLANT)

Resistance	approx. 2500 ohms at +20° C

PRESSURE SENSOR

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

AIR CLEANER

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

CO-TEST

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

VENTING FILTER (only USA)

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

COOLING SYSTEM

Type	Sealed system
Radiator cap valve opens at	0.7 kp/cm² (10.0 psi)
Capacity	approx 12.4 litres=11.0 Imp.qts/13.0 US qts (expansion tank of which 1.5 litres=1.3 Imp. qts/1.5 US qts)
Fan belt, designation	HC-38-888
Fan belt tension: for a force of 7.5—11.0 kp (16.5—24 lb) on the belts midway between the pulleys obtained with a depression of	10 mm (3/8")

THERMOSTAT

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

TIGHTENING TORQUES

	Kpm	Lb.ft.
Cylinder head (oiled screws)	9.0	65
Main bearings	12—13	87—94
Big-end bearings	5.2—5.8	38—42
Flywheel	5.0—5.5	36—40
Spark plugs	3.5—4.0	25—30
Camshaft nut	13—15	94—108
Bolt for crankshaft belt pulley	7—8	51—58
Nipple for oil filter	4.5—5.5	32—40
Sump bolts	0.8—1.1	6—8
Intake and exhaust manifold	1.8—2.2	13—16
Alternator bolt (½″)	7.1—8.6	50—60

WEAR TOLERANCES

CYLINDERS

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

CRANKSHAFT

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

VALVES

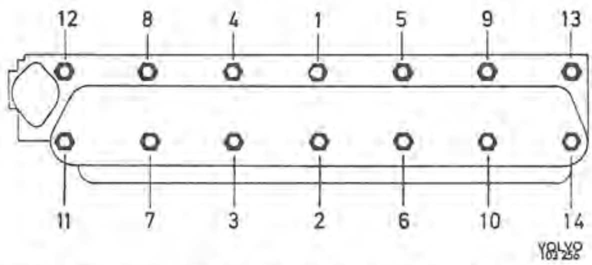
Permissible clearance between valve stems and valve guides, max.	0.15 mm (0.0060″)
Valve stems, permissible wear, max.	0.02 mm (0.0008″)

CAMSHAFT

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

TIMING GEARS

Permissible backlash, max.	0.12 mm (0.0048″)



Tightening sequence for cylinder head bolts (tightened in 3 stages). 1st stage: 4.0 kpm (29 lbft) 2nd stage: 8.0 kpm (58 lbft) 3rd stage: after driving the car for 10 minutes. 9.0 kpm (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	15 000 rpm
Direction of rotation	Optional
Ratio, engine-alternator	1—2
Brushes, minimum length	5 mm (0.20")
Tightening torques:	
Attaching screws	0.28—0.30 kpm (2.0—2.2 lbft)
Pulley nut	4 kpm (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 3000 rpm and approx. 14 V)

VOLTAGE REGULATOR

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

STARTER MOTOR

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

TEST VALUES

Mechanical

Rotor end float	0.05—0.3 mm (0.002—0.012")
Brush spring tension	1.150—1.300 kg (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	2.5—4.0 kpcm (2.17—3.81 lbin)
Pinion idling torque	1.3—1.8 kpcm (1.13—1.56 lbin)
Backlash	0.35—0.45 mm (0.14—0.018")
Minimum diameter of commutaror	33 mm (1.3")
Minimum length of elec. brushes	14 mm (0.6")

Electrical

Unloaded starter motor:	
12.0 V and 40—50 A	69C0—8100 rpm
Loaded starter motor:	
9 V and 185—200 A	1050—1350 rpm
Locked starter motor:	
6 V and 300—350 A	0 rpm

CONTROL SOLENOID

Cut-in voltage	Min. 8 V

IGNITION SYSTEM

B 30 A

Firing order	1-5-3-6-2-4
Ignition timing	
(at 600—800 rpm with vacuum governor disconnected)	10° before TDC
Spark plugs, type	Bosch W 200 T 35 or equivalent
thread	14 mm
spark plug gap	0.7—0.8 mm (0.028—0.032")

tightening torque	3.5—4.0 kpm (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	500—630 grammes (1.10—1.40 lb.)
dwell angle	40±3°
Capacitor	0.2 μ F—25 %

Centrifugal governor:

Advance range, total	12±1° (distr. graduation)
Advance begins at	425—525 rpm (distr.)
Values, 5°	625—725 rpm (distr.)
10°	1150—1650 rpm (distr.)
Advance finishes at	1850 rpm (distr.)

Vacuum governor:

Positive control (not U.S.A.)

Advance range, total	5±1° (distr. graduation)
Advance begins at	6—10 cm Hg
Value, 2.5°	9.5—14 cm Hg
Advance finishes at	14.5—16 cm Hg

Negative control

Retard, total	3±0.5° (distr. graduation)
Retard begins at	16—24 cm Hg
Values 2°	23—31 cm Hg
Retard finishes at	28—32 cm Hg

B 30 E and B 30 F

Firing order	1-5-3-6-2-4
Ignition timing (at 600—800 rpm with vacuum governor disconnected)	10° before TDC
Spark plugs type	225 T 35 (B 30 F 200 T 35)
thread	14 mm (1/2")
spark plug gap	0.7—0.8 mm (0.028"—0.032")
tightening torque	3.5—4.0 kpm (25.3—29.0 lbft)
Pre-engaging resistance to ignition coil	0.9±0.05 ohm

DISTRIBUTOR

Type	Bosch JFURX6
Direction of rotation	Anti-clockwise
Breaker points, gap	Min. 0.25 mm (0.010")
contact pressure	500—630 grammes (1.10—1.40 lb)
dwell angle	42±3°
Capacitor	

Centrifugal governor:

Advance range, total	10.5±1° (distr. graduation)
Advance begins at	400—600 rpm (distr.)
Values, 5°	885—1080 rpm (distr.)
9°	1275—1500 rpm (distr.)
Advance finishes at	1600 rpm (distr.)

Negative control

Drop, total	3.0±0.5° (distr. graduation)
Drop begins at	80—160 mm Hg
Drop 2°	118—190 mm Hg
Drop finishes at	200 mm Hg

LAMP BULBS

	Watts	Socket	Number
Headlights	45/40	P 45 t	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	5	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
Lighting, heater controls, clock	2	Ba 7 s	1
Warning lamp, instrument panel	1.2	W 1.8 d	5
Warning lamp, overdrive	1.2	W 1.8 d	1
Warning lamp, elec. heated rear window	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	1
Rated current 5 A	4
Rated current 8 A (foglights)	4

ELECTRICALLY HEATED REAR WINDOW

Output, at second position of switch .... Approx. 150 W

INSTRUMENTS

SPEEDOMETER GEARS

Tyre 165 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	3.0:1	+0.43
M 410	3.73:1	380754	18	380682	6	3.0:1	+0.43
BW 35	3.31:1	380164	16	381033	6	2.66:1	+0.38

The percentage error in the above table is calculated for a rolling radius of 308 mm (12.1"), 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: 640 (1024).

TYRE 6.85-15

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	3.0:1	—1
M 410	3.73:1	380754	18	380682	6	3.0:1	—1
BW 35	3.31:1	380164	16	381033	6	2.66:1	—0.75

The percentage error in the above table is calculated for a rolling radius of 312 mm (12.3"), 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: 640 (1024).

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	9"
B 30 E, F	468 cm^2 (72.5 sqin)
Release lever play, vehicle with left-hand steering	4—5 mm (0.16—0.20")
vehicle with right-hand steering	2—3 mm (0.08—0.12")

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	11.0—14.0 kpm (80—101 lbft)
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 litre (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/cm^2 (21 psi)
overdrive	36—39 kp/cm^2 (510—550 psi)
Nut for driving flange	11.0—14.0 kpm (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 litres (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	X Converter ratios
2nd gear	1.45:1	X Converter ratios
3rd gear	1:1	X Converter ratios
Reverse	2.09:1	X Converter ratios
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	2100 rpm	
B 30 E	2300 rpm	
B 30 F	2200 rpm	
Weights:	lb	kp
Gearbox	82	37.2
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	14 pints (8.2 litres)	
Normal operating temperature of fluid	approx. 212—240° F (110—115° C)	

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	65	40	117	73	104	65	50	31
B 30 E, F	Full throttle	54	34	97	60	—	—	—	—
	Kick-down	71	44	127	79	111	69	56	35

SPRINGS FOR CONTROL SYSTEM

Spring	Approximate length		Effective number of turns	Wire diameter	
1—2 shift valve	1.094"	27.8 mm	13 1/2	0.024"	0.61 mm
Converter exhausting valve	0.70"	17.8 mm	12	0.018"	0.46 mm
Primary regulator valve	2.941"	74.7 mm	14	0.056"	1.42 mm
Servo orifice control valve	1.005"	25.5 mm	17	0.024"	0.61 mm
Modulator valve	1.069"	27.2 mm	19	0.028"	0.71 mm
Secondary regulator valve	2.593"	65.9 mm	18	0.056"	1.42 mm
2—3 shift valve (inner spring)	1.59"	40.4 mm	22 1/2	0.036"	0.91 mm
Throttle valve (inner spring)	0.807"	20.5 mm	28	0.018"	0.46 mm
Throttle valve (outer spring)	1.174—1.185"	29.8—30.1 mm	19 1/2	0.032"	0.81 mm
Fast 3—2 shift check valve	0.650"	16.5 mm	16	0.007"	0.18 mm

TIGHTENING TORQUES

Application	Lb.ft.	Kpm
Torque converter — drive plate	25—30	3.5—4.1
Transmission case — converter housing	8—13	1.1—1.8
Extension housing — transmission case	30—55	4.1—7.6
Oil pan — transmission case	8—13	1.1—1.8
Front servo — transmission case	8—13	1.1—1.8
Rear servo — transmission case	13—27	1.8—3.7
Pump adaptor — front pump body	17—22	2.4—3.0
Slotted screws	2—3	0.3—0.4
Pump adaptor — transmission case	8—18.5	1.1—2.6
Oil deflector flange — transmission case	4—7	0.6—1.0
Center support — transmission case	10—18	1.4—2.5
Outer lever — manual valve shaft	7—9	1.0—1.2
Pressure point	4—5	0.6—0.7
Oil pan drain plug	9—12	1.2—1.7
Oil tube collector — lower body	1.7—2.5	0.25—0.35
Governor line plate — lower body	1.7—2.5	0.25—0.35
Lower body end plate — lower body	1.7—2.5	0.25—0.35
Upper body end plate front or rear — upper body	1.7—2.5	0.25—0.35
Upper body — lower body	1.7—2.5	0.25—0.35
Valve bodies assembly — transmission case	4.5—9	0.6—1.2
Front pump strainer — lower body	1.7—2.5	0.25—0.35
Downshift valve cam bracket — valve body	1.7—3.5	0.25—0.5

Governor

Governor body — retainer	4—5	0.6—0.7
Cover plate — governor body	1.7—4.0	0.25—0.55

Brake band adjustment

Adjusting screw locking nut, rear servo — case	30—40	4.1—5.5

Special threaded parts

Starter inhibitor switch locknut	4—6	0.6—0.8
Downshift valve cable adaptor — transmission case	8—9	1.1—1.2
Coupling flange — driven shaft	35—50	4.8—6.9
Nipple for oil cooler connection	5—7	0.7—1.0
Nut for nipple	10—12	1.4—1.7

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 (13:43) or 3.73:1 (11:41)
Backlash	0.13—0.20 mm (0.005—0.008")
Pre-loading on pinion bearings, new bearings	11—23 kpcm (9.55—20 lbin)
run-in bearings	6—11 kpcm (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 litres (2.8 Imp.pints = 3.4 US pints)

TIGHTENING TORQUES

	Kpm	Lbft
Flange	28—30	200—220
Caps	5.0—7.0	35—50
Crown wheel	6.5—9.0	45—65

BRAKES

FRONT WHEEL BRAKES

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

Wheel unit cylinders:	
Number per wheel	4
Area per wheel	40.68 cm² (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 cm² (16.3 sqin)
Wheel unit cylinders:	
Number per wheel	2
Area per wheel	22.66 cm² (6.30 sqin)

MASTER CYLINDER

Nominal diameter	23.81 mm (0.94")
Bore	Max. 23.92 mm (0.95")
Piston diameter	Min. 23.66 mm (0.93")

BRAKE LINE

Outer diameter	3/16"

BRAKE VALVE

Make	Ate
Operating pressure	34±2 kp/cm² (484±28.4 psi)

SERVO CYLINDER

Make	Ate
Designation	Bromsgerät 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 cm² (27 sqin)

TIGHTENING TORQUES

	Kpm	Lbft
Attaching bolts, front brake caliper	9—10	65—70
Attaching bolts, rear brake caliper	6—7	45—50
Wheel nuts	10—14	70—100
Stop screw, master cylinder	0.5—0.8	3.6—5.8
Attaching nuts, master cylinder	1.2—1.5	8.7—10.8
Bleeder nipples	0.4—0.6	3.0—4.0
Brake hoses	1.6—2.0	12—15
Warning valve, switch	1.4—2.0	10—15
Brake pipes	1.1—1.5	8—11
Plug, brake valve	10—12	70—85
Lock nut, brake valve	2.5—3.5	18—25

FRONT END AND STEERING GEAR

WHEEL ALIGNMENT (UNLOADED VEHICLE)

Caster	0 to +1°
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")

SERVO 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
Servo pump:	
Make and type	ZF, vane pump
Max. pressure	75±5 kp/cm² (1066±71 psi)
Theoretical capacity at 500 rpm	6.65 l/m (12 Imp.pints=14 US pints/minute)
Min. capacity, 500 rpm, 50 kp/cm² (711 psi), 80° C (176° F) .... (176° F)	4.5 l/m (8 Imp.pints=9.5 US pints/minute)
Regulated capacity	5—8 l/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"
Oil changing quantity	Approx. 1.2 litres (2.0 Imp.pints=2.5 US pints)

TIGHTENING TORQUES

	Kpm	Lbft
Attaching bolt for upper control arm shaft	5.5—7.0	40—50
Nut for steering wheel	3—4	20—30
Nut for pitman arm	17.5—20	125—145
Locknut for tie rod	7.5—9	55—65

SUSPENSION, WHEELS

SPRINGS

FRONT SPRINGS

Type	Helical spring
Wire diameter	15.3 mm (0.60")
External diameter	125.3 mm (4.93")
No. of effective turns	6.5
Test values:	
Loading for a compression of 1 cm (25/64") (measured within a spring length of 185.5—205.5 mm (7⅜—8")	61.9—65.9 kg (136—145 lb.)
Length, fully compressed	max. 126 mm (5.0")
Length, when loaded with 623—653 kp (1370—1437 lb)	195.5 mm (7.7")

REAR SPRINGS

Type	Helical spring
Wire diameter	12.1 mm (0.48")
External diameter	127.1 mm (5.0")
No. of effective turns	8.9
Test values:	
Loading (for a compression of 1 cm = 25/64")	15.88—16.88 kg (35—37 lb.)
Length, fully compressed	max. 114.9 mm (4.52")
Load/spring length	211—225 kp/297 mm (464—495 lb/11.7")

SHOCK ABSORBERS

Type	Double-acting, hydraulic, telescopic
Total length:	
front shock absorbers, compressed	approx. 223 mm (8.78")
unloaded	approx. 340 mm (13.39")
front 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	900 gcm (7.8 lbin)
Tightening torque for wheel nuts	10—14 kpm (72—101 lbft)

TYRES

Type	Tubeless
Size	165 SR 15, 165 HR 15

Part 1

SERVICING AND MAINTENANCE

CONTENTS

LUBRICATION

OIL LEVEL CHECKING AND CHANGING

ENGINE

The oil level is checked with the dipstick, see Fig. 1-15. 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° C = +10° F)	20 W - 40 or 20 W - 50
WINTER (below —12° C = +10° F)	10 W - -30

At very low temperature (below —18° C = 0° F) or when cold-starting difficulties are anticipated, multigrade oil SAE 5 W-20 is recommended. This oil should not be used when the temperature is continuously above 0° C (32° F).

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

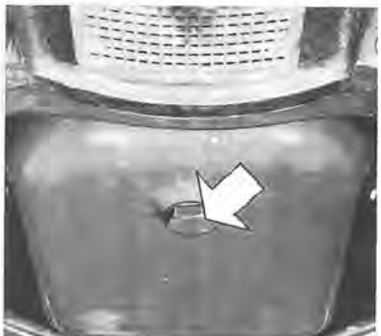


Fig. 1-1. Drain plug on sump

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

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, oil ATF should be used 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 litre (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 litres (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 or chamois leather. Do not use waste or fluffy rags. Insert the dipstick, pull it up and check the oil level. See Fig. 1-5. **N.B. There are different levels for a warm**

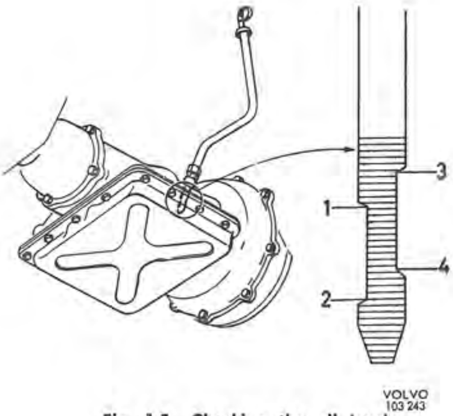


Fig. 1-5. Checking the oil level

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

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

or cold transmission. 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 cold 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 litre (1 pint). For topping-up, use oil ATF, 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 litres (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.

SERVO 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 servo steering components, see Part 6 of this Service Manual. On this occasion, the filter in the oil container should also be changed.

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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, they should be replaced, see Part 6. When being fitted, the rubber seals shoul be filled with multipurpose grease (universal grease).

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.

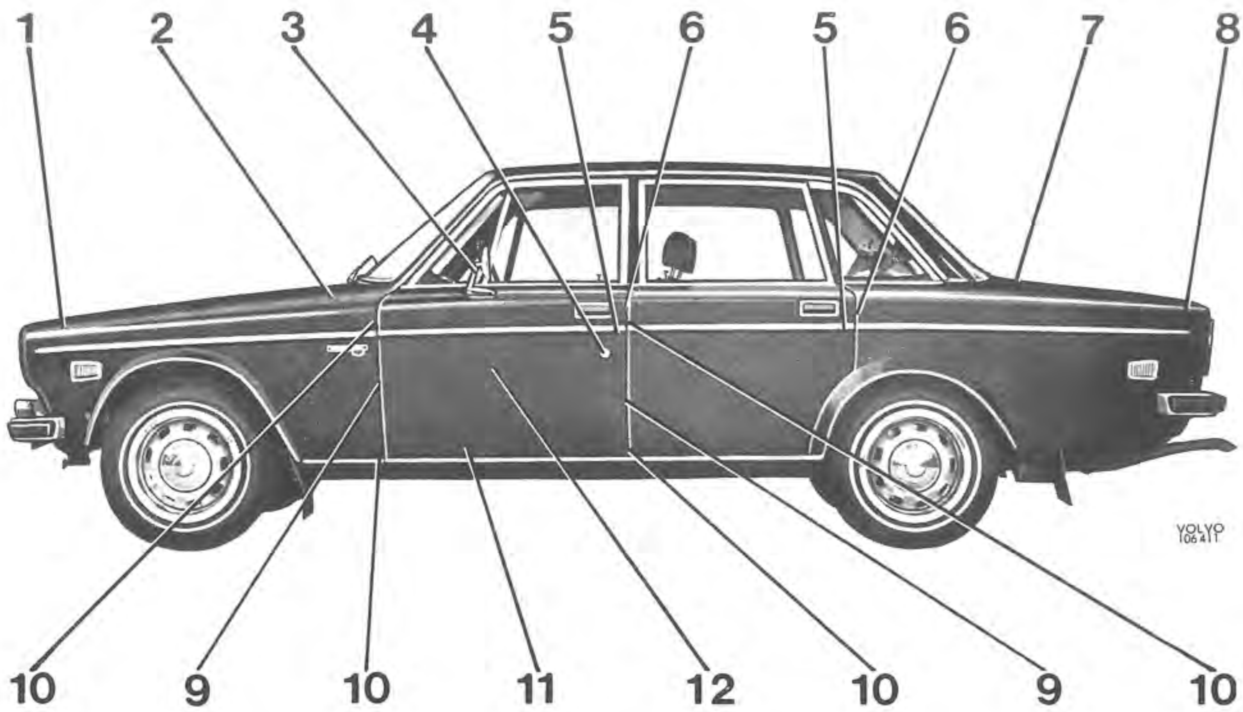

Fig. 1-10. Lubricating points on body

No.	Lubricating point	Lubricant
1	Bonnet (hood) catch	Paraffin wax
2	Bonnet (hood) hinges	Oil
3	Ventilation window catch and hinges	Oil
4	Keyholes	Lock oil
5	Striker plate	See Fig. 1-12
6	Outer sliding surface of door lock	Paraffin wax
7	Luggage compartment lid hinges	Oil

No.	Lubricating point	Lubricant
8	Luggage compartment lid lock	Oil
	Keyholes	Lock oil
9	Door stops	Paraffin wax
10	Door hinges	Grease
11	Front seat slide rails and catches	Paraffin wax and oil
12	Window winders	Oil and grease
	Locks (Accessible after door upholstery panels have been removed.)	Silicon grease

Fig. 1-11. Hinges

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

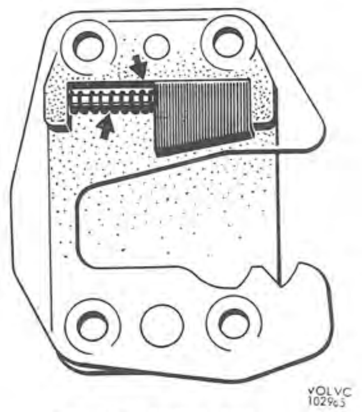

Fig. 1-12. Striker plate

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

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).

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Fig. 1-14. Oil dipstick

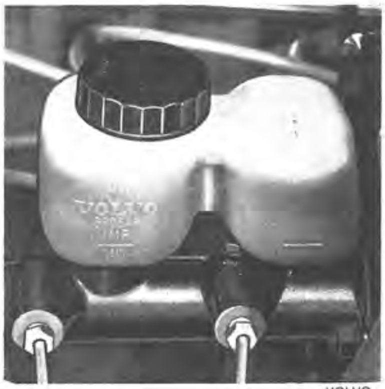

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Fig. 1-15. Brake fluid container

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Fig. 1-16. Expansion tank

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Fig. 1-17. 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/cm² (psi)	Front	Rear
1—3 persons	1.9 (27)	1.9 (27)
Fully lodaded	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).

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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 litres (4.5 Imp.qts = 5.5 US qts)
	including oil filter	approx. 6.0 litres (5.3 Imp.qts = 6.3 US qts)
Gearbox, without overdrive		approx. 0.6 litre (1.1 Imp.pints = 1.3 US pints)
	with overdrive	approx. 1.4 litres (2.5 Imp.pints = 3.0 US pints)
	automatic transmission	approx. 8.2 litres (14.4 Imp.pints = 17.3 US pints)
Final drive		approx 1.6 litres (2.8 Imp.pints = 3.4 US pints)
Servo steering		approx 1.2 litres (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.

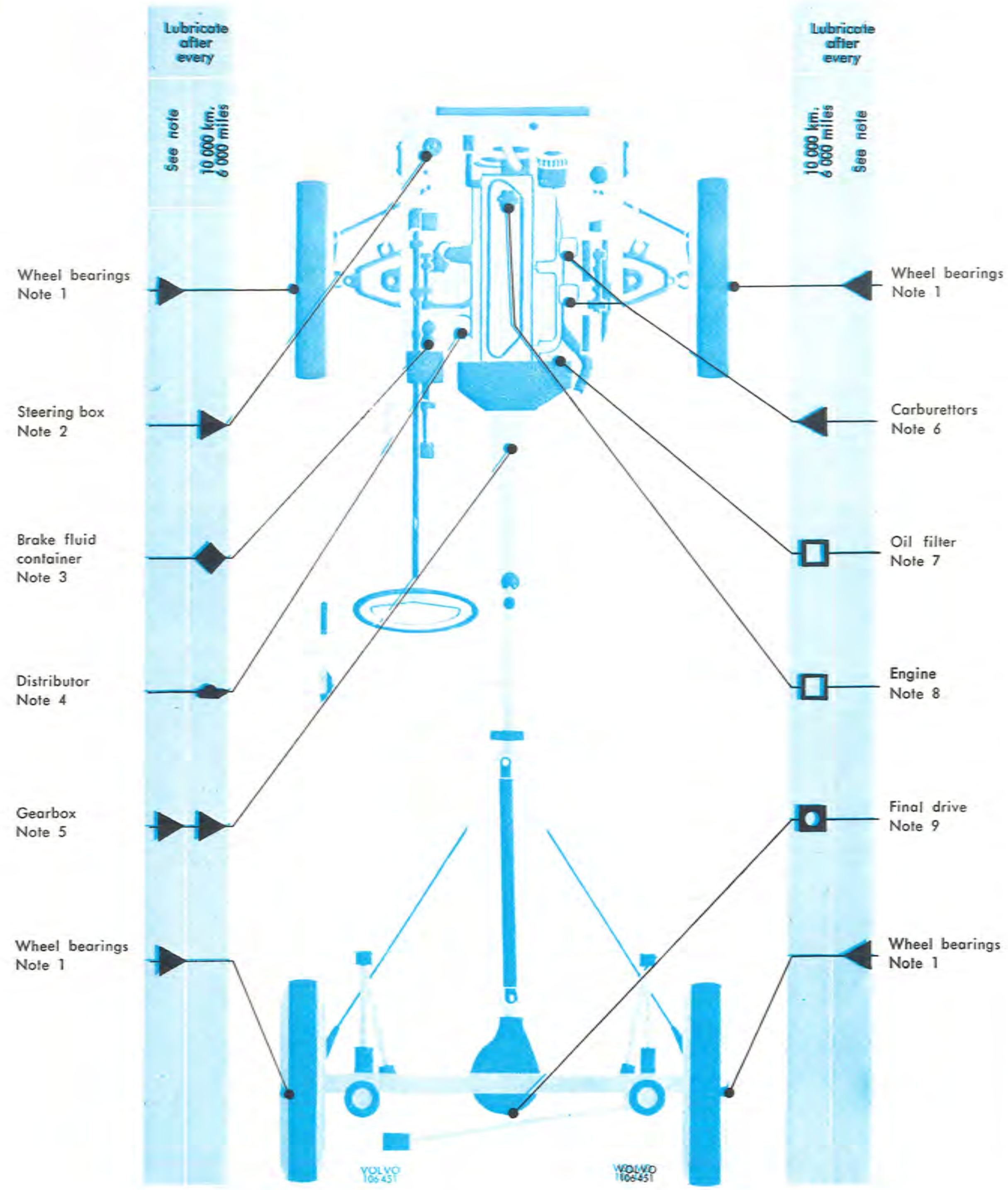
Note 6. Check the oil level in the carburettors when changing the engine oil, see page 1 : 1.

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

CONTENTS

TOOLS

The designation SVO before the tool number is to be replaced by the number 999. This applies also to new production of older tools.

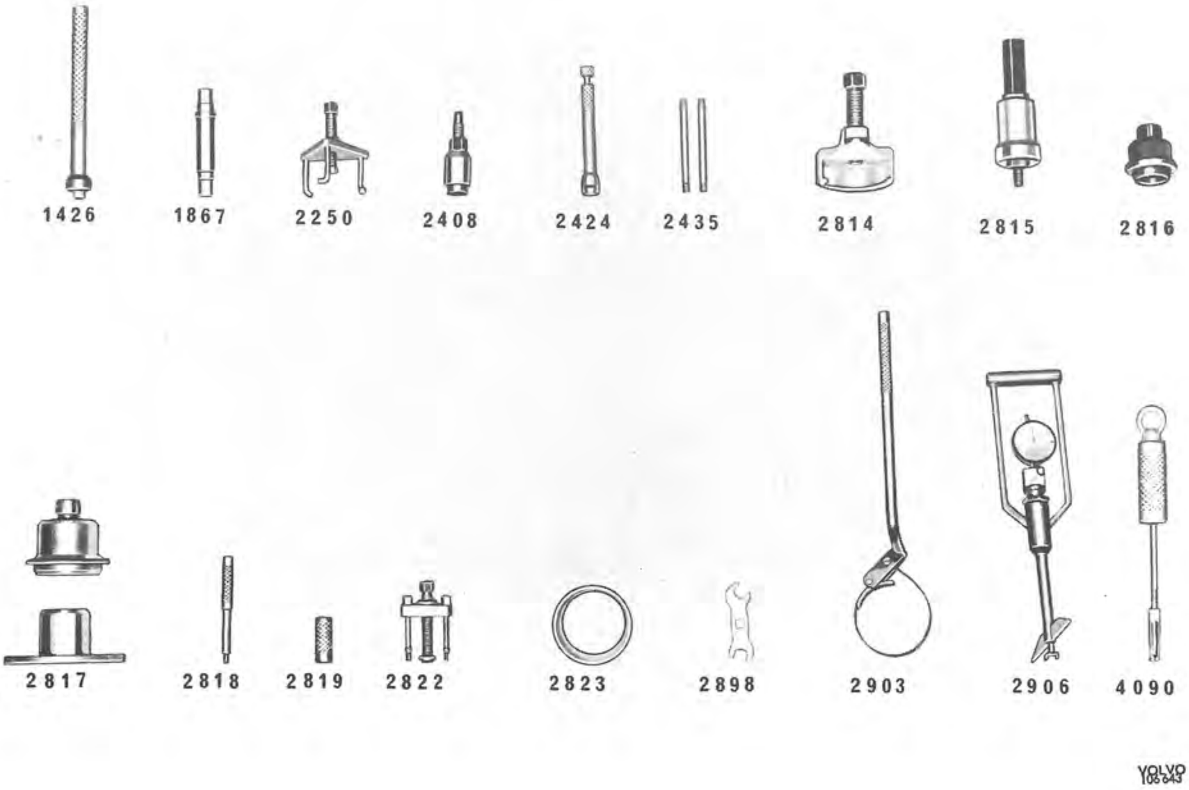


Fig. 2-1. Tools for engine

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

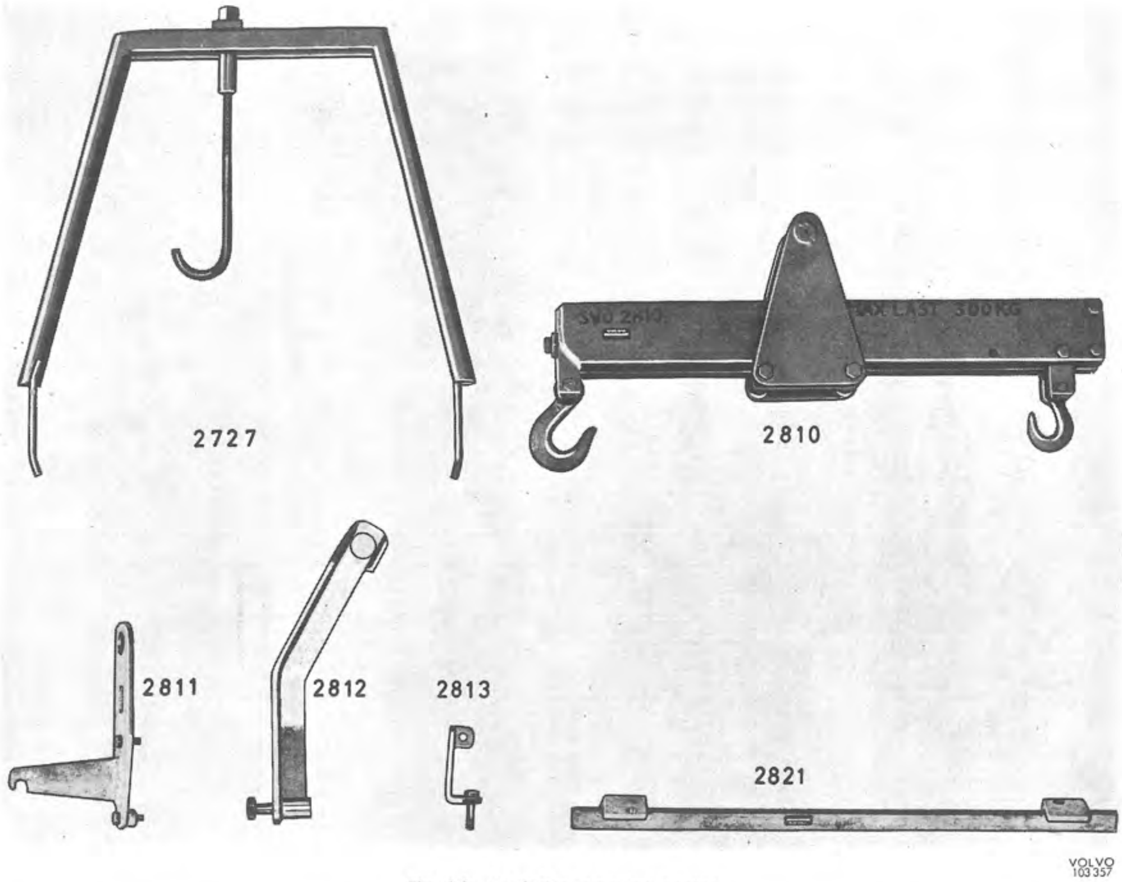


Fig. 2-2. Tools for removing engine

SVO 2727 Tool for lifting engine front or rear end to remove oil sump and gearbox resp.
Used together with tools SVO 2811 and SVO 2821.

SVO 2810 Beam for lifting out and installing engine.
Used together with tools SVO 2811 and SVO 2812.

SVO 2811 Lifting lug for attaching lifting beam 2810 or 2727 in engine front end

SVO 2812 Lifting arm for attaching lifting beam 2810 in rear end of engine (For B 30 E/F altered acc. to separate workshop bulletin)

SVO 2813 Support for lifting arm SVO 2811 for lifting engine with cylinder head removed

SVO 2821 Support for lifting tool SVO 2727 for lifting end of engine

Fig. 2-3. Engine stand

SVO 2520 Stand. Used together with tool SVO 2820
SVO 2820 Fixture for mounting engine on stand 2520

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 positive crankcase ventilation. The fan is of the slip-coupling type.

The B 30 A is provided with two horizontal carburettors as well as an exhaust emission control system which produces cleaner exhaust gases.

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

The B 30 E is equipped with an electronic fuel injection system and oil cooler for the engine oil.

The B 30 F has the same injection system as the B 30 E except that it has lower compression and output and no oil cooler.

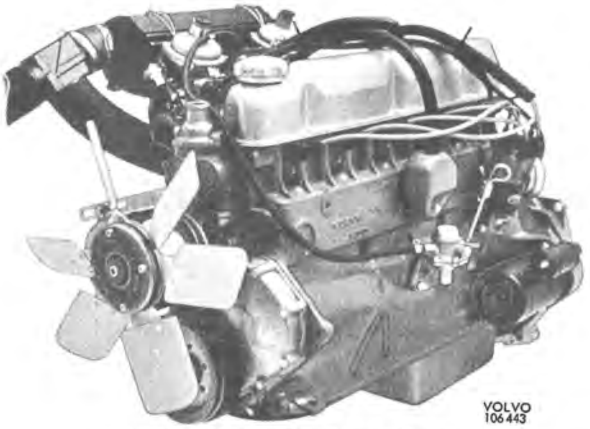


Fig. 2-4. Engine B 30 A viewed from left

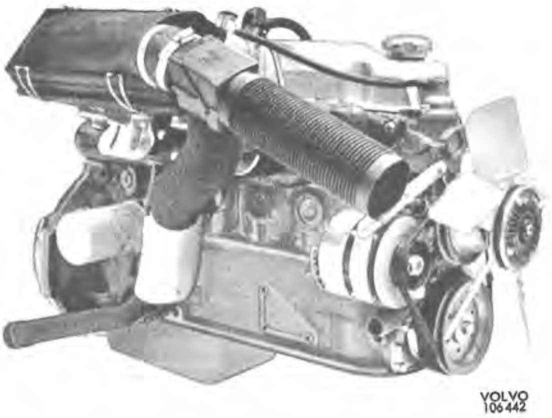


Fig. 2-5. Engine B 30 A viewed from right

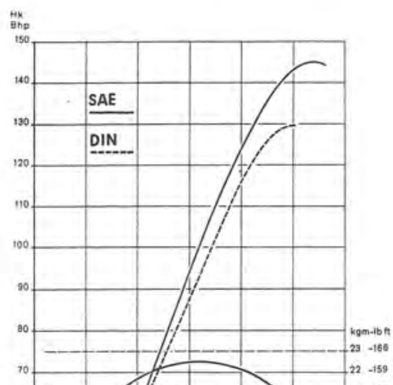


Fig. 2-6. Output and torque curves B 30 A

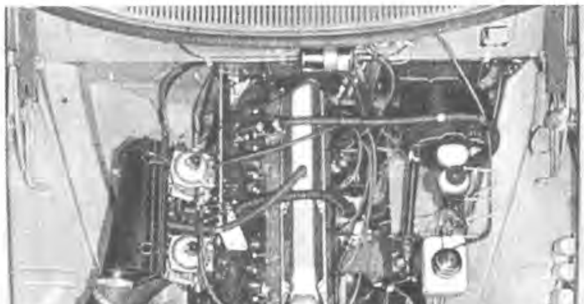


Fig. 2-7. Engine compartment

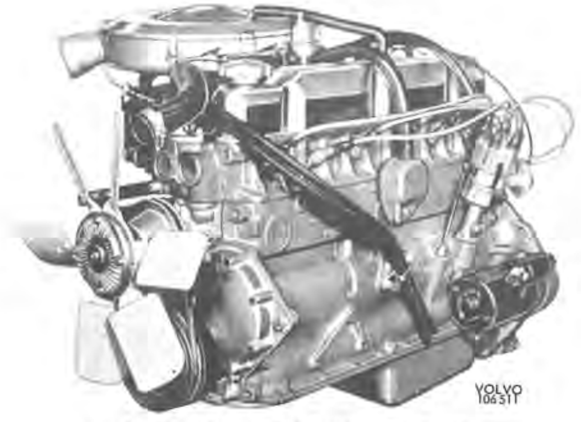


Fig. 2-8. Engine B 30 E viewed from left

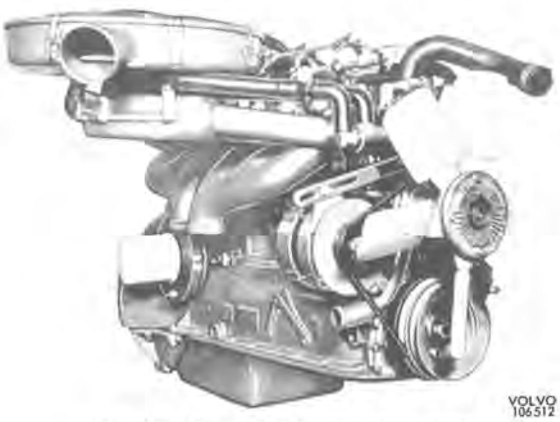


Fig. 2-10. Engine B 30 E viewed from right

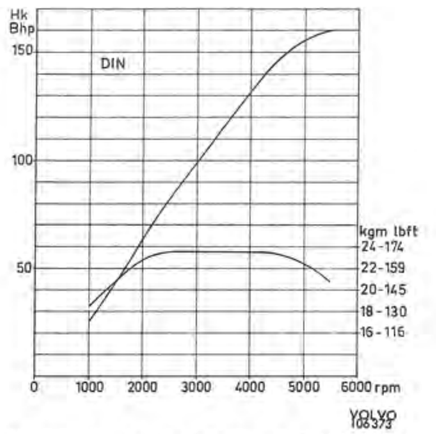


Fig. 2-9. Output and torque curves, B 30 E (DIN)

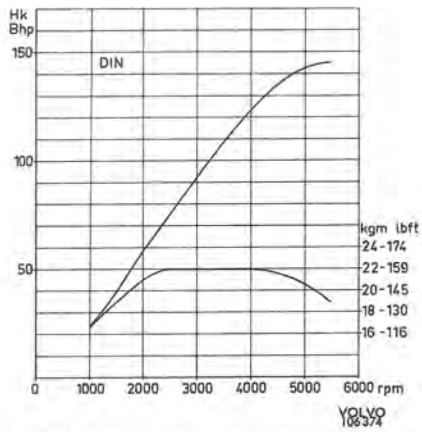


Fig. 2-11. Output and torque curves, B 30 F (DIN)

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 throttle control shaft from the pedal shaft, link rods and bracket. (With automatic transmission: Remove also the throttle cable.) Remove the choke wire from the carburettor and the vacuum hose for the brake servo from the manifold. Disconnect the water hoses for the heater element from the engine.

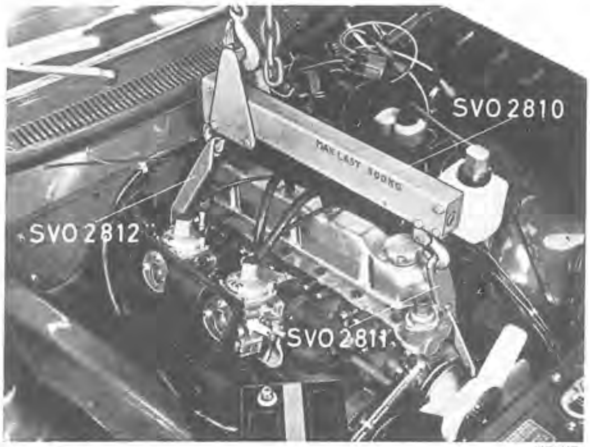


Fig. 2-12. Lifting out engine with lifting tool SVO 2810

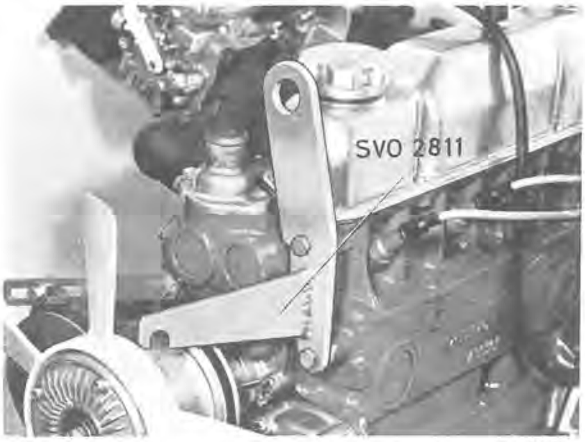


Fig. 2-13. Lifting lug SVO 2811 on engine front end

10. Fit lifting lug SVO 2811 to the front end of the engine as shown in Fig. 2-13 and lifting arm SVO 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 SVO 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.

INSTALLING ENGINE, B 30 A

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

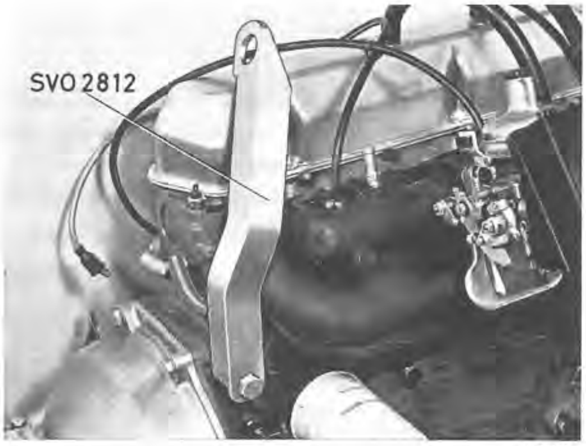


Fig. 2-14. Lifting arm SVO 2812 on rear end of engine

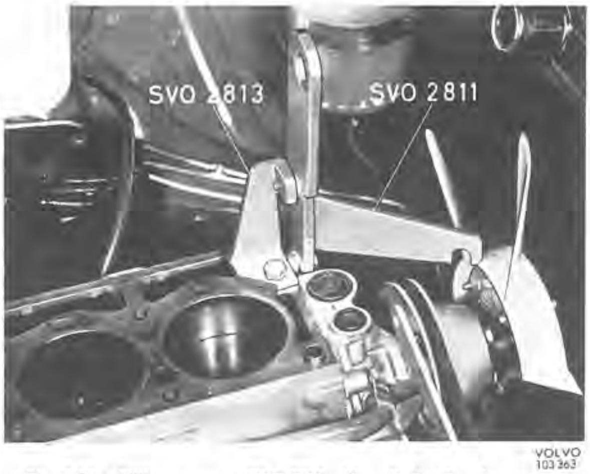


Fig. 2-15. Fitting support SVO 2813 with cylinder head removed

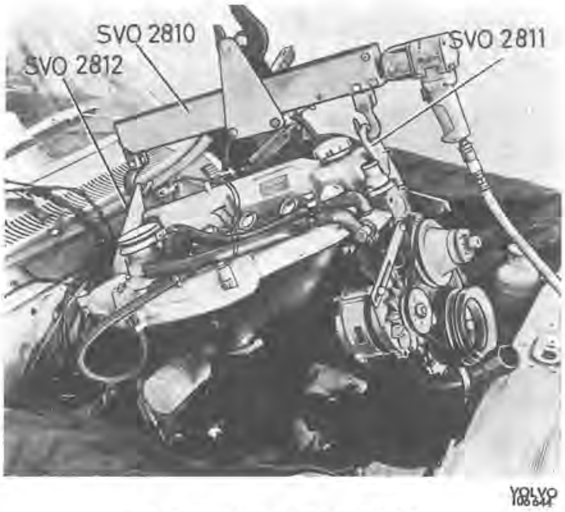


Fig. 2-16. Lifting engine, B 30 E/F

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. (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 from the 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 servo brake and crankcase ventilation hose which comes from the oil trap.
7. Remove the throttle cable from the control arm and the bracket on the inlet duct. (On vehicles with automatic transmission also the throttle cable.)
8. Remove the electric cables from the alternator.
9. Remove the electric cables from the ignition coil and remove the coil.
10. Remove the contact from the impulse contact on the ignition distributor and the electric cables from the starter motor.
11. Disconnect the battery lead from the clamp and place it on the battery shelf.
12. On vehicles with automatic transmission: Divide the cable 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 servo pump for the steering gear and place it on the wheel housing.

26. Fit lifting lug SVO 2811 to the front end of the engine and arm SVO 2812 to the rear of the engine (see Figs. 2-13 and 2-14). (Note that SVO 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 SVO 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 SVO 2811 to the front of the engine and lifting lug SVO 2812 to the rear end of the engine.
Fit SVO 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 servo 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, servo 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 check.

OIL SUMP

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

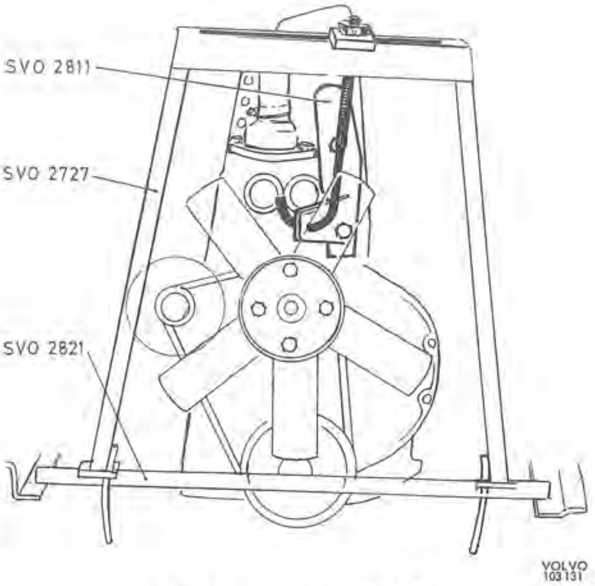


Fig. 2-17. Lifting tool SVO 2727

when doing certain types of work on the engine, the following working method has been evolved:

REMOVING

1. Place support SVO 2821 on the side members as shown in Fig. 2-17. The pins should point forwards and lie against the front plates. The support plates should face upwards. Fit lifting lug SVO 2811, see Figs. 2-17 and 2-13. Place lifting tool SVO 2727 on the support and secure the hook in the lifting lug. 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 refit the bolts. Tighten securely the drain plug.
2. Place the reinforcing bracket in position and tighten all the bolts by hand. Then tighten securely first the bolts for the flywheel casing and then those for the cylinder block.
3. Raise the front axle member and tighten securely the front bolts. Remove the auxiliary bolts, fit and tighten the rear bolts.
4. Fit the nuts for the engine mountings.
5. Lower the vehicle. Remove the lifting tools.
6. Fill with oil and insert the oil dipstick.
7. Start the engine and check for any 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 journalled 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 electric 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 carburettor 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 carburettor to the intake manifold. In this way, the crankcase ventilation system can deal with relatively large quantities of crankcase gases without any escaping into the atmosphere.

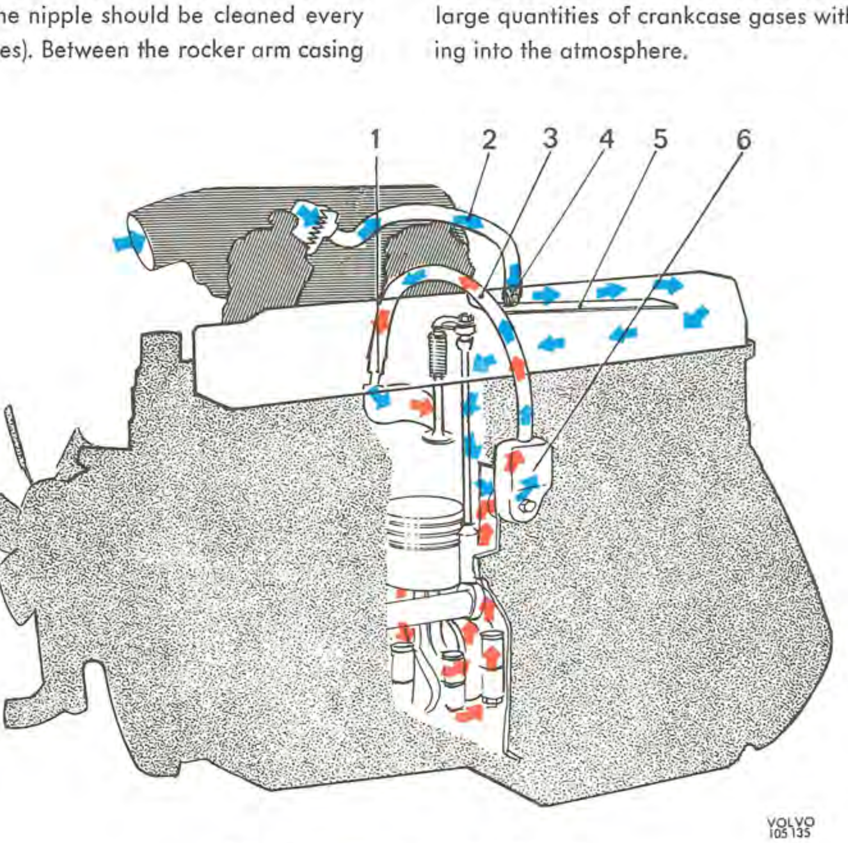


Fig. 2-18. Positive crankcase ventilation

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

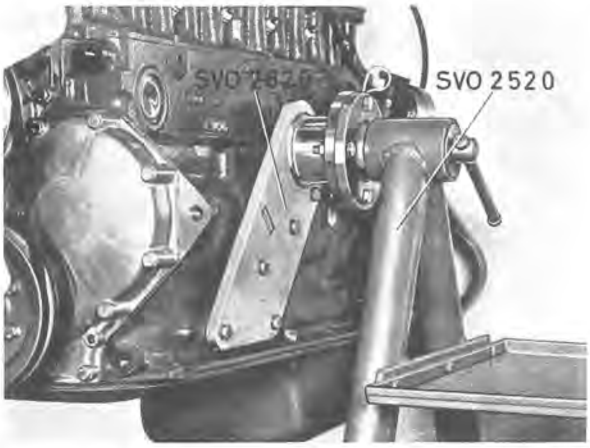


Fig. 2-19. Engine on stand

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 SVO 2520 with fixture SVO 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 carburettors. Take off the cylinder head. Remove the valve tappets with tool SVO 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 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.

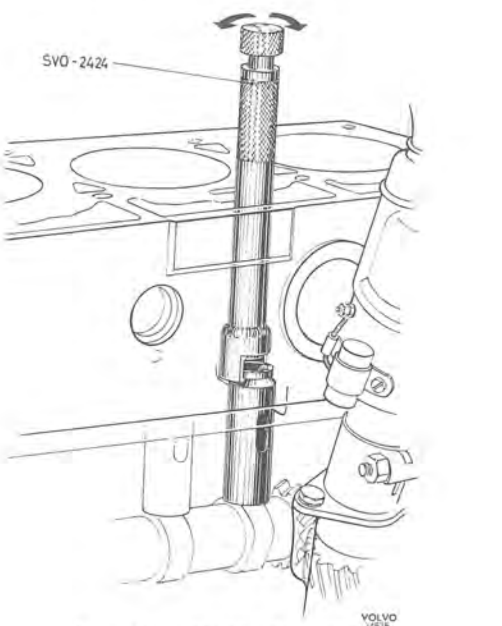


Fig. 2-20. Removing valve tappet

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.

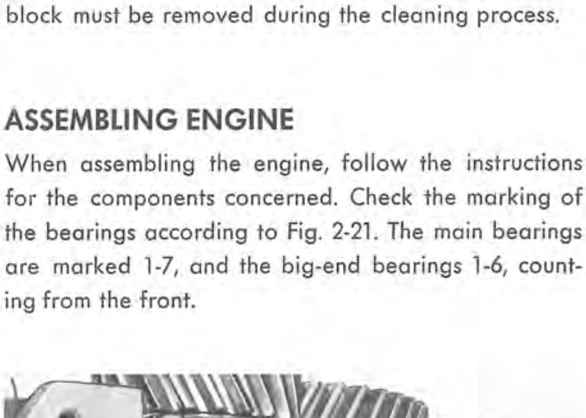


Fig. 2-21. Marking main and big-end bearings
1. Main bearing No. 1 2. Big-end bearing No. 1
3. Main bearing No. 2

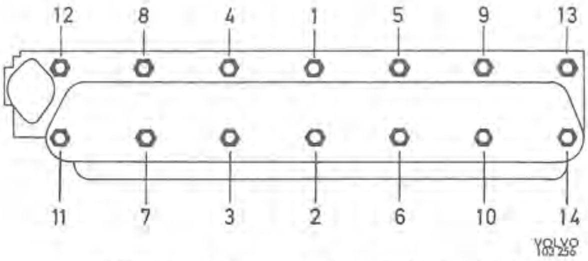


Fig. 2-22. Tightening sequence for cylinder head bolts
To be tightened in three stages
1st stage: 4.0 kpm (29 lbft) 2nd stage: 8.0 kpm (58 lbft)
3rd stage: 9.0 kpm (65 lbft)

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 : 5.

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

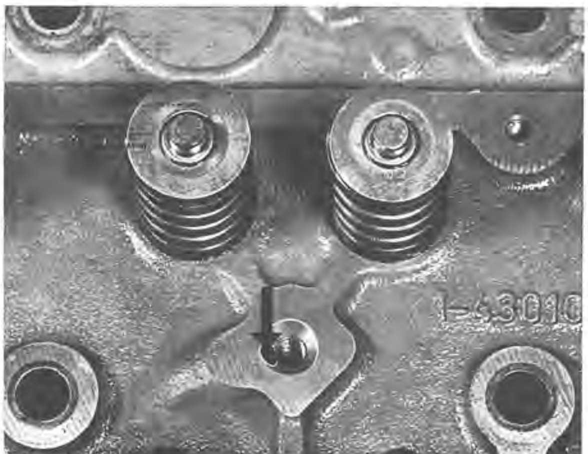


Fig. 2-23. Oil hole in cylinder head

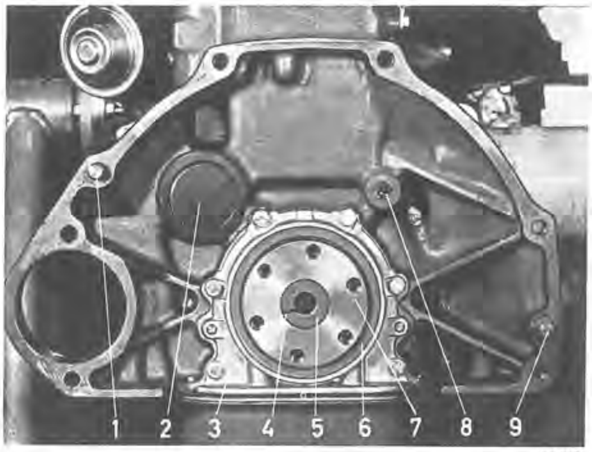


Fig. 2-24. Rear end of engine

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

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, carburettors and air cleaner casing. Remove the throttle control shaft from the pedal shaft, the link rods and bracket.
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 telltale.
5. Unscrew the preheating plate from the exhaust manifold as well as the nuts for the exhaust manifold flange.
6. Remove the tensioning iron of 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. 2-18) 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 SVO 2435 can be suitaly 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 iron 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 9 kpm (65 lbft). Use SVO 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 servo 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 injectiors.
   Remove the cable harness.
6. Remove the temperature sensor for the coolant.
7. Remove the control shaft from the throttle valve shaft and the control bracket from the inlet duct. Lift off the control and place it to the one side.
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 SVO 2435.

3. Check that the oil channel (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: 4.0 kpm (29 lbft), 2nd stage: 8.0 kpm (58 lbft) and the third stage, 9.0 kpm (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 iron 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. Fi 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 and throttle valve.
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 9.0 kpm (65 lbft). Use SVO 2898 for this purpose.
20. Check and if necessary adjust the valve clearance to 0.50—0.55 mm (0.020—0.022"). Fit the rocker arm cover and the air cleaner. Carry out a function check.

CYLINDER HEAD AND VALVES

DISASSEMBLING

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

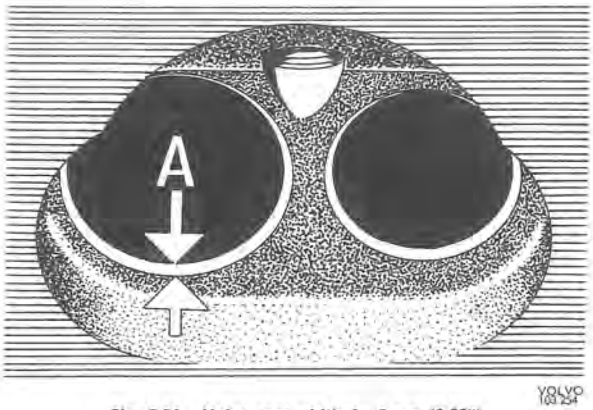


Fig. 2-26. Valve seat width A=2 mm (0.08")

CLEANING

With rotating brushes clean the valves, the cambustion 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 SVO 2818.
2. Press in the new guides using drift SVO 2819, which

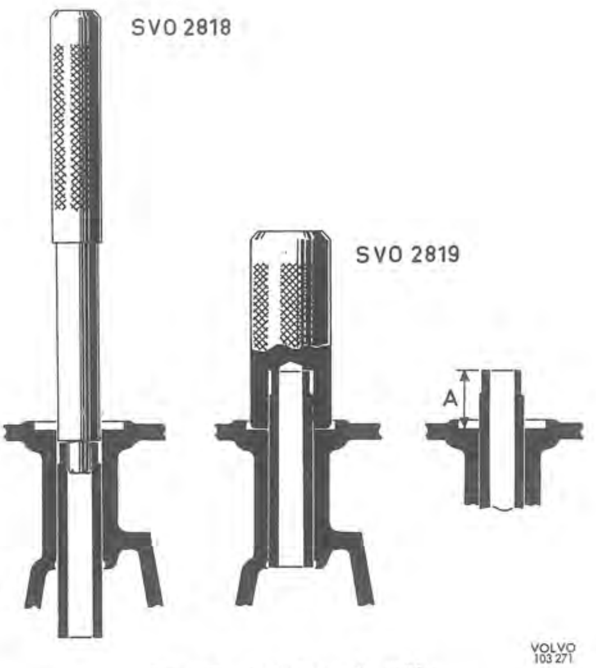


Fig. 2-27. Replacing valve guides
A=17.5 mm (0.689")

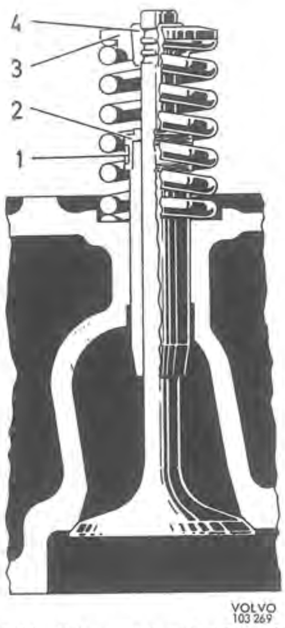


Fig. 2-28. Valve collet and valve guide seal

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

gives the correct pressing-in depth. See Fig. 2-27.

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 SVO 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 valve. 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.

When the piston in No. 1 cylinder is at top dead center (the compression stroke), valves Nos. 1, 2, 3, 6, 7 and 10 (counted from the front) are adjusted, and with the piston in No. 6 cylinder at top dead center, valves Nos. 4, 5, 8, 9, 11 and 12.

CYLINDER BLOCK

MEASURING CYLINDER BORES

The cylinder bores are measured with a special dial indicator. Measuring should be carried out just below

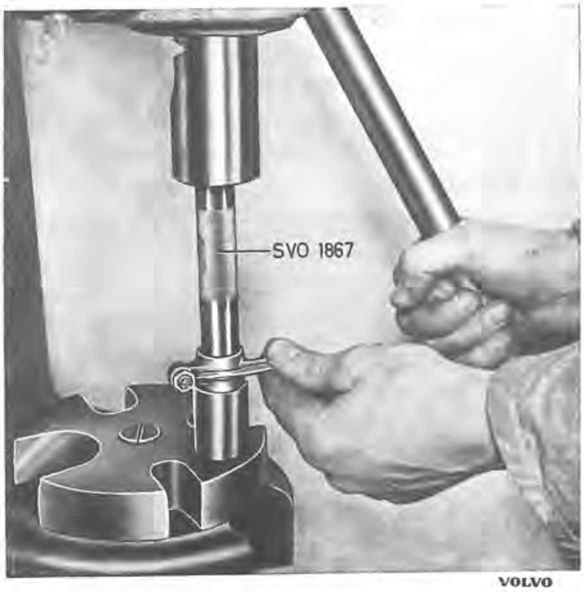


Fig. 2-29. Replacing bush in rocker arm

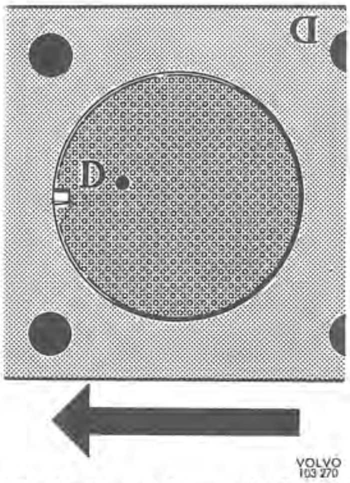


Fig. 2-30. Marking on pistons and cylinder block

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).

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

PISTONS, PISTON RINGS AND GUDGEON PINS

MEASURING PISTONS

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

FIT OF PISTONS IN CYLINDERS

The 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 kp (2.2 lb). This gives the average value for piston clearance. When the above-mentioned force is applied, the piston clearance obtained is equal to the thickness of the feeler gauge used. Feeler gauges which are 0.04 mm (0.0016") or 0.06 mm (0.0024") thick can, therefore, also be used. The test is carried out at several different depths.
Standard bore cylinders have a letter stamped on which shows the dimensions, and the pistons concerned should be marked with the same letter.

PISTON RING FIT

In a new or re-bored cylinder

1. Push down the piston rings one after another in the cylinder bore. Use a reversed piston to ensure that the rings come into the correct position.
2. Measure the ring gap with a feeler gauge. The gap should be 0.40—0.55 mm (0.016—0.022"). If necessary, the gap can be increased with the help of a special file.
3. Check the piston rings in their 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.

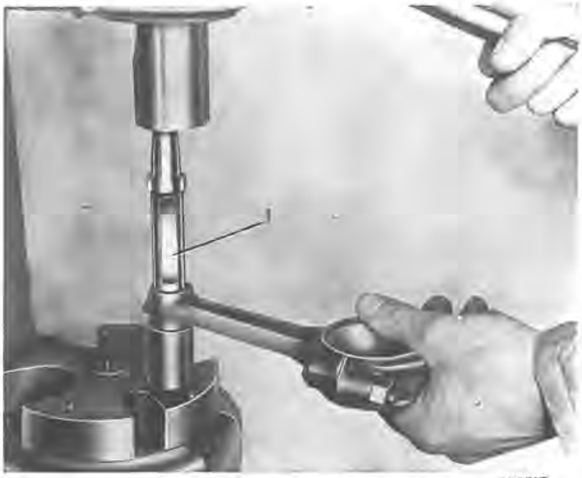


Fig. 2-32. Replacing bush in connecting rod
1. Drift SVO 1867

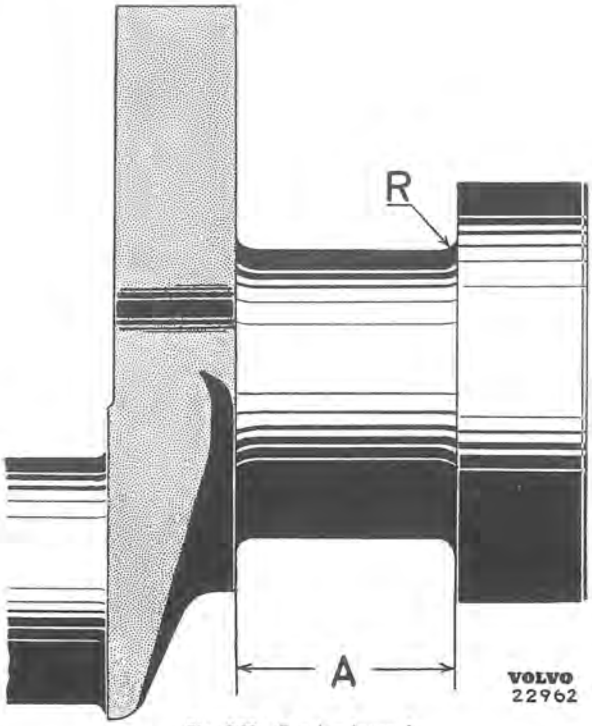


Fig. 2-33. Bearing journal

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 SVO 2832, 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.

CONNECTING RODS

REPLACING BUSHES

If the old bush in a connecting rod is worn, press it out by using drift SVO 1867 and press in a new bush with the same tool, see Fig. 2-32. Mage 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.

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 a 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 neven 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 SVO 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 SVO 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 presure 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 SVO 2817. Use a suitable cushion for the sealing flange to prevent it from being damaged.
3. Press in the sealing ring with tool SVO 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 SVO 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

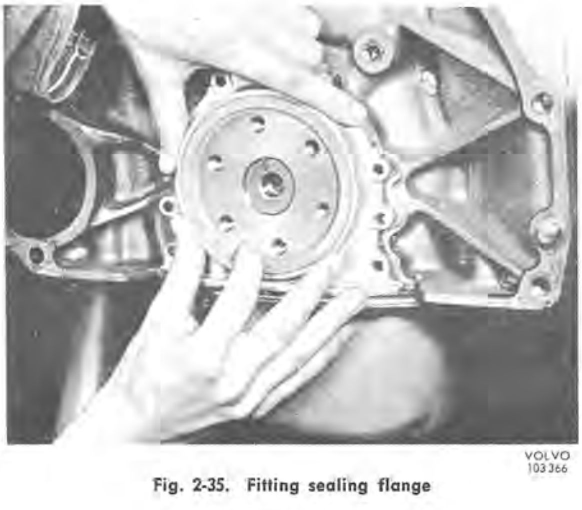


Fig. 2-35. Fitting sealing flange

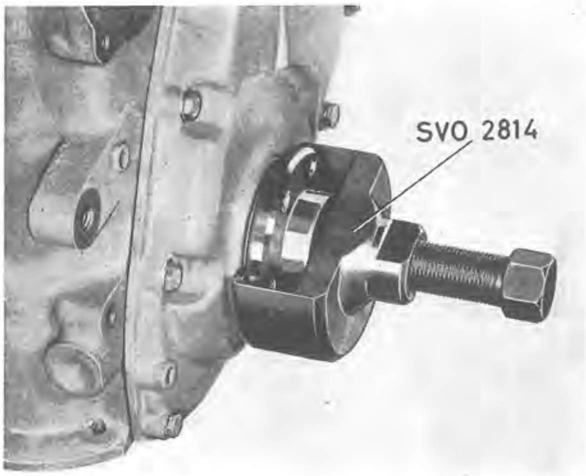


Fig. 2-36. Removing polygon hub

bolt screwed out a couple of turns or completely.

4. Fit the sealing flange, its sealing surface being well cleaned, and a new gasket. (Oil first the sealing ring.) 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 SVO 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

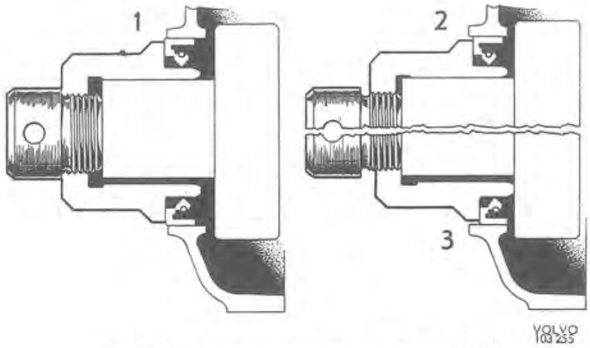


Fig. 2-38. Center spindle position on SVO 2816

4. Remove the oil seal. Lubricate the sealing lip on the new seal and fit the seal with drift SVO 2316, 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 SVO 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 SVO 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 7—8 kpm (50—57 lbft).
6. Fit the flywheel damper and pulley. Since the bolt holes are not located symmetrically, fitting can only be done in one position.

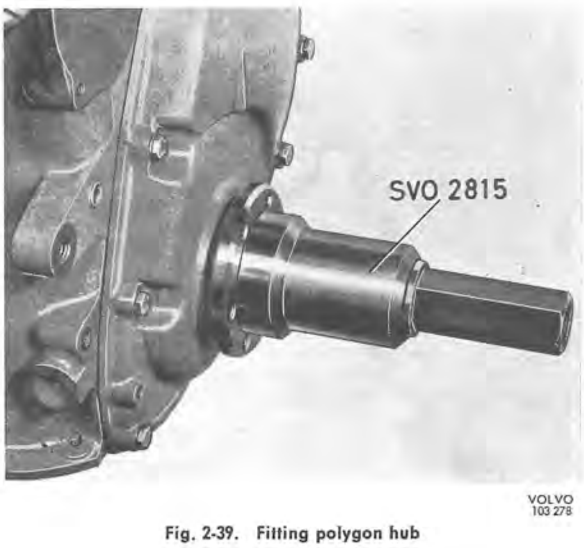


Fig. 2-39. Fitting polygon hub

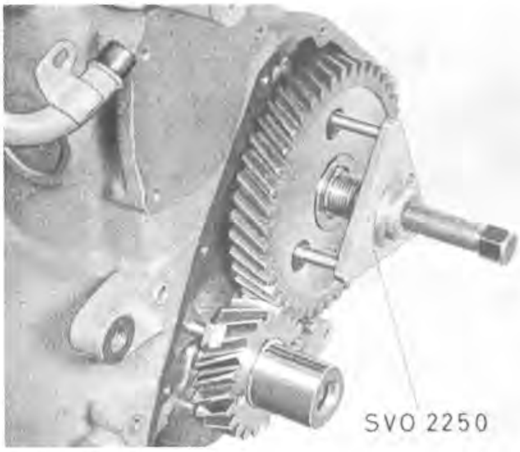


Fig. 2-40. Removing camshaft gear

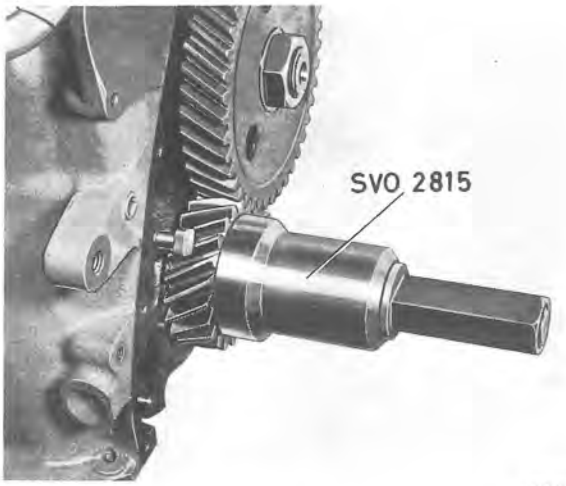


Fig. 2-42. Fitting crankshaft gear

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 SVO 2250, see Fig. 2-40.
5. Pull off the crankshaft gear with puller SVO 2822, see Fig. 2-41.
   Screw out the oil nozzle, blow it clean and re-fit it, see Fig. 2-38. The gears are lubricated from this nozzle.
6. Re-fit the crankshaft with tool SVO 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 13—15 kpm (94—108 lbft). The measuring values for the tooth flank clearance and the camshaft axle clearance, which is deter-

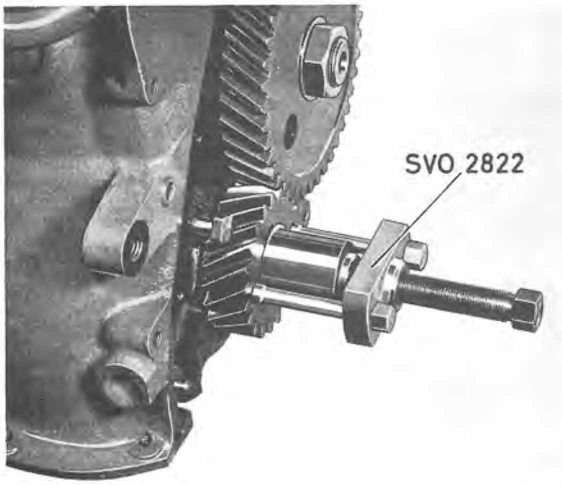


Fig. 2-41. Removing crankshaft gear

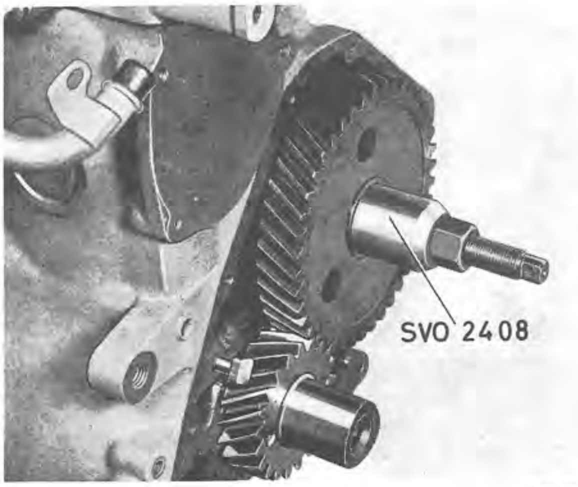


Fig. 2-43. Fitting camshaft gear

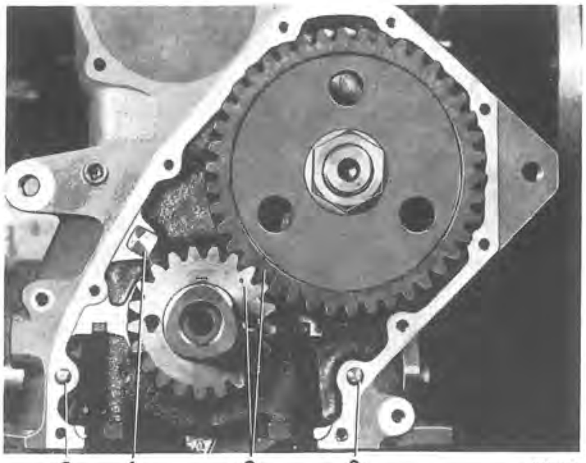


Fig. 2-44. Markings on timing gears
1. Oil nozzle 2. Markings 3. Dowel pin

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) should be screwed out and cleaned. At the same time check the hoses and replace those in poor condition.

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.

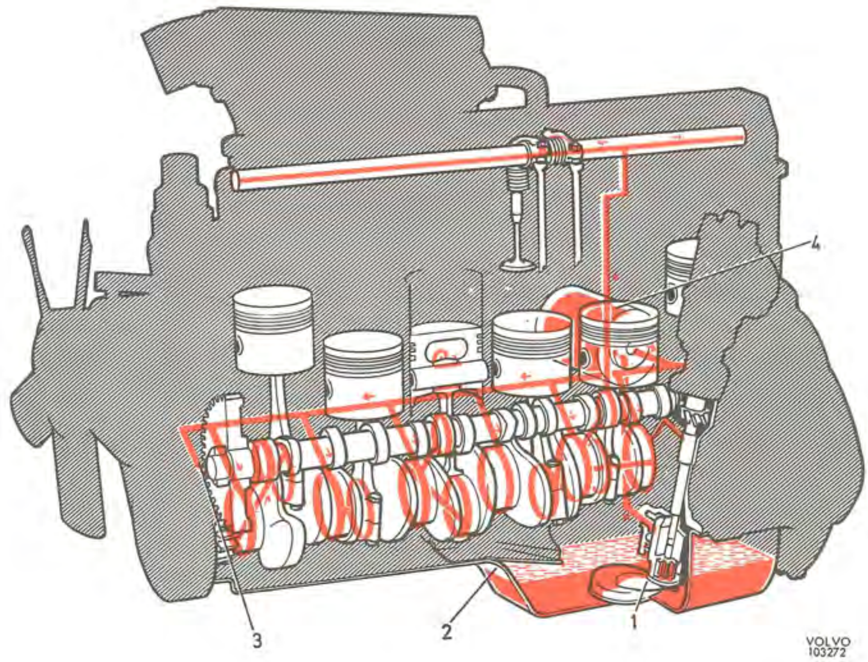


Fig. 2-45. Lubrication system
1. Oil pump
2. Sump
3. Nozzle
4. Oil filter

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.

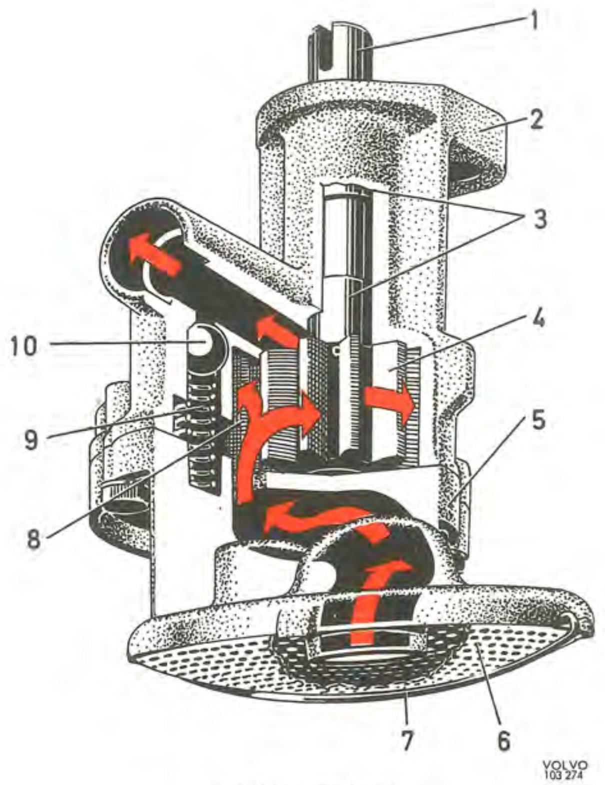


Fig. 2-46. **Oil pump**

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

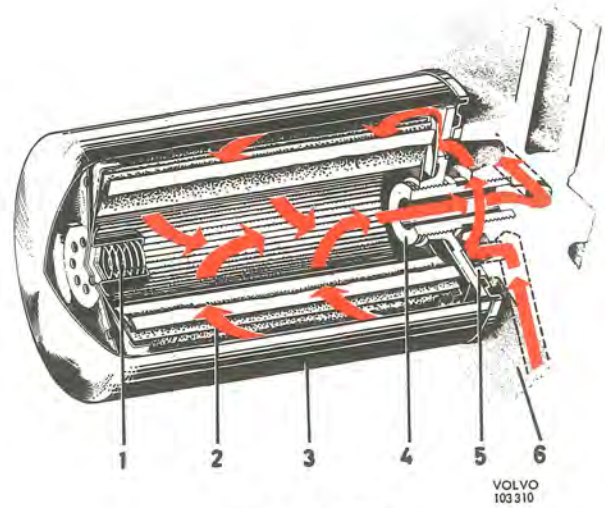


Fig. 2-47. **Oil filter**

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

OIL COOLER

The B 30 E engine is fitted with an oil cooler for the engine oil.

The oil cooler (Fig. 2-48) is fitted between the oil filter and the cylinder block and consists of an inner section for the oil which is surrounded by a cooling jacket. The engine coolant is led through the cooling jacket. On its way to the oil filter, the oil passes through the cooler and some of the heat in the oil is conducted away by the coolant. The coolant cannot pass the shortest way from the inlet (1) to the outlet (3) but is forced to go zig-zag and round the cooler as shown by the blue arrows in the Fig. (2-48). A number of rubber seals (4) force the fluid to go in this direction.

The discs (2) are cooled by the coolant and divide a plate into two sections which is linked to the disc periphery. The oil enters the first section, nearest the engine block (see red arrows), is pressed along the discs into the other sections and along its discs. From there it continues into the oil filter.

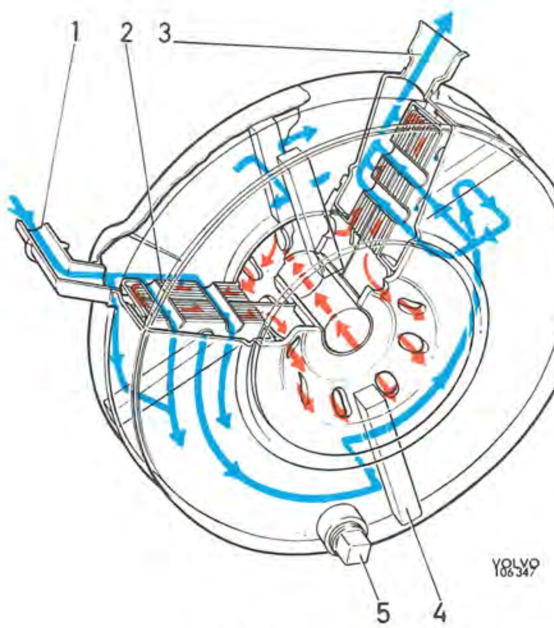


Fig. 2-48. **Oil cooler**

1. Coolant inlet
2. Discs
3. Coolant outlet
4. Rubber seal
5. Drain plug for coolant

REPLACING OIL FILTER

Together with the element and relief valve, the oil filter (see Fig. 2-48) 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, see Fig. 2-50.
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 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 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

VOLVO 103 112

Fig. 2-50. Removing oil filter

REPLACING OIL COOLER

1. Drain off the engine coolant by removing the plug in the oil cooler.
2. Disconnect the clips and the coolant connection on the oil cooler. Remove the oil filter.
3. Unscrew the nut on the nipple for the oil cooler, and pull off the cooler.
4. Fit the oil cooler with a new rubber ring to the connection against the engine block. The O-ring against the cylinder block should be replaced. The O-ring should be inserted into the groove on the oil cooler before re-fitting. Coat the groove with a thin layer of adhesive which is resistant to oil up to temperatures of 140° C (280° F), for example, Pliobond 20. With the nut tightened to a torque of 1 kpm (7 lbft), check that the cooler makes good contact with the cylinder block all round. The nut is finally tightened to a torque of 3.0—3.5 kpm (23—25 lbft).
5. Fit the oil filter and connect the coolant pipe.
6. Fill up with coolant and, if necessary, also engine oil.
7. Start the engine and check for leakage.
   If the nipple for the cooler has been replaced, the new one should be tightened to a torque of 4.5—5.5 kpm (33—40 lbft).

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. 2-51), see "Specifications" for the values concerned.

Check that the tooth flank clearance is 0.15—0.35 mm (0.006—0.014"), see Fig. 2-53.

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 remaer 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. 2-54. 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

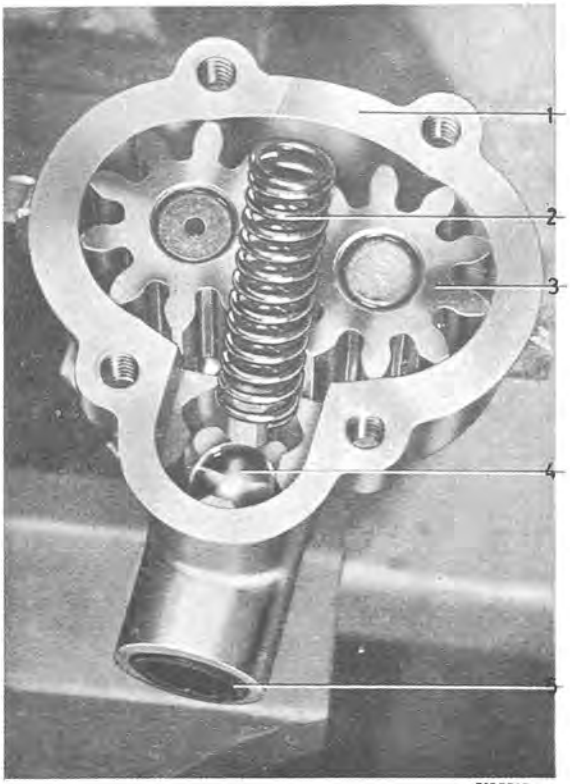


Fig. 2-51. **Oil pump**

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

the block before being tightened. Before fitting the rubber rings on the pipe, apply soapy water since this enables the pipe to take up its position more easily. Tap lightly on the pipe with a soft mallet if necessary.

OILWAYS

Before being fitted, all the oilways must be cleaned very thorougly to avoid damage to the bearings, bearing journals and other components.

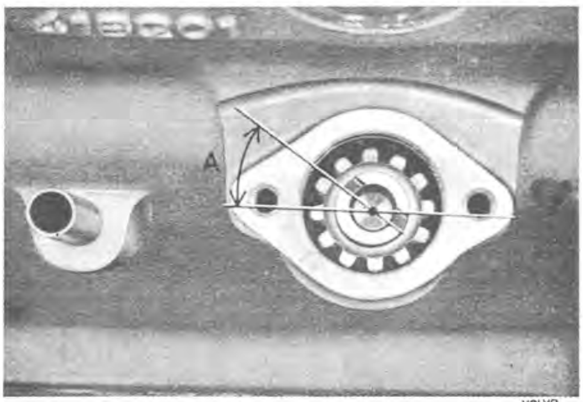


Fig. 2-52. Distributor drive position
A=approx. 35°

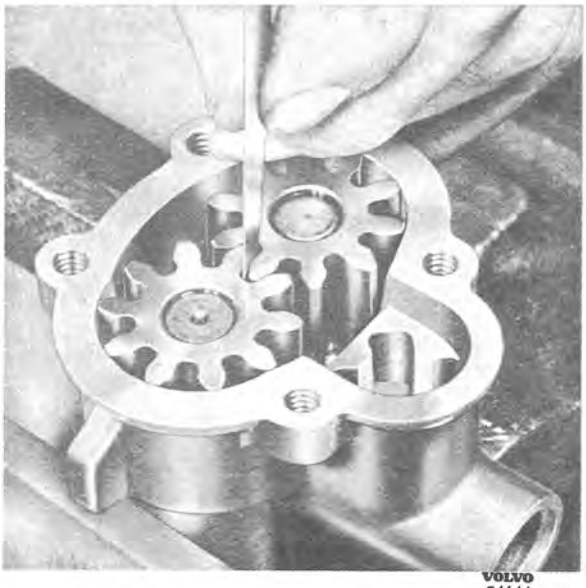


Fig. 2-53. Measuring tooth flank clearance

To clean the cylinder block oilways, remove the sealing plugs. After cleaning and drying with compressed air, fit new plugs.

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. 2-52 (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 in the top dead center, firing position.)

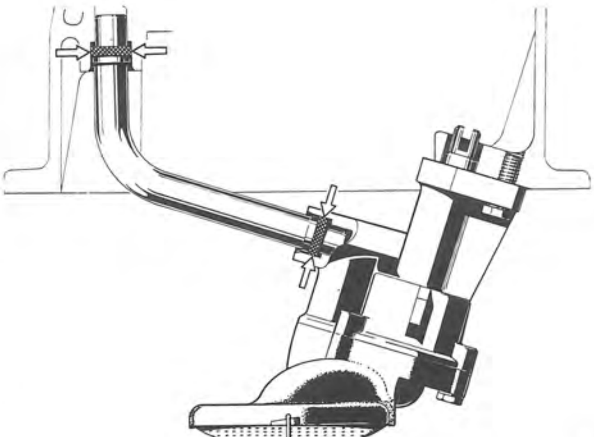


Fig. 2-54. Delivery pipe sealing rings

GROUP 23

FUEL SYSTEM

CARBURETTOR ENGINE

DESCRIPTION

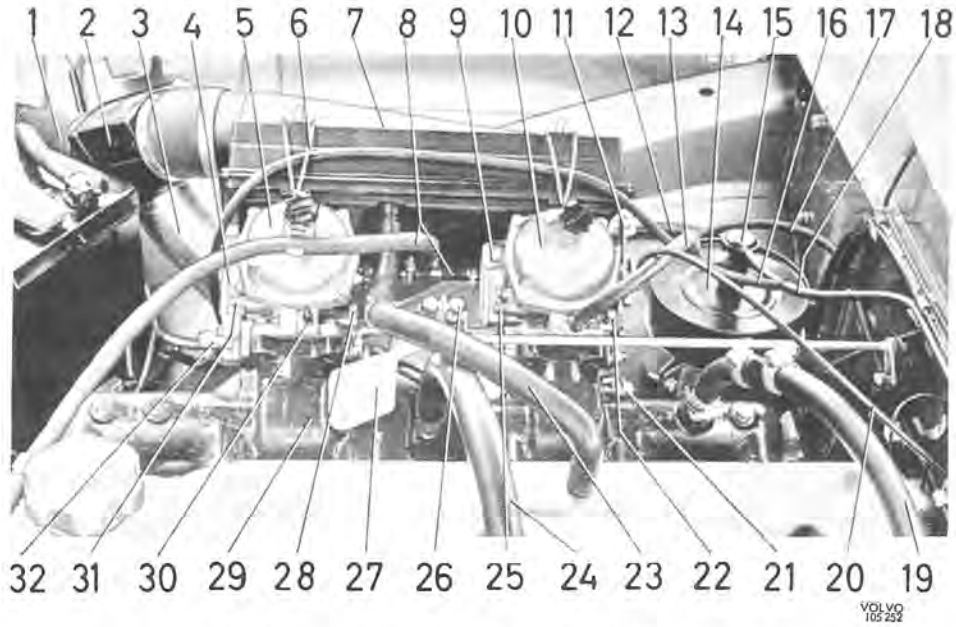


Fig. 2-55. Carburettors, B 30 A engine (for U.S.A.)

1. Cold air hose
2. Constant temperature device flap
3. Warm air hose
4. Temperature compensator
5. Front carburettor
6. Clasp for air cleaner cover
7. Air cleaner
8. Fuel hoses
9. Temperature compensator
10. Rear carburettor
11. Hot start valve
12. Hose between hot start valve and venting filter
13. Hose for fuel fumes to carburettors
14. Venting filter
15. Air valve
16. Vacuum hose for vacuum for air valve and distributor
17. Hose between fuel tank and venting filter
18. Vacuum hose for distributor (negative vacuum setting)
19. Vacuum hose for brake servo
20. Choke wire
21. Secondary throttle
22. Throttle stop screw
23. Air hose for crankcase gases
24. Hose for crankcase gases
25. Idle trimming screw
26. Throttle control
27. Bracket
28. Throttle stop screw
29. Manifold with preheating chamber
30. Vacuum connection
31. Idle trimming screw
32. Throttle by-pass valve

The B 30 A engine is fitted with two horizontal carburettors of type Stromberg 175 CD-2SE (Fig. 2-55), the construction of which is shown in Figs. 2-56, 2-57, 2-59 and 2-60. This type of carburettor has been designed with a view to the exhaust emission control system. It is provided with a fixed jet, pressed into the carburettor 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 carburettor 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 carburettor consists of three main parts of light-alloy, the middle part of which comprises the carburettor 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 carburettor throttle and valve.

Both carburettors are fitted with a temperature compensator (8, Fig. 2-57 and 2, Fig. 2-60). This is con-

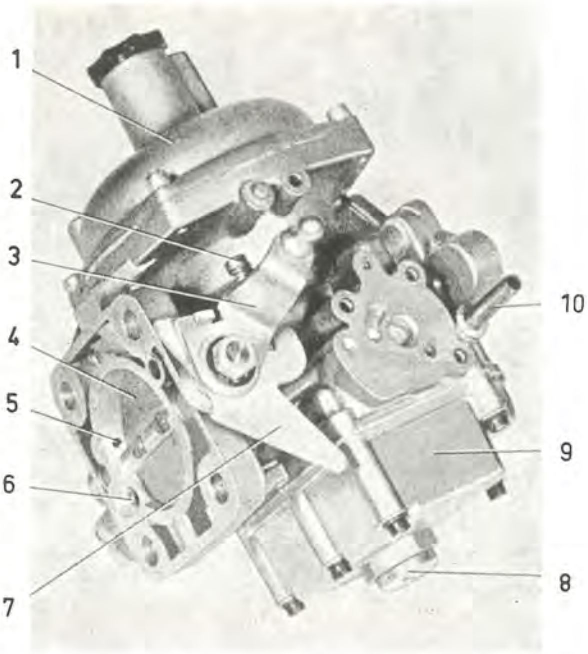


Fig. 2-56. Carburettor, front, from the left

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

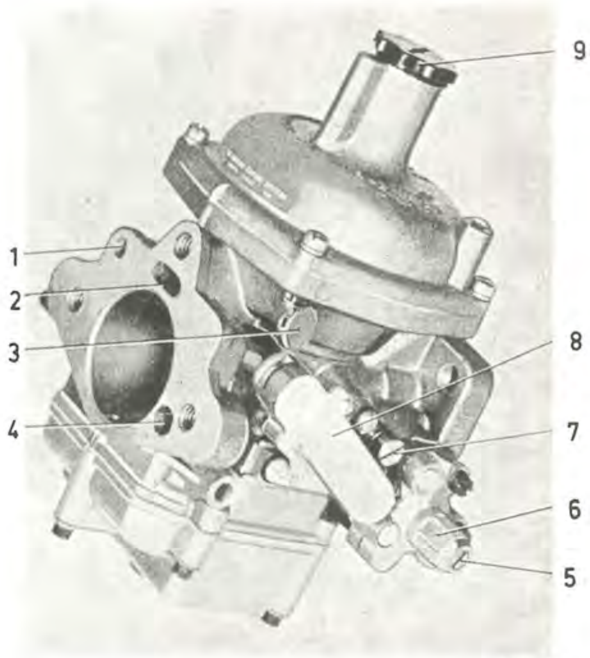


Fig. 2-57. Carburettor, front, from the right

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. Stop screw for by-pass valve
6. By-pass valve
7. Idle trimming screw
8. Temperature compensator
9. Hydraulic damper

structed as an air valve regulated by the carburettor temperature and maintains the fuel-air mixture constant irrespective of the fuel temperature.

The front carburettor is provided with a throttle by-pass valve (6, Fig. 2-57 and Fig. 2-65), the purpose of which is to direct a regulated flow of fuel-air mixture past the carburettor throttle when this is closed at high speeds.

This reduces very much the volume of noxious exhaust gases produced.

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

The hot-start valve (11 Fig. 2-55) is described on page 2 : 30.

The negative vacuum connection for the ignition distributor is located in under the part of the flange for the front carburettor. On vehicles with positive vacuum connection, this is located on the front carburettors. The rear carburettor is fitted with a connection for the venting filter. The front carburettor 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. 2-58). The float (1), which is made up of twin expanded rubber floats, is carried on a bridge on the lower side of the carburettor 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.

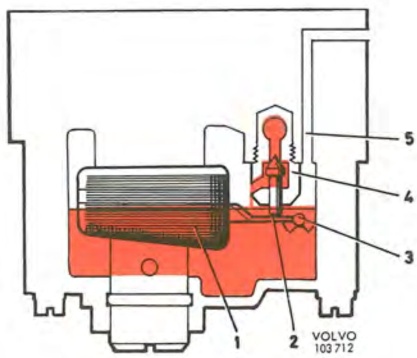


Fig. 2-58. Float system

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

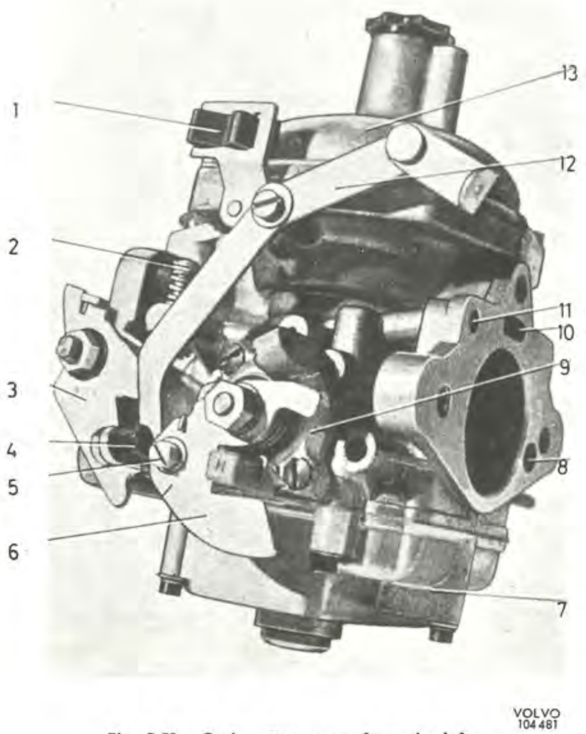


Fig. 2-59. Carburettor, rear, from the left

1. Attaching sleeve for choke control
2. Throttle stop screw
3. Throttle spindle cam
4. Fast idle stop screw
5. Connection for choke control
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

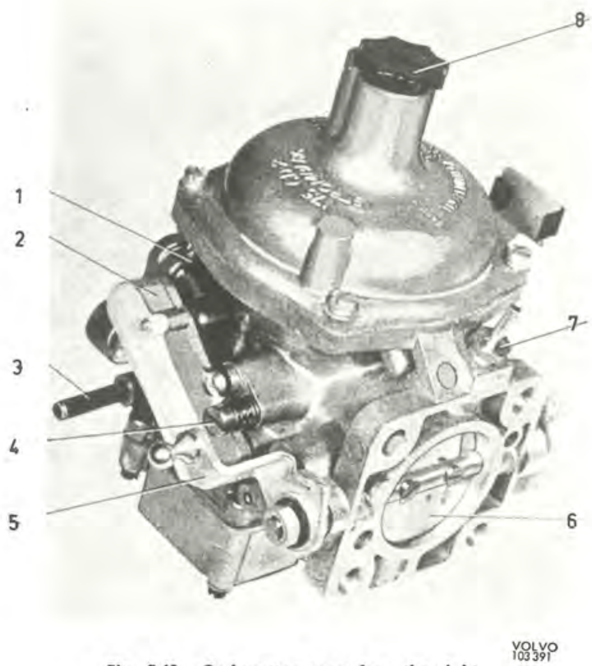


Fig. 2-60. Carburettor, rear, from the right

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

COLD START DEVICE AND FAST IDLE

To facilitate starting during cold weather, the rear carburetor is fitted with a cold start device (Figs. 2-59 2-61 and 2-62).

The cold start device consists of a valve disc (3, Fig. 2-61) 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 cover (5), there is a cam disc (6, Fig. 2-59) 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. 2-61) 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 (2), which terminates in the venturi 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

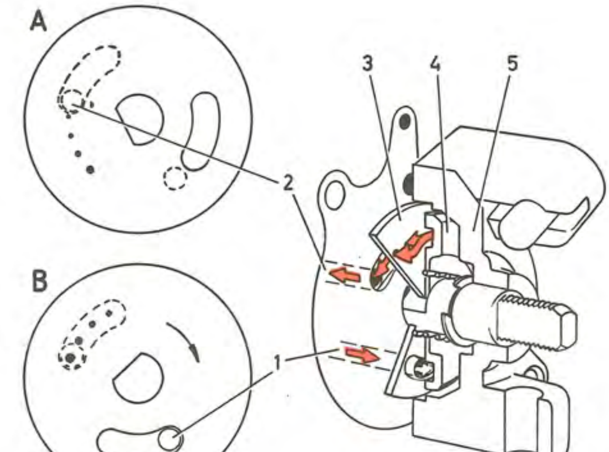


Fig. 2-61. Cold start device

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

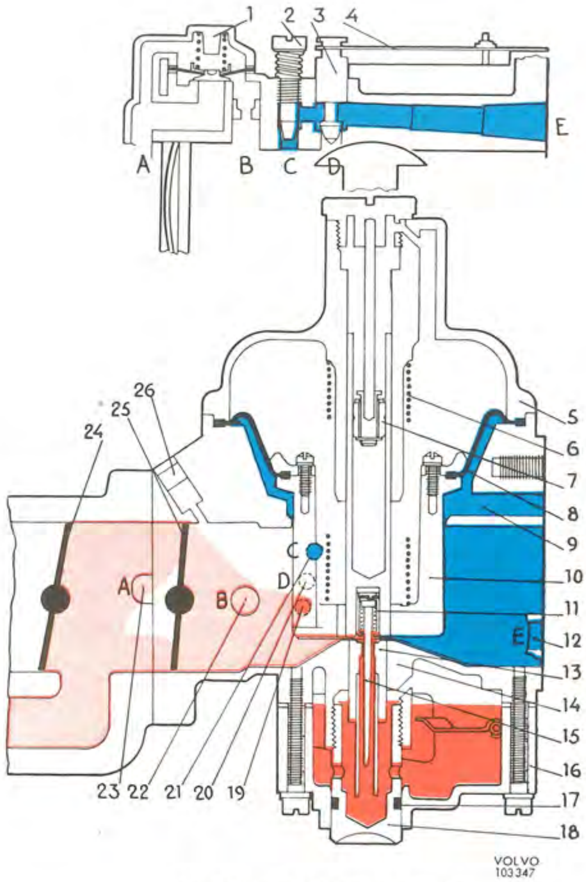


Fig. 2-62. Cold starting, principle

1. By-pass valve
2. Idle trimming screw
3. Valve for temperature compensator
4. Bi-metal spring for temperature compensator
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. Carburettor 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

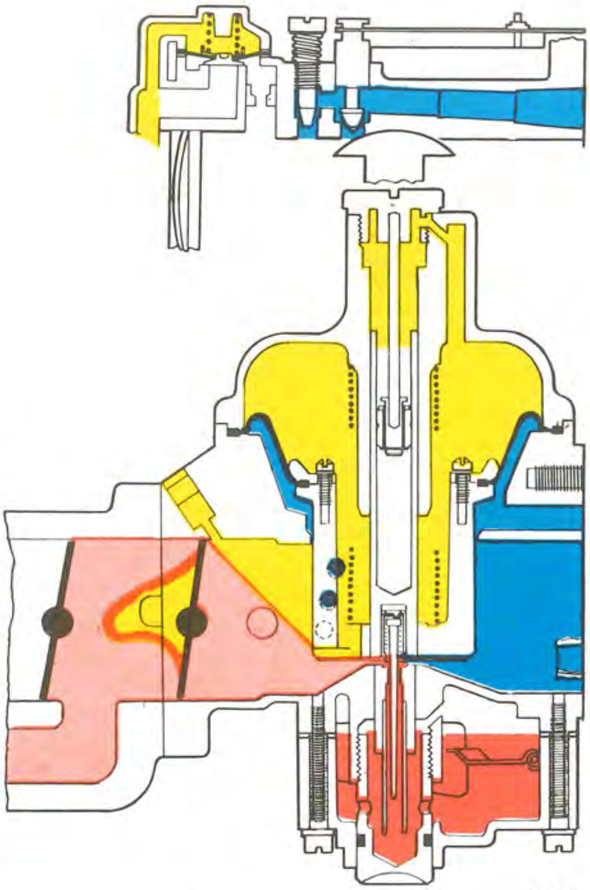


Fig. 2-63. Idling, warm engine

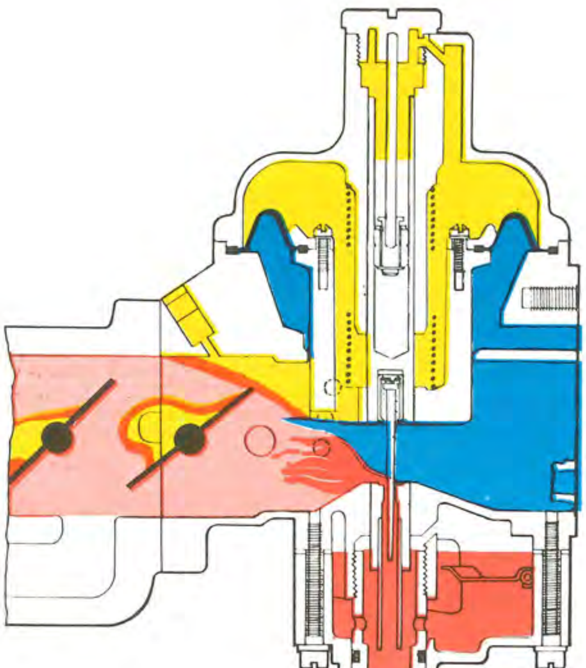


Fig. 2-64. Normal running, with open secondary throttle

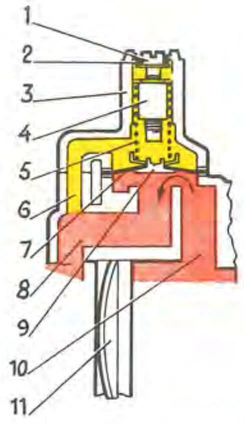


Fig. 2-65. By-pass valve

1. Adjusting screw
2. Rubber ring
3. Cover
4. Nut
5. Spring
6. Drilling to underside of diaphragm
7. Diaphragm
8. Outlet channel for fuel/air mixing
9. Valve
10. Inlet channel for fuel/air mixing
11. Primary throttle

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. 2-59) 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.

IDLING

When the engine is idling, the vacuum in the carburettor suction chamber is low and the column between the air valve and the bridge will be small (see Fig. 2-63). 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. 2-62) is regulated by a bi-metal spring (4) which influences a valves (3). When the engine is hot and the temperature in the carburettor rises, the valve opens and air is supplied to the carburettor venturi to compensate for the increase in the fuel flow, which is obtained due to the alteration in the fuel's viscosity, see Fig. 2-63. Fine adjustment of the engine idling speed can be carried out with the idle trimming screw (2, Fig. 2-62).

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 carburettor by the diaphragm. The pressure difference between the underside of the air valve, where there is pressure in the carburettor 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. 2-62), which is attached to the plunger, out of the jet. The effective choke area widens and increases the fuel flow. See Fig. 2-64.

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. 2-62) 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. 2-66.

The intake manifold is fitted with a secondary throttle

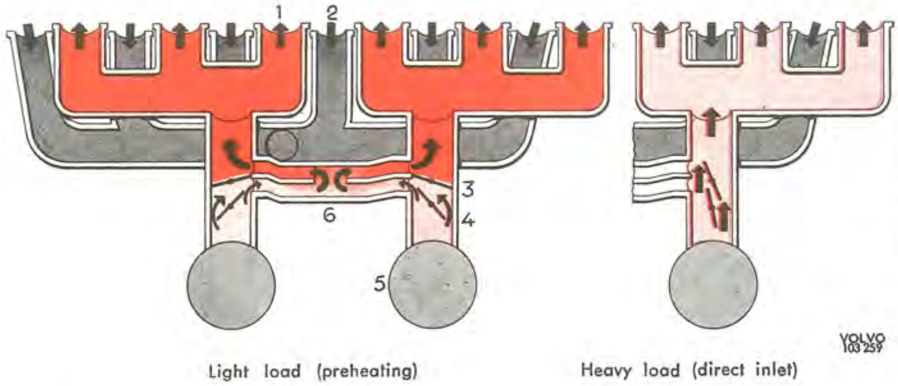


Fig. 2-66. Exhaust emission control system, principle of operation

1. Intake manifold
2. Exhaust manifold
3. Secondary throttle
5. Carburettor
4. Primary throttle
6. Preheating chamber

(3) at each carburettor. For normal driving (with low power output the throttles (3) are closed thus forcing the mixture of fuel and air from the carburettors 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 carburettors directly to the cylinders without going through the preheating chamber.

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

EVAPORATIVE CONTROL SYSTEM AND HOT START VALVE

Vehicles for the USA market are fitted with an evaporative control system which prevents fuel fumes from being released out into the atmosphere. Its function is outlined in Fig. 2-67.

Fuel fumes formed in the fuel tank, especially during warm weather, are led to the expansion tank (2) and from there to the venting filter (3) where they are absorbed by active carbon. The expansion tank is located behind the protective wallboard in the luggage compartment, se Fig. 2-71.

The venting filter (Fig. 2-69) is located in the engine compartment on the right-hand side, see Fig. 2-74.

Fuel fumes from the floatchamber (10, Fig. 2-67) are led via the valve (6) to the venting filter when the engine has been switched on or during idling. Throttling shuts off the connection between the venting filter and the float chamber so that the fumes travel via the valve to the air cleaner (Fig. 2-68).

The air valve (Fig. 2-70) controls the connection between the venting filter and the carburettor venturi. The space above the diaphragm (1) is connected by a line to the carburettor venturi on the side of the throttle facing the induction manifold, see Fig. 2-67. The vacuum in the induction manifold depends on the engine load and speed.

At high vacuum, the vacuum valve is kept closed (Fig. 2-67). When the vacuum drops the valve opens and air is drawn through the venting filter and vacuum valve to the carburettor venturi. Fuel fumes stored in

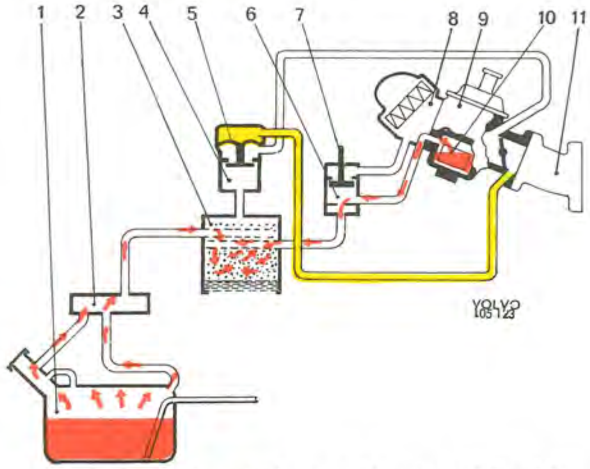


Fig. 2-67. Evaporative control system with control rod (7) at idle

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

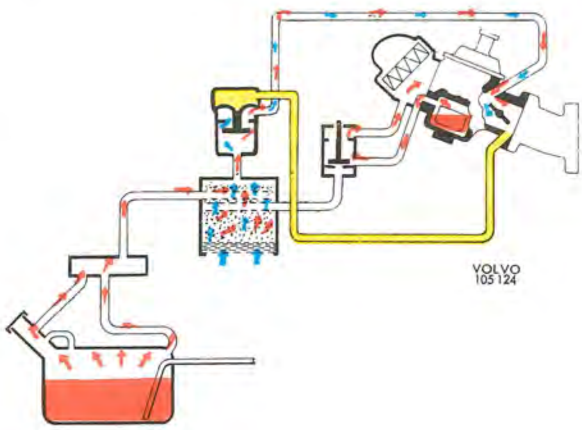


Fig. 2-68. Evaporative control system with control rod at running

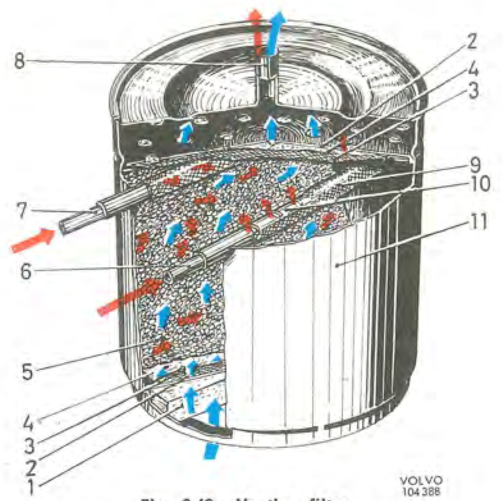


Fig. 2-69. Venting filter

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

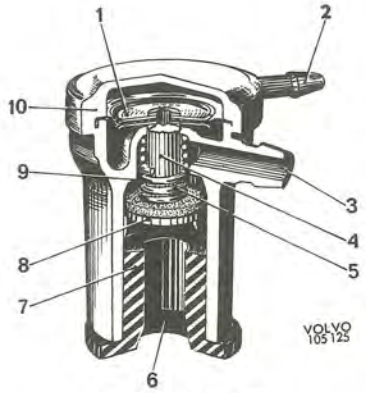


Fig. 2-70. Air valve

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

Fig. 2-71. Expansion tank

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

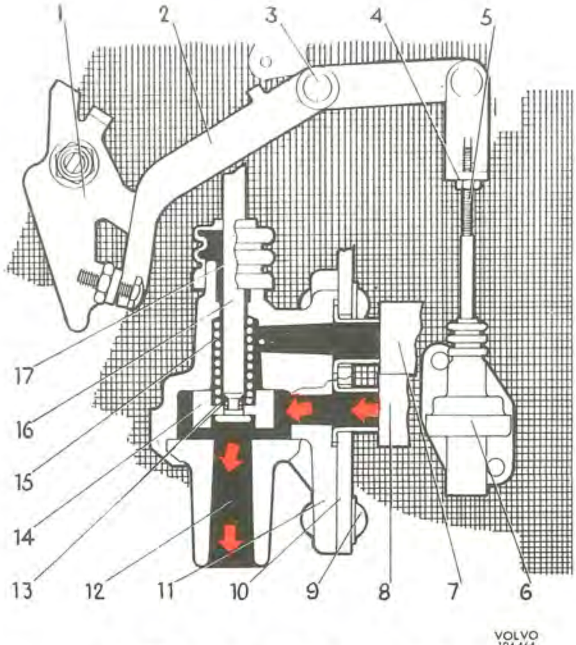


Fig. 2-72. Hot start valve, function, idling

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

the venting filter follow the air into the engine and take part in the combustion (Fig. 2-68).
The valve (6), which is known as the hot start valve, is to be found on all vehicles with twin carburettors. The difference between a valve used on a vehicle with or without an evaporative control unit is that in the latter case there is no hose connected to the

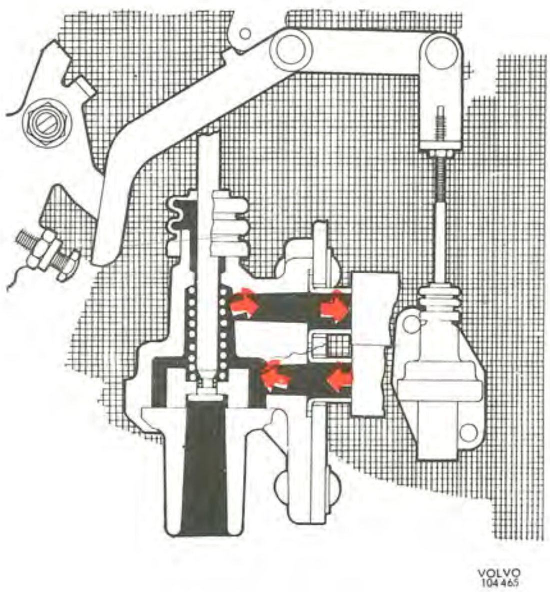


Fig. 2-73. Hot start valve, function, driving

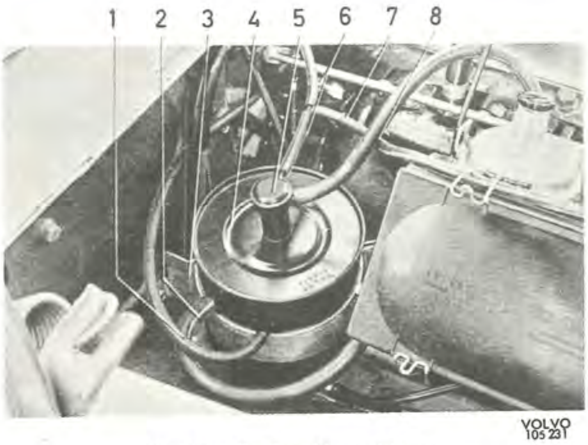


Fig. 2-74. Venting filter and hoses

1. Hose to fuel tank
2. Hose to hot start valve
3. Bracket
4. Venting filter
5. Air valve
6. Vacuum hose to air valve
7. Vacuum hose for distributor and air valve
8. Hose for fuel fumes to carburettor

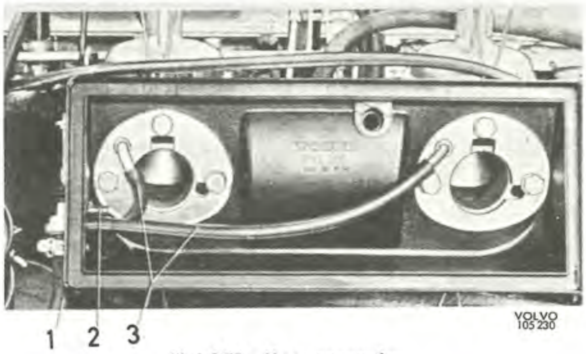


Fig. 2-75. Hose connection

1. Hose between hot start valve and venting filter
2. Outlet to air cleaner
3. Hose to carburettor floatchamber

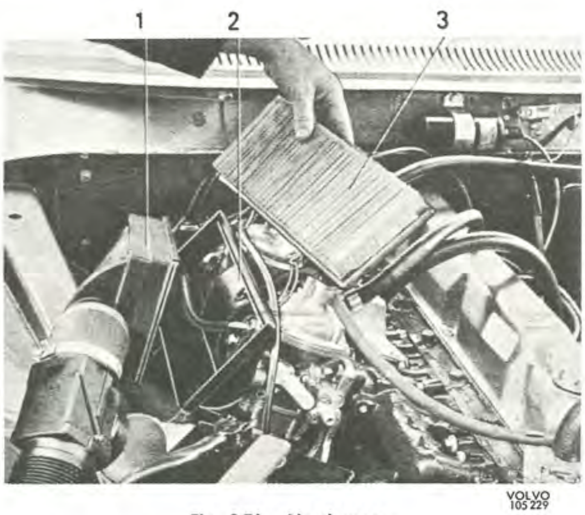


Fig. 2-76. Air cleaner

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

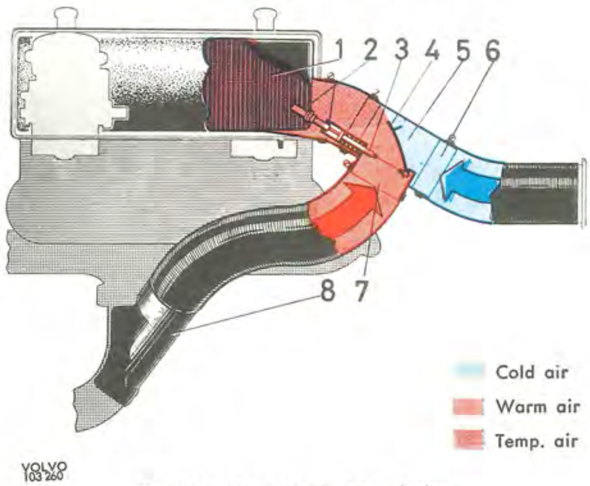


Fig. 2-77. Constant air temp. device

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

outlet (12, Fig. 2-72), and the fumes are led directly out into the atmospere when the engine is switched off or idling.

The function of the **hot start valve** is as follows:

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 the engine obtaining a somewhat "richter" 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. 2-72, 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). (On vehicles fitted with an anti-fume device, the fumes are led from the outlet (12) to the venting filter.) When the accelerator pedal is depressed (See Fig. 2-73), 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 carburettor and into the engine combustion chambers.

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

AIR CLEANER

The air cleaner (Fig. 2-76) 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 (25 000 miles), it should be discarded and replaced by a new none.

The engine is fitted with a **constant air temp. device,** see Fig. 2-77. (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) 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 carburettors is maintained at a constant temperature ($30 \pm 5°$ C $= 87 \pm 42°$ F). This arrangement eliminates the occurrence of ice forming in the carburettors. 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 (15, Fig. 2-78) and fuel is fed to the floatchamber in the carburettor. 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. A diaphragm (8) is fitted in the upper section of the housing and its purpose is to obtain a more even flow of fuel to the floatchamber. The diaphragm compresses the air in the cap (9). When the diaphragm (14) sucks fuel, the compressed air above the diaphragm (8) maintains the pressure in the line to the floatchamber.

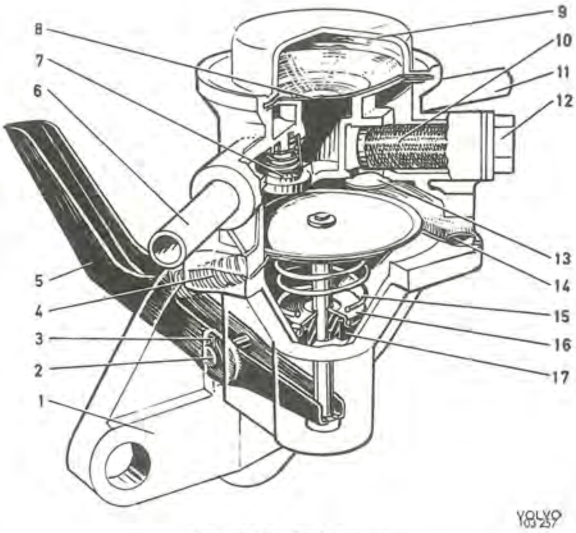


Fig. 2-78. Fuel pump

1. Lower pump housing
2. Pin
3. Circlip
4. Return spring
5. Lever
6. Outlet pipe
7. Outlet valve
8. Diaphragm
9. Cap
10. Strainer
11. Inlet pipe
12. Plug
13. Inlet valve
14. Diaphragm
15. Diaphragm spring
16. Guide
17. Rubber seal

REPAIR INSTRUCTIONS

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

PERIODICAL CHECK

Every 10 000 km (6 000 miles) check that there is oil in the damper cylinders (see, Fig. 2-80).

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 carburettor is carried out, the following should be checked and, if necessary, remedied:

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

Also check that there is no air leakage on the intake side and that the air cleaner is not blocked. To be on the safe side, check also the flap function of the constant air temperature device. (See page 2 : 41.)

The function of the throttle control and throttles should be checked as well. It should be noted here that the engine drops its idling speed, after the engine speed has been raised, somewhat more slowly than with a carburettor without a by-pass valve.

SETTING THE CARBURETTOR

The best setting of the carburettor 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" carburettor or "too lean" fuel mixture, the

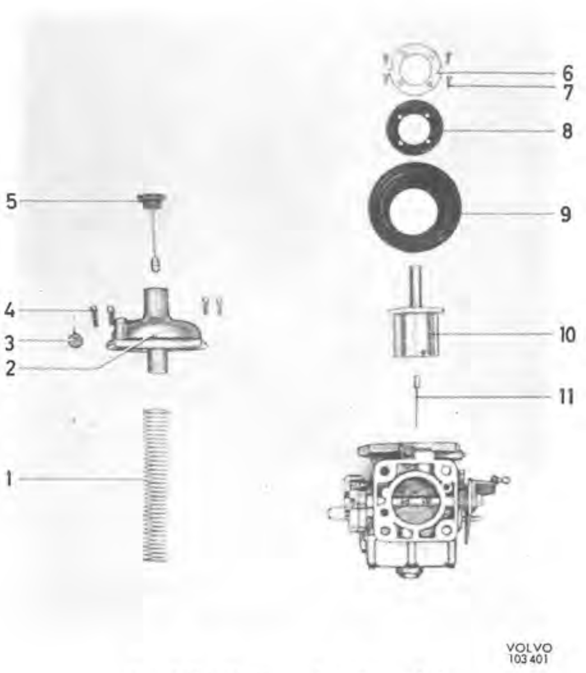


Fig. 2-79. Upper section dismantled

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

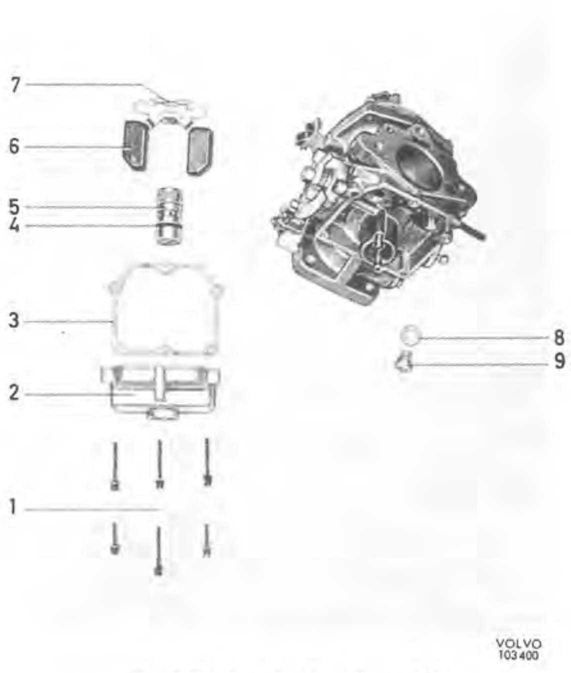


Fig. 2-81. Floatchamber dismantled

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

carburettor 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 800 rpm with the throttle stop screws (2, Fig. 2-56). The speed should be adjusted to 700 rpm for a vehicle with automatic transmission. (If the engine does not reduce its idling speed, see under the heading "By-pass valve".)

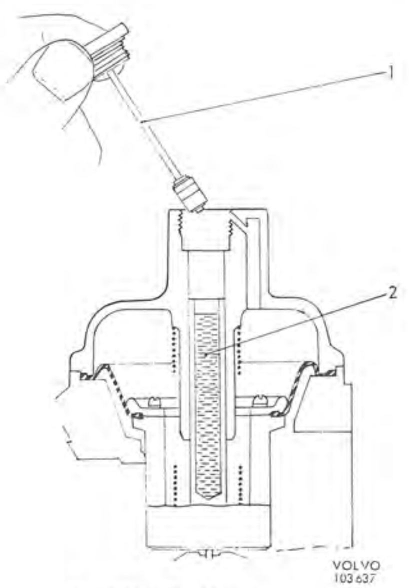


Fig. 2-80. Checking the damper

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

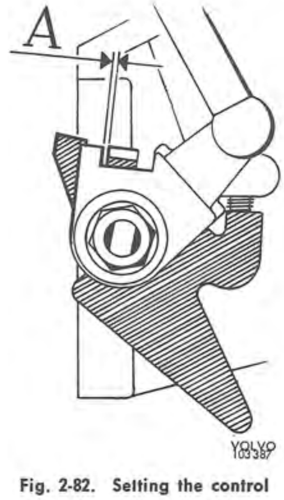


Fig. 2-82. Setting the control

A=0.1 mm (0.004")

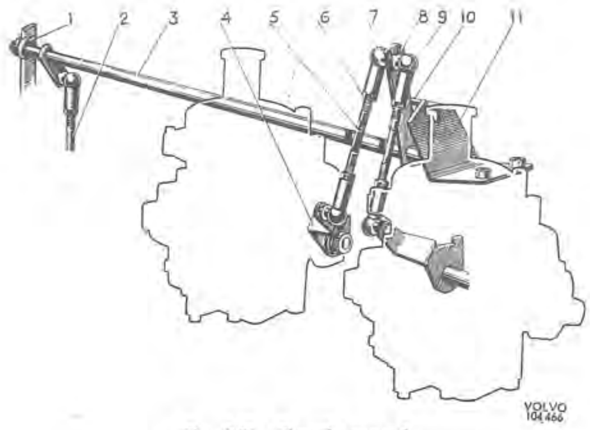


Fig. 2-83. Throttle control

1. Bush
2. Link rod for pedal
3. Control shaft
4. Lever
5. Link rod
6. Locknut
7. Ball joint
8. Lever
9. Lock wire
10. Stop for lever
11. Bracket

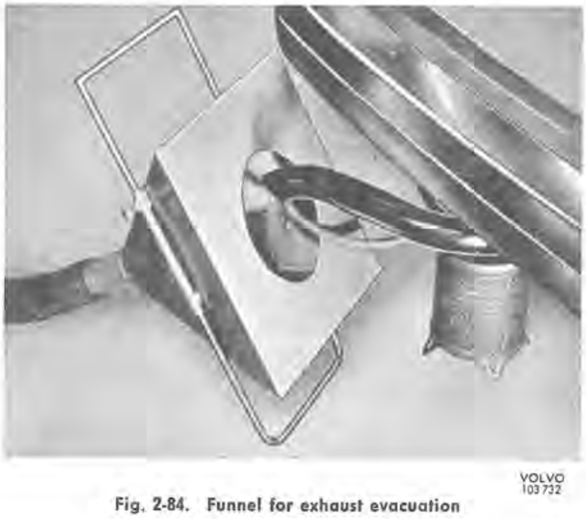


Fig. 2-84. Funnel for exhaust evacuation

N.B. Screw equally for both carburettors. Check to make sure that both carburettors have the same air valve lift. This is checked easily by simply making sure that the distance visually between the bridge of the carburettor housing and the air valve is the same for both carburettors. A more accurate synchronization is not required.

4. Adjust with the idle trimming screws 7, Fig. 2-57 from the basic setting, (they are screwed to bottom) turns so that the best idling speed is obtained. Screw equally for both carburettors.
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 primary throttle spindle flange. See Fig. 2:82.
6. Adjust so that the valve control of the hot start valve is against the carburettor lever with the valve piston in the upper position and the throttle control at idle. (See Figs. 2-72 and 2-73.)
   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 23—25 mm (almost 1") so that the mark on the rapid idle cam comes opposite the centerline of the rapid idle screw.
   Then adjust the rapid idle screw to give an engine speed of 1100—1300 rpm.

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 **carburettor 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. Racing the engine speed cools the carburettor 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 revv 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. 2-84 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.

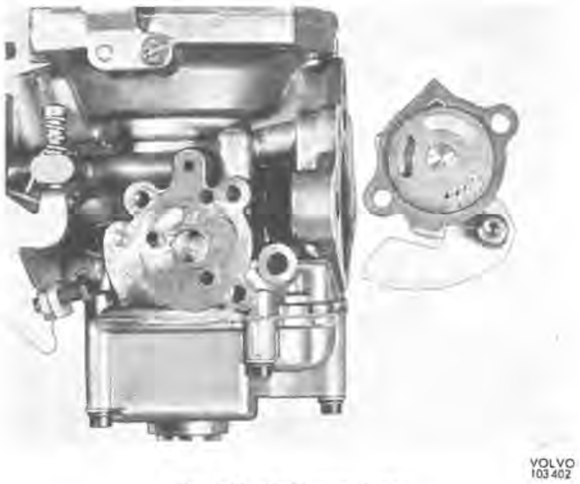


Fig. 2-85. Cold-start device

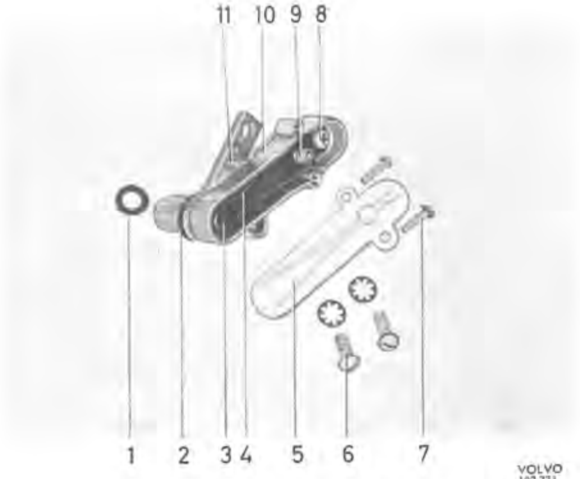


Fig. 2-86. Temperature compensator

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

1. Check that there is oil in the damper cylinders. See under "Periodical Check".
2. Connect a tachometer and run the engine warm at 1500 r.p.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 800 r.p.m. with the throttle stop screws (2, Fig. 2-56). The speed should be adjusted to 700 r.p.m. for a vehicle with automatic transmission. (If the engine does not reduce its idling speed, see under "By-pass valve".)
   N.B. Screw equally for both carburettors. Check that both carburettors have the same air valve lift. This is easily checked by measuring with the eye the distance between the carburettor house bridge and the air valve. The distance should be the same for both carburettors. 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 (7, Fig. 2-57) 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. 2-82.
6. Adjust so that the valve control of the hot-start valve is against the carburettor lever with the valve piston in the upper position and the throttle control at idle. (See Figs. 2-72 and 2-73).
   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 23—25 mm (almost 1") so that the mark on the rapid idle cam comes opposite the centerline of the rapid idle screw.
   Then adjust the rapid idle screw to give an engine speed of 1100—1300 r.p.m.

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

Temperature compensator

3. Should there be a powerful drop in the idling speed during idling for a lengthy period, especially when the weather is warm, check the function of the temperature compensator by removing the

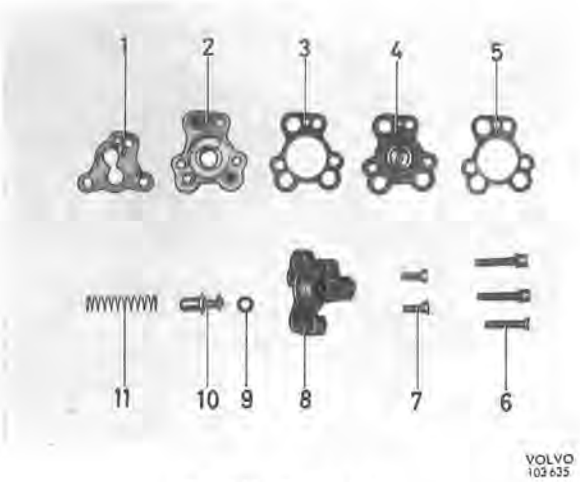


Fig. 2-87. By-pass valve

1. Gasket
2. Housing
3. Gasket
4. Diaphragm
5. Gasket
6. Screws for by-pass valve
7. Screw for cover
8. Cover
9. Rubber ring
10. Adjusting screw
11. Spring

plastic cover and pressing in the valve (3, Fig. 2-86). 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 the 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 carburettor 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.

By-pass valve (front carburettor)

4. With faulty function of the by-pass valve, or if the engine does not reduce speed at idle (first check that the throttle control is correctly adjusted) or if the valve does not open, then adjust as follows:

A **Engine does not reduce speed at idle:**
Turn the adjusting screw (5, Fig. 2-57) to the left until the engine reduces idling speed.
Check the function by running the engine briefly up to about 2 000 r.p.m. The engine should then return to idling speed. (Note that the engine will return to idle somewhat slower than is the case with a carburettor without a by-pass valve.) When correct function is obtained (that is, even the function according to B), turn the screw a further 1/2 turn to the left.

B **The valve does not open:**
Normally the air valve of the front carburettor should go down to the bridge a little after that of the rear carburettor on racing the engine speed. Turn the adjusting screw to the right until normal function is obtained. If this not possible, replace the by-pass valve complete, see under "Replacing the by-pass valve".
NOTE. When adjusting, do not press the adjusting screw inwards since the rubber ring (9, Fig. 2-87) sealing between the screw and cover can drop out of position. Check for air leakage by e.g. placing a finger over the rubber ring hole.

REMOVING THE CARBURETTORS

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

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

FITTING CARBURETTORS

Clean the gasket surface. Fit the protection plates, new gaskets and then the carburettors. 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 hotstart valve. Adjust the carburettors, see under "Setting carburettors".

Checking secondary throttles

Check to make sure that the secondary throttles are centered and can be turned without jamming. Check the location ("A", Fig. 2-88) 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").

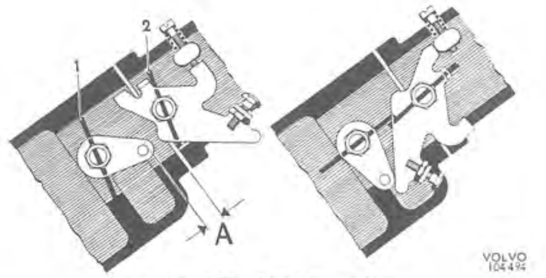


Fig. 2-88. Throttle position

Throttle position at low output — Fully open throttle

1. Secondary throttle 2. Primary throttle

"A"=2.7—4.3 mm (0.11—0.17")

Fig. 2-90. Diaphragm in air valve

CLEANING FLOATCHAMBER

The floatchamber is removed by unscrewing the floatchamber plug (5, Fig. 2-81 and the screws (1). Clean the gasket surface and fit a new rubber ring (4). Fit the floatchamber with a new gasket.

N.B. Fit the floatchamber plug before tightening the floatchamber screws.

FLOAT LEVEL

Before checking the float level, remove the carburettor, 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 carburettor 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.

N.B. Do not bend the arm between the float and the pin.

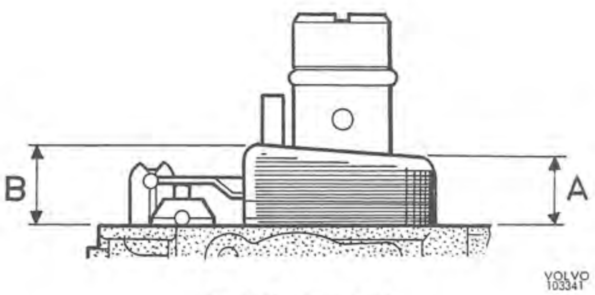


Fig. 2-89. Float level

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

REPLACING DIAPHRAGM

1. Screw out the damper piston. Make line-up marks on the suction chamber cover and carburettor 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.

   N.B. Observe due care that the metering needle is not bent or has moved from its position.
3. Fit the new diaphragm, see Fig. 2-90. 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. 2-91. Fit the cover and fill with damper oil.
5. Plug-seal the suction chamber cover.

Fig. 2-91. Diaphragm in carburettor housing

REPLACING BY-PASS VALVE

The by-pass valve is replaced complete. The valve is removed from the carburettor by screwing out the three screws (6, Fig. 2-87). Clean the gasket surface and fit the new valve with gasket (1). Carry out a function test. Note that the by-pass valve is marked y on the cover.

REPLACING TEMPERATURE COMPENSATOR

The temperature compensator is replaced complete. It is removed from the carburettor by unscrewing the screws. (6, Fig. 2-86). Take out the old seal (1) from the carburettor 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. 2-86).

REPLACING METERING NEEDLE

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

1. Remove the air valve from the carburettor 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. 2-92. Tighten the lock screw.
5. Fit the air valve in the carburettor. Plug-seal the suction chamber cover.

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. 2-93) should be 1.1—1.9 mm (0.04"—0.07") early prod. 0.05—1.1 (0.02"—0.04"). The diameter on the plunger should be 9.32—9.35 mm (0.36—0.37").

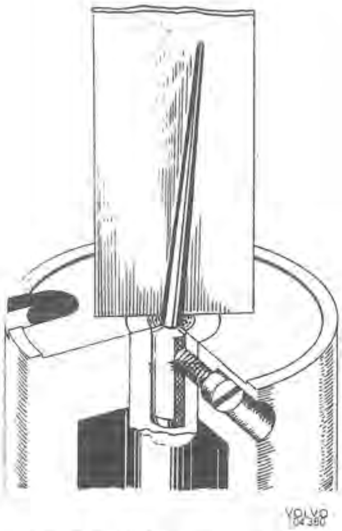


Fig. 2-92. Fitting metering needle

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. 2-73). The interval prescribed for the periodical check is 10 000 km (6 000 miles).

ADJUSTING THE ACCELERATOR PEDAL

The length of the long, vertical link for the pedal is adapted so that there is a clearance of 1 mm (0.039") between the throttle lever lug and the full throttle stop on the carburettors, when the accelerator pedal is fully depressed. With a fully depressed pedal, the force of the driver's foot is taken up by the toe-plate without imposing unnecessary loading on the throttle control.

Fig. 2-93. Damper plunger clearance

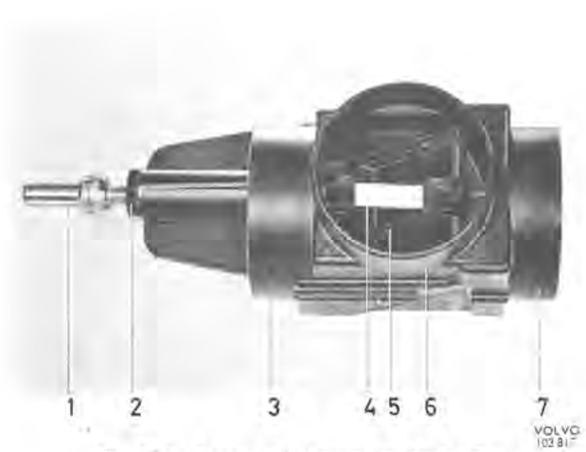


Fig. 2-94. Constant air temperature device flap

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

FLAP HOUSING FOR CONSTANT AIR TEMPERATURE DEVICE

If the flap (5, Fig. 2-94) 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 on the flap spindle projects from both sides of the housing (see 3, Fig. 2-95). 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.

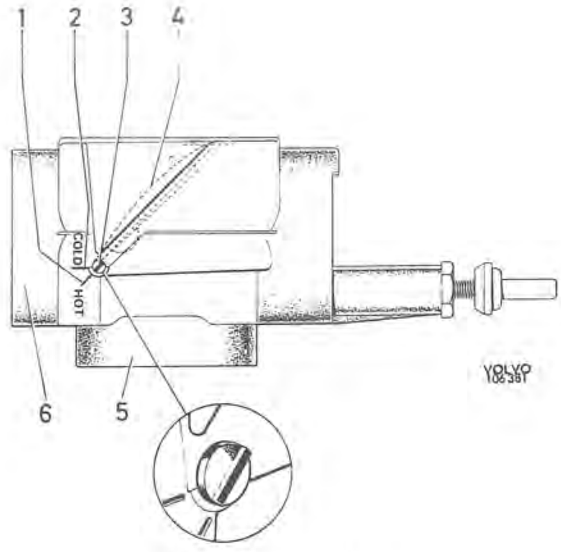


Fig. 2-95. Checking flap function

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

No cleaning of any type should be carried out between the replacements. The insert must on no condition be moistened or oiled.

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

FUEL PUMP

CLEANING THE STRAINER

When cleaning the fuel strainer, unscrew the plug (3, Fig. 2-96).

CHECKING CONDITION OF FUEL PUMP

Before removing the fuel pump, check its condition with a fuel pressure gauge. Connect a pressure gauge and run the engine until the pressure no longer rises. Stop the engine, check the pressure and compare with the values given in "Specifications". Check also the pressure drop after the engine has stopped. If the pressure drops, this is a sign that the valves leak.

REMOVING

Disconnect the connections for the fuel lines and screw off the pump.

DISASSEMBLING

1. Screw out the plug (3, Fig. 2-96) with strainer.

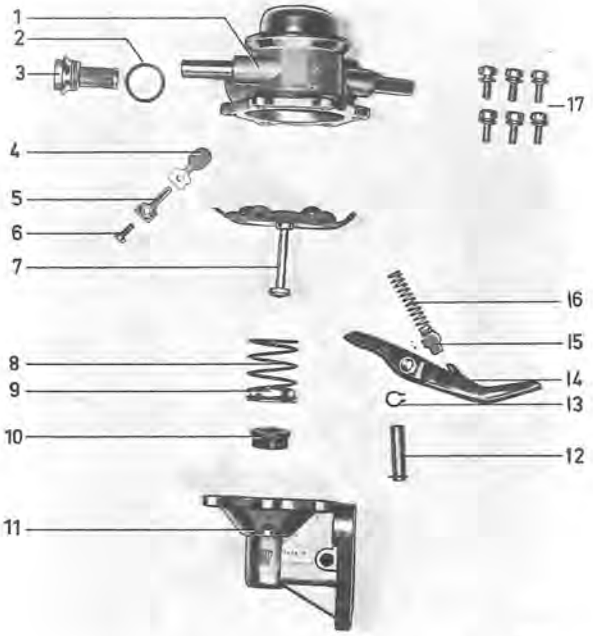


Fig. 2-96. Fuel pump, disassembled

1. Upper pump housing	10. Rubber seal
2. Sealing washer	11. Lower pump housing
3. Plug with strainer	12. Lever pin
4. Inlet valve	13. Circlip
5. Stop arm	14. Lever
6. Screw	15. Spring retainer
7. Diaphragm	16. Return spring
8. Spring	17. Screw
9. Spring guide	

2. Make line-up marks on the upper section and lower section. Screw loose the upper part from the lower part.
3. Remove a circlip (13) from the lever pin 12). Press out the pin. Pull out the lever (14) and the spring (16).
4. Remove the diaphragm with spring (8), guide (9) and rubber seal (10). Lever the rubber seal over the nylon washer and then remove the spring.
5. Screw loose the underside from the upper section, remove the stop arm and the inlet valve (4). The outlet valve cannot be removed.

INSPECTING

Check the diaphragm and gasket for leakage and the moving parts for wear. Replace damaged or worn parts.

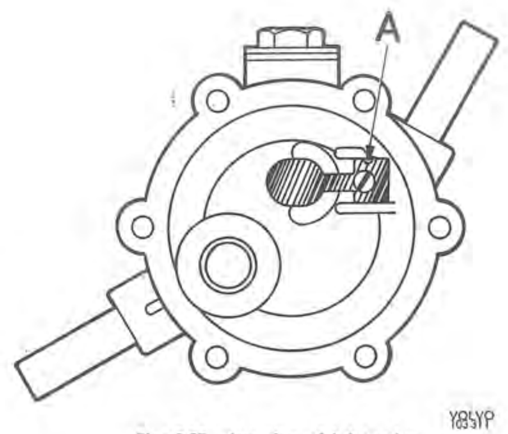


Fig. 2-97. Location of inlet valve

ASSEMBLING

1. Fit the inlet valve, see Fig. 2-97, and the stop arm. Tighten the screw, but only sufficiently so that the spring lies well against the pump body.
2. Fit the spring (8) and guide (9), see Fig. 2-96. Lever on the rubber seal (10 with the flange facing inwards towards the guide.
3. Fit the diaphragm unit in the upper section of the pump. Press downwards so that the rubber seal comes into its correct position.
4. Press down the diaphragm, move in the lever (14) make sure that it locates correctly in relation to the diaphragm rod. Fit the pin (12), circlip (13), spring retainer (15) and spring (16).
5. Fit the upper section observing the line-up marks and secure it.
6. Fit the strainer and plug.

Test the pump. When installing, make sure that the lever locates correctly above its cam.

VENTING FILTER

The foam plastic filter (1, Fig. 2-69) should be changed every 40 000 km (24 000 miles). This is done by slackening the bracket screws, lifting up the venting filter and drawing out the foam plastic filter. Fitting is in reverse order.

FUEL SYSTEM

FUEL INJECTION ENGINE

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. 2-98.

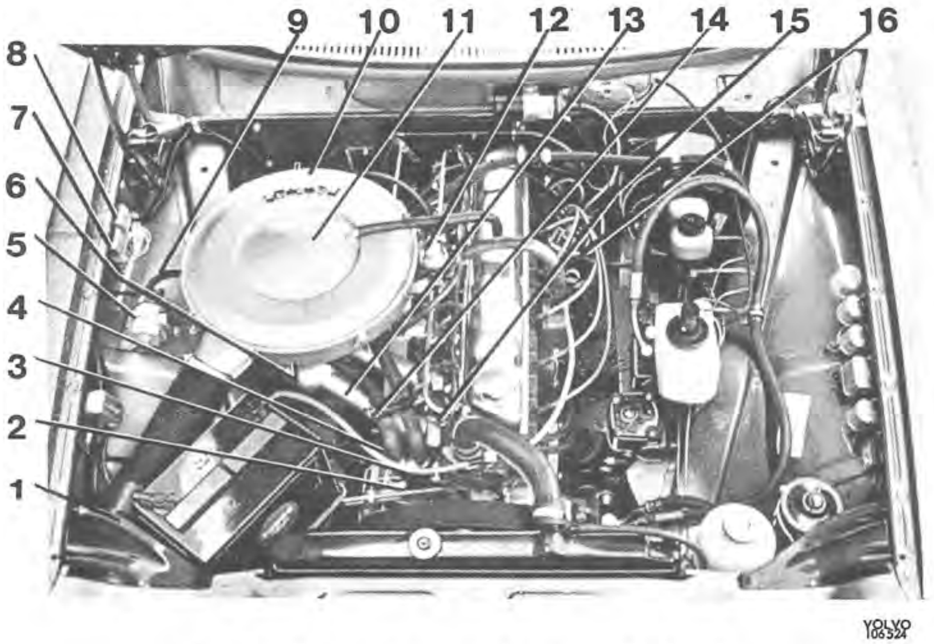


Fig. 2-98. Electronically controlled fuel injection (B 30 E and F)

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

FUNCTION

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

The pressure regulator limits the fuel pressure in the fuel line to 2 kp/cm² (28 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.

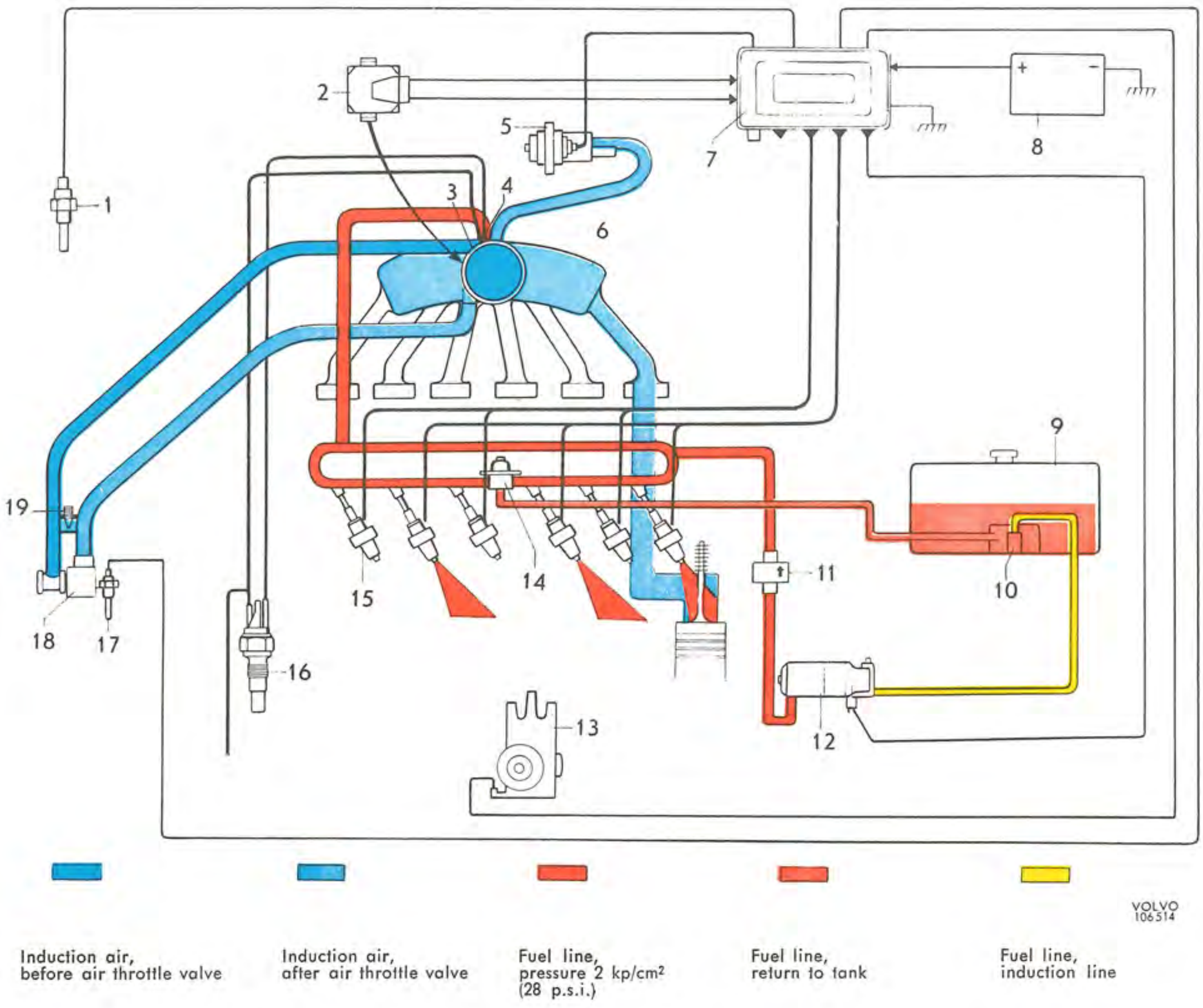


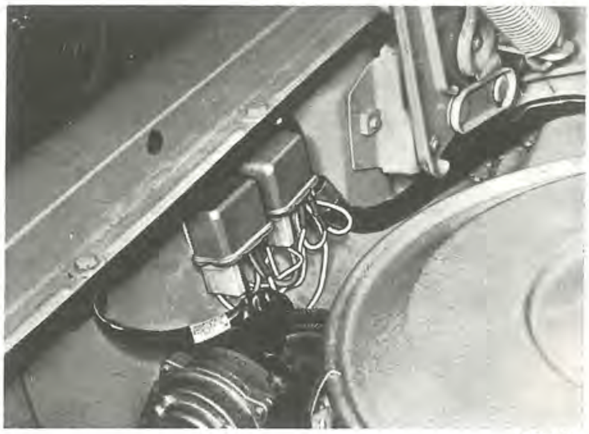
Fig. 2-99. Fuel injection system, principle of operation

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

The control unit processes this information and determines how long the injectors shall remain open in order to provide the right amount of fuel.
In addition to the basic amount of fuel, extra fuel must be supplied to the engine when starting, running warm and during acceleration. At cold start, the engine is supplied with extra fuel through the cold start valve on the inlet duct.
The opening interval for the cold start valve, which reduces with increased engine temperature, is regulated by the thermal 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 at 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. 2-100. 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



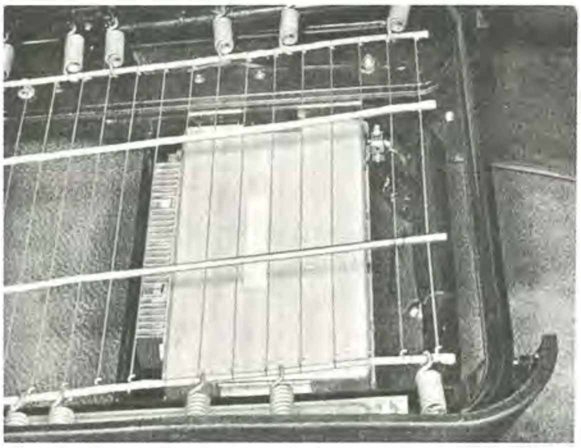
VOLVO
106535

Fig. 2-101. Control relays, installed

operating. The fuel pump is operated via a control relay (pump relay) located on the right wheel housing. The main relay, placed next to the pump relay, feeds the control unit with current.

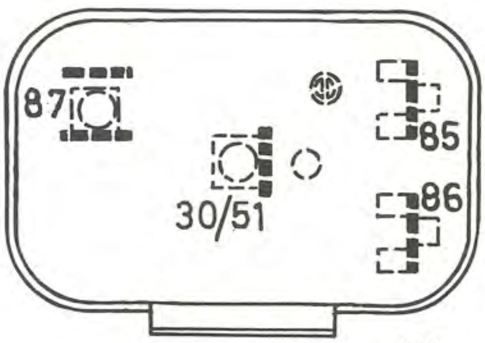
ELECTRIC FUEL PUMP

The electric fuel pump is installed under the vehicle at the right-hand side of the fuel tank, see Fig. 2-103. The pump and motor are enclosed and cannot be repaired. Fuel is sucked in at the front of the pump and discharged at the rear end. Fuel flow in the pump is provided by means of a rotor and electric brushes operating in the fuel. The pump is provided with a built-in relief valve which opens if pressure for some reason or other should exceed 4.5 kp/cm² (64 psi) (fault in pressure regulator, fuel line blockage, etc.). When this happens, fuel is pumped round in the pump without pressure being increased.



VOLVO
105 163

Fig. 2-100. Control unit, installed



VOLVO
104346

Fig. 2-102. Control relay terminals

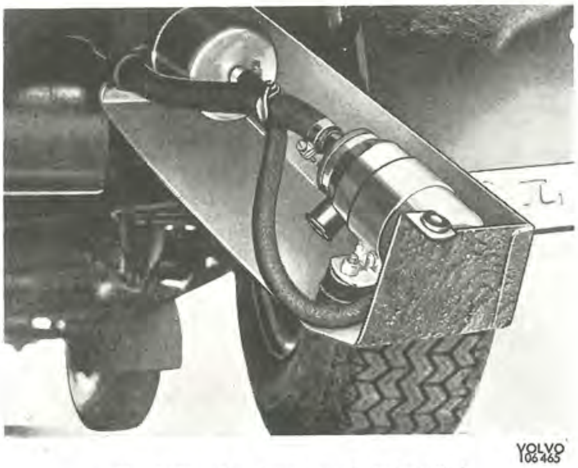


Fig. 2-103. Fuel pump and filter installed

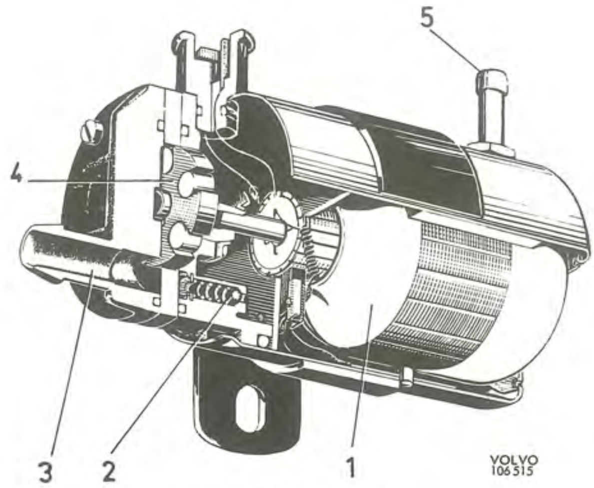


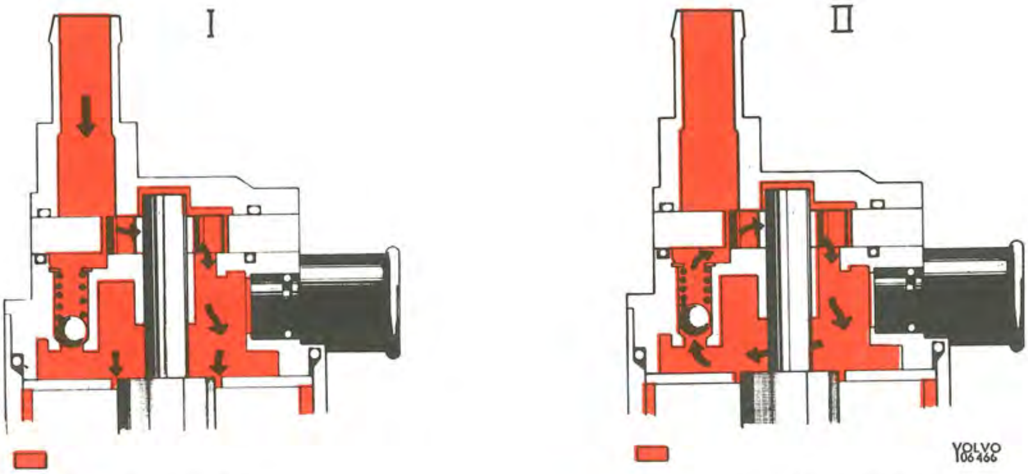
Fig. 2-104. Fuel pump

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

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 (pressure line).



2.0 kp/cm² (28 p.s.i.)

approx 4.5 kp/cm² (64 p.s.i.)

Fig. 2-105. Relief valve function

I Valve closed

II Valve open

Fig. 2-106. Fuel filter, tank

Fig. 2-108. Pressure regulator, installed

PRESSURE REGULATOR

The location of the pressure regulator is shown in Fig. 2-108. It is connected to the distribution pipe. The pressure regulator is a fully mechanical unit which regulates the pressure in the fuel lines to 2.0 kp/cm² (28 psi).

When pressure is lower than 2 kp/cm² (28 psi) the valve (1, Fig. 2-107) is closed. When the pressure exceeds 2 kp/cm² (28 psi) the valves opens and releases excess fuel into the return line to the tank.

INJECTORS

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

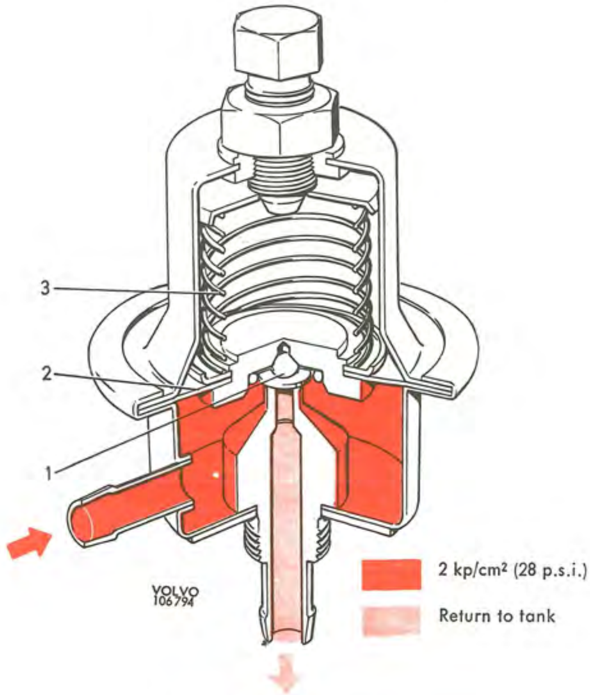


Fig. 2-107. Pressure regulator
1. Valve
2. Diaphragm
3. Spring

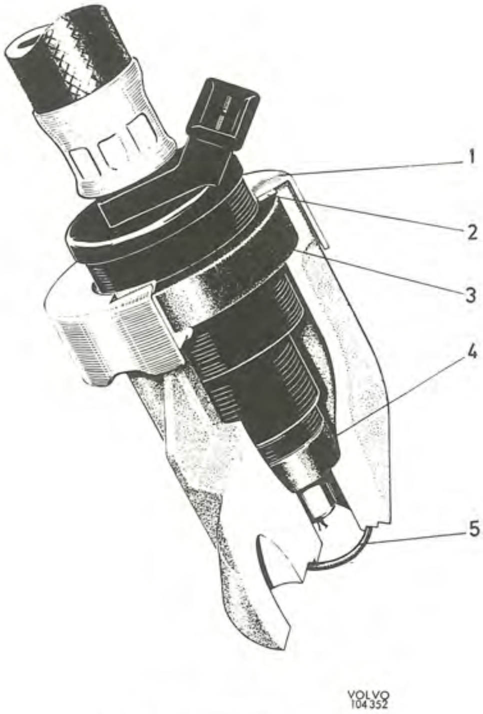


Fig. 2-109. Injector with holder
1. Lock ring
2. Steel washer
3. Rubber seal
4. Rubber seal
5. O-ring

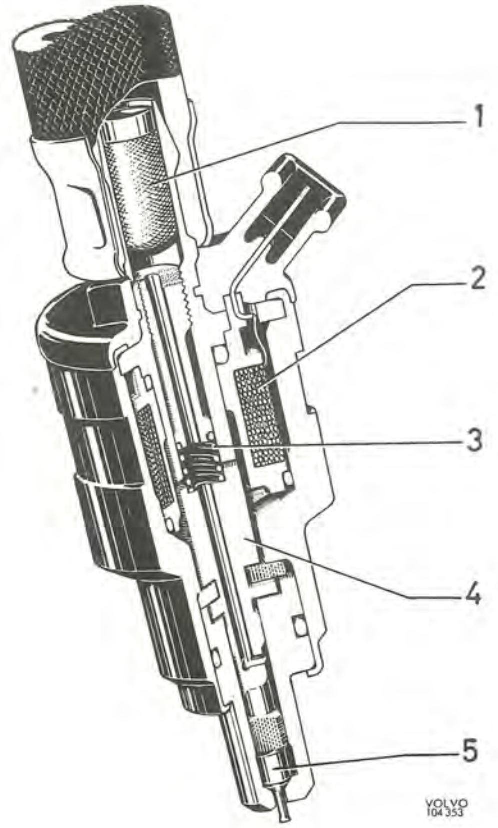


Fig. 2-110. **Injector**
1. Filter
2. Magnetic winding
3. Return spring
4. Magnetic armature
5. Sealing needle

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. 2-110. 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 (4), 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° 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 injection 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. 2-111. 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.

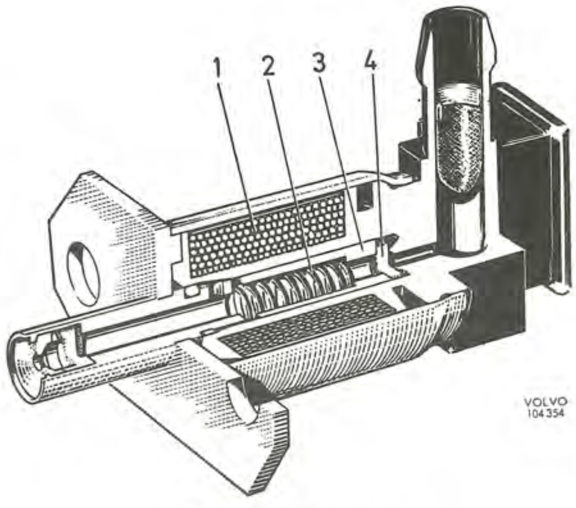


Fig. 2-111. **Cold start valve**
1. Magnetic winding
2. Return spring
3. Magnetic armature
4. Packing

Fig. 2-112. Cold start valve, installed

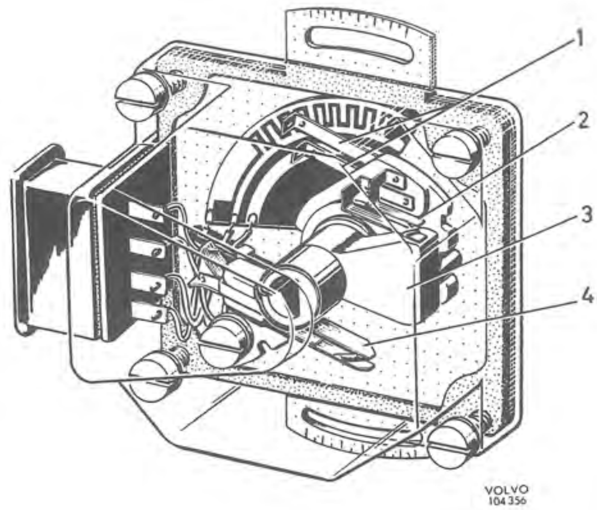


Fig. 2-114. Throttle valve switch

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

THROTTLE VALVE SWITCH

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

During acceleration, the switches (2, Fig. 2-114) 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 contacts (2) to prevent the control unit from receiving impulses for "extra fuel" when the air throttle valve is closed.

PRESSURE SENSOR

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

The pressure sensor is located on the right wheel housing and is connected to the inlet duct by means of a hose, see Fig. 2-115.

The pressure sensor, Fig. 2-116, is built into a housing of light-alloy.

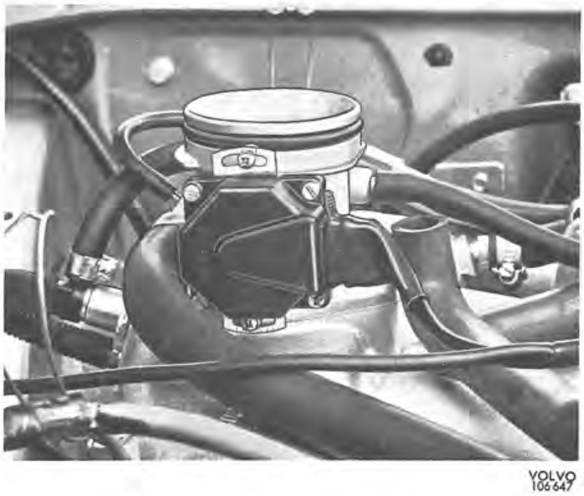


Fig. 2-113. Throttle valve switch installed

Fig. 2-115. Pressure sensor installed

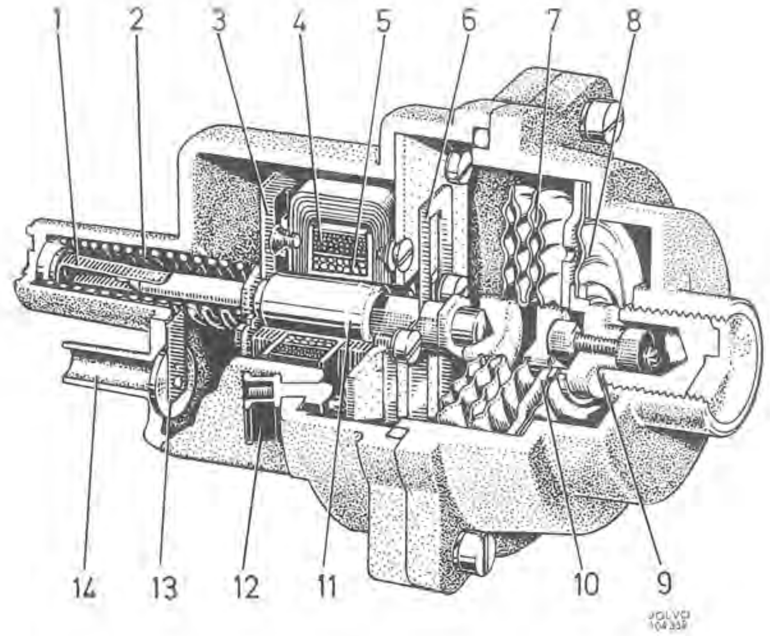


Fig. 2-116 Pressure sensor

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 and in this way permit 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. 2-117.

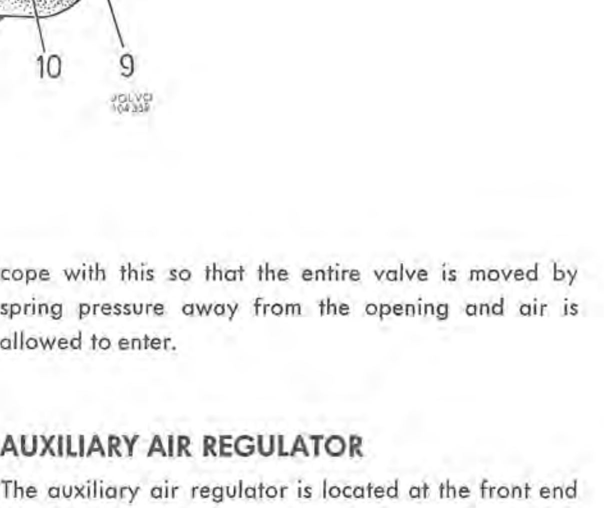


Fig. 2-117. Auxiliary air regulator

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

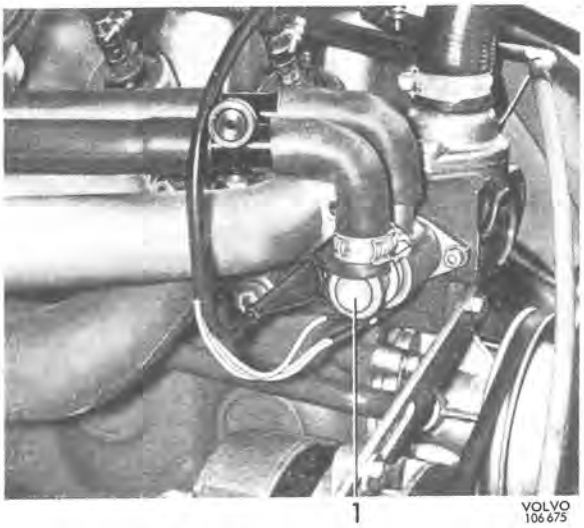


Fig. 2-118. Auxiliary air regulator (1) installed

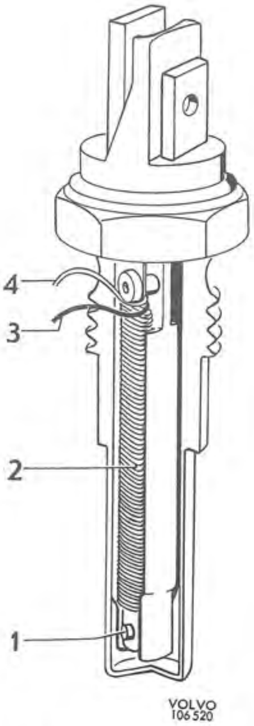


Fig. 2-120. Thermal timer

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

The regulator operating range is from —25° C (—13° F), fully open, to +60° C (140° F), fully closed. At cold start, the auxiliary air regulator opens (how much will depend on the temperature) and admits additional air into the inlet duct. Gradually as the engine heats up, the regulator element (1, Fig. 2-117) 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.

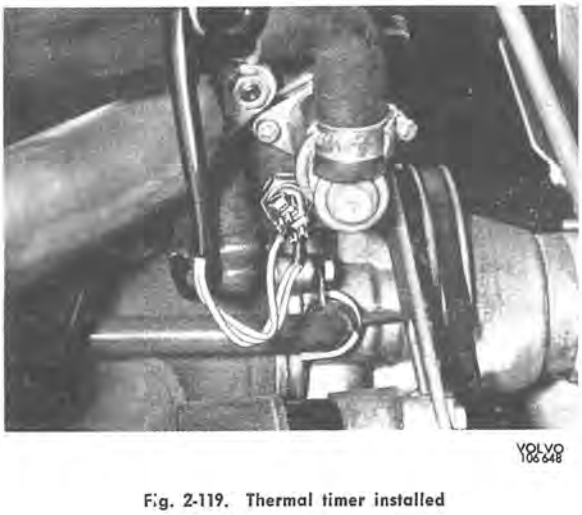


Fig. 2-119. Thermal timer installed

THERMAL TIMER

The thermal timer regulates the injection interval for the cold start valve. With a cold engine (below +35° C =95° 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 (2) and contacts (1) to ground. At the same time a current flows from the starter motor via the cable (3) 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 (4) 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. 2-121. Temperature sensor for intake air, installed

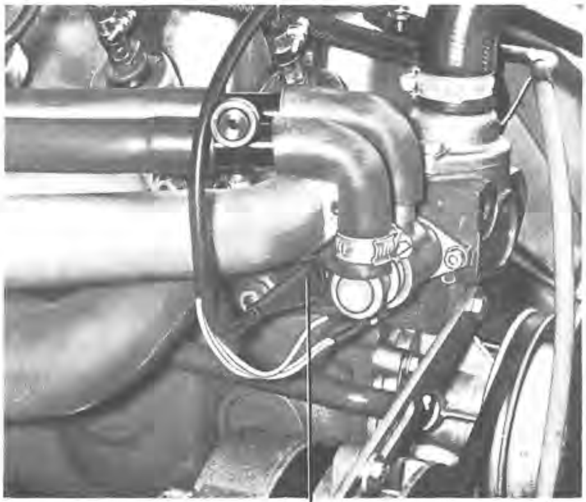


Fig. 2-122. Temperature sensor (1) for coolant, installed

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° C (86° F).

The temperature sensor for the coolant is located at the front of the cylinder head, see Fig. 2-122, and the temperature sensor for the induction air in front of the battery, see Fig. 2-121.

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

AIR CLEANER

The air cleaner is placed above the inlet duct, see Fig. 2-123, 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. 2-124.

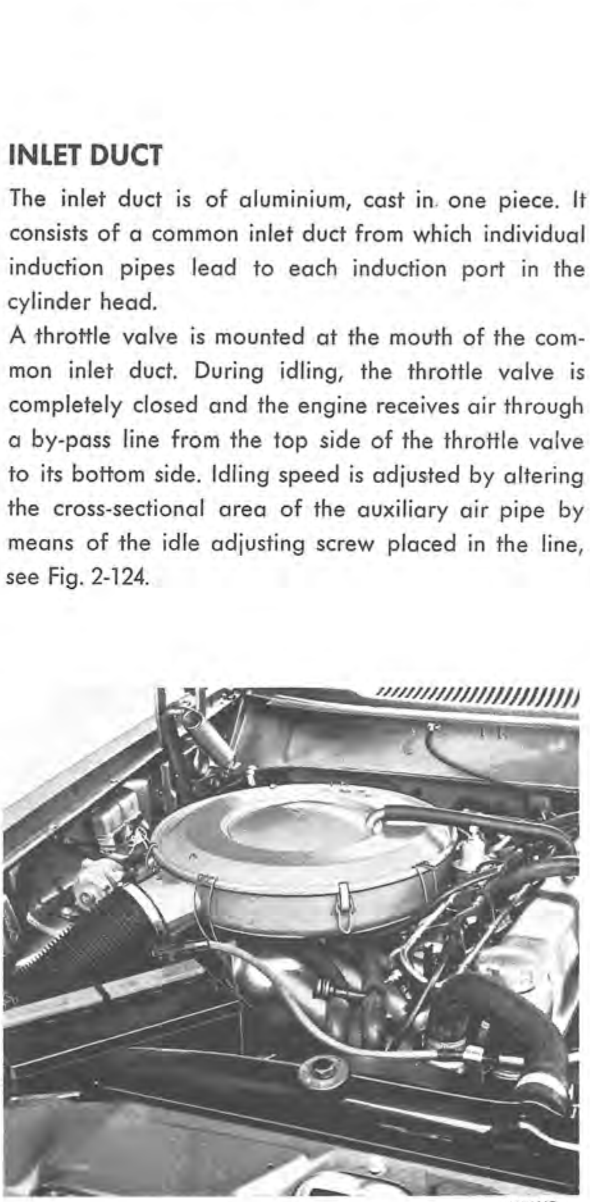


Fig. 2-123. Air cleaner, installed

Fig. 2-124. Idle adjusting screw

TRIGGERING CONTACTS

Below the centrifugal governor in the distributor there is a contact device with two triggering contacts, see Fig. 2-125.

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

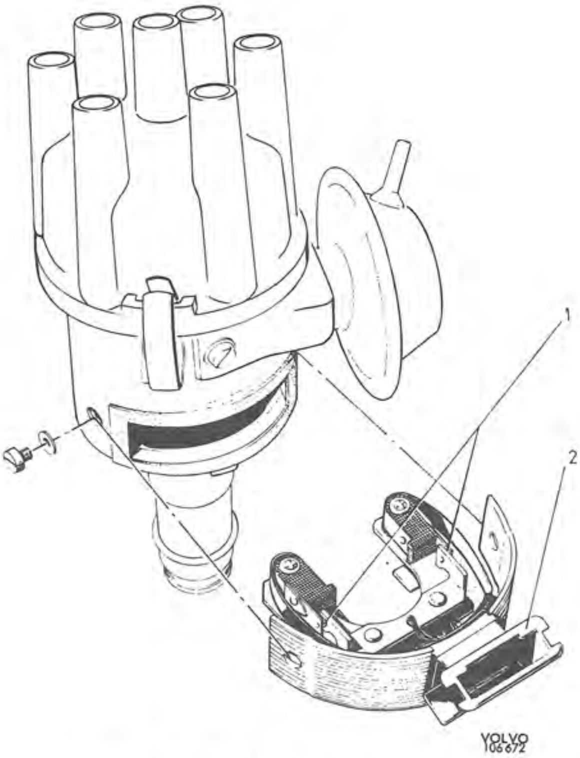


Fig. 2-125. Distributor with control device
1. Triggering contacts 2. Electrical connection

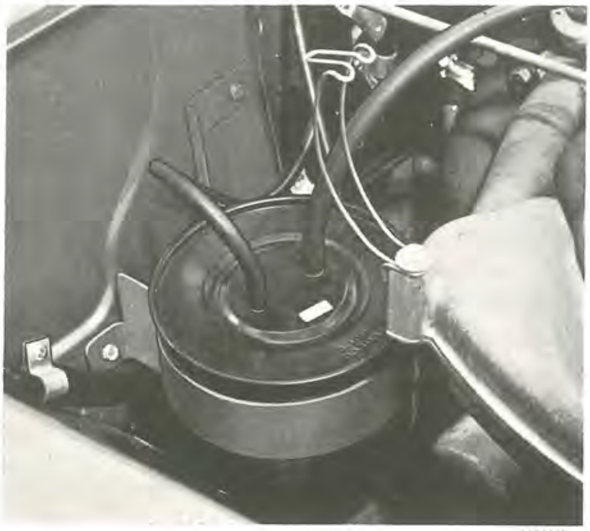


Fig. 2-126. Venting filter, fitted

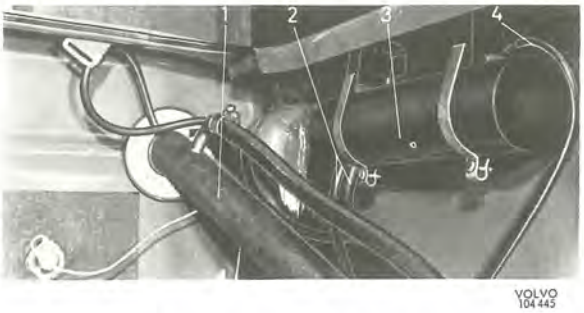


Fig. 128. Expansion container

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

GAS EVAPORATIVE CONTROL SYSTEM

Vehicles intended for the U.S.A market are fitted with a gas evaporative control system, which prevents gas fumes from being released into the atmosphere. The system consists of an expansion cannister and a venting filter, which is filled with active carbon. Also included are the connection hoses between the various components. The venting filter is located in the engine compartment on the right-hand side, see Figs. 2-126 and 2-127. The expansion container is placed behind the protective wallboard in the luggage compartment, see Fig. 2-128.

Gas fumes forming in the hermetically sealed container, particularly during warm weather, are conveyed to the expansion container (2, Fig. 2-129) and from there to the venting filter (4) where they are mixed with the active carbon.

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

The foam plastic filter at the bottom of the venting filter should be replaced after every 40 000 km (25 000 miles).

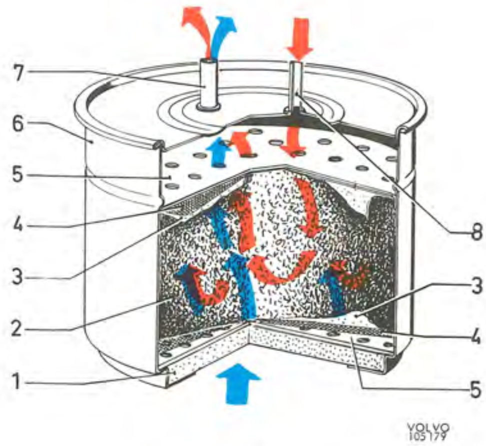


Fig. 2-127. Venting filter

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

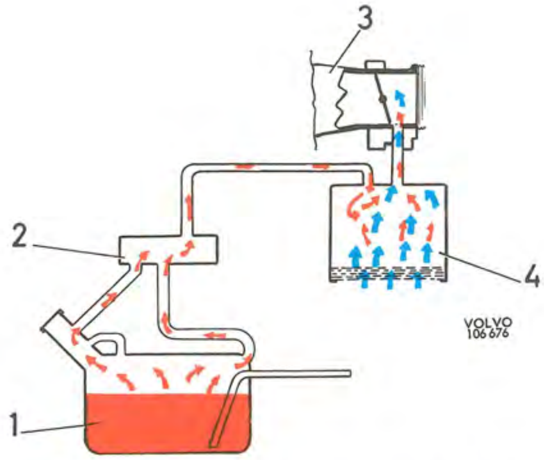


Fig. 2-129. Gas evaporative control system, principle

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

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 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 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

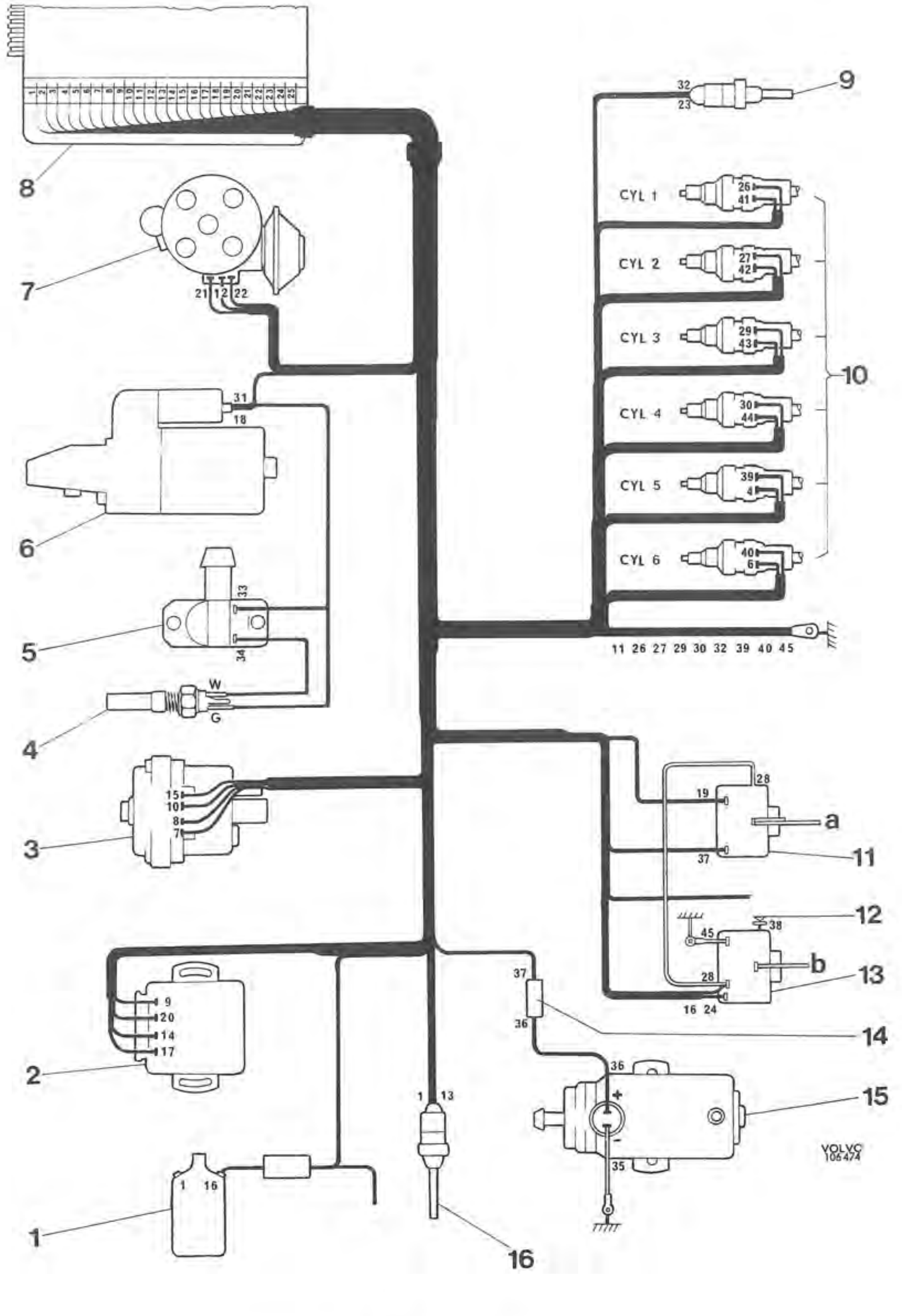


Fig. 2-130. Cable harness

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

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

SPECIAL INSTRUCTIONS FOR WORKING ON VEHICLES WITH ELECTRONIC FUEL INJECTION

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

TESTING OF INJECTION EQUIPMENT WITH BOSCH TEST INSTRUMENT EFAW 228

1. Switch off the ignition.
2. Remove control unit (see page 2 : 62).
   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.)

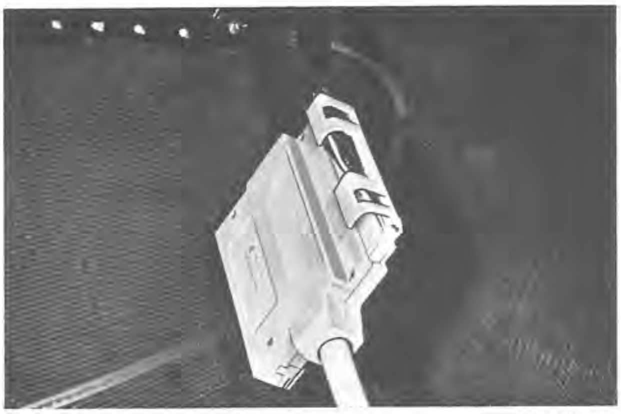


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Fig. 2-131. Test instrument connected to cable harness

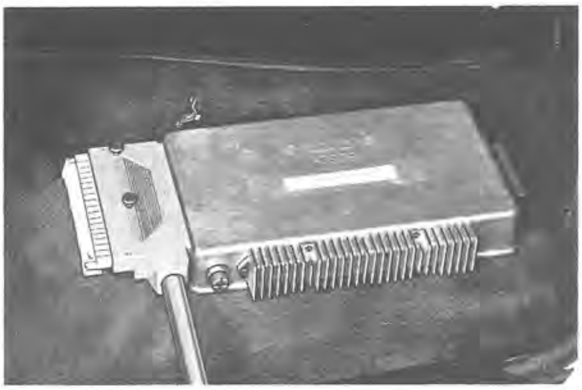

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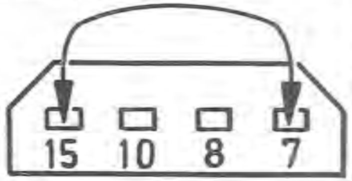
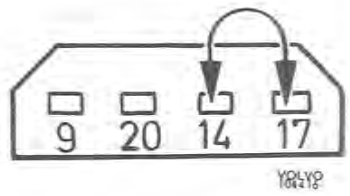
Fig. 2-132. Test instrument connected to cable harness and

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

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

Position of switch "B"	Operate	To measure	Indication (nominal value)	Deviation from nominal value. Possible faults and elimination
Throttle valve switch I	Open and close throttle valve slowly	Impulses for extra fuel during acceleration	Instrument needle swings approx. 10 times between "0" and "∞" when the throttle valve opens. (0 and "∞" Ω) The instrument needle should indicate "∞" when the throttle closes.	**Instrument needle shows "0" or swings when throttle valve closes:** Faulty throttle valve switch, replace.
Throttle valve switch II				
Throttle valve switch III	Check that throttle valve is closed	Functioning of the contacts in the throttle valve switch	0 (0 Ω)	**Resistance "∞":** Throttle valve switch incorrectly adjusted or damaged. Open circuit in cable to switch. (Pull out plug and bridge as shown in Illustration. If the epointer 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 : 66. Replace throttle valve switch if unable to be adjusted.)
Temperature sensor I (intake air)		Resistance in temperature sensor for intake air	2—5 (300 Ω at +20° C= 68° F considerably dependent on temperature. Small reading at higher temperature.)	**Resistance "∞":** Open circuit. (Pull out plug and connect terminals. If reading swing to "0", change sensor, otherwise check cables 1 and 13.) **Reading "0":** Short circuit. Pull out plug. If reading is the same, check cables 1 and 13. If reading swings to "∼", change sensor.)
Temperature sensor II (cooling liquid)		Resistance in temperature sensor for coolant	0.5—3.5 (approx. 2.5 K Ω at +20° C=68° F. Considerably dependent on temperature. Lower reading at higher temperature.)	See "Temperature sensor I". Check cables 23 and 32.

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

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

Position of switch "A"	Operate	To measure	Indication (nominal value)	Deviation from nominal value. Possible faults and elimination
Valve check	Connect pressure gauge to pressure regulator, see page 2 : 65 Press "Pump" button on the instrument	Pressure in fuel system	Nominal value 2.0—2.2 kp/cm² (28—31 psi)	**No pressure build-up (pump does not start):** Check if pump relay cuts in when "Pump" button is depressed. Relay does not cut-in: Open circuit in cable 28, from main relay terminal 87 to pump relay terminals 86, resp. cable 19 from pump relay terminal 85 to control unit. (If the cables are not damaged, change the relay.) Relay cuts-in: Open circuit in cables 27 and 36, from terminal 87 on pump relay to contact on pump or in cable 35, from contact to ground. Faulty pump. (Check cables, measure voltage at plug contact for pump. If voltage is 12 volts, change pump.) **Pressure above or below 2 kp/cm² (28 psi):** Pressure regulator incorrectly adjusted or damaged. (Adjust or change regulator.)
	NOTE. The following controll should only be made when it is ascertained that there is a fault in one of the injectors. Remove the injectors, see page 2 : 65 Press in "Pump" button on the instrument and check the injectors for leakage.	Function and leakage of the injectors		The valve opening may be wet, but the injector must not leak more than 5 drops per minute at 2 kp/cm² (28 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. 2-132. 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 2000 rpm 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 fault, test with a new pressure sensor. If the engine still does not function, test with a new control unit.

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Fig. 2-133. Seat folded back

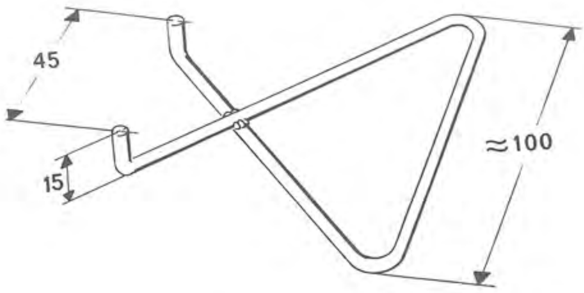

Fig. 2-135. Puller for plug contact
Material: 2 mm (5/64") welding wire

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 told 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 aback the seat and move it to the rear stop position.
4. Bolt the seat securely between the tubular bend and link screw.

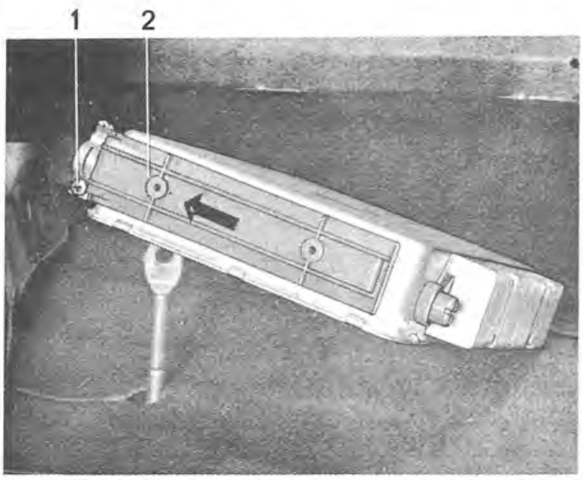

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Fig. 2-134. Removing plastic cover
1. Cap screw
2. Plastic cover

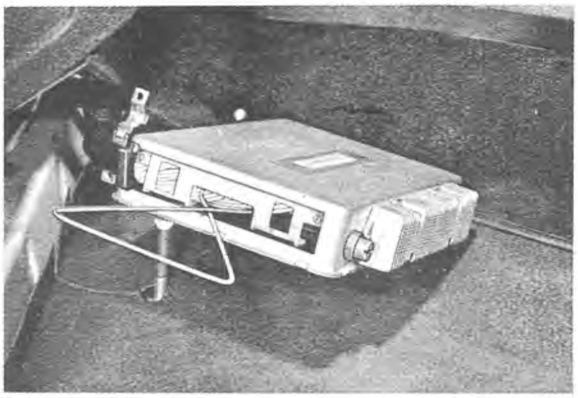

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Fig. 2-136. Removing plug contact

FUEL PUMP

REPLACING

1. Remove the plug contact and bracket on which pump and filter are mounted.
2. Remove the plastic clamp holding the hoses together and clean round the pump's hose connections.
3. Pinch the fuel hoses to the pump with pinchers SVO 2902. Slacken the hose clamps and release the hoses.
4. Remove the screws holding the pump and take down the pump.
5. Install the new pump.
6. Connect the hoses to the pump and remove the pinchers.
7. Place the plastic clamp round the hoses and fit the bracket in position and secure it with the screws.
8. Connect the plug contact and check that the pump is functioning and that the hose connections do not leak.

CHECKING

The pump should deliver 100 litres/h (22 Imp. gals. = 26.4 US gas./h) at a pressure of 2 kp/cm^2 (28 psi). At this oad, current consumption shoud be 5 amps.
NOTE. The pump is pole-sensitive. Observe due care when testing a disconnected pump.

FUEL FILTER

REPLACING (Every 20 000 km = 12 000 miles)

1. Remove the plug contact for the fuel pump and release and take down the bracket on which the pump and filter are mounted.
2. Remove the plastic clamp holding the hoses together and clean round the filter's hose connections.
3. Slacken the hose clamps and remove the filter.
4. Install the new filter. Tighten the hose clamps.
   NOTE. Make sure that the new filter is installed with the arrow pointing in the direction the fuel flows. Also make sure that no dirt enters the connections for the filter.
5. Check there is no leakage at the hose connections.
6. Place the plastic clamp round the hoses and mount the bracket in position.
7. Connect the plug contact to the fuel pump.

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.


VOLVO 106529

Fig. 2-137. Removing fuel pump


VOLVO 106530

Fig. 2-138. Removing fuel filter

VOLVO 106 646

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 2.0 kp/cm^2 (28 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.

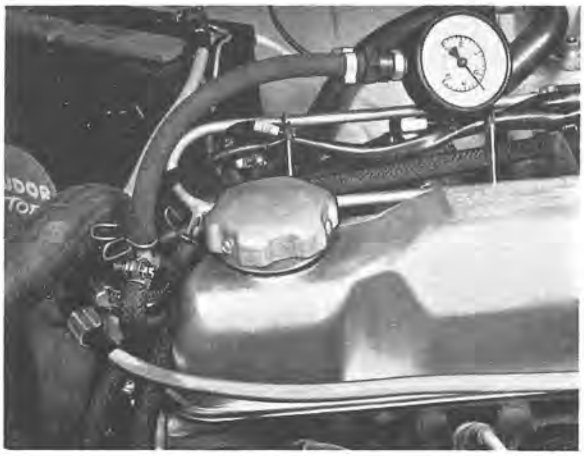
INJECTORS

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.

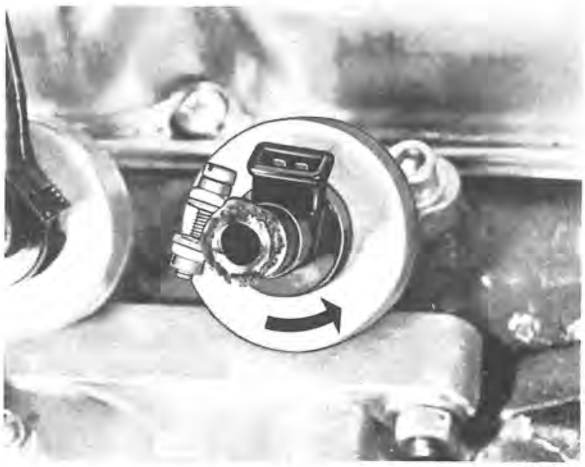
CHECKING

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 kp/cm^2 (28 psi).



VOLVO 106 532

Fig. 2-140. Connecting pressure gauge



VOLVO 106 793

Fig. 2-141. Removing injector

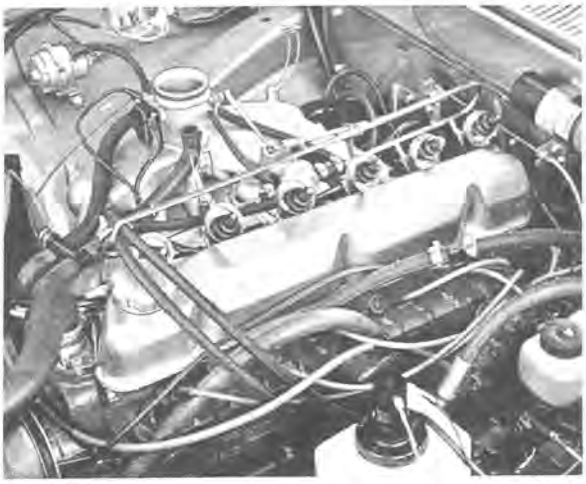


Fig. 142. Injectors removed for checking

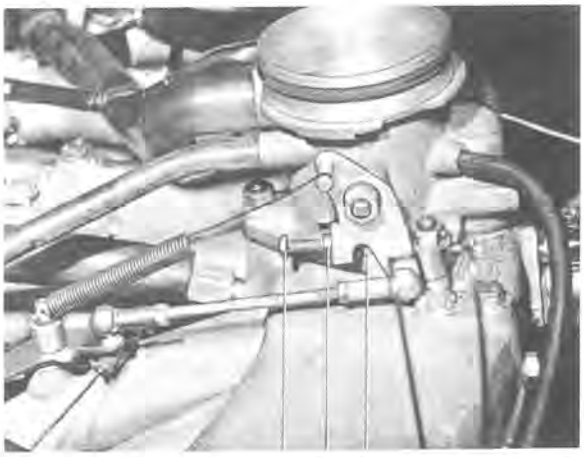


Fig. 2-143. Stop screw for throttle valve
1. Stop screw
2. Locknut
3. Stop on valve spindle

COLD START VALVE

REPLACING

1. Remove the air cleaner.
2. Apply pinchers (SVO 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. Thern screw it in 1/4—1/3 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".

   N.B. The stop screw must **not** be used for idle adjusting.

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 : 61.
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 sound 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.

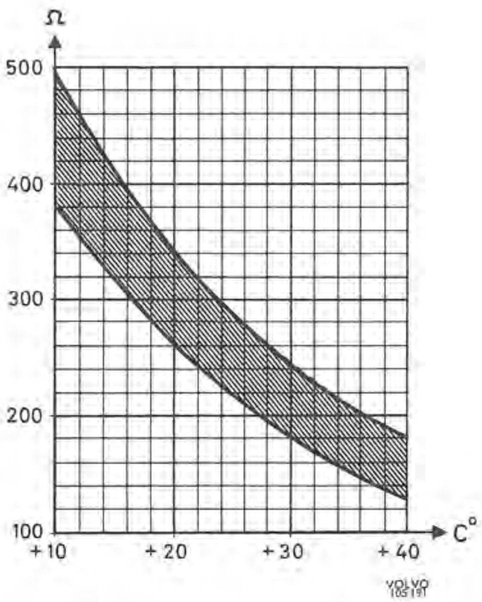


Fig. 2-144. Resistance in temperature sensor for induction air

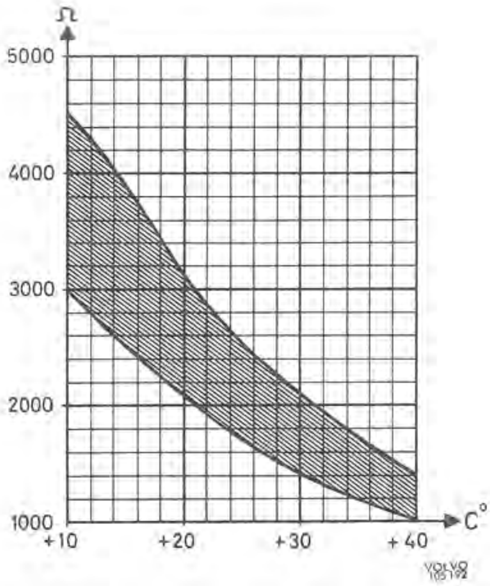


Fig. 2-145. Resistance in temperature sensor for coolant

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 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 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 700—800 rpm.
4. Set the firing to 10° BTDC. (When adjusting, diconnect 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.

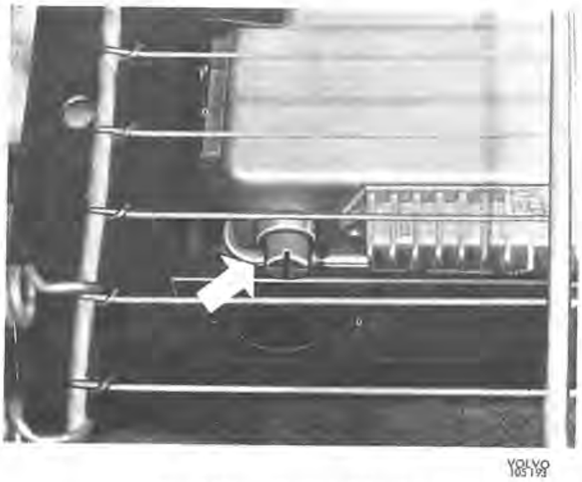


Fig. 2-146. Adjusting CO-value

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.
3. Adjust the idling speed to 900 rpm (for vehicles with automatic transmission, 800 rpm) by means of the throttle stop screw. (If the speed cannot be lowered sufficiently, check the basic setting of the throttle valve, see page 2 : 65.)
4. Fit the hoose 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.

COOLING SYSTEM

DESCRIPTION

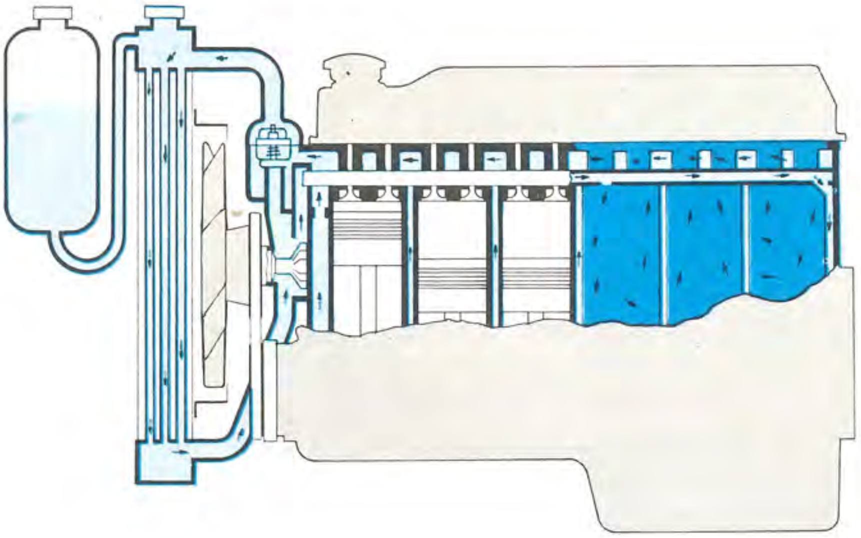


Fig. 2-147. Sealed cooling system

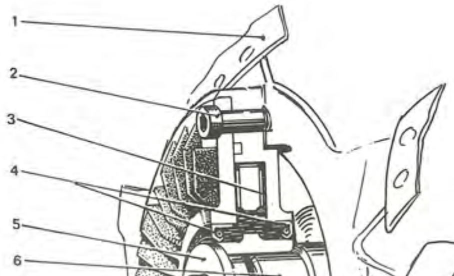


Fig. 2-148. Fan coupling

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. 2-147. 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. 2-148), 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. 2-98. The six fan blades are mounted asymmetrically to keep down the noise level. The fan coupling consists of the casing (11, Fig. 2-148) 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 3500 r.p.m., the slipping

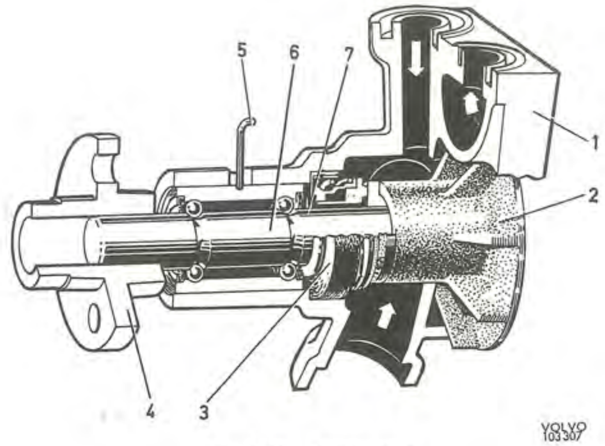


Fig. 2-149. Water pump

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

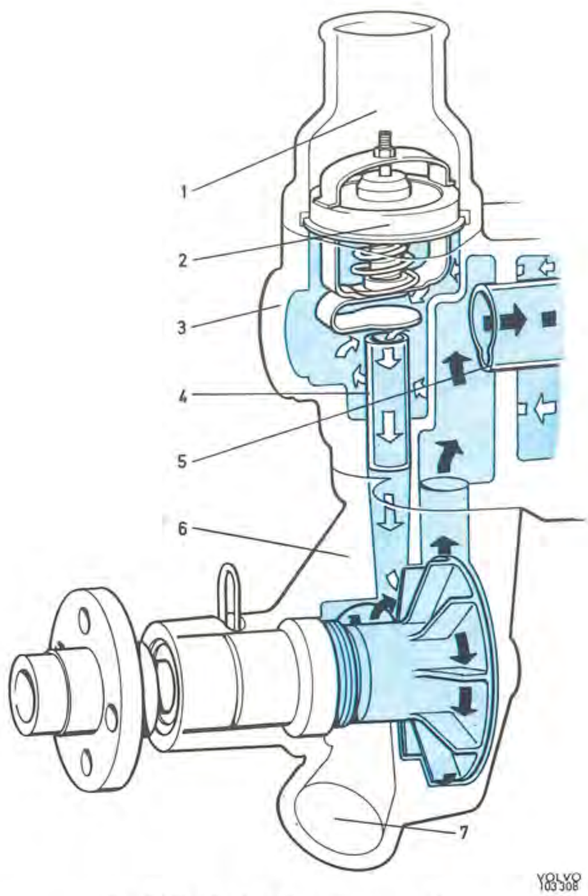


Fig. 2-150. Coolant flow, thermostat closed

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

increases (see Fig. 2-151). With this arrangement, the fan speed should never exceed about 2500 r.p.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. 2-149, 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-frost for cars is used (it is red in colour), it should not be mixed with other types of anti-frost.

COOLING SYSTEM INNER CIRCUIT (BY-PASS)

The cooling system consists of two circuits, an inner and an outer one. When the engine is warming up and in very cold weather when large quantities of heat are required for warming up the inside of the car, the coolant circulates almost exclusively through the inner circuit (the by-pass). This circuit covers the engine and car heater. The thermostat is closed, that is, the outlet to the radiator is shut off. The coolant passes through the thermostat by-pass to the distributing pipe (5, Fig. 2-150) in the cylinder head. This results in a uniform cooling of the warmest parts in the cylinder head. Even the parts around the sparking 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. 2-151.

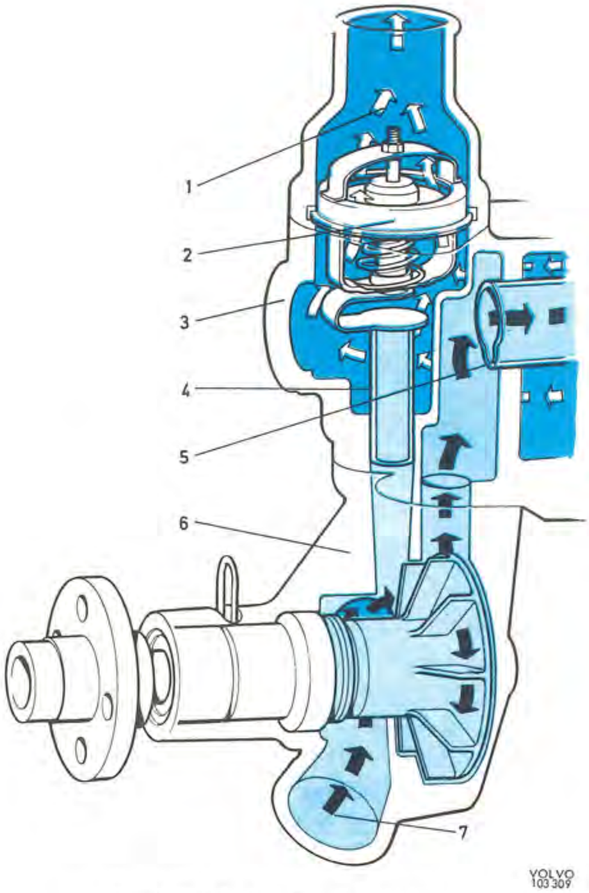


Fig. 2-151. Coolant flow, thermostat open

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 open 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.

N.B. Never top up with water only.

DRAINING THE 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: Remove the radiator cap and make sure that the filling hole and sealing surface are clean. Connect a cooling system pressure tester to the filling hole.

Make a connection for the tester by drilling a hole in a radiator cap, soldering a pipe to the cap and connecting a hoze between the tester and cap.

Carefully pump the pressure up to almost 0.7 kg/cm^2 (10 p.s.i.). Observe the pressure tester gauge. The pressure must not drop noticeably during 30 seconds. If it does, examine and remedy the leakage.

Fig. 2-152. 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 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 that the sealing rings on the upper side of the pump locate correctly. Also press the pump upwards against the cylinder head extension under the bolting, so that the sealing between the pump and cylinder head will be satisfactory. Make sure that the sealing rings at the water pipes are not damaged and press in the pipes thoroughly when attaching.

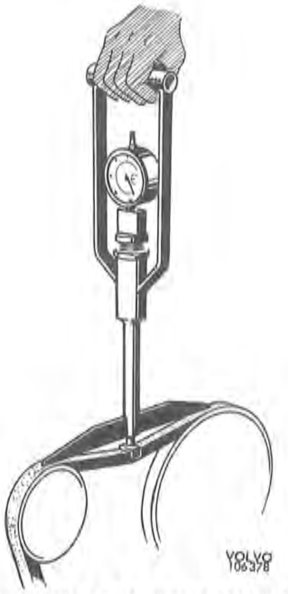


Fig. 2-153. Belt tensioner SVO 2906

TENSIONING THE PULLEY BELT

Belt tensioner SVO 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 of the gauge. Fig. 2-154 shows the correct values.

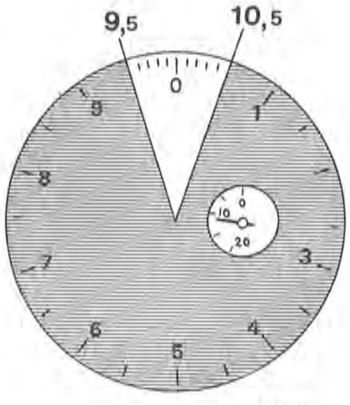


Fig. 2-154. Belt tensioning gauge values

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.

N.B. 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.

Fan belt tensioning:

with SVO 2906			F kp (lb)
A	B	C	
9.5—10.5	8.1—8.6	11.5	7.5—11.0 (16.5—24)

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

B = With belt in outer position (stretched belt)

C = Value when fitting new belt

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

WITHOUT SVO 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. 2-155.

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

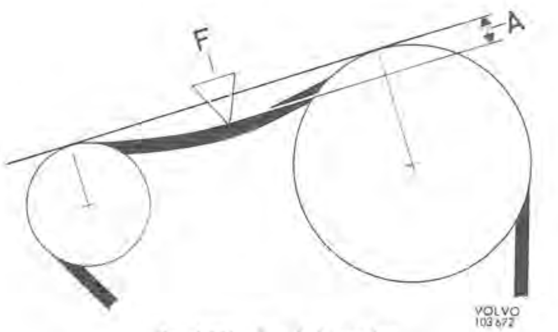


Fig. 2-155. Fan belt tension
F=7.5—11.0 kp (16.5—24 lb)

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. 2-156.

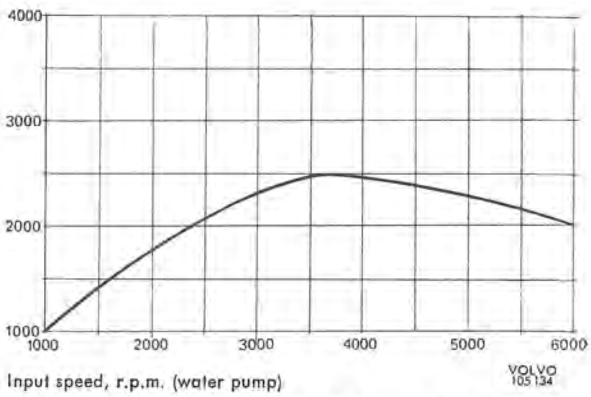


Fig. 2-156. Curve for fan coupling slip

1. Valve guide
2. Valve spring
3. Air preheating flap
4. Valve guide seal
5. Valve collet
6. Intake valve
7. By-pass valve
8. Temperature compensator
9. Exhaust valve
10. Secondary throttle
11. Front carburettor
12. Air cleaner
13. Manifold pipe
14. Bracket
15. Hose for fresh air supply
16. Nipple
17. Fuel hose
18. Carburettor control
19. Hose for crankcase gases
20. Rear carburettor
21. Cylinder head gasket
22. Rocker arm shaft
23. Spring
24. Vacuum hose for ignition distributor
25. Flame protector
26. Adjusting device
27. Rocker arm
28. Bearing bracket
29. Push rod
30. Cable terminal
31. Rubber seal
32. Rubber seal
33. Choke wire
34. Vacuum hose for negative vacuum adjustment
35. Rocker arm casing
36. Ignition cable to ignition coil
37. Cylinder head
38. Distributor
39. Oil dipstick
40. Vacuum governor
41. Valve tappet
42. Retainer
43. Cylinder block
44. Gear wheel
45. Bush
46. Rubber lip seal
47. Flywheel
48. Sealing flange
49. Main bearing bolt
50. Delivery pipe
51. Cover plate
52. Oil pump
53. Sump
54. Cap
55. Connecting rod
56. Splash plate
57. Main bearing
58. Bush
59. Gudgeon pin
60. Circlip
61. Camshaft
62. Piston
63. Piston rings
64. Crankshaft
65. Thrust washer
66. Spacer ring
67. Camshaft gear
68. Nut
69. Seal
70. Crankshaft gear
71. Rubber lip seal
72. Polygon hub
73. Washer
74. Pulley
75. Flywheel damper
76. Fan belt
77. Coolant pipe
78. Fan blade
79. Pulley
80. Flange
81. Washer
82. Center bolt
83. Fan coupling
84. Water pump
85. Alternator
86. Tensioner
87. Water distribution pipe
88. Thermostat

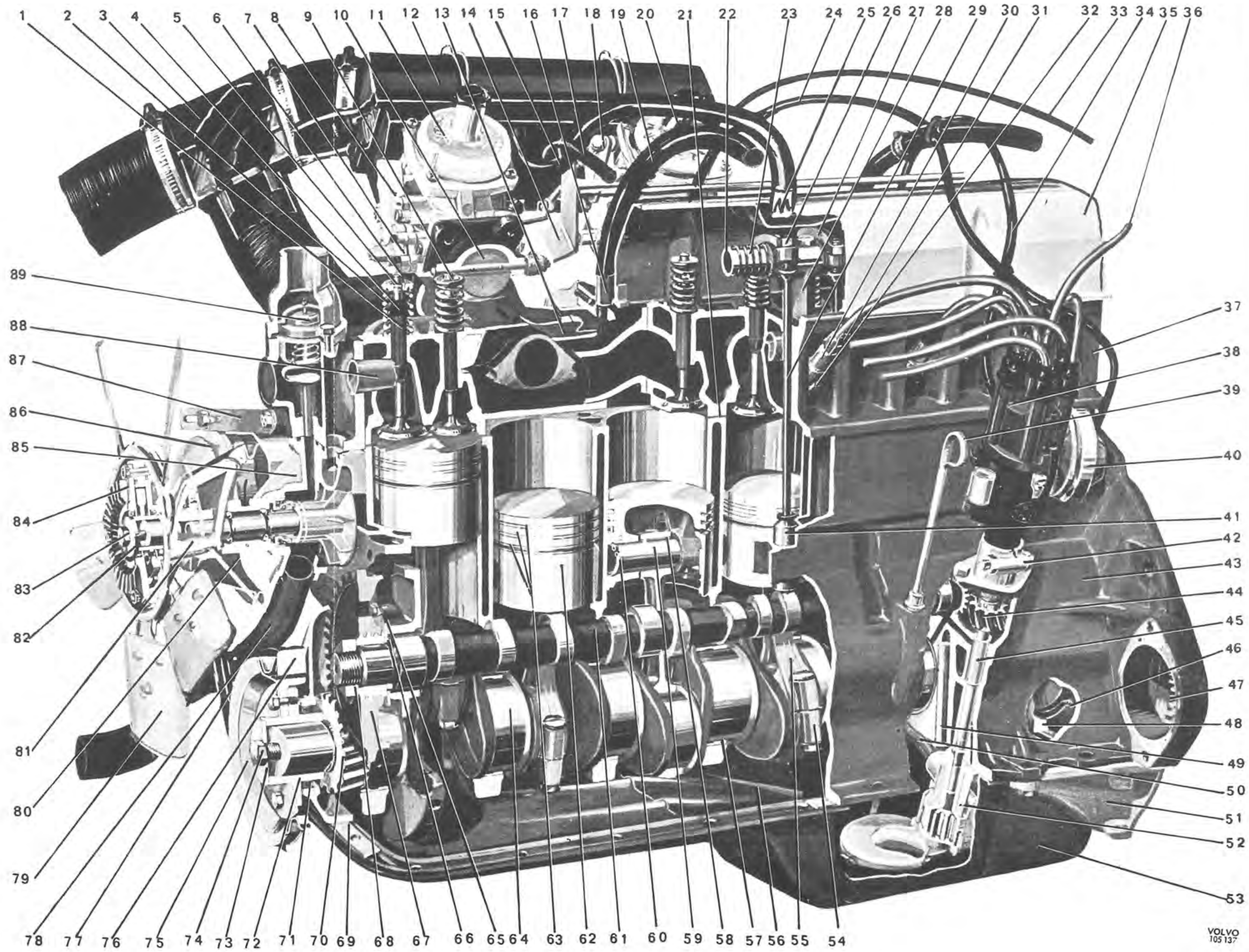


Illustration 2 A. B 30 A Engine

Part 3

ELECTRICAL SYSTEM AND INSTRUMENTS

CONTENTS

GROUP 30

GENERAL

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

GROUP 31

BATTERY

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.

Fig. 3-1. Battery

ALTERNATOR

DESCRIPTION

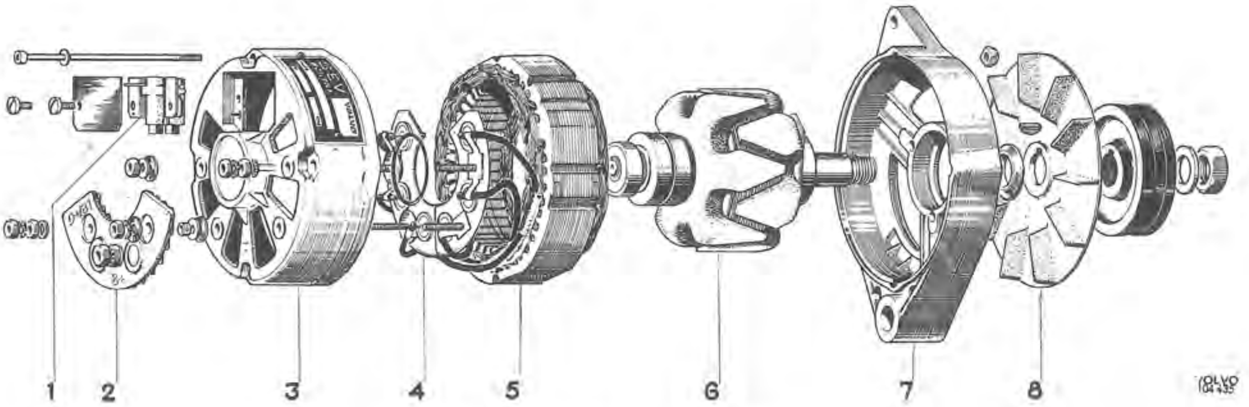


Fig. 3-2. Exploded view of alternator

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

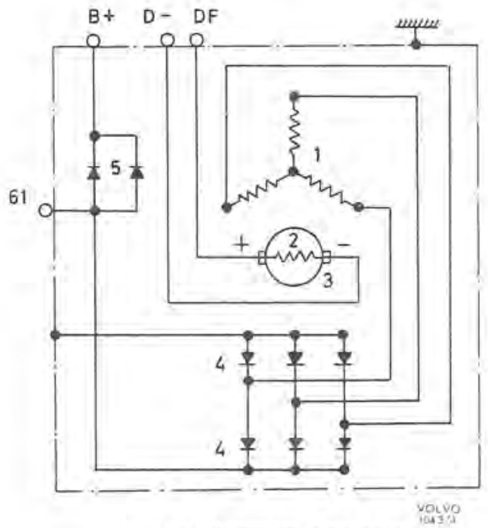


Fig. 3-3. Alternator inner circuit

1. Stator
2. Rotor (field winding)
3. Slip ring and brush holder
4. Rectifier diodes
5. **Isolation 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 15 000 r.p.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.

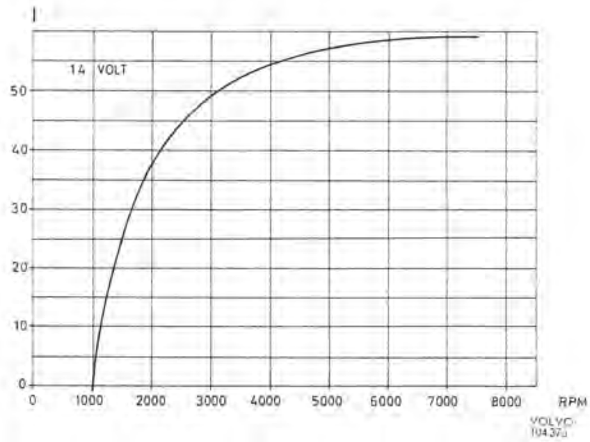


Fig. 3-4. Alternator output curve

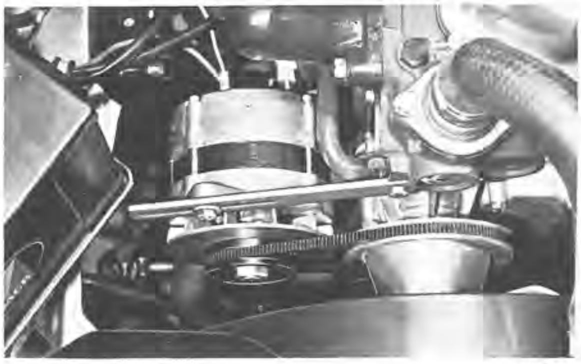
REPAIR INSTRUCTIONS

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.



VOLVO 104469

Fig. 3-5. Alternator fitted

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.

   N.B. The screwdrivers may not be inserted deeper than 2 mm (just over 1/16"), otherwise the stator may be damaged.
6. Release the three screws holding the support plate of the drive end bearing. Release the bearing by knocking the end of the shaft against a piece of wood, see Fig. 3-8.
7. Remove the nuts and washers for the diode-holders.
8. Remove the stator and diode holders for the slip ring end shield.

VOLVO 104470

Fig. 3-6. Removing isolation diodes

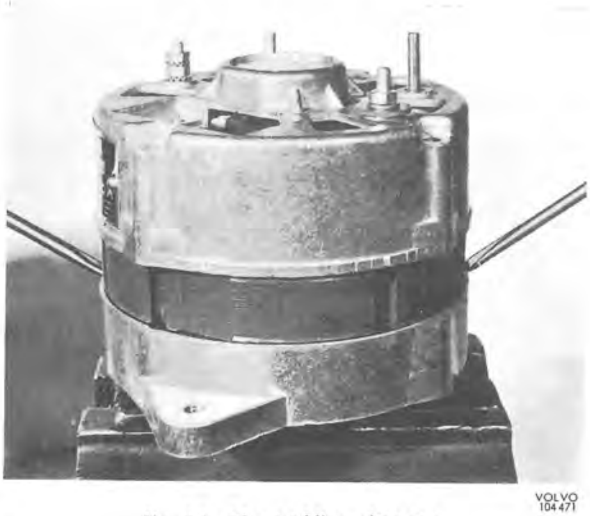


Fig. 3-7. Disassembling alternator

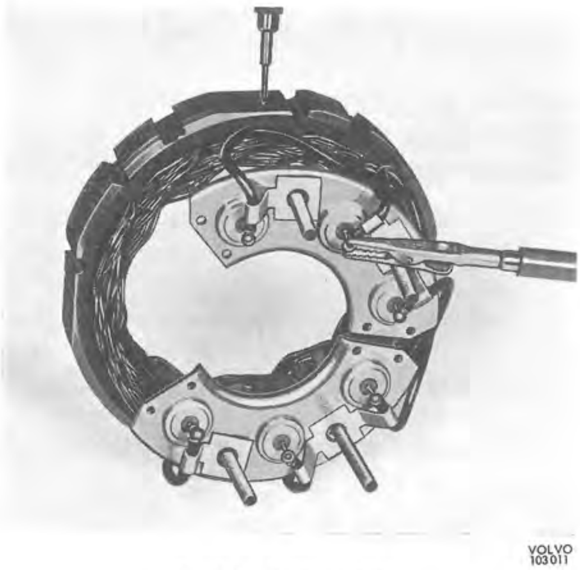


Fig. 3-9. Checking stator

CHECKING DISASSEMBLED ALTERNATOR

STATOR

Check the stator for any short-circuiting. If one or several of the coils are burnt, there must be a 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.

N.B. 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

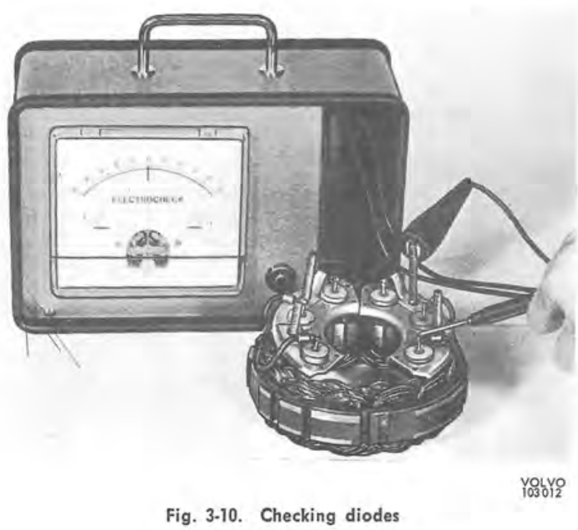


Fig. 3-10. Checking diodes

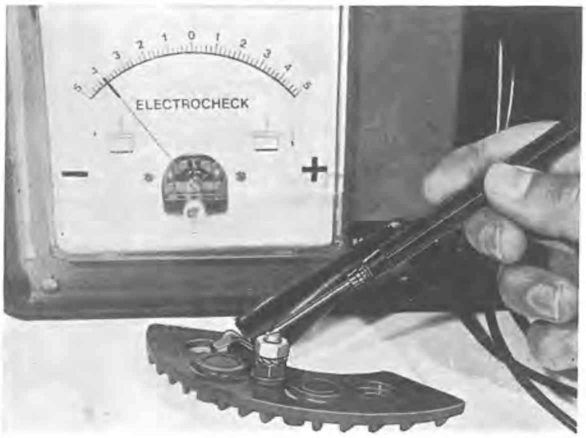


Fig. 3-11. Checking isolation diodes

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 dismantled.)

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

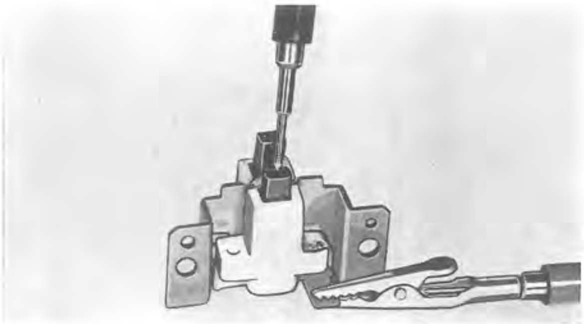


Fig. 3-13. Checking brush holder

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.
   N.B. The complete "+" or "—" diode holder must be replaced even if only one diode is faulty.

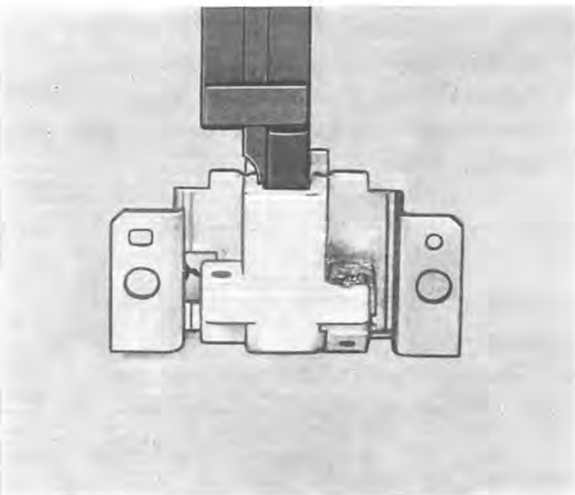


Fig. 3-14. Measuring brush length

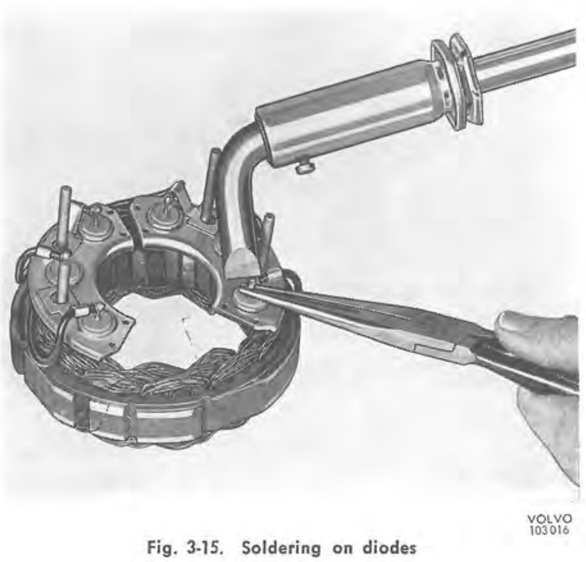


Fig. 3-15. Soldering on diodes

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

REPLACING BEARINGS

DRIVE END SHIELD BEARING

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.

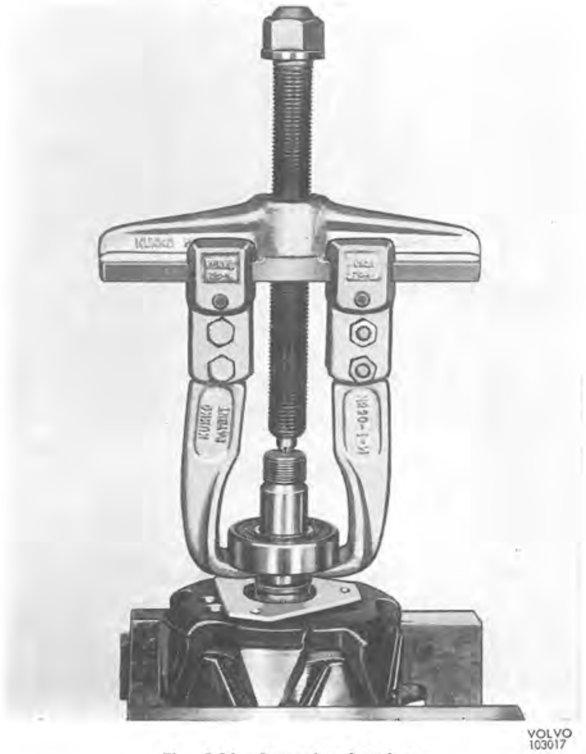


Fig. 3-16. Removing bearing

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

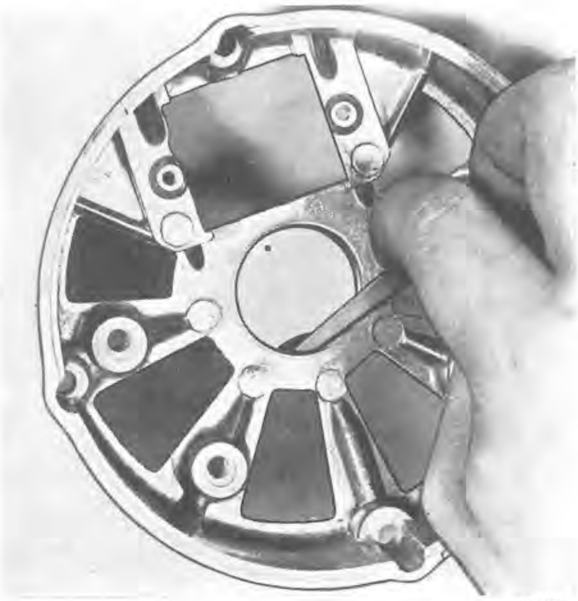


Fig. 3-18. Removing O-ring

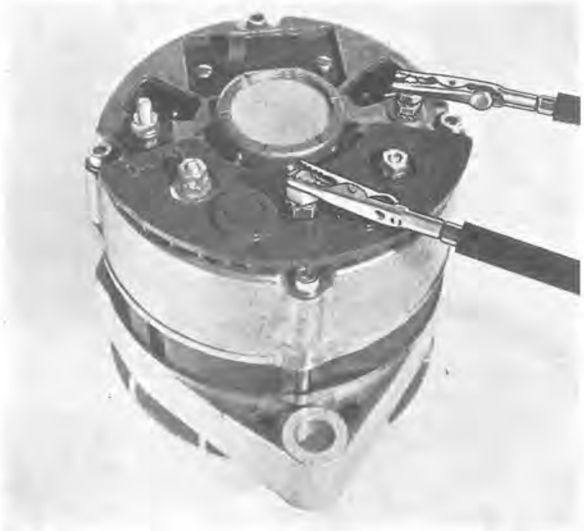


Fig. 3-19. Checking alternator

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 dismantled.

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 0.28—0.30 kpm (2.0—2.2 lb.ft.)
5. Fit the plastic tube and isolation washers on the screws on which the isolation diode is to be mounted.
   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 4 kpm (29.0 lb.ft.).
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. N.B. 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

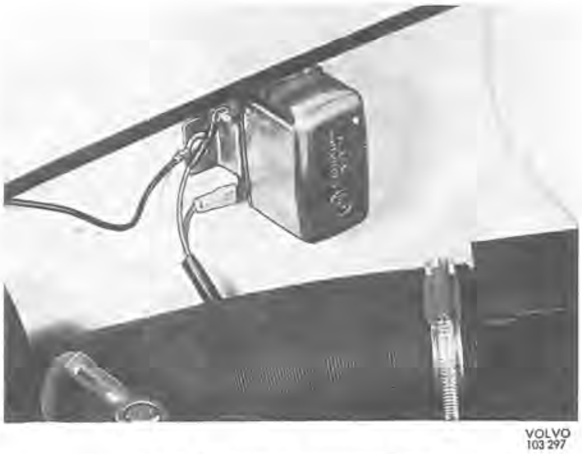


Fig. 3-20. Voltage regulator fitted

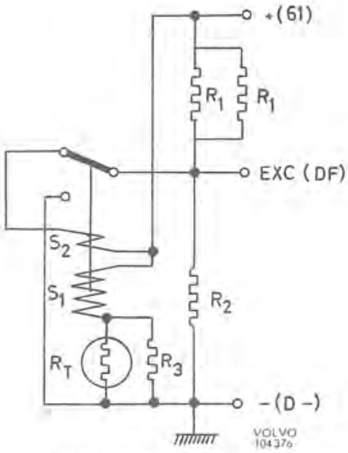


Fig. 3-21. Inner wiring of regulator

S1 Voltage winding
S2 Acceleration winding
R1 Regulator resistances (2) 10 Ω ± 10 %
R2 Damping resistance 30 Ω ± 10 %
R3 Compensation resistance (adapted to RT during manufacture)
RT Compensation thermistor approx. 4 Ω at 25° C (17° F)

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

FUNCTION

When the ignition key is switched on, current flows through the charging warning lamp to +(61) on the regulator. It is then conducted via the regulator through the field winding to earth.
When the alternator starts rotating, alternating current is formed in the stator. This alternating current is rectified by the silicon diodes and the direct current produced is re-fed via the regulator to the field winding until the regulating voltage has been reached.

When the regulating voltage has been reached the armature is attracted by the coil. This causes the contacts to open and the field current must pass the resistances R1, Fig. 3-21.
If in spite of this, the voltage rises, the armature is drawn further down and the movable contact meets the lower contact so that the field winding is earthed at both ends, this causing the voltage to drop rapidly. The cycle is repeated continuously so that the voltage is maintained constant.

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 3000 r.p.m. (Engine speed 1500 r.p.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 5000 r.p.m. (engine speed 25000 r.p.m.) for 15 seconds. Then read off the voltage on the voltmeter. With no load on the alternator, the voltmeter should read 13.1—14.4 volts with the regulator ambient temperature at 25° C (77° F).

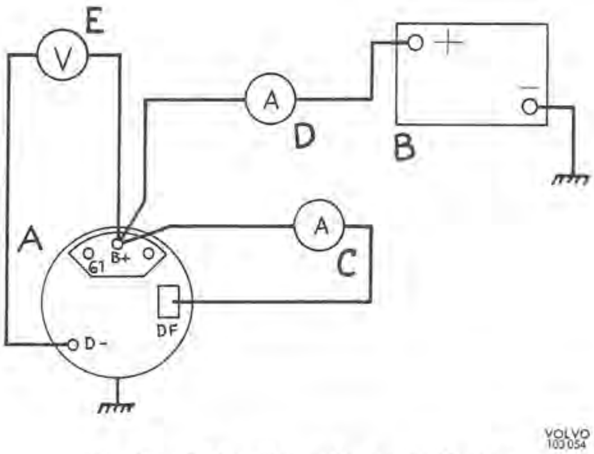


Fig. 3-22. Wiring diagram for testing alternator

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

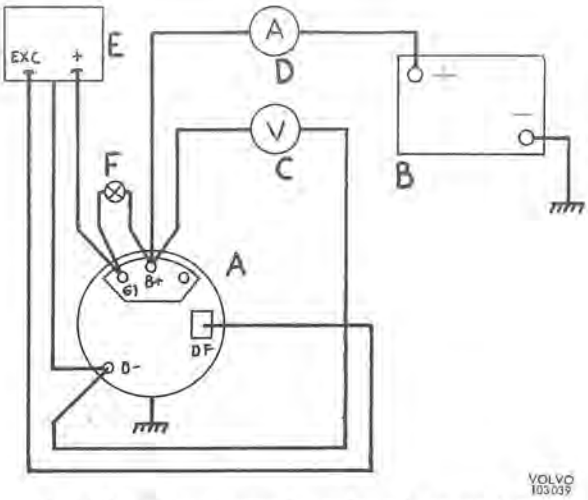


Fig. 3-23. Wiring diagram for testing voltage regulator

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

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

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

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

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

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

Immediately after, or preferably during driving, measure the voltage between B+ and D— on the alternator. The engine should be turning over at about 1500 r.p.m. (3000 alternator r.p.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.

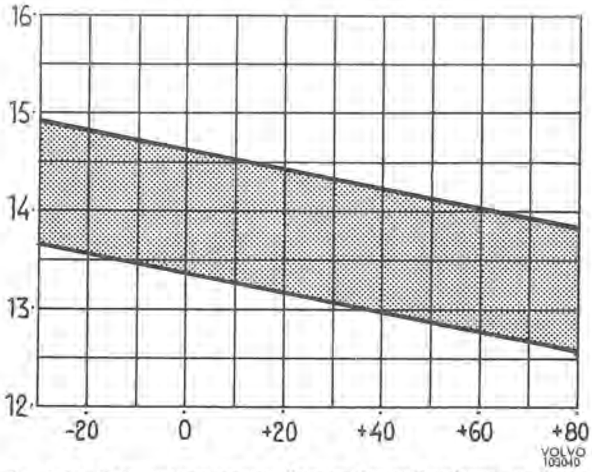


Fig. 3-24. Voltage-temperature diagram for cold voltage regulator

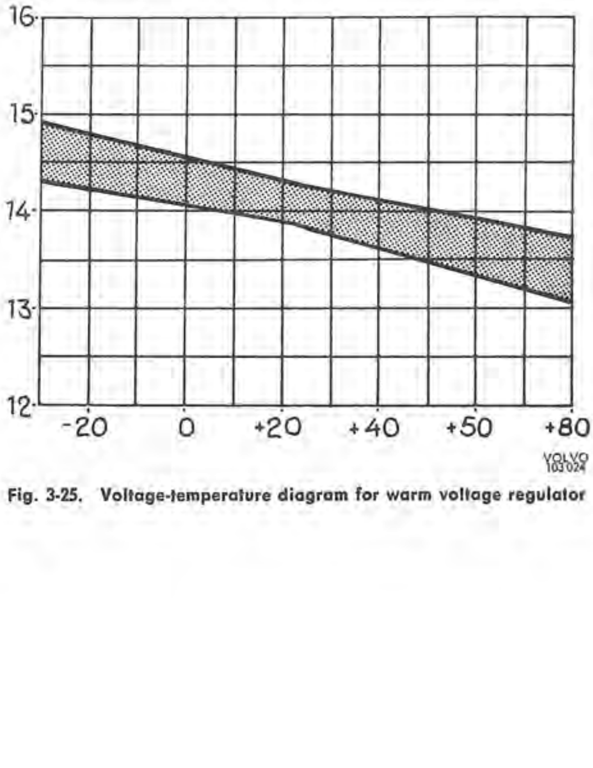


Fig. 3-25. Voltage-temperature diagram for warm voltage regulator

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.

STARTER MOTOR

TOOLS

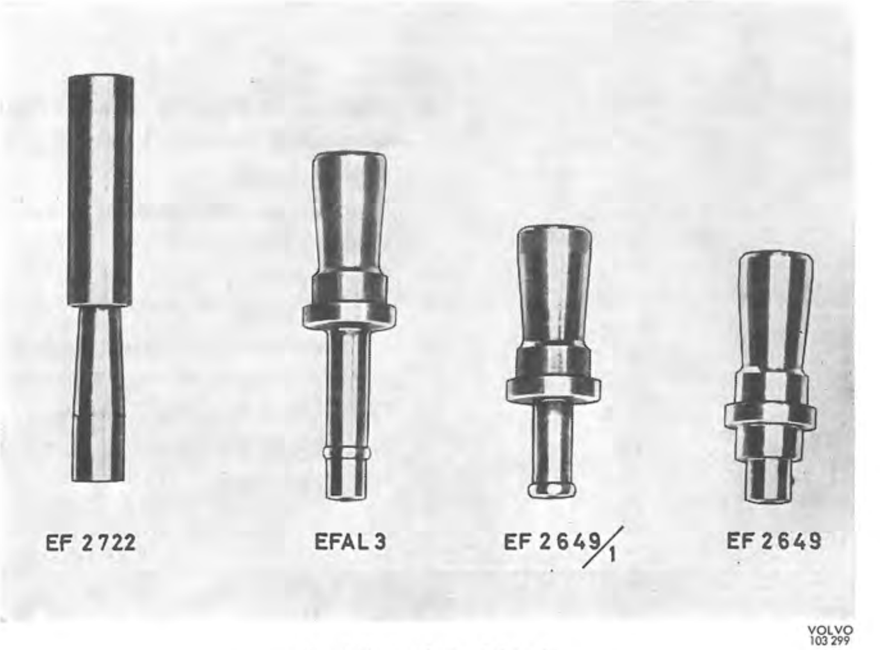


Fig. 3-26 Bosch special tools

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.

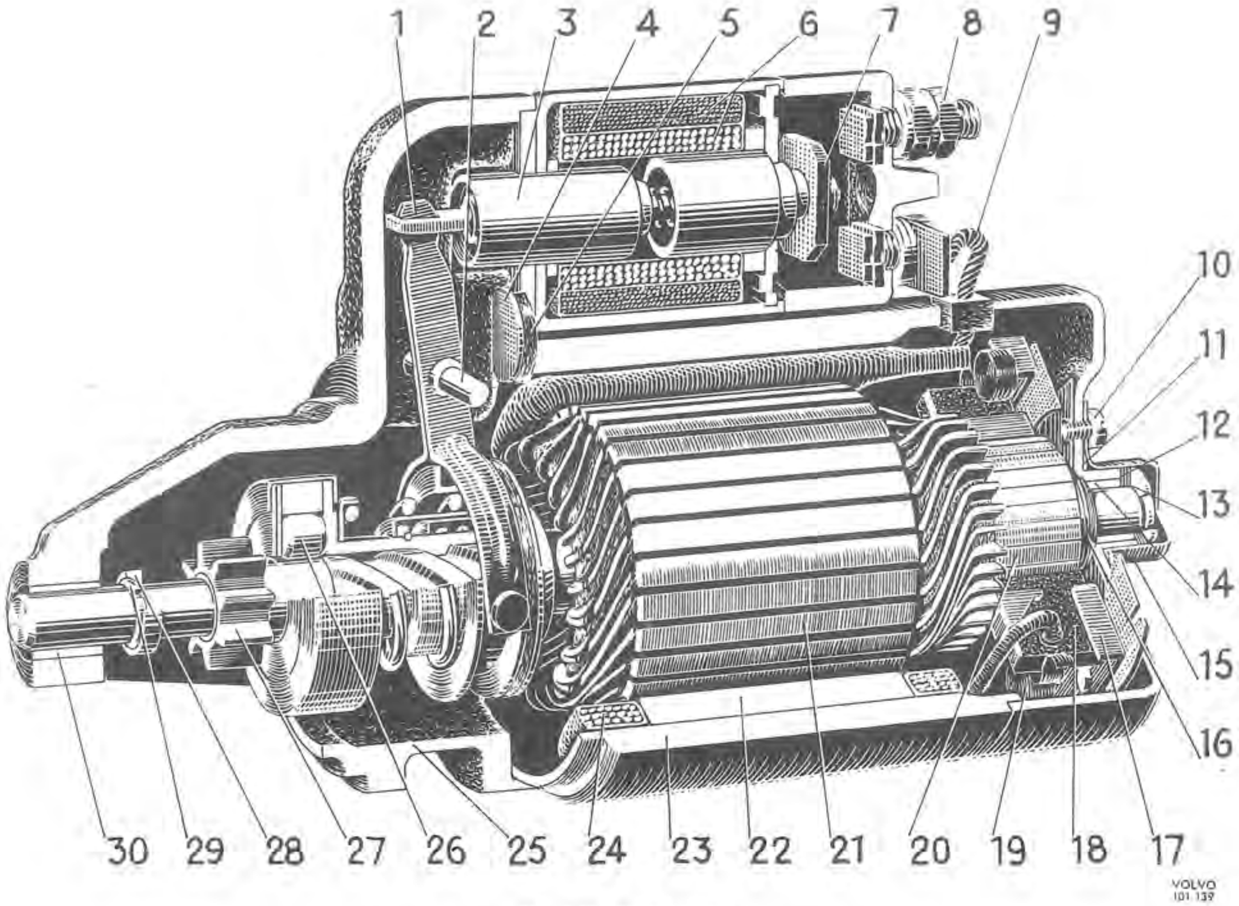


Fig. 3-27. Starter motor

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

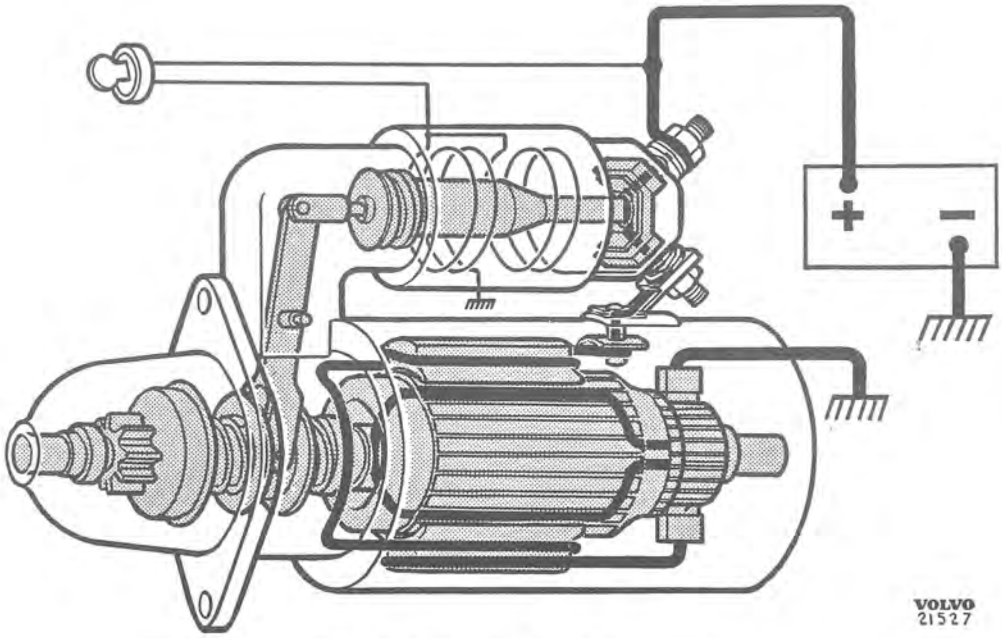


Fig. 3-28. Starter motor, general arrangement

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. N.B. 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

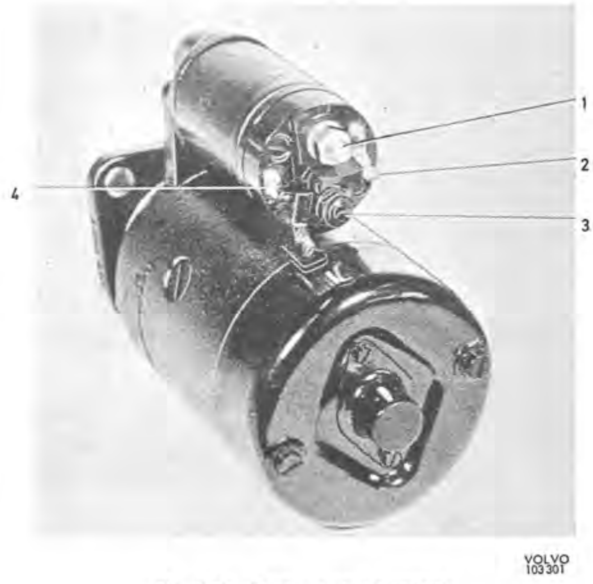


Fig. 3-30. Starter motor terminals

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

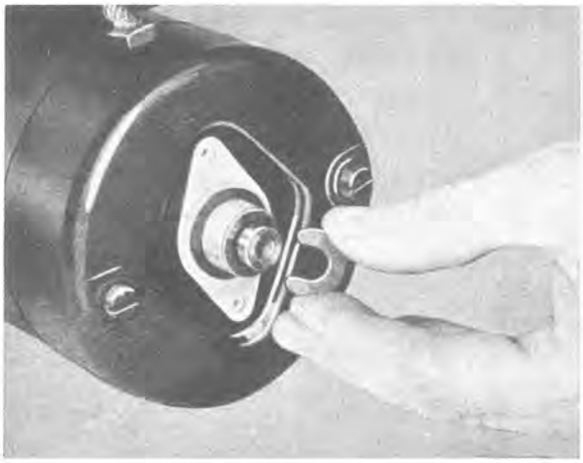


Fig. 3-31. Removing lock washer VOLVO 101 088

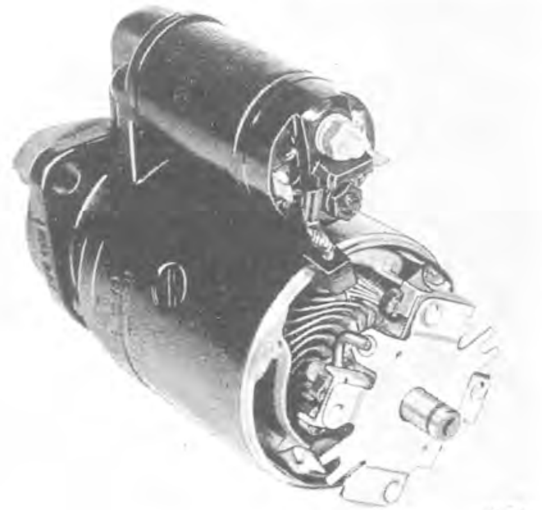


Fig. 3-33. Starter motor with bearing frame removed VOLVO 103302

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").

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. 3-32. Removing adjusting washers VOLVO 101 087

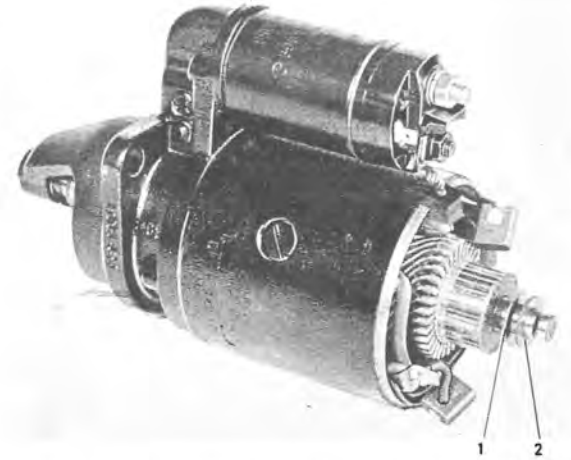


Fig. 3-34. Starter motor with brush bridge removed VOLVO 103 303

1. Steel washer 2. Fiber washer

Fig. 3-35. Control solenoid

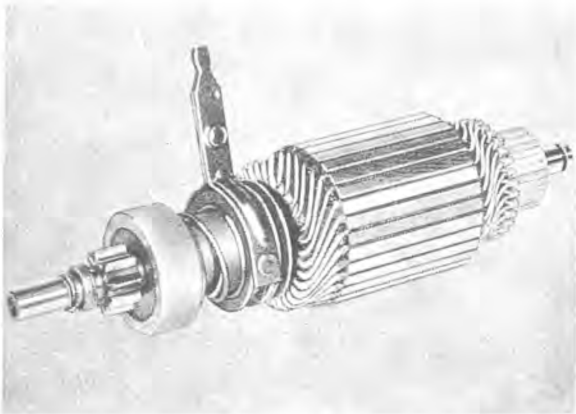


Fig. 3-37. Armature with pinion

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 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 dismantled. 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.

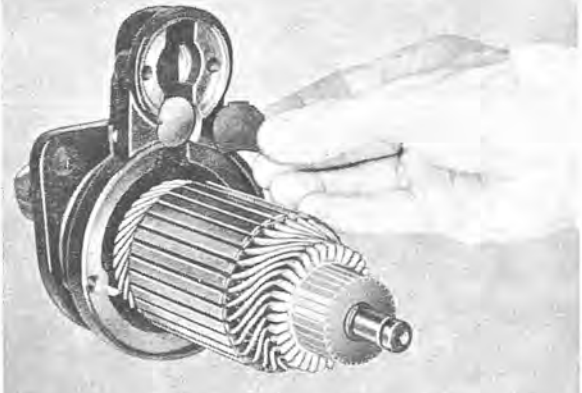


Fig. 3-36. Removing sealing washer

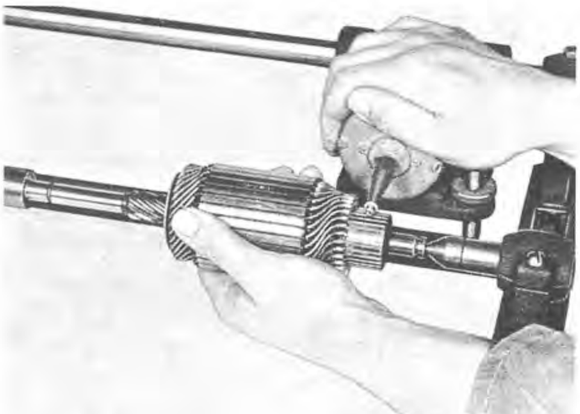


Fig. 3-38. Milling commutator

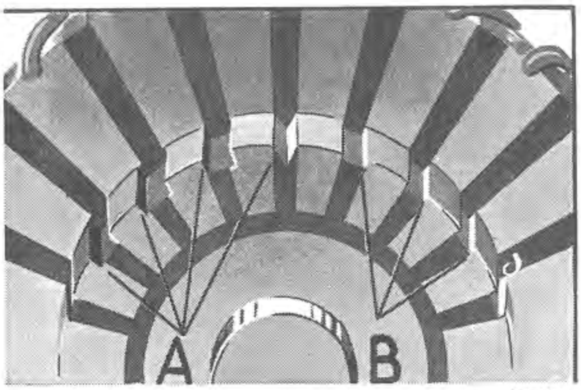


Fig. 3-39.
A. Incorrect milling B. Correct milling

Fig. 3-41. Checking stator

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

Fig. 3-40. Testing armature

REPLACING FIELD WINDINGS

1. If the starter motor has not been dismantled, this must be done. Follow the instructions under the heading "Dismantling".
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.

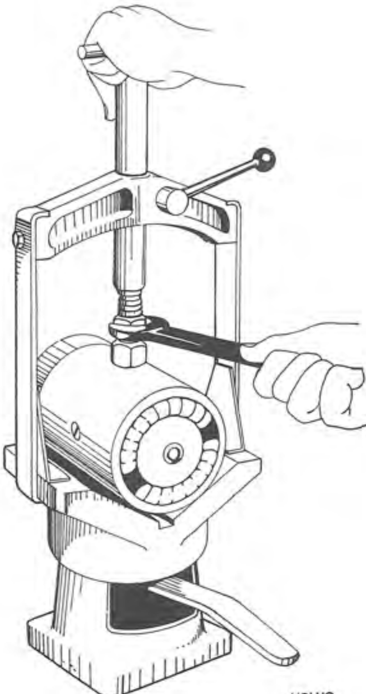
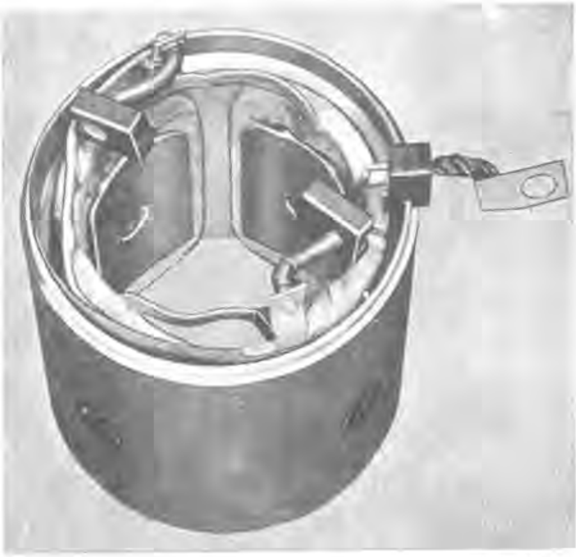


Fig. 3-42. Rotary clamping block for removing field windings



VOLVO 101 078

Fig. 3-43. Stator with soldered brushes

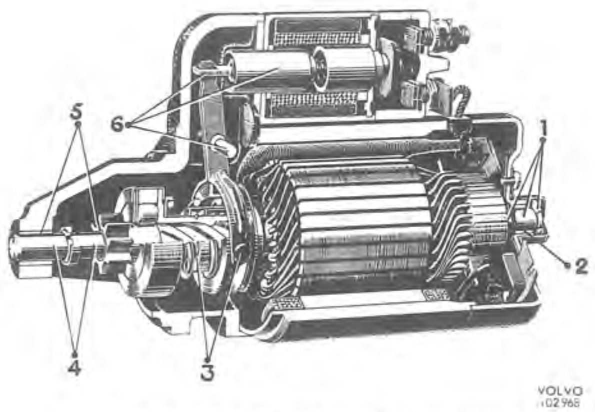


Fig. 3-45. Lubricating scheme for starter motor

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.

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.

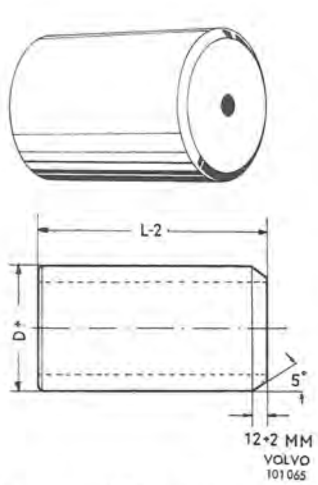


Fig. 3-44. Press drift for fitting field windings

D=66.04—66.09 mm (2.599—2.602") L=85 mm (3.346")

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.

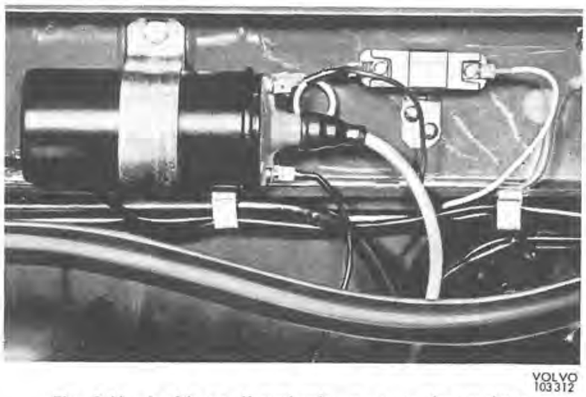


Fig. 3-46. Ignition coil and advance engaging resistor

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

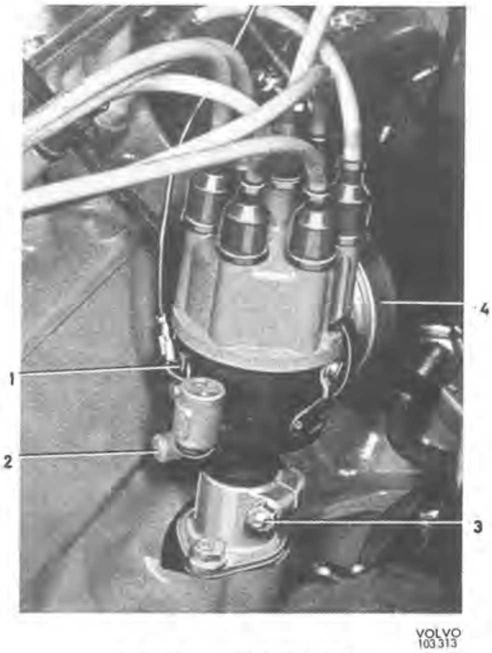


Fig. 3-47. Distributor, B 30 A

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

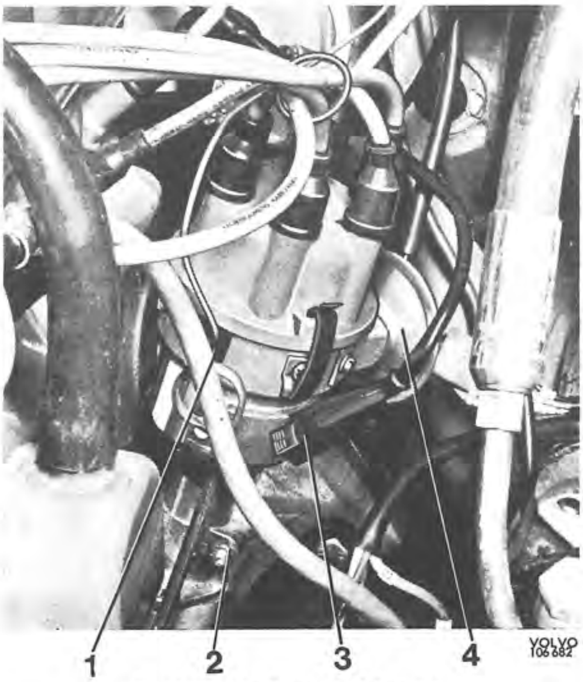


Fig. 3-48. Distributor, B 30 E and F

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

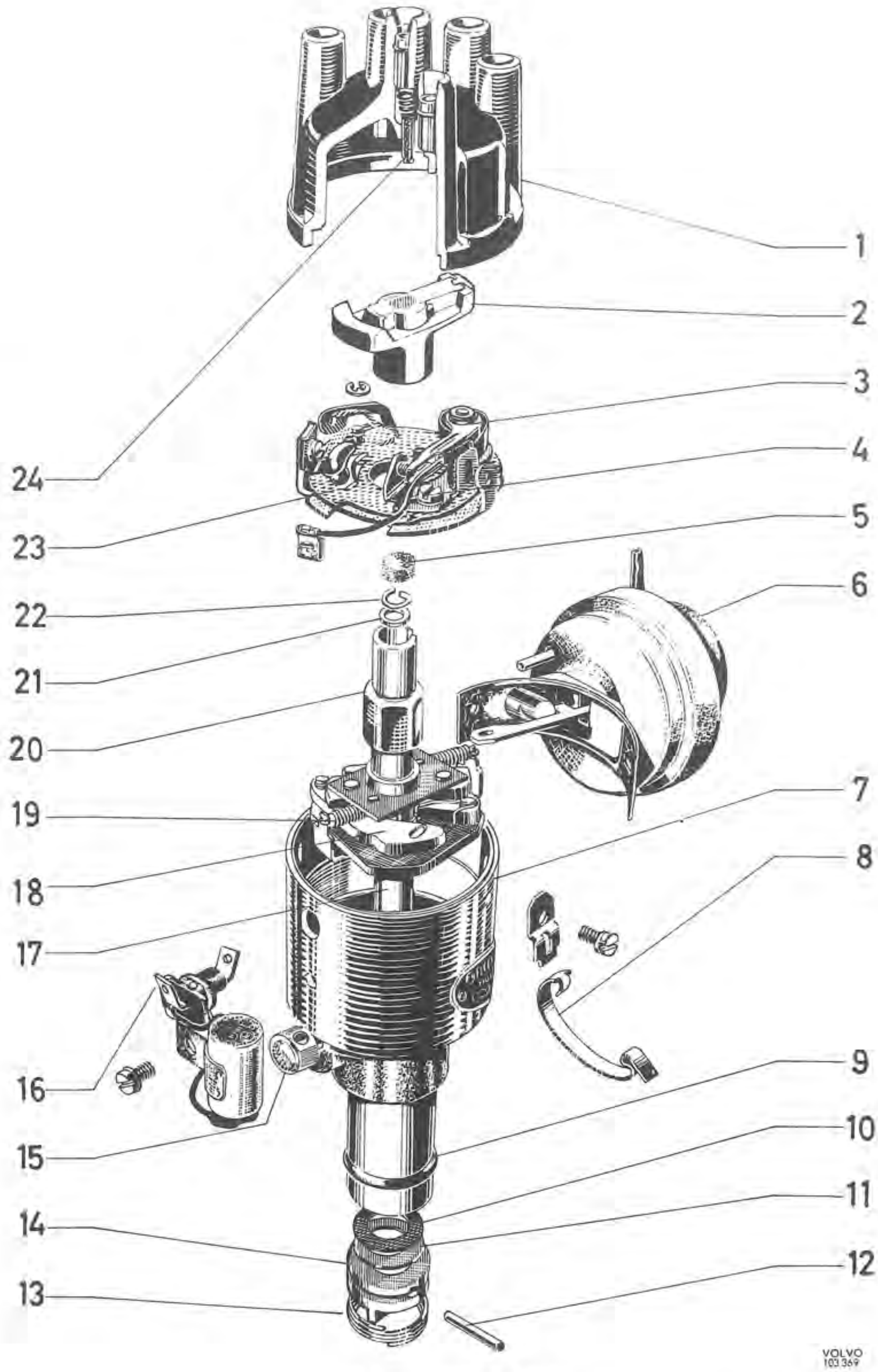


Fig. 3-49. Distributor, B 30 A

1. Distributor cap
2. Distributor arm
3. Contact breaker
4. Lock screw for breaker contacts
5. Lubricating felt
6. Vacuum regulator
7. Distributor housing
8. Cap clamp
9. Rubber seal
10. Fiber washer
11. Steel washer
12. Lock pin
13. Spring ring
14. Flange
15. Lubricator
16. Primary connection
17. Distributor shaft
18. Centrifugal weight
19. Centrifugal governor spring
20. Breaker cam
21. Washer
22. Snap ring
23. Breaker plate
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 carburettors are closed so that there is no vacuum in the connection from the carburettors (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 carburettors 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.

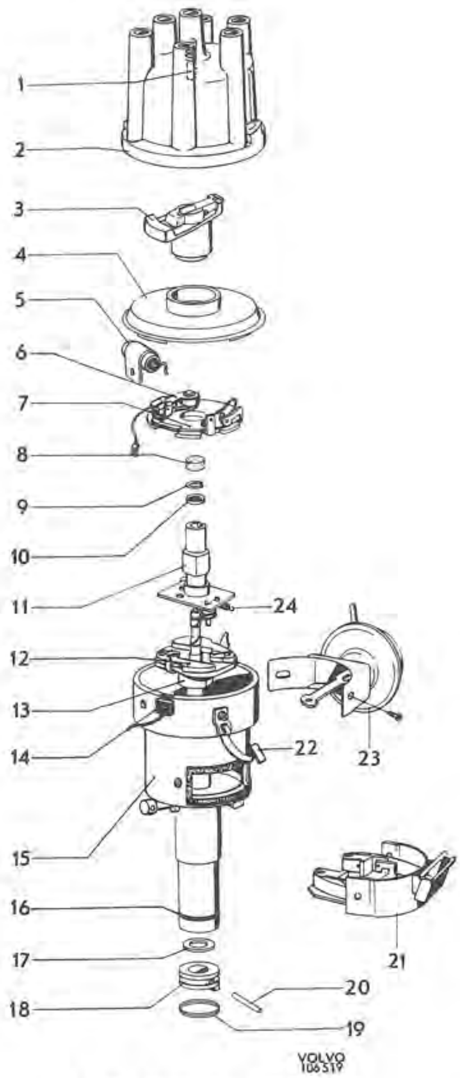


Fig. 3-50. Distributor, B 30 E and F

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

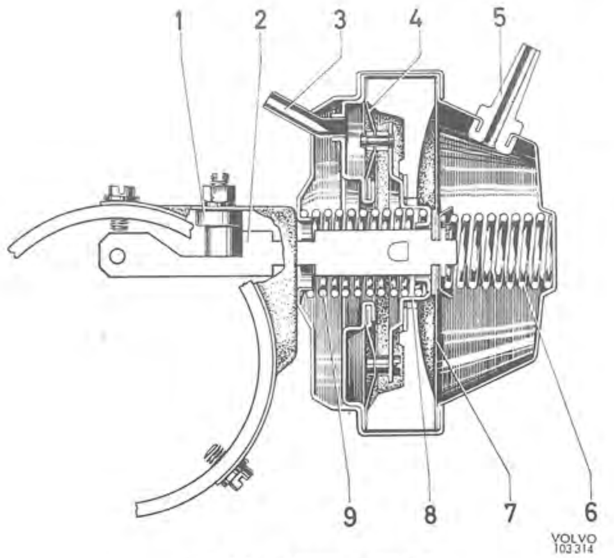


Fig. 3-51. Vacuum regulator

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

Fig. 3-52. Removing vacuum regulator

DISTRIBUTOR B 30 A

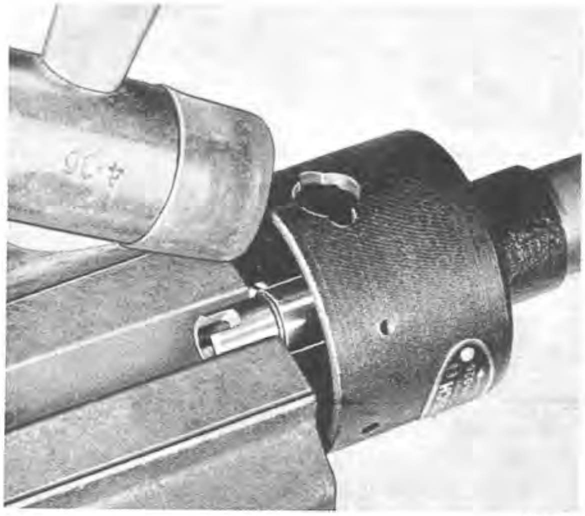
REMOVING

1. Release the lock clamps for the distributor cap and lift of 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

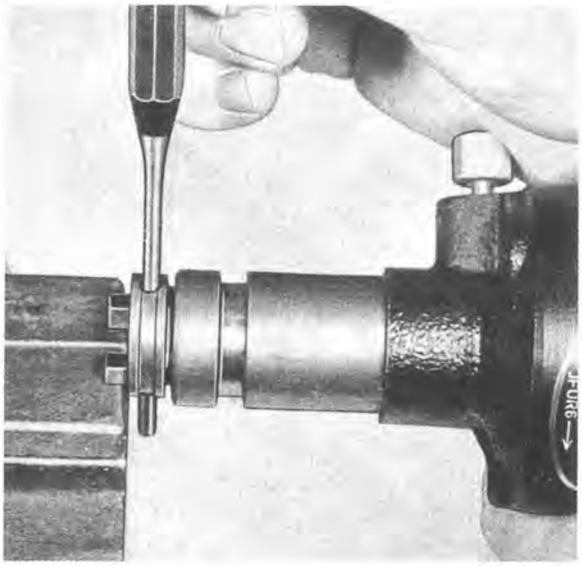
1. Pull off the distributor arm.
   Remove the circlip for the pull rod from the vacuum regulator.
   Remove the vacuum regulator according to Fig. 3-52.
2. Mark up how the clamps for the cap are located and remove them.
   Disconnect the lead from the breaker contacts and remove the primary connection,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



VOLVO 102979

Fig. 3-54. Removing snap ring



VOLVO 103317

Fig. 3-55. Removing driving collar

4. Remove the resilient ring (13, Fig. 3-49) and mark uphow 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

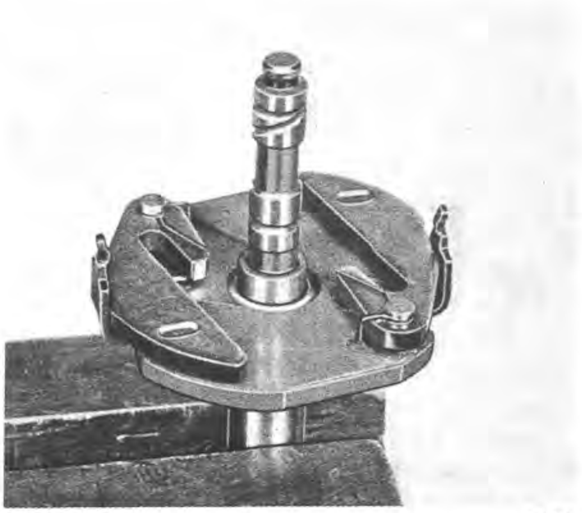
1. The play between the distributor shaft and the breaker camshaft must not exceed 0.1 mm (0.004").
2. The cams on the breaker camshaft must not be scored or worn down so that the dwell angle is altered.
3. The holes in the centrifugal weights must not be oval or deformed in any other way.
4. The centrifugal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



VOLVO 103318

Fig. 3-56. Distributor shaft with centrifugal weights

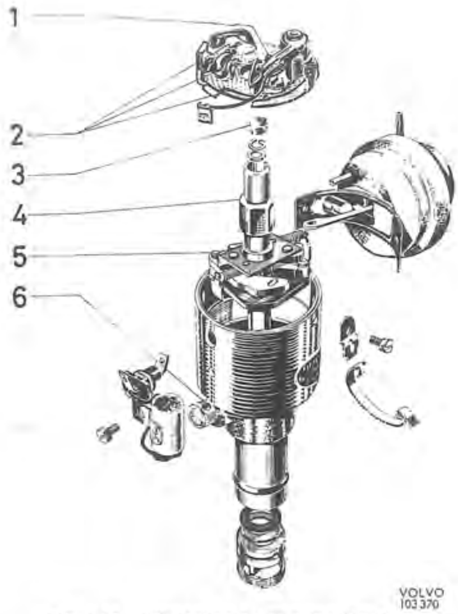


Fig. 3-57. Lubricating scheme for distributor

Use Bosch lubricant (or equivalent) according to below.

1. Ft	1 v 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

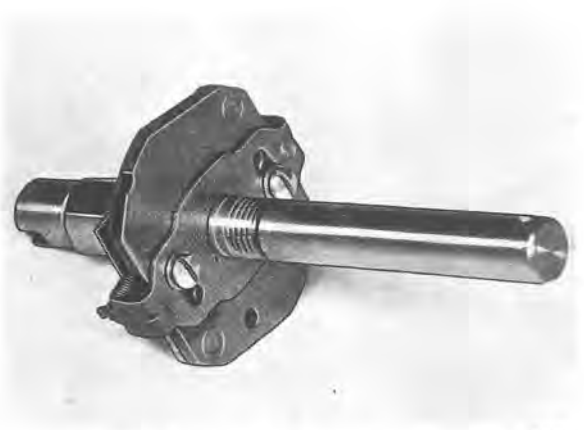
The ignition contact breaker can be replaced with the distributor fitted, but it **should** be done with the distributor dismantled.

1. Remove the distributor rotor arm.
2. Disconnect the electric lead at the primary connection.
3. Remove the screw for the 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 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 3-69 and turning the screwdriver until the dwell angle is the correct one.
   Then tighten the screw for the contact breaker.

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



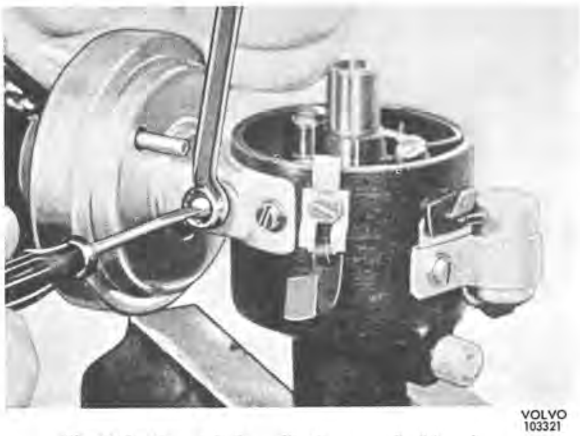
VOLVO 103319

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.p.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 ± 1°.
   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 dismantled and the distributor shaft lifted up (the 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.
   N.B. The governor curve must not be adjusted by bending the spring clamps of the driving collar.
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 1½°. 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.

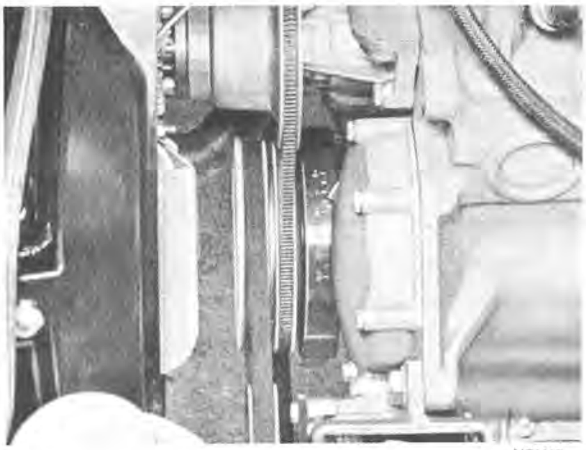
INSTALLING

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.)



VOLVO 103321

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



VOLVO 105434

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

IGNITION SETTING

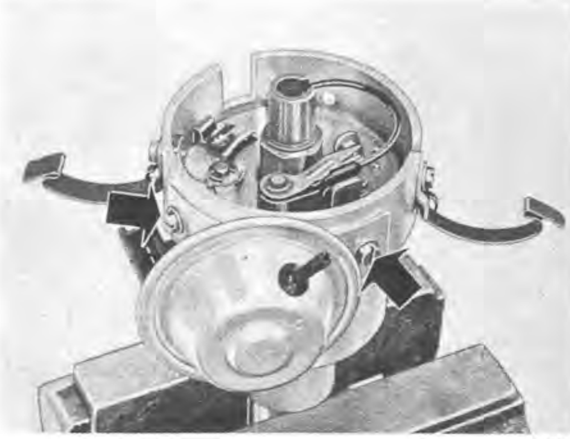
Ignition setting should always be carried out while the engine is running and with the help of a Stroboscope.

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.p.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 (3, Fig. 3-47) and turn it 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.
4. Release the attaching screw and pull up the distributor.

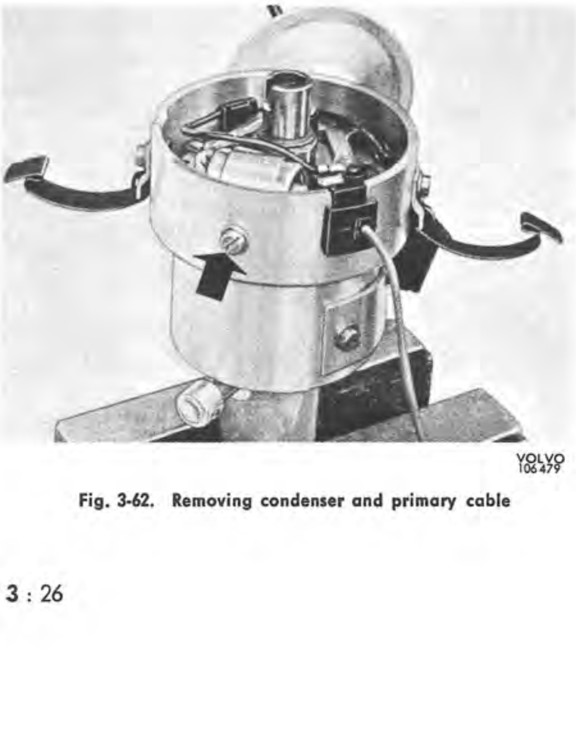


VOLVO 106482

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.
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 top on the distributor housing with a plastic mallet until the locking (9, Fig. 3-50) releases.



VOLVO 106479

Fig. 3-62. Removing condenser and primary cable

VOLVO 106481

Fig. 3-64. Removing triggering contacts

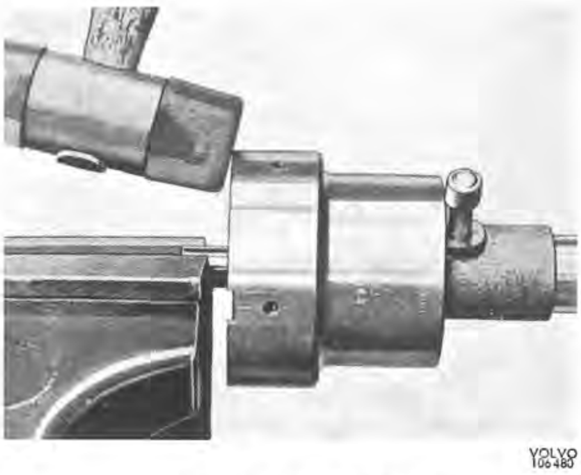


Fig. 3-65. Removing circlip

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.

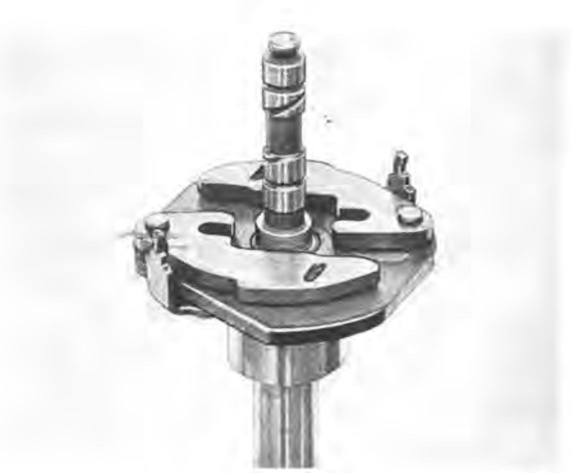


Fig. 3-66. Distributor shaft with centrifugal weights

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. 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.

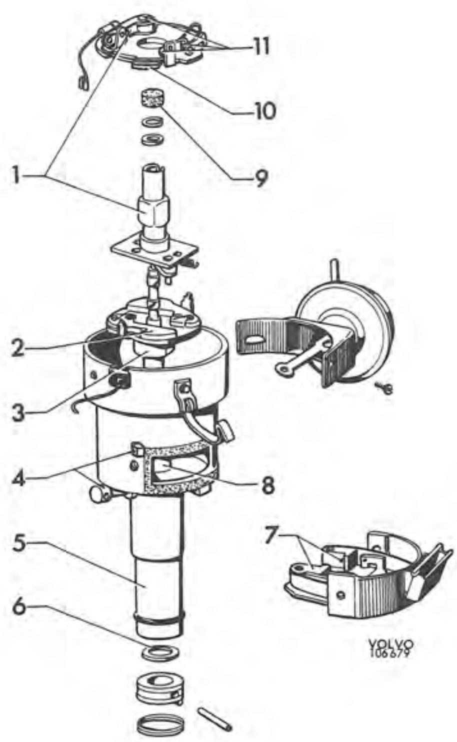


Fig. 3-67. Lubricating chart for distributor

1.	Ft 1 v 4.	Place a little grease on the fiber tab and a light layer on the breaker cam.
2.	Ft 2 v 3.	Grease the weights.
3.	Ft 1 v 4.	Place a light layer on the breaker cam.
4.	Ol 1 v 13.	Fill the lubricator with oil and soak the felts in oil.
5.	Ol 1 v 13.	Place the brushes in oil for at least 1/2 hour before fitting. Soak the lubr. felt in oil.
6.	Ft 2 v 3.	Grease the washers.
7.	Ft 1 v 4.	Place a little grease on the fiber tabs.
8.	Ol 1 v 13.	Oil the shaft before fitting.
9.	Ol 1 v 13.	Soak the lubr. felt in oil.
10.	Ol 1 v 2.	Oil the ignition plate.
11.	Fit 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 trichlorethylene 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.

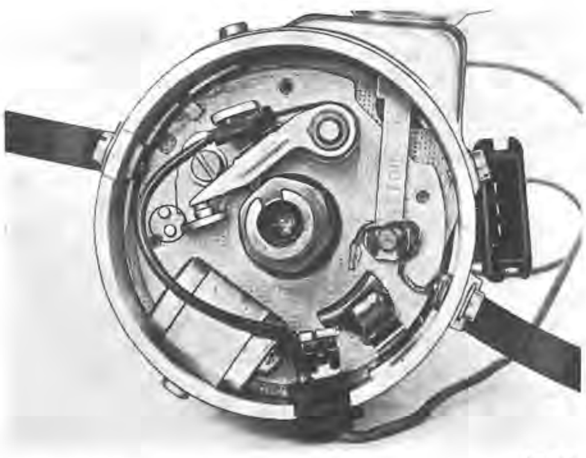


Fig. 3-68. Recess for adjusting ignition breaker contacts

TEST RUNNING DISTRIBUTOR ON TEST BENCH

1. Run the distributor at approx. 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 rpm (below 200 distr. rpm) that the centrifugal governor cannot function. Gradually increase the rpm and read off the values at the prescribed graduation. A recently lubricated distributor should first be run up to max. rpm several times. Permissible tolerance for the centrifugal governor is ± 1°.
4. Run the distributor at low rpm and adjust the protractor so that the marking is obtained at 0°. Connect the vacuum hose from the test bench to the vacuum regulator.
   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 104477

Fig. 3-70. Headlights and foglights

VOLVO 103324

Fig. 3-71. Rear light

The lighting consists of two full- and dipped-beam headlights, parking lights, rear lights and number 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. 3-70. 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 the covers.

Switching between full- and dipped-beam positions is done by moving the turn indicator lever switch towards the steering wheel. This causes the step relay (Fig. 3-90) 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. 3-71.

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.
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.

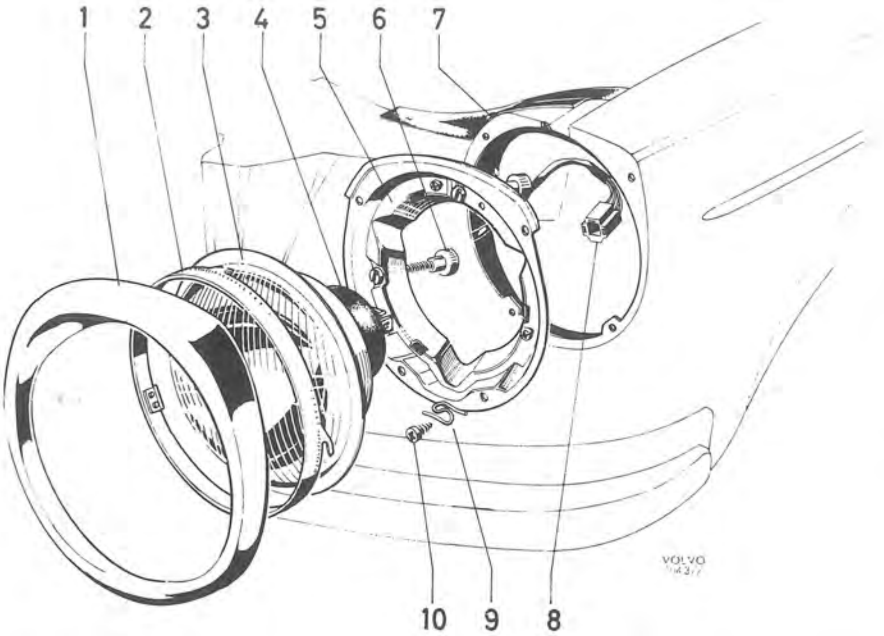


Fig. 3-72. Headlight

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

REPLACING THE 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, pull out the bulb, see Fig. 3-76.
4. Fit the new bulb. Make sure that the bulb collar fits into the socket in the insert.
   N.B. 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 means of the two adjusting screws, see Fig. 3-72.
7. Fit the plastic cover over the space behind the headlight.

VOLVO 104 478

Fig. 3-74. Removing outer rim

VOLVO 103 325

Fig. 3-73. Removing plastic cover

VOLVO 104 479

Fig. 3-75. Screw for inner rim

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.

Fig. 3-76. Removing the bulb

Fig. 3-77. Foglight

1. Holder
2. Bulb electrical connection

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

Adjustment is made by varying the two adjusting 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. N.B. 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. 3-78.
8. Fit the plastic cover.

CHECKING

See "Checking and adjusting headlights".

Fig. 3-78. Foglight attachment

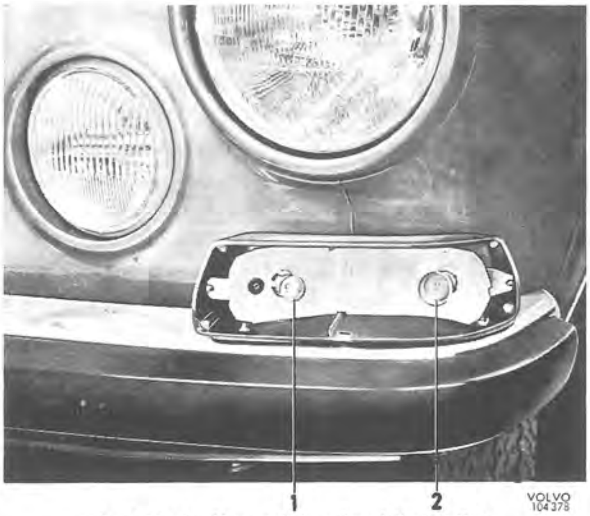


Fig. 3-79. Parking and directional flasher light

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

Fig. 3-81. Bulb location in rear light

1. Directional indicator
2. Back-up light
3. Stop light
4. Rear light

PARKING AND DIRECTIONAL FLASHER LIGHTS

REPLACING BULB

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

LICENSE PLATE LIGHT

REPLACING BULB

1. Remove the screw holding the bulb glass.
2. Remove the glass and replace the bulb.
3. Re-fit the glass and the screw. Check that the sealing is fitted correctly.

REAR LIGHTS

REPLACING BULB

1. Slacken the two screws holding the glass and lift off the glass.
2. Replace the damaged bulb.
   N.B. Do not touch the new bulb globe with your fingers.
3. Re-fit the glass and the screws.

SIDE MARKER LIGHTS

Two flasher marking lights are placed on each side of the car.
To replace the bulb, take off the glass. The glass is fitted on the body by means of two screws.

Fig. 3-80. License plate light with bulb glass removed

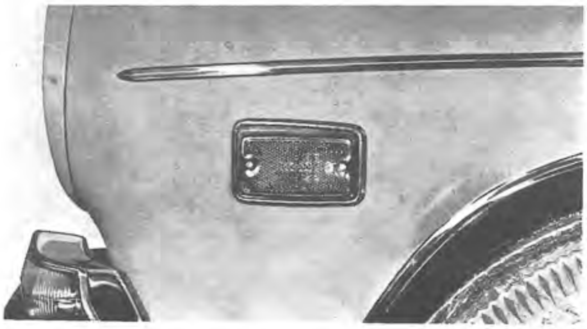


Fig. 3-82. Side marker light

OTHER ELECTRICAL STANDARD EQUIPMENT

DESCRIPTION

DIRECTIONAL INDICATOR SYSTEM

The directional indicator system consists of a thermal-type flasher relay, directional indicator switch, flash lamps on the front bumper and bulbs in the rear lights.

The directional indicators can also be used as simultaneous warning hazard signal flasher lights, when the special switch for this function on the instrument panel is switched on.

The flasher relay is mounted on the switch for the warning hazard signal flashers (see Fig. 3-83). The directional indicator lever switch, see Fig. 3-84, which has automatic parking, is placed under the plastic cover on the steering column.

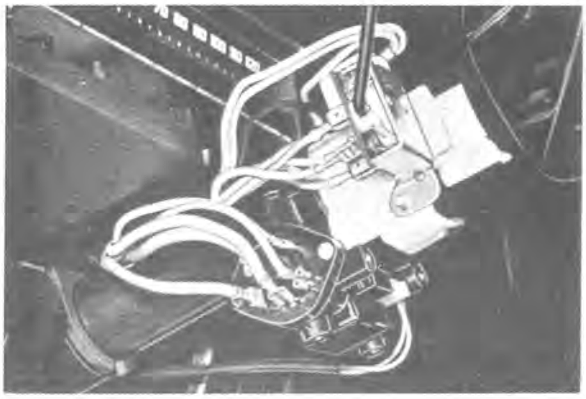


Fig. 3-84. Directional indicator lever switch and ignition switch

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 (Garage 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.

Vehicles intended for U.S.A. are fitted with a special steering wheel lock with a warning device which buzzes when the one of the front doors is opened and the ignition key is left in the ignition switch, in other words, if the steering wheel is not locked.
The buzzer is placed under the dashboard on the left-hand side and is connected between the fusebox (via the ignition) and the door switch on the driver's side.

Fig. 3-83. Switch with flasher relay

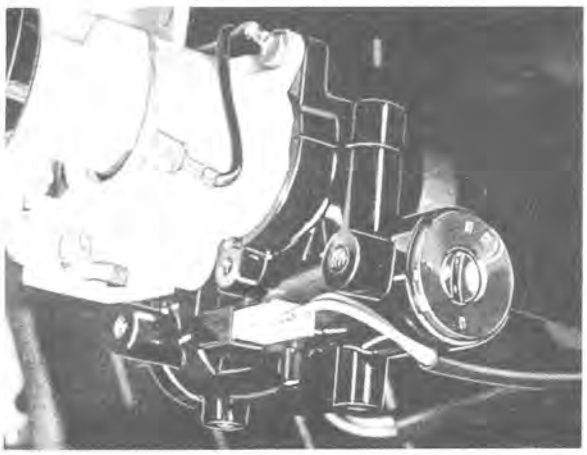


Fig. 3-85. Ignition switch with connection for warning buzzer

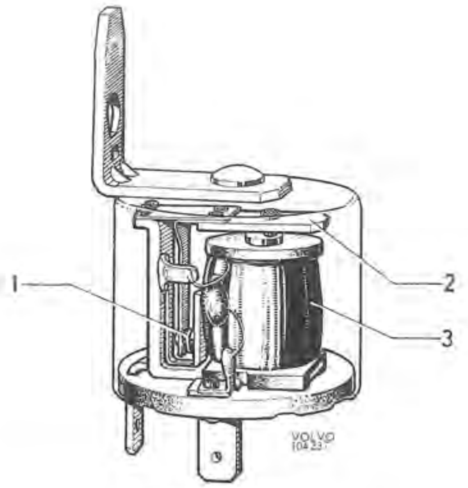


Fig. 3-86. Buzzer
1. Contacts 2. Armature 3. Coil

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 out 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.

HORN

The horn is mounted on the support irons for the front bumper.
One of the horns has a low frequency and the other a high frequency.
The horns can be engaged via a control relay by the horn ring mounted inside the steering wheel.

WINDSHIELD WIPERS

The windshield wipers are driven by an electric motor. The motor is connected to the wiper blades by means of link arms. The motor, which has a permanently magnetized field, has two speeds which are selected by means of the switch mounted on the dashboard. The motor is fitted with 3 brushes, one negative brush and two positive brushes. The positive brushes are connected up one at a time for full and half speed respectively. The gear housing for the wiper unit contains an integrally built parking switch. The

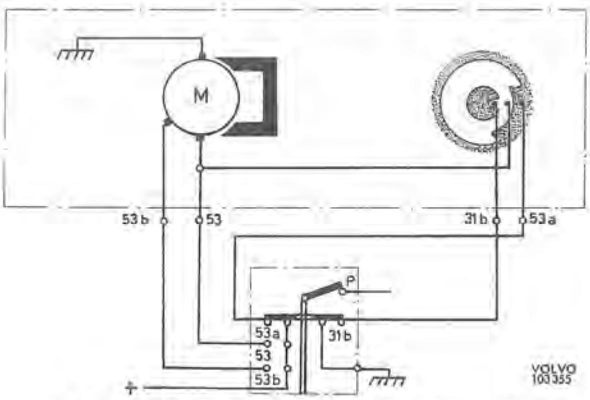


Fig. 3-87. Wiring diagram for windshield wiper motor

purpose of this switch is to return the blades to a suitable, previously determined, parking position irrespective of where the blades are when shut off. See Fig. 3-87.

WINDSHIELD WASHER

The windshield washer, which is placed on the left-hand wheel arch, is driven by an electric motor. The pump located at the bottom of the water container is connected to the motor by means of a shaft. The pump is of the centrifugal type.
Turning the windshield washer switch mounted on the dashboard engages the windshield washer.

SWITCHES

All switches are of the pull-push type. The switches for lighting, ventilation and rear window defroster have three positions. The switch for the windshield wiper has also three positions but the washer is also engaged by turning the knob on this switch. The switch for the warning signal flashers and foglights have two positions.

INTERIOR LIGHTING

The interior lighting consists of a lamp located in the middle of the roof. The lamp is switched on by means of 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.

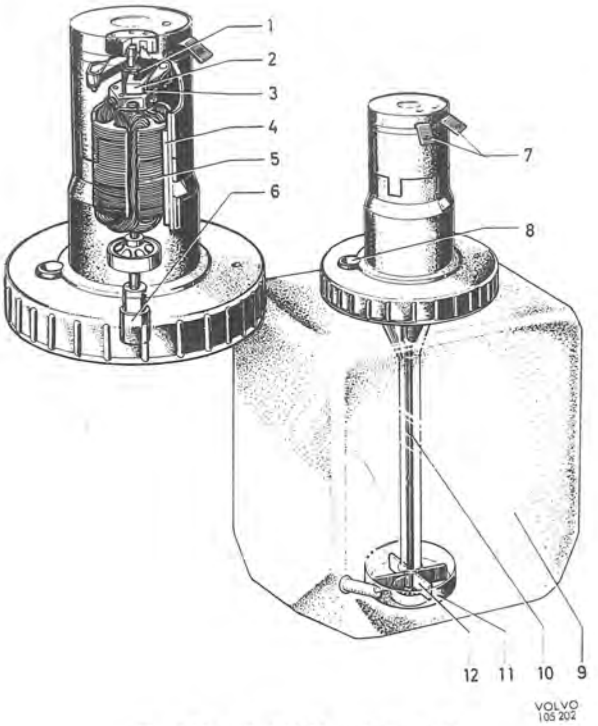


Fig. 3-88. Windshield washer, type I

1. Commutator
2. Brush
3. Spring
4. Fermanent magnet
5. Rotor
6. Flange
7. Connecting lips
8. Wiper fluid hose hole
9. Container
10. Shaft
11. Pump housing
12. Pump impeller

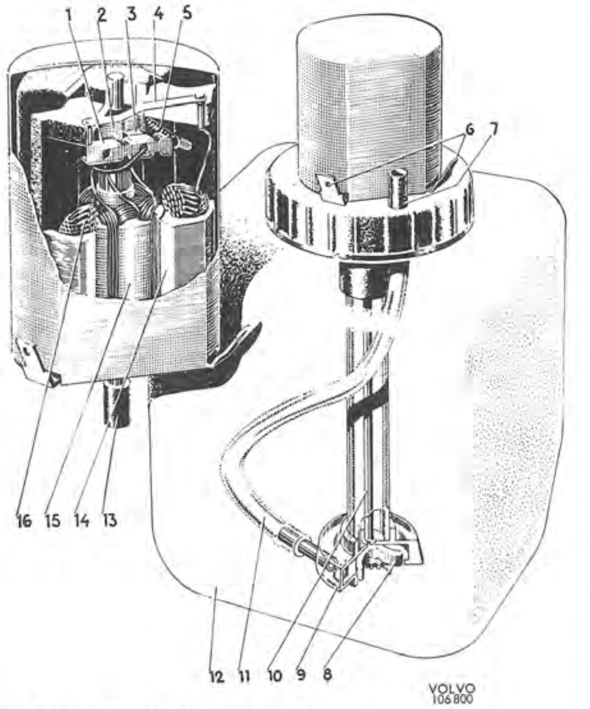


Fig. 3-89. Windshield washer, type II

1. Brush holder
2. Commutator
3. Brush
4. Thermal fusing
5. Spring
6. Connections lips
7. Water outlet
8. Pump impeller
9. Pump housinc
10. Shaft
11. Hose
12. Container
13. Flange
14. Stator
15. Rotor
16. Field winding

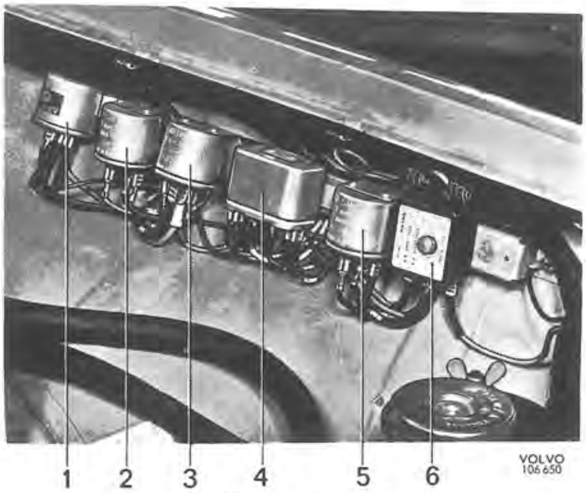


Fig. 3-90. Control relays

1. Foglight relay
2. Reversing light relay (or start relay for vehicles with automatic transmission)
3. Main relay
4. Step relay for dipped/fullbeam switching
5. Horn relay
5. Fusebox for foglights and fuel pump

CONTROL RELAYS

As standard the car is fitted with five control relays. Four of them are mounted on a holder situated on the left-hand wheel arch, see Fig. 3-90. The fifth relay, for the electrically heated rear window, is placed under the dashboard, to the right of the car heater, see Fig. 3-91. The relay cuts out current to the rear window, when the ignition is shut off, this in order to prevent the battery from being discharged when the engine is switched off.

Vehicles with automatic transmission are fitted with a start relay instead of a control relay for the back-up lights.

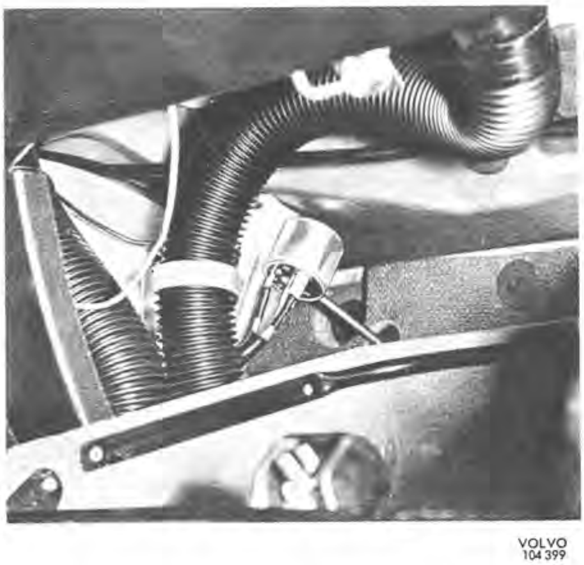


Fig. 3-91. Control relay for rear window defroster

TRUNK/ENGINE COMPARTMENT LIGHTING

The vehicle is equipped with trunk and engine compartment lighting which automatically switches on when the trunk lid or the engine bonnet is opened. In a later type the automatic switches for the lights have been provided with a stop to permit also manual switching on and off.

FUSES

The fuses are mounted in a fusebox secured to a bracket fitted on the car heater behind an opening in the protection panel under the dashboard.
The fuses for the fog lights are mounted in a fusebox on a holder situated on the left-hand wheel arch, see Fig. 3-90.

BRAKE LIGHT SWITCH

The brake light switch is placed on the pedal carrier beneath the dashboard. It is operated mechanically by the brake pedal.

REPAIR INSTRUCTIONS

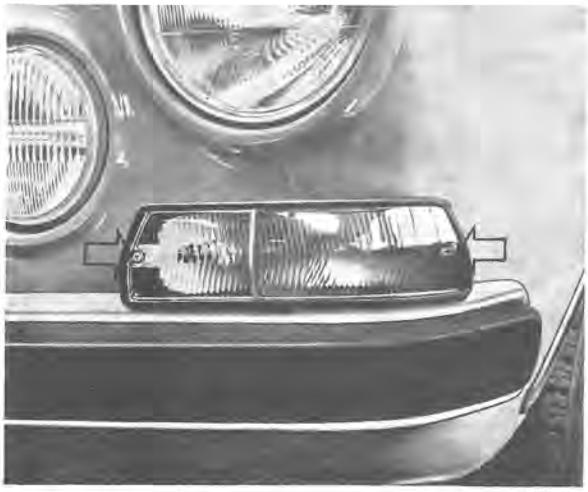


Fig. 3-92. Screws holding glass for directional flashers

REPLACING DIRECTIONAL INDICATOR LEVER SWITCH

Remove the screws holding the plastic covers (one screw for the upper cover, three screws for the lower cover) and remove the covers. Remove the screws holding the switch. (If the vehicle is fitted with an overdrive, the bracket holding the switch for the overdrive must first be removed.) Replace the switch and secure the new one firmly. Fit the plastic covers.

REPLACING IGNITION SWITCH

Remove the plastic covers round the ignition switch. Remove the ignition switch from the steering wheel lock by taking off the two screws holding the ignition switch to the steering wheel lock. Replace the

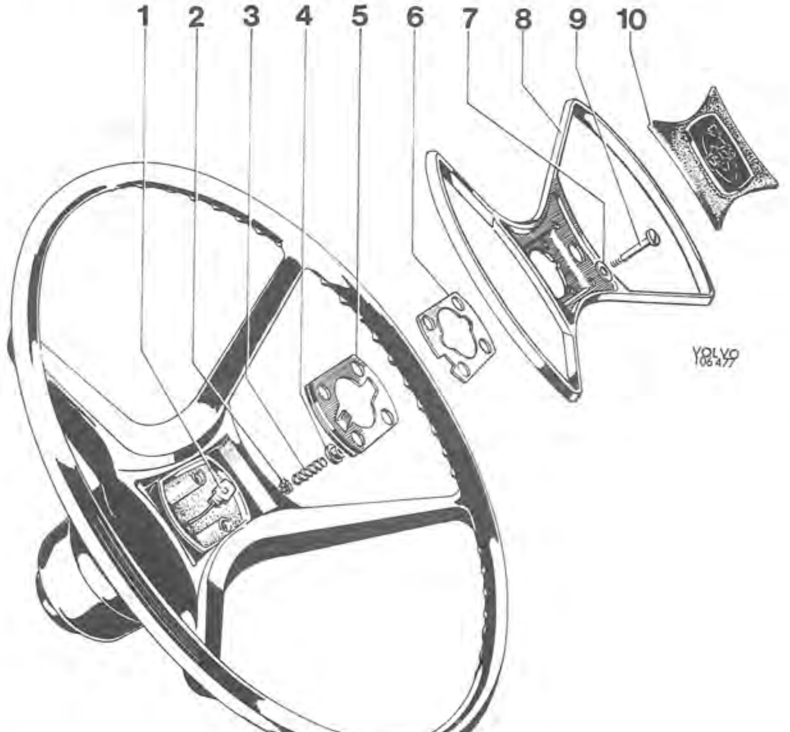


Fig. 3-92. Horn signal assembly

1. Horn cable
2. Tab washer
3. Spring
4. Bush
5. Contact washer
6. Insulating washer
7. Washer
8. Hornring
9. Stop screw
10. Shock guard

ignition switch and fit the new one on the steering wheel lock. Re-fit the plastic covers.

REMOVING AND ADJUSTING HORN RING

Remove the shock guard (10, Fig. 3-93) by inserting a screwdriver in under the guard and levering it off. Remove the electric cable (1) and the four screws (9). The horn is adjusted with the four screws (9, Fig. 3-136) so that a signal is obtained with light pressure on the horn ring, irrespective of where the pressure is applied to the ring.

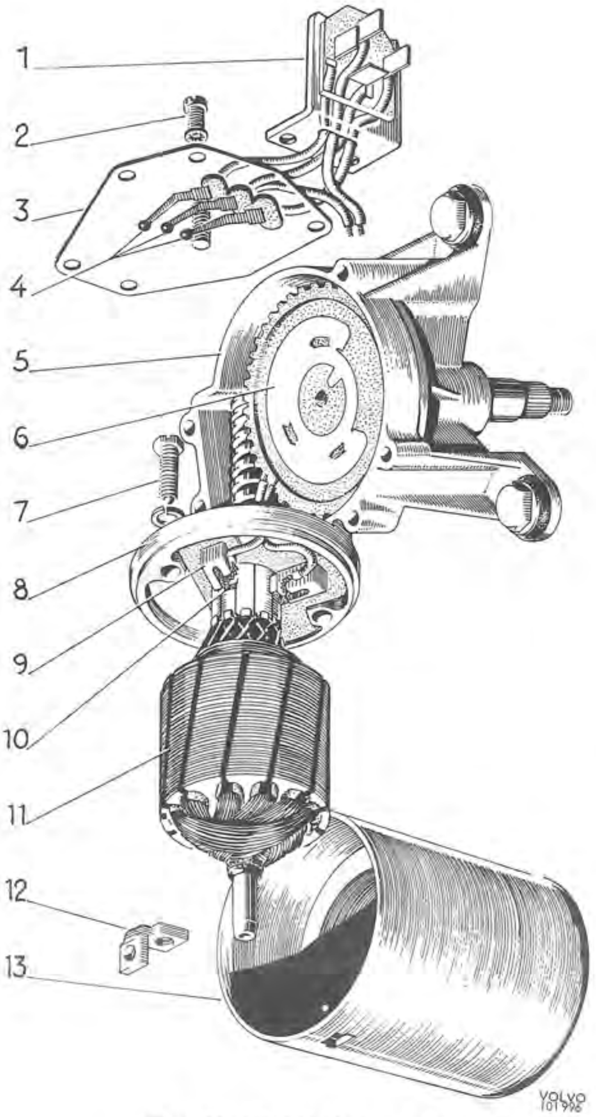


Fig. 3-94. Windshield wiper motor

1. Terminal contact
2. Screw
3. Cover
4. Contacts
5. Housing
6. Gear
7. Screw
8. End
9. Brush holder
10. Brush
11. Rotor
12. Nut
13. Stator

WINDSHIELD WIPERS

REMOVING WINDSHIELD WIPER UNIT, COMPLETE

Disconnect the negative (ground) battery lead from the battery. Remove the wiper arms. Take off the panel under the dashboard. Remove the heater switch. Take off the combined instrument. See Group 38. Remove the intermediate defroster nozzle and its hoses. Remove the wiper motor.

Disconnect the control cables for the heater. Remove the fusebox and disconnect the ground cables. Remove the choke control. Release the attaching screws for the wiper frame and carefully pull out the frame.

DISASSEMBLING WINDSHIELD WIPER MOTOR

Remove the nut on the outgoing shaft and tap loose the crank arm.

Release the five screws (2, Fig. 3-94) and bend the cover (3) out of the way, then press out the plastic gear wheel. Remove the screws (7) and pull out the stator. Remove the screws for the negative brush and the washer on the ball bearing axial lock. Remove the washer for the axial lock. Move the brushes aside and carefully pull out the rotor. Take great care with the brushes since the ball bearing has a larger diameter than the cummutator.

When assembling the motor, adjust the axial play of the plastic gear wheel (6) by means of the adjusting screw in the cover.

INSTALLING WINDSHIELD WIPER UNIT COMPLETE

Fit the wiper frame. Install the intermediate defroster nozzle. Re-fit the fusebox and secure the ground cables. Secure the control cables.

Fit the wiper motor. Fit the choke control and also the combined instrument. Install the switch for the heater. Fit the wiper arms and the battery lead.

Fig. 3-95. Removing switch nut

REMOVING SWITCHES

To remove the lighting switch, first unscrew the switch knob and release the nut with a crosshead screwdriver, see Fig. 3-95.
The knob is screwed onto the threaded switch rod.

REPLACING THE 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 TRUNK OR ENGINE COMPARTMENT LIGHT BULB

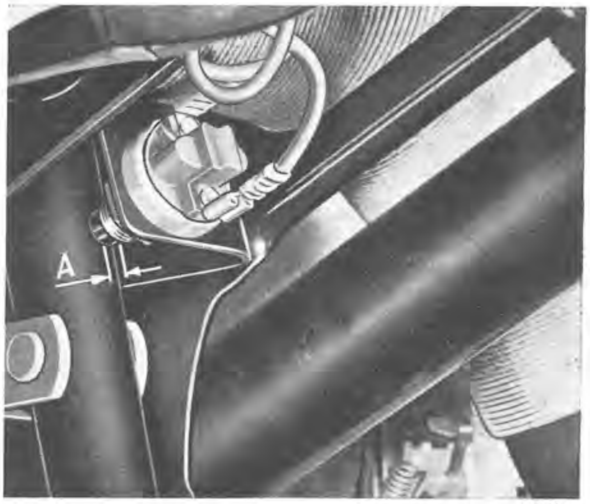
Remove the plastic cover over the bulb by unscrewing the screw securing the cover. Replace the bulb. Re-fit the plastic cover and screw it on securely. Make sure that the tab on the plastic cover is fitted correctly.

REPLACING BRAKE LIGHT CONTACT

When replacing the brake light contact, make sure that the new contact is adjusted correctly so that it functions satisfactorily. The distance between the brake pedal released and the threaded bronze hub on the contact should be 4±2 mm (0.16±0.08") (A, Fig. 3-97). If the distance must be adjusted, release the attaching screw for the bracket and move the bracket until the correct distance is obtained.

VOLVO 104490

Fig. 3-96. Engine (or trunk) compartment light



VOLVO 103332

Fig. 3-97. Brake light contact

INSTRUMENTS

TOOLS

Fig. 3-98. Special tool for removing and fitting tank armature

DESCRIPTION

INSTRUMENTATION

Instrumentation consists of a combined instrument, see Figs. 3-99 and 3-100, comprising speedometer, mileometer and trip meter, voltage stabilizer fed temperature gauge and fuel gauge, warning lamps and rheostat controlled instrument lighting. The temperature gauge, fuel gauge, warning and instrument lighting lamps, voltage stabilizer and rheostat for the instrument lighting are mounted on a common base plate, see Figs. 3-101 and 3-102.

VOLVO
103282

Fig. 3-99. Combined instrument, front side

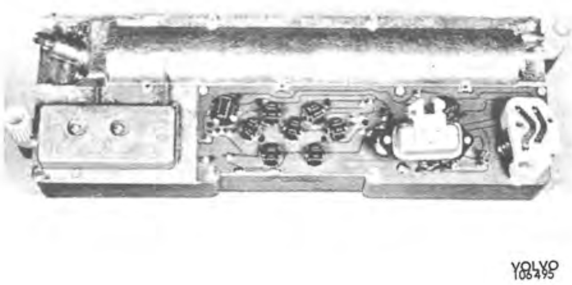


Fig. 3-100. Combined instrument, reverse side

Fig. 3-101. Mounting plate with instruments and warning lamps

Fig. 102. Instrument base plate, reverse side, with warning lamp and instrument lighting lamp

SPEEDOMETER

The speedometer is of the eddy current type. In the speedometer there is a permanent magnet which is mechanically connected with a speedometer cable driven from a worm gear on the gearbox. Surrounding the magnet is a drum, coil spring and roller mounted on a separate shaft. Rotation of the magnet generates eddy currents which produce a turning torque on the drum. The coil spring limits the degree of torque when the speed of the magnet increases. The effect of magnet and coil spring is balanced so that the rotational speed of the roller gives a reading proportional to the speed of the car.
The mileometer and trip meter are driven by a gear drive in the combined instrument.

TEMPERATURE GAUGE

Temperature is measured electrically by means of an instrument of bimetal type. This unit consists of a sender, fitted to the engine, and a registering instrument, mounted in the combined instrument, which is fed through a voltage stabilizer. The sender is of the semi-conductor type, i.e. it contains a semi-conductor, the electrical resistance of which alters with the ambient temperature. The amount of current passing through the sender is proportional to the temperature registered by the instrument.
The amount of current passing through the sender and instrument determines the degree of heat in the bimetal of the instrument and, correspondingly, the reading. As the engine warms up, a higher current is passed through the sender and results in a higher instrument indication.

FUEL GAUGE

The amount of fuel in the tank is measured electrically. Measurement is achieved by means of an indicating instrument of bimetal type and a pickup mounted in the fuel tank. Current is fed through the same voltage stabilizer as for the temperature gauge. The pickup consists of a variable resistor, a lever and a float. Depending upon the amount of fuel in the tank and, correspondingly, the position of the float, a large or lesser part of the pickup resistor is in circuit. The bimetal instrument used here is of the same type as that in the temperature gauge.

VOLTAGE STABILIZER

The temperature and fuel gauges are powered by a voltage of approx. 5.1 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 bimetal spring of the stabilizer 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, thereby producing a regulated effect corresponding to a constant voltage of approx. 5.1 volts. 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 LAMPS

CHARGING

The charging warning lamp is connected to D + (61) on the alternator. The warning lamp 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 is extinguished thus indicating that the alternator is charging.

DIRECTIONAL INDICATORS

The control lamp for the directional indicators flashes when the indicators are engaged. It also flashes when the warning signal flashes are switched on, since the control lamp for these flashers is located in the knob of the traffic indicator switch.
The control lamp for the directional indicators is connected between the flasher sender connection P(c) and the body.

BRAKES

The brake warning lamp receives current from the ignition lock and can be earthed by two procedures. When the parking brake is applied the warning lamp is earthed by a switch, Fig. 3-100, and thus lights, and continues to do so, as long as the parking brake is applied. Should a fault occur in one of the circuits of the hydraulic brake system so that the difference in pressure between the circuits, on application of the brakes, rises to more than 8—10 kg/cm² (114—142 psi), a warning valve, Fig. 3-100, closes and the warning lamp is lit. The warning lamp signals until the fault in the brake system has been remedied and the warning valve is reset. Concerning resetting the warning valve, see Part 5, Brakes, Group 52.

FULL-BEAM HEADLIGHTS

A warning lamp for full leadlights is lit simultaneous to the full-beam headlights. The warning lamp is connected in parallel with the full-beam headlights at the step relay.

OIL PRESSURE

The warning lamp for oil pressure receives current via the ignition lock and is earthed through a pressure sensitive valve on the engine. With the engine running and at normal pressure, the connection between this lamp and earth, through the engine, is

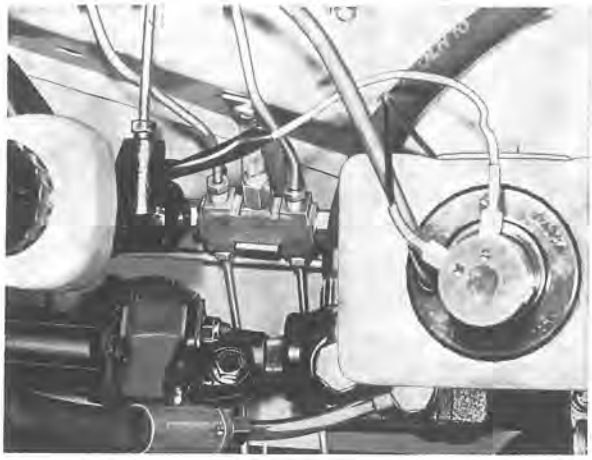


Fig. 3-104. Warning valve

open. When the oil pressure sinks below a pre-determined value the pressure sensitive valve closes the circuit and the warning lamp lights.

OVERDRIVE

The control lamp for the overdrive is located on the combined instrument and lights during the time the overdrive is engaged. It is connected between the switch for the overdrive and body.

ELECTRICALLY HEATED REAR WINDOW

The control lamp for the electrically heated rear window is mounted in the switch knob. It lights when the heating is engaged for the rear window.

CLOCK

Vehicles for markets except U.S.A. are fitted with a electric clock which is located in a panel on the propeller shaft tunnel.

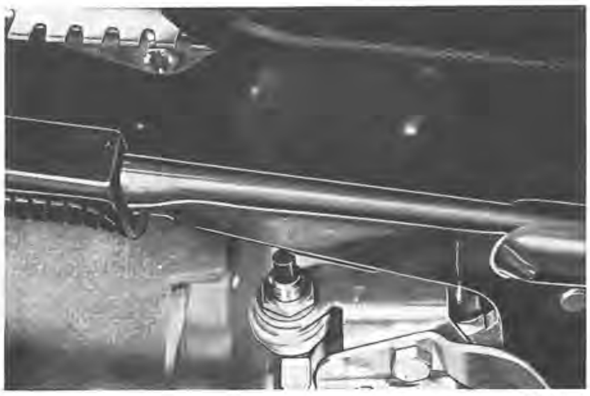


Fig. 3-103. Switch for handbrake warning lamp

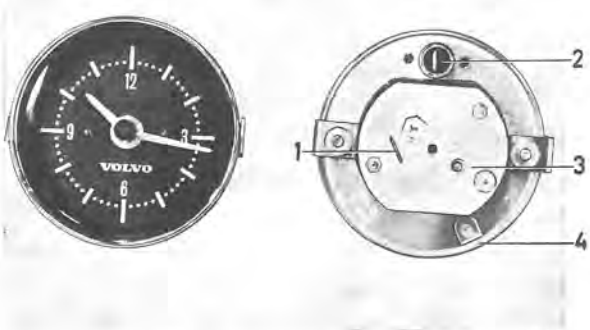


Fig. 105. Electric clock, front and reverse

1. Battery terminal
2. Instrument light bulb
3. Inching screws
4. Ground terminal

During work under the dashboard and instrument panel, the ground cable should de disconnected from the battery to avoid short circuits.

REMOVING THE COMBINED INSTRUMENT

Remove the panel below the dashboard by loosening the two fixing screws, one on the left-hand side of the body and one beside the glove compartment. Then pull the upper section of the panel rearwards so that is loosens from the clips in the dashboard and loosen the panel from the bonnet release mechanism. Remove the controls for the heater unit and the speedometer cable, and also the flange nuts for the instrumentation. Turn the instrument 1/4 turn so that the reverse side of the instrument faces upwards. Detach the electrical connections from the instrument. The instrument can then be lifted out through the opening in the panel.

REPLACING WARNING LAMPS AND INSTRUMENT LIGHTING LAMPS

The lamps on the instrument panel, see Fig. 3-102, are mounted in holders which are turned anti-clockwise for removal. The bulbs are released from their holders by pulling them straight out.
The warning lamp for the overdrive is accessible by pulling the holder straight out.
The switch knob must be screwed off in order to reach the warning lamp for heating the rear window.
To replace the warning lamp for the emergency signal flashers, first remove the glass and then the circlip in the switch knob.

REMOVING INSTRUMENT BASE PLATE

Pull loose the control knob for the rheostat. (This knob is damaged by removal and must always be exchanged for a new one. It may be necessary to break the knob with, e.g., pliers. (The new knob is fitted by pressing it onto the shaft from the rheostat.) Loosen the screws for the rheostat and pull it out from the spade terminals. Loosen the five remaining screws and lift up the instrument base plate.

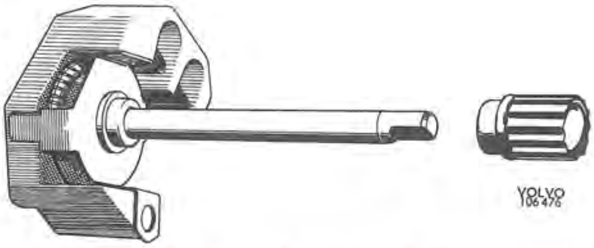


Fig. 3-106. Rheostat for instrument lighting

REMOVING THE FIXING PLATE FOR SPEEDOMETER AND MILEOMETER/TRIP METER

Loosen the snap rings for the attaching nuts and remove the nuts. Loosen the five screws which hold the fixing plate. The fixing plate can be lifted out after all screws for the instrument plate have been removed and the plate is only held in place by the rheostat shaft.
Any repairs or adjustment to the speedometer should always be carried out by an authorized instrument workshop.

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 not bent too sharply. At no point must the radius of a bend be less than 100 mm (4"). If the bending radius is less than this, vibration and noise can occur in the

Fig. 3-107. Speedometer with mileometer and trip meter

instrument. The drive couplings must run true in the outer casing of the cable. This is checked with the cable rotating.

REMOVING AND CHECKING TEMPERATURE GAUGE

The sender and indicating instrument are not repairable and the entire unit must be replaced if damaged. The indicating instrument can be separated from the detached instrument panel when the voltage stabilizer has been removed and the nuts holding the instrument are accessible.
The indicating instrument should be checked with an ohmmeter. The resistance should be approx. 12.5 ohms. Measurement is suitably carried out between the nuts on the reverse side of the instrument plate. On no account should the indicator instrument be checked by connecting the sender cable to the car chassis as this will damage the instrument mechanism (too high a voltage on the instrument resistor and overheating of the bimetal spring). If no ohmmeter is available, the above test can be carried out by placing a 10 ohms resistance between the sender cable and the ground connection on the chassis.
The sender should also be checked with an ohmmeter. Resistance in the sender should, at room temperature, be approximately 200 ohms.
The indicating instrument can also be checked by connection to a 12 volt battery, via a voltage stabilizer, and with a previously checked pickup coupled in series. On heating the sender both the instruments should show a corresponding temperature. A check can suitably be made with a thermometer (sender and thermometer submersed in heated water). Checking values are as follows:

Beginning of green area (at ("C")	40° C (105° F)
At dividing line between green areas	70° C (150° F)
At dividing line between green and red areas	100° C (212° F)

If checking is carried out with on instrument which is mounted on the instrument plate, then a 12 volt supply should be connected to terminal 2 on the instrument plate (see wiring diagram), the sender to terminal 8 and the ground cable to terminal 16. Do not forget to ground the sender.

REMOVING AND CHECKING FUEL GAUGE

The pickup and fuel gauge are not repairable and must be exchanged if faulty or damaged.
The gauge can be removed from the detached instrument panel when the voltage stabilizer and rheostat have been loosened and the nuts to the instrument are accessible. The fuel gauge should be checked with an ohmmeter. The resistance should be approx. 12.5 ohms. Measurement can suitably be carried out between the nuts on the rear side of the instrument plate.
Checking of the gauge by connecting the pickup lead to earth is not permitted as this will damage the gauge (excessive loading on the resistor wire and overheating of the bimetal spring). If no ohmmeter is available the test can be carried out by connecting a 10 ohms resistor between the lead and grounding point on the chassis.
The pickup, Fig. 3-109, can be removed after the carpet and wooden fibre board in the trunk have been lifted

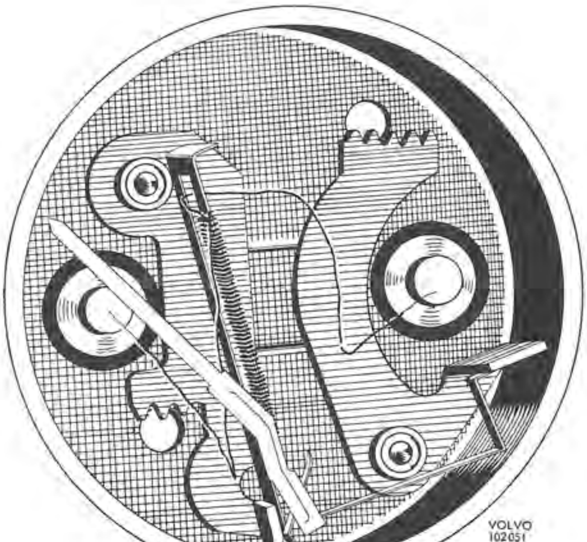


Fig. 3-108. Bimetal type registering instrument

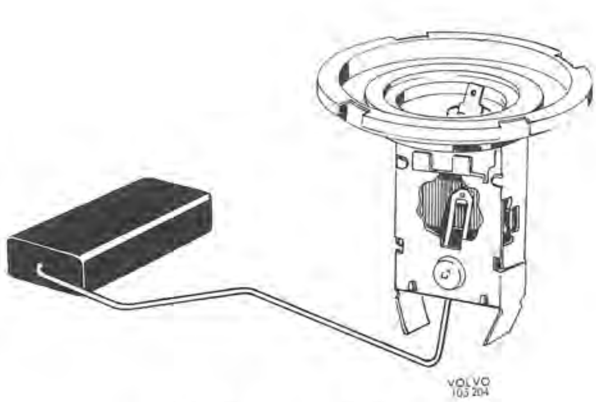


Fig. 3-109. Pickup for fuel gauge

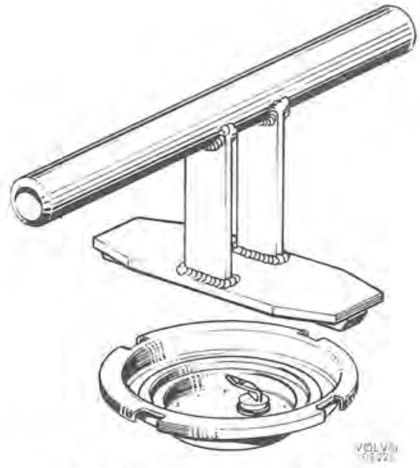


Fig. 3-110. Tool for removing pickup

out. The pickup is attached by means of a bayonet fitting. When removing, use tool SVO 2935 as shown in Fig. 3-110. The pickup should be checked with an ohmmeter.

At the upper stop the pickup should have a resistance of approx. 10 ohms and at the lower, approx. 60—85 ohms. Movement of the float arm should not result in a break in the circuit (reading).

CHECKING VOLTAGE STABILIZER

The voltage stabilizer, see Fig. 3-111, is spring-suspended in a rubber block and connected to the combined instrument by means of three cables.

A functional test on the voltage stabilizer can be carried out with a temperature gauge or a fuel gauge. The instrument (temperature or fuel gauge), is connected in series with a resistance of approximately 12 ohms (instead of pickup) and a constant direct current voltage of 5.1 volts. The reading is then noted. After this the constant direct current is replaced by a 12 volt battery and a voltage stabilizer. Do not omit to connect the cover of the stabilizer to earth. During testing, the stabilizer must lie in the same position as it does in the car. A damaged stabilizer must be replaced by a new unit since it cannot be repaired.

Fig. 3-111. Voltage stabilizer

Pos.	Title	Data
1.	Dir. ind. flashers	32 CP
2.	Parking lights	5 W
3.	Headlight dipped beams	40 W
4.	Headlight main beams	45 W
5.	Distributor firing order	1-5-3-6-2-4
6.	Battery	12 V 60 Ah
7.	Conn. at instrument	
8.	Connector	
9.	Part of 6-pole conn. unit	
10.	Horn ring	
11.	Ignition coil	
12.	Relay for horn	
13.	Starter motor	1.0 hp
14.	Brake warning switch	
15.	Resistor	
16.	Main relay, ignition switch	
17.	Cigarette lighter	
18.	Dip relay for main and dipped beams and headlight flasher	
19.	Alternator	12 V 55 A
20.	Horn	
21.	Warning lamp for main beams	1.2 W
22.	Fusebox	
23.	Flasher unit	
24.	Engine comp. light	18 W
25.	Charging regulator	
26.	Contact, glove compartment light	
27.	Glove compartment light	2 W
29.	Brake contact	
30.	Brake warning lamp	
31.	Oil pressure warning lamp	1.2 W
32.	Battery charging warning lamp	1.2 W
33.	Oil pressure switch	1.2 W
34.	Switch for dir. ind. and headlight flashers	
35.	Voltage stabilizer	
36.	Fuel gauge	
37.	Temperature gauge	
38.	Temperature gauge sensor	
39.	Flashers, warning lamp	
40.	Instrument panel light	1.2 W
41.	Heater control light	2×3 W
42.	Luggage comp. light	3×1.2 W
43.	Windshield wipers	18 W
44.	Heater	
45.	Windshield washer	
46.	Interior lamp	
47.	Switch for heater	10 W
48.	Switch for windshield wipers and washer	
49.	Rheostat, instrument panel light	
50.	Light switch	
51.	Ignition switch	
52.	Door switch	
53.	Switch, elec. heated rear window	
54.	Elec. heated rear window	
55.	Switch for parking brake control	
56.	Fuel gauge tank unit	
57.	Reverse lights	
58.	Brake stoplights	32 CP
59.	Tail lights	32 CP
60.	License plate light	5 W
61.	Overdrive warning lamp	2×5 W
62.	Switch for overdrive	1.2 W
63.	Switch, overdrive on gearbox	
64.	Solenoid for overdrive	
65.	Contact on transmission BW 35	
66.	Contact for reverse lights (M400 and M410 only)	
67.	Relay for reverse lights on M400, M410 and starter relay on BW 35	
68.	Side marker lights	
69.	Warning buzzer, ignition key	5 W
70.	Door switch on driving side	
71.	Foglights	
72.	Fusebox for foglights	
73.	Relay for foglights	
74.	Switch for foglights	
75.	Clock	
76.	Switch for emergency warning flashers	
77.	Choke warning lamp	
78.	Choke contact	
79.	Warning buzzer, lights	
80.	Shift positions light, aut. trans.	
81.	Contact, seat buckle, passenger	
82.	Contact, passenger seat	
83.	Warning buzzer, safety belts	
84.	Warning lamp, safety belts	
85.	Relay, safety belts	
86.	Contact, gearbox M41	
87.	Contact, seat buckle, driver	

Colour code

GN-R	=	Green-red
SB	=	Black
W	=	White
Y	=	Yellow
GN	=	Green
GR	=	Grey
BL	=	Blue
R	=	Red
BR	=	Brown
BL-Y	=	Blue-yellow
W-R	=	White-red

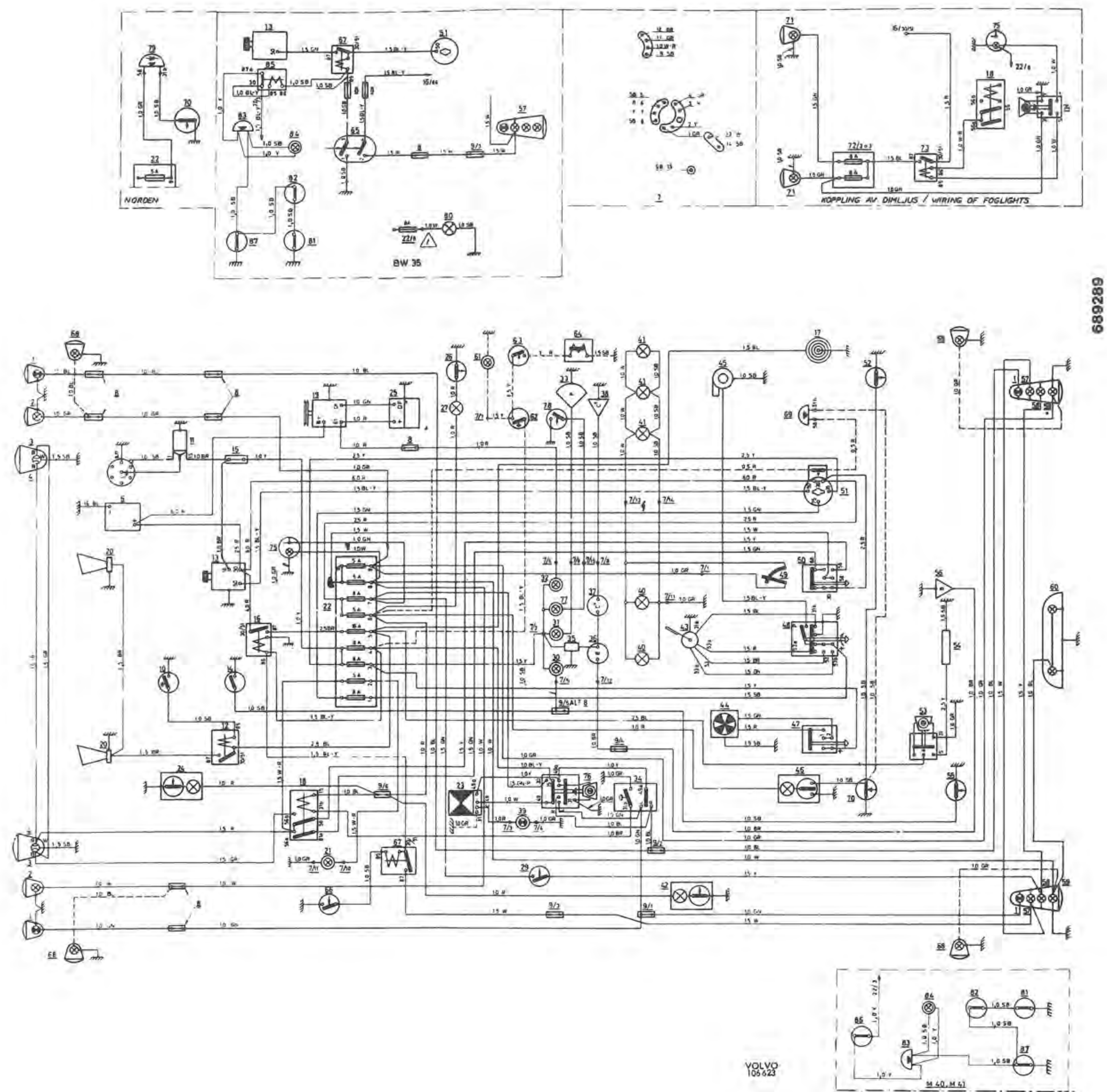


Illustration 3-A. Wiring diagram. 164 Carb. engine

Pos.	Title	Data
1.	Dir. ind. flashers	32 CP
2.	Parking lights	5 W
3.	Headlight dipped beams	40 W
4.	Headlight main beams	45 W
5.	Distributor firing order	1-5-3-6-2-4
6.	Battery	12 V 60 Ah
7.	Conn. at instrument	
8.	Connector	
9.	Part of 6-pole conn. unit	
10.	Horn ring	
11.	Ignition coil	
12.	Relay for horn	
13.	Starter motor	1.0 hp
14.	Brake warning contact	
15.	Resistor	
16.	Main relay, ignition switch	
17.	Cigarette lighter	
18.	Dipped relay for main and dipped beams and headlight flashers	
19.	Alternator	12 V 55 A
20.	Horn	
21.	Main beams warning lamp	1.2 W
22.	Fusebox	
23.	Switch, emergency warning flashers	
24.	Engine comp. light	18 W
25.	Charging regulator	
26.	Switch, glove locker light	
27.	Glove light	2 W
29.	Brake contact	
30.	Brake warning lamp	1.2 W
31.	Oil pressure warning lamp	1.2 W
32.	Battery charging warning lamp	1.2 W
33.	Oil pressure sensor	
34.	Switch for dir. ind. and headlight flashers	
35.	Voltage stabilizer	
36.	Fuel gauge	
37.	Temperature gauge	
38.	Temperature gauge sensor	
39.	Flashers warning lamp	1.2 W
40.	Instrument panel light	2×3 W
41.	Heater control light	3×1.2 W
42.	Luggage comp. light	18 W
43.	Windshield wipers	
44.	Heater	
45.	Windshield washer	
46.	Interior light	10 W
47.	Switch for heater	
48.	Switch for windshield wipers and washer	
49.	Instrument panel light rheostat	
50.	Light switch	
51.	Ignition switch	
52.	Door contact	
53.	Switch, elec. heated rear window	
54.	Elec. heated rear window	
55.	Contact for parking brake warning lamp	
56.	Fuel gauge tank unit	
57.	Reversing lights	32 CP
58.	Brake stoplights	32 CP
59.	Tail lights	5 W
60.	License plate light	2×5 W
61.	Overdrive warning lamp	1.2 W
62.	Switch for overdrive	
63.	Switch for overdrive on gearbox	
64.	Solenoid for overdrive	
65.	Contact on aut. trans. BW 35	
66.	Contact for reversing lights (M400 and M410 only)	
67.	Relay for reversing lights on M400, M410 and starter relay on BW 35	
68.	Side marker lights	5 W
69.	Warning buzzer, ignition key	
70.	Door contact on driving seat side	
71.	Foglights	
72.	Fusebox	
73.	Relay for foglights	
74.	Switch for foglights	
75.	Clock	
76.	Electronic control unit	
77.	Throttle valve switch	
78.	Pressure sensor	
79.	Relay for fuel pump	
80.	Fuel pump	
81.	Main relay for fuel injection	
82.	Temperature sensor I	
83.	Thermal timer contact	
84.	Temperature sensor II	
85.	Triggering contacts	
86.	Injection valves	
87.	Cold start valve	
88.	Spark plugs	
89.	Flasher unit	
90.	Warning buzzer, lights	
91.	Shift positions light	
92.	Contact, seat buckle, passenger	
93.	Contact, passenger seat	
94.	Warning buzzer, safety belts	
95.	Warning lamp, safety belts	
96.	Relay, safety belts	
97.	Contact, gearbox M41	
98.	Contact, seat buckle, driver	

Colcour code

SB	= Black
W	= White
Y	= Yellow
GN	= Green
GR	= Grey
BL	= Blue
R	= Red
BR	= Brown
BL-Y	= Blue-yellow
R-W	= Red-white

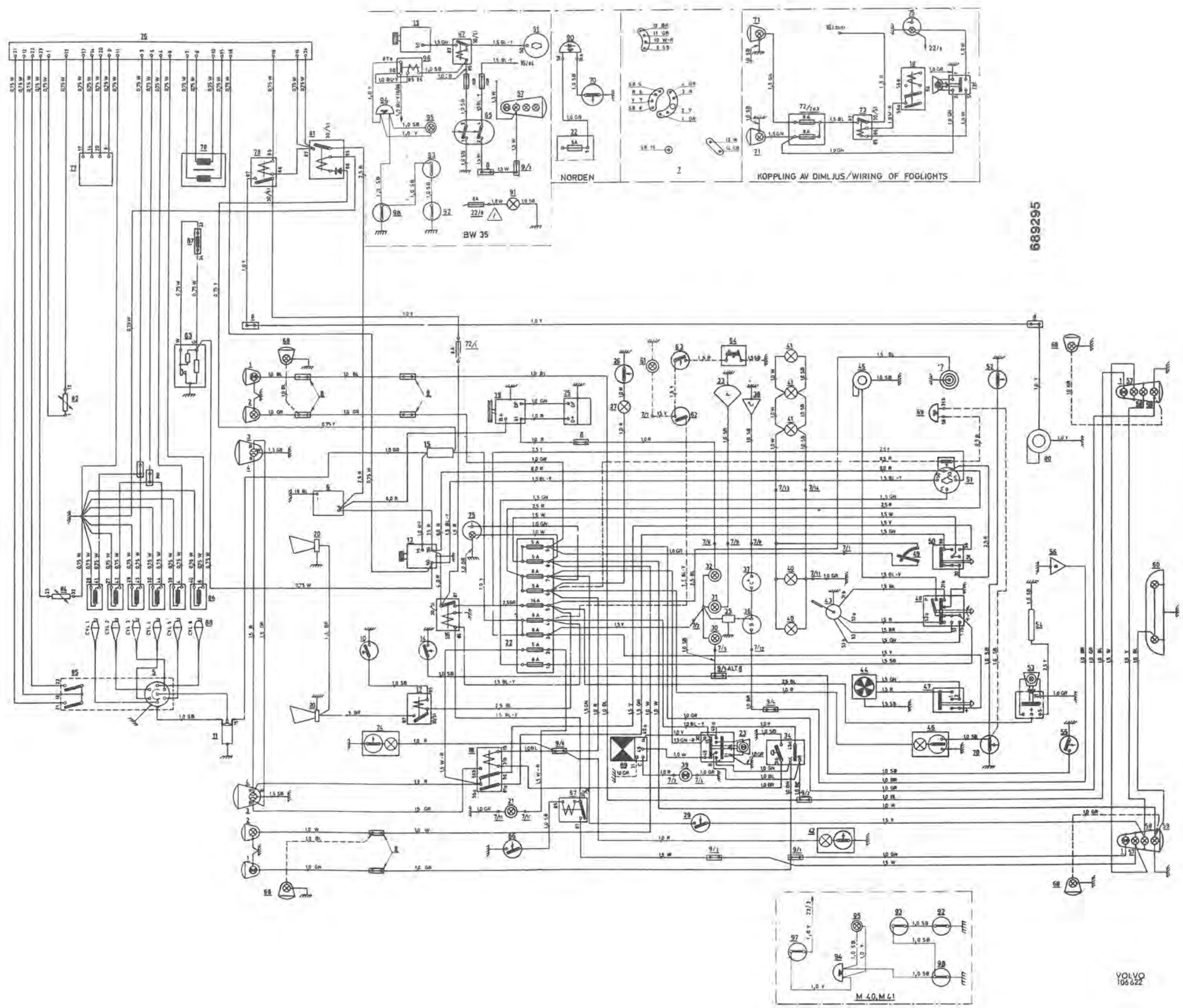


Illustration 3-B. Wiring diagram. 164 Fuel injection engine

Part 4

POWER TRANSMISSION
REAR AXLE

CONTENTS

GROUP 41

CLUTCH

TOOLS

The following tools are used for repairs on the clutch

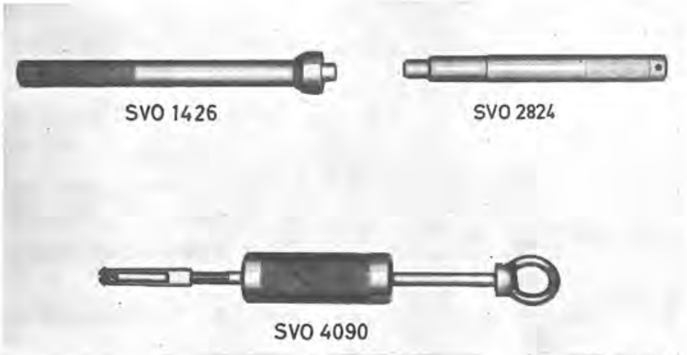


Fig. 4-1. Special tools

SVO 1426 Drift for pilot bearing in flywheel
SVO 2824 Mandrel for centering clutch plate
SVO 4090 Puller for ball bearing in flywheel

The designation SVO before the tool number is to be replaced by the number 999. This applies also to new production of older tools.

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.

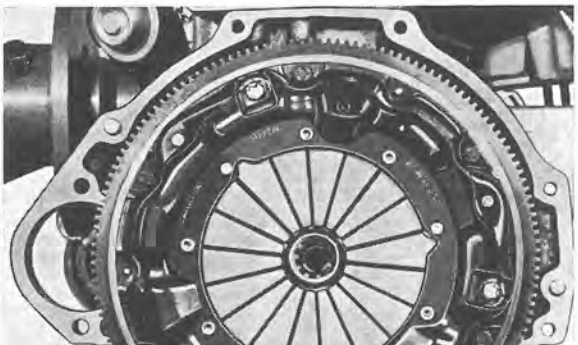


Fig. 4-2. Clutch

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 in the fork (3) on the clutch wire. If this adjustment is insufficient, for example, because of replacement of the clutch wire, the sleeve attachment to the clutch casing is moved by means of the nuts (1).

For right-hand steered vehicles, the corresponding play should be 2—3 mm (0.08—0.12") and adjustment is made by altering the length of the thrust rod.

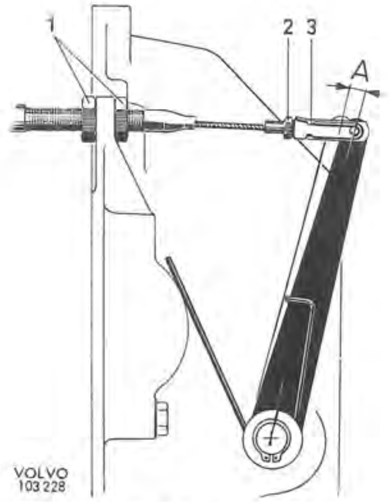


Fig. 4-3. Release lever play
A = 4—5 mm (0.16—0.20")
1. Adjusting nuts 2. Locknut 3. Fork

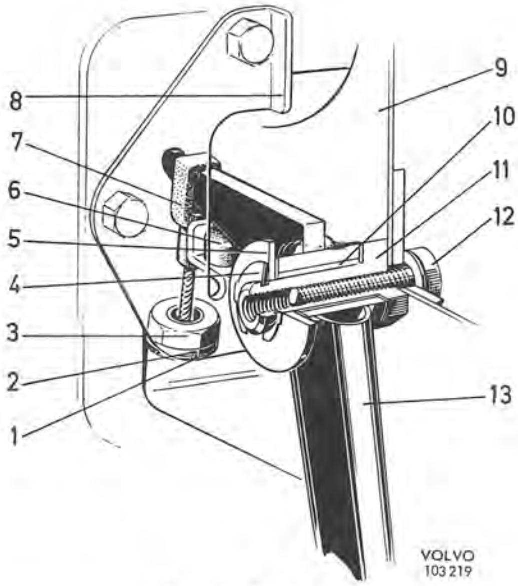


Fig. 4-4. Pedal carrier

1. Rubber bushing
2. Washer
3. Nut
4. Lock washer
5. Washer
6. Rubber stop
7. Clutch wire
8. Stop bracket
9. Bracket
10. Bush
11. Pedal shaft
12. Bolt
13. Clutch pedal

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. Release the bolts and remove the stop bracket for the pedal.
2. Unhook the wire from the pedal. Remove the circlip and lift off the pedal.
3. Drive out the old bushes with a suitable drift. Press in the new bushes. Lubricate them with grease.
4. If the pedal shaft is worn, replace it. It is fixed by means of a bolt.
5. Place the pedal on the shaft and fit the circlip.
6. Hook on the wire to the pedal. Fit the stop bracket. Adjust the pedal play.

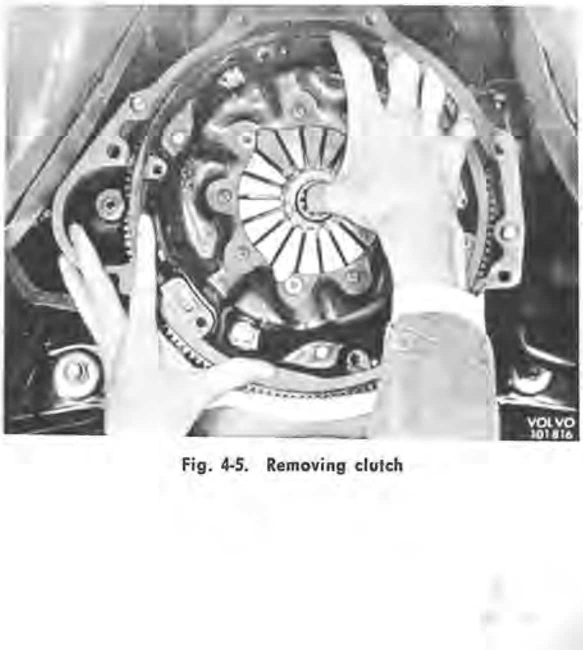


Fig. 4-5. Removing clutch

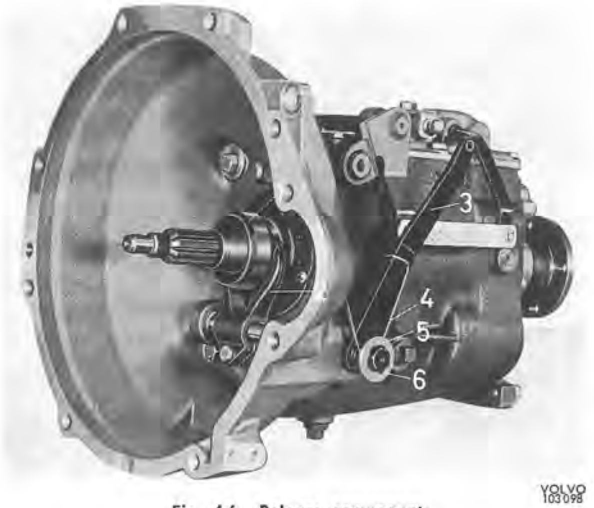


Fig. 4-6. Release components

1. Release bearing
2. Release fork
3. Release shaft and lever
4. Return spring
5. Washer
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 SVO 4090.
2. Pack the bearing with heat-resistant grease. Then fit it with the help of drift SVO 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 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.

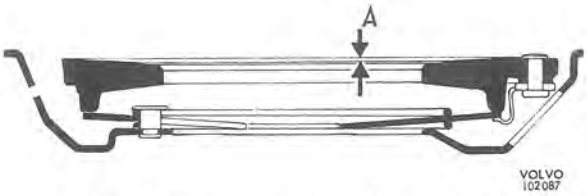


Fig. 4-7. Checking curvature of pressure plate

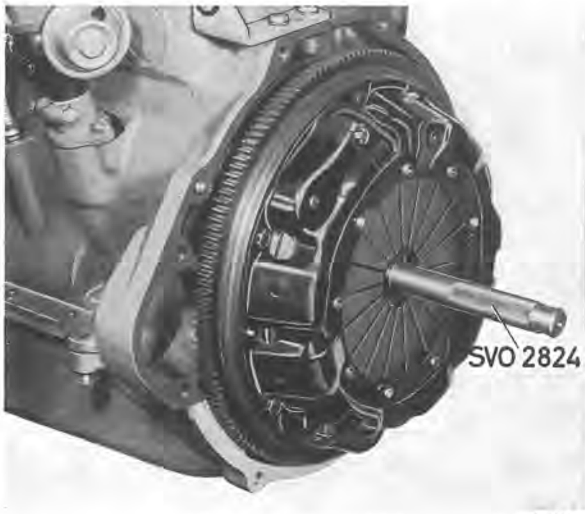


Fig. 4-8. Installing clutch

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 SVO 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.

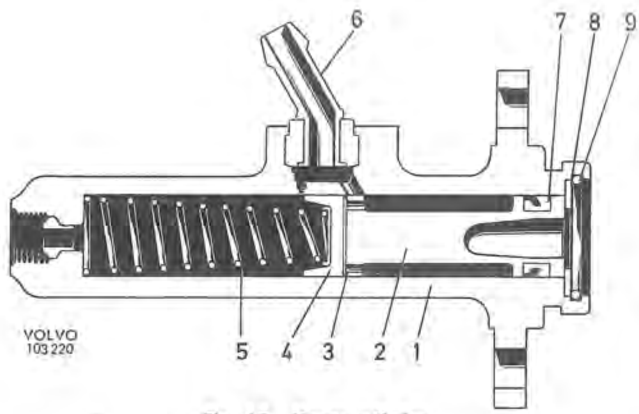


Fig. 4-9. Master cylinder

1. Cylinder
2. Piston
3. Washer
4. Piston seal
5. Spring
6. Connection pipe for fluid container
7. Piston seal
8. Washer
9. Circlip

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 other 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 venting hole in the rubber cover faces downwards.

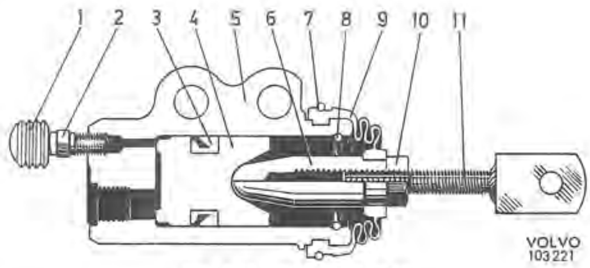


Fig. 4-10. Master cylinder

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

Installing

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

MASTER 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 master cylinder.

Disassembling

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

Inspecting

See under the heading "Inspecting the master cylinder", which applies where relevant.

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.

GEARBOX

TOOLS

The following special tools are used for repairs on the gearbox

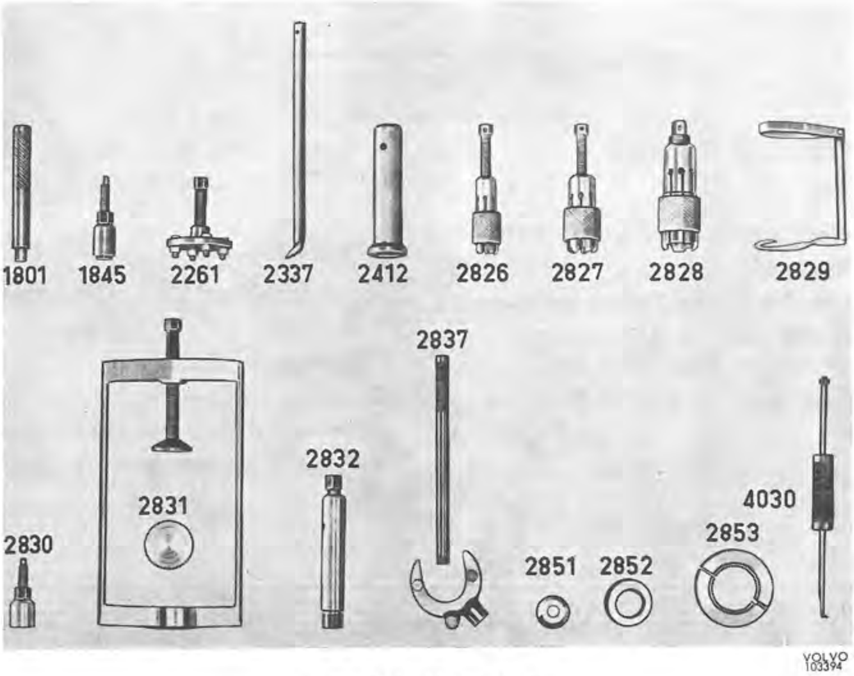


Fig. 4-11. Special tools

SVO 1801 Standard handle 18×200 mm
SVO 1845 Press tool for fitting the flange
SVO 2261 Puller for flange
SVO 2337 Drift for removing oil seal in cover for input shaft
SVO 2412 Drift for fitting oil seal in rear cover
SVO 2520 Stand, see Fig. 4-12. Used together with fixture SVO 2825
SVO 2727 Tool for suspending engine when removing and fitting gearbox, see Fig. 4-16
SVO 2825 Fixture for holding gearbox. Used together with stand SVO 2520
SVO 2826 Puller for front bearing on intermediate shaft
SVO 2828 Puller for rear bearing on mainshaft, M 400
SVO 2829 Device for lifting and installing the mainshaft in gearbox
SVO 2830 Puller for reverse shaft
SVO 2831 Press tool for fitting bearing on intermediate shaft and rear bearing on mainshaft
SVO 2832 Puller for rear bearing on mainshaft, M 410
Used together with SVO 2828
SVO 2833 Fixture for gearbox. Used on garage jack when removing and fitting gearbox, see Fig. 4-17
SVO 2837 Counterhold for flange (handle used only for automatic transmission)
SVO 2851 Drift for fitting oil seal in cover for input shaft
SVO 2852 Cushioning ring for fitting bearing on input shaft and synchronizers on mainshaft
SVO 2853 Ring for disassembling mainshaft
SVO 4030 Puller for oil seal at flange

The designation SVO before the tool number is to be replaced by the number 999. This applies also to new production of older tools.

Fig. 4-12. Stand SVO 2520 with fixture SVO 2825

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 4 B. 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 SVO 2261, see Fig. 4-14.
3. Pull out the old seal with puller SVO 4030. Fit the new oil seal with the help of sleeve SVO 2412.
4. Press on the flange with tool SVO 1845, see Fig. 4-15. Fit the other parts.

REMOVING

1. Secure lift tool SVO 2727 to the engine as shown in Fig. 4-16. The lifting hook is secured round the exhaust manifold.
2. Jack up the vehicle and place blocks underneath. Remove the oil from the gearbox.
3. Remove the gear lever. Disconnect the following:

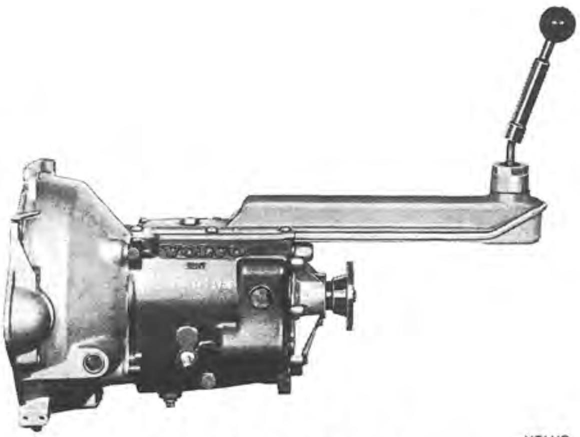


Fig. 4-13. Gearbox M 400

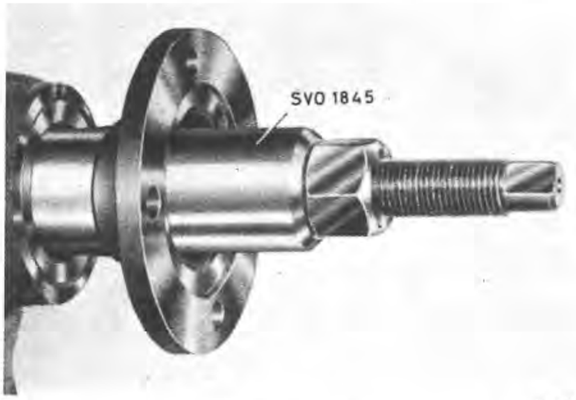


Fig. 4-15. Fitting flange

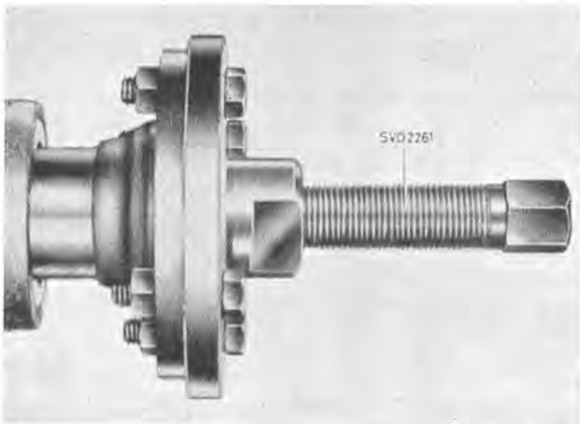


Fig. 4-14. Removing flange

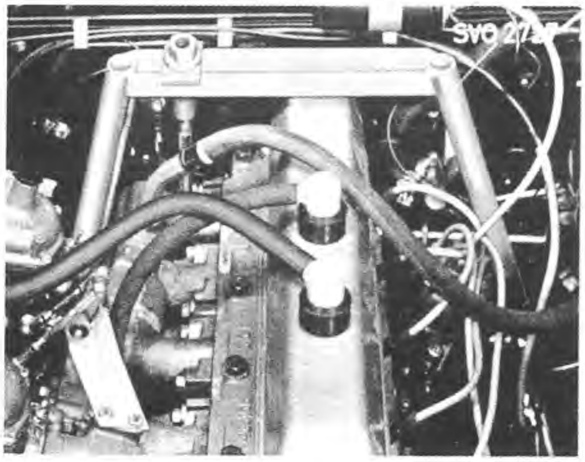


Fig. 4-16. Suspending engine

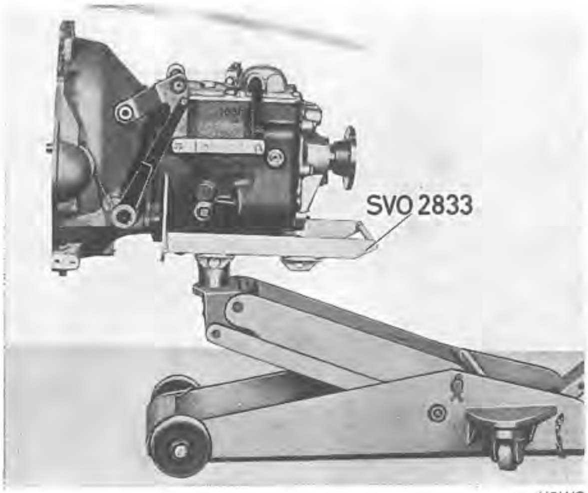


Fig. 4-17. Fixture for removing gearbox

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.

4. Release and remove the supporting member under the gearbox. Disconnect the bracket for the exhaust pipe. Disconnect the speedometer cable. Disconnect the propeller shaft.
5. Lower the rear end of the engine about 4.5 cm (1.8") and then slacken the lines for the reversing lights and overdrive if fitted.
6. Replace the lifting plate on the jack with fixture SVO 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. 4-17.

DISASSEMBLING

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

1. Fit fixture SVO 2825 in stand SVO 2520, see Fig. 4-12. Secure the gearbox in the fixture.
2. Slacken the bolts and lift off the gearbox cover. Remove the springs and the interlock balls for the selector rails.
3. Slacken the nut for the flange. Use for this tool SVO 2837. Pull the flange off with puller SVO 2261, see Fig. 4-14.
4. 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.
5. Turn the gearbox upside down. Pull out the front bearing of the intermediate shaft with tool SVO

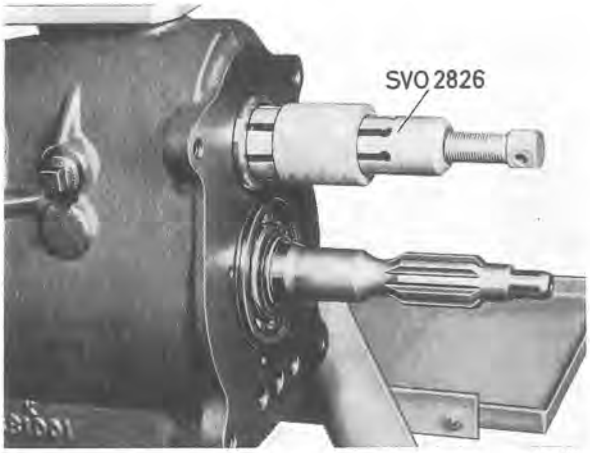


Fig. 4-18. Removing intermediate shaft front bearing

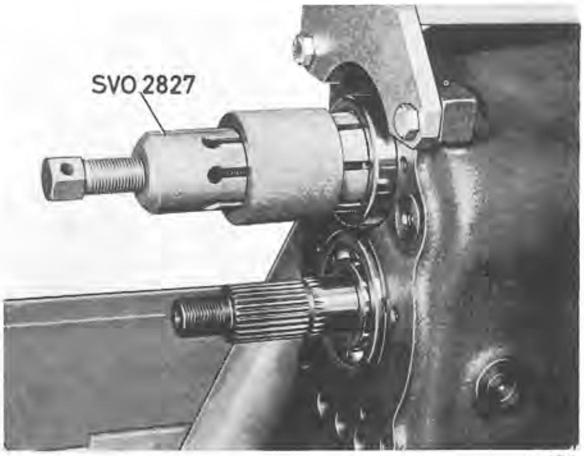


Fig. 4-19. Removing intermediate shaft rear bearing

2826, see Fig. 4-18. Remove the rear cover and then pull off the rear bearing of the intermediate shaft with tool SVO 2827, see Fig. 4-19.

6. Restore the gearbox to its normal position. While doing this ensure that the teeth of the intermediate shaft are not damaged when it drops down into the bottom of the gearbox.
7. 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.
8. Remove the speedometer gear. Pull out the rear bearing of the mainshaft with tool SVO 2828, see Fig. 4-20. If the bearing sticks in the gearbox housing, push the mainshaft forwards so that its drive and synchronizers go against the drive of the intermediate shaft. To prevent this, place a piece of flat iron or similar between the front end of the mainshaft and the gearbox housing.

For the M 410, remove the bolt in tool SVO 2828

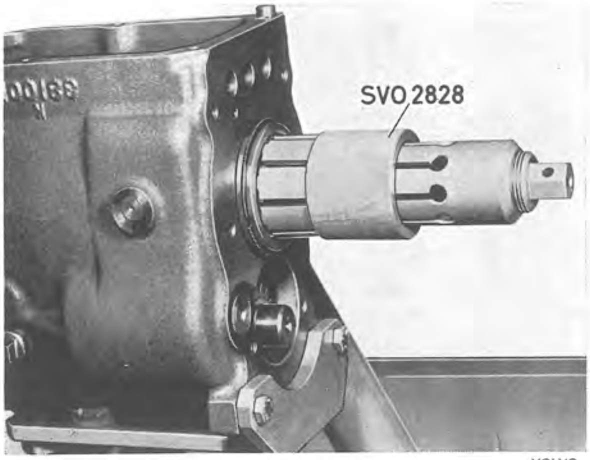


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Fig. 4-20. Removing mainshaft rear bearing, M 400

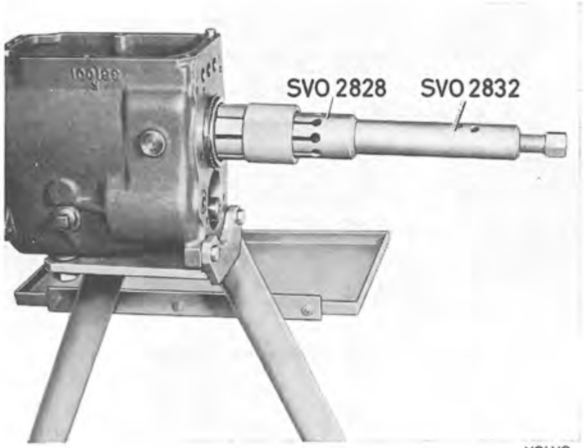

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Fig. 4-21. Removing mainshaft rear bearing, M 410

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Fig. 4-22. Lifting out mainshaft

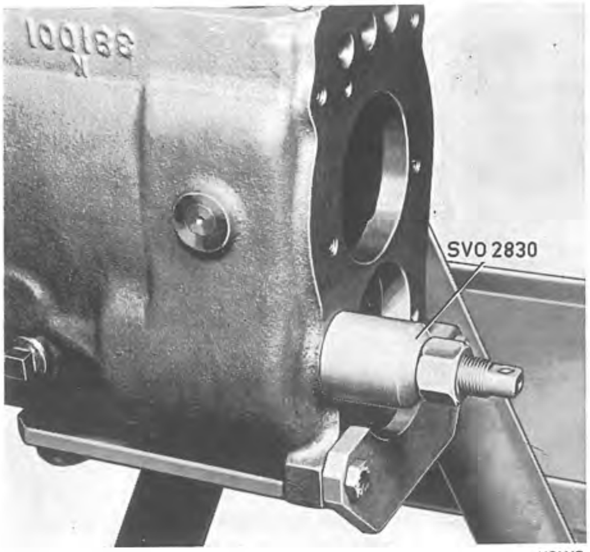

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Fig. 4-23. Removing reverse shaft

and replace it with SVO 2832. Then pull off the rear bearing in the same way as for the M 400 unit, see Fig. 4-21.

9. Pull out the input shaft and remove the synchronizing ring. Remove the thrust washer from the mainshaft rear end. Fit lifting tool SVO 2829 on the mainshaft. Push the engaging sleeve for 1st and 2nd speed rearwards. Lift up the mainshaft as shown in Fig. 4-22.
10. Pull out the reversing shaft with puller SVO 2830, see Fig. 4-23, and remove the reverse gear.
11. Pull out the oil seals from the front and rear covers with drift SVO 2337.

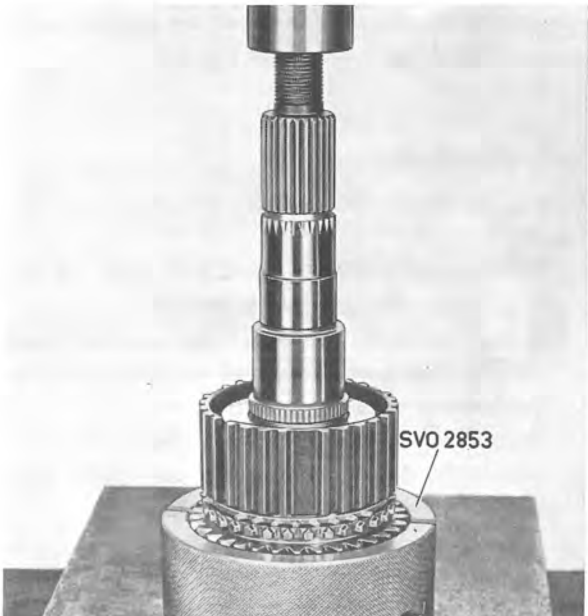

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Fig. 4-24. Disassembling mainshaft, I

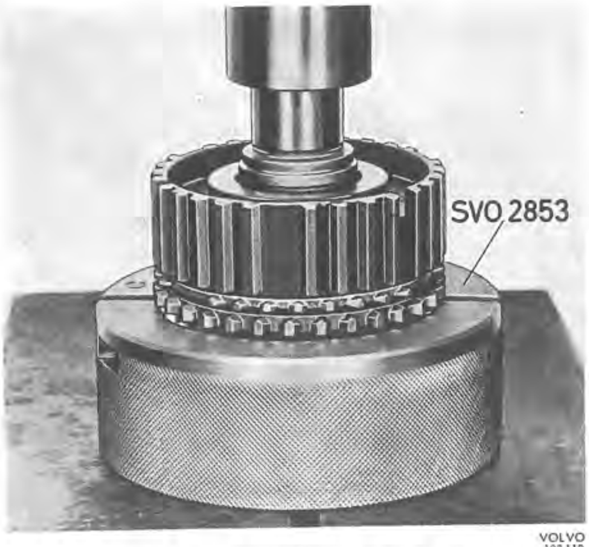

Fig. 4-25. Disassembling mainshaft, II

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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.
3. Fit tool SVO 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 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.
2. Place ring SVO 2852 in a press. Place on 3rd-4th

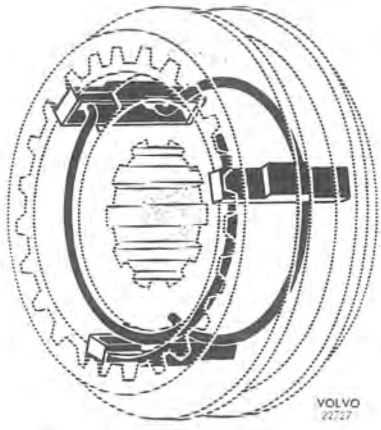

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Fig. 4-26. Assembling synchronizing

synchronizer, synchronizing cone, 3rd speed gear wheel and needle bearing. Make sure that the synchronizing flange locates correctly in the grooves in the synchronizing cone and that the resilient ring fits properly on 3rd gear wheel. Press the mainshaft into the synchronizing hub as shown in Fig. 4-27. 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.
3. Place 1st-2nd speed synchronizer, synchronizing cone, 2nd speed gear wheel and needle bearing on ring SVO 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. 4-27. When doing this, turn the 2nd speed gear

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Fig. 4-27. Installing synchronizing

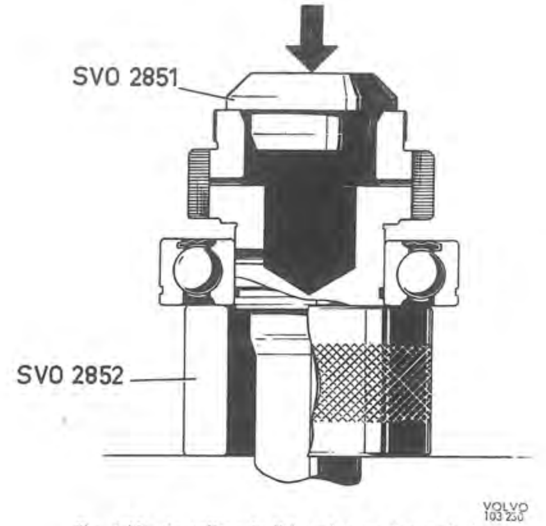

Fig. 4-28. Installing ball bearing on input shaft

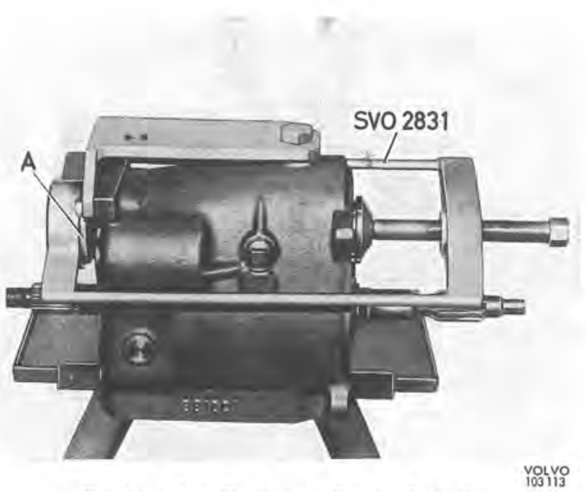

Fig. 4-30. Installing intermediate shaft bearing
A. Insert drift

wheel to prevent it from fastening. Try out a circlip which fits well into the groove on the shaft and fit the circlip.

4. Fit 1st speed gear wheel with needle bearing and synchronizing cone on the mainshaft. Fit on lifting tool SVO 2829.

ASSEMBLING GEARBOX

1. Press the oil seals on to the front and rear covers with drift SVO 2851 and SVO 1801 as well as SVO 2412. Press the ball bearing on to the input shaft with the help of the cushioning ring SVO 2852 and drift SVO 2851, see 4-28. Try out a circlip which fits well into the groove and fit the circlip.
2. Place the gear lever for the reverse shaft on to 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 rear end of the housing or a maximum 0.2 mm (0.08") below.
3. Place the intermediate shaft in the bottom of the gearbox housing. Fit the mainshaft in the housing. Take off the lifting tool and place the thrust washer on to the mainshaft.
4. Fit the rear ball bearing on to the mainshaft. Fit press tool SVO 2831 over the bearing and the mainshaft as shown in Fig. 4-29. Press the bearing on to the shaft. If the bearing does not locate in the housing, the spindle on tool SVO 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 its grooves. Push the input shaft into the housing and on the pin of the mainshaft.

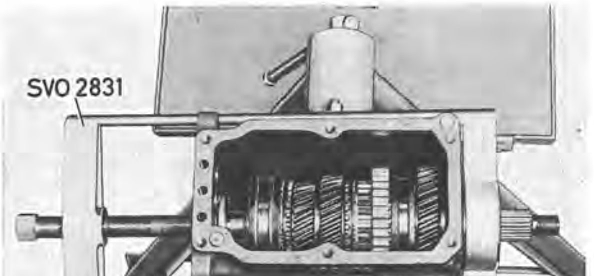

Fig. 4-29. Fitting mainshaft rear bearing

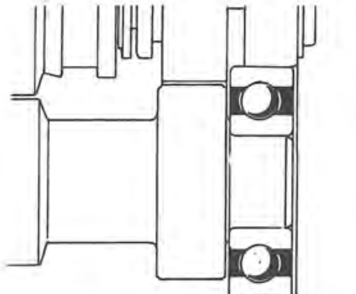

Fig. 4-31. Clearance for intermediate shaft
A = 0.00—0.05 mm (0.002")

6. Turn the gearbox upside down. Press the insert drift into press tool SVO 2831. Then press on the bearings for the intermediate shaft with the press tool, see Fig. 4-30. Fit the clutch casing with a new gasket.
7. Fit selector forks, flanges and selector rails. Make sure that the flange for the reverse gear fits correctly in the gear lever. Fit the bolts and tensioning pins. Use new pins.
8. Turn the gearbox with the rear end upwards. Drive forwards the intermediate shaft so that its front bearing lies against the clutch casing. Fit in shims for the intermediate shaft rear bearing so that they lie evenly with or up to 0.05 mm (0.002") under the rear end (see A, Fig. 4-31).
9. Fit on the large speedometer gear. Fit the rear cover with a new gasket. When fitting, compress the gasket and ensure that the intermediate shaft has the correct clearance, 0.20—0.25 mm (0.008—0.010").
10. Press on the flange with tool SVO 1845. Fit the washer and nut. Tighten the nut to a torque of 11—14 kpm (80—110 lb.ft.).
11. Place the interlocking balls and springs in position. Fit the gearbox, cover and gasket. Fit the cover over the input shaft. Fit also the release bearing.

INSTALLING

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

OVERDRIVE

TOOLS

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

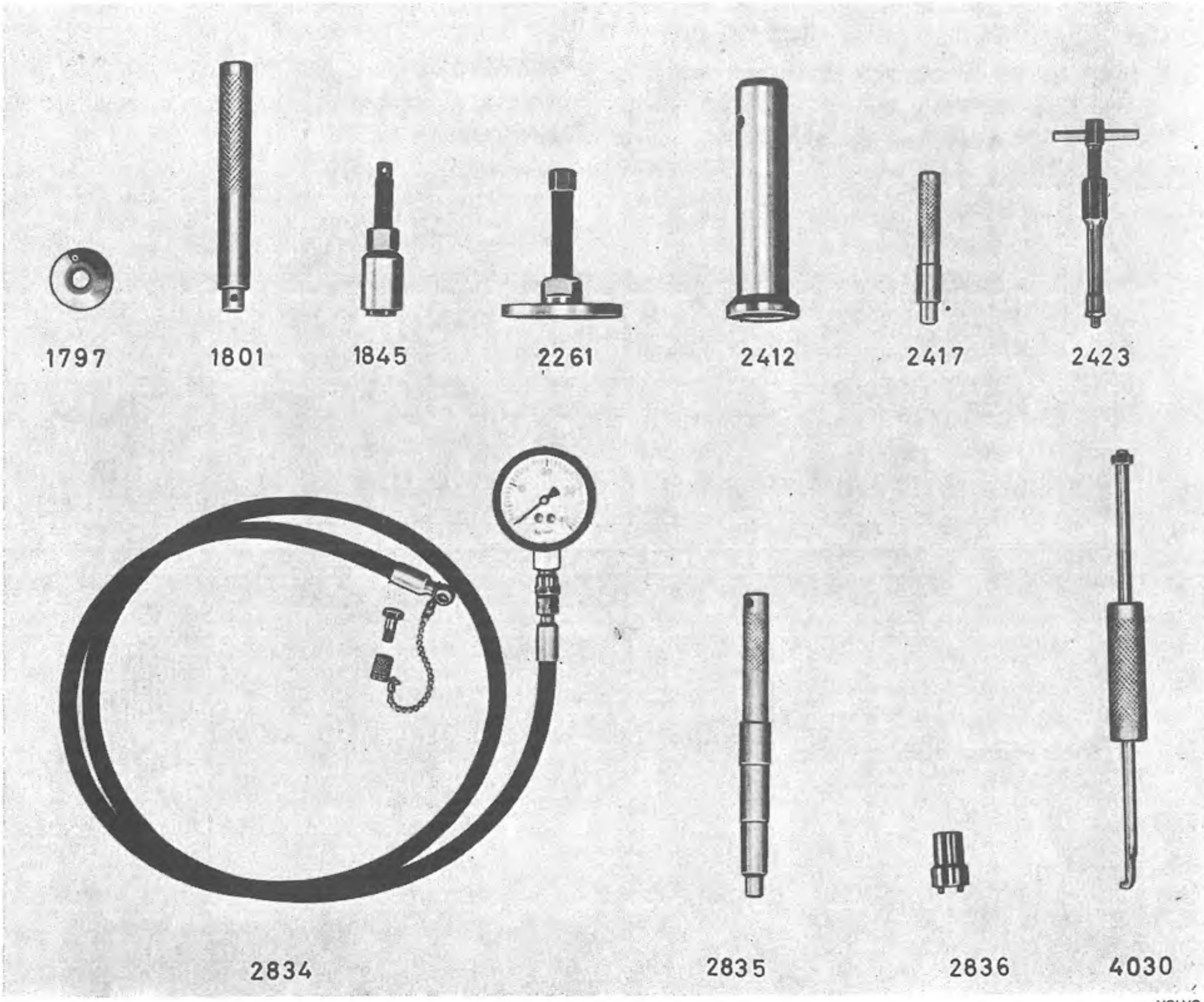

Fig. 4-32. Special tools

SVO 1787 Drift for removing rear bearing, output shaft
SVO 1801 Standard handle
SVO 1845 Press tool for fitting flange
SVO 2261 Puller for flange
SVO 2412 Sleeve drift for fitting front and rear bearings on output shaft and oil seal at flange
SVO 2417 Drift for fitting bush in output shaft
SVO 2423 Puller for bush in output shaft
SVO 2834 Pressure gauge for checking oil pressure
SVO 2835 Centering mandrel for splines in planet carrier and unidirectional clutch
SVO 2836 Socket for removing and fitting plugs for fine filter, oil pump and relief valve
SVO 4030 Puller for oil seal at flange

The designation SVO before the tool number is to be replaced by the number 999. This applies also to new production of older tools.

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. 4-33, 4-41 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. 4-34) 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. 4-34) with the help of the pistons (27, Fig. 4-41) 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.

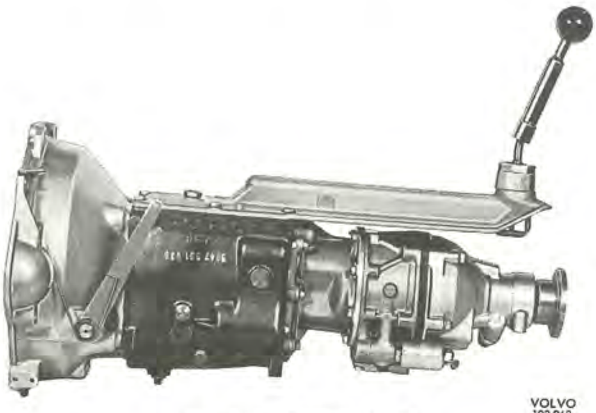

Fig. 4-33. Gearbox M 410

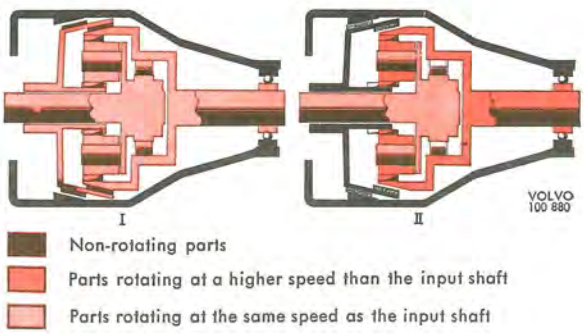

Fig. 4-34. Working principle of overdrive

I. Direct drive position
II. Overdrive position

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. 4-38.

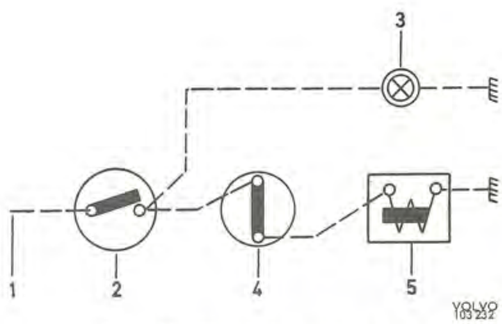

Fig. 4-35. Electrical circuit diagram

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

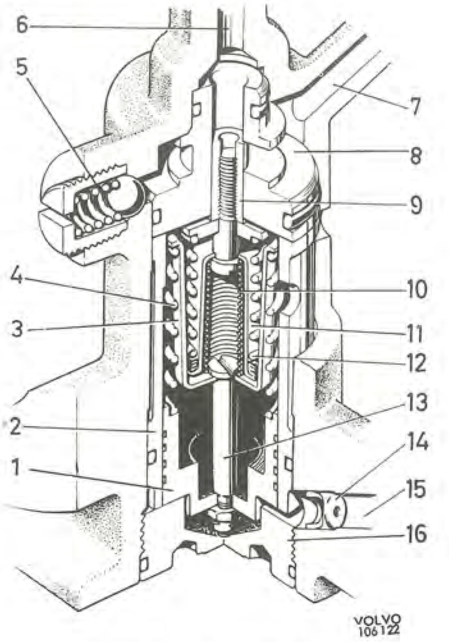

Fig. 4-36. Relief valve

1. O-ring
2. Cylinder
3. Large piston unit
4. Spring
5. Valve ball
6. Channel for oil pump
7. Channel to mainshaft
8. End piece
9. Spring
10. Small piston unit
11. Nozzle
12. Channel from control valve
13. Plug
14. O-ring

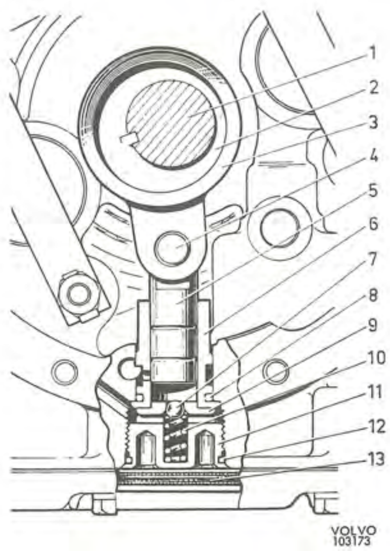

Fig. 4-37. Oil pump

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

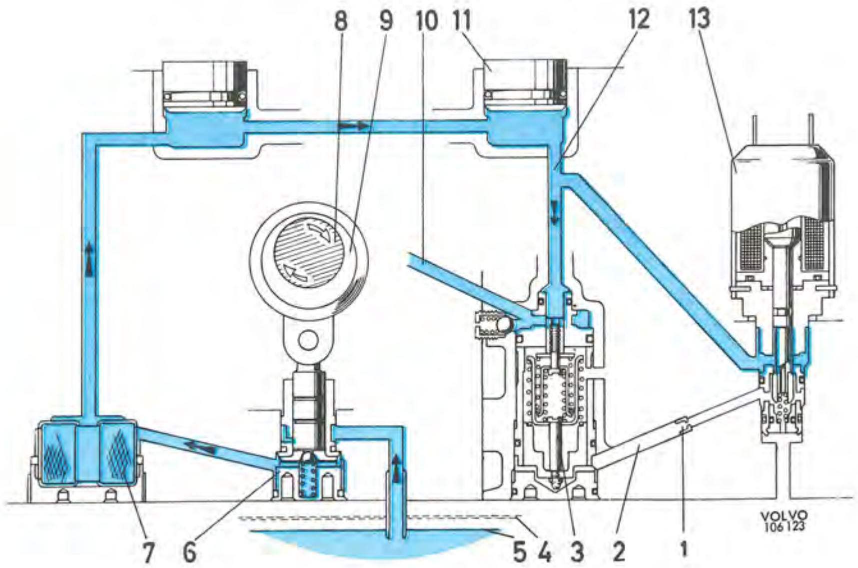

Fig. 4-38. Function with direct drive

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

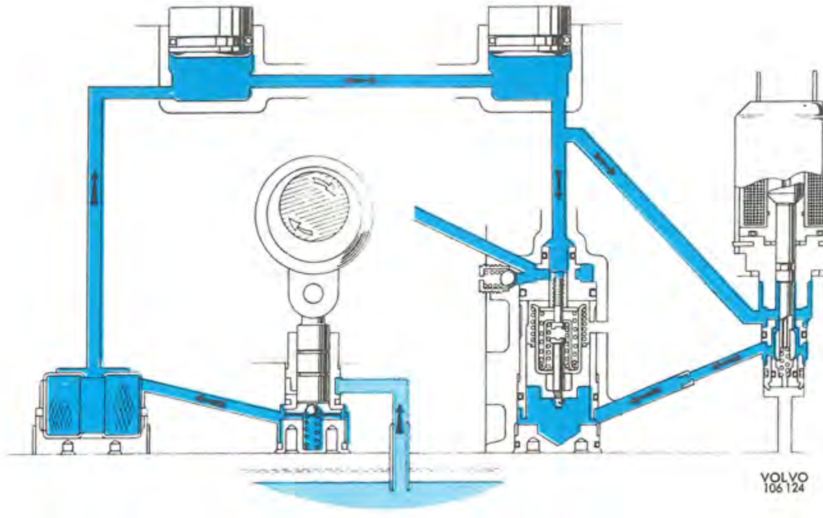

Fig. 4-39. Overdrive in function

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 is closed 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 is engaged, the control valve is displaced and oil flows through the oilway and operates the large piston of the relief valve. This is then moved upwards and causes the springs to tension. The more the springs tension the greater the force is required to press down the small piston, this causing the hydraulic pressure to rise. The pistons are thereby displaced in the hydraulic cylinders, the clutch sliding member is pulled forwards and contact made with the brake ring.

With disengagement of the overdrive, the connection between channels 12 and 2 is closed. 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 gearbox housing, see Fig. 4-40.

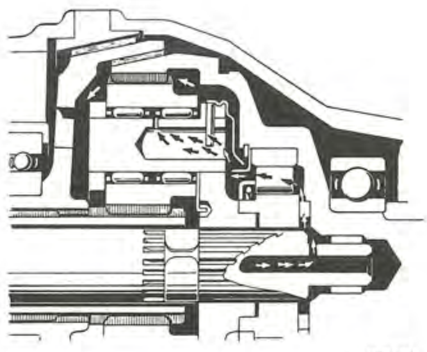

Fig. 4-40. Lubricating system

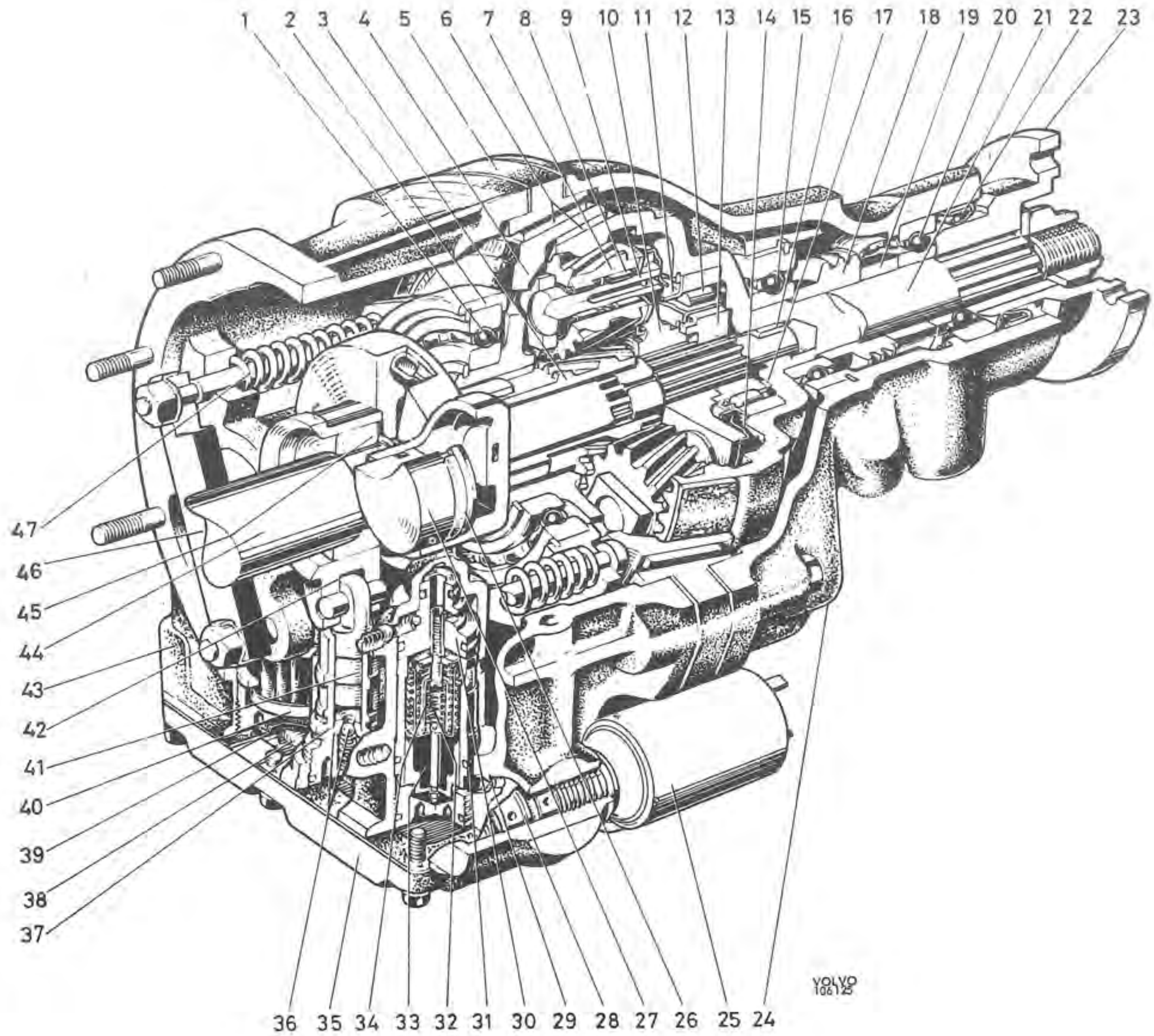

Fig. 4-41. Overdrive

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

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 SVO 2834, see Fig. 4-42.
2. Read off the pressure when driving on direct drive at about 40 km.p.h. (25 m.p.h.). The pressure should then be about 1.5 kp/mm² (21 p.s.i.).
3. Engage the overdrive and check that the pressure rises to 36—39 kp/mm² (510—550 p.s.i.).
4. Disengage the overdrive and check the time for the pressure to drop to 1.5 kp/cm² (21 p.s.i.). 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 4.2—5.5 kpm (30—40 lb.ft.).

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 SVO 2836, see Fig. 4-43. 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. 4-44, 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. N.B. 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.

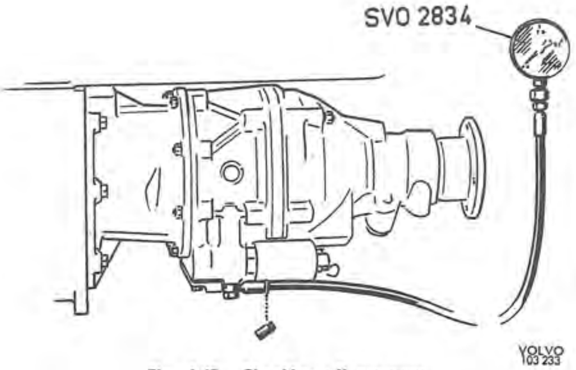

Fig. 4-42. Checking oil pressure

Fig. 4-43. Removing plug

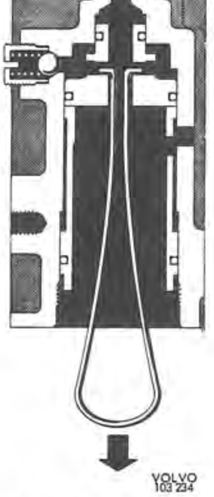

Fig. 4-44. Removing relief valve

Fig. 4-45. Blowing orifice nozzle clean

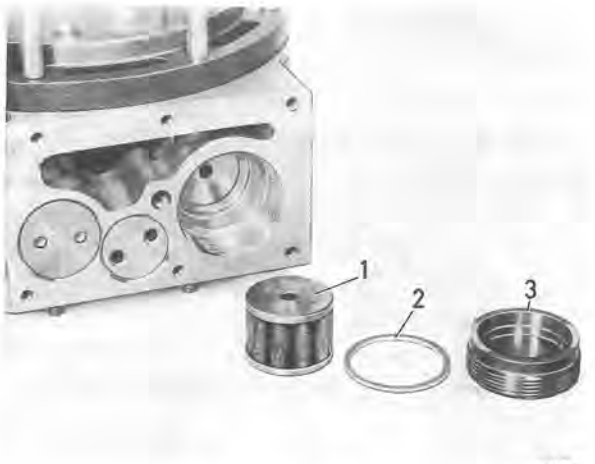

Fig. 4-46. Fine filter
1. Filter 2. Seal 3. Plug

4. Before fitting the parts of the relief valve, it may be suitable to blow the orifice nozzle clean with compressed air, see Fig. 4-45.
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 2.2 kpm (16 lb.ft.).
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. 4-45.

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 SVO 2836. Take out 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 2.2 kpm (16 lb.ft.).

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. 4-46.
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 2.2 kpm (16 lb.ft.).
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/cm^2 (284—335 p.s.i.) 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 dismantling, clean the outside of the unit thoroughly. Then first dismantle 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. 4-47.
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 prefilter. 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".

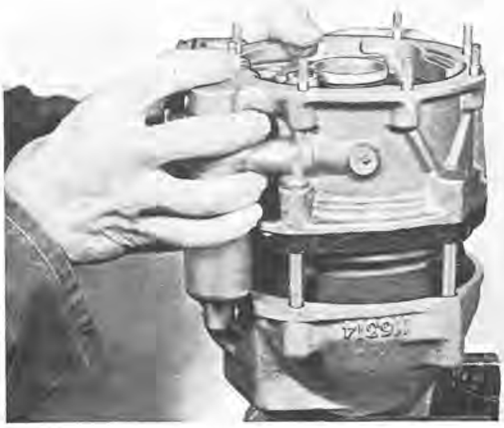

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Fig. 4-47. Disassembling overdrive

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 SVO 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 SVO 1797 and handle SVO 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 SVO 2423, see Fig. 4-48.

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

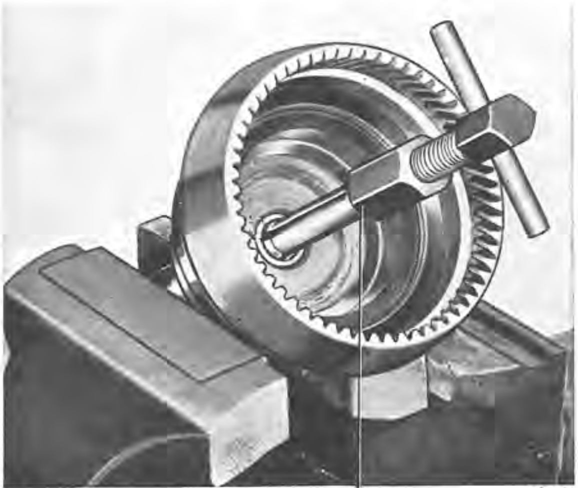

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Fig. 4-48. Removing bush, output shaft
1. Puller SVO 2423

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.

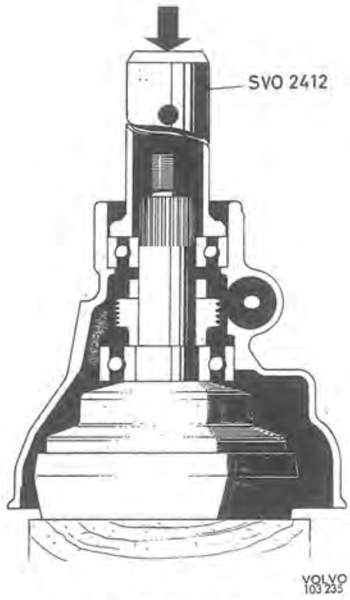

Fig. 4-50. Installing output shaft

ASSEMBLING REAR CASING

1. Push the bush on to the output shaft with drift SVO 2417, see Fig. 4-49. Press the front bearing to the output shaft with drift SVO 2412.
2. Press the rear bearing on to the rear casing section with drift SVO 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 SVO 2412, see Fig. 4-50.
4. Press in the oil seal with drift SVO 2412. Fit the coupling flange, the washer and nut. Tighten the nut to a torque of 11—14 kpm (80—100 lb.ft.).

Fig. 4-49. Fitting bush, output shaft
1. Drift SVO 2417

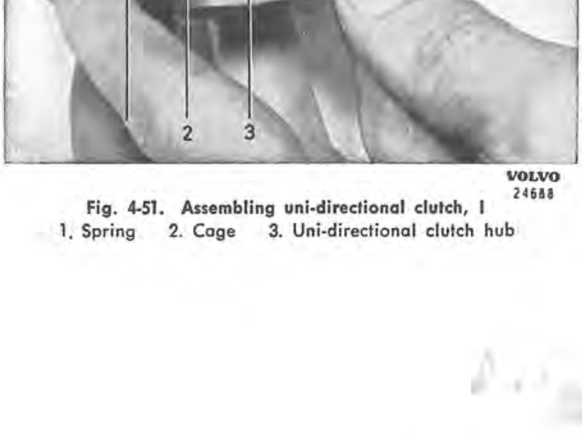

Fig. 4-51. Assembling uni-directional clutch, I
1. Spring 2. Cage 3. Uni-directional clutch hub

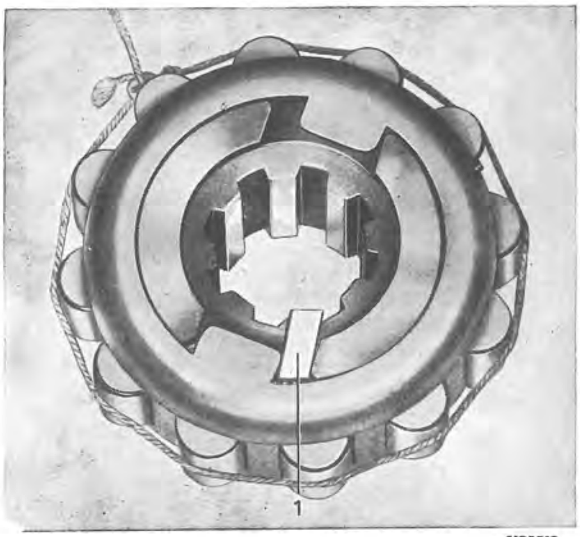

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Fig. 4-52. Assembling uni-directional clutch, II
1. Key

5. Assemble the uni-directional clutch, spring and roller cage, see Fig. 4-51. Turn the roller cage clockwise as far as it will go and lock it in this position with a key as shown in Fig. 4-52. 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. 4-53. Fit the oil thrower and install the circlip, see Fig. 4-54.
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 SVO 2835, Fig. 4-55.

ASSEMBLING CLUTCH UNIT

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

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Fig. 4-53. Fitting the uni-directional clutch

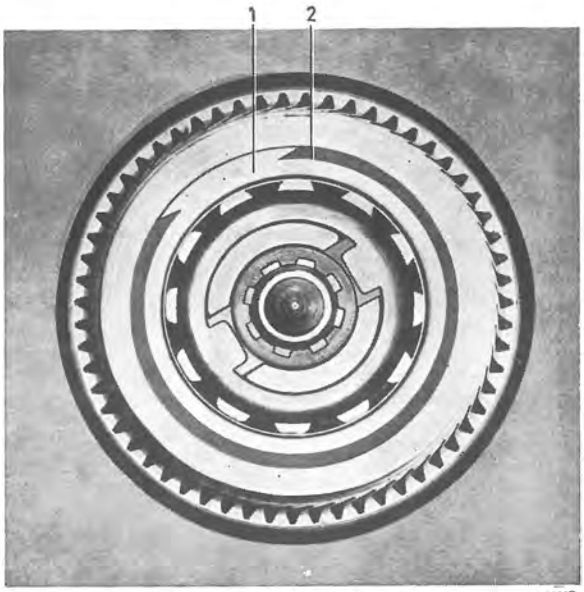

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Fig. 4-54. Installing oil thrower
1. Oil thrower plate 2. Circlip

2. Fit the bolts on the bearing retainer. Then press the bearing with retainer on to the clutch sliding member. Fit the circlip.
3. Fit the sunwheel on to the clutch sliding member. Fit the circlip.
4. Install the clutch unit in position on the output shaft. Fit the four thrust springs on to the bolts.

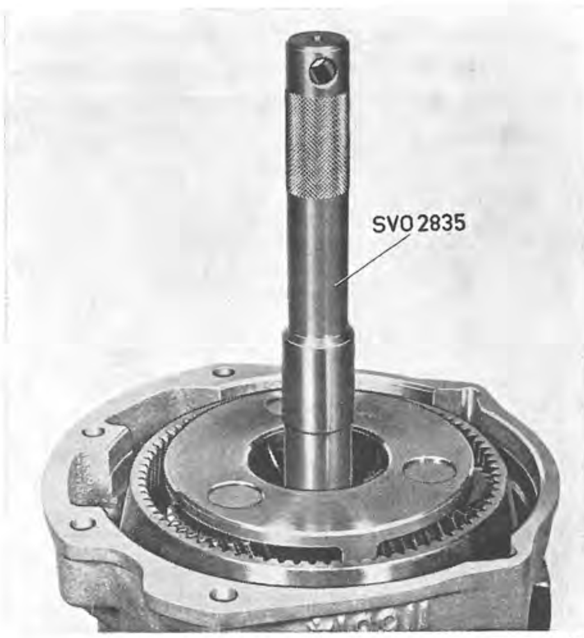

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Fig. 4-55. Installing planet gear

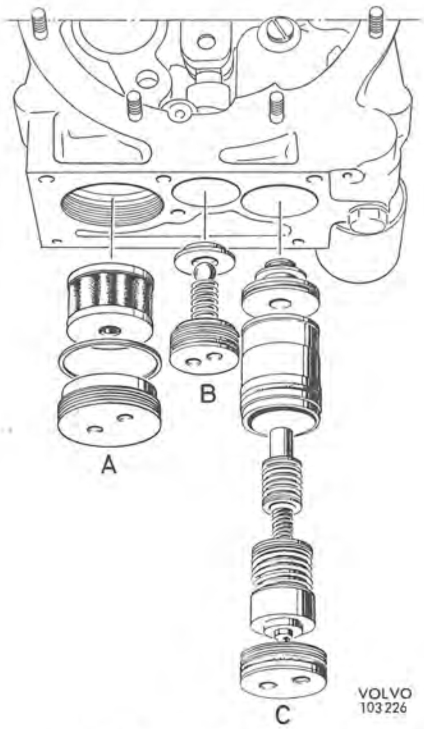


Fig. 4-56. Installing fine filter, oil pump check valve and relief valve

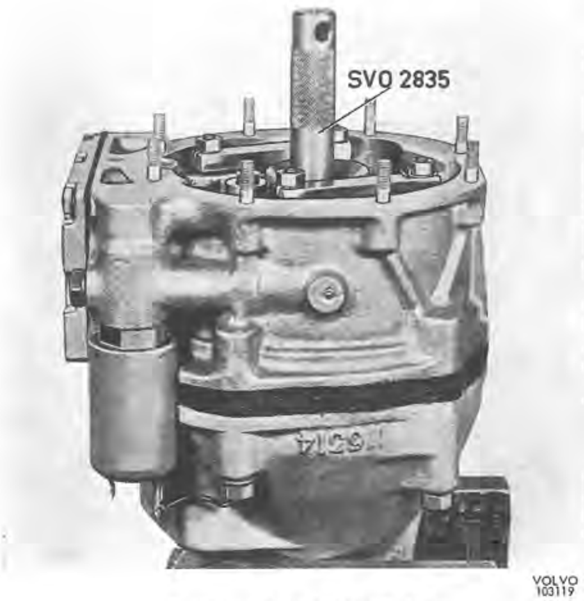


Fig. 4-57. Installing front casing

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 4-56.
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 SVO 2836. The tightening torque is 2.2 kpm (16 lb.ft.). Fit the pre-filter, magnet, gasket and base plate.
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. 4-57. 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).

AUTOMATIC TRANSMISSION

TOOLS

The following special tools are required for repairing the automatic transmission

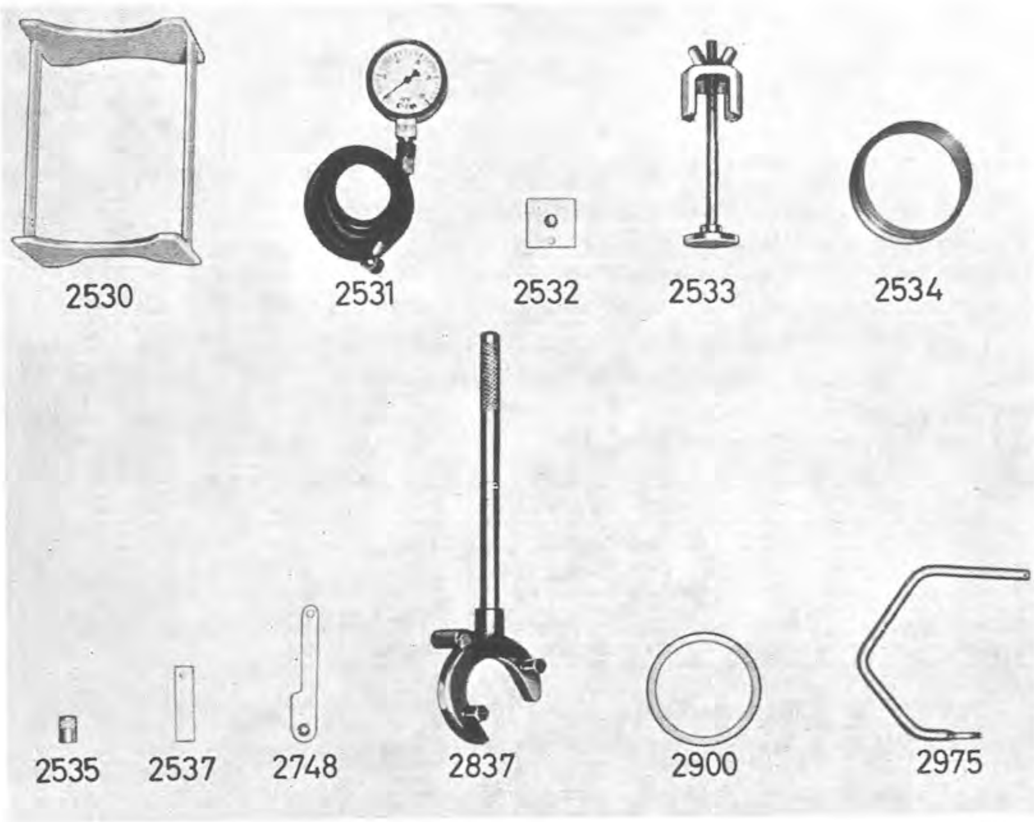


Fig. 4-58 Special tools

SVO 2530 Fixture for disassembling and assembling the transmission.
SVO 2531 Manometer complete with hose and connection for checking the oil pressure.
SVO 2532 Attaching plate for magnetic holder when measuring end float of input shaft.
SVO 2533 Press tool for compressing clutch when removing and fitting the snap ring.
SVO 2534 Ring for fitting piston in rear clutch.
SVO 2535 5/16" square socket for adjusting rear brake band.
SVO 2537 Spacer for adjusting front brake band.
SVO 2746 Transmission fixture when removing and fitting, see Fig. 4-76.
SVO 2748 Wrench for adjusting front brake band.
SVO 2837 Counterhold for flange.
SVO 2900 Ring for fitting piston in front clutch (used together with SVO 2533)
999 2975 Spanner for locknut on contact for starter inhibitor and reversing lights.

Instead of bench rack SVO 2530, the following can be used for disassembling and assembling, see Fig. 4-77:
SVO 2520 Stand
SVO 2934 Fixture

The designation SVO before the tool number is to be replaced by the number 999. This applies also to new production of older tools.

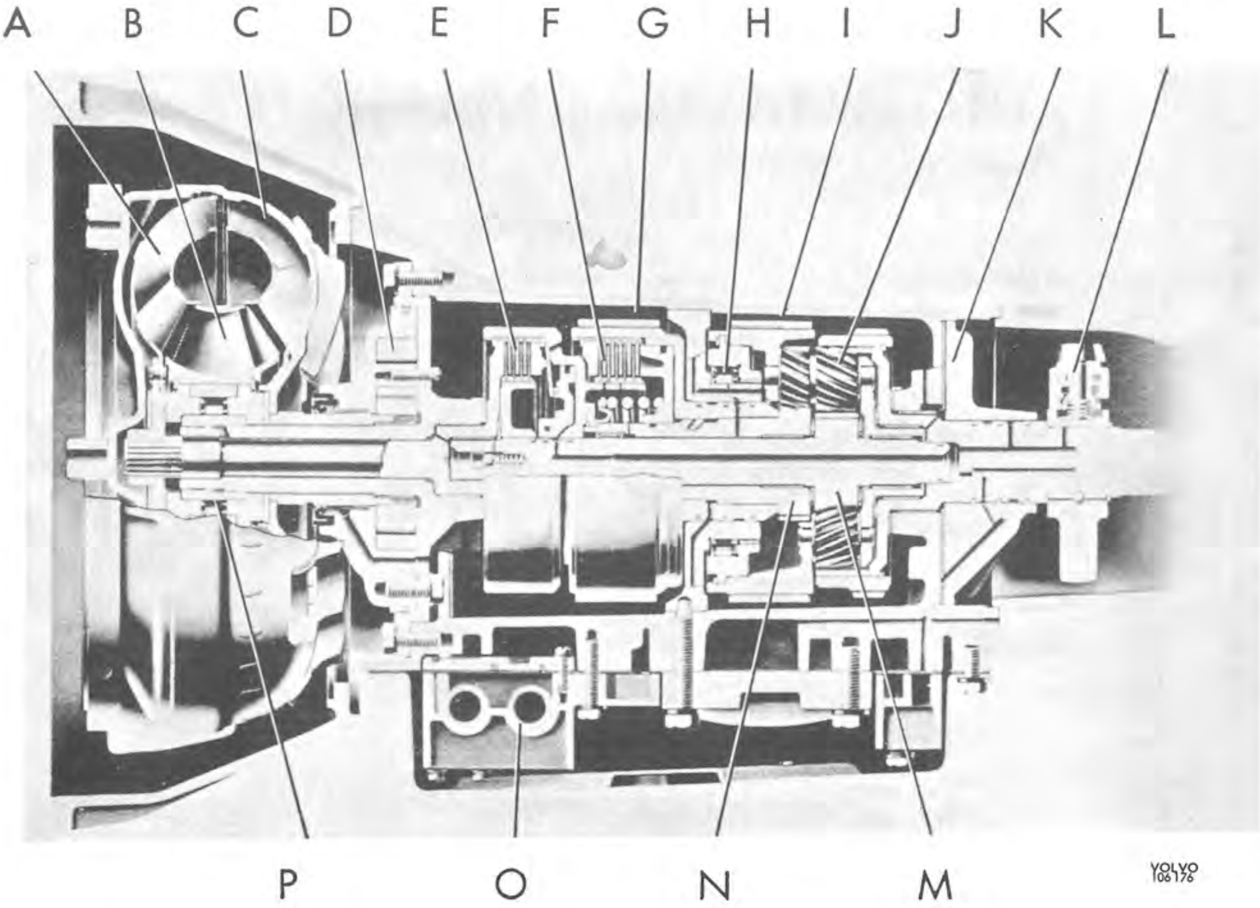


Fig. 4-59. Sectioned view of transmission

A. Turbine
B. Stator
C. Impeller and cover
D. Front pump
E. Front clutch
F. Rear clutch
G. Front brake band
H. One-way clutch in gearbox
I. Rear brake band
J. Planetary gear set
K. Oil deflector flange
L. Governor
M. Reverse sun gear
N. Forward sun gear
O. Control system
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. 4-61.

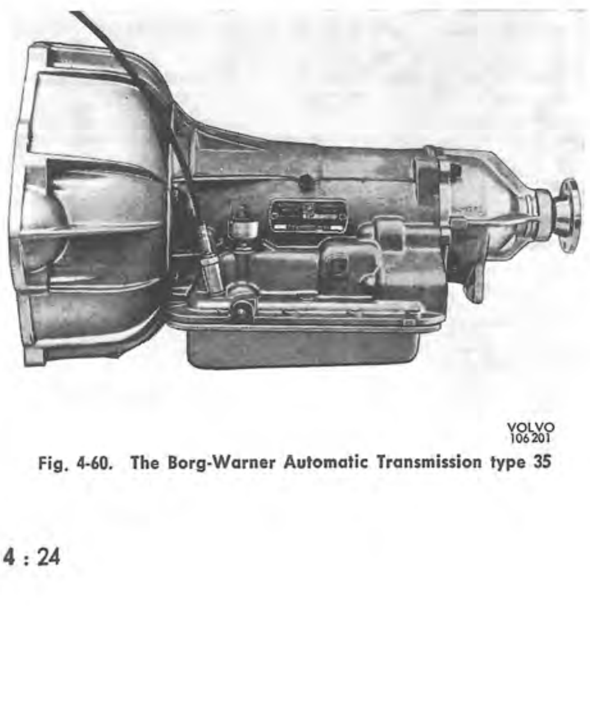


Fig. 4-60. The Borg-Warner Automatic Transmission type 35

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-

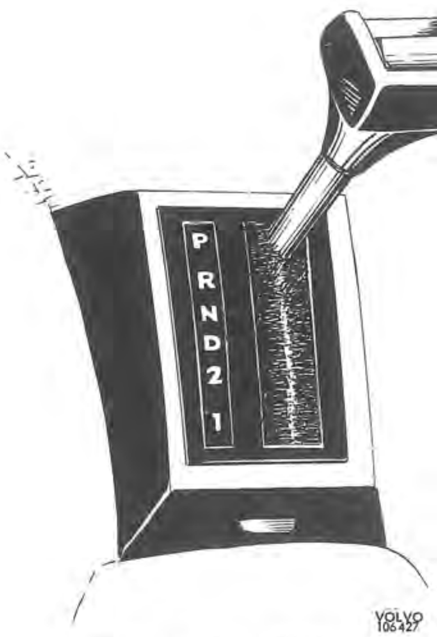


Fig. 4-61. Selector lever positions

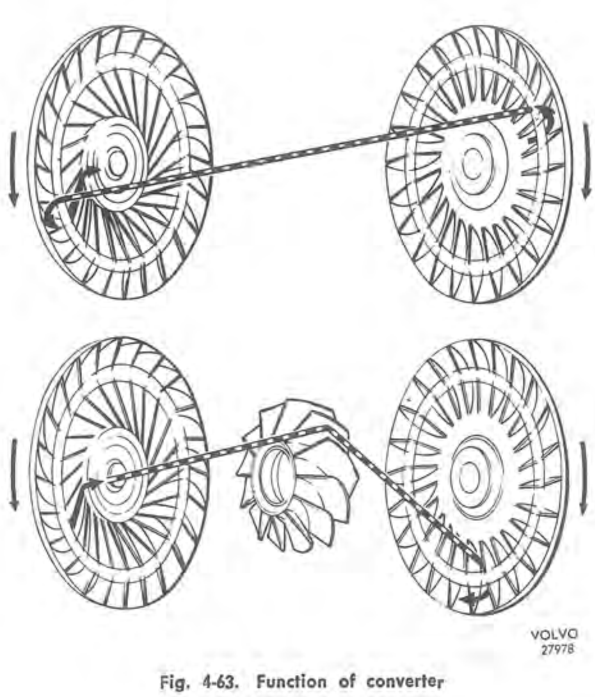


Fig. 4-63. Function of converter

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. 4-63. 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. 4-62. 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.

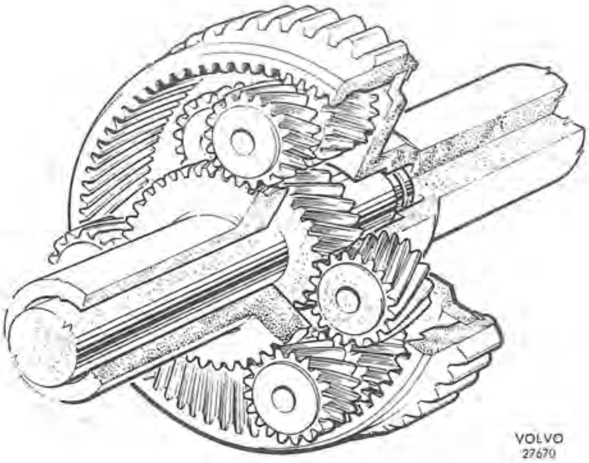


Fig. 4-64. Planetary gear

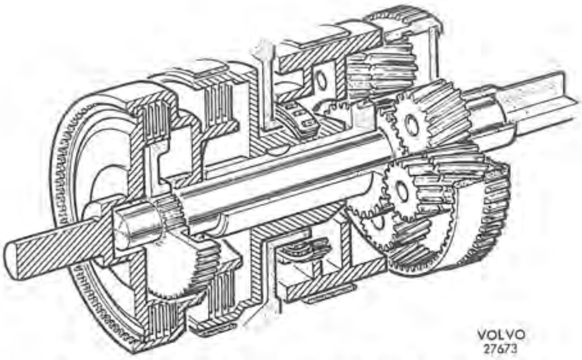


Fig. 4-65. Planetary gear, clutches and brake bands

MECHANICAL POWER TRANSMISSION SYSTEM

PLANETARY GEAR

The planetary gear set consists of two sun gears, two sets of pinions, a pinion carrier and a ring gear, see Fig. 4-64. 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. 4-65, 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 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. 4-67. The oil cooler is connected to the nipple (Fig. 4-66) on the right-hand side of the transmission.

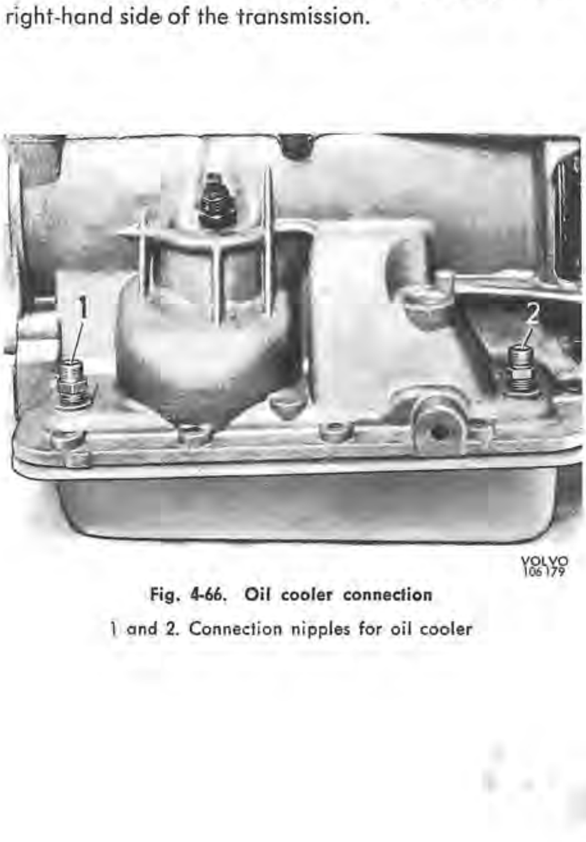


Fig. 4-66. Oil cooler connection

1 and 2. Connection nipples for oil cooler

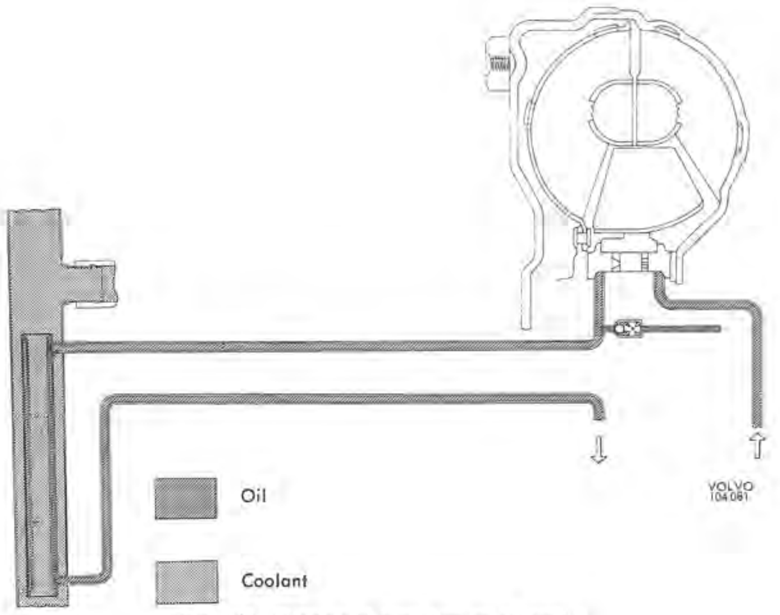


Fig. 4-67. Principle of operation for oil cooler

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 gearbox is properly adjusted and the fluid level is correct. **If the transmission is inoperative, the propeller shaft should be disconnected before starting towing.**

The control system of the automatic transmission is manufactured with the same degree of precision and accurate fits as the injection equipment of a Diesel engine. Fluid circulates through the converter, transmission and control system. **It is therefore necessary to observe the utmost cleanliness when carrying out any work on the transmission.**

WORK ON TRANSMISSION IN VEHICLE

CHECKING FLUID LEVEL

Normally oil changing is only required when the gearbox 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. 4-68. **N.B. There are different oil level marks for a warm or cold transmission.** When the transmission is warm, after the car has been driven about 5—7 miles (8—10 km), the upper area (3 and 4, Fig. 4-68) applies. The lower area (1 and 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.

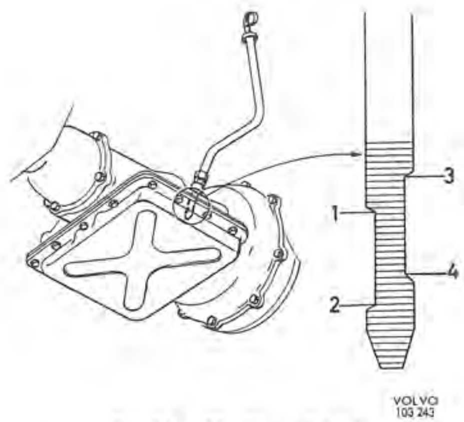


Fig. 4-68. Checking oil level

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. 4-75.

   N.B. 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. 4-78).
3. Release the throttle cable from the cam. Remove the three bolts, see Fig. 4-79, 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. 4-79.
5. Fit the throttle cable to the cam. Mount the oil pipes as shown in Fig. 4-78. 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. 4-69) between the selector lever inhibitor and selector gate when the rod is connected to the lever o nthe transmission.

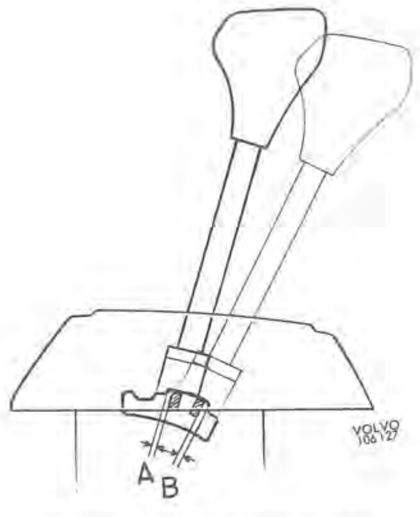


Fig. 4-69. Adjusting selector controls
A = B

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-**

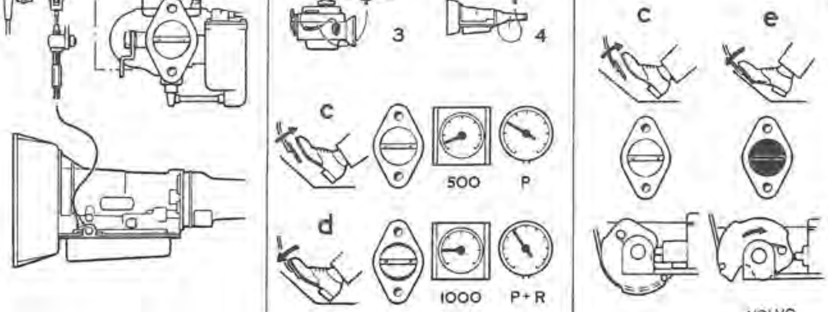


Fig. 4-70. Adjusting throttle cable

A. Adjusting cable stop
B. Adjusting with tachometer and manometer
   1. Check 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 500 r.p.m.
   d. Measure pressure (P+R) at 1000 r.p.m.
   R. Should be 1.1—1.4 kp/cm²
   (15—20 p.s.i.)*
C. Adjust the cam in transmission
   c. Accelerator pedal in idling position
   e. Accelerator pedal fully depressed

ance with A, see Fig. 4-70. 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 160 p.s.i. (11 kg/cm^2).

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 meter to the transmission as shown in Fig. 4-71.

2. Chock the wheels and apply the brakes. Start the engine and move the lever to "D". Read off the pressure at 500 and 1000 r.p.m. At 1000 r.p.m. the gauge to the transmission as shown in Fig. 4-71. pressure should be 15—20 p.s.i. (1.1—1.4 kp/cm^2)* higher than at 500 r.p.m. If the pressure rise is less than 15 p.s.i. (1.1 kp/cm^2), the effective length of the outer cable should be increased by means of the adjuster. Conversely, if the rise is more than 20 p.s.i. (1.4 kp/cm^2) the effective length of the outer cable should be decreased.

N.B. On vehicles with an exhaust emission control system, it may be more suitable to measure the pressure at 700 and 1200 r.p.m. The pressure increase also in this case should be 15—20 p.s.i. (1.1—1.4 kp/cm^2).*

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.

ADJUSTING STARTER INHIBITOR SWITCH

The starter inhibitor switch has two terminals for the starter inhibitor circuit, the function of which is to prevent the engine from being started with the selector in any other position than "N" or "P". There are also two terminals for the reversing light. It is very important that this switch is correctly adjusted, since if the engine can be started in any of the driving positions, the car can easily be set in motion unintentionally and

* AS5—35 EN with effect from serial No. 1829: 25—30 p.s.i. (1.8—2.1 kp/cm^2).

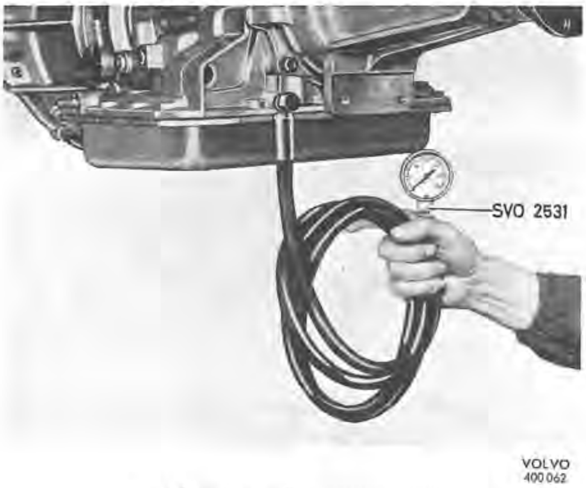


Fig. 4-71. Connecting pressure gauge

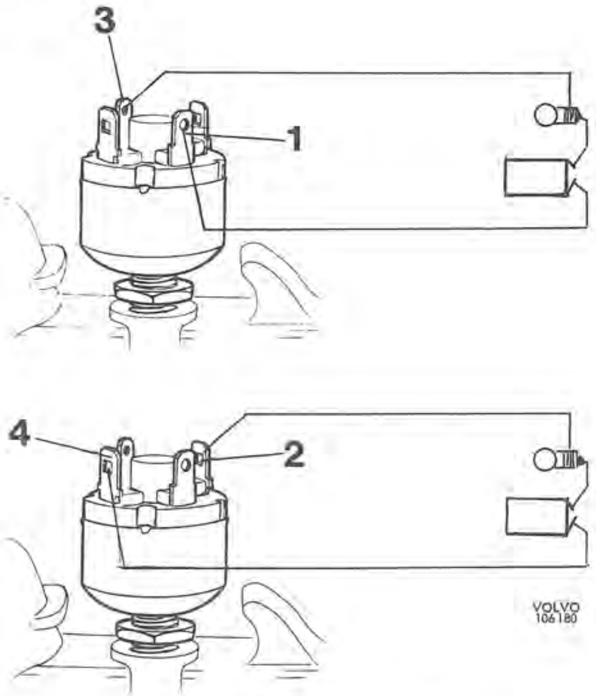


Fig. 4-72. Adjusting starter inhibitor

1 and 3. Terminals for starter inhibitor
2 and 4. Terminals for reversing lights

possibly cause an accident. The switch is adjusted as follows:

1. First check that the selector control is correctly adjusted. Move the selector lever to "D".
2. Slacken the locknut for the switch. If the transmission is installed in the vehicle, use spanner 999 2975 for it. But first remove the lever on the transmission. Screw out the switch until it is only held by a couple of threads.
3. Connect a control lamp to the starter inhibitor terminals (1 and 3) as shown in Fig. 4-72. Screw in the switch until the lamp goes out. Mark this position on the housing and switch with a pencil.
4. Connect the control lamp to both the other terminals (2 and 4) at the bottom of Fig. 4-72. Screw in the switch until the lamp lights again and then mark the switch again. Then screw back the switch to halfway between both the marks. Lock with the locknut. Connect the leads.
5. Apply the brakes and chock the wheels. Check that the engine can only be started with the selector lever in "N" or "P". Move the selector lever to "R" and check that the reversing light goes on when the lighting switch is switched on.

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 removed. Otherwise adjusting is carried out as follows:

1. Slacken the locknut for the adjusting screw.
2. Use the special socket SVO 2535 and connect the torque wrench to the adjusting screw, see Fig. 4-73. Tighten the screw to 10 lb.ft. (1.4 kpm). Back off the adjusting screw one turn.
3. Tighten the locknut and fit any parts which have been removed.

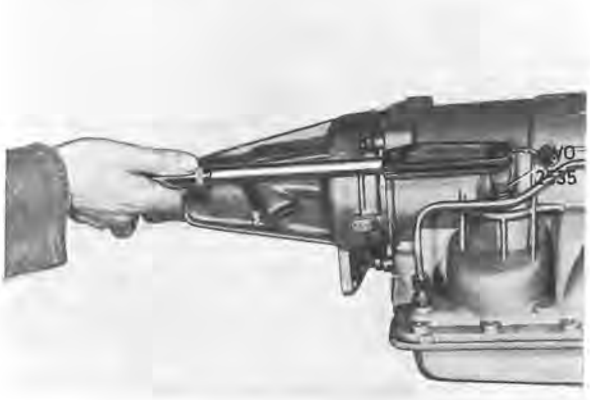


Fig. 4-73. Adjusting rear brake band

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 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. 4-74. 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

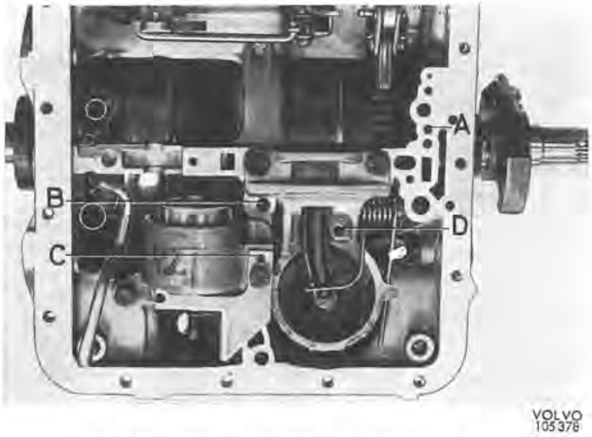


Fig. 4-74. Functioning test with compressed air

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

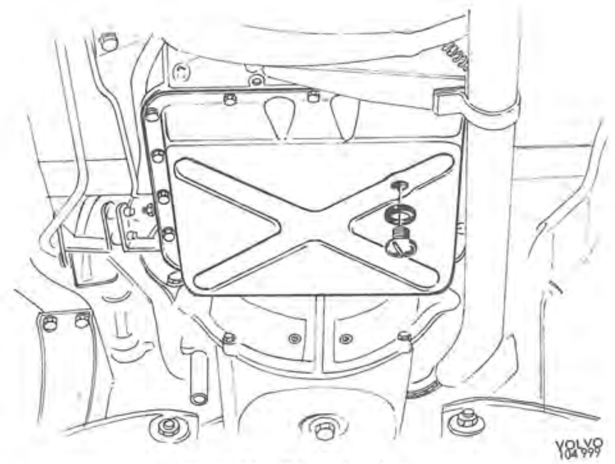


Fig. 4-75. Oil drain plug

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.
2. Drain the oil into a clean container, see Fig. 4-75. **N.B. The oil may be very hot and scald if contact is made with the skin.**
3. Place lifting tool SVO 2727 at the rear end of the engine. Hook the lifting hook securely round the exhaust pipe.
   N.B. Observe due care so that the speedometer cable or the electric cables are not damaged. Tighten the nut for the lifting hook until the sling takes the weight off the engine.
4. 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.
5. 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.
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. Lower the engine about 20 mm (0.8"). Observe due care with the battery lead. If any tensions arise, release the lead clamp.
8. Disconnect the electric cables from the starter inhibitor. Unscrew the screws for the starter inhibitor. Place a jack with fixture SVO 2746 under the transmission. See Fig. 4-76. 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 dismantle 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 as shown in

Fig. 4-76. Fixture for transmission

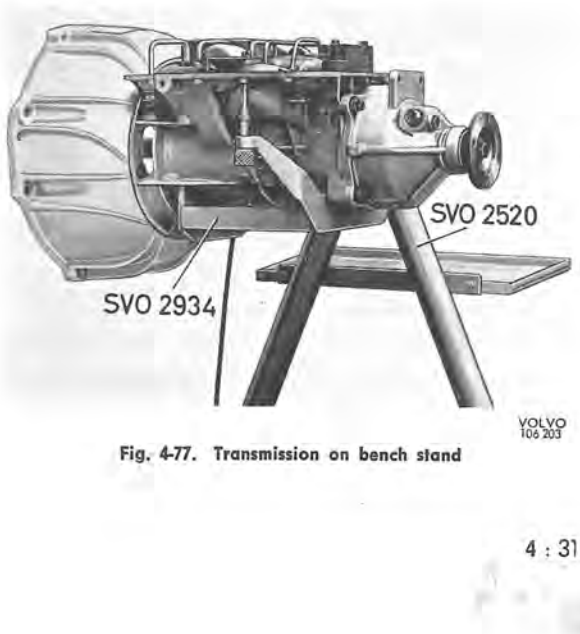


Fig. 4-77. Transmission on bench stand

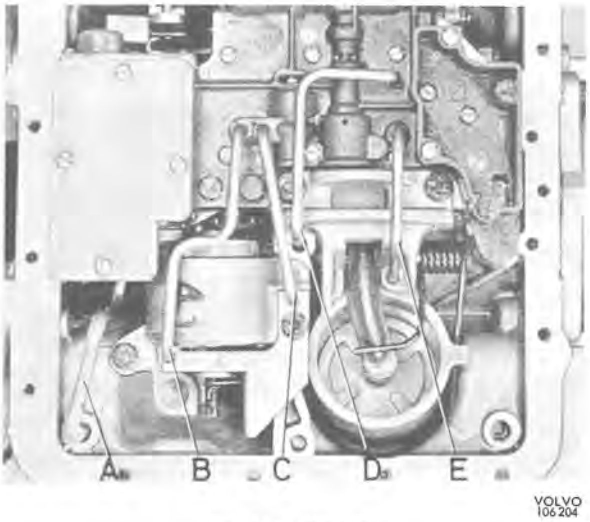


Fig. 4-78. Oil tubes

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

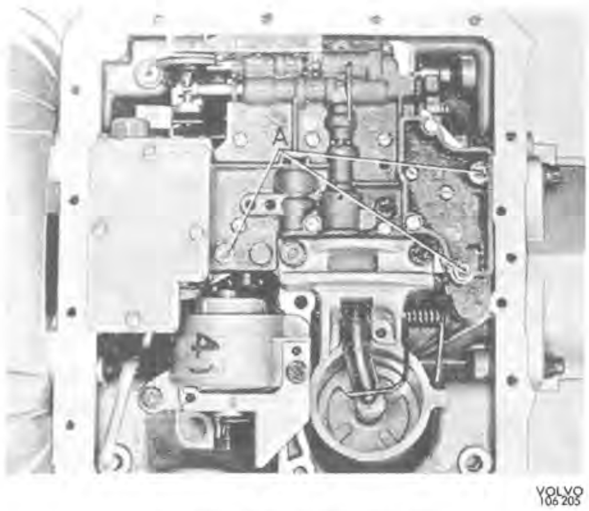


Fig. 4-79. Valve bodies assembly

A. Attaching screws

Fig. 4-77, 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 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. 4-78.

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. 4-79. Lift the valve bodies assembly straight up so that it releases from the oil tubes at the front end.
5. Unscrew the two screws for the bracket of the downshift valve cam.
6. Remove the strainer for the oil pump.
7. Unscrew from above the screws which retain the upper valve body. Turn the valve bodies assembly round and unscrew the other six screws from underneath.
8. Unscrew the eight screws which retain the oil tube collector.
9. Unscrew the four screws which retain the governor line plate. Note that two screws are under one of the strainers.
10. Remove the separating plate and then the check valves for the fast 3-2, see Fig. 4-81. Withdraw the manual control valve, see "A", Fig. 4-82.
11. Remove the stops for the throttle valve and the return spring. Then withdraw the downshift valve, spring and throttle valve, see "B", Fig. 4-82.
12. Remove the dowel pin which retains the plug for the modulator valve. Then remove the plug, valve, plunger and spring.

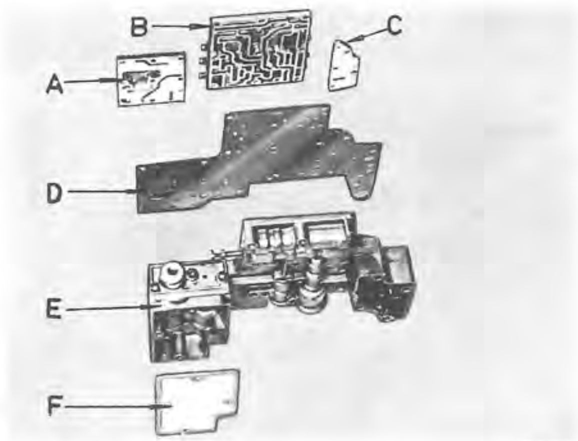


Fig. 4-80. Main components of valve bodies assembly

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

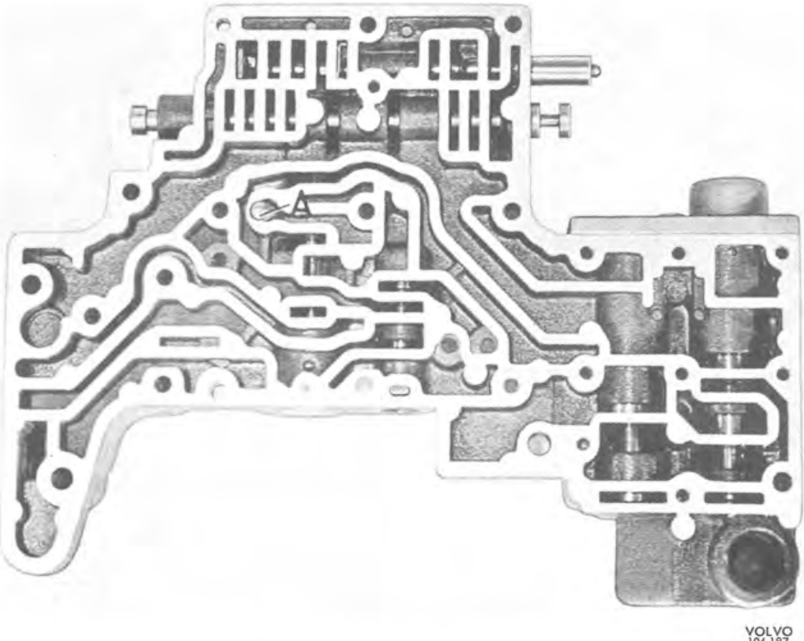


Fig. 4-81. Check valves in lower valve body

A. Check valve for fast 3-2

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. 4-83. 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.

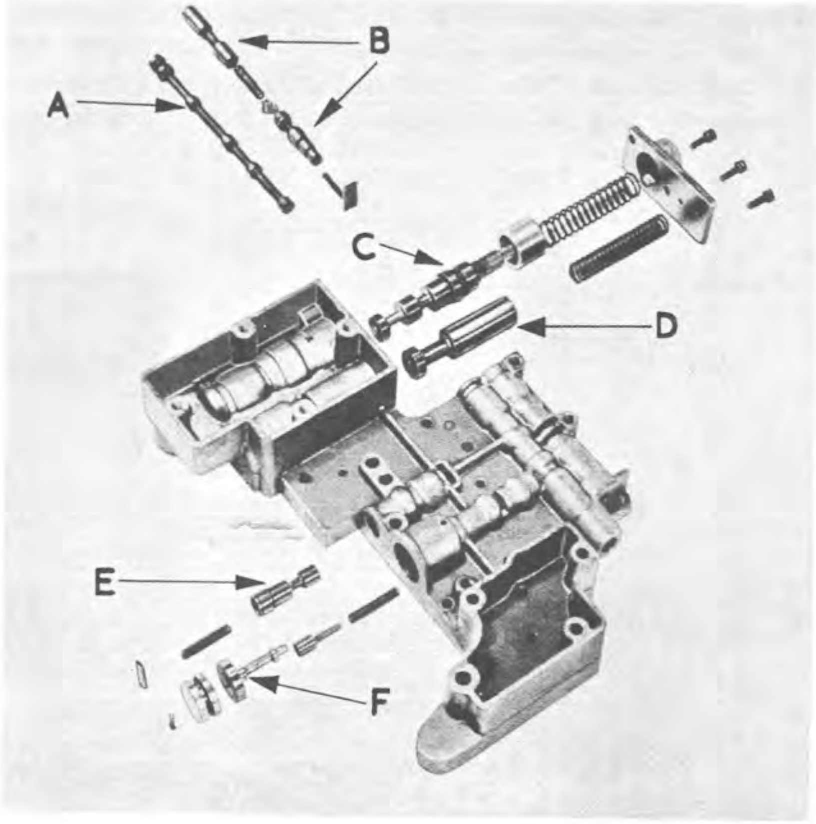


Fig. 4-82. Lower valve body

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

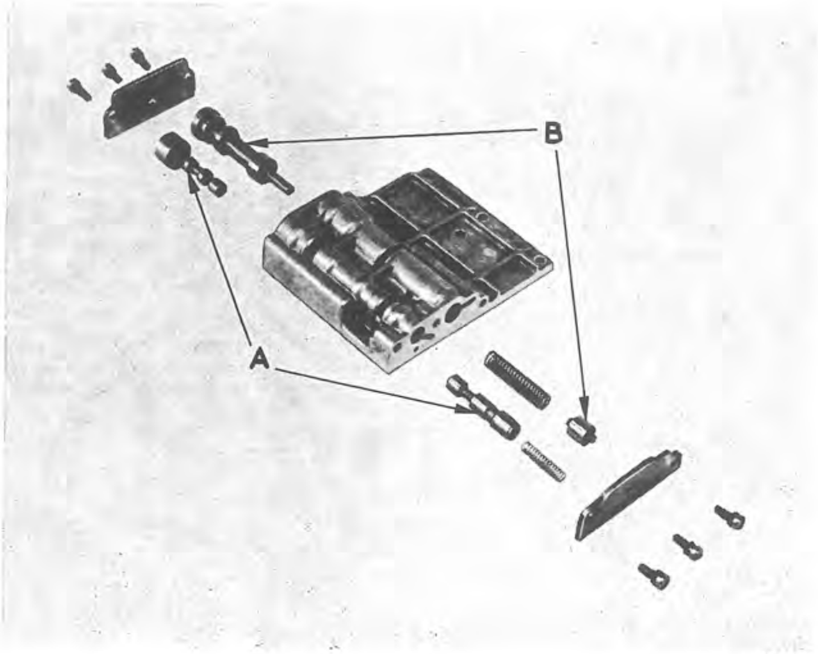


Fig. 4-83. Upper valve body

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

FRONT AND REAR SERVOS

16. Remove the two screws which retain the front servo to the body, withdraw the servo and the strut for the band.
17. Remove the snap ring in the servo with a small screwdriver. Take out the piston and separate the various parts. Drive out the slotted spring pin and lever pivot pin if necessary.
18. Unscrew the two screws which retain the rear servo and withdraw this and the strut.
19. Unhook the spring. Drive out the pivot pin and remove the lever. Pull out the piston.

PUMP ASSEMBLY

20. Remove the oil tubes in the housing. In case of difficulty pull them out with needle-nose pliers as shown in Fig. 4-84.
21. Set up the dial indicator gauge as shown in Fig. 4-85 with plate SVO 2532 and magnetic attachment. Place the point of the gauge against the shaft end, move the shafts and gears backwards and forwards and read of the end float. This should be 0.010—0.030" (0.25—0.75 mm). Note the amount of play.
22. Unscrew the six bolts which retain the pump to the body. Withdraw the pump and remove the

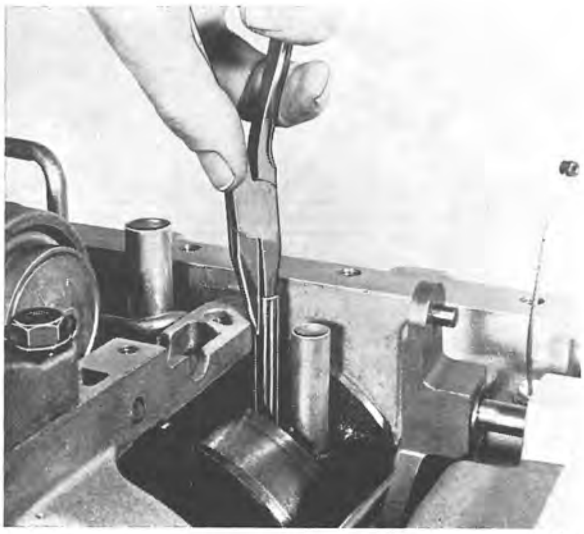


Fig. 4-84. Removing converter inlet and outlet tubes using needle-nose pliers

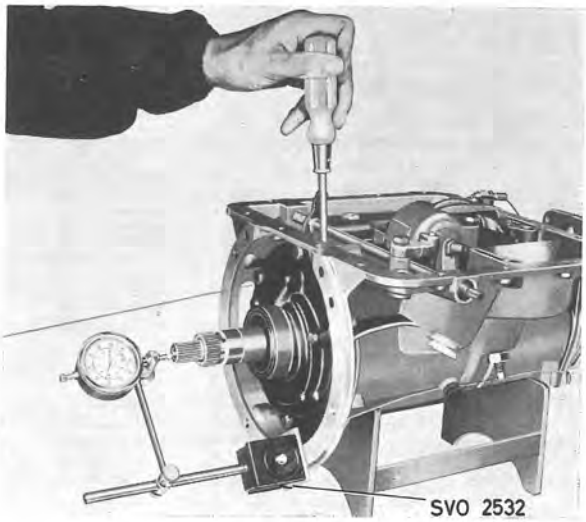
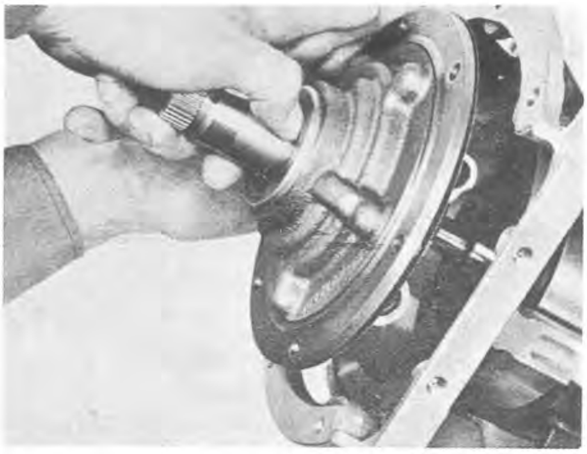


Fig. 4-85. Checking end float



VOLVO
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Fig. 4-86. Removing pump

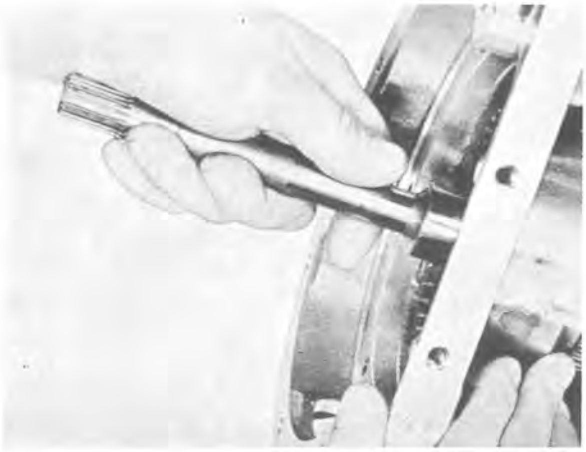

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Fig. 4-88. Withdrawing front clutch assembly

gasket. Push the shaft inwards when withdrawing the pump, see Fig. 4-86.

23. Unscrew the five hexagon bolts and the slotted screw. Separate the pump body, gears and other parts, see Fig. 4-87.

FRONT CLUTCH ASSEMBLY

24. Withdraw the front clutch assembly and input shaft complete, see Fig. 4-88. Take care of the thrust washers. Take out the front brake band.
25. Remove the snap ring with a screwd.:iver. 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. 4-89.
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.
30. Remove the snap ring and take out the pressure plate, inner and outer plates.

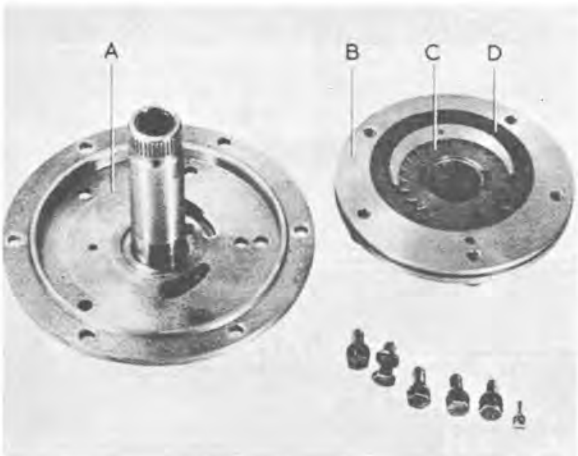

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Fig. 4-87. Converter support separated from pump

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

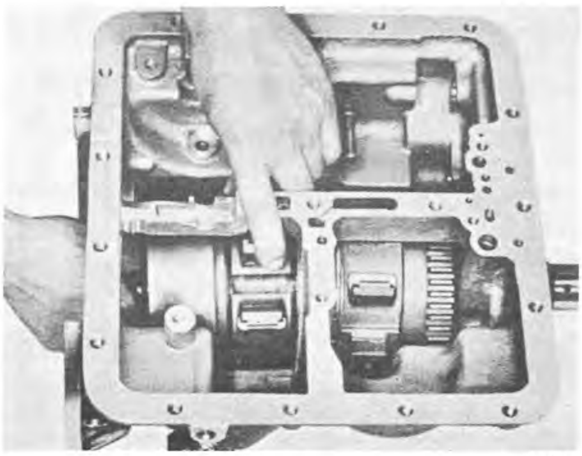

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Fig. 4-89. Withdrawing rear clutch and forward sun gear group

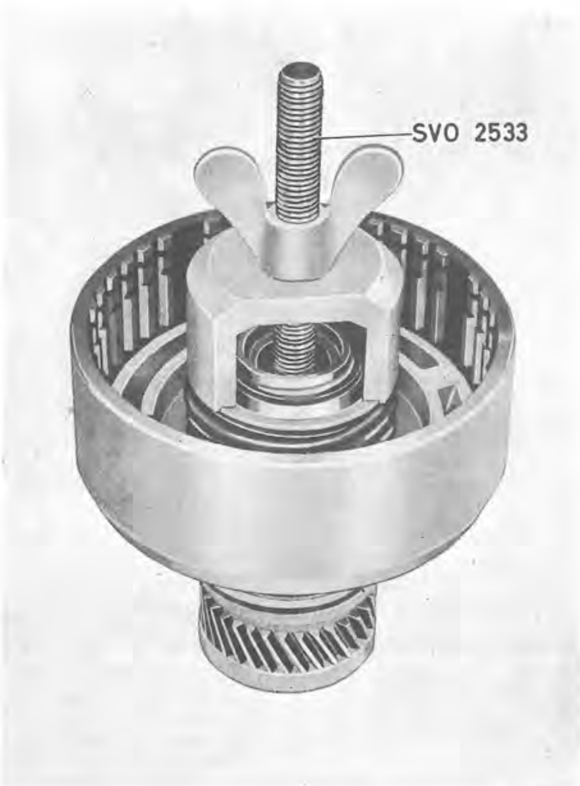


Fig. 4-90. Disassembling rear clutch

31. Place special tool SVO 2533 on the clutch as shown in Fig. 4-90. 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 centre support screws, see Fig. 4-91. Withdraw the centre support and planet gears, see Fig. 4-92. 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.

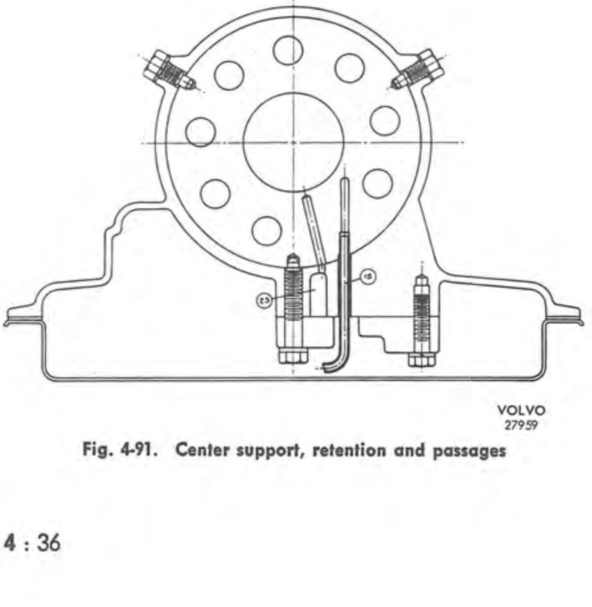


Fig. 4-91. Center support, retention and passages

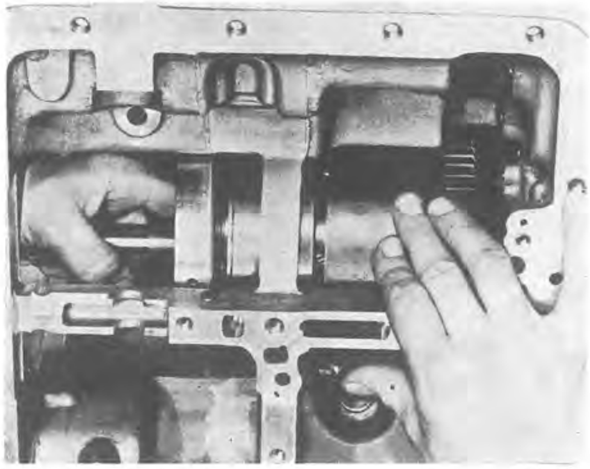


Fig. 4-92. Withdrawing center support and planet gears

GOVERNOR

33. Remove the snap ring, see Fig. 4-93, and withdraw the governor. Take care of the detent ball.
34. Unscrew the two screws and take off the governor sleeve. Take off the spring retainer and separate the various parts. Unscrew the screws and withdraw the cover plate.

OIL DEFLECTOR FLANGE

35. Unscrew the five slotted screws. Withdraw the oil deflector flange.

Fig. 4-93. Withdrawing governor

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 oil cooler connections. Note: Items not described in this section are assembled in the reverse order to dismantling.

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 dismantling. Make sure that the springs for the levers are correctly fitted, see Fig. 4-95. Fitting the detent ball is facilitated by pressing down the ball using a short length of tubing as shown in Fig. 4-94.

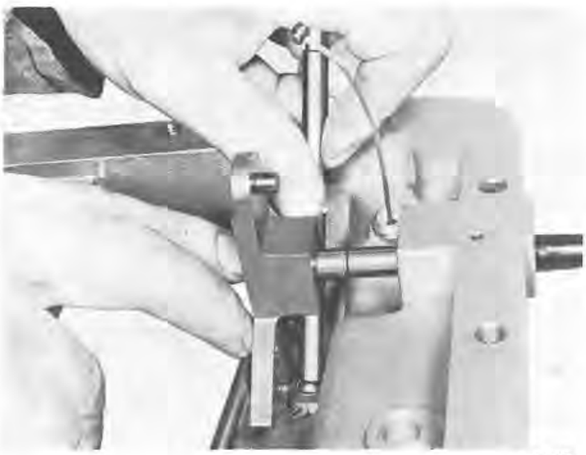


Fig. 4-94. Locating manual valve lever on detent ball spring

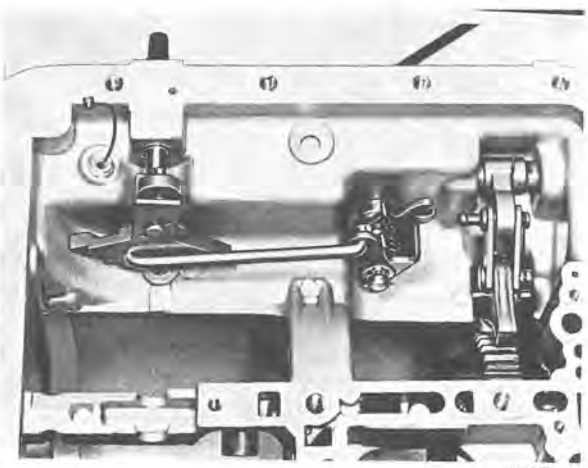


Fig. 4-95. Parking pawl and linkage installed

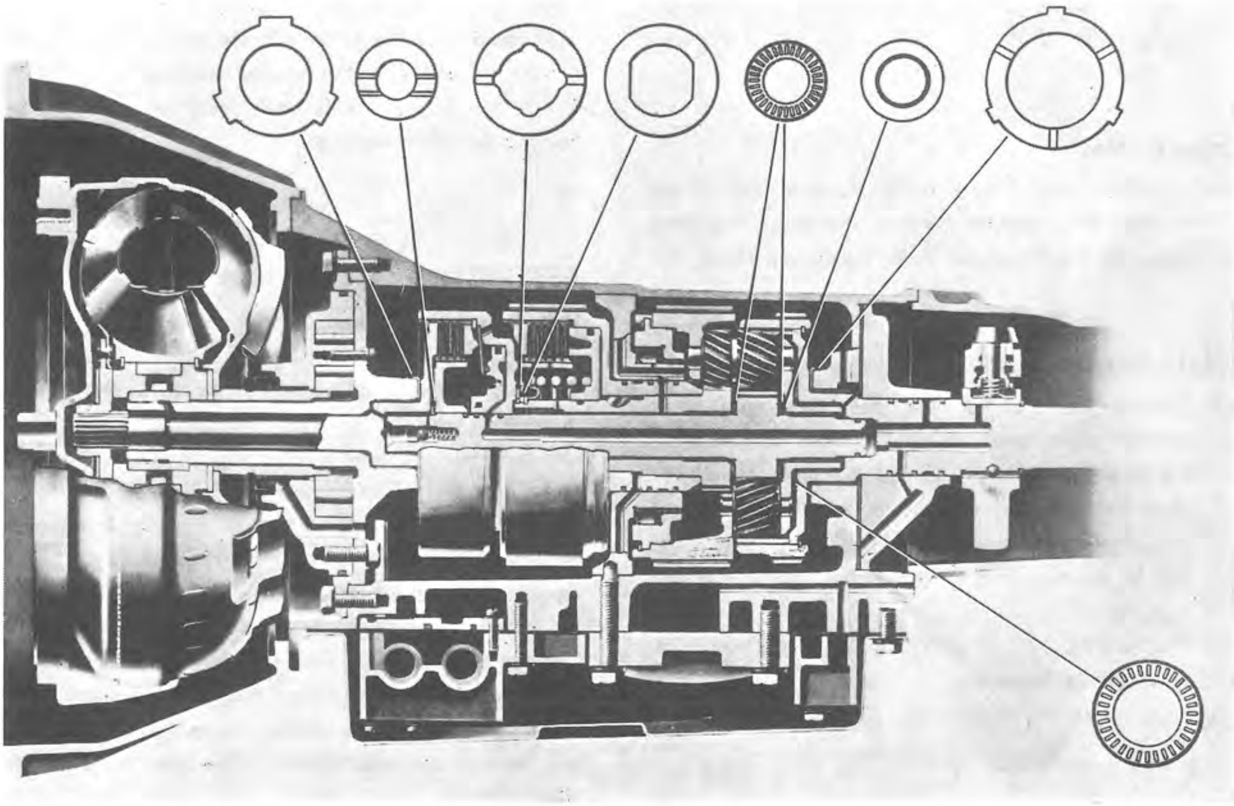


Fig. 4-96. Location of thrust washers

DRIVEN SHAFT

3. The thrust washer for driven shaft, see Fig. 4-96, is stuck onto the transmission case with vaseline. The driven shaft complete with ring gear is then installed into the transmission case.

OIL DEFLECTOR FLANGE

5. Install the three oil sealing rings on the shaft, see Fig. 4-97. Excercise care when doing this as the oil sealing rings are very fragile. Stand the box on its front end and support under the shaft. Centre the oil rings. The oil deflector flange is then fitted.

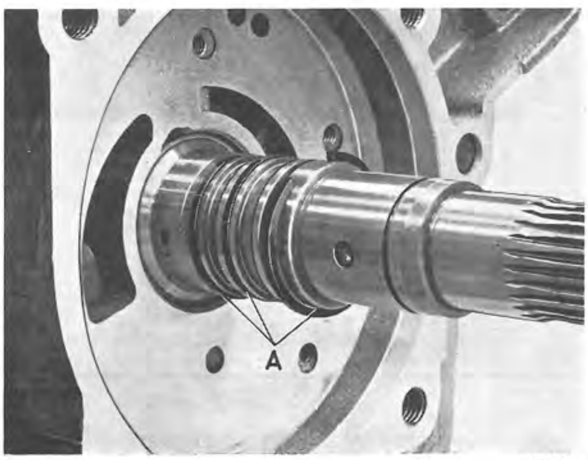


Fig. 4-97. Installing driven shaft oil rings
A. Oil rings

GOVERNOR

6. Place the governor drive ball in the shaft as shown in Fig. 4-100. Fit the governor with the cover-plate facing the rear. Fit the snap ring.

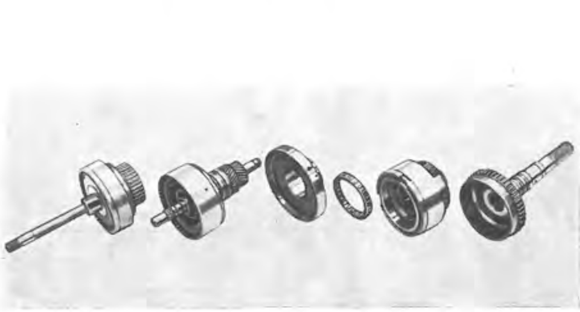


Fig. 4-98. Gear train components

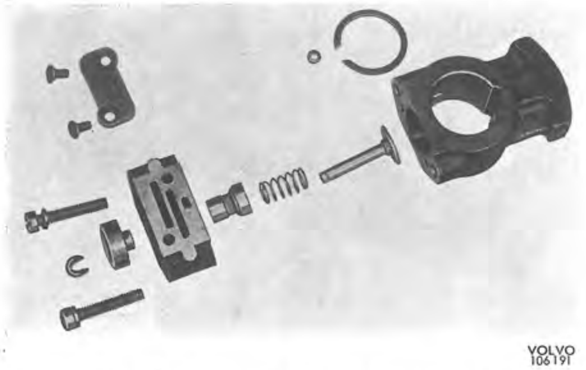


Fig. 4-99. Governor assembly disassembled

REAR BRAKE BAND AND SERVO

7. Place the rear brake band in position in the case, see Fig. 4-101. Then fit the rear servo assembly. Tighten only the rear (short) servo screw since the long one also locates the centre support.

PLANET GEAR AND CENTER SUPPORT

8. Assemble the planet gear, one-way clutch and center support, see Fig. 4-103. Stick the thrust plate and needle thrust bearing to the planet cover with vaseline.
9. 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. 4-91.)
10. 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.

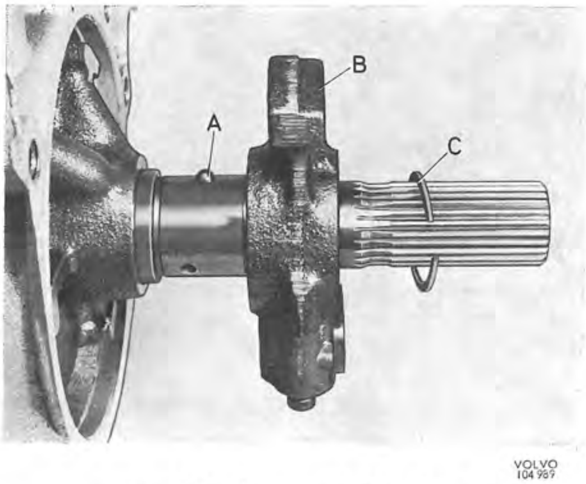


Fig. 4-100. Governor and driven shaft

A. Drive ball
B. Governor assembly
C. Snap ring

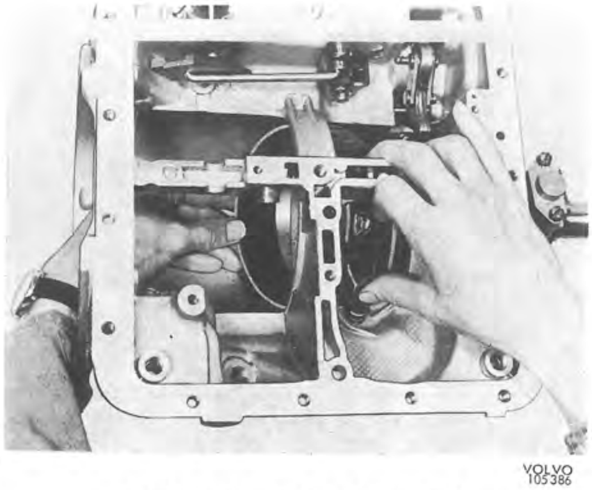


Fig. 4-101. Installing rear brake band

Fig. 4-102. Rear servo assembly disassembled

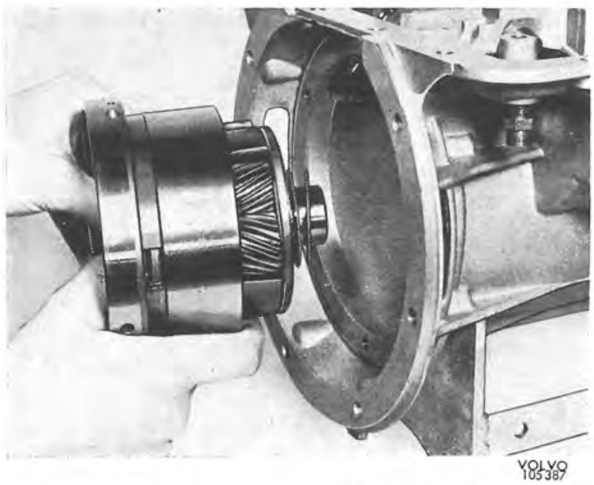


Fig. 4-103. Installing center support and planet gears with needle thrust bearing and plate washer

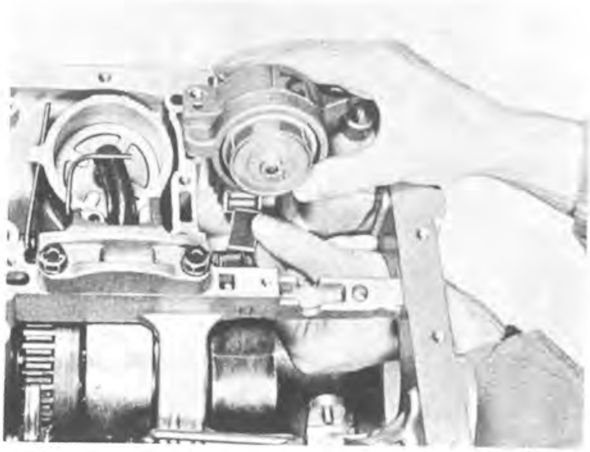


Fig. 4-104. Installing front servo and strut

FRONT BRAKE BAND AND SERVO

11. Place the front brake band in position, see Fig. 4-104. 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

12. Fit the sealing rings for the piston. Use fitting ring SVO 2534 and fit the piston in the clutch case, see Fig. 4-107.
13. Fit the spring, spring seat and snap ring using special tool SVO 2533, which is used when disassembling, see Fig. 4-90.
14. Install the clutch plates. Note that the outer plates are coned and that all the plates should be fitted 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.

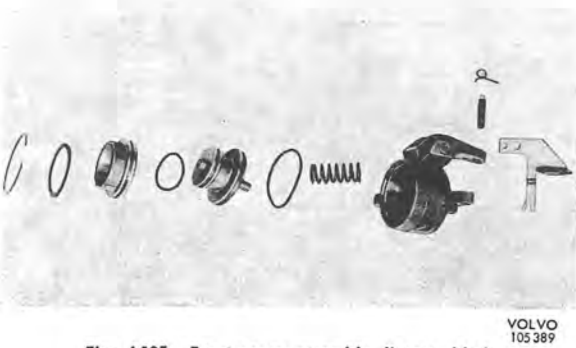


Fig. 4-105. Front servo assembly disassembled

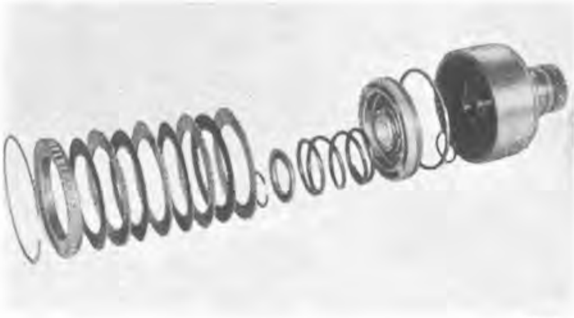


Fig. 4-106. Rear clutch disassembled

15. 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. 4-108.
16. Install the rear needle thrust bearing and fit the clutch in the gearbox as shown in Fig. 4-109.

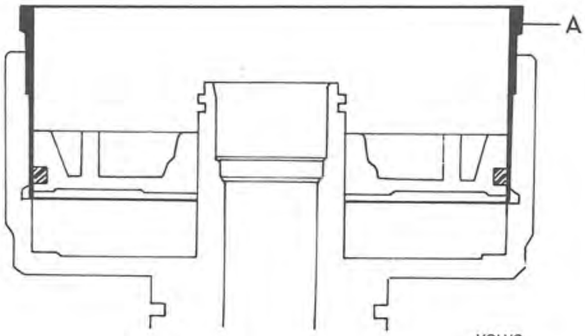


Fig. 4-107. Installing piston for rear clutch

A. Fitting ring SVO 2534

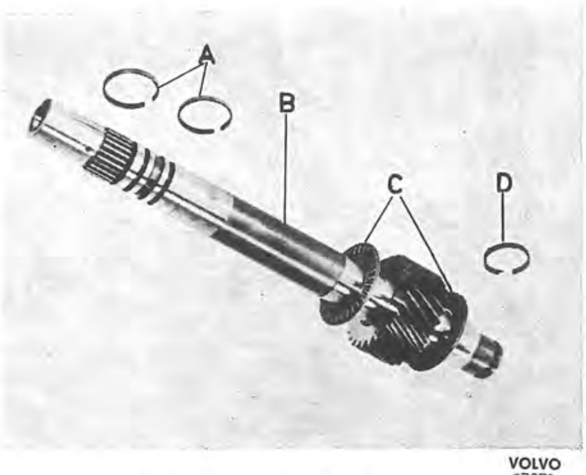


Fig. 4-108. Forward sun gear components

A. Oil sealing rings, front clutch
B. Forward sun gear assembly
C. Needle thrust washers
D. Oil sealing ring, governor feed

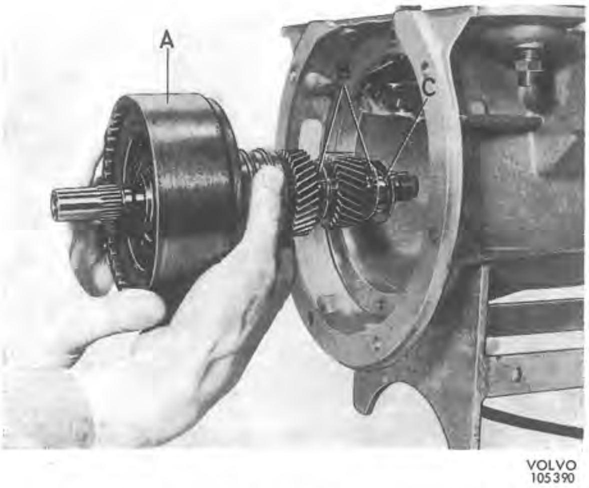


Fig. 4-109. Installing rear clutch and forwards sun gear group

A. Rear clutch
B. Needle thrust bearings
C. Thrust washer plate

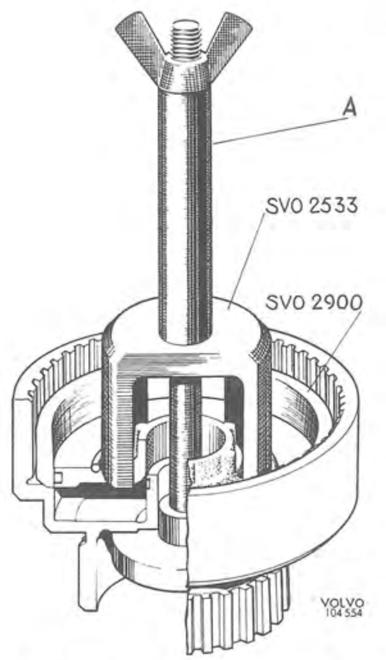


Fig. 4-111. Installing piston for front clutch

A. Tube, length 4.3" (110 mm)

FRONT CLUTCH

17. Fit the sealing ring on the piston and the O-ring in the drum. Place the piston in installation ring SVO 2900. Press it down level with the lower edge of the ring. Use press tool SVO 2533 and tube A as shown in Fig. 4-111. Fit the spring with the dished side facing rear. Put on the snap ring.
18. Install the clutch assembly with its two different thrust washers in the gearbox, see Fig. 4-112. Be careful not to damage the oil sealing rings. For identifying the thrust washers, see Fig. 4-96.
19. 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. 4-113. Fit the snap ring.

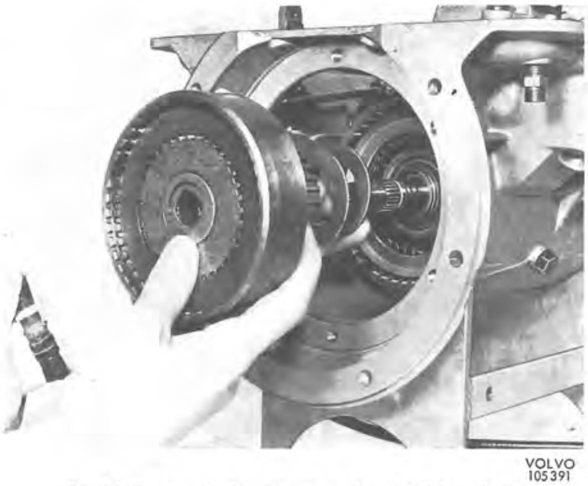


Fig. 4-112. Installation sequence, front clutch cylinder thrust and backing washers

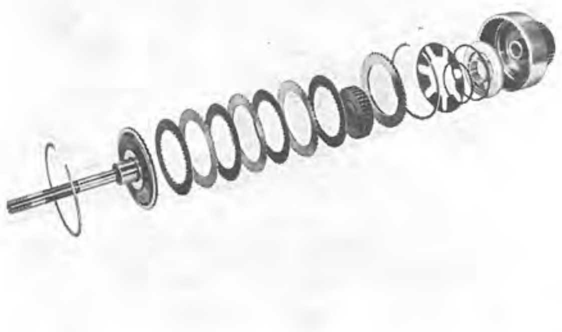


Fig. 4-110. Front clutch disassembled

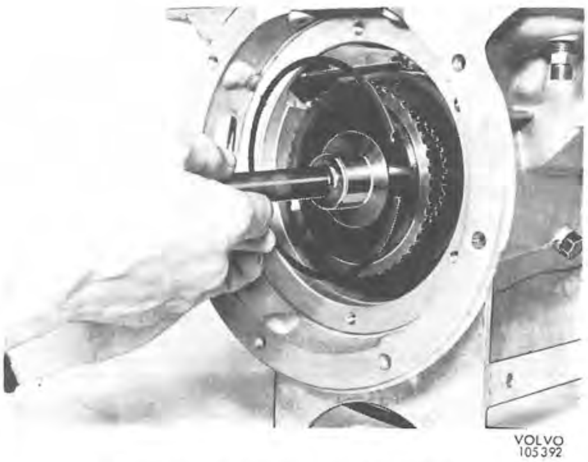


Fig. 4-113. Installation sequence, front clutch snap ring, input shaft and thrust washer

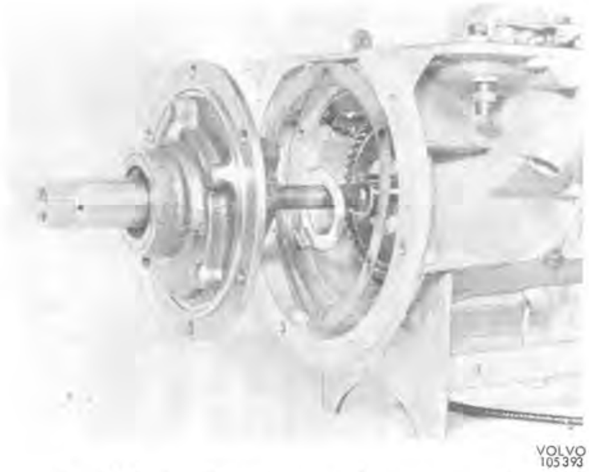


Fig. 4-114. Installation sequence, front pump assembly thrust washer and gasket

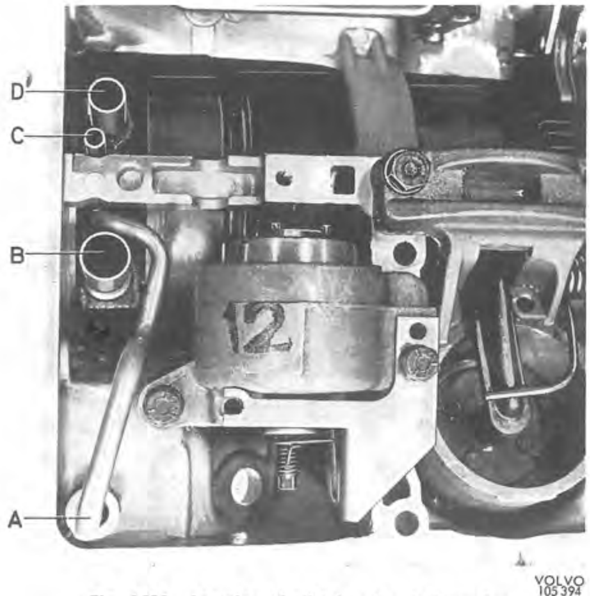


Fig. 4-116. Location of oil tubes, front of gearbox

A. Converter outlet
B. Pump inlet
C. Converter inlet
D. Pump outlet

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.

PUMP

20. Fit the O-ring on the pump body, then assemble the pump in the reverse order to dismantling.
21. Stick on the thrust washer with vaseline and then fit the pump with a new gasket on the transmission case, see Fig. 4-114. Re-check the end float in accordance with point 21, page 34.

EXTENSION HOUSING

22. Place the speedometer gear correctly on the driven shaft as shown in Fig. 4-115. Fit the extension housing with a new gasket and fit the drive flange with washer and nut.

VALVE BODIES ASSEMBLY

23. When assembling, all the component parts which have been dismantled should be thoroughly cleaned and lubricated with oil approved as "Automatic Transmission Fluid, Type A" prior to reassembling in the reverse order to dismantling. 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.

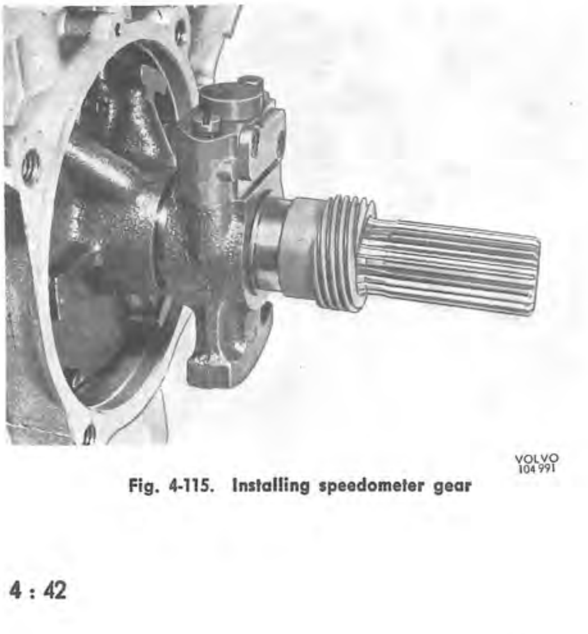


Fig. 4-115. Installing speedometer gear

Fig. 4-117. Adjusting front brake band

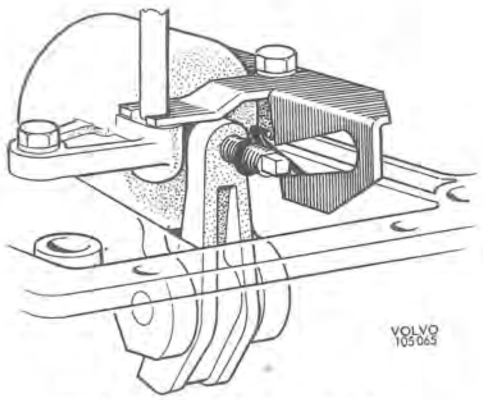


Fig. 4-118. Self-adjusting spring bolt cam

24. Fit the oil tubes for the pump and converter on the pump body, see Fig. 4-116. Do not forget the O-ring for the pump inlet tube.
25. Fit the valve bodies assembly onto the gearbox. Connect the throttle cable.

MISCELLANEOUS

26. Place the spacer block SVO 2537 between the bolt and cylinder, see Fig. 4-117. Tighten the bolt with torque wrench SVO 2748 until the ratchet handle clicks out. This should be at a torque of 10 lb.in. (11.5 kp/cm).
27. Adjust the location of the spring on the adjusting screw. It should be 1—2 threads from the lever. Remove the torque wrench and spacer block. Fit the cam. The long end of the spring sticks into the cam, see Fig. 4-118.
28. Fit the four oil tubes according to Fig. 4-119. Note that the oil tube for releasing the front control cylinder has a constriction (A, Fig. 4-120) on vehicles with B 30 E and B 30 F engine. This end is fitted in the valve bodies system.
29. Adjust the brake bands, see "Adjusting the rear brake band" on page 30. Adjust the starter inhibitor switch, see "Adjusting starter inhibitor switch" on page 29.
30. Place the magnetic piece in the oil pan. Fit the oil pan with a new gasket.

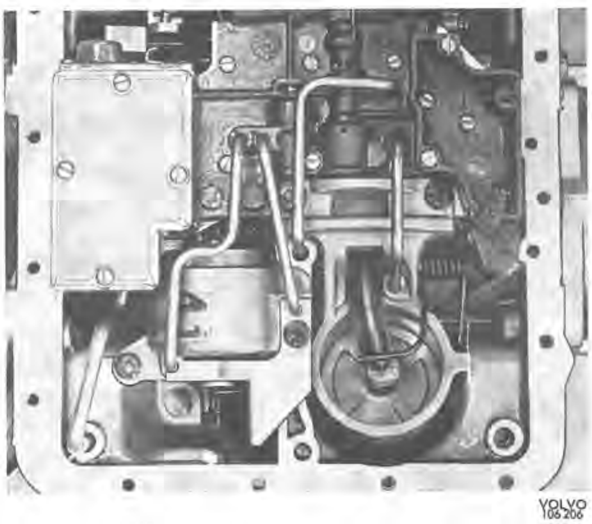


Fig. 4-119. Retention of front and rear pump strainers

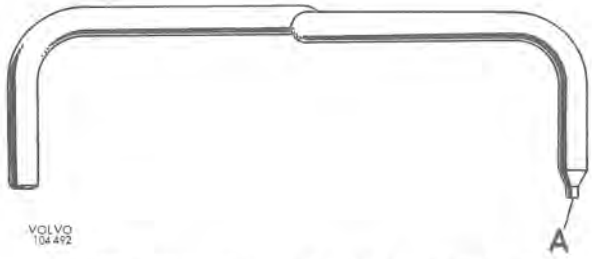


Fig. 4-120. Oil tube for valve bodies system, vehicle with B 30 E and F engines

INSTALLING

The converter, converter housing and gearbox are fitted in the reverse order to removing. Connect the leads for the starter inhibitor switch and reversing light correctly, see Fig. 4-121.

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 (14) on the selector lever housing (6, Fig. 4-123).
2. With the help of a knife lever up at the front edge the cap (1) on the selector lever knob (see Fig. 4-122). 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).

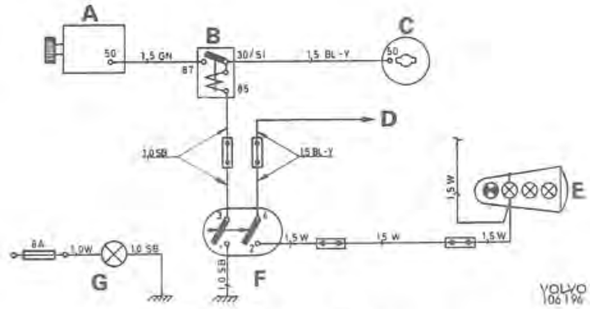


Fig. 4-121. Wiring diagram

A. Starter motor
B. Starter relay
C. Ignition switch
D. Cable for main relay
E. Reversing light
F. Switch on gearbox for starter inhibitor and reversing light
G. Shift positions lamp

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 cover (10) off the selector lever housing.
5. Knock up the tubular studs. Remove the push rod (5) and inhibitor (17). Drive out the shaft (11). Release the screws from the gating (9). Drive out the bushes from the bracket (15).

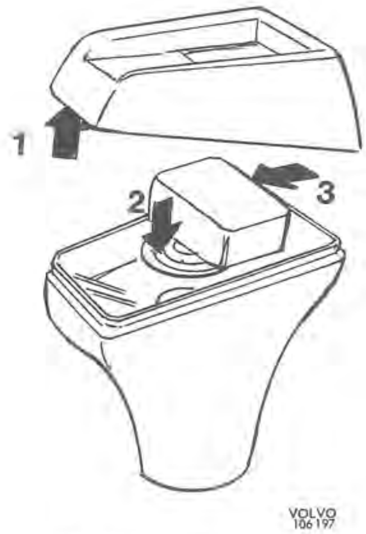


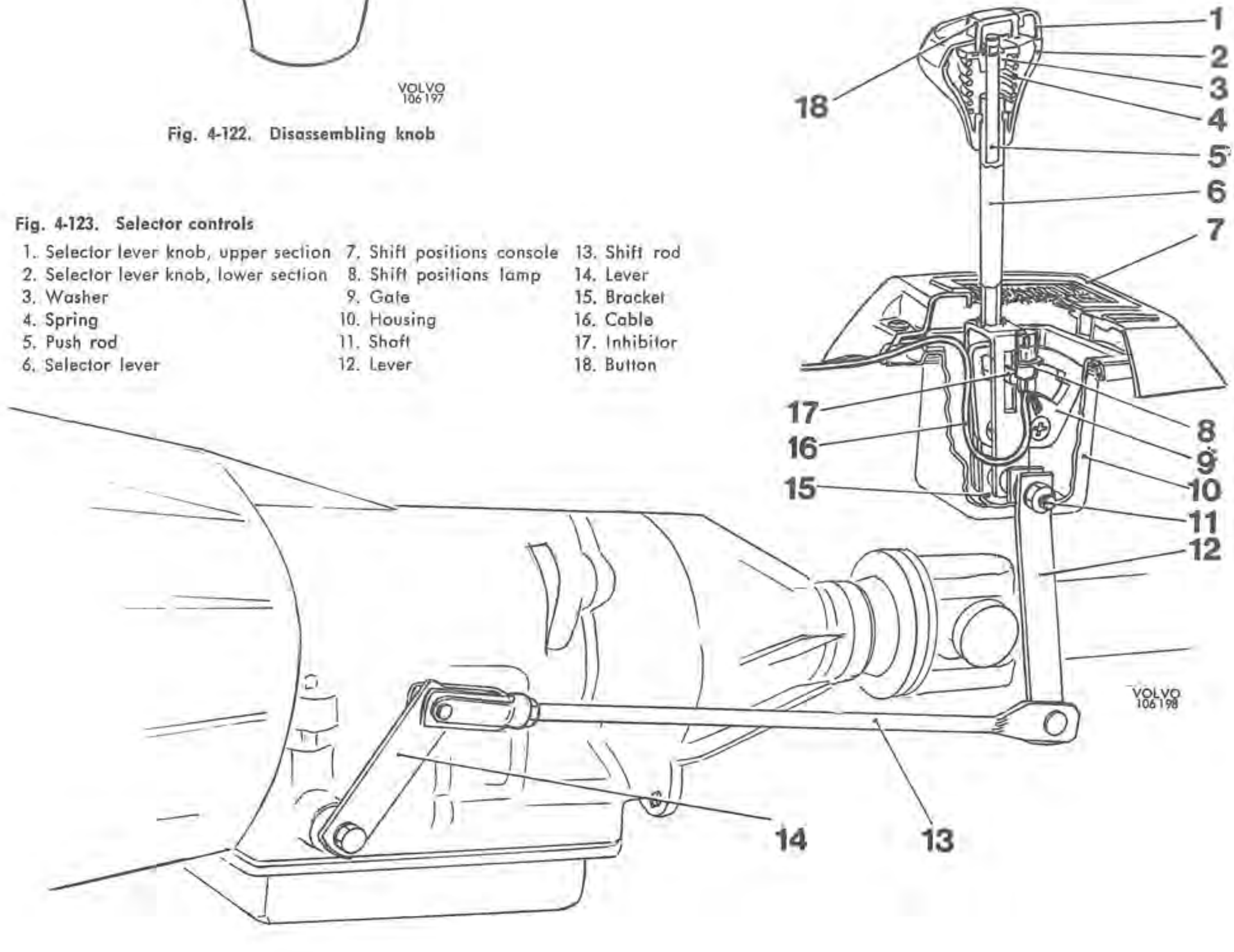
Fig. 4-122. Disassembling knob

ASSEMBLING AND INSTALLING

1. Press the bushes into the bracket and screw tight the gating.
   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".

Fig. 4-123. Selector controls

1. Selector lever knob, upper section
2. Selector lever knob, lower section
3. Washer
4. Spring
5. Push rod
6. Selector lever
7. Shift positions console
8. Shift positions lamp
9. Gate
10. Housing
11. Shaft
12. Lever
13. Shift rod
14. Lever
15. Bracket
16. Cable
17. Inhibitor
18. Button



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. 4-69) 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.

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 25 m.p.h. (40 km.p.h.) in 3rd gear, depress the accelerator to full throttle position. The car should downshift to 2nd gear. Repeat at 40 m.p.h. (65 km.p.h.). The car should accelerator in 3rd gear and should not downshift to 2nd.

c. At 30 m.p.h. (50 km.p.h.) in 3rd gear, depress the accelerator to the kick-down position. The transmission should downshift to 2nd gear.

d. At 15 m.p.h. (25 km.p.h.) 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 40 m.p.h. (65 km.p.h.) 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 5 m.p.h. (8 km.p.h.) and engine braking.

7. Stop, and with "1" still engaged, release brakes and, using full throttle, accelerate to 20 m.p.h. (30 km.p.h.) 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 downshift on a gradient 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 600 r.p.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 can therefore not 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 300 r.p.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 600 r.p.m. below that specified, the converter assembly must be replaced.
3. Below standard acceleration in 3rd gear above 30 m.p.h. (50 km.p.h.) 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

SVO 2846 Special socket for propeller shaft bolts

The designation SVO before the tool number is to be replaced by the number 999. This applies also to new production of older tools.

DESCRIPTION

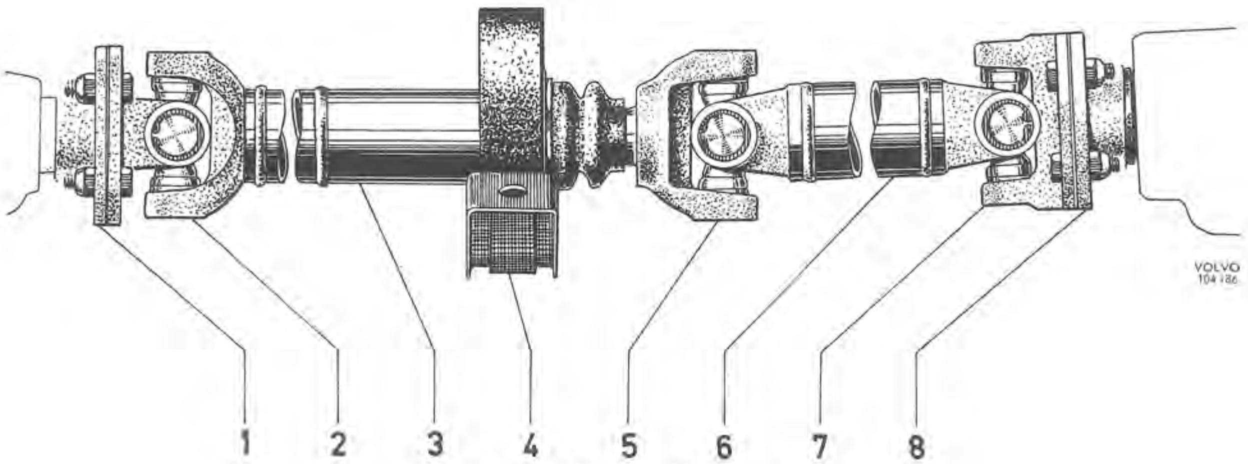


Fig. 4-124. Propeller shaft with support bearing

1. Flange on gearbox
2. Front universal joint
3. Front section of propeller shaft
4. Support bearing
5. Intermediate universal joint
6. Rear propeller shaft
7. Rear universal joint
8. Flange on rear axle

The propeller shaft is of the divided, tubular type, see Fig. 4-124. 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. 4-125. 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.

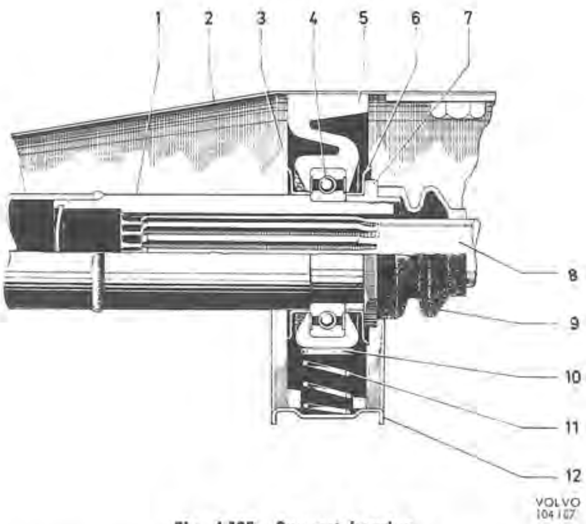


Fig. 4-125. Support bearing

1. Front section of propeller shaft
2. Floor tunnel
3. Dust cover
4. Ball bearing
5. Rubber housing
6. Dust cover
7. Nut
8. Rear section of propeller shaft
9. Rubber cover
10. Washer
11. Suspension spring
12. Cover

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 SVO 2846, see Fig. 4-126. Loosen the cover for the support bearing and take down the propeller shaft complete.

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. 4-127.
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. 4-128.

Fig. 4-126. Removing bolts

VOLVO
103 227

VOLVO
101 778

Fig. 4-128. Removing spider, I

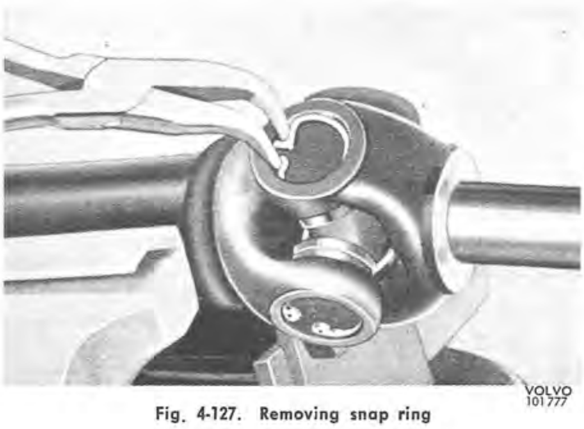


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Fig. 4-127. Removing snap ring

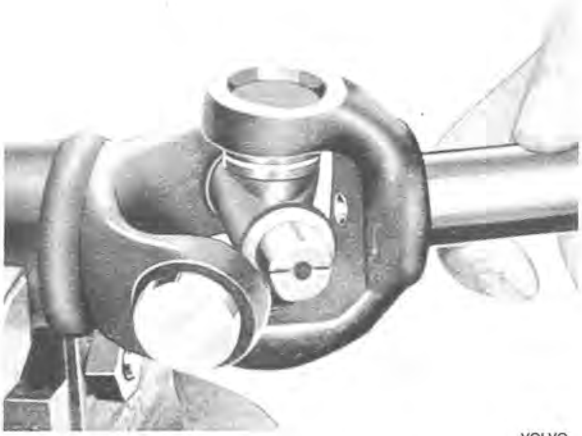

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Fig. 4-129. Removing spider, II

5. Drive out one of the needle bearings with a thin metal punch. Remove the spider, see Fig. 4-129. 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.
N.B. 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.

Fig. 4-130. 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, se Fig. 4-130. 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 following tools are used for repair work on rear axle

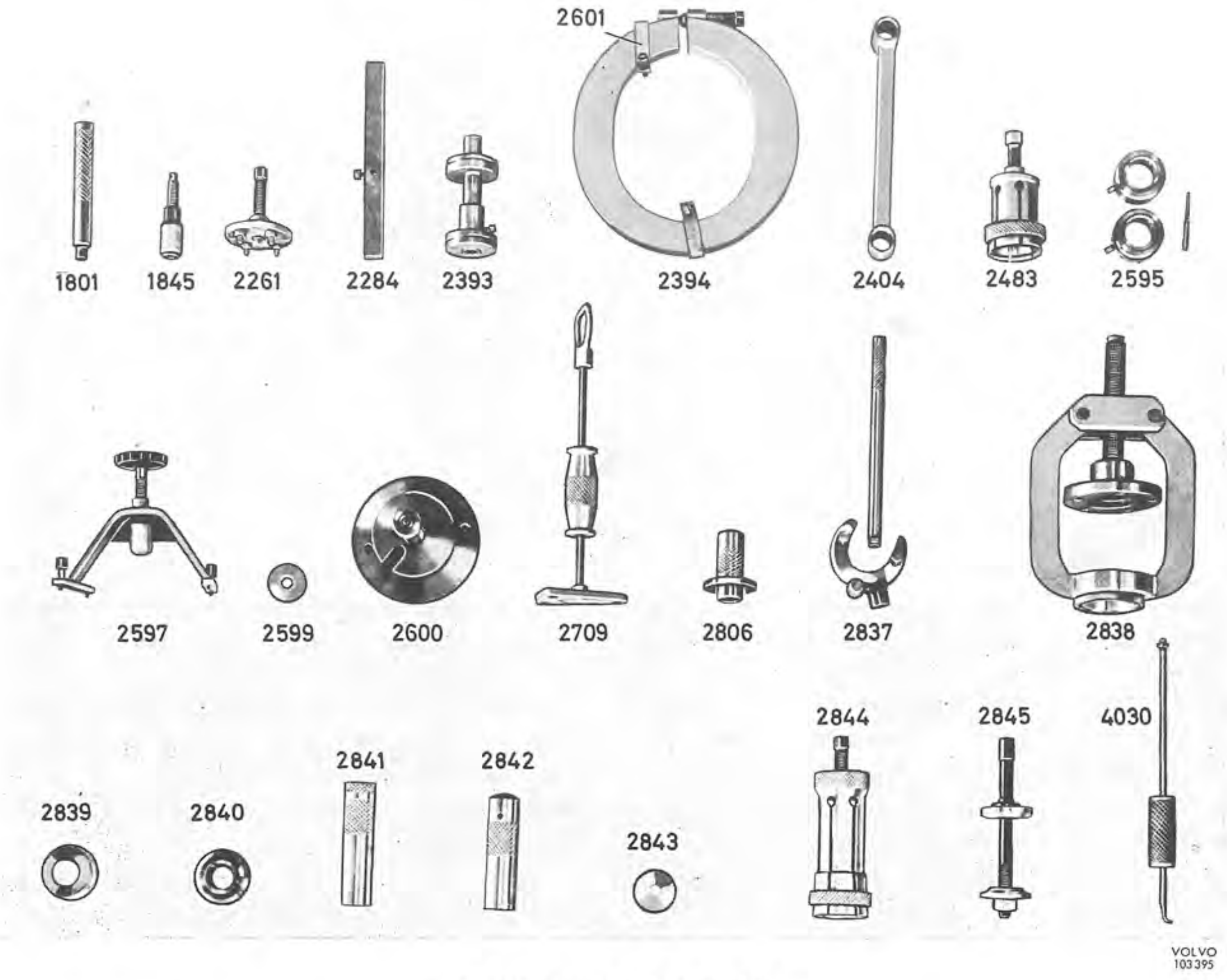

Fig. 4-131. Special tools for rear axle

SVO 1801 Standard handle 18×200 mm
SVO 1845 Press tool for fitting flange
SVO 2261 Puller for flange
SVO 2284 Retainer for dial indicator for final drive adjustment
SVO 2393 Measuring tool for pinion adjustment
SVO 2394 Expander tool used for removing and fitting differential
SVO 2404 Tool for fitting front pinion bearing. Used also when checking tooth mesh
SVO 2483 Puller for differential carrier bearings
SVO 2520 Stand, see Fig. 4-132
SVO 2522 Fixture for rear axle (used together with stand SVO 2520 for work on the final drive)
SVO 2595 Adjusting rings for differential
SVO 2597 Brake for crown wheel, used when checking tooth mesh
SVO 2599 Drift for removing outer ring, front pinion bearing
SVO 2600 Measuring fixture for adjusting rings
SVO 2601 Holder for expander tool SVO 2394 (fitted on tool)
SVO 2709 Puller for drive shaft
SVO 2714 Fixture for rear axle, used on garage jack for removing and fitting rear axle, see Fig. 4-165
SVO 2806 Tool for fitting oil seal at flange
SVO 2837 Counterhold for flange
SVO 2838 Press tool for removing and fitting bearing and lock ring on drive shaft
SVO 2839 Ring for fitting bearing and lock ring on drive shaft. Used together with SVO 2838
SVO 2840 Adjusting ring for pinion
SVO 2841 Box spanner for adjusting ring SVO 2840
SVO 2842 Sleeve for fitting inner ring, rear pinion bearing
SVO 2843 Drift for removing outer ring, rear pinion bearing
SVO 2844 Puller for rear pinion bearing
SVO 2845 Press tool for fitting outer ring, pinion bearing
SVO 4030 Puller for oil seal at flange

The designation SVO before the tool number is to be replaced by the number 999. This applies also to new production of older tools.

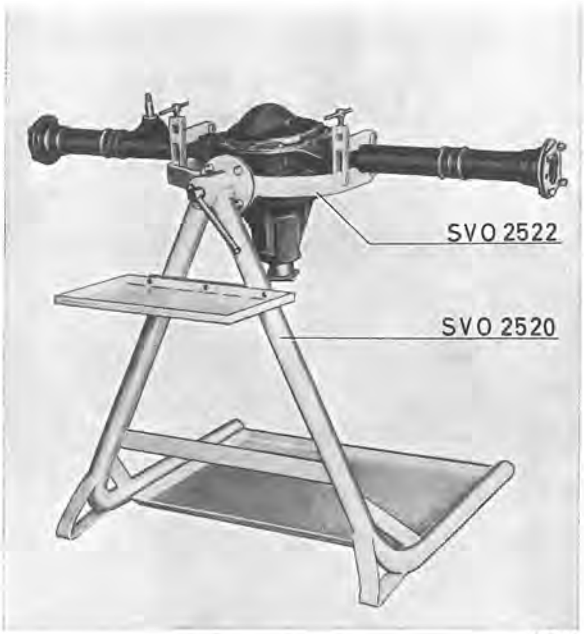

Fig. 4-132. Stand and fixture for rear axle

DESCRIPTION

The rear axle is carried in two support arms. The supports 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.

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 SVO 2709, see Fig. 4-133.
4. Secure press tool SVO 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. 4-134. Screw out the spindle and press off the bearing and lock ring. Remove the oil seal.
5. Fill the space between the seal lips on the new oil with grease. Then place it on the drive shaft. Fit the bearing and lock ring. Turn the bearing correctly, see Fig. 4-136.
   N.B. Always use a new lock ring.
   Place fitting ring SVO 2839 against the bearing and the lock ring. Close the tool arms and lock them round the fitting ring, see Fig. 4-135. Press on the bearing and lock ring by screwing in the spindle.
6. Grease the bearing. Then fit the drive shaft. Tighten the bolts for the thrust washer to a torque of 5 kpm (36 lb.ft.). Fit the brake disc and brake caliper. Connect the brake line. Vent and adjust the brakes, see Part 5.
7. Fit on the wheels and wheel nuts. Lower the vehicle. Tighten the wheel nuts.

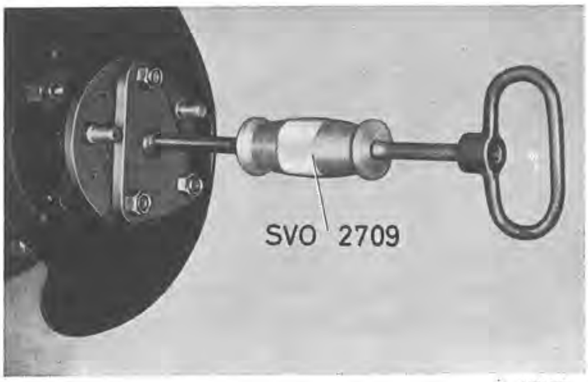

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Fig. 4-133. Removing drive shaft

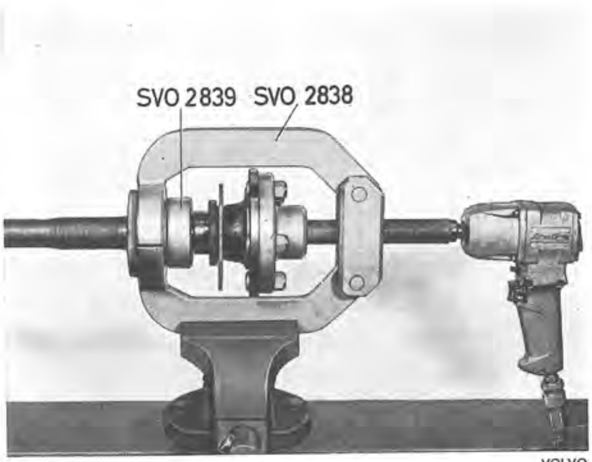

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Fig. 4-135. Fitting drive shaft bearing

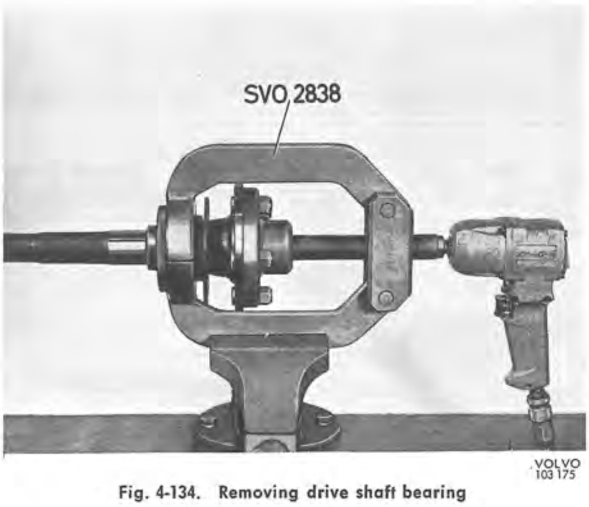

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Fig. 4-134. Removing drive shaft bearing

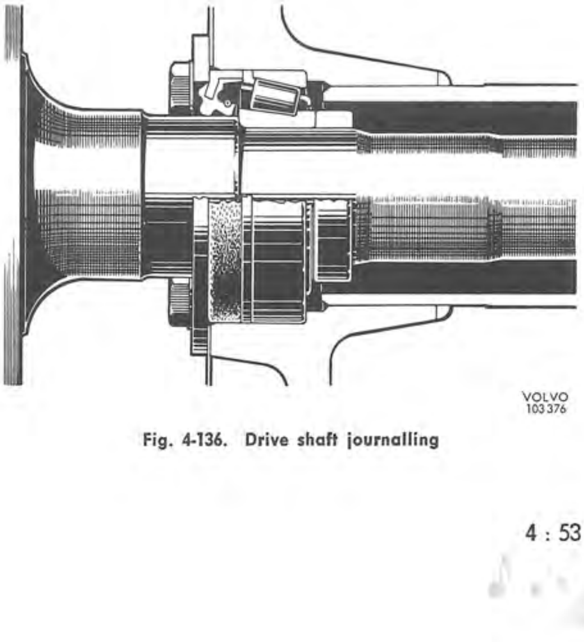

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Fig. 4-136. Drive shaft journalling

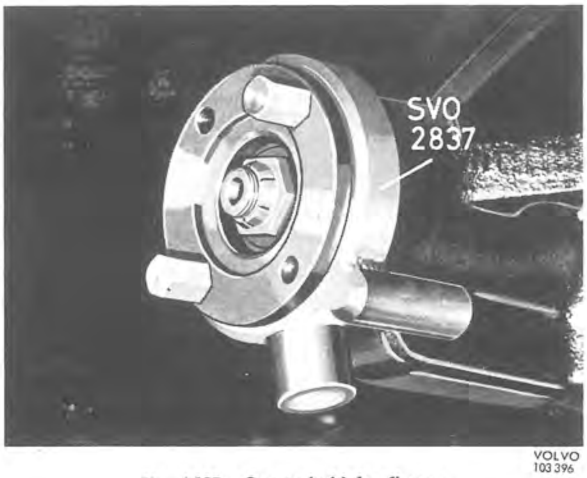

Fig. 4-137. Counterhold for flange

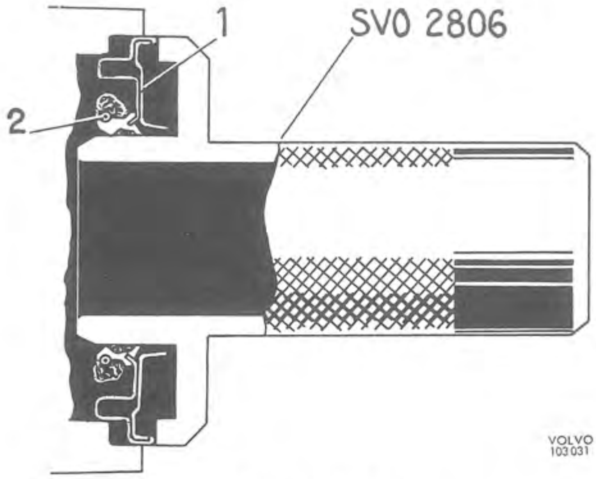

Fig. 4-139. Fitting oil seal
1. Oil seal 2. Spring coil with grease coating

REPLACING THE 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 SVO 2837, see Fig. 4-137. Pull the flange off with puller SVO 2261, see Fig. 4-138. Pull out the old oil seal with puller SVO 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 apply a layer of grease to the spring coil. See Fig. 4-139. This last-mentioned measure is made to prevent the spring coil from jumping out during fitting.
4. Press on the flange with the help of press tool SVO 1845, see Fig. 4-140. Fit the washer and nut.

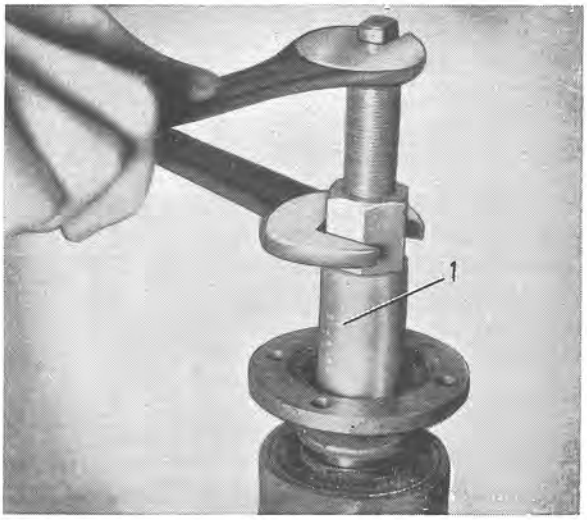

Fig. 4-140. Fitting flange
1. Press tool SVO 1845

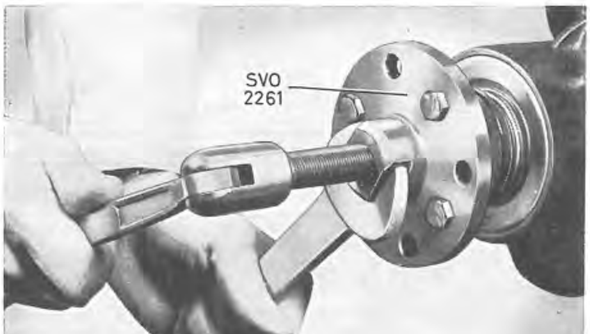

Fig. 4-138. Removing flange

Fig. 4-141. Locating axle prop

Tighten the nut to a torque of 28—30 kpm (200—220 lb.ft.).

5. Connect the propeller shaft section.

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. 4-141. 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 SVO 2714 (compare with Fig. 4-165) 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 SVO 2522. 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 SVO 2709, see Fig. 4-133.
3. Remove the inspection cover.
4. If the final drive is being reconditioned because of noise, the mesh pattern should be checked before dismantling 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. 4-142. If there are no markings, or if they are difficult to see, mark one side with a punch. Remove the caps.
6. Fit tool SVO 2394 in the holes in the drive pinion carrier as shown in Fig. 4-143. Fit the tool with retainers SVO 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 SVO 2337 can be used for this purpose.
7. Turn the final drive and let the oil run out into a container. Use tool SVO 2837 as a counterhold for this purpose, see Fig. 4-137. Pull off the flange with puller SVO 2261, see Fig. 4-138. Press out the pinion.
8. Drive out the front pinion bearing, the washer and the oil seal with standard handle SVO 1801 and drift 2599.
9. If necessary, drive out the rear bearing outer ring out of position, see Fig. 4-144. Use standard handle SVO 1801 and drift SVO 2843.
10. Clean the gasket. File off all burr on the surface on which the indicator retainer SVO 2284 is to slide.

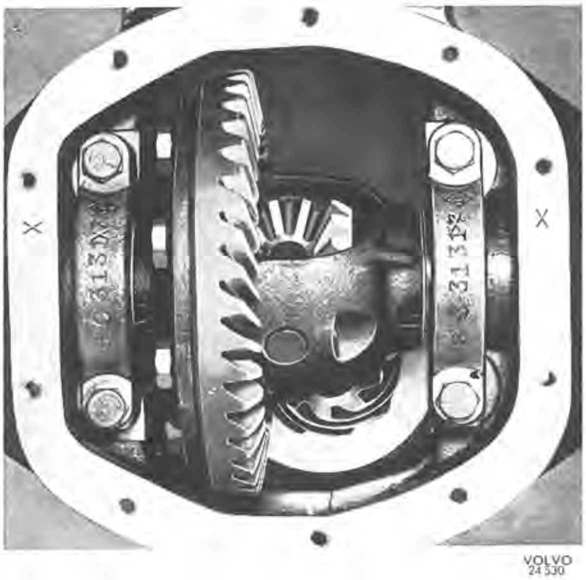

Fig. 4-142. Alignment marking on cap and carrier

Fig. 4-143. Expanding drive pinion carrier

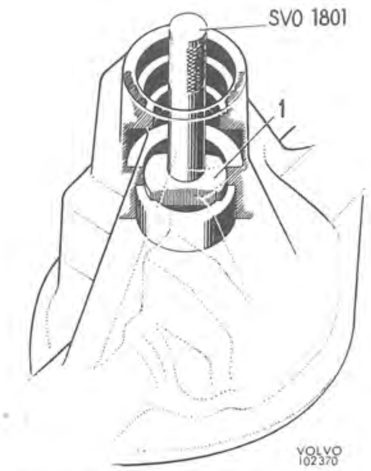

Fig. 4-144. Removing rear pinion bearing race
1. Removing drift SVO 2843

11. If necessary, pull off the rear bearing from the pinion with puller SVO 2844, see Fig. 4-145. The puller is fitted in the following way (see Fig. 4-146): Move the puller down over the rollers and press down the lock ring. Then pull up the puller with the bolt until the rollers lie flush with the edge of the inner race and the edge on the puller. Tap out the lock ring with a hammer.

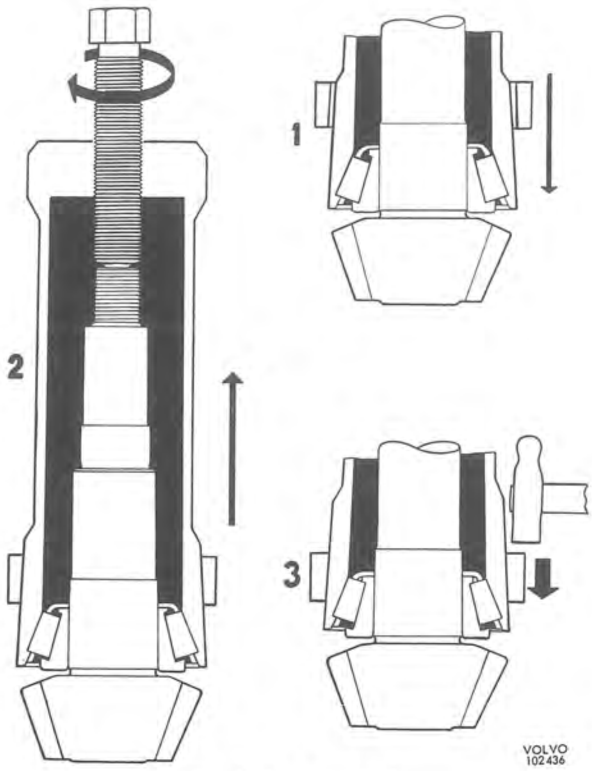

Fig. 4-146. Puller fitted
1. Puller is pressed down over the rollers
2. Rollers are pulled up
3. Lock ring knocked securely into position

DISASSEMBLING DIFFERENTIAL

1. Release the ring gear bolts and remove the crown wheel.
2. Drive out the lock pin, see Fig. 4-147, and then the shaft for the differential gears. Take out the differential gears and the thrust washers.
3. Pull off the differential carrier bearings with puller SVO 2483, see Fig. 4-148. Take care of the shims.

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

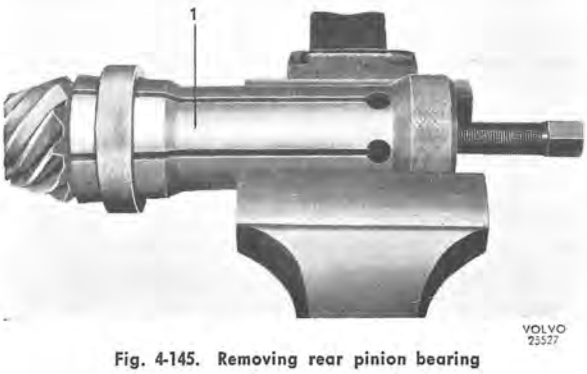

Fig. 4-145. Removing rear pinion bearing
1. Puller SVO 2844

Fig. 4-147. Removing lock pin

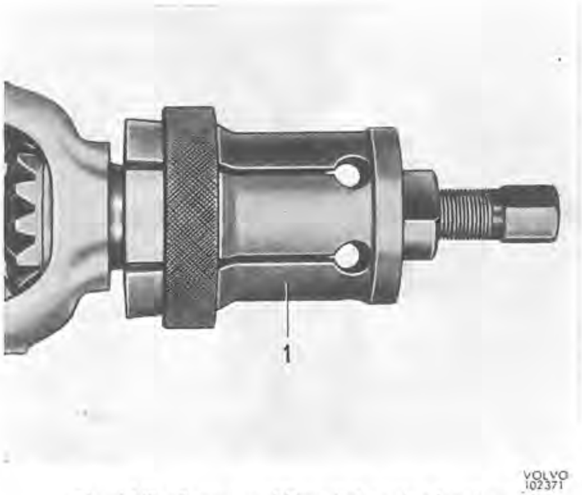

Fig. 4-148. Removing differential carrier bearings
1. Puller SVO 2483

Fig. 4-149. Installing differential gear

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 sizes 0.78 mm, 0.82 mm, 0.86 mm, 0.90 mm and 0.94 mm (0.031, 0.034 and 0.038").

Check also to see whether the cylindrical part of the flange which goes into the oil seal is worn or scratched. If this is the case, replace the flange together with the oil seal.

The pinion nut is provided with a slit for locking. In time this slit loses its locking effectiveness. For this reason, the nut should be replaced if it has been removed a couple of times. The washer under the nut should also be replaced if it has become deformed.

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

Make sure that there are no cracks in the rear casing.

Check that the brackets for the support arms and track rod are intact.

Inspect the drive shafts. Drive shafts which are warped or damaged in any other way should be replaced with new ones.

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

Check the rear axle casing for cracks. Check that the brackets for the support arms and track rod are not damaged.

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. 4-149.
2. Drive in the shaft. Check the differential. If there is any play, fit new dished thrust washers, see Fig. 4-149.
3. Fit the crown wheel. Make sure that the contact surfaces are clean and without any burr. Tighten the bolts to a torque of 6.5—9.0 kpm (47—65 lb.ft.).

INSTALLING PINION

1. Clean the marking surface on the pinion with extremely fine emery cloth. Fit the adjusting ring SVO 2840 and tool SVO 2841 on the pinion, see Fig. 4-150. Place the pinion in the carrier, see Fig. 4-152, and secure the adjusting ring by screwing in the lock screw.
2. The pinion should have a certain nominal measure-

Fig. 4-150. Adjusting ring and tool for pinion location

ment (A, Fig. 4-151) to the centre 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 provided with a plus or minus sign. If there is a plus sign in front of the figure, the nominal measurement should be increased, and if the sign is minus, the nominal measurement should be decreased. The figure indicated on the pinion shows the deviation in thousandths of an inch.

Conversion table, inches to millimetres	
inches	millimetres
0.001	0.025
0.002	0.051
0.003	0.076
0.004	0.102
0.005	0.127
0.006	0.152
0.007	0.178
0.008	0.203
0.009	0.229

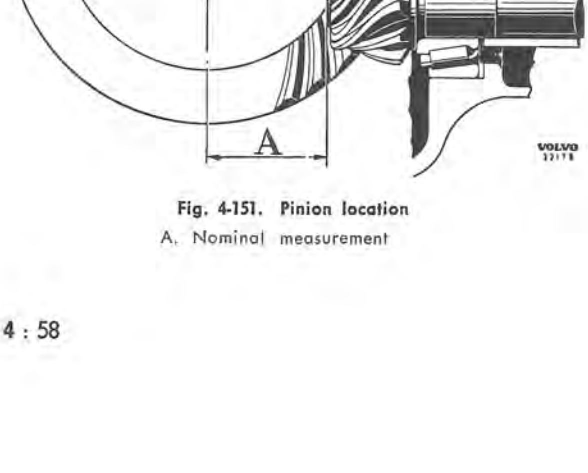

Fig. 4-151. Pinion location
A. Nominal measurement

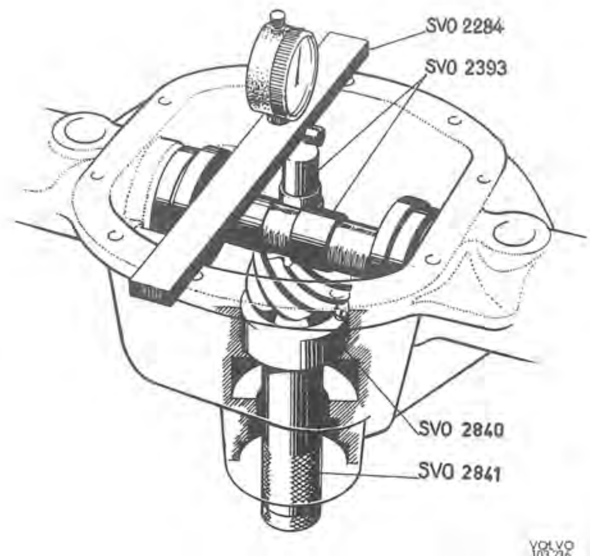

Fig. 4-152. Locating measuring tools

To check the location of the pinion, use a dial indicator, indicator retainer SVO 2284 and a measuring tool SVO 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. 4-152. Place the indicator retainer on the drive pinion carrier and zero-set the gauge against the adjusting jig, see Fig. 4-153. Then move the indicator retainer over so that the indicator comes against the pinion gauge, see Fig. 4-154. If the pinion is marked 0, the adjusting jig and pinion gauge should be at the same height; if the pinion is marked —, the pinion gauge should be higher than the adjusting jig; and if it is marked +, the pinion gauge should be lower than the adjusting jig with correct setting. The setting is adjusted by turning the cam on the pinion until the gauge dial shows the correct value according to the marking. Then lock the

Fig. 4-153. Zero-zetting indicator

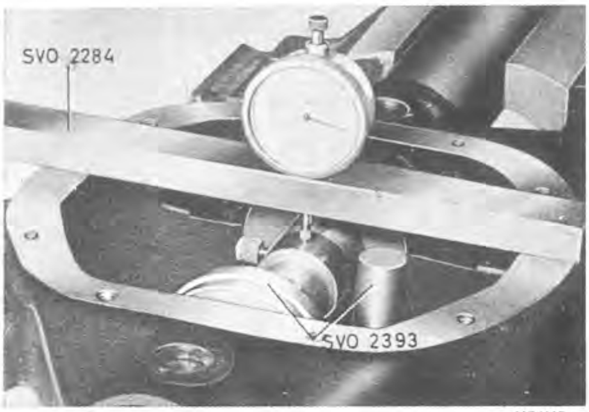

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Fig. 4-154. Measuring pinion location

adjusting ring with the lock screw. Remove the measuring gauge and pinion.

3. Place the rear pinion bearing complete with the outer ring in measuring fixture SVO 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. 4-155. Use retainer SVO 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. 4-156. N.B. 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.

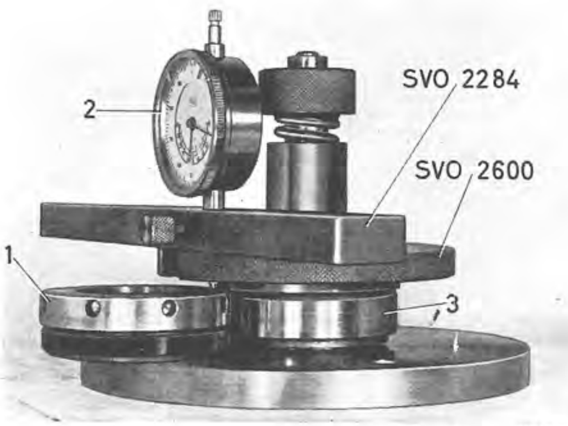

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Fig. 4-155. Determining shim thickness
1. Adjusting ring 2. Dial indicator 3. Bearing, complete

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Fig. 4-156. Measuring shim

4. Press the rear bearing on the pinion with sleeve SVO 2842, see Fig. 4-157. Fit the measured shims and press in both the outer rings of the bearings with tool SVO 2845, see Fig. 4-158.
5. Insert the pinion in the casing and fit on three 0.75 mm (0.03") thick shims and the front pinion bearing. Fot tool SVO 2404 and press tool SVO 1845 on the front end of the pinion and pull in the pinion, see Fig. 4-159. 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 SVO 1845 with a washer and nut. Tighten the nut to a torque of 28—30 kpm (200—220 lb.ft.). Fit on the pinion gauge and the

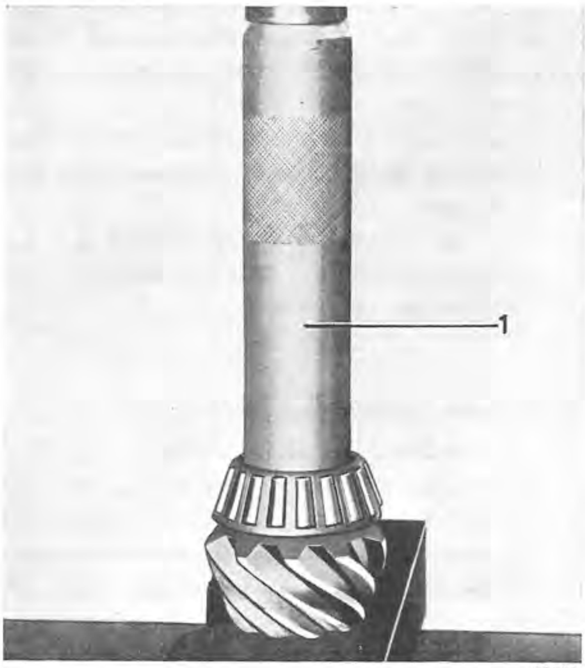

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Fig. 4-157. Installing rear pinion bearing
1. Fitting sleeve SVO 2842

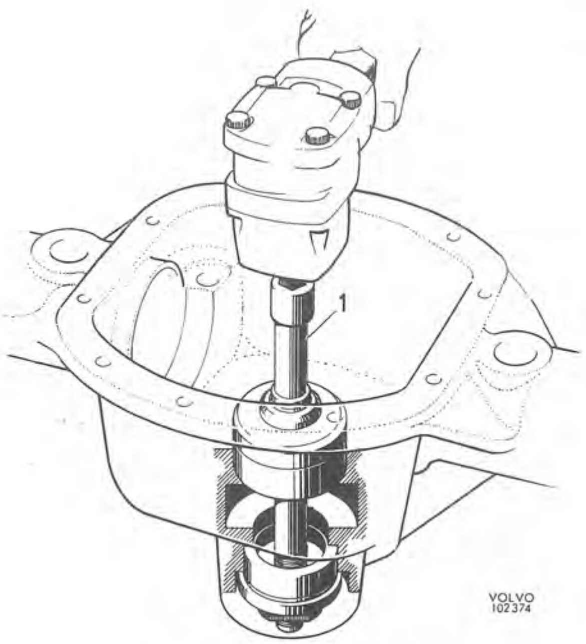

Fig. 4-158. Installing bearing rings
1. Press tool SVO 2845

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 6—11 kpcm (5.20—9.55 lb.in.) for used bearings and 11—23 kpcm (9.55—20 lb.in.) 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 SVO 2284 and measuring tool SVO 2393, see also operation 2.

FITTING THE DIFFERENTIAL

1. Lubricate the inside of the adjusting rings SVO 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. 4-160. Use the dial indicator and adjust in the rings so that the correct tooth flank clearance 0.13—0.20 mm (0.005—

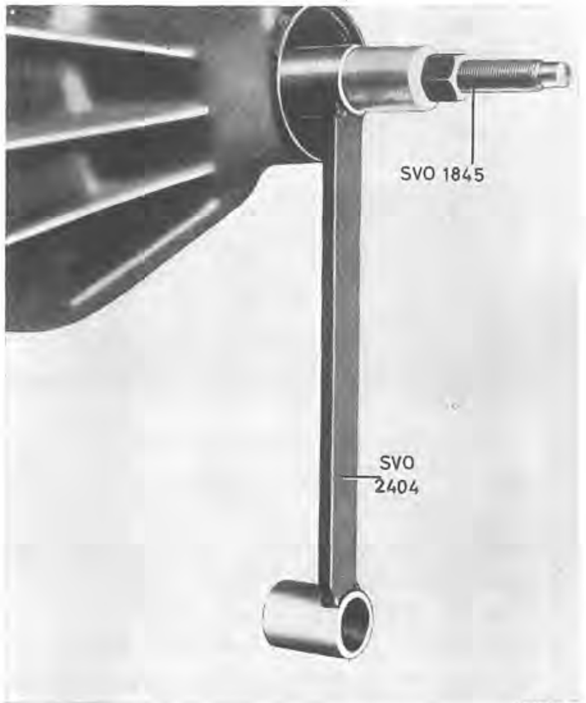

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Fig. 4-159. Installing pinion

0.008") is obtained. Tighten the lock screws in the adjusting rings.

2. Fit on brake tool SVO 2597 as shown in Fig. 4-161. 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 too far towards the toe on the coast side, see not coincide, the pinion location must be adjusted

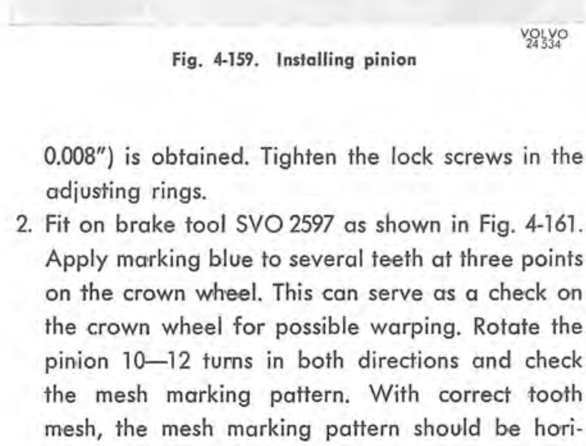

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Fig. 4-160. Adjusting rings for differential
1. Adjusting rings SVO 2595

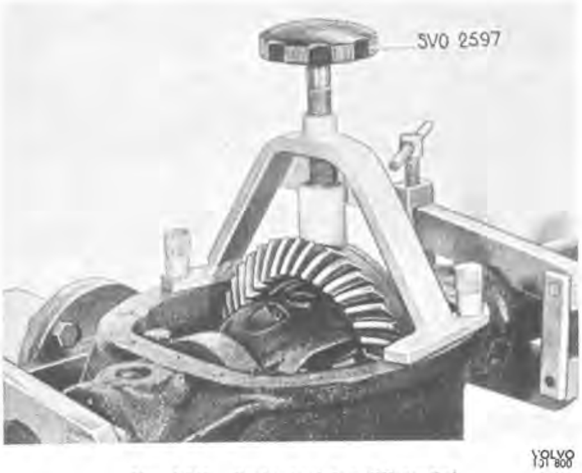


Fig. 4-161. Brake tool for differential

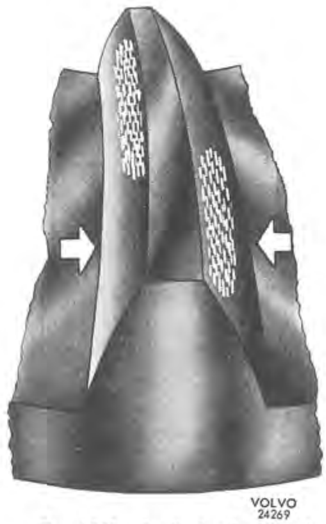


Fig. 4-163. Faulty tooth contact

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. 4-163, 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. 4-164, 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 centre 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 SVO 2284. Zero-set the indicator to the adjusting ring and then place the measuring point facing the bearing, see Fig. 4-155. 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.
N.B. 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.
5. Fit tool SVO 2394 on the drive pinion carrier, see Fig. 4-143. Expand the tool until the pins are exactly flush against the hole edges in the carrier

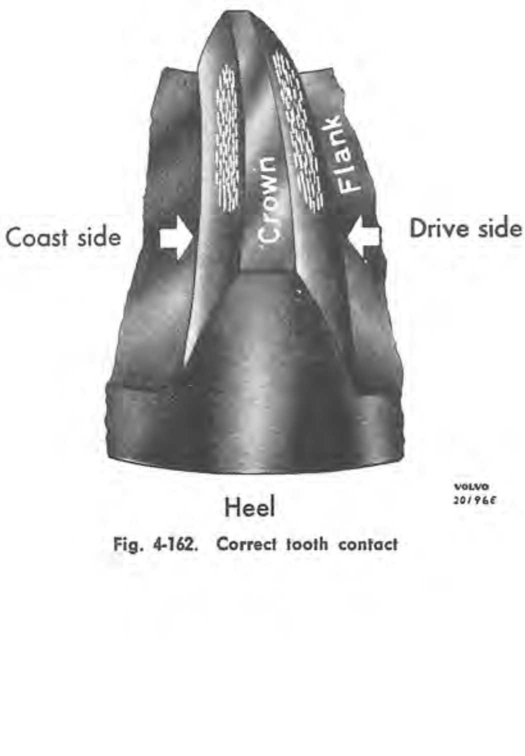


Fig. 4-162. Correct tooth contact

Fig. 4-164. Faulty tooth contact

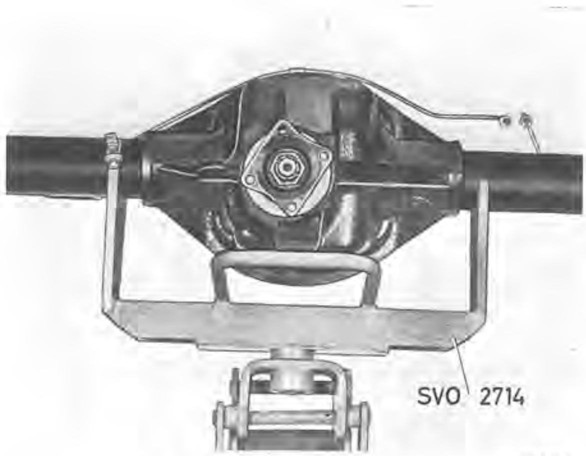


Fig. 4-165. Fixture for rear axle

and then tighten the screws a further 3—5½ turns. Fit the differential and outer rings. Remove tool SVO 2394. Fit the cap and tighten the bolts to a torque of 5.0—7.0 kpm (36—50 lb.ft.).

6. Check the tooth flank clearance and the mesh pattern.

ASSEMBLING THE REAR AXLE

1. Remove spanner SVO 2404. Fit the oil slinger and oil seal. The oil seal is fitted with tool SVO 2806, see Fig. 4-139.

   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 SVO 1845, see Fig. 4-140. Fit the washer and nut. Tighten the nut to a torque of 28—30 kpm (200—220 lb.ft.).
2. Fit the inspection cover and gasket.
3. Fit the drive shafts. Tighten the bolts for the thrust washers to a torque of 5 kpm (36 lb.ft.). Grease the bearing.
4. Then fit the brake discs and brake caliper. Finally fit the brake pipes.

INSTALLING REAR AXLE

1. Place the rear axle on fixture SVO 2714, which is mounted on a garage jack, see Fig. 4-165. 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 handbrake wire in the brackets and at the levers. Adjust the handbrake 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 10—14 kpm (70—100 lb.ft.).

Engagement of "R", "D" or "L"	A	B	C	D	E	F	a	b	c	d	e	f	g	h	l	m	n	p	s	N	O	P	Q	R	S	T	U	V	W	X	Z
Bumpy	—	2	—	1	—	—	—	—	5	3	—	4	—	—	—	—	—	—	—	—	6	—	7	—	—	—	—	—	—	—	—
Delayed	1	—	2	3	—	—	4	7	6	5	—	—	—	—	—	—	—	--	8	9	—	10	—	—	11	—	—	—	—	12	—
None	1	—	2	—	—	—	3	4	5	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	8	9	10
																						—	—	—	—	5	—	—	—	—	—
Starting from rest																															
None forward	—	—	1	—	—	—	—	3	2	—	—	—	—	—	—	—	—	—	—	4	—										
None reverse	—	—	1	—	—	2	7	6	5	—	—	—	—	—	—	3	4	—	—	—	—	9	—	—	8	—	—	—	—	—	—
Seizure reverse	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—
No neutral	—	—	1	—	—	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—
Upshifts																															
No 1—2	—	—	1	—	2	—	8	9	10	—	—	6	7	3	—	4	—	—	—	—	—	—	—	5	—	—	—	—	—	—	—
No 2—3	—	—	1	—	—	—	8	9	10	—	—	6	7	2	—	—	3	4	—	—	—	5	—	—	—	—	—	—	—	—	—
Above normal shift speeds	—	1	—	—	—	—	—	8	9	10	—	2	7	3	—	4	5	6	—	—	—	--	—	—	—	—	—	—	—	—	—
Below normal shift speeds	—	1	—	—	—	—	—	5	6	—	—	2	—	3	—	—	—	4	—	—	—	—	—	—	—	—	—	—	—	—	—
Upshift quality																															
Slip on 1—2	1	2	3	—	4	—	8	9	10	6	—	7	—	—	—	—	—	—	—	—	—	—	—	5	—	—	—	—	—	—	—
Slip on 2—3	1	2	3	—	4	—	9	10	11	7	—	8	—	—	—	—	—	—	—	—	—	5	—	6	—	—	—	—	—	—	—
Rough on 1—2	—	1	—	—	2	—	—	—	10	3	—	4	5	6	—	—	—	—	—	9	—	—	—	—	—	—	7	8	—	—	—
Rough on 2—3	—	1	—	—	2	—	—	—	6	3	—	4	—	—	—	—	—	—	—	—	—	—	5	—	—	—	—	—	—	—	—
Seizure on 1—2	—	—	—	—	—	1	—	5	6	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	3	4	—	—	—	—
Seizure on 2—3	—	—	—	—	1	—	2	3	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Downshifts																															
No 2—3	—	1	—	—	—	—	—	—	—	—	—	—	—	3	—	2	—	—	—	—	—	—	—	—	4	—	—	—	—	—	—
No 3—2	—	1	—	—	—	—	—	—	—	—	—	—	—	3	—	2	—	—	—	—	—	—	4	5	—	—	—	—	—	—	—
Involuntary high speed 3—2	1	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—	—	—
Above normal shift speeds	—	1	—	—	—	—	—	5	6	—	—	4	—	2	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—
Below normal shift speeds	—	1	—	—	—	—	—	5	6	—	—	4	—	2	—	7	8	3	—	—	—	—	—	—	—	—	—	—	—	—	—
Downshift quality																															
Slip on 2—1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—
Slip on 3—2	—	—	—	—	1	—	6	7	8	4	—	5	—	—	3	—	—	—	—	—	—	9	—	2	—	—	—	—	—	—	—
Rough on 2—1	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	1	—	—	—	—	—
Rough on 3—2	—	—	—	—	1	—	—	—	5	3	—	4	—	—	2	—	—	—	—	—	—	6	7	8	—	—	—	—	—	—	—
Line pressure																															
Low, idling	1	—	2	3	—	—	6	8	5	4	—	—	—	—	—	—	—	—	7	—	—	—	—	—	—	—	—	—	9	—	—
High, idling	—	1	—	2	—	—	—	—	—	3	5	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Low at stall	1	2	—	—	—	—	6	8	7	3	—	5	4	9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	—
High at stall	—	—	—	—	—	—	—	—	4	1	—	2	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Stall speed																															
More than 600 r.p.m. below nominal speed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Over 2500	1	—	2	—	—	3	4	5	6	7	—	—	—	—	—	—	—	—	—	8	—	9	—	—	10	11	—	12	—	—	13
Overheating	1	—	—	—	2	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4

The numbers indicate the recommended sequence of fault investigation

FAULT INVESTIGATION KEY

Preliminary adjustment faults

A. Fluid level incorrect.
B. Downshift valve cable incorrectly assembled or adjusted.
C. Manual linkage incorrectly assembled or adjusted.
D. Incorrect engine idling speed.
E. Incorrect front brake band adjustment.
F. Incorrect rear brake band adjustment.

Hydraulic control faults

a. Oil tubes missing or not installed correctly.
b. Sealing rings missing or broken.
c. Valve body assembly screws missing or incorrectly tightened.
d. Primary regulator valve sticking.
e. Secondary regulator valve sticking.
f. Throttle valve sticking.
g. Modulator valve sticking.
h. Governor valve sticking, leaking or incorrectly fitted.
l. Orifice control valve sticking.
m. 1—2 shift valve sticking.
n. 1—2 shift valve sticking.
p. 2—3 shift valve plunger sticking.
s. Pump check valve missing or sticking.

Mechanical faults

N. Front clutch slipping due to worn plates or faulty parts.
O. Front clutch seized or plates distorted.
P. Rear clutch slipping due to worn plates or faulty check valve in piston.
Q. Rear clutch seized or plates distorted.
R. Front band slipping due to faulty servo, broken or worn brake band.
S. Rear brake band slipping due to faulty servo, broken or worn brake band.
T. One-way clutch slipping or incorrectly fitted.
U. One-way clutch seized.
V. Input shaft broken.
W. Pump drive fingers on converter hub broken.
X. Pump worn.
Y. Rear pump worn or drive key broken.
Z. Converter blading and/or one-way clutch fails.

QUICK-REFERENCE 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

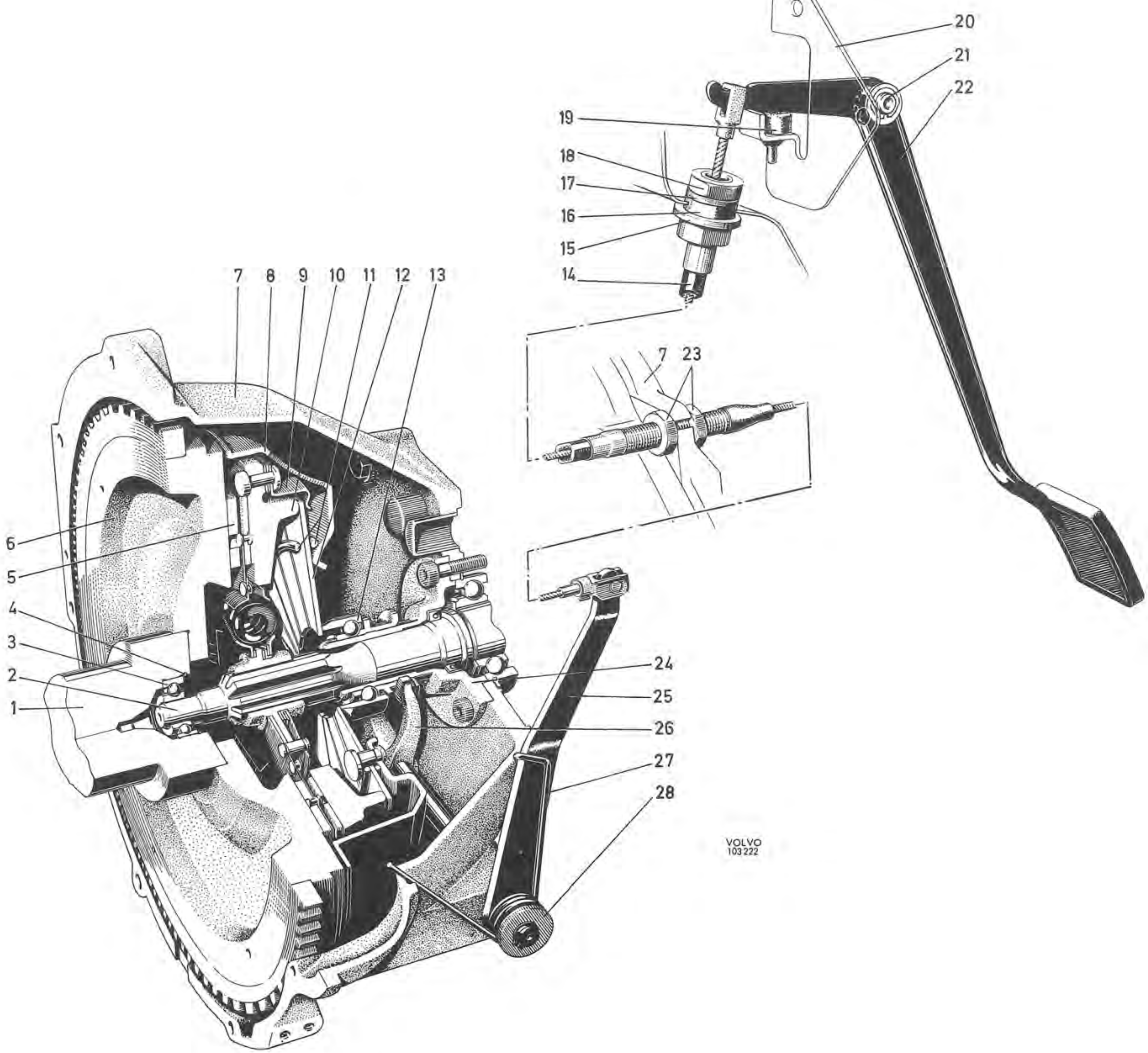


Illustration 4-A. Clutch and clutch controls

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. Bush
24. Thrust washer
25. Ball bearing
56. Friction ring
27. Flange
28. Shaft
29. Bush
30. Gear lever knob
31. Gear lever, upper section
32. Rubber bush
33. Rubber bush
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. Synchronizing hub
57. Synchronizing hub
58. Engaging sleeve
59. Circlip
60. Synchronizing cone
61. Needle bearing
62. Drain plug
63. Gear wheel
64. Countershaft
65. Ball bearing
66. Ball bearing
67. Oil seal
68. Cover
69. Input shaft

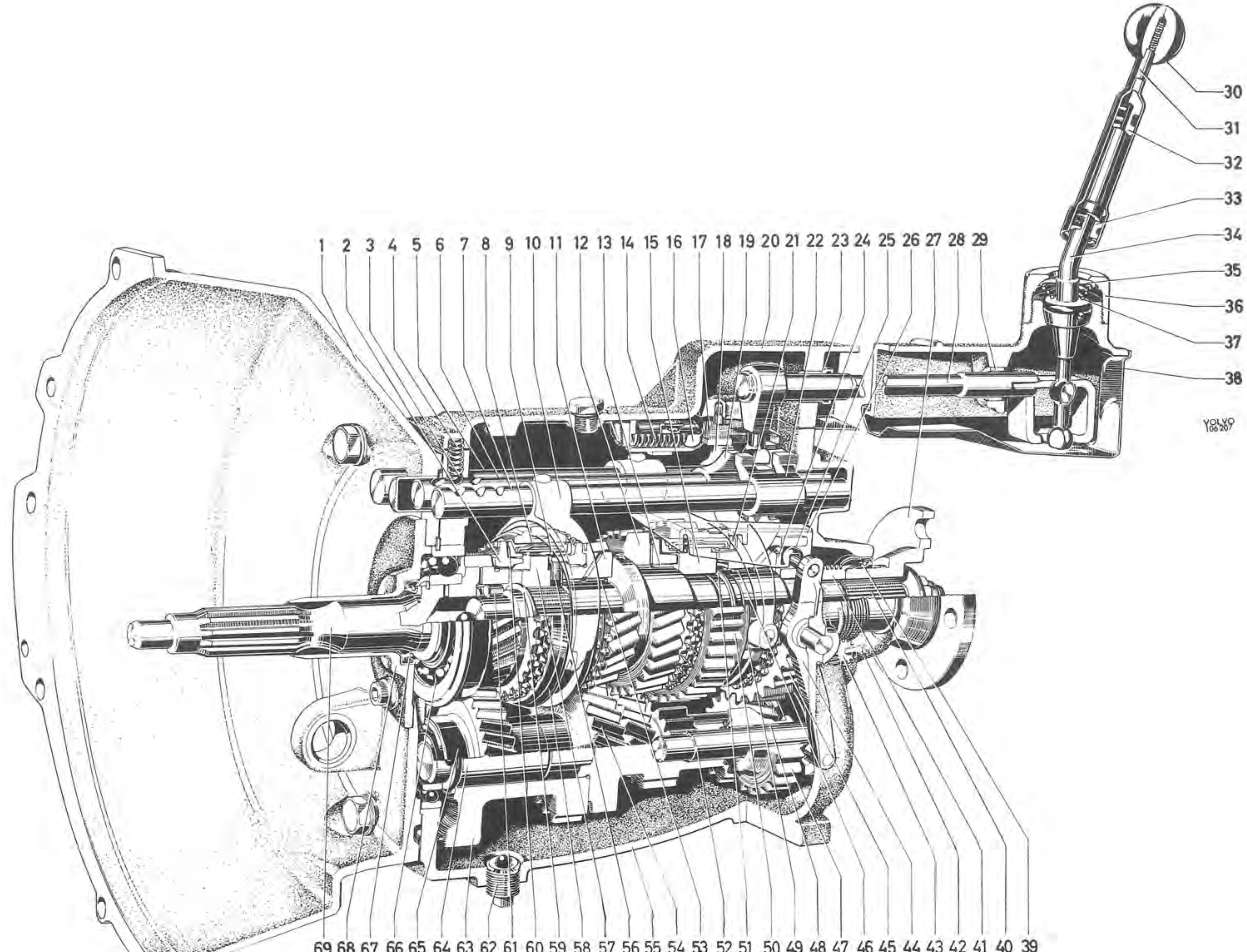


Illustration 4-B. Gearbox

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. Sungear
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

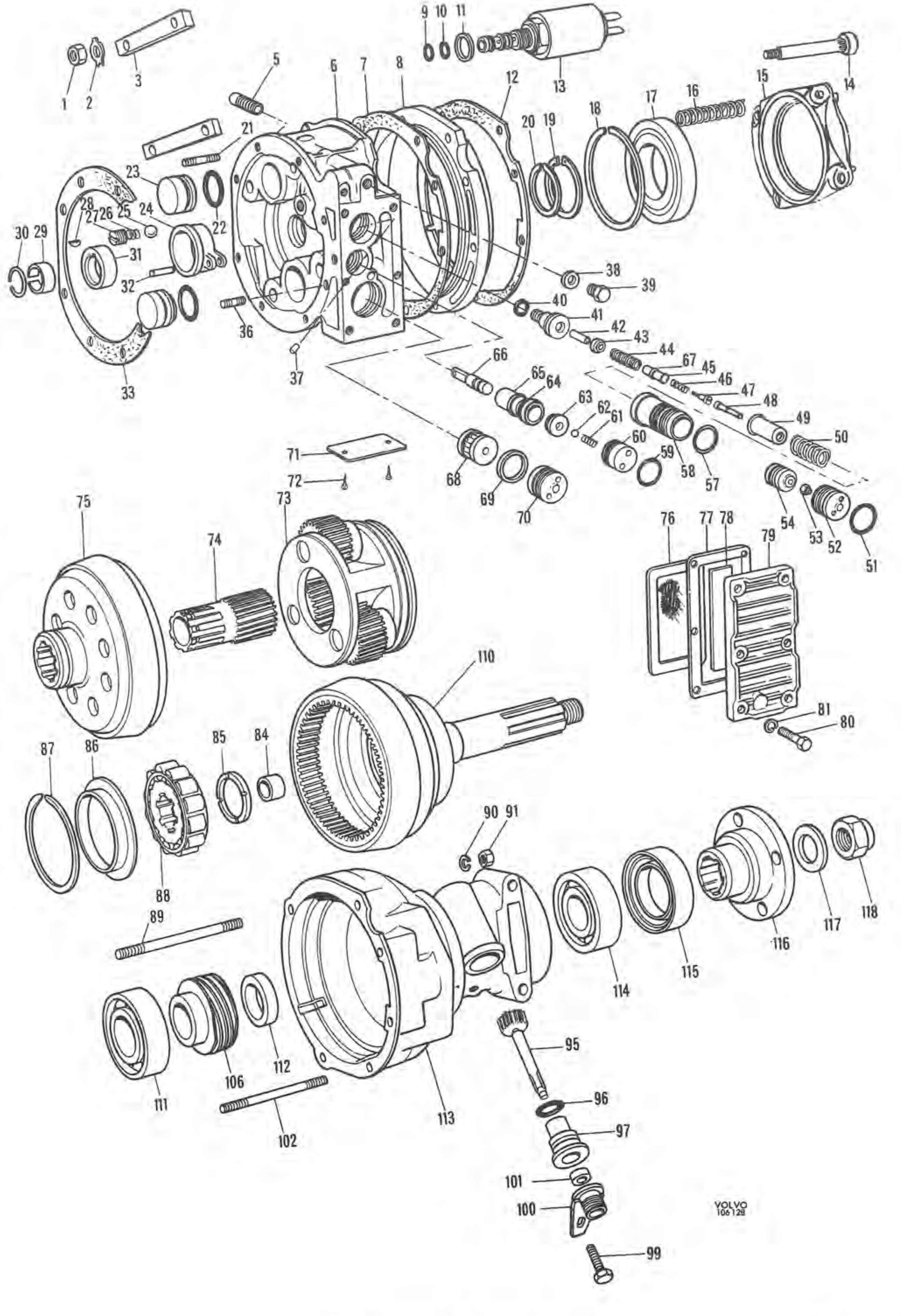


Illustration 4-C. Overdrive

1. Oil seal
2. Front 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 seal
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. Ball
65. Centrifugal governor
66. Snap ring
67. Counter weight
68. Valve housing
69. Valve
70. Spring
71. Speedometer gear
72. Flange

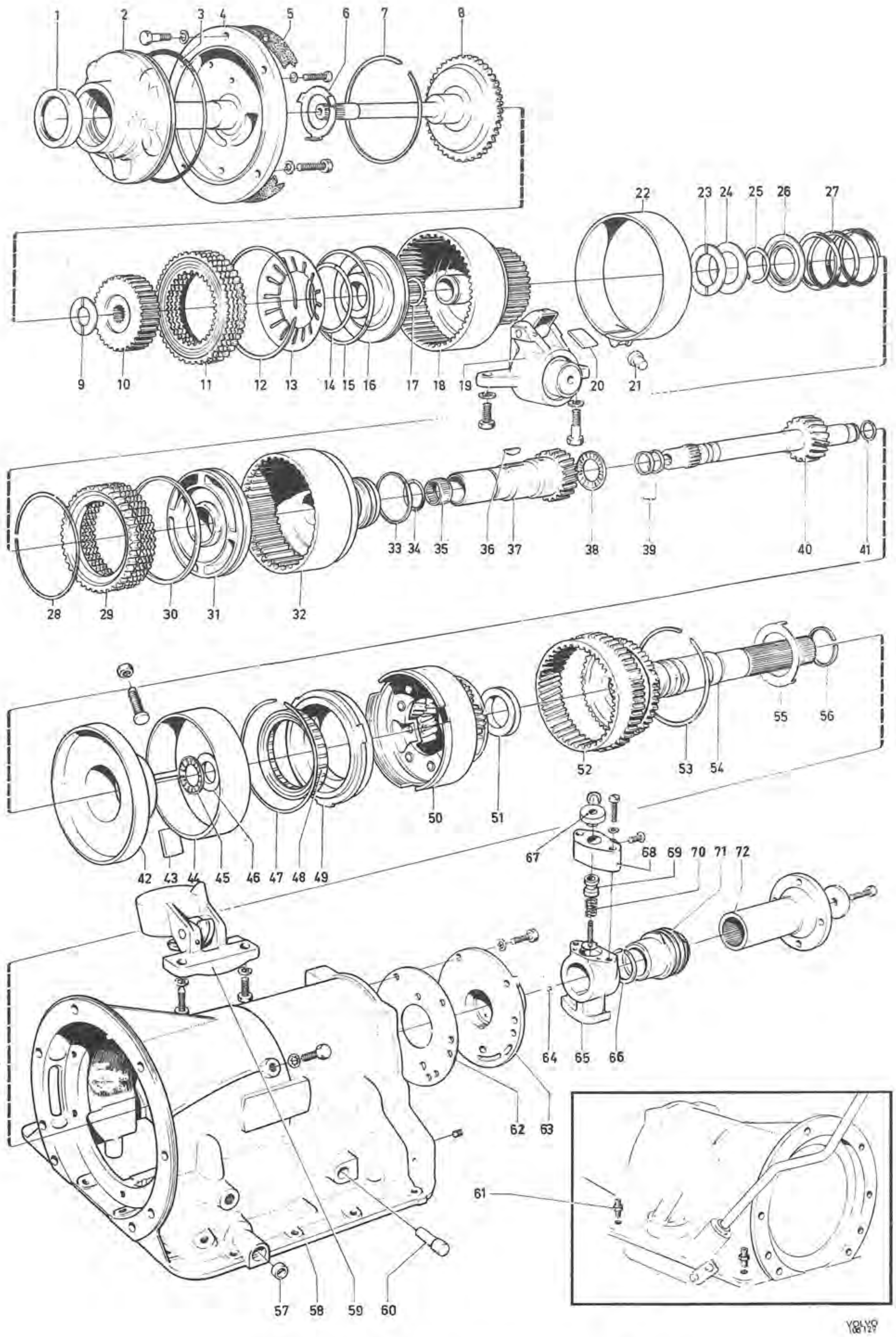


Illustration 4-D. Automatic transmission BW 35

1. Tubular shaft
2. Differential carrier bearing
3. Bearing cap
4. Shims
5. Differential carrier
6. Thrust washer
7. Differential side gear
8. Lock pin
9. Differential pinion
10. Crown wheel
11. Shaft
12. Thrust washer
14. Flange
13. Rear axle casing
15. Dust cover plate
16. Oil slinger
17. Oil seal
18. Shims
19. Front pinion bearing
20. Pinion
21. Rear pinion bearing
22. Shims

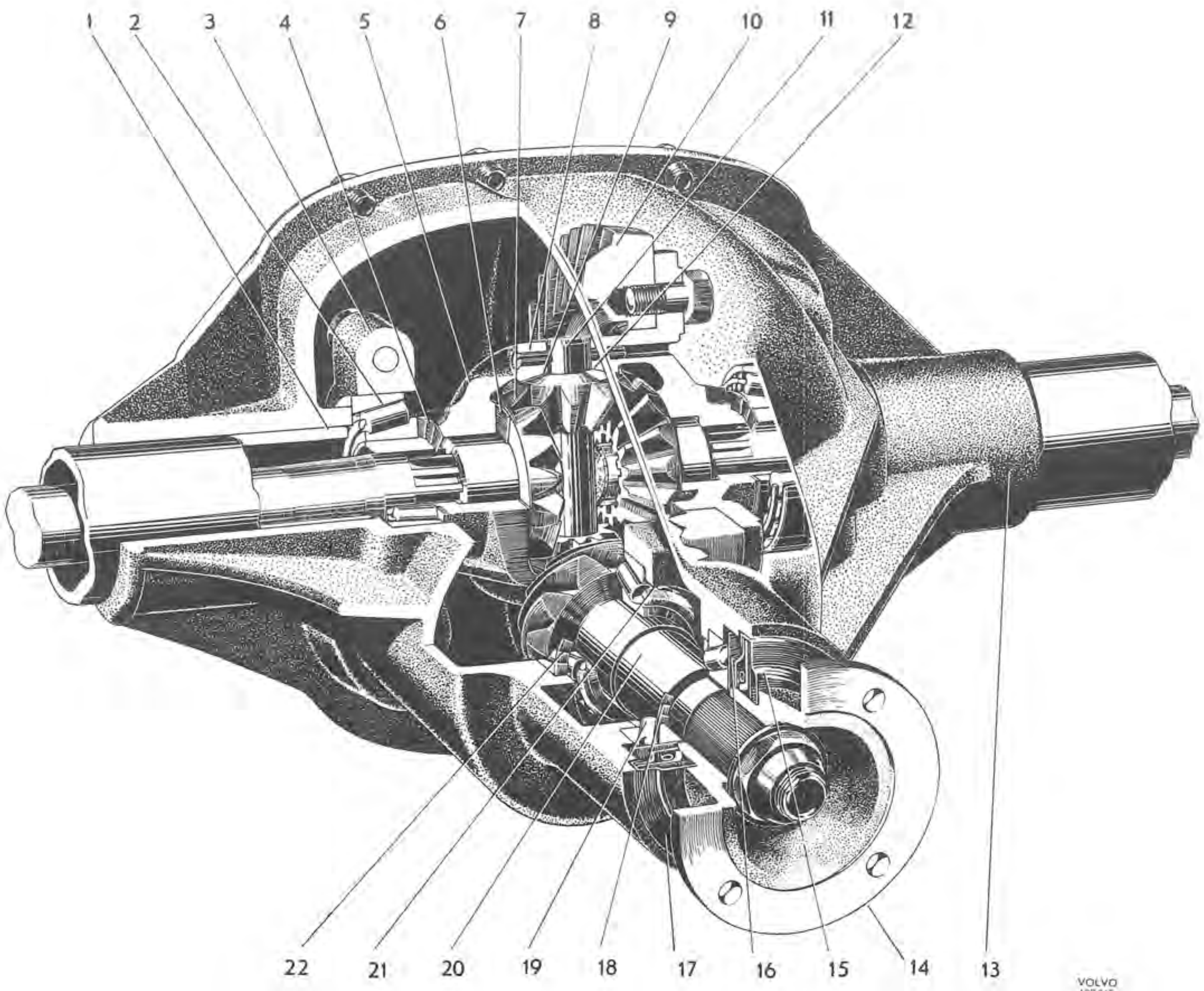


Illustration 4-E. Final drive

Part 5

BRAKES

CONTENTS

GENERAL
TOOLS

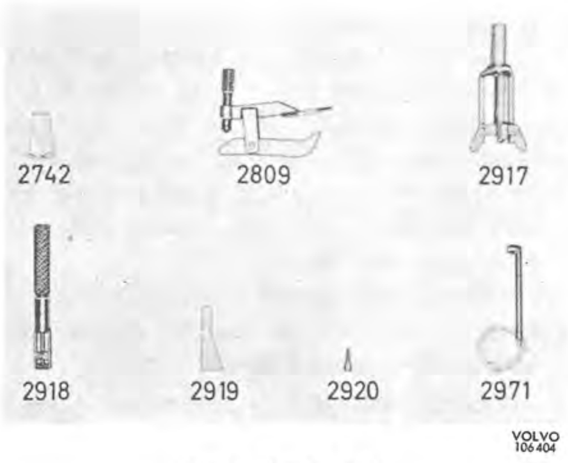


Fig. 5-1. Special tools

SVO 2742 Holder for cable spring
SVO 2809 Tool for pressing in piston
SVO 2917 Extractor for brake pads
SVO 2918 Tool for turning piston
SVO 2919 Template for piston
SVO 2920 Nipple for testing
SVO 2971 Bleeder wrench.

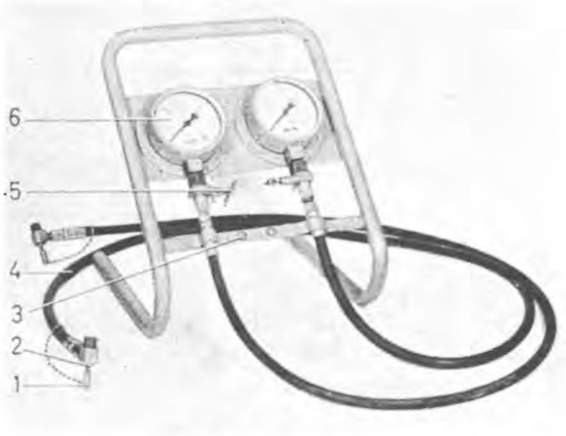


Fig. 5-2. Testing device SVO 2741

1. Nipple plug
2. Connection nipple
3. Enlarging nipple
4. Hose
5. Bleeder device
6. Pressure gauge

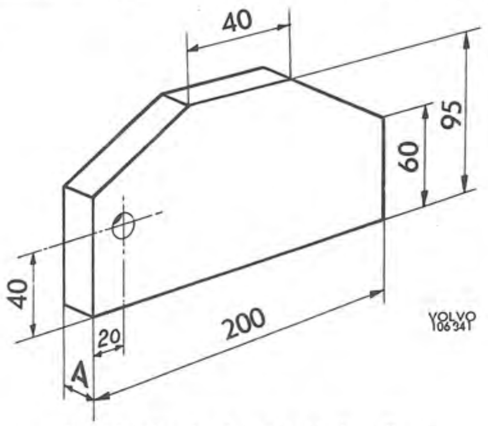


Fig. 5-3. Wooden insert for brake calipers

A=26 mm (1") for front and 13 mm (½") for rear brake calipers

The designation SVO before the tool number is to be replaced by the number 999. This applies also to new production of older tools.

The following special tools are used for repair work on the brake system.

The testing device (Fig. 5-2) is used, for example, to trace faults in the brake system.

Removal of the pistons in the brake caliper is made easier with the help of wooden inserts according to Fig. 5-3.

A hose connection (see 2, Fig. 5-4) is possibly required for removing the pistons in the calipers.

A bleeder unit of the type shown in Fig. 5-5 is used for bleeding the system. A connection cover (see 1, Fig. 5-4) is also required for connecting the unit to the brake fluid container.

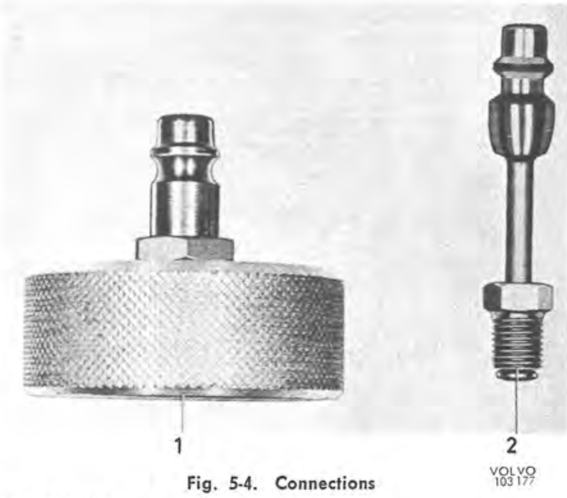


Fig. 5-4. Connections

1. Connection
   (Can be obtained from Volvo Service Dept.)
2. Connection for brake caliper

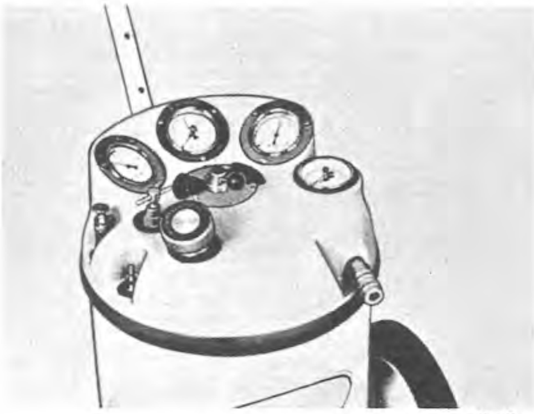


Fig. 5-5. Bleeder unit

DESCRIPTION

The 164 is fitted with two brake systems which are independent of each other. One of these, the footbrake system, is controlled by a brake pedal and operates on all four wheels through a hydraulic system. The other brake system, the parking brake, functions by means of a brake lever and operates both the rear wheels mechanically.

Fig. 5-6 shows the arrangement of the footbrake system which has disc brakes all round.

The hydraulic part has two separate circuits. The master cylinder (1) is of the tandem-type and each front wheel brake unit (13) has two pairs of cylinders entirely separated from each another. One of the circuits serves the lower cylinders of the front wheel brake units and the right rear wheel, while the other circuit takes care of the upper cylinders of the front wheel brake units and the left rear wheel. With such an arrangement, braking effect is ensured, should one of the brake lines fail.

The servo brake cylinder (5) is directly influenced by the brake pedal, and with vacuum assistance from the induction manifold of the engine less pedal pressure is required for braking. The function of the brake valves (10 and 11) is to assist in providing a suitable distribution of braking power between the front and rear wheel brakes.

Concerning a more detailed description of the units making up the footbrake and the parking brake systems, see the respective Groups in question.

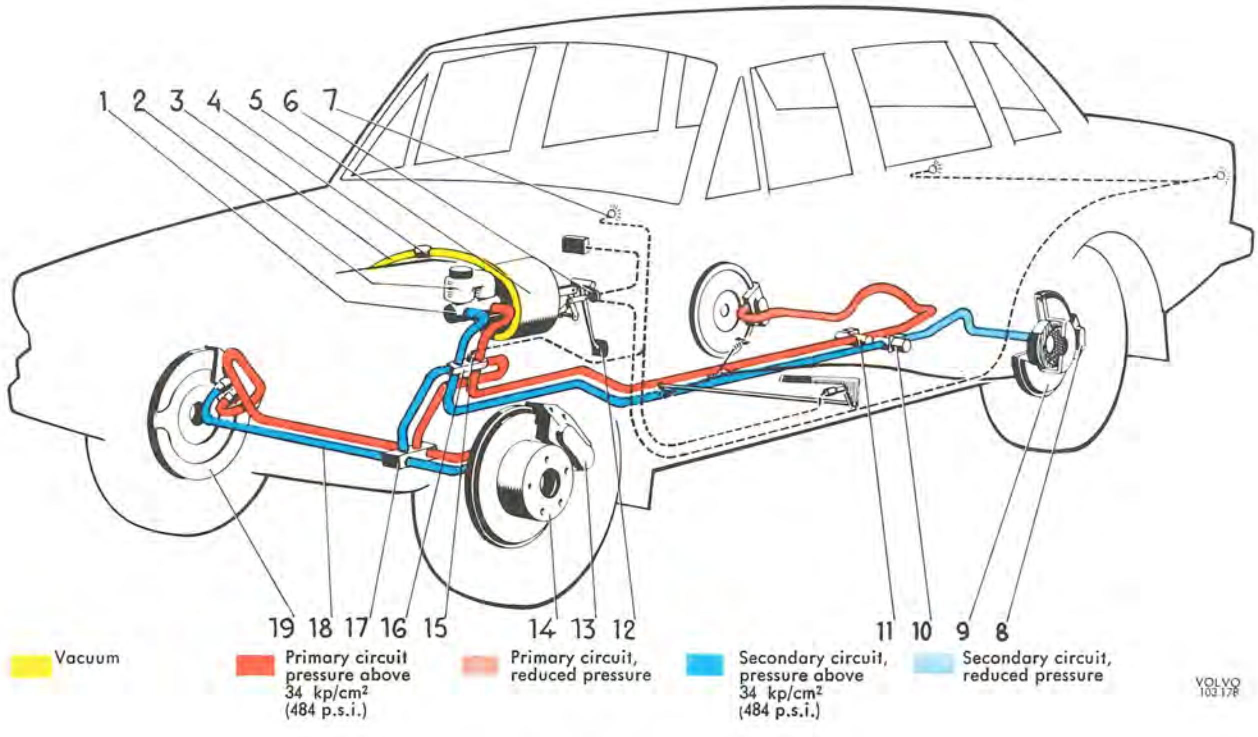


Fig. 5-6. Brake system

1. Tandem master cylinder
2. Brake fluid container
3. Vacuum line
4. Check valve
5. Servo brake cylinder
6. Brake switch
7. Warning lamp
8. Rear brake caliper
9. Brake disc with drum
10. Brake valve, secondary circuit
11. Brake valve, primary circuit
12. Brake pedal
13. Front brake caliper
14. Brake disc
15. Warning switch
16. Warning valve
17. 6-branch union, (double 3-branch union)
18. Brake pipe
19. Cover plate

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.

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 SVO 2741 shown in Fig. 5-2.
3. Depress the brake pedal several times to even out any partial vacuum in the servo 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 p.s.i.), there must not be a difference in pressure of more than 3 kp/cm² (42.7 p.s.i.).
5. With the help of a pedal jack apply the foot-brake to a hydraulic brake pressure of about 100 kp/cm² (1422 p.s.i.). 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 servo 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 p.s.i.). Wait a couple of minutes. The hydraulic pressure should not drop more than 5 kp/cm² (71 p.s.i.).
8. Check the warning valve. Connect a hose to one of the venting 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 p.s.i.) 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 1.4—2.0 kpm (10—14 lb.ft.). Connect the electric cable.
9. Check the brake valve of the secondary circuit by connecting the testing devices to the venting nipple on the left rear wheel brake unit and to the upper outer nipple on one of the front wheel brake units. Apply the footbrake with the pedal jack to the incoming pressure according to the table below. Read off the incoming pressure on the pressure gauge for the front wheel brake unit. Read off the outgoing pressure on the gauge which is connected to the rear wheel brake unit. From the point of view of leakage, the brake valve is not defective if the pressure remains unaltered for at least 15 seconds.

Incoming pressure kp/cm² (p.s.i.)	30 (427)	50 (711)	100 (1422)
Outgoing pressure kp/cm² (p.s.i.)	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 servo 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	Damaged brake line	Replace the damaged line
		Blocked hose	Replace hose
	Difference between circuits greater than 3 kp/cm² (42.7 p.s.i.)	Leakage in one of the circuits	See points 5
		Faulty master cylinder	Recondition master cylinder
5	The pressure drops	External leakage	Tighten connections and replace line or recondition leaking part
		Leaking brake valve	Recondition or replace brake valve
		Leaking seal in wheel unit cylinder	Recondition wheel unit cylinder
		Leaking seal in master cylinder	Recondition master cylinder
6	The pedal does not go down	Leaking vacuum line	Replace vacuum line
		Blocked air filter or leaking seal for front pressure plunger in servo cylinder.	Replace filter or seal
		Faulty servo cylinder	Replace servo cylinder completely

Test operation	Fault	Cause	Remedy
7	The pressure drops more than 5 kp/cm^2 (71 p.s.i.)	Leaking check valve	Remove and blow clean the valve and replace the seal ring. If insufficient, replace check valve
		Leaking seal for front pressure plunger in servo cylinder	Remove master cylinder and replace seal
		Internal fault in servo cylinder	Replace servo cylinder completely
8	The parking brake warning lamp does not light	Wrongly adjusted switch Faulty electrical parts	Adjust the switch Replace faulty parts
	Footbrake warning lamp does not light	Faulty switch	Replace switch
	Warning lamp does not go out when pistons have returned to normal position	Pistons seize	Replace warning valve
	Warning when pressure difference is other than 5—15 kp/cm^2 (71—213 p.s.i.)	Faulty warning valve	Replace valve
9—10	Faulty outgoing pressure	Leaking valve	Recondition or replace brake valve
		Faultily set valve	Adjust if reconditioned valve tested, see page 5 : 19
11	A circuit fades	Blocked equalizing hole in master cylinder	Recondition the master cylinder
	The rear wheel brakes fade	Parking brake cable chafes	Replace the cable
		Faulty adjusted parking brake	Adjust the parking brake
		Faulty brake valve	Recondition or replace brake valve
	A wheel brake fades	Damaged brake line	Replace line
		Blocked hose	Replace hose
		Worn sealing ring	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 fluel level in the master cylinder container is not below the "Min" mark. This can be done without removing the cap. Every 10 000 km (6 000 miles) top-up, if necessary, to the "Max" container mark.

A first-class brake fluid which meets the requirements according to SAE J 1703 should be used for topping-up. Brake fluid with designation DOT 3 or DOT 4 can also be used. Before removal, clean the cap of the container and observe maximum cleanliness when filling with fluid. Avoid spilling the brake fluid onto the paintwork as this can damage it. Check to make sure that the vent-hole in the cap is not blocked.

CHECKING BRAKE PADS

Every 10 000 km (6 000 miles) check the wear on the linings. The brake pads should be replaced when the linings are worn down to a thickness of about 3 mm (1/8"). Under no circumstances must the linings be worn down below 1.5 mm (1/16"). For replacement of the pads, see pages 5 : 10 and 5 : 11.

FUNCTION CHECK

In addition to the regular check on the brakes carried out by the driver as result of the driving done, the brakes should be checked every 10 000 km (6 000 miles) by a workshop mechanic. The footbrake should also be checked then to make sure that it functions satisfactorily; if necessary, check with the help of proper testing equipment (see "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 : 34.

OVERHAUL

Every third year or 60 000 km (36 000 miles) the brake system seals and air filter for the servo cylinder should be replaced. Where driving conditions are mostly dusty, the air filter should be replaced more often.

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 groove in the housing. The brake pads (12) are provided with bonded facings and are held in position by means of guide pins (9).

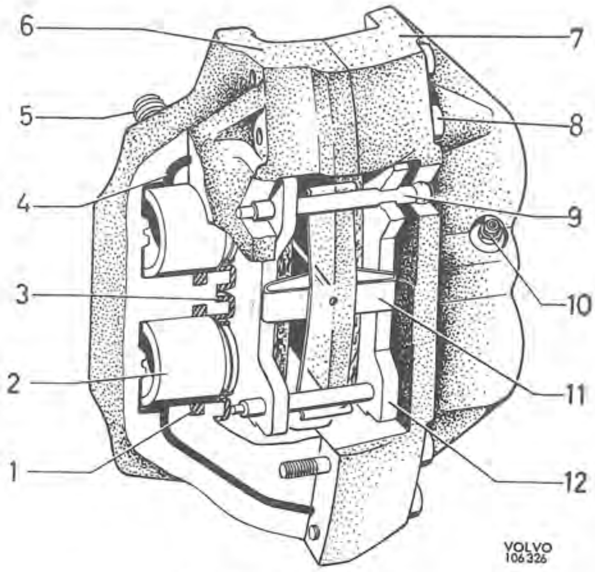


Fig. 5-8. Front wheel brake caliper

1. Sealing ring
2. Piston
3. Rubber dust cover
4. Channel
5. Upper bleeder nipple
6. Outer half
7. Inner half
8. Bolt
9. Guide pin
10. Inner bleeder nipple
11. Damping spring
12. Brake pad

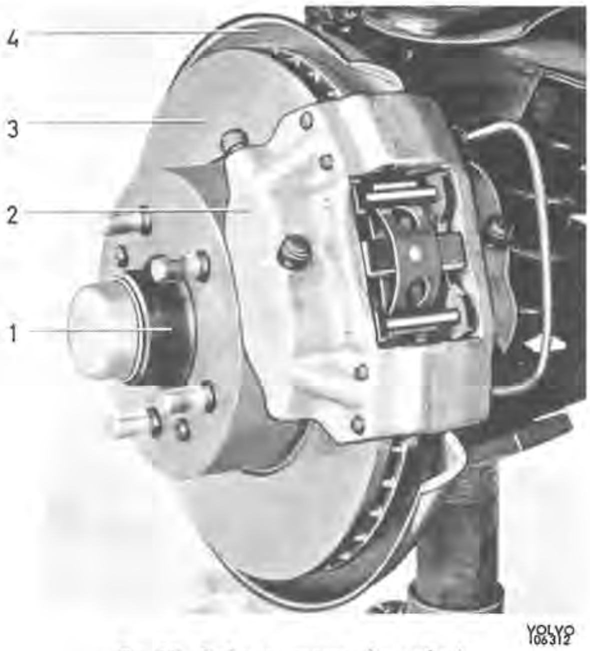


Fig. 5-7. Brake components, front wheel

1. Hub
2. Front brake caliper
3. Brake disc
4. Cover plate

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.

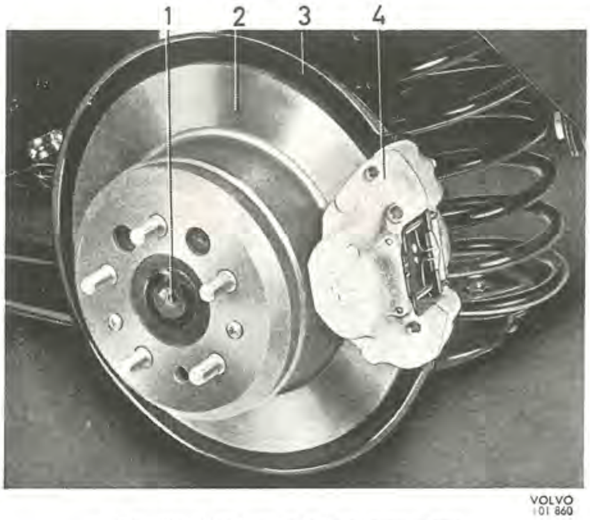


Fig. 5-9. Brake components, rear wheel

1. Drive shaft
2. Brake disc
3. Cover plate
4. Rear brake caliper

The sealing rings (5) have a square section and press against the piston from the slightly oblique groove in the housing. The function of the sealing rings is partly to prevent brake fluid from oozing out and partly to return the pistons to the rest position after braking. The rubber dust covers (3) prevent dirt from entering. The brake pads (9) are provided with bonded facings and are held in position by means of guide pins (11).

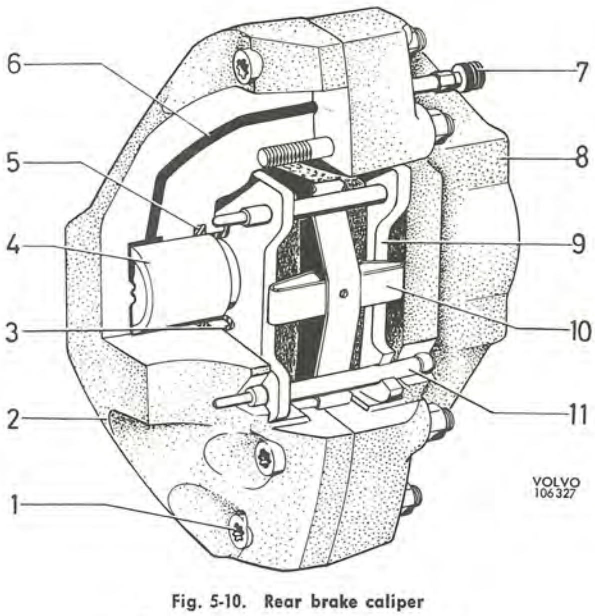


Fig. 5-10. Rear brake caliper

1. Bolt
2. Outer half
3. Rubber dust cover
4. Piston
5. Sealing ring
6. Channel
7. Bleeder nipple
8. Inner half
9. Brake pad
10. Damping spring
11. Guide pin

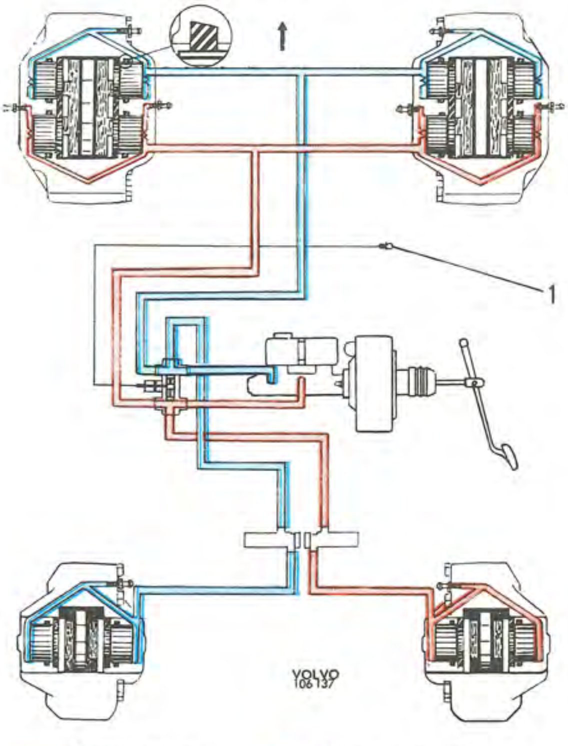
FUNCTION

HYDRAULIC

The lower cylinders of the front wheel brake units and the right rear wheel brake unit are connected through brake lines to the primary chamber of the master cylinder, see Fig. 5-11. In the same way the upper cylinders of the front wheel brake units and the left rear wheel brake unit are connected to the master cylinder through the secondary chamber.

A warning valve is located between the master cylinder and the brake lines for both the circuits. The valve is connected to the same warning lamp which indicates when the parking brake is applied. The lamp will light during brake application if there is too large a pressure difference (about 10 kp/cm^2=142 p.s.i.) 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 brake effect, varies in proportion to the foot effort applied to the pedal. When the pistons are displaced, the sealing rings are ten-



Primary circuit, pressureless

Secondary circuit, pressureless

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/cm² (142 p.s.i.), 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.

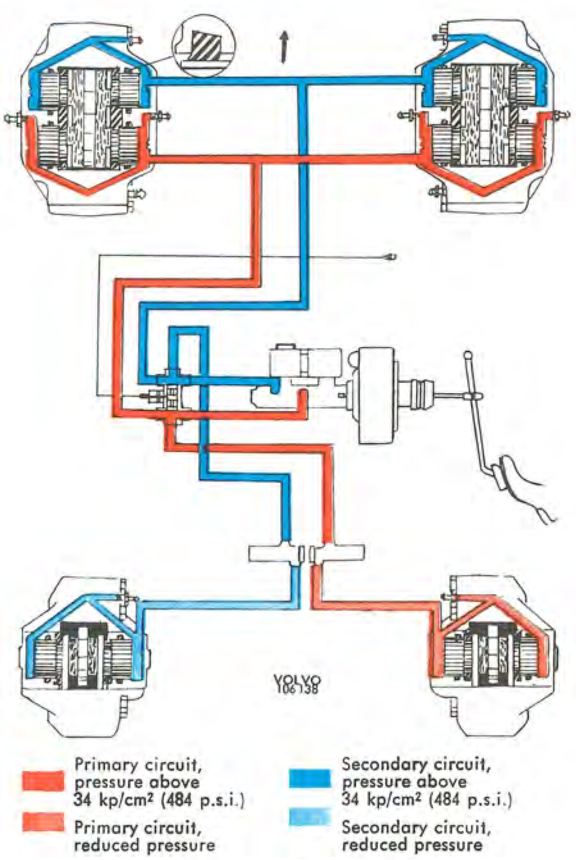


Fig. 5-12. Brake application

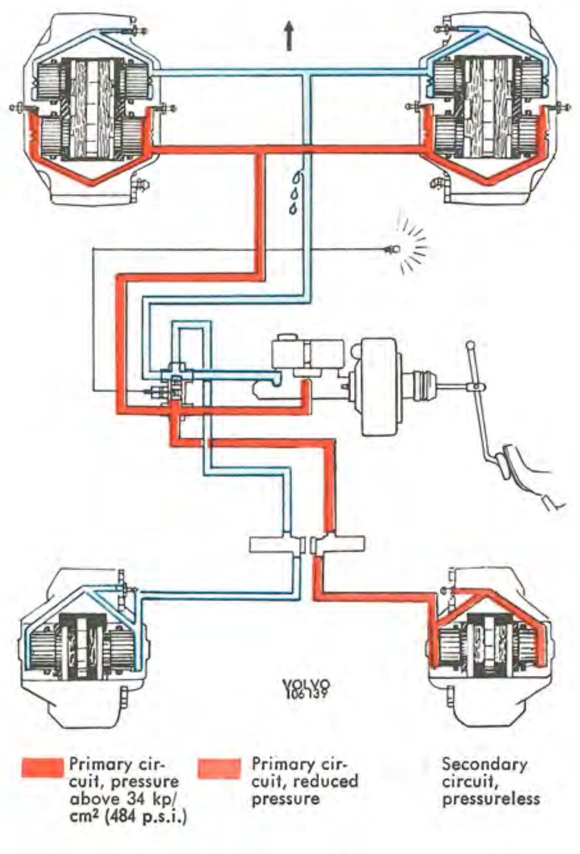


Fig. 5-13. Brake application, leakage in secondary circuit

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 SVO 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.
6. To provide room for the new brake pads, press the pistons into the cylinders.
   With tool SVO 2809, the pistons can be pressed in evenly and without risk of damage according to Fig. 5-16. If carried out properly, this pressing in can be done with another tool more rapidly with the same results, but faulty pressing in with a screwdriver can cause damage to the disc, rubber seal and piston. Note that when pushing in the pistons, the fluid level will rise in the brake fluid container so that the fluid may spurt out.

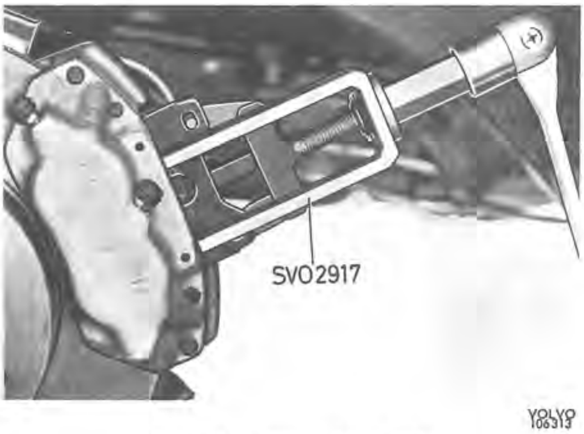


Fig. 5-15. Removing brake pads

7. Concerns rear 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 SVO 2919, see Fig. 5-29. The tolerance is ±2°, that is, when the template is placed against the one recess, the distance to the other (meas. A) may be max. 1 mm (0.039").
   If necessary, adjust the location of the piston with tool SVO 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.

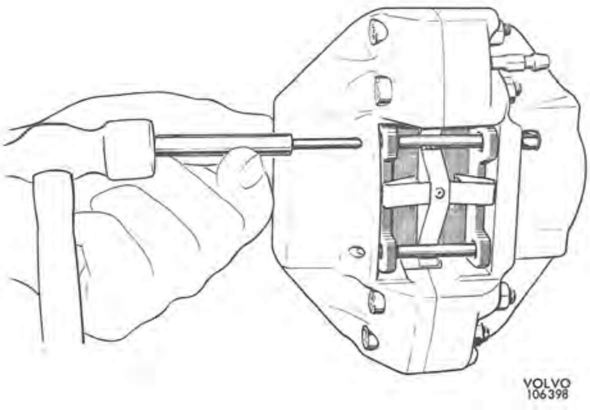


Fig. 5-14. Removing guide pin

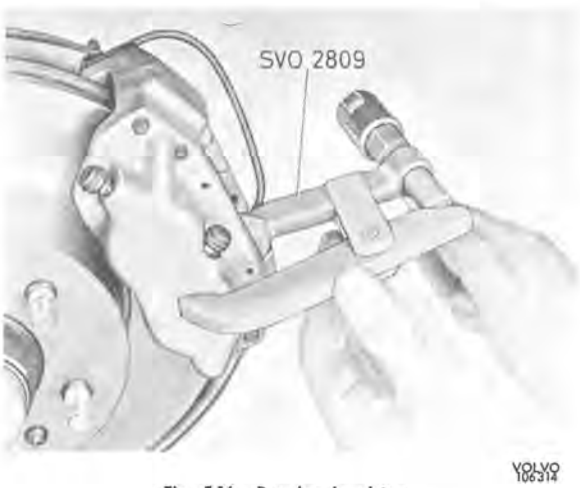


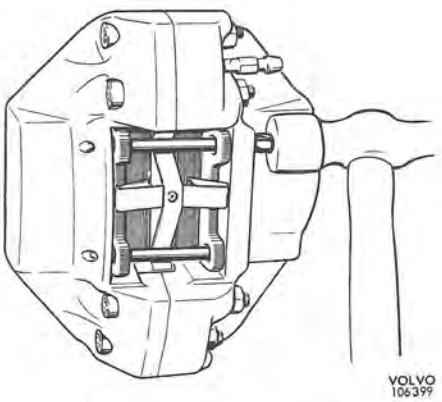
Fig. 5-16. Pressing in piston

VOLVO 106315

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 10—14 kpm (70—100 lbft). Fit the hub caps.
    N.B. The function and lifetime of the linings will benefit if lengthy and hefty braking is avoided in the beginning.



VOLVO 106399

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

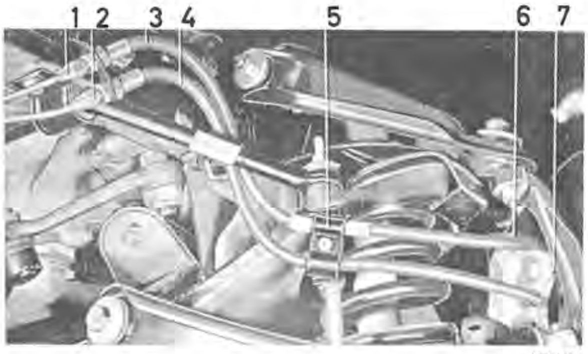


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Fig. 5-19. Installing front brake hoses

1. Connection for the primary circuit
2. Connection for the secondary circuit
3. Upper brake hose
4. Lower brake hose
5. Clip
6. Connection for lower wheel unit cylinder
7. Connection for upper wheel unit cylinder

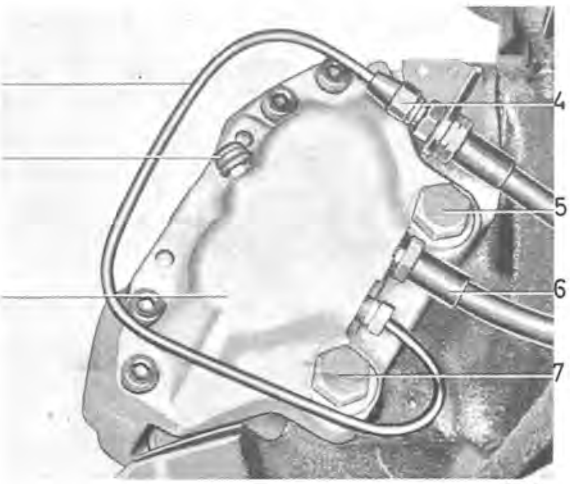

Fig. 5-20. Front wheel brake unit fitted

1. Front wheel brake caliper
2. Lower bleeder nipple
3. Upper bleeder nipple
4. Connection for lower wheel unit cylinder
5. Attaching bolt
6. Connection for upper wheel unit cylinder
7. Attaching bolt

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.

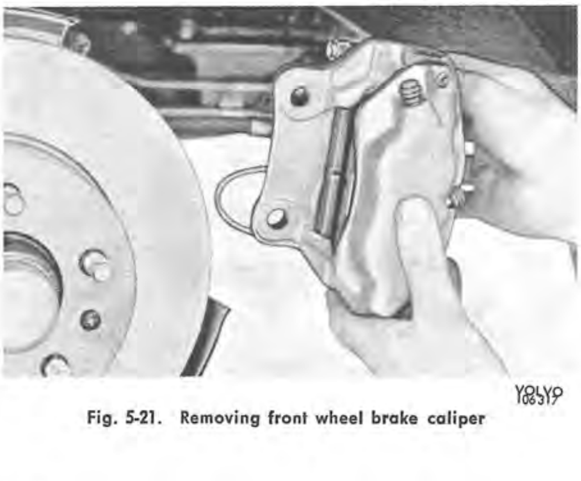

Fig. 5-21. Removing front wheel brake caliper

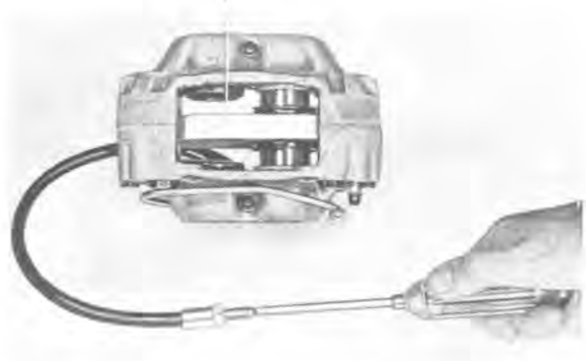

Fig. 5-22. Removing pistons
1. Wooden disc

N.B.: 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.

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Fig. 5-23. Installing sealing ring

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.
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 10—14 kpm (70—100 lb.ft.). 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 and5, Fig. 5-25). Remove the brake caliper, see Fig. 5-26.

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Fig. 5-24. Front brake caliper assembled

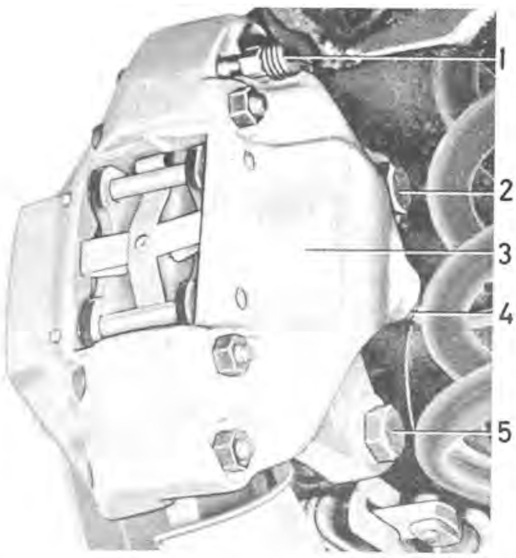

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Fig. 5-25. Rear wheel brake unit installed

1. Bleeder nipple
2. Attaching bolt
3. Rear wheel brake caliper
4. Brake line
5. Attaching bolt

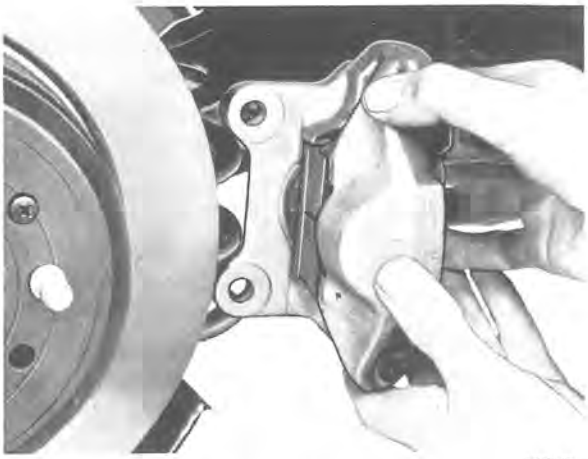


Fig. 5-26. Removing rear wheel brake caliper

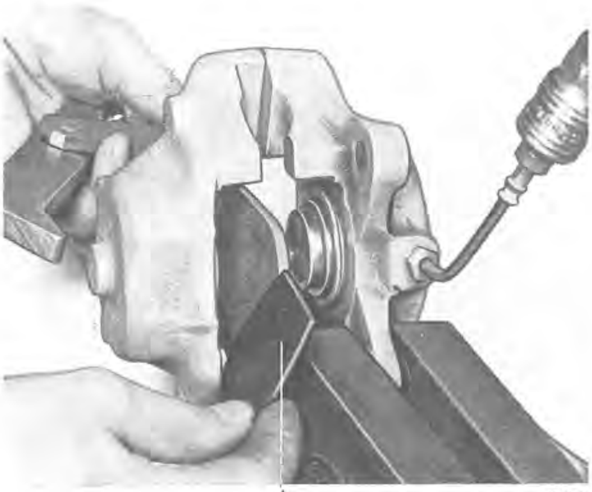


Fig. 5-28. Removing piston
A=Rubber seal

DISASSEMBLING

1. Remove the brakes 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 SVO 2809 (see Fig. 5-28).

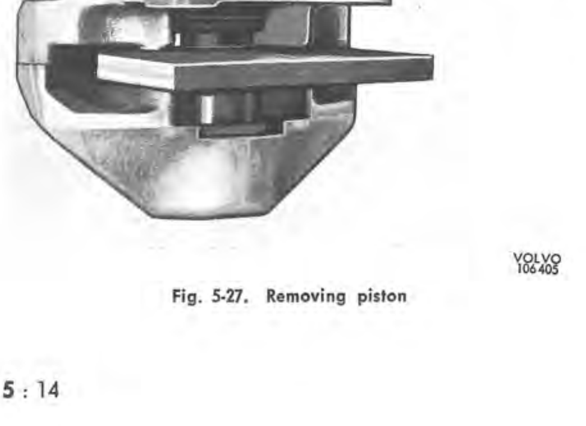


Fig. 5-27. Removing piston

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.

N.B. 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 SVO 2919, see Fig. 5-29. The tolerance is ±2°, that is, when the template is placed against the one recess, the distance to the other (meas. A) may be max. 1 mm (0.039").
   If necessary, adjust the location of the piston with tool SVO 2918. To do this, move the tool into

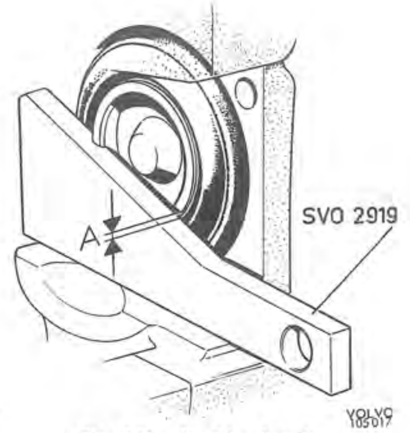


Fig. 5-29. Checking location

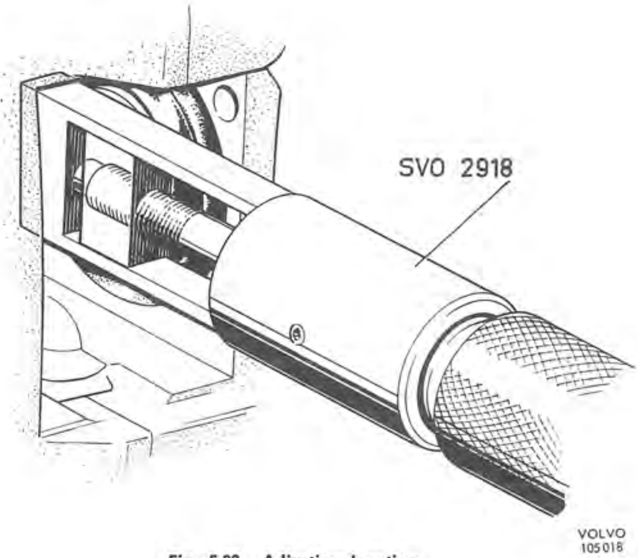


Fig. 5-30. Adjusting location

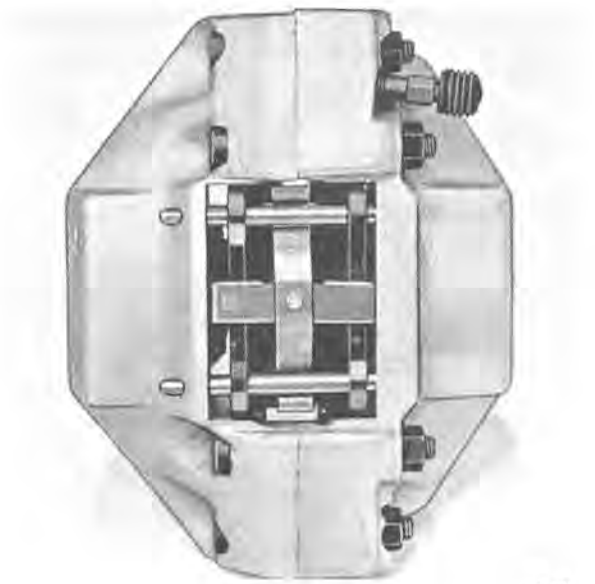


Fig. 5-31. Rear brake caliper assembled

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 avalilable 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 10—14 kpm (70—100 lbft). Fit the hub cap.
4. Bleed the fitted brake caliper, see Group 52.

Fig. 5-32. Checking run-out

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. 5-85. 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:

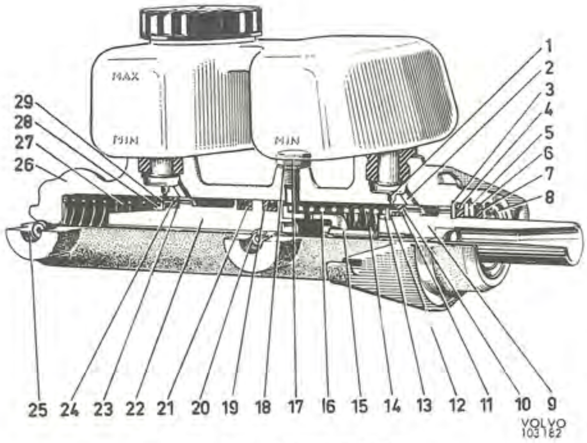


Fig. 5-33. Master cylinder

1. Equalizing hole
2. Overflow hole
3. Washer
4. Piston seal
5. Washer
6. Piston seal
7. Washer
8. Circlip
9. Primary piston
10. Washer
11. Piston seal
12. Washer
13. Thrust washer
14. Spring
15. Screw
16. Spring retainer
17. Stop screw
18. Seal
19. Piston seal
20. Connection for primary circuit
21. Piston seal
22. Secondary piston
23. Washer
24. Piston seal
25. Connection for secondary circuit
26. Cylinder
27. Spring
28. Thrust washer
29. Washer

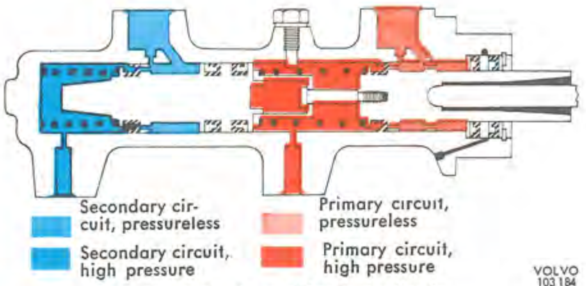


Fig. 5-35. Normal brake application

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).

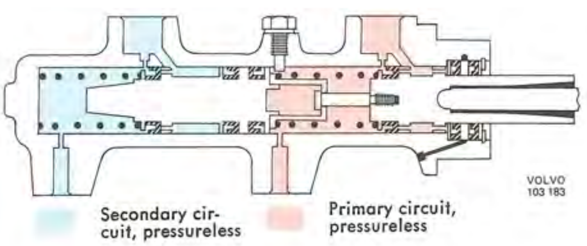


Fig. 5-34. Rest position

1 and 2. Connection for brake fluid container

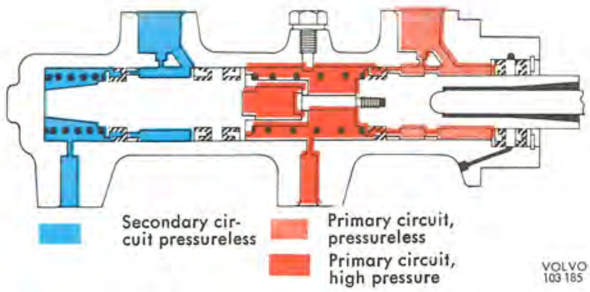


Fig. 5-36. Brake application with leakage in the secondary circuit

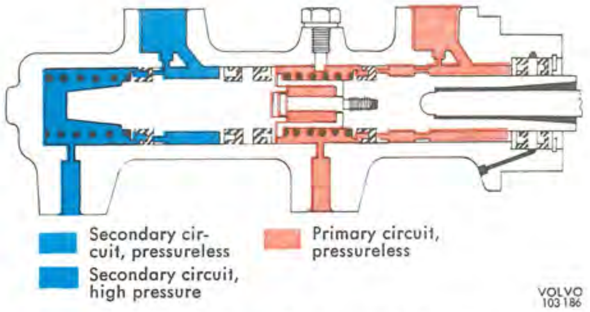


Fig. 5-37. Brake application with leakage in the primary circuit

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

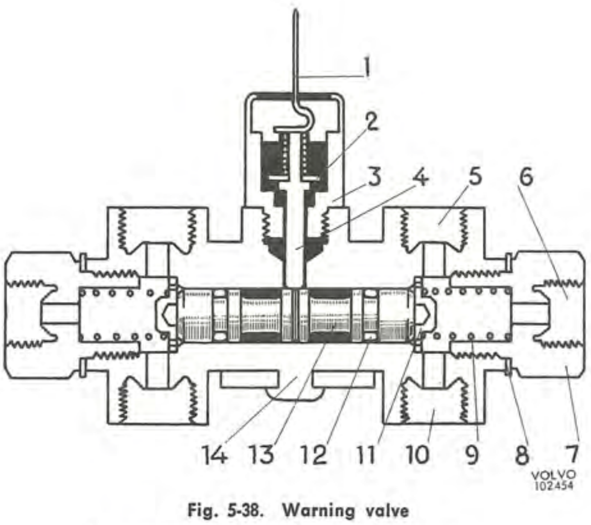


Fig. 5-38. Warning valve

1. Electrical connection
2. Switch washer
3. Switch housing
4. Guide pin
5. Connection, rear wheel brakes
6. Connection, master cylinder
7. End piece
8. Sealing washer
9. Spring
10. Connection, front wheel brakes
11. Thrust washer
12. O-ring
13. Piston
14. Housing

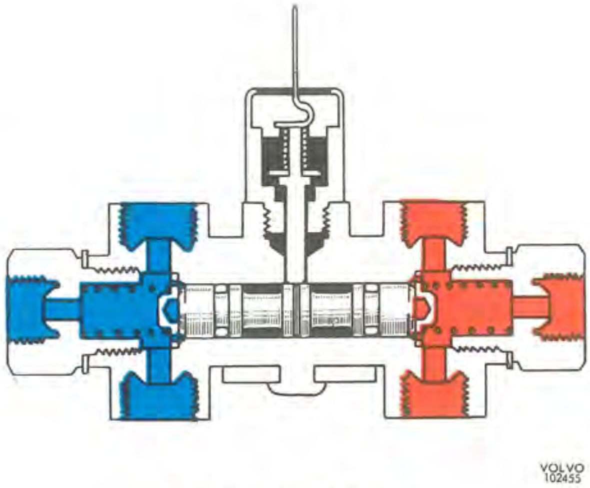


Fig. 5-39. Normal position

circuits exceeds about 10 kp/cm² (142 p.s.i.). 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 kpm/cm² (142 p.s.i.) that the pistons are pushed so far to the right that the quide pin (4) can be pressed downwards. When this happens, the switch washer (2) reaches the housing (3) and current is cut in (Fig. 5-40). The guide pin is prevented from returning to its normal position until the fault has been rectified and the warning switch (3) removed.

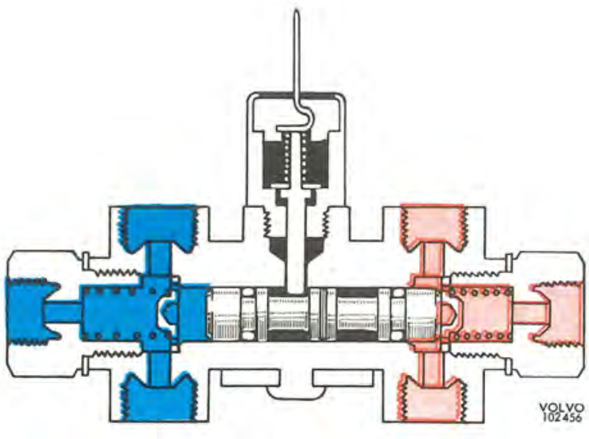


Fig. 5-40. Warning position

BRAKE VALVE

A brake valve is connected to each of the rear wheel brake lines, see Fig. 5-6. When the ingoing brake pressure exceeds 34 kp/cm² (484 p.s.i.) a reduction takes place in the valve. The more powerful the pedal pressure, the greater will be the reduction and thereby the larger the difference between the hydraulic pressure in the front wheel and rear wheel cylinders. This results in a suitable distribution of braking force between both pairs of wheels. The construction of the brake valve is shown is Fig. 5-41 and its function is the following.

When the footbrake is applied, the pressure from the master cylinder is transmitted via the connection (7, Fig. 5-41). The pressure then proceeds through the cylinder (6), the counterbore, past the valves (17) and (4) to cylinder (3) and then on through connection (19) to the rear wheel cylinders, see Fig. 5-42. The hydraulic pressure per unit surface is equal on the different parts of the piston (21), but since its pressure surface is larger in cylinder (3) than in cylinder (6), the force developed will move the piston to the right of the figure. However, this is counteracted by the pressure from the springs (10).

When the hydraulic pressure approaches 34 kp/cm² (484 p.s.i.) the spring pressure is overcome and the piston (21) is moved to the right. By means of pressure from the smaller spring (5), the valve (4) 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

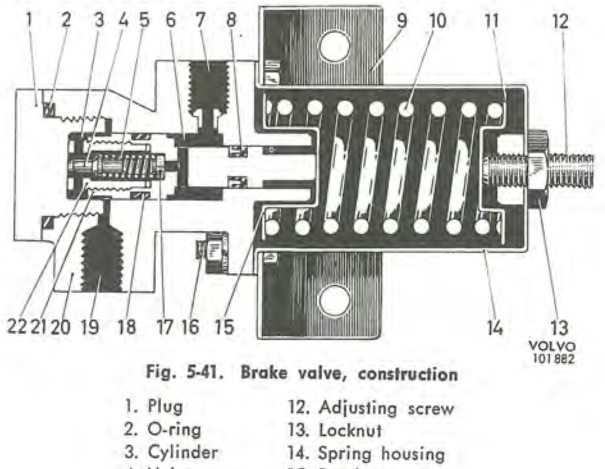


Fig. 5-41. Brake valve, construction

1. Plug
2. O-ring
3. Cylinder
4. Valve
5. Valve spring
6. Cylinder
7. Connection to master cylinder
8. Piston gasket
9. Bracket
10. Spring
11. Retainer
12. Adjusting screw
13. Locknut
14. Spring housing
15. Retainer
16. Screw
17. Equalizing valve
18. O-ring
19. Connection to rear wheel brake cylinders
20. Housing
21. Piston
22. Valve housing

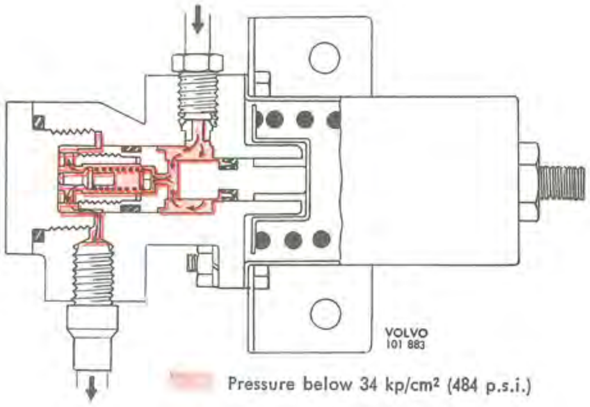


Fig. 5-42. Brake application

in cylinder (6) 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 (3) 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 (6) falls. The piston (21) is moved to the right by spring (10). When the pressure on the right-hand side of the valve (4) 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 (10) 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 (17) is fitted with control channels which ensure an even flow of pressure through the valve.

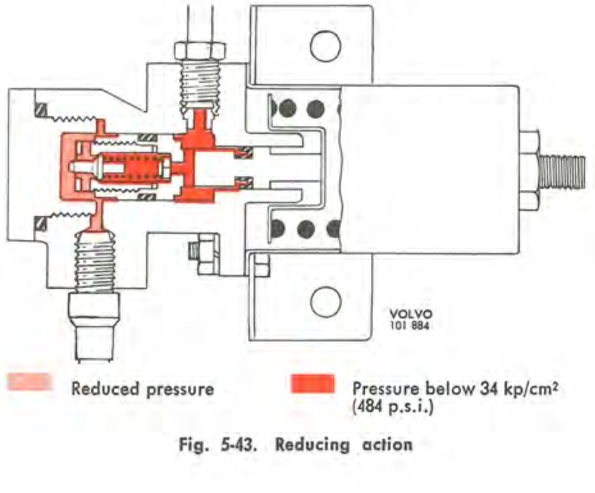


Fig. 5-43. Reducing action

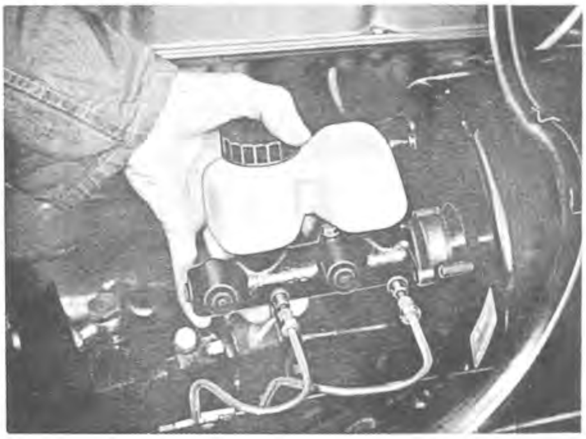


Fig. 5-44. Removing the master cylinder

Fig. 5-46. Container parts

1. Filler cap
2. Strainer
3. Rubber seal
4. Container
5. Rubber seal

MASTER CYLINDER

With regard to repair work on the hydraulic system, the instructions given under "Cleaning" and "Brake Fluid", Group 50, should be observed. When the master cylinder is removed, the brake pedal should not be depressed because the resulting abnormal position for the parts of the servo 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.

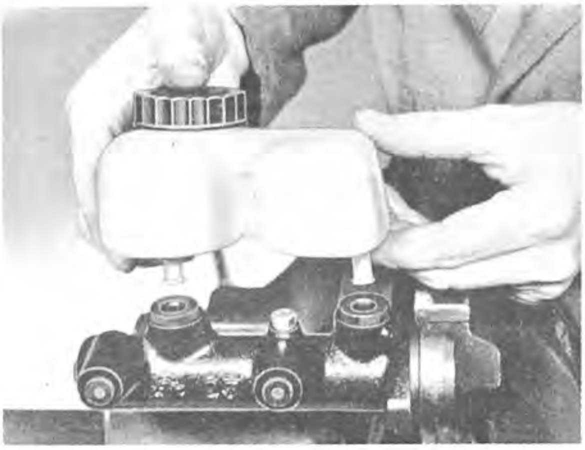


Fig. 5-45. Removing container

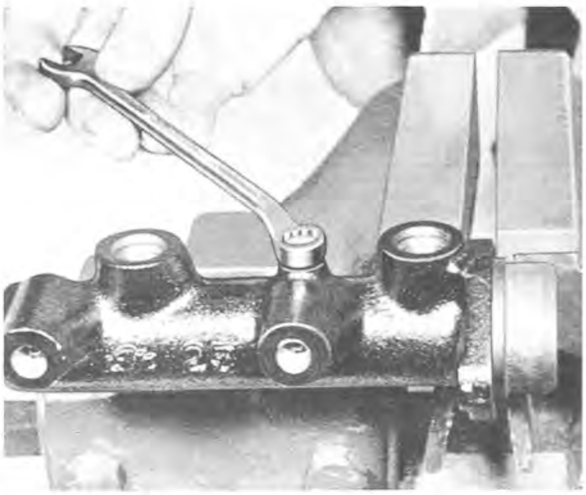


Fig. 5-47. Removing stop screw

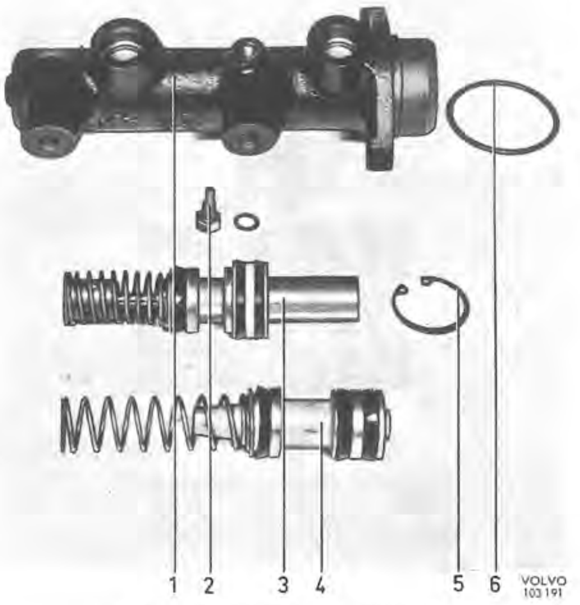


Fig. 5-48. Master cylinder disassembled

1. Cylinder housing
2. Stop screw
3. Primary piston
4. Secondary piston
5. Circlip
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.

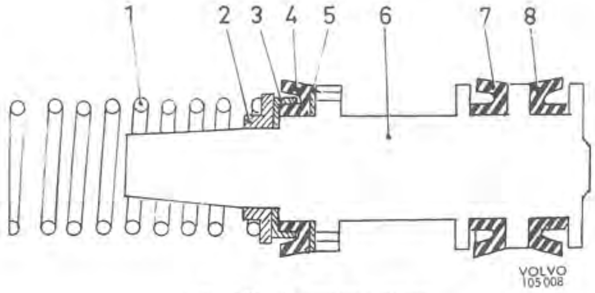


Fig. 5-49. Secondary piston

1. Spring
2. Thrust washer
3. Back-up ring
4. Piston seal
5. Washer
6. Piston
7. 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 0.0—0.8 kpm (3.6—5.7 lb.ft.).
6. Check the movement of the pistons and make sure that the through-flow holes are clear. The

Fig. 5-50. Installing secondary piston

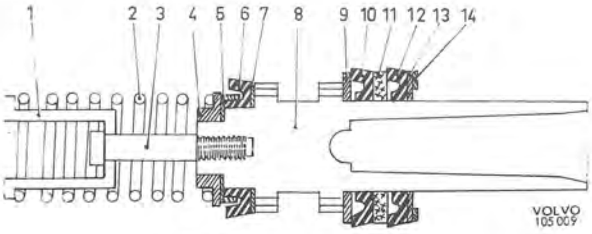


Fig. 5-51. Primary Piston

1. Sleeve
2. Spring
3. Screw
4. Thrust washer
5. Back up ring
6. Piston seal
7. Washer
8. Piston
9. Washer
10. Piston seal
11. Plastic washer
12. Piston seal
13. Washer
14. Circlip

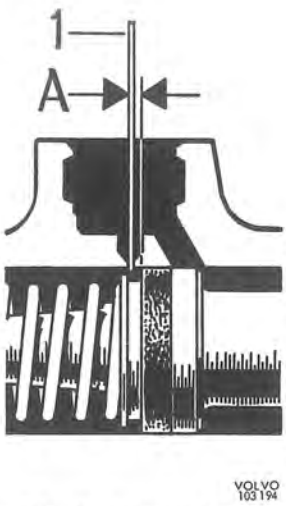


Fig. 5-53. Checking equalizing hole

1. 0.7 mm (22 s.w.g.) soft wire
A=Clearance between washer and seal

equalizing hole 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.

7. 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 vent 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

1. 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 1.2—1.5 kpm (8.7—10.8 lb.ft.).
2. Connect up the lines, see Fig. 5-54. Depress the pedal and tighten the nuts for the lines when fluid free from air forces its way out.
3. Bleed the entire brake system.

Fig. 5-52. Fitting primary piston

Fig. 5-54. Master cylinder fitted

1. Nut
2. Brake fluid container
3. Master cylinder
4. Brake pipe, primary circuit
5. Warning valve
6. Elec. contact
7. Brake pipe, secondary circuit

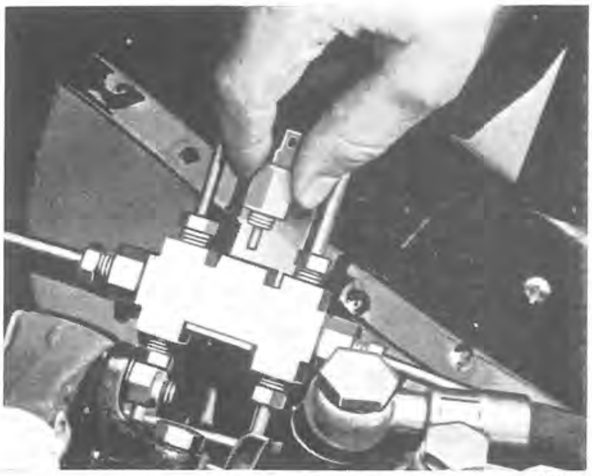


Fig. 5-55. Removing elec. contact

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 1.4—2.0 kpm (10—14 lb.ft.). 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.

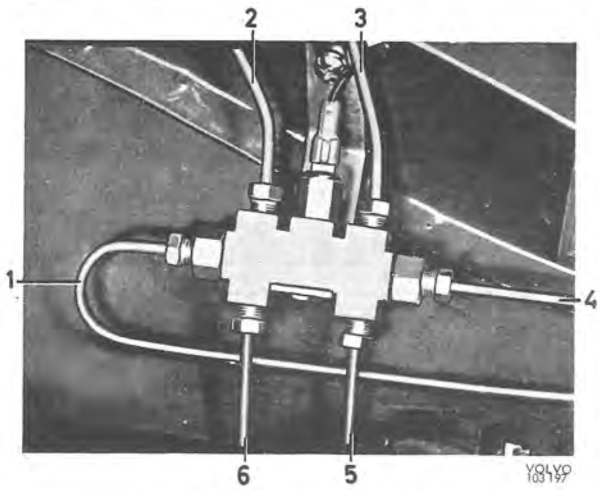


Fig. 5-56. Warning valve installed

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

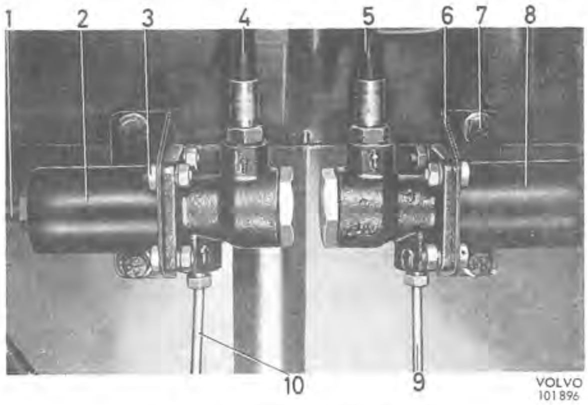


Fig. 5-57. Brake valves installed

1. Adjusting screw
2. Left brake valve (secondary circuit)
3. Screw (assembling)
4. Brake hose to left rear wheel
5. Brake hose to right rear wheel
6. Bracket
7. Attaching screw
8. Right brake valve
9. From the master cylinder primary circuit
10. From the master cylinder secondary circuit

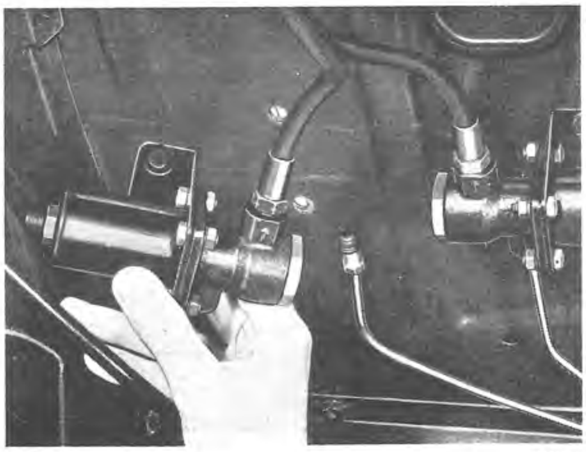
BRAKE VALVE

REMOVING

Unscrew 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.

RECONDITIONING

1. Separate the spring housing from the hydraulic part by removing the four screws (16, Fig. 5-41). Shake out the springs and container. **The adjusting screw must not be removed.**



VOLVO
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Fig. 5-58. Removing brake valve

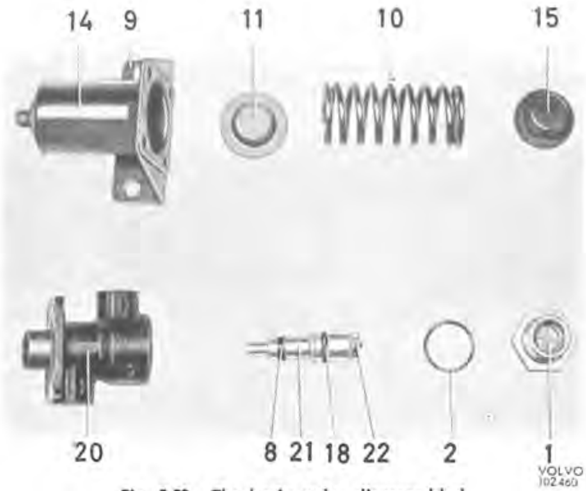


Fig. 5-59. The brake valve disassembled

1. Plug	14. Spring housing
2. O-ring	15. Retainer
8. Piston seal	18. O-ring
9. Bracket	20. Housing
10. Spring	21. Piston
11. Retainer	22. Valve housing

2. Screw out the plug (1) and press out the plunger complete, see Fig. 5-59.
3. Clean the hydraulic part, see under the heading "Cleaning", Group 50.
4. Inspect the parts. If the cylinder surfaces are scratched or damaged by rust, the valve should be replaced complete. However, if the cylinder surfaces are not damaged, replace only the piston complete. When doing so, check that the seal is facing in the direction shown in the Fig. 5-60.
5. Fit the piston (21) complete after having coated it with a brake fluid or a light layer of brake paste. Screw in the plug (1) together with the sealing ring (2). The tightening torque is 10—12 kgm (70—85 lb.ft.).
6. Place the retainer (11) in the housing (14) and turn it according to Fig. 5-41. Place the retainer (15) in the spring (10) and insert it in position in the housing. Now fit the housing on the hydraulic part with help of screws, washers and nuts.

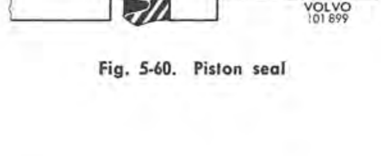


Fig. 5-60. Piston seal

INSTALLING

Screw the brake valve on to the brake hose, see 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.

ADJUSTING

The adjusting screw (12, Fig. 5-41) is not intended for adjusting in the normal meaning of the word. Its function is to balance the variations in the manufacturing. The carefully checked adjustment made at the initial assembling is generally sufficient for the entire lifetime of the valve. **For this reason, the adjusting screw must not be touched.**

If, after reconditioning, it has been established with the help of testing according to "Fault Tracing", paragraph 9, Group 50, that the outgoing pressure lies outside the limit values, an adjustment can be made with the adjusting screw. Turning the screw clockwise increases the outgoing pressure. Lock the screw finally after turning. The tightening torque for the locknut is 2.5—3.5 kpm (18—25 lb.ft.). The adjustment may only be carried out after reconditioning.

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

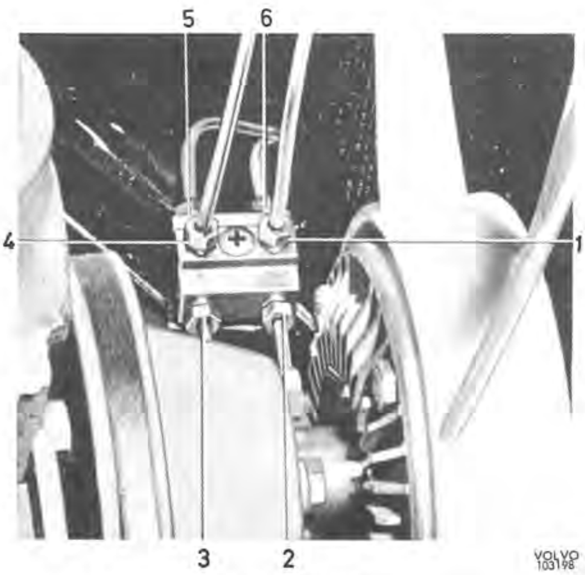


Fig. 5-61. 6-branch union

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

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.

N.B. 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. 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 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 J 1703. 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.**

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 servo 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.

Fig. 5-62. Pedal travel
A=approx. 152 mm (6")

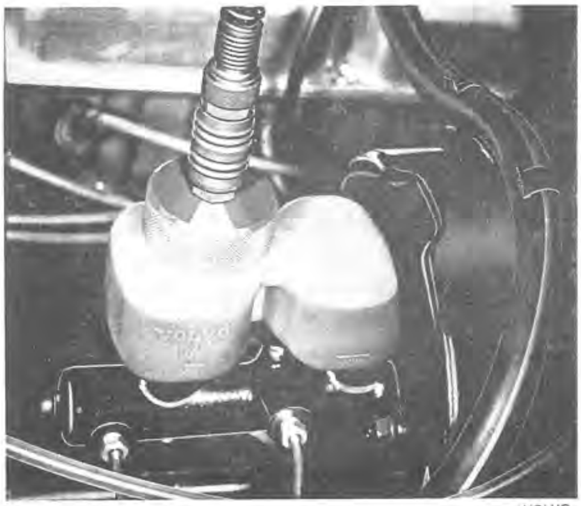


Fig. 5-63. Connecting bleeder unit

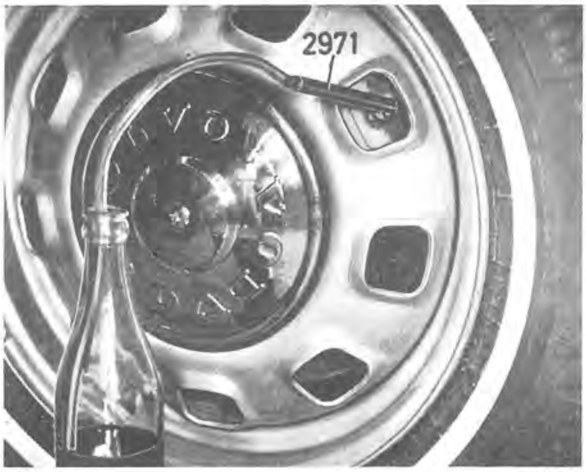


Fig. 5-65. Bleeding front wheel brake unit

4. Fit on the container a cap specially used when bleeding, see Fig. 5-63. Connect the bleeder unit according to the instructions of the manufacturer. The working pressure is 2 kp/cm² (28.4 p.s.i.). 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. 5-64. Note that the bleeder nipple should be opened max. half a turn in order to prevent air from sneaking in via the threads of the nipple.

When bleeding remove the protective cap and fit the bleeder tool SVO 2740. See Figs. 5-65 and 5-66. 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.

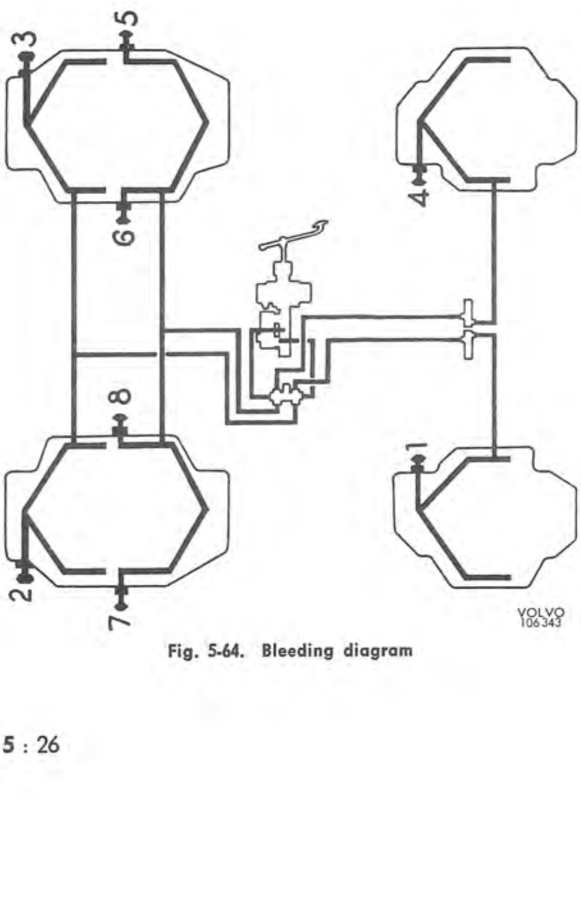


Fig. 5-64. Bleeding diagram

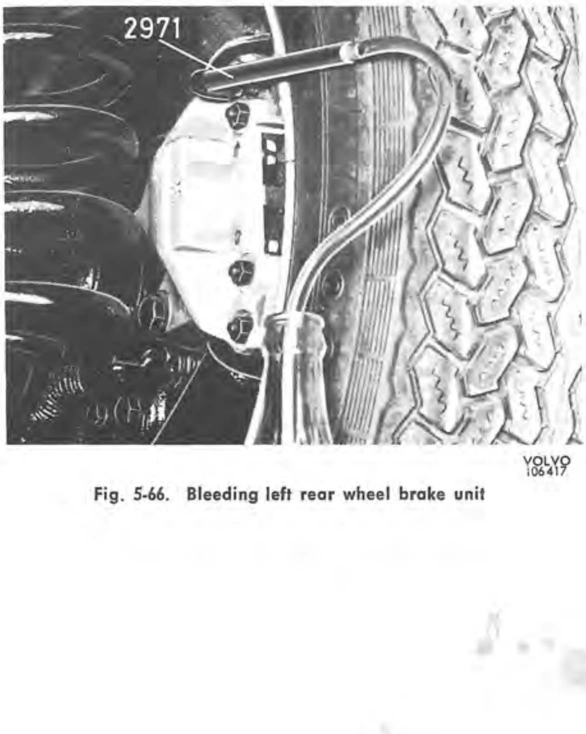


Fig. 5-66. Bleeding left rear wheel brake unit

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 1.4—2.0 kpm (10—15 lb.ft.). 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 servo 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. 5-64 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. 5-67. 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 1.4—2.0 kpm (10—15 lb.ft.). Connect the electric cable. Check that the warning lamp lights only when the parking brake is applied.

Fig. 5-67. Bleeding front wheel brakes

ADJUSTING BRAKE LIGHT SWITCH

Check the distance from the brass hub on the brake light switch to the brake pedal, see Fig. 5-68, 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. 5-69). Remember to tighten the screw after adjustment.

REPLACING BRAKE PEDAL

1. Remove the panel under the dashboard.
2. Remove the bracket (12, Fig. 5-69) 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-

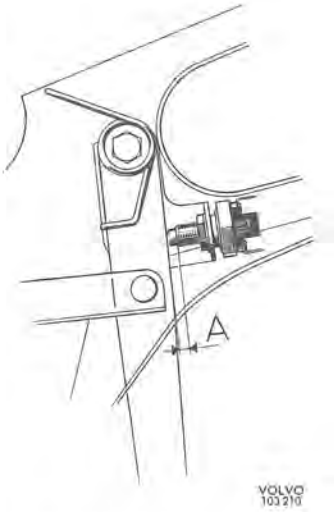


Fig. 5-68. Adjusting brake light switch
A=2—6 mm (1/8")

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 the brake light switch".
7. Re-install the panel.

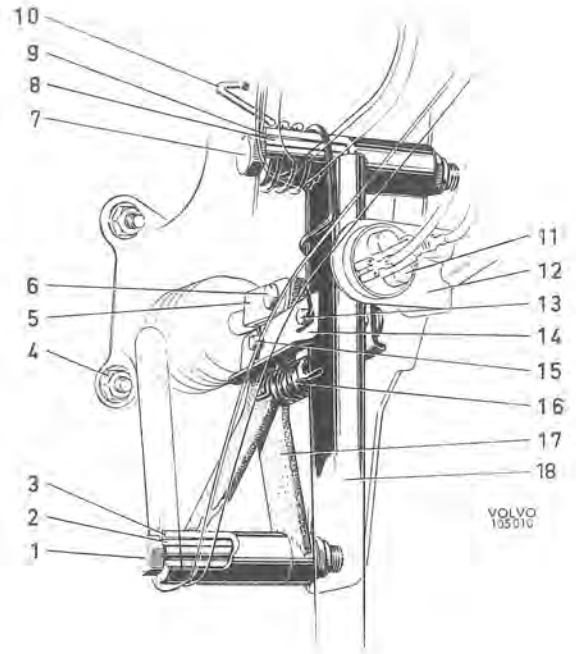


Fig. 5-69. Brake pedal suspension components

1. Bolt
2. Bearing sleeve
3. Bush
4. Nut
5. Thrust rod
6. Split pin bolt
7. Bolt
8. Bearing sleeve
9. Bush
10. Return spring
11. Brake light switch
12. Bracket
13. Split pin bolt
14. Link
15. Split pin bolt
16. Spring
17. Link arm
18. Brake pedal

REPLACING BUSHES IN BRAKE PEDAL AND LEVER

1. Remove the panel under the dashboard.
2. Remove the bracket (12, Fig. 5-69) 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 screws (1—7) and remove the screws.
3. Lift out the pedal (17) and the lever (16).
4. Press out the bearing sleeves (1—8) and the bushes (3—9).
5. Clean the parts. If the bearing sleeves are worn, replace them.
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 lever (16) 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 screw (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 contact (11), see under "Adjusting the brake light switch".
10. Re-install the panel.

AUXILIARY BRAKE SYSTEM

DESCRIPTION

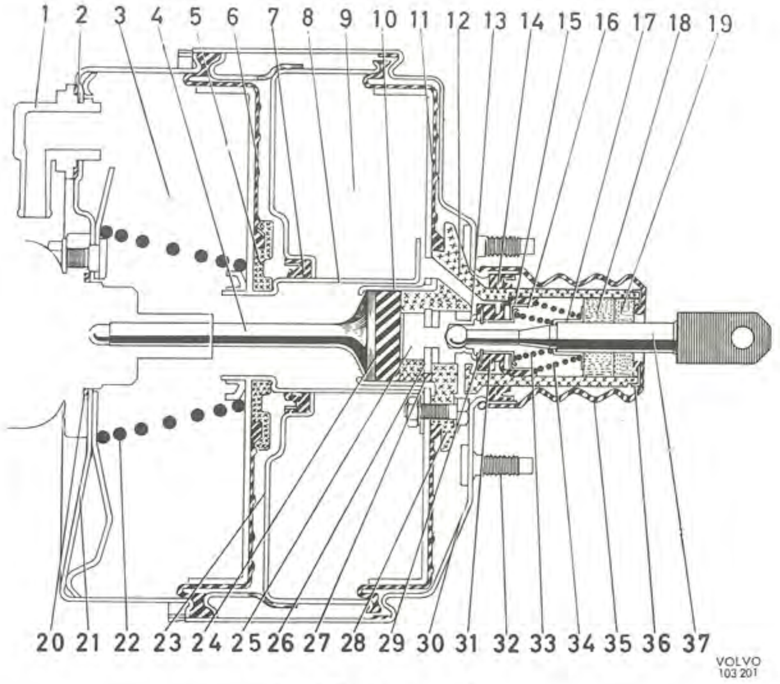


Fig. 5-70. Servo cylinder

1. Vacuum inlet
2. Sealing ring
3. Front vacuum chamber
4. Front thrust rod
5. Retainer
6. Diaphragm
7. Sealing ring
8. Guide sleeve
9. Rear vacuum chamber
10. Retainer
11. Diaphragm
12. Guide housing
13. Valve piston seat
14. Sealing ring
15. Seal
16. Guide
17. Retainer
18. Filter
19. Silencer
20. Sealing ring
21. Cylinder
22. Return spring
23. End
24. Reaction disc
25. Valve piston
26. Stop washer
27. Washer
28. Guide housing
29. Valve guide
30. End
31. Valve plate
32. Attaching screw
33. Valve spring
34. Return spring
35. Rubber cover
36. Washer
37. Rear thrust rod

SERVO CYLINDER

This is a mechanical tandem-type servo device located between the brake pedal and the master cylinder, see Fig. 5-6. Due to the servo 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. 5-70. The servo cylinder functions as follows.

When the system is at rest, the parts of the servo 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

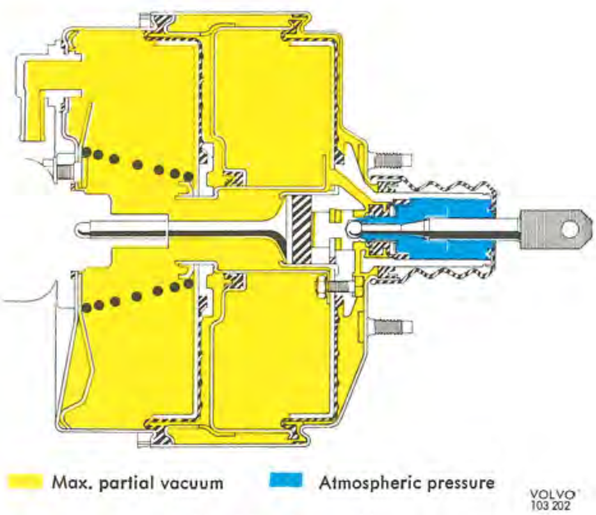


Fig. 5-71. Rest position

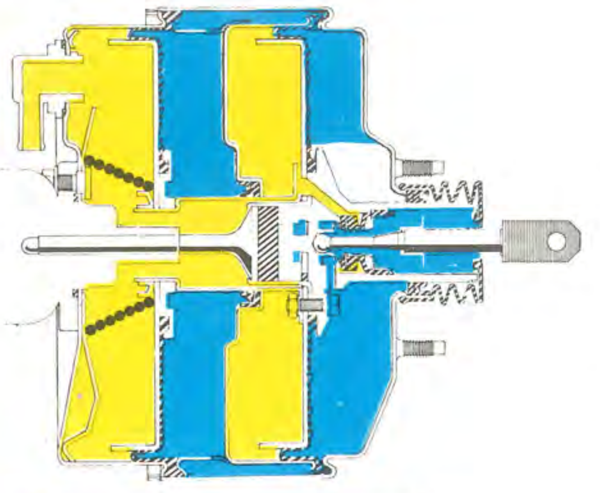


Fig. 5-72. Full brake application

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 servo cylinder are in the position shown in Fig. 5-72 when the pedal pressure provides maximum servo 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. 5-73. 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 servo 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. 5-73 and the new equalizing position is reached. If the brake pedal is released fully, all the parts of the servo 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 servo cylinder functions as an extended thrust rod. As no servo effect is then obtained, greater pressure on the pedal is of course required.

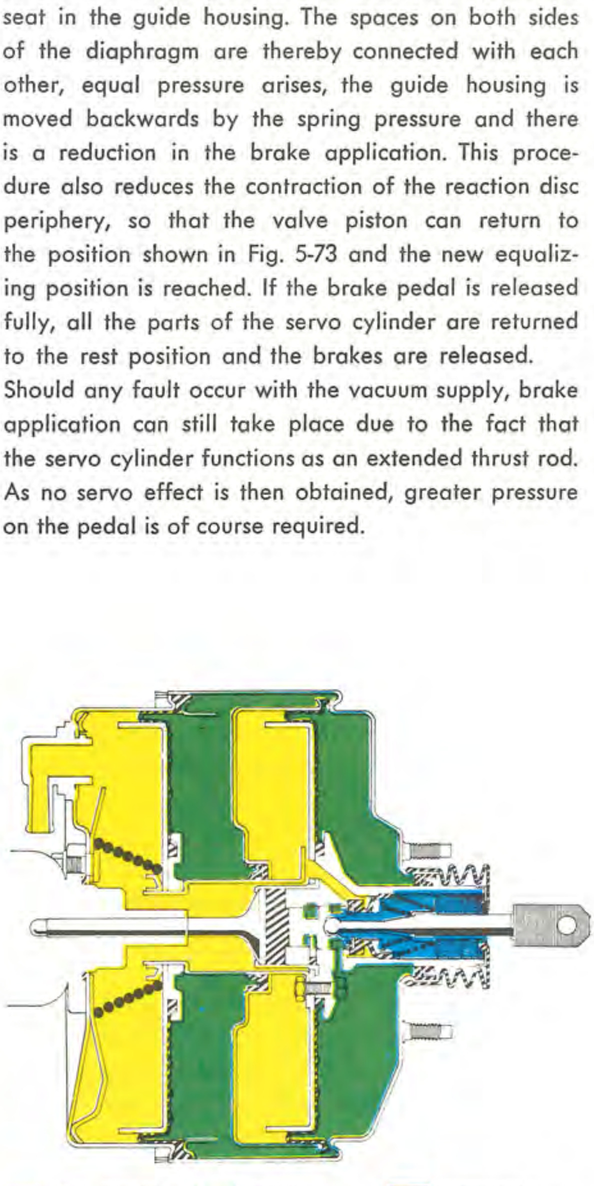


Fig. 5-73. Partial brake application

CHECK VALVE

The check valve (Fig. 5-74) is placed on the line between the engine intake manifold and the servo brake cylinder. Its purpose is to prevent air from flowing back to the servo brake cylinder. The valve only opens when there is a larger degree of vacuum at connection 1 than at connection 2.

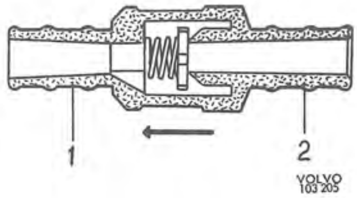


Fig. 5-74. Check valve

1. Connection for intake manifold
2. Connection for servo cylinder

REPAIR INSTRUCTIONS

REPLACING AIR CLEANER AND DAMPER FOR SERVO CYLINDER

REMOVING

1. Remove the panel under the dashboard.
2. Remove the fusing for the brake light.
3. Remove the bracket (12, Fig. 5-69) 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. 5-70).
6. Remove the protective washer, see Fig. 5-75, from the cylinder.
7. Remove the damper (1, Fig. 5-76) and the air cleaner (2).

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. 5-69), and adjust the brake light switch (11), see under "Adjusting the brake light switch" on page 5 : 27.
5. Fit the panel under the dashboard and the fusing.

Fig. 5-75. Removing washer

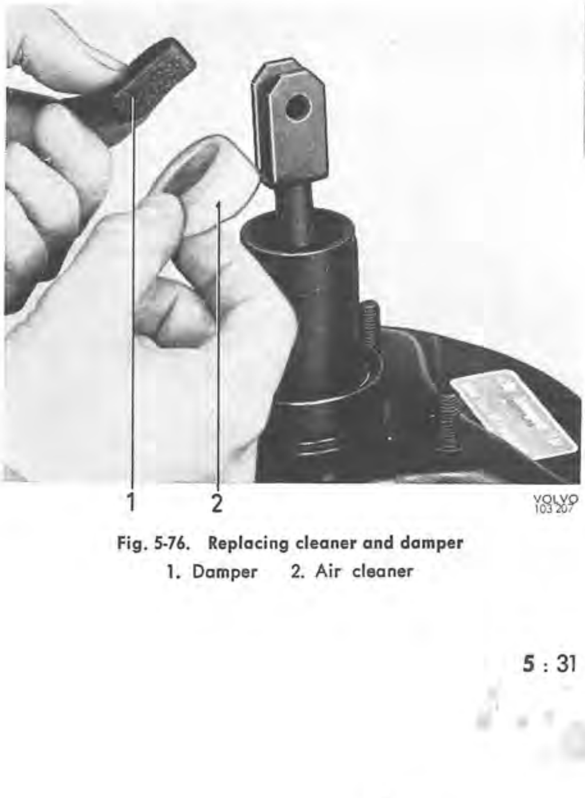
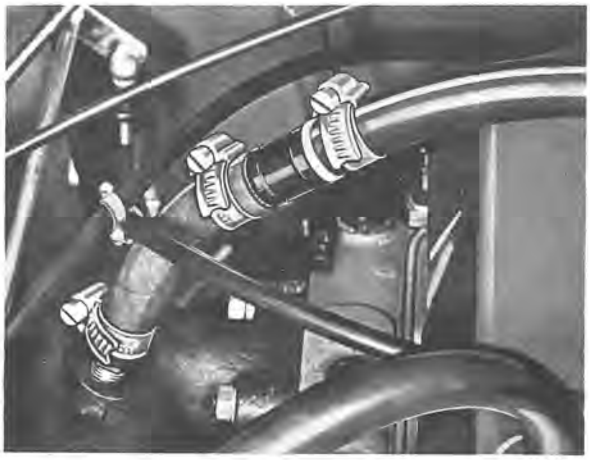


Fig. 5-76. Replacing cleaner and damper

1. Damper 2. Air cleaner



VOLVO 103208

Fig. 5-77. Check valve installed

REPLACING CHECK VALVE

Remove the check valve, see Fig. 5-77, 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 servo cylinder. The vacuum hose connection should face downwards.

REPLACING SERVO CYLINDER

REMOVING

1. Remove the master cylinder, see page 5 : 20. Disconnect the vacuum hose from the servo cylinder.
2. Disconnect the link arm (16, Fig. 5-69) from the brake pedal. Remove the bracket with clutch pedal stop from the cowl.
3. Remove the 4 nuts securing the servo cylinder to the cowl.
4. Pull the servo cylinder forwards and disconnect the fork from the link arm.

INSTALLING

1. Check that the rubber cover (35, Fig. 5-70) is pressed down properly at the protective washer for the cleaner. Secure the fork to the link arm. Push in the servo 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. 5-78. 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-

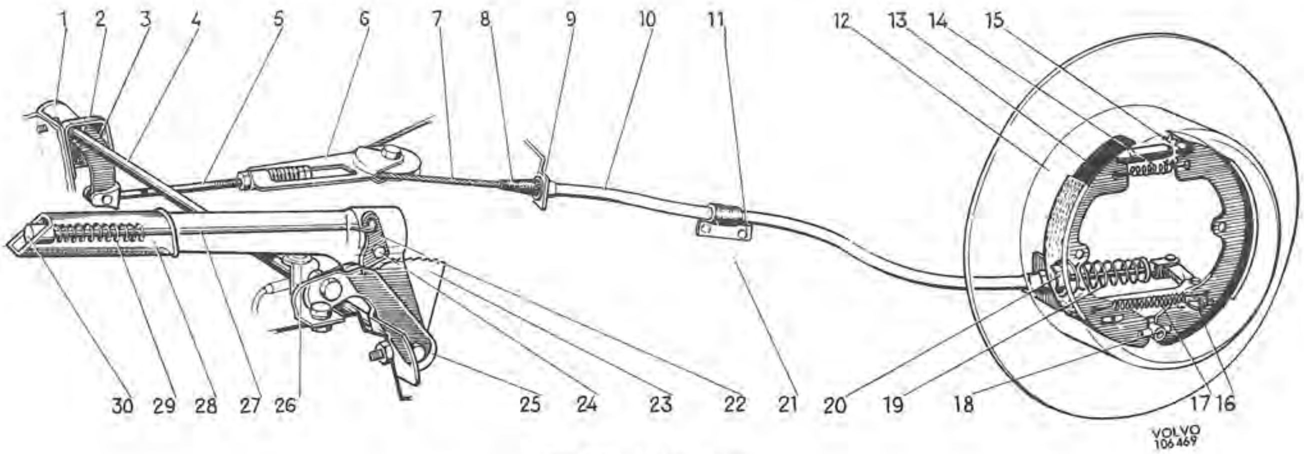


Fig. 5-78. Parking brake

1. Inside support attachment
2. Rubber cover
3. Lever
4. Shaft
5. Pull rod
6. Pulley
7. Cable
8. Rubber cover
9. Front attachment
10. Cable sleeve
11. Attachment
12. Brake drum
13. Brake shoe (secondary shoe)
14. Return spring
15. Adjusting device
16. Lever
17. Movable rod
18. Anchor bolt
19. Return spring
20. Rear attachment
21. Rubber cable guide
22. Pawl
23. Ratchet segment
24. Rivet
25. Outside support attachment
26. Warning valve switch
27. Push rod
28. Parking brake
29. Spring
30. Push button

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. 5-79.

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.

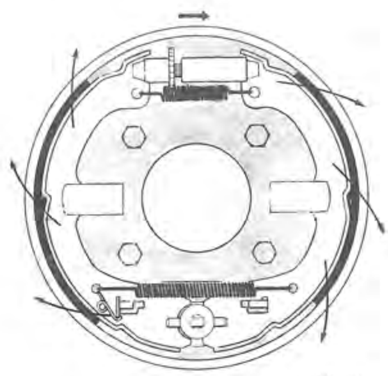


Fig. 5-79. Duo-servo principle

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 misleding results, the spring tension acting on the lever should be reduced. This can be done by fitting holder SVO 2742 (Fig. 8-83) 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. 5-80. When the drum can 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. Connect the cable to the lever and remove the holder SVO 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

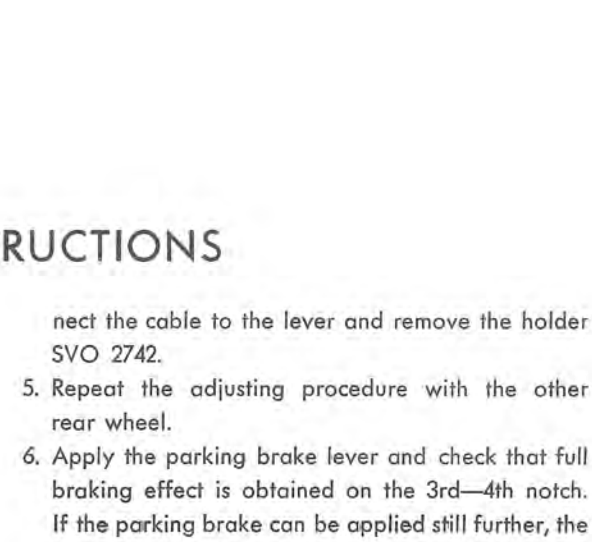


Fig. 5-80. Adjusting the parking brake, rear wheel

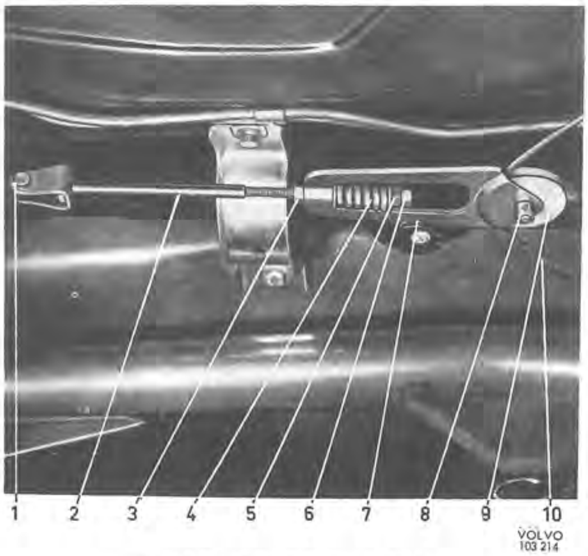


Fig. 5-81. Adjusting device cable

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 10—14 kpm (70—100 lb.ft.). 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 puller (7, Fig. 5-81) or the clevis (4, Fig. 5-82). Remove the wheel from the cable.
4. Remove the rubber cover (8, Fig. 5-78) 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.

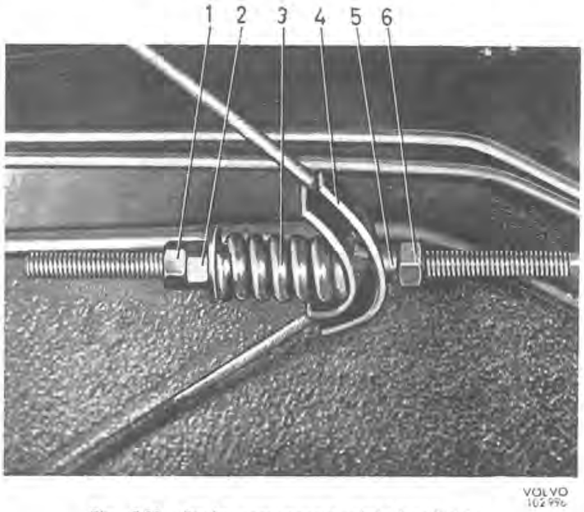


Fig. 5-82. Brake components, right-hand drive

1. Locknut	4. Clevis
2. Adjusting nut	5. Sleeve
3. Spring	6. Locknut

5. Place holder SVO 2742 so that the return spring is held in position according to Fig. 5-83. 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

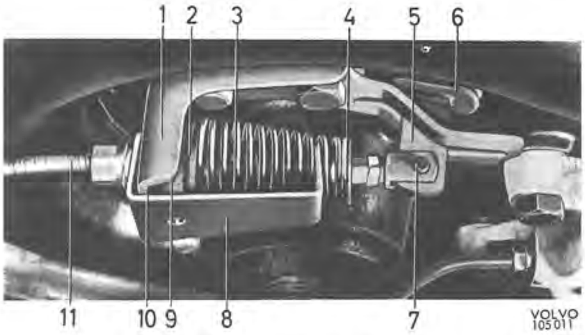


Fig. 5-83. Installing spring tool

1. Cable attachment	7. Lock pin
2. Washer	8. Holder SVO 2742
3. Return spring	9. Nut
4. Washer	10. Lock washer
5. Lever	11. Cable sleeve
6. Rubber cover	

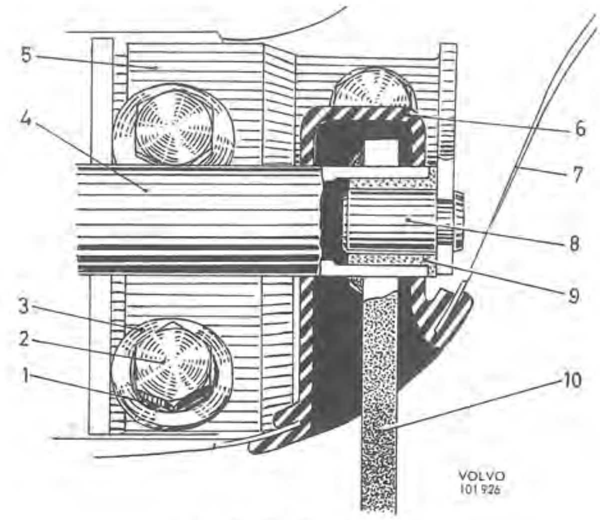


Fig. 5-84. Inner shaft support

1. Spring washer
2. Attachment bolt
3. Flat washer
4. Shaft
5. Inner support attachment
6. Rubber cover
7. Floor
8. Support pin
9. Bush
10. Lever

screwdriver handle upwards, see Fig. 5-80. When the drum can be turned easily, discontinue applying the shoes. Then turn the adjusting screw 4—5 serrations back.

2. 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. 5-83. 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.
3. Fit the cable in the same way as above on the other side of the vehicle.
4. Place the cable sleeve in position in the front attachments and fit rubber covers.
5. 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.
6. Fit the wheels, see operation under "Adjusting the parking brake".

REPLACING PARKING BRAKE LEVER OR RATCHET PARTS

1. Jack up the rear end and prop blocks under the rear axle.
2. Remove the split pin and stretch the cable so that the pull rod (5, Fig. 5-78) can be removed from the lever.
3. Loosen the three attachments for the frame of the seat slide rails and lift the whole seat forwards.
4. Remove the rubber covers, the ratchet segment and the bearing. Pull the parking brake lever with shaft and lever forwards.
5. Unscrew the button (30, Fig. 5-78) 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).
6. Fit the new parts in the reverse order, see Fig. 5-78. 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.

Fig. 5-85. Removing the brake drum

REAR WHEEL BRAKE UNIT (PARKING BRAKE COMPONENT)

DISASSEMBLING

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. Screw loose the brake line (2, 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 (1 and 3, Fig. 5-25). Lift out the caliper, see Fig. 5-26.
4. Remove the attaching bolts for the brake drum and lift off the drum, see Fig. 5-85.
5. Remove both the return springs and the adjusting device. Lift forward the shoes, see Fig. 5-86. Manoeuvering 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. 5-86. Removing the brake shoes

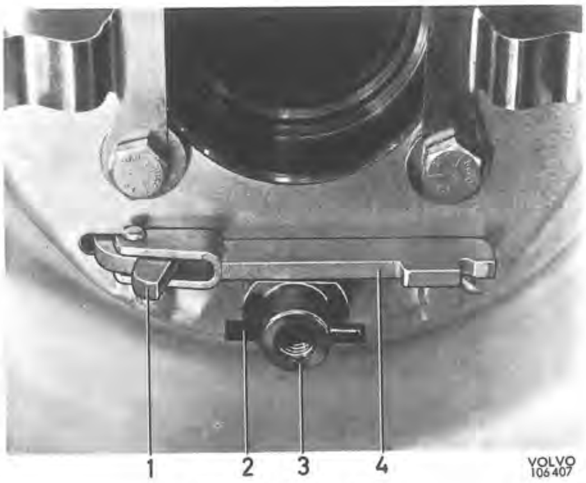


Fig. 5-87. Brake parts

1. Lever 2. Guide pin 3. Anchor bolt 4. Link

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-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. 5-81) or the clevis (4, Fig. 5-82) 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. 5-87. Check that the washer (6, Fig. 5-88) and the spring (7) are in position in the primary shoe. Fit the brake shoes, see Fig. 5-86. 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. 5-88.
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 Locktite, 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 the parking brake.

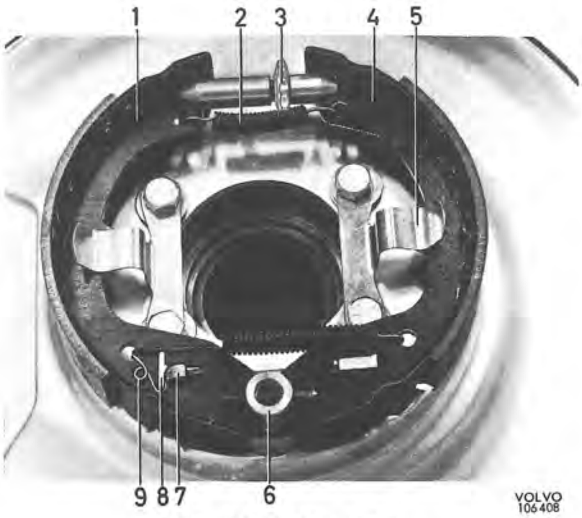


Fig. 5-88. Parking brake

1. Rear brake shoe (spring shoe)
2. Upper return spring
3. Adjusting device
4. Front brake shoe (secondary shoe)
5. Retainer for brake shoe
6. Anchor bolt
7. Lever
8. Washer
9. Spring

Part 6

FRONT END AND STEERING GEAR

CONTENTS

GENERAL

TOOLS

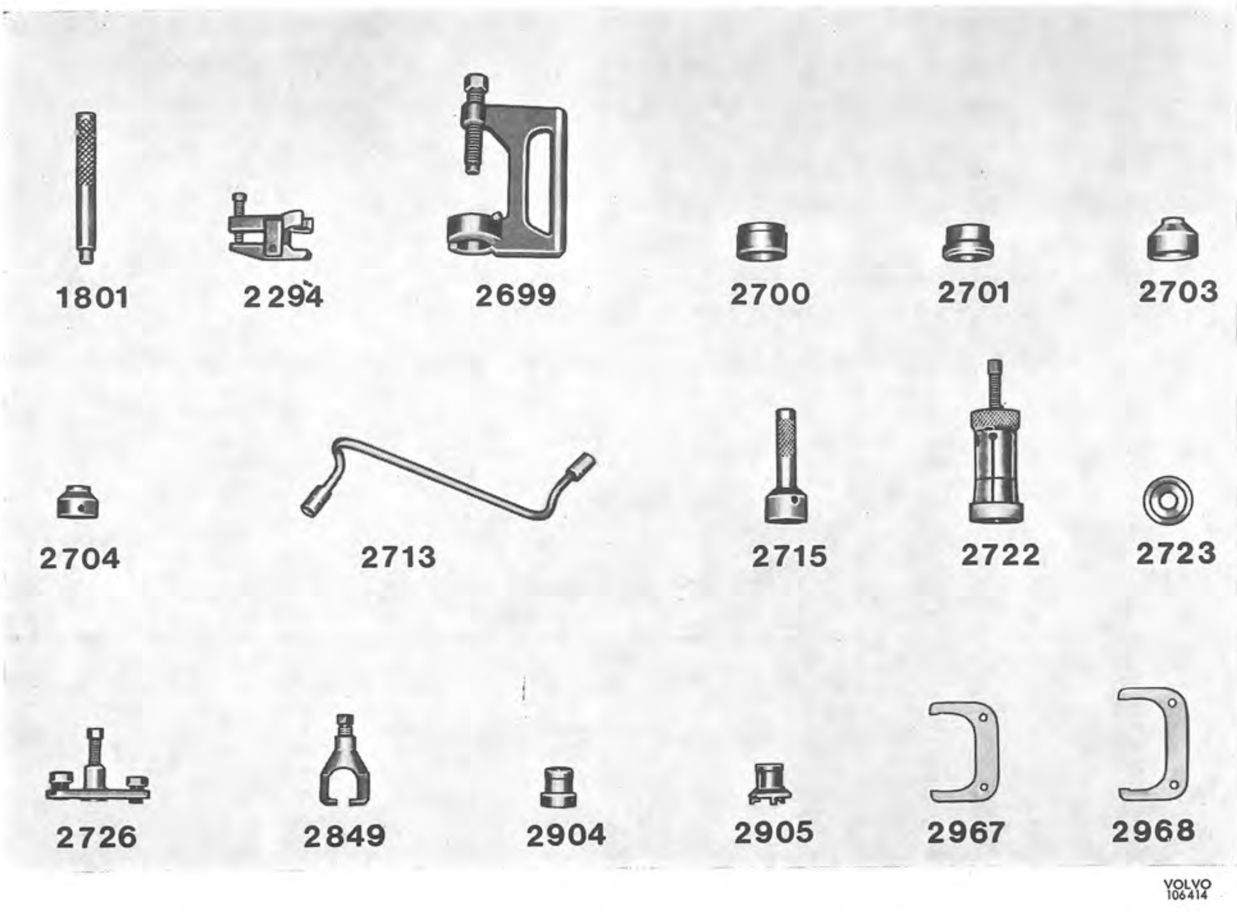


Fig. 6-1. Tools for work on front axle

SVO 1801 Standard handle 18×200
SVO 2294 Press tool, for removing ball joints, tie-rod end
SVO 2699 Press tool, for removing and installing ball joints and rubber bushes, control arms
SVO 2700 Sleeve, for installing ball joint, lower control arms
SVO 2701 Sleeve, for removing and installing ball joint, upper control arms, and bushes in lower control arms, incl. installing ball joint, lower control arms
SVO 2703 Drift, for installing ball joint, lower control arms
SVO 2704 Drift, for installing ball joint, upper control arms
SVO 2713 Spanner (5/8") for upper control arm shaft bolt, wheel adjustment
SVO 2715 Drift, for removing and installing grease cap in hub
SVO 2722 Puller, inner ring, inner front wheel bearing
SVO 2723 Drift, for installing oil seal in hub
SVO 2726 Puller, front wheel hub
SVO 2849 Puller, for pitman arm
SVO 2904 Drift, for removing and installing bush in lower control arms (diagonal tires)
SVO 2905 Drift, for removing and installing bush in lower control arms (radial tires)
SVO 2967 Gauge for lower ball joint, type 1
SVO 2968 Gauge for lower ball joint, type 2

The designation SVO before the tool number is to be replaced by the number 999. This applies also to new production of older tools.

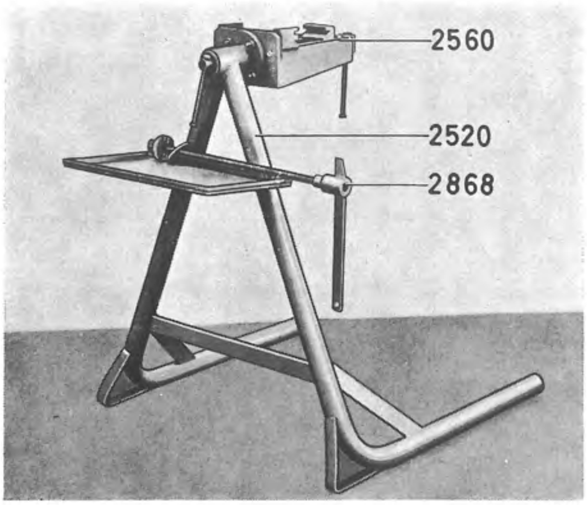


Fig. 6-2. Tools for work with removed front axle

SVO 2520 Stand for fixture
SVO 2560 Fixture
SVO 2868 Press tool for spring

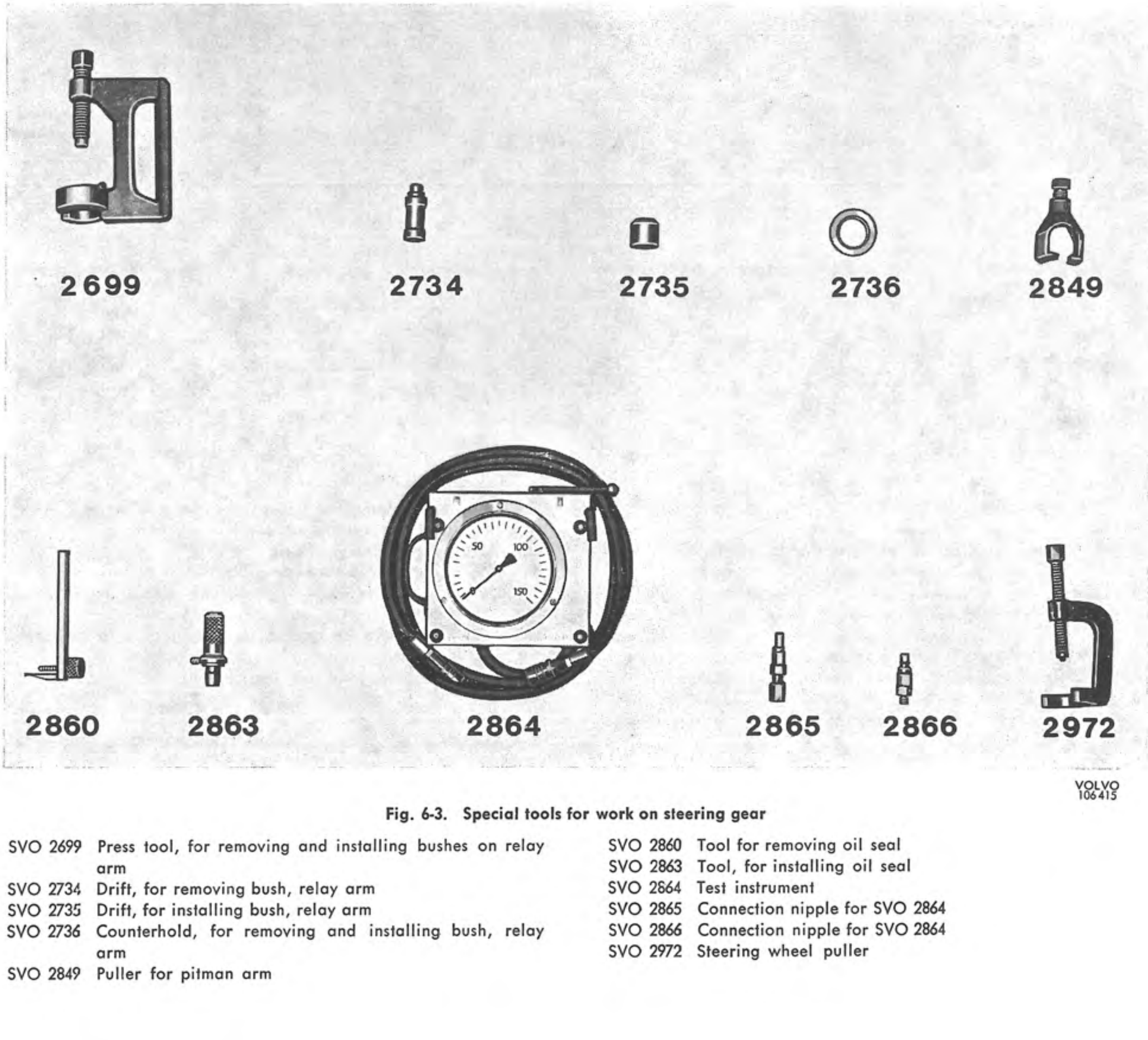


Fig. 6-3. Special tools for work on steering gear

SVO 2699 Press tool, for removing and installing bushes on relay arm
SVO 2734 Drift, for removing bush, relay arm
SVO 2735 Drift, for installing bush, relay arm
SVO 2736 Counterhold, for removing and installing bush, relay arm
SVO 2849 Puller for pitman arm
SVO 2860 Tool for removing oil seal
SVO 2863 Tool, for installing oil seal
SVO 2864 Test instrument
SVO 2865 Connection nipple for SVO 2864
SVO 2866 Connection nipple for SVO 2864
SVO 2972 Steering wheel puller

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.

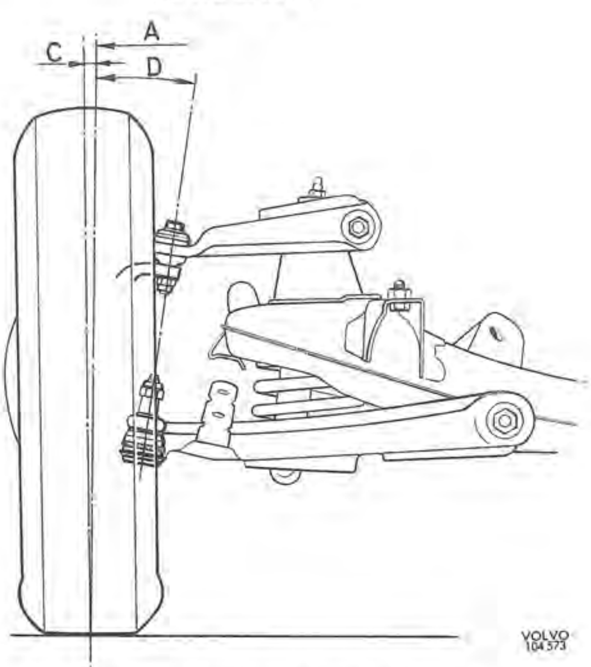


Fig. 6-5. Camber and king pin inclination

A = Verticle line C = Camber D = King pin inclination

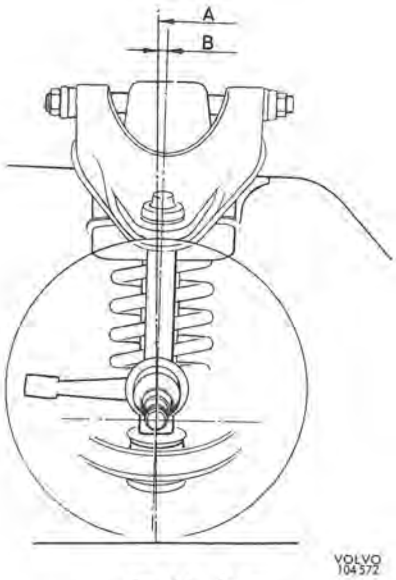


Fig. 6-4. Caster

A = Vertical line
B = Caster

KING PIN INCLINATION

King pin inclination means the inclination of the king pin inwards. Since this car does not have a king pin, the inclination is represented by an angle made between a vertical line and a line through the 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.

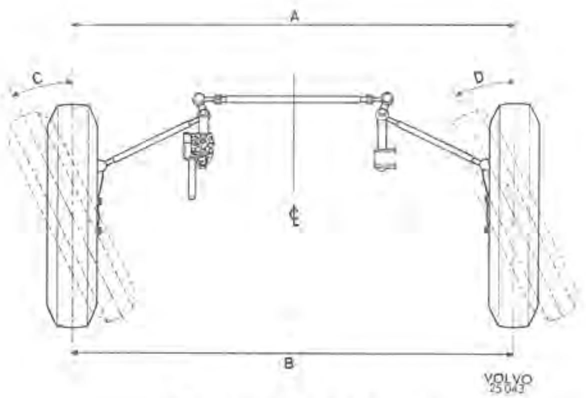


Fig. 6-6. Toe-out and toe-in

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 wishbone 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 box adjustment.
4. Play in intermediate arm journalling 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 10—15 kp (22—33 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 KIN 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±1°.
3. Check the position of the right wheel in the same manner by turning the wheels to the right until the left wheel has turned 20° inwards, when the right turntable scale should give the same reading as previously indicated on the left. Both measurements should thus lie within the above-mentioned tolerances, otherwise it means that the steering gear or front end is distorted.
4. There are no adjusting possibilities, but if the toe-out is incorrect, the steering arms and steering rods should be checked. Replace any parts that are damaged.

ADJUSTING WHEEL ANGLES

N.B. 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.

Fig. 6-7. Adjusting caster and camber
A=Shims

CASTER

The caster for each wheel should be within a tolerance range of 0° to +1°, that is, min. 0° and max. 1° positive. The difference between both sides should, however, not exceed 1/2°.

To adjust, slacken the special bolts at the upper wishbone shaft with tool SVO 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. 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 5.5—7.0 kpm (40—50 lb.ft.).

CAMBER

The camber for each wheel should be within a tolerance range of 0° to +1/2°, that is, it should be min. 0° and max. 1/2° positive.

To adjust, slacken the special bolts at the upper wishbone shaft several turns with tool SVO 2713 (Fig. 6-6). Use one end of the tool for the front bolt and the other for the rear bolt. Then either increase or reduce the number of shims equally for both bolts. More **positive** camber is obtained by **removing** shims, and **negative** camber by **increasing** the number of shims. The shim thickness required for a certain alteration in angle is shown in the diagram in Fig. 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 5.5—7.0 kpm (40—50 lb.ft.).

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°, 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 7.5—9.0 kpm (55—65 lb.ft.).

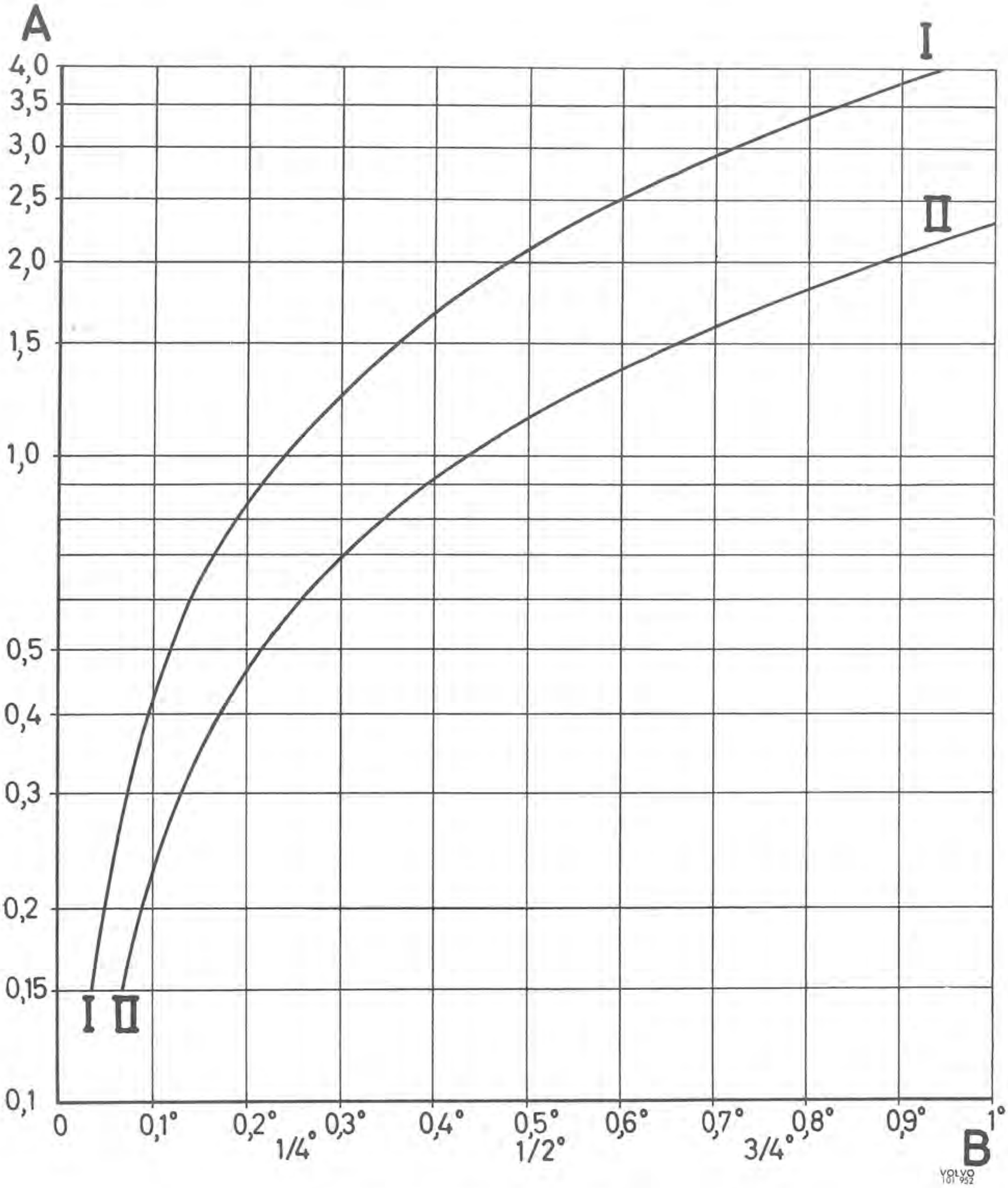


Fig. 6-8. Diagram for alteration of caster and camber

I=Camber
II=Caster
A=Shims (mm)
B=Alteration of angle

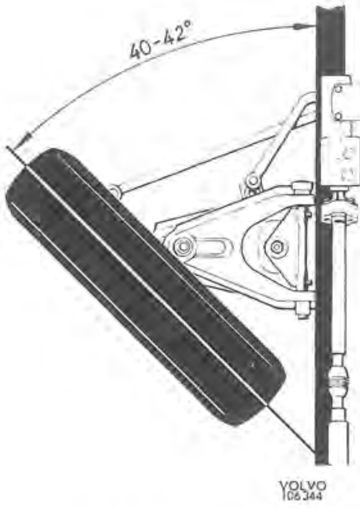


Fig. 6-9. Adjusting max. wheel lock

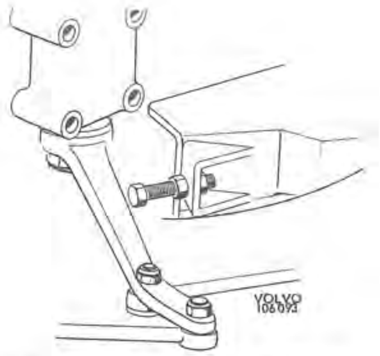


Fig. 6-10. Stop bolt, max. wheel lock

ADJUSTING STEERING LIMITS

Wheel turning is limited by stop bolts, at the pitman arm (Fig. 6-10) and at the relay arm.

Adjusting is done as follows:

1. Turn the left wheel for a left-hand turn as far as it goes. Check that the lock angle of the wheels is 40—42°. If it is not, then adjust to this value with the stop bolt (Fig. 6-10) at the pitman arm.
2. Repeat this procedure with the right wheel and the stop screw on the relay arm.

   N.B. Check that the brake hoses are clear at full wheel lock.

GROUP 62

FRONT END

DESCRIPTION

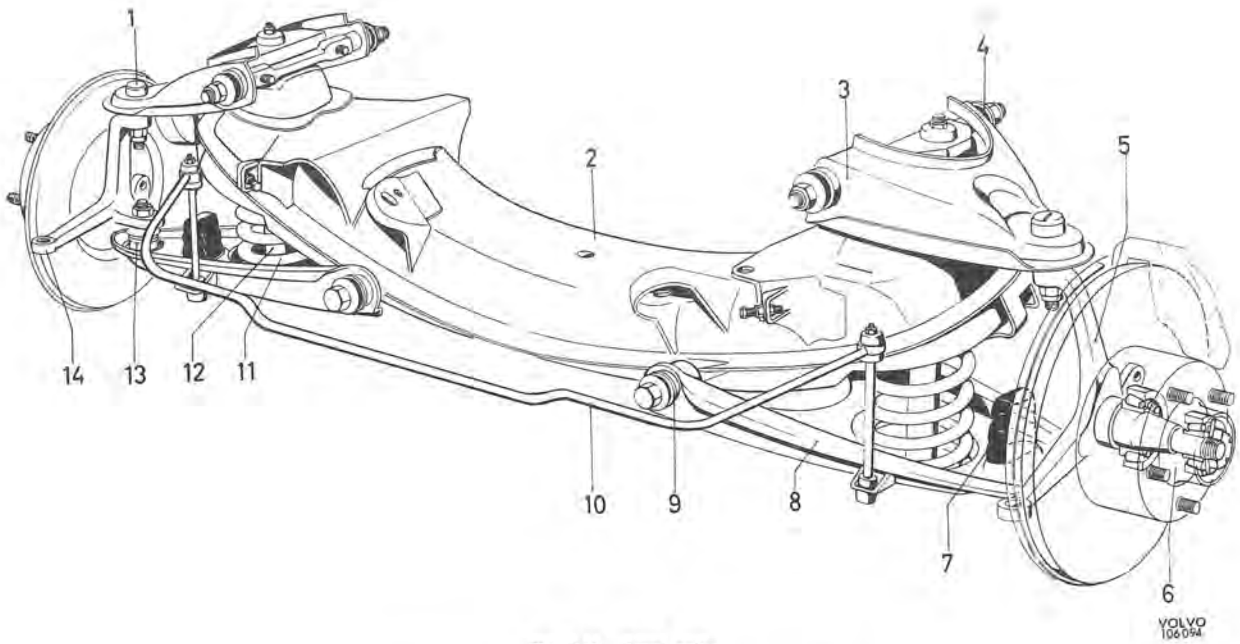


Fig. 6-11. Front axle

1. Upper ball joint
2. Front axle member
3. Upper control arm
4. Upper control arm bush
5. Steering knuckle
6. Hub
7. Rubber buffer
8. Lower control arm
9. Lower control arm bush
10. Stabilizer
11. Spring
12. Shock absorber
13. Lower ball joint
14. Steering arm

The vehicle has independent front wheel suspension. This means that there is no actual front axle, this being replaced by a strong box-section front axle member. This member is bolted to the self-supporting body and the front wheel suspension and springs are fitted at the ends of the member. The construction is illustrated in Fig. 6-11.

The steering knuckle is pivoted on the upper and lower control arms by means of ball joints (1 and 13), which are pressed into control arms. The control arm shafts are carried in rubber bushes, which are journalled in the control arm. Camber and caster are adjusted by means of shims between the upper control arm shaft and its attachment in the front axle member (see Fig. 6-7).

The front wheels are carried in taper roller bearings Fig. 6-11). The front spring assembly consists of coil springs (11) inside which telescopic shock absorbers (12) are fitted. In order to increase its anti-rolling properties, the car is equipped with a stabilizer (10), which is anchored partly to the lower control arms (8) and partly to the body.

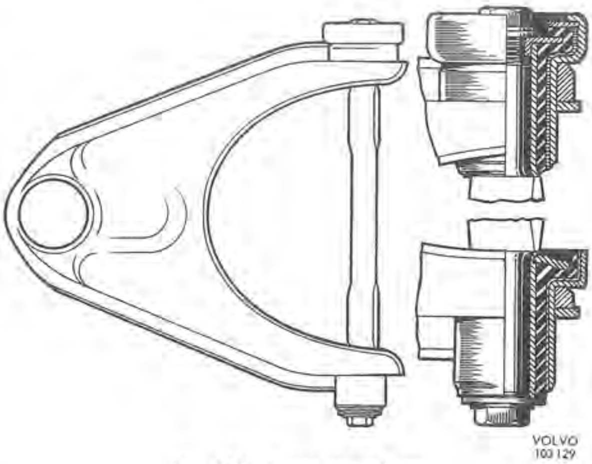


Fig. 6-12. Upper control arm

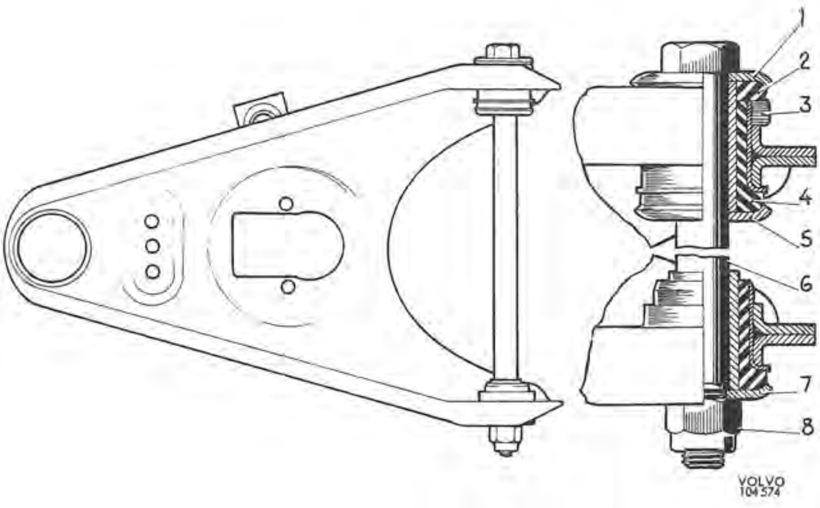


Fig. 6.13. Lower control arm

1. Washer
2. Rubber ring
3. Spacer ring
4. Bush
5. Washer
6. Control arm shaft
7. Washer
8. Nut

GENERAL

The ball joints require no lubrication and are, therefore, not fitted with 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 plate SVO 2811 on the engine and also lifting tool SVO 2727 together with the extension rod SVO 2821, see Fig. 6-14. 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 SVO 2294 according to Fig. 6-15.
4. Remove the stabilizer attaching bolts.

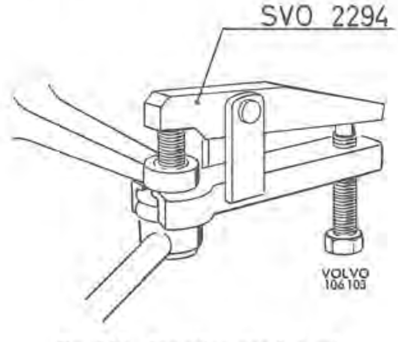


Fig. 6-15. Removing steering rod

5. Loosen the brake hoses from the bracket at the support member.
6. Remove the lower nuts for the front engine mountings.
7. Remove the front axle member attaching bolts, lower and remove the front end.

Disassembling and assembling

For work on a removed front end fixture SVO 2560 and stand SVO 2520 can suitably be used. After the shock absorber has been removed, place tool SVO 2866 according to Fig. 6-16. Compress the spring by screwing in the spindle until there is a clearance at the rubber buffer of the upper control arm.
Concerning other instructions, see under "Removing" and "Installing" for the various components.

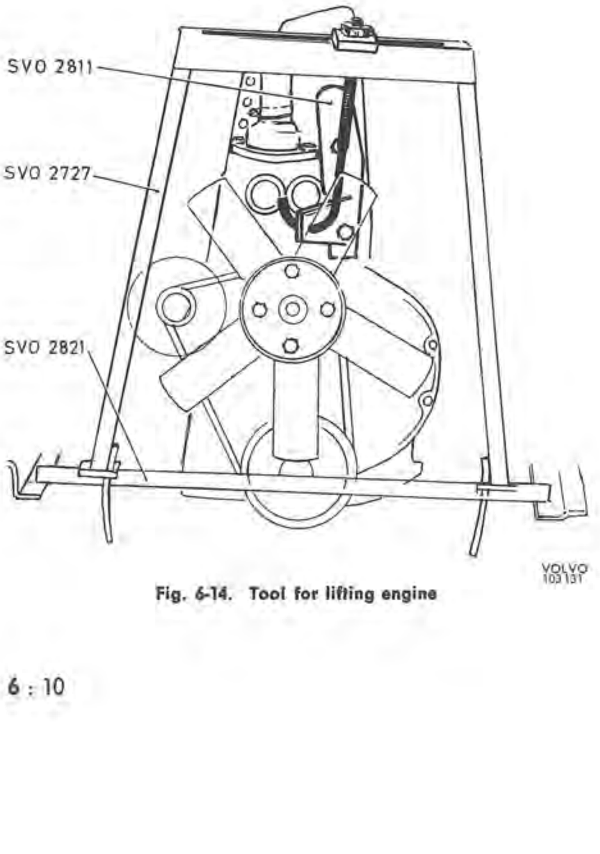


Fig. 6-14. Tool for lifting engine

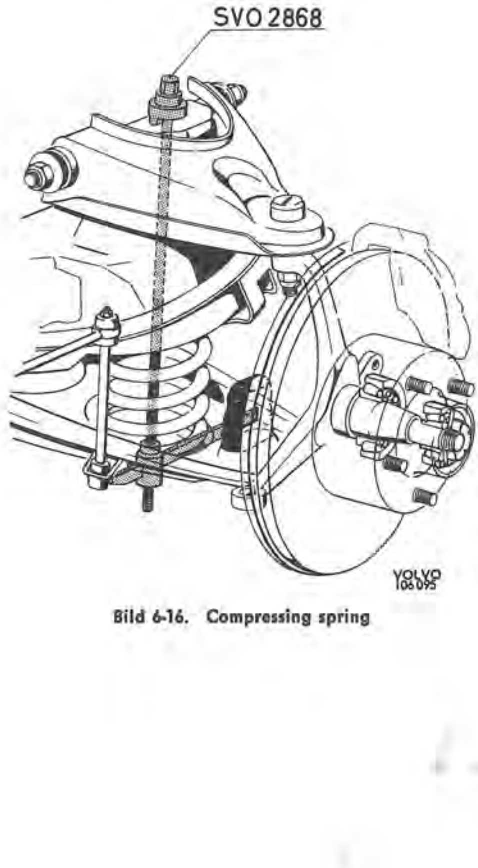


Bild 6-16. Compressing spring

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 2.1—2.5 kpm (15—18 lb.ft.).
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 10—14 kpm (70—100 lb.ft.). 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 SVO 2715, see Fig. 6-17. Remove the split pin and castle nut. Pull off the hub with puller SVO 2726, see Fig. 6-18.

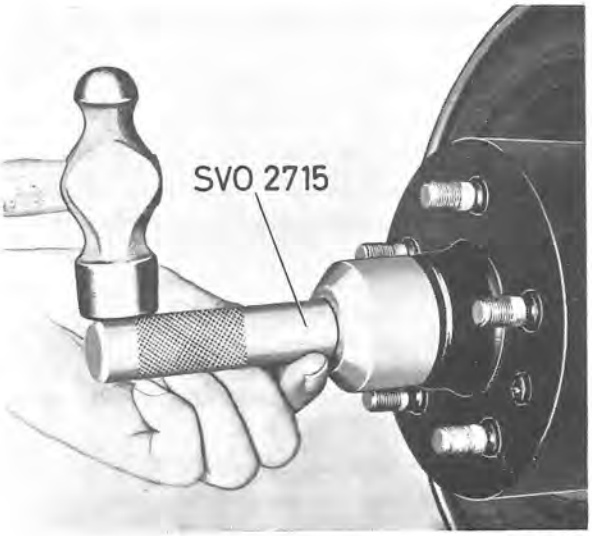


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Fig. 6-17. Removing grease cap

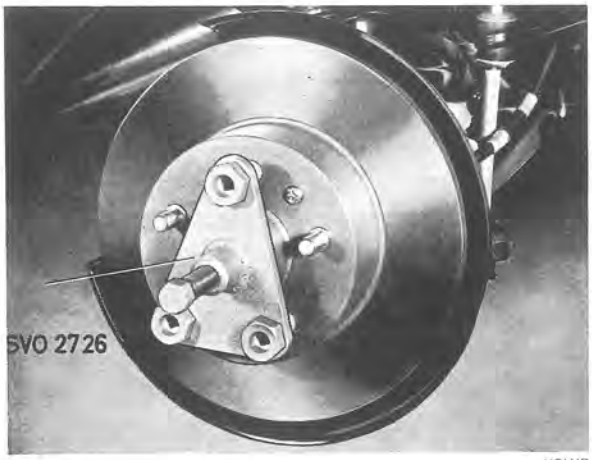

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Fig. 6-18. Removing front wheel hub

If necessary pull off the inner bearing from the stub axle with tool SVO 2722, see Fig. 6-19.

3. Remove the steering rod from the steering arm with tool SVO 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.

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

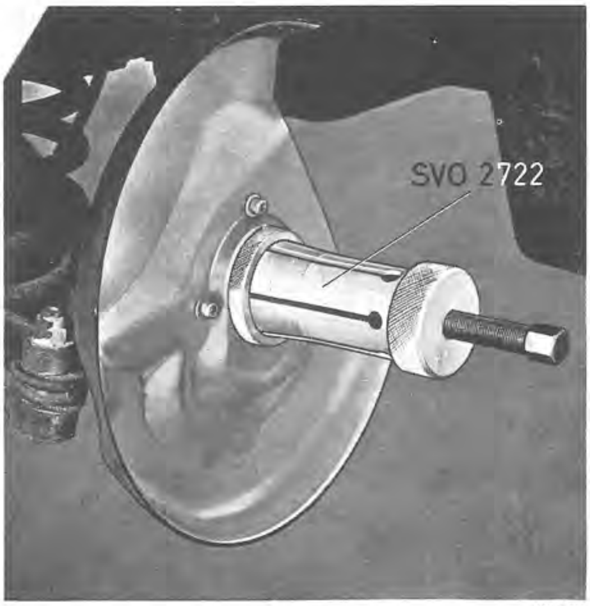

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Fig. 6-19. Removing inner bearing

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 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.

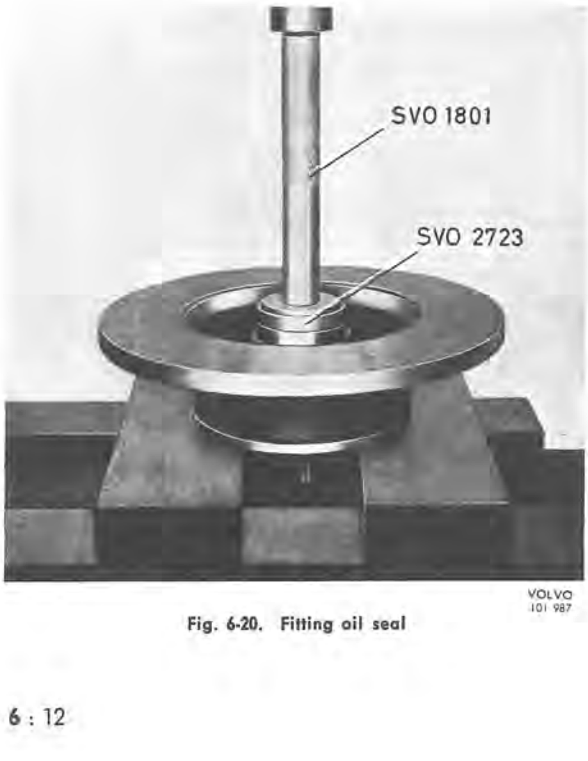


Fig. 6-20. Fitting oil seal

INSTALLING

1. Place the inner bearing in position in the hub and press in the oil seal with tool SVO 2723 and standard handle tool SVO 1801. See Fig. 6-20. Lubricate the felt ring with plenty of, for example, light engine oil.
2. Place the stub axle in position and tighten the ball joint nuts. If the ball joint twists, hold it firmly in position with a screw vice, see Fig. 6-24. Fit the steering rod on to the steering arm.
3. Place the hub on the axle, fit the outer bearing, washer and castle nut.
4. Adjust the front wheel bearings by tightening the nut with a torque wrench to a torque of 7 kpm (50 lb.ft.) 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 SVO 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 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

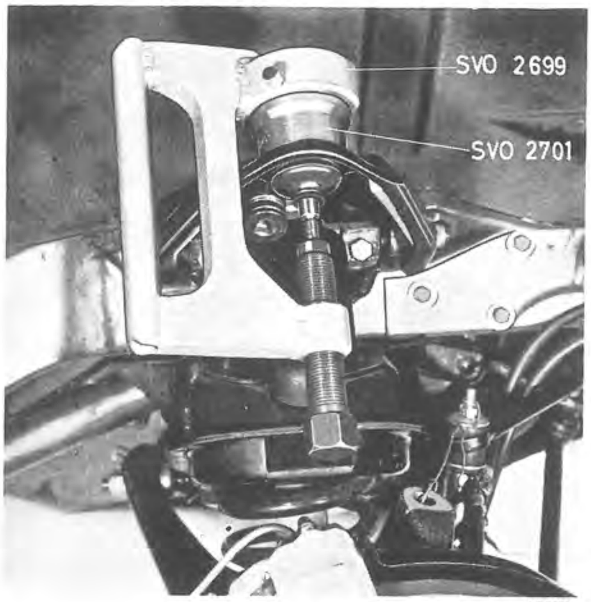


Fig. 6-21. Removing upper ball joint

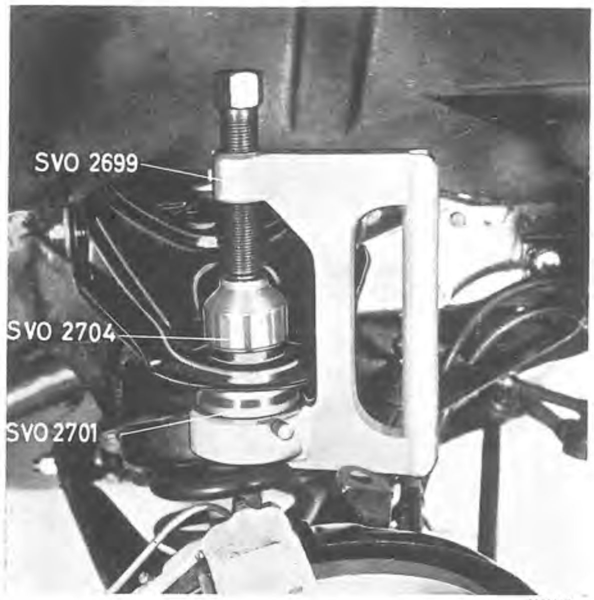


Fig. 6-23. Installing upper ball joint

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. 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 SVO 2699 and sleeve SVO 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.

2. Press the ball joint into the control arm with press tool SVO 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 ±8°) either externally or internally (Fig. 6-22) as the pin has maximum movement along this line. Should the ball joint be incorrectly fitted when being pressed in, turn the tool SVO 2699 half a turn and then press the ball joint into the correct position. The ball joint must not be loose in the control arm.

Fig. 6-22. Location of ball joint in upper control arm

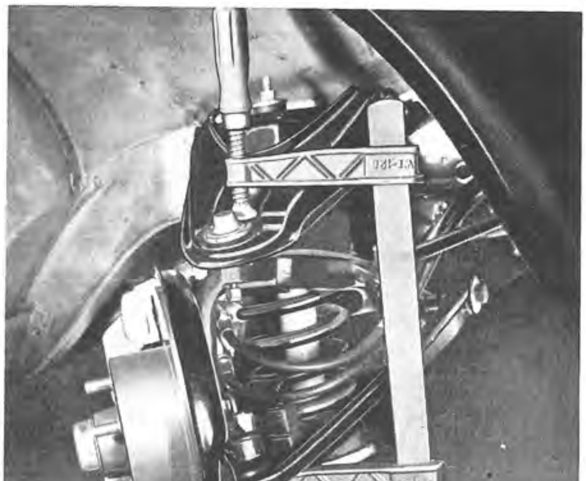


Fig. 6-24. Upper ball joint securely held by vice

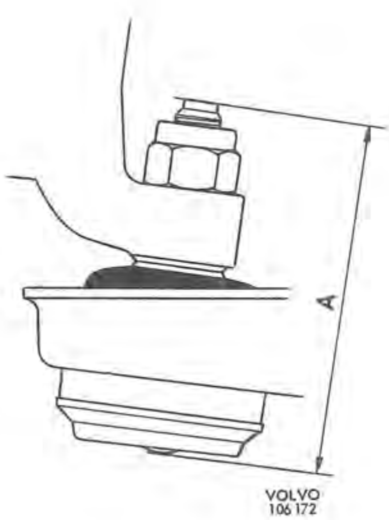


Fig. 6-25. Lower ball joint, type 1 (without spring)

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 10—14 kpm (70—100 lb.ft.). 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 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.

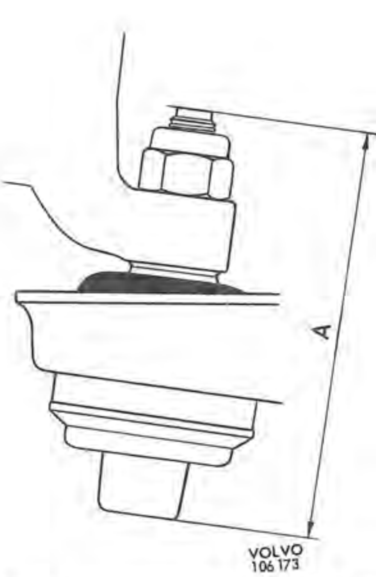


Fig. 6-26. Lower ball joint, type 2 (with spring)

A=Max. 113 mm (4.5")

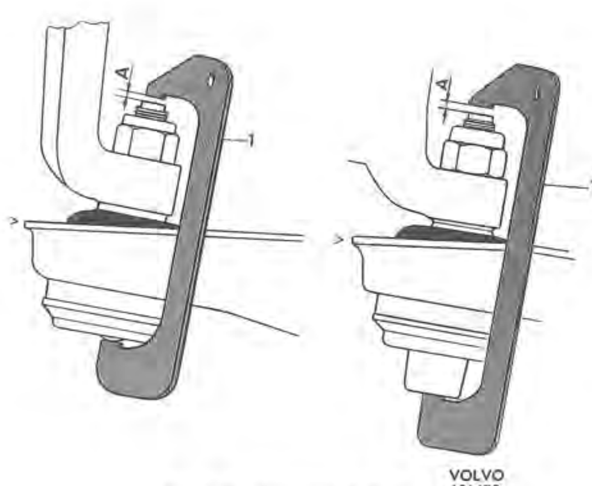


Fig. 6-27. Approved ball joints

1. SVO 2967 for ball joint type 1
SVO 2968 for ball joint type 2
A=Clearance

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 SVO 2294, see Fig. 6-15, and remove the brake lines from the stabilizer bolt.

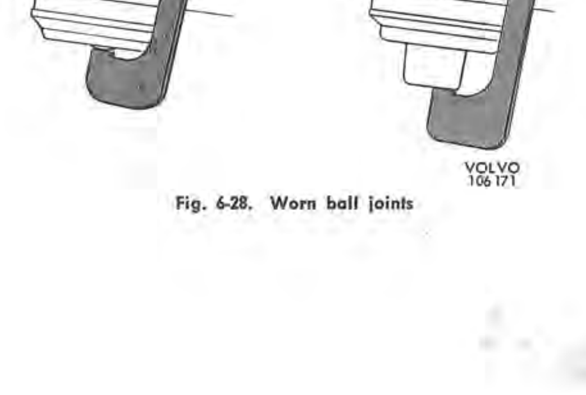


Fig. 6-28. Worn ball joints

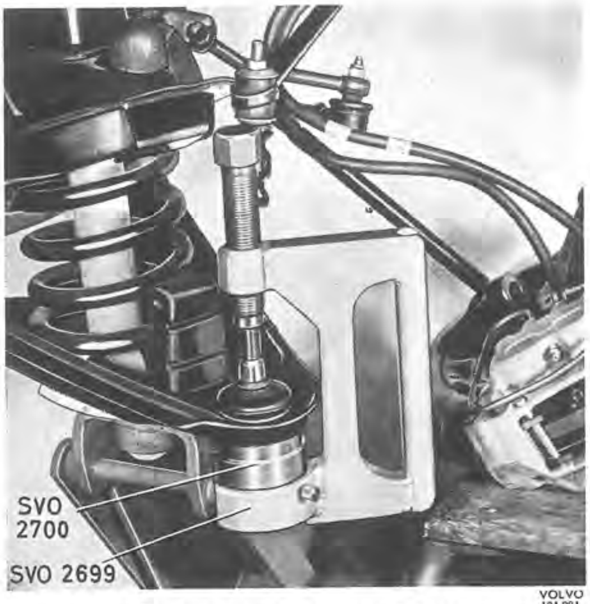


Fig. 6-29. Removing lower ball joint

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 SVO 2699 and sleeve SVO 2700, see Fig. 6-29.

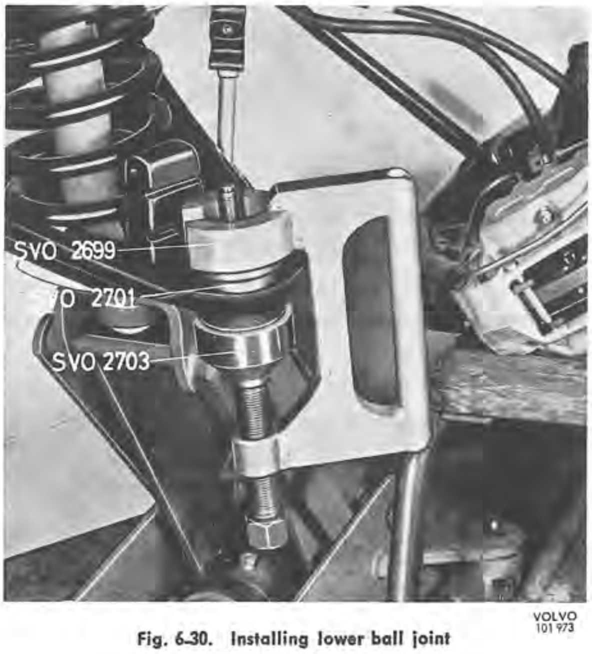


Fig. 6-30. Installing lower ball joint

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 SVO 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 houses to the stabilizer bolt.
5. Install the wheel and wheel nuts. Lower the vehicle and tighten the wheel nuts to a torque of 10—14 kpm (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 SVO 2713, see Fig. 6-7.
   N.B. Take care of the shims. Lift off the control arm.

INSTALLING

N.B. 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 SVO 2713. Tighten the nuts for the control arm shaft to a torque of 5.5—6.2 kpm (40—45 lb.ft.).

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 10—14 kpm (70—100 lb.ft.). 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 SVO 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.

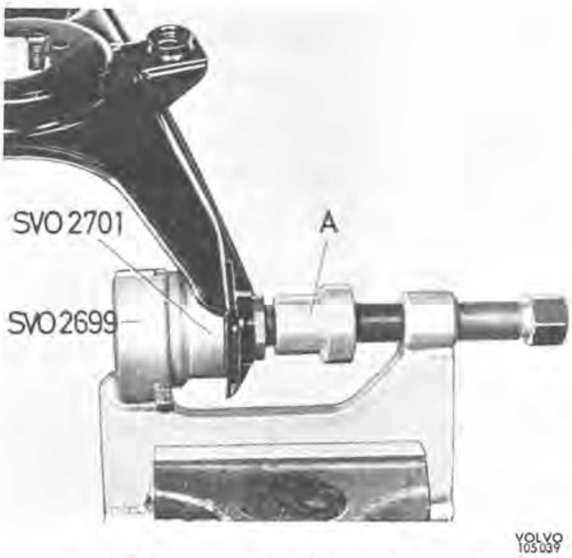


Fig. 6-31. Removing rubber bush, lower control arm

A = SVO 2904 for bushes intended for diagonal tyres and SVO 2905 for radial tyres

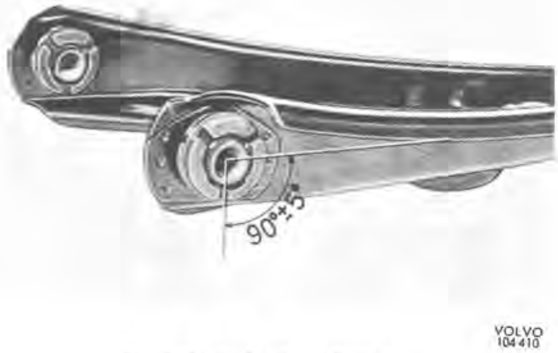


Fig. 6-32. Bushes for radial tyres

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 SVO 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 SVO 2701. Use drift SVO 2904 for bushes where diagonal tyres are fitted and SVO 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 14—18 kpm (100—130 lb.ft.).
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 10—14 kpm (70—100 lb.ft.). Fit the hub cap.

GROUP 64

STEERING GEAR

DESCRIPTION

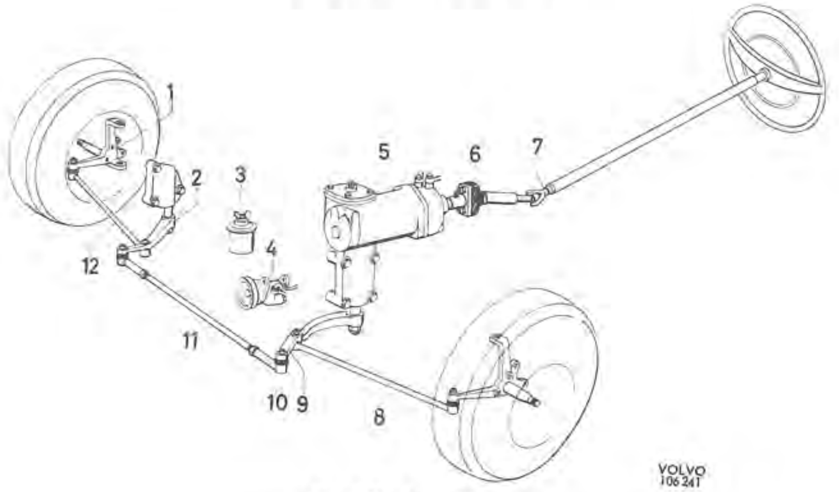


Fig. 6-33. Steering gear

1. Steering knuckle
2. Relay arm
3. Container, servo steering
4. Pump
5. Steering box
6. Rubber coupling
7. Steering column
8. Steering rod, left
9. Pitman arm
10. Ball joint
11. Tie rod
12. Steering rod, right

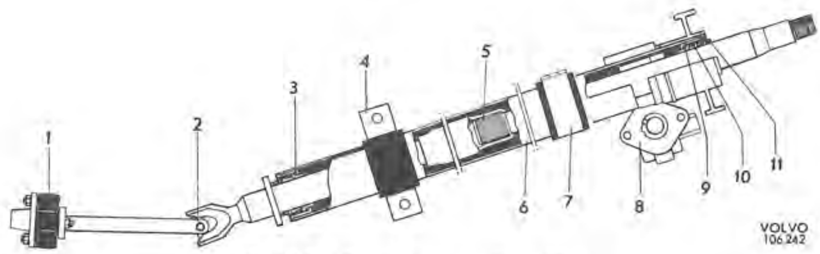


Fig. 6-34. Steering column journalling

1. Rubber coupling
2. Universal joint
3. Lower bearing
4. Lower attachment
5. Safety mechanism
6. Steering column jacket
7. Upper attachment
8. Steering wheel lock
9. Upper bearing
10. Seat
11. Spring

GENERAL

The design of the steering is shown in Fig. 6-33. Steering wheel movement is transmitted to the wheels via the steering column (7), the steering box (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 box 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 linking unit consisting of a clamp sleeve 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 journalled 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.

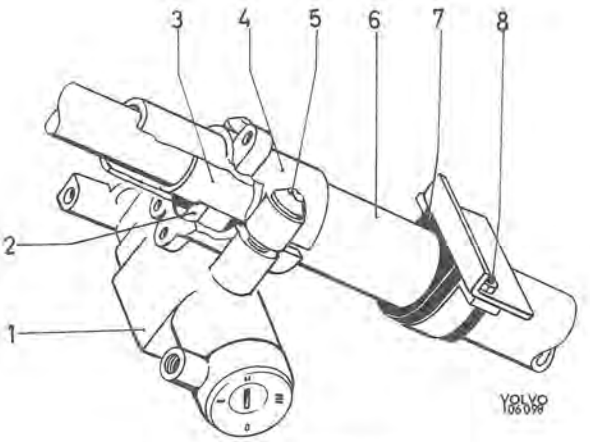


Fig. 6-35. Steering wheel lock

1. Steering wheel lock
2. Lock pin
3. Lock sleeve
4. Cover
5. Shear-off bolt
6. Steering column jacket
7. Attachment
8. Shear-off bolt

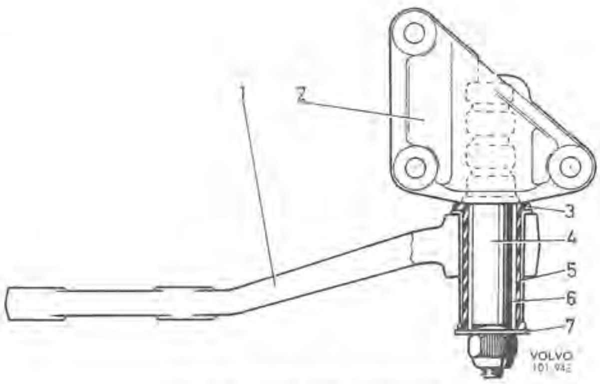


Fig. 6-36. Relay arm journalling

1. Relay arm
2. Bracket
3. Rubber bush
4. Bearing pin
5. Sleeve
6. Sleeve
7. Washer

STEERING RODS AND RELAY ARM

The ball joints of the steering rod are plastic-lined, and this makes maintenance lubrication unnecessary. The tie rod (11, Fig. 6-33) 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 journalling is, in other words, "lubricated for life".

SERVO STEERING

This vehicle is fitted with the ZF recirculating cam and ball nut type servo steering. The main components of the servo system are the steering box, servo 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.

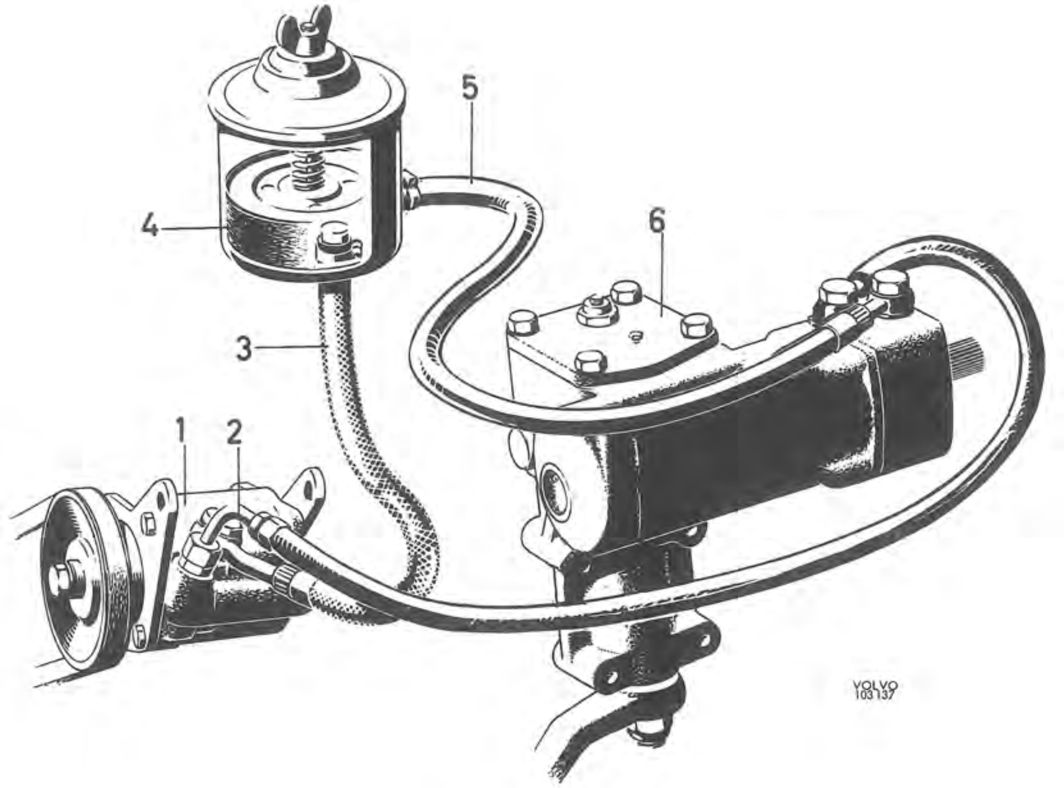


Fig. 6-37. Servo steering

1. Servo pump
2. Delivery oil line
3. Pump suction line
4. Oil container with filter
5. Return oil line
6. Steering box

Steering box

CONSTRUCTION

The steering gear is of the cam and roller type. In addition to the mechanical section, the servo cylinder and control valves are built into the steering box. The lower part of the steering box (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 lever shaft (20).

The axial movement of the piston which determines the direction the wheel turns, is obtained via steering cam (5) and ball nut. The recirculating balls (4) are located in annular grooves and form the thread for the nut. Movement of the steering cam comes from the steering column at the control spindle (16) and the torsion rod (17) secured in the spindle. The steering cam is journalled in the upper section of the steering box 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 steering cam 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 control spindle (16).

The inner race of the taper ball bearing also is an outer race for the double needle bearings of the control spindle.

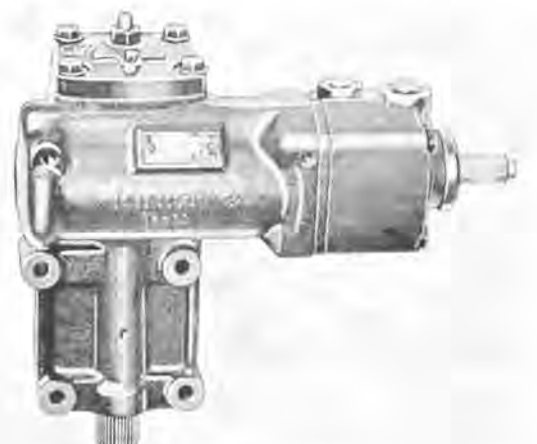


Fig. 6-38. Steering box

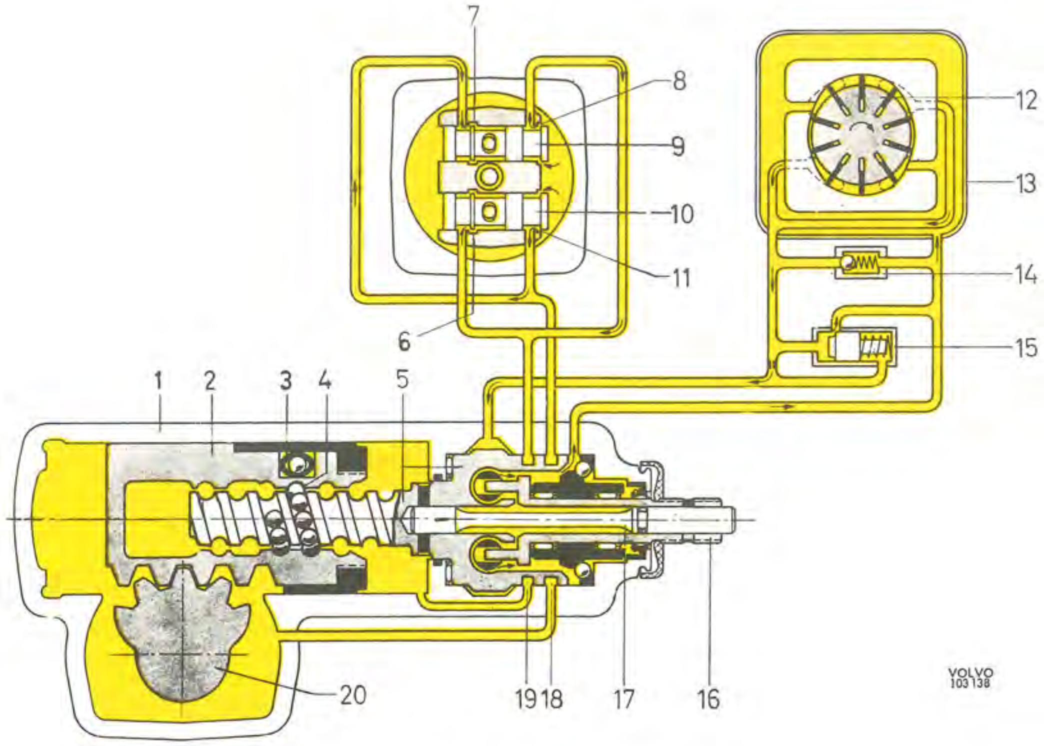


Fig. 6-39. Function, neutral position

1. Steering box
2. Piston
3. Recirculation tube, ball nut
4. Balls
5. Steering cam
6. Return groove
7. Return groove
8. Intake port
9. Control valve
10. Control valve
11. Intake port
12. Servo pump
13. Oil container
14. Safety valve
15. Flow control valve
16. Control spindle
17. Torsion rod
18. Annular groove
19. Annular groove
20. Lever shaft

The lever shaft (20) is journalled in the steering box 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 steering cam 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 lever shaft and the steering cam 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 steering valves 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 valves are connected to the part of the housing where the servo piston operates, a cross-section has been made through the steering valves in addition to the 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 control valves 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 control valve (10) is moved to the right and permits oil under pressure to pass to the annular 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 lever shaft. Oil at the right side of the cylinder is pressed by the piston via the annular groove (19)

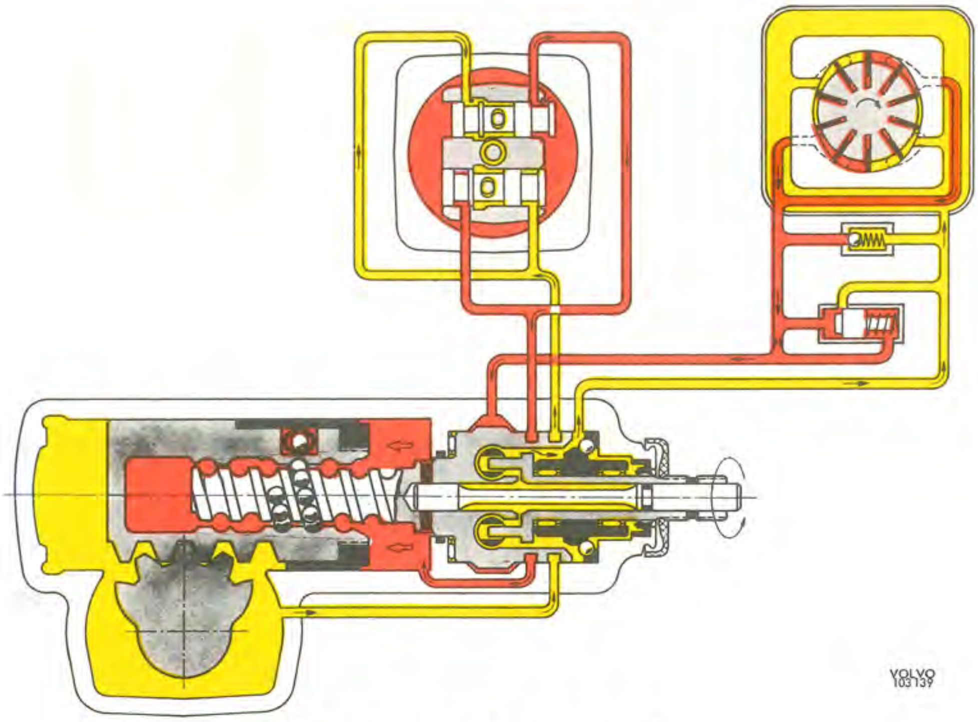


Fig. 6-40. Principle of function, left-hand turn

through the return groove (6) of the control valve (10) back to the oil container (13).

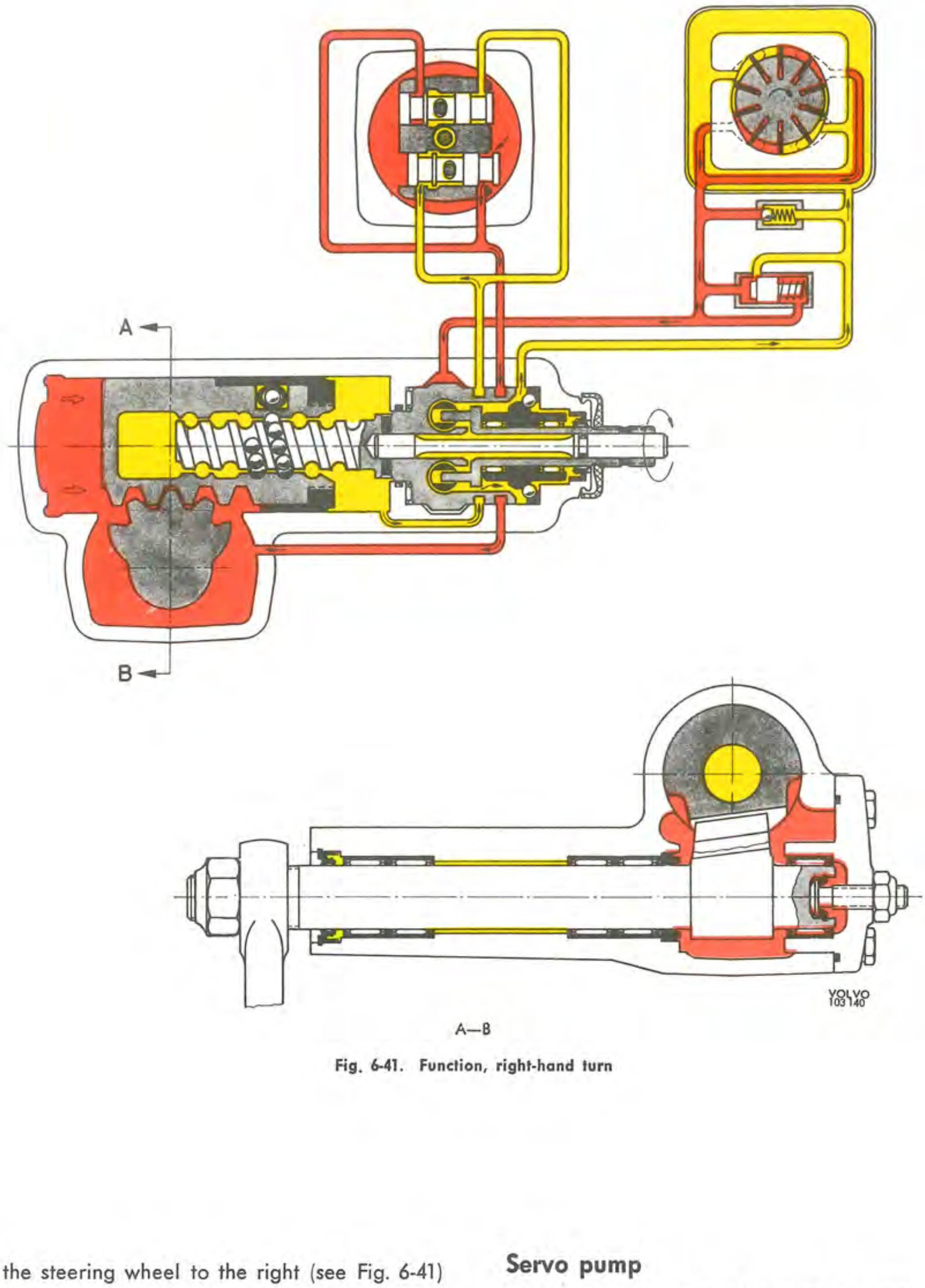
Oil is conveyed under pressure from the pump into an annular chamber round the valve housing (the large circle in the cross-section). In the neutral position (Fig. 6-39) the valves (9 and 10) are so adjusted that oil can pass the intake ports (8 and 11) and flow on to the annular grooves (18 and 19) in the valve housing. From here the oil is led partly to both sides of the piston (2) through the channels (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 control valves. 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 control spindle (16) and the torsion rod (17) to the steering cam (15), 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 steering cam and thus influence the valves placed in the cam. The greater the turning movement, the greater will be the valve displacement. One of the control valves (9) is then displaced to the right and opens the intake port (8) wider, while at the same time the other control valve (10) is displaced to the left and closes the intake port (11). The delivery line of the control valve (9) is linked with the annular groove (19) in the valve housing. This also applies to the return groove (6) of the control valve (10). The delivery line of the control valve (10) is connected to the annular groove (18) and to the return groove (7) for the control valve (9).

Under such conditions, oil under pressure flows in through the intake port (8) to the annular 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 annular 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.



A—B

Fig. 6-41. Function, right-hand turn

Turning the steering wheel to the right (see Fig. 6-41) will screw the piston (2) to the right on the figure. The control valve (10) is displaced to the right and permits oil under pressure to pass to the annular 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 annular groove (19) through the return groove (6) of the control valve (10) back to the oil container (13).

Servo pump

The servo 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

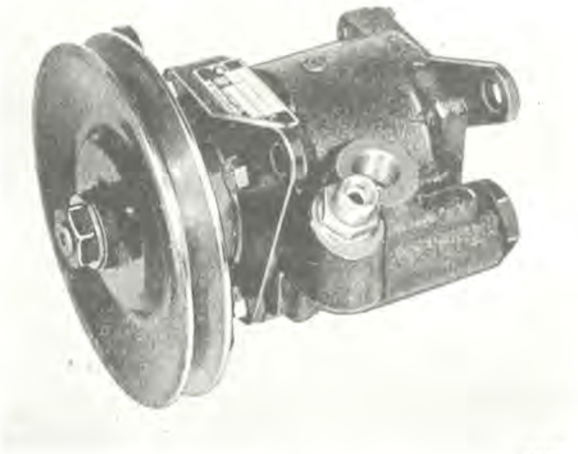


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Fig. 6-42. Servo pump

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

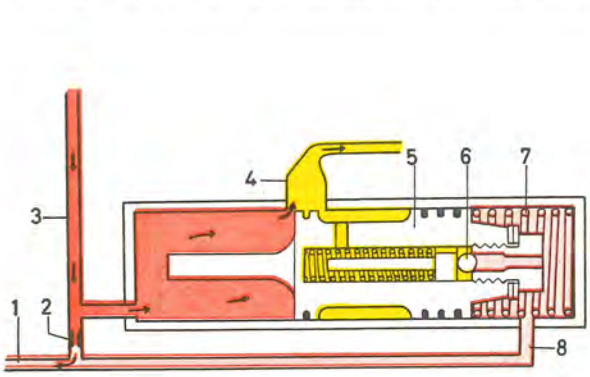

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Fig. 6-43. Control valve, normal position

1. Delivery line
2. Check valve
3. Delivery channel
4. Return channel
5. Control valve
6. Safety valve
7. Spring
8. Link channel

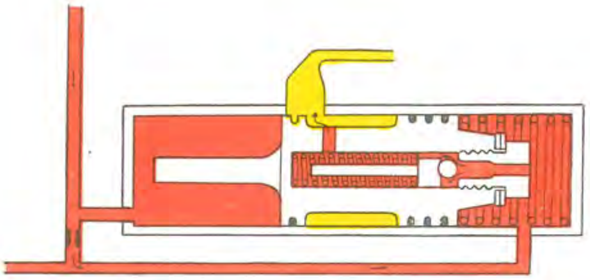

Fig. 6-44. Control valve, maximum pressure

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(2) out into the delivery line (1) and from there to the steering box. 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 p.s.i.) 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.

REPLACING STEERING WHEEL

REMOVING

1. Unscrew the attaching screw for the upper part of the directional indicator switch housing and lift off the housing.
2. Bend loose the impact protection (4, Fig. 6-45). Disconnect the horn cable (3). Unscrew the attaching screws (2) and lift forward the horn ring (1). Take care of springs and washers.
3. Remove the steering wheel nut.
4. Set the wheels straight forwards. Fit steering wheel puller SVO 2972 as shown in Fig. 6-49 and pull off the steering wheel.
5. Remove the flange for the directional indicator switch.

INSTALLING

1. Make sure that the wheels are pointing straight forwards.
2. Fit the flange onto the steering wheel. Place the steering wheel in position and tighten the steering wheel nut to a torque of 3—4 kpm (20—30 lbft).
3. Fit the horn ring with springs. Wire up the horn cable. Check that the horn functions.
4. Fit the upper part of the directional indicator switch housing.

STEERING COLUMN JOURNALLING

The upper bearing can be replaced separately. If the lower bearing is damaged, the steering column shaft must be replaced complete.

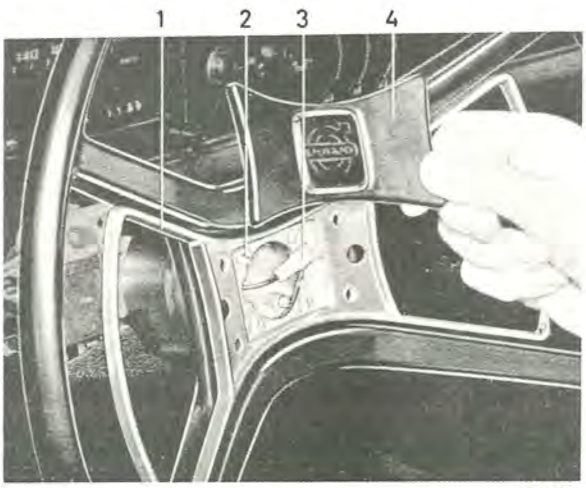

Fig. 6-45. Horn components

1. Horn ring
2. Attaching screw
3. Horn cable
4. Impact protection

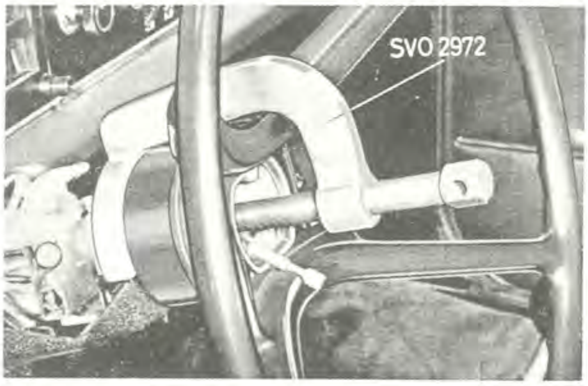

Fig. 6-46. Removing steering wheel

Replacing upper bearing

1. Remove the steering wheel, see under "Replacing steering wheel". Remove the lower 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. Disconnect the ground cable from the battery. Remove the screws between the lower steering column section and rubber coupling.
2. Remove the steering wheel, see under "Replacing steering wheel". Take off the lower part of the directional indicator switch housing.
3. Remove the directional indicator switch and attachment as well as the starter contact. Let the switch and contact remain hanging to the electric cables.
4. Remove the panel under the dash.
5. Remove the lower steering column attachment.
6. Remove the screws in the upper steering column attachment. Use a drill and screw extractor or polygrip pliers. Screw diameter 8 mm (3/16").
7. Pull forward the steering column complete with jacket and bearing. If the steering wheel lock has to be moved over to the new journalling, remove the screws with drill and screw extractor or polygrip pliers.

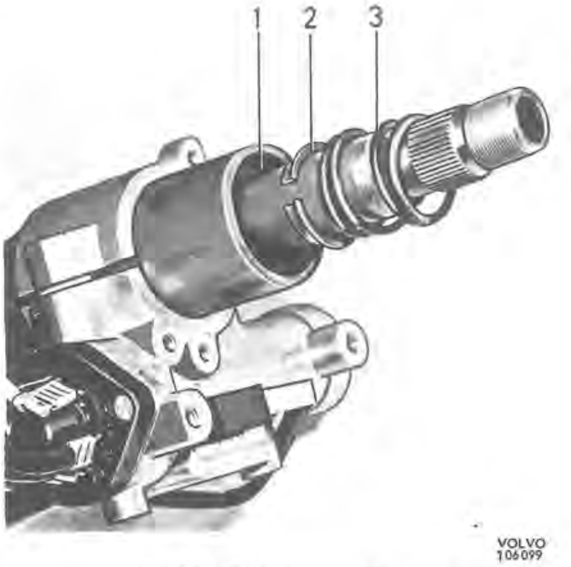

Fig. 6-47. Replacing upper bearing
1. Bearing 2. Seal 3. Spring

INSTALLING

1. Place the steering column with jacket in position. Place the rubber seal on the jacket.
2. Fit the lower steering column section to the rubber coupling.
3. Fit but do not tighten the upper and lower steering column jacket attachments and also the steering wheel lock.
4. Fit the starter contact and the directional indicator switch.
5. Make sure that the front wheels point straight forwards. Fit the steering wheel. Tightening torque is 3—4 kpm (20—30 lbft).
6. Fit the lower part of the directional indicator switch housing. Adjust the location of the steering column tube so that the distance between the dash and the directional indicator switch housing is correct.
7. Fit the horn components and test their function as well as the function of the steering wheel lock. Then tighten the upper and lower steering column tube attachments and also the shear-off bolts for the steering wheel lock.
8. Fit the rubber seal to the dash and also the other components.

Steering wheel lock

With damage to the steering column jacket or locking lug on the steering column, replace the steering column complete. The following instructions apply for changing the steering wheel lock.

1. Disconnect the ground battery lead.
2. Remove the steering wheel, see under "Replacing steering wheel". Take off the lower part of the directional indicator switch housing.
3. Remove the directional indicator switch with attachment. Disconnect the starter contact from the steering wheel lock. Allow the directional indicator switch and starter contact to remain hanging to their cables.
4. Make line-up marks for the location of the steering wheel lock on the steering column jacket. Remove the shear-off bolts for the cover with the help of hammer and punch. If necessary, use an angle drill and bolt extractor or polygrip pliers. Bolt diameter 8 mm (3/16").
5. Place the steering wheel lock in position but do not tighten the bolts.
6. Fit the starter contact and directional indicator switch.
7. Set the wheels straight forwards and fit the steering wheel. Tightening torque 3—4 kpm (20—30 lbft).
8. Fit the horn components and re-connect the battery lead. Test all functions. Then shear-off the shear-off bolts.
9. Fit the other parts.

STEERING RODS AND TIE ROD

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 SVO 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.

When the ball joint is fitted to the steering knuckle, turn the ball pin so that the split pin hole is transverse to the longitudinal direction of the steering rod. Lock the ball joint with the split pin.

After having reconditioned the rods and ball joints, the toe-in should always be checked.

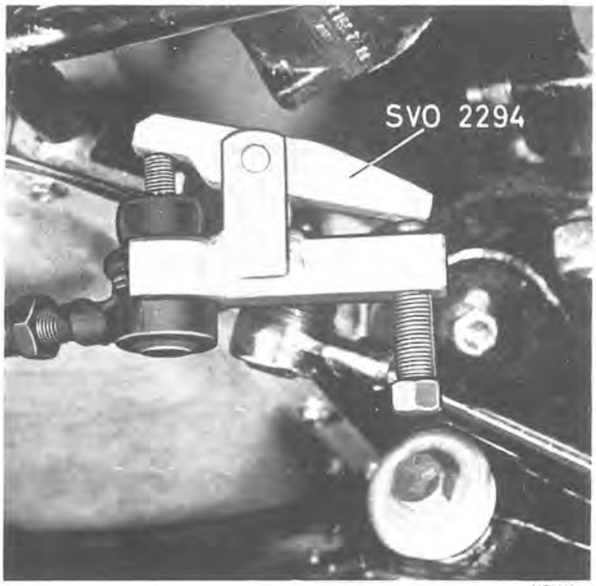

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Fig. 6-48. Removing ball joint

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 SVO 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 SVO 2699 in a vice and press the bush out with a counterhold SVO 2736 and drift SVO 2734 (see Fig. 6-49).
5. Turn the relay arm and press in the new bush with tools SVO 2699 + SVO 2736 and drift SVO 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 7.0—8.5 kpm (50—60 lb.ft.).
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 3.5—4.1 kpm (25—30 lb.ft.).

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 SVO 2294, see Fig. 6-48.
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.

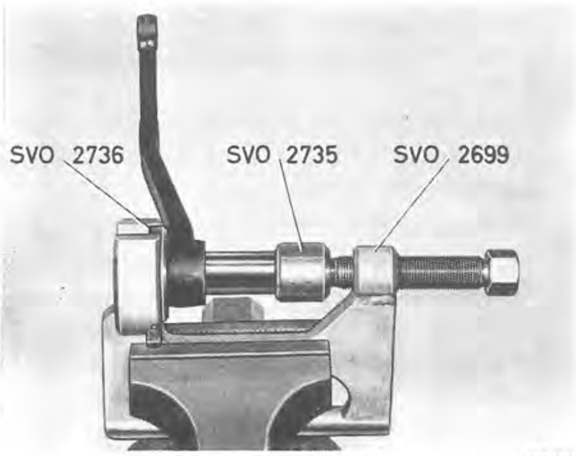

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Fig. 6-50. Installing rubber bush, relay arm

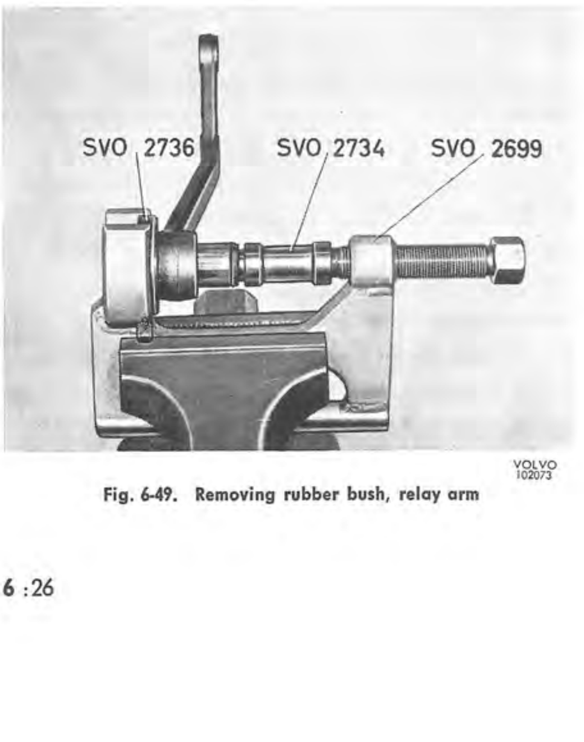

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Fig. 6-49. Removing rubber bush, relay arm

SERVO STEERING

Work on servo steering in vehicle

NOTE: The utmost cleanliness should be observed for all work on the servo 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 servo 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 (¼") 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 (¼") above the level mark.

DRAINING OIL

With the servo steering pump complete, oil is drained off as follows:

Jack up the front end. Screw out the draining 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 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) 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 (1/4") above the level mark. If it rises further than this, there must be air still in the system, in which case continue venting.
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.

Fig. 6-51. Oil level

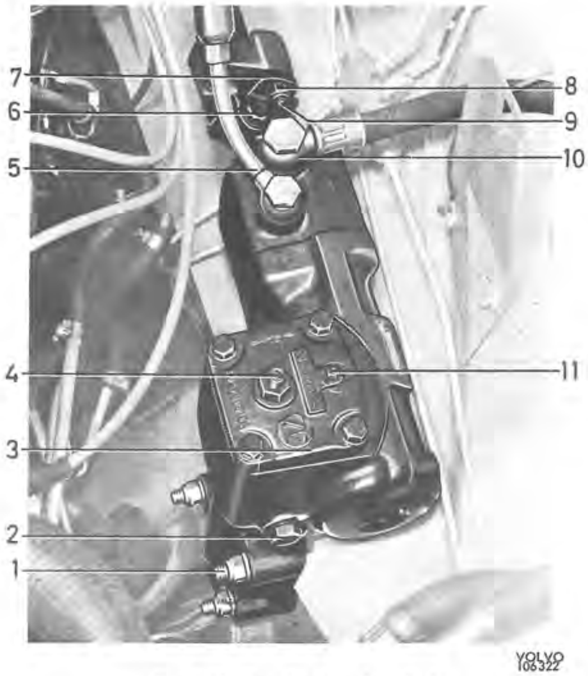

Fig. 6-52. Steering box installed

1. Bolt
2. Drain plug
3. Steering box
4. Adjusting screw
5. Delivery line (early prod.)
6. Clamping bolt
7. Flange
8. Nut
9. Screw
10. Return line
11. Bleeder screw

INSPECTING SERVO 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.

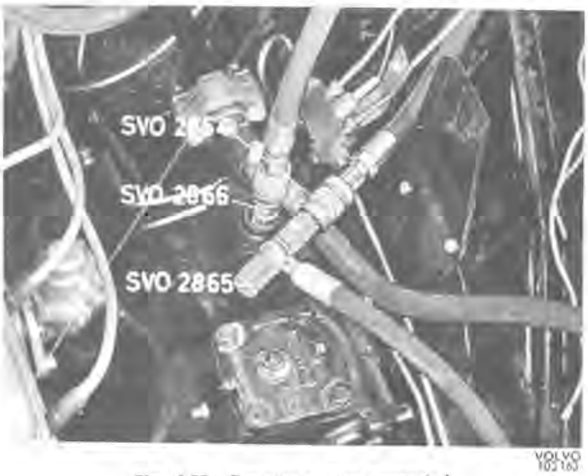

Fig. 6-53. Pressure gauge connected

II. Checking oil level and bleeding

1. Connect the test instrument SVO 2864 to the delivery line at the steering box, see Fig. 6-53. The inlet hose of the instrument is connected to the banjo nipple with tool SVO 2865 (Fig. 6-53) and the outlet hose to the steering box with tool SVO 2866. 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 box and pump

1. Run the engine warm.
2. **Pump testing:** With the engine idling, move the operating lever of the instrument briefly (max. 10 seconds) to the closed position. Read off the max. pressure on the pressure-gauge. This should be maximum 10 % below the indicated maximum pressure of the pump, that is, at least 67 kp/cm^2 (953 p.s.i.). 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 box 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 10 kp (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 box 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 servo 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 box 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 box and flanges concerning play. Re-tighten attaching bolts and replace damaged or worn components.
2. Adjust the pressure point between the piston of the steering box and pitman arm shaft as follows:
   a) Remove the locknut for the pitman arm. Pull the pitman arm off with tool SVO 2849. When fitting the puller, turn the wheels fully to the right, see Fig. 6-57.
   b) Place the steering box in the middle position (count the number of steering wheel turns).

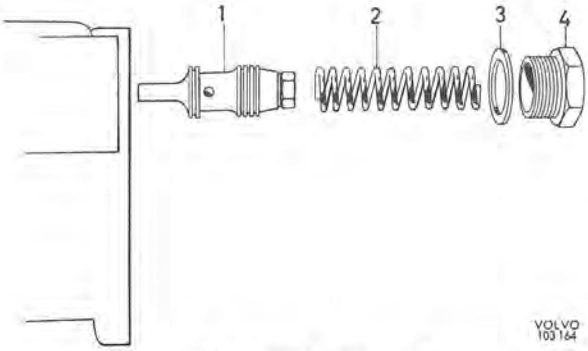

Fig. 6-54. Removing control valve

1. Piston 2. Spring 3. Gasket 4. Plug

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 box in the centre position. Tighten the nut to a torque of (17.5—20 kpm (125—145 lb.ft.).

V. Test driving

If the servo steering is only normally worn and is not damaged or overloaded, the steering should function satisfactorily during the test driving, that is, the hydraulic servo 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 SVO 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.

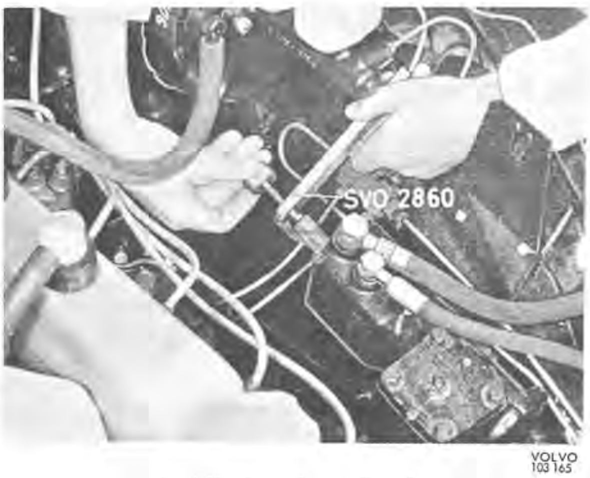

Fig. 6-55. Removing sealing ring

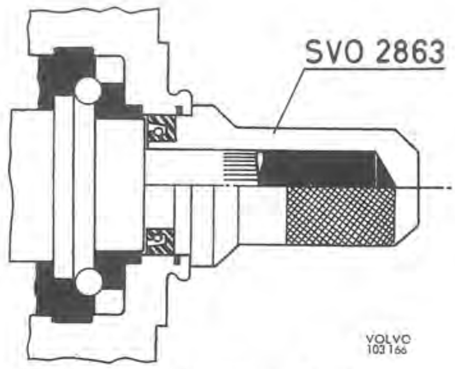

Fig. 6-56. Installing sealing ring

5. Fill the space between the new sealing ring lips with multipurpose grease. Fit the sealing ring on to installation tool SVO 2863 with the help of the loose guide. Remove the guide and fit the sealing ring in the steering box, 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 box housing and the lower flange is 7±5 mm (0.28± 0.20").

   Assemble the other parts.

Replacing steering box

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 SVO 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 box after the connections have been cleaned. Slacken the clamping bolt (6).
5. Remove the attaching bolts (1) and pull the steering box forwards.

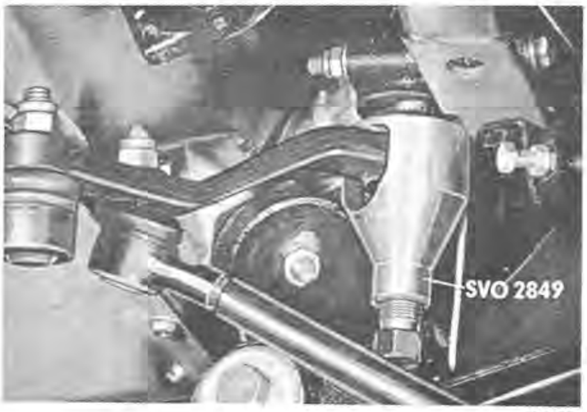

Fig. 6-57. Removing pitman arm

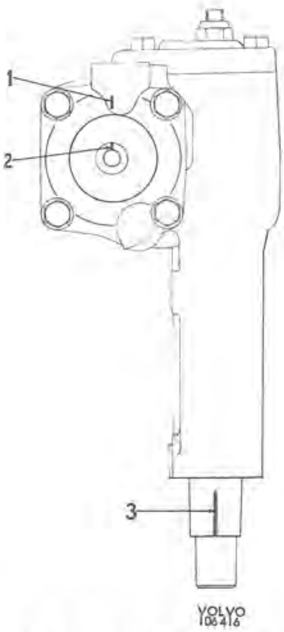

Fig. 6-58. Steering box in middle position

INSTALLING

1. Place the steering box 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 control spindle and housing should coincide.
2. Check to make sure that the steering wheel is pointing the front wheels straight forwards.
3. Fit the steering box 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 box housing and the lower flange is 7±5 mm (0.28±0.20"). Connect 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 forwards and fit the pitman arm. Tighten the nut to a torque of 17.5—20 kpm (125—141 lb.ft.).
5. Fill with oil and bleed, see under the heading "Oil filling and bleeding".

Replacing servo pump

REMOVING

1. Clean round the connections (5 and 6, Fig. 6-59).
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.

INSTALLING

Concerning replacement of pump, supplement the new pump with brackets, pulley and other parts, see Fig. 6-59. When fitting 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. 6-59. 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".

Replacing oil filter

When changing the oil, which is normally done only in connection with replacement of the servo 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.

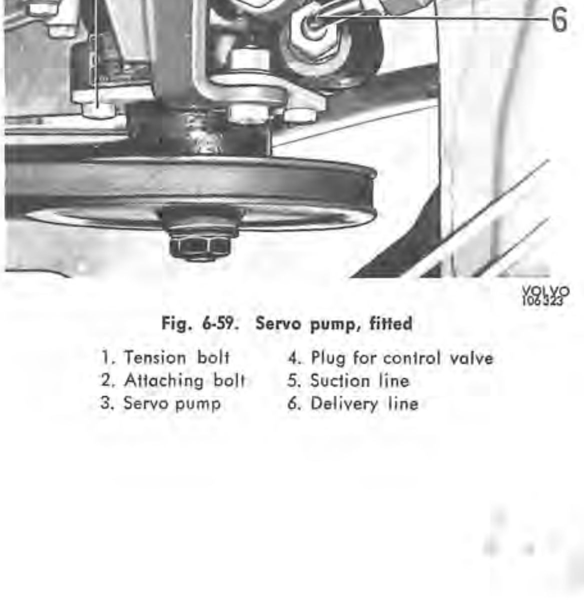

Fig. 6-59. Servo pump, fitted

1. Tension bolt	4. Plug for control valve
2. Attaching bolt	5. Suction line
3. Servo pump	6. Delivery line

Part 7

SPRINGS, SHOCK ABSORBERS, WHEELS

CONTENTS

GROUP 70

GENERAL

TOOLS

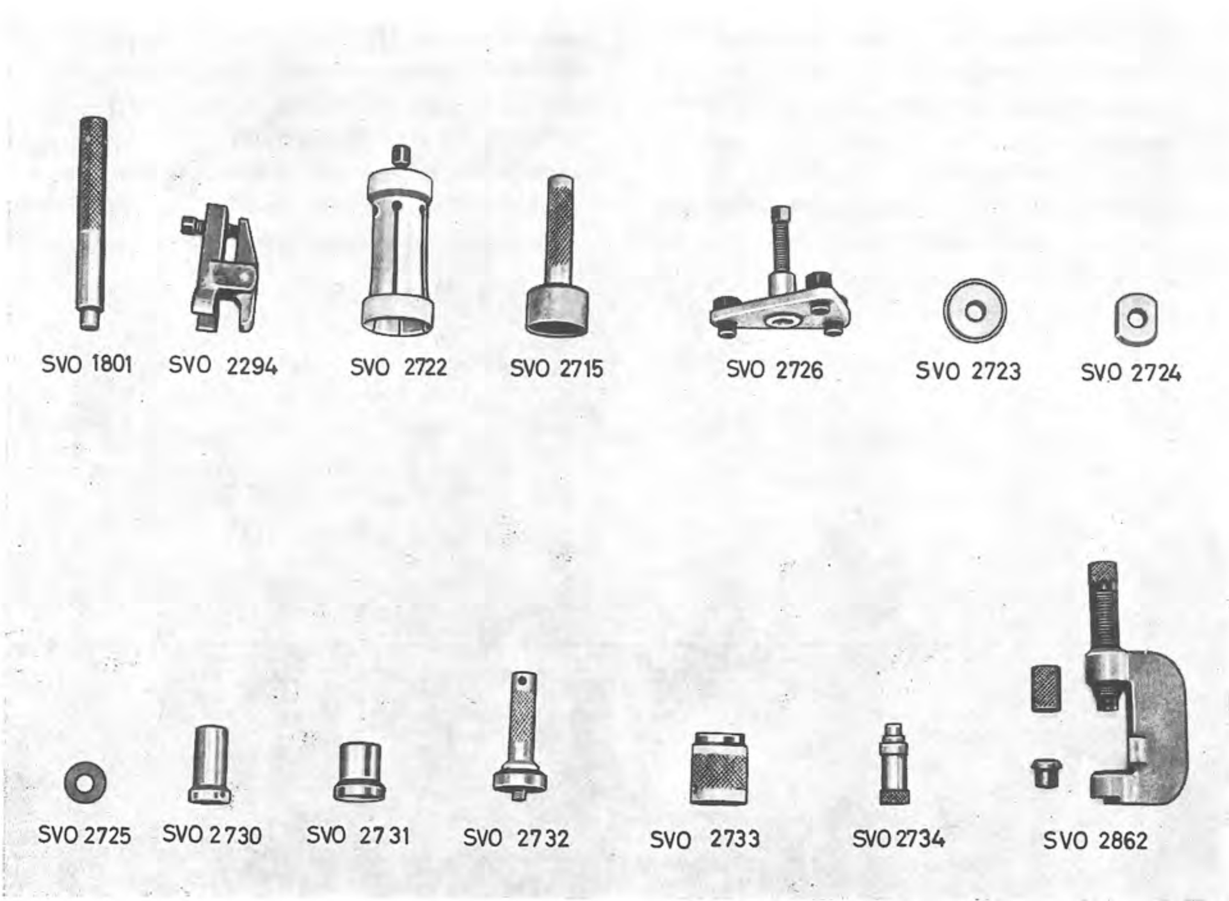

Fig. 7-1. Tools used for work on rear axle suspension and hub

SVO 1801 Standard handle 18×200 mm.
SVO 2294 Puller for ball joint, steering rod.
SVO 2715 Drift for removing and fitting grease cap.
SVO 2722 Puller for inner ring, inner wheel bearing.
SVO 2723 Drift for fitting outer ring, inner front wheel bearing and seal.
SVO 2724 Drift for fitting outer ring, outer front wheel bearing, and removing outer ring, inner wheel bearing.
SVO 2725 Drift for removing outer ring, outer front wheel bearing.
SVO 2726 Puller for front wheel hub.
SVO 2730 Drift for removing and fitting small bush, track bar and rear bush in support arm (+ SVO 2733).
SVO 2731 Drift for removing and fitting large bush, track bar (+ SVO 2733).
SVO 2732 Drift for removing and fitting front bush, support arm.
SVO 2733 Counterhold for removing and fitting bush, support arm, support stay and track bar.
SVO 2734 Drift for removing bush in support stay.
SVO 2862 Press tool for replacing wheel bolt.

The designation SVO before the tool number is to be replaced by the number 999. This applies also to new production of older tools.

GROUP 73

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 upper ends of the rear springs (5, Fig. 7-5) are bolted to the rear side-members (8) and at the lower ends to the support arms (15) behind the rear axle. Rubber buffers (4) fitted on the rear side-members take up any impacts from loading on the springs.

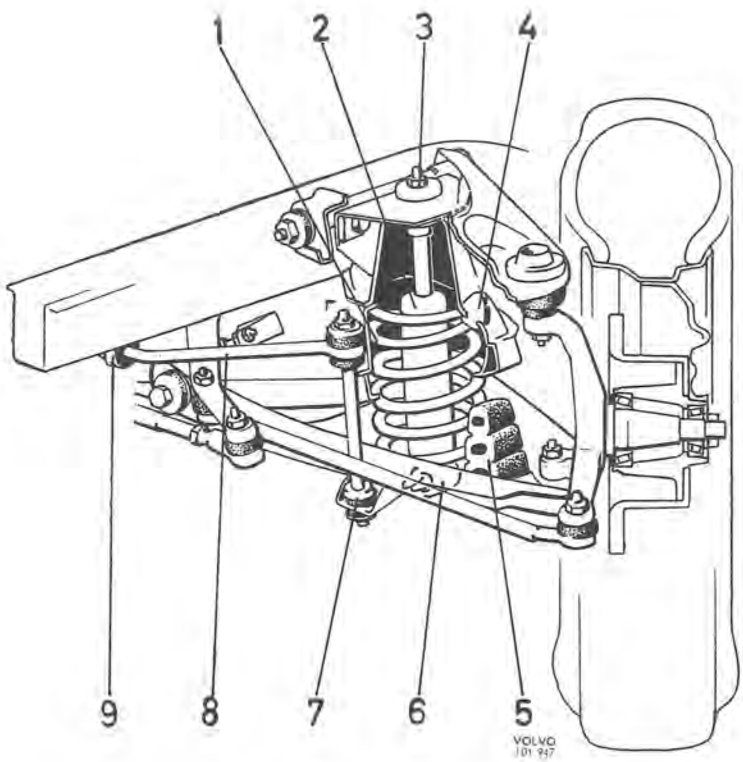

Fig. 7-2. Front spring and shock absorber

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

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. 7-7) 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. 7-4. 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. 7-5) for the shock absorber. Lower the jack carefully and remove the spring.

INSTALLING

1. Install the upper screw and the washer inside the spring as well as the rubber spacer (11) and the washer (10) and then firmly secure the spring to the upper attachment.
2. Raise the jack and securely fix the spring to the lower attachment with the washer (14) and the screw (13).
3. Install the upper shock absorber screw, the wheel and the wheel nuts.
4. Lower the vehicle and tighten the wheel nuts. Install the hub cap.

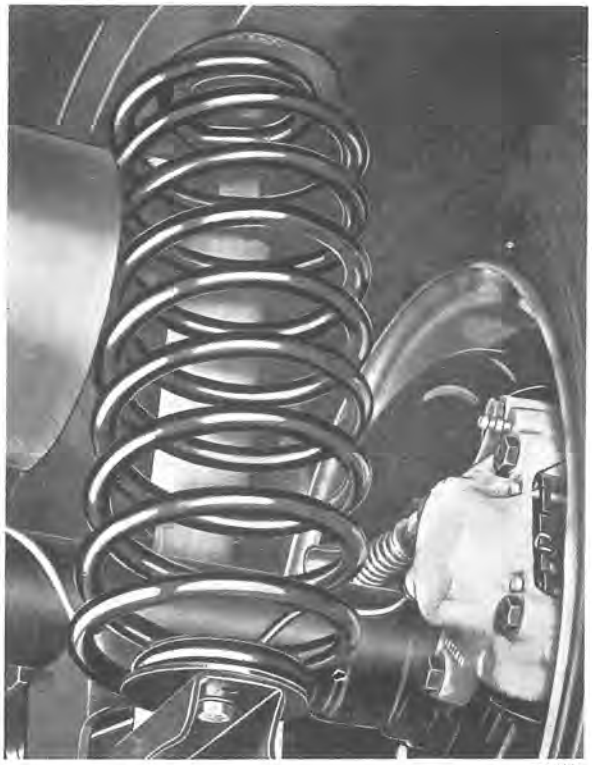

Fig. 7-3. Rear spring

Fig. 7-4. Location of axle prop for propping up vehicle rear end

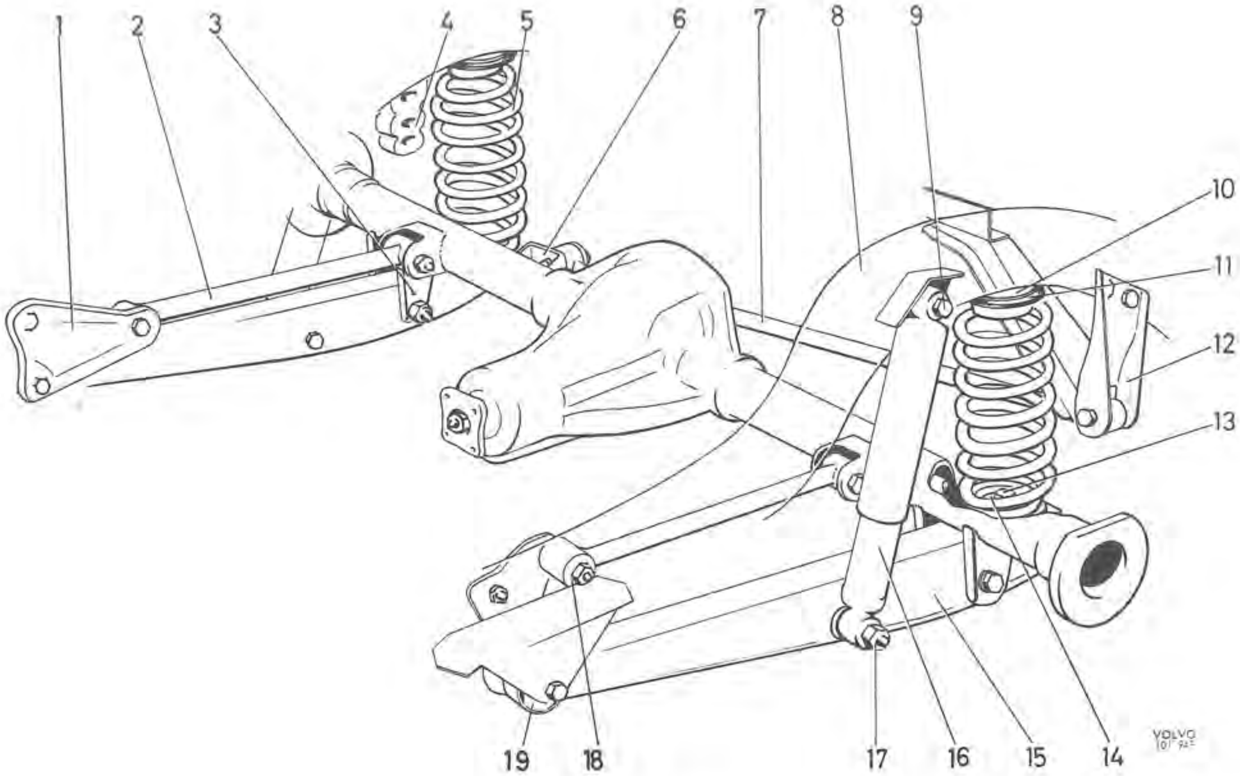

Fig. 7-5. Rear axle suspension

1. Bracket
2. Support stay
3. Bracket
4. Rubber buffer
5. Rear spring
6. Bracket
7. Track bar
8. Rear side-member
9. Upper shock absorber attachment
10. Washer
11. Rubber spacer
12. Bracket
13. Screw lower spring attachment
14. Washer
15. Support arm
16. Shock absorber
17. Lower shock absorber attachment
18. Front support stay attachment
19. Front bush, support arm

SHOCK ABSORBERS AND STABILIZING DEVICES

DESCRIPTION

GENERAL

The 164 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. 7-7) consists of a spindle (5), which with upper bushes (1 and 6), washers (3 och 7) and a spacing sleeve, are fixed into a housing in the front axle member.

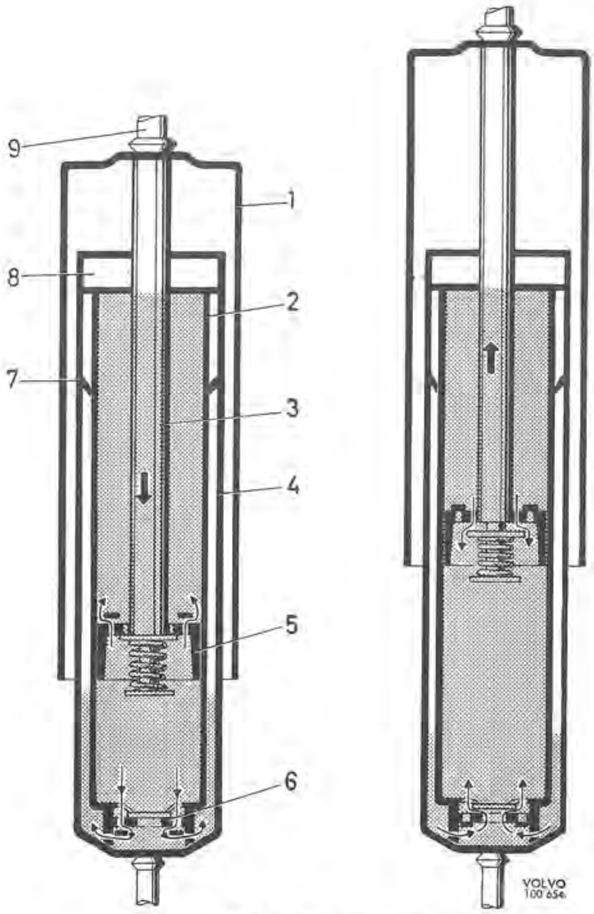

Fig. 7-6. Shock absorber, function

1. Dust cover
2. Working cylinder
3. Piston rod
4. Reservoir cylinder
5. Piston
6. Valve
7. Baffle ring
8. Cover
9. Upper attachment

The lower attachment (Fig. 7-8) 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. 7-9) 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. 7-5). 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.

SHOCK ABSORBERS

DESIGN

The design of the shock absorbers is shown in Fig. 7-6. 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.

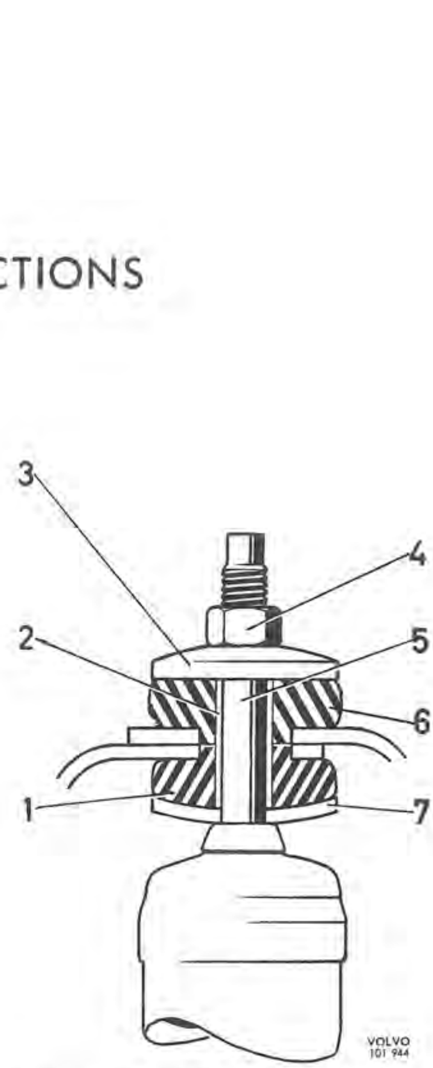

Fig. 7-7. Upper attachment, front shock absorber

1. Rubber bush
2. Spacing sleeve
3. Washer
4. Nut
5. Spindle
6. Rubber bush
7. Washer

REPLACING FRONT SHOCK ABSORBERS

1. Remove the upper nut (4, Fig. 7-7), the washer (3) and the rubber bush (6).
2. Remove the two lower attaching screws (Fig. 7-8)

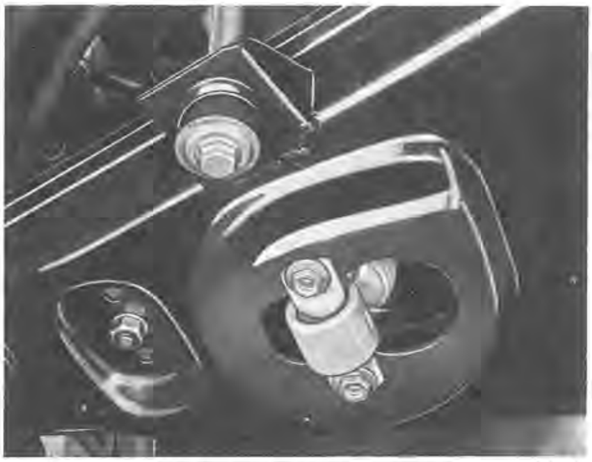

Fig. 7-8. Lower attachment, front shock absorber VOLVO 101 967

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).
4. Pull apart the shock absorber and then fit it. Fit and tighten the lower screws.

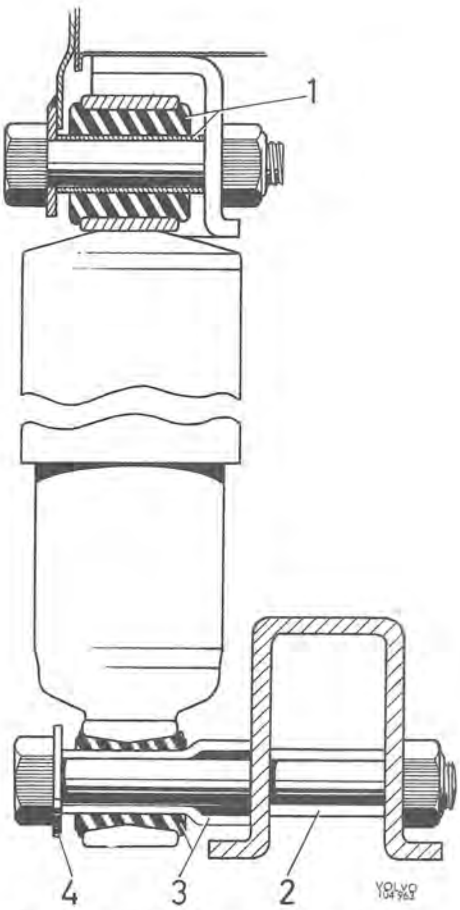

Fig. 7-9. Attachments, rear shock absorber

1. Bush
2. Spacing sleeve
3. Bush
4. Washer

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. 7-4. Remove the wheel. Unscrew and remove the shock absorber.
2. When fitting make sure that the spacing sleeve in the support arm has not been removed (2, Fig. 7-9). Fit and tighten the shock absorber. Fit the wheel and wheel nuts. Lower the vehicle. Put on the hub cap.

REPLACING BUSHES FOR SUPPORT ARM

1. Raise the vehicle by placing props in front of the rear jack attachments according to Fig. 7-4. 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. 7-5). Remove the front screw and take off the support arm.
4. Press out the front bush with tool SVO 2732. Coat the new bush with **oil** and press it in with the same tool according to Fig. 7-10. Make sure that the plane sides of the bush are at right angles to the support arm shaft (Fig. 7-10).
5. Press out the rear bush with tool SVO 2730 and tool SVO 2733.
   Press in the new bush with the same tools, using tool SVO 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 screw for the lower shock absorber attachment.
   N. B. Check that the spacing sleeve and washers are placed correctly, see Fig. 7-9. Remove the props from under the vehicle and lower it.

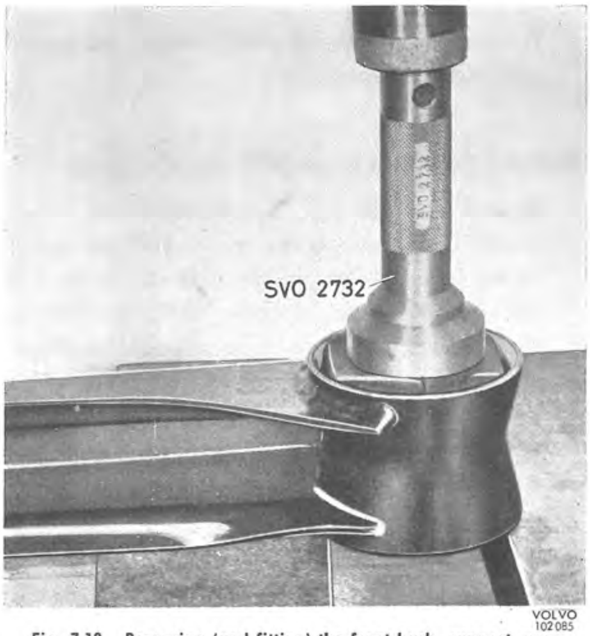

Fig. 7-10. Removing (and fitting) the front bush, support arm

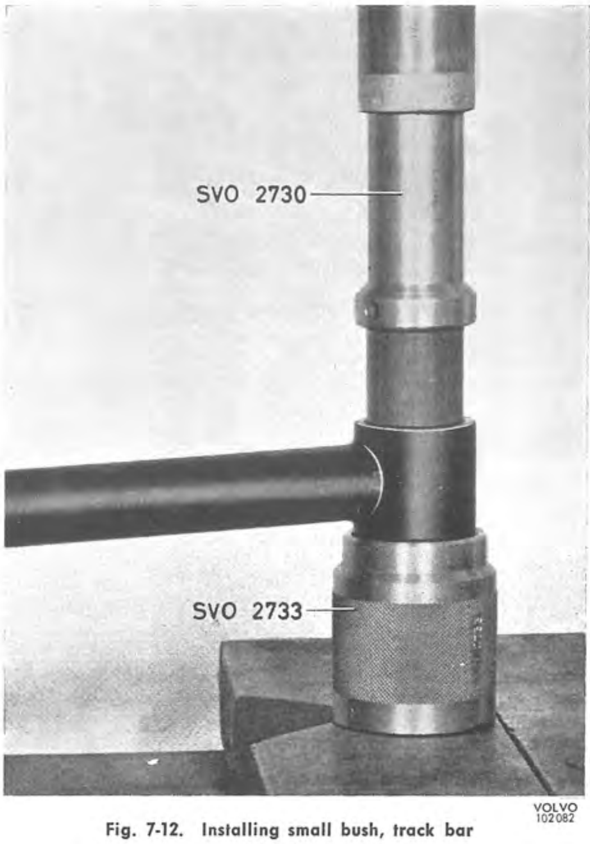

Fig. 7-12. Installing small bush, track bar

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. 7-4.
2. Remove the nuts at both brackets (6 and 12, Fig. 7-5). 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 and make sure that the bar is not bent.
4. If necessary, press out the small bushes with SVO 2730 using SVO 2733 as a counterhold. (Fig. 7-13). Pressing in the bushes can be done with the same tools only in this case SVO 2730 is reversed (Fig. 7-14).
5. The large bushes are pressed out with SVO 2731, and SVO 2733 as a counterhold (Fig. 7-11). When pressing in the bushes, SVO 2731 is reversed (Fig. 7-12).
6. Fit the bar with the screw to the frame bracket (12).
7. Place the other end on the rear axle bracket (6) and fit both washer and nut. Screw on the frame bracket nut.
8. Remove the blocks and lower the vehicle.

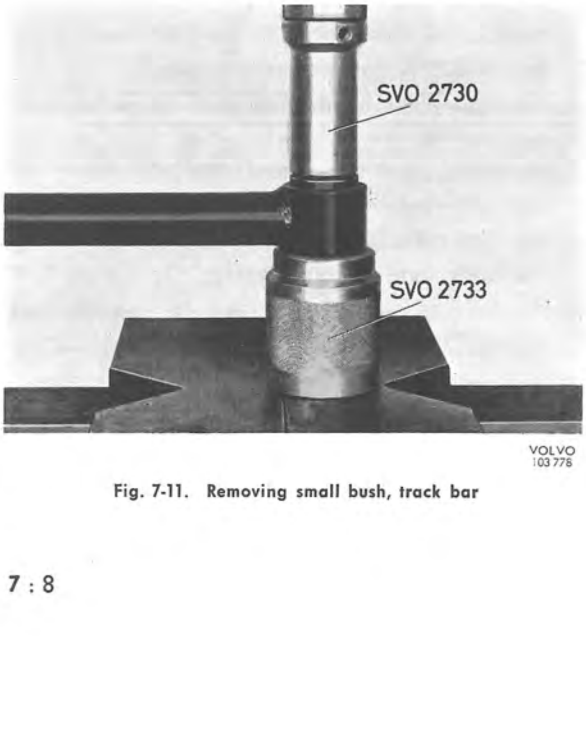

Fig. 7-11. Removing small bush, track bar

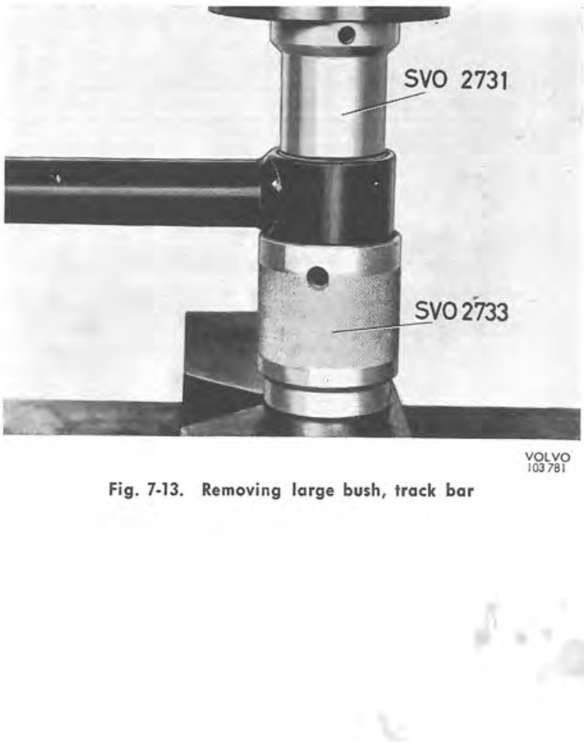

Fig. 7-13. Removing large bush, track bar

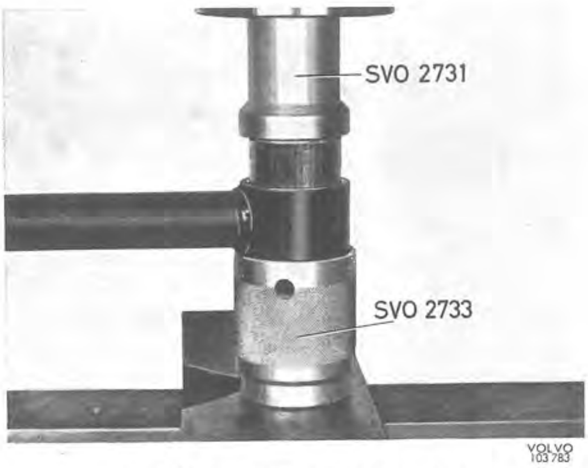

Fig. 7-14. Installing large bush, track bar

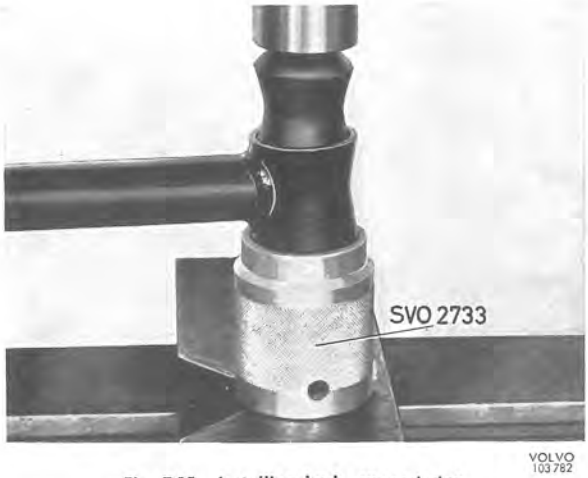

Fig. 7-15. Installing bush, support stay

REPLACING BUSHES FOR SUPPORT STAY

The bushes of the support stay are pressed out with tool SVO 2734 and counterhold SVO 2733. They are suitably pressed in with a drift press directly on the bush and with tool SVO 2733 as a counterhold (see Fig. 7-15). Before pressing in the rubber bush, coat it with oil so that it slides easily in 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. 7-16.

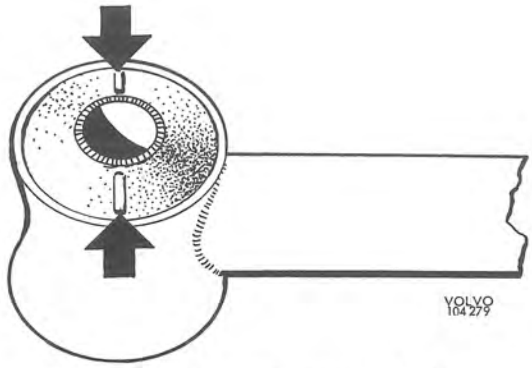

Fig. 7-16. Marking-up support stay bush

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 SVO 2862, without the accessory components, as shown in Fig. 7-17. 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. 7-18) and use a nut runner to screw in the stud completely.

N. B. When replacing a wheel stud, always use a new, oversize stud. The oversize stud can be fitted without previously machining the hole.

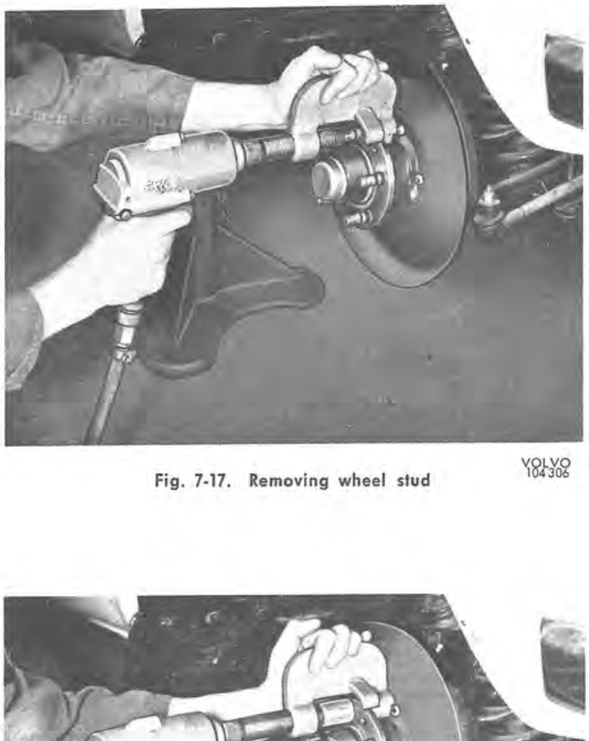

Fig. 7-17. Removing wheel stud VOLVO 104306

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 the front wheel brake unit".
4. Remove the grease cap with tool SVO 2715 (Fig. 7-19). Remove the split pin and castle nut. Pull off

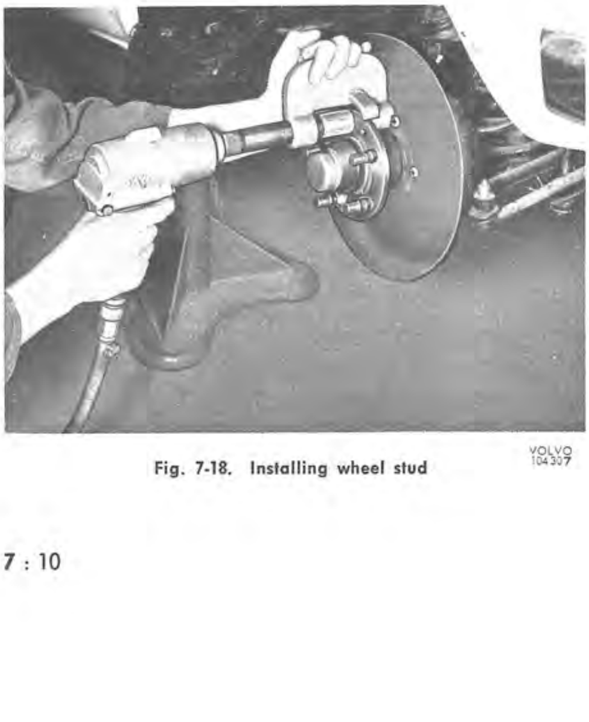

Fig. 7-18. Installing wheel stud VOLVO 104307

Fig. 7-19. Removing grease cap VOLVO 106366

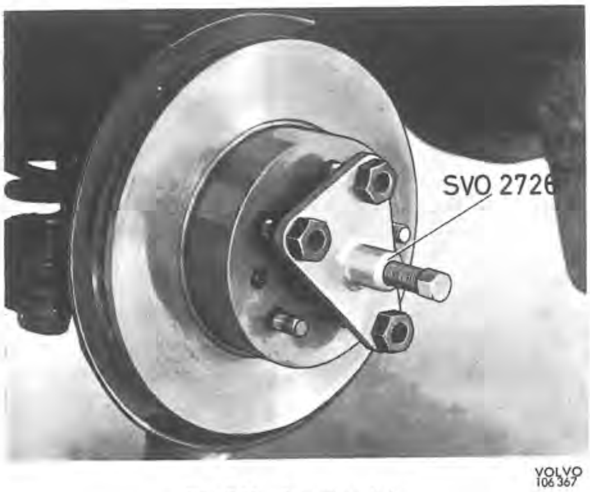

Fig. 7-20. Removing hub

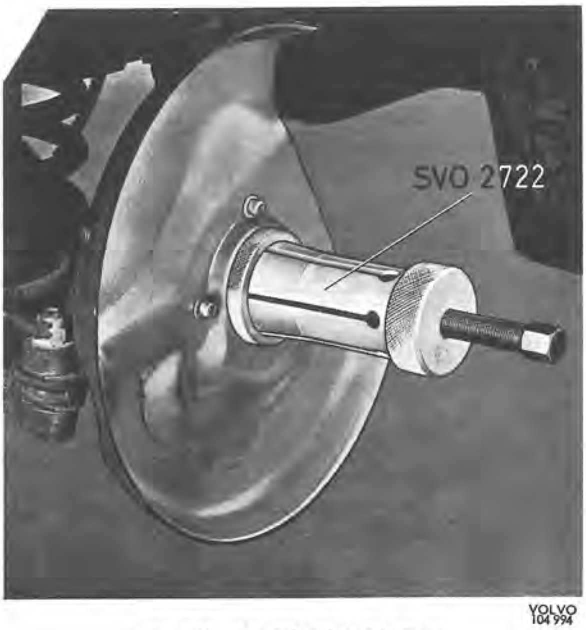

Fig. 7-21. Removing inner bearing

the hub with puller SVO 2726 (see Fig. 7-20). Pull off the inner bearing from the stub axle with puller SVO 2722 (see Fig. 7-21) if the bearing remains in place.

5. Remove the bearing rings. Use drift SVO 2724 (Fig. 7-22) for the inner bearing ring and drift SVO 2725 (Fig. 7-23) for the outer bearing ring together with standard handle SVO 1801.
6. Clean the hub, brake disc and grease cap.
7. Press in the new bearing rings. In addition to using standard handle SVO 1801, use drift SVO 2723 (Fig. 7-24) for the inner ring, and drift SVO 2724 (Fig. 7-25) 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. 7-27.
   Use a high-class bearing grease for the bearing. Place the inner bearing in position in the hub. Press in the seal with drift SVO 2723 and standard handle SVO 1801, see Fig. 7-26.
   The felt ring should be well coated with, for example, light engine oil.
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

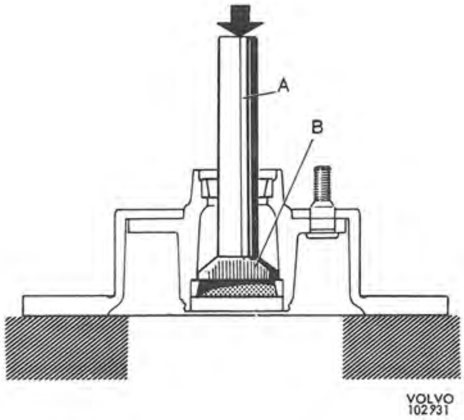

Fig. 7-22. Removing inner bearing ring

A = SVO 1801 B = SVO 2724

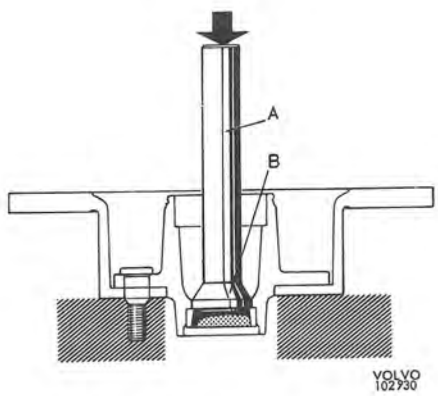

Fig. 7-23. Removing outer bearing ring

A = SVO 1801 B = SVO 2725

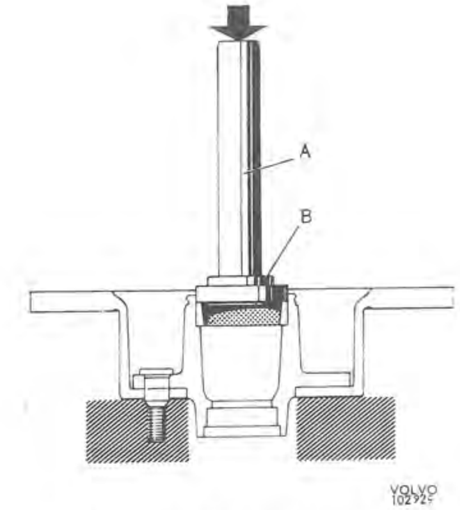

Fig. 7-24. Installing inner bearing ring
A = SVO 1801 B = SVO 2723

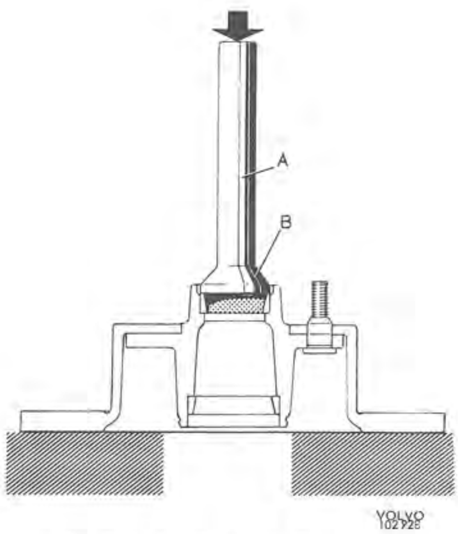

Fig. 7-25. Installing outer bearing ring
A = SVO 1801 B = SVO 2724

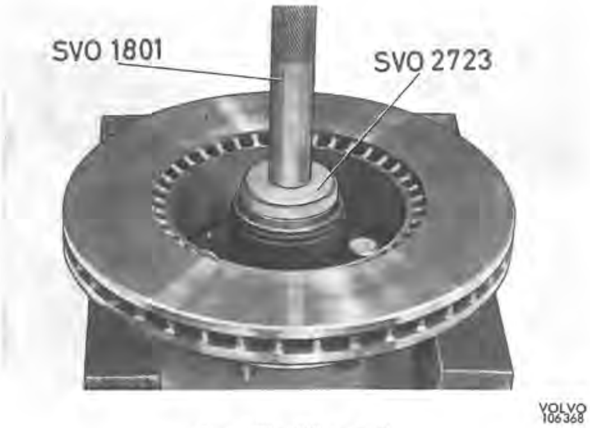

Fig. 7-26. Fitting seal

of 7 kpm (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 SVO 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 10—14 kpm (70—100 lbft). Install the hub cap.

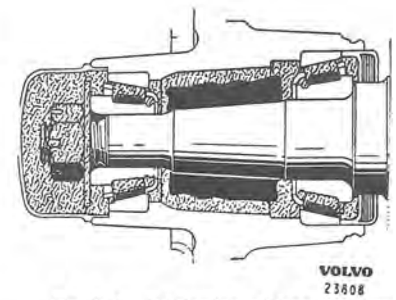

Fig. 7-27. Lubrication of front bearing

Part 8

BODY

CONTENTS

TOOLS

The designation SVO before the tool number is to be replaced by the number 999. This applies also to new production of older tools.

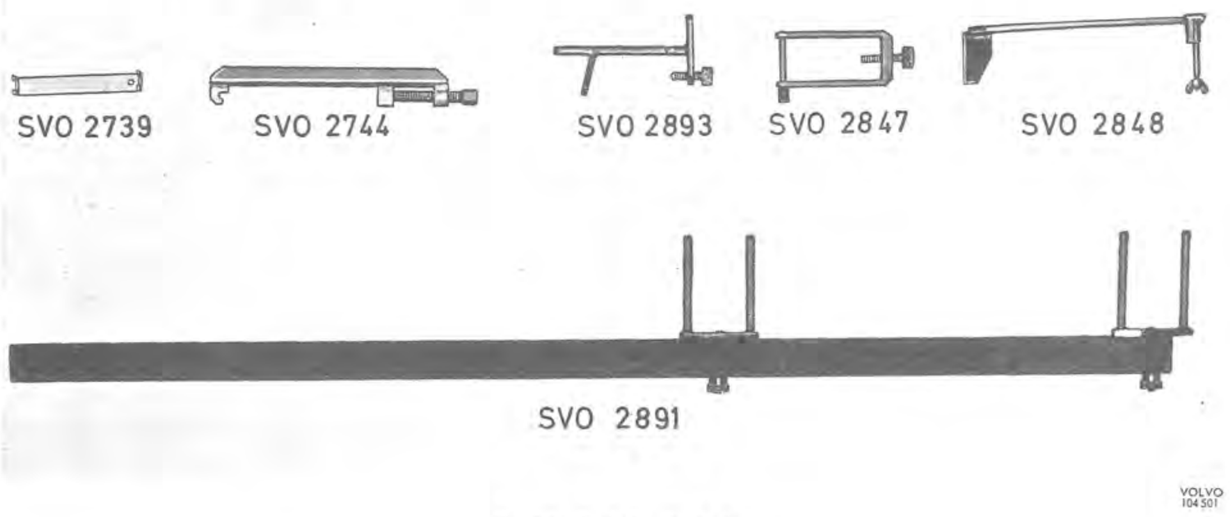

Fig. 8-1. Tools for the body

SVO 2739 Clamp for gas spring, trunk lid
SVO 2744 Press tool for gas spring, trunk lid
SVO 2847 Holder for securing fixture SVO 2777 (2 are used)
SVO 2848 Arm for measuring height of side-member
SVO 2891 Rule for measuring height of side-member
SVO 2893 Holder for fixing measuring rule

Fig. 8-2. SVO 2777 Fixture for replacing side-members

Fig. 8-3. SVO 2899 Fixture for fitting windshield

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, luggage compartment lid and hood.
The floor and frame section (Fig. 8-4) consist 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. There is a flanged hole in the rear floor plate for mounting the fuel tank, the upper port of which forms part of the floor in the trunk. 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 joined 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, windscreen 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. 8-5) consists of a number of pressed steel plates. These roof plates form the upper part of the scuttle, the windscreen 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 SVO 2777. The rear guide pins (7, Fig. 8-6) fit in the holes in the floor plating and are held in position by clamps (8). At the front the

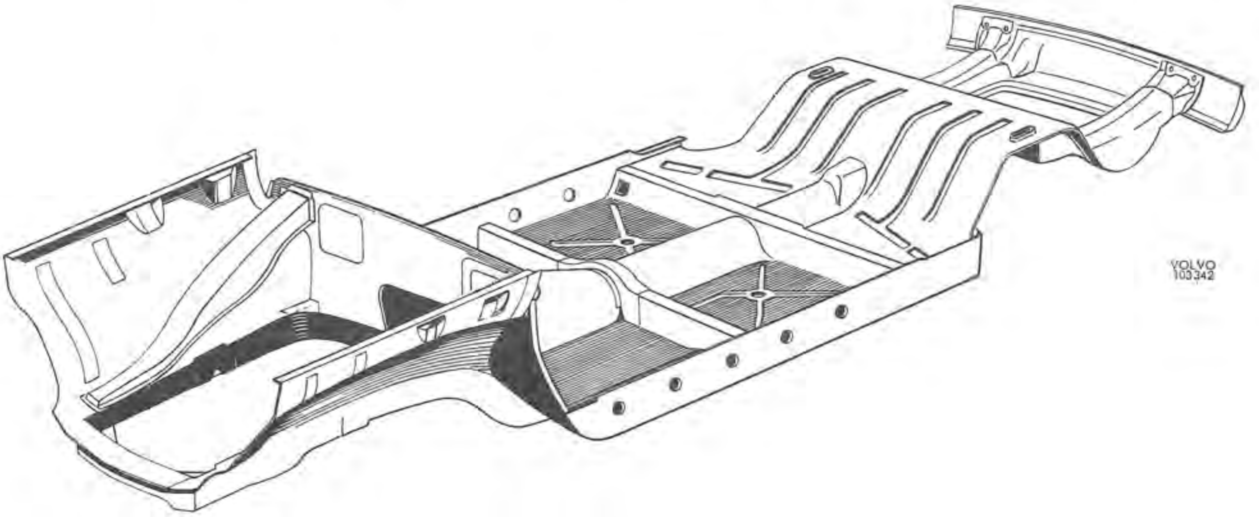

Fig. 8-4. Floor section

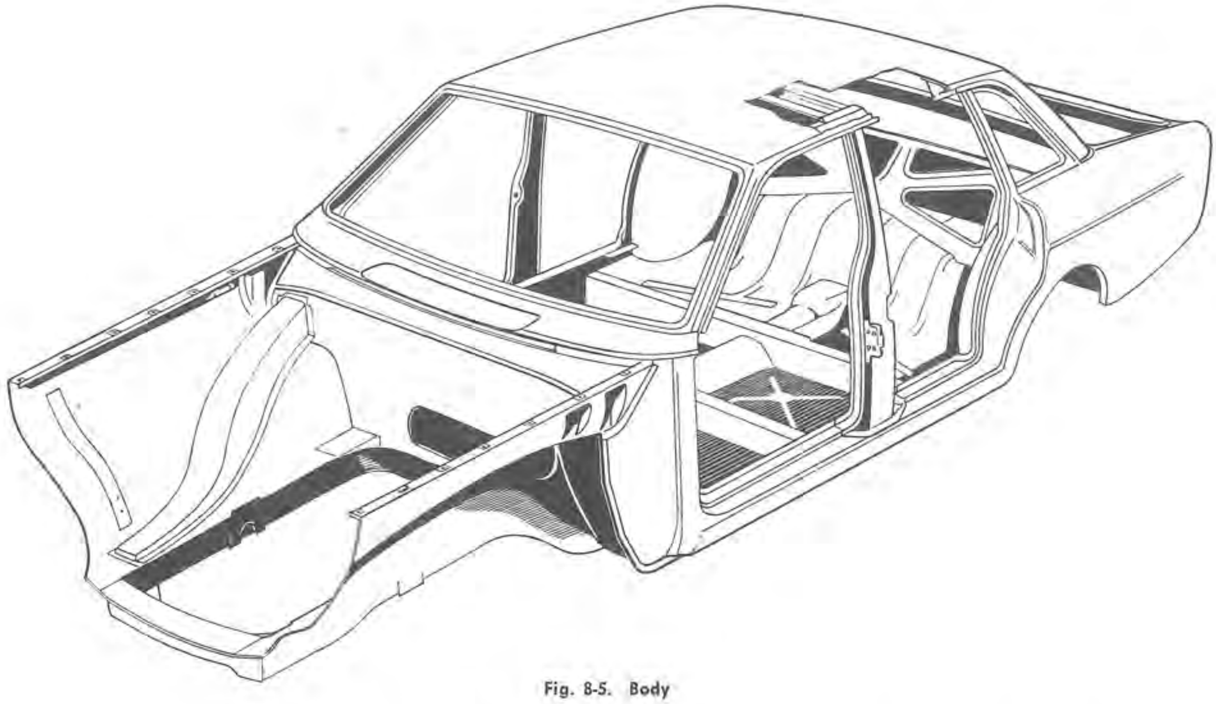

Fig. 8-5. Body

fixture is held in position by retainers SVO 2847 (1), one on each side.

2. Screw the retainer SVO 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 SVO 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 SVO 2893, so that the straight edge remains steady. Do not tighten so hard as to bend the straight edge.
4. The measuring arm SVO 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").

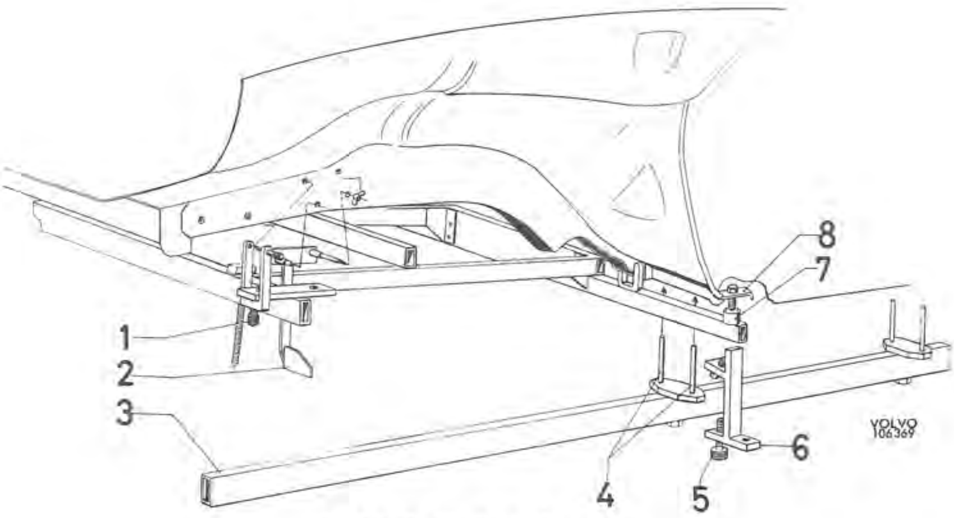

Fig. 8-6. Tool for front side-members

1. Retainers
2. Measuring arm
3. Straight edge
4. Front support studs
5. Bolt
6. Retainer
7. Rear guide pins
8. Clamps

GROUP 82

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 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 of 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 plete 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. 8-7) 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.

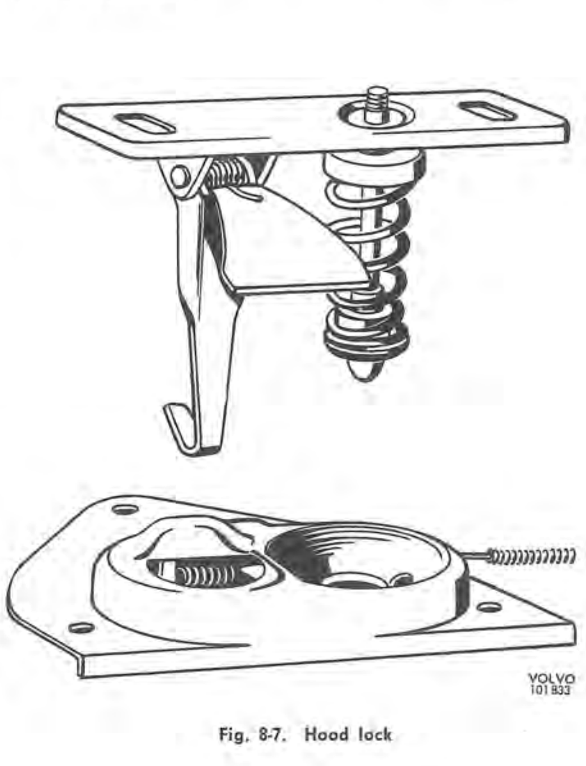

Fig. 8-7. Hood lock

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 logitudinally, 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 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 fitting 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. 8-8). 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.

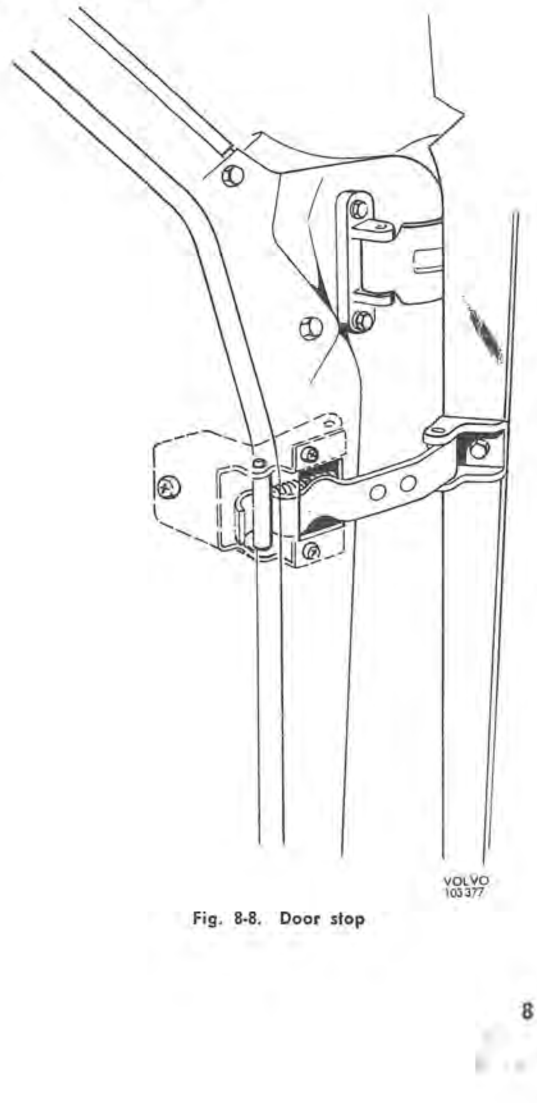

Fig. 8-8. Door stop

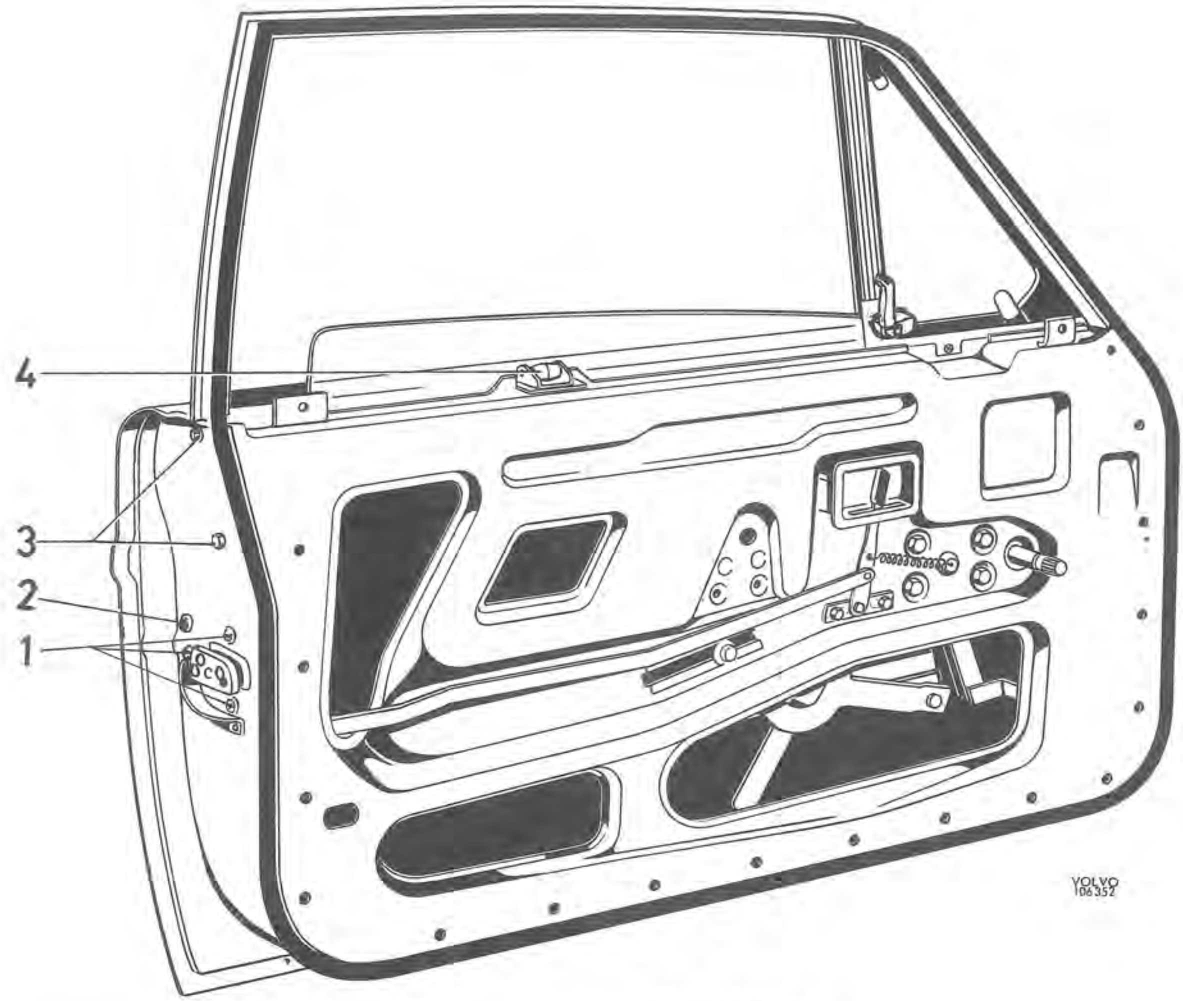

Fig. 8-9. Front door

1. Screws for door lock
2. Holes for lock cylinder attaching screws
3. Screws for door arch
4. Support roller for window winder

Removing and installing front doors

Remove the door stop in accordance with the instructions under "Removing and fittings 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. 8-9).

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 hand hinges are oval, the door can be adjusted laterally. The door can be adjust 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 and Fig. 8-10.

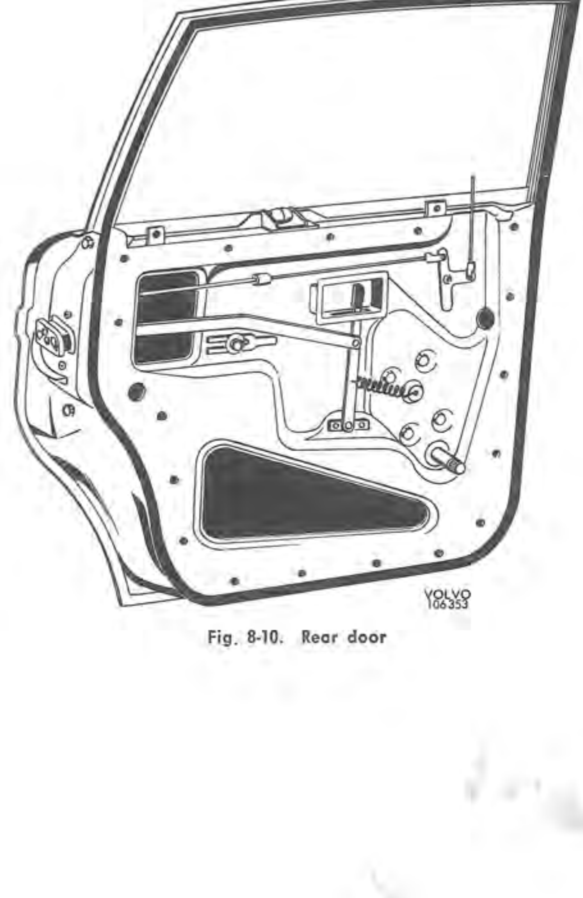

Fig. 8-10. Rear door

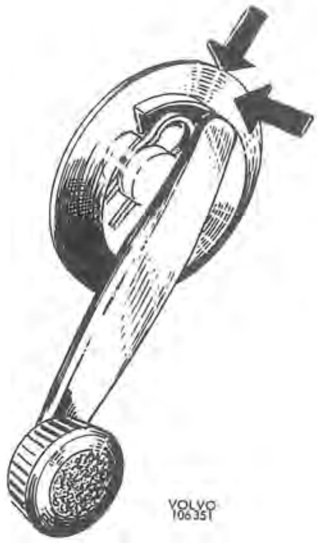

Fig. 8-11. Removing winding handle

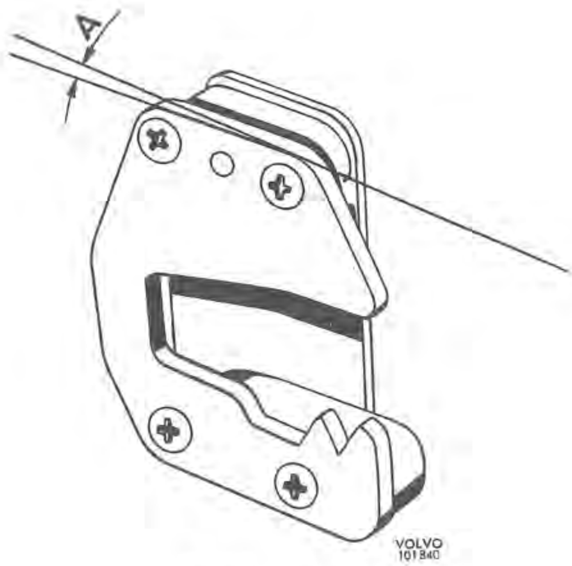

Fig. 8-12. Latch plate
A. Front door 1.5°
Rear door 2.5°

Removing inner handles 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. Remove the window winding handle by pressing in the washer towards the door upholstery and then towards the handle in the same direction as the handle as shown in Fig. 8-11. This releases the spring clip and the winding handle can be taken off.
   When fitting, make sure that the spring clip is fitted so that its open end faces towards the winding handle as shown in Fig. 8-11.
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 press button of the outer handle pressed in, 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.

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. 8-9).
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 two screws for the rear winder rail on the edge of the door. (3, Fig. 8-9).
7. Unscrew the three screws for the door lock. These screws are placed on the rear edge of the door. (1, Fig. 8-9).
8. The lock can then be removed by carefully levering the rear winder rail forwards.

Removing rear door lock

1. Carry out operations 1—3 under "Removing inner handles 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. Wind down the window so that its lower edge

comes level with the upper edge of the door lock.

6. Remove the weather strip for the door frame.
7. Unscrew the attaching screws for the door frame and lift it off.
8. 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, front doors

1. Wind up the window to closed position.
2. Remove inner door handle and upholstery according to previous instructions.
3. Adjust the window vertically so that the hole in the winding rail is opposite the leading of the two attaching screws (7, Fig. 8-13), and undo this screw.
4. Wind down the window so that the rear screw is accessible and unscrew this also.
5. Unhook the return spring (8, Fig. 8-13) 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). The leading screw is accessible through a hole in the winder rail.
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.

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 (7, Fig. 8-14).

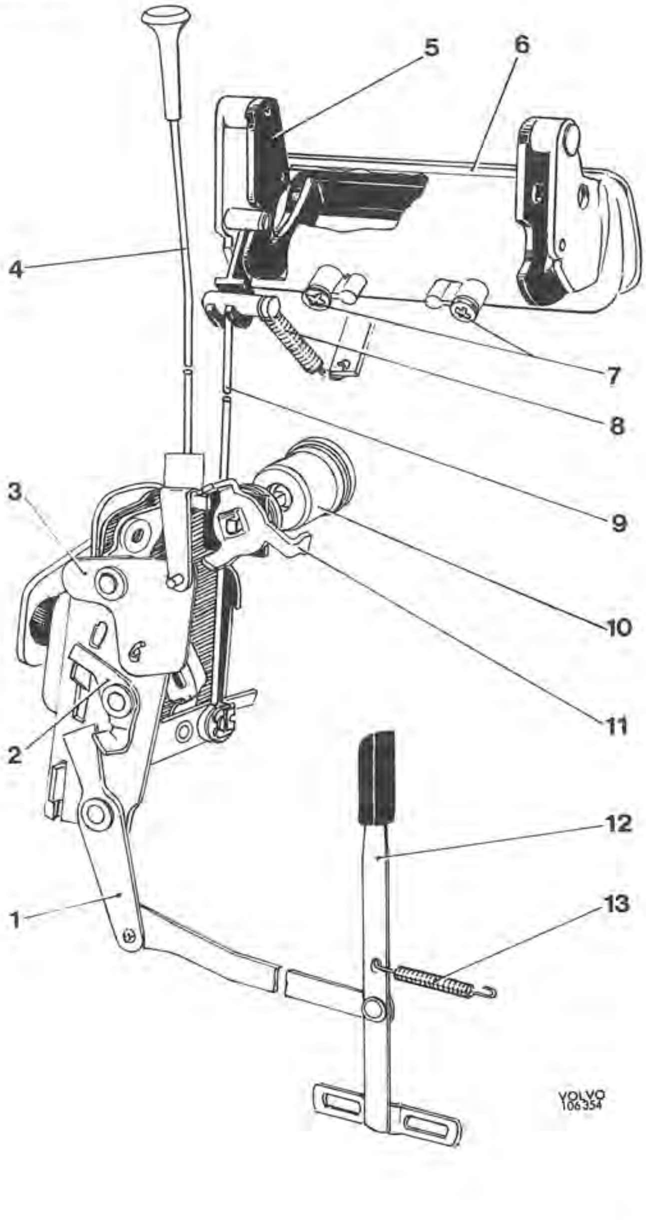

Fig. 8-13. Lock, front door

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

4. Undo the screws (6, 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 (3, Fig. 8-14) in the lifting arm for the handle.
2. Screw in the attaching screws (6, 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 (7, Fig. 8-14) and check that the lock functions properly.
5. Put back the door upholstery and install the inner handle.

Removing front door frame

1. Wind down the window so that it comes near the bottom position.
2. Remove the door panel in accordance with the instructions under "Removing inner handles and upholstery".
3. Unscrew the attaching screws for the bracket for the lower attachement of the front guide rail and remove the bracket.
4. Remove the sealing strip which runs round the door frame.
5. Remove the two attaching screws on the rear edge front edge respectively. The door frame can be removed by lifting it straight up.

Removing rear door frame

See the corresponding section above. However, it is not necessary to carry out point 3 when removing the rear door frame.

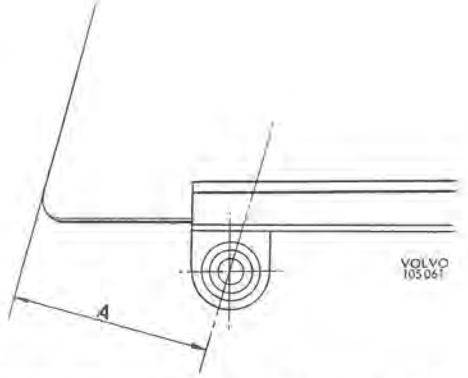

Fig. 8-15. Measurement for front side door A=78.5±2 mm (3.1±0.08")

Removing front door winding window

1. Carry out operations 1—5 under "Removing front door frame".
2. Remove the guide roller for the window. The guide roller is placed at the upper edge of the door as shown in Fig. 8-9.
3. Remove the locking springs and washers between the slide rail and lifting arms. These springs can be removed by pressing them right in and then releasing them, after which they can be taken off.

   N.B. Take care that the window does not fall down in the door. Even if the window is placed

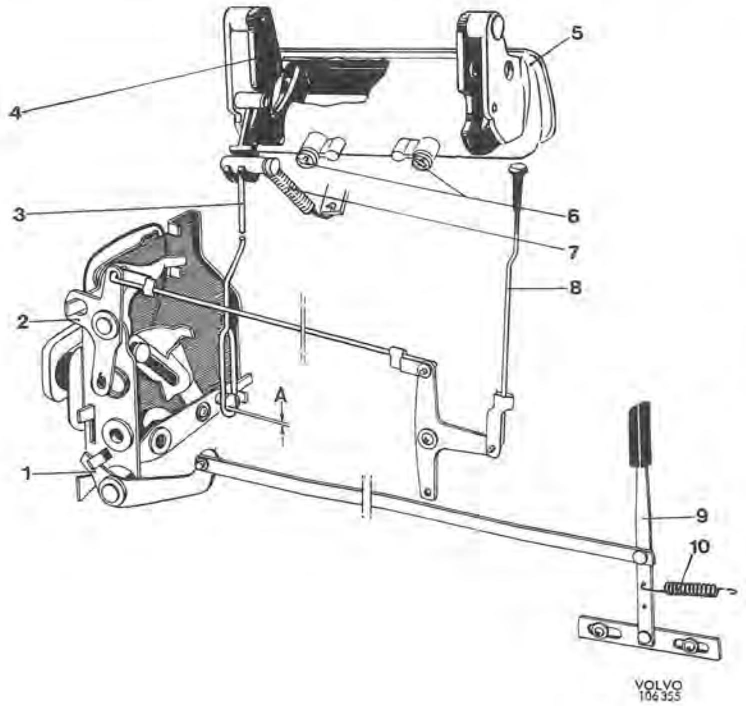

Fig. 8-14. Lock, rear doors

1. Lever
2. Lever
3. Pull rod for outer handle
4. Outer handle
5. Cover for outer handle
6. Screws for outer handle cover
7. Return spring for outer handle
8. Pull rod for lock button
9. Inner door opener
10. Return spring for inner door opener

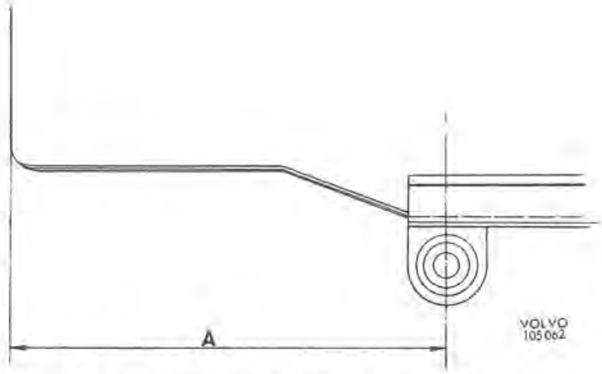

Fig. 8-16. Measurement for rear side door A=169±2 mm (6.7±0.08")

carelessly at the bottom of the door the slide rail can damage the outer plate.

4. Withdraw the window from the pins in the window winder, after which the window can be lifted straight up.

Removing rear door winding window

See the corresponding section above.

Fitting a window in the window winder

If the window winder is to function satisfactorily, the dimensions given in Figs. 8-15 and 8-16 should be followed when fitting a window in the window winder.

Removing ventilation windows

1. Carry out operations 1—5 under "Removing front door frame.
2. Remove the grooved strip from the front slide rail of the winding window and unscrew the screws which hold the plate under the ventilation window. Then unscrew the screws on the opposite side and remove the plate.
3. After the rubber strip round the ventilation window has been removed from the groove all round, the window with strip can be taken off, see Fig. 8-17.

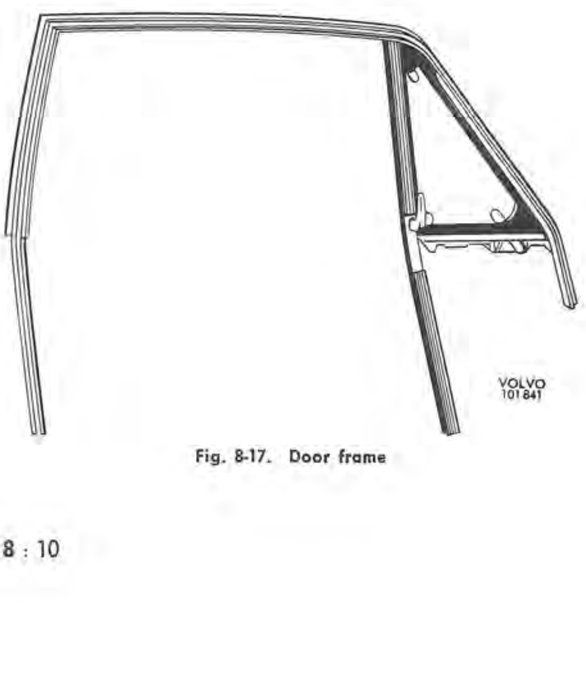

Fig. 8-17. Door frame

Removing front door window winder

1. Wind down the window so that it comes near the bottom position.
2. Remove the door panel in accordance with the instructions under "Removing inner handles and upholstery".
3. Remove the attaching screws between the front guide rail and bracket between the door and bracket. Remove the bracket.
4. Remove the locking springs and washers for the lifting arm. Begin by removing the spring in the door slide. The springs are removed by pressing them right in and then releasing them, after which they can be taken off.
   NOTE. Take are that the window does not fall down into the door. Even if the window is placed carelessly at the bottom of the door, the slide rail can damage the outer plate.
5. Move up the winding window to the top position. Lock the window by placing a screwdriver under the slide rail in the upper rear clip hole for the door upholstery.
6. Remove the attaching screws for the window winder, see Fig. 8-9, and remove it from the door, see Fig. 8-18.

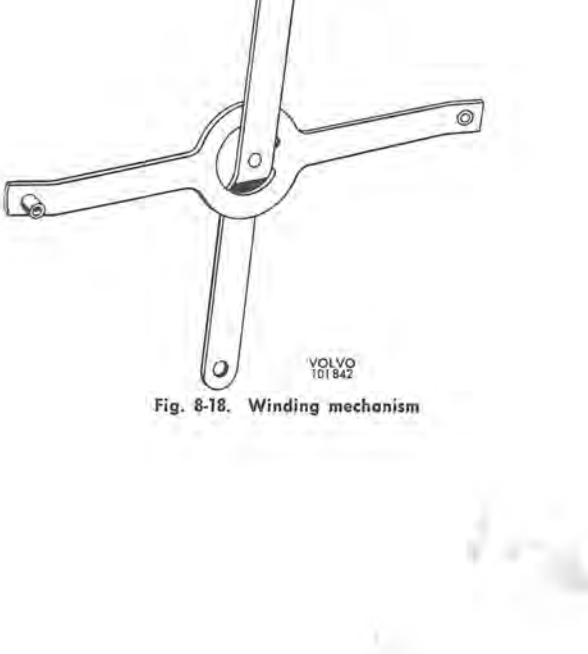

Fig. 8-18. Winding mechanism

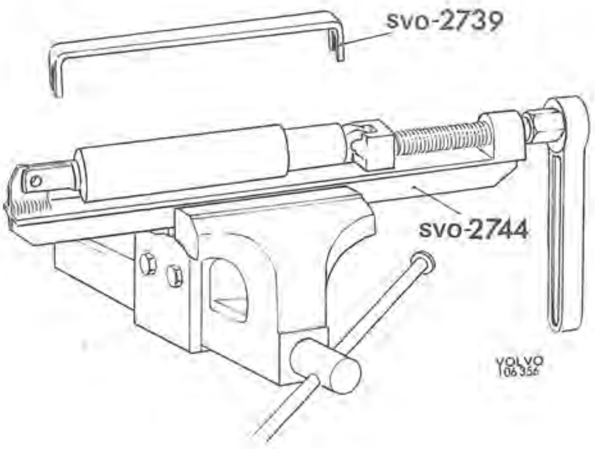

Fig. 8-19. Tools for spring support

Removing rear door winder

Proceed in the same way as described above. However, point 3 does not need to be carried out when removing the rear door window winder.

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 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 SVO 2739 applied and the lid opened fully again, after which the spring support can be removed. When fitting a new spring support press tool SVO 2744 is used as shown in Fig. 8-18 in order to enable clamp SVO 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.

The locking device (Fig. 8-20) 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.

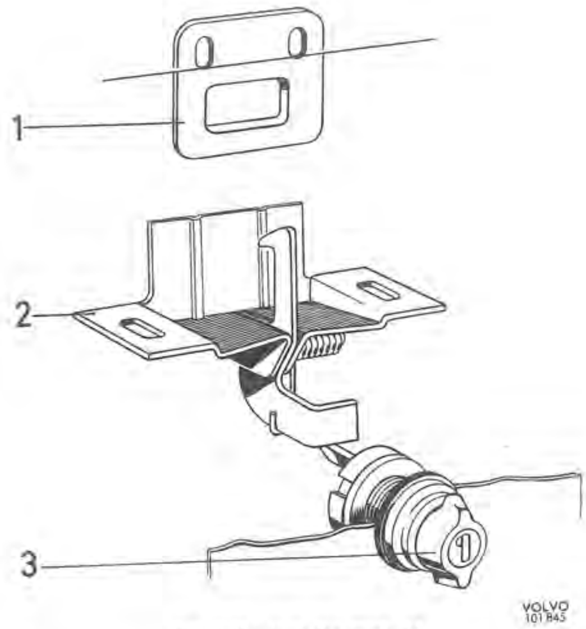

Fig. 8-20. Lock for trunk lid

1. Lock catch, fitted in lid
2. Lock mechanism, fitted in rear section
3. Lock knob, fitted in rear section

To remove the lock, 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.

The lock knob is removed by unscrewing the large slotted nut inside the trunk. The lock knob can then be pulled out backwards.

SUN-ROOF

Removing cable

1. Open the sun-roof and release the clips securing the roof upholstery at the front end. Then move the upholstery back to leave an opening.
2. Crank the sun-roof forwards and slacken the screws at its four attachments (9 and 11, Fig. 8-21), 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 sun-roof 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 sun-roof forwards until it is completely closed and check that it is level with the roof. To adjust vertically, use the front attachments (9) and the lifts at the rear attachments (11). Also check that both the lifts stand straight up when the roof is closed.
6. Unscrew the crank and gear housing (4). Turn the crank to the stop position on the removed gear housing.
7. Fit the gear housing and crank. The crank should now point straight forwards in the vehicle when the sun-roof is completely closed.
8. Put back the upholstery and test the function of the sun-roof.

Replacing sealing strips

The sun-roof must be removed in order to replace the insulating strip and sealing strip there. See points 1 and 2 under "Removing the cable".

When replacing the insulating strip round the roof opening of the sun-roof, all that is required is to crank the roof back to its rearmost position.

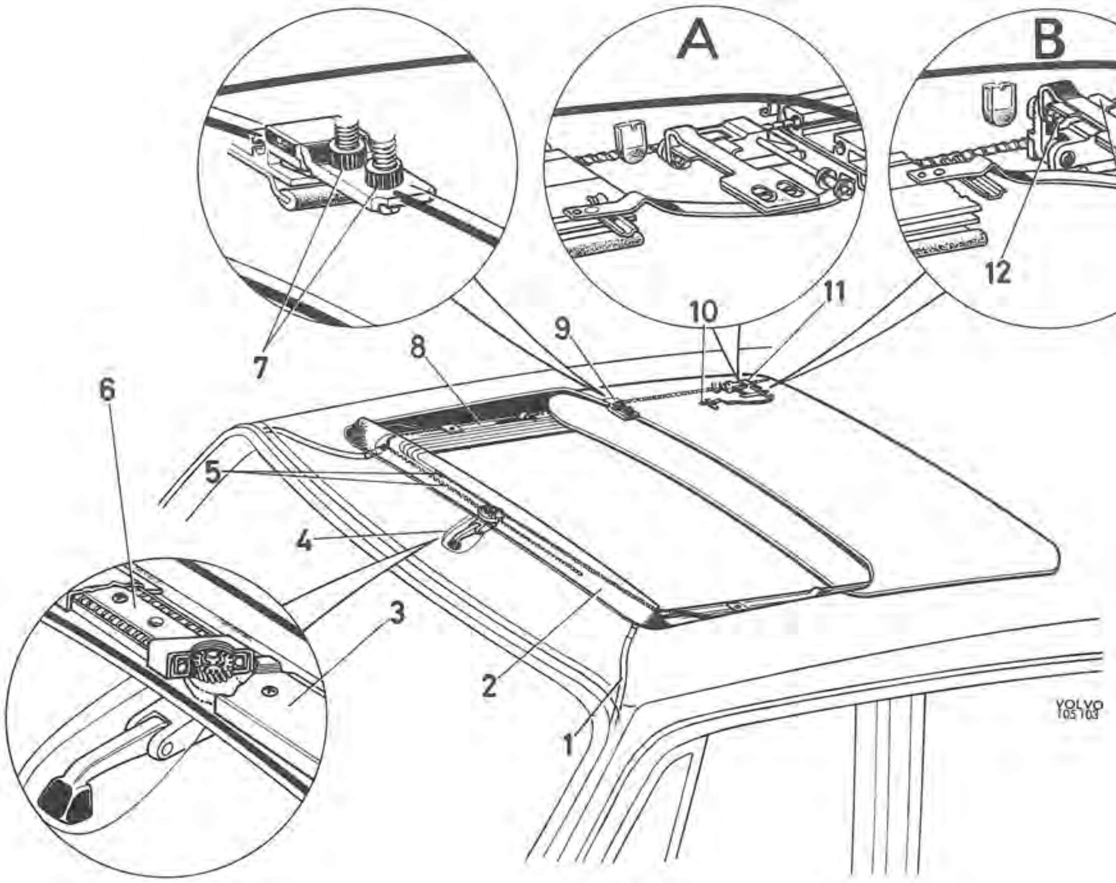

Fig. 8-21. Sun roof

A. Rear attachment when roof is open
B. Rear attachment when roof is closed

1. Drain hose
2. Wind deflector
3. Covering strip
4. Crank housing 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. 8-22.

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. 8-23. Then lever the moulding loose.

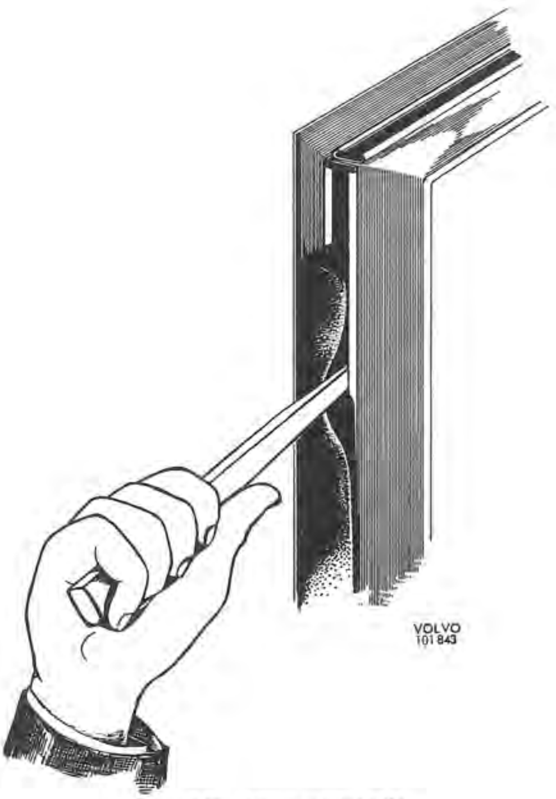

Fig. 8-22. Fitting sealing strip

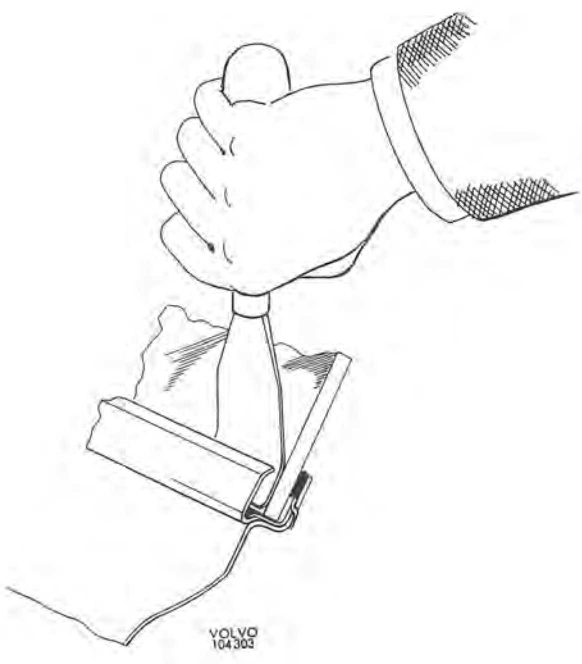

Fig. 8-23. Removing trim moulding

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. 8-24. Lever off the moulding carefully while releasing the rubber strip with the other putty knife.

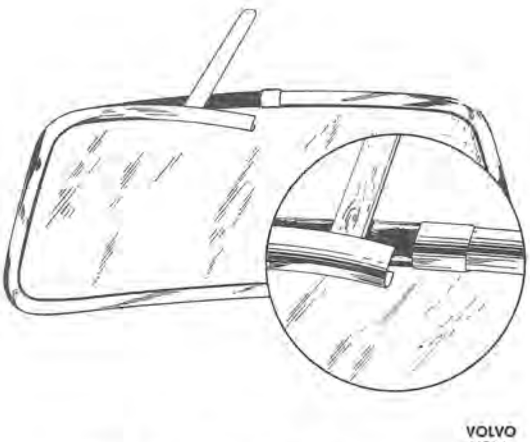

Fig. 8-24. Removing the trim moulding

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. 8-25. Push over the joining pieces and repeat the procedure with the other half of the moulding. Adjust the position of the joining pieces over the joints.

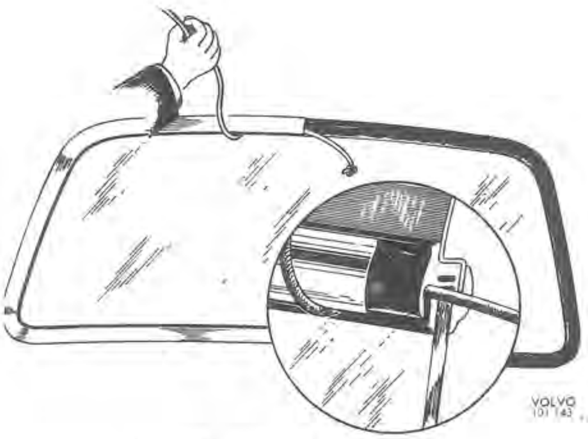

Fig. 8-25. Installing trim moulding

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. 8-26. 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.

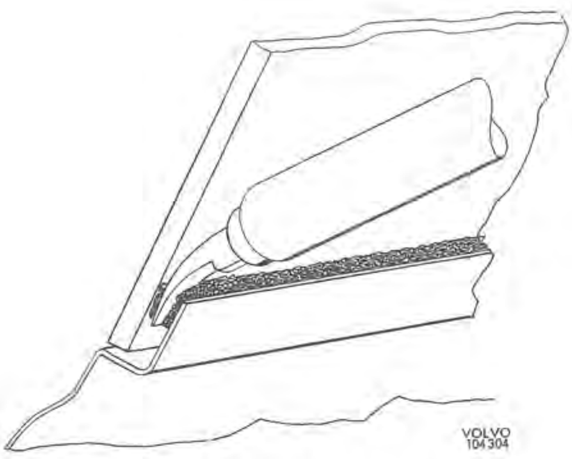

Fig. 8-26. Removing windshield

Installing windshield

1. Inject sealing agent into the holes where the new clips are to be fitted. Use pump No. 210163.
2. Install new clips.
3. Clean well the surfaces where the tape is to lie on the body and windshield. Use ethyl or methyl acetate for the cleaning. Be careful not to touch the cleaned surfaces.
4. Coat the clips with sealing agent No. 686275 so that the agent forms a smooth bridge between the clips and body for the butyl tape to seal against.
5. Coat adhesive on the cleaned surfaces on the body and windshield. Coat an edge between 18 and 21 mm (3/4 and 7/8") in width round the windshield, measured from its outer edge. Apply the adhesive twice to ensure total coverage. Any adhesive spill on the body or glass surfaces can be removed with methyl acetate. The adhesive can be applied within 5 minutes after the cleaning.
6. Install both the spacers on the lower edge of the windshield opening. They should lie between the 2nd and 3rd clip from each windshield post.
7. Install the butyl tape on the body not less than 10 minutes and not more than 1 hour after the adhesive has been applied. Roll the tape round the whole of the windshield opening with the protective paper on. The joint should be opposite one of the side posts and the joint ends should be cut at an angle.
   The tape is best cut with a heated knife.
   Place the tape edge to edge with the spot-welded flange. The tape profile may not be altered by stretching. The protective paper is removed immediately before the windshield is installed. Be careful not to dirty or touch the adhesive surface of the tape.
8. Use a glass lifter for fitting the windshield. Two men are required to fit the windshield. It must be carefully fitted in the opening before being placed against the tape. Once the windshield has been placed in position, then adjusting possibilities are very small. The windshield must not lie against any clip.
9. Install the fixture SVO 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 windscreen 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. 8-27.

Fig. 8-27. Placing cord in rubber strip

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. 8-28. It may sometimes be necessary to adjust the position of the rear window with the palm of the hand. If the cord is difficult to pull out, this may damage the strip, in which case the rear window should be stuck from inside or outside with the palm of the hand if the rubber strip does not "creep" over the edge of the sheet metal properly.

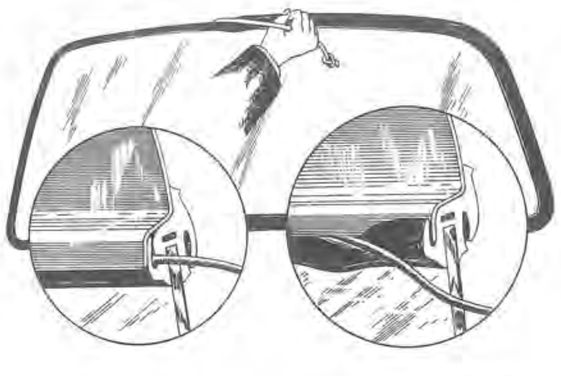

Fig. 8-28. Fitting the rear window

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

INTERIOR FITTINGS AND UPHOLSTERY

Front seats

The front seats (Fig. 8-29) are built up on a tubular frame. The stuffing consists of foam plastic covered with cloth. The seat can be adjusted longitudinally by releasing the catch on the front side of the seat (driver's side) or the outside of the seat (passenger's side) and sliding the seat to the desired position. The driver's seat is adjusted vertically with the lever placed in front of and under the seat. The passenger's seat is adjusted vertically by means of the rear attachments which have been provided with three holes. Both seats are inclined to the desired angle by means of a screw at the front end. The backrest inclination is variably adjustable by pulling up the lever on the reclining mechanism, whereby the backrest is tilted forwards by means of springs or tilted rearwards by leaning backwards in 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 restraints which can be adjusted vertically.

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.

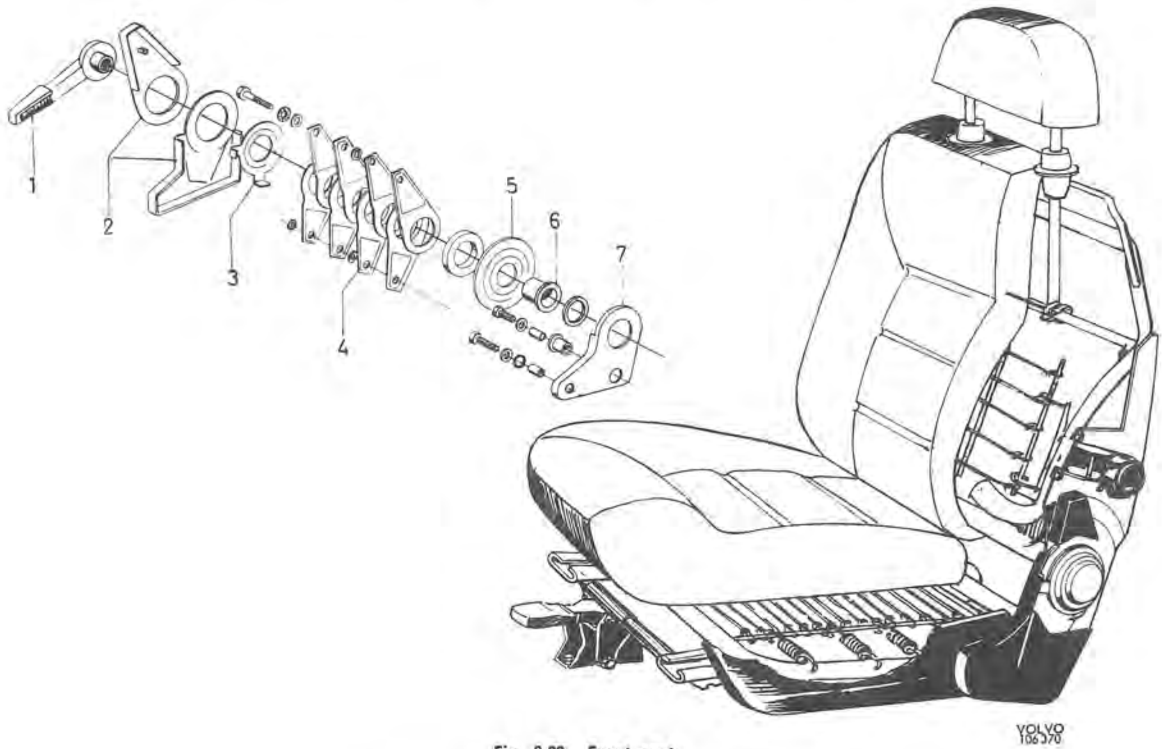

Fig. 8-29. Front seat

1. Handle
2. Covers
3. Thrust washer, outer
4. Friction discs
5. Thrust washer, inner
6. Spacer tube
7. Fitting

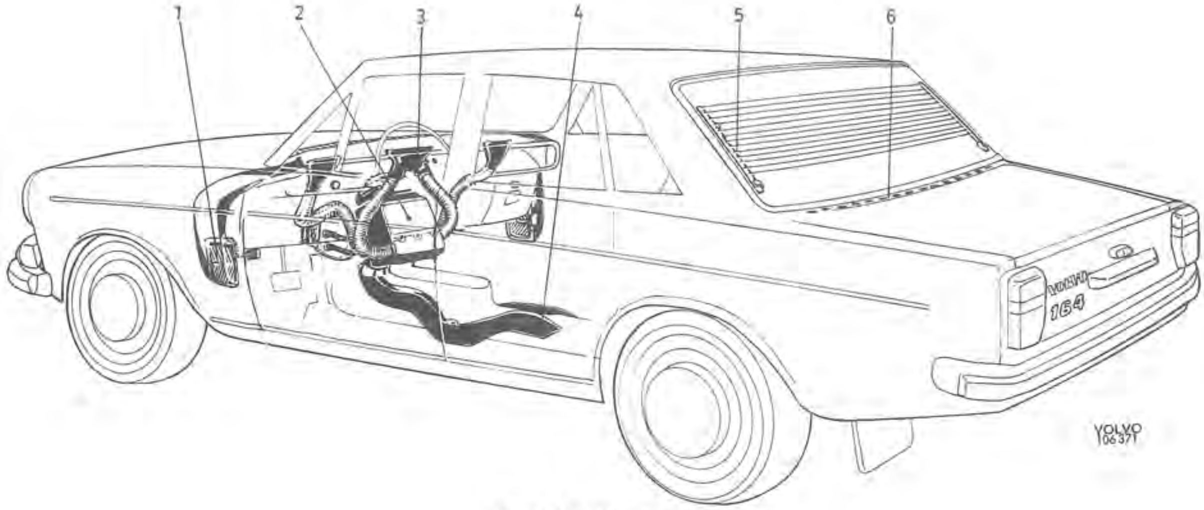

Fig. 8-30. Heater system

1. Fresh air intake
2. Car heater
3. Windshield defroster
4. Air ducting to rear seat area
5. Electrically heated rear window
6. Air extractor vents

Headlining

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.

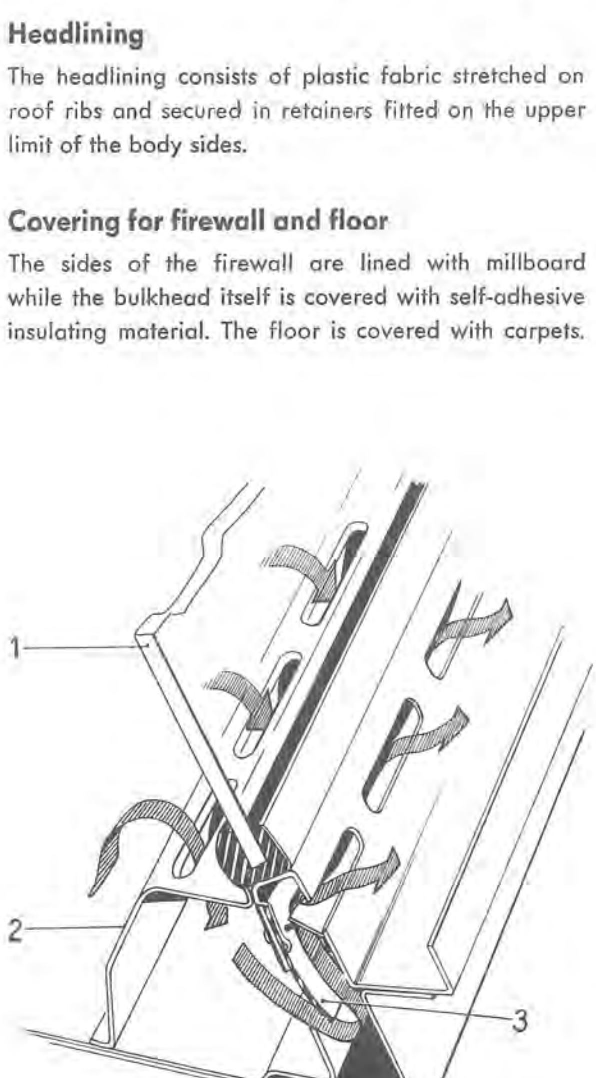

Fig. 8-31. Air extractor vents

1. Rear window
2. Inner panel
3. Non-return valve

HEATING SYSTEM

The heating system is a combined warm air and fresh air system. The incoming air is forced, by a fan, through the cellular system of the heater unit and out into the car. The fresh air can be heated and directed to the required area of the car by means of the various controls.

(Fresh air can also enter into the vehicle through the fresh air intakes in the cowl sides.)

Good compartment ventilation is further improved by air extractor vents located at the base of the rear window. These vents have a total area of 50 cm² (7.8 sq.in.), see Fig. 8-31.

The temperature of the heated air is regulated by means of a heat control valve. The heat control valve is intended to keep the temperature of the heated air at a pre-determined and constant temperature. This is achieved by means of the thermostat which is incorporated in the control valve. The temperature control regulates the supply of heated coolant to the

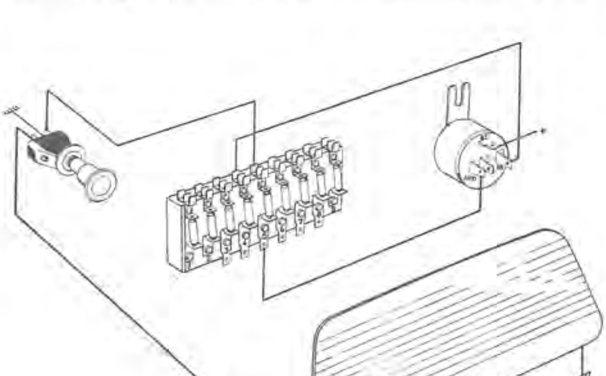

Fig. 8-32. Wiring diagram for electrically heated rear window

cell system. The heater control valve is connected in series with the cell system so that all coolant which passes through the cell system also passes through the control valve. The heated coolant warms up the air which is fed through the heater unit by the heater fan or the slipstream. If the coolant temperature increases, the sensitive body of the thermostat expands thus acting on the valve in the control system and resulting in a lesser flow of coolant. This means that the temperature of air flowing through the unit will be lower and the sensitive body will again be effected. The result will be an increased flow of coolant. This cycle is repeated continuosly so that a stable air temperature is achieved.

The electrically heated rear window is included in the heating system of the car. The electrically heated rear window, which has an output of 150 W, is regulated by means of a switch located on the dashboard. The control switch is connected via a control relay (see wiring diagram) which cuts off the supply of current when the ignition is switched off. This safeguards the battery from discharging when the engine is not turned over. See Group 84 concerning replacing rear window.

REPAIR INSTRUCTIONS

SEATS

Removing front seats

Unfasten the press-studs which hold the seat cushion to the frame and remove the seat cushion. Unscrew the four attaching screws for the slide rails. Lift off the seat.

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.

REPLACING HEADLINING

1. Remove the interior light, sun visors, and rear view mirror.
2. Pull down the edge of the headlining with finger and thumb on one side as shown in Fig. 8-33 so that the plastic edge can be released from its fastening in the rail.
3. Then pull down the headlining all round.
4. Take down the stretchers beginning from the back by bending them down in the middle and releasing them from the edge of the roof as shown in

Fig. 8-33. Removing headlining

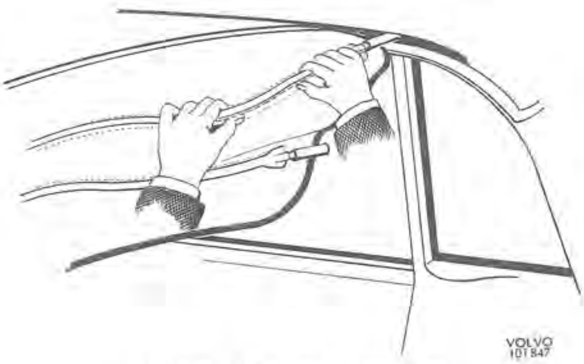

Fig. 8-34. Removing roof stretchers

Fig. 8-33. N.B. Be careful when removing and fitting the stretchers. Careless handling can cause the ends to damage the roof plate.

5. Fit the stretchers in the new headlining. Make sure that they are provided with rubber caps at the ends as shown in Fig. 8-35.
6. Fit the headlining by first inserting the stretchers beginning with the front one.
7. Strech the headlining forwards and tuck in the plastic strip at the front edge.
8. Then stretch the headlining backwards by pulling both ends of a stretcher at the same time. Begin at the front and pull on each stretcher working backwards, after which the rear plastic strip can be tucked into its groove.

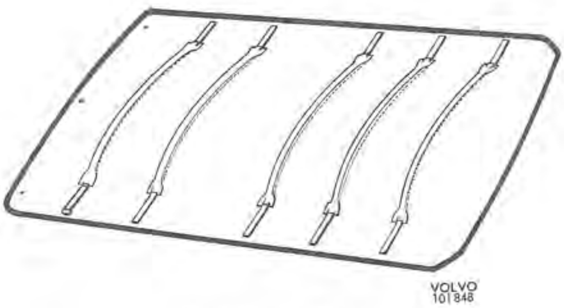

Fig. 8-35. Headlining

9. Now pull over the headlining towards one side and tuck in the plastic strip. Then stretch the headlining over towards the other side and tuck in the plastic strip.
10. Fit the interior light, sun visors and rearview mirror.
11. Any folds in the fabric can be removed by pulling the headlining in the necessary direction. The headlining then moves in the attaching rails.

INSTRUMENT PANEL

Removing instrument panel

The instrument panel is attached to the body with screws. These are accessible partly from above at the edge of the windscreen and partly from underneath at both sides of the panel.

HEATING SYSTEM

Removing heater unit

Drain off the coolant and disconnect the negative battery lead. Remove the hoses to the control valve. Remove the panel, below the dashboard, by loosening the two fixing screws, one on the left cowl side and one beside the glove compartment. Pull the upper section of the panel rearwards so that it loosens from the clips in the dashboard and free the panel from

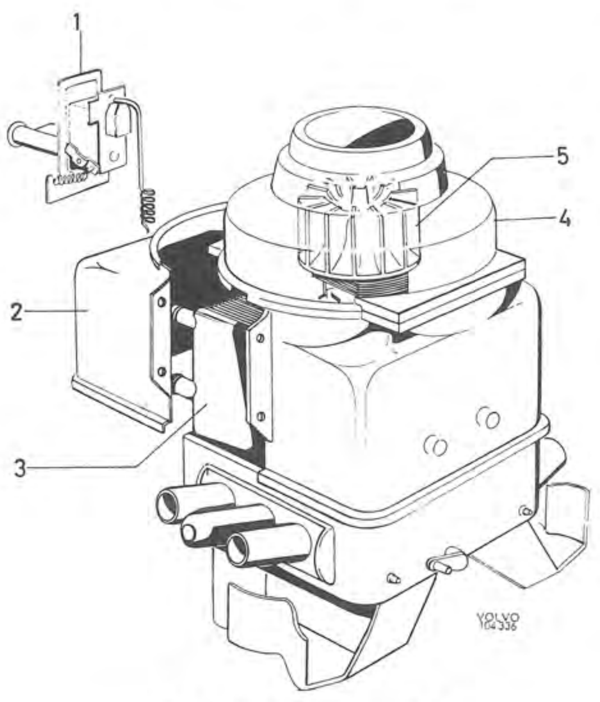

Fig. 8-36. Heater unit, dismantled

1. Heat control valve
2. Heater casing
3. Cell system
4. Fan casing
5. Fan
6. Spring clips
7. Heater casing
8. Rubber bushing
9. Sensitive body for heat control valve

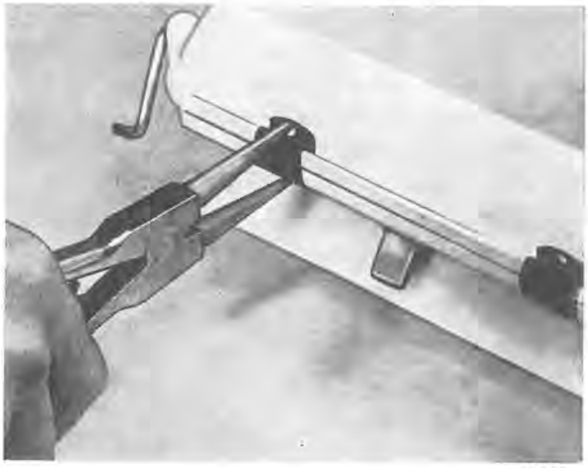

Fig. 8-37. Removing spring clips

the bonnet release control. Remove the mat on the transmission tunnel. Loosen and remove the defroster hoses and control wires and remove the switch for the fan and disconnect the cables to the fan motor.

Remove the two screws which hold the fusebox to the heater. Remove the control valve and loosen the upper hose to the heater unit. Care must be taken with the control valve and the copper tube between the valve and the heater. Plug the outlets on the heater so that the remaining coolant does not run into the car on removal. Loosen the ground cables from the right-hand bracket. Loosen and remove the four screws which hold the heater unit to the brackets and loosen the draining hose. Lift out the heater unit and control valve carefully.

Disassembling heater unit

Remove the four rubber bushes on the sides of the heater unit. Mark the fan casing to facilitate reas-

Fig. 8-38. Disassembling mounting plate

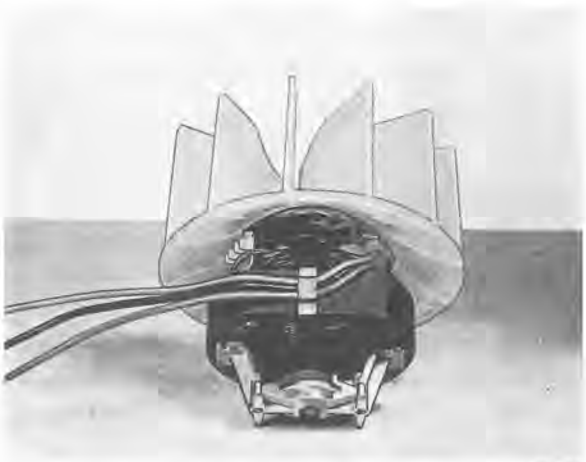

Fig. 8-39. Fan motor

sembly. Remove the spring clips which hold the heater, Fig. 8-37 and separate the two halves. This exposes both the cell system with sensitive body for control valve and the fan motor.

Replacing fan motor

Remove the heater unit and dismantle it as described above. Mark the mounting plate in relation to the fan casing. Loosen the mounting plate with fan motor from the fan casing by straightening the tabs as shown in Fig. 8-38.

Remove the screws which hold the fan motor to the mounting plate. Exchange the fan motor and replace the screws which hold it to the mounting plate. Replace the mounting plate on the fan casing.

Reassemble the heater unit and mount it in the vehicle in accordance with the following description.

Assembling heater unit

Scrape off the previous sealing agent and replace it with a suitably soft sealing agent. Fit the cell system with sensitive body and reassemble the casing halves. Replace the spring clips and the rubber bushings.

Installing heater unit

Place the heater unit in position and connect the drain hose. Install the four screws which hold the heater to the brackets. Connect the ground cables to the right-hand bracket. Install the control valve and the upper hose to the heater. Install the fusebox to the heater. Connect the cables from the fan motor to the switch and mount the switch in the dashboard. Install the control wires to the shutters and control valve. Install the defroster hoses and replace the mat on the transmission tunnel. Fasten the panel in position below the dashboard. Install the hoses to the control valve. Connect the ground battery cable and refill the coolant system.

Removing heater unit controls

The controls are of unitary design as shown in Fig. 8-40. The unit is fixed to the dashboard with three nuts. For removal, first loosen the panel below the dashboard. Next loosen the wires on the heater unit and control valve. The control lighting lamps are removed by pulling them straight out from the holders. Remove the three nuts and take out the control unit.

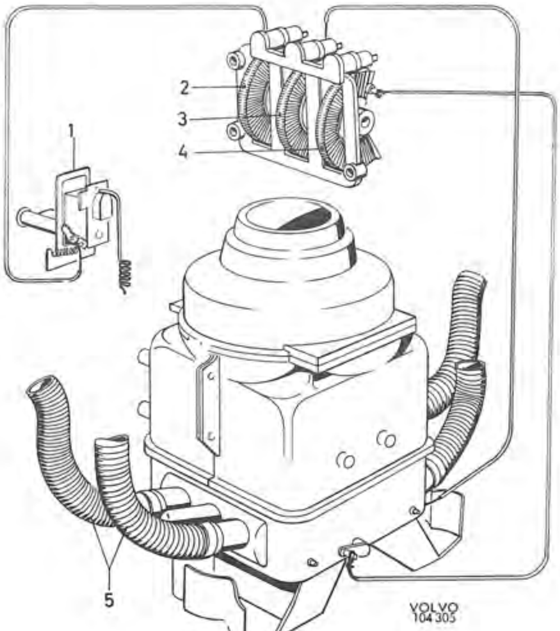

Fig. 8-40. Heater unit controls

1. Heat control valve
2. Heater control
3. Defroster control
4. Heater control, floor
5. Hoses to defroster nozzles

GROUP 86

BUMPERS

The bumpers are made of aluminium and are in one piece. They are faced with a hard-rubber strip which is fitted in the bumper rail by means of screws. The bumpers are mounted on four support bars, the front ones of which are attached to the front side members and the rear ones fitted directly in the body.

Removing and fitting

The front bumber is removed by unscrewing the bolts inside the bumper. The support bars are removed at the front frame members.

The rear bumper is removed by unscrewing the bolts between the support bars and body. The support bars can then be removed from the bumper by unscrewing the bolts inside the bumper.

Installing is in reverse order.

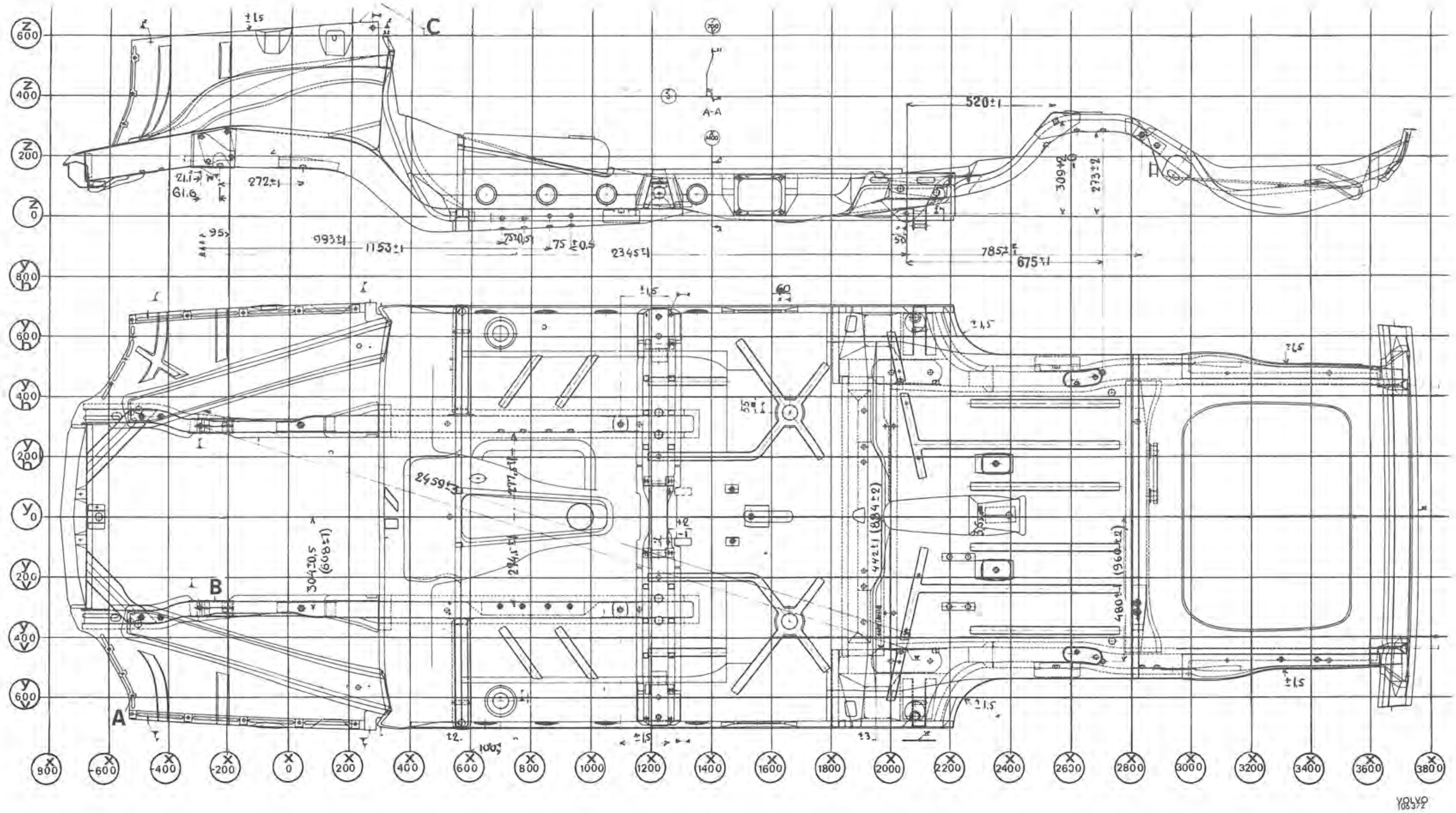

Illustration 8 A. Control for body floor

A = Max. deviation from theoretical position for hole group = 1.5 mm (0.06")
B = 227±1 mm (8.9±0.04"). L = 200 mm (7.9") plane of steering box
C = Max. deviation between these flanges and the Z-direction±1 mm (0.04")

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