VOLVO
SERVICE

SERVICE MANUAL

VOLVO 140 1973

Part 0

GENERAL

GROUP 01

TYPE DESIGNATIONS

This manual deals with Volvo 140-series cars, 1973 models, of the following types:

Type	Type designation
Two-door	142
Four-door	144
Station Wagon	145

TYPE PLATES

1. Vehicle type designation 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 (on left-hand side of engine).
5. Gearbox type designation, part number and manufacturing serial number (underneath gearbox).
6. Plate on left-hand side of final drive casing showing reduction ratio, part number and serial number for final drive.

SPECIFICATIONS

DIMENSIONS AND WEIGHTS

	142	144	145
Length	4630 mm (182.2")	4630 mm (182.2")	4630 mm (182.2")
Width	1705 mm (67")	1705 mm (67")	1705 mm (67")
Height	1442 mm (56.8")	1442 mm (56.8")	1455 mm (57.3")
Wheelbase	2620 mm (103.3")	2620 mm (103.3")	2620 mm (103.3")
Ground clearance, empty	210 mm (8.3")	210 mm (8.3")	210 mm (8.3")
with 2 persons	180 mm (7.0")	180 mm (7.0")	180 mm (7.0")
Track, front	1350 mm (53.6")	1350 mm (53.6")	1350 mm (53.6")
rear	1350 mm (53.6")	1350 mm (53.6")	1350 mm (53.6")
Turning circle	9.6 m (31 ft. 6 in.)	9.6 m (31 ft. 6 in.)	9.6 m (31 ft. 6 in.)
Curb weight, de Luxe	1190 kp (2620 lb)	1210 kp (2665 lb)	1275 kp (2805 lb)
Grand Luxe	1220 kg (2685 lb)	1245 kp (2740 lb)	1295 kp (2850 lb)

LUBRICATION

ENGINE

Lubricant	Engine oil for 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 5W—20
Oil capacity, including oil filter	3.75 dm^3 (6.6 Imp. pints = 7.9 US pints)
excluding oil filter	3.25 dm^3 (5.7 Imp. pints = 6.9 US pints)

GEARBOX (WITHOUT OVERDRIVE)

Lubricant, type	Gear oil
viscosity	SAE 80
Alternative lubricant, type	Engine oil
viscosity, all year round	SAE 30
Oil capacity	0.75 dm^3 (1.36 Imp. pints = 1.56 US pints)

GEARBOX WITH OVERDRIVE

Lubricant, type	Engine oil
viscosity, all year round	SAE 30
alternative	Multigrade oil SAE 20 W—40
Oil capacity	1.6 dm^3 (2.8 Imp. pints = 3.4 US pints)

AUTOMATIC TRANSMISSION

Lubricant	Automatic Transmission Fluid, Type F
Oil capacity	6.4 dm^3 (11.3 Imp. pints = 13.5 US pints)

FINAL DRIVE

Lubricant, type, without limited slip	Oil acc. to MIL-L-2105 B
with limited slip	Oil acc. to MIL-L-2105 B provided with additive for limited slip
viscosity	SAE 90
Oil capacity	1.3 dm^3 (2.3 Imp. pints = 2.7 US pints)

MECHANICAL STEERING GEAR

Lubricant, type	Hypoid oil
viscosity	SAE 80
Oil capacity	0.25 dm^3 (0.4 Imp. pint = 0.5 US pint)

POWER STEERING

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

ENGINE — B20F

GENERAL

Type, designation		B 20 A	B 20 B	B 20 E	B 20 F
Output hp at r/m	SAE	90/4800	118/5800	135/6000	
	DIN	82/4700	100/5500	124/6000	
	SAE J 245				112/6000
Output kW at r/s	SAE	66/80	87/97	99/100	
	DIN	60/78	74/92	91/100	
	SAE J 245				82/100
Max. torque $\frac{\text{kpm}}{\text{lb ft}}$ at r/m	SAE	$\frac{16.5}{119}$/3000	$\frac{17.0}{124}$/3500	$\frac{18.0}{130}$/3500	
	DIN	$\frac{16.0}{116}$/2300	$\frac{15.5}{113}$/3500	$\frac{17.0}{123}$/3500	
	SAE J 245				$\frac{16.0}{115}$/3500
Max. torque Nm at r/s	SAE	162/50	167/58	177/58	
	DIN	157/38	152/58	167/58	
	SAE J 245				156/58

	B 20 A	B 20 B	B 20 E	B 20 F
Compression pressure (warm engine when turned over with starter motor) 4.2—5.0 r/s (250—300 r/m), kp/cm²	10—12	11—13	12—14	9—11
psi	142—170	156—185	170—200	128—156
Compression ratio	8.7:1	9.3:1	10.5:1	8.7:1
Number of cylinders	4	4	4	4
Bore	88.9 mm (3.500″)			
Stroke	80 mm (3.150″)			
Displacement	1.99 dm³ (1.99 liters)			
Weight, including electrical equipment and carburetor, approx.	155 kg (341 lb)			

CYLINDER BLOCK

Material .... Special alloy cast iron
Bore, standard B20A and B20B .... 88.91 mm (3.5004″)
B20E and B20F .... 88.92 mm (3.5008″)
oversize 0.030″, B20A and B20B .... 89.67 mm (3.530″)
B20E and B20F .... 89.68 mm (3.531″)

PISTONS

Material .... Light alloy
Weight, standard .... 507 ± 5 grammes (17.90 ± 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 center piston crown .... 46 mm (1.81″)
Piston clearance, B20A and B20B .... 0.03—0.05 mm (0.0012—0.0020″)
B20E and B20F .... 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″)

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")

CYLINDER HEAD

	B 20 A	B 20 B	B 20 E	B 20 F
Height, measured from cylinder contact face to face for bolt heads	86.7 mm (3.41")	86.2 mm (3.39")	84.9 mm (3.34")	87.0 mm (3.42")
Cylinder head gasket, thickness, standard, unloaded	1.4 mm (0.055")	0.8 mm (0.031")	0.8 mm (0.031")	1.2 mm (0.047")
loaded	1.2 mm (0.047")	0.7 mm (0.028")	0.7 mm (0.028")	1.0 mm (0.039")
Distance from top side of head to overflow pipe upper end (pipe placed under thermostat)	35 mm (1.38")			

CRANKSHAFT

Crankshaft, end float	0.047—0.137 mm (0.0018—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 bearing shell 0.010")	39.061—39.101 mm (1.5438—1.5451")
2 (undersize bearing shell 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")
Max. permissible weight deviation between connecting 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")

FLYWHEEL HOUSING

Max. axial throw for rear face	0.05 mm (0.002") at a diameter of 100 mm (3.9")
Max. radial throw for rear guide	0.15 mm (0.006")

CAMSHAFT

Marking/max. lift heigt B 20 A	A/6.0 mm (0.24")
B 20 B	C/6.7 mm (0.26")
B 20 E and B 20 F	D/7.2 mm (0.28")
Number of bearings	3
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).	
B 20 A	1.10 mm (0.043")
B 20 B	1.45 mm (0.057")
B 20 E and B 20 F	1.40 mm (0.055")
Inlet valve should then open at, B 20 A	10° (A T D C)
B 20 B	0° (T D C)
B 20 E and B 20 F	5.5° (B T D C)

TIMING GEARS

Backlash	0.04—0.08 mm (0.0016—0.0032")
End float, camshaft	0.02—0.06 mm (0.0008—0.0024")

VALVE SYSTEM

VALVES

Inlet

Disc diameter	44 mm (1.732")
Stem diameter	7.955—7.970 mm (0.3132—0.3138")
Valve seat angle	44.5°
Seat angle in cylinder head	45°
Seat width in cylinder head	2 mm (0.080")
Clearance, both hot and cold engine, B 20 A, B 20 E and B 20 F	0.40—0.45 mm (0.016—0.018")
B 20 B	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 seat angle	44.5°
Seat angle in cylinder head	45°
Seat width in cylinder head	2 mm (0.080")
Clearance, both hot and cold engine, B 20 A, B 20 E and B 20 F	0.40—0.45 mm (0.016—0.018")
B 20 B	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 (0.320—0.321")
Height above upper face of cylinder head, B 20 A and B 20 B	17.5 mm (0.689")
B 20 E and B 20 F	17.9 (0.705")
Clearance, valve stem-valve guide, inlet valve	0.030—0.068 mm (0.0012—0.0026")
exhaust valve	0.060—0.097 mm (0.0024—0.0038")

VALVE SPRINGS

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

LUBRICATING SYSTEM

Oil capacity, including oil filter	3.75 dm³ (3.3 Imp. qts = 3.9 US qts)
excluding oil filter	3.25 dm³ (2.8 Imp. qts = 3.4 US qts)
Oil pressure at 33.3 r/s (2000 r/m) (with hot engine and new oil filter)	2.5—6.0 kp/cm² (36—85 p s i)

OIL PUMP

Oil pump, type	Gear
number of teeth on each gear wheel	9
end float	0.20—0.10 mm (0.0080—0.0040")
radial clearance	0.08—0.14 mm (0.0032—0.0055")
backlash	0.15—0.35 mm (0.0060—0.0140")

RELIEF VALVE SPRING (IN OIL PUMP)

Length, unloaded approx.	39.0 mm (1.54")
loaded with 50±4 N (11.0±88 lb)	26.25 mm (1.03")
70±8 N (15.4±1.7 lb)	21.0 mm (0.83")

FUEL SYSTEM B20A, B20B

FUEL PUMP

Diaphragm type pump. Alt. 1 make	Pierburg (PE 15695)
Alt. 2 make	S.E.V. (20005012)
Fuel pressure, measured at same level as pump, 17—100 r/s (1000—6000 r/m)	min. 0.15 kp/cm² (2.1 p s i) max. 0.28 kp/cm² (4.0 p s i)

CARBURETORS

Stromberg, B 20 A

Type	Horizontal carburetor
Make and designation	Zenith-Stromberg 175 CD-2 SE
Number	1
Air intake diameter	41.3 mm (1.63")
Fuel needle, designation	B 1 CC
Idling speed	11.7 r/s (700 r/m)
Oil for damping cylinders	"Automatic Transmission Fluid, Type A"

Stromberg, B 20 B

(Engine in car with right-hand drive)

Type	Horizontal carburetor
Make and designation	Zenith-Stromberg 175 CD-2 SE
Number	2
Air intake diameter	41.3 mm (1.63")
Fuel needle, designation	B1 BL
Idling speed	13.4 r/s (800 r/m)
For cars with automatic transmission	11.7 r/s (700 r/m)
Oil for damping cylinders	"Automatic Transmission Fluid, Type A"

SU, B 20 B

Type	Horizontal carburetor
Make and designation	SU-HIF 6
Number	2
Air intake diameter	41.3 mm (1.63")
Fuel needle, designation	BAZ
cars for Canadian market, designation	BBB
Idling speed	13.4 r/s (800 r/m)
For cars with automatic transmission	11.7 r/s (700 r/m)
Oil for damping cylinders	"Automatic Transmission Fluid, Type A"

CO-test

Hot engine, idling speed	2.5 %

FUEL SYSTEM B 20 E and B 20 F

FUEL FILTER

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

FUEL PUMP

Type	Rotor pump
Capacity	1.67 dm³/s (22 Imp. galls = 26 US galls/h at 28 p s i)
Current consumption	5 amps
Relief valve opens	approx. 4.5 kp/cm² (64 p s i)

PRESSURE REGULATOR

Setting value	2.1 kp/cm² (28 p s i)

INJECTORS

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

COLD-START VALVE

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

AUXILIARY AIR REGULATOR

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

TEMPERATURE SENSOR I (INTAKE AIR)

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

TEMPERATURE SENSOR II (COOLANT)

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

PRESSURE SENSOR

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

AIR CLEANER

Changing intervals	40 000 km (25 000 miles)

CO-TEST

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

VENTING FILTER (only U.S.A)

Changing intervals	40 000 km (25 000 miles)

COOLING SYSTEM

Type	Sealed system	
Radiator cap valve opens at	0.7 kp/cm² (10.0 p s i)	
Capacity	Approx. 10 dm³ (2.2 Imp. galls = 2.6 US galls)	
Fan belt, designation	HC - 38×888	
car with right-hand drive	HC - 38×988	
Fan belt tension: the force for a depression of 10 mm (3/8") between the pulleys should be, with l.h.d.	70—100 N (15.5—22.0 lb.)	
r.h.d.	55—70 N (12.0—15.5 lb.)	
Thermostat	Type 1	Type 2
Type	Wax	Wax
Marking	170	82°
Begins opening at	75—78° C (168—172° F)	81—83° C (177—181° F)
Fully open at	89° C (192° F)	90° C (195° F)

WEAR TOLERANCES

CYLINDERS:

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

CRANKSHAFT

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

VALVES

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

CAMSHAFT

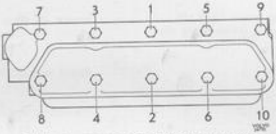
Permissible out-of-round (with new bearings) max.	0.07 mm (0.0028")
Bearings, permissible wear, max.	0.02 mm (0.0008")

TIMING GEARS

Permissible backlash, max.	0.12 mm (0.0048")

TIGHTENING TORQUES

	Nm	Lb. ft.
Cylinder head (oiled screws)	90	65
Main bearings	120—130	87—94
Big-end bearings	52—58	38—42
Flywheel	50—55	36—40
Spark plugs	35—40	25—29
Camshaft nut	130—150	94—108
Bolt for crankshaft pulley	70—80	50—58
Alternator bolt (1/2")	70—85	50—60
Nipple for oil filter	45—55	32—40
Sump bolts	8—11	6—8



Tightening sequence for cylinder head bolts

Tightened in 3 stages. 1st stage: 40 Nm (29 lbft) 2nd stage: 80 Nm (58 lbft) 3rd stage: 90 Nm (65 lbft) after driving car for 10 minutes.

ELECTRICAL SYSTEM

BATTERY

Type	Tudor 6 EX 3 op or equivalent
Grounded	Negative terminal
System voltage	12V
Battery, capacity, standard	60 Ah
Specific gravity of electrolyte:	
Fully charged battery	1.28
When recharging is necessary	1.21
Recommended charging current	5.5 A

ALTERNATOR

B 20 A, l-h steering	Bosch 14 V 35 A
B 20 A, r-h steering	Marshall 14 V 35 A
B 20 B and D, l-h and r-h steering	Marshall 14 V 35 A
B 20 E and F	Marshall 14 V 55 A

S. E. V. MARSHALL A - 14/30

Output	490 W
Max. amperage	35 A
Max. speed	250 r/s (15000 r/m)
Direction of rotation	Optional
Ratio: engine — alternator	1:2
Min. length, brushes	5 mm (0.2")
Tightening torque: Attaching screws	28—30 Nm (2.0—2.2 lb ft)
Nut for pulley	40 Nm (29 lb ft)

Test values

Field winding resistance	5.2±0.2 ohm
Voltage drop across isolating diode	0.8—0.9 V
Output test	30 A (min. at 50 r/s = 3000 r/m and approx. 13 V)

S. E. V. MARSHALL 14 V - 34833 (14 V 55 A)

Output	770 W
Max. amperage	55 A
Max. speed	250 r/s (15 000 r/m)
Direction of rotation	optional
Min. length, brushes	5 mm (0.2")
Tightening torque:	
Attaching screws	2.8—3.0 Nm (2.0—2.2 lb ft)
Nut for pulley	40 Nm (29 lb ft)

Test values

Field winding resistance	3.7 ohms
Voltage drop across isolating diode	0.8—0.9 V
Output test	48 A (min. at 50 r/s = 3000 r/m and approx. 14 V)

BOSCH K 1 - 14 V 35 A 20

Output	490 W
Max. amperage	35 A
Max. speed	200 r/s (12 000 r/m)
Direction of rotation	Clockwise
Ratio, engine — alternator	1:2
Min. diameter of slip rings	31.5 mm (1.24")
Max. permissible radial throw on, slip rings	0.03 mm (0.0012")
rotor body	0.05 mm (0.0020")
Min. length of brushes	8 mm (0.31")
Brush pressure	3—4 N (6.6—8.8 lb.)
Tightening torque for pulley	35—40 Nm (25—29 lb ft)

Test values

Resistance in, stator	0.26 + 0.03 ohm
rotor	4.0 + 0.4 ohm
Output test	35 A (min. at 100 r/s = 6000 r/m and 14 V)

VOLTAGE REGULATOR

S. E. V. MOTOROLA 14 V - 33525

Control voltage, cold regulator	13.1—14.4 V
after driving 45 minutes	13.85—14.25 V

S. E. V. MOTOROLA 14 V - 33544

Control voltage, cold regulator	13.1—14.4 V
after driving 45 minutes	13.85—14.25 V

BOSCH AD - 14 V

Control voltage at 67 alternator r/s, (4000 r/m) cold regulator, read off within 30 seconds (lower two contacts)	14.0—15.0 V
Load current, lower two contacts	28—30 A
Control range (between two upper and lower contacts)	0—0.3 V
Load current, upper two contacts	3—8 A

STARTER MOTOR

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

TEST VALUES

Mechanical

Armature end float	0.05—0.30 mm (0.002—0.12")
Brush spring tension	11.5—13 N (2.53—2.86 lb.)
Distance from pinion to ring gear	1.2—4.4 mm (0.047—0.173")
Frictional torque of rotor brake	0.25—0.40 Nm (2.17—3.81 lb in)
Pinion idling torque	0.13—0.18 Nm (1.13—1.56 lb in)
Backlash	0.35—0.60 mm (0.014—0.024")
Min. diameter of commutator	33 mm (1.29")
Min length of brushes	14 mm (0.55")

Electrical

Unloaded starter motor:	
12.0 volts and 40—50 amp.	115—135 r/s (6900—8100 r/s)
Loaded starter motor:	
9 volts and 185—220 amp.	17.5—22.5 r/s (1050—1350 r/m)
Locked starter motor:	
6 volts and 300—350 amp.	0 r/s

CONTROL SOLENOID

Cut-in voltage	Min. 8 V

IGNITION SYSTEM

Firing order	1-3-4-2

B 20 A:

Ignition timing, 97 octane (RON) at 10—13 engine r/s (600—800 r/m) (vacuum governor disconnected)	14° B T D C
Spark plugs	Bosch W 175 T 35 or corresponding
Tightening torque	35—40 Nm (25.3—29.0 lb ft)

B 20 B:

Ignition timing, 100 octane (RON) at 10—13 engine r/s (600—800 r/m) (vacuum governor disconnected)	10° B T D C
Spark plugs	Bosch W 200 T 35 or corresponding
Tightening torque	35—40 Nm (25.3—29.0 lb ft)

B 20 E:

Ignition timing, 97 octane (RON) at 10—13 engine r/s (600—800 r/m) (vacuum governor disconnected)	10° B T D C
Spark plugs	Bosch W 240 T 35 or corresponding
Tightening torque	35—40 Nm (25.3—29.0 lb ft)

B 20 F

Ignition timing, 94 octane (RON) at 10—13 engine r/s (600—800 r/m) (vacuum governor disconnected)	10° B T D C
Spark plugs	Bosch W 200 T 35 or corresponding
Tightening torque	35—40 Nm (25.3—29.0 lb ft)

DISTRIBUTOR

B 20 A:

Type	Bosch JFUR 4
Direction of rotation	Anti-clockwise
Breaker point, gap	Min. 0.35 mm (0.014")
dwell angle	59—65°
contact force	5.0—6.3 N (1.10—1.40 lb)
Centrifugal governor:	
Advance, total	13±1 degrees (distributor)
Advance begins at	5—8.3 r/s (300—500 distr. r/m)
Values 5°	12.5—15.8 r/s (750—950 distr. r/m)
10°	20.3—29.2 r/s (1220—1750 distr. r/m)
Advance finishes at	40 r/s (2400 distr. r/m)

Vacuum governor:	
Advance total	5±1 degrees (distributor)
Advance begins at	60—100 mm (2.36—3.96") Hg
Values 3°	105—145 mm (4.13—5.71") Hg
Advance finishes at	105—160 mm (5.91—6.30") Hg

B 20 B:

Type	Bosch JFUR 4
Direction of rotation	Anti-clockwise
Breaker point, gap	0.35 mm (0.014")
dwell angle (8.3 r/s=500 r/m)	59—65°
contact force	5.0—6.3 N (1.10—1.40 lb)
Centrifugal governor:	
Advance, total	10.0±1.0 degrees (distributor)
Advance begins at	8.3—10.0 r/s (500—600 distr. r/m)
Values 5°	11.2—12.7 r/s (675—760 distr. r/m)
10°	18.8—29.1 rs (1130—1750 distr. r/m)
Advance finishes at	30.0 r/s (1800 distr. r/m)
Vacuum governor:	
Retard, total	3±0.5 degrees (distributor)
Retard, begins at	160—240 mm (5.91—9.45") Hg
Values 2°	230—305 mm (9.06—12.0") Hg
Retard finishes at	280—320 mm (11.0—12.6") Hg

B 20 E

Type	Bosch JFURX 4
Direction of rotation	Anti-clockwise
Breaker point, gap	0.35 mm (0.014")
dwell angle (at 8.3 r/s=500 r/m)	59—65°
contact force	5.0—6.3 N (1.10—1.40 lb)
Centrifugal governor:	
Advance, total	11.0±1 degrees (distributor)
Advance begins at	6.3—9.2 r/s (375—550 distr. r/m)
Values 5°	13.3—16.2 r/s (800—970 distr. r/m)
7°	16.2—19.0 r/s (970—1140 distr. r/m)
9°	20.0—23.0 r/s (1200—1375 distr. r/m)
Advance finishes at	23.0 r/s (1380 distr. r/m)
Vacuum governor: (negative control)	
Retard, total	5±1 degrees (distributor)
Retard, begins at	30—110 mm (1.18—4.33") Hg
Values 3°	80—125 mm (3.15—4.92") Hg
Retard finishes at	130 mm (5.12") Hg

B 20 F

Type	Bosch JFUX 4
Direction of rotation	Anti-clockwise
Breaker point, gap	0.35 mm (0.014")
dwell angle at 8.3 r/s (500 r/m)	59—65°
contact force	5.0—6.3 N (1.10—1.40 lb)
Centrifugal governor:	
Advance, total	12±1 degrees (distributor)
Advance begins at	7.0—8.8 distr. r/s (420—530 r/m)
Valves 5°	13.8—16.4 distr. r/s (830—980 r/m)
7°	16.6—19.2 distr. r/s (1000—1150 r/m)
10°	24.2—33.0 distr. r/s (1950—1980 r/m)
Advance finishes at	41.7 distr. r/s (2500 r/m)
Vacuum governor: (negative control)	
Retard, total	5±1 degrees (distributor)
Retard, begins at	30—110 mm (1.18—4.33") Hg
Values 3°	80—125 mm (3.15—4.92") Hg
Retard finishes at	130 mm (5.12") Hg

LAMP BULBS

	Power	Socket	Number
Headlights	45/40 W	P 45 t	2
Parking lights, front	5 W	S 8	2
rear	5 W (4 cp)	Ba 15 s	2
Flashers, front and rear	32 cp	Ba 15 s	4
Stop lights	25 W (32 cp)	Ba 15 s	2
Reversing lights	15 W (32 cp)	Ba 15 s	2
Side marker lamps	5 W	Ba 15 s	4
License plate light	5 W	S 8	2
Interior lighting	10 W	S 8	1 (145,2
Glove compartment light	2 W	Ba 9 s	1
Instrument lighting, combined instrument	2 W	W 2.2 d	3
clock	2 W	Ba 7 s	1
Lighting, heater controls	1.2 W	W 1.8 d	3
Control panel lighting	1.2 W	W 1.8 d	3
Gear selector lighting	1.2 W	W 1.8 d	1
Warning lamp, charging	1.2 W	W 1.8 d	1
turn indicators	1.2 W	W 1.8 d	1
parking brake	1.2 W	W 1.8 d	1
headlights	1.2 W	W 1.8 d	1
oil pressure	1.2 W	W 1.8 d	1
electrically heated rear window 142, 144	1.2 W	W 1.8 d	1
145	2 W	Ba 7 s	1
hazard warning signal flasher	1.2 W	W 1.8 d	1
overdrive	1.2 W	W 1.8 d	1
choke	1.2 W	W 1.8 d	1

FUSES

	Number
Rated current 8 A	3
5 A	7
16 A	2

ELECTRICALLY HEATED REAR WINDOW

142, 144, 145

Output .... 150 W

INSTRUMENTS

SPEEDOMETER GEARS

Tyre 165 S 15 and 165 S R 15

Vehicle	Gearbox	Final drive red. ratio	Small S-gear		Large S-gear		Ratio	Error %
			Part No.	Teeth	Part No.	Teeth		
142, 144	M 40	4.10:1	380164	16	380449	5	3.2	+3.44
142, 144, 145	M 40	4.30:1	380166	17	380449	5	3.4	+2.15
142, 144, 145	M 41	4.30:1	380753	20	380682	6	3.33	+4.20
142, 144, 145	BW 35	4.10:1	380164	16	381106	5	3.2	+3.44

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 km p h (50 m p h). Number of speedometer cable revolutions per km (mile) registered: 640 (1030).

Tyre 6.85-15

Vehicle	Gearbox	Final drive red. ratio	Small S-gear		Large S-gear		Ratio	Error %
			Part No.	Teeth	Part No.	Teeth		
142, 144	M 40	4.10:1	380164	16	380449	5	3.2	+2.19
142, 144, 145	M 40	4.30:1	380166	17	380449	5	3.4	+0.86
142, 144, 145	M 41	4.30:1	380753	20	380682	6	3.33	+2.88
142, 144, 145	BW 35	4.10:1	380164	16	381106	5	3.2	+2.19

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 km p h (50 m p h). Number of speedometer cable revolutions per km (mile) registered: 640 (1030).

POWER TRANSMISSION, REAR AXLE

CLUTCH

Clutch, type	Single dry plate, diaphragm spring
Size	8½"
Clutch friction area, total	440 cm² (68.2 sq.in.)
Clutch pedal travel LHD	150 mm (6.0")
RHD	160 mm (6.4")
Throw-out yoke travel	3 mm (0.12")

GEARBOX

M 40

Type designation	M 40
Reduction ratios:	
1st speed	3.41:1
2nd speed	1.99:1
3rd speed	1.36:1
4th speed	1:1
Reverse	3.25:1
Lubricant, see under "Lubrication"	
Oil capacity	0.75 cm³ (1.3 Imp. pints = 1.6 US pints)

Tightening torque	Nm	Lb ft
Nut for driving flange	95—105	65—75

M 41 (GEARBOX M 40 WITH OVERDRIVE)

Reduction ratio, overdrive	0.797:1
Clearance, piston-cylinder in oil pump	0.005—0.040 mm (0.0002—0.0016")
Oil pressure, direct drive	approx. 1.5 kp/cm² (21 p s i)
overdrive	32—35 kp/cm² (455—500 p s i)
Lubricant, see under "Lubrication"	
Oil capacity, gearbox and overdrive	1.6 dm³ (2.8 Imp. pints = 3.4 US pints)

TIGHTENING TORQUE

Nut for driving flange	110—140 Nm 80—100 lbft

AUTOMATIC TRANSMISSION

Make and type	Borg-Warner, type 35
Type designation, B 20 A engine	327
B 20 B engine	325
B 20 E engine	321
B 20 F engine	351 H
Colour of type plate, B 20 A engine	Yellow
B 20 B engine	Bright-green
B 20 E engine	Grey
B 20 F engine	Light orange
Reduction ratios:	
1st gear	2.31:1 × Converter ratios
2nd gear	1.45:1 × Converter ratios
3rd gear	1:1 × Converter ratios
Reverse	2.09:1 × 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	9½" (24 cm)
Torque ratio in converter	2:1—1:1
Normal stall speed, B 20 A engine	36.7 r/s (2200 r/m)
B 20 B engine	35.0 r/s (2100 r/m)
B 20 E engine	42.5 r/s (2550 r/m)
B 20 F engine	40.8 r/s (2450 r/m)
Weights total, with fluid	53.1 kg (117 lb)
Fluid, type	Automatic Transmission Fluid, Type F
Fluid capacity	6.4 dm³ (11.4 Imp. pints = 13.5 US pints)
Normal operating temperature of fluid	approx. 212—240° F (110—115° C)

APPROXIMATE SHIFT SPEEDS AT KICK-DOWN

Car	Engine	Rear axle ratio	1—2 shift		2—3 shift		3—2 shift		3—1 shift	
			km p h	m p h	km p h	m p h	km p h	m p h	km p h	m p h
142, 144	B 20 A	4.10:1	60	37	95	59	86	53	max 49	30
	B 20 B	4.10:1	63	39	105	65	94	58	max 49	30
	B 20 E, F	4.10:1	60	37	108	67	98	—	max 49	30
	B 20 E, F	3.91:1	63	39	112	70	102	63	max 49	30

SPRINGS FOR CONTROL SYSTEM

SPRING	Approximate length		Effective Number of turns	Wire diameter
1—2 shift valve	27.8 mm	1.094"	13½	6.61 mm
Primary regulator valve, B 20 A	72.4 mm	2.850"	14¼	1.37 mm
B 20 B, E, F	74.7 mm	2.940"	14	1.42 mm
*) Primary regulator valve, B 20 A	72.4 mm	2.850"	15	1.42 mm
Servo orifice control valve	27.6 mm	1.086"	24	0.64 mm
*) Servo orifice control valve	30.8 mm	1.213"	25	0.61 mm
Modulator valve	27.2 mm	1.069"	19	0.71 mm
*) Modulator valve	27.2 mm	1.069"	19	0.71 mm
Secondary regulator valve	65.9 mm	2.593"	18	1.42 mm
2—3 shift valve (inner spring)	40.4 mm	1.59"	22½	0.91 mm
Throttle valve (inner spring)	20.5 mm	0.907"	28	0.46 mm
*) Throttle valve (inner spring)	20.5 mm	0.907"	25	0.46 mm
Throttle valve (outer spring)	29.8 —	1.107—	19½	0.81 mm
*) Throttle valve (outer spring)	30.1 mm	1.185"		
Governor valve	29.8 —	1.107—	18	0.81 mm
*) Alternative springs	30.1 mm	1.185"		

TIGHTENING TORQUES

APPLICATION	Nm	Lb ft
Torque converter — drive plate	35—41	25—30
Transmission case — converter housing	11—18	8—13
Extension housing — transmission case	41—76	30—55
Oil pan — transmission case	11—18	8—13
Front servo — transmission case	11—18	8—13
Rear servo — transmission case	18—37	13—27
Pump adaptor — front pump body	24—30	17—22
Slotted screws	3—4	2—3
Pump adaptor — transmission case	11—26	8—18.5
Oil deflector flange — transmission case	6—10	4—7
Center support — transmission case	14—25	10—18
Outer lever — manual valve shaft	10—12	7—9
Pressure point	6—7	4—5
Oil pan drain plug	12—17	9—12
Oil tube collector — lower body	2.5—3.5	1.7—2.5
Governor line plate — lower body	2.5—3.5	1.7—2.5
Lower body end plate — lower body	2.5—3.5	1.7—2.5
Upper body end plate front or rear — upper body	2.5—3.5	1.7—2.5
Upper body — lower body	2.5—3.5	1.7—2.5
Valve bodies assembly — transmission case	6—12	4.5—9
Front pump strainer — lower body	2.5—3.5	1.7—2.5
Downshift valve cam bracket — valve body	2.5—5.0	1.7—3.5
Governor		
Governor body — counterweight	6—7	4—5
Cover plate — governor body	2.5—5.5	1.7—4.0
Brake band adjustment		
Adjusting screw locking nut, rear servo — case	41—55	30—40

Special threaded parts

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

REAR AXLE

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

FINAL DRIVE

Type	Hypoid
Reduction ratio	3.91:1, 4.10:1 or 4.30:1
Warp, crown wheel	max. 0.08 mm (0.0032")
Backlash	0.15—0.20 mm (0.003—0.008")
Pre-loading on pinion bearings, new bearings	1.1—2.3 Nm (9.55—20 lb in)
run-in bearings	0.6—1.1 Nm (5.21—9.55 lb in)
Pre-loading on differential bearings	0.13—0.20 mm (0.005—0.008")
Lubricant, see under "Lubrication"	
Oil capacity	1.3 dm³ (2.3 Imp. pints = 2.7 US pints)

TIGHTENING TORQUES	Nm	Lb ft
Flange	280—300	200—220
Caps	50—70	35—50
Crown wheel	65—90	45—65
Wheel nuts	100—140	70—100

BRAKES

FRONT WHEEL BRAKES

Type	Disc brakes
Brake discs:	
Outside diameter	272.2 mm (10.7")
Thickness new, B 20 E	14.28—14.4 mm (0.562—0.567")
other engines	12.7—12.8 mm (0.500—0.504")
reconditioned, B 20 E	min. 13.14 mm (0.557")
other engines	min. 11.6 mm (0.457")
Warp	max. 0.10 mm (0.004")
Brake linings:	
Thickness, new	10 mm (0.394")
Effective area, Girling	150 cm² (23 sq in)
ATE	140 cm² (22.5 sq in)
Wheel unit cylinders:	
Area, Girling	10.25 cm² (1.6 sq in)
ATE	10.17 cm² (1.5 sq in)

REAR WHEEL BRAKES

Type	Disc brakes
Brake discs:	
Outside diameter	295.5 mm (11.63")
Thickness, new	9.6 mm (0.378")
reconditioned	min. 8.4 mm (0.331")
Warp	max. 0.15 mm (0.006")
Brake linings:	
Thickness, new	10 mm (0.394")
Effective area, Girling	100 cm² (15.5 sq in)
ATE	105 cm² (16.3 sq in)
Wheel unit cylinders:	
Area, Girling	11.43 cm² (1.8 sq in)
ATE	11.33 cm² (1.7 sq in)

MASTER CYLINDER

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

BRAKE VALVE

Operating pressure, 142 and 144	34±2 kp/cm^2 (484±28.4 p s i)
Operating pressure, 145	50±2 kp/cm^2 (711±28.4 p s i)

POWER CYLINDER

Type	Direct operating
Make	Girling
Designation	FD type 50
Ratio	1:3

PARKING BRAKE

Brake drum:	
Diameter	Max. 178.33 mm (7.0")
Radial throw	Max. 0.15 mm (0.006")
Out-of-round	Max. 0.2 mm (0.008")
Brake linings, effective area	175 cm^2 (27 sq in)

TIGHTENING TORQUES

	Nm	Lb ft
Attaching bolts, front brake caliper	90—100	65—70
Attaching bolts, rear brake caliper	60—70	45—50
Wheel nuts	100—140	70—100
Stop screw, master cylinder	10—12	7—9
Attaching nuts, master cylinder	24	17
Bleeder nipples	4—6	3—4.5
Brake hose, front brake caliper	16—20	12—15
Warning valve, switch	14—20	10—15
Brake pipes	11—15	8—11
Plug, brake valve	100—120	70—85
Locknut, brake valve	25—35	18—25

FRONT END AND STEERING GEAR

WHEEL ALIGNMENT (UNLOADED VEHICLE)

Caster	+1° to +2°
Camber	0 to +0.5°
King pin inclination at a camber of 0°	7.5°
Toe-in	2 to 5 mm (0.08—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")

MECHANICAL STEERING GEAR

Number of turns from lock to lock	4.15
Steering gear reduction ratio	17.5:1
Lubricant, see under "Lubrication"	
Oil capacity	approx. 0.25 dm^3 (0.4 Imp. pint=0.5 US pint)

POWER STEERING

Steering wheel diameter	404 mm (15.9")
No. of steering wheel turns, lock to lock	3.7
Steering gear:	
Make and type	ZF, ball-nut type
Reduction ratio	15.7:1
Bearing for steering spindle:	
Needle diameter, part Nos.: 681348	1.992—1.994 mm (0.0784—0.0785")
681357	1.994—1.996 mm (0.0785—0.0786")
681356	1.996—1.998 mm (0.0786—0.0787")
681355	1.998—2.000 mm (0.0787—0.0790")
Bearing sleeve, ext. diameter, alt.	28.0 and 28.15 mm (1.10 and 1.11")
Washer for axial bearing, alt.	1.9—2.4 mm (th.diff. 0.1 mm = 0.039") /0.075—0.095"
Packing at worm, thickness, alt.	1.7 and 1.8 mm (0.067 and 0.075")
Balls, piston — worm, No.	23
diameter, alt.	6.989 mm (0.2752") 6.996 mm (0.2754") 7.000 mm (0.2756") 7.008 mm (0.2760") 7.012 mm (0.2761")
Washer for adjuster screw, thickness, alt.	2.15—2.45 mm (0.085—0.096")/ th.diff. 0.05 mm = 0.002"
Power pump:	
Make and type	ZF, vane type
Max. pressure	75±5 kp/cm² (1066±71 psi)
Theoretical capacity at 83 r/s (500 r/m)	6.65 dm³/min.
Regulated capacity	5—8 dm³/min.
Drive	Belt-driven
Ratio, engine — pump	1:1
Type of oil	Automatic Transmission Fluid, Type A or Dexron
Oil capacity	approx. 1.2 liters (2.1 Imp.pints = 2.5 US pints)

TIGHTENING TORQUES

	Nm	Lb ft
Nut, engine mounting	21—25	15—18
Nut, steering knuckle	70	50
Nut, upper control arm shaft	55—62	40—45
Nut, lower control arm shaft	140—180	100—130
Bolt for upper control arm shaft	55—70	40—50
Nut, upper ball point	85—100	60—70
Nut, lower ball joint	100—120	75—90
Steering wheel nut	28—40	20—30
Mechanical steering:		
Worm, upper cover	17—21	13—15
Power steering:		
Worm, valve housing	34	25
Worm, upper cover	31	22
Nut, adjuster screw	25	18
Nut for pitman arm	170—200	125—145
Attaching nut, steering box and idler arm shaft	35—40	25—30
Locknut for tie rod	75—90	55—65
Nut for steering rod and tie rod M 10	32—37	23—27
3/8—24 UNF	32—37	23—27
7/16—20 UNF	48—62	35—45
Wheel nut	100—140	70—100

SUSPENSION, WHEELS

SPRINGS

FRONT SPRINGS

Type	Helical spring
Wire thickness	15.0 mm (0.59")
Outer diameter	126.0 mm (4.96")
Total number of turns	8.7
Test values:	
Loading for a compression of 1 cm (25/64") (measured within a spring length of 185.5—205.5 mm=7.3—8.1")	527—567 N (115—125 lb)
Length, fully compressed	max. 125 mm (4.9")
Length when loaded with 5400—5700 N (1188—1254 lb)	195.5 mm (7.7")

REAR SPRINGS

	142—144	
Type	Standard	Optional
Wire diameter	Helical spring	Helical spring
External diameter	12.1 mm (0.48")	12.64 mm (0.50")
Number of effective turns	127.1 mm (5.0")	127.60 mm (5.0")
Test values:	8.9	8.5
Loading (for a compression of 1 cm=0.4")	158—168 N (35—37 lb)	199—209 N (44—46.0 lb)
within a spring length of	272—322 mm (10.7—12.7")	258—308 mm (10.15—12.12")
Length, fully compressed	max. 114.9 mm (4.52")	max. 116 mm (4.6")
Load/spring length	2110—2250 N/97 mm (464—495 lb/3.81")	2170—2320 N/283 mm (477—510 lb/11.0")

REAR SPRINGS

	145 HV	145 SV
Type	Helical spring	
Wire diameter	12.85 mm (0.51")	13.10 mm (0.52")
External diameter	127.9 mm (5.1")	127.0 mm (5.0")
Number of effective turns	9.0	8.6
Test values:		
Loading (for a compression of 1 cm=0.4")	196—212 N (43—47 lb)	231—247 N (51—54 lb)
within a spring length of	270—320 mm (10.6—12.6")	280—330 mm (11.0—13.0")
Length, fully compressed	max. 127 mm (5.0")	max. 121 mm (4.8")
Load/spring length	2420—2570 N/295 mm (532—565 lb/11.6")	2360—2500 N/305 mm (519—550 lb/12.0")

SHOCK ABSORBERS

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

Type	Disc
Designation: 142, 144 de Luxe and Grand Luxe	5 J×15 L
145 de Luxe	5 J×15 H
142, 144	4.5 J×15 L
145 and 145 Express	4.5 J×15 H
Radial throw	max. 1.6 mm (0.063")
Warp	max. 1.6 mm (0.063")
Imbalance, complete wheel	0.09 Nm (7.8 lb in)
Tightening torque for wheel nuts	100—140 Nm (72—101 lb ft)

TYRES

Type	Tubeless
Size, 142, 144	165 SR 15-4-PR
145	165 S 15-8-PR, 165 SR 15-4-PR
USA	6.85 S 15-8-PR

BODY

AIR CONDITIONING SYSTEM

Refrigerant, type	Freon 12 (dichlorodifluoromethane)
Compressor, type	York A 209
number of cylinders	2
max. speed	100 r/s (6000 r/m)
lubricating oil capacity	0.3 dm³ (0.6 pint)
lubricating oil, type	Refrigerant compressor oil e.g.: SUNISO 5, BP ENERGOL LPT 100, SHELL CLAVUS 33, TEXACO CAPPELLA E 500
Compressor clutch, type	Electro-magnetic
Compressor belt size	HC 50×1350

TIGHTENING TORQUES

Pulley on engine crankshaft	140—180 Nm	(101—130 lbft)
Pulley on compressor	25—30 Nm	(18—22 lbft)
Oil plug on compressor	5 Nm	(36 lbft)
Unions for refrigerant hoses	42 Nm	(30 lbft)
Union for expansion valve	42 Nm	(30 lbft)
Expansion valve pressure equalizing pipe	28 Nm	(20 lbft)

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 immediately after the car has been driven and while the engine is still warm. To drain the oil, remove the oil drain plug, see Fig. 1-1. When the engine has been emptied of oil, 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 temperatures (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).

Fig. 1-1. Drain plug on sump

The quantity of oil changed is 3.25 dm³ (5.7 Imp. pints = 6.9 US pints). When the oil filter included, the corresponding quantity is 3.75 dm³ (6.6 Imp. pints = 7.9 US pints.)

Carburetors

Each time the oil in the engine is changed, check the oil level in the center spindle of the carburetors to see that it is about 6 mm (1/4") from the top of the spindle. If it is not, fill up with ATF oil.

Fig. 1-2. Checking center spindle oil level

GEARBOX (WITHOUT OVERDRIVE)

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

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 be subsequently 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. 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 80 is used for the gearbox all the year round. As an alternative, engine oil, with vis-

Fig. 1-3. Gearbox

1. Filler plug 2. Drain plug

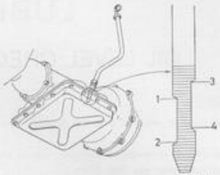


Fig. 1-5. Checking oil level

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

cosity SAE 30, can be used all the year round. The quantity of oil changed is 0.75 dm³ (1.3 Imp. pints = 1.6 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 plug hole.

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

Drain off the old oil after the car has been driven and while the oil is still warm. Observe due care since the hot oil can scald. To empty the oil, remove the plugs (1 and 2, Fig. 1-3) and the cover (Fig. 1-4). Also clean the oil filters, see 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 be up to the filler hole (1, Fig. 1-3). Screw tight the filler plug. Engine oil with viscosity SAE 30 is used all the year round for gearboxes with overdrive. As an alternative, multigrade oil SAE 20 W-40 can be used. The oil change quantity is 1.6 dm³ (2.8 Imp. pints = 3.4 US pints).

Fig. 1-4. Overdrive

AUTOMATIC TRANSMISSION

Normally the oil in the automatic transmission only needs to be changed when the transmission is reconditioned. The oil level, on the other hand, should be checked after every 10 000 km (6 000 miles).

When about to carry out the oil level check, make sure that the vehicle is on level ground. Move the selector lever to position "P" and let the engine run at idle. The filler pipe with dipstick is located in front of the bulkhead on the right-hand side of the engine. Wipe off the dipstick with a cloth or piece of paper. Do not use waste or fluffy rags. Insert the dipstick, pull it up and check the oil level, see Fig. 1-5. **Note that there are different levels for a warm and cold transmission.** For a warm transmission, which is the case after driving about 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 with oil up to the "Max" mark. Do not go above this mark, as this can cause the transmission to eventually overheat. The difference between the "Min" and "Max" marks is about 0.5 dm³ (1 pint). For topping-up, use Automatic Transmission Fluid, ATF, Type F, that is, a fluid meeting Ford specification M2C 33F. Frequent filling up of the transmission indicates leakage which must be put right immediately.

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

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 thereafter be carried out only when overhauling is being done.

The oil should preferably be changed immediately after the vehicle has been driven and while the oil is still warm. When draining the oil, remove the plugs marked 1 and 2 in Fig. 1-6. Clean the magnetic plug (2) well. It is of great importance for the lifetime of the final drive that particles and other impurities accumulated during the running-in are removed.

Fill up with new oil after the drain plug has been screwed tightly back into position.

The oil should be up to the filler hole and the quantity of oil changed is about 1.3 dm³ (2.3 Imp. pints = 2.7 US pints). Oil which meets the requirements of the American Military Standard MIL-L-2105 B, SAE 90, is used as changing oil in the final drive. A final drive fitted with a limited slip is filled at the factory with a transmission fluid which meets the requirements of the American Military Standard MIL-L-2105 B provided with an additive for final drives with limited slip. For subsequent topping-up and when changing, oil is according to MIL-L-2105 B having the above-mentioned additive. The oil level should be checked and the oil changed at the same intervals and in the same way as for a final drive without a limited slip.

STEERING GEAR, MECHANICAL STEERING

To check the oil level in the steering gear, remove the filler plug (Fig. 1-7) and then check to ensure that the oil is up to the hole for the plug.

Normally it is not necessary to change the oil in the steering gear except after reconditioning. However, should the oil have to be changed for any reason, the old oil can be sucked out by using a suitable device, for example, an oil syringe, which is inserted through the filler hole. The steering gear can also be removed and emptied. Hypoid oil SAE 80 is used all the year round for the steering gear.

When empty, the steering gear can be filled with 0.25 dm³ (1/2 pint).

POWER STEERING

CHECKING OIL LEVEL

The oil level should be checked every 10 000 km (6 000 miles). First check the level with the engine stopped to check possible oil loss. The oil level

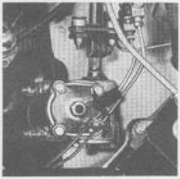


Fig. 1-7. Steering gear

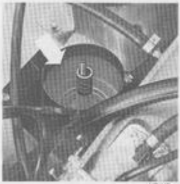


Fig. 1-8. Oil level

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 stopped 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. 1-8. When the engine has stopped, the level should rise to about 5—10 mm (5/8") above the mark.

OIL CHANGING

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

CHECKING BRAKE FLUID LEVEL

This check can be made without having to take off the filler cap (Fig. 1-16). If the check is carried out in connection with a visit to a workshop, brake fluid should be added if the level is lower than the "Max" mark. Under no circumstances may the level be allowed to remain 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 brake fluid. Avoid spilling any fluid onto the paintwork since this will damage it. Check to make sure that the vent hole in the cap is not blocked.

LUBRICATION

DISTRIBUTOR

Lubricate the distributor after every 10 000 km (6 000 miles). The distributor shaft is lubricated by filling the oil cup (3, Fig. 1-9) with engine oil. After filling, close the cup. The contact surface of the cam (2) 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 should be filled with multipurpose grease (universal grease).

Fig. 1-10. Lubricating slide rails

BODY

To avoid squeaking and unnecessary wear, the body should be lubricated as described in the lubricating schedule on next page. Nos. 2, 7, 9 and 10 of the schedule concern lubrication approx. every 10 000 km (6 000 miles) and other parts of the body about once a year. Moreover, during winter the door handles and trunk lid lock should be lubricated with a suitable lock oil which would prevent them from freezing up.

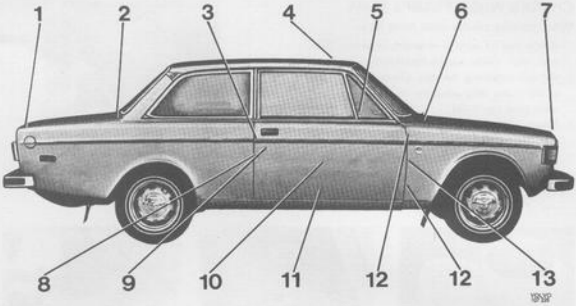


Fig. 1-11. Lubricating points on body

No.	Lubricating point	Lubricant	No.	Lubricating point	Lubricant
1	Trunk lid lock	Oil	8	Striker plate	See Fig. 1-13
	Keyholes	Lock oil	9	Keyholes	Lock oil
2	Trunk lid hinges	Oil	10	Window winders	Oil and grease
3	Outer sliding surface of door lock	Paraffin wax	11	Front seat runners and catches	Paraffin wax and oil
4	Sun roof wind deflector	Oil	12	Door hinges	Grease
5	Ventilation window catch and hinges	Oil	13	Door stops	Paraffin wax
6	Hood hinges	Oil		Locks	Silicon grease
7	Hood catch	Paraffin wax		(Accessible after door upholstery panels heve been removed.)	

Fig. 1-12. Hinges
1. and 3. Hinges 2. Door stop

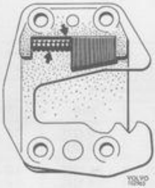


Fig. 1-13. Striker plate
Inner sliding surfaces, spring and pin lubricated with molybdenum disulphide grease

Fig. 1-14. Door lock with guide plate
Apply paraffin wax

CHECKS WHEN FILLING TANK

Make following checks when filling tank:

1. Check that oil level in engine is between "Max" and "Min" marks on the dipstick (see Fig. 1-15).
2. Without removing the cap, check that the level in the brake fluid container is above the "Min" mark (see Fig. 1-16).
3. Check that coolant level is between the "Max" and "Min" marks on the expansion tank (see Fig. 1-17).
4. Check that the fluid container for the windscreen washer is filled (see Fig. 1-18).

Fig. 1-15. Oil dipstick

Fig. 1-16. Brake fluid container

Fig. 1-17. Expansion tank

Fig. 1-18. Fluid container

The following checks should be made every other week:

1. Check that electrolyte level in battery is about 5 mm (3/16") above the plates (see Fig. 1-19). If necessary top up with **distilled** water. Also check that the battery and battery terminals are secure.
2. Check that the tyre pressure corresponds to the following values:

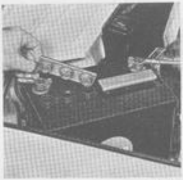


Fig. 1-19. Battery

Recommended tyre pressures

Model	Tyre size	Recommended tyre infl. pressure cold tyres, kp/cm² (psi)				Max. permitt. inflation pressure kp/cm² (psi)
		1—3 persons		Full load		
		Front	Rear	Front	Rear	
142, 144	165R15 C78-15 (4PR)	1.8 (26) 1.5 (21)	1.9 (27) 1.6 (23)	1.9 (27) 1.6 (23)	2.2 (32) 2.1 (30)	2.5 (36) 2.3 (32)
145	175R15 C78-15 (8PR)	1.7 (25) 1.5 (21)	1.8 (26) 1.8 (26)	1.8 (26) 1.6 (23)	2.8 (40) 2.7 (38)	2.8 (40) 2.8 (40)

For sustained high speed driving over 120 kmph (75 mph), cold inflation pressure must be increased 0.28 kp/cm² (4 psi), but not exceed the maximum permitted inflation pressure.

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
Concerning lubrication for final drive with limited slip, 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. 3.25 dm^3 (5.7 Imp. pints = 6.9 US pints)
including oil filter	approx. 3.75 dm^3 (6.6 Imp. pints = 7.9 US pints)
Gearbox	
without overdrive	approx. 0.75 dm^3 (1.3 Imp. pints = 1.6 US pints)
with overdrive	approx. 1.6 dm^3 (2.8 Imp. pints = 3.4 US pints)
Automatic transmission	approx. 6.4 dm^3 (11.3 Imp. pints = 13.5 US pints)
Final drive	approx. 1.3 dm^3 (2.3 Imp. pints = 2.7 US pints)
Steering gear	approx. 0.25 dm^3 (0.4 Imp. pint = 0.5 US pint)

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.

NOTES

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 oil level. See page 1:3.

Note 3. Check brake fluid level. See page 1:4.

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

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

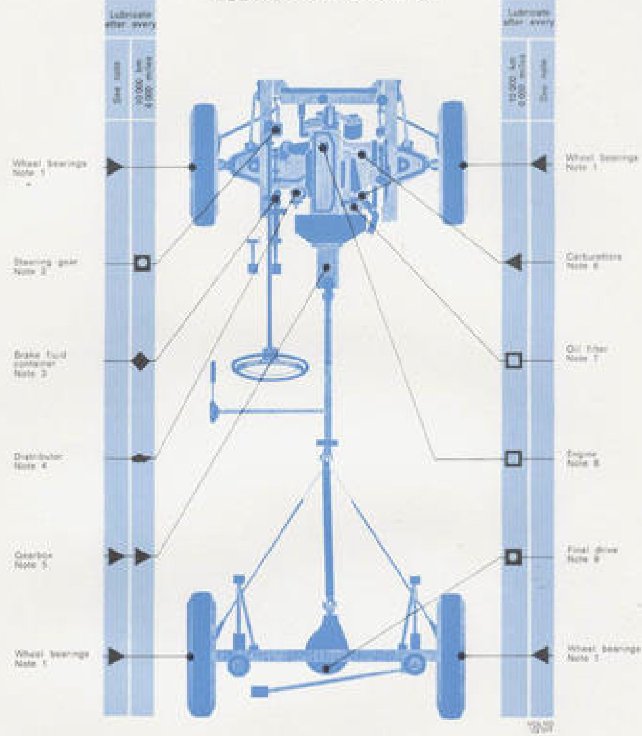
Note 6. Check oil level in the carburetors when changing the engine oil, see page 1:1.

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

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

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

LUBRICATING CHART 140



Part 2

ENGINE

CONTENTS

TOOLS

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

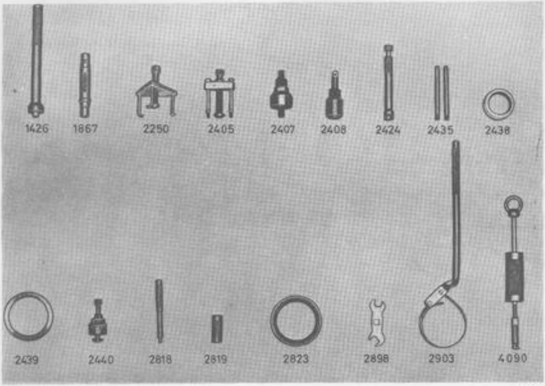


Fig. 2-1. Tools for engine

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

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

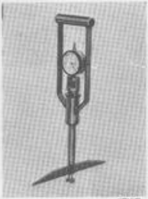


Fig. 2-2. 2906, fan belt tensioner

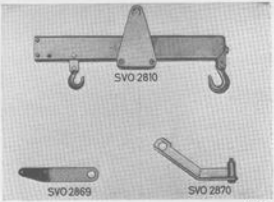


Fig. 2-3. Tools for removing engine

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

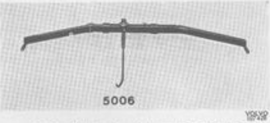


Fig. 2-5. Lifting tool used when removing oil sump.
5006 Lifting tool

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

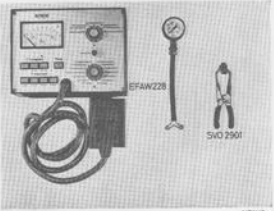


Fig. 2-6. Special tools for B 20 E/F
EFAW 228 Bosch test instrument with pressure gauge
2901 Pinchers, 4 (for pinching fuel lines)

GENERAL
DESCRIPTION

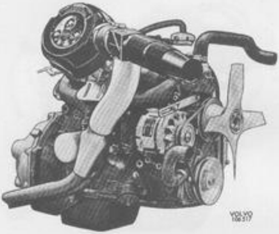


Fig. 2-7. Engine B 20 A viewed from right

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

The engine is a four-cylinder, water-cooled, overhead-valve unit with positive crankcase ventilation. The crankshaft is journalled in five bearings.

The difference in output between the various engines arises mainly from the different camshafts and compression ratios. The engines have a fuel system with low pollutant exhaust gases.

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

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

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

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

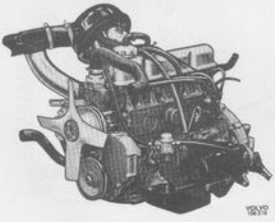


Fig. 2-9. Engine B 20 A viewed from left

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

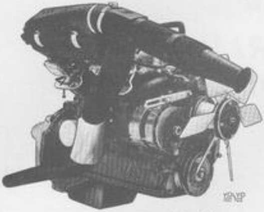


Fig. 2-10. Engine B 20 B viewed from right

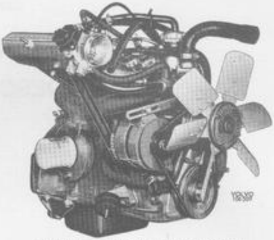


Fig. 2-12. Engine B 20 E (B 20 F) viewed from right

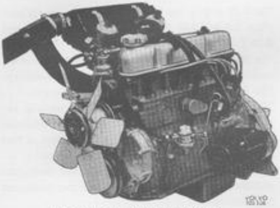


Fig. 2-11. Engine B 20 B viewed from left

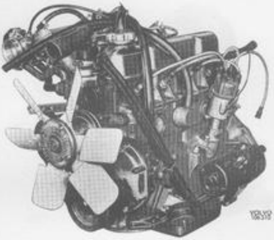
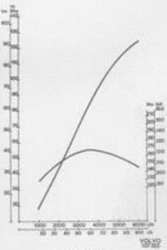
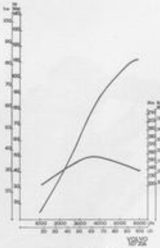


Fig. 2-13. Engine B 20 E (B 20 F) viewed from left

B 20 B (DIN)



B 20 E (DIN)



B 20 F (SAE J 245)

Fig. 2-14. Output and torque curves

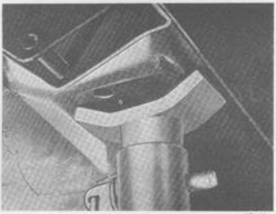


Fig. 2-15. Location of axle prop

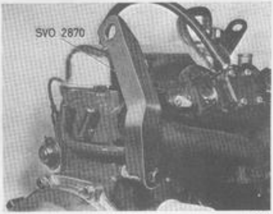


Fig. 2-17. Lifting lug on engine rear end

REMOVING ENGINE, B 20 A, B 20 B

1. Remove the gear lever.
2. Remove the bonnet (hood) from the hinges.
3. Empty the coolant.
4. Disconnect the positive lead from the battery. Remove the distributor cap and the ignition leads from the spark plugs. Remove the electric cable from the distributor. Remove the ignition coil and place it on the one side.
5. Disconnect the fuel hoses from the pump and plug the hose. Remove the electric cables from the starter motor.
6. Remove the air cleaner with air cleaner cover and lift it forwards together with the attached hoses. Remove the electric cables from the alternator and also the temperature and oil pressure tell-tale units.

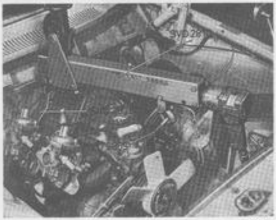


Fig. 2-16. Lifting out engine

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

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

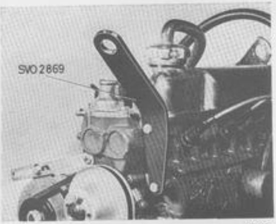


Fig. 2-18. Lifting lug on engine front end

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

INSTALLING ENGINE, B 20 A, B 20 B

1. Fit lifting arm 2869 and arm 2870. Install the engine in position with the help of lifting beam 2810.
   NOTE: Check that the exhaust manifold does not come into contact with the oil filter.
2. Fit the gearbox member.
3. Fit the earth (ground) cable. Install the speedometer hose as well as the propeller shaft.
4. Remove the lifting beam and lifting lugs from the engine. Fit the nuts for the engine front mountings.
5. Secure the exhaust manifold together with gasket and fit the preheating plate.
6. Fit the clutch wire sleeve and connect the wire to the lever. Fit the return spring. Adjust the clutch according to Part 4 (41).
7. Fit the clamp for the exhaust manifold. Lower the vehicle.
8. Connect the water hoses for the heater unit. Install the electric cables to the temperature and oil pressure tell-tale units as well as the alternator. Connect the electric cable for the backup light in the rapid contact. (Connect the electronic cable for the overdrive.)
9. Connect the vacuum hose. Fit the throttle control shaft, the throttle cable, the choke wire as well as the air cleaner casing. Connect the hoses to the air intake and preheating plate respectively.
10. Wire the electric cables to the starter motor and connect the fuel hose.
11. Fit the ignition coil, the distributor cap and the ignition leads as well as the electric cable.
12. Fit the radiator and connect the radiator hoses and hose for the expansion tank. Fill with coolant. Fill with engine oil.
13. Fit the bonnet (hood) and connect the battery lead. Fit the gear lever. Check function and for leakage.

REMOVING ENGINE, B 20 E, B 20 F

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

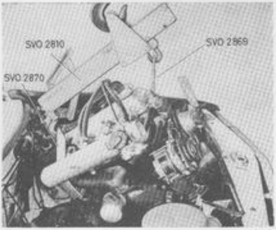


Fig. 2-19. Lifting out engine

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

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

INSTALLING ENGINE, B 20 E, B 20 F

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

REPLACING SUMP GASKET

1. Place the lifting tool 5006 shown in Fig. 2-20 and hook the hook round the alternator tensioning bar next to the engine block. Raise the front end of the engine until there is no weight on the engine mountings. Remove the oil dipstick.
2. Lift up the vehicle by propping up under the front jacking points. Drain off the engine oil.
3. Remove the lower nuts for the engine mountings. Remove the steering rods from the pitman arm and relay arm with tool 2294 according to Fig. 2-21.
4. Place a jack under the front axle member. Remove the rear bolts on the front axle member and screw on instead two auxiliary bolts (UNC 1/2—13×114). Remove the front bolts for the front axle member. Lower and remove

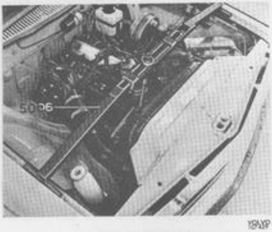


Fig. 2-20. Lifting tool 5006

the jack so that the front axle member is suspended in the two auxiliary bolts.

5. Remove the plug for the oil temperature gauge and reinforcing bracket at the flywheel housing.
6. Remove the bolts for the sump and lift off the sump.
7. Remove the old gasket and clean the contact surfaces of the cylinder block and sump.
8. Place the sump and gasket in position and fit the bolts. Tighten well the drain plug as well as the plug for the oil temperature gauge.

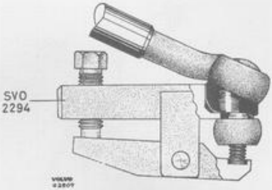


Fig. 2-21. Removing steering rod

9. Place the reinforcing bracket in position and tighten all the bolts by hand. Screw in firmly the bolts in the flywheel housing and then the bolts in the cylinder block.
10. Raise the front axle member, tighten the front bolts. Remove the auxiliary bolts, fit and tighten the rear bolts.
11. Fit the nuts for the engine mountings as well as the steering rods.
12. Remove the blocks from under the vehicle. Take off the lifting tool. Fit the bolt (with washer) for the timing gear casing.
13. Top up with oil and insert the oil dipstick.
14. Start the engine and check for leakage.

ENGINE
DESCRIPTION

CYLINDER BLOCK

The cylinder block (Illustration A) is made of special cast iron and is cast in a single unit. The cylinder bores, which are surrounded by cooling jackets, are machined directly in the block. The oilways in the block are arranged so that the oil filter, which is of the full-flow type, is directly attached to the right-hand side of the block. A reinforcing bracket is mounted to the cylinder block and timing gear casing for taking up vibrations, see Fig. 2-22.

CYLINDER HEAD AND VALVES

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

The valves, which are fitted suspended in the cylinder head, are made of special steel and are carried in replaceable guides. The valve stems are chromed. The valve collet is provided with three lands and the valve with corresponding grooves, which hold the valve but also make suitable rotation possible. (Compare with Fig. 2-34.) The valves are provided with valve guide rubber seals, which are mounted on the guides.

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

The difference in compression between the engines is due to their having different cylinder head gasket thicknesses and different cylinder heads.

CRANKSHAFT AND BEARINGS

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

The bearing shells, which are replaceable, consist of a steel backing with indium-plate lead-bronze bearing metal.

CAMSHAFT AND VALVET TAPPETS

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

CONNECTING RODS, PISTONS AND PISTON RINGS

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

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

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

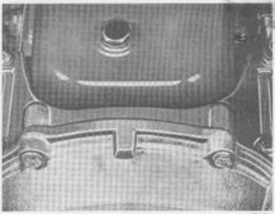


Fig. 2-22. Reinforcing bracket, cylinder block—flywheel housing

POSTIVE CRANKCASE VENTILATION

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

Between the rocker arm casing and the intake manifold there is a hose (4, Fig. 2-23). It is connected to the intake manifold by means of a calibrated nipple (3). (This nipple should be cleaned every 40,000 km = 24,000 miles.) Between the oil trap, which is connected to the crankcase, and the air cleaner there is a hose (2) connected for the fresh-air supply. At the connection to the oil trap there is a flame guard (5), which consists of a metal filter. The partial vacuum which arises in the intake manifold when the engine is running, brings about a partial vacuum in the rocker arm casing and crankcase through the hose (4). Fresh air is supplied to the crankcase through the air cleaner via the hose (2).

As the fresh air supply passes through the carburetor air cleaner, impurities are prevented from getting into the engine. Where there is a high or medium degree of partial vacuum in the crankcase (intake manifold), which happens during idling and when operating under a light load, the system functions as described above. When the partial vacuum

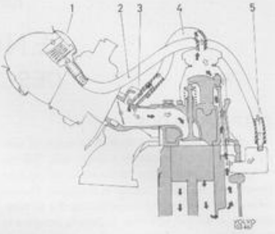


Fig. 2-23. Positive crankcase ventilation

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

in the crankcase is less than that in the air cleaner, which occurs at full load and/or with large flow quantities, no fresh air is supplied. Instead the flow in the connection between the flame trap and air cleaner reverses and the crankcase gases go both ways, partly through the hose (4) and partly through the air cleaner and carburetor to the intake manifold. In this way, the crankcase ventilation system can deal with relatively large quantities of crankcase gases without any escaping into the atmosphere.

REPAIR INSTRUCTIONS

DISASSEMBLING ENGINE

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

1. Place the engine on stand 2520 with fixture 2521 (see Fig. 2-24). Check that the oil has been drained off.
2. Remove the starter motor and reinforcing plate on the lower front edge of the flywheel housing. Remove the flywheel housing together with the gearbox and then remove the clutch and flywheel.
3. Remove the rear flange, taking care not to damage the contact surfaces, thereafter the alternator, water pump and distributor, the rocker casing, rocker arms, the manifold, cylinder head and oil filter.
   Remove the valve tappets with tool 2424, see Fig. 2-25.
4. Remove the timing gear casing and the timing gears. Concerning tools, see under the heading "Replacing the timing gears". Remove the camshaft.
5. Remove the carbon ridge from the cylinder bores. Remove the sump, oil pump and connecting rods with pistons. Replace the caps correctly on their respective connecting rods.
6. Turn the engine upside down and remove the crankshaft. Replace the caps correctly in their respective positions.

CLEANING

After disassembling, all the parts should be thoroughly cleaned. Parts made of steel or cast iron can be washed in a degreasing tank with a caustic soda solution. Light-alloy parts can, however ,be destroyed by caustic soda so that they should preferably be cleaned with white spirit.

Pistons and bearing shells must never be washed in

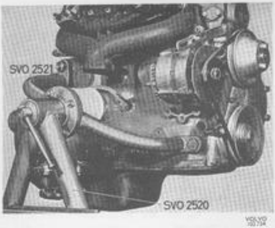


Fig. 2-24. Engine on stand

caustic soda. Rinse the parts with warm water and blow them dry with compressed air after washing. Clean the oilways thoroughly. All sealing plugs at the oilway openings in the cylinder block must be removed during the cleaning process.

ASSEMBLING ENGINE

When assembling the engine, follow the instructions for the parts concerned. Check the marking of the bearings according to Fig. 2-26. The main bearings are marked 1—5, and the big-end bearings 1—4, counting from the front.

Check that all parts are clean and lubricate sliding surfaces with oil before assembling. Always use new gaskets, split pins and lock washers.

No adhesive should be used on the gaskets.

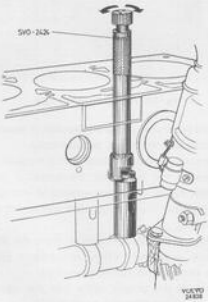


Fig. 2-25. Removing valve tappets

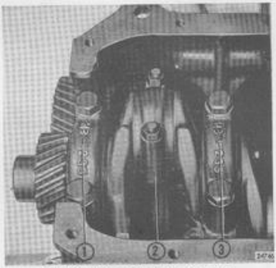


Fig. 2-26. Marking main and big-end bearings
1. Main bearing No. 1 2. Big-end bearing No. 1
3. Main bearing No. 2

The seals on the ends of both the oil pump delivery pipe and the water pump pipes are in the form of rubber rings. These rings, which seal radially, are made of special rubber with very close tolerances. Only genuine Volvo parts should be used. Fitting is facilitated by coating the rings with soap solution. The rings are fitted on the pipes and then pressed into their correct positions before the attaching bolts are tightened. The oil pump flange should lie flush against the cylinder block before tightening. The timing gear casing and rear sealing flange must be accurately centered when fitting. See under the headings "Replacing timing gear casing" and "Fitting rear sealing flange".

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

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

The cylinder head is fitted with the help of guide pins 2435. The bolts must be tightened in a certain sequence as shown in Fig. 2-28, in order to avoid unnecessary stresses. Check that the oil hole (Fig. 2-29) for lubricating the rocker arms is clear. The pilot bearing (5, Fig. 2-27) should be lubricated before fitting with heat-resistant ball bearing grease. The bearing and protecting washer are held in position by a circlip (6).

The most important bolts and nuts should be tightened with a torque wrench, see "Tightening Torques" in "Specifications". Re-tighten the cylinder head bolts. See "Valve grinding and decarbonizing". Use a cylinder head gasket of the right thickness, see "Specifications".

VALVE GRINDING AND DECARBONIZING, B 20 A, B 20 B

1. Drain off the coolant from the radiator and cylinder block. To do this remove the plug on the right-hand side of the engine and disconnect the lower radiator hose.
2. Disassemble the throttle control. Disconnect the choke control.
3. Remove the air cleaner and carburetor.
4. Disconnect the exhaust pipe at the exhaust manifold and disconnect the hoses to the radiator as well as other connections to the cylinder head.
5. Remove the rocker casing, rocker arm shaft and push rods.
6. Remove the cylinder head bolts and disconnect the water pipe as well as the attachement on the rear exhaust manifold. Loosen the alternator tensioner arm. Lift off the cylinder head.
7. Clean the piston crown, combustion chambers, inlet ports and exhaust ports very thoroughly. Do not use emery cloth since small grinding particles can get in between the piston and cylinder walls and consequently cause scoring.
8. Recondition the valve system as described under the heading "Cylinder head and valves".
9. Fit the valves. Screw the guide pins 2435 into the block, one in the front right-hand hole and the other in the left-hand rear hole, see Fig. 2-30. Install a new cylinder head gasket with the "TOP" upwards (wide edge). Install new sealing rings for the water pump and fit the cylinder head. Screw out the guide pins and fit the bolts in these holes as well. For tightening sequence, see Fig. 2-28. Tightening should be in three stages: 1 st stage 40 Nm (29 lb ft); 2nd stage 80 Nm (58 lb ft); 3rd stage: after running the engine, see point 10. Fit the other parts. Fill up with coolant according to the instructions given under "Filling with coolant when the system has been emptied".
10. Adjust the valve clearance for B 20 A 0.45—0.50 mm (0.018—0.020") and for B 20 B 0.55—0.60 mm (0.022—0.024"). (Not final clearance.) Run the engine for 10 minutes. Final-tighten the cylinder head bolts to 90 Nm (65 lb ft) with tool 2889. **Final-adjust** valve clearance to value given in "Specifications".

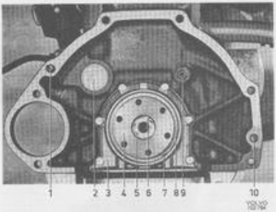


Fig. 2-27. Rear end of engine

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

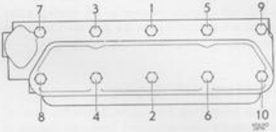


Fig. 2-28. Tightening sequence for cylinder head bolts

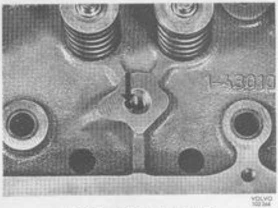


Fig. 2-29. Oil hole in cylinder head

B 20 E, B 20 F

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

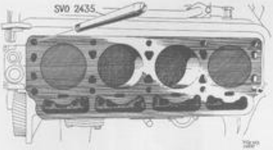


Fig. 2-30. Guide pins for fitting the cylinder head

5. Remove the electric cable from the temperature sensor for the coolant thermometer.
6. Remove the hose for the induction air.
7. Remove the lock pin and bracket for the throttle cable.
8. Pinch the hose from the fuel tank to the distributing pipe and the return line from the pressure regulator. Use pinchers 2901.
9. Remove the hose from the distributing pipe.
10. Remove the heating hose and the upper radiator hose.
11. Remove the alternator tension bar from the cylinder head.
12. Unscrew the bolts for the inlet duct stay.
13. Remove the inlet duct nuts.
14. Remove the clamp for the water pipe.
15. Remove the ignition leads and spark plugs.
16. Remove the rocker arm cover, the rocker arm shaft and the push rods.
17. Remove the cylinder head bolts and lift off the head. Take off the cylinder head gasket, the flange gasket and the rubber rings for the water pump.
18. Clean the piston crown, combustion chambers, inlet ports and exhaust ports very thoroughly. Do not use emery cloth since small grinding particles can get in between the piston and cylinder walls and consequently cause scoring. Recondition the valve system as described under the heading "Cylinder head and valves". Check that the oilway to the rocker arm mechanism on the valve tappet side in the middle of the head is clean. In the cylinder head oil goes up through the bolt hole, between the bolt and hollow partition, through a diagonal oilway to the attaching bolt for the rocker arm shaft and then up into the shaft.

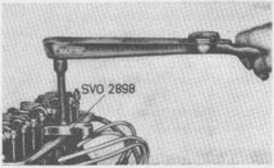


Fig. 2-31. Re-tightening cylinder head bolts

19. Screw the guide pins 2435 into the block, one in the front right-hand hole and the other in the left-hand rear hole, see Fig. 2-30. Install a new cylinder head gasket with the "TOP" upwards (wide edge). Install a new inlet duct gasket and new sealing rings for the water pump. Fit the cylinder head. Screw out the guide pins and fit the bolts in these holes as well. For tightening sequences, see Fig. 2-28. Tightening should be in three stages: 1st stage 40 Nm (29 lb ft); 2nd stage 80 Nm (58 lb ft); 3rd stage: after running the engine, see point 34.
20. Fit push rods and rocker arm shaft. Adjust the valves to 0.45—0.50 mm (0.018—0.020"). (Not final clearance.)
21. Fit the rocker arm cover, the spark plugs and the ignition leads.
22. Fit the clamp for the water pipe.
23. Fit and tighten the inlet duct nuts and bolts.
24. Fit the bolts for the inlet duct stay. Fit the alternator tension bar and adjust the fan belt.
25. Connect the upper radiator hose and the hose for the heating system.
26. Connect the fuel hoses and remove the pinchers.
27. Fit the bracket and lock pin for the throttle cable.
28. Fit the hose for the induction air.
29. Connect the electric cable to the sensor for the temperature gauge and the ground cable to the inlet duct.
30. Place the cable harness in position in the inlet duct mounting.
31. Fit the electric cables for the throttle switch, cold start valve, injectors and temperature sensor for coolant.
32. Connect the hose for the pressure sensor, brake servo, crankcase ventilation and ignition distributor. Re-fit the battery lead.
33. Fill with coolant and check function and for leakage.
34. Run the engine for 10 minutes. Final-tighten the cylinder head bolts to 90 Nm (65 lb ft) with tool 2898. **Final-adjust** valve clearance to value given in "Specifications".

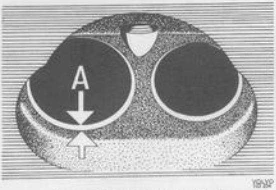


Fig. 2-32. Valve seat width A=2 mm (0.08")

CYLINDER HEAD AND VALVES

DISMANTLING

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

CLEANING

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

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

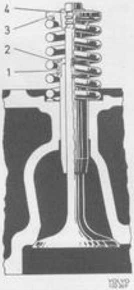


Fig. 2-34. Valve collet and valve guide seal

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

GRINDING VALVES AND VALVES SEATS

1. Grind the valves in a machine after they have been cleaned. Fit new valves if the old ones are excessively worn.
2. Grind the valve seats. Use an electrically driven grinder or a hand milling cutter. A pilot spindle must be carefully fitted before work is started and any worn guides must be replaced with new ones. The seat should be ground until a good sealing surface is obtained. The angle is 45° and the width of the sealing surface should be approx. 2.0 mm (0.08"), see "A" Fig. 2-32. If the sealing surface is too wide after grinding, it can be reduced by using a 70° grinding stone from the inside and a 20° grinding stone from the outside.
3. Coat the valve sealing surfaces with a thin layer of fine grinding paste and lap in the valves against their seats.
   Then clean the valves and seats and check that good sealing is obtained.

REPLACING VALVE GUIDES

1. Press out the old guides with tool 2818.
2. Press in the new guides using drift 2819 which gives the correct depth, see Fig. 2-23. For the B 20 E/F engine a 0.4 mm (0.016") thick washer is placed between the tool and cylinder head.
3. Check that the guides are free from burr and that the valves move easily in them.

ASSEMBLING

1. Check that the parts are in good condition and clean. Test the springs to ensure that they main-

Fig. 2-35. Replacing bush in rocker arm

tain the values given in the "Specifications".

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

REPLACING ROCKER ARM BUSHES AND GRINDING THE ROCKER ARMS

1. If wear amounts to 0.1 mm (0.004"), replace the rocker arm bush. Use tool 1867 for pressing the bush out and in, see Fig. 2-35. Then ream the bush to an accurate fit on the shaft using a suitable reamer. The hole in the bush should coincide with the hole in the rocker arm.
2. If necessary grind the pressure surface against the valve in a special machine.

INSTALLING CYLINDER HEAD

See under "Valve grinding and decarbonizing".

ADJUSTING VALVE CLEARANCE

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

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

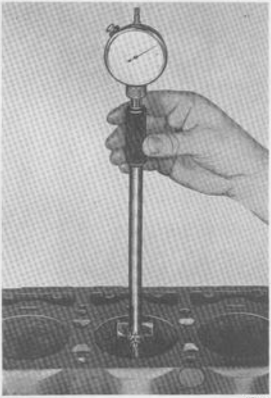


Fig. 2-36. Measuring cylinder bore

CYLINDER BLOCK

MEASURING CYLINDER BORES

The cylinder bores are measured with a special dial indicator as shown in Fig. 2-36. Measuring should be carried out just below the top edge of the bore and only in the transverse direction of the engine. A letter is stamped on each cylinder bore indicating the classification of the bore and piston (only on standard models).

PISTONS, PISTON RINGS AND GUDGEON PINS

Measuring pistons

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

Fit of pistons in cylinders

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

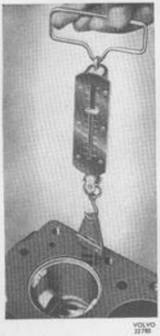


Fig. 2-37. Measuring piston clearance

measured with a feeler gauge 1/2" wide and 0.04 mm (0.0016") (For B 20 E and B 20 F: 0.05 mm [0.0020"]) thick attached to a spring balance. The force applied should be 10 N (2.2 lb). This gives the average value for piston clearance. When the above-mentioned force is applied, the piston clearance obtained is equal to the thickness of the feeler gauge used. The test is carried out at several different depths. See Fig. 2-37. Standard bore cylinders have a letter stamped on which shows the dimensions, and the pistons concerned should be marked with the same letter.

Piston ring fit

IN A NEW OR RE-BORED CYLINDER

1. Push down the piston rings one after another in the cylinder bore. Use a reversed piston to ensure that the rings come into the correct position.

Fig. 2-38. Measuring piston ring gap

Fig. 2-39. Piston ring clearance in groove

2. Measure the ring gap with a feeler gauge, see Fig. 2-38. The gap should be 0.40—0.55 mm (0.016—0.022"). If necessary, the gap can be increased with the help of a special file.
3. Check the piston rings by rolling them in their respective grooves. Also measure the clearance at a few points. See "Specifications" for measurements.

IN A WORN CYLINDER BORE

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

Gudgeon pins

The gudgeon pins are available in oversize 0.05 mm (0.002") larger than the standard diameter 22.00 mm (0.866"). If the gudgeon pin hole in the piston is worn so much that an oversize is necessary, the

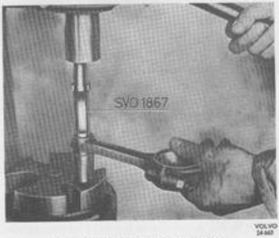


Fig. 2-40. Replacing bush in connecting rod

Fig. 2-41. Gudgeon pin fit

Fig. 2-42. Checking connecting rod

hole should first be reamed out to the correct measurement. Use a reamer fitted with a pilot guide and only take small cuts at a time.
The fit is correct when the gudgeon pin can be pushed through the hole by hand with light resistance.

CONNECTING RODS

Replacing bushes

If the old bush in a connecting rod is worn, press it out by using drift 1867 and press in a new bush with the same tool, see Fig. 2-40. Make sure that the lubricating holes index with the holes in the connecting rod. Then ream the bush to the correct fit. The gudgeon pin should slide through the hole under light thumb pressure but without any noticeable looseness, see Fig. 2-41.

Straightening

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

Assembling and installing piston and connecting rod

When assembling make sure that the piston is facing correctly so that the slot on the piston crown points forwards, see Fig. 2-43. There will be a loud noise if the piston is turned the wrong way. The connecting rod marking should face away from the camshaft side. The gudgeon pins are then fitted, the circlips placed in position and the piston rings installed.
Use piston ring pliers for fitting the rings. The upper compression ring is chromed. Place the bearing shells in their seats. Turn the rings so that their gaps are not opposite one another. Lubricate the piston and bearings surfaces.
Use installation ring 2823, see Fig. 2-44, when fitting the piston and a torque wrench, see "Specifications" for the correct tightening torque.

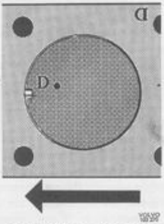


Fig. 2-43. Marking on piston and block

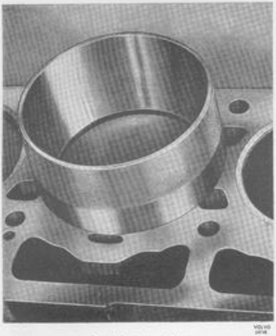


Fig. 2-44. Fitting piston
Installation ring 2823

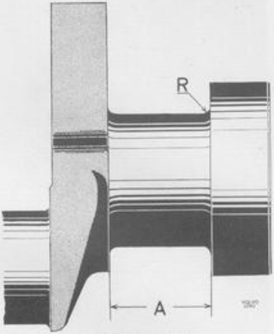


Fig. 2-45. Bearing journal

CRANKSHAFT

After the crankshaft has been cleaned, its journals must be measured with a micrometer. Measuring should be carried out at several points round the circumference and along the longitudinal axis of each journal. Out-of-roundness on the main bearing journal should not exceed 0.05 mm (0.002"), and 0.07 mm (0.003") on the big-end bearing journals. Taper should not exceed 0.05 mm (0.002") on any of the journals.

If the values obtained are close to or exceed the wear limit mentioned above, the crankshaft should be ground to undersize. Suitable bearing shells are available in 2 undersizes. The measurements concerned are to be found in the "Specifications".

Check that the crankshaft is straight to within 0.05 mm (0.002") by using a dial gauge. The crankshaft is placed on two V-blocks and a dial gauge placed against the centre bearing journal after which the crankshaft is rotated. If necessary, straighten the crankshaft in a press.

Grinding crankshaft

Before the crankshaft is ground, a check should be made to ensure that it is straight, this being done as described previously. Grinding is carried out in a special machine whereby the main bearing journals and the big-end bearing journals are ground to identical measurements. These measurements, which are given in "Specifications", must be carefully followed in order to ensure correct clearance with ready-machined bearing shells.

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

The fillets at the ends of the journal should have a radius of 2.0—2.5 mm (0.080—0.100") on all journals, see Fig. 2-45. The width measurement (A) for the pilot bearing depends on the size of the journal and should be ground in order to obtain the correct measurement.

After grinding has been completed, all the burr should be carefully removed from the oilway openings and all the journals lapped with a fine grinding paste to the finest possible surface finish. The crankshaft should then be washed. All the oilways should be cleaned with particular thoroughness in order to remove any metal chippings and grinding residue.

Main and big-end bearings

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

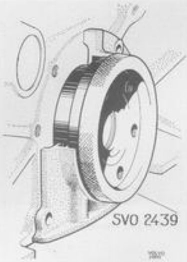


Fig. 2-46. Centering rear sealing flange

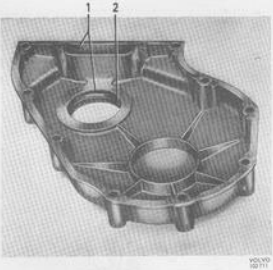


Fig. 2-47. Timing gear casing
1. Drain holes 2. Sealing ring

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

INSTALLING REAR SEALING FLANGE

1. Make sure that the seal is in good condition and that the flange is clean. The drain hole must not be blocked by incorrect fitting of the sump gasket. The sealing ring must not be fitted in the flange.
2. Fit on the sealing flange but do not tighten the bolts.
3. Center the flange with sleeve 2439, Fig. 2-46. Turn the sleeve round while tightening the bolts and adjust the position of the flange if the sleeve jams. Check that the flange comes flush against the underside of the block.
4. Fit a new felt ring and place in the washer and circlip. Press the circlip into position with the centering sleeve. Check that the circlip engages in its groove.

GRINDING FLYWHEEL

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

PILOT BEARING FOR INPUT SHAFT

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

REPLACING OIL SEAL IN TIMING GEAR CASING

1. Release the fan belt. Loosen the attachment of the stabilizer at the frame.
2. Screw out the bolt in the crankshaft. Remove the belt pulley.
3. Remove the circlip for the washer which retains the felt ring. Remove the washer and felt ring. Check that the casing is correctly fitted by inserting a 0.10 mm (0.004") feeler gauge in the gap between the casing and hub on the crankshaft and moving it all round. If the feeler gauge jams at any point, the casing should be centered, see under "Replacing timing gear casing".
4. Fit a new felt ring. Place the washer in position and fit the circlip. Check that the circlip fits properly in position.
5. Fit the remaining parts and tension the fan belt.

REPLACING TIMING GEAR CASING

1. Loosen the fan belt. Remove the fan and pulley on the water pump. Disconnect the stabilizer attachment from the frame.
2. Remove the bolt for the crankshaft belt pulley and remove the pulley.

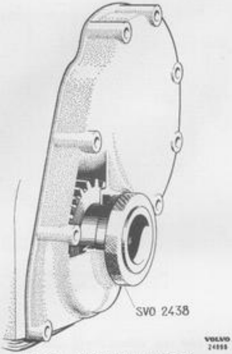


Fig. 2-48. Centering timing gear casing

3. Remove the timing gear casing. Slacken a couple of extra bolts for the sump and be careful not to damage the gasket. Remove the circlip, washer and felt ring from the casing.
4. Make sure that the gaskets are in good condition and that the drain hole is open and clean inside the timing gear casing which is to be fitted, see Fig. 2-47.
5. Place the casing in position and fit the bolts without tightening them.
6. Center the casing with sleeve 2438, see Fig. 2.47. Turn the sleeve while tightening and adjust the position of the casing so that the sleeve is

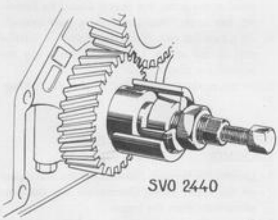


Fig. 2-49. Removing hub on crankshaft

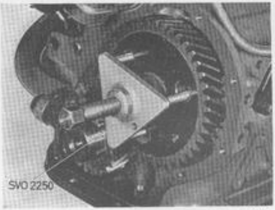


Fig. 2-50. Removing camshaft gear

not jammed. Check after final tightening of the casing that the sleeve can be easily rotated without jamming.

7. Fit a new felt ring washer and circlip. Push them into position with the centering sleeve 2438. Check that the circlip has engaged in its groove.
8. Fit the other parts and tension the fan belt. See "Specifications" for the tightening torque. Fix the stabilizer attachments firmly to the frame.

REPLACING TIMING GEARS

1. Drain off the coolant and remove the cover plate and radiator.
2. Carry out operations 1—3 in previous section.
3. Remove the hub from the crankshaft with puller 2440. See Fig. 2—49.
   Before applying the tool, its large nut must be screwed backwards so that the cone is not tensioned. The center bolt should also be screwed back.
   Then fit the tool, screw in the large nut so that the hub is firmly held and pull it off by screwing in the center bolt.
4. Remove the camshaft nut and pull off the gear by using puller 2250, see Fig. 2-50.
5. Pull off the crankshaft gear by using puller 2405, Fig. 2-51. Screw out the oil nozzle, blow it clean and then re-fit it as shown in Fig. 2-54. The gears are lubricated by oil fed through this nozzle.
6. Fit the crankshaft gear by using tool 2407 and the camshaft gear by using 2408, see Figs. 2-52 and 2-53. Fit the hub on the crankshaft. Do not push the camshaft backwards so that the seal washer on the rear end loosens.

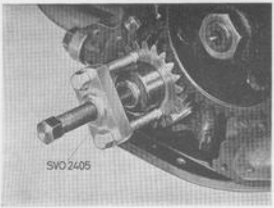


Fig. 2-51. Removing crankshaft gear

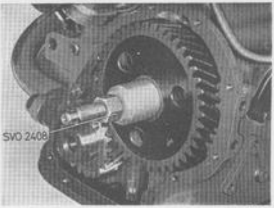


Fig. 2-53. Fitting camshaft gear

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

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

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

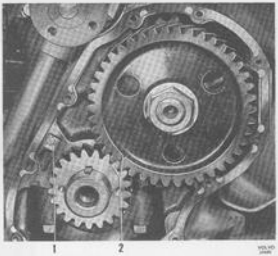


Fig. 2-54. Marking on timing gears
1. Oil nozzle 2. Markings

POSITIVE CRANKCASE VENTILATION

OVERHAUL

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

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

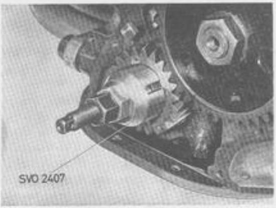


Fig. 2-52. Fitting crankshaft gear

Fig. 2-55. Measuring tooth flank clearance

GROUP 22

LUBRICATING SYSTEM

DESCRIPTION

The engine has a force-feed lubricating system, see Fig. 2-56. Pressure is provided by a gear pump driven from the camshaft and fitted under the crankshaft in the sump. The gear pump forces the oil past the relief valve, which is also fitted on the pump, through the oil filter and then through oil-ways out to the various lubricating points. All the oil supplied to the lubricating points, therefore, first passes through the oil filter.

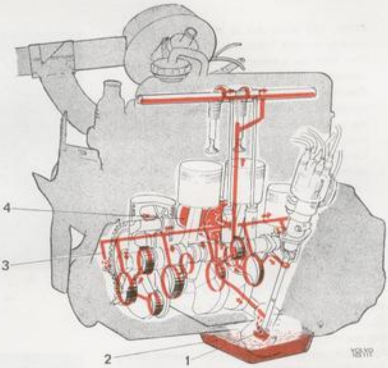


Fig. 2-56. Lubricating system
1. Oil pump
2. Sump
3. Nozzle
4. Oil filter

OIL PUMP, RELIEF VALVE

The oil pump, see Fig. 2-57, is of the gear type and is driven through a gear train from the camshaft. The delivery pipe from the pump to the cylinder block does not have screw unions and is, therefore, automatically tightened in position when the attaching bolts for the pump are tightened. At each end of the pipe there are sealing rings made of special rubber. The relief valve is fitted directly on the pump and consists of a spring-loaded ball. The ball has a cylindrical guide with a stop at the end position and, therefore, operates flexibly. Even at idling speed there is a certain amount of overflow, so that the oil pressure is then relatively low.

OIL FILTER

The oil filter (see Fig. 2-58), which is manufactured as a single unit complete with element, is of the full-flow type and is screwed directly onto the cylinder block. The oil which is fed out to the various lubricating points in the engine first passes through the oil filter element which is made of special paper. In the oil filter there is a by-pass valve which allows the oil to by-pass the element if resistance to flow should become excessive. When replacing the filter, the old one is discarded completely and a new one fitted.

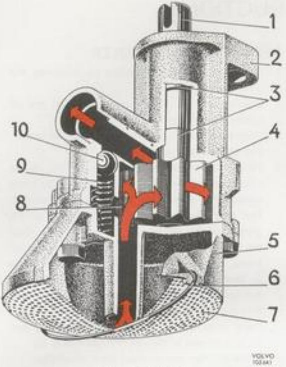


Fig. 2-57. Oil pump

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

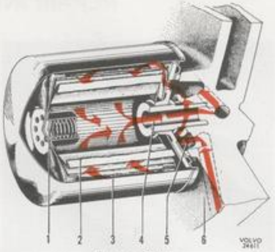


Fig. 2-58. Oil filter

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

OIL COOLER

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

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

Fig. 2-59. Oil cooler

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

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

REPLACING OIL FILTER

Together with the element and relief valve, the oil filter (see Fig. 2-58) is screwed as a complete unit on to a nipple fitted in the cylinder block.

The filter should be replaced every 10 000 km (6 000 miles), when the old filter is discarded. With a new or reconditioned engine, the filter should also be changed the first time after 5 000 km (3 000 miles).

1. Remove the old filter with the help of chain tongs, see Fig. 2-60.
2. Coat the rubber gasket (1, Fig. 2-61) of the new filter with oil and make sure that the contact surface for the oil filter is free from dirt. By smearing it with oil, the gasket slides into better contact with the sealing surface. Screw on the filter by hand until it just touches the cylinder block.
3. Screw on the oil filter a further half turn by hand. **Chain tongs must not be used when fitting.** Start the engine and check that there is no leakage at the joint. Fill up with oil if necessary.

Fig. 2-61. Oil filter ready for fitting

REPLACING OIL COOLER

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

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

OIL PUMP AND RELIEF VALVE

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

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

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

The sealing rings at the ends of the delivery pipe are made of special rubber and are manufactured to very close tolerances, see Fig. 2-65. Use only

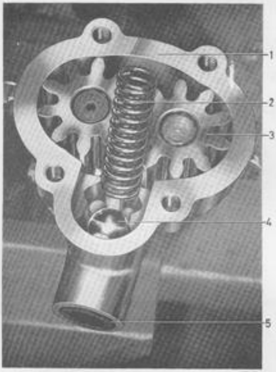


Fig. 2-62. Oil pump

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

genuine Volvo parts. The delivery pipe must be clamped in its correct position first in the oil pump and then the oil pump and pipe together clamped against the block. The pump connecting flange should lie flush against the block before being tightened. Before being fitted, the rubber rings on the pipe can be coated with soapy water since this enables the pipe to take up its position more easily. Tap lightly on the pipe with a soft mallet if necessary.

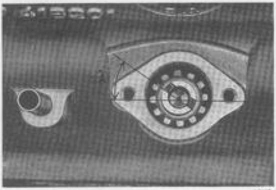


Fig. 2-63. Distributor drive position

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

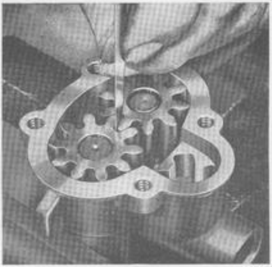


Fig. 2-64. Measuring tooth flank clearance

OILWAYS

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

INSTALLING OIL PUMP

When No. 1 cylinder is at top dead center, install the oil pump drive and distributor. The small part at the groove is turned obliquely upwards-backwards and the groove set at an angle of 35° or 5° to the longitudinal axis of the engine, see Fig. 2-63 (A). Make sure that the shaft goes down into its groove in the pump shaft.
NOTE. When the timing gear marks are opposite each other, then the piston for No. 4 cylinder is in the top dead center position, firing position.)

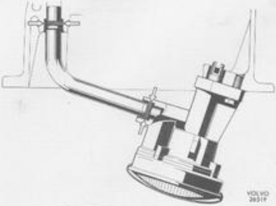


Fig. 2-65. Delivery pipe sealing rings

FUEL SYSTEM

CARBURETOR ENGINES

DESCRIPTION

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

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

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

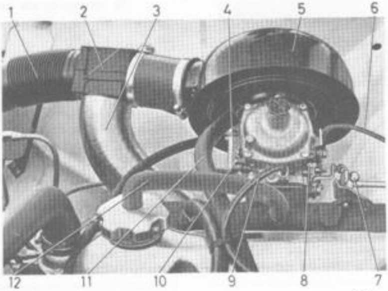


Fig. 2-66. Stromberg-carburetor on B 20 A

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

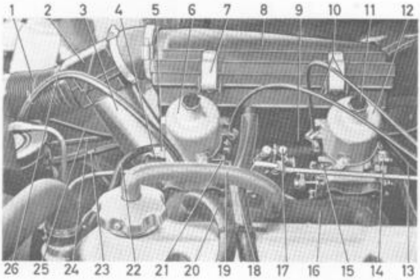
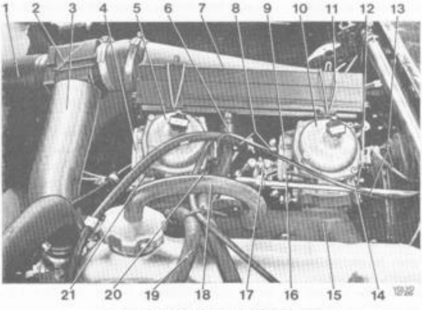


Fig. 2-67. SU-carburetors on B 20 B

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



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

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

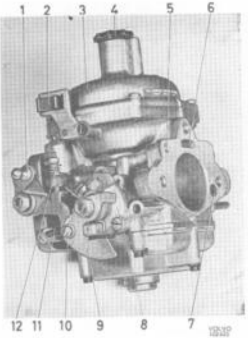


Fig. 2-69. Stromberg-carburetor, left side, B 20 A

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

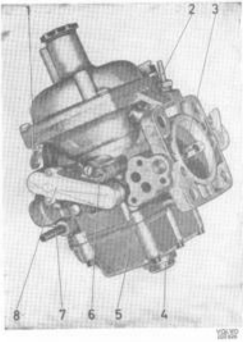


Fig. 2-70. Stromberg-carburetor, right side, B 20 A

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

ZENITH-STROMBERG CARBURETOR

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

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

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

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

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

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

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

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

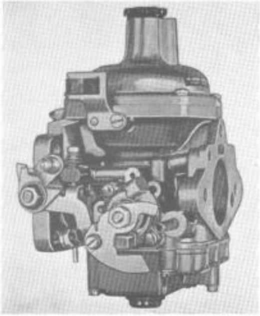


Fig. 2-71. Stromberg-carburetor, front, left side, B 20 B

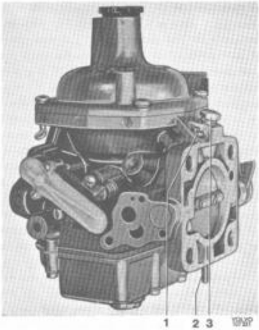


Fig. 2-72. Stromberg-carburetor, front, right side, B 20 B

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

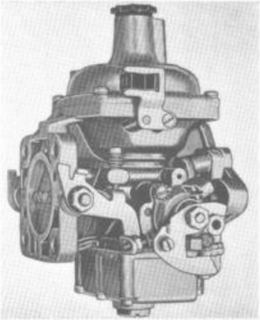


Fig. 2-73. Stromberg-carburetor, rear, left side, B 20 B

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

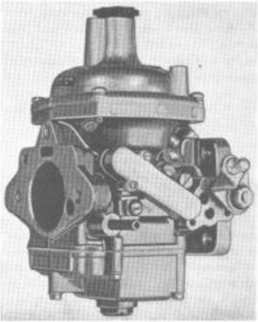


Fig. 2-74. Stromberg-carburetor, rear, right side, B 20 B

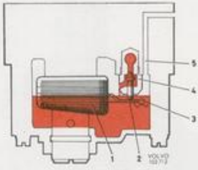


Fig. 2-75. Float system

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

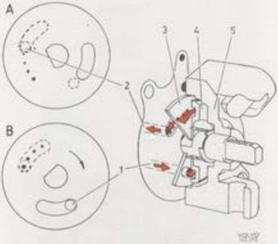


Fig. 2-76. Cold-start device

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

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

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

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

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

Float system

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

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

Cold start device and fast idle

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

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

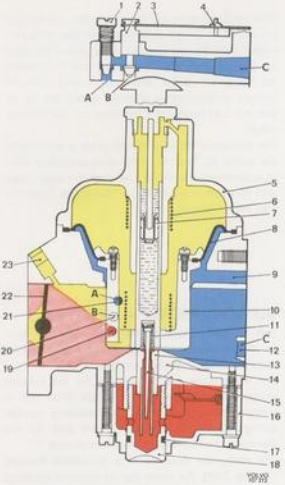


Fig. 2-77. Cold starting, principle

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

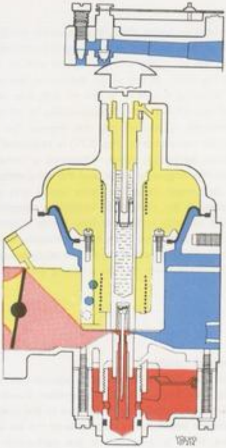


Fig. 2-78. Idling, warm engine

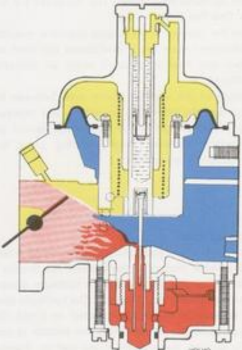


Fig. 2-79. Normal operation

Idling

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

Normal running

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

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

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

Acceleration

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

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

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

SU CARBURETOR — HIF TYPE

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

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

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

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

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

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

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

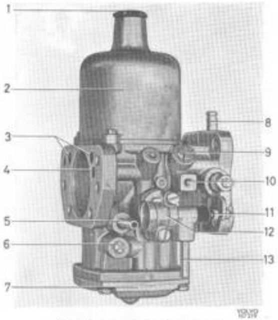


Fig. 2-80. SU-carburetor, front, right side

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

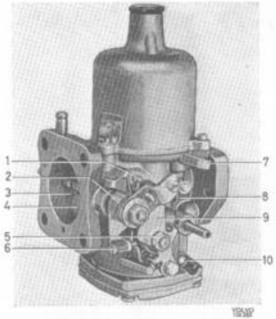


Fig. 2-82. SU-carburetor, front, left side

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

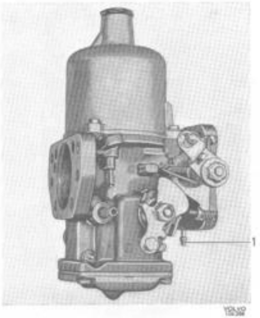


Fig. 2-81. SU-carburetor, rear, right side

1. Vacuum hose connection from distributor

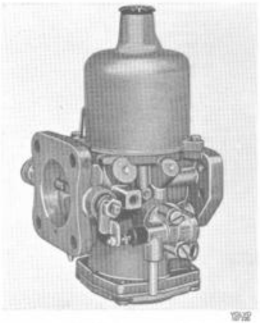


Fig. 2-83. SU-carburetor, rear, left side

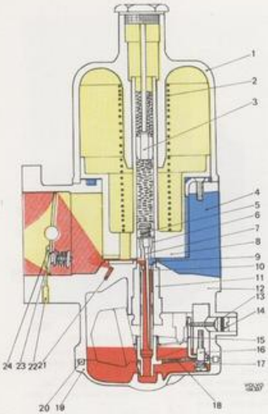


Fig. 2-84. Cold starting, principle

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

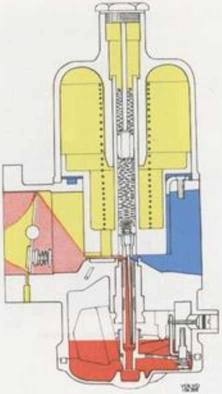


Fig. 2-85. Idling, hot engine

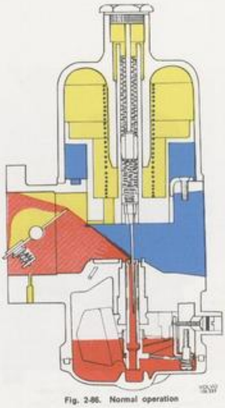


Fig. 2-86. Normal operation

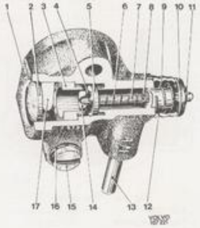


Fig. 2-87. Hot start valve

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

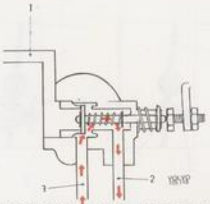


Fig. 2-88. Principle, hot start valve with throttle control in idling position

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

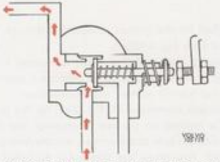


Fig. 2-89. Principle, hot start valve with throttle control in running position

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

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

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

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

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

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

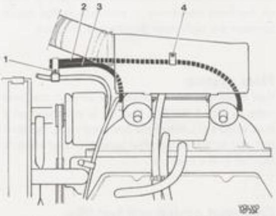


Fig. 2-90. Hoses installed from hot start valves (does not apply to vehicles with gas evaporative control)

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

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

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

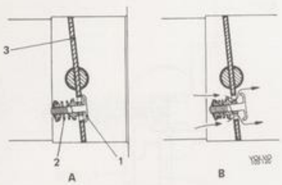


Fig. 2-91. Overrev valve (only on vehicles with gas evaporative control)

A. Idling and running
B. Engine braking

1. Valve
2. Thrust spring
3. Primary throttle

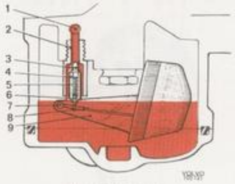


Fig. 2-92. Float system

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

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

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

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

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

Float system

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

Cold start device and fast idle

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

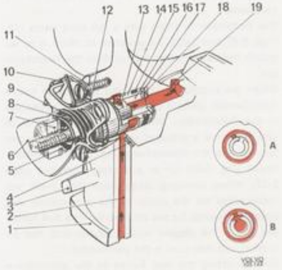


Fig. 2-93. Cold start device

A. Disengaged
B. Engaged

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

way the quantity of additional fuel is regulated. A channel (4) between the floatchamber space above the fuel level and the channel (2) for the fuel give the cold start fuel a little extra supply of air.

The fast idle cam (6) follows the pivotal movement of the spindle and actuates the position of the throttle. The fast idle cam opens the throttle slightly before the slot in the spindle reaches the hole in the valve housing. With this arrangement, the driver can raise the idling speed while the engine is warming up.

Idling

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

Running

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

Acceleration

To provide at any point in the throttle range a temporarily richer mixture at the moment the throttle is suddenly opened, acceleration, a hydraulic damper is incorporated in the valve rod. The hydraulic damper consists of a damper plunger (3, Fig. 2-84) mounted on a rod. The plunger operates in oil. When the throttle is suddenly opened, the vacuum in the suction chamber increases rapidly.

When the air valve (8) lifts, the damper plunger is forced against its seat and oil is prevented from flowing past the lower side of the damper plunger from the upper side, and this retards the movement of the valve (8). A more powerful vacuum is temporarily obtained above the jet so that the fuel-air mixture becomes for the moment richer.

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

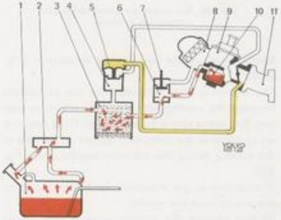


Fig. 2-94. Gas evaporative control system with control rod (7) at idle

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

GAS EVAPORATIVE CONTROL SYSTEM

Vehicles for the Canadian market are fitted with a gas evaporite control system which prevents fuel fumes from being released out into the atmosphere. Its function is outlined in Fig. 2-94 and Fig. 2-95.

Fuel fumes formed in the fuel tank, especially during warm weather, are led to the expansion tank (2) and from there to the venting filter (3) where the fumes are absorbed by active carbon. On the 140 model, the expansion tank is located in the luggage compartment, see Fig. 2-98. (On the 145, it is placed on the right-hand side in the cargo space.) The venting filter (Fig. 2-96) is located in the engine compartment on the right-hand side, see Fig. 2-99.

Fuel fumes from the floatchamber (10, Fig. 2-94) are led via the valve (6) to the venting filter when the engine has been switched off or during idling. Throttling shuts off the connection between the venting filter and the floatchamber so that the

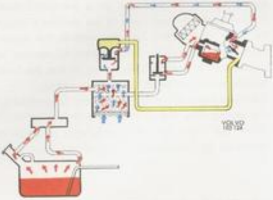


Fig. 2-95. Gas evaporative control system with control rod at running

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

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

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

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

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

HOT START VALVE

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

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

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

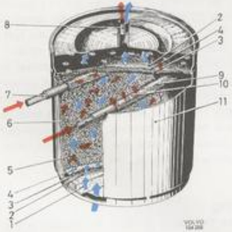


Fig. 2-96. Venting filter

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

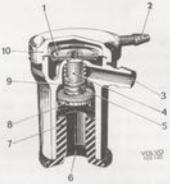


Fig. 2-97. Air valve

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

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

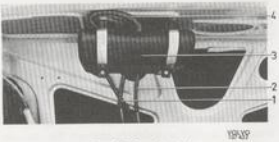


Fig. 2-98. Expansion tank

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

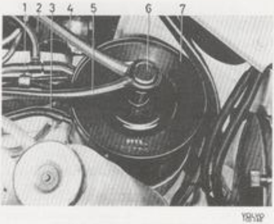


Fig. 2-99. Venting filter, fitted

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

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

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

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

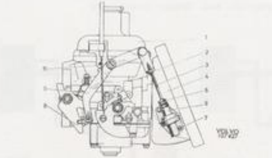


Fig 2-100. Hot start valve on Zenith-Stromberg carburetor (B 20 B)

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

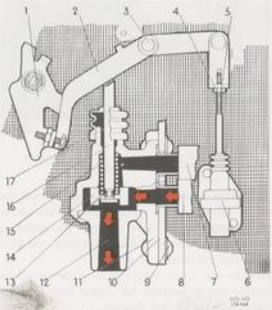


Fig. 2-101. Hot start valve, function, idling (Zenith-Stromberg carburetor)

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

EXHAUST GAS RECIRCULATION (EGR)

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

The system consists of a recirculation line (2,

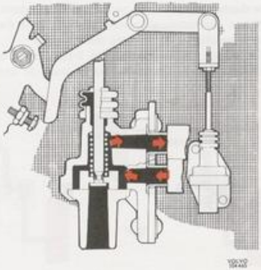


Fig. 2-102. Hot start valve, function, driving (Zenith-Stromberg carburetor)

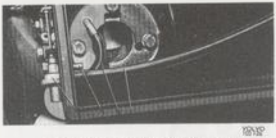


Fig. 2-103. Hose connections, Zenith-Stromberg

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

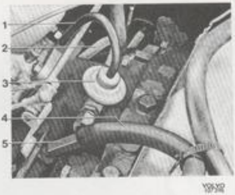


Fig. 2-104. EGR valve, fitted

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

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

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

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

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

With a fully open throttle flap, Fig. 2-106 c, there is atmospheric pressure in the intake manifold and this is transmitted to the vacuum chamber of the control valve. The pressure on both sides of the diaphragm is now equal so that the valve is closed by the spring. Exhaust gas recirculation has now stopped.

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

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

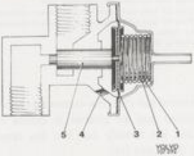


Fig. 2-105. EGR valve

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

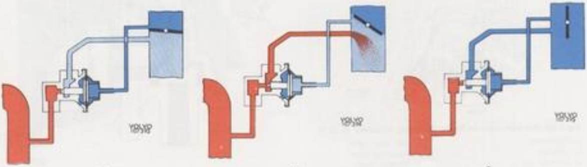


Fig. 2-106. EGR valve, principle function

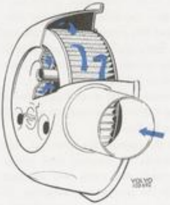


Fig. 2-107. Air cleaner B 20 A

AIR CLEANER

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

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

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

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

The constant air temperature unit consists of a flap housing (5), a hose (6) for cold air and heat-resistant hose (7) for warm air as well as a heater plate (8), which is secured to the exhaust pipe. The thermostat (2) fitted in the flap housing is inserted in the air cleaner housing and regulates the flap (4) by means of the flap control (3). The warm air taken at the exhaust pipe and the cold air taken at the front of the vehicle are regulated by the flap, mixed. The temperature of the mixture then influences the thermostat. In this way, the air supplied to the carburetors is maintained at a constant temperature of approximately 90°F.

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

Fig. 2-108. Air cleaner B 20 B

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

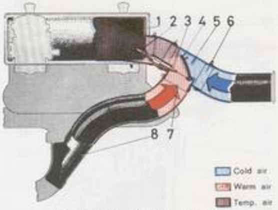


Fig. 2-109. Constant air temperature unit

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

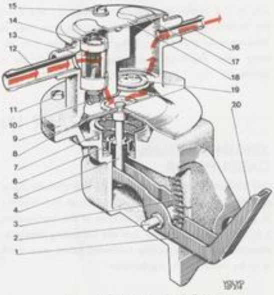


Fig. 2-110. Fuel pump, make S. E. V.

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

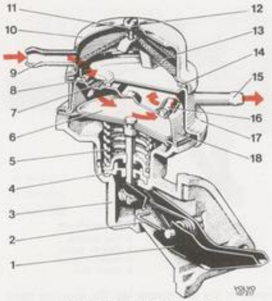


Fig. 2-111. Fuel pump, make Pierburg

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

FUEL PUMP

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

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

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

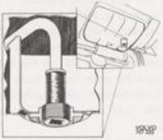


Fig. 2-112. Filter in fuel tank

FILTER IN FUEL TANK

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

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

REPAIR INSTRUCTIONS

ZENITH-STROMBERG CARBURETOR

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

PERIODICAL CHECK

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

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

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

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

SETTING CARBURETOR

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

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

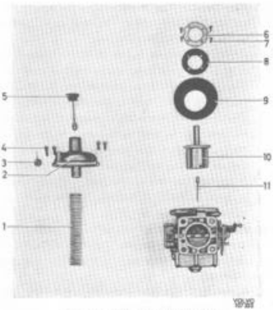


Fig. 2-113. Upper section dismantled

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

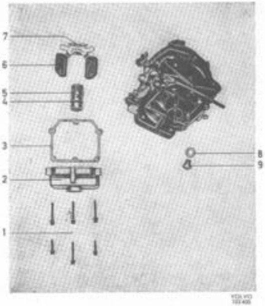


Fig. 2-114. Floatchamber dismantled

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

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

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

SETTING WITHOUT CO-METER

B 20 A

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

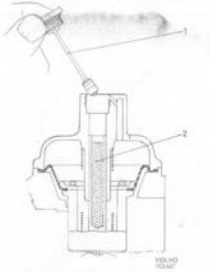


Fig. 2-115. Checking the damper oil

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

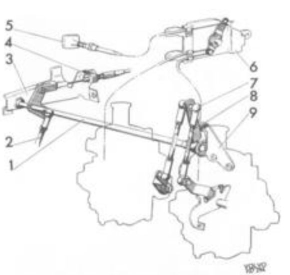


Fig. 2-116. Throttle control, B 20 B

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

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

8. Lubricate all ball joints.

B 20 B

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

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

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

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

SETTING WITH CO-METER

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

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

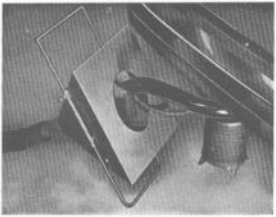


Fig. 2-118. Funnel for exhaust evacuation

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

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

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

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

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

B 20 A

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

   Right-hand steered vehicles:

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

B 20 B

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

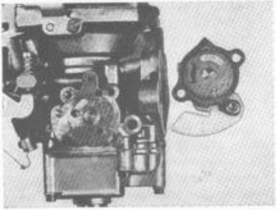


Fig. 2-119. Cold start device

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

6. Adjust the idling screws until the synchro test shows the same register for both carburetors (adjust both screws so that the idling speed is withheld).
7. Connect a CO-meter and check that the CO-content is 2.5 %. With the help of the idle trimming screw (6, Fig. 2-70) the CO-content can be adjusted within small deviations. Screw **equally** for both carburetors. (If the CO-content is too high, check first the temperature compensator, see under "Temperature Compensator".)
8. Adjust the link rods. With the control against its stop on the manifold bracket, the link rods should be adjusted so that there is a clearance of about 0.1 mm (0.004") between the lever and the flange of the primary throttle spindle. See Fig. 2-117.
9. Adjust so that the valve control of the hot start valve is against the carburetor lever with the valve piston in the upper position and the throttle control at idle. (See Figs. 2-100, 2-101 and 2-102.)

   Lubricate the contact surface with Molykote and check that the engine returns to idling speed after revving-up briefly several times.
10. Setting the fast idle: Pull out the choke control 20 mm (0.8").

    Then adjust the fast idle screw (11, Fig. 2-69) to give an engine speed of 18—26 r/s (1100—1600 r/m).
11. Adjust the length of the long, vertical link (2, Fig. 2-116) for the pedal, so that there is a clearance of 1 mm (0.039") between the throttle lever lug and the full throttle stop on the carburettors, when the accelerator pedal is fully depressed.
12. Lubricate all ball joints.

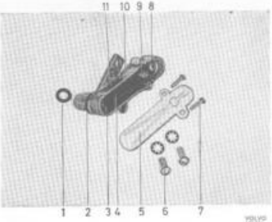


Fig. 2-120. Temperature compensator

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

FAULTY CARBURETOR FUNCTION

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

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

TEMPERATURE COMPENSATOR

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

complete. See under "Replacing temperature compensator".

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

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

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

REMOVING CARBURETORS, B 20 B

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

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

FITTING CARBURETORS, B 20 B

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

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

CLEANING FLOATCHAMBER

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

FLOAT LEVEL

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

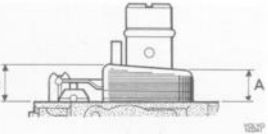


Fig. 2-121. Float level
A= 9—13 mm (1/2")
B=15—17 mm (5/8")

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

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

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

REPLACING DIAPHRAGM

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

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

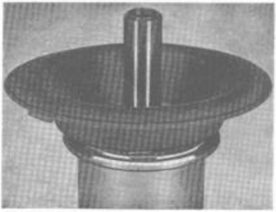


Fig. 2-122. Diaphragm in air valve

Fig. 2-123. Diaphragm in carburetor housing

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

REPLACING TEMPERATURE COMPENSATOR

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

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

REPLACING METERING NEEDLE

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

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

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

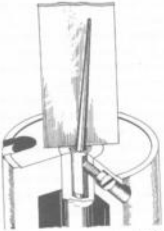


Fig. 2-124. Fitting the metering needle

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

Fig. 2-125. Damper plunger clearance

DAMPER DEVICE

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

With any fault in the damper plunger change it complete.

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

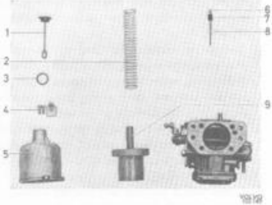


Fig. 2-126. Upper section disassembled

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

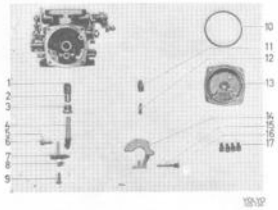


Fig. 2-127. Lower section disassembled

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

SU-CARBURETOR B 20 B

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

PERIODICAL CHECK

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

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

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

Also check that there is no air leakage on the intake side and that the air cleaner is not blocked. To be on the safe side, check also the flap function of the constant air temperature unit.

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

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

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

The floatchambers should be cleaned at the same time.

ADJUSTING CARBURETOR

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

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

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

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

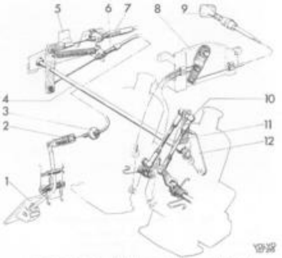


Fig. 2-128. Throttle and choke control linkage, left-hand steered vehicle

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

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

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

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

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

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

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

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

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

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

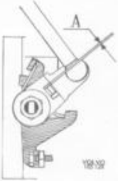


Fig. 2-129. Setting the control
A=0.1 mm (0.04")

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

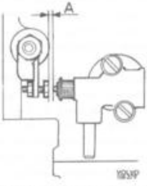


Fig. 2-130. Setting the hot start valve

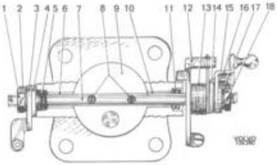


Fig. 2-131. Throttle spindle

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

REMOVING CARBURETORS

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

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

INSTALLING CARBURETORS

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

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

CLEANING FLOATCHAMBER

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

FLOAT LEVEL

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

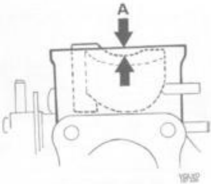


Fig. 2-132. Float level
A=0.5—1.5 mm (0.02—0.06")

At the correct float level, the measurement A (Fig. 2-132) between float and flange should be 0.5—1.5 mm (0.02—0.06").
The float has an adjustable metal tab.
The float is removed by screwing the float shaft out of the chamber.
Note when fitting that the float valve retainer should hook round the float tab (Fig. 2-134).

FIT OF AIR VALVE

The fit can be checked by plugging the air holes in the valve with, for example, small corks. The damper plunger is fitted but not filled with oil. The air valve spring is not fitted. Normally the valve should sink to the bottom, from the position shown in Fig. 2-133 in about 5—7 seconds.
If the valve is worn, both valve and suction chamber should be replaced since they are matched together.

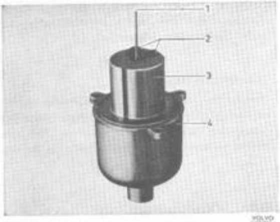


Fig. 2-133. Air valve fit
1. Metering needle
2. Plugs, e.g. rubber or cork
3. Air valve
4. Suction chamber

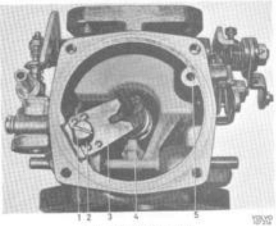


Fig. 2-134. Floatchamber
1. Screw for bi-metal assembly
2. Spring
3. Bi-metal assembly
4. Float valve retainer
5. Drilling to cold start valve

REPLACING METERING NEEDLE AND FUEL JET

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

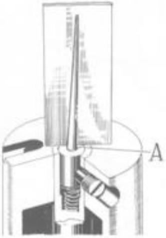
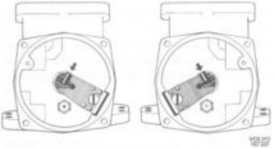


Fig. 2-135. Fitting metering needle

COLD START DEVICE

Replacing seals

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



A
Nozzle fitted in rear carburetor

B
Nozzle fitted in front carburetor

Fig. 2-136. Nozzle angle

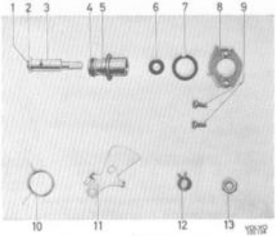


Fig. 2-137. Cold start device, disassembled

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

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

HOT START VALVE

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

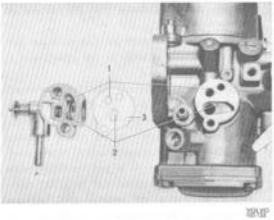


Fig. 2-138. Hot start valve removed

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

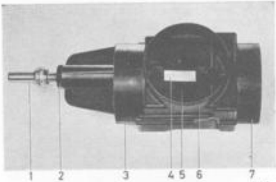


Fig. 2-139. Constant air temperature device flap

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

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

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

DAMPER DEVICE

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

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

REPLACING THROTTLE CABLE

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

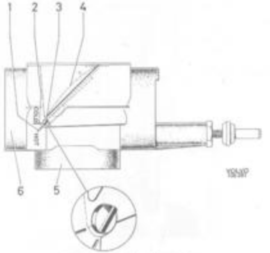


Fig. 2-140. Checking flap function

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

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

FLAP HOUSING FOR CONSTANT AIR TEMPERATURE DEVICE

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

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

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

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

AIR CLEANER

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

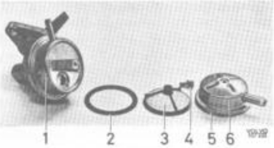


Fig. 2-142. Fuel pump, Pierburg

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

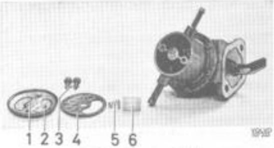


Fig. 2-143. Fuel pump, S.E.V.

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

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

On no condition must the insert be moistened or oiled.

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

FUEL PUMP

PIERBURG

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

Cleaning fuel pump

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

FUEL PUMP

S. E. V.

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

Cleaning fuel pump

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

FUEL FILTER IN TANK

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

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

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

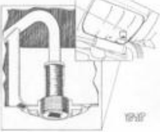


Fig. 2-144. Fuel filter in tank

VENTING FILTER

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

EXHAUST GAS RECIRCULATION (EGR)

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

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

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

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

GROUP 24

FUEL INJECTION ENGINES

DESCRIPTION

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

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

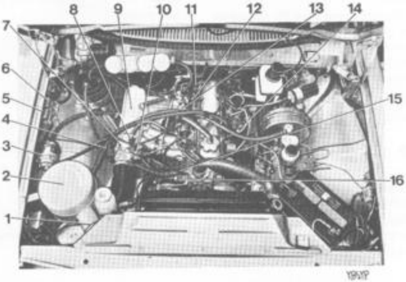


Fig. 2-145. Electronically controlled fuel injection (B 20 E and F)

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

FUNCTION

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

The pressure regulator, which is connected to the end of the pressure line, limits the fuel pressure to 2.1 kp/cm^2 (30 p s i). Excess fuel from the pressure regulator flows back to the tank through the return line. The electro-magnetic fuel injectors, which are mounted in the intake ports in the cylinder head, are connected to the fuel line.

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

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

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

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

The opening time for the cold start valve, which

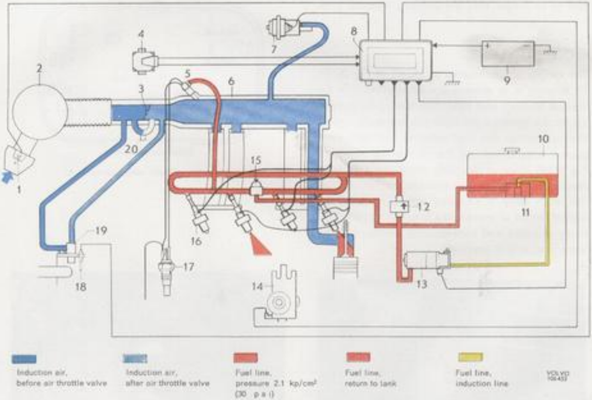


Fig. 2-146. Fuel injection system, principle of operation

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

reduces with increased engine temperature, is regulated by the thermal timer relay.
Over and above the basic fuel, extra fuel must be supplied to the engine for starting, running warm and acceleration. During cold starting, the engine is given extra fuel through the cold start valve on the inlet duct.
During warming-up the control unit receives information from the temperature sensor in the cooling water circuit and as a result permits the injectors to remain open for a little longer time. If the engine is to function as it should with the increased flow of fuel, more air is required. Extra air is obtained through the auxiliary air regulator which gradually closes as the engine temperature rises.
The electronic control unit receives impulses for additional fuel during acceleration from the throttle valve switch. When the accelerator pedal is depressed, impulses are released from the throttle switch to the control unit which issues orders to the injectors to inject a number of times between the ordinary injections. Depressing the accelerator pedal quickly would cause the duration of the injection to be longer than the ordinary injection time.

CONTROL UNIT

The control unit is located as shown in Fig. 2-147. Its function is to process the information from the various sensors and determine the opening interval for the injectors and when the fuel pump should start operating. The fuel pump is operated via a control relay located on the right wheel arch, see Fig. 2-148. Here, in the same place, the main relay feeding the control unit is also placed.
The main relay is provided with a diode in the control circuit to prevent the injection system from being engaged and consequently damaged, if the battery polarity is reversed.

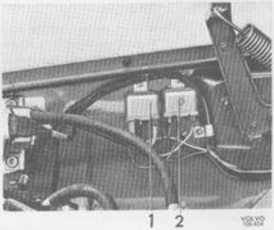


Fig. 2-148. Control relays
1. Pump relay
2. Main relay

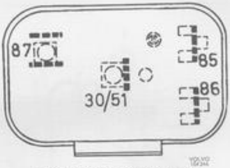


Fig. 2-149. Control relays' connections

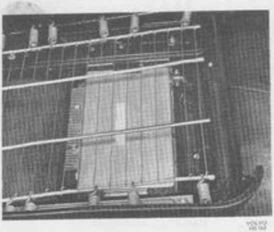


Fig. 2-147. Control unit, installed

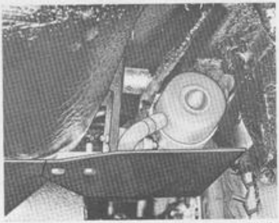


Fig. 2-150. Fuel pump, installed

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

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

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

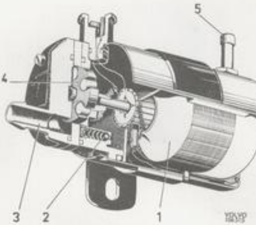


Fig. 2-151. Fuel pump

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

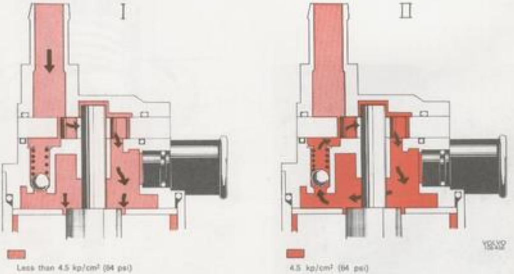


Fig. 2-152. Overflow valve function

I Overflow valve closed
II Overflow valve open

Fig. 2-153. Fuel filter, tank

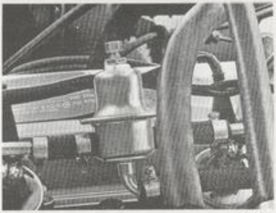


Fig. 2-155. Pressure regulator, installed

FUEL FILTERS

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

PRESSURE REGULATOR

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

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

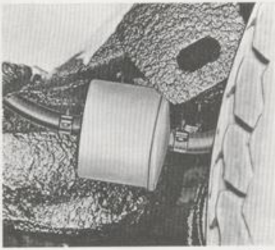


Fig. 2-154. Fuel filter

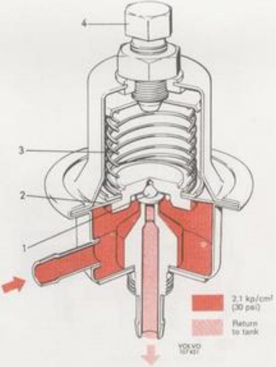


Fig. 2-156. Pressure regulator

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

INJECTORS

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

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

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

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

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

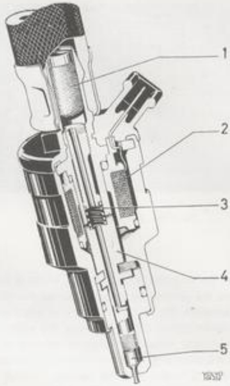


Fig. 2-158. Injector

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

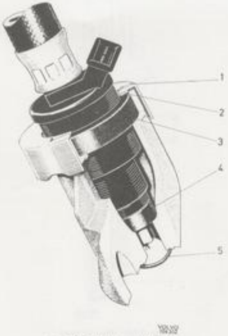


Fig. 2-157. Injector with holder

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

COLD START VALVE

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

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

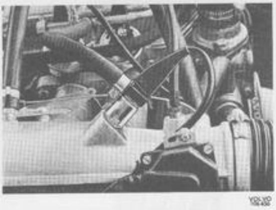


Fig. 2-159. Cold start valve, installed

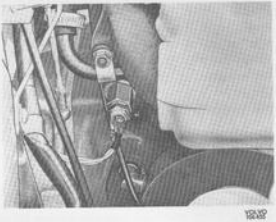


Fig. 2-161. Thermal timer, installed

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

THERMAL TIMER

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

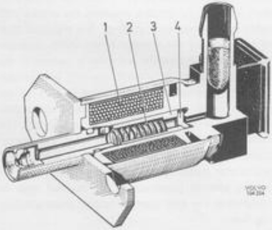


Fig. 2-160. Cold start valve

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

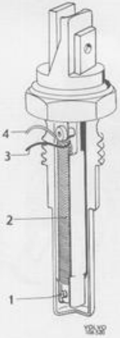


Fig. 2-162. Thermal timer

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

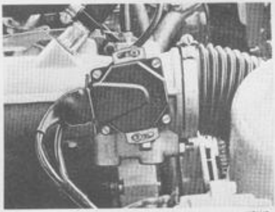


Fig. 2-163. Throttle valve switch

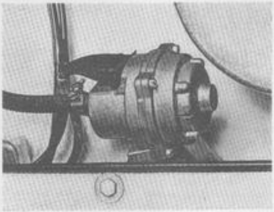


Fig. 2-165. Pressure sensor, installed

THROTTLE VALVE SWITCH

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

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

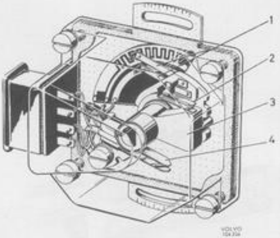


Fig. 2-164. Throttle valve switch

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

PRESSURE SENSOR

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

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

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

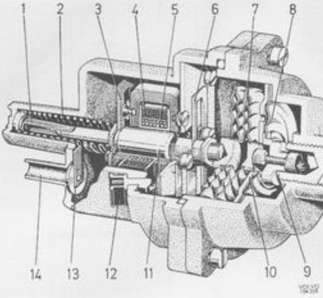


Fig. 2-166. Pressure sensor

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

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

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

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

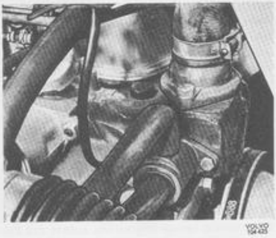


Fig. 2-167. Auxiliary air regulator, installed

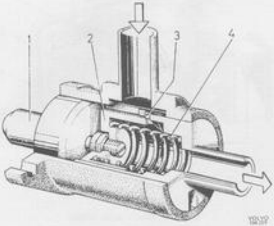


Fig. 2-168. Auxiliary air regulator

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

AUXILIARY AIR REGULATOR

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

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

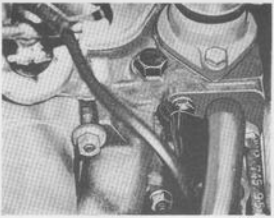


Fig. 2-170. Temperatur sensor for coolant

TEMPERATURE SENSORS

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

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

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

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

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

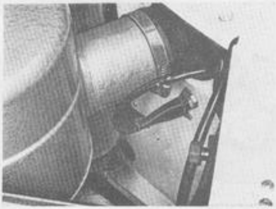


Fig. 2-169. Temperature sensor for intake air

INLET DUCT

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

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

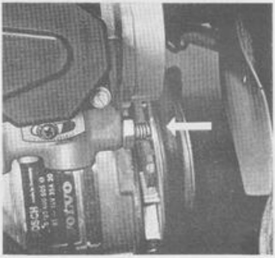


Fig. 2-171. Screw for adjusting idling

TRIGGERING CONTACTS

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

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

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

CABLE HARNESS

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

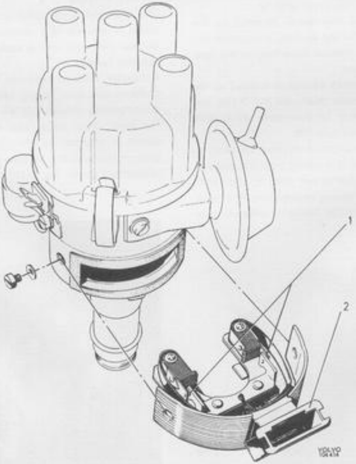


Fig. 2-172. Distributor with contact device

1. Triggering contacts
2. Electrical connection

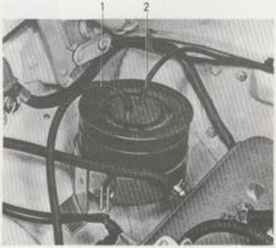


Fig. 2-173. Venting filter, fitted

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

Fig. 2-175. Expansion container

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

GAS EVAPORATIVE CONTROL SYSTEM

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

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

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

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

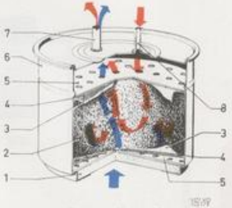


Fig. 2-174. Venting filter

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

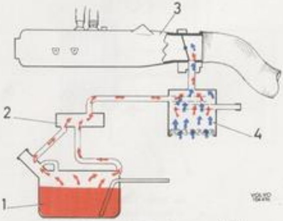


Fig. 2-176. Gas evaporative control system, principle

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

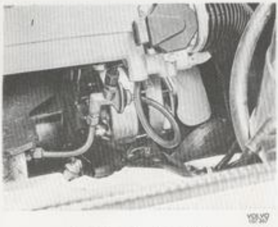


Fig. 2-177. EGR valve, installed

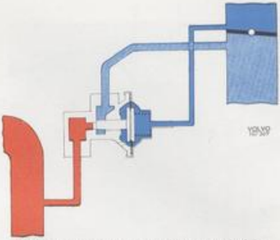


Fig. 2-179 a. Air shutter closed, no exhaust gas recirculation

EXHAUST GAS RECIRCULATION (EGR)

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

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

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

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

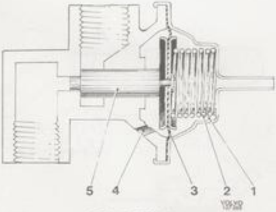


Fig. 2-178. EGR valve

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

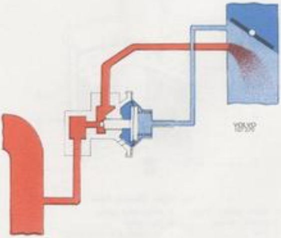


Fig. 2-179 b. Air shutter partly open, exhaust gas recirculation

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

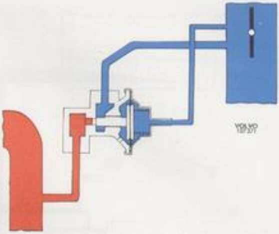


Fig. 2-179 c. Air shutter fully open, no exhaust gas recirculation

CABLE HARNESS NUMBERING

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

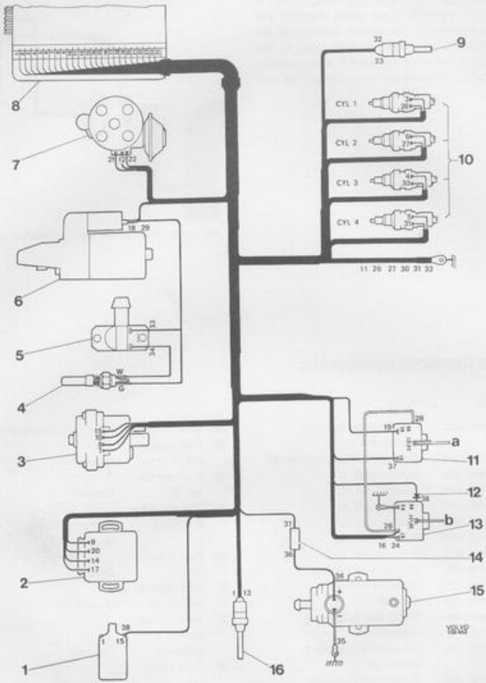


Fig. 2-180. Cable harness

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

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

REPAIR INSTRUCTIONS

SPECIAL INSTRUCTIONS FOR WORK ON VEHICLES WITH ELECTRONIC FUEL INJECTION

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

TESTING INJECTION EQUIPMENT WITH BOSCH TEST INSTRUMENT EFAW 228

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

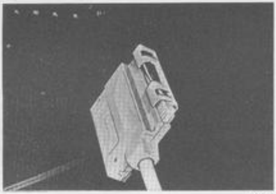


Fig. 2-181. Test instrument connected to cable harness

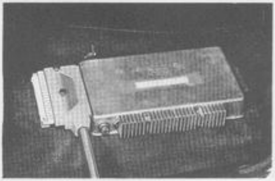
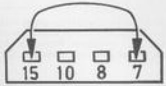
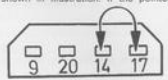


Fig. 2-182. Test instrument connected to cable harness

Position of switch "B"	Operate	To measure	Indication (nominal value)	Deviation from nominal value. Possible faults and elimination
Voltage I	Switch on ignition	Voltage supply for the control unit	11.0—12.5 (1.0—12.5 volt)	**No reading:** 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	Voltage at terminal 50 of starter solenoid	9.0—12.0 (9.0—12.0 volt)	**No voltage, starter operates:** Open circuit in cable 18 from terminal 50 on starter motor to control unit. **No voltage as above, starter does not operate:** 1. Ignition/starter switch defective. 2. Open circuit in cable between ignition and terminal 50 on starter. **Voltage below 9.0 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				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 as 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	0,8—1,0 on the Ω scale (approx. 90 Ω)	**Resistance considerably smaller than nominal value:** Damage to insulation. (Pull plug out of pressure sensor and if test instrument shows "∞", replace pressure sensor, otherwise cables 7 and 15.) **Resistance considerably larger than nominal value:** Voltage drop in cables or contacts. (Check cables and contacts.) **Resistance "0":** Short circuit to ground, short circuit in secondary windings. (Pull plug out of pressure sensor and if test instrument shows "∞" replace pressure sensor, otherwise check cables 7 and 15.) **Resistance "∞":** Open circuit in sensor or cables. (Pull plug out of sensor. Bridge plug as shown in Illustration. If test instrument indicates 0, replace pressure sensor. If "∞" indicated, check cables 7 and 15.) 
	Push in "Secondary" button		3—4 on Ω scale (approx. 350 Ω)	See under "Primary". If needle of the test instrument shows "∞", connect terminals 8 and 10 in the plug instead of 7 and 15.)
Distributor contact I Distributor contact II	Read off test instrument with switch in position I. Switch to position II. If the test instrument swings to 0 in the first position, it should now indicate ∞ and if the instrument shows ∞ in the first position, it should now indicate 0. Switch to position I. Run the engine with short strokes on the starter motor until the instrument shows a reading opposite to the first reading. Switch to position II again and check to make sure that the reading changes.	Functioning of the triggering contacts in the distributor	0 and "∞" (0 and "∞"Ω)	**Resistance between 0 and "∞":** Check terminal on distributor. Check cables 12, 21 and 22. (If there is no fault in the terminal or cables change the contact insert in distributor.)

Position of switch "B"	Operate	To measure	Indication (nominal value)	Deviation from nominal value. Possible faults and elimination
Throttle valve switch I Throttle valve switch II	Open and close throttle valve slowly	Impulses for extra fuel during acceleration	Instrument needle swings approx. 10 times between "0" and "∞" when the throttle valve opens. (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 III	Check that throttle valve is closed	Functioning of the contacts in the throttle valve switch	0 (0 Ω)	**Resistance "∞":** Throttle valve switch incorrectly adjusted or damaged. Open circuit in cable to switch. (Pull out plug and bridge as shown in Illustration. If the pointer swings to "0", there is no damage in the cables. Re-connect the switch. Check setting of throttle valve switch acc. to page 2-80. Change switch if unable to be adjusted.) 98119
	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 2-80. 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 swings 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.

Valves	Adjust instrument to "∞" again (with switch "B" in position "valves") Push buttons: 1 = injector for cyl. 1 2 = injector for cyl. 4 3 = injector for cyl. 2 4 = injector for cyl. 3	Resistance of the windings in the injector with cable	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 "3":** Ground cable from the injectors has a bad connection on the engine. (Check ground cables for respective valves, 26, 27, 30 and 31.)

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

Position of switch "B"	Operate	To measure	Indication (nominal value)	Deviation from nominal value. Possible faults and elimination
Valve check	Connect pressure gauge to pressure regulator, see page 2:78 Press "Pump" button on the instrument	Pressure in fuel system	Nominal value 2.1 kp/cm² (30 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 terminal 86, resp. cable 19 from pump relay terminal 85 to control unit. (If the cables are not damaged, change the relay.) Relay cuts-in: Open circuit in cables 27 and 36, from terminal 87 on pump relay to contact on pump or in cable 35, from contact to ground. Faulty pump. (Check cables, measure voltage at plug contact for pump. If voltage is 12 volts, change pump.) **Pressure above or below 2.1 kp/cm² (30 psi):** Pressure regulator incorrectly adjusted or damaged. (Adjust or change regulator.)
Press in "Pump" button briefly	For leakage in fuel system (pressure side)		Pressure may drop to approx. 1.2 kp/cm² (16 psi) when "pump" button is released. Pressure may then drop very slowly.	**Pressure drops rapidly below 1.2 kp/cm² (16 psi) when "Pump" button is released:** Leakage in fuel system pressure side, pump-pressure regulator. Run up pressure again. Place pinchers (2901) on fuel hose between distributor pipe and fuel pipe from pump. If pressure ceases to drop, fault is in pump or fuel line. If pressure drops in spite of this, remove pinchers from hose, run up pressure again and place pinchers on hose between pressure gauge and pressure regulator (after having released "Pump" button). If pressure does not drop more, then pressure regulator is faulty. If pressure continues to drop, remove pinchers from hose. Run up pressure again and place pinchers on hose between distributing pipe and cold start valve. If pressure ceases to drop, fault is in cold start valve. If pressure continues to drop, fault is in one of injectors, see below.

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

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

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

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

Remove instrument and fit control unit.

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

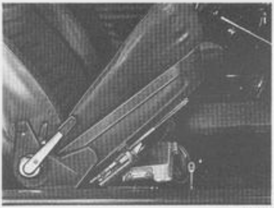


Fig. 2-183. Removing control unit

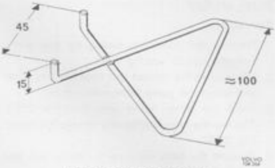


Fig. 2-185. Puller for plug contact
Material: 2 mm (5/64") welding wire

CONTROL UNIT

REMOVING

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

INSTALLING

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

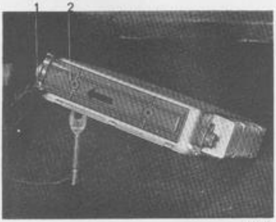


Fig. 2-184. Removing plastic cover
1. Cap screw 2. Plastic cover

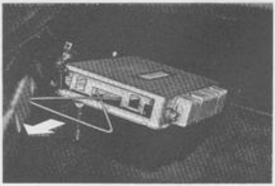


Fig. 2-186. Removing plug contact

FUEL PUMP

REPLACING

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

CHECKING

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

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

Fig. 2-187. Removing fuel pump

FUEL FILTER

REPLACING

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

PRESSURE REGULATOR

REPLACING

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

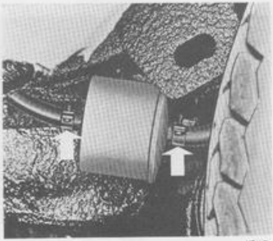


Fig. 2-188. Removing fuel filter

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

ADJUSTING

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

INJECTORS

REPLACING

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

CHECKING

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

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

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

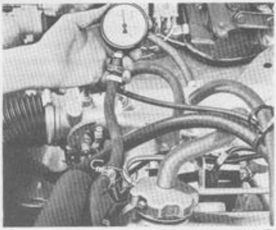


Fig. 2-189. Connecting pressure gauge

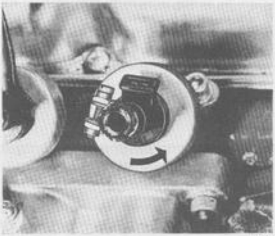


Fig. 2-190. Removing injector

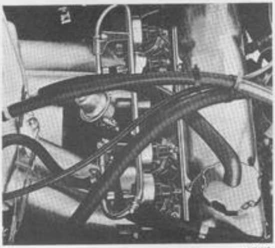


Fig. 2-191. Injectors removed for checking

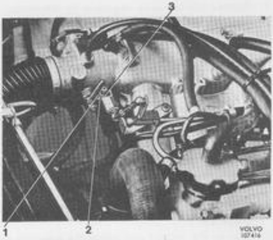


Fig. 2-192. Stop screw for throttle valve
1. Locknut
2. Stop screw
3. Stop on throttle valve spindle

COLD START VALVE

REPLACING

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

THROTTLE VALVE

ADJUSTING

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

THROTTLE VALVE SWITCH

REPLACING

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

ADJUSTING

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

CHECKING

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

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

THERMAL TIMER

REPLACING

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

AIR CLEANER, 140

REPLACING (every 40 000 km = 24 000 miles)

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

TEMPERATURE SENSOR I (INDUCTION AIR)

REPLACING

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

CHECKING

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

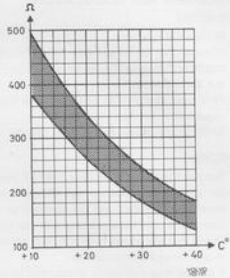


Fig. 2-193. Resistance in temperature sensor for induction air

TEMPERATURE SENSOR II (COOLANT)

REPLACING

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

CHECKING

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

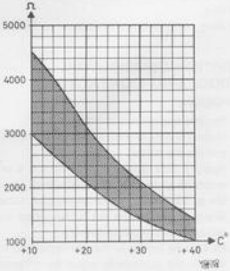


Fig. 2-194. Resistance in temperature sensor for coolant

AUXILIARY AIR REGULATOR

REPLACING

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

CHECKING

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

PRESSURE SENSOR

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

CHECKING

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

IGNITION DISTRIBUTOR TRIGGERING CONTACTS

REPLACING

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

ADJUSTING THE IGNITION

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

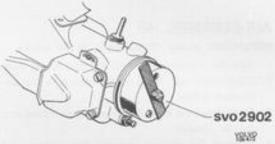


Fig. 2-195. Cover for ignition setting

ADJUSTING THE IDLING

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

ADJUSTING THE CO-VALUE

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

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

   Turning the adjusting screw clockwise increases the CO-content.

EXHAUST GAS RECIRCULATION (EGR)

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

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

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

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

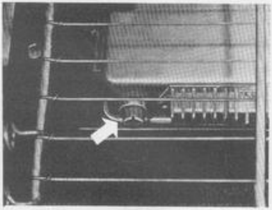


Fig. 2-196. Adjusting the CO-valve
Arrow = adjusting screw

GROUP 26

COOLING SYSTEM

DESCRIPTION

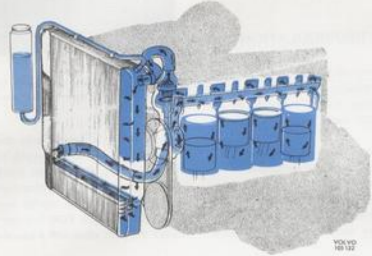


Fig. 2-197. Sealed type cooling system

GENERAL

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

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

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

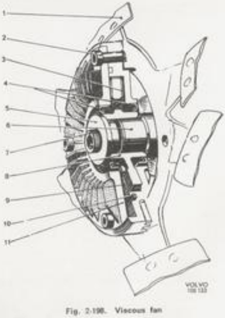


Fig. 2-198. Viscous fan

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

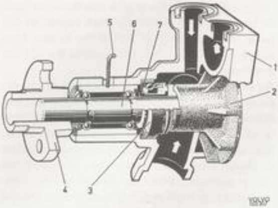


Fig. 2-199. Water pump

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

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

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

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

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

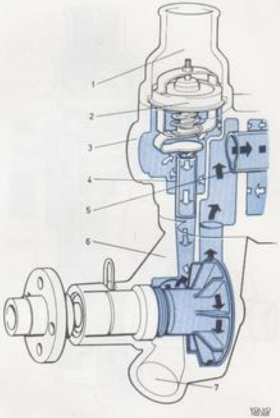


Fig. 2-200. Coolant flow, thermostat closed

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

through the inner circuit (the by-pass). This circuit covers the engine and car heater. The thermostat is closed, that is, the outlet to the radiator is shut off. The coolant passes through the thermostat by-pass to the distributor pipe (5, Fig. 2-200) in the cylinder head. This results in a uniform cooling of the warmest parts in the cylinder head. Even the parts around the spark plugs are also cold and thereby maintained at a constant temperature. The coolant surrounding the cylinder walls is circulated by means of thermo-syphon action.

COOLANT SYSTEM OUTER CIRCUIT

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

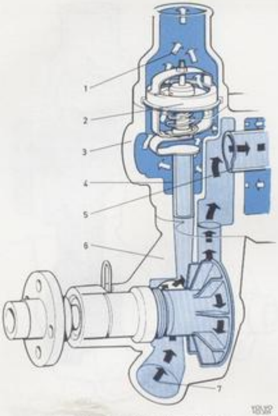


Fig. 2-201. Coolant flow, thermostat open
Concerning numbers above, see previous figure

Coolant flows from the engine into the upper part of the radiator is cooled and then sucked by the pump out from the lower part of the radiator from where it is conveyed into the engine through the distributing pipe.
An air cushion forms in the upper part of the expansion tank and permits the coolant to expand without involving any loss of coolant so that there is air suction at reduced temperature and volume. This arrangement ensures that the cooling system is always filled with coolant, thus minimizing the risk of corrosion. When the cooling system is being topped up, it will probably be difficult to prevent air from entering this system. The air, however, is subsequently separated and forced out into the expansion tank where it is replaced by coolant from this tank. It is, therefore, important to check the coolant level after the system has been emptied and filled with new coolant.
The expansion tank cap is provided with a valve which opens when the pressure in the system goes up to 0.7 atmospheric gauge. There is also a valve which opens when there is a partical vacuum in the system and admits air into the expansion tank.

REPAIR INSTRUCTIONS

RADIATOR
TOPPING UP WITH COOLANT

Topping up with coolant, consisting of 50 % ethylene glycol and 50 % water (all year round) is done in the expansion tank, when the level has fallen to the "Min" mark.
NOTE. Never top up with water only.

DRAINING COOLING SYSTEM

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

FILLING EMPTY SYSTEM WITH COOLANT

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

COOLING SYSTEM LEAKAGE CHECK

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

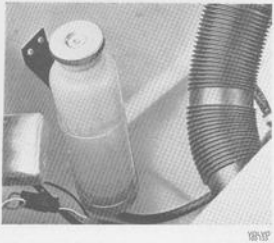


Fig. 2-202. Expansion tank

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

REPLACING RADIATOR

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

REPLACING WATER PUMP

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

Fig. 2-203. Belt tensioner 2906

THERMOSTAT

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

TENSIONING THE PULLEY BELT

Belt tensioner 2906 can be suitably used for checking and adjusting the belt tension.
The gauge is placed on the belt as shown in the Fig. 2-203. The belt must lie in the fork on the thrust rod. Push the gauge down until both ends on the stop rule lie against the belt. In this position, read off the gauge. Fig. 2-204 shows the correct values. (See also the table.)

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

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

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

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

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

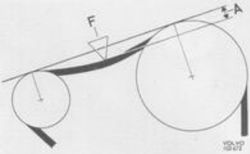


Fig. 2-205. Fan belt tension
F=See table A=10 mm (approx. 3/8")

Without 2906

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

FAN COUPLING

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

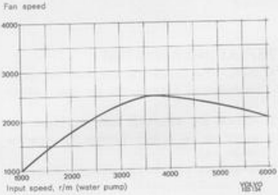


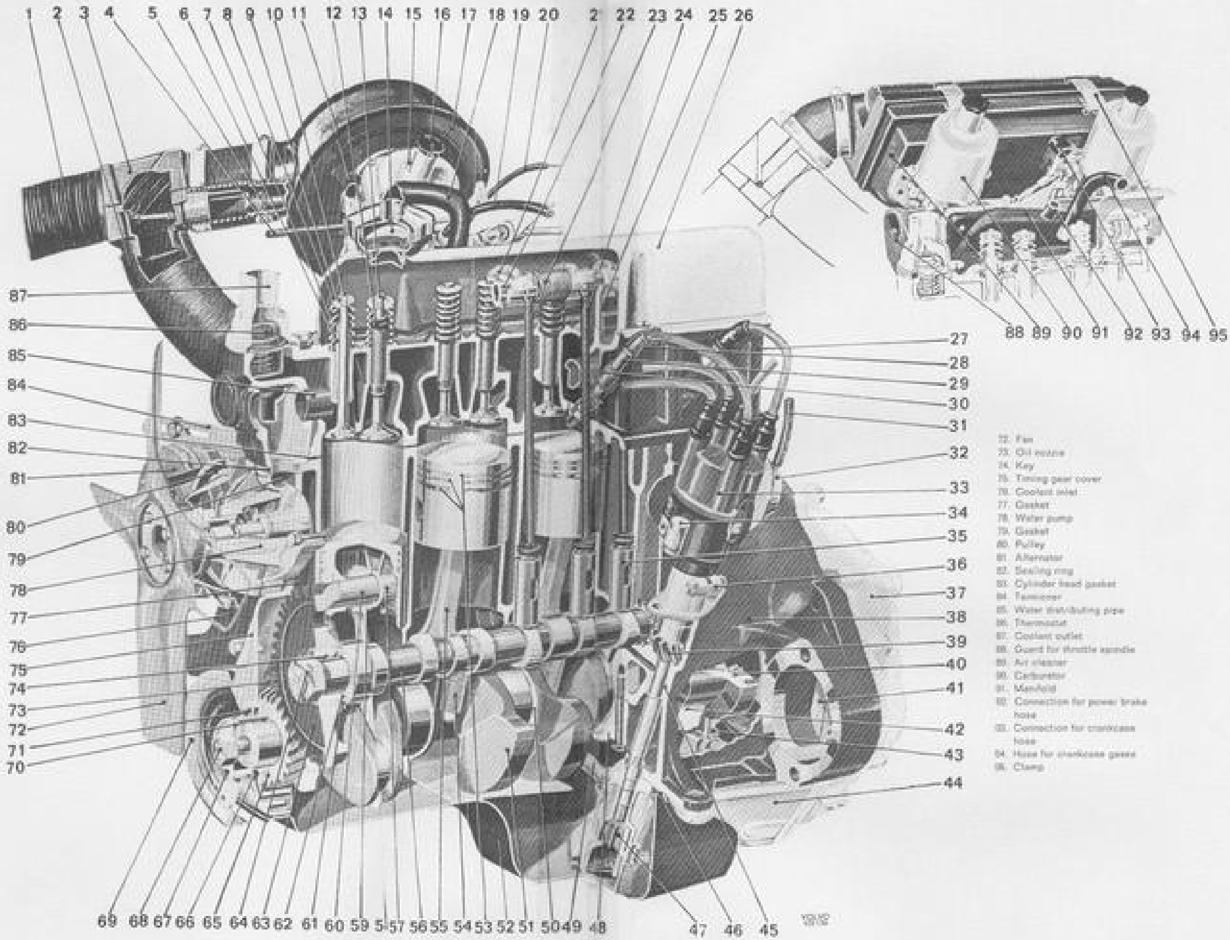
Fig. 2-206. Curve for fan coupling slip

Fan belt tensioning:

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

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

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



72. Fan
73. Oil nozzle
74. Key
75. Timing gear cover
76. Coolant inlet
77. Gasket
78. Water pump
79. Gasket
80. Pulley
81. Alternator
82. Sealing ring
83. Cylinder head gasket
84. Tensioner
85. Water distributing pipe
86. Thermostat
87. Coolant outlet
88. Guard for throttle spindle
89. Air cleaner
90. Carburetor
91. Manifold
92. Connection for power brake hose
93. Connection for crankcase hose
94. Hose for crankcase gases
95. Clamp

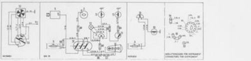
Illusation 2-A. Engine, B 20

Part 3

ELECTRICAL SYSTEM AND INSTRUMENTS

CONTENTS

Pos. Title	Data
1. Battery	12 V 60 Ah
2. Connection box	
3. Ignition switch	
4. Ignition coil	
5. Distributor, firing sequence	1-3-4-2
6. Starter motor	
7. Alternator	
8. Changing regulator	
9. Fusebox	
10. Light switch	
11. Dip relay for main and dipped beams	
12. Headlights	45 W
13. Dipped beams	40 W
14. Position light	5 W
15. Rear light	5 W
16. Side marking lights	5 W
17. Plate light	2x5 W
18. Brake stop light contact	
19. Brake stop lights	32 cp
20. Connection at instrument	
21. Contact on gearbox M 40, M 41	
22. Reverse lights	32 cp
23. Flasher unit	
24. Dir. ind. switch	
25. Switch, emergency warning flashers	
26. Flasher lights	32 cp
27. Part of 6-pole connection block	
28. Rev counter	
29. Thermometer	
30. Fuel gauge	
31. Voltage stabilizer	
32. Flasher light warning lamp	1.2 W
33. Diode	
34. Warning lamp for main beams	1.2 W
35. Warning lamp for battery charging	1.2 W
36. Parking brake warning lamp	1.2 W
37. Choke warning lamp	1.2 W
38. Oil pressure warning lamp	1.2 W
39. Brake warning lamp	1.2 W
40. Vacant warning lamp	
41. Parking brake contact	
42. Choke control contact	
43. Temperature sensor	
44. Oil pressure sensor	
45. Brake warning contact	
46. Brake level sender	
47. Horn	
48. Horn ring	
49. Switch, windshield wipers/washer	
50. Windshield wipers	
51. Windshield washer	
52. Switch, fan	
53. Fan	
54. Switch, elec. heated rear window	
55. Elec. heated rear window	
56. Clock	
57. Cigarette lighter	
58. Rheostat for instrument panel lighting	
59. Instrument panel lighting	3x2 W
60. Lighting for controls	3x1.2 W
61. Shift positions light, aut. trans.	1.2 W
62. Glove locker contact	
63. Glove locker lamp	
64. Interior lamp	
65. Door switch on left side	
66. Door switch on right side	
67. Reminder buzzer for ignition key	
68. Joint	
69. Connection at instrument	
70. Passenger seat contact	
71. Reminder buzzer for seat belt	
72. Seat belt warning lamp	1.2 W
73. Contact for seat belt	
74. Switch for overdrive M 41	
75. Contact for overdrive on gearbox M 41	
76. Solenoid for overdrive on gearbox M 41	
77. Overdrive warning lamp	1.2 W
78. Contact on automatic transmission BW 35	
79. Reminder buzzer for lights	
80. Control unit	
81. Throttle valve switch	
82. Pressure sensor	
83. Relay for fuel pump	



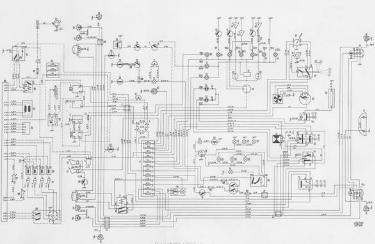


ILLUSTRATION 3-A.
WIRING DIAGRAM 142/144

Pos. Title	Data
84. Main relay for fuel injection	
85. Thermal timer contact	
86. Start valve	
87. Temperature sensor I	
88. Temperature sensor II	
89. Injection valves	
90. Cut-in contact	
91. Spark plug	
92. Fusebox	
93. Fuel pump	
94. Connection at instrument	
95. Connection at instrument	

Colour code	
SB	Black
Y	Yellow
Bl	Blue
Bl-Y	Blue-Yellow
Bl-R	Blue-Red
Gn-R	Green-Red
R	Red
Gn	Green
W-R	White-Red
W	White
Br	Brown
Gr	Grey

GROUP 30

GENERAL

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

GROUP 31

BATTERY

DESCRIPTION

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

REPAIR INSTRUCTIONS

REMOVING

1. Remove the cable terminals on 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 down with clean, lukewarm water.
4. Clean the battery shelf and the cable terminals. Use a special steel brush or pliers for the cable terminals.

FITTING

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

SERVICING

If the battery is to function satisfactorily, the acid must be maintained at the specified level above the plates. Ensure that the acid level is about 5 mm (3/16") above the plates. If the level is too low, fill with distilled water to the extent necessary. Also make sure that the battery is securely fixed and that the cable terminals are well-tightened.

The cable terminals and battery terminal studs should be coated with a light layer of vaseline to prevent oxidation.

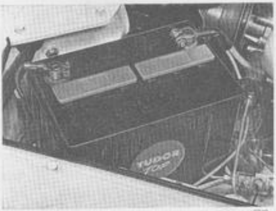


Fig. 3-1. Battery

ALTERNATOR

S.E.V. MARSHALL 14 V—71270202

DESCRIPTION

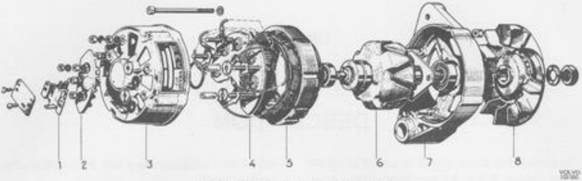


Fig. 3-2. S.E.V. Marshall alternator dismantled

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

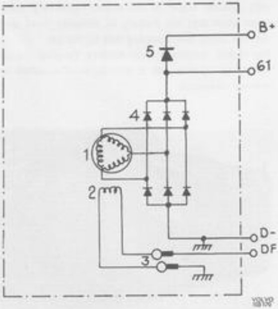


Fig. 3-3. Inner wiring of the alternator

1. Stator
2. Rotor (field winding)
3. Slip rings and brush holder
4. Rectifier diodes
5. Isolation diode

The alternator is a three-phase, delta-connected alternating unit which is belt-driven from a pulley on the crankshaft.

The alternator has a built-in rectifier in the slip ring end shield. This rectifier consists of six silicon diodes. The rotor is a claw-pole type with the field winding fed across two slip rings. The rotor is so designed as to permit a maximum alternator speed of 250 r/s (15000 r/m).

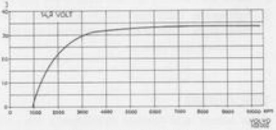


Fig. 3-4. Output curve for alternator

The isolation diode (2, Fig. 3-2) placed on the outside of the alternator has two functions: it acts as an extra cut-out current protection for the alternator should any of the six rectifier diodes stop functioning; and it makes simple connecting up of the warning charging lamp possible.

The alternator is self-limiting (max. 35 amps) and for this reason a simple voltage regulator can be used with only voltage control.

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 an aid 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 adjustment arm.
4. Remove the bolt holding the alternator to the engine block.
5. Remove the fan belt and lift the alternator forwards.

DISASSEMBLING ALTERNATOR

1. Release the two screws holding the brush holder and remove the isolation plate. Pull out the brush holder.
2. Fix the pulley with belt in a vice with soft jaws, see Fig. 3-6.
3. Remove the nut and washer. Lift off the pulley, fan, key and spacer washer.
4. 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.
5. Mark the drive end shield, stator and slip ring end shield to avoid confusion when assembling. Remove the four attaching screws.

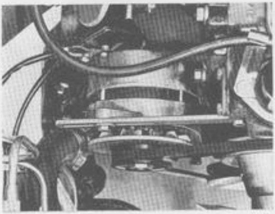


Fig. 3-5. Alternator fitted

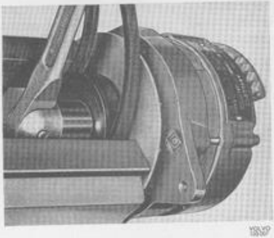


Fig. 3-6. Removing pulley nut

Fig. 3-8. Removing drive end shield

6. Remove the rotor and drive end shield with the help of two screwdrivers, which are inserted in two of the slots between the stator and drive end shield, see Fig. 3-7.

   NOTE. The screwdrivers may not be inserted deeper than 2 mm (just over 1/16"), otherwise the stator may be damaged.
7. 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.
8. Remove the nuts and washers for the diode holder for the negative diodes.
9. Remove the stator and diode holders for the slip ring end shield.

CHECKING DISASSEMBLED ALTERNATOR

STATOR

Check the stator for any short-circuiting. If one or several of the coils are burnt, there must be a short-circuit in the stator. Connect a test lamp (12 V, 2—5 W) between the stator plates and a terminal on the stator, see Fig. 3—9.

If the lamp lights, the isolation between the stator winding and the stator plates must be burnt out, in which case the stator should be replaced.

NOTE. Only a 12 V, 2—5 W test lamp may be used; 110 or 220 V, D.C. or A.C. lamps may NOT be used. This applies to all the alternator components.

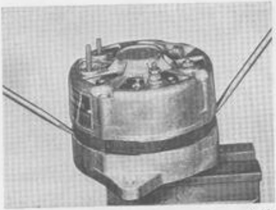


Fig. 3-7. Disassembling alternator

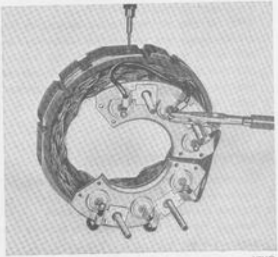


Fig. 3-9. Checking stator

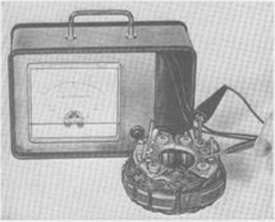


Fig. 3-10. Checking diodes

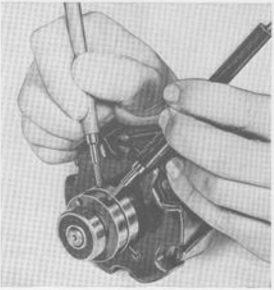


Fig. 3-12. Check-measuring rotor

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 the isolation diode is faulty, replace the holder, complete with isolation diode.

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.

Fig. 3-11. Checking isolation diode

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 5.2±0.2 ohms.

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. (New bearings should always be fitted 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 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.

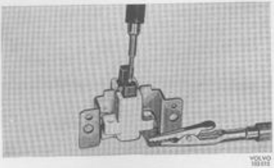


Fig. 3-13. Checking brush holder

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 points so as not to damage the new diode.)
3. Solder on the diodes, see Fig. 3-15.
   NOTE. The complete "+" or "—" diode holder must be replaced even if only one diode is faulty.

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.**

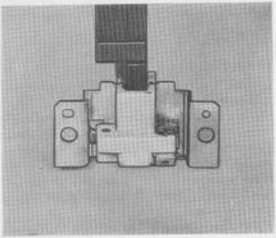


Fig. 3-14. Measuring brush length

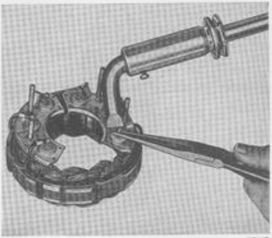


Fig. 3-15. Soldering diodes

REPLACING BEARINGS

DRIVE END SHIELD BEARINGS

Removing

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

Fitting

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.

Fitting

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

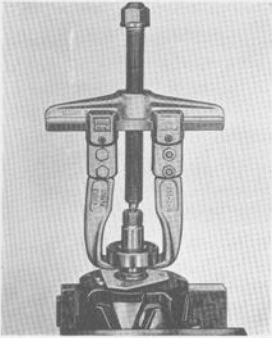


Fig. 3-16. Removing bearings

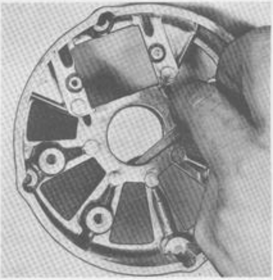


Fig. 3-18. Removing O-ring

REPLACING SLIP RING END SHIELD O-RING

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

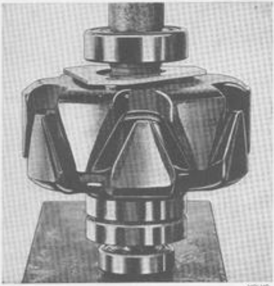


Fig. 3-17. Fitting bearings

ASSEMBLING ALTERNATOR

1. Fit the stator and the diode holders in the slip ring end shield. (Do not forget the isolation washers for the positive diode holder). Fit the nuts and washers on the negative diode holder screws.
2. Press the rotor into the drive end shield. Fit the three screws for the drive bearing support plate.
3. Fit together the rotor and stator sections.
4. Fit the attaching screws. Tightening torque 2.8—3.0 Nm (2.0—2.2 lbft).
5. Fit the plastic tube and isolation washers on the screws on which the isolation diode is to be mounted.
   Fit the isolation diode, put on the nuts and washers. Fit the brush holder.
6. Fit the spacer washer, key, fan, pulley, washer and nut. Tightening torque 40 Nm (29.0 lbft).

7. Connect a test lamp between B+ and the alternator frame. Switch the connections. The lamp should light only in one direction, se 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 26) and secure the alternator. NOTE. Force may only be applied to the front end of the alternator when adjusting the belt tension.
3. Fit the leads to the alternator.
4. Fit the battery lead.

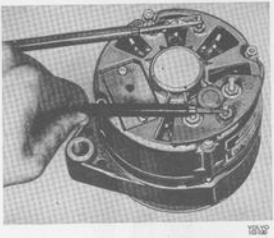


Fig. 3-19. Checking alternator

VOLTAGE REGULATOR

S.E.V. MARSHALL

DESCRIPTION

Fig. 3-20. Voltage regulator fitted

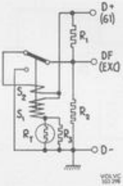
The regulator, Fig. 3-20, is a twin contact regulator with one upper movable contact and a lower one. The movable contact is secured to an armature which is actuated by a voltage coil. The regulator also contains three resistors and one thermistor.

FUNCTION

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

When the alternator starts rotating, alternating current is formed in the stator. This alternating current

is rectified by the silicon diodes and the direct surrent 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 resistor 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 grounded at both ends, this causing the voltage to drop rapidly. The cycle is repeated continuously so that the voltage is maintained constant.



S1 Voltage winding
S2 Acceleration winding
R1 Regulator resistance 100±10%
R2 Damping resistance 300±10%
R3 Compensation resistance (adapted to RT during manufacture)
RT Compensation thermistor approx. 4Ω at 25°C (77°F)

Fig. 3-21. Inner wiring of regulator

TESTING 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 grounding.
Check the fan belt. 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 ground, 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.

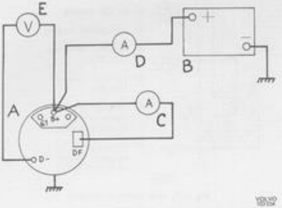


Fig. 3-22. Wiring diagram for testing alternator

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

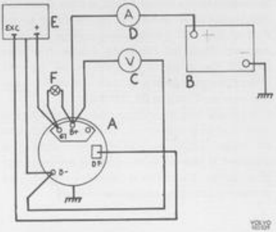


Fig. 3-23. Wiring diagram for testing voltage regulator

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

Check that the current through the field winding (ammeter C) is 2—2.5 amps. (If the current is not the correct one, then check the brush holder and field winding.) Run the alternator to a speed of 50 r/s (3000 r/m). (Engine speed 25 r/s = 1500 r/m). The alternator should then produce at least 30 amps at about 13 volts. (A further load may be conncted up in order to maintain the voltage at about 13 volts.) Measure the voltage at B+ and 61 when the alternator charges.

The voltage should be 08.—0.9 volt higher at terminal 61, otherwise the isolation diode is faulty and should be replaced.

CHECKING VOLTAGE REGULATOR

(In a test bench or in the vehicle)

Connect up the alternator and regulator as shown in Fig. 3-23. Run the alternator at about a speed of 83.5 r/s (5000 r/m) (engine speed 42 r/s = 2500 r/m) for 15 seconds. Then read off the voltage on the voltmeter. With no load on the alternator, the voltmeter should read 13.1—14.4 volts with the regulator ambient temperature at 25°C (77°F).

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

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

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

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

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

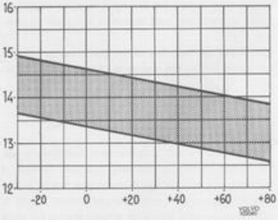


Fig. 3-24. Voltage-temperature diagram for cold voltage regulator

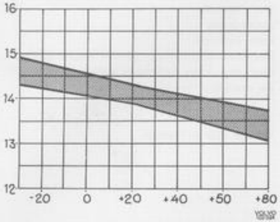


Fig. 3-25. Voltage-temperature diagram for warm voltage regulator

Immediately after, or preferably during driving, measure the voltage between B+ and D— on the alternator. The engine should be turning over at about 42 r/s (2500 r/m) when the measuring is being carried out. When the regulator ambient temperature is about 25°C (77°F), the voltage should be 13.85—14.25 volts. For other ambient temperatures, see Fig. 3-25.

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 diode. 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 terminal on regulator or alternator. Short-circuiting in isolation diode.

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.

ALTERNATOR

S.E.V. MARSHALL 14 V—34833

DESCRIPTION

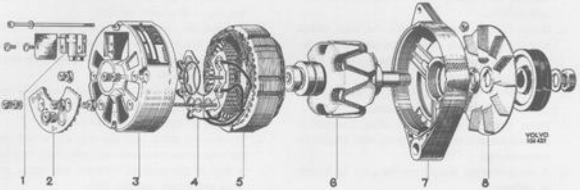


Fig. 3-26. Exploded view of alternator

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.

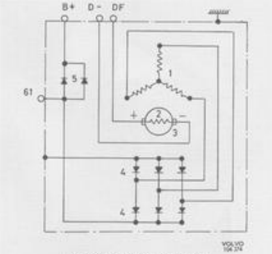


Fig. 3-27. Alternator inner circuit

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

The alternator has a roating field (rotor) and stationary generating windings (stator).
The rotor is of the claw-pole type with the field windings fed over the slip rings. The construction of the rotor has made it possible for the alternator to have a max. speed of 250 r/s 15 000 r/m.)
The isolation diodes (2, Fig. 3-26), 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.

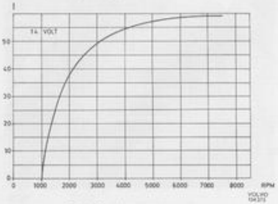


Fig. 3-28. Alternator output curve

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 belt and lift the alternator forwards.

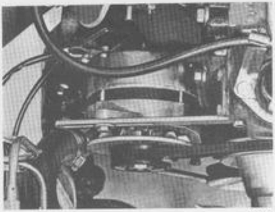


Fig. 3-29. Alternator fitted

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. 3-30.
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. 3-31.

   NOTE. The screwdrivers may not be inserted deeper than 2 mm (just over 1/16"), otherwise the stator may be damaged.
6. Release the three screws holding the support plate of the drive end bearing. Release the bearing by knocking the end of the shaft against a piece of wood, see Fig. 3-32.
7. Remove the nuts and washers for the diode holders.
8. Remove the stator and diode holders for the slip ring end shield.

Fig. 3-30. Removing isolation diodes

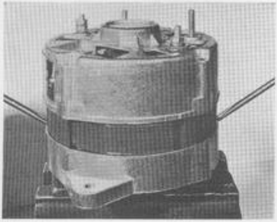


Fig. 3-31. Disassembling alternator

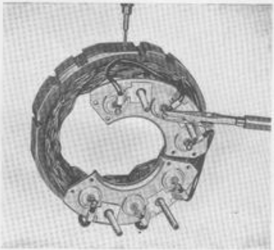


Fig. 3-33. Checking stator

CHECKING DISASSEMBLED ALTERNATOR

STATOR

Check the stator for any short-ciruiting. 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. 3-33.

If the lamp lights, the isolation between the stator winding and the stator plates must be burnt out, in which case the stator should be replaced

NOTE. Only a 12 V, 2—5 W test lamp may be used; 110 or 220 V, D.C. or A.C. lamps may NOT be used. This applies to all the alternator components.

Check the diodes with a diode tester, see Fig. 3-34.

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 3-17) 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. 3-36. At 25°C (77°F) the resistance should be 3.7 ohms.

Fig. 3-32. Removing drive end shield

Fig. 3-34. Checking diodes

Fig. 3-35. 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 betwen 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. 3-37. Connect the test lamp between the brush holder frame "—" brush. The lamp

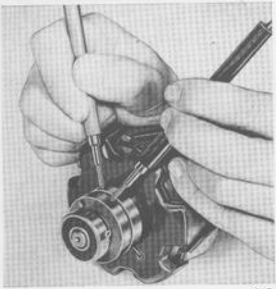


Fig. 3-36. Check-measuring rotor

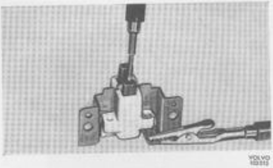


Fig. 3-37. Checking brush holder

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. 3-38.

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. 3-39.
   NOTE. The complete "+" or "—" diode holder must be replaced even if only one diode is faulty.

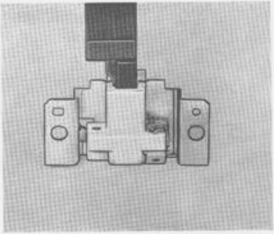


Fig. 3-38. Measuring brush length

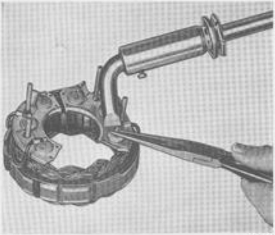


Fig. 3-39. Soldering on diodes

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. 3-40.

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. 3-41.

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.

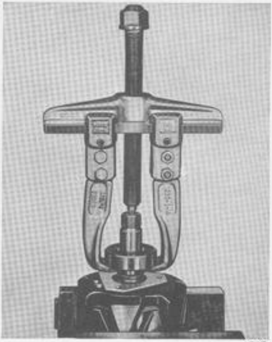


Fig. 3-40. Removing bearing

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. 3-42.
2. Wash the groove clean.
   Check that the hole in the bearing shield is not blocked.

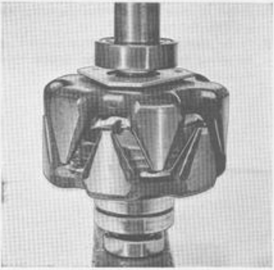


Fig. 3-41. Fitting bearing

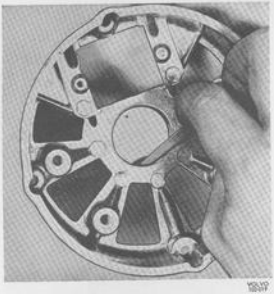


Fig. 3-42. Removing O-ring

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 dismantld.

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 screw.
2. Press the rotor into the drive end shield. Fit the three screws for the drive bearing support plate.
3. Fit together the rotor and stator sections.
4. Fit the attaching screws. Tightening torque 2.8—3.0 Nm (2.0—2.2 lbft.)
5. Fit the plastic tube and isolation washers on the screws on which the isolation diode is to be mounted.

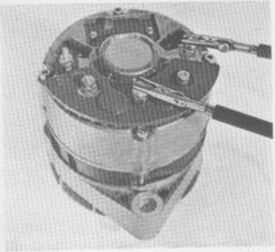


Fig. 3-43. Checking alternator

Fit the isolation diode, put on the nuts and washers. Fit the brush holder.

6. Fit the spacer washer, key, fan, pulley, washer and nut. Tightening torque 40 Nm (29.0 lbft).
7. Connect a test lamp between B+ and the alternator frame. Switch the terminals. The lamp should light only in one direction, see Fig. 3-43. After any repairs, the alternator shoul dbe 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 (se Part 2, Engine, Group 25) and secure the alternator. NOTE. Force may only be applied to the front end of the alternator when adjusting the belt tension. Fit the leads to the alternator.
4. Fit the battery lead.

VOLTAGE REGULATOR

DESCRIPTION

Fig. 3-44. Voltage regulator fitted

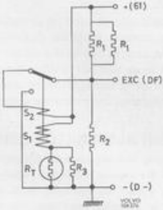


Fig. 3-45. Inner wiring of regulator

S1 Voltage winding
S2 Acceleration winding
R1 Regulator resistances (2) $10\Omega \pm 10\%$
R2 Damping resistance $300\Omega \pm 10\%$
R3 Compensation resistance (adapted to RT during manufacture)
RT Compensation thermistor approx. 4Ω at 25°C (77°F)

The regulator, Fig. 3-44, 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 in, 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. 3-45.

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 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, Grup 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. 3-46. Check that the current through the field winding (ammeter C) is 3—3.5 amps. (If the current is not the correct one, then check the brush holder and field winding.) Run the alternator to a speed of 50 r/s (3000 r/m). (Engine speed 25 r/s (1500 r/m). The alternator should then produce at least 48 amps at 14 volts. (A further load may be connected up in order to maintain the voltage at 14 volts.) This applies to a warm alternator and an ambient temperature of 25°C (77°F).

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

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

CHECKING VOLTAGE REGULATOR

(In a test bench or in the vehicle)

Connect up the alternator and regulator as shown in Fig. 3-47. Run the alternator at about a speed of 83.5 r/s (5000 r/m) (engine speed 42 r/s = 2 500 r/s) for 15 seconds. Then read off the voltage on the voltmeter. With no load on the alternator, the voltmeter should read 13.1—14.3 volts with the regulator ambient temperature at 25°C (77°F).

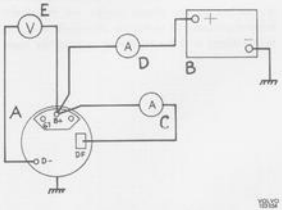


Fig. 3-46. Wiring diagram for testing alternator

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

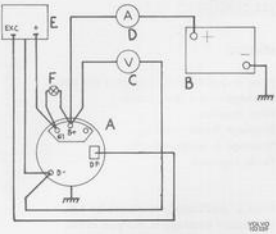


Fig. 3-47. Wiring diagram for testing voltage regulator

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. 3-48.

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

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

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

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

Immediately after, or preferably during driving, measure the voltage between B+ and D— on the

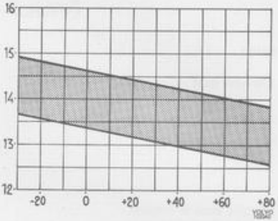


Fig. 3-48. Voltage-temperature diagram for cold voltage regulator

alternator. The engine should be turning over at about 25 r/s (1500 r/m) 50 r/s (3000 alternator r/m) when the measuring is being carried out. When the regulator ambient temperature is about 25°C (77°F) the voltage should be 13.85—14.25 volts. For other ambient temperatures, see Fig. 3—49.

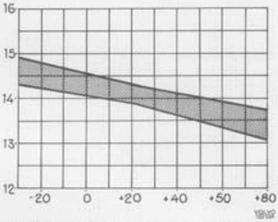


Fig. 3-49. Voltage-temperature diagram for warm voltage regulator

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.

ALTERNATOR

BOSCH

DESCRIPTION

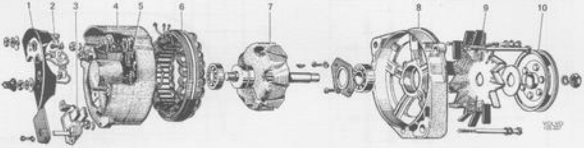


Fig. 3-50. Bosch alternator dismantled

1. Rectifier (plus diode plate)
2. Magnetizing rectifier
3. Brush holder
4. Slip ring end shield
5. Rectifier (negative diodes)
6. Stator
7. Rotor
8. Drive end shield
9. Fan
10. Pulley

The alternator is a three-phase, star connected alternating unit. The rectifier, which is built into the slip ring end shield, consists of six silicon diodes. Also housed in the slip ring end shield are three so-called magnetizing diodes, which feed the field winding via the voltage regulator. This type of generator differs from a D.C. generator in that it has a rotating field winding (rotor) and a stationary main winding (stator). The rotor is a 12-pole claw-type with the field winding fed across two slip rings.

Since the alternator is self-limiting concerning the current (max. 35 amps), a simple mechanical voltage regulator is used with only voltage control as its function.

FUNCTION, ALTERNATOR—VOLTAGE REGULATOR

When the ignition is switched on, current flows through the charging warning lamp to terminal D+ on the voltage regulator. Via the regulator, the current is conducted through the field winding to ground.

When the rotor starts rotating, alternating current is formed in the stator. Most of the current is rectified by the positive and negative diodes and is conducted via B+ on the alternator to the battery. A small part of the current is rectified by the magnetizing diodes and is led via 61/D+ to the voltage regulator and from there to the field winding. This cycle is repeated until the regulating voltage has

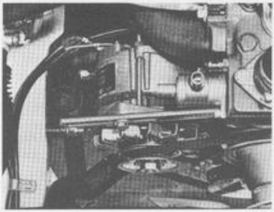


Fig. 3-51. Alternator fitted

been reached, at which point the lower contacts (1, Fig. 3-72) on the voltage regulator open and field current must pass a control resistance. If the voltage rises in spite of this, the armature on the voltage coil is pulled further down so that the upper contactc (2, Fig. 3-72) close, whereby the field winding is grounded at both ends, this causing the voltage to drop rapidly. The cycle is repated continuously so that the voltage is maintained constant.

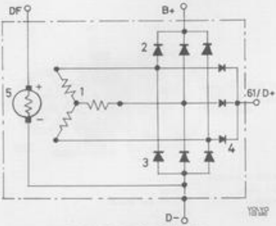


Fig. 3-52. Inner wiring of alternator

1. Stator
2. Positive diodes
3. Negative diodes
4. Magnetizing diodes
5. Rotor

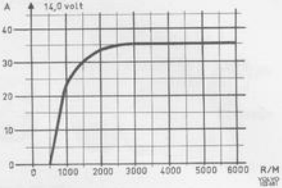


Fig. 3-53. Alternator output curve

A = amps. RM = alternator speed/minute

REPAIR INSTRUCTIONS

SPECIAL INSTRUCTIONS FOR WORK ON ALTERNATOR EQUIPMENT

1. When replacing or fitting the battery make sure that the proper polarity is observed when connecting up the new battery.
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 about to charge the battery installed in the vehicle, disconnect the negative battery lead.
5. When using an extra battery as an aid in starting, always connect it in parallel.
6. When carrying out any electric welding on the vehicle, disconnect the negative battery lead as well as the B+ lead on the alternator and pull the two-pin plug out of the voltage regulator. 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 arm.
4. Remove the bolt securing the alternator to the engine block.
5. Remove the fan belt and lift out the alternator.

DISASSEMBLING ALTERNATOR

1. Remove the nut and washer for the pulley and take off the pulley, the spacer washer and fan. Remove the key.

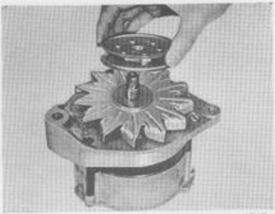


Fig. 3-54. Removing pulley

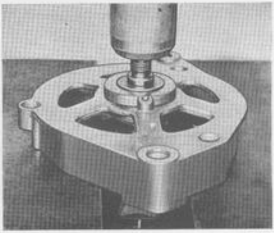


Fig. 3-57. Removing rotor

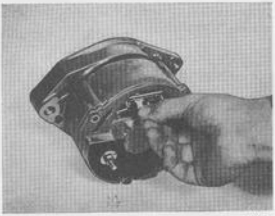


Fig. 3-55. Removing brush holder

2. Remove the screws holding the brush holder and then take off the holder, se Fig. 3-55.
3. Remove nuts, washers and screws holding together the alternator and take off the drive end shield and rotor from the stator and then the slip ring end shield.
4. Press the rotor out of the drive end shield.
5. Remove the screws for the washer which holds the drive end shield bearing and press out the bearing.
6. Remove the nuts for the positive diode plate and lift up and bend aside the plate, see Fig. 3-59.
7. Solder loose the stator connections from the terminal points and lift off the stator.

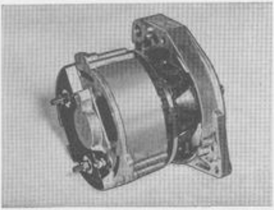


Fig. 3-56. Removing rotor and drive end shield

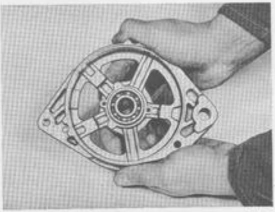


Fig. 3-58. Removing drive end shield bearing

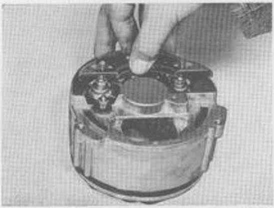


Fig. 3-59. Removing positive diode plate

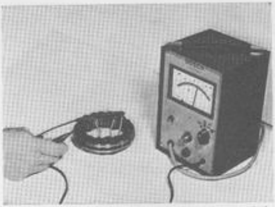


Fig. 3-61. Checking stator resistance

CHECKING DISASSEMBLED ALTERNATOR

STATOR

Cneck the stator isolation by connecting a 40 V alternating current between the body and a phase lead. Check the stator for breakdown by measuring the resistance between the phase leads, see Fig. 3-61.

The resistance should be 0.26 ohm + 10 %.

ROTOR

Check the rotor isolation by connecting a 40 V alternating current between the rotor frame and a slip ring, see Fig. 3-62.

Measure the resistance between the slip rings.

The resistance should be 4 ohms + 10 %.

If the slip rings are burnt or damaged in any other way, they can be lathed. For the lathing, a tailstock chuck should be used. The diameter of the slip rings may be less than 31.5 mm (1.3"). After the lathing, check the slip rings for possible out-of-round with a dial indicator. Max. radial throw is 0.03 mm (0.0012").

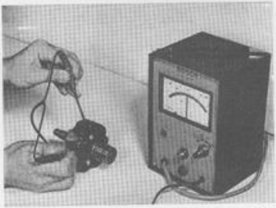


Fig. 3-62. Checking rotor isolation

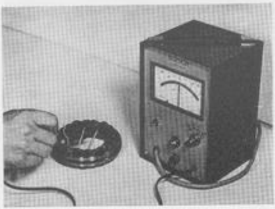


Fig. 3-60. Checking stator isolation

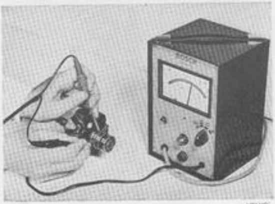


Fig. 3-63. Checking rotor resistance

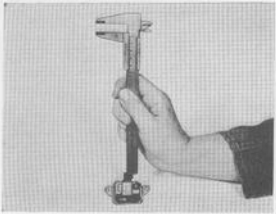


Fig. 3-64. Checking brush length

BRUSH HOLDER

Check the brush holder isolation with a 40 V alternating current. Measure the length of the brush as shown in Fig. 3-64. Minimum length is 8 mm (0.32").

DIODES

Check the diodes with a diode tester. If a diode is faulty, replace as follows:

REPLACING DIODES

POSITIVE DIODES

1. Solder loose the positive diode plate from the terminal points. Press out the faulty diode with a suitable drift.

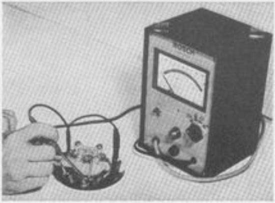


Fig. 3-65. Checking diodes

2. Calibrate the hole in the positive diode plate with a suitable tool (for example, Bosch EFLJ 57/0/3 ond 57/0/).
3. Press the new diode in with a suitable tool. Before fitting the new diode, oil it with silicon oil (for example, Bosch Ol 63 V 2).
4. Paint the new diode and any bare spots on the outside of the heat sink with black chlorinated rubber enamel (Bosch Ft87V1 or corresponding) to prevent corrosion..
5. Solder the heat sink to its original position. Check with the diode tester.

NEGATIVE DIODES

1. Solder loose the negative diodes from the terminal points and lift off the positive diode plate with the magnetizing diodes.
2. Press out the faulty diode with a suitable tool.
3. Oil the new diode with silicon oil (for example, Bosch Ol 64 V 2) and install it in the end shield.
4. Solder the negative diodes to the terminal points and check with the diode tester.

MAGNETIZING DIODES

1. If a magnetizing diode should be faulty, replace the entire plate with all three diodes.

ASSEMBLING ALTERNATOR

1. Fit the stator in the slip ring end shield and solder the stator leads to the terminal point. Fit the positive diode plate.
2. Grease the drive end bearing (use Bosch Ft 1 V 34 or corresponding) and fit the bearing and washer in the drive end bearing shield.
3. Press the drive end bearing shield and spacing ring on the rotor, see Fig. 3-66.
4. Grease the slip ring end shield bearing (Bosch Ft 1 V 35 or corresponding). Coat the slip ring end shield bearing seat with a light layer of Molykote paste and assemble the alternator. (Do not forget the spring ring on the slip ring end shield bearing seat.) Assemble the alternator components together with the screws and nuts. The screw should be tightened to a torque of 5.0—6.0 Nm (3.6—4.3 lbft) and the nuts to 4.5—6.0 Nm (3.3—4.3 lbft).
5. Fit the brush holder.

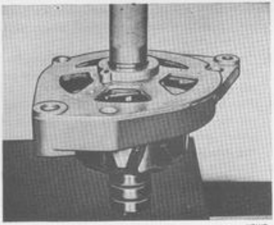

VOLVO

Fig. 3-66. Assembling the rotor and drive end shield

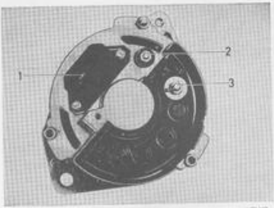


Fig. 3-67. Alternator terminals

1. DF To field winding
2. 61/D+ From magnetizing rectifier
3. B+ To battery

6. Fix the key, fan, spacer washer and pulley. Place the washer in position and tighten up the pulley with the nut.
7. Tighten the nut to a torque of 40 Nm (29.0 lbft). After assembling the alternator, test-run it on a test bench before installing it in the vehicle.

INSTALLING ALTERNATOR

1. Install the alternator and fit the fan belt at the same time.
2. Fit the attaching bolts and tensioning iron without tightening it.
3. Adjust the belt tension (see Part 2, Engine, Group 26) and secure the alternator.
   NOTE. Force may only be applied to the front end of the alternator when adjusting the belt tension.
4. Re-fit the leads to the alternator.
5. Re fit the negative lead to the battery.

VOLTAGE REGULATOR

BOSCH

DESCRIPTION

The voltage regulator is located on the wheel housing at an angle behind the headlamp, see Fig. 3-68. It is a mechanical, single—pole voltage regulator with a lower contact, a movable contact and an upper contact, see Fig. 3-72. It is connected to the charging circuit by means of a three-pole plug. The regulator resistance is placed under a plate underneath the regulator. Temperature compensation is operated by a bimetal spring which influences the spring tension so that the regulator receives lower regulating voltage at higher temperatures.

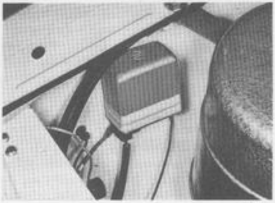


Fig. 3-68. Voltage regulator fitted

REPAIR INSTRUCTIONS

REPLACING VOLTAGE REGULATOR

1. Remove the negative battery lead.
2. Pull the plug out of the voltage regulator.
3. Remove the screws and change the regulator.
4. Fit on the new regulator and insert the plug.
5. Re-fit the negative battery lead.

Concerning regulator adjustmet, see under "Testing and adjusting the voltage regulator".

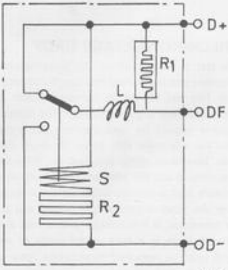


Fig. 3-69. Inner wiring of voltage regulator

S Voltage winding 35 Ω
R' Regulator resistance 2.45 Ω
RF Compensation resistance 50 Ω
L Contact impedance coil

TESTING ALTERNATOR AND VOLTAGE REGULATOR

For all testing of the alternator equipment, fixed clamps should be used. 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. Disconnect the battery before connecting up any instruments.

TESTING ALTERNATOR CIRCUIT

Before carrying out any tests on the alternator or regulator in the vehicle, check the battery and the vehicle wiring for fault in the leads or isolation, loose or corroded lead terminals and poor earthing. **Check the fan belt.** Any of the faults just mentioned must be repaired before the electrical checks are 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 connections 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 cable or contact, which must be remedied immediately. After repairing the faulty leads or contacts, measure once agarin. With the same load as above, measure the voltage drop between th 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, mesaure again.

TESTING ALTERNATOR

(In a test bench or in the vehicle)
Connect up the alternator as shown in Fig. 3-70. Run it to a speed of 100 r/s (6000 r/m). Regulate the voltage to about 14 volts by means of the load resistance F. The alternator should produce 35 amps at 100 r/s (6000 r/m) and a voltage of 14 volts.
At the same time check to make sure that the charging warning lamp does not light or glow.
If the alternator does not meet the above requirements first check the brushes and diodes.

TESTING AND ADJUSTING VOLTAGE REGULATOR

(In a test bench or in the vehicle)
Connect up the regulator to an alternator in good condition as shown in Fig. 3-71.

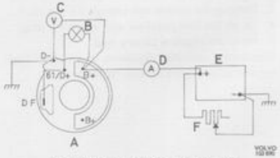


Fig. 3-70. Wiring diagram for testing alternator

A. Alternator
B. Control lamp 12 volts, 2 watts
C. Voltmeter 0—20 volt
D. Ammeter 0—60 amps.
E. Battery 60 ampèrehours
F. Load resistance

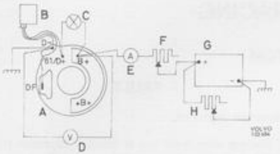


Fig. 3-71. Wiring diagram for testing voltage regulator

A. Alternator
B. Voltage lamp 12 volts
C. Control lamp 12 volts, 2 watts
D. Voltmeter 0—20 volts
F. Regulator resistance
G. Battery 60 ampèrehours
H. Load resistance
E. Ammeter 0—50 amps.

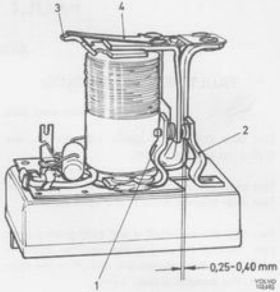


Fig. 3-72. Voltage regulator

1. Regulator contact for lower control range (lower contact)
2. Regulator contact for upper control range (upper contact)
3. Spring tensioner
4. Spring upper section: Steel spring
Lower section: Bi-metal spring

Run the alternator to a speed of 67 r/s (4000 r/m) (engine speed 33.5 r/s (2000 r/m). Load the alternator with about 28—30 amps.

Rapidly lower the alternator speed to about 16.9 r/s (1000 r/m) (in vehicle, idling speed), raise the speed again to 67 r/s (4000 r/m) engine speed 33.5 r/s (2000 r/m) and adjust the load to about 28—30 amps. Read off the voltmeter. The voltage should be 14.0—15.0 volts and the regulator should be regulated on the left (lower) contact (1, Fig. 3-72). The reading should be made within 30 seconds after the test has begun. Reduce the load on the alternator to 3—8 amps and read off the regulating voltage. This voltage should now lie within the tolerance 0 volt to minus 0.3 volt in relation to the first reading. The regulator should now be regulated on the right (upper) contact (2, Fig. 3-72).

The regulating voltage in the lower regulating range is adjusted by bending the tensioner for the bimetal spring, see Fig. 3-73.

If the tensioner is bent downwards, the regulating voltage should drop, if bent upwards the opposite should be the effect. If the regulating voltage in the upper regulating range is too high or too low in relation to the lower regulating range (0 volt to mins 0.3 volt) this is adjusted by bending the holder for the left (lower) contact and correcting at the same time the gap between the right (upper) contact and the movable contact according to Fig. 3-72.

If the holder is bent towards the right (upper) contact, the regulating voltage in the upper regulating range will drop. To avoid faulty adjustments due to residual magnetism in the regulator core, it is necessary to reduce the alternator speed down towards 0 after each adjustment and then increase the speed and make a new reading.

(If the adjusting is comprehensive and the regulator is warm, it can be suitably cooled to ambient temperature by means of compressed air before the final reading is made.)

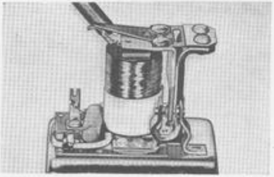


Fig. 3-73. Adjusting control voltage

FAULT TRACING

SYMPTOM

FAULT TRACING METHOD	FAULT
Warning lamp does not light with engine off.	
Test lamp (12 volts 2 watts) between B+ and 61/D+ on alternator lights.	Warning lamp burnt out or break in its circuit to D+ on regulator.
Test lamp between B+ and 61/D+ does not light. Test lamp between 61/D+ and earth lights.	Short-circuiting in a positive diode.
Test lamp between 61/D+ and earth gives a weak light. Remove the plug at the regulator and connect an ammeter between B+ and DF on the alternator. The ammeter shows: 0 amp.	Worn brushes, oxide on slip rings or breakage in rotor winding.
2.0—2.5 amps.	Breakage in regulator or in lead DF from regulator to DF on alternator.
Warning lamp lights with engine off or running.	
Disconnect the plug at the regulator: Control lamp still lights.	Short-circuiting in the circuit between D+ on regulator and 61/D+ on alternator.
Warning lamp goes out. Re-fit the plug in the regulator and connect an ammeter between B+ and D+ on the alternator. Read off the value on the ammeter: Less than 2.0—2.5 amps.	Defective regulator (breakage).
Greater than 2.0—2.5 amps.	Short-circuiting in the circuit between DF on the regulator and DF on the alternator. Short-circuiting in the winding.
Warning lamp lights with engine off but starts to give a weak light when engine is running.	
Test lamp between B+ and 61/D+ on the alternator with the engine running: Does not light.	Transition resistance in the charging circuit or in the lead to the warning lamp.
Gives a weak light.	Defective regulator (overcharging of the battery) or defective alternator (insufficient charging of the battery).
Fit new regulator. Test lamp between B+ and 61/D+: Does not light.	Removed regulator defective.
Gives a weak light.	Defective alternator.

GROUP 33

STARTER MOTOR

TOOLS

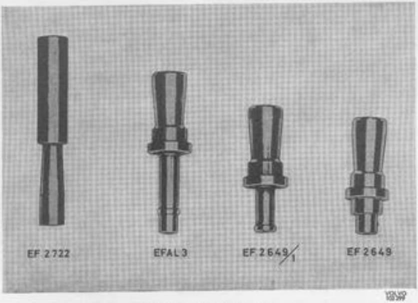


Fig. 3-74. Bosch special tools

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. 3-75, is mounted 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.
Turning the ignition key to the starting position cuts in the solenoid causing the armature in the solenoid to be drawn in and the starter pinion to engage the ring gear on the engine flywheel. When the armature has moved a certain distance, the contacts for the main current close and the starter motor starts running.

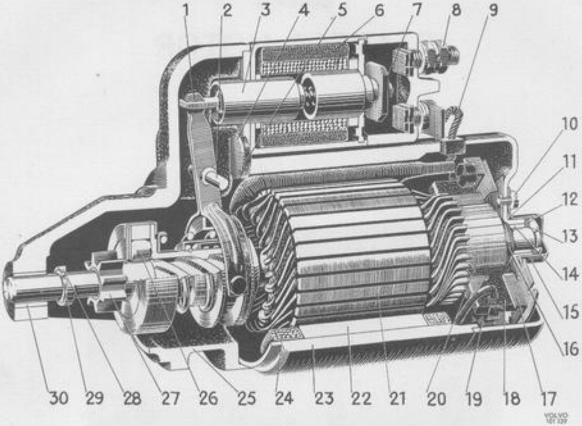


Fig. 3-75. Starter motor

1. Shift lever
2. Pivot pin (bearing screw)
3. Plunger
4. Steel washer
5. Rubber washer
6. inding
7. Contact plate
8. Terminal for battery lead
9. Connection lead to field
10. Screw
11. Rubber gasket
12. Shims
13. Snap ring
14. Bush
15. Commutator end frame
16. Adjusting washers
17. Brush holder
18. Brush
19. Brush spring
20. Commutator
21. Armature
22. Pole shoe
23. Stator
24. Field winding
25. Drive end frame
26. One-way clutch
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 timing gear casing and lift it off.

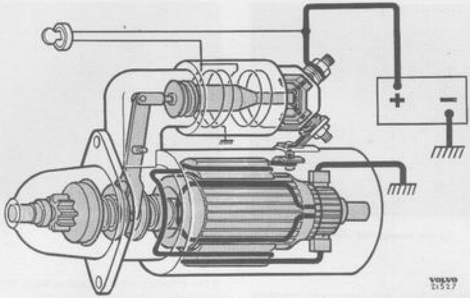


Fig. 3-76. Starter motor, general arrangement

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. 3-79 and 3-80.
3. Remove the two bolts holding the commutator end fram and remove the frame.
4. Lift up the brushes and holders.
5. Remove the brush bridge from the rotor shaft. NOTE. The washers are as shown in Fig. 3-80. When the bridge is removed, the negative brushes follow also, but the positive 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.

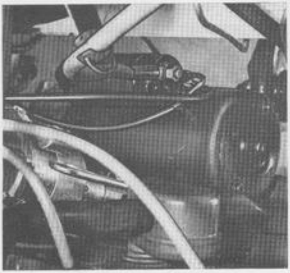


Fig. 3-77. Starter motor installed

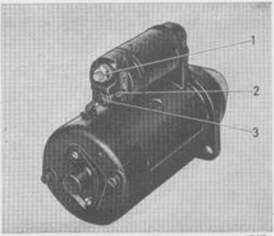


Fig. 3-78. Starter motor terminals
1. From battery 2. From ignition switch 3. To field winding

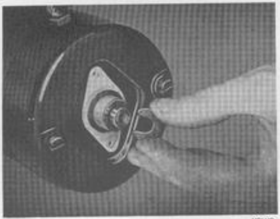


Fig. 3-79. Removing lock washer

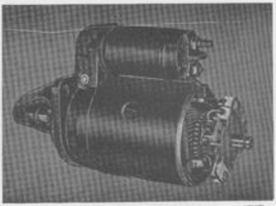


Fig. 3-81. Starter motor with bearing shield removed

8. Remove the drive end frame and armature from the stator.
9. Remove the rubber washer and metal washer, see Fig. 3-84.
10. Remove the screw on which the shift lever is carried.
11. Lift the armature with pinion and lever 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 commuator shuld be checked with a micrometer after turning. A radial throw of 0.08 mm (0.003") may be considered permissible. The isolation between the laminations should be milled down to 0.4 mm (0.016") below the surface of the laminations, see Fig. 3-86 and 3-87. 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. 3-88. If the blade vibrates in any position when the armatures is rotated, one of the following faults can be the reason: shorting through the armature frame,

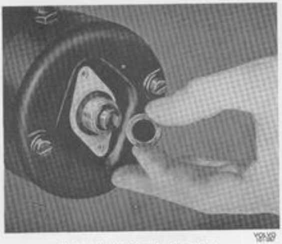


Fig. 3-80. Removing adjusting washers

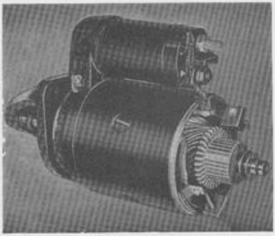


Fig. 3-82. Starter motor with brush bridge removed

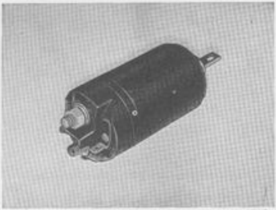


Fig. 3-83. Control solenoid

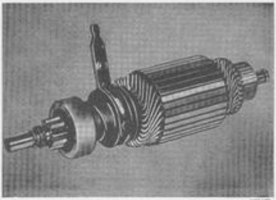


Fig. 3-85. Armature with pinion

shorting in the sommutator or between the windings. Check the stator with 40 volts A.C., see Fig. 3-89.
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 armature in several times and test again by connecting it to a battery. If the control solenoid does not function after the above measures, replace it with a new one.

REPLACING BRUSHES

When replacing the brushes, the starter motor is removed and disassembled. The brushes are soldered loose from their attachments in the brush

Fig. 3-84. Removing sealing washer

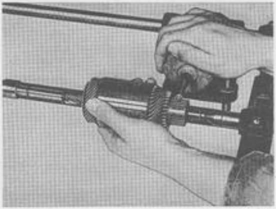


Fig. 3-86. Milling commutator

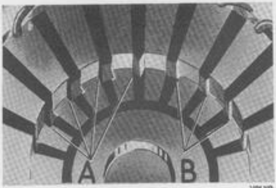


Fig. 3-87. Commutator milling
A. Incorrect milling B. Correct milling

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 less than 14 mm (approx. 1/2") should be replaced with new ones.

INSTALLING SELF-LUBRICATING BUSHES

The self-lubricating bushes are only worn insignificantly during operation if they are lubricated in the correct manner. If lubricating is neglected, the bushes dry out, with the result that they wear quickly. For replacement purposes, 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.

Fig. 3-88. Testing armature

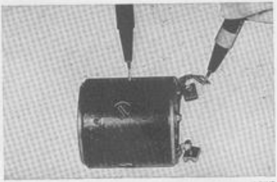


Fig. 3-89. Checking stator

Replace the bushes as follows:

1. Drive out the worn bushes with the help of a suitable tool.
2. Clean the hole for the bushes and cut away any burr.
3. Press in the new bushes with the help of a suitable drift.
   NOTE. Before a self-lubricating bush is fitted, it should lie in light oil for at least a 1/2 hour.

REPLACING FIELD WINDING

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

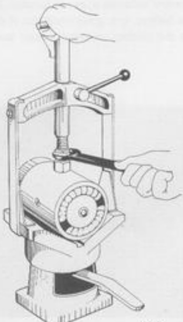


Fig. 3-90. Rotating clamping block for removing field winding

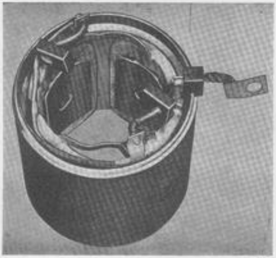


Fig. 3-91. Stator with soldered brushes

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 rotating clamping block (Bosch EF AW 9 or similar) and unscrew the pole screws as shown in Fig. 3-90.
4. Before fitting new field coils, warm them sligtly. Then place the pole shoes in position in the field coils and slide them into the stator. Tighten the pole screws lightly. Press in a suitable drift. Set up the stator in the rotating clamping block and tighten the pole shoes firmly.
5. Force out the press drift with a press tool. Check the fitted field windings for breakage and short-circuiting.

ASSEMBLING STARTER MOTOR

1. Lubricate the parts of the starter motor according to Fig. 3-93.

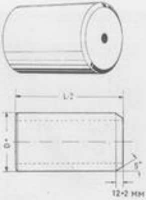


Fig. 3-92. Press drift for fitting field winding
D=66.4—66.09 mm (2.599—2.602") L=85 mm (3.346")

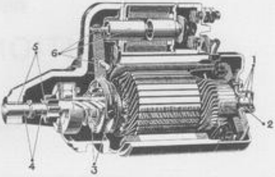


Fig. 3-93. Lubricating scheme for starter motor

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

1.	Ft 2 V 3.	Place a thin layer of grease on the isolation 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 armature thread and the engaging lever groove.
4.	Ft 2 V 3.	Place a thin layer of grease on the armature shaft.
5.	Ol 1 V 13.	Place the bushes in oil for a 1/2 hour before fitting.
6.	Ft 2 V 3.	Lubricate the engaging lever joints and the iron core of the solenoid with a thin layer of grease.

2. Fit the starter pinion on the armature shaft, and the wear washer as well as the snap ring. Seure the wear washer in position.
3. Fit the engaging arm 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 drive end frame.
7. Secure the solenoid in the shift lever. Screw tight the solenoid.
8. Fit the washers on the armature shaft as shown in Fig. 3-82.
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 casting 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

TOOLS

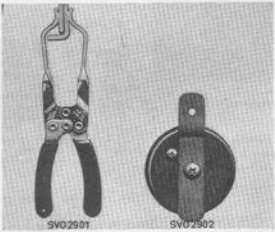


Fig. 3-94. Special tools for ignition setting, B 20 E
SVO 2901 Pinchers SVO 2902 Cover

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 ignition system is of the battery ignition type. It consists of the following main parts: Ignition coil, distributor, ignition lead and spark plugs.

IGNITION COIL

The ignition coil is fitted on the firewall, see Fig. 3-95. The function of the ignition coil is to transform the battery voltage to high tension voltage for the spark plugs. It consists of a core of laminated metal around which is a winding of heavy copper wire, the primary winding, and a winding of fine copper wire, the secondary winding. The primary winding

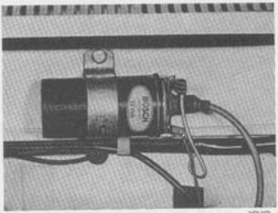


Fig. 3-95. Ignition coil installed

operates at battery voltage from the distributor contact breakers. The other winding, the high-tension winding, is connected to the center terminal on the distributor cap, from where the high-tension current is distributed to the engine spark plugs.

DISTRIBUTOR

The distributor, Figs. 3-96 and 3-97, is fitted on the left-hand side of the engine and is driven from the camshaft. The adjustment of the distributor in relation to engine speed is regulated by a centrifugal governor fitted under the breaker plate. The adjustment in relation to loading is controlled by a vacuum regulator.

The vacuum regulator on the B 20 A engine raises the firing when the load on the engine reduces. On the B 20 B and B 20 E, F engines the vacuum regulator lowers the firing below the basic setting during idling and engine braking. Reducing the firing is part of exhaust emission control and prevents the engine from emitting excessive, noxious exahust gases at idling and engine braking.

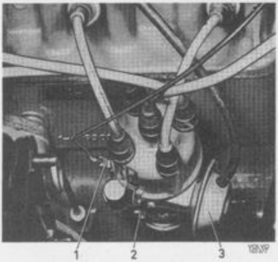


Fig. 3-96. Distributor B 20 B fitted

1. Primary connection 2. Attaching screw 3. Vacuum regulator

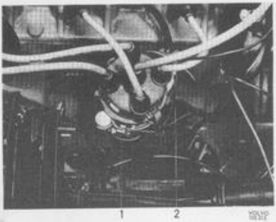


Fig. 3-97. Distributor B 20 E, F installed

1. Primary connection 2. Plug control for triggering contacts, fuel injection system

B 20 B-engines with automatic transmission (early prod., intended for U.S.A.) are fitted with a plastic holder on the hose between the carburettor and the vacuum regulator in the distributor, see Fig. 3-98.

The function of the plastic holder is to delay the resetting of the vacuum regulator about 6 seconds. Two triggering contacts for the fuel injection system are located under the centrifugal governor in the distributor of the B 20 E, F-engines. The contacts are mounted on a contact device and cannot be adjusted. With fault in these contacts, replace the entire device.

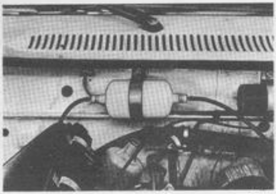


Fig. 3-98. Installing plastic holder, early prod.

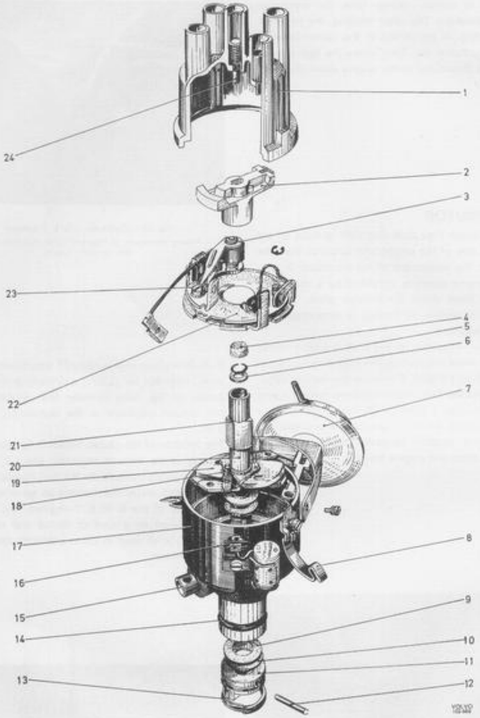


Fig. 3-99. Distributor, B 20 B

1. Distributor cap
2. Distributor arm
3. Contact breaker
4. Lubricating felt
5. Circlip
6. Washer
7. Vacuum regulator
8. Cap clasp
9. Fiber washer
10. Steel washer
11. Driving collar
12. Lock pin
13. Resilient ring
14. Rubber seal
15. Lubricator
16. Primary connection
17. Distributor housing
18. Centrifugal governor spring
19. Centrifugal weight
20. Breaker camshaft
21. Breaker cam
22. Breaker plate
23. Lock screw for breaker contacts
24. Rod brush (carbon)

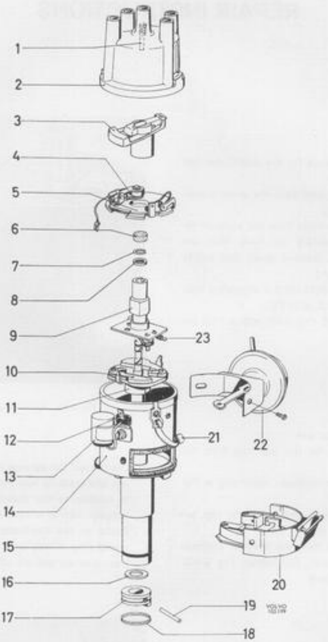


Fig. 3-100. Distributor, B 20 E, B 20 F

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

DISTRIBUTOR

REMOVING

1. Release the lock clasps for the distributor cap and lift off the cap.
2. Remove the primary lead from the primary connection (1, Fig. 3-96).
3. Remove the vacuum hose from the vacuum regulator. (When removing the hose from the bakelite connection, observe great care not to break the connection.)
4. Pull out the plug contact for the triggering contacts (concerns B 20 E, B 20 F).
5. Slacken the screw (2, Fig. 3-96) 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. 3-101.
2. Mark up how the lock clasps for the cap are located and remove them.
   Disconnect the lead from the breaker contacts and remove the primary connection, Fig. 3-102.
   Lift up the breaker plate.

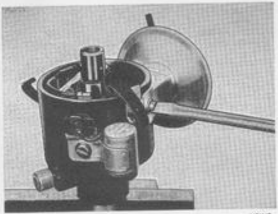


Fig. 3-101. Removing vacuum regulator

Fig. 3-102. Removing primary connection

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. 3-103) until the circlip (5, Fig. 3-99) has released and lift off the breaker cam.

Fig. 3-103. Removing circlip

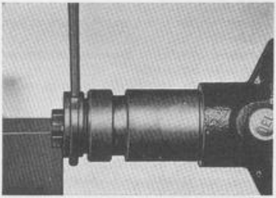


Fig. 3-104. Removing driving collar

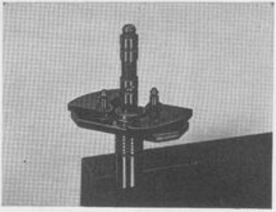


Fig. 3-105. Distributor shaft with centrifugal weights

4. Unscrew the screws holding the contact device and remove the device (concerns B 20 E, B 20 F).
5. Remove the resilient ring (13, Fig. 3-99) and mark up how the driving collar (11, Fig. 3-99) is located in relation to the distributor shaft.
   Tap out the pin (Fig. 3-104), lift off the driving collar and pull up the distributor shaft.
   Check that no washers have been lost.
6. Remove the lock springs for the centrifugal weights and lift up the weights.

INSPECTING

Distributor plate

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.

The contact plate must not be loose, worn or have burr on.

Distributor shaft

The play between the distributor shaft and the breaker camshaft must not exceed 0.1 mm (0.004"). The cams on the breaker camshaft must not be scored or worn down so that the dwell angle is altered.

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

The centrifugal weight springs must not be deformed or damaged.

Distributor housing

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. 3-106.
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 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 fiber 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 the driving collar.
4. Fit the contact device (concerns B 20 E, B 20 F). Check the packing, replace if necessary.
5. Fit the breaker plate. Fit the lock clasps for the cap. Fit the primary connection and connect the lead from the breaker contacts.
6. Fit the vacuum regulator.

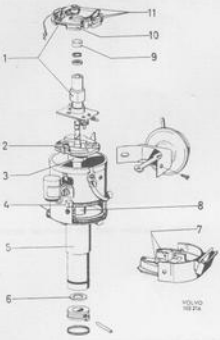


Fig. 3-106. Lubricating scheme for distributor

Use Bosch lubricant (or equivalent) according to below

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 drench the felts in oil.
5. Ol 1 v 13. Place the brushes in oil for a least 1/2 hour before use 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. Drench the lubr. felt in oil.
10. Ol 1 v 2. Oil the breaker plate.
11. Ft 1 v 26. Grease the bush for the movable contacts, the pin for the vacuum regulator and the ball.

7. 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".

Fit the distributor arm.

REPLACING CONTACT BREAKER

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

1. Remove the distributor rotor arm.
2. Disconnect the electric lead at the primary connection.
3. Remove the screw for the contact breaker and lift up the old contacts.
4. Lubricate the distributor according to the instructions given in Fig. 3-106.
5. Fit the new contact breaker.
6. Connect the electric cable at the primary connection.
7. Check that the 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 at 8.4 r/s (500 r/m) in its ordinary direction of rotation (anti-clockwise) and adjust the contact breaker dwell angle according to the "Specifications".
2. Adjustment is made by slackening a little the screw for the breaker contacts and then inserting a screwdriver in the recess, Fig. 3-107, and turning the screwdriver until the dwell angle is the correct one.
   Then tighten the screw for the contact breaker.
3. Run the distributor and set the protactor on the test bench so that a marking comes opposite 0°

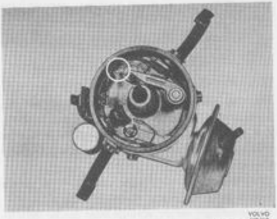


Fig. 3-107. Recess for adjusting the contact breaker

at such a low speed (below 5 distr. r/s=300 distributor r/m) that the centrifugal governor does not function. Increase the speed slowly and read off the values at the prescribed graduations. A newly lubricated distributor should first be run up to maximum speed several times. Permissible tolerance for the centrifugal governor is ±1°.

4. Run the distributor at low speed and adjust the protractor so that a 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

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 plug contact to the triggering contacts (concerns B 20 E, F).
5. Connect the primary lead. Fit on the distributor cap.
6. Start the engine and set the ignition. (If the engine does not start, turn the distributor housing until it does so.)

IGNITION DISTRIBUTOR TRIGGERING CONTACTS, B 20 E, B 20 F

REPLACING

1. Remove the ignition distributor.
2. Undo the two screws securing the holder and pull out the holder.
3. Apply a little grease (Bosch Ft 1 V 4 or corresponding) to the fiber deflecting pieces of the contact breaker lever on the new holder.
4. Check to see if the rubber ring is not damaged, replace if necessary.
5. Fit the new holder in the distributor and secure it.
   (It is not possible to adjust the contacts.)
6. Fit the distributor and adjust the ignition.
7. Check the contacts with test instrument EFAW 228 in accordance with the test chart.

IGNITION SETTING

Ignition setting should always be carried out with the engine running and with the help of an ignition-setting lamp (Stroboscope) and rev. counter.

B 20 A AND B 20 B

1. Clean the pulley so that the graduation marks can be seen, see Fig. 3-108.
2. Disconnect the hose from the vacuum regulator. (On the B 20 B the hose should be pinched or plugged to prevent the engine taking in unwanted air.)
   NOTE. On the B 20 F with exhaust gas recirculation, the vacuum hose to the EGR valve should be disconnected at the valve.
3. Connect the timing light to the No. 1 cyl. spark plug and the battery. Connect a rev. counter.
4. Start the engine and run it at the speed given in the "Specifications". Point the timing light at the graduations on the pulley. Slacken the attaching screw (2, Fig. 3-96) and turn it until the firing position agrees with the figure given in the "Specifications". Fix the distributor and check that the firing position and speed have not altered.
5. Remove the timing light and rev. counter and fit the hose to the vacuum regulator.
   Connect the vacuum hose to the EGR valve (B 20 F with EGR).

B 20 E, B 20 F

1. Clean the pulley so that the graduation marks can be seen, see Fig. 3-108.
2. Remove the hose connected to the distributor's vacuum regulator at the inlet duct. Also discon-

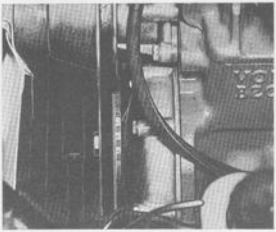


Fig. 3-108. Graduation for ignition setting

nect the hose between the air cleaner and inlet duct, at the duct.

3. Connect the timing light to the No. 1 cyl. spark plug and the battery. Connect a rev. counter.
4. Start the engine. Fit the plastic cover, SVO 2902, on the inlet duct, see Fig. 3-109, and adjust down the engine speed to 11.6—13.4 r/s (700—800 r/m) by moving the bar over the hole in the plastic cover.
5. Point the timing light at the graduations on the pulley. Remove the distributor and turn it until the firing position agrees with the figure given in the "Specifications". Fix the distributor and check that the firing position and speed have not altered.
6. Remove the timing light, rev. counter, plastic cover and pinchers. Fit the hose to the vacuum regulator as well as the hose between the air cleaner and inlet duct.

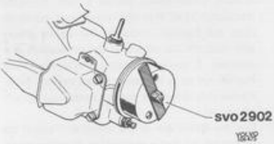


Fig. 3-109. Tools for adjusting engine speed during ignition setting, B 20 E, B 20 F

LIGHTING

DESCRIPTION

Fig. 3-110. Headlights

Fig. 3-111. Rear and license plate lights

The lighting consists of two full- and dipped-beam headlights, parking lamps, rear lamps, license plate light and side marker lights.
The headlights are fitted in the grille. They are switched on and off by the lighting switch on the instrument panel. Switching between full- and dipped-beam positions is done by moving the directional indicator lever switch towards the steering wheel. The relay (1, Fig. 3-132) then connects up the lighting. 140 GL is equipped with halogen lights, H-4 lamps, for both fullbeam and dipped headlights (does not apply to USA).
The rear lamps have separate bulbs for rear lights, stop lights, reversing lights and directional indicators.

REPAIR INSTRUCTIONS

HEADLIGHTS

REPLACING HEADLIGHT INSERT

1. Disconnect the cables by pulling the connection contact backwards. (The battery must first be removed when about to replace the insert for the left-hand headlights. When about to replace the insert for the right-hand headlight on vehicles with a B 20 A or B 20 B engine, first lift the expansion tank for the radiator out of the way (for the B 20 E, F engine, remove the air cleaner.)
2. Remove the three plastic holders securing the insert in the case by undoing the screws. Press the insert backwards and lift it out.
3. Place the new insert in position. Re-fit the three plastic holders. Check to make sure that the holders fit in the lugs on the insert.
   Secure the insert.
4. Fit the connection contact and check the lighting.

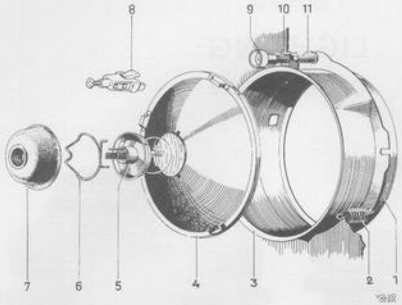


Fig. 3-112. Headlights

1. Ring
2. Spring
3. Retainer
4. Insert
5. Bulb
6. Bulb holder spring
7. Rubber cover
8. Plastic holder
9. Adjusting knob
10. Nut
11. Screw

REPLACING HEADLIGHT BULB

1. Disconnect the cables by pulling out the connection contact (1, Fig. 3-113), and remove the rubber cover underneath.
2. Compress and remove the spring (1, Fig. 3-114), holding the bulb to the insert and take out the bulb.
3. Fit a new bulb. (Do not touch the globe with your fingers.) Make sure it is fitted correctly. The small nibs on the bulb collar should fit in the insert recesses.
4. Fit the spring and the rubber cover.
5. Connect the connection contact and check the lighting.

CHECKING AND ADJUSTING

The headlights should be examined to check the condition of the glass, reflector and bulb. If the glass is damaged by flying gravel or cracked or defective in any other way, the insert should be replaced. Glass which has become "sand-blasted" by flying gravel, 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.

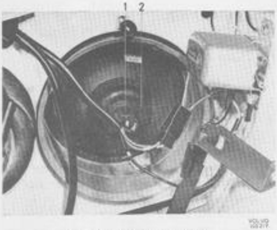


Fig. 3-113. Headlight, rear side

1. Connection contact 2. Rubber cover

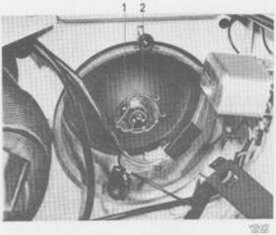


Fig. 3-114. Headlight, rear side

1. Spring 2. Bulb

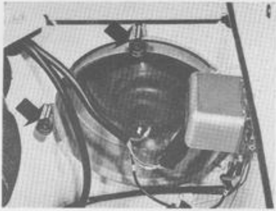


Fig. 3-115. Adjusting screws

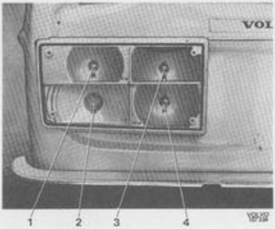


Fig. 3-117. Bulb location

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

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

The headlights should be adjusted in accordance with current legislation. Approved equipment should be used.

Adjustment is made by varying the two adjusting screws behind the headlight, see Fig. 3-115. The upper screw adjusts the headlight vertically and the screw at the side adjusts the headlight laterally.

REAR LIGHTS

REPLACING BULBS

1. Screw loose the four screws holding the glass, see Fig. 3-116, and lift off the glass.
2. Replace the bulb.
3. Re-fit the glass.

REPLACING REAR LIGHT

The rear light is replaced as a complete unit.

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

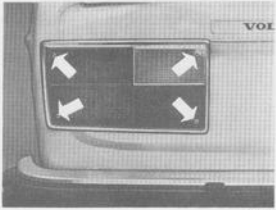


Fig. 3-116. Removing glass, rear light lens

Fig. 3-118. Removing license plate light

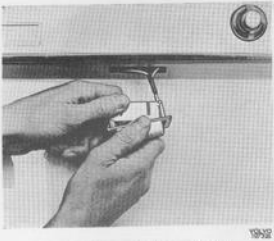


Fig. 3-119. Disassembling license plate light

REPLACING LICENSE PLATE LIGHT

1. Remove the license plate light with the help of a crosshead screwdriver according to Fig. 3-118.
2. Disconnect the electric cable from the plate.
3. Disassemble the plate according to Fig. 3-119.
4. Replace the bulb.
5. Re-connect the electric cable to the plate.
6. Install the plate by pressing it firmly into its recess.

145:

The license plate light consists of two bulb housings secured to the tailgate. The bulbs are changed as follows:

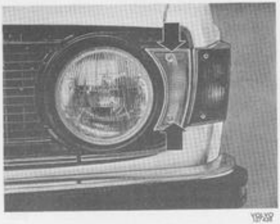


Fig. 3-120. Parking light, screws holding the lens

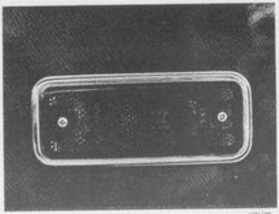


Fig. 3-121. Side marker light

Press in the catches in the bulb housing by inserting a screwdriver in the opening on the left-hand side of the housing, see Fig. 3-118. Pull the housing out of its attachment.
Pull out the cover end not provided with a pin.
The bulb is now accessible for replacement.
When installing, fit first the guide pins in the recesses and then press on the cover. Check that the rubber liner is correctly in position and push the bulb housing securely into the attachment.

PARKING LIGHTS

The parking lights are mounted on the outside of the headlights. When removing the light to change the bulb etc., unscrew the two screws, Fig. 3-120, holding the lens to the grille and this will allow all the parts belonging to the light to be accessible for removal.

SIDE MARKER LIGHTS

Two flasher marker lights are placed on each side of the car.
To replace the bulb, take off the lens, which is fitted to the body by means of two screws.

OTHER ELECTRICAL STANDARD EQUIPMENT

DESCRIPTION

DIRECTIONAL INDICATOR SYSTEM

The directional indicator system consists of a thermal-type flasher relay (electronic flasher relay for USA), directional indicator switch, flash lamps on the front mudguards and bulbs in the rear lights. The directional indicator lever switch is located under the plastic casing on the left-hand side of the steering column, see Fig. 3-123. It switches on the right or left indicators in two stages. Stage one is used when changing a lane and stage two when changing direction. The switch has automatic return to neutral. The control lamp for the directional indicator is wired in parallel across the switch.

The directional indicator signals can also be used as emergency warning flashers, which are switched on by the emergency warning flasher switch mounted on the control panel. The flasher function is then looked after by the flasher relay placed on the reverse side of the control panel, see Fig. 3-122.

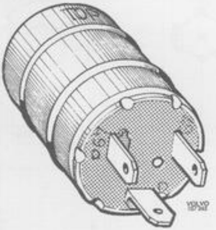


Fig. 3-122. Flasher relay

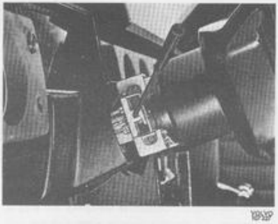


Fig. 3-123. Directional indicator lever switch

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 (intermediate position).
2. Same as position 1 but also current to ignition coil (Driving position).
3. Same as position 2 but also current to starter motor solenoid (Starting position). When the ignition key is released in position 3, it returns automatically to position 2.

Vehicles intended for U.S.A. are fitted with a special steering wheel lock with a reminder buzzer which buzzes when the driver's door is open and the ignition key is in the ignition switch, in other words, if the steering wheel is not locked.

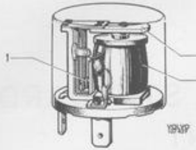


Fig. 3-124. Buzzer
1. Contacts
2. Armature
3. Coil

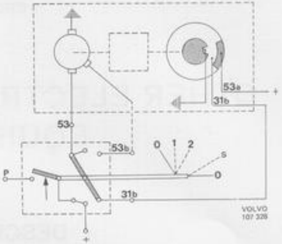


Fig. 3-125. Wiring diagram for windshield wiper motor, Electrolux

The buzzer is placed under the dashboard on the left-hand side and is connected between the fuse-box (via the ignition) and the door switch on the driver's side. The buzzer consists of a pair of contacts and a coil. When current passes across the contacts and through the coil, the armature is drawn down towards the core of the coil. While the armature is being drawn down towards the core, the contacts cut 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.

WINDSHIELD WIPERS

The windshield wipers are driven by an electric motor. The motor is connected to the wipers by means of a combined cable and linkage system. It has a permanently magnetized field and three brushes, one of which is a minus brush and the other two being plus brushes. Both the plus brushes are connected one at a time so that the engine has two different speeds, 0.57±0.07 r/s (34±4 r/m) and 0.92±0.8 r/s (55±5 r/m). The function of the parking switch, which is built into the gear housing, is to return the wiper blades to a suitable, predetermined, parking position, see Figs. 3-125 and 3-126, irrespective of where the wiper is switched off.

HORNS

The horns are mounted to the left of the radiator behind the grille.

One of the horns has a low frequency and the other a high frequency.

The horn pad mounted in the steering wheel operates the horns.

FUSES

The fuses are collected in a fusebox, which is placed next to the left fresh air vent. The fuses are accessible when the cover is taken off.

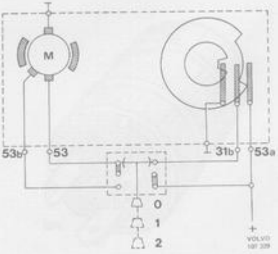


Fig. 3-126. Wiring diagram for windshield wiper motor, SWF

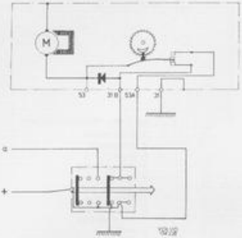


Fig. 3-127. Wiring diagram for tailgate window wiper
a. To tailgate window washer

WINDSHIELD WASHER

The windshield washer, which is located on the left-hand side of the dashboard, is driven by an electric motor, see Fig. 3-129. The pump is placed at the bottom of the water container and is linked with the motor by a shaft. The pump is of the centrifugal type, and there are two versions, see Figs. 3-129 and 3-130.

Both wipers and washers are operated by a lever mounted on the steering column, see Fig. 3-134.

SWITCHES

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

TAILGATE WINDOW WIPER, 145

The tailgate window wiper is operated by an electric, single-speed motor with a permanently magnetized field. It is connected to the wiper blade by means of a link arm. A parking switch, see Fig. 3-127, is built into the wiper motor. The function of this switch is to park the wiper blade irrespective of its position when switched off. The location of the tailgate window wiper can be seen from Fig. 3-128.

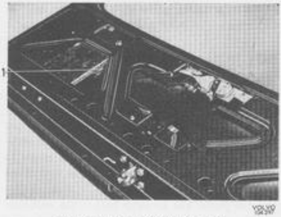


Fig. 3-128. Tailgate window wiper, fitted
1. Wiper motor

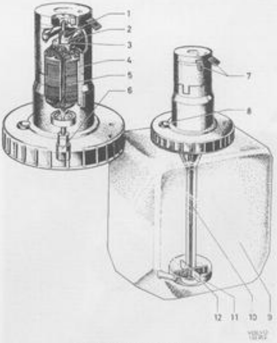


Fig. 3-129. Windshield washer

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

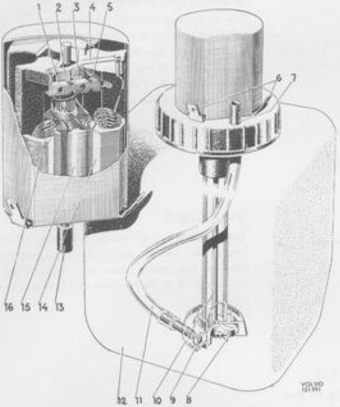


Fig. 3-130. Windshield washer

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

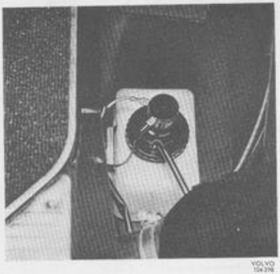


Fig. 3-131. Tailgate window washer, fitted

TAILGATE WINDOW WASHER, 145

The tailgate window washer for the 145 model is of the same type as the windshield washer. It is placed in a cavity to the right under the floor of the cargo space, see Fig. 3-131.

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.

The 145 model has an extra light in the roof over the cargo space. Opening the tailgate switches on this light.

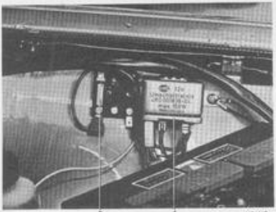


Fig. 3-132. Control relays

1. Step relay for dipped, full-beams switching
2. Fuse for fuel injection system (140 GL)

BRAKE LIGHT SWITCH

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

CONTROL RELAYS

As standard the cars in the 140-series are fitted with three control relays, a step relay for the full-beam and dipped lights, a control relay for the back-up lights and a control relay for the rear window defroster. Vehicles with automatic transmission are fitted with a start relay instead of a control relay for the back-up lights.

REPAIR INSTRUCTIONS

REPLACING SWITCHES FOR FLASHERS AND WINDSHIELD WIPERS

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

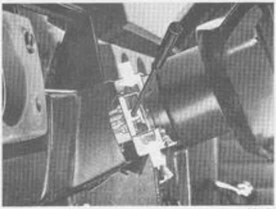


Fig. 3-133. Switch for flashers

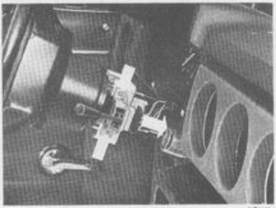


Fig. 3-134. Switch for windshield wipers

Fig. 3-135. Removing flasher light glass

REPLACING FLASHER LIGHTS

1. Remove the electric cable from the the cable harness in engine compartment.
2. Remove the light glass, see Fig. 3-135.
3. Remove the housing from the fender. Pull out the electric cable with its grommet.
4. Fit the new electric cable with grommet and install the housing.
5. Fit the bulb and connect the electric cable to the harness.
6. Check the flasher function and fit the glass.

REMOVING CONTACT BAR

1. Remove the impact guard (1, Fig. 3-136). (Carefully lever it loose with the help of a screwdriver.)
2. Disconnect the electric cable (4, Fig. 3-136) from the contact bar (3, Fig. 3-136).
3. Remove the four attaching screws (2, Fig. 3-136) for the contact bar and lift off the bar. Installation of the contact bar is in reverse order to removal. After installation, check the flasher function.

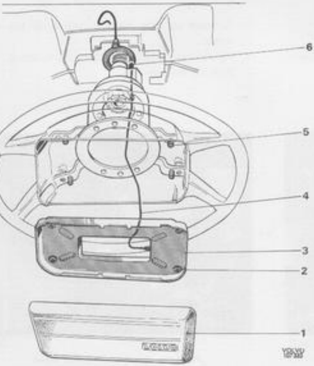


Fig. 3-136. Contact bar

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

WINDSHIELD WIPERS

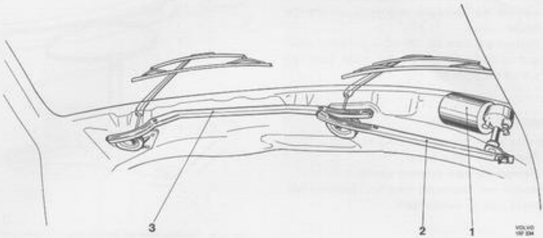


Fig. 3-137. Windshield wiper unit

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

REMOVING WIPER MOTOR

1. Remove the drive link from the lever on the wiper motor after having first removed the lock device, see Fig. 3-138.
2. Remove the contact from the wiper motor.
3. Remove the three attaching screws (Fig. 3-139). Lift out the wiper motor.

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

INSTALLING WIPER MOTOR

1. Place the wiper motor in position and fit the attaching screws, see Fig. 3-139.
2. Connect up the contact to the wiper motor.
3. Fit the drive link to the lever on the wiper motor.
4. Check the wiper function.

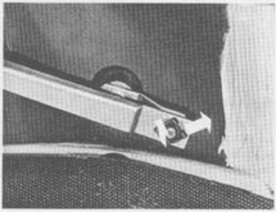


Fig. 3-138. Removing locking for drive link

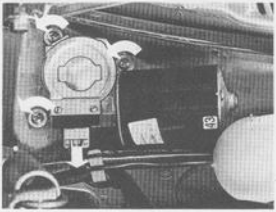


Fig. 3-139. Removing windshield wiper motor

(vehicles with standard heating system)

1. Remove the right-hand side panel and the defroster hoses.
2. Remove the drive link for the wiper motor lever and unscrew the nut for the cable stretcher. Lift off the drive link.

REMOVING DRIVE LINK

(vehicles with combined heating system)

1. Remove the glove locker.
2. Remove the right defroster nozzle.

Otherwise see "Removing drive link" (vehicles with standard type air conditioner).

INSTALLING DRIVE LINK

(vehicles with standard heating system)

1. Place the cable's flange nipple in the segment recess and then lever the cable over the segment, see Fig. 3-140. This work should be done with the greatest care in order not to score the segment or damage it in any other way, as this would lead to disturbance in operation.
2. Fit the connecting rod for the wiper motor lever. Thereafter tension the cable.
3. Check to make sure the wipers are functioning properly.
4. Fit the defroster hoses and side panel.

INSTALLING DRIVE LINK

(vehicles with combined heating system)

See points 1—3 under "Installing drive link" (vehicles with standard heating system).

4. Fit the defroster nozzle and glove locker.

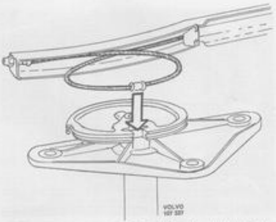


Fig. 3-140. Installing cable for drive link and parallel drive link, left-hand side

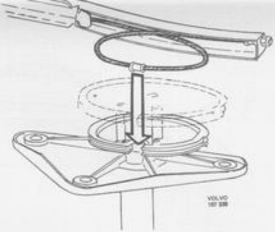


Fig. 3-141. Installing cable for parallel drive link, right-hand side

REPLACING CABLE

1. Remove the drive link and the parallel drive link.
2. Bend up the lock washer with the help of a screwdriver, and remove the washer. Remove the old cable.
3. Fit the new cable in position and also a new lock washer.
4. Re-install the cable stretcher in the drive link. The nut should be screwed on only a couple of threads.
5. Fit the drive link and parallel drive link.

REMOVING PARALLEL DRIVE LINK

Left-hand side

1. Remove the defroster hose.
   (On vehicles with combined heating system, remove the air duct between the defroster nozzle and the air vent in the dashboard.)
2. Remove the nut for the cable stretcher and disconnect the cable from the segment.

Right-hand side

1. Remove the side panel and defroster hose.
   (On vehicles with air conditioning of combined type, remove glove locker and right-hand defroster nozzle.)
2. Disconnect the drive link and remove it.
3. Remove the nut for the cable stretcher and disconnect the cable from the segment.
4. Lift forward the parallel drive link.

INSTALLING PARALLEL DRIVE LINK

Left-hand side

1. Place the cable's flange nipple in the large segment recess and thereafter prise the cable over the segment, see Fig. 3-140. Great care should be observed when doing this in order not to score the segment or damage it in any other way, otherwise this might lead to disturbance in operation.

Right-hand side

1. Place the cable's flange nipple in the small segment recess and thereafter prise the cable over the inner segment, see Fig. 3-141. Great care should be observed when doing this work so as not to score the segment or damage it in any other way, as this could lead to disturbance in operation. Tension the cable.
2. Place the drive link cable's flange nipple in the front segment recess and thereafter prise the cable over the segment, see Fig. 3-140.
   Fit the drive link to the lever on the wiper motor. Tension the cable.
3. Check the wiper function.

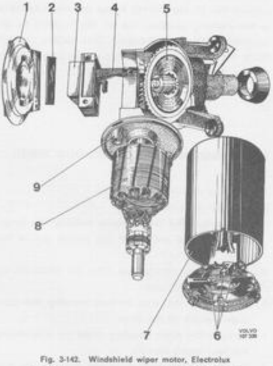


Fig. 3-142. Windshield wiper motor, Electrolux

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

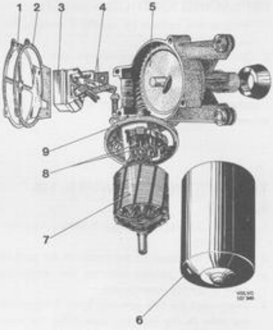


Fig. 3-143. Windshield wiper motor, SWF

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

4. Fit the defroster hoses and the side panel. (On vehicles with combined heating system, fit the defroster nozzle and the glove locker.)

REPLACING WIPER ARM BEARING

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

REPLACING SWITCHES ON CONTROL PANEL

1. Disconnect the ground cable from the battery.
2. Unscrew the control panel and lift up from the bottom until the contacts are accessible.
3. Disconnect the contact harness from the switch.
4. Remove the switch by first pressing in the lock springs and then pressing the switch out of the panel, see Fig. 3-148.

REPLACING IGNITION SWITCH

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

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

TAILGATE WINDOW WIPER, 145

REMOVING

1. Remove the negative (ground) battery lead from the battery.
2. Take off the panel on the inside of the tailgate.
3. Unscrew the screws securing the reinforcing plate under the wiper motor.
4. Disconnect the link arm and bend the reinforcing plate to the side and take down the wiper motor.
5. Mark up and disconnect the electric cables from the motor.

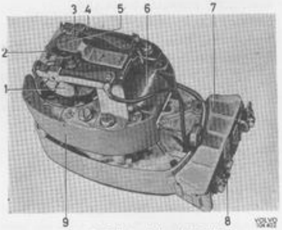


Fig. 3-145. Tailgate window wiper motor

1. Rotor
2. Brush spring
3. Brush
4. Brush holder
5. Stop tab for rotor
6. Permanent magnet
7. Parking switch
8. Diode
9. Pole shoe

EXAMINING PARKING SWITCH

If the wiper blade does not park in the proper position when the wiper is switched off, the fault can be sought in the switch or in the wiper motor parking switch, provided that the wiper blade arms are correctly fitted on the outgoing shaft. If there is current up to connection 53a on the wiper motor and if connection 31b is grounded, the switch and cables are functioning properly and the fault will lie in the parking switch in the wiper motor, see Fig. 3-144.

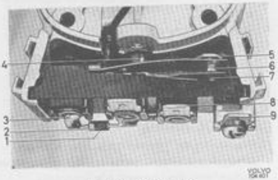


Fig. 3-144. Parking switch

1. Connection 31b
2. Diode
3. Connection 53
4. Lift tab
5. Contact 53a
6. Contacts (2) 53
7. Contact 31b
8. Connection 53a
9. Connection 31

Check that the parking switch is functioning as follows:

With the lift tab in the inner position, the spring with contact 53 (6, Fig. 3-144) should lie against contact 53a (5, Fig. 3-144). When the wiper blade is in the parking position, the lift tab is lifted by an eccentric in the drive housing. This causes contact 53 (6, Fig. 3-144) to be pressed against contact 31b (7, Fig. 3-144).

DISASSEMBLING TAILGATE WINDOW WIPER MOTOR

1. Remove the casing.
2. Unhook the brush spring.
3. Disconnect the two screws holding the brush holder bridge and bend the bridge out of the way.
4. Pull the rotor straight up. Note the small ball on the lower shaft end.
5. Disconnect the two screws holding the pole shoe and lift off the shoe.
6. Remove the drive housing cover by unscrewing the four small screws.
7. Pull the intermediate drive and drive on the output shaft straight out, see Fig. 3-146. Note the washer on the top side of the output shaft drive and flat washer underneath.

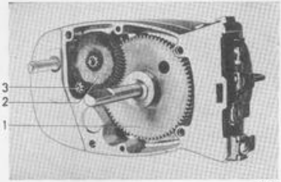


Fig. 3-146. Drive housing

1. Drive on output shaft
2. Intermediate drive, fiber
3. Rotor shaft drive

INSPECTING

Clean all the parts and check them for wear and mechanical damage. Check the rotor for short-circuiting between commutator and rotor frame and also for short-circuiting between and breakage in the winding coils. Short-circuiting between the commutator and rotor frame is tested by connecting a 40 V test lamp (alternating current) between them. The lamp must not light. Short-circuiting between the coils is tested with a small type of growler or with Bosch coil tester EFAW 90 or 95 with armature tester EFAW 96 or corresponding. Total disconnection to any commutator disc is checked with a 12 V test lamp (direct current). One of the measuring leads of the test lamp is placed on a commutor disc and the other is wound round the commutator. The lamp should light. If one of the wires to any commutator disc is broken, this is noticed by considerable burning damage on one or several of the diametrically placed discs.
Check with a test lamp or voltmeter that the diode is in circuit from connection 31b to connection 53 (+ to 31b and — to 53) and that it checks current flow in the opposite direction.

ASSEMBLING TAILGATE WINDOW WIPER MOTOR

1. Apply plenty of grease to the drive housing. Bosch Ft 1 V 35 or corresponding.
2. Place the large drive with the output shaft and intermediate drive in position in the drive housing, see Fig. 3-146, (do not forget the two washers) and fit the cover.
3. Place the pole shoe in position and secure it firmly with the two screws.
4. Apply a light oil film to the rotor shaft and its bush.
5. Fit the rotor. Make sure that the ball on the end of the rotor shaft is in position.
6. Screw the brush holder bridge firmly into position and hook on the brush spring.
7. Test-run the motor and fit the casing.

INSTALLING

1. Connect the electric cables to the motor.
2. Fit the link arm at the motor and place the motor and reinforcing plate in position.
3. Fit and screw tightly the screws securing the motor and reinforcing plate.
4. Connect the link arm to the output shaft and fit the panel on the inside of the tailgate.
5. Connect the ground lead to the battery.

REPLACING INTERIOR LIGHT BULB

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

REPLACING BRAKE LIGHT SWITCH

When replacing the brake light switch, make sure that the new switch is adjusted correctly so that it functions satisfactorily. The distance between the brake pedal released and the threaded bronze hub on the switch should be 4±2 mm (0.16±0.008") (A, Fig. 3-147). If the distance must be adjusted, release the attaching screw for the bracket and move the bracket until the correct distance is obtained.

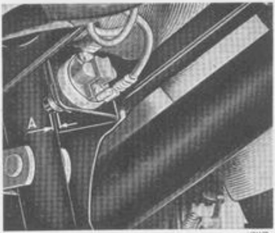


Fig. 3-147. Brake light switch

REPLACING HEADLIGHT SWITCH

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

Installation is in reverse order to removal.

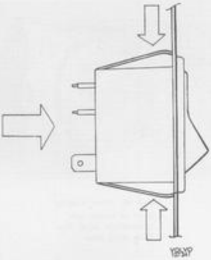


Fig. 3-148. Removing switch

GROUP 38

INSTRUMENTS

TOOLS

Fig. 3-149. Special tool for removing and installing tank fittings

Special tools may now be preceded by SVO or 999, e.g., SVO 1801 or 999 1801.

DESCRIPTION

The instrumentation consists of a combined instrument, see Figs. 3-150 and 3-151. It comprises a speedometer, mileometer and trip meter, rev counter (only on certain models), temperature gauge, fuel gauge, warning lamps for parking brake, fullbeams, brake circuit failure, oil pressure, battery charging, choke and overdrive (for vehicles fitted with such). Also connected to the combined instrument is a voltage regulator which maintains the feed voltage constant for the instrumentation.

Fig. 3-150. Combined instrument, front side

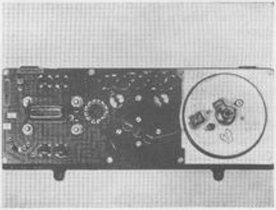


Fig. 3-151. Combined instrument, reverse side

SPEEDOMETER AND MILEOMETER

The speedometer and mileometer are integrally built and are driven by a drive line from a worm on the output shaft of the gearbox.

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

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

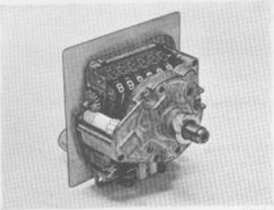


Fig. 3-152. Speedometer and mileometer

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

REV COUNTER

The rev counter consists partly of a transistorized registration and amplifier unit and partly of a rotational coil system.

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

The rotational coil system consists of an annular shaped permanent magnet round which a coil is fitted. The coil is movable the length of the magnet

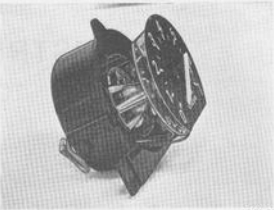


Fig. 3-153. Rev counter

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

TEMPERATURE GAUGE, COOLANT

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

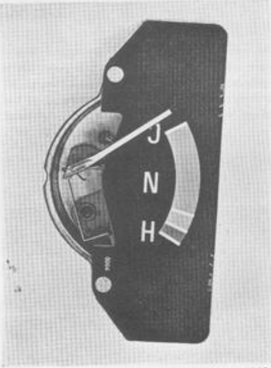


Fig. 3-154. Registering instrument for temperature gauge

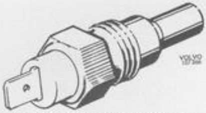


Fig. 3-155. Sensor for temperature gauge

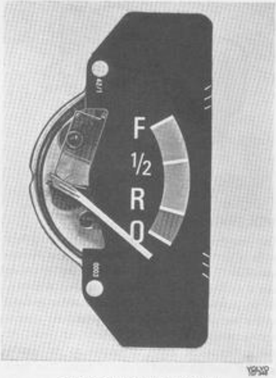


Fig. 3-157. Registering instrument, fuel

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

FUEL GAUGE

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

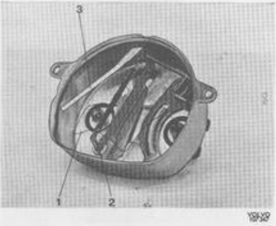


Fig. 3-156. Registering instrument, disassembled

1. Resistance wire
2. Bimetal spring
3. Pointer

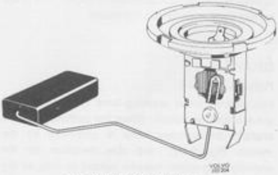


Fig. 3-158. Sender for fuel gauge

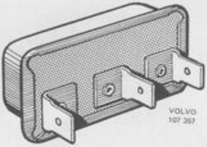


Fig. 3-159. Voltage stabilizer

VOLTAGE STABILIZER

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

BATTERY CHARGING

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

DIRECTIONAL INDICATORS

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

BRAKES

PARKING BRAKE

The parking brake warning lamp receives current via the ignition switch. When the parking brake is applied, the warning lamp is grounded by the switch, Fig. 3-161, and this switches on the warning lamp which remains lighted as long as the parking brake is on.

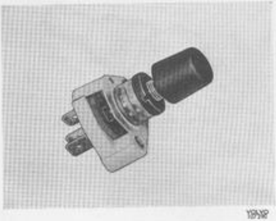


Fig. 3-160. Rheostat for instrument lighting

BRAKE CIRCUIT FAILURE

Should a fault arise in any of the two circuits of the hydraulic brake system, so that there is a pressure difference between the circuits of more than 8—10 kp/cm² (114—142 psi) when the brakes are applied, this actuates the warning valve, Fig. 3-162, and the warning lamp goes on. The warning lamp remains lighted until the fault in the brake system has been put right and the warning valve re-set. Concerning re-setting the warning valve, see Part 5 Brakes, Group 52.

FULL-BEAM HEADLIGHTS

The warning lamp for the full-beam headlights flashes simultanously with the full-beam headlights. It is wired parallel with the headlights at the step relay.

Fig. 3-161. Switch for parking brake control

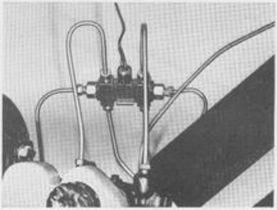


Fig. 3-162. Warning valve

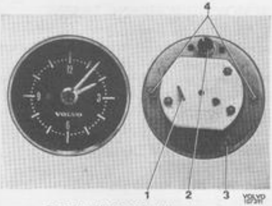


Fig. 3-163. Electric clock, front and reverse
1. Battery connection
2. Bulb
3. Battery connection
4. Attaching screws

OIL PRESSURE

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

CONTROL PANEL

The control panel contains a rheostat for the instrument panel lighting, cigarette lighter and switch with built-in warning lamp for the electrically heated rear window and emergency warning flashers.
The control panel also contains the controls for the heating unit as well as a reminder lamp for the seat belts.

OVERDRIVE

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

CHOKE

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

CLOCK

The clock, Fig. 3-163, is electrically driven and placed above the control panel.

REPAIR INSTRUCTIONS

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

REMOVING COMBINED INSTRUMENT

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

REMOVING WARNING LAMPS

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

REMOVING REV COUNTER OR GUARD COVER

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

REMOVING SPEEDOMETER WITH MILEOMETER

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

REMOVING VOLTAGE STABILIZER

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

REMOVING CABLE PLATE

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

REMOVING TEMPERATURE GAUGE AND FUEL GAUGE

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

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

Fig. 3-164. Tool for removing sender for fuel gauge

REMOVING SENDER FOR FUEL GAUGE

The sender, which is located in the fuel tank, is held in position with a bayonet fixture. When removing, use tool 2738, see Fig. 3-164.

REPLACING SENSOR FOR TEMPERATURE GAUGE

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

REMOVING CLOCK

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

Installation is in reverse order to removal.

CHECKING SPEEDOMETER WITH MILEOMETER

If the speedometer or mileometer is not functioning, the reason may be due to a fault in the instrument or speedometer cable or the worm, which is located on the gearbox, for driving the cable.

In order to decide which component is faulty, carry out the following:

If the speedometer functions while the mileometer does not, or vice-versa, then the instrument is defective and should be replaced. No attempt should be made to repair the instrument.

When both the speedometer and mileometer stop functioning, the fault is probably in the speedometer cable or the worm. Disconnect the speedometer cable from the instrument and see whether it rotates. If it does, this means that it has broken from the worm, in which case replace the cable and check the drive at the same time at the gearbox. Check to see whether the drive couplings can rotate easily. If it jams, the instrument should also be replaced.

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

Speed of drive couplings			
8.35	16.70	29.20	r/s
(500)	(1000)	(1750)	(r/m)

Speedometer reading			
31.5 ± 2.5	60.5 ± 2.5	104.5 ± 2.5	Mph

CHECKING SPEEDOMETER CABLE

It is most important that the speedometer cable is correctly fitted if the speedometer is to function without trouble. It is vitally important that the cable is not bent too sharply. At no point must the radius of a bend be less than 100 mm (4"). If it is less than this, vibration and noise can occur in the instrument. The drive couplings must run true in the outer casing of the cable. This is checked with the cable rotating.

CHECKING TEMPERATURE GAUGE

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

The fault tracing is as follows:

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

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

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

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

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

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

CHECKING REMOVED TEMPERATURE SENSOR

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

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

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

CHECKING FUEL GAUGE

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

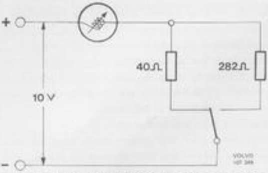


Fig. 3-165. Wiring diagram for checking temperature gauge or fuel gauge indicating instrument

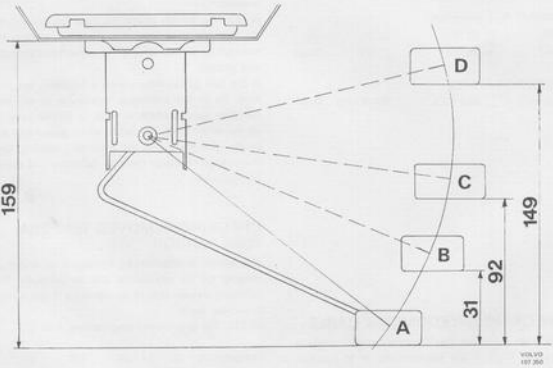
CHECKING REMOVED FUEL SENDER

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

With regard to the various positions of the float, see Fig. 3-166. Its measurement indications indicate the number of mm the float should be lifted from its bottom position.

CHECKING REMOVED VOLTAGE STABILIZER

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



Position	Resistance in ohms	Position	Resistance in ohms
A	282 ± 48	C	75 ± 11.5
B	146 ± 19	D	40 ± 5

Fig. 3-166. Checking fuel sender

A = Empty tank
B = Reserve (8 dm³ = 1.8 galls.)
C = Half tank (29 dm³ = 6.5 galls.)
D = Full tank (58 dm³ = 13 galls.)

Part 4

POWER TRANSMISSION, REAR AXLE

CONTENTS

GROUP 41

CLUTCH

TOOLS

The following tools are used for work on the clutch.

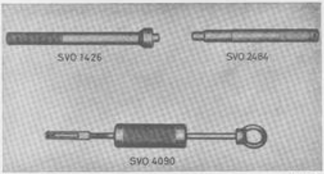


Fig. 4-1. Special tools

999 (SVO) 1426 Drift for pilot bearing in flywheel.
999 (SVO) 2484 Mandrel for centering clutch plate.
999 (SVO) 4090 Puller for ball bearing in flywheel.

DESCRIPTION

The clutch (Illustration 4-A) is of the diaphragm spring type. It is available in two different versions (Figs. 4-2 and 4-3), but both mainly consist of a pressure plate, a diaphragm spring and clutch casing. The diaphragm spring has a double function, that of a clutch lever when declutching and a pressure spring when engaging.

The clutch is operated by the clutch pedal, the movements of which are transferred to the clutch via a wire, a lever and a release bearing.

Fig. 4-2. Clutch, type I

Fig. 4-3. Clutch, type II

WORK ON CLUTCH IN VEHICLE

REPLACING CLUTCH WIRE

1. Unhook the return spring for the release fork. Slacken the rear nut and possibly the front nut a couple of turns. Disconnect the wire from the release fork.
2. Loosen the clamp holding the wire to the reinforcing member of the wheel housing.
3. Remove the panel under the dashboard. Take off the bearing bolt for the pedal. Disconnect the wire from the pedal. Slacken the nut for the wire sleeve. Remove the wire.
4. Fit the new wire in the reverse order to removal.

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

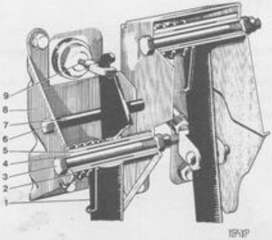


Fig. 4-4. Pedal carrier

1. Clutch pedal
2. Return spring
3. Bolt
4. Shaft
5. Bush
6. Bolt for pedal stop
7. Rubber sleeve
8. Bracket
9. Clutch wire

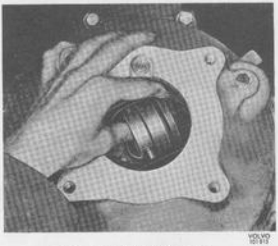


Fig. 4-5. Removing release bearing

Fig. 4-6 Removing clutch

REMOVING CLUTCH

1. Remove the gearbox according to the instructions given in Group 43.
2. Remove the upper bolt for the starter motor.
3. Remove the release bearing. Disconnect the wire from the release fork. Slacken the wire sleeve from the bracket.
4. Slacken the bolts and remove the flywheel housing.
5. Slacken the bolt for the release fork ball joint. Remove the ball and the release fork.
6. 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.

REPLACING CLUTCH FACINGS

1. Drill out the old rivets with a drill having the same diameter as the rivets, 3.5 mm (0.14"), and remove the old facings.
2. Check the clutch plate. The indentations on the tongues should be even. The clutch plate must not be warped. The clutch springs and rivets in the hub should fit securely and not show any signs of looseness. Check to make sure that there are no cracks.
   If the clutch plate has any of the above defects, it should be replaced with a new one.
3. Rivet on the new facings (preferably in a rivet press). NOTE. The rivets should be inserted from the side on which the facing lies and riveted up from the opposite direction against the disc. Use every other hole in the facing. After riveting, the facings should be spaced from each other as determined by the indentations on the clutch disc. See Fig. 4-7. This is most important in order to achieve a smooth engagement when starting and driving.
   The clutch facings must be absolutely free from oil. Oil on the facings can cause clutch grabbing.

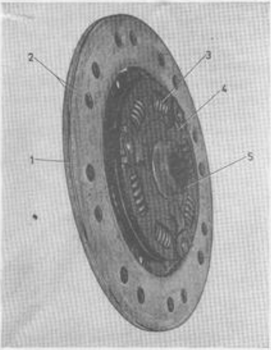


Fig. 4-7. Clutch disc

1. Disc 2. Facings 3. Spring 4. Damping spring 5. Hub

INPUT SHAFT BEARING IN FLYWHEEL

1. The bearing is pulled out with puller 4090, see Fig. 4-8. The bearing is cleaned in petrol (gasoline).

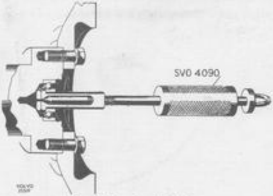


Fig. 4-8. Removing pilot bearing

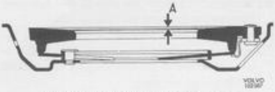


Fig. 4-9. Checking curvature of pressure plate

If the bearing, upon inspection, runs smoothly and evenly and has no noticeable play, it should be packed with ball bearing frease and refitted. NOTE. Heat-resistant grease should be used.
The bearing should be pressed in by drift 1426.

INSPECTING

As the clutch cannot be disassembled, it must be replaced complete if faulty. Check the clutch carefully. Check the pressure plate for damage by heat, cracks, scoring of other damage on the friction surface. Check the curvature of the pressure plate with a 240 mm (9½") long steel ruler, which is placed diagonally across 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 0.03 mm (0.0012"), see Fig. 4-9. There must be no "crowning", i.e. clearance between the straight edge of the ruler and the outer diameter of the pressure plate. Carry out the check at several points. Check the pressure spring carefully; if it is cracked or damaged in any other way, the clutch should be replaced.
Check the release bearing by turning it round a few times under light pressure so that the balls rotate against the races. The bearing should turn easily without binding at any point. The release bearing should also slide easily on the guide sleeve from the gearbox.

INSTALLING

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

Fig. 4-10. Fitting clutch

1. Set up the clutch plate (the longest side of the hub facing backwards) together with the clutch and insert the centering mandel 2484 so that the guide journal on this centres the pilot bearing in the flywheel, see Fig. 4-10.
2. Fit 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 release yoke in the flywheel housing.
4. Place the upper bolt for the starter motor in the housing. Then fit the housing. Fit on the bolts in the following order: First the four upper (7/16"), and then the lower bolts for the starter motor, and finally the two lower (3/8"). The nut for the starter motor upper bolt is fitted after the clutch wire has been fitted.
5. Insert the wire sleeve in the bracket and put on the rear nut. Securely fix the wire in the release fork. Fit the release bearing.
6. Fit and tighten the nut for the upper starter motor bolt.
7. Fit the gearbox according to the instructions given in Group 43.
8. Adjust the clutch pedal play.

GROUP 43 A

GEARBOX

TOOLS

The following special tools are required for carrying out gearbox repairs.

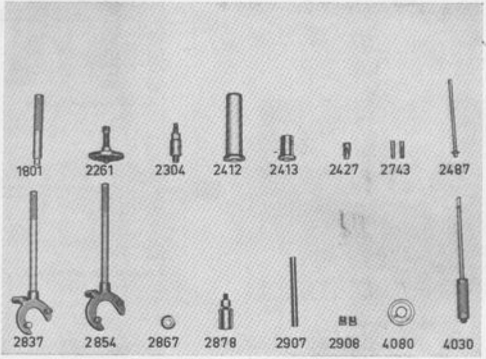


Fig. 4-11. Special tools

999
(SVO)
1801 Standard handle 18×200 mm
2261 Puller for flange
2304 Press tool for fitting flange
2412 Drift for fitting bearing on input shaft and for fitting input shaft in housing
2413 Drift for fitting oil seal in rear cover
2427 Universal joint for 2487
2487 3/8" hexagon socket spanner for upper gearbox bolts
2743 Guide pins for gearbox
2837 Counterhold for flange (cars fitted with B 20 E)
2854 Counterhold for flange (cars fitted with B 20 A, B and F)
2867 Drift for fitting oil seal in cover for input shaft

999
(SVO)
2878 Puller for removing reverse shaft
2907 Mandrel for fitting idler gear
2908 Centering plug for thrust washer, used (two) together with 2907 when fitting idler gear
4030 Puller for oil seal in rear cover
4080 Drift for fitting bearing in rear cover

The following tools are also used:
2520 Stand for fixture 2922
2727 Engine suspension device
2922 Fixture for gearbox when disassembling and assembling (used together with 2520)

DESCRIPTION

(Concerning gearbox with overdrive [M 41], see also Group 43 B "Overdrive")

M 40 is a four-speed fully synchronized gearbox, that is, all gears except reverse are in constant mesh. The construction of the gearbox is shown in Fig. 4-12 and illustration 4-B. In the neutral position the gears on the mainshaft rotate freely. For this reason they are provided with bronze bushes. Engaging a gear connects the corresponding gear wheel to the mainshaft by means of an engaging sleeve.

The gear lever positions are shown in Fig. 4-13. The power transmission path of the different speeds is shown in Figs. 4-14—4-18.

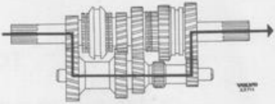


Fig. 4-14. Power path 1st speed

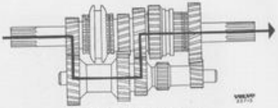


Fig. 4-15. Power path 2nd speed

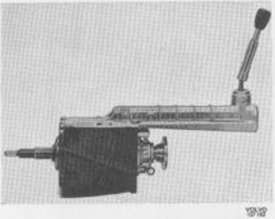


Fig. 4-12. Gearbox

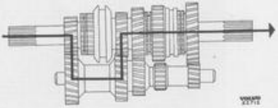


Fig. 4-16. Power path 3rd speed

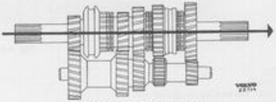


Fig. 4-17. Power path 4th speed

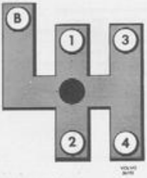


Fig. 4-13. Gear lever positions

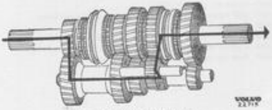


Fig. 4-18. Power path reverse

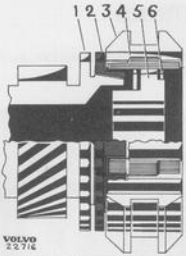


Fig. 4-19 Neutral position

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

The design and function of the synchronizing mechanism are shown in Figs. 4-19—4-21. When a gear is engaged, the gear selector fork presses the engaging sleeve (3, Fig. 4-19) towards the corresponding gear. The inserts (4) then press the synchronizing cone (2) against the cone on the gear (1). If the synchronizer and gear wheels are rotating at different speeds, the synchronizing cone will turn in relation to the engaging sleeve. However, the synchronizing cone is prevented from turning more than half a tooth-width by the engaging springs, see Fig. 4-20. The teeth on the synchronizing cone then have half their width in contact with the teeth on the engaging sleeve and in this way prevent it from engaging. Due to friction between the synchronizing cone and the gear, the gear attains the same rotational speed as the synchronizer. When they are both rotating at the same speed, the engaging sleeve is able to turn back the synchronizing cone and the gear engages, see Fig. 4-21.

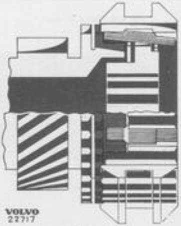


Fig. 4-20. Synchronizing

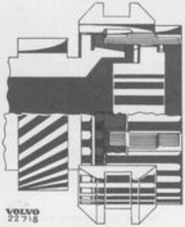


Fig. 4-21 Gear engaged

WORK ON GEARBOX IN VEHICLE

REPLACING OIL SEAL

1. Carry out operations 1—5 under the heading "Removing" to extent necessary.
2. Slacken the flange nut. Use 2854 as a counterhold for cars fitted with B 20 A, B and F and 2837 for cars fitted with B 20 E engines, see Fig. 4-22. Pull off the flange. Use puller 2261, see Fig. 4-23.
3. Pull out the old oil seal with puller 4030. Fit the new seal with the help of sleeve 2413, see Fig. 4-24.
4. Press on the flange with tool 2304, see Fig. 4-25. Fit the remaining parts.

Fig. 4-22. Counterhold for flange

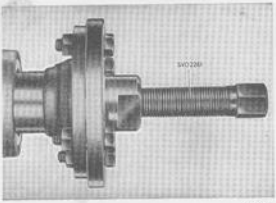


Fig. 4-23. Removing flange

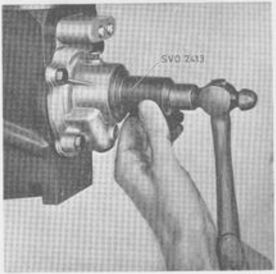


Fig. 4-24. Fitting oil seal

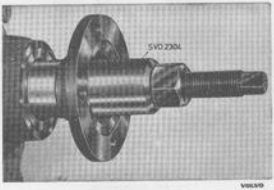


Fig. 4-25. Fitting flange

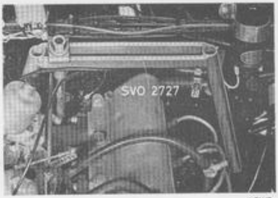


Fig. 4-26. Suspending engine

REMOVING

1. Fix tool 2727 on the engine, see Fig. 4-26. Place the lifting hook round the exhaust pipe.
2. Remove the gear lever.
3. Jack up the vehicle and prop up underneath. Begin with the rear end. Drain the oil from the gearbox.
4. Loosen and remove the supporting member under the gearbox. Disconnect the front universal joint from the gearbox flange. Disconnect the speedometer cable. Disconnect the rear engine mounting and the bracket for the exhaust pipe.
5. Lower the rear end of the engine about 2 cm (0.8") and then slacken the lines for the reversing lights and overdrive, if fitted.
6. Slacken the right upper and left lower gearbox bolts with spanner 2487, flexible joint 2427, extension piece with 3/8" square end and ratchet handle, see Fig. 4-27. Fit two guide pins 2743, see Fig. 4-43. Slacken the other two bolts. Pull out the gearbox backwards and lower it.

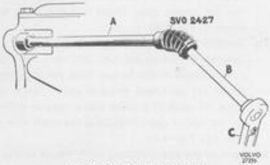


Fig. 4-27. Removing gearbox bolts
A=SVO 2487
B=Extension with 3/8" square
C=Ratchet handle

DISASSEMBLING

The following description applies to gearboxes without overdrive. If the gearbox is fitted with an overdrive, unscrew the bolts in the rear end and remove the overdrive. Then carry out the operations described below as far as necessary.

1. Fit fixture 2922 in stand 2520. Place the gearbox in the fixture, see Fig. 4-28.
2. Unscrew the bolts for the gearbox cover. Lift off the cover. Remove the spring and interlock balls for the selector rails.
3. Remove the cover over the selector rails. Unscrew the selector fork bolts.
4. Slide the selector fork backwards to 1st speed position. Drive out the pin slightly (it must not foul the 1st speed gear wheel). Then move the selector fork forwards sufficiently to allow the pin to pass in front of the gear. Drive out the pin.

Fig. 4-28. Gearbox in fixture

5. Slide 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.
6. Unscrew the bolts for the rear cover. Turn the cover so that it does not lock the shaft for the idler and reverse gears. Drive out the shaft for the idler gear. **NOTE. The shaft must be driven out backwards.** Let the idler gear fall into the bottom of the gearbox.
7. Pull out the mainshaft.
8. Unscrew the bolts and remove the cover over the input shaft. Lever out the oil seal from the cover with a screwdriver or similar.
9. Drive out the input shaft. If necessary, remove the circlip and press the ball bearing off the shaft.
10. Take out the idler gear. Pull out the shaft for the reverse gear with puller 2878, see Fig. 4-29. Take out the reverse gear and other parts.

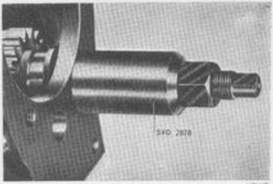


Fig. 4-29. Removing reverse gear

Fig. 4-30. Disassembling mainshaft, M 41

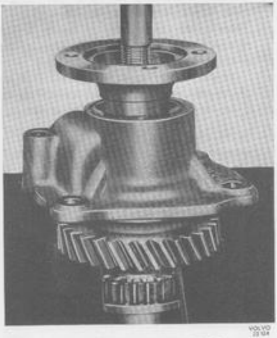


Fig. 4-31. Disassembling mainshaft, M 40

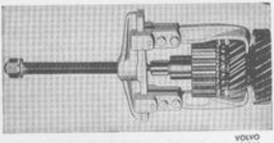


Fig. 4-32. Removing front synchronizer

DISASSEMBLING MAINSHAFT

1a. Gearbox with overdrive (M41):
Remove the circlip and press off the rotor for the overdrive oil pump. Remove the circlip for the mainshaft rear bearing. Slide the engaging sleeve for 1st speed and 2nd speed forwards. Place the shaft in a press and a support under the 1st speed gear. Press out the shaft as shown in Fig. 4-30.

1b. Gearbox without overdrive:
Unscrew the flange nut. Use 2837 resp. 2854 as a counterhold on the flange. Slide the engaging sleeve for 1st speed and 2nd speed forwards. Place the shaft in a press and a support under the 1st speed gear. Press out the shaft with a drift, see Fig. 4-31.

2. Remove the synchronizing cone, thrust washer, engaging sleeves, inserts, and springs from the shaft.
3. Remove the snap ring on the front end of the shaft. Pull off the synchronizing hub and 3rd speed gear with a puller, see Fig. 4-32. Remove the thrust washer.
4. Remove the snap ring and then the thrust washer, 2nd speed gear, synchronizing cone and spring.
5. Remove the oil seal from the rear cover and take out the speedometer gear. If necessary, remove the snap rings and press out the ball bearing.

INSPECTING

Check the gear wheels, particularly for cracks or chips on the tooth surfaces. Damaged or worn gears must be replaced.
Check the ball bearings, particularly for scoring or cracks on the races or balls.

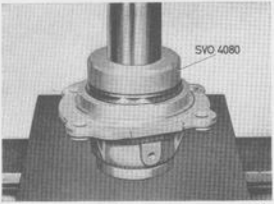


Fig. 4-33. Fitting ball bearing in rear cover

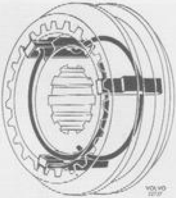


Fig. 4-35. Assembling synchronizer

ASSEMBLING

ASSEMBLING MAINSHAFT

1. Press the ball bearing into the rear cover, see Fig. 4-33, and fit the snap ring. There are different thicknesses of snap rings, so select one which fits snugly into the groove.
2. Gearbox without overdrive:
   Place the speedometer gear on the bearing in the rear cover. Press in the oil seal with drift 2413, see Fig. 4-34.
3. Fit the parts for the 1st and 2nd synchronizer on the mainshaft. Fit the springs correctly, see Fig. 4-35.

4.a Gearbox without overdrive:
Fit the synchronizing cone, 1st speed gear and thrust washer. Place the rear cover on the shaft. Ensure that the speedometer gear is positioned correctly. Fit on the flange. Use a sleeve which fits into the recess in the flange, press on the cover and flange, see Fig. 4-36. Fit the washer and nut for the flange. Use 2854 resp. 2837 as a counterhold on the flange and tighten the nut.

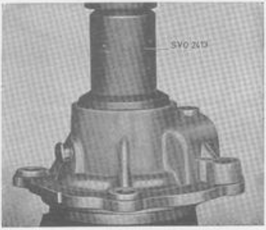


Fig. 4-34. Fitting oil seal in rear cover

Fig. 4-36. Fitting rear cover, M 40

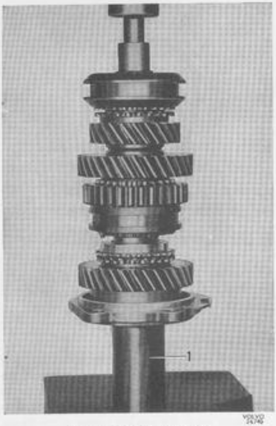


Fig. 4-37. Fitting rear cover, M 41
1. Sleeve

4b. Gearbox with overdrive (M41):
Place the rear cover and ball bearing on a cushioning ring or sleeve as shown in Fig. 4-37. Place on the thrust washer, 1st speed gear and synchronizing cone. Press in the shaft. Select a snap ring of suitable thickness and fit it. Fit the key, the rotor for the oil pump and snap ring.

5. Fit the synchronizing cone, 2nd speed gear wheel and thrust washer on the shaft. Select a circlip which fits snugly into the groove on the shaft and fit it.
6. Fit the thrust washer, 3rd speed gear and synchronizing cone on the shaft. Assemble the 3rd and 4th speed synchronizing parts. Fit the snap rings correctly, see Fig. 4-35. Then fit the synchronizer on the mainshaft. Select a locking ring of the correct thickness and fit it.

ASSEMBLING GEARBOX

1. Fit the striker lever and striker. Fit the reverse gear and reverse shaft. The reverse shaft is fitted so that it projects 7.0—7.6 mm (9/32") outside the gearbox housing, see Fig. 4-38.

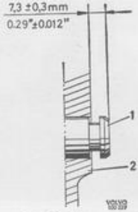


Fig. 4-38. Fitting reverse shaft

2. Place mandrel 2907 in the idler gear. Fit the spacing washers and needles (24 in each bearing). Use grease to hold the needles and washers in position.
3. Fix the washers to the housing with grease and guide them up into position, with the centering plugs 2908, see Fig. 4-39. Lay the idler gear in the bottom of the housing.
4. Press the bearing onto the input shaft with the help of drift 2412, see Fig. 4-40. Select a snap ring of suitable thickness and fit it. Place the 14 bearing rollers for the mainshaft in position in the input shaft. Use grease to hold the rollers in place. Press the input shaft into position in the housing. Press the oil seal into the cover with drift 2867.
Then fit the cover over the input shaft. Do not forget the O-rings for the bolts.
5. Place the mainshaft in the housing. Turn the rear cover so that the countershaft can be fitted.

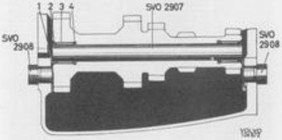


Fig. 4-39. Fitting idler gear
1. Thrust washer 3. Needle bearing
2. Spacing washer 4. Spacing washer

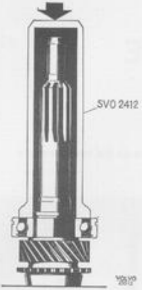


Fig. 4-40. Fitting ball bearing on input shaft

6. Turn the gearbox upside down. Fit the countershaft from the rear. Hold against 2907 with the hand. Ensure that the thrust washers do not loosen and fall down.

7a. Gearbox without overdrive:
Fit the bolts for the rear cover.

7b. Gearbox with overdrive:
Fit the overdrive. Use new locking for the intermediate flange.

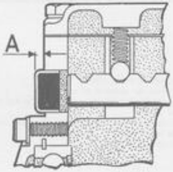


Fig. 4-41. Fitting end cap over selector rail
A=approx. 4 mm (0.16")

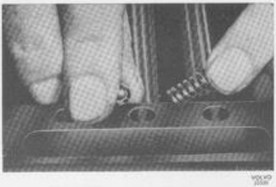


Fig. 4-42. Fitting interlock balls and springs

8. Fit the selector rails and forks. Move the selector fork over the rear position when fitting the pin. Use a new pin. Fit the cover over the selector rails.
NOTE. If the end caps at the front end of the housing have been removed, these should be fitted in the same way as previously, i.e. the center end cap should project about 4 mm (0.16") outside the face of the housing, see Fig. 4-41.

2. Place the interlock balls and springs in position, see Fig. 4-42. Fit on the gearbox cover. Check that all the gears engage and disengage freely.

INSTALLING

Make sure that guide pins 2743 are fitted acc. to Fig. 4-43. Installing is done in the reverse order to removing. Fill up the gearbox with oil.

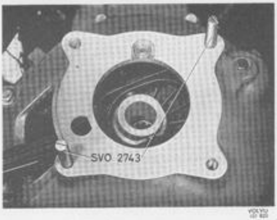


Fig. 4-43. Guide pins for gearbox

GROUP 43 B

OVERDRIVE

TOOLS

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

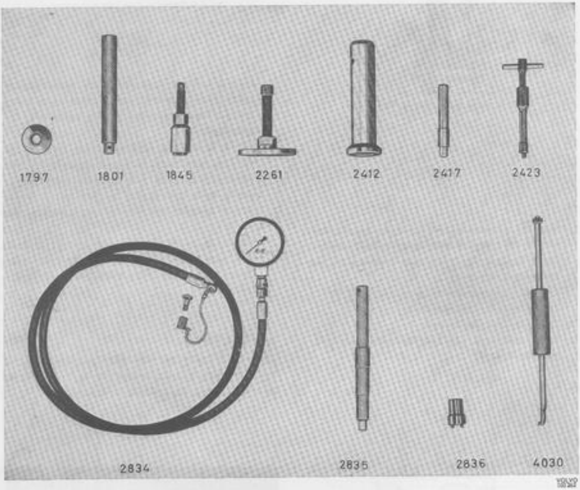


Fig. 4-44. Special tools

999
(SVO)
1797 Drift for removing rear bearing, output shaft
1801 Standard handle
1845 Press tool for fitting flange
2261 Puller for flange
2412 Sleeve drift for fitting front rear bearing on output shaft and oil seal at flange
2417 Drift for fitting bush in output shaft

999
(SVO)
2423 Puller for bush in output shaft
2834 Pressure gauge for checking oil pressure
2835 Centering mandrel for splines in planet carrier and unidirectional clutch
2836 Socket for removing and fitting plugs for fine filter, oil pump and relief valve
4030 Puller for oil seal at flange

DESCRIPTION

The overdrive unit is of the epicyclic type and is attached to the rear end of the gearbox. Its design and construction are shown in Fig. 4-52 and Illustration 4-C. The working principle of the overdrive is as follows:

DIRECT DRIVE POSITION

When travelling forwards 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. 4-45), is pressed by four springs against the tapered part of the output shaft. When reversing or when the engine acts as a brake, 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—45) with the help of the pistons (27, Fig. 4-52) in the hydraulic cylinders. This also locks the sunwheel. Since the planet gear retainers are linked to the mainshaft through the splines, the planet gears are forced to rotate around the sunwheel. As a result of this, the output shaft will rotate at a higher speed than the mainshaft.

ELECTRICAL SYSTEM

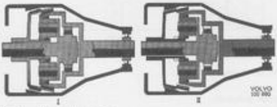
The overdrive is engaged by electro-hydraulic means. On the gearbox cover there is a contact which cuts in when 4th speed is engaged. Thus the overdrive can only be engaged when this speed is engaged. It is switched on by means of a switch placed underneath the steering wheel. This switch closes the circuit via the switch on the gearbox to a solenoid on the overdrive. This moves the solenoid armature which 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. 4-49.



Non-rotating parts

Parts rotating at a higher speed than the input shaft

Parts rotating at the same speed as the input shaft

Fig. 4-45. Working principle of the overdrive

I. Direct drive position
II. Overdrive position

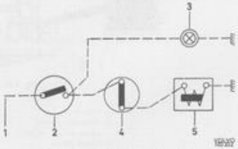


Fig. 4-46. Electrical circuit diagram

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

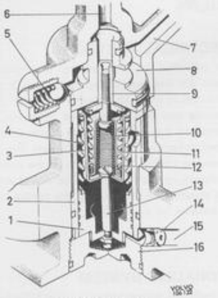


Fig. 4-47. Relief valve

1. Dashpot piston
2. Dashpot sleeve
3. Dashpot spring cup
4. Dashpot spring
5. Relief valve for lubricating oil pressure
6. Drilling from oil pump
7. Drilling to mainshaft
8. Relief valve body
9. Relief valve spindle
10. Residual spring
11. Relief valve spring cup
12. Relief valve spring
13. Dashpot spindle
14. Orifice nozzle
15. Drilling from operating valve
16. Dashpot plug

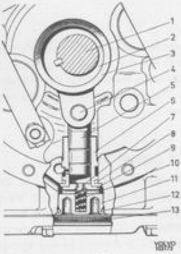


Fig. 4-48. Oil pump

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

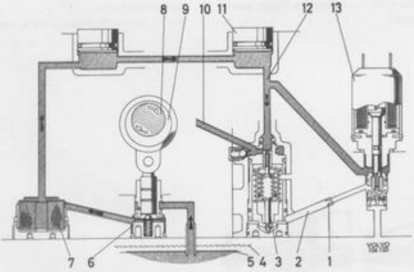


Fig. 4-49. Function with direct drive

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

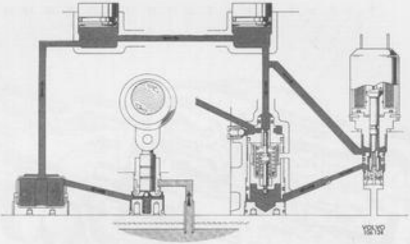


Fig. 4-50. Overdrive in function

The oil is drawn through the pre-filter by the plunger pump and is conveyed under pressure through the fine filter. From here the oil flows further through the hydraulic cylinders to the relief and control valves. The control valve closes and the large piston of the relief valve is in its lower position. This offloads 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 closes. The connection between channel 2 and the sump then opens. This permits oil under the large piston of the relief valve to flow out into the sump, the pressure in the system drops and direct drive is engaged. Because of the orifice nozzle in the channel and owing to a suitable balancing of the spring force, a certain time passes for the piston of the relief valve to move from one outer position to the other. This interval 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 led via the planet gear back to the gearbox housing, see Fig. 4-51.

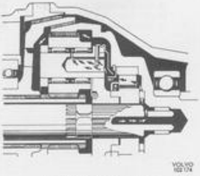


Fig. 4-51. Lubricating system

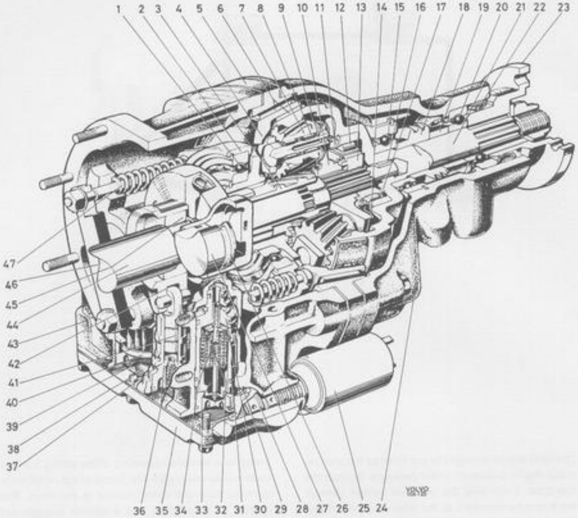


Fig. 4-52. Overdrive

1. Thrust bearing
2. Thrust bearing retainer
3. Sunwheel
4. Clutch sliding member
5. Brake ring
6. Clutch member linings
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 operating valve and connect the pressure gauge 2834, see Fig. 4-53.
2. Read off the pressure when driving on direct drive at about 40 kmph (25 mph). The pressure should then be about 1.5 kp/cm² (21 psi).
3. Engage the overdrive and check that the pressure rises to 32—35 kp/cm² (455—500 psi).
4. Disengage the overdrive and check the time for the pressure to drop to 1.5 kp/cm² (21 psi). The time must not exceed 3 seconds.

REPLACING SOLENOID AND OPERATING VALVE

The solenoid and operating valve are integrally built as one unit, which is replaced complete. For removing and fitting, use a 25 mm (1") fixed spanner. Use a new seal and O-rings when fitting. The tightening torque should be 42—55 Nm (30—40 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 2836, see Fig. 4-54. 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 units and a loop, see Fig. 4-55, for the cylinder and washer.
3. Wash all the parts in white spirit and blow them dry with compressed air. Check them carefully for wear and damage. The pistons should run easily in their cylinders. Faulty parts must be replaced. NOTE. The following units are available as spare parts: End washer, cylinder, the small piston, adjuster washer, low-pressure spring, large piston, plug and the O-rings.

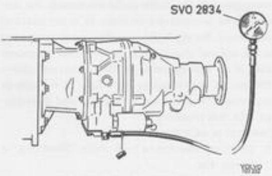


Fig. 4-53. Checking oil pressure

Fig. 4-54. Removing plug

Fig. 4-55. Removing relief valve

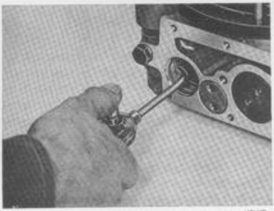


Fig. 4-56. Blowing orifice nozzle clean

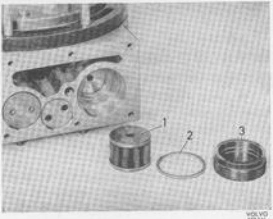


Fig. 4-57. Fine filter
1. Filter 2. Seal 3. Plug

4. Before fitting the parts of the relief valve, it may be suitable to blow the orifice nozzle clean with compressed air, see Fig. 4-56.
5. Fit the new O-rings on the end washer, cylinder and plug. Lubricate the parts with oil. Then install them in the following order: End washer, cylinder, small piston, low-pressure spring, large piston and plug. Tighten the plug to a torque of 22 Nm (16 lbft).
6. Fit the pre-filter and base plate with a new gasket. Make sure that the magnet is in position on the base plate. Fill with oil.

CLEANING ORIFICE NOZZLE

The orifice nozzle is accessible after the cylinder of the relief valve has been removed according to above. Blow the orifice nozzle clean with compressed air, see Fig. 4-56.

CHECKING AND REPLACING CHECK VALVE

1. Remove the base plate and pre-filter. Collect the oil in an oil container. Warning. If the vehicle has been recently driven, the oil may be hot and scald if contact is made with your skin.
2. Remove the plug with tool 2836. Take 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 22 Nm (16 lbft).
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. 4-57.
3. Clean all the parts in white spirit. Then blow them dry with compressed air.
4. Fit the fine filter, a new seal and the plug. Tighten the plug to a torque of 22 Nm (16 lbft).
5. Re-fit the pre-filter and the base plate with a new gasket. Make sure that the magnet is in position on the base plate. Fill with oil.

REMOVING OVERDRIVE

To facilitate removal, the vehicle should first be driven with the overdrive engaged and then 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—355 psi) is connected to the output at the operating valve. The overdrive is engaged and disengaged with this pressure.

Removal is as follows:

1. Carry out operations 1—5 under "Removing" in Group 43a.
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 disassembling, clean the outside of the unit thoroughly. Then first disassemble the main parts as follows:

1. Place the overdrive vertically in a vice provided with copper jaws. Remove the solenoid and operating valve.
2. Bend down the locking tab, unscrew and remove the nuts for the piston bridge pieces. Remove the bridge pieces.
3. Unscrew the nuts holding the brake ring, front and rear casing. Loosen the nuts gradually all round in order to avoid any distorted tension from the springs. Lift off the front casing and brake ring, see Fig. 4-58.
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 carrier complete.

REMOVING FRONT CASING

1. Place the casing with the front side downwards on a bench. Connect compressed air to the hole for the operating valve and blow out the pistons.
2. Disconnect the base plate and remove the pre-filter. Then remove the plugs and take out the parts for the respective fine filter, relief valve and pump check valve. See also under the heading "Work on overdrive in vehicle".

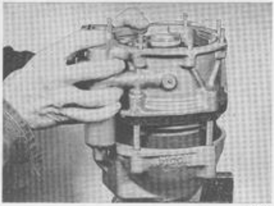


Fig. 4-58. Disassembling overdrive

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

DISASSEMBLING CLUTCH UNIT

1. Remove the circlip for the sunwheel. Pull out the sunwheel backwards.
2. Remove the inner circlip for the bearing. Hold the bearing body and tap loose the clutch sliding member with a rubber mallet.
3. Remove the outer circlip and press the bearing out of the bearing housing.

DISASSEMBLING REAR CASING

1. Remove the bolt and pull out the retainer, the bush and the speedometer pinion.
2. Remove the nut and pull off the flange with puller 2261. Place the housing in a press and press out the output shaft.
3. Remove the spacer, the speedometer drive gear. Pull out the bearing on the output shaft, sutitably with a so-called knife extractor. The rear bearing and oil seal are pressed out of the housing with drift 1797 and handle 1801.
4. Remove the circlip and the oil thrower, which hold the uni-directional clutch on the output shaft. Lift out the uni-directional clutch components. Remove the thrust washer. If necessary pull the bush on the output shaft with puller 2423, see Fig. 4-59.

INSPECTING OVERDRIVE

Before inspecting, clean all the parts in white spirit and then blow them dry with compressed air. Pay

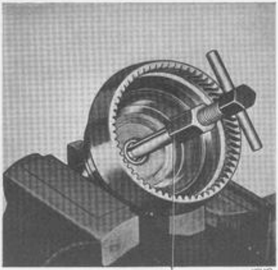


Fig. 4-59. Removing bush, output shaft
1. Puller 2423

particular attention to the cleaning of the filters and all the oilways. Check that the orifice nozzle in the channel between the relief and operating valves is clean. If it is not possible to blow the nozzle clean, it can be cleaned with a pointed wooden stick or suchlike. Hard objects must not be used since this 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.

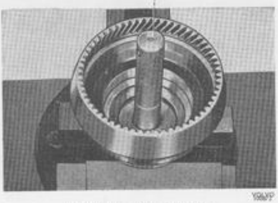


Fig. 4-60. Fitting bush, output shaft
1. Drift 2417

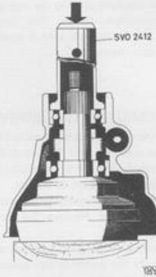


Fig. 4-61. Fitting output shaft

ASSEMBLING REAR CASING

1. Push the bush on to the output shaft with drift 2417, see Fig. 4-60. Press the front bearing to the output shaft with drift 2412.
2. Press the rear bearing on to the rear casing section with drift 2412.
3. Place a wooden block under the output shaft as support. Fit the speedometer driving gear and spacer. Press on the rear casing with drift 2412, see Fig. 4-61.
4. Press in the oil seal with drift 2412. Fit the coupling flange, the washer and nut. Tighten the nut to a torque of 110—140 Nm (80—100 lbft).

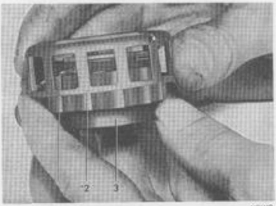


Fig. 4-62. Assembling uni-directional clutch, I
1. Spring 2. Cage 3. Uni-directional clutch hub

Fig. 4-63. Assembling uni-directional clutch, II
1. Key

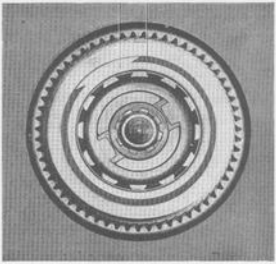


Fig. 4-65. Fitting oil thrower
1. Oil thrower plate 2. Circlip

5. Assemble the uni-directional clutch, spring and roller cage, see Fig. 4-62. Turn the roller cage clockwise as far as it will go and lock it in this position with a key as shown in Fig. 4-63. 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. 4-64. Fit the oil thrower and install the circlip, see Fig. 4-65.
7. Fit the speedometer pinion and bush. Fit the retainer and bolt.
8. Place the planet carrier complete with planet gear in position on the output shaft. Guide up the splines into the planet carrier and uni-directional clutch with drift 2835, Fig. 4-66.

ASSEMBLING CLUTCH UNIT

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

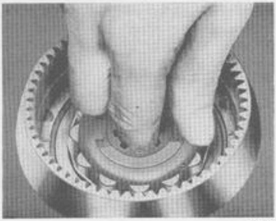


Fig. 4-64. Fitting uni-directional clutch

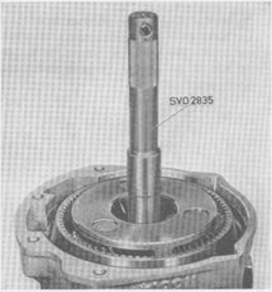


Fig. 4-66. Fitting planet gear

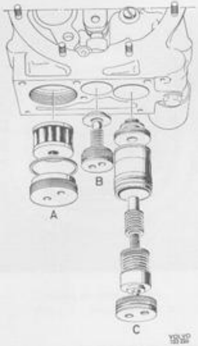


Fig. 4-67. Fitting fine filter, oil pump check valve and relief valve

Fig. 4-68. Fitting front casing

ASSEMBLING AND FITTING 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 Fig. 4-67.
2. Place the connecting rod and pump plunger in position in the casing. Then push in the cylinder. After that fit the non-return body, non-return ball, spring and plug.
3. Tighten the plugs for the fine filter, relief valve and pump check valve with torque wrench and tool 2836. The tightening torque is 22 Nm (16 lbft). Fit the pre-filter, magnet, gasket and base plate.
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. 4-68. 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 round.
6. Fit both the thrust washers. Tighten and lock the nuts. Fit the operating valve and solenoid.

INSTALLING OVERDRIVE

Fitting 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.

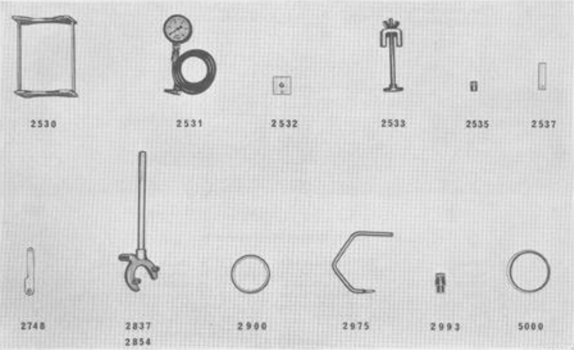


Fig. 4-69. Special tools

999
(SVO)
2530 Fixture for disassembling and assembling the transmission.
2531 Manometer complete with hose and connection for checking the oil pressure.
2532 Attaching plate for magnetic holder when measuring end float of input shaft.
2533 Press tool for compressing clutch when removing and fitting the snap ring.
2535 5/16" square socket for adjusting rear brake band.
2537 Spacer for adjusting front brake band.
2746 Transmission fixture when removing and fitting, see Fig. 4-87.
2748 Wrench for adjusting front brake band.

999
(SVO)
2837 Counterhold for flange (cars fitted with B 20 E)
2854 Counterhold for flange (cars fitted with B 20 A, B and F)
2900 Ring for fitting piston in front clutch (used together with 2533)
2975 Spanner for contact for starter inhibitor, etc.
2993 Guide for fitting piston in front clutch.
5000 Ring for installing piston in rear clutch.

Instead of bench stand 2530, the following can be used when disassembling and assembling, see Fig. 4-88.
2520 Stand
2604 Fixture

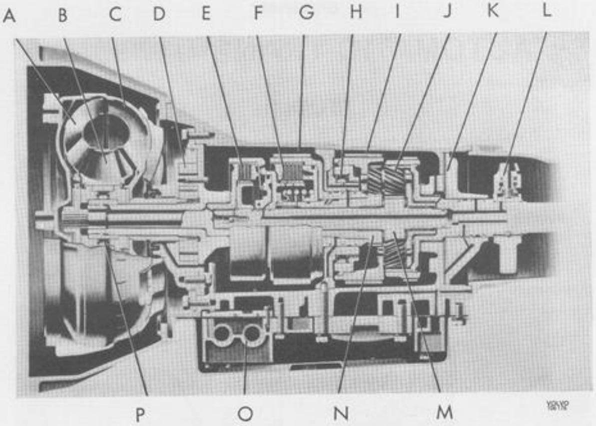


Fig. 4-70. Sectioned view of transmission

A. Turbine
B. Stator
C. Impeller and cover
D. Pump
E. Front clutch
F. Rear clutch
G. Front brake band
H. One-way clutch in transmission
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

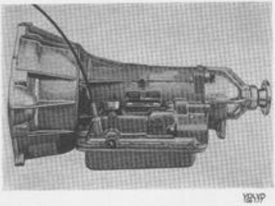


Fig. 4-71. The Borg-Warner Automatic Transmission type 35

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 control with positions "P", "R", "N", "D", "2" and "1", see Fig. 4-72.

THE TORQUE CONVERTER

The torque converter serves both as a clutch and as an extra (hydraulic) gear between the engine and transmision. 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 transmission. The converter also provides extreme low-speed flexibility when the transmission is in 3rd gear and, since it can multiply engine torque, it gives 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 supported 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. 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. 4-72. Selector lever positions

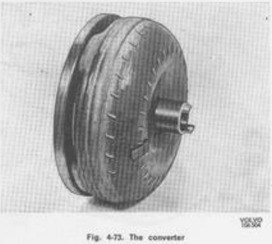


Fig. 4-73. The converter

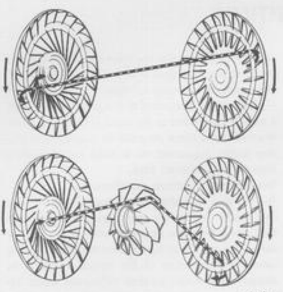


Fig. 4-74. Function of converter

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 gearbox components.

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. 4-75. 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 assembly 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 under 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. 4-76, consist of multi-disc units operated by hydraulic pistons. In all forward gears the front clutch connects the converter to the forward sun gear; for reverse, the rear clutch connects the converter to the reverse sun gear.

BRAKE BANDS

Brake bands, operated by hydraulic servos, hold elements of the gear set stationary to effect an output speed reduction and a torque increase. In "lockup", the rear band holds the pinion carrier stationary and provides the 1st gear ratio of 2.39:1 and, in reverse, a ratio of 2.09:1. The front band holds the reverse sun gear stationary to provide the 2nd gear ratio of 2.45:1.

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.

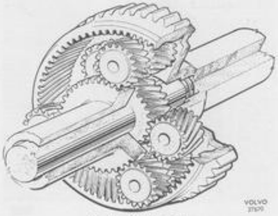


Fig. 4-75. Planetary gear

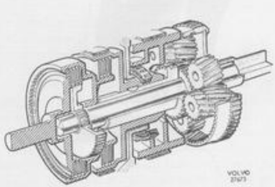


Fig. 4-76. Planetary gear, clutches and brake bands

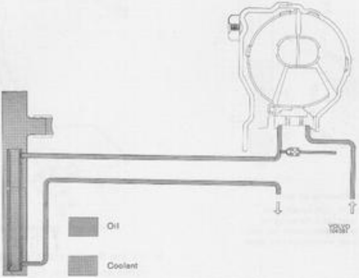


Fig. 4-77. Principle of operation for oil cooler

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. 4-77. The oil cooler is connected to the nipples (1, 2, Fig. 4-78) on the right-hand side of the transmission.

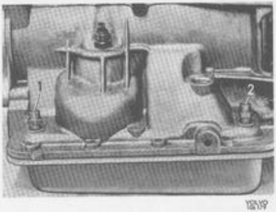


Fig. 4-78. Oil cooler connection
1. Connection nipple for oil cooler
2. Connection nipple for oil cooler

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 gearbox 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 transmission has been reconditioned. However, the oil level should be checked every 10 000 km (6 000 miles).

When checking the oil level, the car should be on level ground. Move the selector to position "P" and let the engine idle. The filler 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 or clean paper. Fluffy rags must not be used. Insert the dipstick, then pull it up and note the oil level, see Fig. 4-79.

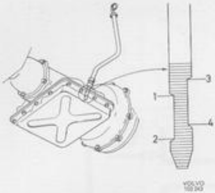


Fig. 4-79. Checking oil level
1. Max. oil level, cold transmission
2. Min. oil level, cold transmission
3. Max. oil level, transmission run warm
4. Min. oil level, transmission run warm

NOTE. There are different oil level marks for a warm or cold transmission. When the transmission is warm, after the car has been driven about 8—10 km (5—7 miles), the upper area (3 and 4, Fig. 4-79) 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" marks 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.

REMOVING AND FITTING THE VALVE BODIES ASSEMBLY

1. Jack up and prop up under the vehicle. Drain off the oil into a vessel which is absolutely clean. See Fig. 4-86.
   NOTE. The oil may be very hot and scald if contact is made with the skin.
2. Release the bolts for the oil sump and remove the sump. Carefully remove the oil tubes (Fig. 4-89).
3. Release the throttle cable from the cam. Remove the three bolts, see Fig. 4-90, which secure the valve bodies assembly to the transmission casing. Remove the valve bodies assembly straight downwards so that it releases from the oil tubes at the front end.
4. Make sure that the oil tubes are in position on the front pump body. Place the valve bodies assembly in position and secure it with the three bolts, see Fig. 4-90.

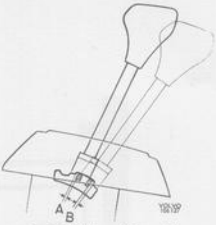


Fig. 4-80. Adjusting selector controls

5. Fit the throttle cable on the cam. Mount the oil tubes as shown in Fig. 4-89. 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 277691 and then fit the plug.
6. Lower the vehicle, fill with oil.

ADJUSTING THE SELECTOR CONTROLS

1. Disconnect the shift rod from the transmission lever. Place the lever in position "2". Also set the selector lever to position "2".
   Adjust the length of the shift rod to provide a small clearance (min. 1 mm=0.04", see B, Fig. 4-80) between the selector lever inhibitor and the inhibitor plate when the rod is connected to the lever on the transmission.
3. Move the selector lever to position "D" and check that the clearance to the sliding plate is the same or somewhat greater than in position "2". Adjust if necessary.
4. Lock the bolt with the circlip and tighten the locknut. Make sure that the control rod lug follows with the yoke.
5. Check that the clearances (A and B) are the same in positions "D" and "2" after the yoke has been moved to positions "P" and "1". Also check that the output shaft is locked with the selector lever in position "P".

ADJUSTING THE THROTTLE CABLE

Correct adjustment of this cable is most important for satisfactory operation of the transmission. There are three different methods .**Adjust first in accordance with A, see Fig. 4-81. Method B is to be applied if the transmission is not funtioning 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.

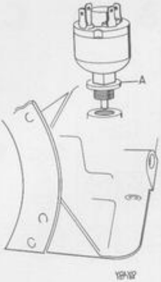


Fig. 4-83. Fitting starter inhibitor
A. Packing

REPLACING STARTER INHIBITOR SWITCH

1. Disconnect the electric cables from the contact. Unscrew the contact with spanner 2975.
2. Fit a new packing (A, Fig. 4-83) on the contact. Screw in the contact and tighten it with the spanner 2975. Hook up the electric cables.
3. Check that the engine can only be started with the shift selector in positions "P" and "N", that the back-up lights go on with the selector in position "R" and that the seat reminder functions in "D", "2" and "1".

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 has been released and the rubber removed. Otherwise adjusting is carried out as follows:

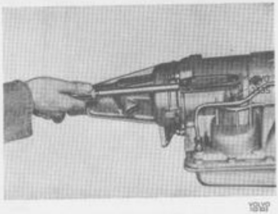


Fig. 4-84. Adjusting rear brake band

1. Slacken the locknut for the adjusting screw.
2. Use the special socket 2535 and connect the torque wrench to the adjusting screw, see Fig. 4-84. Tighten the screw to 14 Nm (10 lbft). Back off the adjusting screw one turn.
3. Tighten the locknut and fit any parts which have been removed.

AIR PRESSURE CHECKS

Air pressure checks can be made on the gearbox 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. 4-85. 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 that the clutch is functioning by turning the input shaft. Keep air pressure applied for several seconds to check for leaks. Then listen for a thump indicating that the clutch is releasing when the air pressure is removed.

Front servo "C"

Apply air pressure to the hole immediately adjacent to the rear retaining bolt. Observe the movement of the piston pin.

Rear servo "D"

Apply air pressure to the hole on the servo body. Observe the movement of the servo lever.

A. Adjusting cable stop
B. Adjusting with tachometer and manometer
1. Chock the wheels and apply the brakes
2. Select position "D"
3. Connect a revolution counter (a)
4. Connect a pressure gauge (b)
c. Measure pressure (P) at 8.3 r/s (500 r/m)
d. Measure pressure (P+R) at 16.6 r/s (1000 r/m)
R. Should be 1.1—1.4 kp/cm² (15—20 psi)
C. Adjust the cam in transmission
c. Accelerator pedal in idling position
e. Accelerator pedal fully depressed

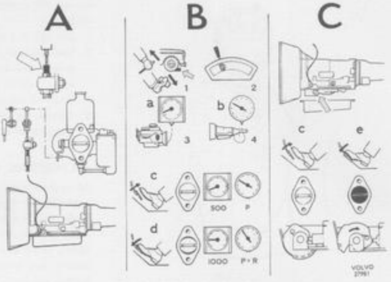


Fig. 4-81. Adjusting throttle cable

2. Screw up the threaded sleeve until it almost lies against the stop (for vehicles with single carburettor), and 1 mm (1/32") from the stop for vehicles with twin carburettors, the stop bearing crimped on the cable.
3. With the accelerator pedal fully depressed, check that:
   a. the carburettor lever is at the fully open stop.
   b. the line pressure at converter stall speed amounts to at least 11 kp/cm² (160 psi).

B. If the cable stop has been damaged or moved, the cable must be adjusted as follows:
1. Connect a tachometer to the engine and manometer to the transmission as shown in Fig. 4-82.
2. Chock the wheel and apply the brakes. Start the engine and move the lever to "D". Read off the pressure at 8.3 and 16.6 r/s (500 and 1000 r/m). At 16.6 r/s (1000 r/m) the pressure should be 1.16—1.4 kp/cm² (15—20 psi) higher than at 8.3 r/s (500 r/m). If the pressure rise is less than 1.1 kp/cm² (15 psi) the effective length of the outer cable should be increased by means of the adjuster. Conversely, if the rise is more than 1.4 kp/cm² (20 psi) the effective length of the outer cable should be decreased.

NOTE. On vehicles with an exhaust emission control system, it may be more suitable to measure the pressure at 11.6 and 20 r/s (700 and 1200 r/m). The pressure increase also in this case should be 1.1—1.4 kp/cm² (15—20 psi).

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 carburettor 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 carburettor 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 that at all times the outer cable is correctly located in the adjuster.

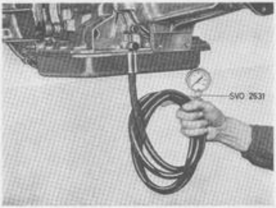
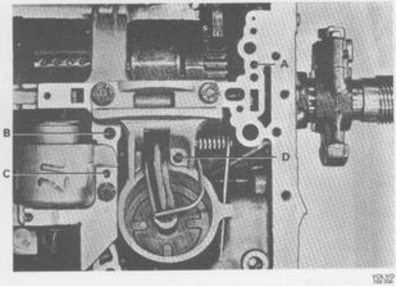


Fig. 4-82. Connecting manometer



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

Fig. 4-85. Functioning test with compressed air

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 blocks under the front and rear axles.
2. Drain the oil into a clean container, see Fig. 4-86. **NOTE. The oil may be very hot and scald if contact is made with the skin.**
3. Place lifting tool 2727 at the rear end of the engine. Hook the lifting hook securely round the exhaust pipe.
   NOTE. 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 transmission 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 gearbox. 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.

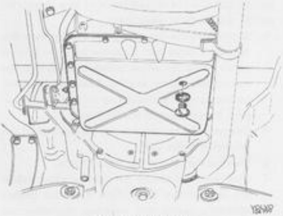


Fig. 4-86. Oil drain plug

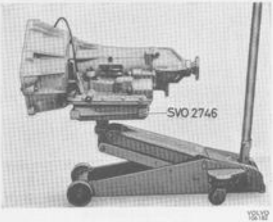


Fig. 4-87. Fixture for transmission

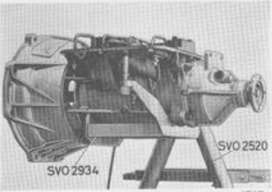


Fig. 4-88. Transmission in fixture 2934

8. Disconnect the electric cables from the starter inhibitor. Unscrew the screws for the starter motor. Place a jack with fixture 2746 under the transmission. See Fig. 4-87. 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 as general rule it is advisable only to dismantle 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.

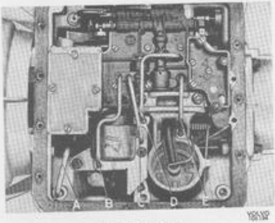


Fig. 4-89. Oil tubes
A. Converter outlet
B. Front servo release
C. Front servo application
D. Rear clutch
E. Rear servo

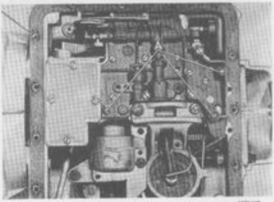


Fig. 4-90. Valve bodies assembly
A. Attaching bolts

When disassembling, the transmission should be inverted and placed on the bench cradle or in the fixture 2934 as shown in Fig. 4-88, 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 overleaf.

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" plain washer. Loosen and withdraw the rear housing. Remove the speedometer gear.
3. Unscrew the bolts for the oil pan and remove this. Lever out the oil tubes B—E carefully as shown in Fig. 4-89.

THE VALVE BODIES ASSEMBLY

Work on the whole assembly should preferably be carried out in a Diesel test-room or in a room with similar 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 case, see Fig. 4-90. 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.

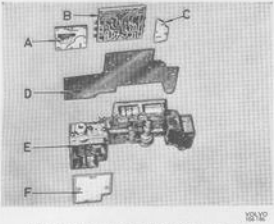


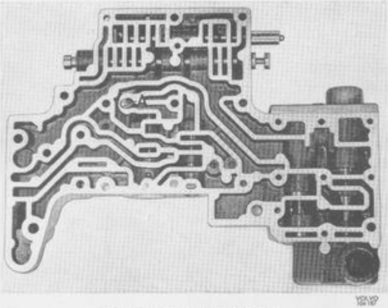
Fig. 4-91. Main components of valve bodies assembly

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

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 valve for the fast 3-2, see Fig. 4-92. Withdraw the manual control valve, see "A", Fig. 4-93.
11. Remove the stops for the throttle valve and the return spring. Then withdraw the downshift valve, spring and throttle valve, see "B", Fig. 4-93.
12. Remove the dowel pin which retains the plug for the modulator valve. Then remove the plug, valve and then the spring and valve.
13. Remove the stop for the servo orifice control valve and then the spring and valve.
14. From the manual valve side of the lower valve body, remove the following components: three screws, lower body end plate, primary regulator spring, primary regulator valve sleeve, primary regulator valve, secondary regulator valve spring and secondary regulator valve.
15. Remove the six screws and end plate from the upper valve body, see Fig. 4-94. 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.

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 the lever. Pull out the piston.



A. Check valve for fast 3-2

Fig. 4-92. Check valves in lower valve body

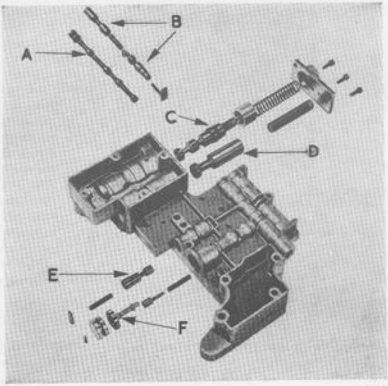


Fig. 4-93. Lower valve body

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

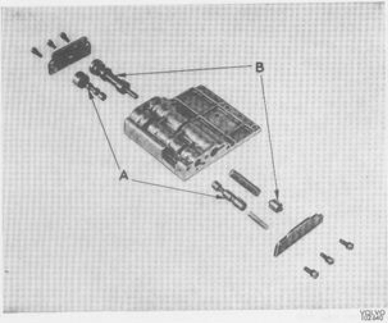
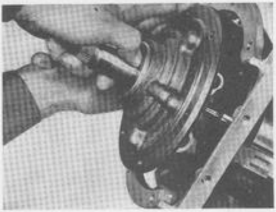


Fig. 4-94. Upper valve body

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

VOLVO

Fig. 4-95. Removing converter inlet and outlet tubes using needle-nose pliers

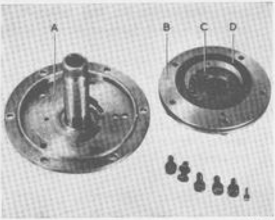


VOLVO
27663

Fig. 4-97. Removing pump

PUMP ASSEMBLY

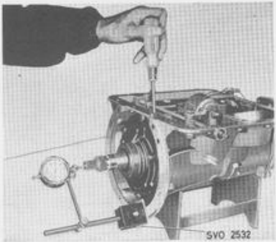
20. Remove the oil tubes in the housing. In case of difficulty pull them out with needle-nose pliers as shown in Fig. 4-95.
21. Set up the dial indicator gauge as shown in Fig. 4-96 with plate 2532 and magnetic attachment. Place the point of the gauge against the shaft end, move the shafts and gears backwards and forwards and read off the end-float. This should be 0.25—0.75 mm (0.010—0.030"). Note the amount of play.
22. Unscrew the six bolts securing the pump to the body. Withdraw the pump and remove the gasket. Push the shaft inwards when withdrawing the pump, see Fig. 4-97.
23. Unscrew the five hexagon bolts and the slotted screw. Separate the pump body, gears and other parts, see Fig. 4-98.



VOLVO
27669

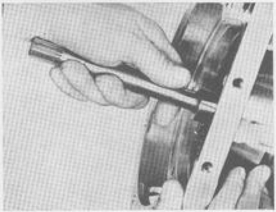
Fig. 4-98. Converter support separated from pump

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



VOLVO
400561

Fig. 4-96. Checking end float



VOLVO
27970

Fig. 4-99. Withdrawing front clutch assembly

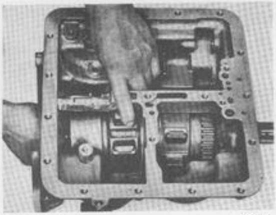


Fig. 4-100. Withdrawing rear clutch and forward sun gear group

FRONT CLUTCH ASSEMBLY

24. Withdraw the front clutch assembly and input shaft complete, see Fig. 4-99. Take care of the thrust washers. Take out the front brake band.
25. Remove the snap ring with a screwdriver. Withdraw the input shaft. Take out the inner and outer plates and the clutch hub.
26. Remove the snap ring, spring, and piston. If the piston is tight, lay the clutch body with the opening downwards on a bench and blow out the piston with compressed air.

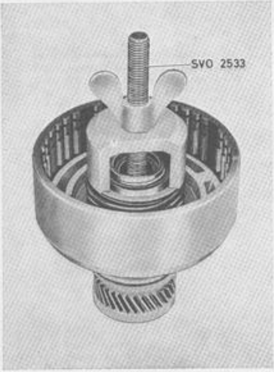


Fig. 4-101. Dismantling rear clutch

REAR CLUTCH ASSEMBLY

27. Withdraw the rear clutch assembly together with the forward sun gear shaft, see Fig. 4-100.
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.
31. Place special tool 2533 on the clutch as shown in Fig. 4-101. Tighten the wing nut until the snap ring releases. Remove the snap ring and screw back the wing nut. Remove the special tool, then the retainer and spring. Withdraw the piston. If necessary blow out the piston with compressed air.

CENTER SUPPORT AND PLANET GEARS

32. From the outside of the transmission case remove the two center support screws, see Fig. 4-102. Withdraw the center support and planet gears, see Fig. 4-103. Take out the rear brake band. Separate the center support, one-way clutch and planet gears. Remove the snap ring and the outer race of the one-way clutch.

GOVERNOR

33. Release the bolt (1) and pull the governor off the shaft, see Fig. 4-104.
34. Press the valve unit together and remove the clip. Remove the various parts.

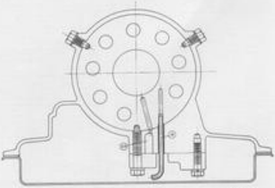
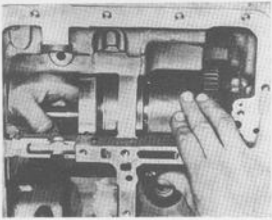
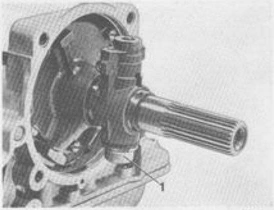


Fig. 4-102. Center support, retention and passages



VOLVO
27963

Fig. 4-103. Withdrawing center support and planet gears



VOLVO

Fig. 4-104. Removing governor
1. Bolt

OIL DEFLECTOR FLANGE

35. Unscrew the five slotted screws. Withdraw the oil deflector flange.
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 all locking clips. Push the manual valve lever in on the shaft and remove the slotted spring pin. Separate the parts. The anchor pin for the parking pawl can be withdrawn with a magnet or shaken out. If the manual valve lever shaft is to be removed, drive the spring pin out of the housing.
39. The throttle cable and other parts in the body are removed as necessary.

INSPECTING

After the cleaning, all parts should be thoroughly checked for wear or 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 that items not described in this section are assembled in the reverse order to disassembling.

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. 4-106. Fitting the detent ball is facilitated by pressing down the ball using a short length of tubing as shown in Fig. 4-105.

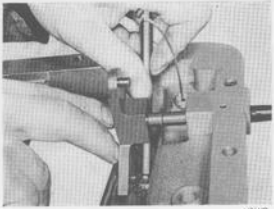


Fig. 4-105. Locating manual valve lever on detent ball spring

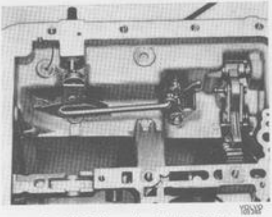


Fig. 4-106. Parking pawl and linkage installed

DRIVEN SHAFT

3. The thrust washers for the driven shaft, see Fig. 4-107, are stuck onto the transmission case with vaseline. The driven shaft complete with ring gears is then installed into the transmission case.

4. Fit the three oil sealing rings on the shaft, see Fig. 4-108. Exercise care when doing this as the oil sealing rings are very fragile. Stand the box on its front end and support under the shaft. Center the oil rings. The oil deflector flange is then fitted.

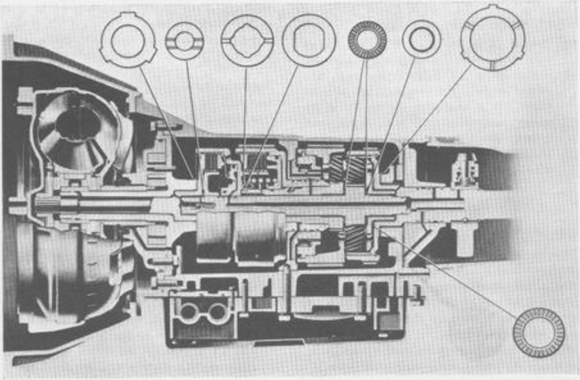


Fig. 4-107. Location of thrust washers

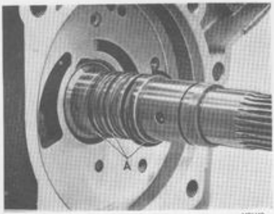


Fig. 4-108. Installing driven shaft oil rings

Fig. 4-110. Governor assembly dismantled

GOVERNOR

5. Push the governor onto the shaft as shown in Fig. 4-111. Make sure that the bolt enters the recess in the shaft. Tighten the bolt to a torque of 20—25 Nm (15—18 lbft). This torque must not be exceeded.
   NOTE. It is not certain that the spring washer will be fully compressed when tightening the bolt.

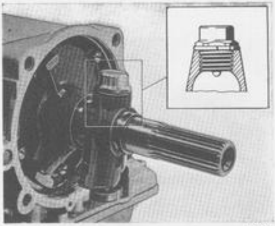


Fig. 4-111. Governor and driven shaft

REAR BRAKE BAND AND SERVO

6. Place the brake band in position in the case, see Fig. 4-112. Then fit the rear servo assembly. Tighten only the rear (short) servo screw since the long one also locates the center support.

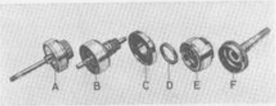


Fig. 4-109. Gear train components

A. Input shaft and front clutch group
B. Rear clutch and forward sun gear group
C. Center support
D. One-way clutch
E. Planet gears and rear drum assembly
F. Driven shaft and ring gear assembly

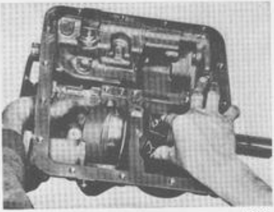


Fig. 4-112. Installing rear brake band

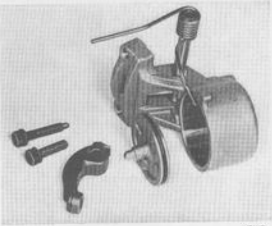


Fig. 4-113. Rear servo assembly dismantled

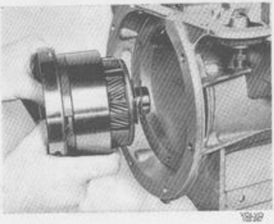


Fig. 4-114. Installing center support and planet gears with needle thrust bearing and plate washer

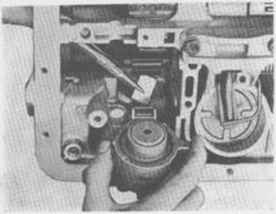


Fig. 4-115. Installing front servo and strut

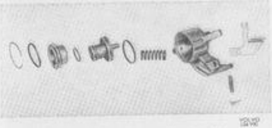


Fig. 4-116. Front servo assembly dismantled

PLANET GEAR AND CENTER SUPPORT

7. Assemble the planet gear, one-way clutch and center support, see Fig. 4-114. Stick the thrust plate and needle thrust bearing to the planet cover with vaseline.
8. Turn the fluid passage holes in the center support upwards and fit the assembled unit into the transmission case. (Note that the holes point downwards when the transmission is turned the right way up, see Fig. 4-102).
9. Fit the two center support screws from outside. Remember that the lock washers also serve as sealing washers so that the flat surface should face inwards. Then tighten the servo screw locating the support.

FRONT BRAKE BAND AND SERVO

10. Place the front brake band in position, see Fig. 4-115. 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-adjusting is fitted later.

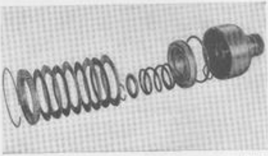


Fig. 4-117. Rear clutch dismantled

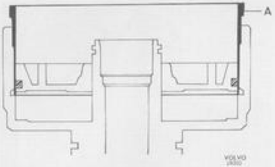
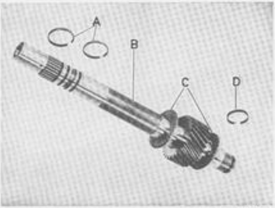


Fig. 4-118. Installing piston for rear clutch
A. Fitting ring 5000

REAR CLUTCH

11. Fit the sealing rings for the piston. Use fitting ring 5000 and fit the piston in the clutch case, see Fig. 4-118.
12. Fit the spring, spring seat and snap spring using special tool 2533, which is used when disassembling, see Fig. 4-101.
13. 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.
14. Place the front needle thrust bearing on the rear sun gear shaft. Fit the shaft in the rear clutch assembly. Install the oil sealing rings, see Fig. 4-119.
15. Install the rear needle thrust bearing and fit the clutch in the transmission as shown in Fig. 4-120.



VOLVO 27972

Fig. 4-119. 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

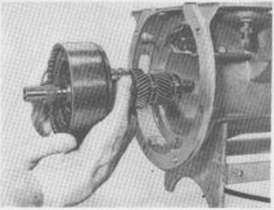


Fig. 4-120. Installing rear clutch and forward sun gear group

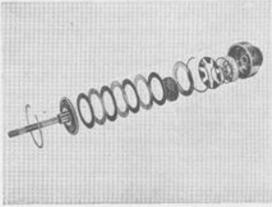


Fig. 4-121. Front clutch dismantled

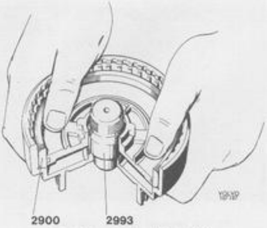


Fig. 4-122. Fitting piston for front clutch

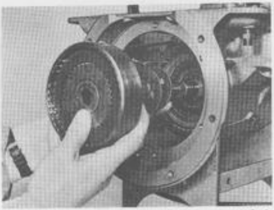


Fig. 4-123. Installation sequence, front clutch cylinder, thrust and backing washers

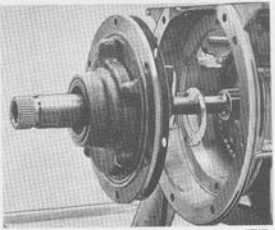


Fig. 4-125. Installation sequence, front pump assembly, thrust washer and gasket

FRONT CLUTCH

16. Place the guide 2993 in the clutch housing (drum). Fit the sealing ring on the piston and a new O-ring in the drum. Place the piston in the fitting ring 2900. Press it down until it is level with the lower edge of the ring. Place the piston over the guide in the clutch housing according to Fig. 4-122. Hold the housing in your hands and push down the piston with the thumbs. Remove the tool. Fit the spring with the dished side facing rear. Fit the snap ring.
17. Install the clutch assembly with its two different thrust washers in the transmission, see Fig. 4-123. Be careful not to damage the oil sealing rings. For identification of the thrust washers, see Fig. 4-107.
18. Fit the pressure plate, inner and outer plates, and hub. Fit the thrust washer for the clutch hub and input shaft into the front clutch, see Fig. 4-124. Fit the snap ring.

The front and rear clutches can also be installed in transmission 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 centered, both the rear thrust washers placed on, and then the rear clutch and sun gear are assembled with the front clutch.

PUMP

19. Fit the O-ring on the pump body, then assemble the pump in the reverse order to disassembling.
20. Stick on the thrust washer with vaseline and then fit the pump with a new gasket on the transmission case, see Fig. 4-125. Re-check the axial play in accordance with point 21, page 4:37.

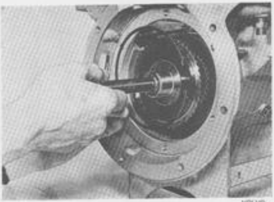


Fig. 4-124. Installation sequence, front clutch snap ring, input shaft and thrust washer

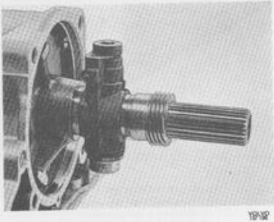


Fig. 4-126. Installing speedometer gear

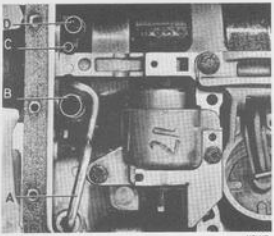


Fig. 4-127. Location of oil tubes, front of transmission

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

EXTENSION HOUSING

21. Place the speedometer gear correctly on the driven shaft as shown in Fig. 4-126. Fit the extension housing with a new gasket and fit the drive flange with washer and nut.

VALVE BODIES ASSEMBLY

22. When assembling, all the component parts which have been dismantled should be thoroughly cleaned and lubricated with oil approved as "Automatic Transmission Fluid, type F" prior to reassembly in the reverse order to disassembling. Line up the component parts of the valve bodies assembly by using two of the retaining bolts. Check the free movement of all valves in their bores. Check that the strain-

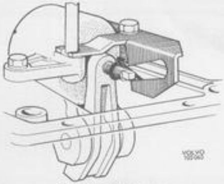


Fig. 4-129. Self-adjusting

er is flat so that it makes a complete seal when screwed down. Tighten the screws to the specified torque.

23. Fit the oil tubes for the pump and converter on the pump body, see Fig. 4-127. Do not forget the O-ring for the pump inlet tube.
24. Fit the valve bodies assembly onto the transmission. Connect the throttle cable.

MISCELLANEOUS

25. Place the spacer block 2537 between the bolt and cylinder, see Fig. 4-128. Tighten the bolt with torque wrench 2748 until the ratchet handle clicks out. This corresponds to a torque of 115 Nm (10 lbin)
26. Adjust the position of the spring on the adjusting screw. It should be 1—2 threads from the lever. Remove the torque wrench and spacer block and then fit the cam. Insert the longer end of the spring in the cam, see Fig. 4-129.
27. Fit the four oil tubes according to Fig. 4-130. NOTE. The oil tube for releasing the front con-

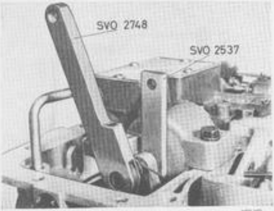


Fig. 4-128. Adjusting front brake band

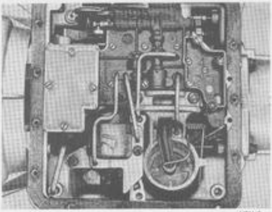


Fig. 4-130. Retention of pump strainer

Fig. 4-131. Oil tube with constriction

trol cylinder is provided with a constriction (A, Fig. 4-131) on vehicles with the B 20 E and B 20 F engine. This end is fitted in the control system.

28. Adjust the rear brake band, see "Adjusting the rear brake band" on page 4:32. Fit the starter inhibitor switch, see "Replacing starter inhibitor switch" on page 4:32.
29. Place the magnetic piece in the oil pan. Fit the oil pan with a new gasket.

INSTALLING

The converter, converter housing and transmission are installed in the reverse order to removing. Connect correctly the leads for the starter inhibitor switch, reversing light and seat reminder, see Fig. 4-132.

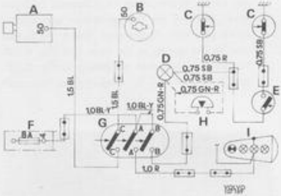


Fig. 4-132. Wiring diagram

A Starter motor
B Ignition
C Contact for seat belt
D Reminder lamp for seat belt
E Contact in passenger seat
F Fusebox
G Contact on gearbox
H Reminder buzzer for seat belt (certain markets)
I Reversing lights

Colour code:
BL = blue
BL-Y = blue-yellow
GN-R = green-red
R = red
SB = black

SELECTOR CONTROLS

REMOVING AND DISASSEMBLING

1. Set the selector control in position "P". Prop up under the vehicle. Remove the shift rod from the selector lever on the selector lever housing.
2. With help of a knife pry up at the front edge the cap on the selector lever knob and remove it. Press down the spring washer and push the button forwards so that it releases from the thrust rod. Remove the washer and spring and pull up the lower part of the selector lever knob.
3. Unscrew the retaining screws and lift off the gear positions console. Take out the socket for the console lamp. Remove the selector lever housing screws and lift up the selector lever housing.
4. Release the nut and remove the lever. Remove the screws and take the cover off the selector lever housing.
5. Knock up the tubular studs. Remove the push rod and inhibitor. Drive out the shaft. Release the screws from the gating. Drive out the bushes from the bracket.

INSPECTING

Check the various parts, especially for wear. Replace worn bushes, link rods, etc.

ASSEMBLING AND FITTING

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.

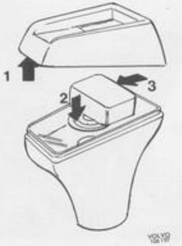


Fig. 4-133. Disassembling knob

3. Fit the push rod and inhibitor. Drive in the tubular stud. Assemble the selector lever housing and gear 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 gear positions console lamp should be connected to one of the screws. Fit the lamp socket and then the console for the gear positions.
6. Fit the lower part of the selector lever knob. Put on the washer and spring. Press down the washer and fit the button. Snap the selector lever knob cap into position. Set the selector lever to position "P".
7. If the shift rod has been disassembled, its length should be just 405 mm (16 inches) from the center for the bolts. Grease the bushes and then connect the shift rod to the levers. Make sure that the lock on the shift rod comes on the inside of the lever on the selector lever housing.
8. Check the clearance for the selector gating in positions "D" and "2". The clearance (A and B, Fig. 4-80) should be the same in both shift positions or somewhat greater in position "D". (Min. 1 mm = 0.04"). Adjust if necessary. Check that there is still the same clearance after the selector lever has been shifted to positions "1" and "P". Also check that the output shaft is locked with the lever in position "P".
9. Lower the vehicle.

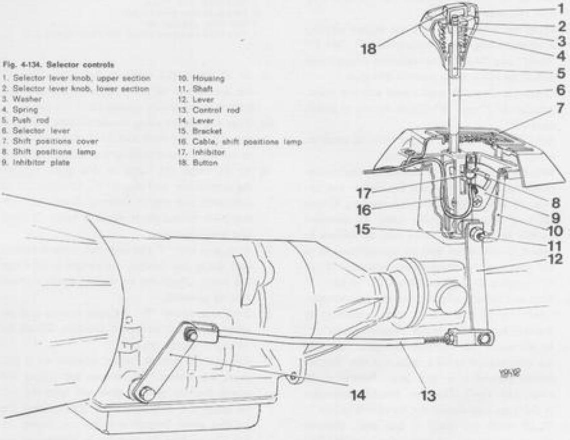


Fig. 4-134. Selector controls

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 cover
8. Shift positions lamp
9. Inhibitor plate
10. Housing
11. Shaft
12. Lever
13. Control rod
14. Lever
15. Bracket
16. Cable, shift positions lamp
17. Inhibitor
18. Button

FAULT TRACING

ROAD-TESTING

(Used together with the fault-tracing scheme.)
It is important to gain as much information as possible on 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.

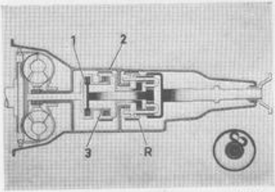
TEST NO.

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", "N—1" and "N—R". Transmission engagement should be felt in each position selected.
3. Check the converter stall speed with the transmission in "1" and "R". Check for slip or clutch squawk.
   Note. Do not stall for longer than 10 seconds or the transmission will overheat.
4. With the transmission at normal running temperature, select "D". Release the brakes and accelerate with minimum throttle opening. Check for 1—2 and 2—3 shifts. Note. At minimum throttle openings, the shifts may be difficult to detect. Confirmation that the transmission is in 3rd gear may be obtained by selecting "2" or "1", when a 3—2 downshift should be felt.

5a. Stop and restart using full throttle acceleration. Check for 1—2 and 2—3 shifts according to the shift speed table in the "Specifications".

b. At 40 kmph (25 mph) in 3rd gear, depress the acceleration to full throttle position. The car should downshift to 2nd gear. Repeat at 65 kmph (40 mph). The car should accelerate in 3rd gear and should not downshift to 2nd.

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



VOLVO
27977

Fig. 4-135. Principle diagram for fault tracing

1. Front clutch gives 1st gear
2. Front brake band gives 2nd gear
3. Rear clutch gives 3rd gear

R. Rear brake band gives reverse and engine braking in "L"

d. At 25 kmph (15 mph) in 3rd gear, depress the accelerator to the kick-down position. The transmission should downshift to 1st gear.

6a. Stop and restart using forced throttle acceleration. Check for 1—2 and 2—3 shifts according to the shift speed table in the "Specifications".

b. At 65 kmph (40 mph) in 3rd gear, release the accelerator and select "1". Check for 3—2 downshift and engine braking. Check for roll-out 2—1 downshift at about 8 kmph (5 mph) and engine braking.

7. Stop, and with "1" still engaged, release brakes and, using full throttle, accelerate to 30 kmph (20 mph). Check for no slip or clutch squawk and no upshifts.
8. Stop and select "R". Release brakes and reverse using full throttle if possible. Check for no slip or clutch squawk.
9. Stop on the brakes, facing downhill 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".

TEST	ACTION	FAULT
1.	Starter will not operate in "P" or "N"	19
	Starter operates in all selector positions	20
2.	Excessive bump on engagement of "D", "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 rpm 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", and 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" an "D 3"	8
	Drag on 2—3 shift	5, 6
5a.	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
6a.	As test 6a above	
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-cell-aneous	Screech or whine, increasing with engine speed	17
	Grinding or grating noise from transmission	18
	Knocking noise from torque converter area	23
	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 iding 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 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 outwards.
20. Adjust starter inhibitor switch inwards.
21. Replace torque converter.
22. Examine torque converter drive plate for cracks or fracture.

FAULT TRACING ON THE CONVERTER

The converter housing is welded together and cannot therefore be repaired but must be replaced in the event of defects. There is no drain plug since fluid changes do not occur and fluid filling is done through the transmission.

The stall speed means the speed obtained at full throttle on the engine with the lock-up engaged but with the car stationary. Check that the transmission has the correct running temperature and that the fluid level is correct before the stall speed test. The test must not take place longer than ten seconds, otherwise the transmission will overheat.

Fault-tracing on the converter is carried out as follows:

1. If the general performance of the vehicle is below standard, check the converter stall speed with an accurate tachometer by applying maximum pressure on the footbrake pedal, selecting "Lock-up" and fully depressing the accelerator. If the stall speed is up to 5 r/s (300 r/m) below that specified, the engine is not developing its full power.
2. Inability to start on steep gradients combined with poor acceleration from rest indicates that the converter stator one-way clutch is slipping or that the stator support is fractured. This condition permits the stator to rotate in an opposite direction to the turbine and torque multiplication cannot occur. Check the stall speed and, if it is more than 10 r/s (600 r/m) below that specified, the converter assembly must be replaced.
3. Below standard acceleration in 3rd gear above 50 kmph (30 mph) combined with a substantially reduced maximum speed, indicates that the stator one-way clutch has locked in the engaged condition. The stator will then not rotate with the turbine and impeller, therefore the fluid flywheel phase of the converter performance cannot occur. This condition will also be indicated by excessive overheating of the transmission, although the stall speed will remain as specified. In this case the converter assembly must be replaced.
4. Stall speed which is higher than that specified, indicates that the converter is not receiving its required fluid supply or that the clutches of the automatic transmission are slipping.

PROPELLER SHAFT

DESCRIPTION

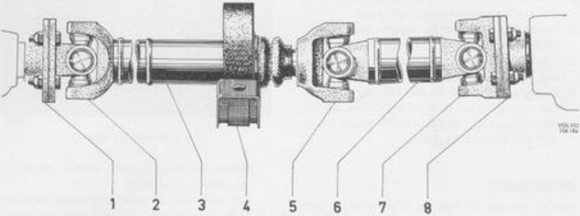


Fig. 4-136. Proppeller shaft with support bearing

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. 4-136. 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 fitted in a rubber bearing housing, which is attached to the propeller shaft tunnel with a cover, see Fig. 4-137. The propeller shaft is fitted with three universal joints. Each joint consists of a spider with four ground trunnions which are carried in flange yokes by means of needle bearings.

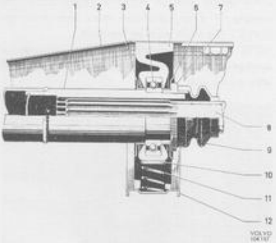


Fig. 4-137. Support bearing

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

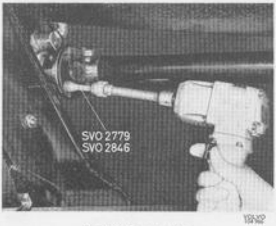


Fig. 4-138. Removing bolts

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 complete support bearing.
3. Press the old bearing out of the rubber housing. Fit in the new bearing.
4. Fit the support bearing and the other parts in the reverse order to removing. If the splined joint appears dry, lubricate it with grease mixed with molybdenum disulphide.

REMOVING

Jack up the car. Slacken the propeller shaft from the gearbox and rear axle flanges. The bolts can be loosened by an air impact wrench and special socket 2779 for cars fitted with B 20 A, B and F and 2846 for cars fitted with B 20 E, see Fig. 4-138. Loosen the cover for the support bearing and take down the complete propeller shaft.

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. Take the support bearing out of the housing.

DISASSEMBLING UNIVERSAL JOINTS

1. Remove the snap rings which secure the needle bearings in the yokes, see Fig. 4-139.
2. Secure the shaft in a vice so that the universal joint comes as near as possible to the vice jaws.

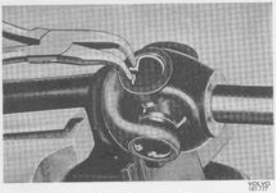


Fig. 4-139. Removing snap ring

Fig. 4-140. Removing spider, I

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. 4-140.
5. Drive out one of the needle bearings with a thin metal punch. Remove the spider. See Fig. 4-141. 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, inspection must be carried out very carefully. The shaft should be set up between centers and checked along its entire length with an indicator gauge while it is rotating. If it is out-of-true more than 0.25 mm (0.010"), the shaft must be replaced.

NOTE. No attempt should be made to straighten a damaged propeller shaft — it should be replaced with a new one.

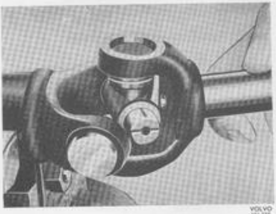


Fig. 4-141. Removing spider, II

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. During possible fitting of 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.
2. Insert the spider in the flange yoke. Push over the spider in one direction so far that the needle bearing can be fitted onto the trunnion, see Fig. 4-142. Then press in the needle bearing so far that the snap ring can be fitted. Use a drift with a diameter slightly less than that of the needle bearing sleeve.

Fig. 4-142. Fitting spider

3. Fit the other needle bearing and snap ring in the same way. Also the fitting of the spider in the other yoke should be carried out in the same way as described in the previous paragraph.

INSTALLING

Installing is in reverse order to removing.

GROUP 46

REAR AXLE

TOOLS

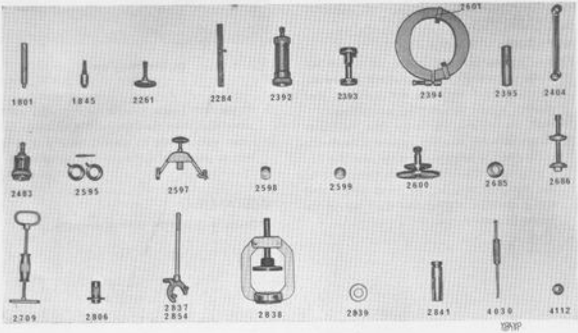


Fig. 4-143. Special tools for rear axle

999 (SVO)	
1801	Standard handle 18×200 mm
1845	Press tool for fitting flange
2261	Puller for flange
2284	Retainer for dial indicator for final drive adjustment
2392	Puller for rear pinion bearing
2393	Measuring tool for adjustment of pinion
2394	Expander tool used for removing and fitting differential
2395	Sleeve for fitting inner ring rear pinion bearing
2404	Tool for fitting front pinion bearing
2483	Puller for differential carrier bearings
2520	Stand (Fig. 4-144)
2522	Fixture for rear axle (used together with stand 2520 for work on the final drive) (Fig. 4-144)
2595	Adjusting rings for differential
2597	Brake for crown wheel, used when checking tooth contact
2598	Drift for removing outer ring, rear pinion bearing
2599	Drift for removing outer ring, front pinion bearing

999 (SVO)	
2600	Measuring fixture for adjusting rings
2601	Holder for expander tool 2394 (fitted on tool)
2685	Adjusting ring for pinion
2686	Press tool for fitting outer rings, pinion bearing
2709	Puller for drive shaft
2714	Fixture for rear axle, used on garage jack for removing and fitting rear axle, see Fig. 4-182
2806	Tool for fitting oil seal at flange
2837	Counterhold for flange (cars fitted with B 20 E)
2838	Press tool for removing and fitting bearing and ring on drive shaft lock
2839	Ring for fitting bearing and lock ring on drive shaft. Used together with 2838
2841	Spanner for adjustment ring 2685
2854	Counterhold for flange (cars fitted with B 20 A, B and F)
4030	Puller for oil seal at flange
4112	Drift for fitting differential carrier bearings

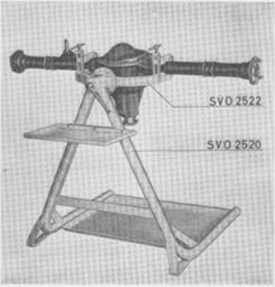


Fig. 4-144. Stand and fixture for rear axle

DESCRIPTION

The rear axle is carried in two support arms. The support arms are provided with a couple of robust bushes and are attached to the body. The rear axle housing is attached to the support arms with levers. In order to take up the rear axle torque, there are two torque rods attached to the drive shaft tubular covers and to the body. A track bar prevents the body and rear axle from moving sideways in relation to each other. The principle of the rear axle suspension is shown in Fig. 4-183. The design of the rear axle is shown in illustration 4 E.

The final drive is of the hypoid type, that is to say, the drive pinion lies below the center of the crown wheel. It consists of the drive pinion, 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 attached to the differential carrier by means of bolts. 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 bearing.

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. 4-145. There is an oil seal in the outside of the drive shaft bearings.

WORK ON REAR AXLE IN VEHICLE

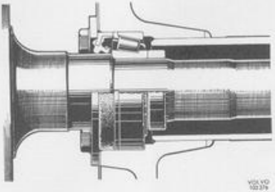


Fig. 4-145. Drive shaft journalling

REPLACING BEARINGS AND DRIVE SHAFT OIL SEALS

1. Jack up the vehicle and place props under the rear axle. Remove the wheels.
2. Disconnect the brake pipe from the brake caliper. Slacken the bolts for the brake disc and remove the disc.
3. Slacken the bolts for the thrust washer. These are slackened through the holes in the drive shaft flange. Pull out the drive shaft with puller 2709, see Fig. 4-146.
4. Secure press tool 2838 in a vice. Secure the drive shaft to the spindle plate. Screw in the spindle so that the tool arms can be placed against the bearing, see Fig. 4-147. Screw out the spindle and press off the bearing and lock ring. Remove the oil seal.

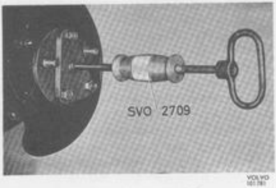


Fig. 4-146. Removing drive shaft

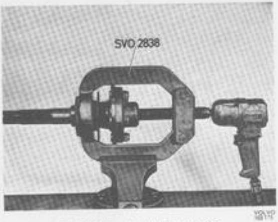


Fig. 4-147. Removing drive shaft bearing

5. Fill the space between the lips on the new seal with grease. Then place the seal on the drive shaft. Fit the bearing and lock ring. Turn the bearing correctly, see Fig. 4-145.
   NOTE. Always use a new lock ring.
   Place fitting ring 2839 against the bearing and the lock ring. Close the tool arms and lock them round the fitting ring, see Fig. 4-148. 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 50 Nm (36 lbft). Fit the brake disc and brake caliper. Connect the brake line. Bleed and adjust the brakes, see Part 5.
7. Fit on the wheels and wheel nuts. Lower the vehicle. Tighten the wheel nuts.

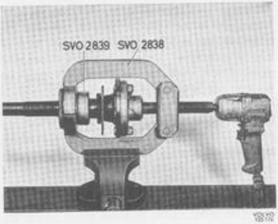


Fig. 4-148. Fitting drive bearing

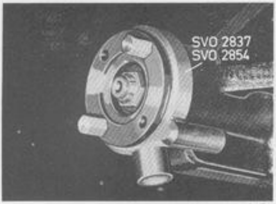


Fig. 4-149. Counterhold for flange

REPLACING PINION OIL SEAL

1. Disconnct the rear section of the propeller shaft from the flange on the pinion. Check for looseness of the pinion in its bearing. If it is loose, this must be remedied before a new oil seal is fitted. See the instructions under the heading "Assembling".
2. Remove the nut for the flange. For this purpose, use tool 2854 as a counterhold for cars fitted with B 20 A, B and F and 2837 for cars fitted with B 20 E, see Fig. 4-149. Pull off the flange with puller 2261, see Fig. 4-150. Pull out the old oil seal with puller 4030, see Fig. 4-151.
3. Coat the seal lips of the new ring with grease. Lubricate also the spring coil so that it does not jump off during fitting. Then fit the oil seal with 2806, see Fig. 4-152.

Fig. 4-150. Removing flange

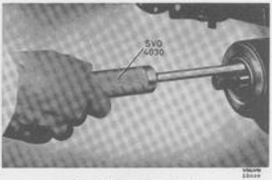


Fig. 4-151. Removing oil seal

4. Press on the flange with the help of press tool 1845, see Fig. 4-153. Fit the washer and nut. Tighten the nut to a tightening torque of 280—300 Nm (200—220 lbft).

REMOVING

1. Place blocks in front of the front wheels. Loosen the rear wheel nuts. Place fixture 2714 on a garage jack and lift up the rear end with this. Compare with Fig. 4-182. Place props in front of the rear jack attachments, see Fig. 4-154, and then lower the jack slightly. Note that the props must not be placed at a point further than the dash line indicated in the figure. Remove the rear wheels.

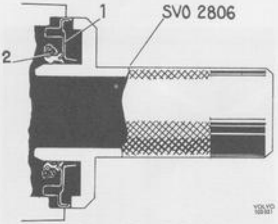


Fig. 4-152. Fitting oil seal
1. Pinion oil seal
2. Spring coil with grease

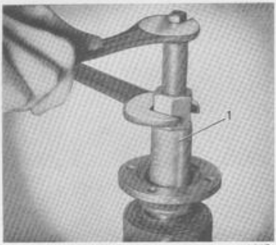


Fig. 4-153. Fitting flange
1. Press tool 1845

2. Loosen the upper attaching bolts for the shock absorbers. Disconnect the parking brake wires from the levers and brackets on the brake backing plate. Use a spring fixture for this purpose, see Part 5.
3. Loosen the propeller shaft 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 spring.

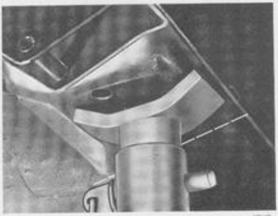


Fig. 4-154. Locating rear axle prop

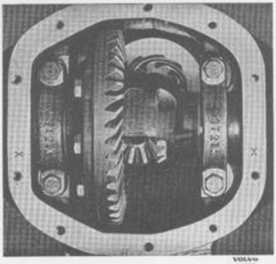


Fig. 4-155. Alignment marking on cap and carrier

5. Lower the jack until the support arms release from the spring. Slacken the bolts holding the rear axle casing to the support arms. Lower the jack and pull the rear axle forwards.

DISASSEMBLING

1. Place the rear axle in fixture 2522. The rear axle is placed with the underside of the final drive facing inwards to the fixture support, when the pinion is pointing downwards. Remove the brake pipes.
2. Slacken the bolts for the brake backing plates and brake shoe retainer. They are slackened through the holes in the drive shaft flanges.

Fig. 4-156. Expanding drive pinion carrier

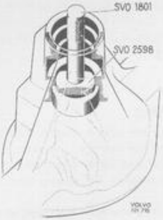


Fig. 4-157. Removing rear pinion bearing race

Pull out the drive shafts with puller 2709, see Fig. 4-146.

3. Remove the inspection cover.
4. If the final drive is being reconditioned because of noise, the contact pattern should be checked before disassembling takes place, as this might assist in locating the fault. Before doing this, clean the teeth so that no misleading contact pattern is obtained.
5. Check the alignment markings on the cap and carrier, see Fig. 4-155. If there are no markings, or if they are difficult to see, mark one side with a punch. Remove the cap.
6. Fit tool 2394 in the holes in the drive pinion carrier as shown in Fig. 4-156. Fit the tool with retainers 2601. Tension the tool until it fits exactly in the holes in the carrier. Then tension the bolt a further 3—3½ turns. Lift out the differential carrier with crown wheel. Tool 2337 can be used for this purpose.
7. Turn the final drive and let the oil run out into a container. Remove the nut for the flange. Use for this purpose tool 2837 resp. 2854 as a counterhold. Pull off the flange with puller 2261, see Fig. 4-150. Press out the pinion.
8. Drive out the front pinion bearing, the washer and the oil seal with standard handle 1801 and drift 2599.
9. If necessary, drive the rear bearing out of position, see Fig. 4-157. Use standard handle 1801 and drift 2598.
10. Clean the gasket surface. File off all burr on the surface on which the indicator retainer 2284 will slide.
11. If necessary, pull off the rear bearing from the pinion with puller 2392, see Fig. 4-158. The puller is fitted in the following way:
    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. Knock out the lock ring with a hammer. See also Fig. 4-159.

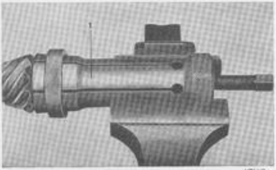


Fig. 4-158. Removing rear pinion bearing
1. Puller 2392

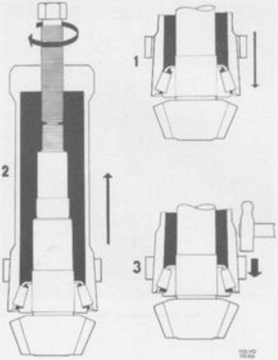


Fig. 4-159. Fitting puller

Fig. 4-160. Removing lock pin

DISASSEMBLING DIFFERENTIAL

1. Loosen the ring gear bolts and remove the crown wheel.
2. Drive out the lock pin, see Fig. 4-160, and then the shaft for the differential gears. Take out the block, the differential gears and the thrust washers.

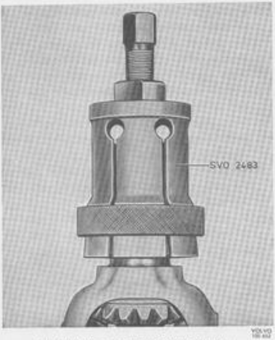


Fig. 4-161. Removing differential carrier bearings

3. Pull off the differential carrier bearings with puller 2483, see Fig. 4-161. Do not loosen the shims. Concerning the fitting of the puller, see also Fig. 4-159.

INSPECTING

First clean all the parts thoroughly. Check all the bearing races and bearings. The races, rollers or roller retainers must not be scratched or damaged. All damaged bearings and bearing races must be replaced.

Check both the pinion drive and crown wheel carefully for damage to the teeth. The most common damage is from seizing gear teeth, see Figs. 4-162 and 4-163. This is caused by incorrect running-in, wrong oil, insufficient tooth flank clearance or faulty tooth contact. If the cause of the seizing is not remedied at an early stage, the whole 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 avaliable in nine thicknesses from 0.74 mm (0.029") to 0.98 mm (0.039") with 0.04 mm (0.0016") difference between each.

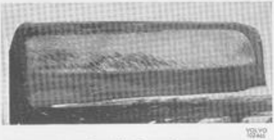


Fig. 4-162. Gear seizing

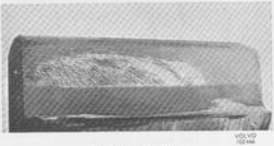


Fig. 4-163. Gear seizing

Fig. 4-164. Fitting differential gear

Also check to see whether the cylindrical part of the flange which goes into the oil seal is worn or scratched. If so, 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 deformed.

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

Make sure that there are no cracks in the rear axle casing. Check that the brackets for the support arms and track rod are intact.

ASSEMBLING

The greatest cleanliness should be observed when assembling and adjusting final drives. Dirt in a tapered roller bearing can result in completely inaccurate measurement values.

On measuring the bearing clearance or pre-loading, the bearing should be oiled and rotated several turns loaded.

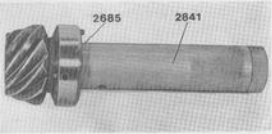


Fig. 4-165. Adjusting ring and tool for pinion location

ASSEMBLING DIFFERENTIAL

1. Place the differential side gears and the thrust washers in the differential carrier. Then "roll" in the differential pinions both simultaneously with the dished thrust washers, see Fig. 4-164. Drive in the shaft.
2. Check the differential unit. If the gear play has not been measured, check it according to the instructions given under the heading "Inspecting". If oversize washers are fitted, this play can be checked by turning the gears one turn. The requisite torque should not exceed 10 Nm (7.0 lbft). The tool for making this check can be easily made from a shortened drive shaft which is adapted to a suitable torque wrench. After the checking and any replacement of the thrust washers, fit the lock pin.
3. Fit the crown wheel. Make sure that the contact surfaces are clean and without burr. Place washers under the bolts. Tighten the bolts. The tightening torque is 65—90 Nm (45—60 lbft).
   NOTE. Always use new bolts for those gears where the bolts are locked only by means of friction in the thread and the contact surface of the screw head. To achieve the effect intended, the bolts are tightened to their limit. A certain permanent elasticity is thereby obtained in the bolt which becomes distorted if further tightening is attempted.

INSTALLING PINION

1. Clean the marking surface on the pinion with extremely fine emery cloth. Fit the adjusting ring 2685 and tool 2841 (or 2684) on the pinion, see

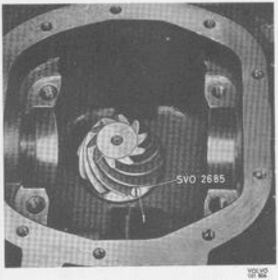


Fig. 4.166. Locating pinion with adjusting tool
1. Lock screw

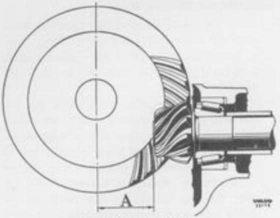


Fig. 4-167. Pinion location
A Nominal measurement=2.55"

Fig. 4-165. Place the pinion in the carrier so that the bolt on the adjusting ring faces the large side of the carrier, see Fig. 4-166.

2. The pinion should have a certain nominal measurement (A, Fig. 4-167) 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. Here there is an important difference between Volvo-manufactured and other types of rear axles.
   On final drive units made by Volvo, the surface is generally ground down 0.3 mm (0.012") so that the deviation is always indicated by plus tolerance and in hundredths of a millimetre. The plus sign is excluded. On other final drive units, the deviation is indicated in thousandths of an inch and with plus or minus sign. If there is a plus sign in front of the figure, the nominal measurement is to be increased and, in the case of a minus sign, the nominal measurement is to be decreased.
   To check the location of the pinion, use a dial indicator, indicator retainer 2284 and a measuring tool 2393, which consists of two parts: a pinion gauge and an adjuster fixture.
   The check is carried out in the following way: Place the pinion on the ground surface of the

Conversion table, inches to millimeters

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

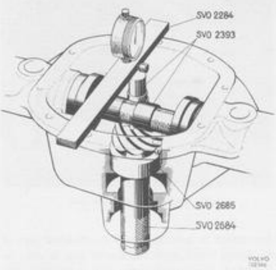
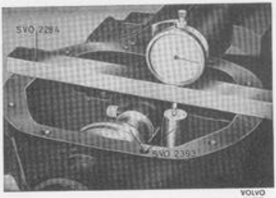


Fig. 4-168. Locating measuring tools

VOLVO 24536

Fig. 4-169. Zero-setting indicator



VOLVO 24537

Fig. 4-170. Measuring pinion location

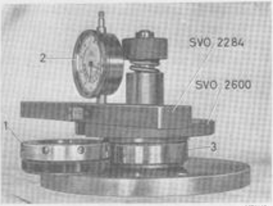


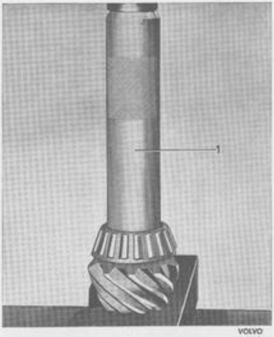
Fig. 4-171. Determining shim thickness
1. Adjusting ring 2. Dial indicator 3. Bearing complete

pinion and the adjusting jig in the differential bearing position as shown in Fig. 4-168. Place the indicator retainer on the drive pinion carrier and zero-set the gauge against the adjusting jig, see Fig. 4-169. Then move the indicator retainer over so that the indicator comes against the pinion gauges, see Fig. 4-170.

If a Volvo final drive unit is fitted and the pinion is, for example, marked 33, the pinion gauge should lie 0.33 mm (0.013") under the adjuster fixture. Concerning the other final drive units, if the pinion is marked O, the adjuster fixture and pinion gauge should be at the same height; if the pinion is marked —, the pinion gauge should be higher than the adjuster fixture; and if it is marked +, the pinion gauge should be lower than the adjuster fixture with correct setting. The setting is adjusted by turning the cam on the pinion until the gauge dial shows the correct value. Then lock the adjusting ring with the lock screw. Remove the measuring tool and pinion.

Fig. 4-172. Measuring shims

3. Place the complete rear pinion bearing with the outer ring in measuring fixture 2600. Put on the plate, spring and nut. Turn the nut with the flat side facing upwards. The plate, and thereby the bearing, is turned forwards and backwards several times so that the rollers take up the correct position. Place the adjusting ring in the measuring fixture as shown in Fig. 4-171. Use retainer 2284 and dial indicator and 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 at once the thickness the shims should have. Measure shims for the correct thickness with a micrometer, see Fig. 4-172. NOTE. It is almost impossible to obtain a shim with exactly the correct thickness. However, they must not be 0.03 mm (0.0012") thicker than the measured value, but up to 0.05 mm (0.002") thinner.
4. Press the rear bearing on the pinion with sleeve 2395, see Fig. 4-173. NOTE. The washer under the rear bearing inner ring on a Volvo final drive must **not** be fitted when reconditioning. Place on the measured shims and press in both the outer rings of the bearings with tool 2686, see Fig. 4-174.
5. Insert the pinion in the casing and fit on three 0.75 mm (0.03") thick shims and the front pinion bearing. Fit tool 2404 and press tool 1845 on the front end of the pinion and pull in the pinion,



VOLVO
23528

Fig. 4-173. Fitting rear pinion bearing
1. Sleeve 2395

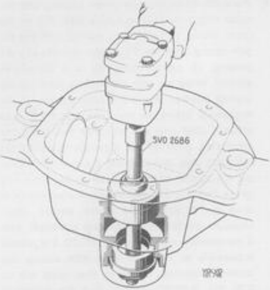


Fig. 4-174. Fitting bearing races

see Fig. 4-175. Use the nut tightener until it presses the pinion forwards so that it does not strike the bearing positions.

6. Replace press tool 1845 with washer and nut. Tighten the nut to a tightening torque of 280—300 Nm (200—220 lbft). Fit on the pinion gauge and the dial indicator retainer. Pull down the pinion while turning it forwards and backwards at the same time. Zero-set the indicator. Then press the pinion upwards, turning it at the same time forwards and backwards. Read off the clearance.

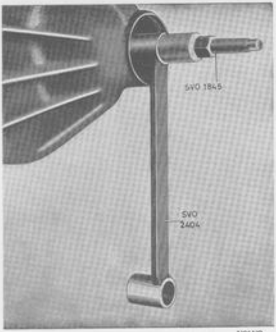


Fig. 4-175. Fitting pinion

7. Remove the pinion. Remove the shims corresponding to the measured clearance + 0.07 mm (0.003"). Fit on the pinion.
8. Then check the pinion bearing fit with the torque gauge. The torque gauge should show 60—110 Ncm (5.20—9.55 lbin) for used bearings, and 110—230 Ncm (9.55—20 lbin) for new bearings when the pinion rotates. On new final drive units, stresses can be higher due to another type of installation method. In other words, there is no fault.
   Often an alteration in the thickness of the shims is required because of the tolerances which must be present.
9. Check the location of the pinion with the dial indicator, retainer 2284 and measuring tool 2393, see also point 2.

INSTALLING DIFFERENTIAL

1. Lubricate the inside of the adjusting rings 2595 and put them on the differential carrier. The ring with the black-oxidized adjusting ring should be placed on the crown wheel side. Also lubricate the bearing location in the carrier. Place the differential carrier and the adjusting rings in the final drive housing, see Fig. 4-176. Use the dial indicator and adjust in the rings so that the correct backlash 0.15 mm (0.006") is obtained. The tooth flank clearance may vary between 0.13 mm (0.005") and 0.20 mm (0.008"), but should be kept as near 0.15 mm (0.006") as possible. Tighten the lock screws in the adjusting rings.
2. Fit on brake tool 2597 as shown in Fig. 4-177. Mark with colour several teeth at three points on the crown wheel. This can act as a check for possible crown wheel warping. Rotate the pinion 10—12 turns in both directions and check the contact marking pattern. At the correct tooth contact, the contact marking pattern should

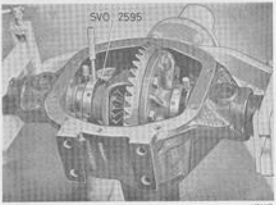


Fig. 4-176. Adjusting rings for differential

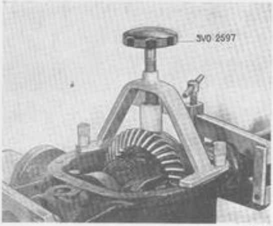


Fig. 4-177. Brake tool for differential

be horizontal in the middle of the tooth but somewhat nearer to the toe than the heel. The pattern on the reverse side and driving side should coincide with each other. See Fig. 4-178. If the patterns do not coincide, the location of the pinion must be adjusted before assembling is continued. If the patterns lie too far towards the heel on the driving side and too far towards the toe on the reverse side, see Fig. 4-179, the pinion should be moved inwards.

If the contact patterns lie too far towards the toe on the driving side and too far towards the heel on the reverse side, see Fig. 4-180, 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 fitted.

3. When the correct backlash and contact pattern are obtained, remove the differential and adjusting ring. Then place the center washer on the measuring fixture. Fit a bearing into the measuring fixture, likewise the plate, spring and nut. Fit the nut, with the flat side facing downwards. Rotate the plate forwards and backwards several times. Put on the dial indicator and retainer 2284. Zero-set the indicator to the adjusting ring and then place the measuring point facing the bearing, see Fig. 4-171. Read off the indicator. With a micrometer measure the shims, the total thickness of which corresponds to the read-off value + 0.07 mm (0.003"). Place the shims together with the measured bearing to the one side. Repeat the above procedure with the other bearing.

   NOTE. Make sure which side the respective bearing and shims are to be fitted on.

4. Fit the shims on the differential carrier and press on the bearings. For this purpose use drift

Fig. 4-178. Correct tooth contact

Fig. 4-179. Faulty tooth contact

Fig. 4-180. Faulty tooth contact

Fig. 4-181. Fitting differential bearings

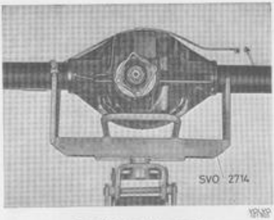


Fig. 4-182. Fixture for rear axle

4112, see Fig. 4-181. When fitting the second bearing, use drift 2599 as a cushioning ring so as not to damage the first bearing already pressed on.

5. Fit tool 2394 on the drive pinion carrier, see Fig. 4-156. Expand the tool until the pins are exactly flush against the hole edges in the carrier and then tighten the screws a further 3—3½ turns. Fit the differential and outer rings. Remove tool 2394. Fit the cap and tighten the bolts to a torque of 50—70 Nm (36—50 lbft).
6. Check the backlash and the contact marking patterns.

ASSEMBLING REAR AXLE

1. Remove spanner 2404. Fit the oil slinger. Smear the oil seal lips with grease. Lubricate the spring coil also with grease to prevent it from jumping out during fitting. Then fit the oil seal with drift 2806. Press on the flange with the help of tool 1845, see Fig. 4-153. Fit the washer and nut. Tighten the nut to a tightening torque of 280—300 Nm (200—220 lbft).
2. Fit the inspection cover and gasket.
3. Fit the drive shaft. Tighten the bolts for the thrust washers to a torque of 50 Nm (36 lbft). Grease the bearings.
4. Then fit the brake discs and brake caliper. Finally fit the brake pipes.

INSTALLING REAR AXLE

1. Place the rear axle on fixture 2714, which is mounted on a garage jack, see Fig. 4-182. 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 at the same level with the attachment on the body. Fit the track rod.
3. Fit the attaching bolts for the spring. Tighten the nuts for the torque rods and support arms.
4. Fit bracket, union and brake hoses. Fit the universal joint to the flange.
5. Fit the upper bolt for the shock absorbers. Fit the parking brake wire in the brackets and at the levers. Adjust the parking brake and bleed the brake, see Part 5.
6. Fit on the wheels and wheel nuts. Lower the vehicle. Tighten the wheel nuts to a tightening torque of 100—140 Nm (70—100 lbft).
   Fill with oil. Use only hypoid oil.

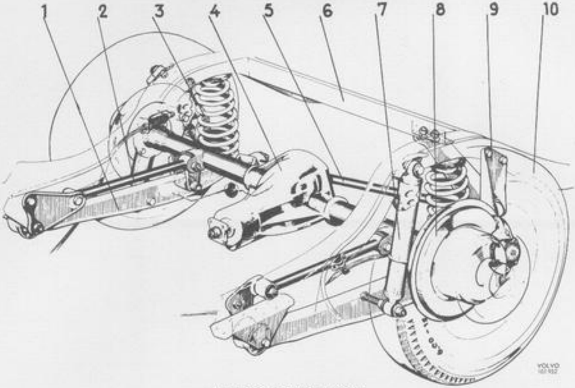


Fig. 4-183. Rear axle with suspension

1. Support arm
2. Torque rod
3. Spring
4. Rear axle
5. Track rod
6. Member system in body
7. Shock absorber
8. Disc brake
9. Bracket for track rod
10. Wheel

	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	Y	Z
Engagement of "R", "D", "2" or "I"																																
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	—	—	—	—	6	—	3	4	—	—	—	—	9	—	—	8	—	—	—	—	—	—	—
Seizure reverse	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—
No neutral	—	—	1	—	2	—	8	9	3	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—
Upshifts																																
No 1—2	—	—	1	—	2	—	8	9	10	—	—	6	7	3	—	3	—	—	—	—	—	—	—	5	—	—	—	—	—	—	—	—
No 2—3						—	8	9	10	—	—	6	7	2	—	—	3	4	—	—	—	5	—	—	—	—	—	—	—	—	—	—
Above normal shift speeds	—	—	1	—	—	—	—	8	9	10	—	2	1	3	—	4	5	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Below normal shift speeds	—	—	1	—	—	—	—	5	6	—	—	2	—	3	—	—	—	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Upshifts 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	—											—	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	—	—	—	—	—	—	6	8	7	3	—	5	4	9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	—	—
High at stall	—	—	—	—	—	—	—	—	4	1	—	2	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Stall speed																																
More than 10 r/s (600 r/m) below nominal speed						—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Over 2500	1	—	2	—	—	3	4	5	6	7	—	—	—	—	—	—	—	—	—	8	—	9	—	—	70	11	—	12	—	—	—	13
Overheating	1	—	—	—	2	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4

The numbers indicate the recommended sequence of fault investigation

FAULT INVESTIGATION KEY

Preliminary adjustment faults

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

Hydraulic control faults

a. Oil tubes missing or not installed correctly.
b. Sealing rings missing or broken.
c. Valve bodies 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 plate 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. Front pump drive fingers on converter hub broken.
X. Front pump worn.
Z. Converter blading and/or one-way clutch fails.

QUICK-REFERENCE FAULT-TRACING CHART FOR AUTOMATIC TRANSMISSION

1. Flywheel casing
2. Clutch cover
3. Clutch plate
4. Flywheel
5. Crankshaft
6. Support bearing in crankshaft
7. Circlip
8. Adjusting nuts
9. Return spring
10. Release fork
11. Dust cover
12. Holding plate
13. Release bearing
14. Thrust spring
15. Clutch plate shaft (input shaft gearbox)
16. Cover, gearbox
17. Support rings
18. Pressure plate
19. Retainer
20. Clutch wire
21. Washer
22. Rubber bush
23. Washer
24. Nut
25. Rubber sleeve
26. Bolt for pedal stop
27. Bracket
28. Bolt for pedal shaft
29. Return spring
30. Clutch pedal

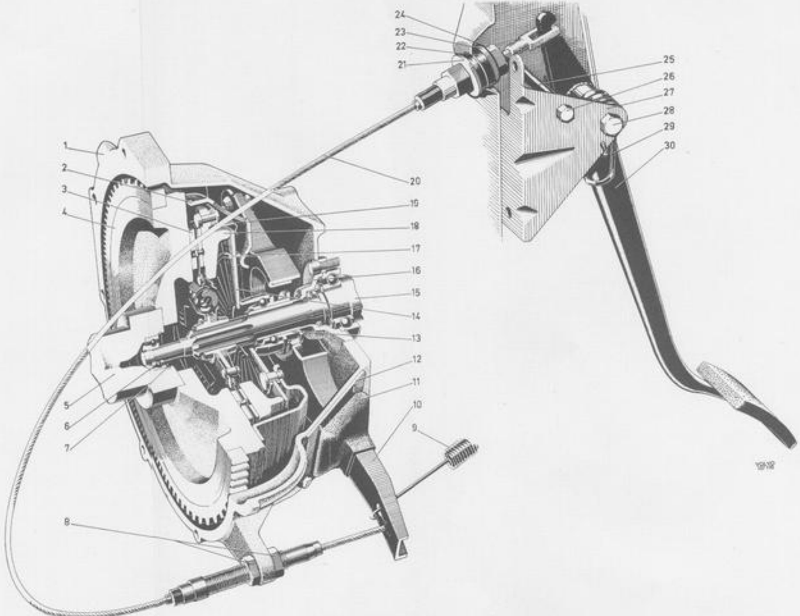


Illustration 4-A. Clutch and clutch controls

1. Gear lever, upper section with knob
2. Rubber bushes
3. Gear lever, lower section
4. Washer
5. Spring
6. Cover
7. Bush
8. Protective cover
9. Gearbox cover
10. End casing
11. Rear cover
12. Ball bearing
13. Striker (x-ray)
14. Bush
15. Gear shifter rod
16. Contact for reversing lights and belt reminder
17. Selector fork, 1st and 2nd speeds
18. Gate
19. Sliding plate
20. Sleeve (reverse catch)
21. Spring
22. Sleeve
23. Spring
24. Insert
25. Engaging sleeve and gear wheel for reverse
26. Synchronizing cone
27. Bush (Needle bearings)
28. Gear wheel for 2nd speed
29. Thrust washer
30. Circlip
31. Thrust washer
32. Gear wheel for 3rd speed
33. Bush (Needle bearings)
34. Mainshaft
35. Spring
36. Interlock ball
37. Synchronizing hub
38. Insert
39. Selector rail for 3rd and 4th speeds
40. Selector rail for 1st and 2nd speeds
41. Selector rail for reverse
42. Engaging sleeve
43. Spring
44. Synchronizing cone
45. Ball bearing
46. Roller bearing
47. Sealing ring
48. Cover
49. Input shaft
50. Spacer washer
51. Thrust washer
52. Housing
53. Needle bearing
54. Spacer washer
55. Countershaft
56. Idler gear
57. Reverse shaft
58. Reverse gear
59. Bush
60. Striker lever (x-ray)
61. Bush (Needle bearings)
62. Gear wheel for 1st speed
63. Thrust washer
64. Speedometer worm gear
65. Bleeder nipple
66. Oil seal
67. Flange

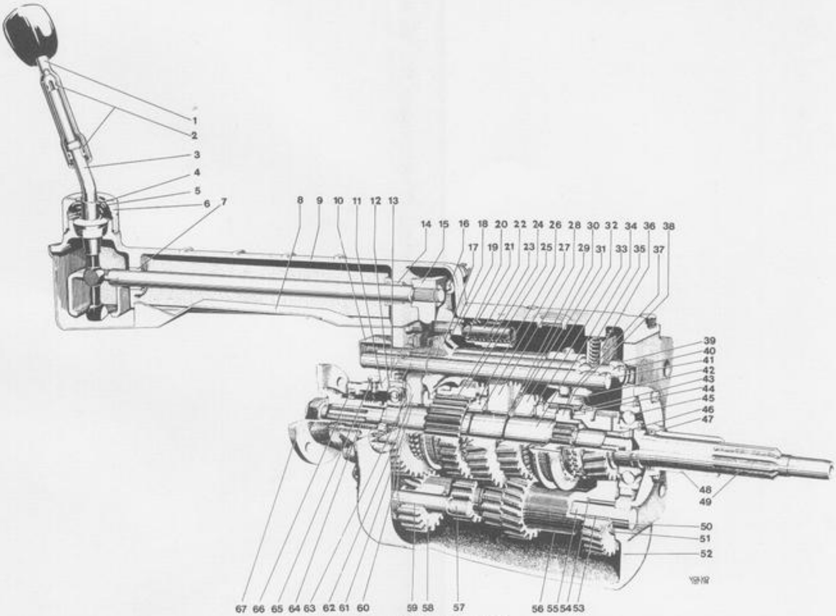


Illustration 4-B. Gearbox M 40

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. Thrust 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. Sunwheel
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

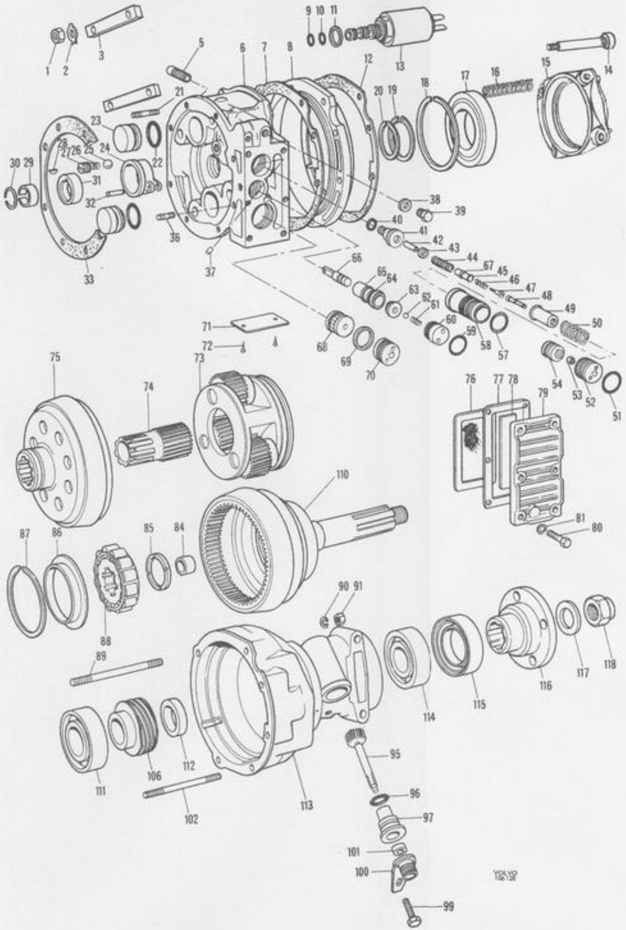


Illustration 4-C. Overdrive

1. Oil seal
2. Pump
3. O-ring
4. Pump body
5. Gasket
6. Thrust washer
7. Snap ring
8. Input shaft
9. Thrust washer
10. Hub
11. Disc kit
12. Snap ring
13. Spring
14. Ring
15. Piston ring (rubber)
16. Piston and reed
17. Rubber ring
18. Front clutch cylinder
19. Front servo
20. Servo strut
21. Contact pin
22. Brake band
23. Thrust washer
24. Thrust washer
25. Snap ring
26. Spring seat
27. Spring
28. Snap ring
29. Disc kit
30. Piston ring (rubber)
31. Piston
32. Rear clutch cylinder
33. Oil ring
34. Rubber ring
35. Needle bearing
36. Key
37. Reverse sun gear
38. Needle thrust plate
39. Oil rings
40. Forward sun gear
41. Oil ring
42. Center bearing
43. Servo strut
44. Brake band
45. Needle thrust bearing
46. Thrust plate
47. Snap ring
48. Free wheel
49. Brace
50. Planetary gear
51. Thrust plate and bearing
52. Gear
53. Snap ring
54. Driven shaft
55. Washer
56. Oil ring
57. Seal ring
58. Transmission case
59. Rear servo
60. Stop shaft
61. Nipple
62. Plate
63. Oil deflector flange
64. Lock bolt
65. Spindle
66. Spring
67. Valve
68. Centrifugal governor
69. Counterweight housing
70. Speedometer gear
71. Flange

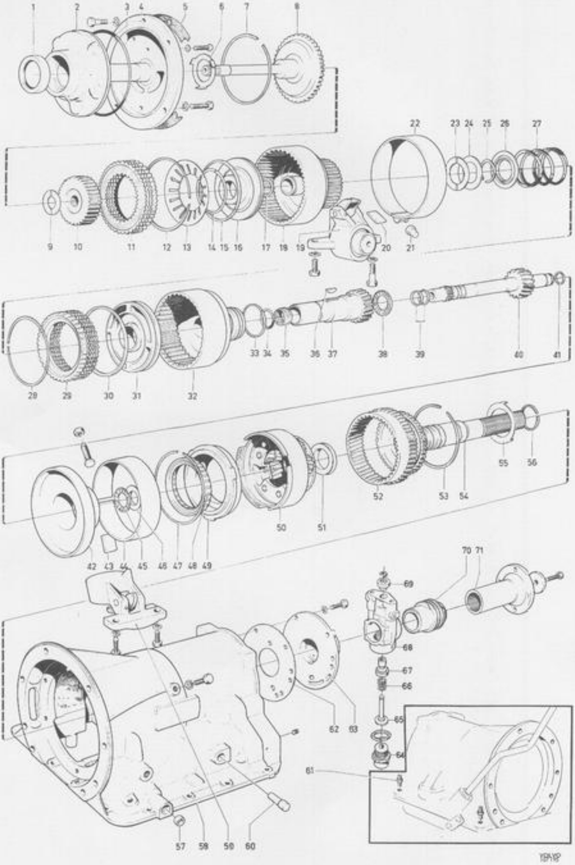


Illustration 4-D. Automatic transmission BW 35

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

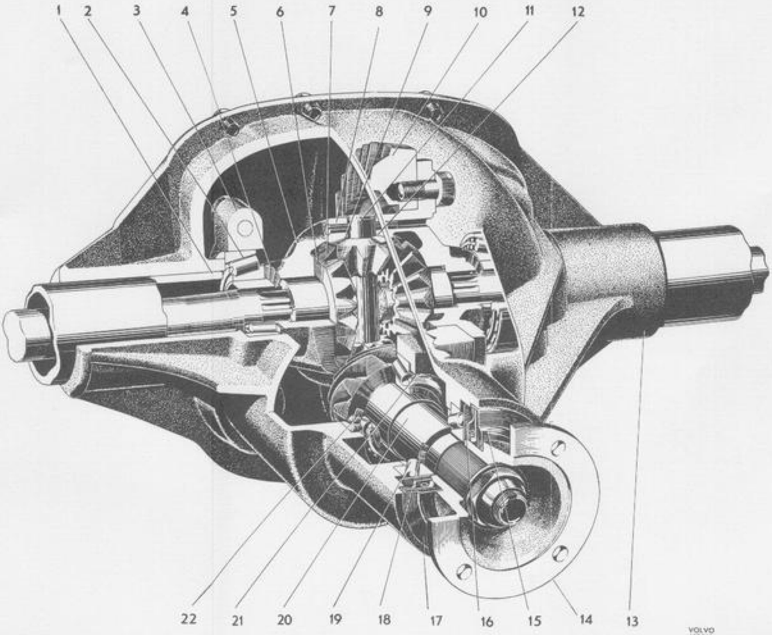


Illustration 4-E. Final drive

Part 5

BRAKES

CONTENTS

GENERAL

TOOLS

Remarks

Brake calipers of make ATE are supplied for certain markets. Where the instructions for these differ from the other brake caliper make (Girling), the letters ATE will follow. The ATE brake caliper is mounted at the factory as follows:

145: For all markets expect USA.

142 and 144: VENV, i.e., vehicles by Volvo Europa Naamloze Vennootschap, Belgium.

The following special tools are used for repair work on the brake system. The special tools are marked 999 or SVO (e.g., 999 2742 or SVO 2742).

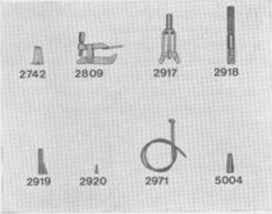


Fig. 5-1. Special tools

999 (SVO)
2742 Holder for cable spring
2809 Tool for pressing in piston
2917 Extractor for brake pads
2918 Tool for turning piston ATE
2919 Template for piston, ATE
2920 Nipple for testing, ATE
2971 Bleeder wrench
5004 Drift for piston seal, master cylinder

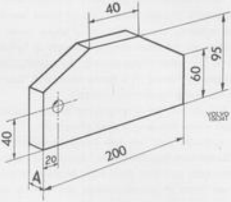


Fig. 5-3. Wooden insert for brake calipers
A=15.5 mm (5/8") for front brake calipers
13 mm (1/2") for rear brake calipers

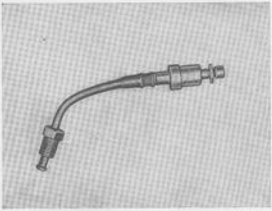


Fig. 5-4. Connections

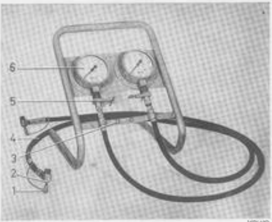


Fig. 5-2. Testing device 2741

1. Protection cover
2. Connection nipple
3. Enlarging nipple
4. Hose
5. Bleeder tap
6. Pressure gauge

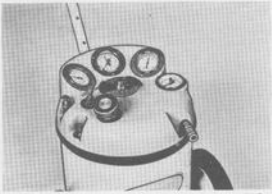


Fig. 5-5. Type of bleeder unit

The testing device (Fig. 5-2) is used, for example, to trace faults in the brake system.
Removal of the pistons in the brake calipers is made easier with the help of wooden inserts according to Figs 5-3 and 5-4.

A hose connection (see 2, Fig. 5-4) is required for removing the pistons in the calipers.
A bleeder unit, of the type shown in Fig. 5-5, is required for maintaining the hydraulic system under constant pressure. Also needed is a connection cover for the brake fluid container, see Fig. 5-60.

DESCRIPTION

The 140 is fitted with two brake systems with 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, this due to the fact that the master cylinder (1) is of the tandem-type and that each front brake caliper (13) has two pairs of cylinders which are entirely separated from each other. 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 cylinder (5) is directly actuated by the brake pedal and with the help of vacuum from the engine induction manifold results in less pedal pressure being 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.
The warning valve (16) warns the driver when there is an abnormal pressure difference between the circuits. Concerning a more detailed description of the units making up the footbrake and the parking brake systems, see the respective Groups in question.

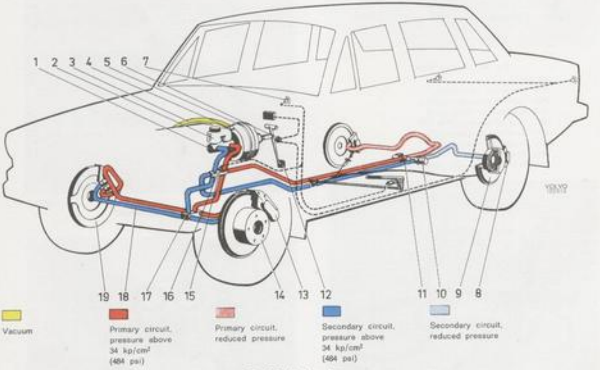


Fig. 5-6. Brake system

1. Tandem master cylinder
2. Brake fluid container
3. Vacuum line
4. Check valve
5. Servo 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 in general, only methylated spirit is free from benzene. Brake fluid is an excellent but expensive cleaning agent. From most viewpoints, **methylated spirit** is therefore the most suitable.

Petrol, white spirit, trichloroethylene or alcohol with benzene must not be used for cleaning as, like the slightest trace of mineral oil, they attack the rubber seales 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 precipiate 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 condition 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 fulfit the requirements according to the standard SAE J 1703, should be used for the brake system. Brake fluid with the designation DOT 3 or DOT 4 can also be used. Fluids which only fulfit the requirements according to SAE 70 R 1, for example HD-quality and FS-VV-H 910 A, should not be used. Avoid mixing brake fluids produced by different firms.

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 obsorption of moisture and small impurities. 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, from some kind of brake testing, that the capacity of the footbrake system is not what it should be. Fault tracing can also be carried out with a view to preventing faults.

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 both the inside bleeder nipples at one of the front brake calipers and connect up the testing device 2741 shown in Fig. 5-2. Nipple 2920 is also used for the ATE.
3. Depress the brake pedal several times to even out any partial vacuum in the servo 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/cm^2 (1422 psi), the pressure must not differ more than 3 kp/cm^2 (42.7 psi).
5. Apply the footbrake with the help of a pedal jack to a hydraulic brake pressure of about 100 kp/cm^2 (1433 psi). Check pipes 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 presure. Start the engine.

Here a considerable lowering of the pedal should be felt when the servo cylinder starts to operate.

7. Stop the engine after it has run for at least 1 minute. With the help of the pedal jack apply a hydraulic pressure of 25 kp/cm² (356 psi).
   Wait a couple of minutes. The hydraulic pressure should not drop more than 5 kp/cm² (71 psi).
8. Check the warning valve (Fig. 5-37). Connect a hose to one of the bleeder nipples of the testing device and open the device. Switch on the ignition switch and check that the warning lamp lights when the parking brake is applied. Release the parking brake. With a pedal jack apply the footbrake slowly. When the warning lamp lights, check the pressure on the pressure gauge. The lamp should light at a pressure difference of 5—15 kp/cm² (71—213 psi) between the circuits.
   After the test, shut off the bleeder nipple and remove the pedal jack. Disconnect the electrical cable and unscrew the warning valve switch so that the warning valve returns to its normal position. Screw in the warning switch to a tightening torque of 1.4—2.0 Nm (10—14 lb ft). Connect the electrical cable.
9. Check the brake valve of one circuit. Connect the testing devices to the bleeder nipple on the left rear wheel brake unit and to the upper nipple on one of the front wheel brake units. Apply the footbrake with the pedal jack to the incoming pressure according to the table in the adjacent column. 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.

Model	Incoming pressure kp/cm² (psi)	Outgoing pressure kp/cm² (psi)
142—144	30 (427) 50 (711) 100 (1422)	30 (427) 36—42 (512—597) 50—59 (711—839)
145	45 (640) 65 (924) 100 (1422)	45 (640) 52—57 (739—810) 62—69 (882—981)

10. Check the other brake valve in the same way by connecting it to the right rear wheel brake unit and the inner, lower 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 check 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 partical vacuum in the servo brake cylinder.

Test operation	Fault	Cause	Remedy
3	Pedal too low or too high	Faulty adjustment	Adjust, see page 5:27
4	Fading pressure	Damaged brake line	Replace the damaged line
		Blocked hose	Replace hose
	Difference between circuits greater than 3 kp/cm² (42.7 psi)	Blockage in one of the circuits	See point 5
		Faulty master cylinder	Recondition master cylinder
5	Pressure drops	External leakage	Tighten connections and replace line or recondition leaking part
		Leaking brake valve	Replace brake valve
		Leaking seal in wheel unit cylinder	Recondition wheel unit cylinder
		Leaking seal in master cylinder	Recondition master cylinder

Test operation	Fault	Cause	Remedy
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 power cylinder	Replace power cylinder completely
7	The pressure drops more than 5 kp/cm² (71 psi)	Leaking check valve	Remove and blow clean the valve and replace the seal ring. If insuffient, replace check valve.
		Leaking seal for outgoing thrust rod in power cylinder	Remove master cylinder and replace seal
		Internal fault in power cylinder	Replace power cylinder complete
	Pressure increases	Leaking rear sealing ring in power cylinder	Replace rear sealing ring
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/cm² (71—213 psi)	Faulty warning valve	Replace valve
9—10	Faulty outgoing pressure	Faulty valve	Replace brake valve
11	All wheel brakes fade	Faultily adjusted front pressure plunger in power cylinder	Adjust the pressure plunger
	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
		Faultily adjusted parking brake	Adjust the parking brake
		Faulty brake valve	Replace brake valve
	A wheel brake fades	Damaged brake line	Replace line
		Blocked hose	Replace hose
		Worn sealing ring	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 of importance, 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 the 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 page 5:10.

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 resulting 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 5:35.

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 replace the air filter more often.

WHEEL BRAKE UNITS

DESCRIPTION

The figures in the following description show the Girling type brake caliper. For the 145 (except USA) and VENV-built vehicles in the 140-series, the brake caliper is of make ATE, see Fig. 5-29.

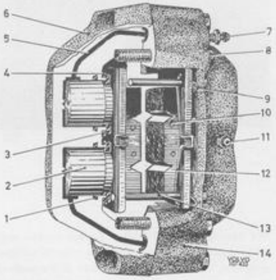


Fig. 5-8. Front wheel brake caliper

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

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 cover plate (4) protects the disc from dirt.

Mounted on the stub axle is the front wheel brake 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 14, Fig. 5—8) bolted together and located on either side of the brakes 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 piston 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 (10) are provided with bonded facings and are held in position by means of retaining pins (13).

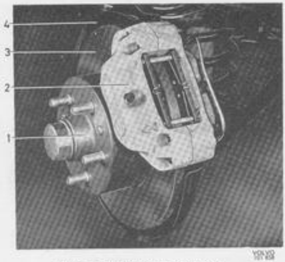


Fig. 5-7. Brake components, front wheel

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 (6 and 11, 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.

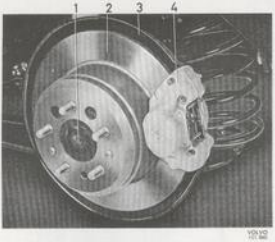


Fig. 5-9. Brake components, rear wheel

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

The sealing rings (1) 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 (10) are provided with bonded facings and are held in position by means of retaining pins (13).

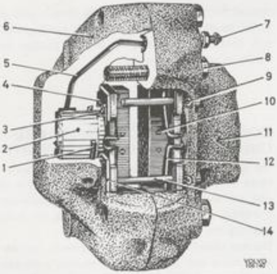


Fig. 5-10. Rear brake caliper

1. Sealing ring
2. Piston
3. Rubber dust cover
4. Retaining ring
5. Channel
6. Outer half
7. Bleeder nipple
8. Bolt
9. Retaining clip
10. Brake pad
11. Inner half
12. Damping spring (alt. 1)
13. Retaining pin
14. Washer

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. 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. Fig. 5-11 shows the general arrangement of the connections for a car with left-hand drive. Also installed are brake valves and a warning valve. For a car with right-hand drive, the connections to the master cylinder are reversed but are otherwise the same in principle.

When the pressure in the master cylinder rises as a result of brake application, the pistons in the brake calipers are displaced and press the pads with brake linings from both sides against the rotating friction surface of the brake disc, see Fig. 5-12. The pressure applied, and thus the braking effect, vary in proportion to the foot effort applied to the pedal. When the piston is displaced, the sealing ring is tensioned laterally. It remains in this state as long as the footbrake is applied.

Should leakage occur in one of these circuits, full

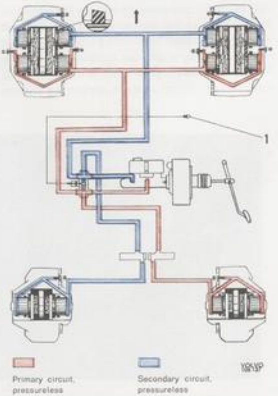


Fig. 5-11. Rest position

1. Warning lamp

braking effect is still obtained on both the front wheels and one rear wheel if pedal pressure is increased. When there is a presure difference in the brake circuits (about 10 kp/cm^2 = 142 psi), the piston of the warning valve is pressed over to one side where the pressure is less and the warning lamp lights. The warning lamp remains lighted until the leakage in the circuit concerned has been remedied and the warning switch returned to normal.

When the brake pedal is released, the hydraulic pressure on the piston ceases. Since with this system there is no residual hydraulic overpressure in the lines, the tension in the sealing rings is sufficient to move the pistons back to a certain extent, see Fig. 5-11. This results in a clearance being formed between the brake linings and the brake disc. With such an arrangement, the linings will always be in the rest position at a certain distance from the brake disc, irrespective of the wear. For this reason, the brakes are self-adjusting.

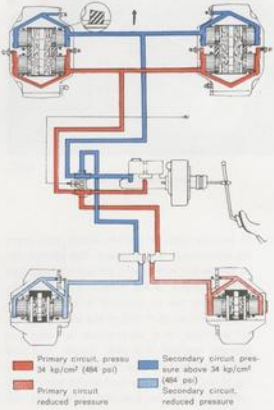


Fig. 5-12. Brake application

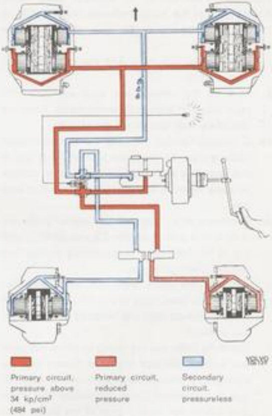


Fig. 5-13. Brake application, leakage in secondary circuit

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 up under the rear axle and front jack attachments. Unscrew the wheel nuts and lift off the wheels.

3a. Concerns Girling: Remove the hairpin-shaped locking clips for the guide pins. Pull out one of the lock pins while holding the damper springs in place. Remove the springs and the other lock pin.

3b. Concerns ATE: Tap out the upper guide pin with a drift with diameter 2.5 mm (9/64"), see Fig. 5-14. Take out the tensioning spring. Tap out the lower guide pin.

4. Pull out the pads with tool 2917, see Fig. 5-15. If the used pads are to be re-fitted, mark them to ensure they are restored to their original position.
5. Carefully clean out the cavity in which the pads are located. Replace any dust covers that are damaged. If dirt has penetrated into the cylinder due to a damaged cover, recondition the brake unit. Check the friction area of the brake disc.

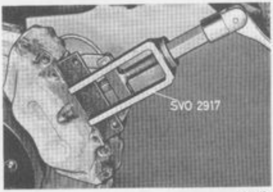


Fig. 5-15. Removing brake pads

6. To provide room for the new brake pads, press the pistons into the cylinders. The pistons can be pressed in evenly and without risk with tool 2809 according to Fig. 5-16. If done properly, the pistons can be pressed in perhaps more rapidly with another tool in the same way but, for example, if a screwdriver is used and wrongly applied, the pad, rubber seal and piston may be damaged. Note that when pressing in the pistons, the fluid brake level in the container rises so that the brake fluid can spurt out.
7. Concerns rear wheels brakes ATE: Check to make sure the pistons are in the proper position to avoid brake squeal. The piston recess should incline 20° in relation to the lower guide area on the caliper. Check the position with template 2919, see Fig. 5-27. The tolerance is ±2°, that is, when the template is placed against the one recess, the distance to the other (meas. A) may be max. 1 mm (0.039").

   If necessary, adjust the location of the piston with tool 2918. To do this, move the tool into position, see Fig. 5-28, 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.

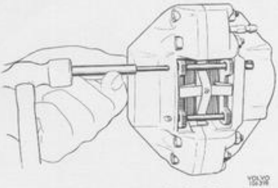


Fig. 5-14. Removing guide pin, ATE

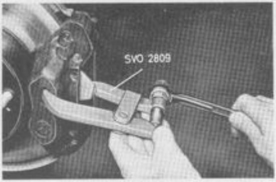


Fig. 5-16. Pushing in piston

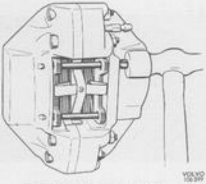


Fig. 5-18. Fitting guide pin, ATE

8a. Concerns Girling: Fit the new pads. Place one of the lock pins in position and fit the damper springs and the other lock pin. Fix the pins with new locking clips. Check that the pads are movable.

8b. Concerns ATE: 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. 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.

Fig. 5-17. Fitting brake pads

9. After replacing the necessary brake pads, depress the brake pedal several times to chek that the movement is normal. Generally the system does not require bleeding after replacing the brake pads.

10. Re-fit the wheels after cleaning the contact surfaces and brake disc of sand, dirt, etc. Tighten the nuts sufficiently so that the wheels are securely held. Lower the vehicle and tighten finally the wheel nuts. Tighten each other nut a little at a time until all are finally tightened to a torque of 100—140 Nm (70—100 lb ft). 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.

RECONDITIONING WHEEL BRAKE UNITS

When working with the hydraulic system, observe the instructions given under "Cleaning" and "Brake Fluid", Group 50.

Front brake calipers

REMOVING

1. Remove the hub caps and slacken the wheel nuts slightly. Temporarily block the vent-hole in the brake fluid container cover to reduce leakage.

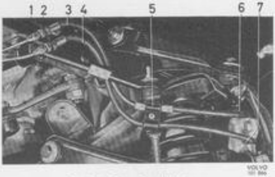


Fig. 5-19. Fitting front brake hoses

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

2. Jack up the front end and place blocks under the front jack attachments. The control 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 come kind of protective casing on the brake lines to prevent unnecessary leakage. Disconnect the connection (6) for the upper hose from the brake.
4. Screw out the attaching bolts (5 and 7, Fig. 5-20) and remove the brake caliper.

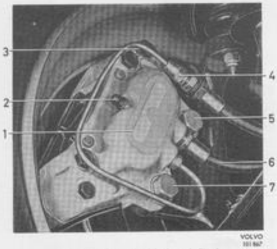


Fig. 5-20. Front wheel brake unit fitted

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

DISASSEMBLING

1. Remove the brake pads, see ops. 3a and 3b 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. 5-21. The pistons can then be easily removed. If a piston feels stiff to remove so that more pressure is required, connect up an airline, see Fig. 5-26. Lever off the rubber covers.
3. Remove the sealing rings with the help of some blunt tool. Be careful not to damage the edges of the grooves. Screw out the bleeder nipple and brake lines.

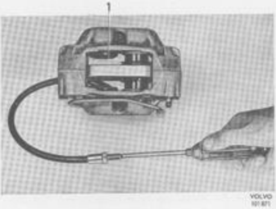


Fig. 5-21. Removing pistons

1. Wooden disc

N.B. The brake caliper halves should not be separated. The reason for this is that subsequent assembling would require 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".

Fig. 5-22. Front brake caliper assembled

ASSEMBLING

1. Coat the working surfaces of the pistons and cylinders with brake fluid.
2. Fit the sealing rings in the cylinders.
3. Fit the pistons with the large diameter end facing inwards. Make sure that the pistons are fitted in straight and are not scratched.
4. Fit the rubber cover on the piston and housing. Fit the lock rings, see Fig. 5-22.
5. Fit the brake pads, see ops. 8a and 8b under "Replacing brake pads".
6. Fit the bleeder nipples and also the brake lines.

INSTALLING

1. Place the calipers in position. Check that the contact surfaces of the retainer are clean and not damaged. Check the location of the brake caliper in relation to the brake disc. Axial deviation is checked by measuring with a feeler gauge on both sides of the disc the distance between disc and caliper support nib. The difference in measurement is max. 0.55 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 in 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 (0.008and0.016"). Fit the attaching bolts after they have been coated with a couple of drops of Locktite, type AV. Check that the brake disc can rotate easily in the brake pads.
2. Fit the hoses and their connections as well as the guide clip, see Fig. 5-19. It is important that the hoses are fitted correctly, that is, without being tensioned and with the control arms off-loaded. 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, etc., and then tighten the nuts sufficiently so that the wheel cannot be displaced on the hub. Lower the vehicle and tighten the wheel nuts. Tighten every other nut a little at a time until all are finally tightened to a torque of 100—140 Nm (70—100 lb ft). Fit the hub cap.
4. Bleed the brake system, see Group 52.

Rear brake calipers

REMOVING

1. Remove the hub caps and slacken the wheel nuts slightly. Tempararily plug the vent-hole in the brake fluid container cap to reduce leakage.
2. Jack up the rear end and prop blocks under the rear axle. Screw out the wheel nuts and take off the wheel. Release the parking brake.
3. Disconnect the brake line connection (2, Fig. 5-23) and fit the protective cover. Screw out the attaching bolts (1 and 3). Lift off the brake caliper, see Fig. 5-24.

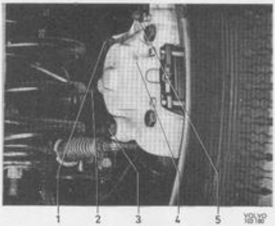


Fig. 5-23. Rear wheel brake unit fitted

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

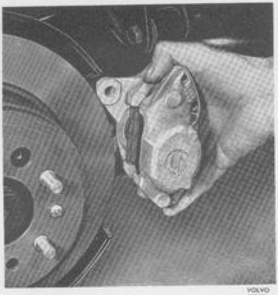


Fig. 5-24. Removing rear brake caliper

DISASSEMBLING

1. Remove the brake pads, see ops. 3a and 3b under "Replacing the brake pads".
2. Remove the retaining ring 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 airline, see Fig. 5-25. The pistons can then be easily removed. Lever off the rubber covers.
3. If a piston feels stiff to remove, connect up an air line, see Fig. 5-26. If one of the pistons is removed, the cylinder can be sealed by means of a rubber washer and 2809 (see Fig. 5-26).

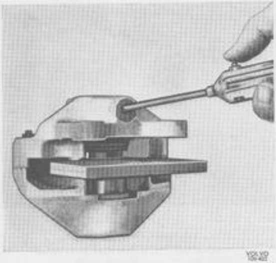


Fig. 5-25. Removing piston

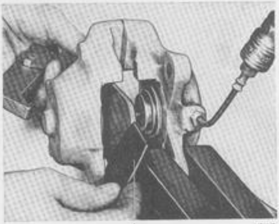


Fig. 5-26. Removing piston
A=rubber dust cover

4. Remove the sealing rings with the help of a blunt tool. Take care not to damage the edges of the grooves. Screw out the bleeder nipple.

N.B. The brake caliper halves should not be separated. The reason for this it that subsequent assembling would require 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.
Sealing rings and rubber dust covers are replaced after each reconditioning. If any of the cylinders is scored, scratched, etc., the entire cylinder housing must be replaced complete. 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 seals in the cylinders.

3a. Concerns Girling: Fit one of the pistons into the caliper. Make sure that the piston is fitted in straight and is not scratched.

Fig. 5-27. Checking location

3b. Concerns ATE: Check to make sure the pistons are in the proper position to avoid brake squeal. The piston recess should incline 20° in relation to the lower guide area on the caliper. Check the location with template 2919, see Fig. 5-27. The tolerance is ±2°, that is, when the template is placed against the one recess, the distance to the other (meas. A) may be max. 1 mm (0.039").

If necessary, adjust the location of the piston with tool 2918. To do this, move the tool into position see Fig. 5-28, 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 ops 8a and 8b under "Replacing brake pads".
6. Screw in the bleeder nipple.

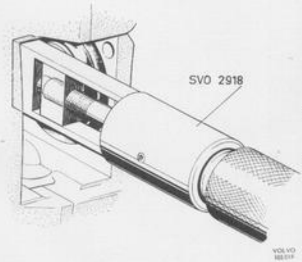


Fig. 5-28. Adjusting location

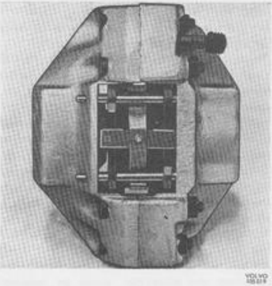


Fig. 5-29. Rear brake caliper assembled

INSTALLING

1. Place the caliper in position. Check that the contact surfaces of the retainer are clean and not damaged. Check the location of the brake caliper in relation to the brake disc when the drive shaft is at the outer position within the clearance limits. Axial deviation is checked by measuring with a feeler gauge on both sides of the disc the distance between disc and caliper support nib. The difference in measurement is 0.25 mm (0.010"). The caliper should be parallel with the disc. This is checked by measuring the distance to the upper and lower support nibs on the caliper. The brake caliper location can be adjusted with shims, which are available in thicknesses between 0.6 and 1.8 mm (0.024 and 0.072"). Coat the attaching bolts with a couple of drops of Locktite, type AV, and then fit them.
2. Connect the brake line, see Fig. 5-23.
   Remove the plug for the vent-hole in the brake fluid container cover.
3. Clean the wheel contact surfaces and disc before fitting on the wheel. Tighten the wheel nuts so much that the wheel cannot be moved. Lower the vehicle and tighten the wheel nuts finally. Tighten each other nut a little at a time until all are finally tightened to a torque of 100—140 Nm (70—100 lb ft). Fit the hub cap.
4. Bleed the fitted brake caliper, see Group 52.

BRAKE DISC

The brake disc should be examined with regard to the friction surface, run-out and 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 linigs. The run-out must not exceed 0.1 mm (0.004") for the front wheel brakes and 0.15 (0.006") for the rear wheel brakes at the outer edge of the disc and is measured, for example, according to Fig. 5-30. 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. 5-31 and 5-85. Tap on the inside of the disc with several light blows from a plastic hammer or similar tool.

If for some reason a new brake disc is not available, the old one can be reconditioned by fine-polishing or fine-turning. Accurate disc aligning is required and the maching should be equal on both sides.

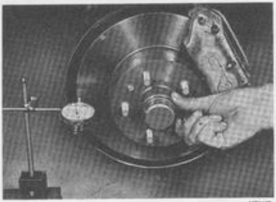


Fig. 5-30. Checking run-out

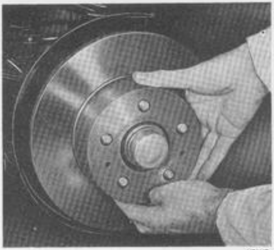


Fig. 5-31. Removing brake disc

After the machining, the disc thickness may not be 1.2 mm (0.48") less than the original thickness, see "Specifications". The surface finish should be max. 3 μ measured on an arbitrary diameter and max. 5 μ measured radially. After the reconditioning, the disc throw may not exceed 0.1 mm (0.004") and its thickness may not vary more than 0.03 mm (0.0012").

HYDRAULIC FOOTBRAKE SYSTEM

DESCRIPTION

MASTER CYLINDER

The master cylinder is of the tandem type and its construction is shown in Fig. 5-32. Its function is the following:

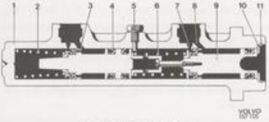
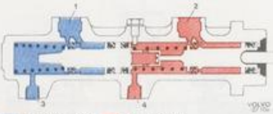


Fig. 5-32. Master cylinder

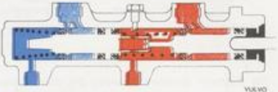
1. Cylinder
2. Return spring for secondary piston
3. Secondary piston
4. Piston seal
5. Stop screw
6. Return spring for primary piston
7. Equalizing hole
8. Overflow hole
9. Primary piston
10. Thrust washer
11. Circlip



Secondary circuit, pressureless — Primary circuit, pressureless

Fig. 5-33. Rest position

1. and 2. Connections for brake fluid container
3. Connection for primary circuit
4. Connection for secondary circuit

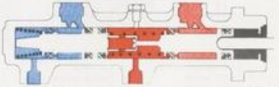


Secondary circuit, pressureless — Primary circuit, pressureless
Secondary circuit, high pressure — Primary circuit, high pressure

Fig. 5-34. Normal brake application

When the system is at rest (Fig. 5-33), the pistons are kept pressed back by the force of the springs. When the pistons are in this position, the connections between the fluid brake 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 to the container and the pressure in front of the piston rises. This pressure influences the secondary piston so that it is also moved to the left. The same overpressure arises in front of both pistons (Fig. 5-34), the brake fluid is forced out into the respective brake line and 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. 5-35).



Secondary circuit, pressureless — Primary circuit, pressureless — Primary circuit, high pressure

Fig. 5-35. Brake application with leakage in secondary circuit

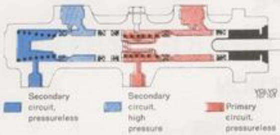


Fig. 5-36. Brake application with leakage in primary circuit

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. 5-36).

WARNING VALVE

The footbrake system is fitted with a warning valve, the construction of which is shown in Fig. 5-37. Its function is to warn the driver when the pressure difference between the two brake circuits exceeds about 10 kp/cm² (142 psi). The valve operates as follows:

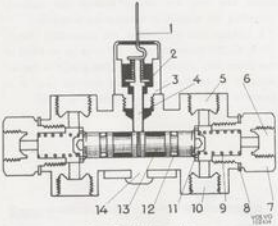


Fig. 5-37. Warning valve

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

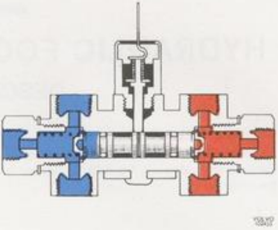


Fig. 5-38. Normal position

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. 5-38). 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 kp/cm² (142 psi) that the pistons are pushed so far to the right that the guide pin (4) can be pressed downwards. When this happens, the switch washer (2) reaches the housing (3) and current is cut in (Fig. 5-39). If the circuits are made pressureless, the guide pin is prevented from returning to its normal position. This can happen by screwing out the warning switch (3).

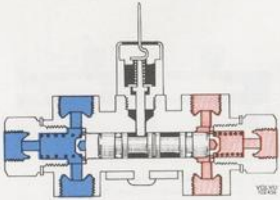


Fig. 5-39. Warning position

BRAKE VALVE

A brake valve is connected to each of the rear wheel brake lines, see Fig. 5-6. When the ingoing brake pressure exceeds 34 kp/cm^2 = 484 psi (145, 50 kp/cm^2 = 711 psi) a reduction takes place in the valve. The more powerful the pedal pressure, the greater the reduction and thereby the larger the difference between the hydraulic pressure in the front wheel and rear wheel cylinders. This results in a suitable distribution of braking force between both pairs of wheels. The construction of the brake valve is shown in Fig. 5—40 and its function is the following:

When the footbrakes are applied, the pressure from the master cylinder is transmitted via the connection (4, Fig. 5-40). The pressure then proceeds through the cylinder (5), the counterbore, past the valves (8) and (2) to cylinder (11) and then on through connection (10) to the rear wheel cylinders, see Fig. 5-41. The hydraulic pressure per unit surface is equal on the different parts of the piston (9), but since its pressure surface is larger in cylinder (11) than in cylinder (5), the force developed will move the piston to the right of the figure. However, this is counteracted by the pressure from the spring (6).

When the hydraulic pressure approaches 34 kp/cm^2 = 484 psi (145, 50 kp/cm^2 = 711 psi) the spring pressure is overcome and the piston (9) is moved to the right. By means of pressure from the smaller spring (3), the valve (2) shuts off the connection between the two cylinders and forms two separate systems, one for the front wheels and one for a rear wheel.

With continued increase in pressure in the master

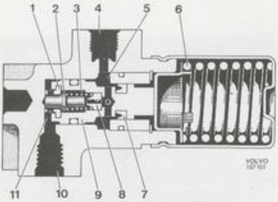
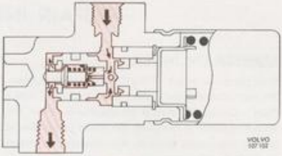


Fig. 5-40. Brake valve, construction

1. Valve seat
2. Valve
3. Valve spring
4. Connection to master cylinder
5. Cylinder
6. Spring
7. Piston seal
8. Equalizing valve
9. Piston
10. Connection to rear wheel brake cylinders
11. Cylinder

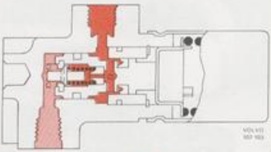


Pressure below 34 kp/cm^2 (484 psi) (145, 50 kp/cm^2 = 711 psi)

Fig. 5-41. Brake application

cylinder and front wheel cylinders, the hydraulic pressure in cylinder (5) moves the piston to the left so that the valve rod comes up against its stop and opens the valve, this causing the pressure in cylinder (11) to increase. Due to the larger pressure surface in this cylinder, the plunger 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 incoming pressure, see Fig. 5-42. The difference in these pressures is determined by the different areas and spring tension.

When the brake pedal is released, the pressure in the cylinder (4) falls. The piston (9) is moved to the right by the spring (6). When the pressure on the right-hand side of the valve (13) 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, the spring (6) presses the left piston back to its original position where the valve is held in the open position by mechanical means, see Fig. 5-41. The equalizing valve (8) is fitted with control channels which ensure an even flow of pressure through the valve.



Reduced pressure

Presure above 34 kp/cm^2 (484 psi) (145, 50 kp/cm^2 = 711 psi)

Fig. 5-42. Reducing action

REPAIR INSTRUCTIONS

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 fuid spill over.
2. Remove the lines from the master cylinder and fit plastic plugs.
3. Remove the two attaching nuts for the master cylinder and lift the cylinder forwards. Empty out the brake fluid.

DISASSEMBLING

1. Fix the flange of the master cylinder firmly in a vise.
2. Place both hands under the container and pull it up from the rubber seals, see Fig. 5-43. Remove the filler cap and strainer from the container and also the rubber seals from the cylinder see Fig. 5-44.
3. Unscrew the stop screw. Remove the circlip from the primary piston with the help of circlip pliers. Remove the pistons. If it is not possible to shake out the secondary piston, it can be removed by blowing air in the hole for the brake switch.

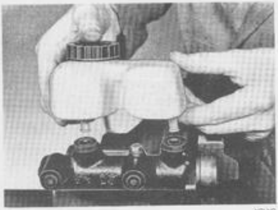


Fig. 5-43. Removing container

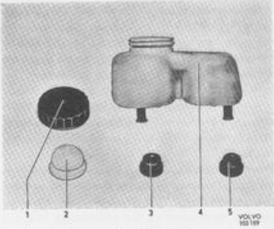


Fig. 5-44. Container parts

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

4. Remove the seals from the secondary piston. Be careful not to damage the surfaces of the plunger.

INSPECTING

Before inspecting, all the parts should be cleaned according to the instructions given under "Cleaning", Group 50.

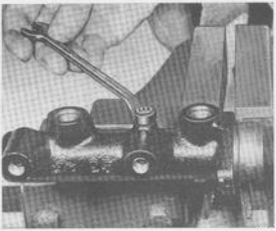


Fig. 5-45. Removing stop screw

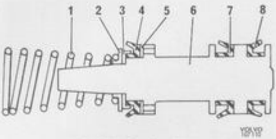


Fig. 5-46. Secondary piston

1. Spring
2. Spring plate
3. Back-up ring
4. Piston seal
5. Washer
6. Piston
7. Piston seal
8. Piston seal

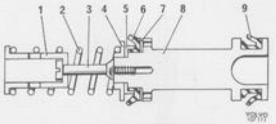


Fig. 5-48. Primary Piston

1. Sleeve
2. Spring
3. Screw
4. Thrust washer
5. Back-up ring
6. Piston seal
7. Washer
8. Piston
9. Piston seal

Examine the inside of the cylinder carefully. If scored or scratched, the cylinder should be replaced. Rust and similar damage can as a rule be eliminated by honing the cylinder. The procedure for this varies with different makes of tools so that no general description can be given. Follow, therefore, the instructions of the manufacturer. Clean the cylinder carefully after honing and check that the holes are clear.

If wear on the cylinder or secondary piston is suspected, the diameter should be measured with a micrometer or indicator. The cylinder diameter may not exceed 22.40 mm (0.881"), while the diameter of the piston may not be less than 22.05 mm (0.870"). With each reconditioning, the piston parts in the repair kit replace the used ones. Also replaced is the stop screw, its washer and lock ring. The rubber seals and washers for the container should also be changed.

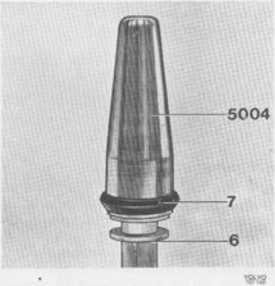


Fig. 5-47. Fitting piston seal

6. Piston
7. Piston seal

ASSEMBLING

1. Fit the parts on the secondary piston, see Figs. 5-46 and 5-47. Make sure that the piston seals are turned correctly.
   When fitting seals 7 and 8, use tool 5004. Apply brake fluid to the sleeve and seal and press the seal onto the sleeve. Then place the tool on the piston, see Fig. 5-47, and push on the seal. With the tool adjusting screw, adjust to a suitable position when fitting inner and outer seals.
2. Coat the cylinder with brake fluid and dip the piston and seals in brake fluid before fitting. Slide the spring onto the secondary piston and fit the piston.
   Be careful when inserting the seals in the cylinder.
3. Assemble the new primary piston according to Fig. 5-48 and fit it as shown in Fig. 5-49. Press in the piston and fit washer (10, Fig. 5-32 and circlip (11).

Fig. 5-49. Fitting primary piston

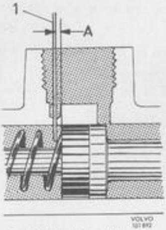


Fig. 5-50. Checking equalizing hole
0.5 mm (25 s.w.g.) soft copper wire
A=approx. 0.5 mm (0.020")

4. Check that the hole for the stop screw is clear and fit screw (5) and sealing washer. The tightening torque should be 10—12 Nm (7—9 lb ft).
5. Check the movement of the pistons and make sure that the through-flow holes are clear. The equalizing hole is checked by inserting a soft copper wire with diameter 0.5 mm (25 s.w.g.) through the hole, see Fig. 5-50. If the equalizing hole is not clear, then the master cylinder is generally wrongly assembled.
6. Fit rubber seals (3 and 5, Fig. 5-44). Check that the vent-hole (2. Fig. 5-60) in the cap is clear and fit the strainer (2) and filler cap in position. Fit the container, compare Fig. 5-43.

INSTALLING

1. For the correct function of the master cylinder, the outgoing thrust rod of the servo cylinder must not prevent the primary piston from returning to its resting position. Thus, when fitted and in the resting position, the thrust rod and primary piston should have a clearance (dimension C. Fig. 5-51) between them.

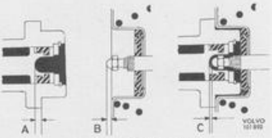


Fig. 5-51. Adjusting thrust rod
C=Clearance 0.1—1.0 mm (0.004—0.04")

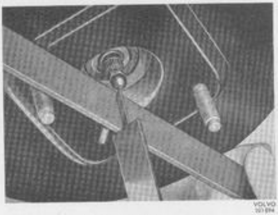


Fig. 5-52. Measuring thrust rod

Before fitting the master cylinder, check the clearance first by, for example, measuring with slide calipers the distance between the face of the attaching flange and the center of the primary piston, dimension A, Fig. 5-51. Then measure how much the thrust rod (the adjuster screw) projects outside the fixed surface of the servo cylinder, dimension B. For this measurement, the thrust rod should be pressed in fully and a partial vacuum should exist in the cylinder so that the engine, if necessary, can be started. Dimension A reduced by dimension B will result thereby in the clearance C, and should be 0.1—1.0 mm (0.004—0.04"). When adjusting, lock the screw with a couple of drops of Locktite, type B.

2. Fit the master cylinder in position and then the washers and attaching nuts. Tightening torque 24 Nm (17 lb ft).
3. Connect the pipes, see Fig. 5-53.
4. Bleed the entire brake system

WARNING VALVE

Normalizing pistons

1. Disconnect the electrical cable and screw out the warning switch (Fig. 5-54) so that the pistons return to normal position.
2. Repair and bleed the faulty hydraulic circuit.
3. Screw in the warning switch to a torque of 14—20 Nm (10—15 lb ft). Connect the electrical cable.

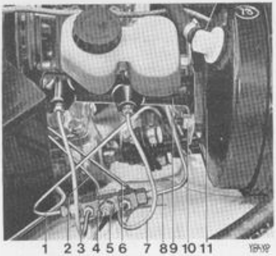


Fig. 5-53. The master cylinder installed

1. To left brake valve
2. To 6-branch union, lower
3. From secondary circuit (master cylinder)
4. Warning valve
5. Warning switch
6. To 6-branch union, upper
7. From primary circuit (master cylinder)
8. To right brake valve
9. Master cylinder
10. Attaching nut
11. Power cylinder

REPLACING WARNING VALVE

Disconnect all connections. Remove the attaching nut and then the velve. Fit in reverse order to removal.

Fig. 5-53 shows the different connections. Bleed the brake system.

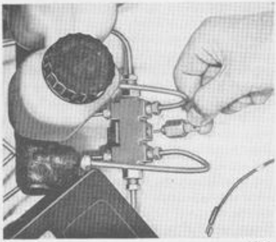


Fig. 5-54. Removing warning switch

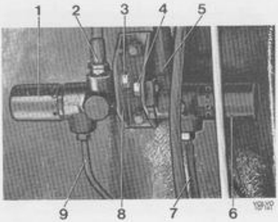


Fig. 5-55. The brake valves installed

1. Left brake valve
2. Brake hose to left rear wheel
3. Attaching screw
4. Attaching screw
5. Brake hose to right rear wheel
6. Right brake valve
7. From the master cylinder
8. Bracket
9. From the master cylinder secondary circuit

BRAKE VALVES

CHECKING

For checking the brake valve with testing device 2741, see page 5:4, Pos. 9. The valve cannot be repaired if faulty and must be replaced.

REPLACING

1. Unscrew and plug the connection (9, Fig. 5-55) of the brake pipe. Loosen the brake hose (5) a maximum 1/4 turn at the valve. Remove the attaching screw (4) and unscrew the valve from the brake hose, see Fig. 5-56.
2. Screw the new brake valve onto the brake hose, with new seal, compare Fig. 5-56. Place the valve in position and check that there is no tension in the hose. Fit the attaching screw and connect up the brake pipe. Tighten up the connection. Bleed the brake system.

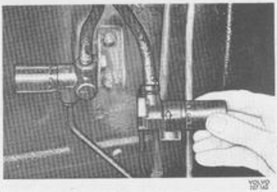


Fig. 5-56. Removing brake valve

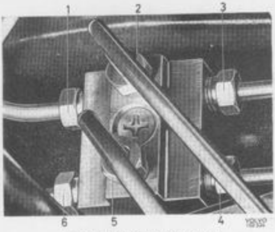


Fig. 5-57. 6-branch union connections

1. Primary circuit of the master cylinder
2. Left, lower wheel unit cylinder
3. Right, lower wheel unit cylinder
4. Right, upper wheel unit cylinder
5. Left, upper wheel unit cylinder
6. Secondary circuit of the master cylinder

BRAKE LINES

CLEANING

The brake lines can be cleaned by flushing them with brake fluid or spirit and then by blowing them clean with moisture-free, filtered, compressed air. The purpose of this is to remove all brake fluid and dirt particles and should be carried out in connection with the complete reconditioning of the hydraulic system and a new fitting.

When complete reconditioning is being carried out, the brake service unit (see Group 50) can suitably be connected to the master cylinder and then the system emptied through the bleeder nipple. 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 in Group 50. Do not top 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 blockage 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 no load on the front wheels.

1. To prevent unnecessary spilling of brake fluid, the existing filter 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 against anything during driving. Particularly important points are where the pipes pass the steering rod, where they must not come nearer than 10 mm (3/8"). If the pipe is not bent correctly, it should be adjusted manually before being fitted. Bending a pipe which is already connected often results in deformation at the connections. The front brake hoses may 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. Then fit the filler cap with the 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 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 only one rear brake caliper has been removed and little brake fluid run out, it is generally 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 come into contact with the friction surfaces or linings. Avoid spilling any fluid on the paintwork as this can damage it.

Should the car be placed on props during the bleeding, the rear end ought to be raised higher than the front end.

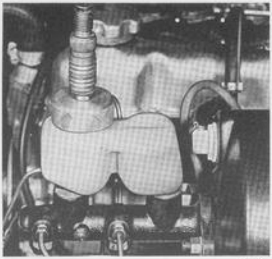


Fig. 5-58. Connecting bleeder unit

When filling with oil the following should be observed: The brake fluid must fulfil the requirements according to SAE J 1703. Brake fluid with the designation DOT 3 or DOT 4 can also be used. Brake fluid which has been bled from the system must under no circumstances be returned to the bleeder unit or the brake fluid container. Bleeding of the entire brake system is as follows:

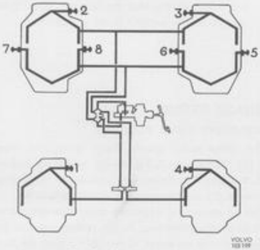


Fig. 5-59. Bleeding sequence

1. Left rear wheel
2. Left front wheel, upper, inner
3. Right front wheel, upper, inner
4. Right rear wheel
5. Right front wheel, outer
6. Right front wheel, lower, inner
7. Left front wheel, outer
8. Left front wheel, lower, inner

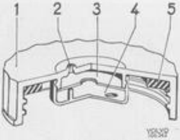


Fig. 5-60. Cover

1. Cover
2. Vent-hole
3. Washer
4. Casing
5. Gasket

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 140 mm = 5 1/2") 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. Clean round the cap on the brake fluid container, also round the contact on the warning valve. Remove the warning switch, see Fig. 5-54. Fill if necessary with brake fluid to the "Max" mark on the container.
3. Fit on the container a cap specially used when bleeding, see Fig. 5-58. This cap can be obtained fram AB Volvo Service Department. Connect the bleeder unit according to the instructions of the manufacturer. The working pressure is 2 kp/cm^2 (28.4 psi). The type of bleeder unit which may be used is shown in Fig. 5-5.
4. Bleeding should take place in the order shown in Fig. 5-59.
   When bleeding, remove the protective cap and fit the bleeder tool 2971, see Figs. 5-61 and 5-62.

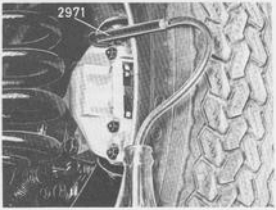


Fig. 5-66. Power cylinder

Fig. 5-62. Bleeding front wheel brake unit

Allow the other end of the hose to hang down into a collecting vessel. Open the bleeder nipple maximum 1/2 a turn. Close the nipple when brake fluid free from air bubbles flows out. Make sure that there is no leakage between the nipple and tool, as this could give rise to misleading results. Re-fit the protective caps on the nipples.

5. Generally it is only necessary to bleed each circuit once. If the brake pedal can still be depressed without any resistance worth mentioning or if it feels spongy, repeat the bleeding.
6. After bleeding has been completed, disconnect the bleeder unit. This will make the unit hose pressureless and the cap can be screwed off. Blow clean the vent-hole in the standard cap and re-fit this on the container.
7. Fit the warning switch and tighten it to a torque of 14—20 Nm (10—15 lb ft). Connect the electric cable. Check to make sure that the warning lamp lights when the parking brake is on.

MECHANICAL BLEEDING

1. Check to make sure there is full return on the brake pedal and that neither carpets nor suchlike prevent full travel (about 140 = 5 1/2") from being utilized during the bleeding. Depress the brake pedal several times in order to even out any underpressure in the power cylinder and in this way disconnect it.
2. Clean round the cap on the brake fluid container as well as round the switch on the warning valve. Remove the warning switch, see Fig. 5-54. If necessary, fill the container with brake fluid up to the "Max." mark. Blow the vent-hole of the cap clean.
3. Required for the bleeding is a plastic hose which can be pressed onto 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 being sucked in. 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.
4. Bleeding should be carried out in the order shown in Fig. 5-59 and as follows:
   Remove the masking cap and fit the ring spanner and plastic hose on the bleeder nipple. Allow the opening of the pipe to hang down below the surface of the fluid in the glass bottle, see Fig. 5-62. Open the bleeder nipple at the most 1/2 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 masking caps on the nipples.
5. Generally it is only necessary to bleed each circuit once. If the brake pedal can still be depressed without any resistance worth mentioning or if it feels spongy, repeat the bleeding.
6. Fil the brake fluid container with brake fluid up to the "Max" mark.
7. Fit the warning switch and tighten it to a torque of 14—20 Nm (10—15 lb ft). Connect the electric cable. Check that the warning lamp lights only when the parking brake is applied.

BRAKE PEDAL

ADJUSTING PEDAL POSITION

The brake pedal should travel about 140 mm = 5 1/2" (dimension A, Fig. 5—63) before the pistons in the master cylinder are pressed to the bottom without the assistance of hydraulic pressure.

The travel can be measured only by bleeding both circuits simultaneously. At the bottom position the pedal should be about 10 mm (3/8") from the floor (dimension B).

When the brake pedal is released, it should take up the same position as the clutch pedal provided, of course, that the clutch pedal is correctly adjusted. When the master cylinder is removed, do not

Fig. 5-63. Pedal travel
A = approx. 140 mm (5½")
B = approx. 10 mm (⅜")

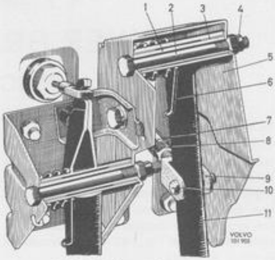


Fig. 5-65. Pedal suspension components

1. Bearing sleeve
2. Screw
3. Nylon bush
4. Nut
5. Bracket
6. Return spring
7. Thrust rod
8. Locknut
9. Fork
10. Split pin bolt
11. Brake pedal

depress the brake pedal, otherwise the subsequent abnormal position of the parts of the power brake cylinder can cause damage.

The position of the pedal is adjusted by loosening the locknut (8, Fig. 5—65) and removing the split pin bolt (10) and then turning the fork (9). Do not forget after adjusting to tighten the locknut and fit the split pin.

ADJUSTING BRAKE SWITCH

On adjusting the switch, measure the distance between the brake pedal released and the threaded brass hub on the switch (dimension A, Fig. 5-64). This distance should be 4±2 mm (0.16±0.08"). If this is not the case, slacken the attaching screws for the bracket and move the bracket until the correct distance is obtained. Secure the attaching screws.

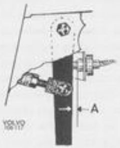


Fig. 5-64. Adjustment measurement, brake warning light switch

REPLACING PEDAL OR BUSHES

1. Remove the split pin bolt (10, Fig. 5-65). Lever off the return spring (6). Unscrew the nut (4) and pull out the screw (2). Lift the pedal (11) forwards.
2. Press out the bearing sleeve (1) and the bushes (3).
3. Clean the parts. If the bearing sleeve is worn, replace it.
4. Press the new bushes (3) in position in the pedal and lubricate them with a thin layer of ball bearing grease. Fit the bearing sleeve (1) and the return spring (6).
5. Place the pedal in position and fit the screw (2) and the nut (4). Fit on the return spring. Fit the split pin bolt (10) and the split pin.

POWER BRAKE SYSTEM

DESCRIPTION

POWER CYLINDER

This is a mechanical power device located between the brake pedal and master cylinder, see Fig. 5—6. Less pedal pressure is required when braking due to the power cylinder, which is assisted by vacuum from the engine induction manifold. The construction as well as the designation and location of the parts are shown in Fig. 5-66. The power cylinder functions as follows:

When the system is at rest, the parts of the servo cylinder are in the position shown in Fig. 5-67. The valve spring holds the valve plate pressed against the inner seat of the housing and closes the air inlet. Since the outer seat of the housing is at a level lower than the inner one, the overflow channel is opened. An equivalent vacuum exists on both sides of the diaphragm which, together with the piston plates, is held pressed against the rear end stop for the return spring.

When the brake pedal is depressed, the ingoing thrust rod is pushed forwards (to the left). The central parts of the power cylinder accompany discs which take up an oblique position due to the thrust washer pressing on the outer section of the discs. The discs press the valve plate against the outer, lower seat of the valve housing and this shuts off the overflow channel and thereby the connection between the front and rear sides of the diphragm. With continued movement forwards of the valve housing, the piston discs are positioned at a more oblique angle and, by means of the lever, they lift the valve plate center from the inner shaft of the valve housing. This opens the connection between the air inlet and the overflow channel. Outside air can then flow in behind the diaphragm. When a partial vacuum exists on the front side, the diaphragh is pushed forwards. The consequent move-

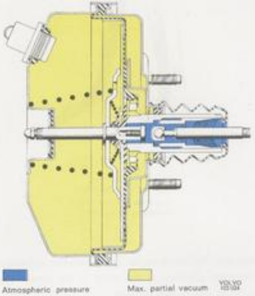


Fig. 5-67. Rest position

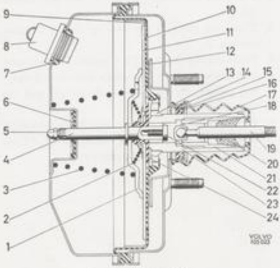


Fig. 5-66. Servo cylinder

1. Thrust washer
2. Valve spring
3. Return spring
4. Outgoing thrust rod
5. Adjusting screw
6. Sealing ring
7. Packing
8. Check valve
9. Guide
10. Diaphragm
11. Piston discs
12. Rear end
13. Relief valve
14. Guide
15. Sealing ring
16. Lock washer
17. Rubber cover
18. Air inlet
19. Ingoing thrust rod
20. Filter
21. Plastic sleeve
22. Bolt
23. Valve housing
24. Valve plate

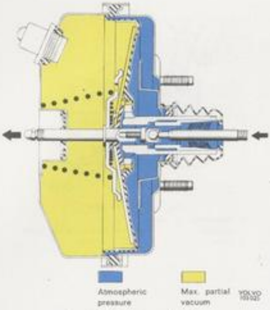


Fig. 5-68. Full brake application

If the pressure on the pedal is increased, the pressure of the valve housing on the piston discs will alson increase and thus cause the discs to take up a more oblique position. This opens the air inlet, more air can flow in and greater braking is obtained until the new equilibrium position has been reached. If the pressure on the pedal is reduced, the pressure behind the diaphragm can straighten out the piston discs and the valve plate lifts from the outer position of the valve housing. This links up both sides of the diaphragm with each other via the overflow channel. The pressure strives to reach an equilibrium, at which point the force on the rear side of the diaphragm reduces and thereby also the brake application. The spring pressure on the thrust washer pushes back the piston discs so that their oblique position becomes greater. When the new point of equilibrium has been reached, the valve pedal is fully released, all the parts of the power cylinder return to rest position and the brakes stop functioning. Should any fault occur with the vacuum supply, brake application can still take place due to the fact that the power cylinder functions as an extended thrust rod. As no power effect is then obtained, greater pressure on the pedal is, of course, required.

ment is transmitted via the thrust washer to the outgoing thrust rod. This boosts the force applied to the master cylinder. At the pedal pressure which gives maximum power effect, the parts of the power cylinder take up the position shown in fig. 5-70. The boost is then about 1:3.

If the pedal pressure is less than that mentioned above, the same procedure takes place in the beginning. When air flows to the rear side of the diaphragm and reinforces the outgoing brake pressure, it also strives to straighten out the obliquely-positioned piston discs. Since the turning point of the discs is now their contact with the thrust washer, the straightening up of the disc by pedal pressure is counteracted via the valve housing. When a power pressure corresponding to the pedal pressure has been obtained, the discs have turned so that the valve plate is against the inner seat of the valve housing, see Fig. 5-69. The air supply is shut off, the pressure behind the diaphragm remains constant and is unable to overcome the hydraulic counterpressure in the master cylinder. The moving parts of the power cylinder remain, therefore, in this position and constant braking is obtained as long as the same pressure is maintained on the pedal.

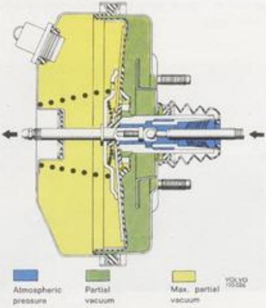


Fig. 5-69. Partial brake application

CHECK VALVE

The check valve is placed where the line from the engine intake manifold is connected to the power brake cylinder. Its purpose is to prevent air from flowing back to the power brake cylinder. The valve only opens when there is a larger degree of vacuum at connection 1 than at connection 4.

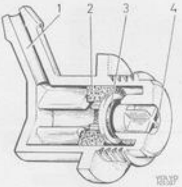


Fig. 5-70. Check valve

1. Connection for intake manifold
2. Filter
3. Valve
4. Connection for power cylinder

REPAIR INSTRUCTIONS

REPLACING CHECK VALVE

Remove the vacuum hose from the check valve. Bend out the valve with the help of two screw-drivers. Then remove the gasket.

Fit a new gasket and check that its flange fits properly into position in the cylinder, see Fig 5-71. Coat the inside of the gasket with the special grease in the repair set and carefully press in the check valve. Make sure that the gasket remains in the proper position. Connect the vacuum hose so that its highest point is at the attachment to the check valve.

REPLACING FRONT SEALING RING

Remove the master cylinder. Carefully bend out the old sealing ring without damaging the thrust rod. Wipe the outgoing thrust rod and recess wall clean and lubricate them and the new sealing ring with grease, number 649 49008.

Fit the new sealing ring with sealing flange facing outwards, see Fig. 5-72. Press the ring to the bottom. Re-fit the master cylinder.

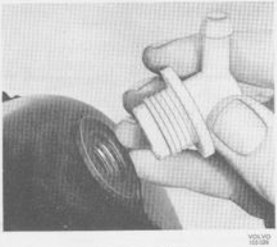


Fig. 5-71. Fitting check valve

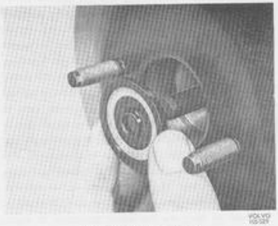


Fig. 5-72. Fitting sealing ring

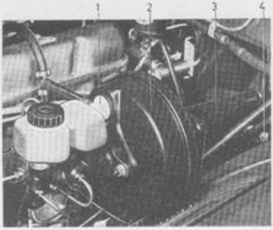


Fig. 5-73. Power cylinder fitted

1. Check valve
2. Power cylinder
3. Bracket
4. Attaching bolt

REPLACING POWER CYLINDER

REMOVING

1. Remove the master cylinder.
2. Loosen the fork from the brake pedal by removing its split pin bolt.
3. Lever the vacuum hose from the check valve. Remove the ignition coil and hose from the power cylinder.
4. Remove the attaching bolts for the brackets and lift out the power cylinder.
5. Undo the locknut (2, Fig. 5-74) and screw off the fork (1). Remove the rubber cover (4) and bracket (5). Unscrew the thrust rod (3) from the rear thrust rod of the power cylinder.

INSTALLING

1. Apply a couple of drops of Loctite type B to the power cylinder thrust rod and then screw in the thrust rod (3, Fig. 5-74) as far as possible on the power cylinder thrust rod.
2. Fit the brackets on the power cylinder. The attaching nuts should not be tightened until after the power cylinder has been fitted in the vehicle.
3. Fit the rubber cover (4) in position. Screw on the locknut (2) and fork (1). The distance between the hole center of the fork and the end (meas. A) of the thrust rod should be about 45 mm 1.8").
4. Place the power cylinder, upper attaching bolts for bracket and attaching bolt sfor support bracket in position in the vehicle. Then fit the lower attaching bolts for bracket and tighten all bolts and nuts on the brackets.
5. Fit the clamp for the ignition coil and hose and connect the vacuum hose to the check valve. Make sure that the highest point of the vacuum hose is at the connection.
6. Connect the fork to the brake pedal and lock it with the split pin. Check and if necessary adjust the pedal position.
7. Check the thrust rod clearance and fit the master cylinder. Bleed the entire brake system.

Fig. 5-74. Fitting the fork

1. Fork
2. Locknut
3. Thrust rod
4. Rubber cover
5. Bracket
6. A=approx. 45 mm (1.8")

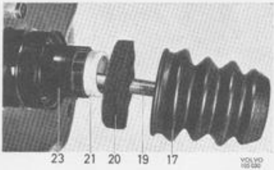


Fig. 5-75. Filter parts

17. Rubber cover
19. Ingoing thrust rod
20. Filter
21. Plastic
23. Valve housing

WORK ON REMOVED POWER CYLINDER

CHANGING AIR CLEANER

Lever off the rubber cover and pull out the old filter. Fit the new filter on the thrust rod, see Fig.

5-75. Move the filter into position in the sleeve. Fit on the rubber cover. Make sure that it is properly fitted in position at both ends.

CHANGING REAR SEALING RING

Lever off the rubber cover. Bend out the lock washer (16, Fig. 5-76). Press in the valve housing and make sure that the sealing ring and guide accompnies the valve out when it springs back. Check to make sure that the valve housing is not scored.
Lubricate the new sealing ring, valve housing and sealing areas of the new rubber cover with grease, number 649 49006.
Fit a new guide (14), sealing ring (15) and lock washer (16), see Fig. 5-76. The sealing lip and the guide bevel should face outwards. Carefully press the lock washer ring on until it just bottoms against the sealing ring all round. Fit on the rubber cover and make sure that it is properly fitted at both ends.

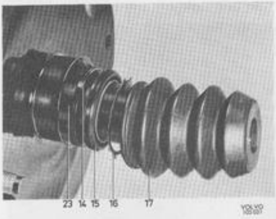


Fig. 5-76. Sealing parts

14. Guide
15. Sealing ring
16. Lock washer
17. Rubber cover
23. Valve housing

PARKING BRAKE

DESCRIPTION

The construction of the parking brake is shown in Fig. 5-77. The parking brake lever (28) 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 block (6). From here the movement is transmitted through cable (7) to the rear wheel brake units. At each 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 brakes shoes are held pressed against the anchor bolt (18) by the lower spring. The upper ends are joined through the adjusting device (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-centering 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.

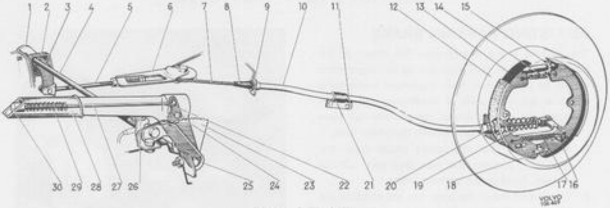


Fig. 5-77. Parking brake

1. Inside support attachment
2. Rubber cover
3. Lever
4. Shaft
5. Pull rod
6. Block
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 lever
29. Spring
30. Push button

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 "floting" suspension of the shoes, the primary shoe is thus pressed upwards and the secondary shoe downwards until the latter's lower end moves towards the anchor bolt, see Fig. 5-78. Due to the fact that the turning center 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 linigs 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.

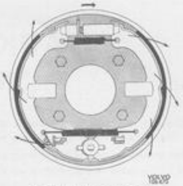


Fig. 5-78. Duo-servo principle

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, place props 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 2742 (Fig. 5-81) or by disconnecing 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. 5-79. When the drum cannot be rotated easily, discontinue applying the shoes. Then turn the adjusting screw back 4—5 serrations. Check that the 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 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.

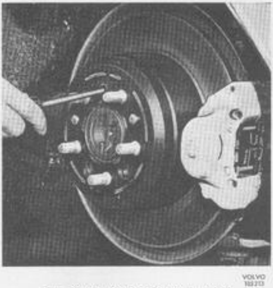


Fig. 5-79. Adjusting parking brake, rear wheel

If the parking brake can be applied past these notches, the cable should be tensioned. This is done by loosening the locknuts and screwing in the block (7, Fig. 5-80) 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 nut sufficiently so that the wheel cannot be moved. Lower the vehicle and tighten the nuts. Tighten every other nut a little at a time until all are tightened to a torque of 100—140 Nm (70—100 lb ft). Fit the hub caps.

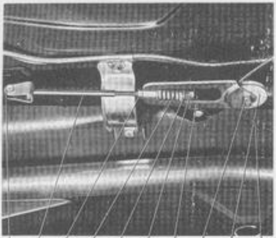


Fig. 5-80. Brake components

1. Split pin bolt
2. Pull rod
3. Stop nut
4. Spring
5. Adjusting nut
6. Locknut
7. Block
8. Nut
9. Pulley
10. Cable

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 nut (8, Fig. 5-80) and take off the pulley (9) from the block (7).
4. Remove the rubber cover (8, Fig. 5-77) from the cable sleeve front attachment and remove the nut. Remove the attachment of the rubber suspension in the frame member. Remove the cable from the other side's attachment in the same way.
5. Place holder 2742 so that the return spring is held in position according to Fig. 5-81. Bend up the lock and remove the lock pin so that the cable releases from the lever.
6. Remove the return spring with washers. Loosen the nut for the rear attachment of the cable sleev. Lift the cable forwards after having loosened both sides of the attachments.

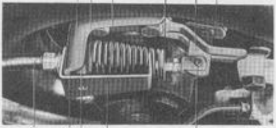


Fig. 5-81. Installing spring tool

1. Cable attachment
2. Washer
3. Return spring
4. Washer
5. Lever
6. Rubber cover
7. Lock pin
8. Holder 2742
9. Nut
10. Lock washer
11. Cable sleeve

INSTALLING

1. Adjust the brake shoes of the rear wheels. Check here 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 screwdriver handle upwards, see Fig. 5-79. 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. 5-81. Oil the lock pin and fit it together with the cable on the lever. Fit the attachment and rubber cable guide on the frame member.
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 the lock washers.
5. Lubricate the bolt and fit the block on the pull rod. Adjust so that the parking brake gives full effect at the 3rd—4th notch.
6. Fit the wheels, see operation 7 under the heading "Adjusting parking brake".

REPLACING PARKING BRAKE LEVER OR RATCHET PARTS

1. Jack up the rear end and prop up under the rear axle.
2. Remove the split pin and stretch the cable so that the pull rod (5, Fig. 5-77) 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.

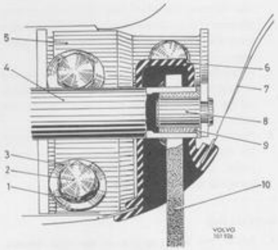


Fig. 5-82. Inner shaft support

1. Spring washer	6. Rubber cover
2. Attachment bolt	7. Floor
3. Flat washer	8. Support pin
4. Shaft	9. Bush
5. Inner support attachment	10. Lever

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. 5-77) 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. 5-77. Make sure that the rivet is firmly fixed but does not obstruct the movement of the pawl. Lubricate the bushes with a thin coat of ball bearing grease. Do not forget to lock the pull rod and make sure that the rubber covers seal well.

REAR WHEEL BRAKE UNIT (PARKING BRAKE COMPONENT)

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 up under the rear axle, remove the nuts and take off the wheels. release the parking brake.
3. Screw loose the brake line (4, Fig. 5-22) from the rear brake caliper and plug the connection. Brake fluid must not spill onto the disc or brake pads. Remove the attaching bolts (2 and 5, Fig. 5-23). Lift out the caliper.
4. Remove the attaching bolts for the brakedrum and lift off the drum, se Fig. 5-83.
5. Remove both the return springs and the adjusting device. Lift forward the shoes, see Fig. 5-84. Manipulating 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 all the parts except the brake linings. Check that the lever joint does not chafe and replace parts which are damaged or worn.

If the brake linings are oily or worn down to the rivets, replace the shoes completely. The brake drum should be replaced if its friction surface is concave, or if its out-of-round exceeds 0.2 mm (0.008"). Rust spots can, however, be polished off. Wipe the contact surfaces on the backing plate.

Fig. 5-83. Removing brake drum

Fig. 5-84. Fitting brake shoes

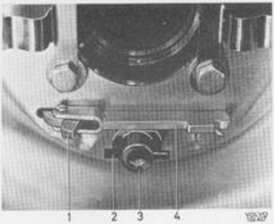


Fig. 5-85. Brake parts

1. Lever
2. Guide pin
3. Anchor bolt
4. Link

ASSEMBLING

1. If new linings or drums are to be fitted, slacken the locknut (6, Fig. 5-80) to remove tension in the cable.
2. Coat the 6 guide lips on the backing plate as well as the lever joint and adjusting screw with heat-resistant graphite grease intended for this purpose. Check that the lever and anchor bolt parts are correctly fitted, see Fig. 5-85. Check that the washer (8, Fig. 5-86) and the spring (7) are in position on the primary shoes.
3. Fit the brake shoes, see Fig. 5-84. The shorter sleeve on the adjusting device should be turned forwards on the right-hand side and backwards on the left-hand side, see Fig. 5-86.

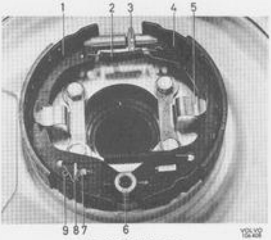


Fig. 5-86. Parking brake

1. Rear brake shoe (primary 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

4. Hook on the return spring.
5. Fit the brake drum with attaching bolts.
6. Place the brake caliper in position. Fit the attaching bolts (1 and 3, Fig. 5-23) after smearing the bolts woth 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 operations 4—6 under "Adjusting parking brake".
8. Bleed the fitted brake caliper, see Group 52.
9. Fit the wheel, see operation 7 under "Adjusting parking brake".

Part 6

FRONT END AND STEERING GEAR

CONTENTS

GROUP 60

GENERAL

TOOLS

Special tools are marked 999 or SVO (e.g. 9991801 or SVO 1801).

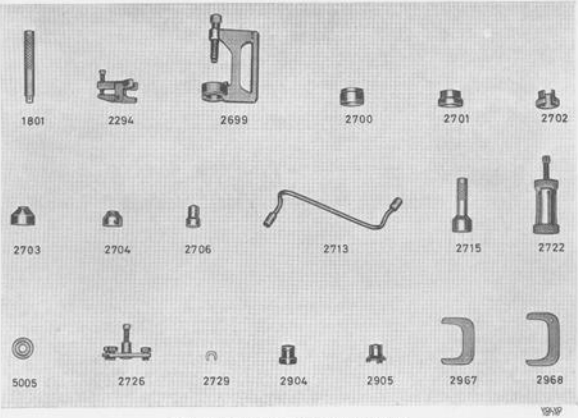


Fig. 6-1. Tools for wheel adjustment and work on front axle

999
(SVO)
1801 Standard handle 18×200
2294 Press tool, for removing ball joints, tie-rod end
2699 Press tool, for removing and fitting ball joints and rubber bushes, control arms
2700 Sleeve, removing lower ball joint
2701 Sleeve, removing and fitting upper ball joint and bushes in lower control arm, also fitting lower ball joint
2702 Sleeve, removing and fitting bushes, upper control arm
2703 Drift, fitting lower ball joint
2704 Drift, fitting upper ball joint
2706 Drift, removing and fitting bushes, upper control arm
2713 Spanner (⅝") for upper control arm shaft bolt
2715 Drift, fitting and removing grease cap on hub
2722 Puller, inner ring, inner front wheel bearing
2726 Puller, front wheel hub
2729 Spacer, removing shaft, upper control arm
2904 Drift, removing and fitting bushes for diagonal tyres, lower control arm
2905 Drift, for removing and fitting bushes for radial tyres
2967 Gauge for lower ball joint, type 1
2968 Gauge for lower ball joint, type 2
5005 Drift, for fitting outer ring, inner front wheel bearing and spacer hub

For removal and fitting of front end complete, engine lift tool 2727 is also used, see Fig. 6-16.

Fig. 6-2. Tools for work with removed front axle

999
(SVO)
2520 Stand for fixture
2560 Fixture
2868 Press tool for spring

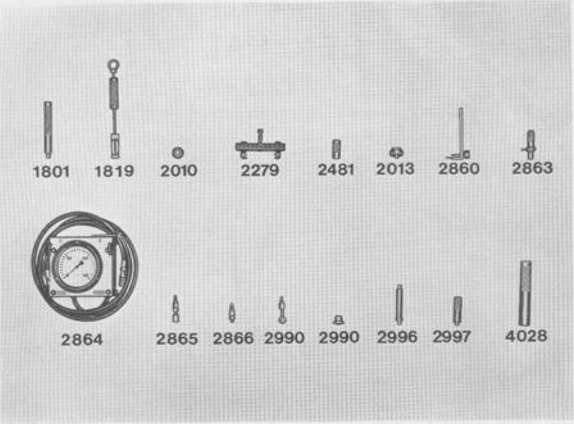


Fig. 6-3. Tools for work on power-assisted steering

999
(SVO)
1801 Standard handle 18×200
1819 Extractor for needle bearings
2010 Drift for fitting upper sealing ring
2013 Drift for fitting bearing ring
2279 Puller for pulley
2481 Sleeve for fitting bearing sleeve
2860 Extractor for sealing ring
2863 Drift for fitting sealing ring
2864 Test instrument
2865 Connection nipple for 2864
2866 Connection nipple for 2864
2990 Connection nipple for 2864 (R-H steered vehicle)
2990 Drift for fitting needle bearing and sealing ring
2996 Drift for removing and fitting needle bearing, pump
2997 Drift for fitting sealing ring, pump
4028 Drift for fitting lower sealing ring

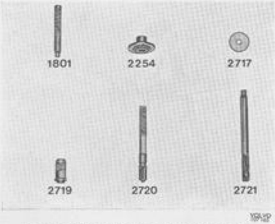


Fig. 6-4. Tools for work on removed mechanical steering

999
(SVO)
1801 Standard handle 18×200
2254 Guide for reamer SVO 2721
2717 Drift, for fitting upper bearing race, steering worm
2719 Sleeve, for fitting sealing ring, pitman arm shaft
2720 Tool for removing bush, pitman arm shaft
2721 Reamer for bush, pitman arm shaft

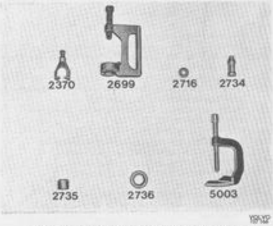


Fig. 6-5. Tools for work on other steering components

999
(SVO)
2370 Puller, pitman arm
2699 Press tool, for removing and fitting bushes on relay arm
2716 Drift, for fitting bush, pitman arm shaft
2734 Drift, for removing bush, relay arm
2735 Drift, for fitting bush, relay arm
2736 Counterhold, for removing and fitting bush, relay arm
5003 Puller for steering wheel

WHEEL GEOMETRY

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. 6-6).

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. 6-7) and negative if the wheel inclines inwards. Faulty camber causes uneven tyre wear.

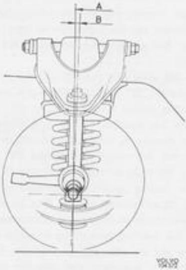


Fig. 6-6. Caster
A=Vertical line
B=Caster

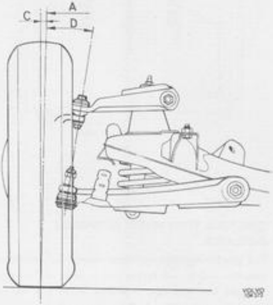


Fig. 6-7. Camber and king pin inclination
A=Vertical line C=Camber D=King pin inclination

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. 6-7).

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 lifts very sligtly 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. 6-8.

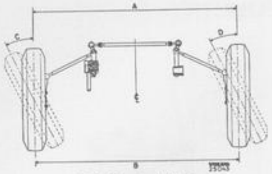


Fig. 6-8. Toe-out and toe-in

CHECKING WITH WHEEL ALIGNMENT INDICATOR

The wheel alignment indicator should be calibrated between —2 to +5 m/km and is used as follows: Straight line with the indicator when the car is about 2 metres (6½ ft) from the indicator. **Let go** the steering wheel and slowly drive over the indicator plate (2—4 kmph=2½ miles). NOTE. The steering wheel must **not** be touched until the front wheels have come on the other side of the indicator.

If the green lamp on the indicator board remains lighted, then the front end is properly adjusted and the wheels are properly aligned.

If one of the red lamps light, and a buzzer starts buzzing, then there is something wrong with the front wheel alignment and it should be adjusted.

PROCEDURE BEFORE WHEEL ADJUSTING

Wheel angles can be influenced by the factors listed below. Therefore, before measuring and adjusting, any faults should be remedied.

1. Check tyre pressure and wear.
2. Play in front wheel bearings.
3. Play in ball joints or control arm attachments.
4. Broken springs.
5. Abnormal (temporary) equipment or loading.

Other factors which can influence the steering during driving without being revealed when measuring the wheel angles are:

1. Wheel out-of-true more than 2.5 mm (0.1").
2. Poor shock absorbers.
3. Faulty steering gear 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 type. 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 kin pin inclination cannot be measured directly. Instead, the angular alteration which occurs when the wheel is turned from 20° outwards to 20° inwards is measured on the instrument.

Most types of modern wheel alignment measuring instruments require that the wheels are locked with, for example, the help of a pedal jack. When measuring the toe-in, the so-called "wheel spreader" should be applied at the front between the wheels at a spring force of 100—150 N (22—33 lb). When measuring the wheel angles, follow the instructions for the measuring instruments concerned.

CHECKING KING PIN INCLINATION

The king pin inclination, which on this vehicle is represented by the inclination of the centreline of the ball joints, should be 7.5° at a camber of 0°. This cannot be adjusted and is difficult to measure exastly due to the tension and resilience in the parts, so that the angle read off on the instruments will not be the exact king pin inclination but can serve as a guide.

CHECKING TOE-OUT

1. Before running the vehicle front wheels onto turntables, set the turntables to zero and lock-them. Make sure the wheels point straight ahead.
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 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 possibilites, but if the toe-out is incorrect, the steering arms and steering rods should be checked. Replace any parts that are damaged.

ADJUSTING WHEEL ANGLES

NOTE. The front wheel angles are always adjusted in the following order:

1. Caster
2. Camber
3. Toe-in

To save time and labour, caster and camber should be adjusted at the same time, see under "Adjusting the camber".

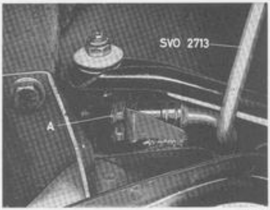


Fig. 6-9. Adjusting the caster and camber
A=Shims

CASTER

The caster for each wheel should be within a tolerance range of 1° to +2°, that is, min 1° and max. 2° positive. The difference between both sides should not, however, exceed $\frac{1}{2}$°.

To adjust, slacken the special bolts at the upper control arm shaft with tool 2713 (Fig. 6-9). Use one end of the tool for the front bolt and the other for the rear bolt. After the bolts have been slackened several turns, the requisite number of shims can be either removed or added, whichever is the case. Positive caster is obtained by either **adding** shims to the **rear** bolt or **removing** shims at the **front** bolt.

The diagram in Fig. 6-8 shows the shim thicknesses required for a certain alteration in angle. Shims are stocked in thicknesses of 0.15—0,5—1.0—3.0 and 6.0 mm (0.006—0.020—0.039—0.12 and 0.24"). The caster is altered to the same extent by either

1. removing a shim at one of the bolts,
2. adding a shim to the other bolt,
3. moving over half of the required shim thickness from one bolt to the other.

For proper camber, adjustment should be according to alternative 3.

After adjustment has been carried out, tighten the bolts to a torque of 55—70 Nm (40—50 lbft).

CAMBER

The camber for each wheel should be within a tolerance range of 0° to +$\frac{1}{2}$°, that is, it should be min. 0° and max. $\frac{1}{2}$° positive.

To adjust, slacken the special bolts at the upper control arm shaft several turns with tool 2712(Fig. 6-9). Use one end of the tool for the front bolt and the other for the rear bolt. Then either increase or reduce the number of shims equally for both bolts. More **positive** camber is obtained by **removing** shims, and **negative** camber by **increasing** the number of shims.

The shim thickness required for a certain alteration in angle is shown in the diagram in Fig. 6-10. Shims are stocked in thicknesses of 0.15—0.5—1.0—3.0 and 6.0 mm (0.006—0.020—0.039—0.12 and 0.24"). The camber is altered by removing or adding an equal number of shims at both the bolts.

After adjustment has been carried out, tighten the bolts to a torque of 55—70 Nm (40—50 lbft).

To save time and labour adjust the caster and camber at the same time by removing or adding shims for the camber and altering the number of shims for the caster. If, for example, the camber is increased 0.6° and the caster $\frac{1}{4}$°, 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.

TOE-IN

Toe-in should be 2—5 mm ($\frac{1}{8}$") with the wheel spreader. Incorrect toe-in is adjusted by slackening the locknuts on the tie rod, after which the rod is turned in the required direction. The distance between the tyres at the front is reduced, that is to say, toe-in is increased by turning the tie-rod in the normal direction of rotation of the wheels. Tighten the locknut after adjustment to a torque of 75—90 Nm (55—65 lbft).

Fig. 6-10. Diagram for alteration of caster and camber

I = Camber
II = Caster
A = Shims (mm)
B = Alteration of angle

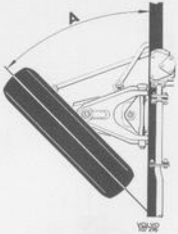


Fig. 6-11. Adjusting max. wheel lock
A=40—41° without power steering
38—39° with power steering

ADJUSTING STEERING LIMITS

Turning of the wheels is limited by stop screws at the pitman arm (Fig. 6-12) and at the relay arm. Adjusting is done as follows:

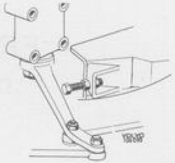


Fig. 6-12. Adjusting screw, max. wheel lock

1. Turn the left wheel for a left-hand turn as far as it goes. Check the wheel lock according to Fig. 6-11. If the lock is not as in this figure, then adjust to this angle with the adjusting screw (Fig. 6-12).
2. Repeat this procedure with the right wheel and the stop screw on the other arm.
   NOTE. Check that brake hoses are clear at full wheel lock.

FRONT AXLE

DESCRIPTION

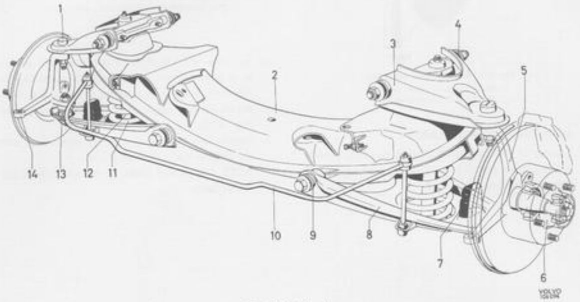


Fig. 6-13. Front axle

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. Coil 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 robust box-section front axle member, which is bolted to the self-supporting body. The front wheel suspension and springs are fitted at the ends of the member. The construction is illustrated in Fig. 6-13.

The steering knuckle is pivoted on the upper and lower control arms by means of ball joints (1 and 13) which are pressed into the control arms. The control arms shafts are carried in rubber bushes (4 and 9), which are journalled in the control arms. 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. 6-9).

The front wheels are carried in taper roller bearings Fig. 6-13. The front spring assembly consists of coil springs (11) inside which telescopic shock absorbers (12) are fitted. In order to increase its anti-roll properties, the car is equipped with a stabilizer (10) which is attached partly to the lower control arm and partly to the body.

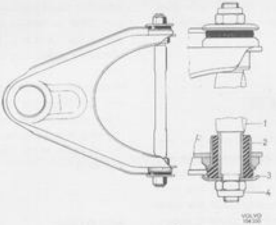


Fig. 6-14. Upper control arm
1. Control arm shaft 2. Bush 3. Washer 4 Nut

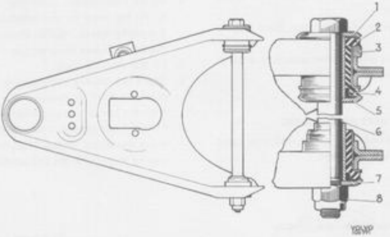


Fig. 6-15. Lower control arm

1. Washer
2. Rubber ring
3. Spacer ring
4. Bush
5. Washer
6. Control arm shaft
7. Washer
8. Nut

REPAIR INSTRUCTIONS

GENERAL

The ball joints require no lubrication and are therefore not fitted with lubricating nipples. However, the rubber seal should be inspected every 20 000 km (12 000 miles) and if necessary replaced when grease has to be added.

The control arms may only be straightened to a minor extent and then only in a cold condition. If the old part deviates to any great extent when compared to a new one, it should be replaced.
No straightening whatsoever is permitted for stub axles with steering knuckles.

The **tightening torque** is given in the "Specifications". Otherwise the standard torque applies for the respective bolting.

FRONT END COMPLETE

REMOVING

1. Install the lifting tool 2727 according to Fig. 6-16. Fix the plate with the upper screw (no flat washer) for the timing gear casing. Raise the engine until the weight is taken off the front engine mountings. Temporarily block the vent-hole in the brake fluid container cover to reduce leakage. Remove the hub caps and loosen a couple of turns the nuts for the front wheels.
2. Jack up the vehicle under the front jack attachment. Remove the front wheels.
3. Disconnect the steering rods from the steering arms with tool 2294 according to Fig. 6-21.
4. Remove the brake hose clamps from the stabilizer screws and remove the screws.
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 screws, lower and remove the front end.

DISASSEMBLING AND ASSEMBLING

Fixture 2560 and stand 2520 can suitably be used for work on a removed front end.

After the shock absorber has been removed, place tool 2868 as shown in Fig. 6-17. Compress the spring by screwing the spindle until there is clearance at the rubber buffer of the upper control arm.

Concerning other instructions, see under "Removing" and "Installing" for the various components.

If the rubber buffer which limits the engine mounting stop is to be replaced, place the new buffer on the rear side of the front axle member as shown in Fig. 6-18.

INSTALLING

1. Fix 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 mountings.
4. Fit the brake hoses according to Fig. 5-15 (Part 5). Fit the bolts for the stabilizer. Firmly secure the brake hoses. NOTE. Check the location of the brake hoses according to Fig. 5-15 (Part 5).
5. Fit the steering rods.
6. Bleed the brakes according to the instructions given in Part 5. Remove the temporary seal from the brake fluid container cap.
7. Fit the front wheels. Lower the vehicle and remove the lifting device. Then fit the timing gear casing screw with the flat washer.

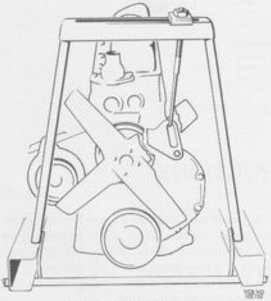


Fig. 6-16. Lifting tool for engine

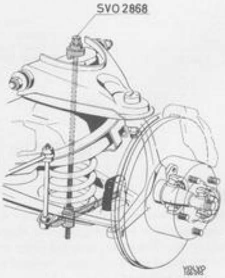


Fig. 6-17. Compressing spring

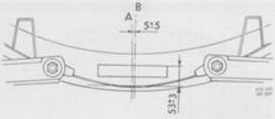


Fig. 6-18. Locating rubber buffer
A. Member centreline B. Buffer centreline

STEERING KNUCKLE

REMOVING

1. Remove the front wheel brake unit according to Part 5, "Removing the front wheel brake unit", points 1—4.
2. Remove the grease cap with tool 2715. Remove the split pin and castle nut. Pull off the hub with puller 2726, see Fig. 6-19. Pull off the inner bearing for the steering knuckle with tool 2722, see Fig. 6-20.
3. Remove the steering rod from the steering arm with tool 2294, see Fig. 6-21.
4. Slacken but do not remove the nuts for the ball joints and 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 steering knuckle.

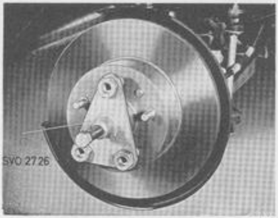


Fig. 6-19. Removing front wheel hub

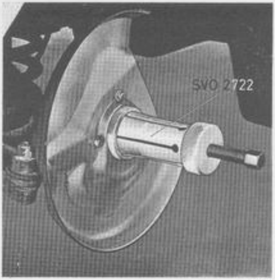


Fig. 6-20. Removing inner bearing

EXAMINING BEARING COMPONENTS

Clean the hub and grease cap thoroughly. Make sure that all the old grease, even inside the hub is removed. Compressed air can suitably be used for a comprehensive cleaning of the bearings. Then wash the bearing components in white spirit and allow them to dry. Drying by means of compressed air should be avoided since the air often contains water and dust particles. Accessible bearing components are dried with cotton or cloth rags (but not waste). The bearing surfaces must be dry of cleaning fluid in order not to reduce the adhesion of the grease which is 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,

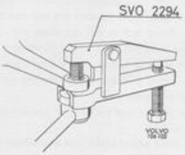


Fig. 6-21. Removing steering rod

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 by hand 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 bearings not greased remain unprotected. Observe the greatest cleanliness when fitting them.

INSTALLING

1. Place the inner bearing in position in the hub and press in the sealing washer (1, Fig. 6-20) until it goes against the bearing outer ring. Use drift 5005 and standard handle 1801.
2. Place the steering knuckle in position and tighten the ball joint nuts. If the ball joint twists, hold it firmly in position with a screw vice (see Fig. 6-22). Fit the steering rod onto the steering arm.
3. Press the sealing ring (2, Fig. 6-20) onto the steering knuckle without the tool until it bottoms. It is important that the ring is not fitted at an angle.
4. Place the hub on the steering knuckle, fit the outer bearing, washer and castle nut.
5. Adjust the front wheel bearings by tightening the nut with a torque wrench to a torque of 70 Nm (50 lbft). 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 steering knuckle, slacken the nut further until the split pin can be fitted. Check that the wheel rotates easily but without any play.
6. Fill the grease cap half full of grease and fit it with tool 2715.
7. Fit the front wheel brake unit and wheel according to Part 5 "Fitting front wheel brake unit".

Fig. 6-22. Fitting sealing ring

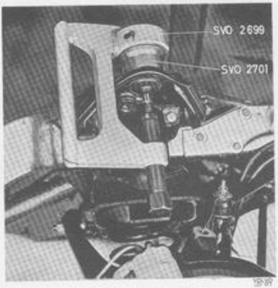


Fig. 6-23. Removing upper ball joint

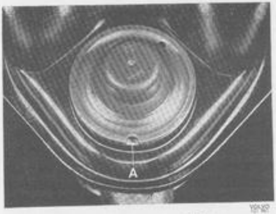


Fig. 6-24. Location of upper ball joint
A=Slot

UPPER BALL JOINT

CHECKING WEAR

In principle this check can be made with the front end either jacked up or lowered. However, the upper control arm should not be against the rubber stop.

Check to see whether the ball joint has any **radial** clearance by bending up the wheel. If there is radial clearance, the upper ball joint should be replaced. Note: Do not mix up possible play in the wheel bearings with clearance in the ball joint.

Axial clearance should not be measured for the upper ball joint.

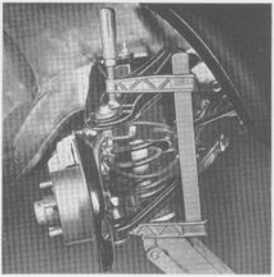


Fig. 6-26. Upper ball joint securely held by vice

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 axle with a wire to avoid straining the brake hoses. See Fig. 6-23.
4. Loosen the nuts for the control arm shaft a ½ turn. Lift up the control arm slightly and press out the ball joint with press tool 2699 and sleeve 2701, see Fig. 6-23.

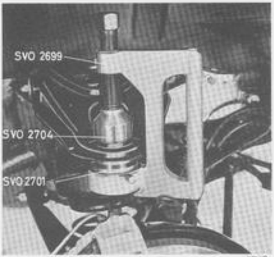


Fig. 6-25. Fitting the upper ball joint

INSTALLING

1. Before fitting the ball joint, check that the rubber cover is filled with grease. Bend the pin end over the slot, see Fig. 6-24. Check that the grease forces its way out. If necessary top up with multipurpose grease.
2. Press the ball joint into the control arm with press tool 2699, sleeve 2701 and drift 2704, see Fig. 6-25. Make sure that the ball joint recess comes in line with the longitudinal shaft of the control arm (within ±8°) either externally or internally, see Fig. 6-24, as the pin has maximum movement along this line. Should the ball joint be incorrectly fitted when being pressed in, turn the tool 2699 half a turn and then press the ball joint into the correct position.
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. 6-26.
4. Fit the wheel and wheel nuts. Lower the vehicle and tighten the wheel nuts to a torque of 100—140 Nm (70—100 lbft). Fit the hub cap.

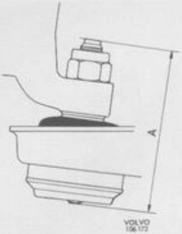


Fig. 6-27. Lower ball joint, type 1 (without spring)
A=Max. 99.3 mm (3.91")

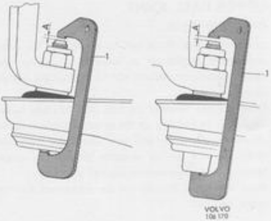


Fig. 6-29. Approved ball joints
1. 2967 for ball joint type 1
2968 for ball joint type 2
A=Clearance

LOWER BALL JOINT

CHECKING WEAR

There are two types of lower ball joints. Type 2 (Fig. 6-28) has a built-in spring, while type 1 (Fig. 6-27) does not have such a spring.

This tool is available for marking a quick check on the lower ball joint in its operationg 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. 6-29) can be fitted over the ball joint, then the joint can be approved. If the length of the ball joints is greater than the tool span (see Fig. 6-30), the ball joint should be replaced.

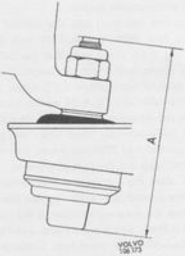


Fig. 6-28. Lower ball joint, type 2 (with spring)
A=Max. 113 mm (4.5")

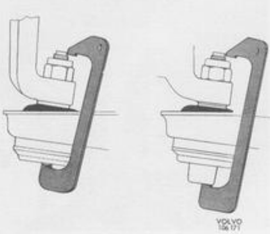


Fig. 6-30. Worn ball joints

REMOVING

1. Remove the hub cap and slacken the wheel nuts slightly.
2. Jack up the vehicle under the front jack attachment. Remove the wheel.
3. Disconnect the steering rod from the steering arm with tool 2294, see Fig. 6-21, and disconnect the brake lines from the stabilizer bolt.
4. Loosen the nuts for the upper and lower ball joints, but do not remove them. Knock with a hammer until the ball joints loosen from the axle. Raise the lower control arm with the jack. Remove the nuts.
5. Remove the steering knuckle with hub and the front wheel brake unit, and place them on a stand or similar.

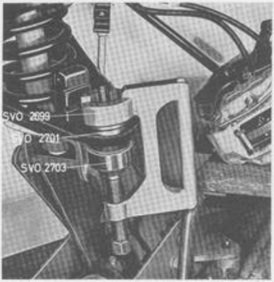


Fig. 6-32. Fitting lower ball joint

INSTALLING

1. Press the ball joint out of the lower control arm with press tool 2699 and sleeve 2700, see Fig. 6-31.
2. Check that the rubber cover 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 rubber cover with grease.

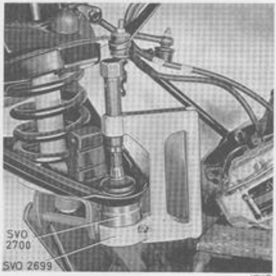


Fig. 6-31. Removing lower ball joint

3. Press the ball joints into the control arm with tools 2699+2701+2703, see Fig. 6-32. Should the ball joint not fit correctly, turn the tool 180° and tighten finally with the tool in this position. The ball joint must not be loose in the control arm.
4. Fit 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, see Fig. 6-26. Fit the steering rod and lower the jack in order to take the load off the control arms. Point the wheels straight forwards and fasten the brake hoses to the stabilizer screw.
5. Fit the wheel. Lower the vehicle and tighten the wheel nuts. Fit the hub cap.

UPPER CONTROL ARM

REMOVING

1. Carry out operations 1—3 described in "Replacing upper ball joint".
2. Remove the screws for the control arm shaft with tool 2713, see Fig. 6-9.

   NOTE. Keep the shims in a safe place. Lift off the control arm.

Fig. 6-33. Removing control arm shaft. 1. Removal tool 2729

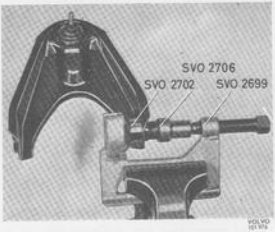


Fig. 6-35. Fitting first rubber bush, upper control arm

REPLACING BUSHES

1. Remove the nuts (4, Fig. 6-14) and the washers (3) for the control arm shaft.
2. Fix the control arm shaft securely in a vice. Carefully bend out the control arm ends so that tool 2729 can be fitted, see Fig. 6-33. Drive out one of the bushes with a fiber club and tool 2702, see Fig. 6-34. Turn the control arm, move tool 2729 over to the other side and drive out the other bush in the same way as for the first one.
3. Hold press tool 2699 firmly in a vice. Press in one of the bushes with tool 2702 and tool 2706, see Fig. 6-35.
4. Fit the control arm shaft and press in the other bush with the sleeve 2702 + drift 2706, see Fig. 6-36. Make sure that the shaft fits the recess of the tool 2702.
5. Fit the washers (3) and the nuts (4). Tighten the nuts when the control arm is fitted.

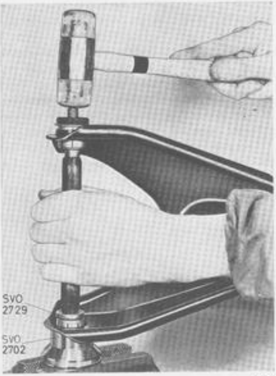


Fig. 6-34. Removing control arm shaft. 2. Driving out shaft

FITTING

NOTE. The control arms is fixed with a special screw containing a nylon plug.

1. Place the control arm in position and fit the screw by hand. Fit the shims in the position they occupied previously. Tighten the screws with tool 2713. Tighten the nuts for the control arm shaft to a torque of 55—62 Nm (40—45 lbft).

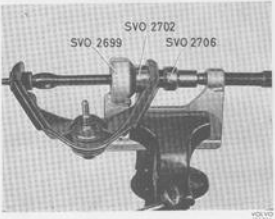


Fig. 6-36. Fitting second rubber bush, upper control arm

2. Fit the upper ball joint in the steering knuckle and tighten the nut.
3. Fit the wheel and wheel nuts. Lower the vehicle and tighten the wheel nuts to a torque of 100—140 Nm (70—100 lbft). Fit the hub cap.

LOWER CONTROL ARM

REMOVING

1. Remove the hub cap and loosen the wheel nuts a couple of turns.
2. Jack up the vehicle at the front jack attachment. Remove the wheel.
3. Remove the shock absorber, see Part 7, "Removing shock absorber".
4. Disconnect the steering rod from the steering arm with tool 2294, see Fig. 6-21. Loosen the clamp for the brake hoses. Remove the screw for the stabilizer.
5. Place the jack under the lower control arm. Loosen the nuts for the ball joints, and knock with a hammer until the ball joints loosen from the steering knuckle. Remove the nuts and lower the jack. Remove the steering knuckle with the front brake wheel unit and place them on a stand or suchlike.
6. Then lower the jack and remove the spring.
7. Remove the nut from the control arm shaft and take off the latter. 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.

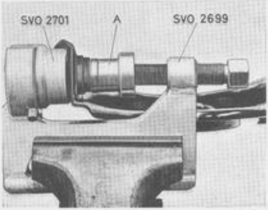


Fig. 6-37. Removing bush, lower control arm
A=2904 for bushes intended for diagonal tyres and 2905 for radial tyres

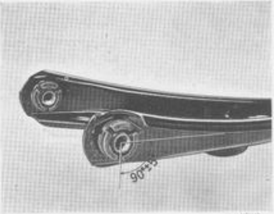


Fig. 6-38. Bushes for radial tyres

REPLACING BUSHES

Note that there are special bushes intended for radial tyres. When about to replace the bushes, bear in mind if the vehicle is fitted with radial or diagonal tyres.

1. Tension the press tool 2699 in the vice. Remove the washer (1, Fig. 6-15), the rubber ring (2) and the spacer ring (3). Press the bushes out with counterhold 2701. Use drift 2904 for bushes where diagonal tyres are fitted and 2905 for radial tyres. The tools are placed as shown in Fig. 6-37. The bushes are, of course, pressed out in the direction towards their flanges.
2. Press in the bushes with control arm and drift (A, Fig. 6-37) facing in the opposite direction.

Note. Both the bushes should be faced with the flange towards the rear in the vehicle, see Fig. 6-15. 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. 6-38.

INSTALLING

1. Supplement the control arm with rings and washers as shown in Fig. 6-15. Fit the control arm in position.
   Fit the control arm shaft. Keep the control arm fairly horizontal and tighten the nut for the control arm shaft.
2. Fit the spring. Raise the jack and fit the steering knuckle according to point 8 in "Replacing ball joint, lower control arm".
3. Fit the shock absorber according to Part 7, "Installing shock absorber".
4. Fit the wheel. Lower the vehicle. Tighten the wheel nuts. Fit the hub cap.

STEERING GEAR

DESCRIPTION

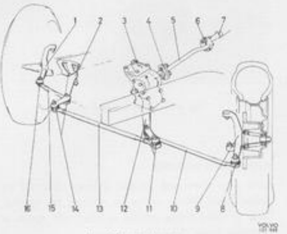


Fig. 6-39. Steering gear

1. Steering knuckle, right
2. Relay arm
3. Steering box
4. Lower steering column flange
5. Lower steering column section
6. Upper steering column flange
7. Upper steering column section
8. Ball joint
9. Steering knuckle, left
10. Steering rod, left
11. Ball joint
12. Pitman arm
13. Tie rod
14. Ball joint
15. Steering rod, right
16. Ball joint

GENERAL

The layout of the steering is shown in Fig. 6-37. Movement of the steering wheel is transmitted to the wheels via the divided column (7 and 5), the steering box (3), the pitman arm (12), the tie rod (13), the steering rods (10 and 15) as well as the steering knuckles (1 and 9).

The vehicle may have a mechanical steering gear or power steering. In the latter case, the steering gear also includes a power pump and oil reservoir.

STEERING COLUMN JOURNALLING

The steering column is divided. Its upper section is journalled by means of two ball bearings in a jacket, which is attached to the body by means of a rubber bush (4, Fig. 6-40) and slide (6). The lower and upper sections of the steering column are linked by means of a safety device (1). In the event of frontal collision causing compression of the front end, the lower steering column flange breaks loose from that of the upper section and the lower section pushes upwards. The upper section remains in position and this eliminates possibility of the steering wheel being forced backwards and upwards inside the car.

On the other hand, the entire steering column journalling can be pushed forwards-downwards if, e.g., the driver is thrown against the steering wheel.

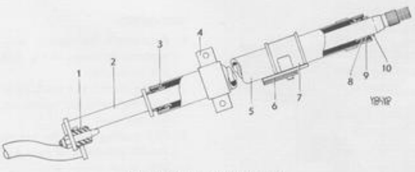


Fig. 6-40. Steering column journalling

1. Safety mechanism
2. Upper steering column section
3. Lower bearing
4. Lower attachment
5. Steering column jacket
6. Upper attachment
7. Steering wheel lock
8. Upper bearing
9. Seat
10. Spring

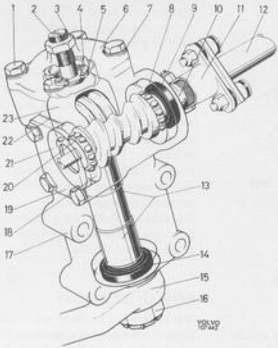


Fig. 6-41. Steering gear

1. Bolt
2. Adjusting screw, sector shaft
3. Locknut
4. Circlip
5. Adjusting washer
6. Cover
7. Tab washer
8. Upper ball bearing worm
9. Oil seal, worm
10. Worm
11. Flange
12. Lower steering column section
13. Bushes, sector shaft
14. Oil seal, sector shaft
15. Pitman arm
16. Nut
17. Steering housing
18. Lower bearing race, worm
19. Worm cover
20. Lower ball bearing, worm
21. Washer
22. Spacer
23. Sector shaft

MECHANICAL STEERING GEAR

The steering gear is of the "worm and roller" type and its construction is shown in Fig. 6-41. It has a ratio of 17.5:1. The worm (10) is journalled in two ball bearings (8 and 20) and it is tensioned by means of shims (22). The pitman arm shaft (sector shaft) is journalled in two bushes (13) and its roller in two needle bearings. Since the roller mesh in the steering worm is determined by the axial position of the pitman arm shaft, the adjusting screw (2) regulates the steering gear clearance. The steering gear is lubricated with hypoid oil.

STEERING RODS AND RELAY ARM

The ball joints of the steering rod are plastic-lined, which makes maintenance lubrication unnecessary. The tie rod (13, Fig. 6-39) has replaceable ball joints (p-ends) while the ball joints of the steering rods (10 and 15) are made in one piece with the rod.

The relay arm (Fig. 6-67) 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".

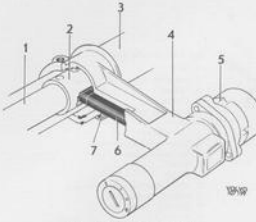


Fig. 6-42. Steering wheel lock

1. Steering shaft
2. Lock sleeve
3. Steering column
4. Steering wheel lock
5. Contact
6. Lock pin
7. Attachment

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 dash-board with two screws.

POWER STEERING

This vehicle can be fitted with the ZF recirculating ball and nut type power steering. The main components of the power steering gear are the steering gear, power pump and oil reservoir with filter. These are connected to the various oil lines, see Fig. 6-43. The number of steering wheel turns from lock to lock is 3.7.

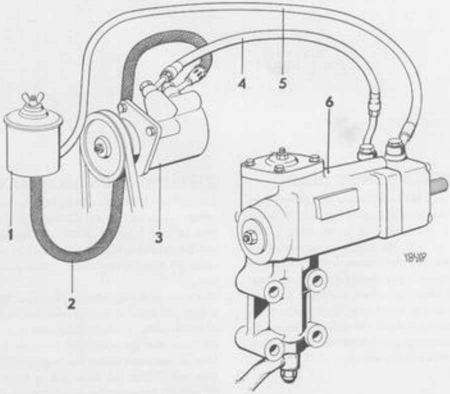


Fig. 6-43. Power steering

1. Oil reservoir with filter
2. Pump suction line
3. Power pump
4. Delivery oil line
5. Return oil line
6. Steering gear

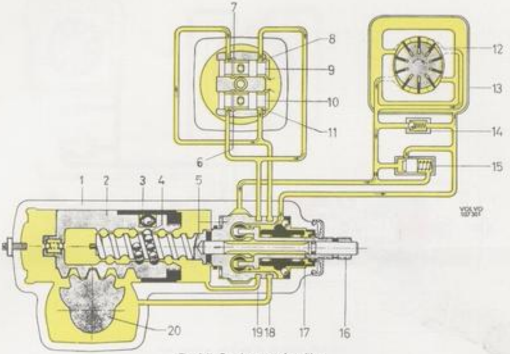


Fig. 6-44. Function, neutral position

1. Steering housing
2. Piston
3. Recirculation pipe ball nut
4. Balls
5. Worm
6. Return groove
7. Return groove
8. Intake port
9. Control valve
10. Control valve
11. Intake port
12. Power pump
13. Oil reservoir
14. Safety valve
15. Flow control valve
16. Steering spindle
17. Torsion bar
18. Annular groove
19. Annular groove
20. Pitman arm shaft

Power steering gear

CONSTRUCTION

The power steering gear is of the ball nut type. In addition to the mechanical section, the power cylinder and control valves are built into the steering housing. The lower part of the steering housing (1, Fig. 6-44) is in the form of a cylinder in which the piston (2) is fitted. On the one side the piston is in the form of a rack gear which meshes with the tooth segment of the sector shaft (20).

The axial movement of the piston, which determines the direction the wheel turns, is obtained via the worm (5) and ball nut. The recirculating balls (4) are located in annular grooves and form the thread for the nut. Movement of the worm comes from the steering column at the steering spindle (16) and the torsion bar (17) secured in the spindle. The worm is journalled in the upper section of the steering housing partly by means of an axial thrust needle bearing and partly by means of a taper ball bearing.

The inner race of the taper ball bearing also is an outer race for the double needle bearings of the steering spindle.

The worm head has two control valves (9 and 10): they are drawn out in the figures. These valves are influenced by two pins in the lower end of the steering spindle (16).

The pitman arm shaft (20) is journalled in the steering housing and side cover by means of needle bearings, see Fig. 6-46. 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 sector shaft and the steering cam thread. Fig. 6-43 shows the steering gear for left-hand steering while Figs. 6-44—6-46 show that for right-hand steering. The following description of the function applies to both.

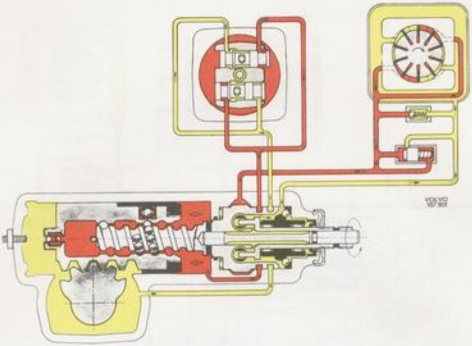


Fig. 6-45. Principle of function, left-hand turn
Concering references to numbers, see Fig. 6-44

FUNCTION

The location of the steering valves as well as that of the oil flow are shown schematically in Figs. 6-44, 6-45 and 6-46. In order to illustrate more clearly how the valves are connected to the part of the housing where the power 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.

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.6-44) 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 reservoir.

When the steering wheel is turned to the left (see Fig. 6-45) movement is transmitted via the control spindle (16) and the torsion bar (17) to the worm (15), so that the piston 2) is screwed to the left in the figure (downwards in the vehicle). Since the torsion bar is resilient, the steering spindle will be turned in relation to the worm and thus influence the valves placed in the worm. The greater the turning movement, the greater will be the valve displacement. One of the 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 bar.

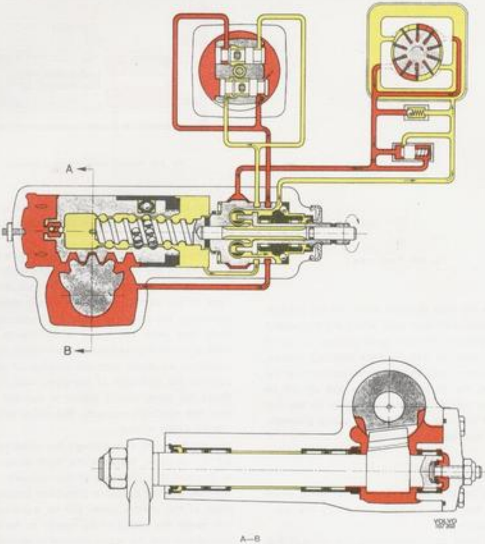


Fig. 6-46. Function, right-hand turn

Turning the steering wheel to the right (see Fig. 6-46) 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 reservoir (13).

Power pump

The power pump (Fig. 6-47) 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. 6-46. This permits the area between the rotor, the wall of the intermediate piece and two of the vanes to alter when the rotor rotates. When a couple of vanes are moved from the suction side to the pres-

Fig. 6-47. Power pump

sure 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. 6-48) maintains the valve pressed to the left of the spring (7). The oil supplied by the pump passes through the delivery channel (3) via the check valve (2) out into the delivery line (1) and from there to the steering housing. The space to the right of the

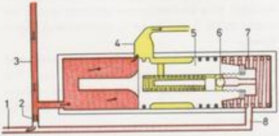


Fig. 6-48. Control valve, normal position

1. Delivery line
2. Check valve
3. Delivery channel
4. Return channel
5. Control valve
6. Safety valve
7. Spring
8. Link channel

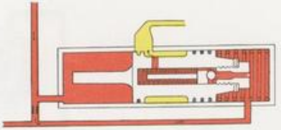


Fig. 6-49. Control valve, maximum pressure

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. 6-48. 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/cm^2 (1066 psi) the spring pressure on the safety valve (6) is overcome, that is, the inner part of the control valve, and oil can then pass out to the return channel (4). See Fig. 6-49. 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 reservoir

The oil reservoir is placed in the engine compartment where it is easily accessible. It is provided with a filter, from the center of which oil is sucked to the pump. By means of the by-pass valves, oil can flow past the filter should it become blocked. The oil level can be seen against the level line after removing the cap.

REPAIR INSTRUCTIONS

GENERAL

The ball joints for the tie rod and steering rods are plastic-lined. For this reason, they do not require any maintenance. Since sealing is most important with regard to the lifetime of these ball joints, the ball joints should be checked every 10 000 km (6 000 miles) to make sure that their rubber seals are intact. If they are craked or damaged in any other way, they should be replaced. When fitting, fill the rubber seals with universal grease. With regard to **tightening torque**, see "Specifications". Otherwise the standard torque for the respective bolts apply.

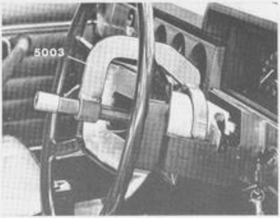


Fig. 6-51. Removing steering wheel

REPLACING STEERING WHEEL

Removing

1. Lever loose the impact guard (5, Fig. 6-50).
2. Unscrew the attaching screws for the upper part of the directional indicator switch housing and lift it off.
3. Remove the steering wheel nut.
4. Set the wheels straight forwards. Fit steering wheel puller 5003 according to Fig. 6-51 and pull off the steering wheel.

Installing

1. Make sure that the wheels are pointing straight forwards.
2. Place the steering wheel in position with the slip contact to the left.
3. Fit the steering wheel nut. Tightening torque is 30—40 Nm (20—30 lbft).
4. Fit the impact guard and test the horn.
5. Fit the upper part of the directional indicator switch housing.

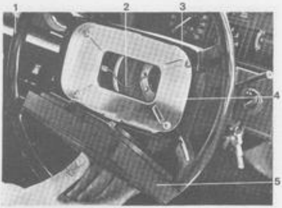


Fig. 6-50. Steering wheel components

1. Steering wheel
2. Collapse mechanism
3. Housing
4. Horn ring
5. Impact guard

STEERING COLUMN JOURNALLING

The upper bearing can be replaced separately. If the lower bearing is damaged, the steering column shaft must be replaced complete.

Replacing upper bearings

1. Remove the steering wheel, se under "Replacing steering wheel". Remove the upper part of the directional indicator switch housing.
2. Remove the directional indicator switch from its attachment on the steering wheel column.
3. Remove the attachment from the steering column.

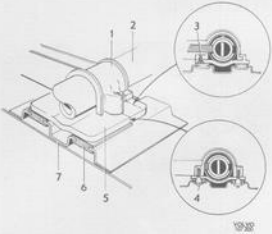


Fig. 6-52. Upper attachment

1. Steering wheel lock
2. Steering column
3. Slotted screw
5. Attaching plate
6. Slide
7. Side member (dash)

4. Pull out the spring and seat.
5. Remove the bearing.
6. Fit the new bearing after having greased it with universal grease.
7. Re-fit the other parts.

Replacing complete journalling

1. Remove the steering wheel and steering wheel lock, see the instructions for this.
2. Remove the directional indicator switch and the other components from the steering column.
3. Remove the nuts at the coupling between the upper and lower steering shafts. Remove the nut and clamp for the lower attachment.
4. Pull forward both the upper and lower steering shafts complete.
5. Fit the new components in reverse order to removal. Check all functions before shearing off the shear bolts for the upper steering column attachment and steering wheel lock.

STEERING WHEEL LOCK

With damage to the steering column or the steering shaft lock lug, replace the steering shaft complete. The following instructions apply to replacement of the steering wheel lock.

Removing

1. Remove the combined instrument, see Part 3.
2. Remove the contact piece (5, Fig. 6-42) of the steering wheel lock.
3. Drill off the collars on the shear bolts (4, Fig. 6-52). Start with a small drill and finish with, for example, a 13 mm (½") one. The bolt guide has a diameter of 12 mm (15/32").
4. Remove the attaching bolts and take off the left impact guard and side member (7) with slide piece (6).
5. Screw out the bolt (3) and unhook the attaching plate (5).
6. With a spanner turn back the lock pin and lift up the steering wheel lock.

Installing

1. Fit the new steering wheel lock and the electrical part in position. Hook on the attaching plate (5, Fig. 6-52) and screw in the bolt (3). Check the locking function.
2. Fit the side member (7) with the slide piece (6) which must be in good condition. Fit the impact guard.
3. Fit the shear bolts (4) but do not shear off the heads.
   Fit the contact piece.
4. Check all the functions of the steering wheel lock. Thereafter tighten up the bolts until the heads shear off.
5. Fit the combined instrument and the other parts, see Part 3.

MECHANICAL STEERING HOUSING

Removing

1. Jack up the front end of the vehicle.
2. Release the bolt (A, Fig. 6-53) at the lower flange. Remove the nuts (B) and push the lower part of the flange as far down as possible on the guide bolt.

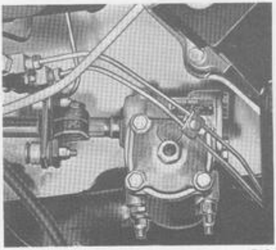


Fig. 6-53. Steering housing fitted

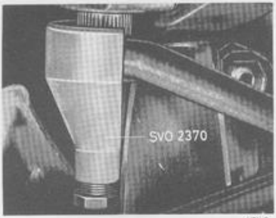


Fig. 6-54. Removing pitman arm

3. Remove the locknut for the pitman arm. Pull off the pitman arm with 2370. When the puller has been placed there, turn the wheel completely to the left (Fig. 6-54).
4. Remove the nuts and bolts and lift off the steering housing.

Disassembling

1. Mark up and remove the flange if it is still on the shaft of the steering worm.
2. Place the steering gear in the middle position (Fig. 6-62). Remove the four bolts (1, Fig. 6-41) for the upper cover (6). Pull up the cover and pitman arm shaft a bit and drain the oil. Pull out the cover and pitman arm shaft.
3. Remove the bolts and lower cover (19). Take care of the spacers (22).
4. Carefully knock on the steering worm shaft (10) so that the lower bearing outer races come loose from the housing. Take out the steering worm with bearings.
5. Remove the locknut (3) and screw the adjusting screw (2) out of the cover. The adjusting screw can be removed from the pitman arm shaft after the circlip has been removed, see Fig. 6-55.
6. Remove the sealing rings (9 and 14, Fig. 6-41) from the steering worm and pitman arm shaft with a screw driver. Take care not to damage the steering housing.

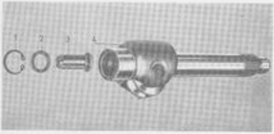


Fig. 6-55. Pitman arm shaft

1. Circlip
2. Adjusting washer
3. Adjusting screw
4. Pitman arm shaft

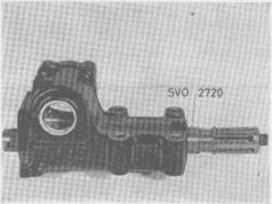


Fig. 6-56. Fitting tool 2720

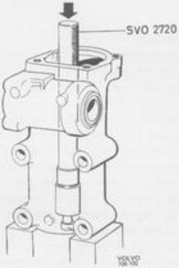


Fig. 6-57. Removing bushes, pitman arm shaft

Inspecting

Wash all the parts in white spirit except the gasket and sealing rings, which should be replaced when reconditioning. Check the pitman arm shaft. The roller may not be scratched, scored or heavily worn on contact surfaces or be loose in the pitman arm shaft. If this is the case or if the pitman arm shaft has any other kind of damage, replace the shaft. Examine the contact surfaces of the steering worm against the roller and the inner races of the ball bearings. Scoring or heavy wear, etc., are reasons for replacing the steering worm. The outer rings of the bearings and the balls should be examined. Scored or bearings damaged in any other way should be replaced. Remove the outer ring for the upper bearing with drift 2718 and standard handle 1801.

Check to see if the pitman arm shaft is loose in the bushes or if the bushes are damaged. If this is the case, replace the bushes in the steering housing, in which case they are removed by tool 2720. Insert the tool with the expander sleeve, loose, see Fig. 6-56. Pull in the tool until the expander comes in position in the bush. Press out the bush according to Fig. 6-57. For the other bush, fit the tool in from the opposite direction. The bush in the pitman arm shaft cover cannot be removed so that the cover must replaced complete.

Assembling

1. Press the bushes of the pitman arm shaft from opposite directions with drift 2716 and standard handle 1801, see Fig. 6-58. Ream the bushes with reamer 2254. Use the guide 2254, which is attached to the housing by means of two bolts, see Fig. 6-59. Clean the housing carefully from metal chippings after the reaming.
2. If the outer race of the upper bearing has been removed, it is pressed back into position by means of tool 2717. Press in the bearing so that it is against the shoulder in the housing. Fit the sealing ring for the guide bolt.
3. Fit the guide bolt with bearing in the housing carefully so that the sealing ring is not damaged. Fix the housing in a vice so that the guide bolt is horizontal. Fit the lower cover and washer together with shims of the same thickness as previously. The two bolts with the through-going holes are coated with a non-hardening sealing agent. Tighten the cover while checking that the guide bolt rotates easily without any play. If properly located the bearings should require a torque of 0.1—0.25 Nm (1—2 lbin) in order to rotate the guide bolt. The torque is measured with a cord and spring balace as shown in Fig. 6-60. The balance should give a reading of 10—25 N (2.2—5.5 lb). If this is not the case, adjust by inserting or removing shims.
4. Fit the adjusting screw, washer and lock ring on the pitman arm shaft, see Fig. 6-55. The adjusting screw play axially should be as little as possible and should not exceed 0.05 mm (0.002"). The play is reduced by exchanging the washer (2) for a thicker one. However, the adjusting screw should rotate easily after fitting.
5. Oil and fit the pitman arm shaft. Put on the cover together with gasket. Unscrew the adjusting screw so far that the roller on the pitman arm shaft goes free from the guide bolt when the bolts for the cover are tightened. Fit and tighten the bolts.

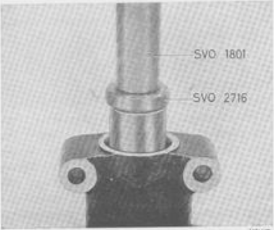


Fig. 6-58. Fitting pitman arm shaft bush

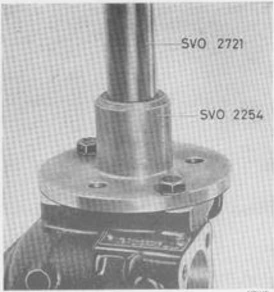


Fig. 6-59. Reaming

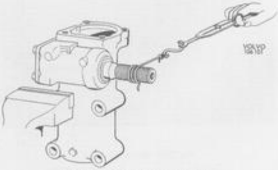


Fig. 6-60. Checking bearing location

Fig. 6-61. Fitting sealing ring, pitman arm shaft

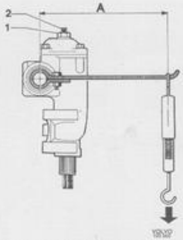


Fig. 6-63. Checking tensioning, cam — roller

A=210 mm (8¼")

1. Locknut
2. Adjusting screw

6. Coat the sealing ring with oil and fit it with tool 2719 as shown in Fig. 6-61.
7. Locate the steering gear centrally (see Fig. 6-62). Screw in the adjusting screw so far that a noticeable resistance is felt when rotating it forwards and backwards over the centre position. The adjustment of the "pressure point" can be measured in different ways. The measurement, for example, can be done with a cord and balance, see Fig. 6-60, in which case the balance should give a reading of 80—140 N (18—31 lb) when it pulls the guide bolt over the center position. With the swing iron and spring balance position as shown in Fig. 6-63, the balance should give a reading of 4—7 N (9—15 lb). When the gear is properly located, lock the adjusting screw by means of the stop nut. Repeat the test after the stop nut has been tightened securely.

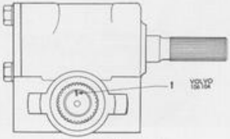


Fig. 6-62. Center position

8. Fit the flange on the steering column in the same position it had before being removed.
9. Fill with 0.25 dm³ (½pint) hypoid oil SAE 80 in the steering housing.

Installing

1. Fit the steering in position and secure it.
2. Fit the pitman arm so that the line-up mark on the pitman arm shaft coincides with that on the pitman arm and tighten the nut.
3. With the steering wheel set the wheels so that they point straight forwards, and secure both halves of the lower flange. Check that the distrance between the steering housing and lower flange is 27±5 mm (1±3/16").
4. Lower the vehicle.

STEERING RODS AND TIE ROD

If bent the steering rods and tie rod may not be straightened out but should be replaced. This also applies if they are damaged in any other way.

The ball joints cannot be disassembled or adjusted so when worn or damaged they must be replaced. The ball joints of the tie rod can be replaced individually. When removing, first take off the split pins and crown nuts. Then place tool 2294 on the ball joints as shown in Fig. 6-64. 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 in the same number of turns and this

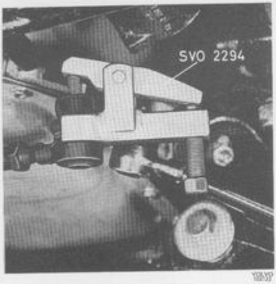


Fig. 6-64. Removing ball joint

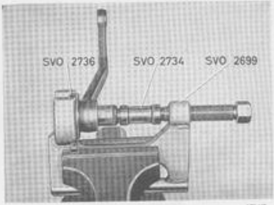


Fig. 6-65. Removing rubber bush, relay arm

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 point are replaced complete. To make sure that the steering rods are not mixed up when installed, the left one is marked "L" and the right steering rod "R" at their outer ends. The marked end should be fitted to the steering knuckle.

After having reconditioned the rods and ball joints, the toe-in should always be checked.

RELAY ARM

Replacing as complete unit

1. Jack up the front end of the vehicle.
2. Disconnect the steering rod and tie rod ball joints from the relay arm with puller 2294 as shown in Fig. 6-64.
3. Remove the three attaching bolts for the bracket (2, Fig. 6-67) 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.

Replacing bush

1. Jack up the front end of the vehicle.
2. Diconnect the ball joint for the steering rods and tie rod from the relay arm with puller 2294 as shown in Fig. 6-64.
3. Remove the nut and washer (7, Fig. 6-67) and take down the relay arm (1).
4. Secure the press tool 2699 in a vice and press out the bush with counterhold 2736 and drift 2734 (Fig. 6-65).
5. Turn the relay arm and press in the new bush with 2699 + 2736 and drift 2735 (Fig. 6-66).
6. Place the relay arm in position, fit the washer (7) and nut.
7. Connect and lock the ball joints for the rods. Lower the vehicle.

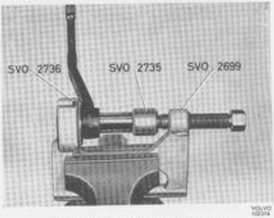


Fig. 6-66. Fitting rubber bush, relay arm

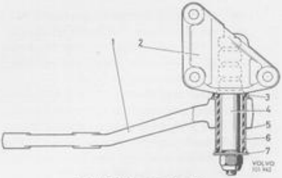


Fig. 6-67. Relay arm journalling

1. Relay arm
2. Bracket
3. Rubber bush
4. Bearing pin
5. Sleeve
6. Sleeve
7. Washer

POWER STEERING

Work on power steering in vehicle

NOTE: The utmost cleanliness should be observed for all work on the power steering equipment. Always clean the connections before disconnecting them, also the outside of the oil container before removing its cover.

Only Automatic Transmission Fluid, Type A or Dexron may be used for the power 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. 6-68. When the engine has stopped, the oil level may rise to 5—10 mm (¼") above the level mark.

DRAINING OIL

With the power steering pump complete, oil is drained off as follows:

Jack up the front end. Screw out the draining plug (6, Fig. 6-74). 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 reservoir and pump. Stop the engine and turn the steering wheel from full lock to full lock until all the oil has run out.

FILLING WITH OIL AND BLEEDING

NOTE: The oil capacity is about 1.2 dm^3 (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 reservoir.
2. With oil within easy reach, start the engine. Gradually fill the reservoir with oil as the level drops. When the level has stabilized itself, 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 (4, Fig. 6-74) ½—1 turn. Close it when oil starts flowing out.
5. Continue turning the steering wheel until the oil in the reservoir is practically free from air bubbles.
6. Stop the engine. The oil level should then rise 5—10 mm (¼") above the level mark. If it rises further than this, there must be air still in the system, in which case continue bleeding.
7. Lower the front end.

After the bleeding, a small number of air bubbles may remain in the system. When the pump causes pressure to be applied to the oil during driving, these air bubbles will eventually disappear in the reservoir.

INSPECTING POWER STEERING

The inspection procedure described below can be applied with a view to fault tracing or preventing possible faults.

I. Checking outer sealing

1. Check to make sure that all screw unions are not damaged. Re-tighten if necessary.
2. Chack the hoses for damage. Replace those that are damaged.

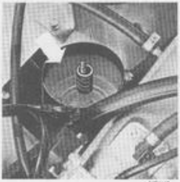


Fig. 6-68. Oil level

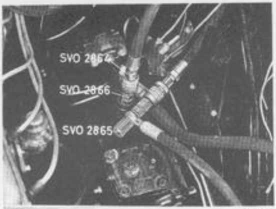


Fig. 6-69. Pressure gauge connected

II. Checking oil level and bleeding

1. Connect the test instrument 2864 to the delivery line at the steering housing, see Fig. 6-69. The inlet hose of the instrument is connected to the banjo nipple with tool 2865 (Fig. 6-69) and the outlet hose to the steering housing with tool 2866 (r-h steered vehicle, tool 2990). Check to make sure that the operating lever of the instrument is in the open position (to the left).
2. Jack up the front end of the vehicle. Check that the oil level is 5—10 mm (¼") 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 (¼").

II'. Checking hydraulic function for steering housing and pump

1. Run the engine warm.
2. **Pump testing:** With the engine idling, move the operating lever of the instrument briefly (max. 10 seconds) to the closed position. Read off the max. pressure on the pressure-gauge. This should be maximum 10 % below the indicated maximum pressure of the pump, that is, at least 67 kp/cm² (953 psi). If pressure less than this is obtained, examine the pump and drive as follows:
   a) Check the tension and condition of the drive belt. Replace the belt if defective.
   b) Remove the pump control valve, see Fig. 6-70. Observe the utmost cleanliness. Wash and blow clean before screwing out the plug (4, Fig. 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 gear test.** Place a 6 mm (0.24") thick shim on each stop bolt limiting the full steering wheel lock. With the engine at idle and the instrument open, turn the steering wheel to the left until there is resistance from the shim on the stop bolt. Increase the force on the steering wheel by about 100 N (22 lb) and maintain this for about 5 seconds while reading off the gauge.

   If the oil pressure in the steering gear agrees with the previously determined oil pressure for the pump, continue the test. If the pressure is lower, first check to make sure there is no external leakage. Thereafter adjust the unloading valve according to below. If this does not remedy the fault, the pressure drop may be due to another internal leakage and this means that the steering gear must be replaced or reconditioned.
   Turn the steering wheel until it is stopped by the shim on the right-hand side and repeat the test. Even here the pressure should coincide with that of the pump, the only difference being that the opening point for the unloading valve cannot be adjusted.
   Replace the shims with 1 mm (0.04") thick ones and repeat the test. In this case, the unloading valve should open, that is, the power effect should not be obtained at the end positions.

Adjusting unloading valve. The unloading valve should be open in both directions about 3° before stop.
The function of the valve can therefore be checked with shims as above.
The valve's opening point in the left end position can be adjusted. To do this release the locknut for the adjusting screw at the front end of the housing. Screwing out the nut delays the opening point,

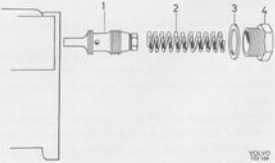


Fig. 6-70. Removing control valve
1. Piston 2. Spring 3. Gasket 4. Plug

screwing it in advances it. Lock the screw after adjustment.

IV. Checking mechanical function

1. Check the mechanical components of the front end and steering such as ball joints, rods, bearings, steering housing and flanges concerning play. Re-tighten attaching bolts and replace damaged or worn companents.
2. Adjust the pressure point between the piston of the steering housing and pitman arm shaft as follows: NOTE. This adjustment should only be made if there is reason to suspect a fault. Accurate adjustment is made in connection with reconditioning.
   a) Remove the locknut for the pitman arm. Pull the pitman arm off with tool 2370. When fitting the puller, turn the wheels fully to the right, see Fig. 6-54.
   b) Place the steering housing in the middle position (count the number of steering wheel turns).
   c) Slacken the nut for the adjusting screw (8, Fig. 6-74).
   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 center 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 center position. In the center 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 175—200 Nm (125—145 lbft).

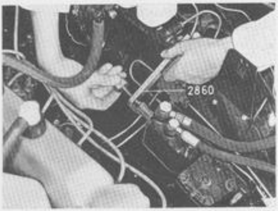


Fig. 6-71. Removing sealing ring

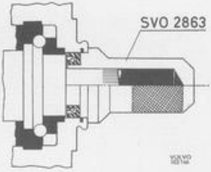


Fig. 6-72. Installing sealing ring

REPLACING STEERING SPINDLE SEALING RING

1. Dismantle the flange device by removing the two nuts and the screw. Move the rubber disc and lower steering column section to the one side.
2. Mark up the location of the flange on the steering spindle. Slacken the clamping bolt and pull off the flange.
3. Remove the rubber cover as well as the circlip for the sealing ring.
4. Carefully apply tool 2860 to the sealing ring. Tighten the screw (Fig. 6-71). This also tightens the sealing ring. If the ring sticks in the circlip groove, carefully turn the tool backwards and forwards.
5. Fill the space between the new sealing ring lips with multipurpose grease. Fit the sealing ring on to installation tool 2863 with the help of the loose guide. Remove the guide and fit the sealing ring in the steering housing, see Fig. 6-72.
6. Fit the circlip and cover.
7. Re-fit the flange according to the line-up marks. Check that the distance between the steering housing and the lower flange is 7±5 mm (0.28 ±0.20").
   Assemble the other parts.

Replacing steering housing

REMOVING

1. Jack up the front end.
2. Drain the oil, see under "Draining the oil".
3. Remove the locknut for the pitman arm. Pull the pitman arm off with tool 2370. When fitting the puller, turn the wheels fully to the right, see Fig. 6-54.
4. Disconnect the oil lines (1 and 2, Fig. 6-74) from the steering housing after the connections have been cleaned. Slacken the clamping bolt.
5. Remove the attaching bolts (8) and pull the steering housing forwards.

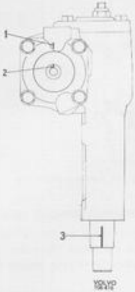


Fig. 6-73. Steering housing in middle position
1—3 Line-up marks

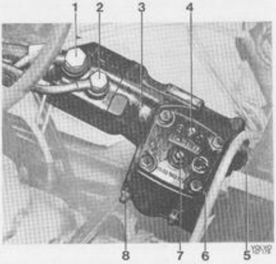


Fig. 6-74. Steering housing installed

1. Return line
2. Delivery line
3. Steering housing
4. Bleeder screw
5. Adjusting screw
6. Drain plug
7. Adjusting screw
8. Nut

INSTALLING

1. Place the steering housing in the middle position. A slight increase in resistance should then be felt and the position of the pitman arm shaft lands should be as in Fig. 6-73 and the line-up marks on the steering 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 housing spindle in the flange of the lower steering column section. Fit and tighten the attaching bolts (8, Fig. 6-74). Tighten the clamping bolt. Check that the distance between the steering housing and the lower flange is 12±3 mm. Connect the oil lines. The longer delivery line should run in a curve backwards, (see Fig. 6-43) and should be clamped.
4. Point the front wheels straight forwards and fit the pitman arm. Tighten the nut to a torque of 175—200 Nm (125—141 lbft).
5. Fill with oil and bleed, see under the heading "Oil filling and bleeding".

Reconditioning steering gear

In the instructions below the figures in brackets refer to those on Illustration A. With regard to work which can be carried out with the power steering in the vehicle and also removal and fitting, see the previous pages.

DIASSEMBLING

1. Secure the steering gear in a vice as shown in Fig. 6-59.
2. Remove the locknut (17) and the attaching bolts (19) for the cover. Screw in the adjusting screw (11) through the cover and remove the cover (16). Take out the loose needles in the cover bearing (14).
3. Remove the circlip (13) and adjusting screw (11), see Fig. 6-76. Adjust the pitman arm shaft (10) to the center position and lift it up, see Fig. 6-73. With a magnet remove the loose rollers in the bearings (3 and 7).

Fig. 6-75. Removing cover

Fig. 6-76. Removing circlip

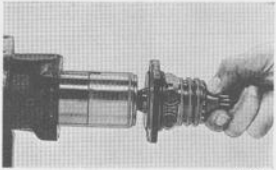


Fig. 6-78. Removing worm

4. Remove the rubber cover (51) and the attaching bolts (50 and 52). Pull off the valve housing (56), see Fig. 6-77. Remove the lock ring (53) and press out the sealing ring (54).
5. Pull out the worm (68), cover (30) and piston (22), see Fig. 6-78.
6. Lift the piston and screw out the worm, see Fig. 6-79. Take care when the 23 balls drop out that they do not get damaged. Remove the cover (30), needle bearings (36) and bearing washer (35). Remove the packing (34) and O-ring (33), shims (32) and O-rings from the cover.
7. With a screwdriver remove the upper sealing ring (9) in the housing. The ring should be demolished but carefully in order not to damage the bearing in the housing. Turn the housing and remove the circlip (1), see Fig. 6-80. Remove the sealing ring (2) with a chisel. The retainer (3) for the needle bearings should only be removed if the bearing is to be replaced, see under "Inspecting".

Fig. 6-79. Removing piston

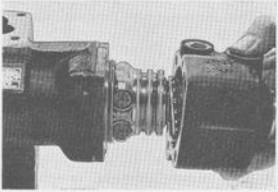


Fig. 6-77. Removing valve housing

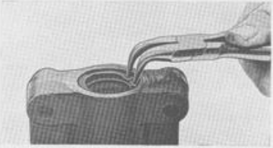


Fig. 6-80. Removing circlip

Fig. 6-81. Removing bearing sleeve

8. Clamp the worm between, for example, copper jaws in a vice. Remove the inner bearing sleeve (60) and the bearing (61), see Fig. 6-81. Remove all rings (62—67) from the worm.
9. Secure the piston between soft vice jaws and unscrew the ring nut (27) with a hook spanner, see Fig. 6-82. Remove the sleeve (24) and its ring (25), the packing (41) and the pipe halves (42).
   Remove the plug (21) and the valve components (44, 45, 46).
   Disassemble the worm valve head. The parts are fitted and fixed in special apparatuses and their mutual position must not be altered.

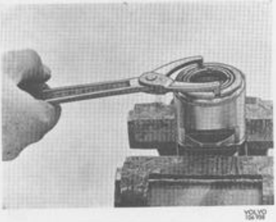


Fig. 6-82. Removing ring

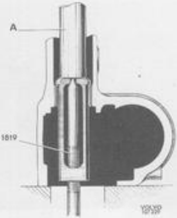


Fig. 6-83. Removing needle bearing
A=Drift

INSPECTING

NOTE. Clean all parts thoroughly in a cleaning agent. Sealing rings and other rubber parts may not be washed in tricholorethylene, but preferably in a cleaning agent which is completely soluble in water. Since new sealing parts are to be used when assembling, washing off the old parts is generally unnecessary.

Housing and cover

1. Check the cylinder bore in the housing for wear and scoring. The piston must run easily in the cylinder.
2. Check the sealing surfaces and threads in the connections for the delivery and return line for damage.
3. Check the needle bearings in the housing and the cover for damage. Replace if necessary. For removal, use tool 1819 (Fig. 6-83) and for pressing in, drift 2995 and handle 1801 (Fig. 6-84).
4. Check the threads in the cover and housing for damage.
5. Check the bearing ring in the valve housing. If it is to be replaced, knock it out with a chisel and fit the new one with tool 2013.

Piston and worm

1. Check the threading on the worm and piston.
2. Check the piston and sleeve slide surfaces for scoring.
3. Check the piston teeth for damage.

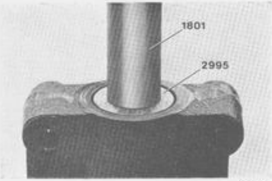


Fig. 6-84. Fitting needle bearing

Fig. 6-86. Fitting cover

30. Cover
35. Bearing washer
36. Needle bearing
68. Worm

Steering shaft

1. Check the steering shaft for cracks.
2. Check the gears for wear and scoring.
3. Check the bearing surfaces for wear and scoring.
4. Check the sealing rings for wear and corrosion.
5. Check the serration for damage.
6. Check the adjusting screw threads and the two flat surfaces for damage. Check sealing surfaces for damage and paint residues. Remove the paint.

ASSEMBLING

Before assembling the parts, wash them well and lightly oil them. All seals should be replaced by new ones.

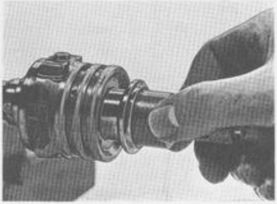


Fig. 6-85. Checking bearing

1. Fit the needle bearings (61) in the bearing sleeve (60) and test it on the worm spindle (Fig. 6-85). The sleeve should turn easily without any noticeable play. If there is any noticeable play, test with thicker needles in the needle bearing. These are available in four sizes with a difference between each of 2 μm (0.002 mm = 0.0008"), see "Specifications". Bearing sleeves are available with external diameter 28.0 mm (1.102") and 28.015 mm (1.103"). Use tool 2481 for installing the sleeve.
2. Tighten up the valve housing (56) with the large bore facing upwards (see Fig. 6-86). Fit the preassembled worm in the housing. Fit the needle bearing (36), the bearing washer (35) and the cover (30), see Fig. 6-86. Secure the cover with the help of the bolts (50 and 52) and four nuts M8. Tightening torque is 34 Nm (25 lbft). Check to make sure there is no looseness in the journalling. A torque of 0.15—0.25 Nm (1.3—2.2 lbin) is required to turn the worm. If this is measured according to Fig. 6-87, the scale should give a reading of 17—29 N (3.7—5.4 lb).

   NOTE. The test should be done without a sealing ring.

   The preload can be regulated by replacing the bearing washer (35).

   There are bearing washers in 6 different thicknesses between 1.9 and 2.4 mm (0.075 and 0.094").

   When the correct pre-load has been obtained, remove the valve housing.

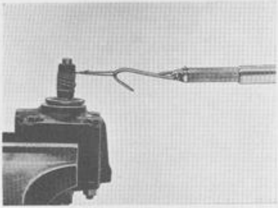


Fig. 6-87. Checking torque

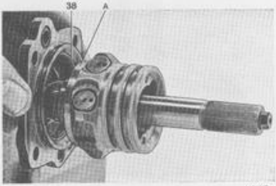


Fig. 6-89. Checking packing
38. Packing A. Contact surface

3. Place the O-rings (63, 65 and 67) in the grooves on the worm. Carefully fit the packings (62, 64 and 66) in position on top of the O-rings, starting with the inner one (see Fig. 6-88).
4. Place the O-ring (37) in position in the cover (30). A 1.7 mm (0.067") packing (38) is placed on the O-ring.
   Apply marking colour to the contact surface (A) and fit the worm (Fig. 6-89). Rotate the worm. Lift it out and check its contact against the packing. If the worm has not made a perfectly satisfactory sealing against the packing, replace the packing with a 1.8 mm (0.071") one.
   Remove and clean the worm. Fit all the O-rings on the cover's valve housing side. Fit the same number of shims (32) previously there. Fit the O-ring (33) and then the packing (34). Oil the packings in the cover. Place the bearing washer (35) and bearing (36) in the cover.
5. Fit the sealing ring (54) on the fitting tool 2863 with the help of the loose guide. Remove the guide and fit the sealing ring in the valve housing, see Figs. 6-90 and 6-72. The sealing ring should face inwards. Fit the circlip (53).
6. Fit the pre-assembled cover and valve housing onto the worm with the help of the fitting sleeve 2863. Screw the cover and valve housing together with the four bolts and nuts. Tightening torque 34 Nm (25 lbft).
   Check the worm torque (see Fig. 6-87). This should now be 0.4—0.6 Nm (3.5—5.2 lbin), that is, the balance should give a reading of 45—70 N (10—15 lb). If any other value is obtained, adjust with the shims. Remove the worm and bearing from the valve housing.

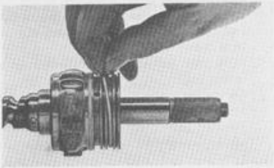


Fig. 6-88. Fitting packing

Fig. 6-90. Fitting sealing ring

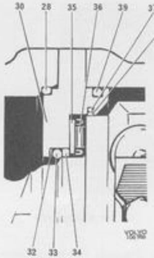


Fig. 6-91. Sealing components

28. O-ring
30. Cover
32. Shims
33. O-ring
34. Packing
35. Bearing washer
36. Needle bearing
37. O-ring
38. Packing
39. O-ring

7. Clamp the piston between soft jaws in a vice. Slide the sleeve (24) onto the worm. Insert the worm far enough into the front piston bore that its top comes opposite the first recess for the pipe half. Fill the bore (Fig. 6-92) with the balls. Screw the worm further down by hand so that the balls are carried up to the rear piston for the recirculating pipe. When 16 balls have been inserted, the first ball should appear at the other recess. Thereafter insert the remaining 7 balls. The balls should be greased in order to facilitate installation. Place the halves together and install them, see Fig. 6-93.

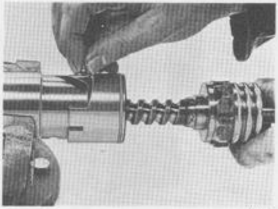


Fig. 6-92. Inserting balls

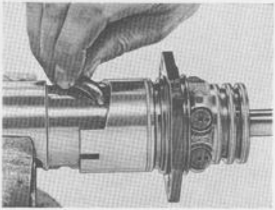


Fig. 6-93. Fitting pipe halves

Check the torque required to turn the worm in the piston. The correct value is 0.2—0.4 Nm (1.7—3.5 lbin). If the torque is measured with a cord (see Fig. 6-94), the balance should give a reading of 23—46 N (5—10 lb). If any other value is obtained, all 23 balls should be replaced. Sets are available with balls in 5 different sizes.
After the correct value has been obtained, remove the 23 balls and keep them in a safe place.

8. Place the O-ring (26) and the piston ring (25) in the recess on the sleeve (24).
Fit the pre-assembled cover (30) with bearing washer (35), bearing (36), ring (27) and sleeve (24) on the worm, see Fig. 6-75.

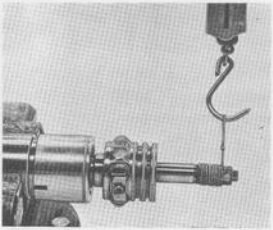


Fig. 6-94. Checking torque

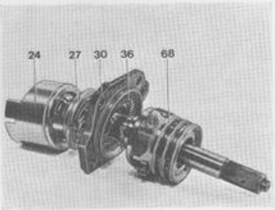


Fig. 6-95. Worm components

24. Sleeve
27. Ring nut
30. Cover
36. Needle bearing
68. Worm

Move the worm into the piston while fitting the 23 balls, see point 7. Fit the packing (41), see Fig. 6-96. Assemble the piston and sleeve and fit the pin (23) if it has been removed. The sleeve recess should be on the gear side.

Warning! The worm must not be pulled so far out of the piston that the balls run out (into the piston). Tighten the circlip (27) and lock it, see Fig. 6-97. When doing this, protect the worm to make sure that no metal filings get into the piston.

Fit the valve components (44, 45 and 46) and the plug (21) in the piston.

9. Tighten up the housing (4) with the neck facing downwards. Fit the washer (8) in the housing. Fit the sealing ring (9) with the sealing lip facing upwards. Use tools 2010 and 1801, see Fig. 6-98.
10. Oil the O-ring (28) and fit it on together with the other O-rings in position in the cover with

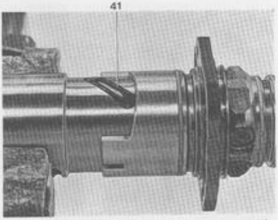


Fig. 6-96. Packing fitted

41. Packing

Fig. 6-97. Locking circlip

the help of grease. Move the piston complete in with cover and worm into the housing, see Fig. 6-78.

11. Tension out the sealing ring (54) with tool 2863. Place the bearing (59) in position. Fit the valve housing (56), see Fig. 6-99. The tightening torque for the bolts (50 and 52) is 34 Nm (25 lbft).
12. Place the piston teeth in the center position, that is, the opening between the second and third teeth about opposite the steering shaft hole (Fig. 6-100). Fine-adjust by setting the worm scribe mark to coincide with that on the housing (Fig. 6-58).

If the bearings (3 and 7) have not been replaced, place the needle in position with the help of grease.

Place appropriate tape on the steering shaft serration to protect the sealing ring in the housing. Fit the steering shaft (Fig. 6-101) using great care in order to avoid damage to the sealing ring in the housing. Push the steering shaft into the bottom position. Turn the steering spindle forwards and backwards while pressing in the steering shaft at the same

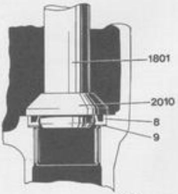


Fig. 6-98. Fitting sealing ring

8. Washer 9. Sealing ring

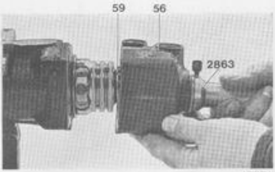


Fig. 6-99. Fitting valve housing
46. Valve housing 59. Ball bearing

time so that the steering shaft and piston take up the correct position in relation to each other.

Fit the adjuster screw (11), and adjuster washer (12) and lock ring (13) on the steering shaft (10). Check the adjuster screw play on the shaft. This may go up to a maximum 0.05 mm (0.002"). The play is adjusted by replacing the adjuster washer (12). This washer is available in 7 thicknesses between 2.15—2.45 mm (0.085—0.096"). Start with the thicker washers and choose the first dimension which gives a clearance after the lock ring has been fitted.

13. Fit the needles in the bearing (14). Place the O-ring (15) on the cover. Fit the cover by screwing up the adjuster screw (11) until the cover fits. Fit the nut (17) temporarily. Fit washers (20) and bolts (19). The tightening torque is 31 Nm (22 lbft). Fit the protective casing (51).
14. Fit the sealing ring (2) with the help of tool 4028. Fit the lock ring (1) in position. Remove the tape.

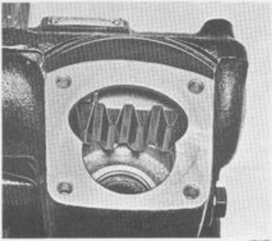


Fig. 6-100. Center position

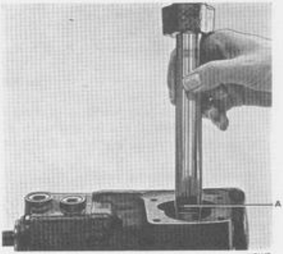


Fig. 6-101. Fitting steering shaft
A. Tape

15. Turn the steering spindle to the end position. Check for sufficient torque about 1/2 turn from the end position (Fig. 6-102). Adjust the steering spindle to the center position. Screw in the adjuster screw (11) so that a noticeable pressure point is obtained. Measure the torque and adjust so that the balance gives a reading of 45—60 N (10—13 lb) greater than at the end position, but max. 185 N (40 lb).

Tighten the nut (17) to a torque of 25 Nm (18 lbft) while holding the adjuster screw in position.

FUNCTION TEST

After assembling test the function of the power steering and to make sure that it does not leak. When doing this, follow the instructions given on page 6-32.

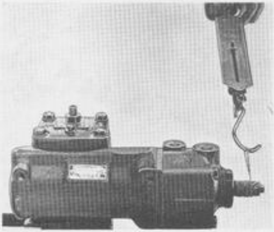


Fig. 6-102. Checking torque

Replacing power pump

REMOVING

1. Clean round the connections (at 2 and 3, Fig. 6-103).
2. Disconnect the suction line (2) and collect the oil running out.
3. Disconnect the delivery line (3), and unscrew the tensioning bolt (4) and the attaching bolts (5). 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. 6-103. 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, this resulting in noise in the pump.

1. Place the pump in position and connect up the oil lines with new seals fitted.
2. Fit the attaching bolts and other components, see Fig. 6-103. Tension the drive belt so that it can be pressed in about 5 mm (3/16") halfway. Tighten the bolts and the connections.
3. Fill with oil and bleed, see under "Oil filling and bleeding".

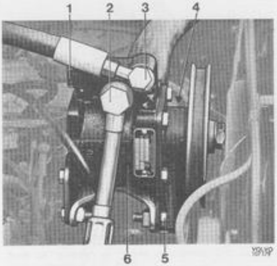


Fig. 6-103. Power pump, fitted

1. Plug for control valve
2. Suction line
3. Delivery line
4. Tensioning bolt
5. Attaching bolt
6. Power pump

Reconditioning power pump

DISASSEMBLING

1. Unscrew the nut (1, Fig. 6-104) and pull off the pulley. If necessary use puller 2279. Remove the brackets.

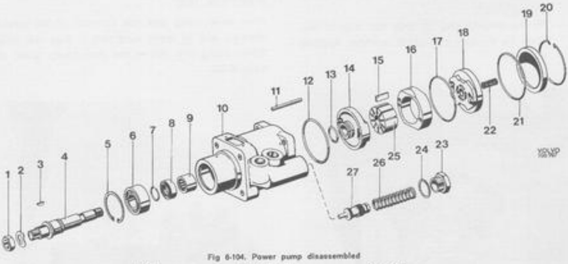


Fig 6-104. Power pump disassembled

1. Nut
2. Washer
3. Key
4. Shaft
5. Circlip
6. Bearing
7. Circlip
8. Sealing ring
9. Needle bearing
10. Housing
11. Pin
12. O-ring
13. O-ring
14. Inner plate
15. Blade
16. Intermediate piece
17. O-ring
18. Outer plate
19. Cover
20. Circlip
21. O-ring
22. Spring
23. Plug
24. Packing
25. Rotor
26. Spring
27. Control valve piston

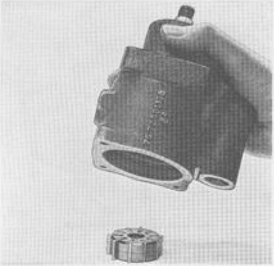


Fig. 6-105. Removing rotor

2. Remove the circlip (20) with polygrip pliers.
3. Remove the cover (19), spring (22) and plate (18). Use polygrip pliers.
4. Shake out the intermediate piece (16) and rotor (25), see Fig. 6-105. If it is not easy to remove the intermediate piece, allow it remain until later on.
5. Remove the circlip (5) at the drive end.
6. Carefully press out the shaft (4).
7. Press the plate (14) out of the housing. The intermediate piece should follow at the same time, if not already removed.
8. Screw out the plug (23) and shake out the spring (26) together with the valve (27).
9. Press out the needle bearing (9) and sealing ring (8) at the same time with tool 2996, see Fig. 6-106.
10. Take the O-rings out of the housing.

INSPECTING

Clean all parts

1. Check the shaft (4, Fig. 6-104) for scoring from the sealing ring and needle bearing. Check the threads and lands for damage. If the bearing (6) is damaged, it can be removed after the circlip (7) has been taken off.
2. Check the needle bearing (9) and replace if necessary.
3. Check the plates (14 and 18) for wear and scoring.
4. Check the rotor (25), intermediate piece (16) and blade (15) for wear. The blade should go easily into the rotor. These parts are replaced together in sets.
5. Check that the control valve piston (27) does not jam in the housing bore. Make sure that the piston has the same tolerance group as the housing, that is, that the numbers agree ("1" and "2" or "11").
   Screw the control valve piston apart. When doing this, do not hold round the steering surfaces but use polygrip pliers at the holes. Take care of the parts, clean and inspect. If there is any damage, replace the piston complete.
   Assemble the parts. The number of washers will determine the opening pressure.
6. Blow all channels in the housing clean.

ASSEMBLING

Before assembling, all parts should be well cleaned and lightly oiled. All seals should be replaced with new ones.

1. Press the needle bearing (9, Fig. 6-104) into the housing with the help of drift 2996, se Fig. 6-107. The bearing should be pressed in until the tool bottoms so that the needle bearing outer edge is 37.0—37.2 mm (1.45—1.46") from the edge of the housing.

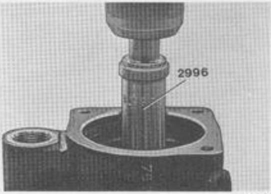


Fig. 6-106. Removing sealing ring

Fig. 6-107. Fitting needle bearing

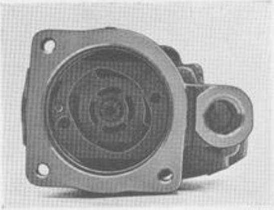


Fig. 6-109. Intermediate piece fitted

2. Apply universal grease between the lips of the sealing ring (8) and press it in with drift 2997.
3. Place the O-ring (12) in position in the inner groove of the housing.
4. If the bearing (6) has been removed, press the shaft into the bearing. Fit the circlip (7) in its groove.
5. Fit the shaft with bearing. Fit the circlip (5) in its groove.
6. Place the O-ring (13) in its groove on the plate (14). Fit the plate as shown in Fig. 6-108.
7. Fit the intermediate piece (Fig. 6-109). The small hole on the pin and the other two opposite the plate holes.
8. Place the O-ring (17) in position in the housing.
9. Fit the rotor (25) with the smooth drill against the drive side. Fit the 10 blades (15) with the rounded surface facing outwards towards the intermediate piece (Fig. 6-110).
10. Fit the plate (18) on the intermediate piece according to Fig. 6-111. The pin should be in one of the two outer holes.
11. Place the O-ring (21) in its groove (Fig. 6-112). Fit the spring (22) and cover as shown in Fig. 6-112. Hold the cover down with pliers and fit the circlip (20) in its groove.
12. Fit the control valve piston (Fig. 6-113). Fit the spring (26), packing (24) and plug (23).
13. Fit the nipple, brackets and pulley, see Fig. 6-47.

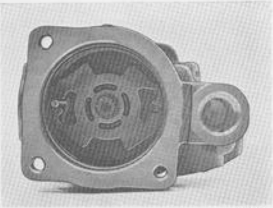


Fig. 6-108. Inner plate fitted

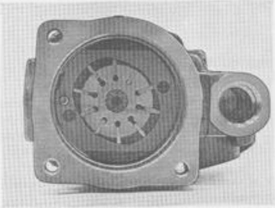


Fig. 6-110. Rotor blade fitted

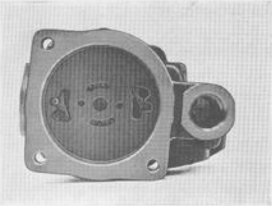


Fig. 6-111. Outer plate fitted

Fig. 6-113. Fitting control valve

Fig. 6-112. Fitting cover

Replacing oil filter

When changing the oil, which is normally done only in connection with replacement of the power steering components, the filter should also be replaced. This is accessible after the spring and retainer in the oil container have been lifted off. Clean the container before fitting the new filter. Also replace the gasket in the outer cover.

FAULT TRACING SCHEME

When fault tracing in vehicles with power steering, always start by checking the oil level, see page 31. Any leakage must be put right before adding oil.

FAULT	
REASON	**ACTION**
THE CAR WANDERS	
Too low oil level or air in system.	Check oil level and bleed according to page 31.
Abnormal loading.	Distribute loading.
Unsuitable tyre equipment.	Shift wheels.
Faulty wheel adjustment.	Check and adjust wheels.
Loose steering parts.	Check and tighten up.
THE CAR PULLS TO ONE SIDE	
Too low or uneven air pressure in tyres.	Check air pressure (see Part 7).
The front spring have fatigued or have different height.	Remove and check spring (see Part 7).
A roller bearing is too tight.	Check the bearings. Replace damaged bearings and adjust (see Part 7).
Faulty tracking.	Check-measure the body and straighten up if necessary. (See Part 8).
Bent steering rod.	Replace damaged rod.
Incorrect camber.	Check and adjust the camber. Pulling can be influenced by giving the wheels different inclination with the tolerance.
STEERING STIFF TO RIGHT AND LEFT	
Too low oil level or air in system.	Check oil level or bleed according to page 31.
Pump control valve jams or is blocked.	Remove, clean and check control valve.
Filter blocked, channel blocked.	Remove filter, clean channel.
Excessive caster.	Check and adjust the caster.
Jamming ball joints.	Replace ball joint.
Damaged sealing rings in power steering gear.	Recondition or replace steering gear.
STEERING HEAVY EITHER TO LEFT OR TO RIGHT	
Pressure builds up only on one side of the power piston.	Recondition or change power steering gear.
HEAVY STEERING WITH RAPID STEERING WHEEL TURNS	
Pump pulley belt slips.	Tension or replace pulley belt.
Pump control valve blocked.	Remove, clean and check the control valve.
Pump has too little capacity.	Recondition the pump.
Air in the power system.	Bleed the system, fill oil according to page 31.

FRONT WHEEL SHIMMY

Air in system.	Bleed the system.
Unbalanced or warped wheels.	Balance the wheels and eventually align (see Part 7).
Incorrect whel adjustment.	Check the wheel adjustment.
Loose or worn front wheel bearings.	Adjust or replace bearings.

SHOCKS AND JARRING IN THE STEERING WHEEL

Too low oil level or air in the system.	Check the oil level or bleed according to page 36.
Axial play on steering shaft.	Adjust the pressure point.
Worm loose.	Recondition worm.
Looseness in other steering components.	Tighten or replace worn component.

THE STEERING WHEEL CONTINUES TO FULL LOCK

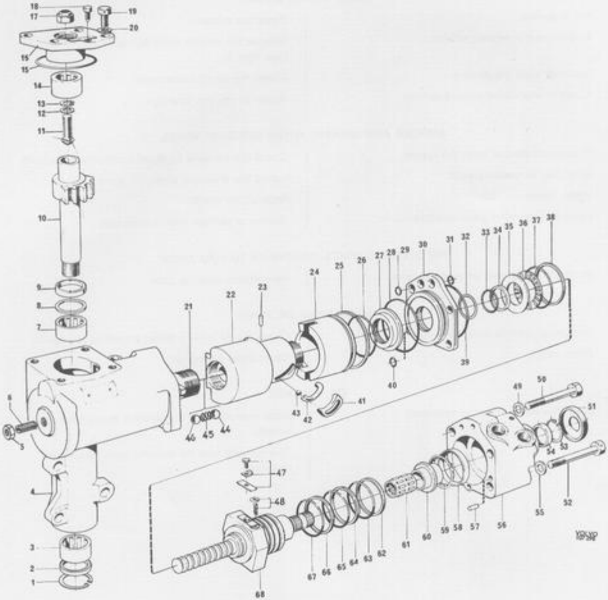
Incorrect adjustment on steering valve.	Recondition steering gear.

NOISE FROM OIL PUMP

Too low oil level or air in the system.	Check the oil level or bleed according to page 36.
Worn pump.	Recondition the pump.

OIL LEAKAGE

Defective seals or bad connections.	Clean and wipe dry the steering gear on the outside. Test-run and load the steering gear. Locate the leakage.



1. Circlip
2. Lower sealing ring
3. Needle bearing
4. Housing
5. Locknut
6. Adjuster screw
7. Needle bearing
8. Washer
9. Upper sealing ring
10. Steering shaft
11. Adjuster screw
12. Adjuster washer
13. Circlip
14. Needle bearing
15. O-ring
16. Cover
17. Locknut
18. Bleeder screw
19. Bolt
20. Washer
21. Plug
22. Piston
23. Pin
24. Sleeve
25. Piston ring
26. O-ring
27. Ring nut
28. O-ring
29. O-ring
30. Cover
31. O-ring
32. Shim
33. O-ring
34. Packing
35. Bearing washer
36. Needle bearing
37. O-ring
38. Packing
39. O-ring
40. O-ring
41. Packing
42. Pipe halves
43. Ball
44. Valve ball
45. Spring
46. Valve ball
47. Lock parts
48. Valve parts
49. Washer
50. Bolt
51. Rubber cover
52. Bolt
53. Circlip
54. Sealing ring
55. Washer
56. Valve housing
57. Guide pin (only early prod.)
58. Bearing ring
59. Ball bearing
60. Bearing sleeve
61. Needle bearing
62. Packing
63. O-ring
64. Packing
65. O-ring
66. Packing
67. O-ring
68. Worm

Illustration A. Steering gear disassembled

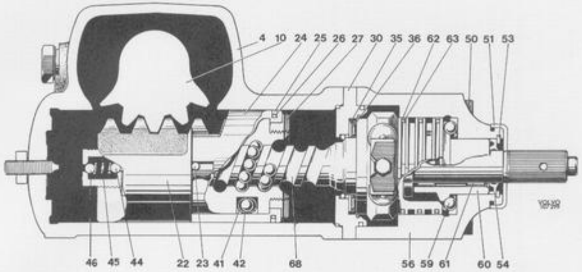
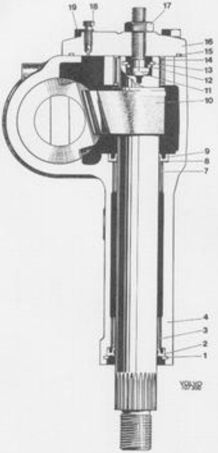


Illustration B. Steering gear assembled



1. Circlip
2. Lower sealing ring
3. Needle bearing
4. Housing
7. Needle bearing
8. Washer
9. Upper sealing ring
10. Steering shaft
11. Adjuster screw
12. Adjuster washer
13. Circlip
14. Needle bearing
15. O-ring
16. Cover
17. Locknut
18. Bleeder screw
19. Bolt
22. Piston
23. Pin
24. Sleeve
25. Piston ring
26. O-ring
27. Ring nut
30. Cover
35. Bearing washer
36. Needle bearing
41. Packing
42. Pipe half
44. Valve ball
45. Spring
46. Valve ball
50. Bolt
51. Rubber cover
53. Circlip
54. Sealing ring
56. Valve housing
59. Ball bearing
60. Bearing sleeve
61. Needle bearing
62. Packing
63. O-ring
68. Worm